Mini-Micro Systems

A CAHNERS PUBLICATION

SEPTEMBER 1982

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CIRCLE NO. 4 ON INQUIRY CARD

Ramtek

Ada has come of age. The first complete Ada compiler runs on a 16-bit desk-top computer (see p. 207). Cover photo by Roy Carafano, courtesy of Western Digital Corp.

p. 48 ..... Retailer legislation postponed

p. 145 .... The British are coming

CP BPA ABP

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MINI-MICRO WORLD

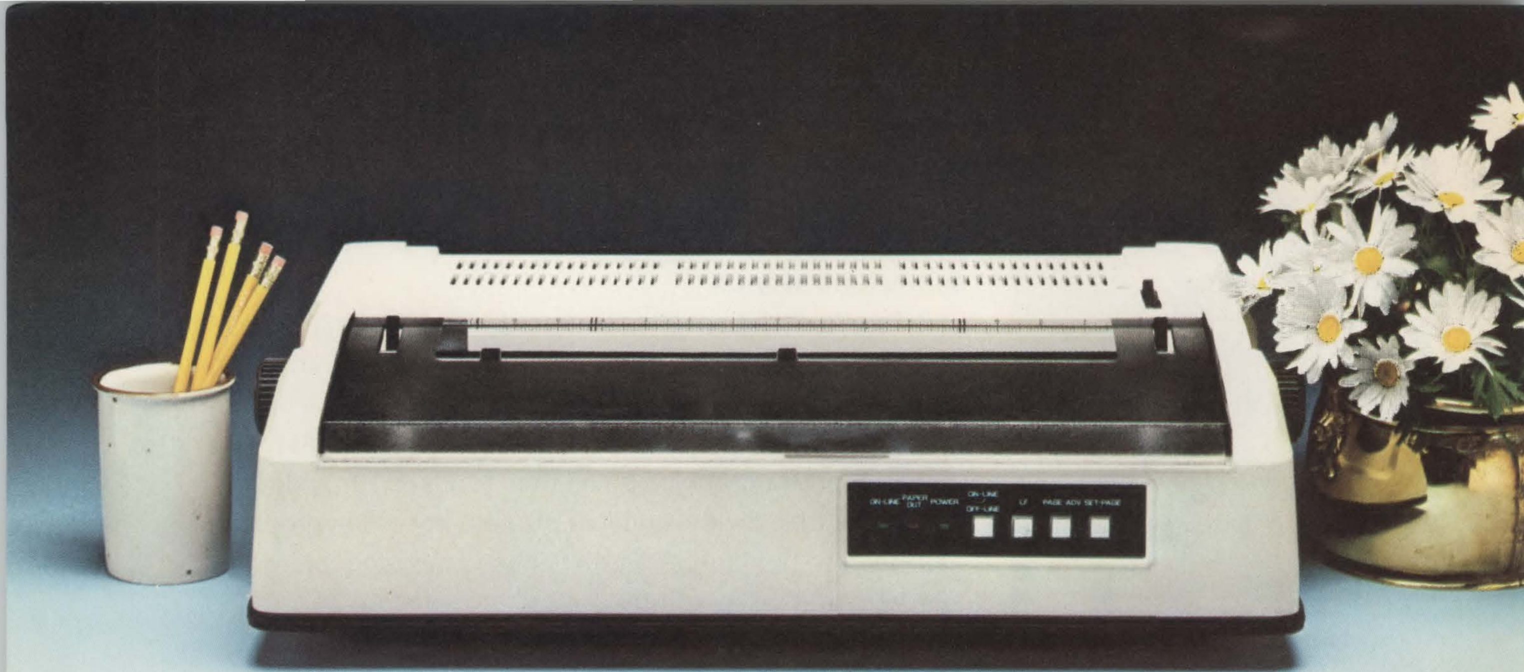
INTERPRETER

SYSTEMS IN INDUSTRY

FEATURES

For feature highlights, see p. 179

DEPARTMENTS



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CIRCLE NO. 6 ON INQUIRY CARD

ETHERNET CHIP PRODUCTS DUE NEXT MONTH

Early next month, Intel Corp., Santa Clara, Calif., will introduce its long-awaited VLSI chips that interface equipment to Ethernet local-area networks. The two-chip set—consisting of a serial interface chip and a CSMA/CD controller chip—will meet the level 1 and 2 Ethernet specifications and provide network-management and diagnostic functions. Network statistics such as framing or alignment errors and packet collisions will be tracked by the chips, says a spokesman. Not yet priced, the Intel chips will be available in sample quantities in October, with volume production slated for the first quarter of 1983. Another Ethernet product to surface next month is from 3Com Corp., Mountain View, Calif., which will introduce a controller designed to link specific personal computers to Ethernet LANs. The 3Com device, unlike existing 3Com controllers, will incorporate a VLSI chip that the firm developed jointly with SEEQ Technology, Inc., San Jose, Calif. Scheduled for introduction this month, the SEEQ Ethernet chip will provide Ethernet CSMA/CD controller functions but will not handle any serial interface requirements, which are typically performed by a separate chip or by discrete devices. Under the joint arrangement, SEEQ will initially provide 3Com with its chip on an exclusive basis, but SEEQ product marketing manager Dane Elliot expects to begin offering sample quantities of the chip in November, with production volumes available in January. Along with the SEEQ chip, the 3Com plug-in controller board will include an on-board transceiver and will sell for less than $1000 in single-unit quantities.

OKIDATA TO CEASE PRINTER MANUFACTURING

Okidata Corp. will terminate all manufacturing at its 10-year-old Mount Laurel, N.J., plant by March, 1983, a company spokesman says. Products will be imported from Japanese parent, Oki Electric Industry Co., Ltd. The Mount Laurel facilities will still be used to modify those imports. Last April, Okidata notified customers that its model CP 210 would be phased out. This was followed by news in August about the demise of the Slimline product line, which the Pacemark line replaces. Okidata is retraining employees who will be affected by the manufacturing termination.

MC68000-BASED MICRO TO FOLLOW IBM PC

Reports that a follow-on product to IBM Corp.'s year-old Personal Computer took on more substance in August as the company held private showings of a Motorola MC68000-based version to selected third-party vendors. Aimed at the small-business-system market, the new PC includes a 10M-byte, 5¼-in. Winchester disk drive and is said to be priced attractively for value-added remarketers. Definite information has not emerged as to how IBM plans to maintain compatibility with its original 8088-based PC or what impact the new PC will have on the System 23, which holds the desk-top small-business-system slot in IBM's third-party remarketing plan.

CORRECTION

Mini-Micro Systems erred in this space in the August issue, (MMS, August, p. 5) by not sufficiently verifying reports that Fortune Systems Corp., San Carlos, Calif., had encountered problems with its 32:16 desk-top computer system. We reported that one out of three of all systems shipped did not function when received by customers, and that Thomson CSF had returned all 200 Fortune systems it had received. Fortune president Gary Friedman has informed us that the company at that time had not shipped that many machines to Thomson CSF, and that Thomson has not returned any of its Fortune computers. Friedman adds that the report that one out of three systems shipped has not functioned upon delivery "is simply not true." The editors regret the errors.

NOETICS PLANS RIDGE-BASED MINICOMPUTERS

Mountain View, Calif.-based start-up Noetics, Inc., has taken delivery of the first system shipped by its Sunnyvale neighbor Ridge Computers, Inc. (see "Pipelining and new OS boost mini to 8 MIPs," p. 258, and MMS, April, p. 5). Noetics plans to convert the scientifically oriented 32-bit Ridge Thirty-Two minicomputer, which uses Ridge's proprietary bus structure and operating system, into a general-purpose OEM machine that uses Multibus peripherals and the UNIX operating system. Noetics also plans a Ridge-based turnkey business-publication system that includes Noetics's bit-mapped terminals, database-management capability, integrated text/graphics software and a Xerox laser printer. First shipments for both products are slated for mid-1983. The prices are not yet determined.

TEKTRONIX OFFERS PASCAL DEVELOPMENT FOR 16-BIT MPUs

Tektronix, Inc.'s Design Automation Division this month begins deliveries of a Pascal language-development system aimed initially at Intel's 8086, 8087 and 8088, and Zilog's Z8001, Z8002 and Z1860; support for Motorola's MC68000 will follow soon. Called LANDS, the development package runs on the Beaverton, Ore., company's 8560 multi-user software-development system under its UNIX-like TNIX operating system. LANDS consists of a language-directed editor, a Pascal compiler, an integration control system and a debugger, which together offer features such as syntax checking, a screen editor and debug and software/hardware integration at the Pascal level. LANDS sells for $8000. The modules can be purchased separately: Pascal is priced at $4500, the language-directed editor at $1500 and the debugger at $2000.

The company also plans to begin offering interface software to link its series 8500 development systems with those from Intel, Motorola and Zilog. The first package in Tektronix's Vendor Interface Program is aimed at Intel's Intellec Series II and III, and sells for $500.

PRAGMA DELAYS CARTRIDGE DRIVE

Pragma Data Systems, Sunnyvale, Calif., has put its DAC-2000 ½-in. tape-cartridge drive for 8-in. Winchester drive backup on a six-month production hold following a management decision that the drive in its current form could not be produced in high volumes. Specific problems focused on the tape-handling system of the drive. One company source, however, says that the original design, including two spinning heads 180 degress apart and a unique tape-advance system, will be retained. In the wake of Pragma's decision, the company has laid off 38 of its 50 employees and has delayed a version for 5¼-in. Winchester backup another six months. Another casualty is the departure of engineering vice president Bruce Manildi.

PICK TO OFFER 32-BIT CO-PROCESSOR

Pick Computer Works, which abandoned its efforts to sell systems running the Pick operating system in the late 1970s, is planning to reenter the hardware business. This time, president Dick Pick has a 32-bit microcomputer designed specifically to run the Pick operating system. Code-named Vulture, the product will be marketed as a co-processor or "accelerator" with systems running the Pick operating system, on which it is expected to improve throughput speed of Pick applications by a factor of five to 10. An unidentified component manufacturer will execute the design in silicon using Advanced Micro Devices' 2900 family technology. The product is expected to be available for beta tests early next year.

MICRO FLOPPY STANDARDS ISSUE SETTLING

The industry committee developing standards for sub-4-in. diskette media probably will propose a standard at the upcoming American National Standards Institute meeting in Las Vegas (MMS, July, p. 6.; August, p. 10). The standard will be a modified version of the media developed by Sony Corp. for use on its 3½-in. drive announced in 1980 (MMS, April, 1981, p. 17). The committee will stress compatibility with existing 5¼-in. diskettes.

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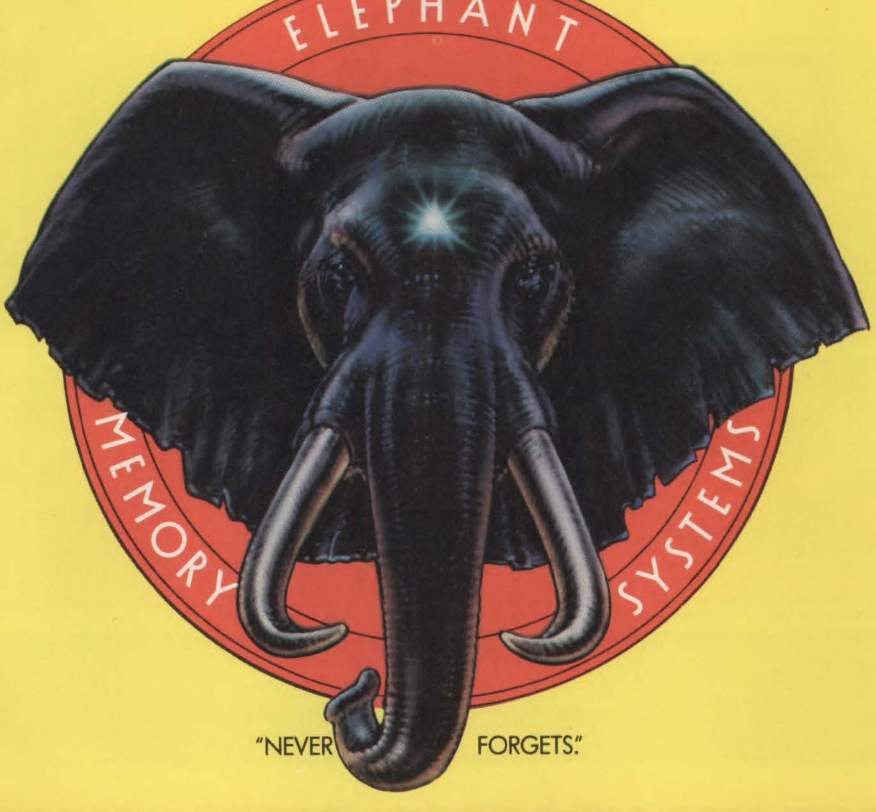

MORE THAN JUST ANOTHER PRETTY FACE.

Says who? Says ANSI.

Specifically, subcommittee X3B8 of the American National Standards Institute (ANSI) says so. The fact is all Elephant™ floppies meet or exceed the specs required to meet or exceed all their standards.

But just who is "subcommittee X3B8" to issue such pronouncements?

They're a group of people representing a large, well-balanced cross section of disciplines—from academia, government agencies, and the computer industry. People from places like IBM, Hewlett-Packard, 3M, Lawrence Livermore Labs, The U.S. Department of Defense, Honeywell and The Association of Computer Programmers and Analysts. In short, it's a bunch of high-caliber nitpickers whose mission, it seems, in order to make better disks for consumers, is also to make life miserable for everyone in the disk-making business.

How? By gathering together periodically (often, one suspects, under the full moon) to concoct more and more rules to increase the quality of flexible disks. Their most recent rule book runs over 20 single-spaced pages—listing, and insisting upon—hundreds upon hundreds of standards a disk must meet in order to be blessed by ANSI. (And thereby be taken seriously by people who take disks seriously.)

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CIRCLE NO. 8 ON INQUIRY CARD

VERTEX READYING THIN-FILM MEDIA DRIVES

A line of 5¼-in. Winchesters sporting thin-film media and mini composite ferrite heads is slated to be announced at the upcoming Comdex show in Las Vegas by San Jose, Calif., start-up Vertex Peripherals, Inc. According to one report, the new drives will support capacities in the 30M- to 70M-byte range at average access times of 30 msec. using rotary voice-coil actuators. The new drives will operate at transfer rates that are Seagate ST-506 compatible, and could be available in evaluation versions by year-end. Pricing is not available.

MODEM STORES, FORWARDS DATA WITHOUT HOST

A $595 intelligent modem that can store as many as 12 typewritten pages will be available next month from Visionary Electronics, Inc., San Francisco. Called the Visionary 100, the 8085-based device comes with 2K bytes of RAM, expandable to 24K bytes, to send or receive data such as text files while the host processor is running other tasks or is shut down. The unit features auto dial, auto answer, RS232C interface and data rates from 300 to 1200 bps with the host CPU, and 300 bps to phone lines.

APPLE, IBM PC WINCHESTER SUBSYSTEMS COMING

More Winchester disk drive subsystems are forthcoming for the IBM Personal Computer and the Apple III. Newport Beach, Calif., start-up Microlution Corp. is expected to introduce a subsystem at the November Comdex show in Las Vegas. Company founder Gerard Guyod says Microlution's subsystem is special in that it has embedded programming aids that make the subsystem's presence transparent to a user. Guyod may in turn encounter some heavy competition at Comdex: Cynthia Peripherals reportedly plans to introduce a similar Winchester disk subsystem and software, codenamed Cyndibox, that will attach transparently to the IBM, Apple and a number of other microcomputers.

N.Y. SYSTEM HOUSE TO OEM SORD COMPUTERS

Business Computers International is expecting to sign on OEM agreement with Sord Computer Systems, Inc., of Japan to market Sord's products under the Socius Computer System's logo. BCI is expecting to offer Sord's line of M23 desk-top microcomputers (MMS, June, p. 73), as well as a new M23P. The newer version, based on a Z80A and including 128K bytes of RAM, will have two Sony 3½-in. drives embedded in its keyboard. It will be portable with an optional battery pack and an LCD using an 8 × 80 or 16 × 176 format. A monochromatic CRT version is expected to be priced at less than $2200, while the LCD portable model will sell for about $2500. The system will run a proprietary Sord operating system, Lifeboat Associates' SB-80, BASIC and PIPS, a product said to combine spread-sheet analysis and page-oriented database-management systems.

PRIMAGES STEPS INTO DAISY PRINTER MARKET

Primages, a Bohemia, N.Y., start-up founded by Redactron veterans Tony Mauro and Ted Reintillo, is planning to unveil a daisy-wheel printer this month. The 45-cps device is said to incorporate patented advances in stepper-motor technology that will bring the mechanism from its top speed to a halt in less than 3 msec., with a stop-positioning error rate of less than 1 percent of the 186-degree stepper angle. Company officials say the stepper-motor technology may support follow-on printers operating at 60 cps. The printer, which will be assembled in Taiwan using American-made electronics and critical mechanical parts, is expected to list for less than $1700. A version with an integrated sheet feeder is expected to sell for less than $1900. In 5000-lot OEM orders, prices are $700 and $800, respectively. Samples are slated for year-end, with production following in April. The printers use a proprietary, 100-petal daisy wheel. A 135-petal wheel will also be available.

Breakpoints

TECH FILES: A quick look at industry developments

Random disk files: Chatsworth, Calif.-based **Tandon Corp.** is expected to expand its R&D operations and start a media division in the San Francisco Bay area. The new operation will concentrate on thin-film disks for small Winchesters, and will be headed by Sham Tandon, formerly with Ampex Corp., and a cousin of Tandon president and founder Jugi Tandon. . . . **Quantum Corp.**, Milpitas, Calif., will unveil an 85M-byte, 8-in. Winchester this fall. The four-disk drive, designated the Q2080, will use a modified version of the torque-motor actuator/optical encoder used on Quantum's lower capacity drives. It will operate at 789 tracks per in., compared to 345 tpi for the company's 40M-byte model. Average access time is 40 msec., say company sources, compared to 65 msec. for the 40M-byte device. Pricing has not been set. . . . High-capacity 8-in. hardware is scheduled to be unveiled next year by Los Gatos, Calif., start-up **Oktas Corp.** Founded by former Amlyn engineering vice president and co-founder Ron Higgins, the company plans to design a drive that will compete with the 160M-byte, 230-mm. fixed storage device recently unveiled by Control Data Corp. (MMS, September, 1981, p. 10), and then license the drive for manufacturing. . . . **MiniScribe Corp.**, Longmont, Colo., is expected to drop its two-thirds-high MiniScribe III 5¼-in. Winchester, and offer a redefined half-high version this fall. The drive will store 10M bytes per platter or will be available in a 6.4M-byte Seagate ST-406 compatible version. Both versions will incorporate the company's rack and pinion actuator, and will be priced at less than $400 in large-volume orders. Evaluation hardware is set for the third quarter.

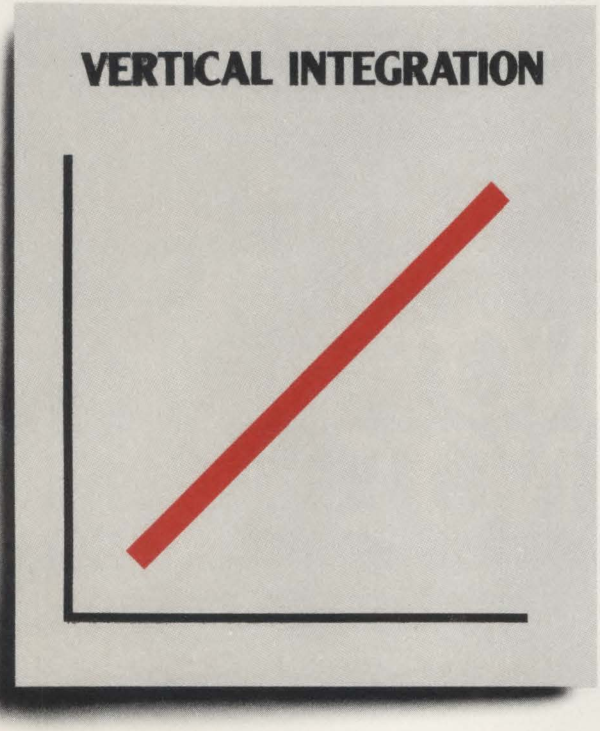
Microfiles: Signetics Corp., Sunnyvale, Calif., partner of Motorola, Inc., and Mostek Corp. in the VME single-board computer bus standard, will use Wescon to show its first products built to the standard's specifications. Included in the offering are an MC68000-based CPU board, a 256K-byte RAM board, a hard/floppy disk drive controller (as many as four drives) and a system controller that, among other things, handles bus arbitration, a function typically left to the CPU board. Single-quantity prices are $2050 for the CPU, $2550 for the RAM, $420 for the system controller and $220 for the disk controller. A video-display controller, using the company's 267X video controller (MMS, March, p. 62), is planned for mid-1983. Signetics also will deliver a user work station for MC68000 cross-software development this month. The $5500 system uses Pascal through VMS on a VAX 11/730 to /782.

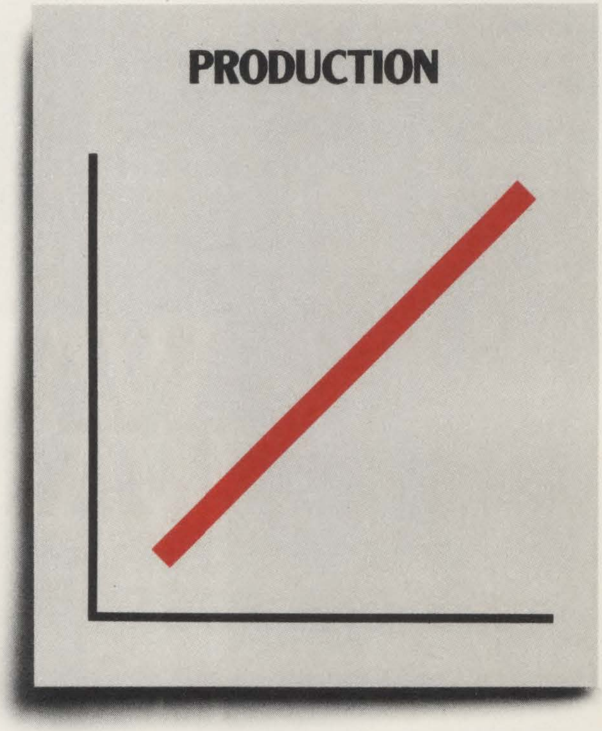
Mini Files: Commodore Business Machines is moving back to retail chains for its Commodore 64, a personal computer aimed roughly at the Apple II market. Commodore products have been handled by the ComputerLand chain in the past, but were withdrawn in favor of independent dealers. Under a new national distribution agreement with the Hayward, Calif.-based ComputerLand headquarters, the 64 is expected to be sold through 230 franchise stores. In addition, Commodore has signed 31 MicroAge outlets and is talking to other chains, including Sears. The higher end Commodore 128 and 256 may have similar chain-store distribution.

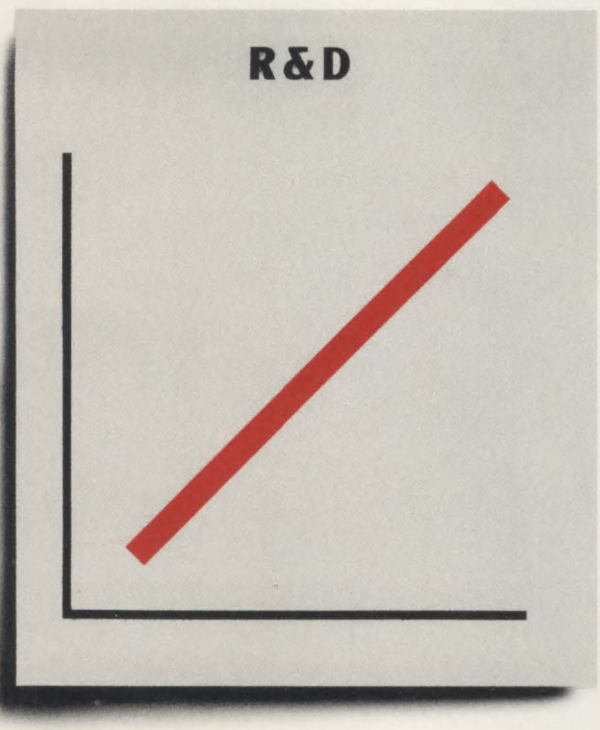
Terminal files: Digital Equipment Corp. is about to almost halve the price of its VT-18X upgrade kit, which adds stand-alone computing to the VT-100 terminal via two 5¼-in. floppy disk drives and a Z80-based CPU board, and can run with a CP/M kit. Arthur Campbell, terminal products group manager, says the VT-18X did not meet sales expectations and is being repriced to give it an aggressive price/performance ratio. The VT-18X is being reduced from $2395 to $1295; CP/M for the upgrade kit has been dropped from $250 to $200.

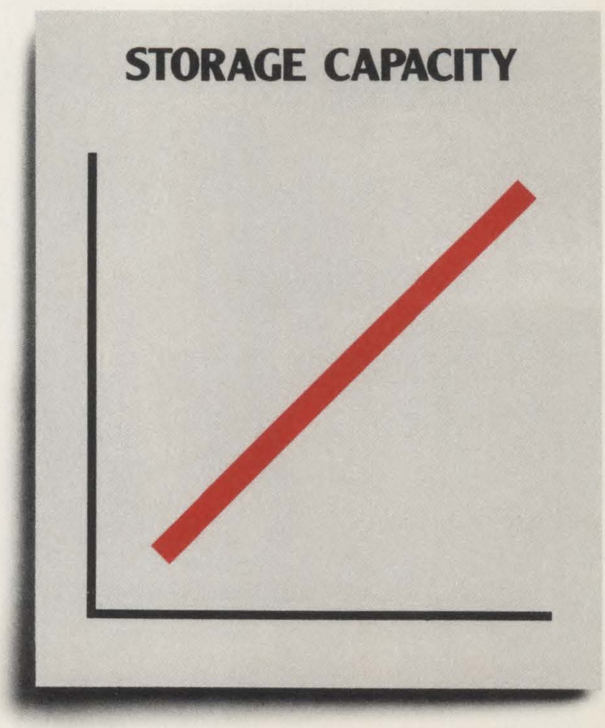
Printer files: Epson America, Inc., which has been barraged by rumors that it will halve the price of its MX-70 and MX-80 printers, says those speculations are not true. A company spokesman says the MX line will be phased out by February, 1983. A new printer series, called the FX that runs at twice the speed of the MX will be introduced in November. Additionally, a new low-cost printer will be unveiled in January or February.

IF OTHER WINCHESTERS HAD THESE,









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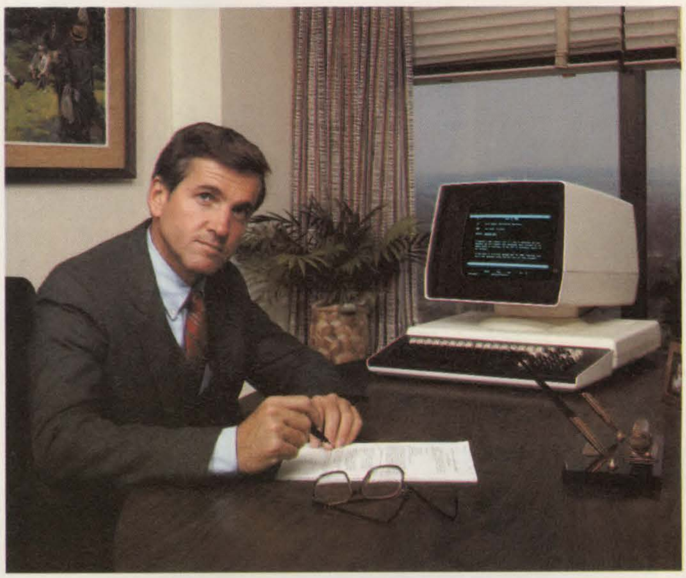

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CIRCLE NO. 38 ON INQUIRY CARD

TeleVideo 970 leapfrogs into X.364/VT-100-compatible market

Although the originality of its marketing and manufacturing approach has pushed TeleVideo Systems, Inc., into the top three independent-terminal manufacturers, few would credit the Sunnyvale, Calif.-based company with innovation in terminal form or function. Its initial success, for example, was a Lear Siegler look-alike that had the ADM-3A's code structure but a price tag $50 lower. But now, in a play for the ANSI X.364/VT-100-compatible market dominated by Digital Equipment Corp., TeleVideo claims to have given video-terminal design an original twist with its 970 terminal.

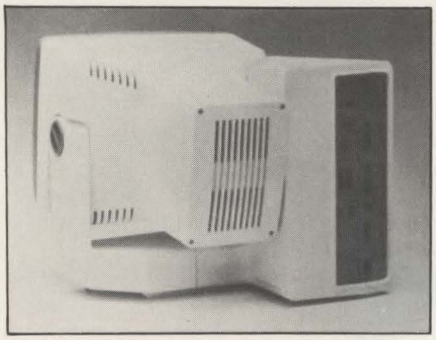
"With the 970 terminal, we're taking a risk," says vice president of marketing and sales Steve Tatum. "We've always been a follower. Now we've decided what we think the product should be. C. Itoh did the DEC look-alike. We've leapfrogged over the top."

The TeleVideo 970's most striking aspect is its profile, the result of mounting the logic boards and power supply in a vented case on the side of the shrouded CRT. In this configuration, the tube is perfectly balanced, allowing an operator to adjust screen tilt with one finger. Moreover, the vertical placement of the PC boards in the "cooling tower" allows true convection cooling, which Tatum says provides an estimated 60-percent longer life for the terminal's electronics. Other general terminals on the market such as Visual Technology, Inc.'s Visual 50, also offer true convection cooling.

Inside the unusual shell beats the heart of a VT-100 emulator, with 132-character columns, double-height/double-width characters and ANSI X.364 codes for VT-100 plug compatibility. But the 970 is set apart by its 14-in. screen, standard advanced video attributes, a nonvolatile setup menu and eight resident fonts. The low-profile keyboard provides a palm rest and "00" and "cancel entry" keys for an accountant-style keyboard.

The features were chosen after the company surveyed its customers' wants, says Tatum. But TeleVideo's choice of the VT-100 market was a given: it is the largest general-purpose terminal market in which TeleVideo has no presence. DEC's installed base of VT-100s is an estimated 250,000; VT-100 emulators from companies such as General Terminal Corp., DataMedia Corp., Direct Corp. and Visual Technology, Inc., bring the total to more than 300,000, according to estimates by two market-research firms.

But terminal industry analyst Bob Sarnekoff of Dataquest, Inc.,



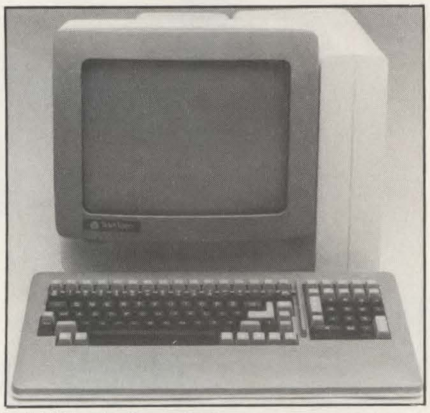

The TeleVideo 970's most striking aspect is its profile, *the result of mounting the logic boards and power supply in a vented case. Vertically placed PC boards are convection cooled to give the terminal's electronics an estimated 60-percent longer life span. Another result of the design is a balanced CRT terminal that can be tilted with one finger.*

Cupertino, Calif., says the VT-100 market is not easy to crack. "A lot of companies decided that was an attractive market two years ago when DEC was having trouble getting enough VT-100s out the door," he says. "But once DEC got up to steam, most of those companies got steamrollered."

Companies have enjoyed success in that market, however, including C. Itoh Electronics, Inc., which confirms it will have an estimated 25,000 DEC-compatible terminals installed by year-end. C. Itoh's terminal line product manager, Joe Friedmann, believes that it is necessary for a terminal to emulate the VT-100's form as well as its function, down to the LED message lights. "That way, there is no cross-training of operators," he says.

Gnostic Concepts, Inc.'s program manager for terminal research, Robert Katzive, points out a potential pitfall: any firm in the VT-100-emulation market can be hurt by DEC pricing moves. "DEC has a lot of room to bring its price down if it has to," he says. Although DEC's list price for the VT-100 is $1945, the terminals are often available for $1300 to $1400 in small quantities, say several industry participants.

TeleVideo's Tatum counters that the 970 at $1495 has more features than the VT-100; further, he says, TeleVideo can match DEC price reductions should a price war develop. But he says a price war is unlikely because it won't be necessary to take market share from the VT-100 for the 970 to increase TeleVideo's volume substantially.



TeleVideo's Steve Tatum *says the company supports the ANSI X.364 codes for VT-100 plug compatibility because standardization in the general-purpose terminal market is moving in that direction.*

"I don't want to overemphasize the 970's VT-100 compatibility," says Tatum. "We went the ANSI X.364 route because we think the general-purpose market is moving in that direction. Standardization is necessary from a software point of view," he says.

Analyst Katzive corroborates Tatum's theory. For example, Katzive says, the terminals intended for use in the UNIX world will probably follow ANSI X.364 protocols and VT-100 functions because American Telephone & Telegraph's terminal prototypes for the office-automation market have adapted such code structure and function. "It looks like TeleVideo is thinking ahead," he says.

Despite general praise for TeleVideo's price/performance, quality control and strategy, however, Katzive believes that Tatum may be overstating the case for both the 970 and TeleVideo in general. If TeleVideo ships the 9000 units a month it claims, says Katzive, it has nearly doubled volume since the beginning of the year, which Katzive deems unlikely given economic conditions. Further, he thinks the company may be overextending with the 970 and will find itself unable to maintain profitability of all its terminal models. Tatum says the shipment figures are true, and are up 100 percent over the beginning of the year. He adds there still is a demand for other models in the line, and when demand for them drops off, so will the products. Until then, he says, there will be no impact on profitability.

—Kevin Strehlo

Z80 BOARD FOR APPLE III CP/M COMPATIBILITY

The Apple III personal computer now can run CP/M-based application programs using the Apple SoftCard III System. The Apple SoftCard III System was developed by Microsoft Corp. and is distributed exclusively by Apple Computer, Inc. The system supports the Apple 5M-byte ProFile mass-storage system. Both sophisticated operating-system and CP/M files can be stored on ProFile. The board plugs into any Apple III peripheral card slot. The Apple SoftCard III System includes a plug-in Z80 microprocessor card, CP/M software, four manuals that describe card installation and software use and Microsoft BASIC. The system will be available from authorized Apple dealers in July. Suggested retail price is $450.

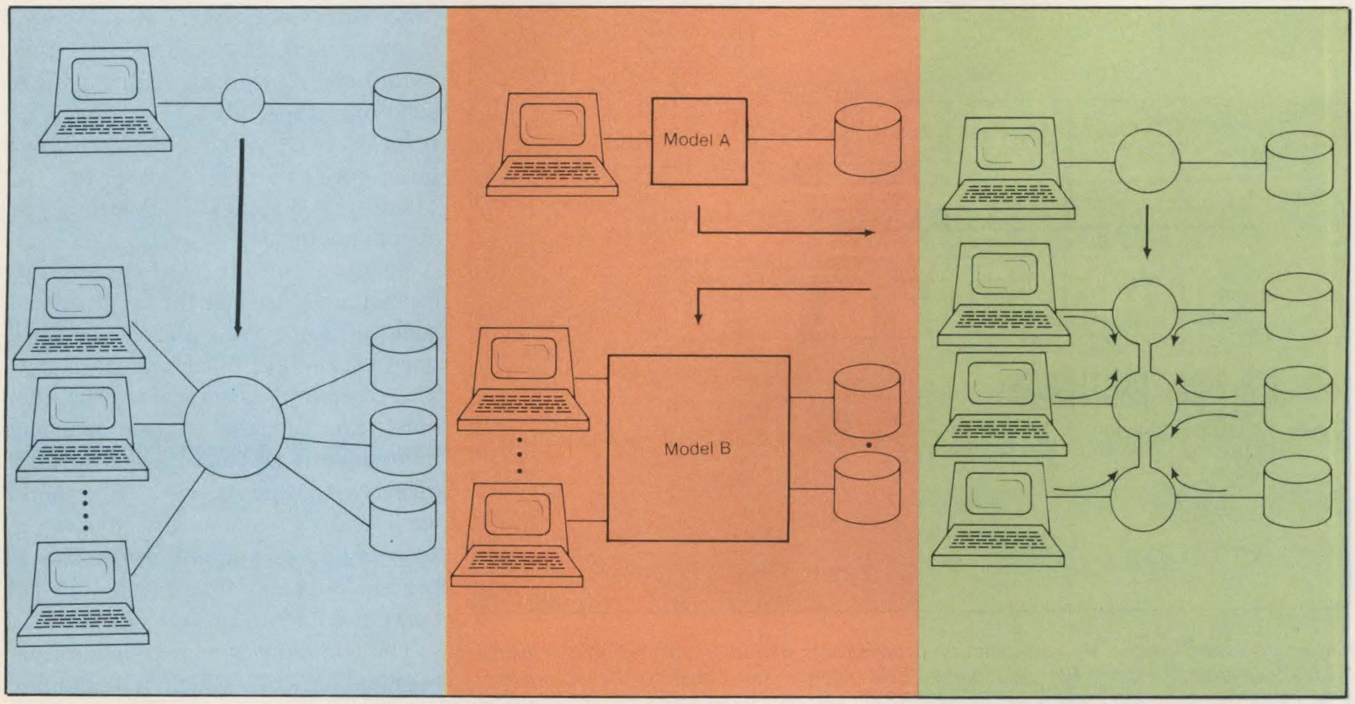
Multi-68000 transaction CPU sports 'additive' architecture

This month, after a two-year gestation, Synapse Computer Corp. will ship its first product, a transaction-processing system based on multiple MC68000 microprocessors from Motorola, Inc. Called the Synapse N+1, the fault-tolerant machine features an expansion rather than an upgrade architecture: processors are added to increase power as applications grow.

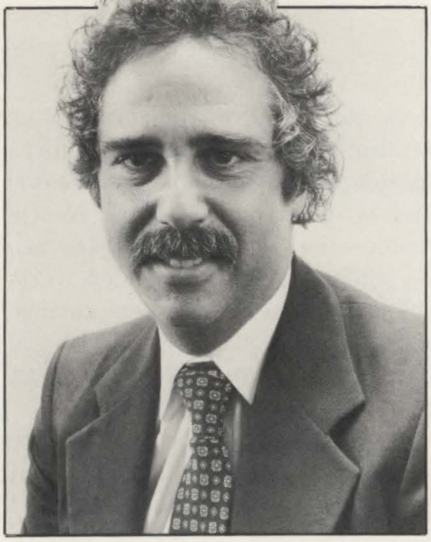
The system is aimed at a market for high-availability machines that is estimated to reach $19.5 billion by 1985, according to market-research figures quoted by the company. Executives at the Milpitas, Calif., computer manufacturer won't give a number for the market share they think they can get. A company spokesman, however, says, "If you look at the names of our backers, it's safe to say they have intergalactic ambitions." Among those financers are Storage Technology Corp. founder Jesse Aweida; Hambrecht & Quist; and Sevin Rosen partners, founded by industry analyst Ben Rosen and Mostek Corp. founder, L.J. Sevin.

Synapse co-founders Mark Leslie and Elliot Nestle compare the expansion-architecture approach to transaction-processing systems of more traditional designs: the upgrade architecture, typified by systems from IBM Corp., in which a user goes to the next highest product family member when existing system-processing, terminal-management or data base-management capabilities are exhausted, and the multiple-computer architecture, like that developed by Tandem Computer, Inc., in which more than one computer is used to expand in the application. The Synapse N+1 does not require replacement or replication of a system. It requires merely incremental microprocessor and I/O growth. Leslie and Nestle believe the Synapse hardware can be configured and expanded to do the job of systems with performance ranging from that of a Digital Equipment Corp. VAX 11/780 to an IBM 3081.

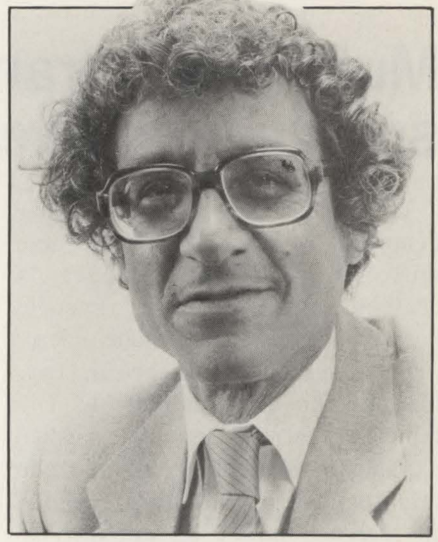
Synapse's expansion architecture is built around two independent 32M-byte-per-sec. buses and as much as 16M bytes of shared memory. Two kinds of processors—both based on the MC68000—are connected to the buses and share memory. The first is a general-purpose processor, which handles instruction execution. Its performance is helped by 16K bytes of cache memory. The second is an I/O processor, which manages as many as 16 device controllers, such as those for disk or tape drives, or communications subsystems. A separate communications processor,



Synapse's expansion architecture *(left), whereby performance is boosted by adding microprocessors and I/O capability, as compared with the upgrade architecture of the 1960s, in which a user goes to the next highest family member to gain power, and the multiple-computer architecture of the 1970s, in which more than one computer is used to grow in an application. (Source: Synapse Computer Corp.)*



Synapse founders Mark Leslie (left) and Elliot Nestle *say that their company has an impressive group of backers including Storage Technology founder Jesse Aweida.*



also built on the MC68000, supports as many as 16 lines. The system supports as many as 28 processors sharing memory. Application programs reside in the shared memory.

"The I/O scheme has been designed from a transaction-processing point of view," says Leslie. "Processors can be added in any mix to change the characteristics of the system," he continues. Each additional general-purpose processor serves as backup for the others, he explains. He says system redundancy goes all the way to the power supplies and fans.

However, rather than have a fully redundant backup function, such as the approaches taken by Tandem and Stratus Computer, Inc. (MMS, December, 1981, p. 5), Synapse's N+1 degrades incrementally over multiple failures.

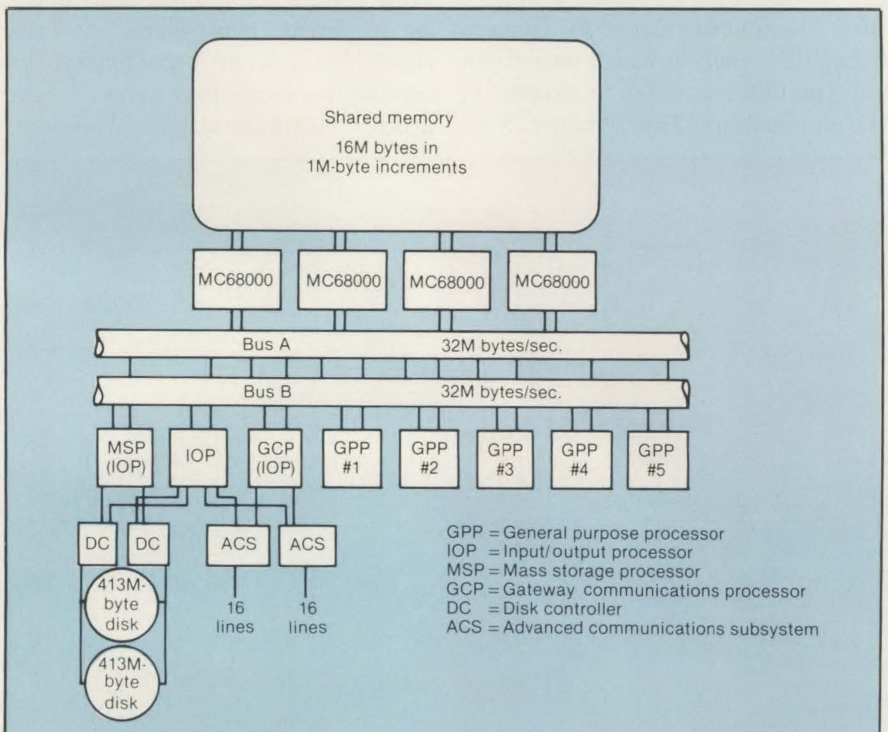
At the heart of the N+1's software is the operating system called Synthesis, written in Pascal. Synthesis and a relational database system and transaction monitor software, both written in Pascal, are bundled with the hardware. Pascal and COBOL compilers and debuggers, and several software-development packages, including a screen forms editor, a spooler and a database-administration tool, are available.

A typical N+1 system, selling for about $350,000, includes two general-purpose processors, three I/O processors, 6M bytes of memory, memory and disk controllers, two 151M-byte Winchester disk drives, a 6250-bpi tape drive, a 600-lpm printer, two consoles, 30 asynchronous ports and software. A 413M-byte Winchester disk drive is also available.

Synapse targets the machine at financial institutions for applications such as funds transfer, credit-card verification and electronic banking. The company expects to market the hardware through system houses, independent software vendors and directly to end users. "We think we'll get a 40:40 split between system houses and end users," says the spokesman. "The remaining 20 percent could go either way."

The company has established five regional offices, which will handle sales and service.

—Larry Lettieri



Memory on the Synapse N+1 transaction processor *is shared and accessed by multiple MC68000 microprocessors. Two independent 32M-byte-per-sec. buses, for an aggregate of 64M bytes per sec., are shared by the MC68000s and two other types of processors: a general-purpose processor for instruction execution and an I/O processor that manages as many as 16 device controllers. (Source: Synapse Computer Corp.)*

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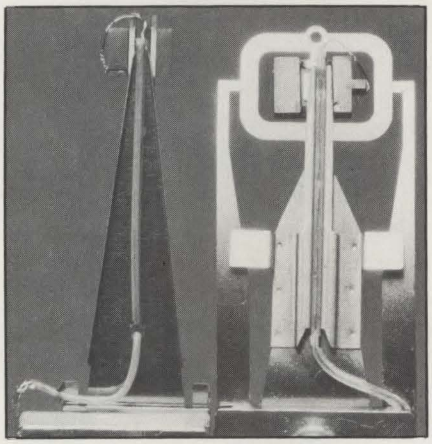
CIRCLE NO. 132 ON INQUIRY CARD

IBM's Whitney technology moves into 8-in. disk drive

Elements of IBM Corp.'s advanced Whitney disk drive technology—the basis for the mainframe vendor's thin-film 3370, 3375 14-in. drives and its 1G-byte 3380—are beginning to appear in Winchester disk drives aimed at the OEM market.

The code name for a series of high-capacity end-user drives, Whitney technology could set a pattern for future drive development at OEM vendors planning higher performance, higher capacity hardware. It combines key design elements already incorporated into Winchester drives with significantly increased areal densities (12M bits per sq. in. on the 3380, compared to 7M bits per sq. in. on the 3350), thin-film read/write heads, a new head flexture design and an improved read/write channel.

The first fixed/removable 8-in. OEM drive to use two key elements of Whitney technology, the 50M-byte 7110, may be ready for unveiling at the upcoming Comdex show by Longmont, Colo., start-up Amcodyne, Inc. The two key elements incorporated by Amcodyne are the 3370-style head flexture and the use of run-length-limited codes. The head flexture design, says Jim Morehouse, director of mechanical engineering at Amcodyne and a company co-founder, is better suited not only for small rigid-disk drives using removable cartridges, but for new fixed-disk designs as well. The head flexture is a spring-steel suspension perhaps 1 in. long. It is attached to the head-arm assembly at one end, and to the head at the other.



Whitney versus Winchester: *A head flexture characteristic of disk drives based on IBM's Whitney technology is shown at right connected to a two-rail, thin-film read/write head manufactured by Dastek Corp. To the left is an example of the flextures used extensively on Winchester disk drives until now, and the three-rail ferrite heads commonly found on this hardware.*

"Compared to the gimballed flextures derived from Winchester-technology drives, there's less vibration in a 3370 Whitney suspension," Morehouse says. "It has a better mechanical structure, and it's more stable in ramp-loaded designs such as ours." In a ramp-loaded design, the read/write heads are brought in over the surface of the disk after it has started . If conventional Winchester flextures are used, Morehouse says, there's a tendency for them to flutter. As a result, they can come into contact with the disk. "If this happens," Morehouse says, "the lubricant on the disk can get eaten away, heads can become abraded, and head crashes can result."

The stability that makes Whitney flextures appealing for designers of disk-cartridge drives also offers significant improvements in reliability to companies that are also concerned with fixed-disk design, he adds. When a conventional Winchester starts, the head drags along the surface of the disk before it begins to fly, he explains. Again, the lubrication and the heads get abraded, and head crashes can result.

"Ramp loading the heads may actually lead to a more reliable head/disk interface on fixed-disk drives," Morehouse says. He notes that Amcodyne has done some comparative testing and has found

Comparing the competitors

Company	Amcodyne	Century Data Systems	Control Data Corp.	Data Peripherals, Inc.
Model no.	Amcodyne 7110	Century C2048	9457 (Lark II)	DP-100
Capacity (M bytes fixed/removable)	25/25	16/32	25/25	11.6*
Track capacity (bytes)	20,762	20,160	20,160	13,440
Transfer rate (bytes/sec.)	1.229M	1.208M	1.2M	875K
Positioning times (msec.)				
track/track	10	8	10	15
average	35	30	35	60
Bit density (bpi)	10,000	9873	10,161	6968
Track density (tpi)	550	480	715	478
Dimensions (in.)	4.63 × 8.55 × 14	6.87 × 8.55 × 17	5.18 × 8.58 × 21	4.62 × 8.55 × 14.25
Price (per 500 units)	$2350	$2700	$3070	$1475

*removable-only drive

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CIRCLE NO. 12 ON INQUIRY CARD

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that in 12 life-cycle tests, the company was able to generate 50,000 ramp-loaded head launches before a crash, compared to 10,000 launches off the surface of a disk.

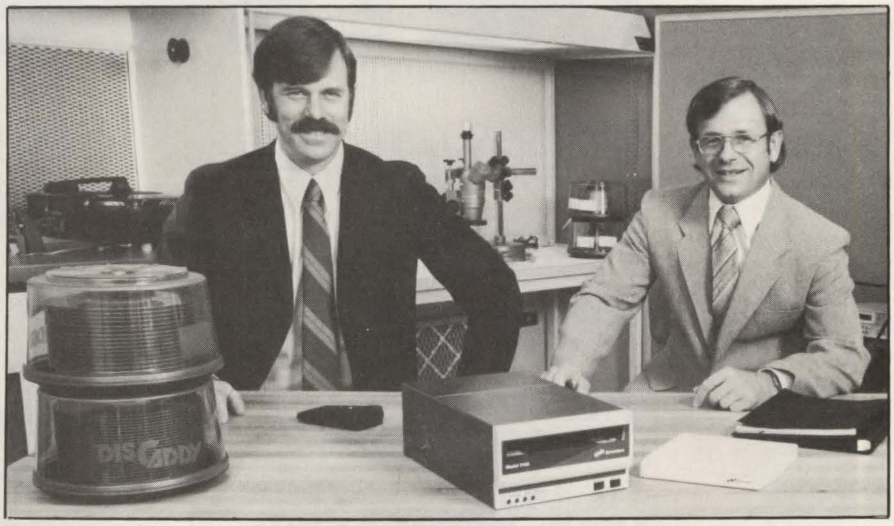
A number of other drive designers are reaching much the same conclusion about ramp loading, but for a slightly different reason. Ramp loading permits the heads to be retracted completely away from the surface of the disk, thus avoiding any inadvertent media contact while the drive is being shipped or moved.

The second element of Whitney technology incorporated into the 7110 takes the form of the 2,7 RLL code that has shown up only in a small number of OEM drives. Use of an RLL code, explains Dick Laatt, director of electrical engineering and a second company co-founder, permits more data in the form of bits per in. to be generated for each flux reversal per in. In the case of the 3370, for example, Laatt says, a flux density of 8128 fcpi translates into a bit density of more than 12,000 bpi. In Amcodyne's 7110, the disk-cartridge and fixed disk operate at flux densities of 6700 fcpi, and bit densities of 10,000 bpi.

The 2,7 code that Amcodyne uses specifies that there will never be fewer than two binary ZEROs between successive ONEs, and never more than seven ZEROs (hence the run-length limitation). This code is implemented on a custom chip, replacing the 16 chips typically required to implement an RLL code. "We had to do this for real estate," Laatt says, "and for timing."

The company sees the chief competition for the 7110 coming from Control Data Corp.'s enhanced Lark II 25M-byte fixed/25M-byte removable drive scheduled to be shipped in evaluation quantities this fall. The 7110 will be compatible with Lark and SMD interfaces, but without the interface card required by CDC's device. Laatt says his company is also looking at the proposed Shugart Associates standard interface and at intelligent interfaces. "We could implement any interfaces," he says. "But the Lark is the real competition."

Like the Lark, the 7110 incorporates an embedded servo system that among other things eliminates head/disk-alignment problems in the removable cartridge. The com-



Amcodyne's Dick Laat (right) and Bob Morehouse display a prototype 7110 *25M-byte fixed /25M-byte removable disk drive, which brings IBM's Whitney technology to the Winchester market.*

AMCODYNE DISCOUNTS THIN-FILM HEADS

While Amcodyne plans to use 3370 head flextures for its new hardware, it has no intention of making immediate use of the thin-film heads that are also characteristic of drives developed under the code name Whitney. "This (thin-film heads) is the least significant aspect of Whitney technology," says Jim Morehouse, director of mechanical engineering and an Amcodyne co-founder. "We looked at their potential, but there are not enough of them available in quantity, and we didn't want to play 'bet your company' on such a critical component."

Instead, he explains, Amcodyne has combined the 3370-style flexture with mini composite heads—a move that increases the performance of the drive, compared to ferrite components, while at the same time allowing future retrofit of thin-film heads if they become available in satisfactory quantities.

The Amcodyne heads differ from conventional Winchester ferrite heads in that they have two rails, instead of three. The core and gap of the head are built into one of the two rails and bonded with glass. The result is a head that does not suffer from unwanted interference from stray magnetic impulses from other adjacent tracks, but one that is not as easy to manufacture in volume. But this is "not a technology problem as is the case with thin-film heads," he says. "It's a tooling problem."

Dick Laatt, director of electrical engineering at Amcodyne and a second company co-founder, also believes that the heads may offer superior performance compared to existing thin-film components at current track-density levels, and that for now, Amcodyne's product line will not need this element of Whitney technology. "Thin-film read/write heads can give you a 15-percent improvement in terms of flux density," he says. "But after that, their performance plateaus and can actually fall off." Laatt believes that Amcodyne could use thin-film heads at some future date, but for the moment, they are too expensive.

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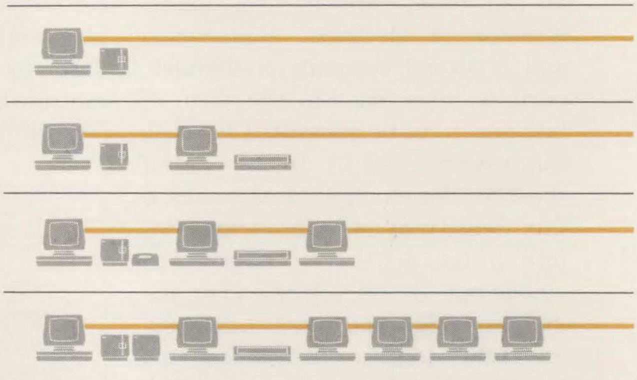

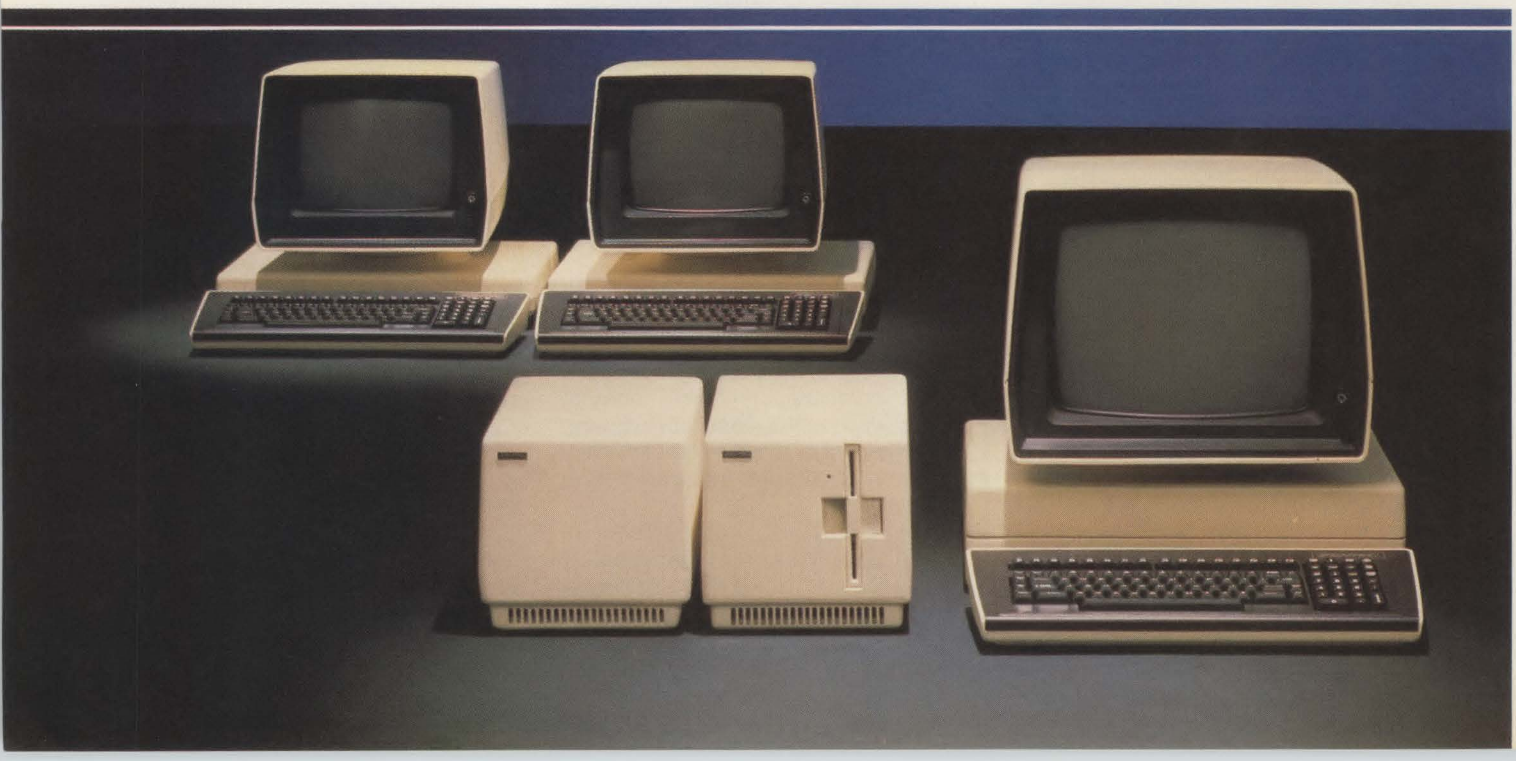

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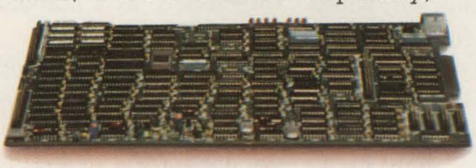

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pany is cooperating with the American National Standards Institute on the development of servo standards for these cartridges, thus expediting interchange of disk cartridges between drives of different vendors, and is talking with Century Data Systems about establishing data formats. (It should be noted, however, that the Lark uses a cartridge with dimensions that are different from those used by Amcodyne and a number of other vendors.)

Jim Porter, Mountain View, Calif., industry analyst and publisher of *Disk/Trend Report,* feels Amcodyne is taking a necessary step in this regard. "The big problem with 8-in. fixed and removable drives is that cartridges cannot be interchanged. These vendors will be a lot more successful if they'd cooperate with each other."

Porter estimates that the market for fixed/removable hardware is considerable, and that two years from now, 10 to 15 percent of all small-business systems installed will use a removable disk-cartridge drive. This translates into an estimated 40,000 to 60,000 drives a year, he says, noting that 5¼-in. drives should dominate.

The 7110 is priced at $2350 in 1000-lot quantities, excluding power supply. Evaluation versions are scheduled to be delivered during the fourth quarter of this year. with small-production versions set for early 1983.

—John Trifari

CORRECTION

Mini-Micro Systems erred in a chart that listed the performance of four microprocessors (July, p. 20). The chart appeared on p. 22, and incorrectly listed certain attributes of the Motorola 68000. The correct data for the 68000 follow. The editors regret the error.

	Motorola 68000
Speed	12.5 MHz (full production)
Architecture	All internal data - 32 bits Data bus - 16 bits
Address range (bytes)	Linear 16M
Data bus	Unmultiplexed - no speed penalty
Packaging	64-pin DIP

Pick jockeys for position in standard operating-system race

Pick author and head of Pick Computer Works Dick Pick, *helped create a machine-independent, nonprocedural, report-generating language, then worked on his own to surround the language with an operating system.*

After 10 years of installations on a handful of minicomputer brands, the Pick operating system is emerging as a competitor with products such as Western Electric's UNIX in the race to become an industry-standard, transportable operating system for all levels of computers. Pick Computer Works, headed by Pick author Dick Pick, is "coming out of the closet," says Pick senior licensing executive James H. Zukin.

Pick has already begun its drive into the 16-bit microcomputer market with implementations for the Motorola Inc. MC68000 and Intel Corp. 8086/88 microprocessors. Another strategic marketing thrust has been directed at IBM Corp. products that go through the Value Added Remarketer program, which now includes the Series/1, 4300 and System 23 computers, but is expected also to include the popular IBM Personal Computer (MMS, July, p. 268). Pick has also reduced its pricing to an initial fee as low as $100,000 and has allowed its licensees to use the Pick name for the first time.

All these moves represent a shift from Pick's historical position as a software-development company that, Zukin says, sold implementations only to finance further development of the operating system. Skip Bushee, an analyst with Cupertino, Calif.-based INFOCORP market-research firm, says the changes are important if Pick wants to compete as a standard operating system.

"Pick has a very good reputation, but the problem has been that Dick Pick's policies have prevented many vendors from using the system," says Bushee. "All the companies we talk to are very interested in Pick because UNIX is not designed for commercial applications and has shortcomings—especially in database management. But Pick has made it damned difficult."

What Pick has going for it, supporters say, is its track record as a successful commercial operating system. Unlike UNIX, which was written for Digital Equipment Corp. systems and intended for program-development applications, Pick was designed from the start for small-business-system applications and has been adapted to a variety of machines.

Pick Computer Works senior vice president Tim Holland says that in the decade since it first appeared on Microdata Reality minicomputers (see "Pick: a 20-year project," p. 34), the operating system has been

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installed on 9000 computers. Zukin estimates that users have paid an average of $10,000 per license for a total of $90 million in Pick operating-system fees. In addition, an extensive network of system houses and dealers have developed $250 million worth of application programs. INFOCORP's Bushee estimates there are 4000 to 5000 UNIX installations. A large number of those are said to be in university, rather than commercial, environments.

Analyst Jean Yates, whose Yates Ventures has devoted much of its energies to tracking UNIX as a proposed industry standard (MMS, June, p. 155), acknowledges that there has been a rising demand for information on Pick as well. "There's an incredible interest in Pick because Bell Labs is not supporting UNIX," she reports, but points out that the lack of Bell support can be attributed to federal regulatory controls. She adds, "If Bell isn't willing to meet the needs for a commercially viable UNIX, people will look elsewhere."

The Datamedia 932 multi-user microcomputer *is based on the MC68000 and is the first such system to run the Pick operating system. Competitors will follow soon.*

Pick officials say that interest in Pick has grown so much that 116 vendors approached the company last year seeking licenses for the operating system. From them, Pick has chosen a strategic handful that are expected to greatly expand the Pick base. These include:

- Pennsauken, N.J., terminal manufacturer Datamedia, which has introduced its 68000-based 932 system that sells for about $22,000 in a six-terminal configuration, and is said to be the lowest priced Pick system to date (see "A look at Datamedia's MC68000/Pick system," p. 42).
- Computer Distributors, Inc., Bellevue, Wash., which has begun marketing an IBM Series/1 minicom-

PICK: A 20-YEAR PROJECT

The Pick operating system traces its roots to the mid-1960s when TRW Inc. was required by the federal government to come up with a sophisticated database system to manage the Cheyenne helicopter contract. The government did not specify what hardware was to be used, so TRW programmers—including Dick Pick—came up with a machine-independent, nonprocedural, report-generating language.

After leaving TRW, Pick worked on his own to surround the reporting language with an operating system. The first implementation was done for Microdata, and a user-friendly, disk-based, multi-user, virtual operating system with an integral database manager emerged. Its report generator, which used prose statements instead of a high-level language, was dubbed English by Microdata. The operating system featured built-in data security such as password protection; variable field, record and file handling; integrated word-processing utilities; built-in program-development tools; and a library of business applications.

In addition, the built-in relational database facility with its variable-length records (as much as 32K bytes each) is said to save disk space compared to fixed-length database schemes. The virtual memory design automatically shifts programs and data between real memory and disk using a least recently used algorithm, which is said to eliminate the need for programmers to overlay or segment programs.

The operating system was available only on Microdata systems until the late 1970s when Pick severed his ties with Microdata. Pick Computer Works then made an unsuccessful bid to become a system vendor with a French-built Intertechnique mini designed to outperform Microdata systems in the same price range. Pick soon returned to full-time software development and sold the rights to the system to Evolution Computer Systems Corp. The next official Pick implementation was done for The Ultimate Corp., a group of former Microdata dealers headed by Ted Sabarese and configuring systems based on Honeywell Level 6 and DPS 6 minicomputers. Ultimate met with greater success than the financially troubled Evolution. In four years, the company has grown to $30 million in annual sales, placing 600 Honeywell machines and nearly 100 of its newer DEC LSI-11-based products.

As Ultimate was gearing up, Prime Computer, Inc., introduced its Prime Information package, a small business-oriented product designed by former Microdata personnel and generally regarded as a Pick package.

In 1980—before Ultimate's LSI-11 product hit the market—Applied Digital Data Systems introduced what was heralded as the first microcomputer implementation of the Pick operating system. The ADDS Mentor, based on the Zilog Z8000 microcomputer, fills the market slot below Pick minicomputers, but above new Datamedia products. However, ADDS is expected to introduce a lower end product by year-end as well as a new high-end Mentor version. Holland says ADDS expects to ship 1000 systems this year and 4000 in 1983.

Pick officials say they are in the 18th year of a 20-year project that will culminate in a major revision in 1984. That revision, R84, is expected to shore up communications weaknesses and to embed as many as a dozen standard applications to reduce the number of application programs required.

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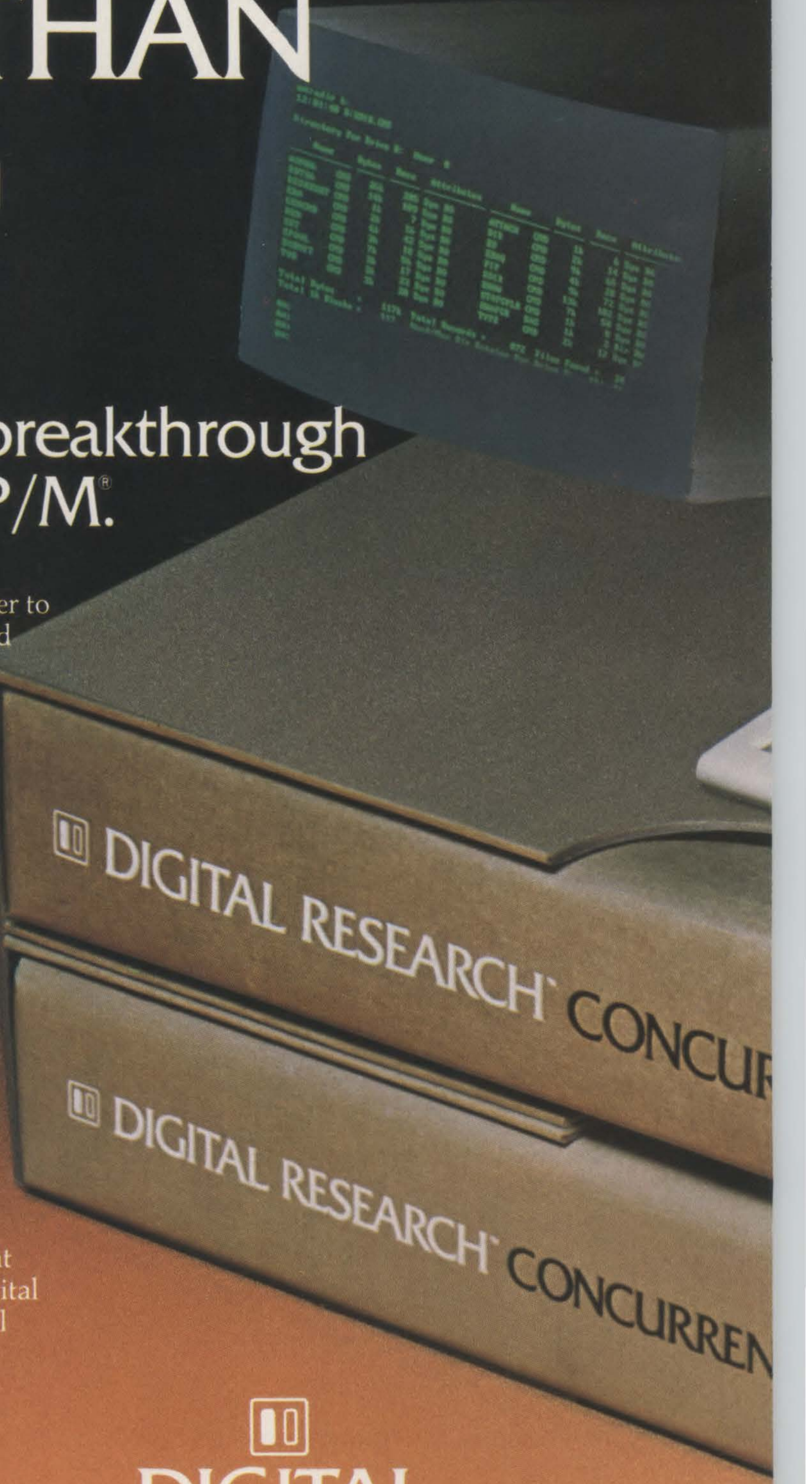

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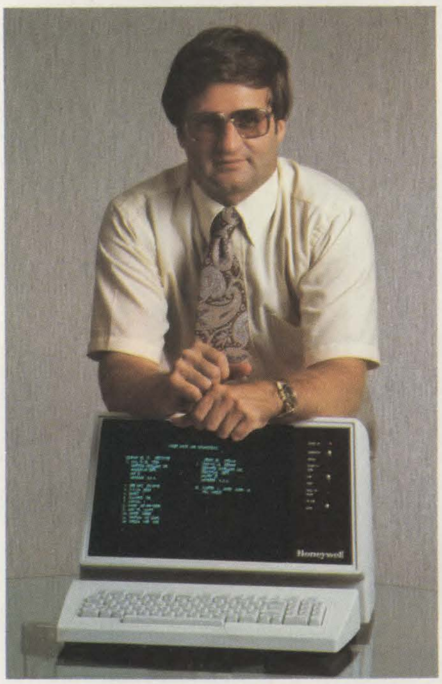

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puter with the Pick operating system that will be sold through IBM VARS.

• Systems Management, Inc., Rosemont, Ill., an IBM VAR and long-time distributor of Pick products, that will market the CDI product, and that has contracted with Pick for an implementation of the operating system on IBM 4300 series mainframes.

• Altos Computer Systems, which is planning a fall introduction of a Pick-based version of its ACS 8600 desk-top, multi-user system built around the 8086.

In addition to these announced products, Pick is working on an implementation for the IBM Personal Computer in anticipation of a multi-user version that would be sold through the VAR channel. The company also plans an implementation for National Semiconductor Corp.'s NS16000 microprocessor. Another implementation under negotiation would put the operating system on Fortune Systems' 68000-based 32:16 (MMS, August, p. 5).

Pick is also casting about for a supermini implementation for the operating system among candidate systems from Gould S.E.L., Data General Corp. and Perkin-Elmer Corp.

"We've reached our critical mass and are now exploding on the market," says Holland, who predicts that the installed base will double within two years and will reach at least 50,000 within five years. That number could increase significantly, however, if the IBM PC implementation is well received.

With eight Pick implementations in active marketing during 1982 (including the IBM Series/1), the company expects "at factory" values of those machines to reach $366 million this year, with those systems carrying an estimated retail value of $800 million. This compares with at-factory levels of $240 million in 1981 and $186 million in 1980.

However, Pick's internal forecasts, which rely heavily on the presumed success of the IBM base products, call for a quadrupling of that at-factory number to more than $1.6 billion in 1984. At that time, Pick analysts predict, the Series/1

The Pick operating system has branched out *to be used on a variety of machines since its beginning on Microdata Reality equipment in 1974. Intertechnique minicomputers followed—briefly through Pick Computer Works, then through Evolution and now through an overseas operation of General Automation. Prime minicomputers came up in 1979, and, in the same year, Honeywell Level 6 minicomputers were brought up for the Ultimate Corp., which now has added an implementation for DEC LSI-11s. Other microcomputer implementations began in 1980 with the Zilog Z8000 for ADDS, and a Motorola MC68000 version came up this year for Datamedia and is believed to be under consideration at Fortune Systems. The Intel 8086/88 will start with an implementation for Altos Computer Systems, and an 8088 version is in the works for the IBM Personal Computer. Other IBM products include the Series/1, which will be marketed by CDI through companies such as SMI, while SMI is expected to be the first to offer a 4300 version.*

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A LOOK AT DATAMEDIA'S MC68000/PICK SYSTEM

This month, Datamedia Corp., the Pennsauken, N.J.-based CRT-terminal vendor, is expected to begin limited production of its first computer system, a Motorola MC68000-based system running the Pick operating system.

The 932, as the Datamedia box is dubbed, is the first implementation of Pick on the MC68000. It is expected to retail for $15,000 in a free-standing cabinet version that includes 128K bytes of memory, 12M bytes of 5¼-in. Winchester-disk storage, 10M bytes of streaming-tape backup capacity, six terminal ports, two printer ports, one IEEE 488 port and the Pick operating system. The system can be expanded to include 2.1M bytes of RAM, 76M bytes of disk, 80M bytes of tape backup and 16 terminal ports.

Datamedia president Bill Shipman says typical eight-terminal configurations are expected to retail in the $25,000 to $30,000 range, but a six-user system can be configured for as little as $22,000.

Shipman says the 932 will be marketed through dealers and system houses including existing Pick resellers who are seeking lower priced hardware for their applications. Datamedia has added 2780/3780 protocol emulations to the Pick package, and says it will use a dedicated I/O microcomputer to handle 3270 SNA/SDLC and X.25 emulations.

"We perceived a gap in the Pick world and saw a way to fill it," Shipman says. But he admits that Datamedia may have the honor of being the lowest priced Pick system for only a short while until other competitors line up. However, he adds that the company is also planning a desk-top microcomputer system that will "most likely" be Pick-based as well and could compete with a Pick production from Altos.

alone will have an at-factory value of $100 million.

Another factor in those projections is the assumption of an ever-expanding Pick world. That expansion, in turn, is at least partially predicated on the industry's response to Pick's loosening of its admittedly restrictive licensing practices.

A major revision of Pick's pricing strategy has reduced the price of implementations from more than $1 million for a minicomputer to a starting price of $250,000. Holland points out that the pricing was intentionally high in the past because minicomputer implementations were restricted to one vendor per machine, and all development costs had to be recovered from a single implementation. He also says the pricing reflected not only the cost of the implementation, which includes debugging and initial handholding, but also some of the cost of the 300 man-years of work that have gone into the Pick operating system. Further, he notes, the pricing is not that high when the prohibitive expense of internal operating-system development is considered.

In the microcomputer market, Pick's implementation is generally $100,000, with commitments for royalty levels based on a $250 end-user fee for a single-user system to as much as $1000 for a high-end 16-bit microcomputer. The lower fees reflect both the lower price of the hardware and the fact that microcomputer licenses are nonexclusive, so development costs can be amortized over many products.

However, to ensure that microcomputer vendors are serious about selling Pick in reasonable quantities, Zukin says, licensees are required to commit to royalties of $100,000 the first year, $200,000 the second, $300,000 the third and $400,000 in the fourth for a total investment of $1 million.

Another change at Pick involves a move toward actively marketing the system. The company has just added its first vice president of marketing, William W. Walsh, formerly president of ESCOM/Mountain States, a Denver-based Prime Computer, Inc., and Microdata Corp. dealer.

CDI general manager John Craig says his company has been encouraging Pick to develop greater visibility in the market. "With the introduction of the IBM (Series/1) product, the company will become more promotion-conscious," he says. CDI president Dennis Brown points out that the IBM name will help to promote Pick. "With the IBM name on the front of it, we are opening doors we've never opened before. We've got one dealer already bidding 300 systems," Brown says. CDI, an IBM MasterVAR (a value-added distributor that resells IBM products to dealers and system houses rather than end users), has signed 11 dealers to date and expects to add another 20 by year-end.

Holland agrees that the IBM connection will do much to spread Pick's reputation. "CDI signed a three-year contract with IBM for 1000 Series/1s, and I wouldn't be surprised if they do that in one year," Holland says. Zukin says Pick intends to have the biggest share of the IBM VAR market.

Another potential accelerant in Pick's growth is the Altos implementation, which Zukin characterizes as Pick's "experiment" in the computer-retailing channel. He says that, by 1984, Altos could be the number two Pick house in terms of unit shipments.

Ron Conway, North American sales and marketing vice president at Altos, estimates that of the company's projected sales of 30,000 to 40,000 units in 1983, as many as 5000 will go out the door with the Pick operating system.

—*Geoff Lewis*

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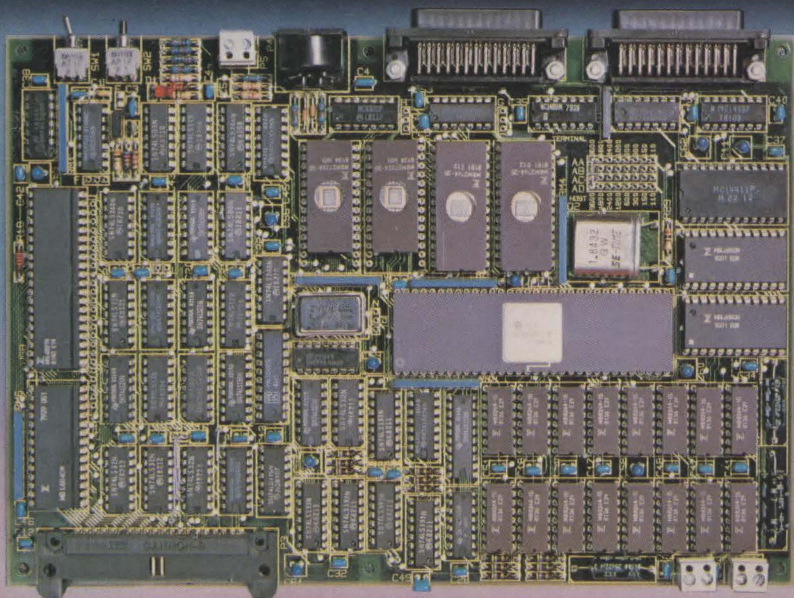

Support for graphics standards swells to 15 vendors

Digital Equipment Corp., Intel Corp. and Tektronix, Inc., have been joined by 12 vendors of graphics hardware and software in support of two graphics standards undergoing finalization by American National Standards Institute committees (MMS, July, p. 48). One, North American Presentation Level Protocol Syntax, defines the interface and communication protocol for videotex. The other, Virtual Device Interface, defines the interface between graphics utilities software and a broad range of hardware devices that display, enter or output graphic information in such applications as CAD/CAM and business graphics. Both standards are aimed at improving software portability among different machines and reducing overall costs for graphics.

The 12 companies are AEL Microtel, Ltd., Burnaby, British Columbia; Digital Research, Inc., Pacific Grove, Calif.; Graphics Software Systems, Wilsonville, Ore.; Hazeltine Corp., Commack, N.Y.; International Computers Ltd., London, England; ISSCO Graphics, San Diego, Calif.; Mannesmann Tally, Kent, Wash.; Microsoft, Bellevue, Wash.; Norpak Ltd., Kanata, Ontario, Canada; Precision Visuals, Boulder, Colo.; Westinghouse Electric Corp., Pittsburgh, Pa.; and Xerox Corp., Dallas.

The companies' support of the standards includes technical and research personnel for the ANSI committees to accelerate the development and evaluation process, and commitment to develop and market products based on the two standards.

One product has already surfaced from Norpak in a NAPLPS videotex decoder that conforms to the working version of the standard defined by American Telephone & Telegraph in 1981. AEL Microtel has shown a prototype NAPLPS device. Moreover, once the NAPLPS standard is finalized, Intel plans to release a graphics controller chip dubbed the 82720 and a board set based on that chip that will lower the cost of videotex to users. "Current TTL implementation costs about $500 in quantity," says ANSI X3L2 committee member Bruce Cohen, an Intel graphics software engineer. "The LSI version will be a factor of two to four cheaper."

Cost savings from the VDI standard will result from its implementation in silicon. The commands of graphics utility software must be translated by software device drivers into the hardware instructions of each plotter, terminal, digitizer and similar device. "We have written more than 40 device drivers for our DI-3000 graphics software, and it's not cheap," explains Jim Warner, president of Precision Visuals. "The VDI standard will make each device driver much easier to write." A VLSI-based top-end for graphics devices will eventually map hardware instructions into the VDI standard interface, eliminating the need for such device drivers.

The VDI and NAPLPS standards are similar in function, which has led to speculation about which standard would emerge victorious. But participants say there is no conflict between the VDI and NAPLPS standards because they are intended for different purposes. "VDI may be encoded in more than one manner and is intended to support many types of devices," says Intel's Cohen, "whereas NAPLPS is bound only to ASCII code and raster-scan devices." Although NAPLPS's data compression will make it difficult to express VDI's more orthogonal capabilities in videotex, several companies intend to provide translation from VDI to NAPLPS.

ANSI is considering several other graphics standards, including PMIG (programmer's minimal interactive graphics), GKS (graphic kernel system) and an enriched version of the CORE system. Observers stress that these standards, which implement the higher level graphic application programmer interface, do not conflict with the proposed VDI and NAPLPS standards.

ANSI committee X3H33, under the direction of Thomas Reed of Los Alamos Laboratory, is finalizing VDI. It is expected to be available in final form for public comment in the fourth quarter of 1983. The committee is considering NAPLPS, and it should make public review before year-end. —*Kevin Strehlo*

TI ADDS 99000-BASED MINIS

Texas Instruments Inc.'s Business System 600 Series includes seven packaged minicomputer systems based on TI's single-board 990/10A CPU, which contains the TMS99000 microprocessor. With the computers, TI has increased system reliability by decreasing the number of circuit boards from five and one-half (in the 990/10 CPU) to one in the 990/10A CPU. In most cases, the 990/10A is said to increase computer system throughput 1.5 times over the current mid-range 990/10 processor.

The 990/10A CPU includes the TMS99000 processor, 256K to 512K bytes of 64K error-correcting dynamic RAM and an asynchronous communications port. All Business System 600 computers include the 990/10A CPU, a 13-slot chassis, new front-panel and cabinet styling and a 911 video display terminal with a dual controller. The family's price range is $22,500 to $49,000. Shipments are scheduled to begin in the third quarter of this year.

Legislation to restrict retailer locations may be postponed a year

A U.S. House of Representatives hearing on the Retail Dealers Act, legislation that would sharply restrict the freedom of manufacturers of computer, word processor and other office equipment to sell their products in some geographic areas, was postponed in July, which means chances for the act to be passed this year are dim.

The Act, H.R. 4009, attempts to provide office- and computer-equipment retail dealers with sanctions protecting them from supplier actions that may adversely affect the dealers' business interests. Such actions include a manufacturer's opening of a retail outlet within 20 miles of its current one. A similar bill has already been approved by the Senate Commerce Committee.

The dealers' new rights under the bill would include a 60-day notice of a manufacturer's decision to establish a new dealer and the ability to sue for damages against any manufacturer's action considered unfair or inequitable.

Thomas Campbell, director of the Federal Trade Commission's Bureau of Competition, was scheduled to testify at the canceled hearing. A copy of his prepared statement shows that the FTC believes the act is very bad legislation.

His statement pointed out that the FTC opposes the bill because H.R. 4009 will have two principal anticompetitive effects. For one, it will deny consumers the benefits of increased intrabrand competition, resulting from the establishment of new additional dealerships. Secondly, it will tend to result in market inefficiencies and increased costs. These increased costs in distribution systems will be passed on to consumers.

"Under H.R. 4009, manufacturers and distributors, who heretofore exercised broad independent business judgment in determining or modifying their marketing policies, strategies and practices, will find themselves unduly restricted by a statute requiring them to give advance notice and/or compensate dealers for the 'privilege' of making legitimate business decisions," which is a provision of the act.

Campbell also stated, "This environment may result in suppliers' insisting on strict territorial restrictions and limitations in dealership agreements, thus limiting the suppliers' obligations to provide notice or pay compensation. Suppliers may also tend to spend greater resources in policing territorial limitations to prevent dealers from unilaterally expanding their market areas. As a result, distributional flexibility, innovation and efficiency may be substantially reduced."

The Computer and Business Equipment Manufacturers Association also opposes the legislation. It filed a statement with Congress that argued the legislation should be called a "lawyers full-employment act" because of the amount of litigation it will create if enacted. The language of the bill is so ambiguous, it said, that attorneys will have to be called upon to decipher what the phrases mean.

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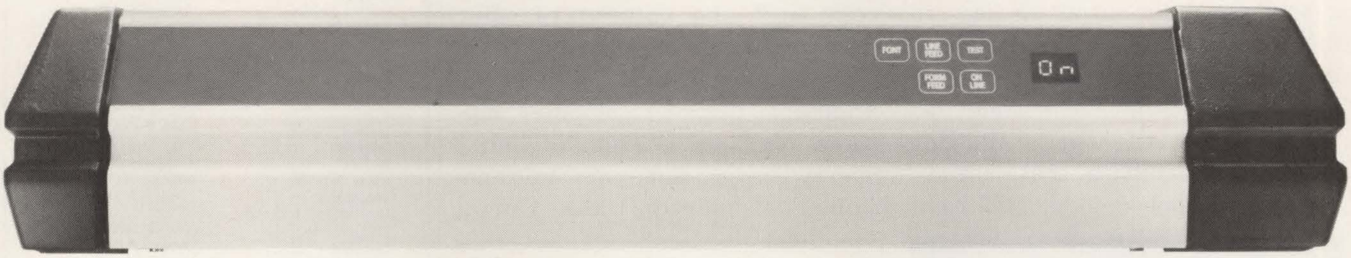

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GENERAL ELECTRIC

CIRCLE NO. 73 ON INQUIRY CARD

Color-output devices bloom, improvements to follow

The recent explosion of attractive color-graphics CRT displays signals a need for color-output devices to meet that burgeoning market, evidenced in part by the promise of such forthcoming technologies as Epson America, Inc.'s ink-dot printer (MMS, July, p. 266). However, color-output devices still have not reached a balance in price, speed and quality. For example, costs increase when a manufacturer adapts black-and-white printers for color, and develops graphics software.

Tektronix's model 4662 option 31 eight-pen plotter *offers higher output quality than plotters, and although typically slower than printers, some users will make that trade-off for quality.*

Okidata's Pacemark 2410 dot-matrix printer *produces two-color output. A model with more colors is expected next year.*

The minicomputer and microcomputer market for color output is ready to open, but not until at least a year from now, says Chet Baffa, vice president of marketing at Okidata Corp., Mount Laurel, N.J. He cites a lack of software as the reason. While the necessary printers and plotters for color output exist, graphics software to run the devices is in demand but not supplied, he says.

Ralph Finley, head of the Electronic Printer Industry Service at Dataquest, Inc., a Cupertino, Calif., market-research firm, agrees: "To handle color properly, it takes almost an order of magnitude more computing horsepower than for black and white," he says. "Color software is much more difficult to write and develop." Finley adds that, while low-end and very high-end computers offer color, mid-range models have virtually none. For instance, none of the traditional business computer suppliers, such as Burroughs Corp., Sperry Univac, Honeywell Information Systems and IBM Corp., support color. "Some minicomputer vendors such as Digital Equipment Corp. and Hewlett-Packard Co. have special software packages to generate color data with pen plotters," says Finley. "But those packages take a very experienced programmer quite a while to learn, write and load to get good output."

Finley says a limiting factor is development time. Hardware is available now, Finley says, and points to the Integral Data Systems, Inc., and PrintaColor offerings. "Another couple of dozen entries are coming down the pike within the next six months," he says.

Even if graphic-software development catches up with output-device technology, some price/performance adjustments must be made. Most companies are now modifying their black-and-white output devices to include color, which requires modifications to the computer and/or printer, says Ian Mallender, printer industry consul-

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UNISTAR 100 comes with C and 68000 ASM, with Pascal, COBOL, Fortran 77 and BASIC as options.

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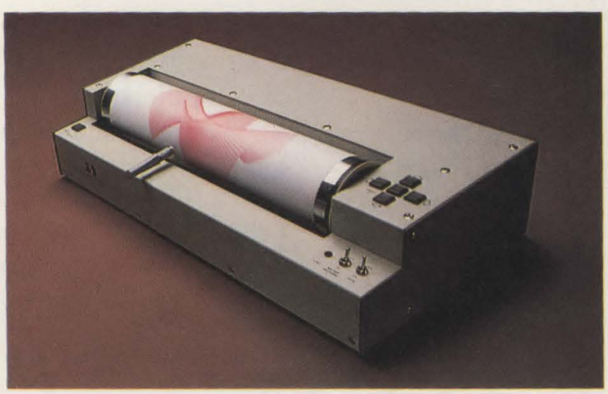

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CIRCLE NO. 127 ON INQUIRY CARD

tant and president of Advanced Technology Resources Corp., an El Dorado, Calif., research firm. That's a temporary problem, however, Mallender says, because the industry is just now beginning to build color printers from the ground up. "All of the expense (of adapting black-and-white printers) will go away by the time the new printers come in," he says.

In the meantime, users must weigh output-device preferences. While printers have the advantage over plotters of producing both alphanumeric data and graphics, some observers believe that plotters offer higher quality graphics. Most observers prefer two types of printers for color hard copy to duplicate CRT graphics.

Mallender says non-impact ink-jet printers and impact dot-matrix printers with multicolor ribbons are the major contenders. Finley adds pen plotters to his list of color-output contenders (see "HP reinforces commitment to business color graphics").

Frank DiChristina, national sales manager of Norcross, Ga.-based ink-jet printer manufacturer Printa-Color, says ink-jet printers have high quality, high resolution and high speed. The company's 5000 GP 1024 non-impact, dot-addressable, ink-jet printer offers a 1024 × 1024 image with a resolution of 120 dpi. It is based on the Siemens mechanism. DiChristina says that the printer produces as many as 125 colors. Per-copy cost is about 9¢, and the printer also produces graphs in a few minutes, compared to longer typical waits when a printer must interact with a plotter, he notes.

DiChristina doesn't discount plotters as competition. He believes, however, that the devices are slow and usually involve much manual interaction despite their characteristically high-quality output.

One problem associated with ink-jet printers, however, is that they can produce only one copy at a time because the print head does not touch the paper. With Epson's newly developed ink-dot technqiue, ink flows onto pins on a head, and the pin hits the paper directly. Although Epson is tight-lipped about its printer, an informed source says the product does not need special paper, can print multiple colors in one pass and can make black-and-white copies. Epson is expected to unveil the ink-dot printer formally next year.

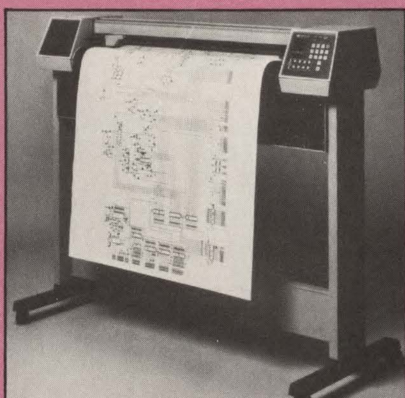
Peter Eisenhauer, vice president of marketing and sales at Milford, N.H., dot-matrix printer manufacturer Integral Data Systems, believes dot-matrix printers are the answer for color output. If a

HP REINFORCES COMMITMENT TO BUSINESS COLOR GRAPHICS

With new plotters manufactured at its San Diego, Calif., division, Hewlett-Packard Co. hopes to hop on the color graphics bandwagon with its latest offering, the model 7585A. The HP 7585A, says the company, addresses the need for high-performance, low-priced E/AO-sized plotting on minicomputers and desk-top systems, and features 4G acceleration and speeds as high as 24 ips. The 7585A has GPIB and RS232C interfaces.

The plotter incorporates HP's micro-grip drive technology, used on the model 7470 microcomputer plotter introduced last March. That approach is a departure from conventional plotter technology, which uses heavy moving arms to transport the pen, or drums and belts to transport the paper. Instead, the drawing medium is moved in one direction, while the drawing pen travels in another.

The technology was used in the earliest chart recorders, but it is enhanced by the way the HP plotter transports the drawing medium. Sprocket holes and mechanisms were



HP's model 7585A plotter, *targeted for use with minicomputers and desk-top systems, incorporates technology that improves paper handling and output.*

previously required to drive the paper. Instead of moving the underlying platen upon which the paper rests, a single sheet of paper is moved. The 7585A must overcome the mass of only one sheet of paper, resulting in better control and higher speed and acceleration, says the company. Consequently, less power is used to produce a plot, and the use of less powerful motors can lower plotter production costs.

The microgrip drive comprises a series of rotating metal grit wheels under the plotter bed. The grit wheels are coated with a layer of aluminum-oxide particles. When the plotter is instructed to hold the plot, two grit wheels secure each side of the paper firmly against a pinch wheel made of hard rubber. The particles on the coated grit wheels indent the paper surface at thousands of points along the edges as the paper passes through the plotter. Each time the paper is passed, the indentations realign themselves with the same grit particles. As a result, the company claims, the graphic quality is enhanced, and the repeatability of any plot is made relatively foolproof.

At $22,750, says product marketing engineer Mick O'Rourke, the plotter will carry HP from the explosive low-cost CAD-system market into the higher cost mapping market, which requires larger drawings.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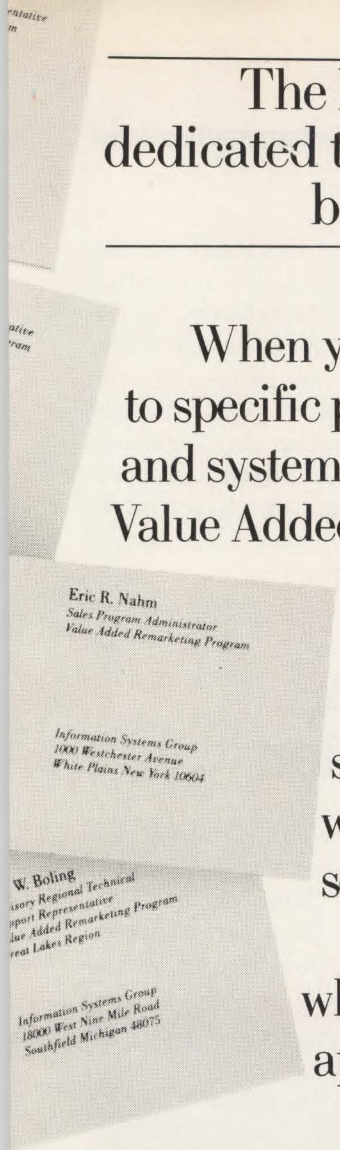

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computer system processes data and graphics, Eisenhauer explains, outputting both at a reasonable speed and price is the best of both worlds. A dot-matrix printer is the way to go, particularly when formed or solid images are needed because the printer can more rapidly fill dense fields of color, he says.

IDS's offering is the 80- or 132-column Prism printer (MMS, January, p. 207). A black-and-white version sells for approximately $900. The addition of a color-graphics option provides 12 colors and boosts the price to about $1500. Prism offers speeds of 110 to 150 cps, which can be increased to 200 cps with an optional module.

Some observers say that dot-matrix printers have problems producing clear colors, mainly because they use ribbons that can easily become polluted by the many passes a print head must make to achieve colors.

Okidata's Baffa feels that dot-matrix printers are more cost-effective than ink-jets. Dot-matrix printers, however, usually have speed penalties when producing dots in graphics, he says. Baffa claims that an average microcomputer user wants a noncomplicated image and questions whether dot-matrix quality meets that need. A small businessman, he says, probably doesn't want anything more complicated than high-quality bar charts, expense curves and diagrams.

Okidata's new product is the Pacemark 2410 letter-quality matrix printer, introduced at this year's National Computer Conference. Pacemark prints black-and-white symbols (with red, when applicable) at 85, 175 and 350 cps, and offers 72 × 72 or 144 × 144 dpi graphics capabilities. Oki is said to be readying a color dot-matrix ribbon printer for next year.

Plotters provide higher quality output than dot-matrix or ink-jet printers, says Craig Montgomery, product line manager of Tektronix's plotter group. One application that is gaining popularity and is easily addressed by plotters, he says, is color transparencies for business presentations. The primary limitation of a plotter, he concedes, is speed. "In most of my experience with users," says Montgomery, "they prefer to make a trade-off between higher quality results versus slower throughput in the case of the plotter." A plotter strength, says Montgomery, is the need for less expensive materials. Tektronix's initial entry into the color output market is the year-old model 4662 option 31 eight-pen multicolor plotter, which is supported by Plot 10 and Plot 50 software. It plots at 16 to 22 in. per sec. at 0.127 resolutions.

—Nancy Love

Largest user of robots, GM, becomes a supplier

Vendors and analysts in the robotics industry are trying to decipher what happens when one of the industry's largest customers—General Motors Corp.—becomes a competitor. The first fruits of the affiliation between GM and Fujitsu Fanuc Ltd. of Japan, called GM-Fanuc Robotics Corp., are expected to have their initial impact on the

WESTINGHOUSE ROBOT BRIDGES TECHNOLOGY GAP

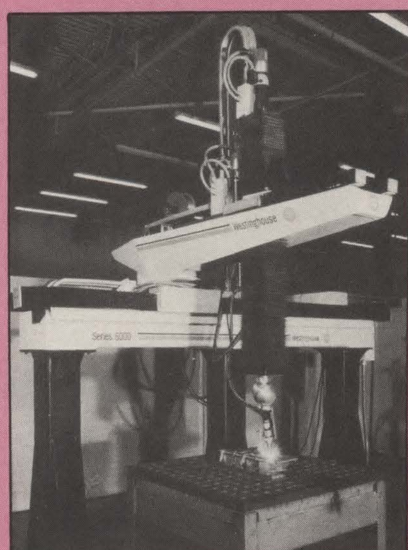
This month at the International Machine Tool Show in Chicago, Westinghouse is expected to introduce a robot that bridges the gap between robot and machine-tool technology.

The Series 6000 is a Westinghouse-designed five-axis robot for arc-welding, burning, material-handling, assembly and similar applications. Pricing is not available.

The 6000 is manufactured by Westinghouse's Industry Automation Division and features repeatability of ±0.006 in., a vertical payload of 100 lbs. with ±0.010 accuracy and off-line programming by machine-tool language.

The robot uses Westinghouse's Producer computer numeric controls that allow the robot to interface with various peripherals and auxiliary equipment including multi-schedule welding power supplies, part positioners, automatic fixturing, sensory-feedback systems and other external devices.

The combination of CNC control with the robot allows robotic operations to be combined with machine-tool capabilities, such as off-line programming with the Automatically Programmed Tool language. The Producer CNC provides several methods of data entry including manual data input, paper-tape reader or magnetic cassette.



The Westinghouse Series 6000 robot, *which was designed by the company, bridges the gap between robot and machine-tool technology, and will be used in applications such as material handling and assembly.*

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Printing Speed (Char. per Sec.)	10	150	150	120	120	200
	12	180	180	—	—	120
	12.5	—	—	150	150	—
	13.3	200	200	—	—	—
	15	—	—	180	180	150
	16.4	—	—	200	200	164
Enhanced	10	—	—	—	—	100
Expanded Print (Double Width)		Yes	Yes	Yes	Yes	Yes
Dot Addressable Graphics (Dot/In., H/V)		60/72	60/72	75/72	75/72	72/72
Max. Line Width (In.)		8.0	13.2	8.0	13.2	13.2
Audible Alarm		Opt.	Opt.	Opt.	Opt.	Yes
Out-of-Paper Sense		Yes	Yes	Yes	Yes	Yes
Ribbon, Continuous Loop Cartridge (Yds)		30	30	30	30	30
Interfacing: **Parallel Cent. Comp.**		Yes	Yes	Yes	Yes	Yes
RS-232-C Serial		Yes	Yes	Yes	Yes	Yes

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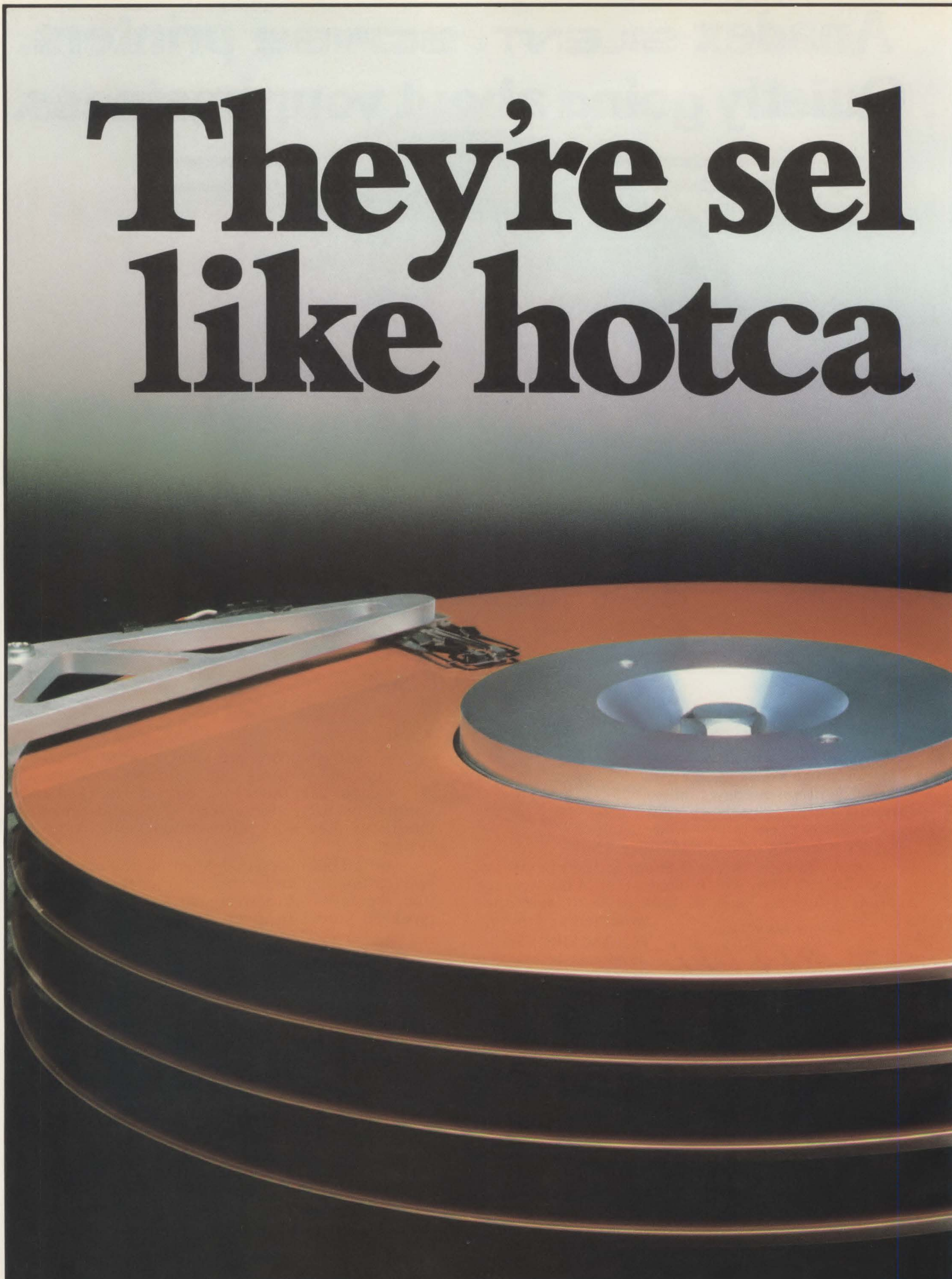
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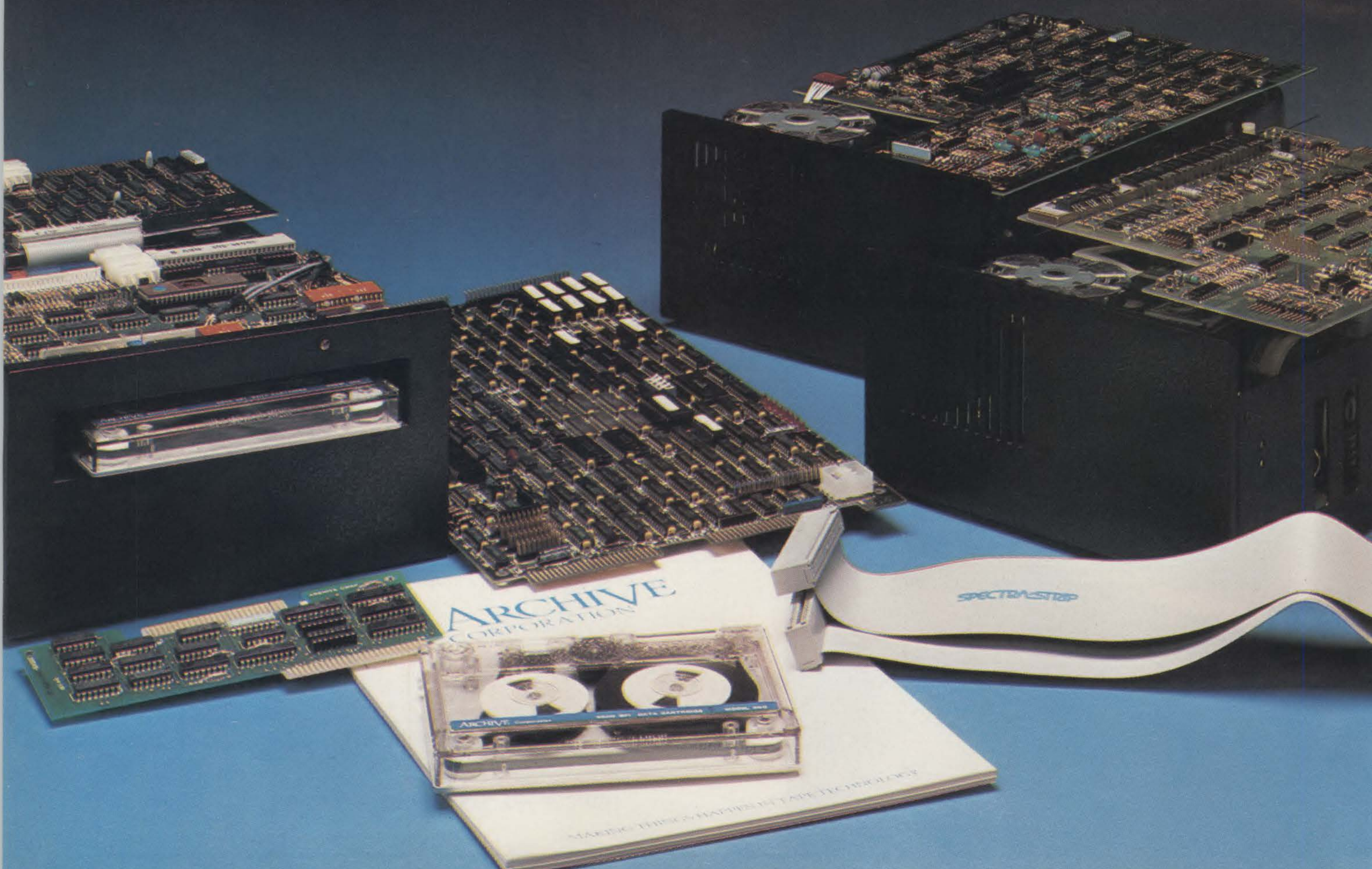

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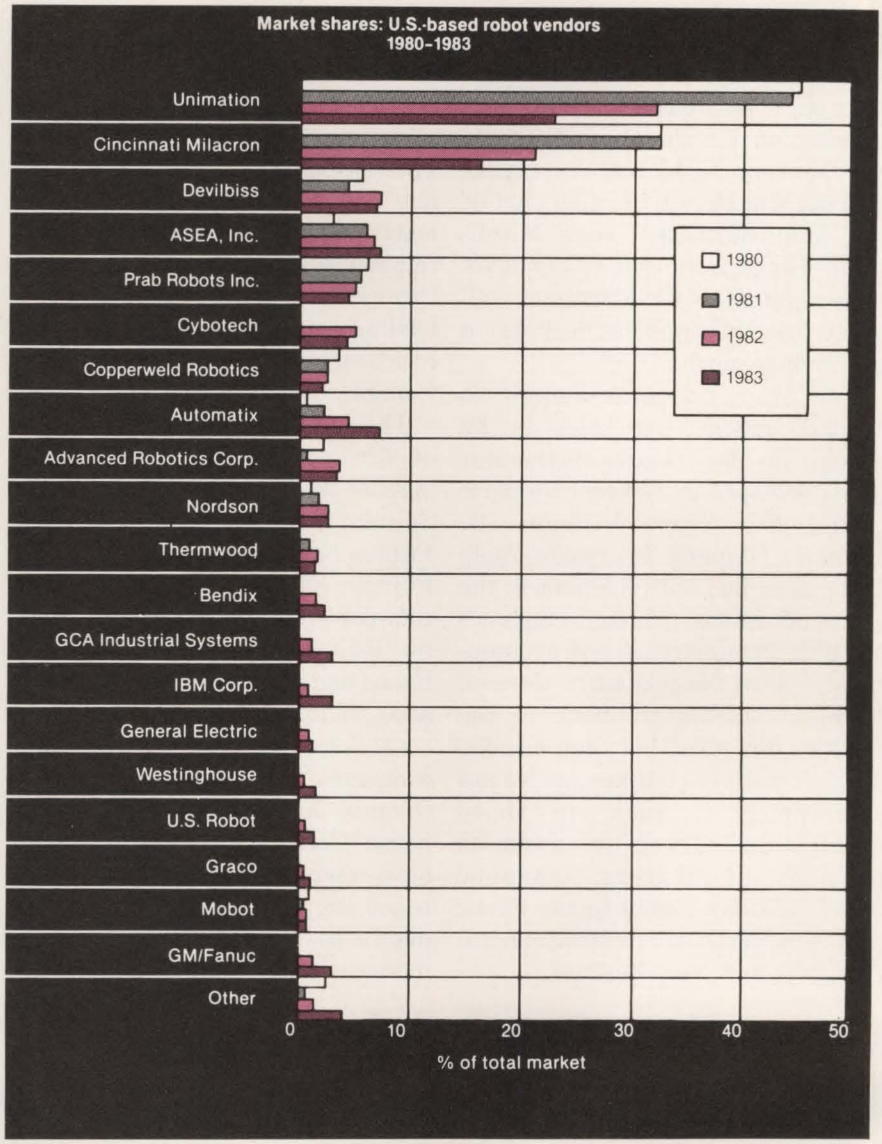

GM, the industry's largest robot user, joins the competition as a supplier. *The market-share percentages are based on midpoints of company and industry estimates. (Source: Bache Halsey Stuart Shields, Inc.)*

domestic robot industry this fall.

GMFanuc was formed last June when GM and Fanuc each put $5 million into the Troy, Mich., start-up headed by Eric Mittelstadt, formerly executive assistant in the GM Overseas Group.

Much of GMFanuc's initial business will be from GM plants, and one analyst estimates that 90 percent of the start-up's 1982 sales will go to GM.

"GM may be the single largest domestic user of robots through 1990 and is among the top five users in the world," says Laura Conigliaro, an analyst with Bache Halsey Stuart Shields, Inc. "Now GM has their own semi-captive supplier."

Conigliaro estimates that of a total robotic market of $195 million to $210 million, GMFanuc will do between $2 million and $4 million in sales. Conigliaro predicts that in 1983, GMFanuc's sales will rise to between $6 million and $10 million out of a total market of $240 million to $290 million.

GMFanuc considers itself independent rather than semi-captive and is looking for substantial sales outside of GM. "We expect that our penetration of GM's robotic business will be very high, but we expect that GM will be only a small part of our total business," says Mittelstadt. He expects that Conigliaro's sales estimates for GMFanuc will prove low, although he declines to say by how much.

One way GMFanuc hopes to expand outside GM sales is by picking up the robotics distributor base developed by General Numeric Corp., Elk Grove Village, Ill. "General Numeric is a partnership that Fanuc had with Siemens in the U.S. and whose primary emphasis has been in numerical-control equipment," says Mittelstadt. "General Numeric started to move in the robotics direction, but then decided it didn't want to continue, so we are attempting to pick up those distributors." There are about 12 possible distributors. GMFanuc holds exclusive rights to the Fanuc robots in North and South America, Australia and New Zealand.

The robots sold by GMFanuc will initially be built in Japan, except for a numerically controlled painter system that is assembled in Detroit. The sales of the painter systems are not included in Conigliaro's estimates. The average GMFanuc system will sell for about $45,000 and is typically used for machine-tool loading and unloading and material handling of loads as heavy as 45 lbs., Conigliaro says.

The company's six-member board of directors will include three persons from each partner, with Dr. Seiuemon Inaba, president of Fujitsu Fanuc, serving as chairman. Fujitsu Fanuc is an independent company that is 47-percent owned by Fujitsu. Conigliaro estimates Fanuc had worldwide sales of about $500 million last year.

GM is the latest among a group of companies, including such giants as General Electric Corp., Westinghouse Corp. and IBM Corp., that have struck deals with Japanese robot manufacturers. Those agreements have raised the specter of increased, stiff competition for the young domestic robot industry. "Like everyone else, we sort of shrugged our shoulders when we heard of the GM and Fanuc affiliation," says George Crosby, president of U.S. Robots, Conshohocken, Pa. "We are still not quite sure what it means," he says. U.S. Robots is one of a group of robotic-system firms started within the past several years.

"Obviously, the GM and Fanuc deal will put a lot of robots in GM plants, and the opportunity for us to sell into GM is lessened," Crosby says. "But GM is a large user, and each plant manager seems to have a decent degree of freedom. I don't think anyone thinks that the door is closed to GM robot sales. Selling robots is a bit different from selling automobiles. It takes three strengths to sell into the robotics market: good engineering, good customer support and money. GM has the good engineering, will develop the customer support and has the resources despite recent lean times," Crosby says.

—Eric Lundquist

Canadian firm claims first IBM-compatible portable micro

Several companies have been rushing to market with variations of the successful IBM Corp. Personal Computer, but Dynalogic Info-Tech Corp., Ottawa, Ontario, says it has the first portable IBM look-alike.

Hyperion, which is scheduled to go into full production in January with a U.S. price tag of $4995, packs an Intel Corp. 8088 microcomputer with 256K bytes of RAM, dual 5¼-in. floppies, a 25 × 80 (7-in.) CRT display, a keyboard and a built-in modem into a package that weighs 20 lbs. and fits under an airline seat. "I firmly believe we have gotten a jump on the market with an IBM-like portable. We think we'll be six to eight months ahead, which will be enough," says marketing vice president Richard Crutchlow.

"Enough," he explains, means a long enough head start for the market to identify the Hyperion as *the* IBM portable personal computer and to exceed Dynalogic president Murray Bell's projections of 15,000 unit sales by the end of fiscal 1983 next August. Bell's projections call for retail sales of about $65 million, with gross revenues of $45 million for Dynalogic.

In addition to portability—the system has a built-in handle for short moves and a carrying case for travel—the Hyperion has several claimed advantages over its model, the IBM PC. Crutchlow says that the

Dynalogic's Hyperion, *said to run IBM Personal Computer software, is packaged in a 18- × 10- × 8½-in. package with a carrying slot for the detachable keyboard. The package was designed by Hovey/Kelley Design, which also designed the Apple III's packaging.*

standard configuration—with its 256K-byte memory, built-in 300-bps modem, 640K-byte disk capacity, MS/DOS BASIC interpreter with graphics support, Multiplan, executive text editor, electronic mail and telephone-management packages—sells for about $1000 less than a

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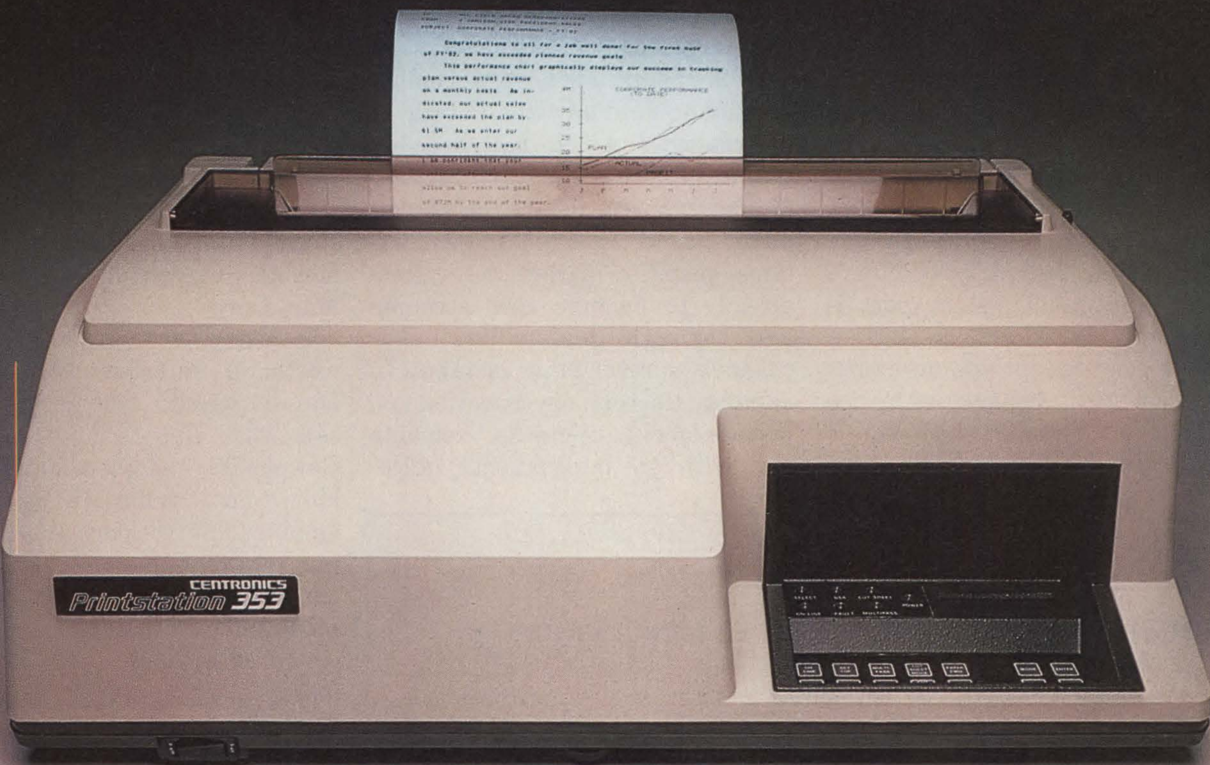

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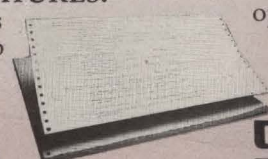

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comparably equipped IBM PC. In addition, it offers a standard RS232 port supporting asynchronous communications at rates as high as 19.2K bps and synchronous or bit-synchronous transmission as fast as 100K bps. Crutchlow says the company plans to bundle industry-standard protocol emulations into the system price. Although the company does not plan to offer a printer, a parallel printer port is provided.

Other features include an amber phosphor CRT display with 256 displayable characters and 640 × 250 or 320 × 250 dot-addressable graphics. Options are expected to include an expansion chassis with a 10M-byte Winchester disk and four IBM-compatible I/O slots. Software options will include a BASIC compiler, COBOL, FORTRAN and Pascal.

Dynalogic, which has been in business for nine years as a supplier of disk subsystems and microcomputer-based small-business systems, plans to market the system directly to Fortune 1000 accounts and through dealer/distributor channels to reach other markets. In addition, the company is working on private-label agreements, including one with an international office-equipment supplier that Crutchlow declines to identify.

Dynalogic, a privately held company, was incorporated early this year as Dynalogic Info-Tech when Bytec Management Corp. pumped more than $1 million into the firm and became the major shareholder with 75 percent of Dynalogic's stock. Bytec is headed by Dr. Michael Cowpland, president of Mitel Corp.

Industry analyst Ken Bosomworth of International Resource Development, Norwalk, Conn., says that Bytec's (and especially Cowpland's) endorsement lend credibility to Dynalogic's admittedly ambitious first-year goals. More importantly, Bosomworth points out, there seems to be a real market potential for such a product.

"In our local ComputerLand store, which is among the highest volume outlets in the chain, Apple and Osborne are selling neck and neck, but IBM is outselling either of them by six to one. If that's indicative of the nationwide market, it would suggest that a product combining the two (the IBM Personal Computer's performance and the Osborne's portability) would be well-received," Bosomworth reasons.

He characterizes both Dynalogic and Osborne products as "transportable," reserving the "portable" label for smaller, hand-held products. However, he says that relative portability (compared to modular, desk-top systems) is one of the many attributes that will attract buyers. Bosomworth predicts that Osborne will sell 80,000 systems this year, but maintains that the Osborne computer's success is not the result of its portability. "Osborne went after Apple with a lower priced package. I think many people are buying Osborne because it's cheaper. For a minority, portability was the key factor," he says.

—Geoff Lewis

MINIBITS

IBM ENHANCES 8100 ANNOUNCES NEW LEASES

IBM Corp. has expanded the IBM 8100 information system so that several other small IBM systems can be attached, and has enhanced its operating system. The Displaywriter, terminals for the Series/1 processor, the 3640 plant communication system and the 5280 distributed-data system now can communicate and interact with the 8100 as if they were IBM 3270 terminals through a "data-stream compatibility" feature. Users also can communicate via an 8100 processor with databases in host System/370, 30XX or 4300 processors. In addition, IBM enhanced the 8100 distributed-processing control executive (DPCX) operating system to support the high-end 8140 model C processor, allowing more terminal users to work under DPCX. The new operating system release is priced at $394 monthly.

IBM also announced new term leases. Under the offering, customers have the option of getting a lower lease rate if they and the equipment qualify for investment tax credit. The tax benefit is retained by the partnership, thereby producing a lower lease rate. Or customers can take the ITC directly. Both options are noncancelable and are available for three, four or five years at fixed rates. Eligible products include processors and selected input/output equipment for IBM System/34, System/38, 4341, 4331, 4321 and 8100. The standard IBM lease and rental prices on most of the eligible processors will be increased 8 percent.

APPLE-COMPATIBLE VENDOR INJUNCTION DENIED

Franklin Computer Corp. announced last month that a U.S. District Court judge in Pennsylvania has denied the preliminary injunction sought by Apple Computer, Inc., against it. The judge ruled that Apple had failed to show a reasonable probability of success on the merits in its suit to enjoin Franklin from manufacturing and selling the Franklin ACE Computer, an Apple II-compatible microcomputer that includes extra features. Apple brought suit for patent and copyright violations following Franklin's introduction of the ACE in March, the announcement notes. In commenting on the decision, R. Barry Borden, chairman of Franklin, said: "In designing the Franklin computers, we have been guided by counsel and have acted at all times in compliance with the copyright and patent laws." Following Apple's action in May, Franklin filed a $150-million antitrust action, charging Apple with unfair and illegal practices including harassment of dealers, banning of mail-order sales and unlawfully interfering with Franklin's promotional activities.

Tough Q&A, not laws, best for U.S. vendors

U.S. OEM hardware vendors, looking over their shoulders at increasingly severe competition from Japanese suppliers, should put less faith in government policies that will restrict imports and focus more on beating the Japanese at their own game by boosting product quality, says one executive at a San Francisco Bay Area maker of intelligent terminals where extensive quality and assurance procedures have been implemented.

"In the long run, it costs a lot less to get it right the first time," says Jeffrey Thwait, vice president of operations at Zentec Corp., Santa Clara, Calif. "Knowledgeable OEM customers know that the cost of ownership has nothing to do with the price paid for a terminal such as ours or for any other peripheral." Thwait stresses that OEMs buying peripheral hardware must support that product for a number of years and that anything a vendor can do to improve quality and cut the cost associated with this support may give customers a competitive edge. "The Japanese understand the need for higher quality," he says. "But in general, U.S. vendors are not well organized to build higher quality products. Q&A is looked on as a necessary evil in this country."

The subjective impact of higher versus lower levels of quality control at the manufacturing site show up the minute something goes wrong. "A service call to an end-user site can cost an OEM anywhere from $100 to $200 just to get a field engineer on-site," he says, "to say nothing of what it could cost to fix the device once he gets there." Thwait's figures on the raw cost of servicing hardware once it's in the field are derived in part from studies he was involved in while working at IBM Córp. during the 1960s. "Our calculations then showed that the way things were going at IBM, more field engineers would be required in 1985 than design engineers," he says. "IBM had to re-examine the way things were being built." Many of the procedures and policies that resulted and that were used later by the mainframe giant were subsequently incorporated into the manufacturing cycle at Zentec.

"Anything that will fail will fail within the first six months of its life," Thwait explains, adding that Zentec starts by looking for weak components using a testing philosophy designed to accommodate differing levels of quality at the company's vendors. "All the components are cooked at 125°C (257°F) and then go through a 48-hour temperature-cycling routine," he says. "Heat is a major killer at the component level, and by cycling the temperature, we get rid of parts with weak bondings and seals." Zentec's testing is handled by the vendors themselves if the company feels that the job is done up to spec, or by third-party test houses. "We send parts out if we don't trust the manufacturer," he explains.

As a result of temperature (and later functional) tests at this level, Zentec starts with more than 99.5 percent good components, Thwait says. "It costs us only 6¢ to burn in each of these parts," he adds. "It can cost us over $10 to find and correct a defective chip at the subassembly level, excluding the cost of reinserting a new IC and retesting the board."

Board-level tests are also rigorous. Each PC board is first cooked, and then put through a 48-hour temperature-cycling routine. Voltages are then applied, and functional tests run through a special connector built onto each board—another technique borrowed from IBM, Thwait says.

It is at the final test stage, however, that Zentec's Q&A procedures are more noticeable. Prominently positioned in the company's assembly area is a home-built automatic test system called the Carousel, comprising 240 burn-in boxes, each capable of handling one terminal. "Every terminal must operate error-free for 24 straight hours at 135°F," Thwait explains. "Sometimes a terminal will stay on the rack three or four days. "Before being placed on the Carousel, however, each terminal goes through a series of functional tests using diagnostic routines built into a special on-board test chip. These chips are programmed to accommodate customized terminal configurations, reflecting the fact that less than 10 percent of Zentec's business is off the shelf.

The Carousel is under the control of a single operator who monitors the status of each machine while it is under test and who removes each terminal from its burn-in box after it has completed its 24-hour test. Once a terminal has come off test at the Carousel, it goes to a final Q&A station where the diagnostics are run again, and the device is checked for appearance and process documentation.

While stressing the benefits that this type of testing can bring, however, Thwait concedes that Zentec's Q&A procedures are expensive. The Carousel, for example, installed in late 1980, cost more than $1 million. Perhaps even more costly is the total number of Zentec employees involved in Q&A functions. Thwait says 85 people are directly involved in manufacturing at Zentec, of which 35 are directly involved in Q&A work. Before the Carousel was installed, this number was much higher. "We used to have a 50-50 split between Q&A and

SEIKO ENTERS U.S. GRAPHICS MARKET

Seiko Instruments USA, Inc., a wholly owned subsidiary of the giant Japanese company Daini Seikosha, which also exports Epson printers into the U.S., has entered the U.S. graphics market. Seiko introduced raster-scan graphics terminals with anti-aliasing implemented in hardware rather than in firmware or software. Seiko says the hardware approach results in a 10 to 100 times reduction in the time the system devotes to smoothing the jaggedness inherent in raster displays. The $21,850 GR2412 is a seven-color intelligent terminal based on a Z8002/Z80 architecture, and has a 19-in. CRT screen, 1024 × 780 resolution, a FORTRAN-based software support package and a 128K-byte buffer memory (optionally expandable to 768K bytes). The monochrome GR2212 lists for $17,850.

Another anti-aliasing CRT terminal is available from Berkeley, Calif.-based startup Jupiter Systems. The Jupiter 7 desk-top raster system emulates the Tektronix 4014 and is plug-compatible with the AED 512 and 767. The 13-in. CRT screen displays 256 colors in 768 × 575 resolution. An enhanced version with 1280 × 1024 resolution was expected at SIGGRAPH late last month. The price is $13,560.

assembly personnel," he says, "but as the company grows and as we bring in more automated test systems, we are generally reducing the number of people involved in testing as a percentage of the total staff." A total of 35 more Zentec employees are involved in writing test programs and planning.

It is the integration of these two staffs rather than the total number of individuals involved that can make the difference as far as quality is concerned, he says, noting that manufacturing should be looked at as a process-control procedure." To Thwait that means the integration of hardware vendors such as Zentec with the ultimate end users of Zentec's products.

Zentec demands the same quality control from its suppliers, Thwait goes on. "Our customers want to see calibration records, reliability figures and the results of noise-emission tests, among other things," he says, adding that the number of customer audits that his company has gone through has trebled over the past year.

"What our customers demand of us, we demand of our vendors." he says. "We want to see a process-control operation at their facility." That means rigorously certifying its vendors, Thwait continues, forcing them to pay for their mistakes, and cutting them off if necessary. "If everyone adopted this attitude," he says, "maybe the peripheral business would be less vulnerable to Japanese inroads." —*John Trifari*

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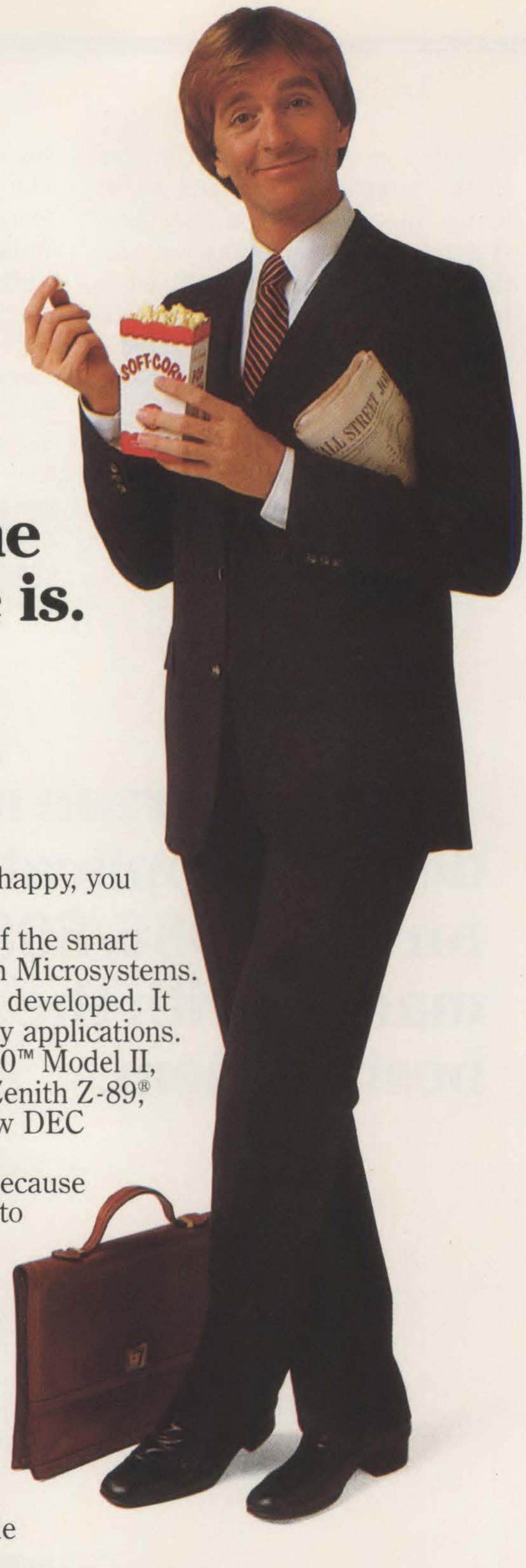

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Calendar

Peripherals '82

The International Peripheral Equipment and Software Exposition, "Peripherals '82", co-sponsored by Mini-Micro Systems magazine and the Cahners Exposition Group, will be held at the Convention Center in Anaheim, Calif., Sept. 29, 30 and Oct. 1.

This specialized conference, the first show devoted solely to peripherals for minicomputers and microcomputers will include displays by more than 100 companies and will feature daily technical sessions.

For more information, on Peripherals '82, contact Janet Schafer, Cahners Exposition Group, 222 West Adams St., Chicago, Ill. 60606, at (312) 263-4866.

SEPTEMBER

19-23 Ninth World Computer Congress, IFIP '83, Paris, France, sponsored by the International Federation for Information Processing. Contact: Program Committee, IFIP '83, IBM T.J. Watson Research Center, P.O. Box 218, Yorktown Heights, N.Y. 10598.

20-21 "Designing Software for Microcomputers and Robotics Systems" Course, Detroit, sponsored by the Engineering Society of Detroit. Contact: Carol Lynn, Engineering Society of Detroit, 100 Farnsworth, Detroit, Mich. 48202, (313) 832-5400.

20-24 COMPCON Fall '82, Washington, D.C., sponsored by the IEEE Computer Society. Contact: COMPCON '82, P.O. Box 639, Silver Spring, Md. 20901, (301) 589-3386.

20-24 The International Symposium on Subscriber Loops and Services, Toronto, Canada, sponsored by the IEEE. Contact: John D. Fahey, General Committee Chairman, Fl. 22, 393 University Ave., Toronto, Ontario M5G 1W9, (416) 599-6264.

21-23 International Technology Exposition, San Francisco, sponsored by Control Data Corp. Contact: W.M. Shaffer, Control Data Corp., 8100 34th Ave., S., Minneapolis, Minn. 55440, (612) 853-5748 or (800) 328-1870.

21-25 International Business Equipment Exhibition, Jakarta, Indonesia, sponsored by the Indonesian Government. Contact: Jeff Wolf, TMAC, 680 Beach St., Suite 428, San Francisco, Calif. 94109, (415) 474-3000 or (800) 227-3477.

23-25 MEDcomp '82 Conference on Medical Computer Science/Computational Medicine, Philadelphia, sponsored by the IEEE Computer Society, Technical Committee on Computational Medicine. Contact: Gerald H. Leach-Lewis, Exhibits Manager, IEEE Computer Society, P.O. Box 639, Silver Spring, Md. 20901, (301) 589-3386.

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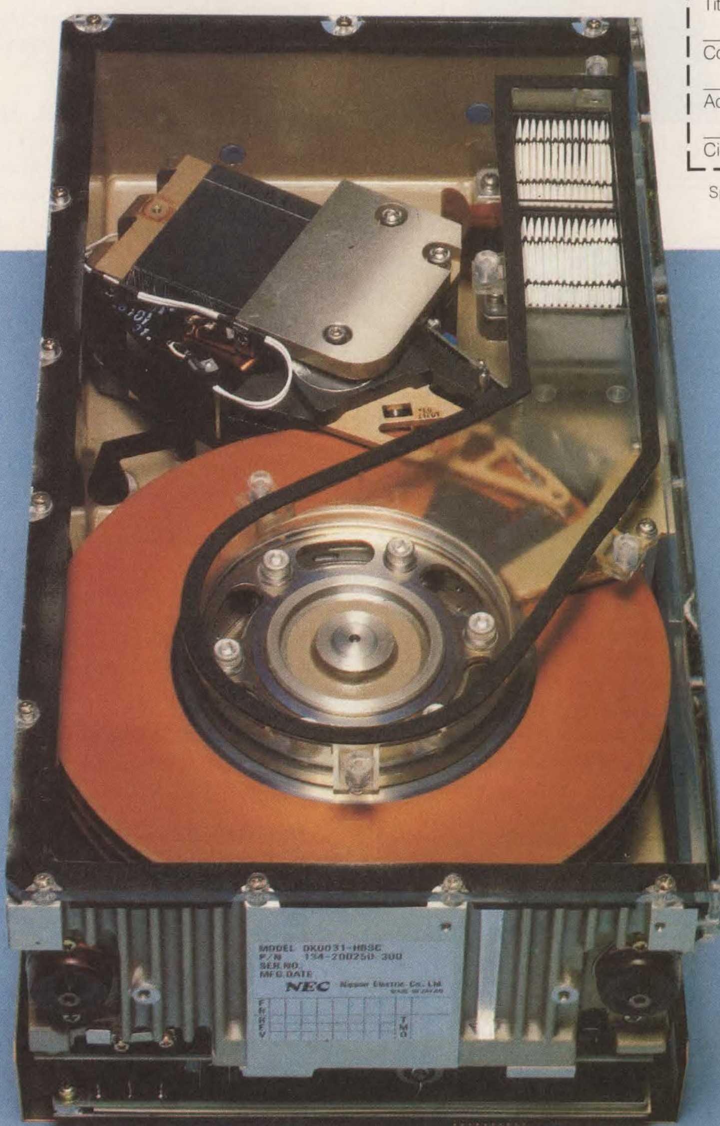

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Calendar

28-30 **Federal Computer Conference,** Washington, D.C., sponsored by Federal Educational Programs. Contact: Federal Education Progams, P.O. Box 368, Wayland, Mass. 01778, (617) 358-5181 or (800) 225-5926.

SEPT. 29-OCT. 1

Networking Systems Seminar, Madison, Wisc., sponsored by the University of Wisconsin-Extension, Department of Engineering and Applied Science. Contact: Francis P. Drake, Program Director, Department of Engineering & Applied Science, University of Wisconsin-Extension, 432 N. Lake Street, Madison, Wisc. 53706, (608) 263-7427.

OCTOBER

1 **Local Area Network Seminar,** New York, sponsored by Ungermann-Bass, Inc. Contact: Vinnie Spoon, Seminar Coordinator, (617) 273-5858.

4-6 **Sixth Annual Data Entry Management Conference & Exhibition,** New York, sponsored by the Data Entry Management Association. Contact: Marilyn S. Bodek, DEMA, P.O. Box 3231, Stamford, Conn. 06905, (203) 322-1166.

4-6 **Third International APL Users Meeting,** Toronto, Canada, sponsored by I.P. Sharp Associates Ltd. Contact: Rosanne Wild, Marketing Services Department, I.P. Sharp Associates Ltd., Suite 1900, Exchange Tower, 2 First Canadian Place, Toronto, Ontario, Canada M5X 1E3, (416) 364-5361.

5-7 **NEPCON CENTRAL '82,** Rosemont, Ill., sponsored by the Cahners Exposition Group. Contact: Cahners Exposition Group, 222 W. Adams St., Chicago, Ill. 60606, (312) 263-4866.

5-7 **Southwest Semiconductor Exposition,** Phoenix, managed by Cartlidge & Associates, Inc. Contact: Cartlidge & Associates, Inc., 4030 Moorpark Ave., Suite 205, San Jose, Calif. 95117, (408) 554-6644.

7 **Invitational Computer Conference,** Amsterdam, the Netherlands, sponsored by B.J. Johnson & Associates, Inc. Contact: Susan Fitzgerald, Conference Manager, B.J. Johnson & Associates, Inc., 3151 Airway Ave., #C-2, Costa Mesa, Calif. 92626, (714) 957-0171. Also to be held Oct. 13, Milan, Italy, and Oct. 19, Munich, West Germany.

11-14 **Information Management Expo & Conference,** New York, sponsored by Clapp & Poliak, Inc. Contact: Clapp & Poliak, Inc., (800) 223-1956.

12 **NECOM '82,** Boston, sponsored by Norm De Nardi Enterprises. Contact: Carol L. Reimer, Show Administrator, Norm De Nardi Enterprises, 289 S. San Antonio Rd., Suite 204, Los Altos, Calif. 94022, (415) 941-8440.

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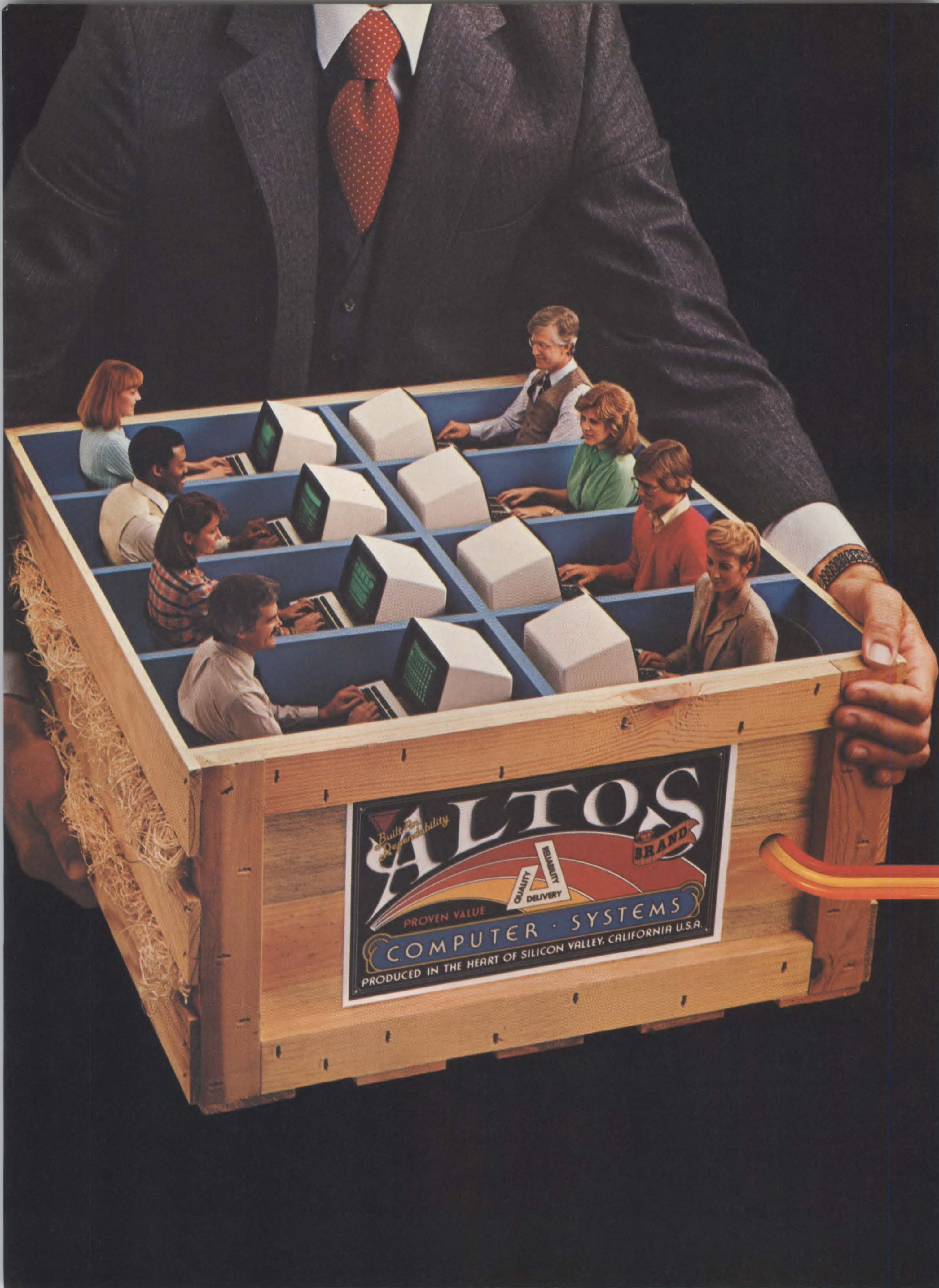
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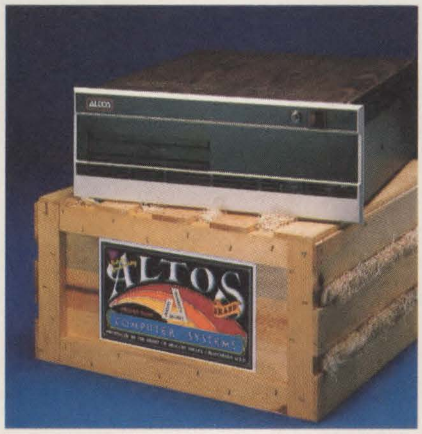

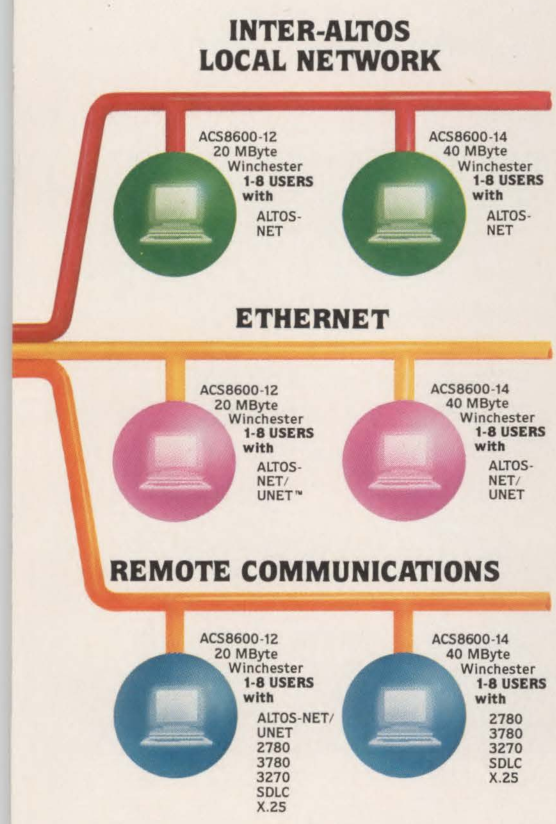

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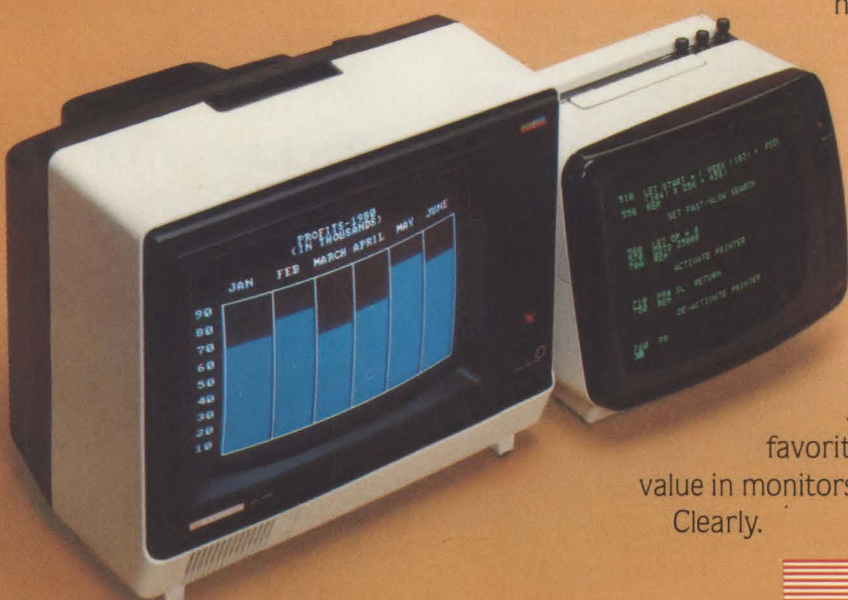

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CIRCLE NO. 39 ON INQUIRY CARD

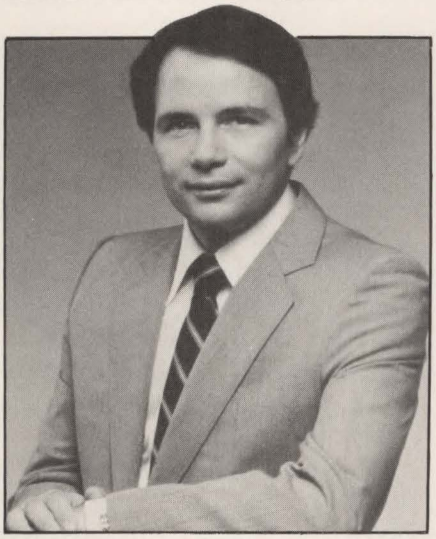
Xerox tries divide & conquer strategy for Office Products Division

After seven years of losses, Xerox Corp.'s Dallas-based Office Products Division has been split into two entities, shifting responsibility for all Ethernet-based products to a newly created Office Systems Division in Palo Alto, Calif., where Ethernet and related products were first developed, and keeping stand-alone products such as the 820 microcomputer and typewriters in Dallas.

The new organization is headed by Donald J. Massaro, the former president of OPD, and will be responsible for further development of Ethernet and related products as well as for their marketing by Xerox's major account-oriented direct sales force. In Dallas, Massaro has been replaced by William C. Jackson Jr., a former IBM Corp. employee, who is credited with launching the division's highly successful electronic-typewriter line. Jackson will be responsible for manufacturing products for both organizations in Dallas and will oversee marketing of stand-alone products.

Robert Ruebel has been shifted from OPD vice president of sales and marketing to OSD senior vice president of marketing, reporting to Massaro. However, Ruebel will remain in Dallas and will have responsibility for the OPD and OSD products.

Xerox officials say the reorganization was undertaken to allow Massaro to devote more attention to the systems products, which include Ethernet installations, the Star 8010 professional work station and other Ethernet-related 8000 series products such as file communications servers. Products such as the 860 word processor, which function as stand-alone products but also



Donald J. Massaro *has moved from the presidency of Xerox Corp.'s Office Products Division in Dallas to head the newly formed Office Systems Division in Palo Alto. OSD is responsible for Ethernet-based products.*

attach to Ethernet, will be marketed through both organizations. Jackson says the move "allows the people charged with marketing systems products to be relieved of dealing with a lot of other issues such as manufacturing, engineering and developing alternate channels of distribution."

The move came as the corporation was reporting a decline of $85 million in second-quarter revenues from 1981 levels of $2.2 billion and an $18.3 million drop in net income. For the half, net income skidded $52 million from the previous year's levels. In reporting the corporate results, Xerox president David T. Kearns singles out the 820 as a disappointing performer in the OPD product lineup.

Xerox declines to reveal OPD results, but says the division now is not expected to achieve profitability until 1984. Two years ago, the company said OPD would turn profitable in 1981, but last year attributed continuing losses to delays in shipments of the 8010. Industry analysts estimate that 1981 losses at OPD may have run as high as $90 million on sales of approximately $300 million.

The 820 program is undergoing major changes following the resignation of several key executives last spring, who left after the 820 reportedly failed to meet first-year goals and after disputes over future product direction. The company has now replaced the original Z80-based system with a faster Z80A version that also includes an upgrade of the CP/M operating system. The $3295 820-II is available with a new choice of 5¼- and 8-in. floppy and hard disks. A system with a 10M-byte Winchester disk and an 8-in. floppy lists for $7695.

Jackson says the broader range of 820-II is expected to overcome some of the problems Xerox had in marketing the original personal computer through third-party chan-

XEROX MAKES SMALLTALK-80 OS, LANGUAGE AVAILABLE

The Smalltalk-80 system, developed at Xerox Corp.'s Palo Alto Research Center, is both an object-oriented programming language and an operating system that now is being offered with the Xerox 1100 scientific processor. It has sophisticated graphics capabilities and interactive support for software development. The Xerox 1100, also developed at the center, is a powerful scientific work station and information processor used for artificial-intelligence applications and exploratory software development. Both the Xerox 1100 and the Smalltalk-80 system are marketed by Xerox Electro-Optical Systems, Pasadena, Calif. The price of the Xerox 1100 scientific information processor is $59,000. The prepaid license fee for Smalltalk-80 is $5000 per 1100 units.

William C. Jackson, Jr., *will replace Don Massaro as head of Xerox's Office Products Division, and focus that group's activities on stand-alone products, such as electronic typewriters and the 820 personal computer.*

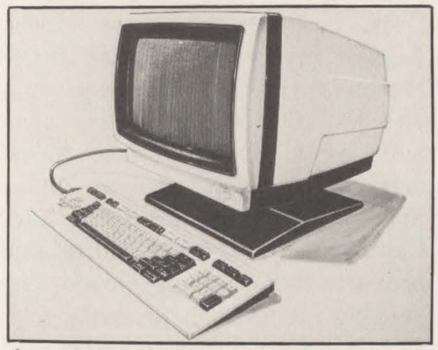
nels. "The 820-II is more generically attractive as a small computer. With the 820-I, we confused ourselves and the outside world by calling it a professional work station," he says, conceding that 820-I results were disappointing, but confirming reports that the system had achieved only half its sales goal. An unidentified Xerox official, however, says the 820 was "marginally profitable."

Under the new organization, Jackson will also be responsible for third-party marketing for the 820. The company recently dropped a national distribution agreement with Hamilton/Avnet, through which Xerox had expected to channel $76 million in 820s over three years. Hamilton/Avnet officials say the 820-I was not clearly enough defined in the market to "pull it through" the dealer/computer retailer channels.

Cliff Lindsey, an analyst with Cupertino, Calif.-based Dataquest, Inc., says that the Ethernet-related systems products are on an upswing since the beginning of the year. "Stars are shipping in the 100s per month, but if they continue at this rate they will be shipping at least 1000 per month by the end of the year," he says. *—Geoff Lewis*

Beehive bets future on UNIX-based desk-top micros

Custom-terminal manufacturer Beehive International is betting the company on a move into UNIX-based desk-top computers. The outcome of that wager, says vice president of marketing John McPhail, depends on the Salt Lake City, Utah, company's ability to attract top-notch new talent to Utah while attuning the corporate culture to the nuances of marketing software-driven products to Fortune 1000 companies.



An artist's rendering of the Beehive "TI" *smart terminal, scheduled for release in November, is based on the MC68008 microprocessor and is a member of Beehive's workstation family. MC68000-based products will follow next year.*

But McPhail says the market is there, and the steps necessary to gain a modest share of it have been defined through 1986. He describes the introduction of the CP/M-based Topper at this year's National Computer Conference and the scheduled debut of a smart terminal at Comdex in November as part of a planned evolution toward an MC68000-based family that he expects to quintuple Beehive's net sales by 1986. "If we don't make it, we have only our poor execution to blame," he says.

Beehive's diversification into desk-top systems stems from founder and president Warren Clifford's desire for continued growth. Funded by his initial investment of only $10,000 in 1968, Beehive has grown to annual revenues of $40 million. But that growth curve may have peaked because Beehive's chosen niche, custom OEM terminals, totals only $80 million in sales annually.

To plot a growth path out of that confining market, Clifford lured long-time company consultant McPhail to Beehive's Salt Lake City headquarters. McPhail has followed the terminal industry since a stint with "glass teletype" pioneer Infoton Corp. He recently gained insight into the engineering-oriented work-station market as one of the founding partners of CAD/CAM start-up Telesis, Inc. That experience, supplemented by a study done for Beehive by Gnostic Concepts Inc. and an internal Beehive investigation, led McPhail to conclude that the terminal-like technology and explosive growth potential of the small-system market made it the best Beehive opportunity.

But Beehive has several key obstacles to overcome before it can impact that market, says McPhail. One is visibility: few buyers among the Fortune 1000 have ever heard of Beehive because its terminals always carry another computer company's name. Beehive's salespeople must expand their horizon beyond pitching a terminal's hardware benefits to large OEM accounts, and must start thinking in terms of the end-user benefits of work-station hardware/software solutions. Further, Beehive's average margin must be increased to finance the more extensive marketing necessary to woo end users. "We couldn't afford to wait for our 68000-based advanced terminal line," says McPhail, "so we came up with a kind of transition product."

That product, Topper, a Z80A-

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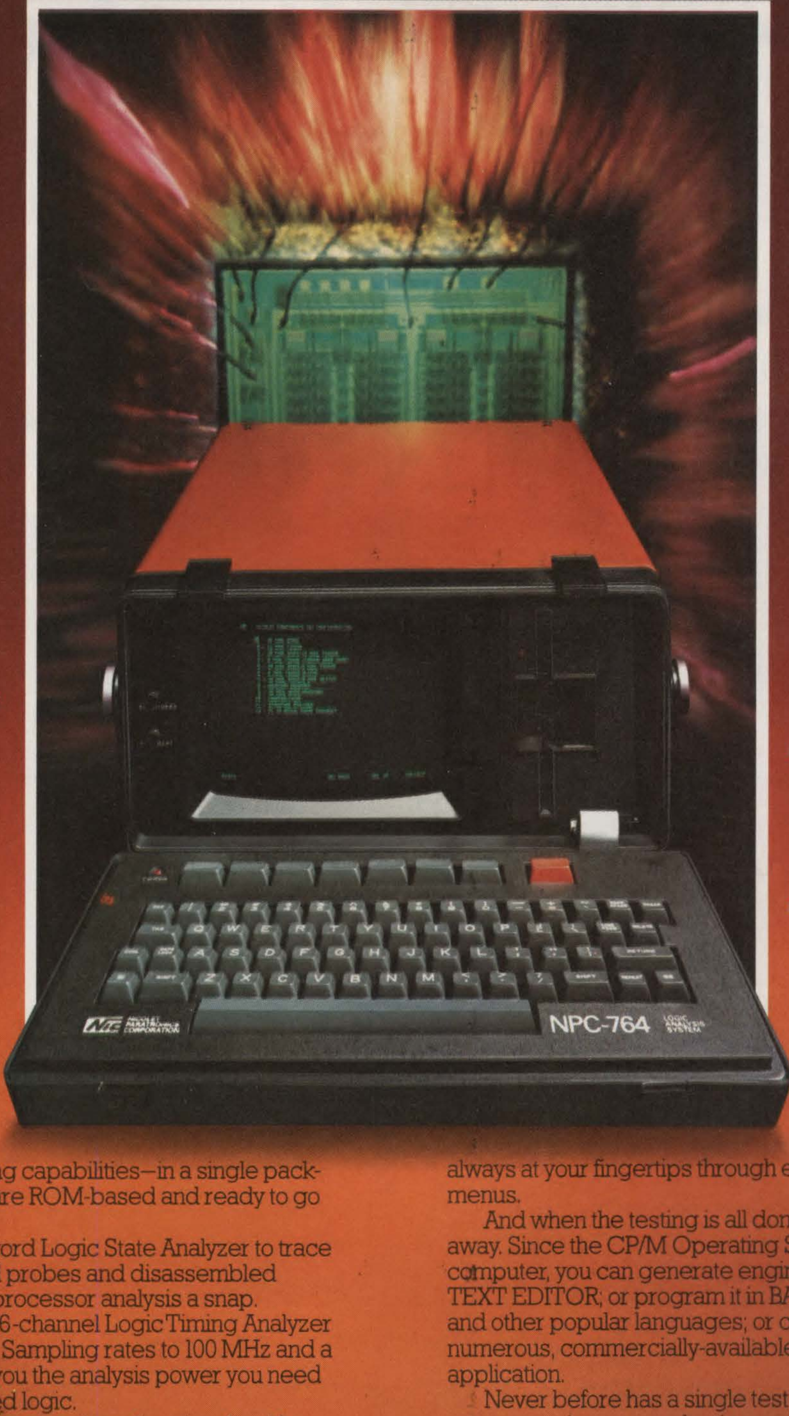

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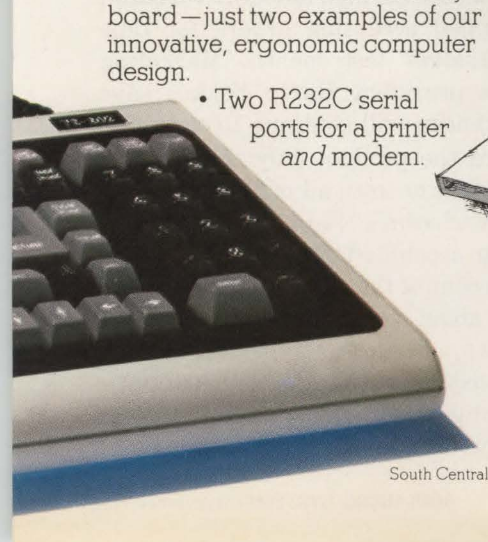

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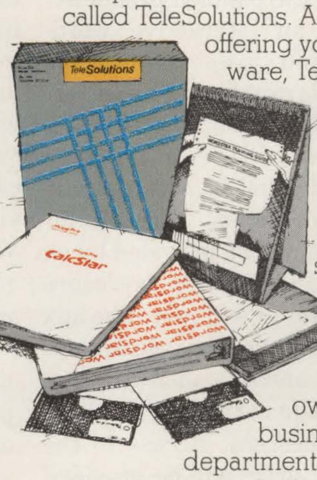

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*Prices are suggested retail excluding applicable state and local taxes—Continental U.S.A., Alaska and Hawaii.

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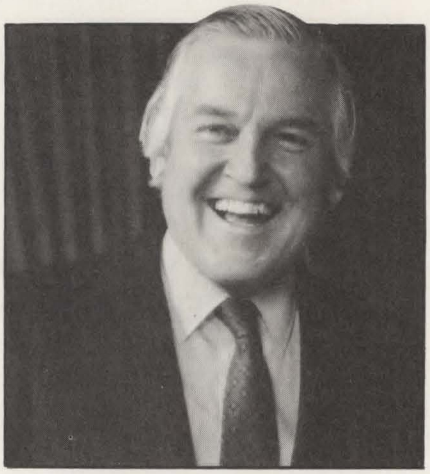
That learning curve leads next to the smart terminal, internally code-named T1, which will reportedly be the first product based on the Motorola 8-/16-bit 68008 microprocessor to reach the market. McPhail says the T1's 14-in. screen will display 132 characters in a 7 × 9 dot matrix, an improvement in clarity over the 5 × 7 format used by other 132-character terminals. Ergonomic features include an optional pedestal that provides 360° swivel and 20° tilt. If a smaller footprint is desired, the terminal module fits a 14-sq.-in. space while providing 5° tilt.

Although intended to be a $995 list successor to Beehive's OEM line of smart terminals, the T1 is a member of the work-station family central to Beehive's plan. McPhail points out that the T1's processor is software-compatible with the 68000, upon which the next two members of the family, due at NCC



Vice president of marketing at Beehive, John McPhail, *describes the CP/M-based Topper work station as a transition product in the company's evolution toward MC68000-based machines.*

next year, are based. The T2, like the T1, does not offer rotating memory, but does add bit-mapped graphics and pre-processing. Moreover, as many as 16 T1s and T2s will be supported by the stand-alone T4 work station as a cluster under UNIX. The T4 is expected to include 128K bytes of memory, UNIX and two 5¼-in. floppies for approximately $6000.

Although details on the T4's software are not firm, its intended niche is. "We aim to improve the productivity of the engineer and manufacturing manager," says McPhail. One of the planned productivity tools is an interactive word-processing and graphics package called "wordgraphics." In an enhanced configuration for an engineer, the T4 will be a CAD/CAM design vehicle tied to a potentially large local database. Storage for that database will be provided by an "aux box," an auxiliary enclosure upon which the T4 will rest. The aux box will house overflow electronics from the T4 and as much as 100M bytes of storage in the form of three 5¼-in. Winchesters. Access to the corporate database will be provided as well, says McPhail, via a series of controllers including the 3278 protocol converter used in Topper and a forthcoming local-area network board.

Although McPhail says some elements of the engineering work station will be based on proprietary software under development in-house, most of the software will come from third parties.

Jean Yates, president of UNIX-oriented consulting firm Yates Ventures, supports Beehive's readiness to use outside expertise. "Interactive Systems, Inc., in Santa Monica was a good choice to do the transport of UNIX to Beehive's hardware; not attempting the port itself shows the company knows its own limitations," Yates says.

But fierce competition will make Beehive fight to gain any market share at all, she adds. McPhail recognizes that the competition will be tough. But he says Beehive needs only about 1 percent of the small-system market on top of its existing business to reach the goal of $206 million in annual revenues for fiscal year 1986. McPhail wants that market share. *—Kevin Strehlo*

Verbatim sells cartridge line to drive vendor DEI

Sunnyvale, Calif., media vendor Verbatim Corp. plans to sell its 3M-compatible ¼-in. tape-cartridge line along with all production machinery to San Diego, Calif., drive vendor Data Electronics, Inc., for an unspecified amount. Verbatim stopped accepting orders for tape cartridges last month. Marketing vice president Harry Fekkes says Verbatim will continue to manufacture the product only through this month, or until all orders are filled.

Verbatim's ¼-in. tape-cartridge line accounted for approximately 7 percent of the company's total sales, or about $4 million to $5 million a year, Fekkes says. Verbatim's decision to sell the line to DEI—along with its 0.15-in. DC-100 tape-cartridge business—was based

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That's why the first reaction to our Cynthia D100 Series 10½″ disk drives was almost universally... "Holy Moses!"

But, when you think about it, every industry standard began as a new standard. From 14″ to 5¼″. The 10½″ is no different.

Actually, the 10½ Commandments are really a compendium of critical considerations, specifically: when you need the power and performance of a 14″ drive in a package ⅓ the volume, specify Cynthia; when you need a more efficient use of surface storage space than an 8″ drive, specify Cynthia; when you need an optimal-sized drive for high performance, highly reliable stand-alone systems, specify Cynthia. Amen.

What it all comes down to is the fact that Cynthia D100 Series 10½″ disk drives are proving to be the optimum answer in a myriad of minicomputer and distributed processing applications. In fact... we've already shipped over 12,000 units to satisfied customers in the United States and throughout the world. It's this unique combination of proven product experience, together with the technological achievements of our parent company, Cii Honeywell Bull, that have made us the recognized leader in 10½″ technology.

Sure, our Cynthia D100 Series disk drives may not be what you've previously considered "industry standard." But when you consider the inherent advantages of the 10 ½″ format, together with technological advances like our patented embedded servo design, you may find that this new standard may be an infinitely better standard. It's easy to find out. Just call us at (415) 856-8181. Or drop us a line.

Cynthia Peripheral Corporation... we're setting new standards in disk drive technology.

Cynthia Peripheral Corporation.

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Palo Alto, CA 94303
(415) 856-8181
TWX: 910-373-2088

Europe:
Cii Honeywell Bull,
Cynthia OEM Division,
Phone: (3) 055.55.58.
les Clayes-sous-Bois, France.

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CIRCLE NO. 45 ON INQUIRY CARD

on the need to dedicate company resources to the development and production of sub-4-in. floppy disks, he explains, noting that demand for that product should begin to develop strongly by the second quarter of next year. Standards for sub-4-in. flexible media are scheduled to be presented this month to the American National Standards Institute by an industry committee that includes Verbatim (MMS, July, p. 6).

Verbatim's decision to drop out of the ¼-in. tape-cartridge business will leave only two vendors supplying this type of ¼-in. media to domestic OEM drive vendors—DEI and 3M, St. Paul, Minn.—both of which also build drives. DEI had previously announced its intentions to offer this media. Fekkes does not foresee any problems for other drive vendors as a result of his company's decision to sell its media line to DEI, however. "Vendors such as Archive Corp. and Cipher Data Products, Inc., will still have two sources of supply available to them—just like they've always had," he says. "They will continue to rely on 3M, and in Verbatim's place, DEI will sell them media."

Verbatim Corp.'s ¼-in. tape-cartridge line *has been sold to tape-cartridge drive vendor Data Electronics, Inc. The sale leaves other hardware drive vendors with two sources of supply for this media—DEI and 3M—both of which also make drives. Included in the sale to DEI is Verbatim's 0.15-in. DC-100 line.*

Tom Makmann, marketing vice president at Costa Mesa, Calif.-based Archive agrees that his company will face no major problems as a result of Verbatim's decision, but does not greet it with 100-percent enthusiasm. "This is not the most desirable development," he says. "It's in our company's interest to have as many sources of supply for ¼-in. tape-cartridge media as possible." Things could be worse from Archive's point of view, however. "It would be more detrimental to us if no one picked up the line," he explains. Verbatim's tape-cassette business is not included in the deal with DEI.

—John Trifari

CARTRIDGE-TAPE DRIVE STANDARDS GROUP FORMS

Four manufacturers of ¼-in. cartridge-tape drives have formed an international group to develop proposed standards to promote industry-wide compatibility. Members of the Working Group for Quarter-Inch Cartridge Drive Compatibility are Archive Corp., Costa Mesa, Calif., Cipher Data Products, Inc., and Data Electronics, Inc., San Diego, Calif., and Tandberg Data A/S, Oslo, Norway. Other manufacturers of ¼-in. drives are encouraged to join.

In Transition

Centronics Data Computer Corp., Control Data Corp., NCR Corp. and International Computers Ltd. have finalized an agreement whereby CDC purchased about 2.33 million shares of Centronics common stock for $25 million. Centronics has acquired the printer business of Computer Peripherals, Inc., in return for about $2.6 million shares of Centronics's common stock to CDC, NCR and ICL. The result is that CDC owns about 35 percent, and NCR and ICL each own about 5 percent of Centronics's common stock. John Tincler remains president of the new Centronics concerns.

Point-of-sale-system supplier **Data Terminal Systems, Inc.,** Maynard, Mass., has terminated about 290 employees worldwide and plans to reduce operating expenses by 25 percent in the wake of a major internal reorganization. The moves are an attempt to boost the company's break-even sales level.

Keydata Corp., a Watertown, Mass., time-sharing service, has emerged from the Chapter XI bankruptcy protection it sought about one and one-half years ago. The accepted reorganization plan calls for a cash payment of 40¢ per dollar to unsecured creditors owed less than $12,000. Larger unsecured creditors get a compensation package consisting of cash, five-year notes and new stock. New shares will be converted at a rate of 27.7 shares for each 100 existing shares. The company has dropped its minicomputer and distributed-processing products, and is concentrating resources on on-line business data-processing services for distributors and manufacturers. The reorganized company will begin operations with about $8 million in annual sales, and more than $1 million in cash.

Tektronix, Inc., alumnus James C. Towne has joined **Microsoft Corp.,** Seattle, Wash., as president and chief operating officer. He replaces Microsoft co-founder William H. Gates, who has become executive vice president with responsibility for product design, internal development, outside software licensing and documentation. Gates remains chairman. The fast-

Microsoft's six-month search for a professional manager to handle its booming business *culminated in the hiring of former Tektronix executive James C. Towne (r.), who replaces Microsoft cofounder William H. Gates as president. Gates has become executive vice president, and remains chairman.*

paced $35-million company has doubled annual sales over last year, tripled its sales force, moved into a 60,000-sq.-ft. headquarters and is opening a sales office in London, thus triggering the search for the professional manager. Towne previously was vice president and general manager of Tektronix's Instruments Division.

Financing

A start-up headed by Zilog founder Dr. Federico Faggin, has received an unspecified amount of funding from Merrill Lynch Venture Capital, Inc. The company, **Creative Communications, Inc.,** Santa Clara, Calif., plans to announce its first product, an advanced information system, in the middle of next year.

Massachusetts Computer Corp., Littleton, Mass., has raised more than $5 million in second-round financing from a group of investors led by Hambrecht & Quist, and named William R. Hambrecht to its board of directors. MASSCOMP manufactures medium-scale computers for scientific and engineering use.

Formations

Intel Corp., Matra S.A. and **Harris Corp.**'s joint venture, Matra-Harris Semiconducteurs, S.A., have announced joint funding of a French design center for ICs. The new venture, called CIMATEL, will design NMOS devices that will be manufactured by Intel Corp. and Matra-Harris. CIMATEL eventually will have 50 employees. Matra-Harris will supply equipment, Intel will provide CAD technology, and both will share operating expenses. Additionally, both companies are cooperating under a technology exchange agreement in which Matra-Harris will design CMOS versions of Intel NMOS ICs.

Oki Semiconductor, Inc., Santa Clara, Calif., has formed a division to market electronic components and subsystems, including keyboards, intelligent displays, modem boards and floppy disks, in North America. The new division, dubbed the Functional Device Division, is expected to grow at at least a 50-percent compound annual rate.

Four Atlanta, Ga., software houses have joined forces as a start-up firm called **Solid Software, Inc.** The four—Georgia Software Consultants, System Sciences of America, Jim Reeves & Associates and Pro Soft—will market a line of vertical applications packages for microprocessor-based systems. The new venture's Professional Services Division will offer contract programming and consulting services. James V. Reeves serves as the company's general manager.

Tandy Corp., Fort Worth, Texas, and **Matra S.A.** of France have signed an agreement to set up manufacturing in France for the TRS-80 model III microcomputers. If both companies' boards of directors and the French government approve the plan, a new corporation called Matra-Tandy Electronique, S.A. will be formed.

Pleased about their new agreement to manufacture TRS-80 Model III microcomputers in France *are (left to right) Herschel Winn, senior vice president and corporate secretary of Tandy, John Roach, president of Tandy, and Jean-Luc Legardere, chief executive of Matra, and Pierre Yves LeBihan of Matra.*

Able Computer, Irvine, Calif., has moved into its ½-acre, 1500-sq.-ft. English Marketing and Support Center, Newbury, Berkshire, England. The center will be the focal point for all sales, service repairs and training in the U.K., Belgium and the Netherlands....Sunnyvale, Calif-based engineering-workstation manufacturer **Daisy Systems Corp.** has opened a technical center in Waltham, Mass., to provide technical and sales support, customer service, maintenance and sales to customers east of the Mississippi River, including Canada....**Digital Equipment Corp.** has leased 32,000 sq. ft. in the Irvine, Calif., Executive Park for its southwest regional headquarters....**Digital Research, Inc.,** Pacific Grove, Calif., has opened an Eastern regional sales office in the Boston area. Bruce Cohen, formerly with Datapoint Corp., will serve as manager.

Distribution, Service Deals

Six independent computer retailers already have paid deposits to become Byte franchisees, a new

Compared to Cynthia, most Cartridge Disk Drives are strictly for the Birds.

Funny, isn't it? While some people are crowing about the fact that they're just now delivering compact fixed/removable hard disk drives, we've been shipping them for years. Over 12,000 of them, to be exact.

On top of that, we can offer you a choice.

Need 10MBytes of formatted capacity on a removable disk in a compact, high performance package? Our D120's your answer. Want 10MBytes of fixed disk storage with an additional 10MBytes of removable disk-to-disk backup? Voila ... D140. Both are powerful, 10½″ rigid disk drives, incorporating the latest disk drive technology in a compact, proven package.

Whichever Cynthia cartridge drive you choose, you'll be receiving a reliable, field-proven design, with over 6,000 hours MTBF. You'll also be receiving Cynthia's patented embedded servo track positioning system which ensures consistently accurate head positioning, with no head alignment required. Cynthia D120 and D140 drives also incorporate proven 3330 technology ramp load heads and high performance linear voice coil actuators to deliver consistently reliable performance in a wide range of applications.

Need more?

Cynthia D120 and D140 disk drives have it. Like SASI*-compatible controllers that provide simple, low-cost integration to your host bus. And all DC power for international flexibility. Plus you get a proven track record in cartridge disk drives that only our parent company, Cii Honeywell Bull, can provide.

So why take a flier on just any fixed/removable disk drive? Check out the Cynthia D120 and D140's today. Call us for an evaluation unit. Or write for free product information. We'll send it to you. By air, of course.

Cynthia Peripheral Corporation ... we're setting new standards in disk drive technology.

*SASI™ is a trademark of Shugart Associates

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Now there's a new packaged solution to these applications for the 80s and beyond. The VMC 68/2 Microcomputer System. It brings all the power, versatility, and economy of the MC68000 MPU into the industrial arena. With the promise of increased capability as the upward-compatible M68000 Processor Family grows into the future.

You've seen the benchmarks and results. MC68000 is the acknowledged leader in the 16/32-bit class. It keeps on going where others run out of gas . . . as with its full, 16 megabyte direct-addressing capability.

Processor, memory, basic I/O, compact 16 megabyte disk storage unit, industry-standard peripheral interfaces . . . it's all there with VMC 68/2. A complete system based on Motorola's field-proven VERSAmodule™ microcomputer hardware and software modular elements. Assembled, tested, ready to apply to your toughest requirements now. Yet easy to expand many times as your needs expand.

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Tuned to industrial environments.

VMC 68/2 hardware and software is dependable in production environments like fluctuating factory temperatures. The Processor Unit operates rock-solid from 0° to 50° C in a rack or on the table. The operating system offers real-time multitasking features for quick response to multiple random events. And since I/O requirements can vary between applications, the VMC 68/2 I/O Channel easily tailors specialized I/O elements in small modular amounts to meet your needs exactly.

Powered by real-time VERSAdos™ software.

The plug-in VMC 68/2 lets you devote your resources to your payoff: your application and the challenge to develop application software quickly, efficiently, with low risk and no hassle.

And here's where it saves you valuable time and money — with the proven real-time VERSAdos operating system and utilities . . . with advanced, high-level languages like Pascal and FORTRAN . . . with easy-to-use text editor and structured Macro Assembler . . . and with comprehensive self-test and diagnostics software to check its own state of health.

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Who will win the battle of the Multibus Giants?

You will!

Re-Introducing Zendex. (You may call us *"The Little Giant."*)

Until 1979, there was only one company in our field. We will call it "The Giant."

It seemed unfair that OEMs and Systems Houses should be dependent on a single source for certain board products. Even unAmerican! (Not to mention the wasted opportunity for a new company like Zendex to make a profit!)

So Zendex was founded to establish the alternative. Multibus* compatible boards and development systems for the professional and industrial markets, with delivery "off-the-shelf." Plus:

- 10 to 20% higher performance, speed or expandability.
- 10 to 20% lower price.

It has paid off. Now there are two giants in the field: The original Giant, 98 times our size. And us, Zendex. (We respect Intel* and hope their growth is proportionate to ours.) Zendex may not be very big, but we are an authentic Little Giant nevertheless. For 15 or 20 other companies have seen a good thing in our market. And we are as big as all of them combined.

You haven't heard much about Zendex? You will. Here are our new products:

- A number of new proprietary board level products and sub-systems, based on all three major 16-bit processors, the Intel 8086; the Motorola 68000; and the Zilog Z8000. You see, we think each of these competitive items has something the others lack. So, at Zendex, you can get the equivalent of all three. Zendex will be the only multibus manufacturer offering three major 16-bit processors…from one source and with a common operating system.
- Expanded development systems with hard disk…*and both ISIS-*and UNIX*compatible operating systems.*
- And, very exciting, the Quota™ Modular OEM Configurable Computer. Our answer to the Intel 86/330. Let's sound competitive! The Intel box holds two disk drives, ours has room for three. Intel's card cage has six slots; our Quota has nine slots.

Who will win the battle of the Multibus Giants? You will. Because competition works to your benefit. You can start by being one of the first to get our new catalog. Fresh off the press.

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BOX SCORE OF EARNINGS

This table, which appears every month, lists the revenues, net earnings and earnings per share in the periods indicated for companies in the computer industry and computer-related industries. A parenthesis denotes a loss.

Company	Period		Revenues	Earnings	EpS
Advanced Micro Devices	3 mos	6/27/82	83,018,000	3,773,000	.22
	3 mos	6/28/81	70,934,000	1,595,000	.10
Apple Computer, Inc.	3 mos	6/25/82	142,681,000	15,193,000	.26
	3 mos	6/26/81	90,719,000	11,858,000	.21
Burroughs Corp.	3 mos	6/30/82	1,060,290,000	36,480,000	.86
	3 mos	6/30/81	834,159,000	31,325,000	.75
Convergent Technologies, Inc.	3 mos	6/30/82	16,459,000	2,065,000	.11
	3 mos	6/30/81	1,540,000	(109,000)	(.01)
Corvus Systems, Inc.	year	5/29/82	26,838,000	2,353,000	.30
	year	5/30/81	10,325,000	706,000	.16
Data General Corp.	12 weeks	6/5/82	189,035,000	3,525,000	.32
	12 weeks	6/6/81	174,151,000	9,675,000	.91
Datapoint Corp.	3 mos	4/30/82	99,402,000	(22,993,000)	(1.14)
	3 mos	4/30/81	116,902,000	12,873,000	.63
Honeywell, Inc.	3 mos	7/4/82	1,321,400,000	85,600,000	3.83
	3 mos	6/28/81	1,304,300,000	71,400,000	3.15
Intel Corp.	3 mos	6/30/82	216,437,000	8,194,000	.18
	3 mos	6/30/81	201,201,000	9,710,000	.22
Lexidata Corp.	3 mos	6/30/82	8,318,200	1,039,300	.18
	3 mos	6/30/81	4,472,200	777,500	.18
Management Assistance, Inc.	3 mos	6/30/82	85,983,000	1,073,000	.13
	3 mos	6/30/81	82,826,000	962,000	.12
Micom Systems, Inc.	3 mos	6/30/82	15,914,000	2,510,000	.38
	3 mos	6/28/81	11,346,000	1,392,000	.23
Monolithic Memories, Inc.	12 weeks	6/13/82	17,001,000	400,000	.06
	12 weeks	6/7/81	16,217,000	983,000	.15
Storage Technology Corp.	3 mos	6/25/82	270,199,000	21,003,000	.60
	3 mos	6/26/81	214,707,000	15,831,000	.54
Sykes Datatronics, Inc.	3 mos	5/31/82	10,351,223	576,350	.05
	3 mos	5/31/81	8,934,644	1,614,000	.13
Tandon Corp.	3 mos	6/25/82	44,245,442	4,606,283	.41
	3 mos	6/26/81	15,020,560	1,354,772	.15
Visual Technology, Inc.	3 mos	6/30/82	6,504,000	755,000	.21
	3 mos	6/30/81	4,352,000	469,000	.16
Zenith Radio Corp.	3 mos	7/3/82	291,800,000	(4,100,000)	(.22)
	3 mos	7/4/81	274,700,000	2,100,000	.11

Comments: Pressures from foreign currency translation and from strong market competition continue to be reflected in quarterly and annual results. Convergent Technologies has continued to improve performance since becoming public in May. Second-quarter revenues reflect a tenfold increase over those of the same quarter last year, and revenues for the first half of the fiscal year increased from $3 million last year to $24 million this year. Although Data General is optimistic about long-term prospects, profit margins still suffer from what the company attributes to increased costs and slowed order and shipment levels, the result of sluggish worldwide economies. Near term, however, Salomon Brothers, Inc.'s High Technology Monthly report notes persistent rumors that the company will be acquired, which it says has kept the stock a good performer. DG consolidated results of its 85-percent-owned Japanese subsidiary, Nippon Data General, in this quarter for the first time. Datapoint recorded its first quarterly loss in nearly a decade. Part of the reason is a reversal of some revenues of previous quarters. In that regard, Datapoint, its directors and independent auditors and others are defendants in lawsuits alleging misrepresentations in issuing financial statements and conditions over the past two years. Honeywell's second quarter earnings were aided by the sale in June of 27.1 percent of Cii Honeywell Bull stock to France's Compagnie des Machines Bull. Income for MAI declined from the second to third quarter this year. The company attributes the drop to lower revenue in its Basic Four information-processing system operation. While net income for Monolithic Memories was down from its third fiscal quarter last year, the company remained profitable, partly a result of the settlement of a theft claim. New order bookings this quarter were the highest for any quarter in two years.

venture in the **Byte Industries** Franchise Recruitment program aimed at retailers. Franchises can provide added support and identity for retailers. Initial fees are $5000, plus a 3-percent royalty on sales and a 2-percent royalty for a co-op advertising fund....**Cromemco, Inc.,** recently entered hardware and software distribution agreements with Kierluff Electronics, Inc., and Hallmark Electronics, Corp....**IBM Corp.** has authorized 17 additional retail stores to become IBM Personal Computer dealers, bringing the total to 90 independent dealers....**Intech Systems Corp.,** Reston, Va., has reached an agreement with Toshiba America, Inc., Tustin, Calif., to sell the Toshiba T-100 personal computer through its 120 dealers in 34 states....Santa Clara business-software company **Micro Focus** has entered a marketing and distribution agreement with MicroSoftware Associates, Tokyo, Japan. MicroSoftware has exclusive marketing rights in Japan....**NorthStar Computers, Inc.,** San Leandro, Calif., has signed a two-year contract valued at $25 million to $30 million with Avnet Corp., a large electronic-equipment distributor, for its line of microcomputers. Additionally, NorthStar signed an international distribution agreement with TRW, Inc.'s TRW Datacom International division. NorthStar's overseas distributors will be transferred to and supported by TRW Datacom.

Wet Ink

Torrance, Calif.-based **CADO Systems Corp.** has signed an agreement with Mexico's largest office-products company, Groupa Printaform S.A. to manufacture CADO information-processing systems for sale in Mexico. Printadata has a dealer and subdistributor network in 25 Mexican cities. ...**Cipher Data Products, Inc.,** San Diego, will provide $7.2 million in memory-storage peripherals to Perkin-Elmer Corp.... Mansfield, Mass.-based Motorola subsidiary **Codex Corp.** has renewed a contract to supply AT&T with Codex line-sharing units and local-area data sets. The two-year contract is expected to produce a combined 1982 volume of $7 million for Codex. Codex also signed a $1.4-million contract with Farmland Industries, Kansas City, a multibillion-dollar agriculture-industry cooperative and grain manufacturer with more than 800 U.S. offices. The purchase is for Codex's minicomputer-based DNCS 400 network-control-and-management system to monitor Farmland's network telephone circuits.... **Lockheed DataPlan, Inc.,** San Jose, Calif., a subsidiary of Lockheed Aircraft Services, has purchased 120 Durango Systems, Inc., computers. The Durango systems will be bundled with software containing flight-plan, weather-service, international flight-handling and aircraft-schedule information.... **Prime Computer, Inc.,** Natick, Mass, has signed a $10.5-million contract to provide 32 Prime minicomputers and 340 I/O terminals to the Mexican government. The systems will be used by the Secretariat de Educacion Publica in one of Mexico's first major data-processing decentralization efforts.... **Rockwell International Corp.'s Electronic Devices division,** Anaheim, Calif., has signed a license agreement with SEEQ Technology, Inc., San Jose, under which the division will obtain SEEQ semiconductor-process technology and product design. The agreement allows Rockwell to use SEEQ's nonvolatile memory-circuit design and process technology. The plan is in part targeted at helping Rockwell's division become a major commercial semiconductor factor.

Quarterly Report

Net earnings by **IBM Corp.** for the second quarter of this year ending June 30 increased 24.4 percent from $804 million in 1981's quarter to $1 billion this second quarter. Gross income from sales, rentals and service for the quarter rose almost 17 percent from $6.9 billion in that quarter in 1981 to $8.05 billion this quarter. Despite the recession and inflationary pressures, demand for IBM's new products is strong.

The word at **Modular Computer Systems, Inc.,** Fort Lauderdale, Fla., is lean operations. The company is focusing on reducing overhead, including changes in international operations, which now will be directed from Florida instead of England. The efforts are aimed at improving Modcomp's earnings and staff productivity and reducing costs. The company reported first- and second-quarter results for the period ending June 30. Net income for the first six months of 1982 is $990,000, compared to a net loss of $142,000 for the same period in 1981. Six-month sales this year were $46.05 million compared to $37.9 million for the same period in 1981.

Annual Report

Fast-paced **Wang Laboratories, Inc.,** Lowell, Mass., set new records for revenues and earnings in its fiscal year 1982, which ended on June 30. During the year, the company reached two corporate milestones: revenues exceeded $1 billion, and net earnings exceeded $100 million. Revenues for the year totaled $1.16 billion, up 35 percent from $856 million in 1981. Net earnings were $107.1 million, up 37 percent from $78.1 million last year. New orders for products and services were $1.33 billion, up 32

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That's where Dysan's quality comes in. Dysan diskettes and mini-diskettes are manufactured to the toughest quality standards in the industry. Every diskette is tested between the tracks as well as on the tracks to insure you 100% error-free recording over the entire disc surface. Dysan quality protects your investment of $186.50.

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

Dysan CORPORATION

Our Media Is Our Message

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Santa Clara, CA 95050

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

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

CIRCLE NO. 50 ON INQUIRY CARD

percent from the $1 billion last year. The backlog is a record-breaker as well: $635 million. The reasons Wang cites for the stellar report are that it has improved asset management, produced steady quarterly business growth and maintained pretax margins.

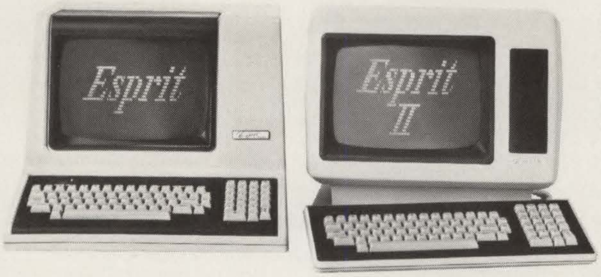
Industry Monitor

Dun & Bradstreet, Inc., reported that **U.S. business failures in the first six months of 1982 were high**—more than those for the entire year of 1980 and 45 percent ahead of the first half of 1981. Almost 12,000 businesses closed during the 26-week period ending July 1. That compares with about 17,000 closings in 1981. Weekly failure rates for manufacturing- and service-related companies nearly doubled from last year.

Many emerging businesses are missing monetary savings by not taking advantage of tax deferments, according to reports by partners at Los Angeles international accounting and consulting firm Coopers & Lybrand. For example, a company's chief executive could adopt an installment method of reporting sales of inventory, thereby postponing the company's taxes on accounts receivable. Business managers also can take advantage of the diversity in state tax laws, such as locating a warehouse or sales subsidiary in a neighboring state with a more favorable tax structure. Coopers & Lybrand partner Bent Peterson notes that, "With proper analysis of costs and the identification of expenses in developing new product lines, a business may also be entitled to the new R&D tax credit, which few businesses are currently employing to their maximum advantage." The key to overall tax reduction, the partners say, is careful planning and strategic timing of financial transactions.

COMPARE?

We did. And we won!



Compared to the Hazeltine Esprit™ and the new Esprit II™, the competition doesn't compare very well. Hazeltine has the best video quality among the budget terminals. And the Esprit line offers:

- **detached keyboard**
- **communications buffer**
- **page mode**

along with many other very practical features that you won't find on other entries in the low priced field.

We also compared price. And we won again. With Esprit, you get better performance and more features for less money.

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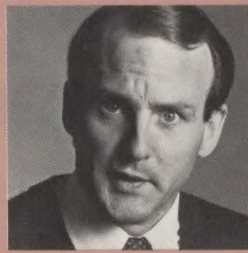

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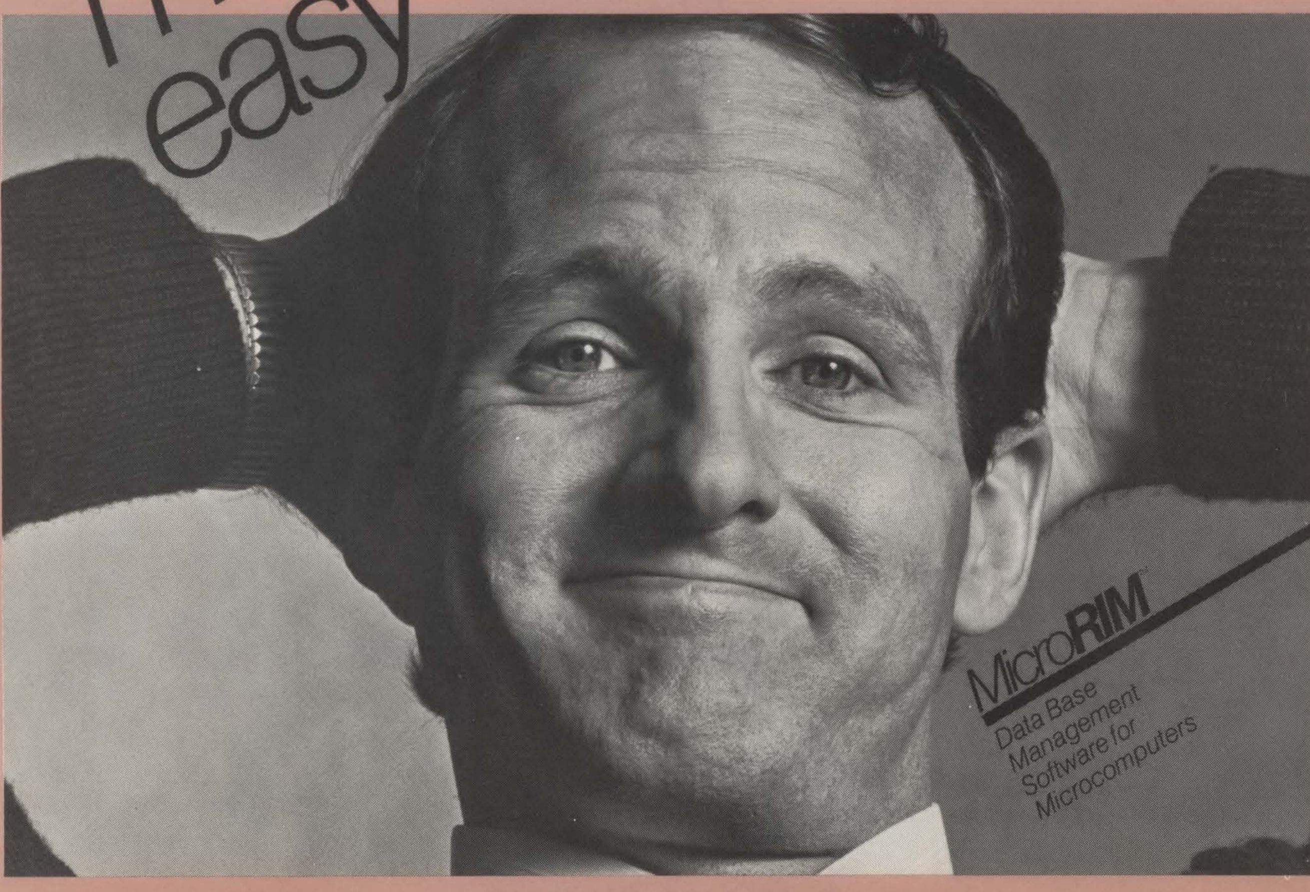
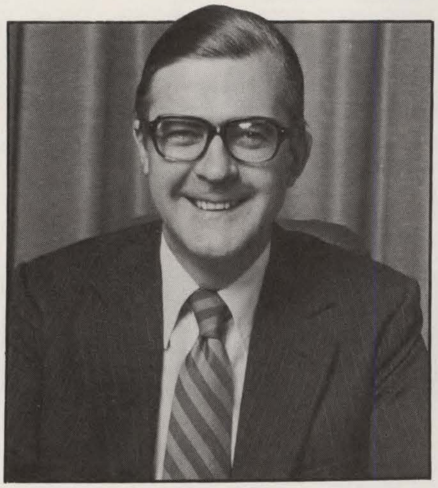


CIRCLE NO. 97 ON INQUIRY CARD

Britain, Japan team up for 5th-generation computer

While many U.S. computer manufacturers view Japan's fifth-generation computer plans with suspicion, confusion or even skepticism, the British government is actively seeking ways to help the Japanese achieve their goals—and at the same time make a lot of money for British information-technology companies.



Kenneth Baker, *Britain's Minister of Information Technology, set up a committee this year to investigate cooperative efforts between Britain and Japan for fifth-generation computers.*

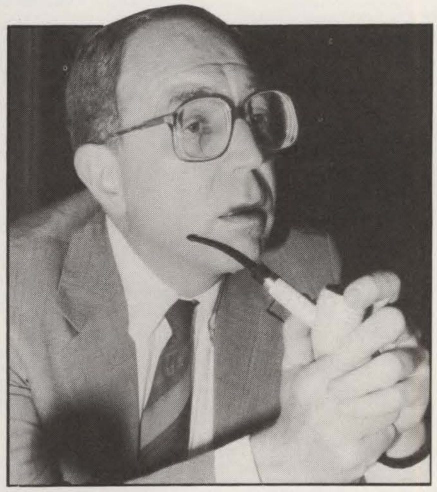
This year, Kenneth Baker, minister of information technology at the Department of Industry, set up a committee to investigate areas of cooperation between Britain and Japan. Chaired by John Alvey, senior director of technology at common carrier British Telecom, the committee is expected to report its findings very soon. Baker hinted at full government support in a speech at the "Fifth Generation: Dawn of the Second Computer Age" conference in London in July. Staged by one of Europe's leading minicomputer systems houses, SPL International, the conference was the first major event on the subject held in the West, and followed a fifth-generation seminar in Japan in October last year.

Another conference speaker, Philip Hughes, Alvey Committee member and chairman of software house Logica Holdings, urged that any cooperation between Japan and Britain should be a long-term agreement, with the roles of the participants, and even the terms of royalty payments on jointly developed products, precisely defined.

The Japanese IC industry is well-equipped to provide the processing power and memory capacity needed for marketable fifth-generation machines. But Japan needs an English-speaking Western ally to cooperate in developing complex software. Britain fits this profile and, unlike the U.S., does not pose a threat to Japan's dominant role in the project.

Another speaker at the London conference, specialist in knowledge-based expert systems Edward Feigenbaum of Stanford University, Stanford, Calif., underlined the importance of the fifth-generation program for Japan. "It has been chosen by the Japanese as their way of getting ahead of the U.S. It's a coming-of-age rite for them," he said. Knowledge-based expert systems are a key fifth-generation product, and Feigenbaum noted that the fifth-generation project in Japan is called knowledge-based information-processing systems (KIPS). He pointed out that some Japanese initiatives under way in Britain include the use of expert systems for automating programming and for VLSI design. He estimated that the Japanese were already spending about $100 million a year on developing knowledge-based systems compared with only $50 million in the U.S.. "We are losing the lead at a rate of one day each day," he warned.

He also pointed out expert systems projects in the U.S., including a joint effort in VLSI expert-system development between Stanford and Xerox Corp., Palo Alto, Calif., and a Digital Equipment Corp. application in which salesmen use expert systems to determine optimal configurations for customers. DEC is also working with the Massachusetts Institute of Technology on expert systems for diagnosing computer and PC-board faults.



Edward Feigenbaum *of Stanford University estimates that the Japanese already are spending about $100 million a year on developing advanced knowledge-based systems, which means the U.S. is losing its lead at the rate of one day each day.*

In Britain, SPL International sells expert systems based on DEC minicomputers. England's largest computer manufacturer, ICL, already has a long-term agreement covering high-speed logic circuitry with Japanese company Fujitsu Ltd.

ICL and Britain's two biggest electronics manufacturers, Plessey Co. Ltd. and General Electric Co. Ltd. (no connection with General Electric Co. in the U.S.) are represented on the 10-person Alvey committee.

—*Keith Jones*

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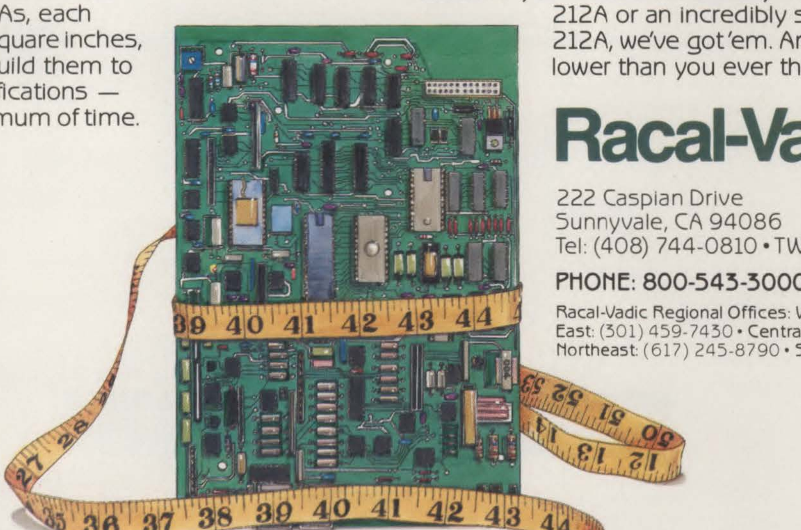

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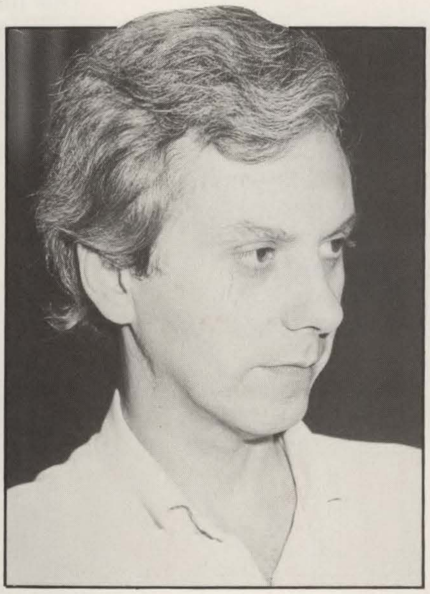
CIRCLE NO. 172 ON INQUIRY CARD

'Fifth-generation' languages targeted at mini, micro users

Prolog, the nonprocedural language favored by the Japanese for "fifth-generation" computer systems, is being used in Europe for practical applications. Moreover, implementations for several microcomputers and for Digital Equipment Corp. VAX superminicomputers are being offered to potential U.S. users by London-based LPA Ltd.

LPA offers Micro Prolog for microcomputers configured around the Zilog Inc. Z80 and running under Digital Research, Inc.'s CP/M version 2.2. LPA director Keith Clark says that Micro Prolog versions for two 16-bit processors, the Intel Corp. 8088 and Motorola Inc. MC68000 are under development. Micro Prolog emanated from London University's Imperial College, one of Europe's leading centers of Prolog expertise. Clark, a senior lecturer and a member of the Prolog team at Imperial, explains that LPA is an independent company established to exploit Micro Prolog commercially. LPA will fund the 8088 version, but development of the MC68000 implementation will be supported by a grant from the British government's Science and Engineering Research Council.



Keith Clark, *director of London-based LPA, Ltd., which has brought a nonprocedural "fifth-generation" language to the U.S. for use on several microcomputers and DEC's VAX 32-bit minicomputers.*

The VAX implementation, called MPROLOG, originates from the Institute for Coordination of Computer Techniques in Budapest, Hungary. A Prolog interpreter was first implemented there in 1975, and MPROLOG was introduced in 1980. It offers improvements, such as modular programming and better interactive programming aids, over Prolog. The first hosts for MPROLOG were Siemens and IBM Corp. mainframes, but VAX implementations have been developed over the last year at the Catholic University, Nijmegan, the Netherlands, and at Edinburgh University, Scotland.

At the Fifth Generation conference staged by SPL International in London in July, Peter Szeredi, a member of the Prolog team in Hungary, outlined some of the many applications for the language in that country. The most successful are scientific information retrieval, software generation and analysis, computer architecture design, CAD for buildings and pharmaceutical research.

Prolog is considered to be well-suited to manipulating knowledge databases because it is written in terms of relations.

Clark claims that LPA has sold 200 Micro Prolog licenses, including "20 or 30" in the U.S. For $380, a customer can buy a copy of Micro Prolog on a floppy disk plus the Micro Prolog manual and 130-page primer. The price includes postage. The Micro Prolog primer, which details the language, is available separately from LPS for $15, including postage. Prices for the VAX MPROLOG have not been announced, but Clark says that potential U.S. purchasers of the language can contact its Hungarian vendors via LPA.

—Keith Jones

Fifth-generation MIT computers bring parallel architectures to U.S.

Data-driven dataflow computers, which use an approach to parallelism regarded with favor by the Japanese in their "fifth-generation" computer strategy, that is also getting attention in England, are under development much nearer to home—at the Massachusetts Institute of Technology (MMS, July, p. 74). Such computers will change the nature of programming: existing procedural languages will be deemphasized and superceded by functional nonprocedural languages, which eventually will filter down for use on all types of computers.

Two teams at MIT, Cambridge, Mass., are taking different approaches to the subject. Both proposed machines employ a ring-networked multiprocessor architecture, but one queues operands between nodes in its network, while the other allows them to flow freely, each labeled with a tag token indicating at which node it should be executed.

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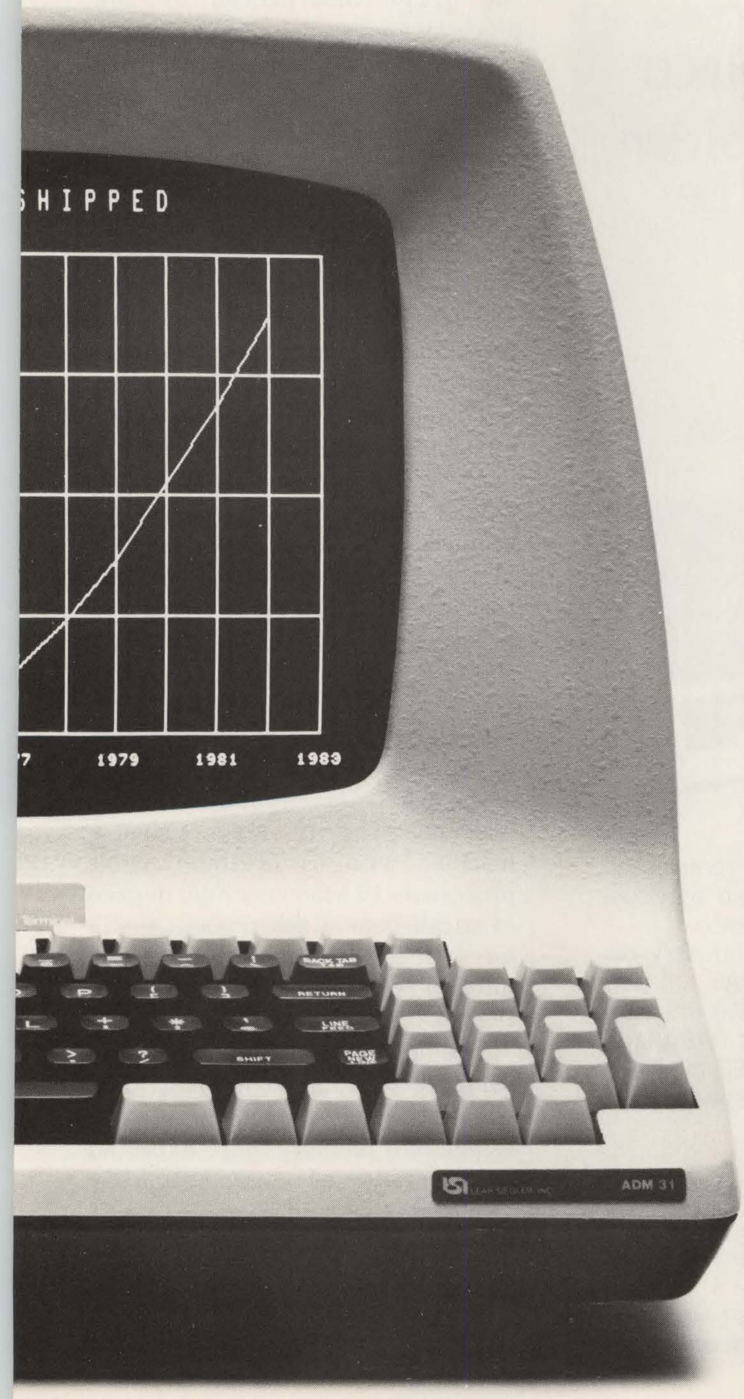

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*1981 Datamation Brand Preference Study of the Data Processing Industry, OEM and End-User Markets. Infosystems Magazine, 1981 Survey of Terminal Usage. 1982 Brand Preference Survey conducted by Data Communications Magazine.

CIRCLE NO. 92 ON INQUIRY CARD

Nodes in the tag token machine will each be associated with a processing element storing and executing a program called an interpreter, but differing radically from any conventional interpreter. Instead of interpreting a succession of high-level language instructions, the dataflow interpreter interprets a description of the graph that indicates the paths between dataflow machine nodes that operands must follow to execute a program.

Called U (unraveling or unfolding), the interpreter for the tag token machine can initiate several inter-loop procedure calls without programmer intervention, says project team member Robert Thomas. The machine hosting U is designed to execute Irvine Dataflow (ID) language, conceived at the University of California, Irvine, by Professor Arvind. He is now head of the Functional Languages and Architectures Group at MIT, which is bringing the project to fruition. An ID program is compiled down to the graph interpreted by the processing elements at run time.

MIT's Computational Structures Group, headed by Professor Jack Dennis, is working on the queued operands machine. The machine is designed to execute the VAL value-oriented algorithmic language. IBM Corp. and the Department of Defense's Advanced Research Projects Agency are providing financial support for both projects.

Thomas notes that the tag token structures enables the ID machine to execute instructions in parallel by default, while the VAL computer requires parallelism to be specified in the program. Thomas explains that the ID team is developing a 32-bit single-processor machine. Based on the Advanced Micro Devices, Inc., 2903 bit-slice chip set, the processor executes the U interpreter in microcode. U is part of the instruction set of the dataflow machine. The ID team plans a machine with 64 of these 32-bit processors to achieve a high degree of parallelism. Each processor will have local memory and some interconnected memory for storing the token tagged operand packets.

The next stage will be a machine using custom LSI logic chips. The only IC being developed by MIT is an associative memory chip, expected to be ready for incorporation by year-end, that will be used to pair tokens with tags. There will be one such chip in each processor.

Each processor will also require much RAM to store the dataflow graph, the microprogram executed

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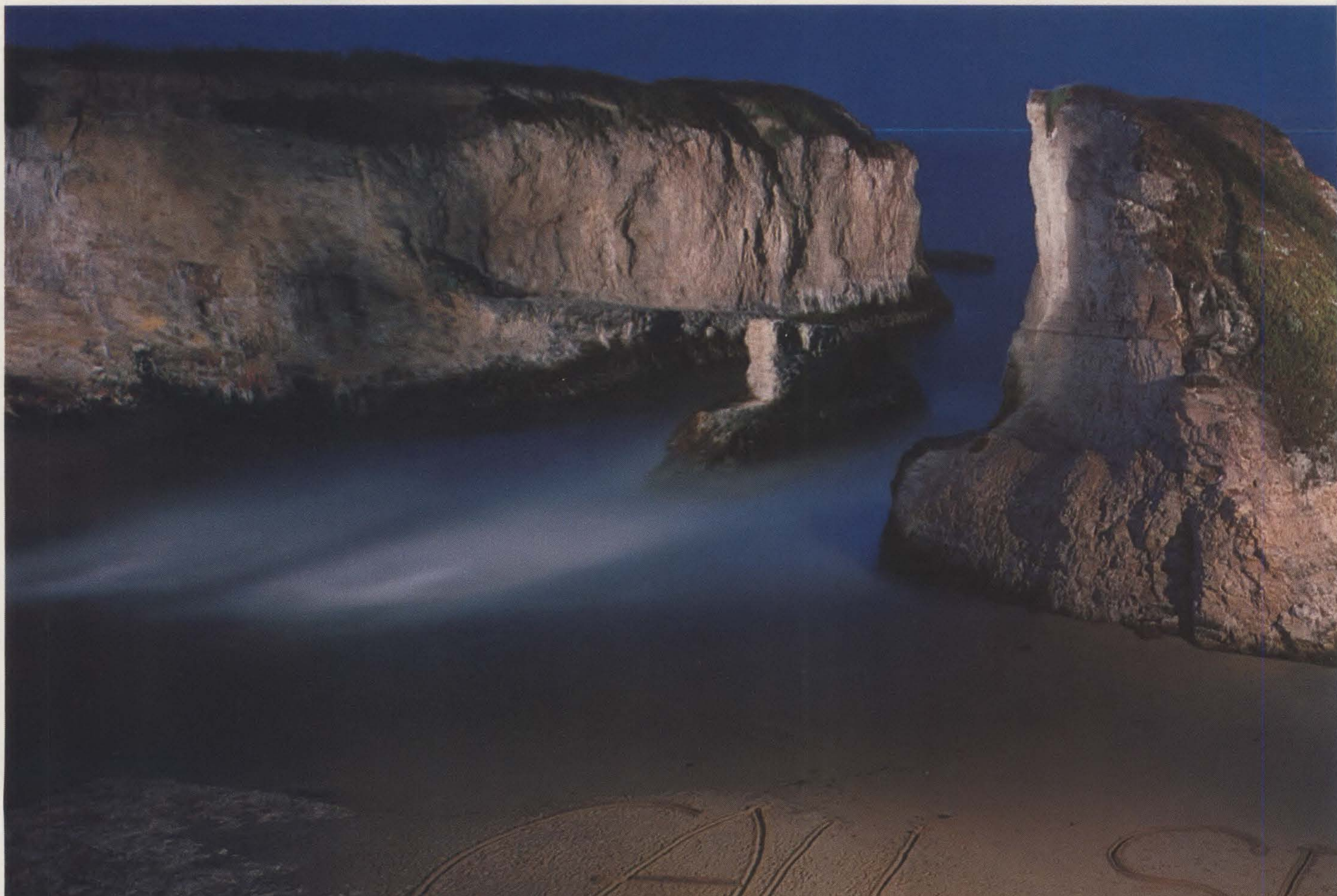

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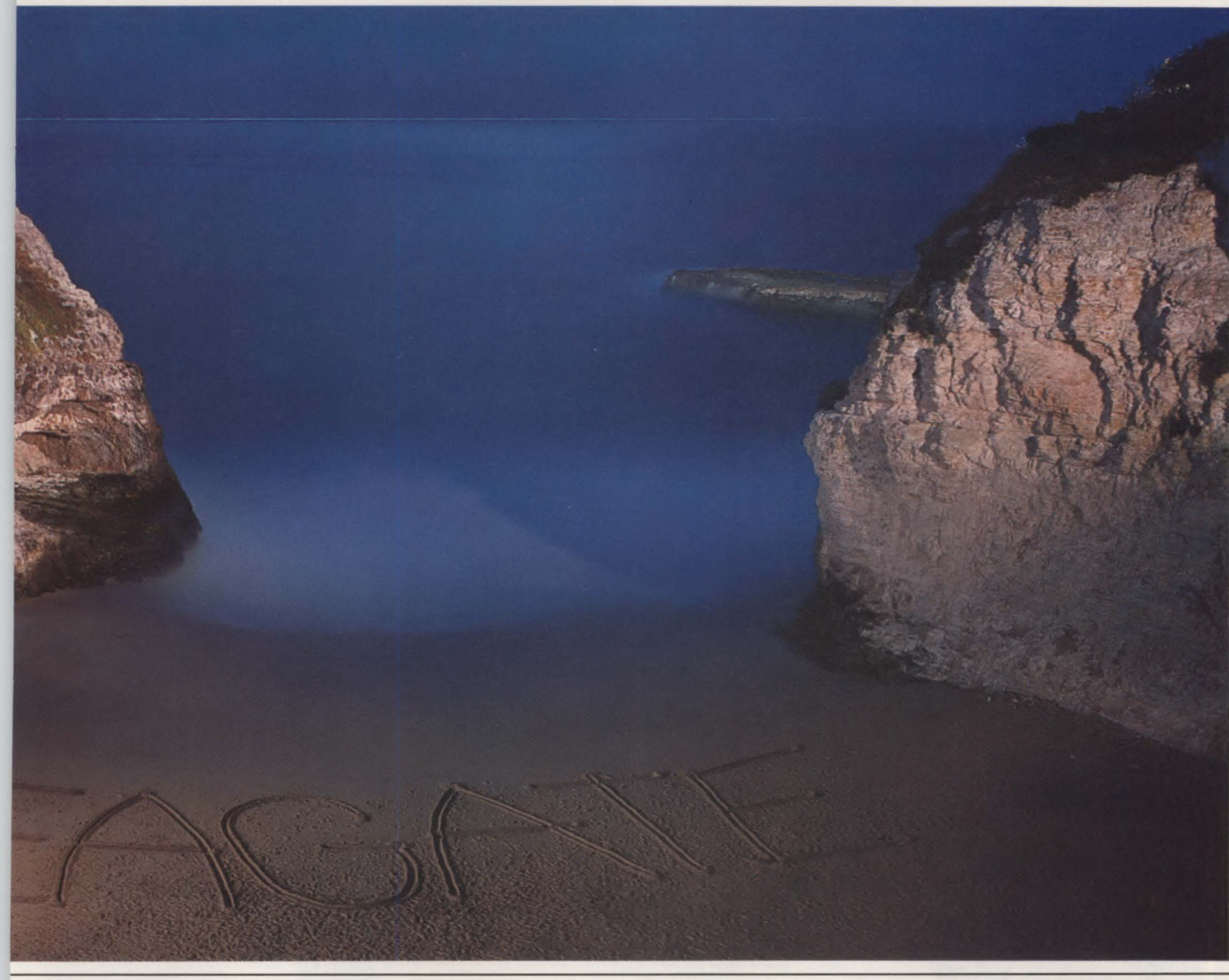

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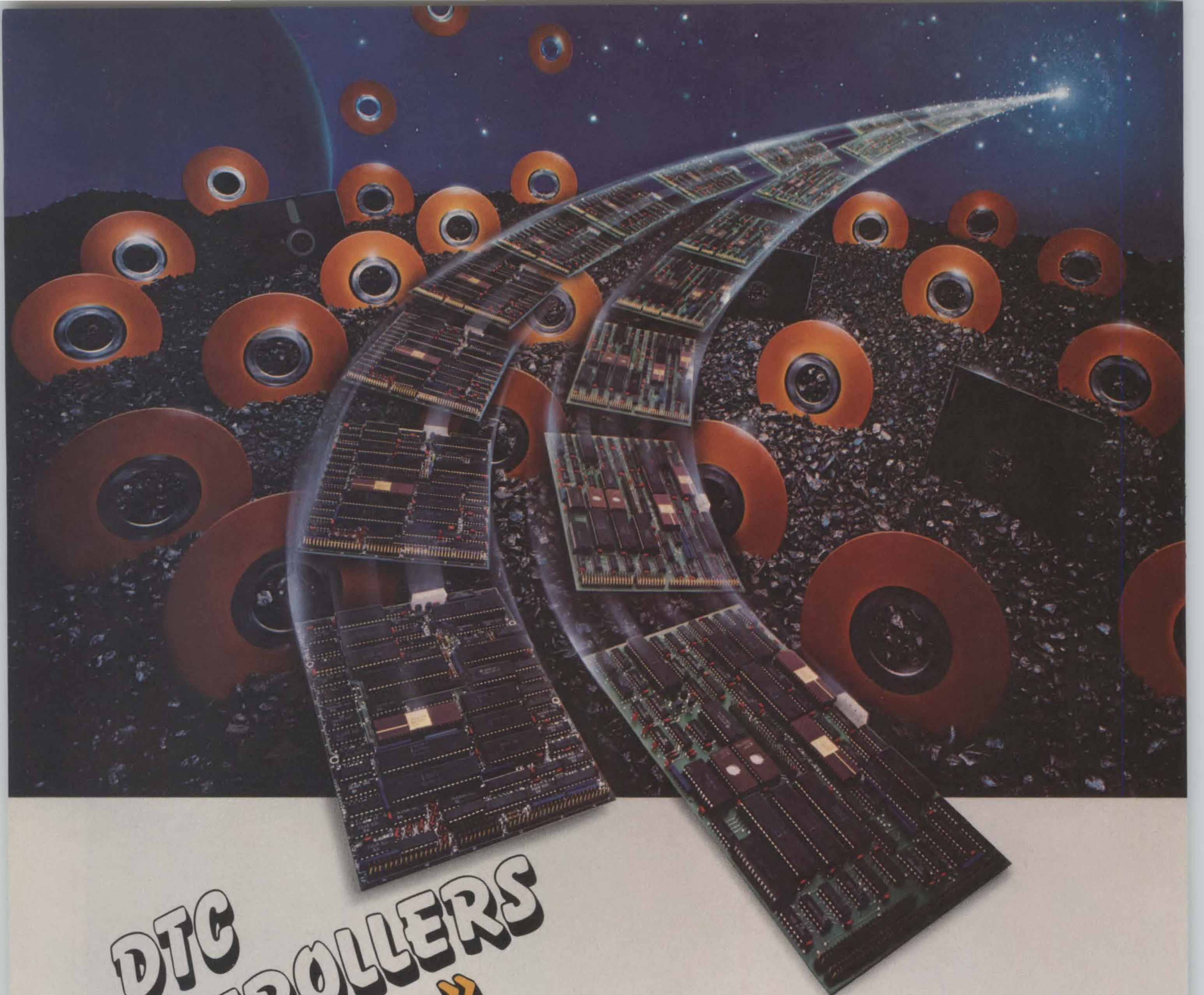

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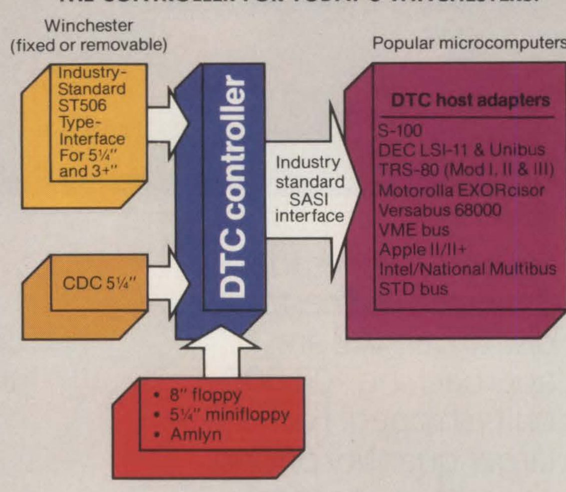

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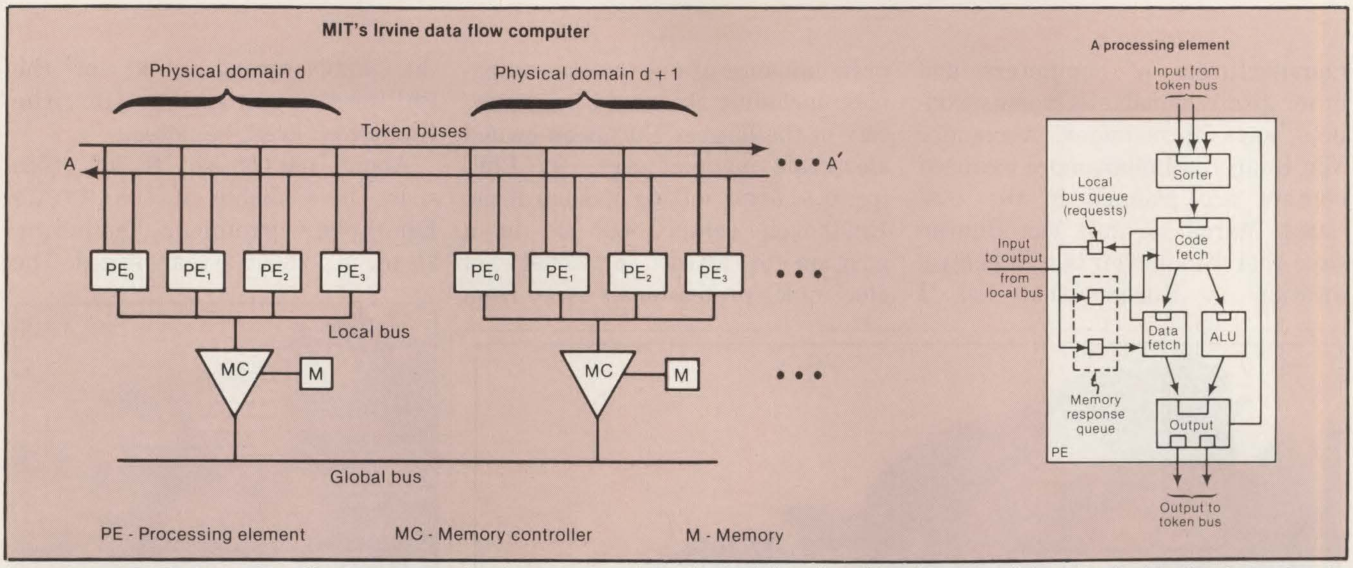

A section of MIT's Irvine Dataflow *computer showing two complete physical domains of hardware modules attached to the ring network. There are two counter-rotating token buses connected at their ends, A and A*[1].

by the processor and the data being executed. The amount of memory will initially be about twice the size needed by a conventional computer for the same application. But the ID machine offers a much higher MIPS processing rate, says Thomas. Memory size ratio is expected to fall to that of conventional computers within as few as 10 years because of the better graph encoding in the ID machine and the tendency to run memory-hungry applications with a high degree of parallelism on conventional machines.

The ID team is simulating the proposed hardware using software on a Digital Equipment Corp. DECsystem 20 mainframe at MIT. The first ID compiler, produced some years ago, took about six weeks to write, using the University of California, Irvine, version of LISP. A new ID compiler written in the MAC LISP developed at MIT will generate object code, first for the DECsystem 20 and later for a powerful simulator to be run on an IBM 370/168 mainframe at IBM's research center at Yorktown Heights, N.Y.

The graph to which ID programs are compiled consists of strings of bits that can comprise operation codes, constants or pointers to the next nodes in the machine. While ID programs will be compiled at first on a conventional computer, they will later be compiled on the dataflow machine using a compiler written in ID, Thomas says.

He underlines the great commercial potential for the ID dataflow computer. "Our aim is to produce a general-purpose computer that can be used for conventional applications as well as scientific," he says. "Operating systems are a subject for future research. I suspect they will be easier to develop than those for conventional computers offering the same functions. In fact, multiprogramming is the default mode on our machine. Data will be uniquely identified, and there will be multiple disconnected graphics in each node."

Thomas acknowledges that similar hardware development is under way at Manchester University in England. Highlighting a major difference between the Manchester and MIT designs, Thomas notes, "We are looking for much less associative memory and will use it only for data that need to be matched associatively—to match input operands to functions."

Although the Manchester team is ahead of MIT with its hardware, it relies on MIT for ID programs to test hardware performance.

Meanwhile, the main thrust of the MIT VAL team is toward hardware optimized for scientific applications. An engineering model employing standard microcomputers to emulate the processing elements is in operation at MIT. The aim is to produce a dataflow supercomputer offering the performance of existing von Neumann-type supercomputers but made of more than 6000 low-cost ICs fabricated in N-Channel MOS or complementary MOS (CMOS) technology.

—Keith Jones

Europe's trade center wants U.S. firms

The first World Trade Center for Electronics opens its doors at the end of September in Eindhoven, the Netherlands, about 100 miles south of Amsterdam. The WTCE, a member of the network of world trade centers established by many major municipalities in the last decade, is symbolized by the organization that occupies the giant twin towers in lower Manhattan. The WTCE is dedicated to promoting manufacturers of computers and other professional electronic products, says its manager, Alexander Van Buuren. Similar, more localized centers are planned in the U.S. (MMS, March, p. 20). Van Buuren says that Eindhoven is in a central location in Europe that has a predominance of electronics companies, including the world headquarters of the largest European-owned electronic manufacturer, NV Philips. U.S. firms setting up shop at the Eindhoven center will be in a position to attract a variety of electronics professionals away from the 35,000-strong ranks of the Philips organization in the Eindhoven area, he notes.

About 400,000 sq. ft. of office space is available at the WTCE's Eindhoven premises, including 30-sq.-m., $6000-a-year offices. The

The first World Trade Center for Electronics, *Eindhoven, the Netherlands, opens its doors in September. Manager Alexander Van Buuren hopes to attract U.S. executives visiting the November Comdex Europe show.*

WTCE provides supporting facilities such as access to Telex machines, photocopiers and secretarial services. Van Buuren believes small firms may be interested in Dutch venture-capital brokers at the complex. Other attractions are the Netherlands' use of English as the main business language and the ability of many staff members to speak German and French.

Van Buuren urges U.S. executives who want to see the facility to take the 90-min. train ride to Eindhoven while they are at the November Comdex show in Amsterdam.

—Keith Jones

NEXT MONTH IN MMS

Two profile surveys will hold the spotlight in the October feature section of Mini-Micro Systems:

- Available add-in memory board products and their vendors will be tabulated and factors analyzed that affect their markets and distribution channels.

Other articles will cover:

- Memory technologies
- Vertical magnetic recording

Letters

OEM PRICING

To the editor:

The July issue included an article about Synfobase, COREM International's back-end database machine (MMS, July, p. 83). While we appreciate the positive response generated by this exposure, we must correct certain errors in the text.

Synfobase's pricing schedule is not yet final, but it will reflect the cost requirements of our OEM affiliates. In keeping with our desire to reduce the cost, COREM will not create user interfaces for each OEM. The complexity of this task will vary with the complexity of each application. We must also note that our standard configuration includes a 5M-byte Winchester (formatted), with 10M bytes optional. A floppy backup is also available.

Sheila Dubman
COREM International, Inc.
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ADA COMPILERS

To the editor:

Telesoft welcomes the story "Western Digital, Telesoft first in market with subset compilers" (MMS, November, 1981, p. 32). Whereas the reporting was generally accurate, we would appreciate correction of several serious misstatements in that article.

First, while true that TeleSoft's Ada compiler does not yet produce code for several of the more complex Ada features, it does indeed handle many of the features needed for abstract data types. The current TeleSoft compiler does not produce executable code for Ada packages (including separate compilation), Ada concurrent tasks, Ada exceptions and much of the overloading facility. The significant major facilities still largely missing are Ada's generics, derived types and operator overloading.

Second, it is extremely misleading to say that Western Digital's MicroAda is an extended version of TeleSoft's compiler. Western Digital was delivered, and licensed to use, a very early version of the TeleSoft compiler. Since that time, TeleSoft has undertaken considerable further development resulting in major additions to its compiler—additions not reflected in the Western Digital product. Contrary to implications of the article, TeleSoft Ada does indeed already compile code for Ada access types, Ada subtypes and text I/O.

Telesoft Ada also implements the Ada predefined type "FLOAT," contrary to the statement about "real numbers." However, the full Ada facility dealing with real numbers is relatively complex and not yet completely defined in the ANSI standardization of Ada. A recent decision in the standardization process appears to have resolved a major controversy over Ada-derived types, thus making it reasonable for implementors to press ahead with the derived-types facility—as TeleSoft is doing.

MMS correctly called attention to the Department of Defense Ada compiler validation tests and their significance in the effort to assure that Ada programs will be truly portable among many different machines. TeleSoft has made extensive use of the validation tests to assure that the portion of Ada already implemented does indeed comply with the language standard. The availability of a comprehensive set of validation tests so early in the implementation of a major programming language is an unusual feature of Ada. TeleSoft has found these tests to be extraordinarily useful.

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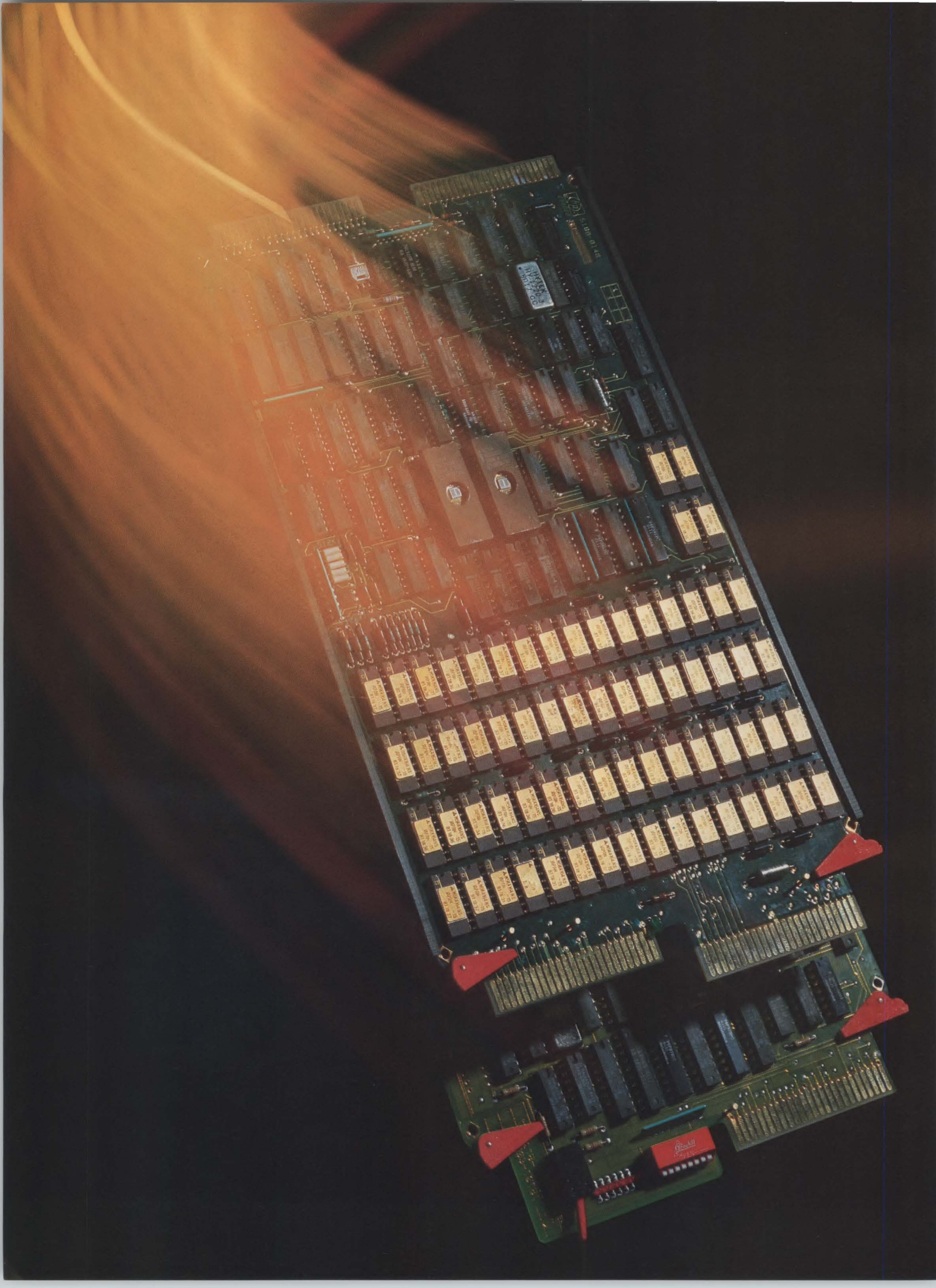

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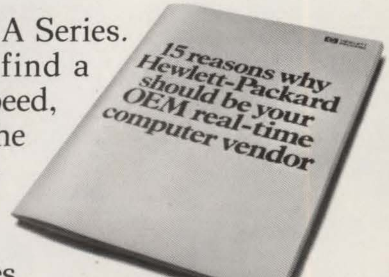

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$$= \sum_{j=1}^{K} X_j^2 V''(\beta_j) + \sum_{\substack{i=1 \\ i \neq j}}^{K} \sum_{j=1}^{K} X_i X_j \operatorname{cov}''(\beta_i, \beta_j) + \sigma^2$$

IBM entry into personal-computer market seen shifting industry focus

By Geoff Lewis
Associate Editor

When IBM Corp. entered the personal-computer market last summer, one waggish commentator observed that for the giant mainframer to master the intricacies of the low-end microcomputer market would be like an elephant learning to dance. A year later, visitors to the demonstration center at IBM PC headquarters in Boca Raton, Fla., are greeted by an IBM PC running a canned color-graphics program showing a Fred Astaire-like pachyderm tap-dancing.

While it might be too much to expect to find IBM's legions of gray pinstripers dancing in the aisles, enthusiasm for the PC is running high at IBM, as the systems move out the doors of computer stores to the tune of 10,000 units per month, according to estimates compiled by Richardson, Texas-based Future Computing. IBM won't confirm those estimates, but readily admits that it underestimated the demand for its PC and is adding manufacturing capacity to catch up with a production shortfall.

IBM competitors and market observers point out that there is a built-in demand among end users for any product bearing the IBM logo, but most concede that IBM has successfully gauged the market, delivering a system that fills the requirement for a "professional" personal computer and developing the third-party distribution strategy required for it. "IBM did it right because it is a marketing-driven company," says Dr. Egil Juliussen of Future Computing.

Not another Hula Hoop

The impact of IBM's success has been manifested in several ways. James Finke, who recently resigned the presidency of Commodore Business Machines, says, "The clichés are right about IBM's legitimizing the market. It makes everybody's business more solid because the public sees the personal computer as part of a real trend and not another Hula Hoop." Finke says IBM's success has convinced other computer manufacturers—including companies such as Digital Equipment Corp., which he says was "sitting on the fence"—to take the plunge into the personal-computing market.

"The perception is that IBM will set the standards," Finke continues, "but it doesn't matter whether they do or not. It's a classic IBM move. They introduced really underwhelming technology and ho-hum packaging, but when you add up the pieces, you come up with something very competent." What IBM is likely to add

Personal computers by stores
(2Q '82—U.S. only)

Computer stores (total) / Personal computers	Apple II	Atari 800	Commodore CBM	HP-85	IBM PC	NEC PC-8001	Osborne I	TRS-80 Model III	Xerox 820	Zenith Z89
Radio Shack (700)	-	-	-	-	-	-	-	700	-	-
Computerland (235)	200	130	65	-	235	-	200	-	150	-
Compushop (17)	17	-	-	-	17	-	-	-	-	-
Xerox stores (40)	40	-	-	-	-	-	40	-	40	-
IBM product centers (18)	-	-	-	-	18	-	-	-	-	-
Sears business systems centers (5)	-	-	-	-	5	5	-	-	-	-
Control Data business centers (35)	-	-	-	-	-	-	-	-	-	-
Heath stores (65)	-	-	-	-	-	-	-	-	-	65
Other stores (1085)	943	235	100	165	50	200	90	-	175	185
Total stores (2200)	1200	365	165	165	325	205	330	700	365	250

Source: Future Computing, Inc.

Who's winning the battle for personal-computer market share can be gauged by the number of outlets carrying a product, *according to Future Computing. But signing stores doesn't guarantee success, Egil Juliussen points out, saying that a survey this year revealed that Xerox's third-party outlets each sold an average of 1.8 820s in a one-month period, while Apple stores averaged 17 system sales over the same period.*

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Data Electronics, Inc.
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Distributed Logic Corp.
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Fujitsu America Inc.
Hazeltine
Hewlett Packard
Integral Data Systems, Inc.
International Memories, Inc.
Iomega Corp.
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Memorex Corporation
Micro Peripherals, Inc.
MiniComputer Technology
Monolithic Systems Corp.
NEC Information Systems, Inc.
Okidata Corporation
Pertec Computer Corp.
Pioneer Magnetics
Plessey Peripheral Systems
PRIAM
Printronix
Quantum
Remex
Rotating Memory Systems
Scientific Micro Systems
Siemans Corporation
SONY Corporation
Tandberg Data, Inc.
TEC, Inc.
TECSTOR, Inc.
TRILOG
Universal Data Systems
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Sept. 28	**Chicago, IL**
Oct. 11	**Westchester, NY**
Nov. 3	**Palo Alto, CA**
Nov. 8	**Denver, CO**
1983	
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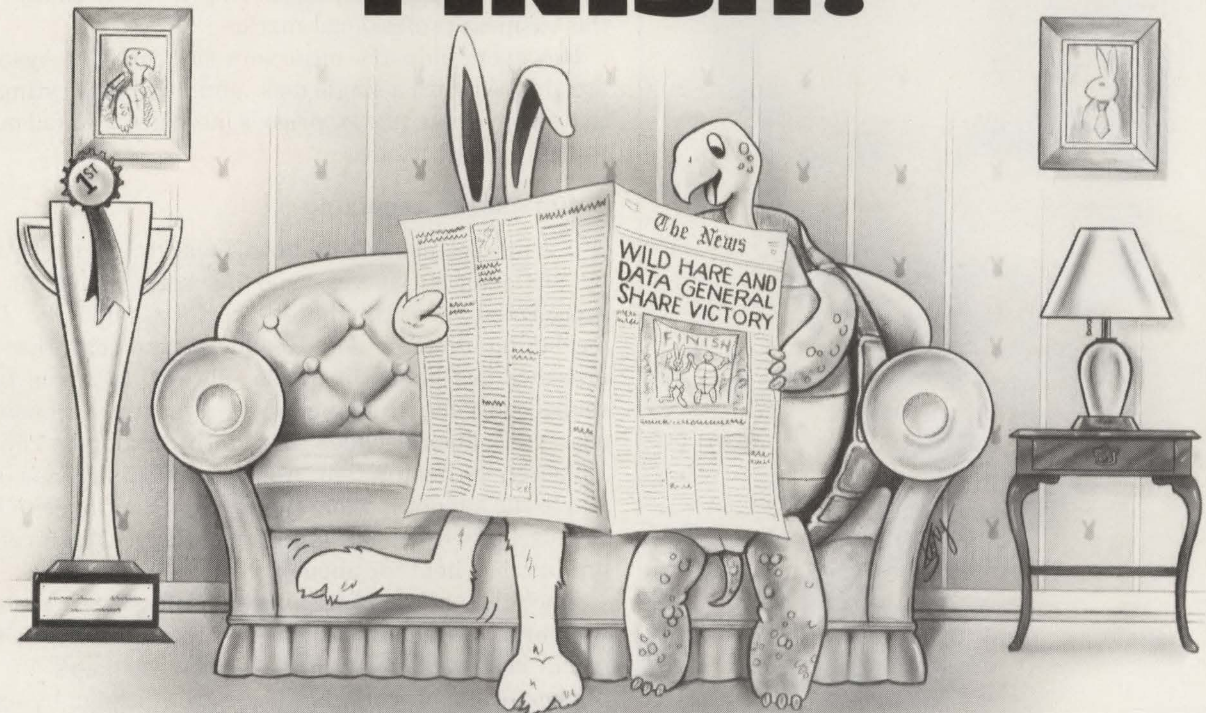

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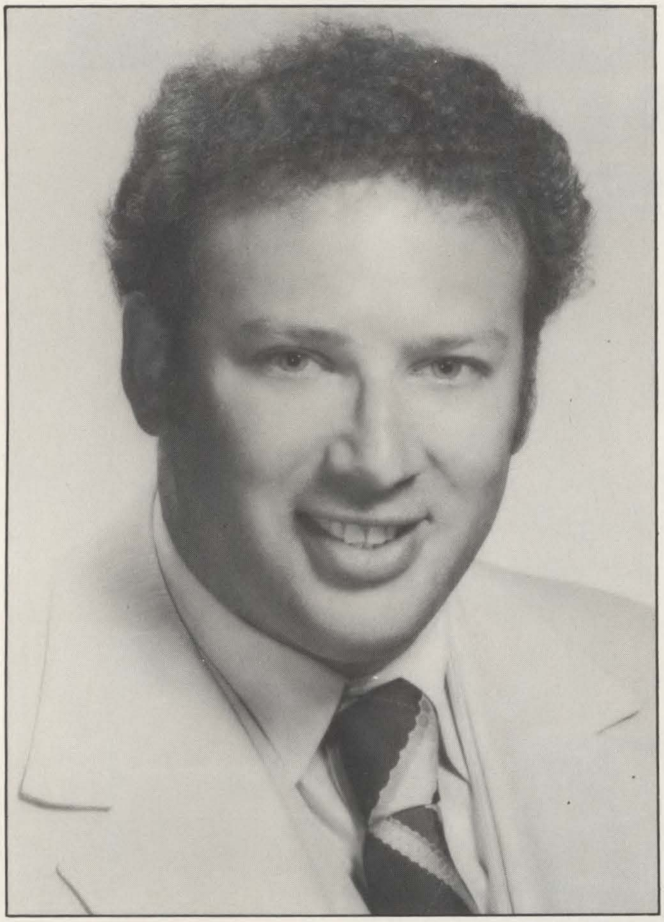

Byte Industries' David Pava *says the performance of personal computers hasn't advanced significantly since the mid-1970s, but he believes vendors have improved product packaging and software to attract small-business and professional users.*

to the industry, Finke says, are standards for product support, software and cosmetics.

These items, says Byte Industries president David Pava, had been sorely lacking in the early years of the personal-computer industry. Pava, whose company has served as both a retailer and distributor of microcomputers and more recently as a franchisor of computer stores, also maintains that the performance of the personal-computing microcomputers has not advanced significantly since the industry's infancy in the mid-1970s. What has changed is the vendors' awareness of issues such as packaging and software as the end-user profile has shifted from the hobbyist to the small businessman or executive within a large company.

Although the IBM product was introduced with a bare-bones configuration using a television display and retailing for less than $1500, the product has sold squarely into the small-business and professional personal-computing segments of the market. As such, it has become somewhat of a measuring stick for other vendors targeting that market. H.L. Sparks, IBM director of PC sales and service, estimates that the average retail price of the IBM PC has been $3000 to $3500 and maybe a little higher." Systems typically include expanded memory (up from the 16K-byte base model), a display and one or two floppy disks, he says, adding that the company recently introduced a standard configuration with 64K bytes of memory, a 320K-byte floppy, a display and a printer for $3695 to fit the business/professional market.

However, industry observers say that few systems are shipped with a single disk, and Juliussen estimates that the average IBM PC price is more likely to fall in the $4000 to $4500 range.

Entire market benefiting

IBM did not pioneer its target market segment, but, by virtue of its success and marketing clout, it has accelerated growth there. Apple Computer, Inc., marketing director Joe Roebuck says that the IBM presence has helped increase sales of its Apple III, a souped-up version of the Apple II geared to business users. Roebuck declines to quantify that growth, but Juliussen estimates that Apple is shipping some 4000 Apple IIIs a month, while the Apple II continues to lead the market with 20,000 units a month—a sales level the product has held for about a year.

Since the arrival of IBM in the professional personal-computer segment, the ranks of competitors in that niche has swollen with both new vendors in the personal-computer market and new offerings by existing players. Some of the significant new entries include Digital Equipment Corp. with its dual-processor Rainbow 100, Victor Business Products with its Intel 8088-based 9000 and Wang Laboratories Inc. with its 8086-based Wang Professional Computer. Established personal-computing and microcomputer vendors have also targeted this market with products such as the Hewlett-Packard Co. HP-86, the Radio Shack model 16, the Commodore Business Machines BX256, the NEC Information Systems Advanced Personal Computer and the Zenith Data Systems Z-100.

How these IBM competitors fare, says Juliussen, will be determined by how well they can exploit the third-party distribution channels needed to get such products to market in high volumes. "Distribution is the crucial aspect of anybody's success, and IBM is the only company that has come into the market with a good plan that has worked," he says.

IBM's ability to formulate an effective retail policy was largely a function of timing. "The company did its homework," Pava says, noting that IBM's PC rollout to retail stores has been closely controlled and reflects an awareness of the successes and failures of other vendors' retail channels.

Michael Shabazian, now vice president of planning and finance at ComputerLand, was one of the imple-

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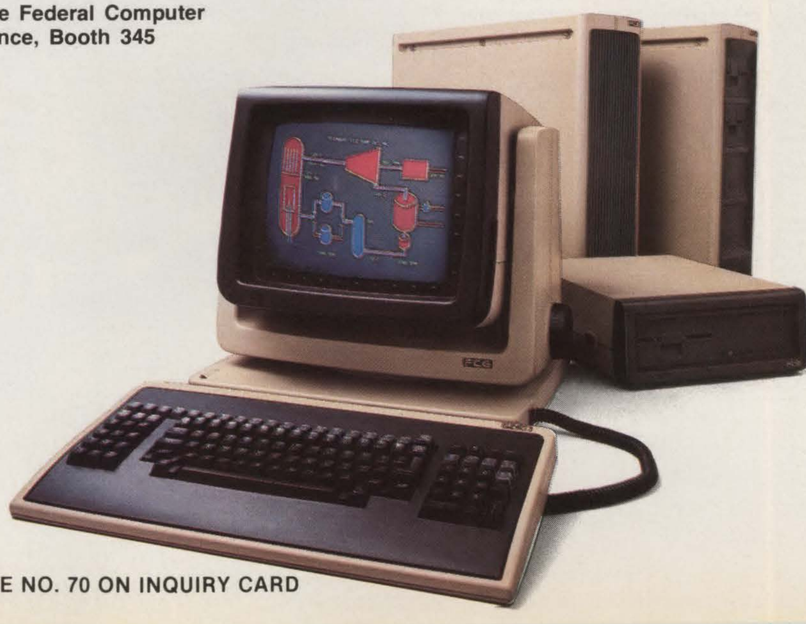

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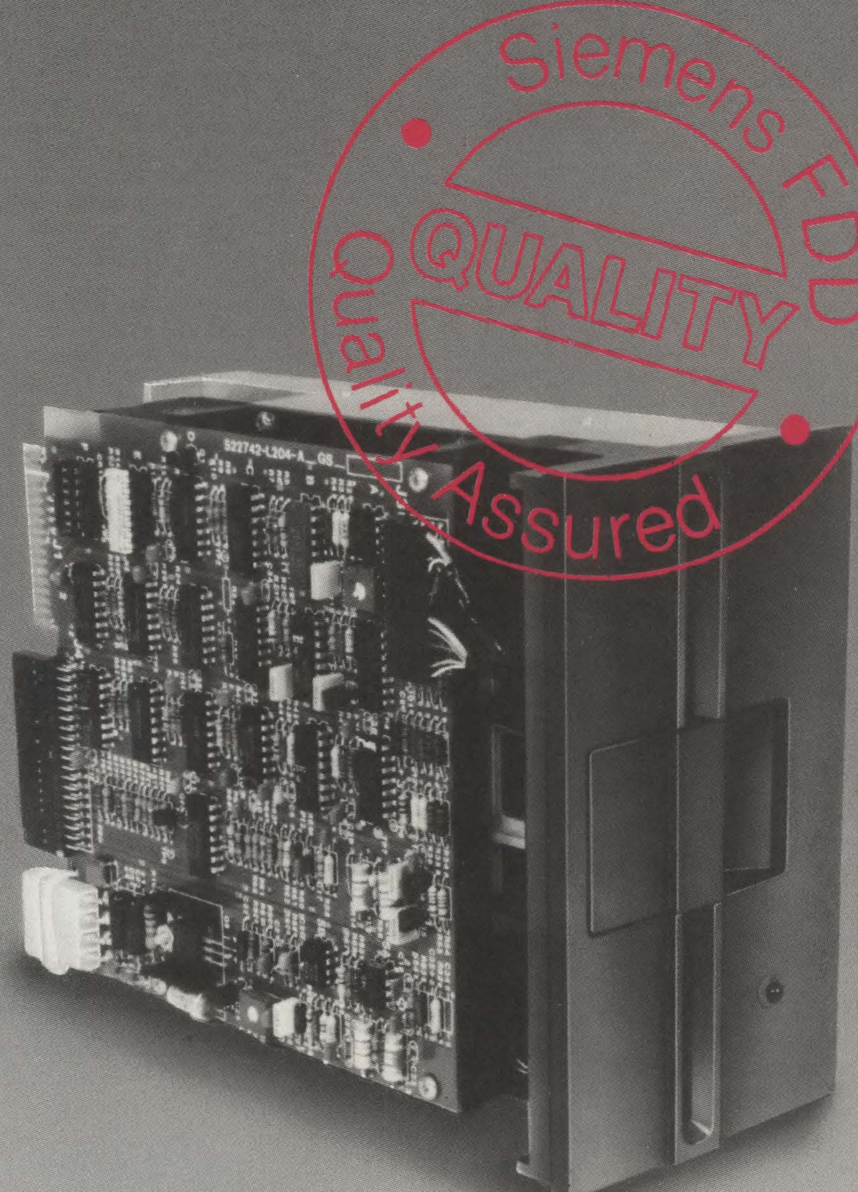

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menters of IBM's retail strategy. Until June, he served as IBM national accounts sales manager for the PC at ComputerLand. Shabazian concedes that IBM, which wanted to serve the "sacred cow" of customer service and support and still play in the microcomputer market, approached third-party distribution apprehensively. However, he points out, by entering the market when it did, IBM could study how the retail channel had developed. "IBM learned from the history of the business and had the advantage of seeing other peoples' experience," Shabazian says. As a result, IBM formulated both product- and channel-management strategies that paid off in the market.

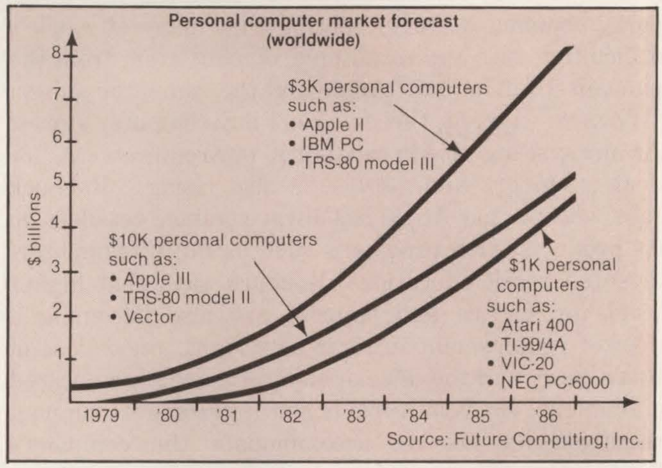
Maintaining the IBM reputation

Shabazian went to work with the ComputerLand headquarters staff in San Leandro, Calif., in April, 1981, five months before the IBM PC was introduced. The objective was to devise methods of delivering the type of pre-sale education and post-sale support and service that IBM customers expected from IBM's sales force. To ensure that the ComputerLand franchises lived up to IBM standards, the manufacturer insisted that store management and service personnel attend IBM training classes. The requirement was enforced in the contract that each store signed with IBM. Each store also was qualified individually, and before it could be certified to carry the IBM product, in-store service personnel had to attend a two-day training course (now extended to three days). The store owner or manager was required to attend product-orientation and marketing training sessions at IBM.

"The objective was not immediate volume, but a carefully planned, phased rollout," Shabazian says. In the year since its introduction, the IBM PC has found its way onto shelves of 235 ComputerLand stores, 17 Compushops, five Sears outlets, 17 IBM product centers and some 80 independent dealers. According to Future Computing's statistics, this compares with 120 outlets for the Apple II and more than 900 stores for the Apple III. Future Computing uses the number of stores through which a product is sold as a rough guide to unit sales, but cautions that a correlation between the two figures is not always valid (see chart, p. (119).

Equally important to IBM's success in the third-party channel is what it did not do. One of the pitfalls it avoided was the two-tier distribution scheme using a national wholesaler as an intermediary between the manufacturer and the dealer. Although Shabazian believes that wholesale distribution must have been considered at IBM, it was decided that IBM had to maintain close ties with the retailers who dealt with the public.

By going directly to its retailers, IBM avoided some of



The IBM Personal Computer has found its way into the mainstream *of the $2000 to $5000 "professional" personal computer market, which Future Computing identifies as the market's largest and fastest growing segment. However, the company describes the $6000 to $10,000 personal computer/very small-business system segment—in which industry observers soon expect to find a hard-disk multi-user IBM PC—as the most "wide open" in terms of market opportunity.*

the perils that have faced both Apple and Xerox. Apple last year found a growing "gray market" for its systems that evolved when excess inventory was sold off by distributors and large dealers. The result was that the Apple II was sold through mail-order houses that undercut authorized Apple dealers. Similarly, Xerox 820s found their way into discount houses that also undersold authorized dealers. Juliussen asserts that as long as distributors allow products to slip into price-cutting mail-order and discount channels, qualified computer retailers won't touch the systems involved.

Dealing with discounters

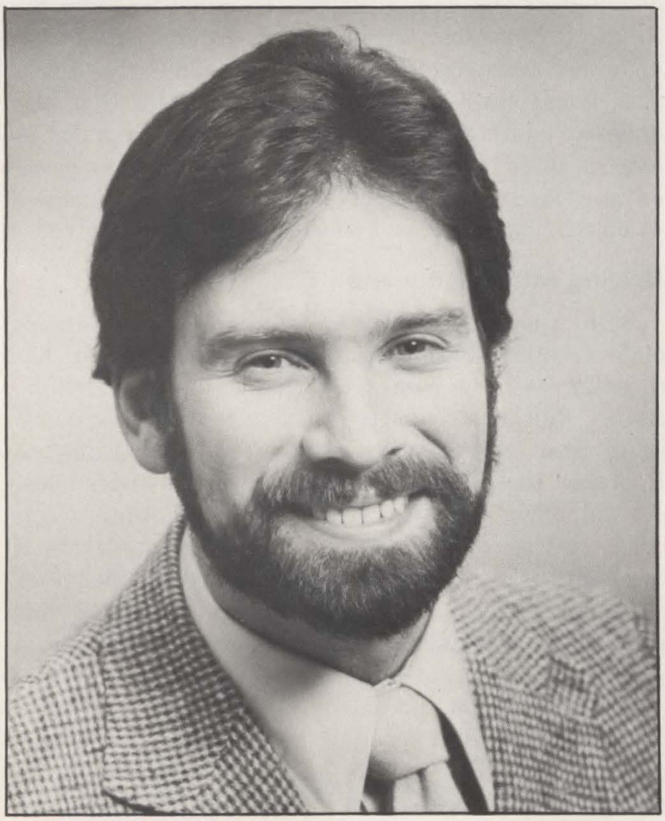
Both Apple and Xerox have taken steps to assure uniform pricing throughout their networks. Xerox has recently ended its contract with distributor Hamilton/Avnet, which was expected to handle $76 million in 820 sales over three years. Apple has, according to Roebuck, successfully eliminated the mail-order houses. But, Pava points out, there are no guarantees that price cutting can be successfully eliminated. "In a free-enterprise system, it is hard to make it illegal for some crazy guy to sell the product at a ridiculously low price," he says, adding that a buyer can still get a 48K-byte Apple II for less than dealer cost.

William Barton, president of Datel, a New York computer retailer expecting to add the IBM PC this month, says, "Discounting has been prevalent in the market for two years. IBM is a product that won't be discounted, and that's very important to me." Barton expects to sell twice as many IBM PCs as Apples.

Apple's Roebuck disagrees with the contention that

IBM is setting any standards for handling the third-party channel, however, noting that many of Apple's difficulties with the retail environment stem from the pioneer status of both Apple and the computer stores. "When we started, there weren't any computer stores. As our systems rise in capability, our requirements for dealer support and service is also rising," Roebuck says, adding that Apple has always trained retailers on its products with programs such as CORE (computer-oriented retail education). Roebuck says that higher levels of service and support are also becoming a market requirement in their own right, regardless of IBM's entry and the development of more sophisticated equipment. He says Apple is not upgrading its support requirements just to accommodate the company's forthcoming Lisa small-business microcomputer. "If we never even have another product, we'd have to deliver service and installation support," he explains, adding that the need for such support can be traced to the growing number of first-time users coming into the market since IBM "blessed" the personal-computer concept.

"You have to make sure you have a full-service organization to supply the proper support for these systems," says Robert Reid, vice president of marketing for Zenith, which recently launched a dual-processor Z100 to compete in the IBM/Apple III arena. The Intel 8085/88-based system lists for $4099 in a dual-floppy version with a built-in monitor and 128K bytes of RAM, but the product sells for $3249 in a single-disk configuration without display.



Zenith's Robert Reid *says the company is adding small regional distributors that are expected to sign experienced computer dealers. The manufacturer also offers on-site service contracts, an unusual option for personal-computer owners.*

Rising support/service levels

Zenith, Reid notes, dropped its agreement with distributor Leading Edge in favor of smaller, regional distributors, which are seen as better able to sign experienced computer dealers. To compete with IBM, he says, "We'll have to provide even better training and support." That effort is being aided by the addition of marketing support representatives who go into the field to work with dealers.

A support innovation Zenith claims to have introduced into the market is third-party on-site service. Starting two years ago, Zenith signed 300 independent service organizations to provide on-site repairs. "In a business application, if the system goes down, it is just like what happens when your copier or typewriter breaks: somebody should come in and fix it," he says, adding that both Apple and IBM rely on carry-in service. An annual service contract generally runs 12 to 15 percent of the system's purchase price, Zenith says.

Another competitor in the business-oriented personal-computer market that boasts a long track record with independent dealers is Victor Business Products, the Chicago-based Kidde, Inc., subsidiary that entered the microcomputer market with the 8088-based Victor 9000 manufactured by Sirius Computer. The system is aimed at business users and has an entry-level price of $4995, including dual floppies. Victor, which has sold desk-top and programmable calculators through dealers in the past, has signed some 300 dealers for the 9000 and expects to have 500 in place by year-end. Computer marketing director Roy McIlwaine says the company does not plan to use retail computer stores and will stick with its dealers, most of which have sold small-business systems in the past, and which Victor sees as more able to provide a "solutions sell." Only about 25 percent of the dealer base has been culled from among the Victor calculator dealers that the company deemed "upgradeable" for computer sales.

Although Victor has specialized with some small-business vertical applications such as those for pharmacies and office-equipment dealers, McIlwaine says, the company is also aiming its products at the Fortune 1000 major accounts market in which its calculators are widely used. "IBM has made it possible for corporate MIS (management-information system) people to look at personal computers, and they look at us because we have the communications protocols that IBM doesn't

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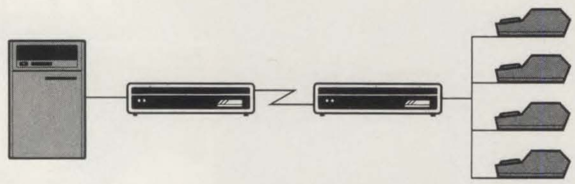

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have running yet," he says.

New progams emerging

The demand for quality third-party distribution is getting more critical throughout the industry, and new programs by major suppliers are emerging to ensure that products are properly supported. Kent Henscheid, product manager for HP's personal-computer division, says, "We want to make sure the local dealer can supply face-to-face support." The division recently implemented a new dealer policy that is designed to encourage individual small-business sales of HP products such as the new HP-86. Under the new policy, the company eliminates volume-purchase incentives for dealers so that they will concentrate on small-volume customers. The company discourages mail-order sales, but offers more dealer training and is starting a pilot program that would enable some dealers to perform service in their stores.

Finke, who resigned his post at Commodore over a dispute about third-party retailing policies, sees a need for a "high-level chain of computer stores." Finke says, "ComputerLand franchises do a good job, but they are very independent. There isn't a chain out there with a consistent level of support." Finke plans, therefore, to establish a new chain that will comprise existing, successful stores. The parent company would buy the dealers with a half-cash, half-stock deal. Store owners would get a management contract to stay on as managers. Finke plans to provide a one-month training course for managers to update them on the products that the chain handles and will require each store to install a learning center for customer training.

Pava agrees that an upgraded computer retailing environment is required to keep the industry healthy and to support the growing number of business users. "You've got to be able to supply a competent sales person to help select the equipment, and you need the capability to provide after-market support, advice, education and training. If you sell a product at the fully loaded retail price, you can afford to offer the pre-sale support profitably, but you've got to charge for post-sale support." He says chains of retail stores will be an important factor in getting products into customers' hands in a responsible way, but adds, "Imposing order on the process will take a cooperative effort by both the manufacturers and the distributors." ■

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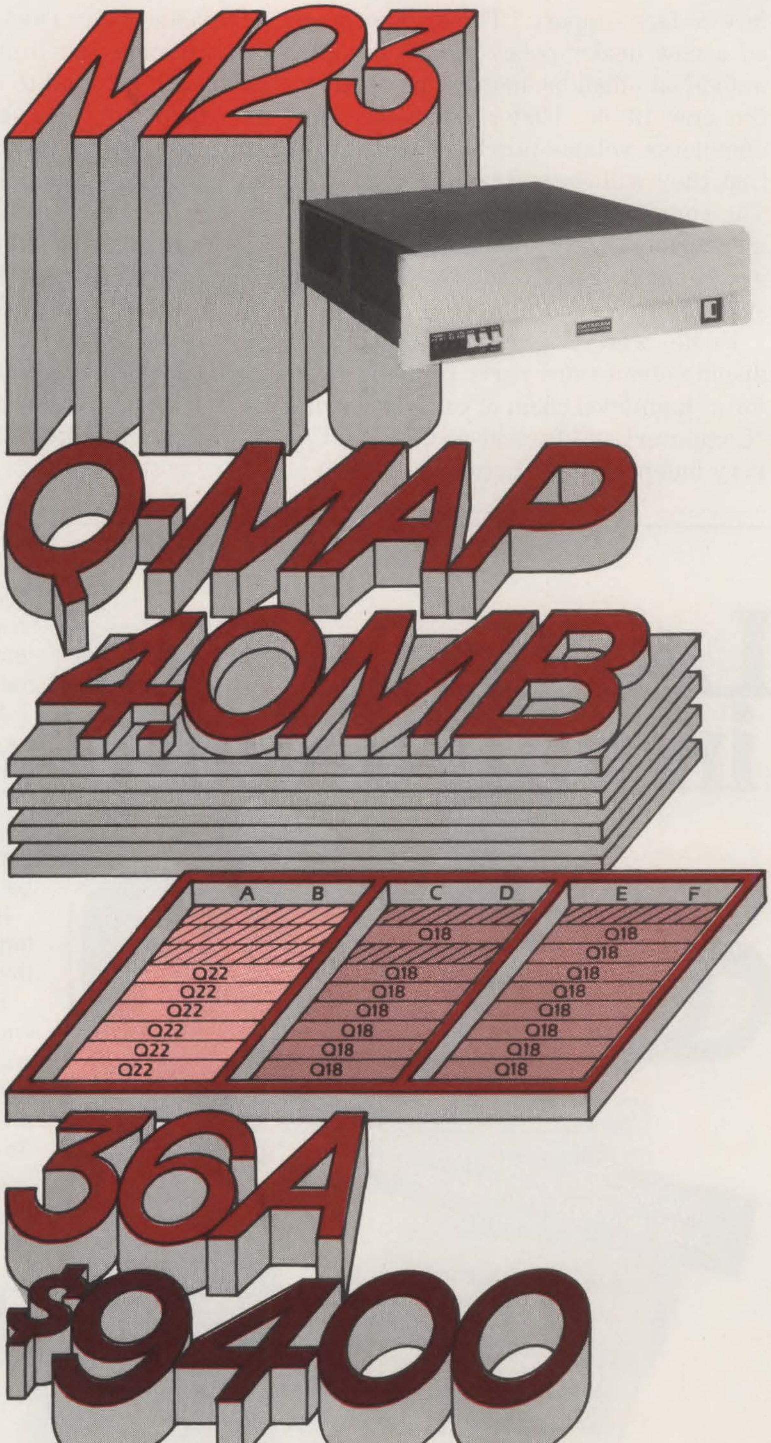


DATARAM CORPORATION

CIRCLE NO. 58 ON INQUIRY CARD

Thin-film heads two years out, say OEM Winchester makers

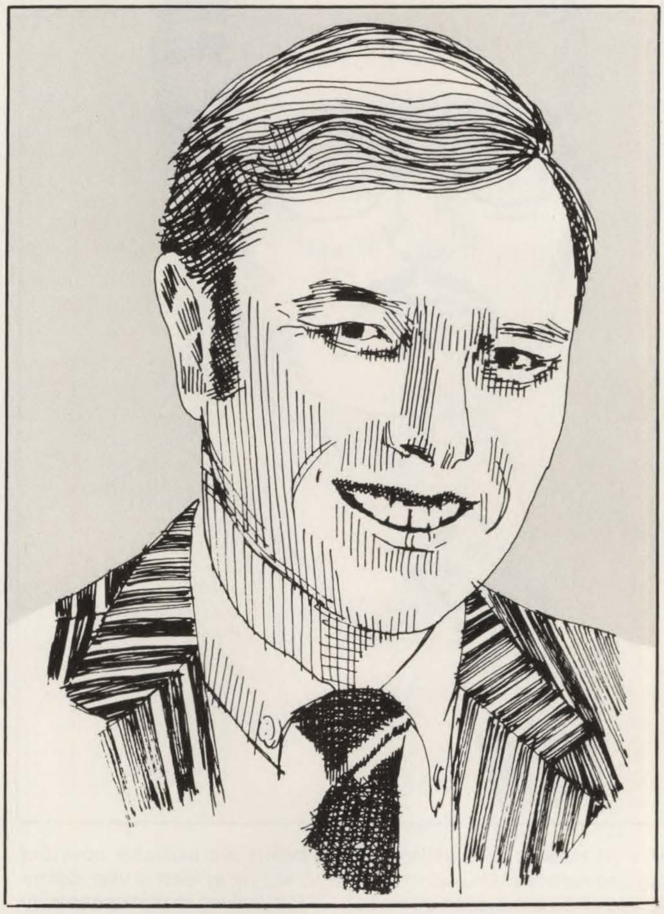
by John Trifari
West Coast Bureau Manager

High-performance thin-film read/write heads, despite their ability to easily resolve bit densities in excess of 10,000 flux changes per in. (fcpi) have lost some of their luster in the eyes of OEM 5¼-in. Winchester vendors. Many feel it could be several years before production quantities are available and this technology reappears as a consideration in the design of small, high-capacity rigid-disk drives.

Proponents of thin-film read/write heads do have technology on their side. Conventional ferrite heads such as those used in most Winchester disk drives lose their ability to resolve data as flux densities pass 10,000 fcpi. Thin-film heads, manufactured with semiconductor-like optical techniques, have a much higher frequency response and exhibit superior flying characteristics at low-flying heights. As a result, these heads may eventually permit drive designers to build Winchesters with bit densities two to three times higher than those available on the market today—at the low costs associated with large-scale semiconductor runs. Future bit densities could increase still further through the use of thin-film media, which, like thin-film heads, is produced with semiconductor methods. Both thin-film heads and media are available today, but no single drive yet incorporates both technologies.

The high areal densities and low costs associated with thin-film technology are particularly attractive to designers of 5¼-in. Winchesters, given the large market projected for this hardware. Designers planning high-capacity drives of this size, however, are constrained by a set of envelope dimensions derived from 1M-byte floppy-disk drives and by spindle height—both of which limit the number of platters that can be incorporated into a drive. As a result, technologies such as thin-film read/write heads that can effectively increase data storage per disk surface are becoming increasingly attractive.

But although thin-film heads have the potential to deliver the high areal densities designers need, prevailing opinion among OEM Winchester vendors is that the definite arrival time for thin-film head proliferation is uncertain. Many companies planning high-capacity drives this year and next are actively exploring other ways to support high areal densities on small drives. In some cases—for example, at Evotek Corp., Fremont, Calif., International Memories, Inc., Cupertino, Calif., and Texas Instruments Inc., Houston—this issue has been settled for the time being in favor of thin-film media, rather than thin-film heads.

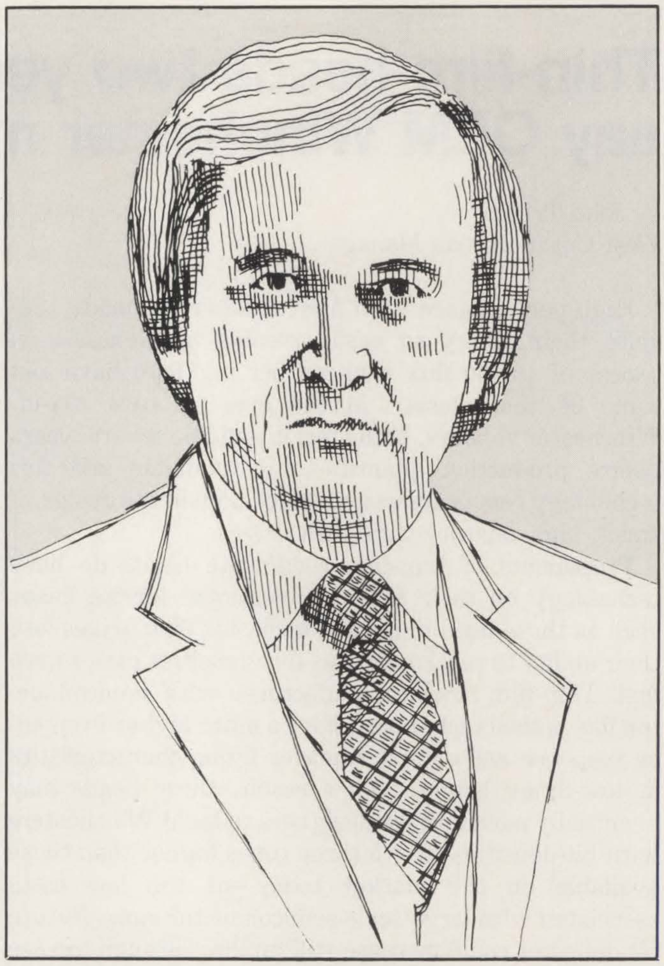


Maxtor's Jim McCoy: *"The reset button has been pushed on thin-film head technology. In its place, head vendors have come up with new ferrite designs that will easily match the present-day specifications and performance claimed for thin-film heads at a far lower cost." McCoy and three others recently announced the formation of Maxtor and their intention to build 5¼-in. Winchesters in the higher than 50M-byte range.*

At other companies looking at higher capacity hardware some consideration is being given to vertical recording techniques, where data is stored perpendicularly to the plane of the media, despite the fact that they remain unproven in any disk-drive market (MMS, September, 1981, p. 163). Meanwhile, almost all OEM vendors of small Winchesters are moving rapidly to incorporate higher performance ferrite heads into their hardware regardless of its capacity.

"As far as OEM Winchester suppliers are concerned, the reset button has been pushed on thin-film head technology," says James McCoy, former Menlo Park,

IMI's Al Hasler: *"Evaluation thin-film heads are available now, but they are inconsistent and expensive. It will be at least a year before we see small production quantities." IMI is looking to higher capacity small drives using a combination of thin-film media and manganese-zinc ferrite heads.*



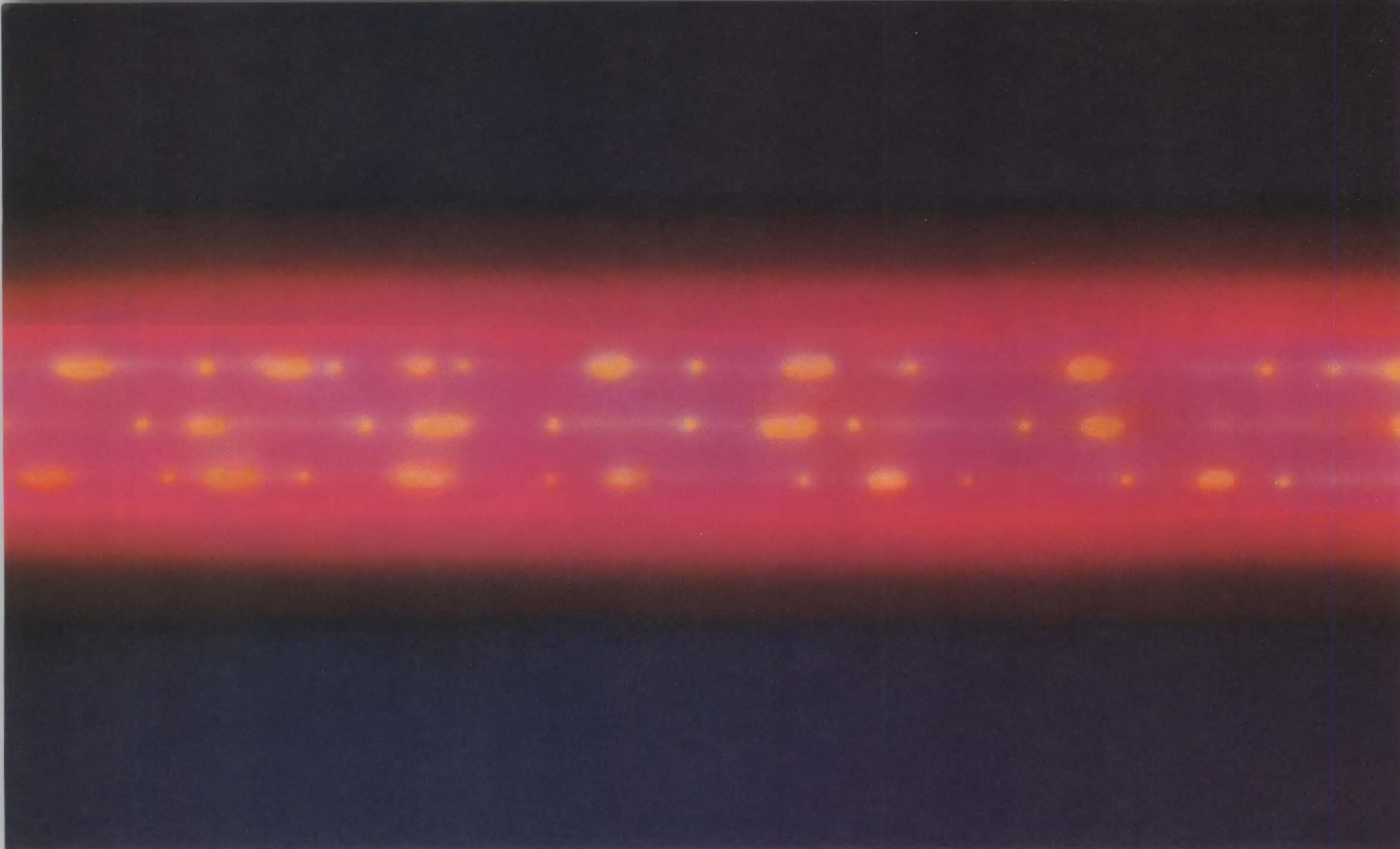
Seagate's Finis Conner: *"We believe that thin-film heads will ultimately find widespread use in small Winchesters, but before we use them, we must be assured we can get the volumes we need at a competitive cost." Seagate's decision to drop the ST-512, the first small Winchester to use thin-film read/write heads, is cited by many in the industry as impacting the application of this technology to 5¼-in. rigid drives.*

Calif., industry analyst and now president of Maxtor Corp., a Santa Clara, Calif., start-up that this year plans to announce a series of high-capacity 5¼-in. Winchesters. "In its place, head vendors have come up with new ferrite designs that will easily match the present-day specifications and performance claimed for thin-film heads at a far lower cost."

According to McCoy, thin-film head technology may not be a major factor in the OEM disk-drive business for another two years, and many OEM disk-drive executives agree. "The industry is moving rapidly to 3370-class flexture arms with mini ferrite sliders or two-rail mini composite heads," says Al Hasler, IMI co-founder and engineering vice president. "Evaluation thin-film heads are available now, but they are inconsistent and expensive. It will be at least a year before we will see small production quantities."

Finis Conner, executive vice president and co-founder of Seagate Technology, the Scotts Valley, Calif., firm that pioneered the 5¼-in. Winchester, also feels that thin-film head technology still has a way to go before it can become a factor in the design of these compact drives. "We believe that thin-film heads will ultimately find widespread use in small Winchesters," he says, "but before we use them, we must be assured that we can get the volumes we need at a competitive cost." If thin-film heads are available in quantity, he goes on, "We'll use them like anyone else, but I'm not holding my breath."

Many view Seagate's current wariness as a major setback to thin-film head vendors, given the company's preeminent position in the OEM 5¼-in. Winchester market and its earlier enthusiastic espousal of thin-film head technology. In early 1981, for example, it announced the 12M-byte ST-512, the first small Winchester to use thin-film heads (MMS, April, 1981, p.



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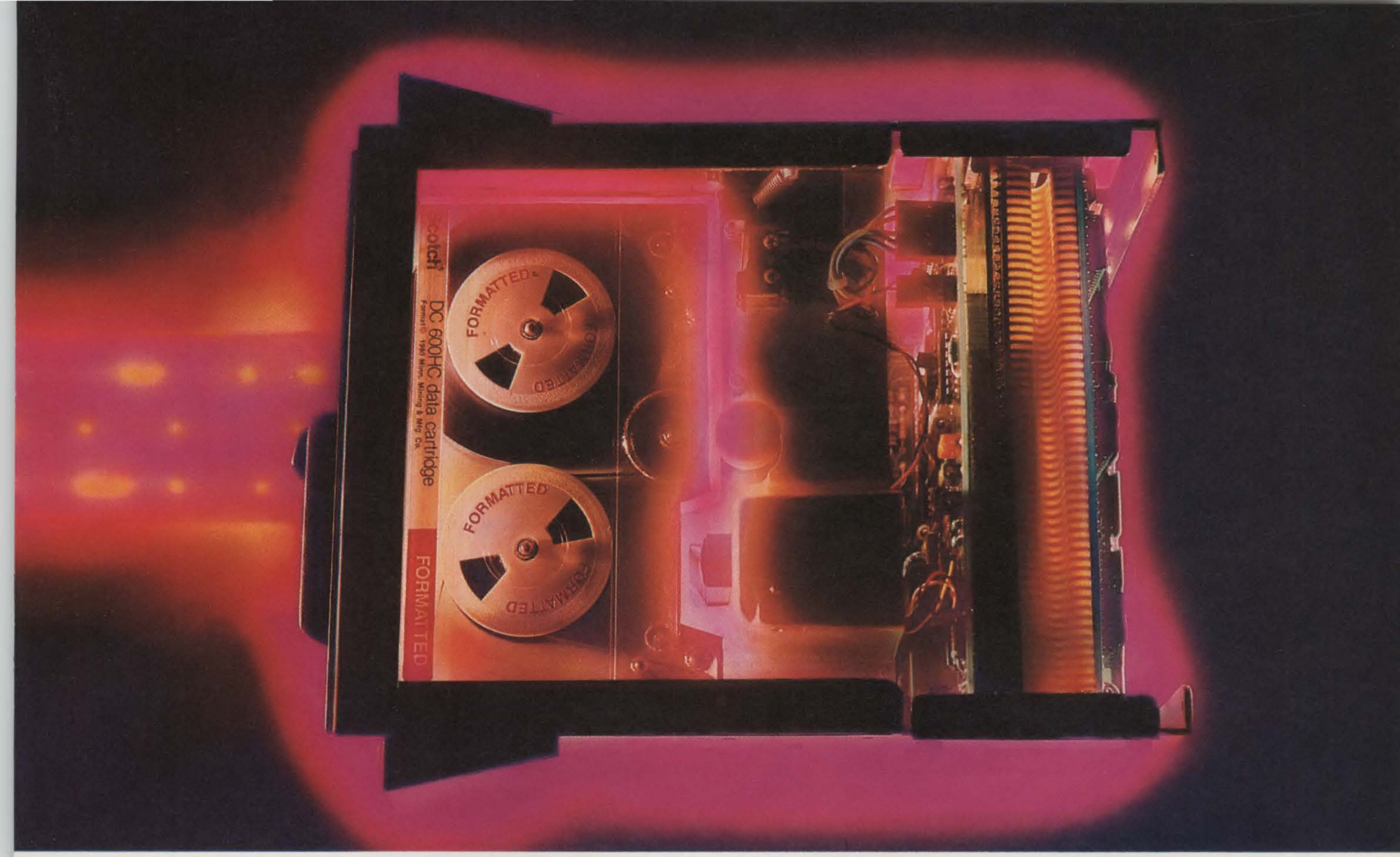

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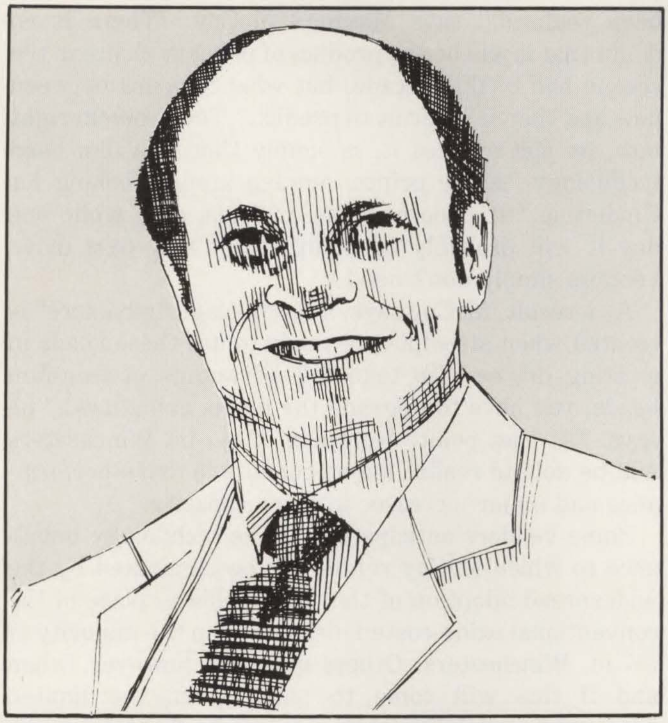


Cybernex's Bill Klein: *"There is no longer any argument over the advantages of (thin-film) heads. The challenge now is to show that they can be made in quantity." Klein feels that this technology will arrive in the OEM market sooner than people think, and says his company will be producing large-scale evaluation quantities by early next year.*

135), and as late as last fall, it was anticipating the announcement of two more 5¼-in. thin-film drives—a 38M-byte, fixed-disk Winchester and a 6M-byte, disk-cartridge drive (MMS, November, 1981, p. 46).

The ST-512 was abruptly canceled early this year due to a combination of factors that included the inability of Seagate's sole source for thin-film heads, Dastek Corp., Los Gatos, Calif., to produce heads that were cost competitive with advanced ferrite designs. It is anticipated that the 6M-byte ST-706 disk-cartridge drive will be announced at Comdex this fall with conventional read/write heads. The fate of the ST-538 remains uncertain. Seagate has since moved quickly to correct any damage caused by a lack of competitively priced heads in large volume. At the same time that it announced the cancellation of the ST-512, the company unveiled the ST-412, a 12M-byte drive using manganese-zinc ferrite composite heads (MMS, January, p. 17). Seagate subsequently announced a 6M-byte version of this drive, and a three-platter, 19M-byte model.

"When Seagate gave up," says IMI's Hasler, "everyone else down the line did the same," a thought echoed by one thin-film head vendor. "Since Seagate bailed out, interest in applying thin-film head technology to 5¼-in. Winchesters has waned," says Joe Crespo, marketing vice president at Magnex Corp., San Jose, Calif. "For the OEM market, we have to get the price down, and we don't think that will happen until late 1983."

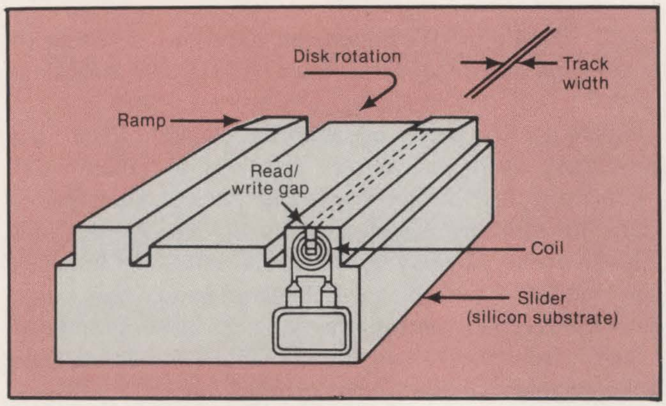
Getting the price of thin-film heads down and producing them in volume are key to selling this technology to OEMs, agrees Bill Klein, president of thin-film start-up Cybernex Corp., San Jose, Calif. Klein believes, however, that OEM drive vendors will use thin-film heads sooner than some people think, and says his company already has a substantial number of orders from drive vendors. Klein, expecting the announcement of 5¼-in. drives in the 50M- to 100M-byte range by year-end and 200M-byte drives by the end of next year, is planning early 1983 shipments at 50,000-lot prices ranging from $35 to $65, depending upon performance specifications. Large-scale production runs are set for later that year, he says.

For the moment, though, it appears that most drive vendors think no head vendor will for some time be able to meet production demand for these heads at a price that OEM drive vendors can afford. One reason: thin-film head manufacturing yields have not been anywhere near what they had to be, and, as a result, single-unit costs were (and still are) high. "Almost anyone can build prototype heads, and manufacture 50 per week," says an executive at one thin-film head vendor. "But to build them in volume is another matter."

At the 5-percent yield not uncommon during 1981, thin-film heads cost $95 each, he says. To be competitive with present-day ferrite heads, however, thin-film heads must cost less than $20 in volume. The rewards awaiting head vendors that succeed in this quest can be substantial, he says. "If you can get the process down pat and push yields to the 40-percent range, you can laugh all the way to the bank. Thin-film technology is the only way to build cheap, cheap heads."

Thin-film head yields at Dastek directly impacted pricing to Seagate, says one industry source, adding, "When it came to supplying the low-end Winchester market, Dastek could not price these components low enough to compete with more advanced ferrite heads." One cause of lower yields at Dastek at the time was the semiconductor process being used, concedes marketing vice president Arnold Cooley. "We didn't fully understand what was involved," he says, without further elaboration, "but we've finally got the process down, and we expect to be shipping double-layer (dual eight-turn) heads to the OEM and PCM plug-compatible manufacturer markets by the end of the year."

Increasing the number of turns in a thin-film head complicates the vendors' problems. As the number of turns increases, explains Oz Fundingsland, sales vice president at Applied Magnetics Corp., Goleta, Calif.,



Thin-film technology head: *inverted view of two-rail thin-film device shows coil and gap at rear of slider. The device is made using a semiconductor process that integrates the metallic windings and core directly into a silicon substrate.*

the manufacturing process becomes more complex, and yields decrease. To resolve data, he explains, heads designed for small drives must have more turns than heads aimed at 14-in. hardware. "A 5¼-in. disk moves at a slower speed under the head compared to a 14-in. disk, assuming both are spinning at the same rpm." As a result, he goes on, signal amplitudes decline. "A single-layer, eight-turn head that gives a good 300- to 450-μV signal on a 14-in. drive—more than enough to read data—may only produce a 100-μV signal on a 5¼-in. drive—not enough to separate the signal from the noise," he explains. Adding turns increases the ability of these heads to resolve data, he says, but complicates the manufacturing process, making dual-layer heads such as those planned by Dastek more attractive. AMC started sampling dual eight-turn heads during the second quarter of this year.

Another contributor to lower yields are the mechanical processes involved in machining the completed head wafers—a problem Dastek encountered as it geared up to produce heads for Seagate. "At the time, we didn't have the high-volume mechanical capabilities to do things like slice the heads," Cooley explains. He notes this is no longer the case, and says Dastek is shipping more than 2000 heads per month, some of which are being sent to a San Jose OEM spin-off set up to manufacture and market the head maker's line of 400M-byte, 14-in. OEM thin-film Winchesters. "We're satisfied that we can be commercially successful next year," he says of the future. Of the past, he says simply, "Dastek and Seagate didn't put enough thought into the decision to put thin-film heads into a low-capacity drive."

But while Seagate's defection from the thin-film head camp is perhaps the most dramatic setback the industry encountered during 1981, it is not the only reason why OEM acceptance of this technology may be further delayed. "The promise of thin-film heads has not yet been realized," says Maxtor's McCoy. "There is no doubt that it will be the product of primary choice in the second half of this decade, but what happens between now and then is difficult to predict." The problem right now, as McCoy sees it, is simply that thin-film head technology "is the prince running around looking for Cinderella." It's too new, he explains, and, while one day it will probably catch up, right now OEM drive vendors simply don't need it.

As a result, McCoy says, a "technologic imbalance" is created when attempts are made to use these heads in existing drives. "To take full advantage of thin-film heads, you have to upgrade the media being used," he says. "At that point, designers of 5¼-in. Winchesters will be able to realize major benefits in drive performance and major increases in drive capacity."

Some vendors anticipate that the technology imbalance to which McCoy refers will be eliminated by the widespread adoption of thin-film media in place of the conventional oxide-coated disks used on the majority of 5¼-in. Winchesters. Others question, however, when and if this will come to pass, given the limited production capability that now exists for this media compared to that already in place for conventional oxide-coated disks. Only two manufacturers—Ampex Corp., Redwood City, Calif., and Poly Disk Systems, Inc., Torrance, Calif.—sell thin-film disks in any volume. Seagate co-founder Al Shugart estimates the two manufacturers' combined production capacity is only about 60,000 platters per year, which is nowhere near enough to meet potential demand, he says. Shugart anticipates that thin-film media could become widely used in disk drives supplied by his company—especially in the ST-706 5¼-in. Winchester due for announcement this fall.

Other vendors look to vertical recording as the natural partner of thin-film heads. When this technology will appear is also an open question. Only one U.S. company, San Jose-based Lanx Corp. (MMS, September, 1981, p. 163), has announced plans to offer media capable of supporting vertical recording in small rigid drives. Vertimag Systems, Inc., Minneapolis, which plans prototypes of flexible media using vertical recording, may also offer a rigid product, however. "Lanx is coming in sooner than people expect," says Tim Martin, president of CenStor, Inc., a San Jose start-up founded to build single-pole thin-film read/write heads similar to those proposed by several Japanese designers for use with vertical recording. "We plan to have these heads available in 1984." Lanx demonstrated 5¼-in. media capable of operating at 15,000 to 20,000 fcpi using head flying at 20 μin. at this year's NCC show in Houston.

Klein at Cybernex also sees vertical recording

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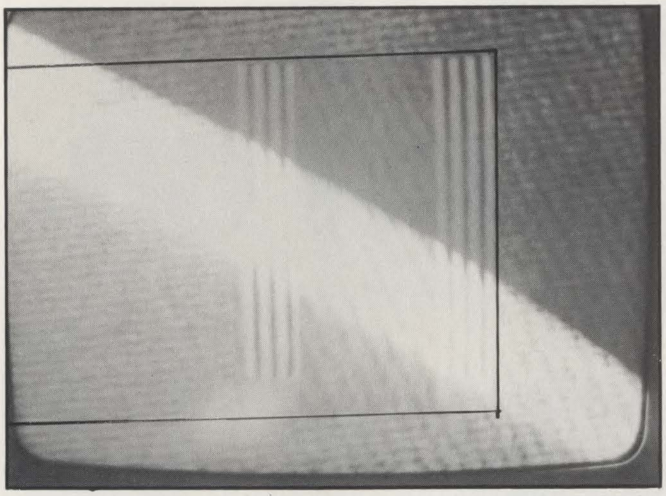

Microscopic look at a thin-film head undergoing a flatness check. *Area within black border shows the leading edge of one of the two rails on the thin-film slider. Each vertical black line is approximately 10 μin. wide—a little less than the height these heads fly off the surface of the disk. Area within the border is about 1/10 the total surface area of the head. (Photo courtesy of Cybernex Corp.)*

techniques incorporated into small drives, but feels that it will not live up to potential until it is used in conjunction with thin-film heads. "When people discuss vertical recording, they start talking about flux densities in the 40,000- to 50,000-fcpi range," he says. "If you want to operate at these densities, you must use thin-film heads." Klein predicts that drives combining vertical recording with thin-film heads will appear in 1985. He says drives combining thin-film heads and thin-film media will appear first, however, and that some of this hardware could show up this fall at Comdex.

The prospects for the widespread application of thin-film read/write head technology to small Winchesters are also reflected in the relationship that has existed for a number of years between the OEM drive industry and vendors building hardware for the IBM plug-compatible market. But the jury is still out as to what extent success in applying thin-film heads to 5¼-in. Winchesters is related to the success of vendors such as Control Data Corp., Memorex Corp. and Storage Technology Corp. in selling PCM drives.

Traditionally, the application of much of the technology adopted by these plug-compatible vendors has subsequently been used in the OEM market since IBM had already proven it and had created a customer base. Moreover, by the time these technologies got to the OEM market, the PCM vendors also had a track record with them, and as a result of the demand they created, a sub-industry of independent vendors had sprung up, making key elements of the technology available at prices OEMs could afford. Such has been the case with the oxide-coated media and nickel-zinc ferrite heads first used on 14-in. Winchester disk drives. This common scenario to a great extent explains why thin-film media has not met with the widespread acceptance that many feel is its due (IBM Corp. never made a Winchester with thin-film media; hence, there never were any PCM thin-film media drives).

Despite the announcement by IBM two years ago of the 600M-byte 3370—the first drive to incorporate thin-film read/write heads—these heads have not quite followed the PCM-to-OEM pattern. For starters, the 14-in. 3370 has not prompted an active domestic PCM business (only Storage Technology Corp., Louisville, Colo., has announced such a device), despite the fairly large number of 3370s that have been installed. "The PCM market isn't interested in the 3370," explains AMC's Fundingsland. "People were waiting for the higher capacity (1G-byte) 3380." The 3380, however, has been delayed, and, as a result, PCM efforts have been pushed back.

Also, what 3380 PCM efforts are under way at this time involve in-house development of thin-film read/write heads, a move some observers see as further cutting into the potential market for independent third-party vendors. Coupled to this is a lack of any OEM standard for thin-film heads—even though OEM vendors have shown a propensity for moving away from dependence on IBM standards (the 5¼-in. Winchester is itself perhaps the best example of this). "When Storage Tech, Memorex and CDC come up to speed with PCM offerings," says Jim Money, a former co-founder of Dastek, "we'll see more OEM drives." But the PCM market, he says, will take at least a year to mature.

Dastek's Cooley, however, anticipates that the OEM market will support thin-film head development on its own. "Dependence on IBM technology is important," he says, "but OEMs think differently. We plan to ship a lot of heads to that market." As far as PCM vendors are concerned, Cooley goes on, he sees Dastek as a second source for 3380 heads.

Cybernex's Klein also believes the efforts of the PCM vendors, rather than hampering the market for thin-film heads, will speed things up for all concerned. "When these companies develop products like this in-house that's great," he says. "They'll debug the heads, and we'll be in a position to bid as a second source." By 1985-86, he goes on, thin-film heads will be a commodity item for all markets. "There's no longer any argument over the advantages of these heads," he says. "The challenge now is to show that they can be made in quantity." Few OEM drive vendors will quarrel with Klein on that score, but many of them do question his schedule: "Thin-film read/write heads for small Winchesters are a year away," says IMI's Hasler, "and that's best case." ■

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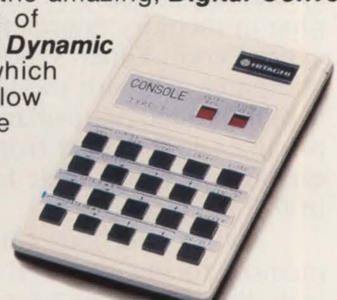

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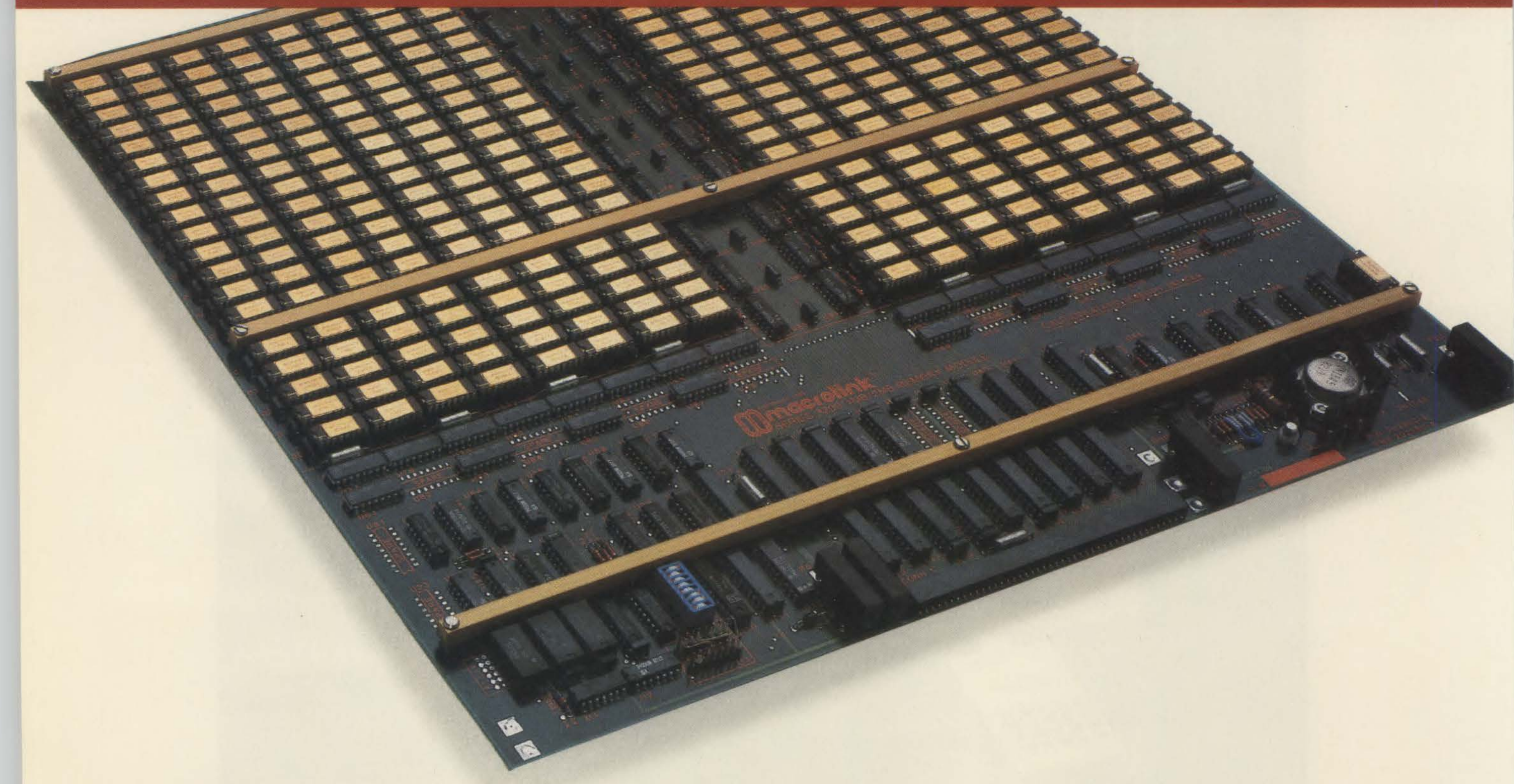

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CIRCLE NO. 108 ON INQUIRY CARD

U.S. businesses targeted as major videotex market

By Dwight B. Davis
Associate Editor

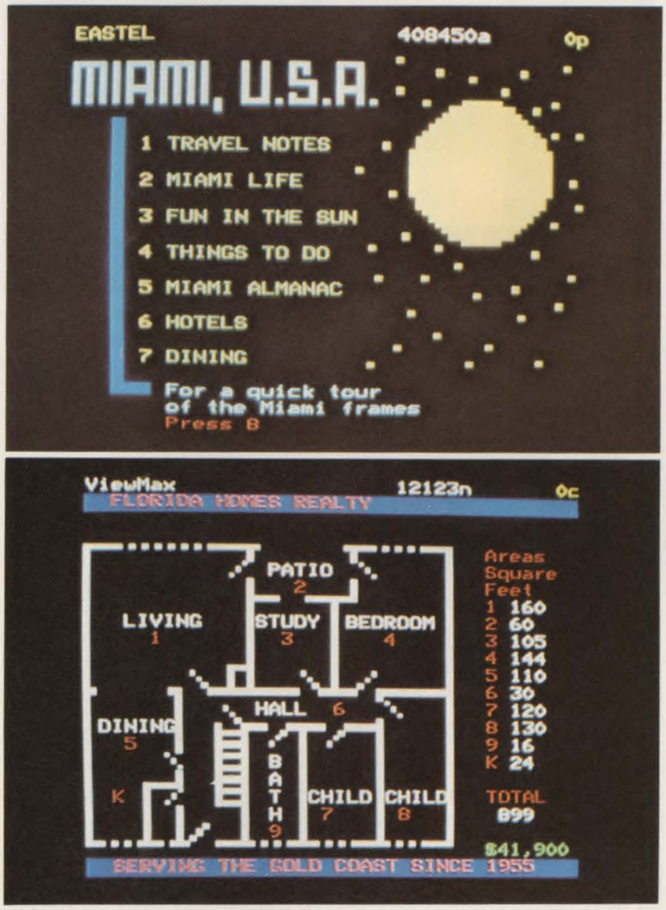
Videotex, the two-way information service pioneered in England, is generating growing interest among business users, despite some initial setbacks the technology suffered in the consumer market. The ratio of business to residential users of British Telecommunications' Prestel system has held at 85:15 for more than a year, although attempts to market the service to business customers have been paltry compared to those expended in developing the consumer market. British Telecom and videotex promoters in other countries have noted this business momentum, and are implementing strategies to sell private videotex systems and public services.

With its decade-long history centered in Europe and Canada, videotex has yet to gain widespread recognition in the U.S. American Telephone & Telegraph is promoting and testing its presentation-level protocol specification, but is concerned primarily with public applications of videotex. The U.S. market for business videotex has been relatively slow to develop, but should soon accelerate now that IBM Corp. has introduced its Series/1-based SVS/1 private videotex system in this country (MMS, August, p. 83).

IBM isn't the only company marketing private videotex systems to U.S. customers, but as is often the case, the company's move into a new market is expected to legitimize and stimulate a sluggish sector. Many companies expect to benefit by IBM's U.S. entry, including Modular Computer Systems, Inc. (Modcomp), Fort Lauderdale, Fla., and Rediffusion Computers Ltd., Sussex, England.

Modcomp has been selling its ViewMax private videotex system worldwide for about a year and a half (MMS, October, 1981, p. 31), and Rediffusion has just entered the U.S. market through a marketing agreement with Blodgett Computer Information Systems, Inc., based in Salt Lake City, Utah. Blodgett will sell Rediffusion's RS2800 Telecentre videotex systems and its Teleputer work-station terminals.

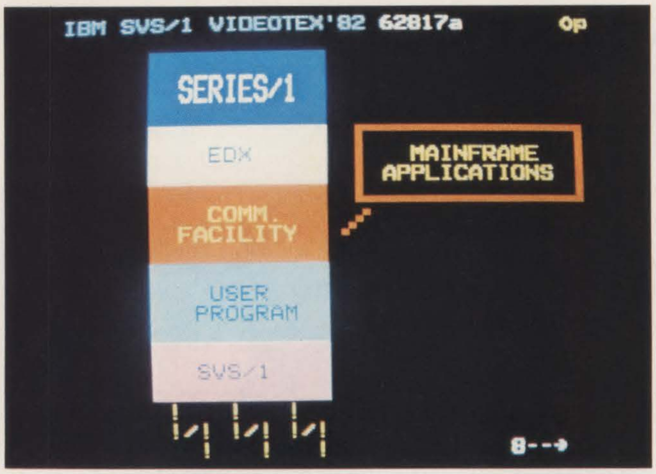
These companies and others, including Tandy Corp., Fort Worth, Texas, expect videotex (also known as viewdata) to serve as the tool that brings computer-based information to "casual" office workers—people untrained in computer use who are not currently accessing such information. Videotex simplifies the user interface to computerized databases, displaying



Videotex can act as a bridge *between various industries and the customers they serve, as illustrated in these two frames displayed on Modcomp's ViewMax system. In one, information about city's attractions is distributed electronically to tourists. The second frame shows how realtors can transmit graphic and textual data about homes to prospective buyers.*

"pages" of textual and/or graphic information along with easy-to-understand user prompts. Typically, videotex pages, which can consist of several display "frames," are designed on some type of frame-creation terminal and stored on-line. Some vendors, however, offer software that converts standard file-oriented database information into videotex page formats. In private operations, videotex systems can serve a simple information-retrieval function, can be the foundation for computer-based education and training programs or can be used in more complex transaction-type operations.

The market for business-related videotex is difficult to determine, partly because the business and consumer markets overlap somewhat. While some companies



Displayed on an SVS/1, *this frame illustrates the various components of IBM's private videotex system. Running on Series/1 computers, the SVS/1 system operates under the Event Driven Executive operating system and can access external mainframe applications and databases through user-written communications interfaces.*

operate totally private systems with only company personnel having access to the videotex information, other businesses, such as the travel industry and banking, depend on customer access to their systems.

Don Popilek, Modcomp's director of marketing for viewdata and communications products, predicts the total U.S. business and consumer market for videotex will be between $4.7 billion and $11 billion by 1988. "My goal at Modcomp this year is to deliver $8.2 million worth of private viewdata products," he says, noting that he had reached 80 percent of this worldwide goal by July. Popilek claims that Modcomp, IBM and Rediffusion are the major factors in the private videotex arena, with Aregon Systems Inc. and its IVS-3 system "up and coming."

Rediffusion claims it is the leading supplier of corporate videotex systems, having sold 130 systems worth $27 million, primarily in the U.K. Through its agreement with Blodgett, Rediffusion expects to generate U.S. revenues of about $20 million over the next five years.

Support for Prestel growing

Most of the main players offering private videotex systems have chosen a Prestel-compatible approach for their graphic displays. This strong support for the British standard by business videotex vendors is mirrored by the installed base of all videotex systems. At the recent Videotex '82 conference in New York, Richard Hooper, chief executive of British Telecom Information Services, quoted figures from an independent survey performed by Communications Studies & Planning International. Released in April, the survey indicated there were then 774,385 British standard (Prestel) viewdata and teletext (one-way) sets in operation in 15 countries, which constituted 98 percent of all sets in the world.

Standards issues relating to videotex include the number of lines displayed on a screen and the transmission protocols used, but graphics options remain the most hotly debated topics. Prestel is associated with block-character alphamosaics, although the British standard is scheduled to incorporate higher levels of graphics resolution such as alphageometrics and alphaphotographics (using slow-scan television techniques). The British standard, along with the French standard, is a subset of a European-adopted approach known as the Conference of European Post and Telecommunications Administrations (CEPT) standard.

In the U.S., however, AT&T has been working to consolidate support for its Presentation-Level Protocol, which uses coding for alphamosaics and alphageometrics that is different from the CEPT approach. The use of Prestel-compatible coding by many of the private videotex vendors now addressing the U.S. market will almost certainly have a negative impact on AT&T's efforts to lock domestic users into the PLP protocol. Popilek at Modcomp predicts the failure of PLP within the next 12 to 15 months.

Whether or not Popilek's prediction occurs, vendors of private videotex systems generally agree that business applications don't often require higher resolution graphics than those available through alphamosaics. Charles M. Doolittle, manager, Videotex Project Office at IBM, White Plains, N.Y., says IBM is actively developing standards and points out that the company has not endorsed an approach, even though the SVS/1 uses a Prestel-like method. Doolittle says, "There is a tendency in the U.S. residential market toward alphageometrics, and some companies will want full-motion video with text overlays." However, he says, "Our internal evaluation indicates that alphamosaics will handle almost all business applications" (see "IBM explores videotex in-house," p. (146)).

Private videotex, like consumer videotex, is relying primarily upon phone lines as the transmission medium. "The telephone lines will probably remain the primary transmission medium," says Doolittle, "although some systems will operate over cable-based local-area networks in the future."

Dedicated versus integrated videotex

Videotex technology, while a distinct form of information access, must serve in conjunction with some business or residential application. This relationship dictates that videotex be viewed primarily as an interface tool to access a computer-based application. Haines Gaffner, president of Link Resources Corp., New York, predicts, "In the next three to four years,

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IBM EXPLORES VIDEOTEX IN-HOUSE

Since the beginning of the year, IBM Corp. has operated a prototype videotex system in its White Plains, N.Y., facility to study videotex business applications and user interfacing requirements. "The focus of our study is the casual user, who for the most part would not have a terminal today," explains Peter Grimm Jr.

Grimm described the prototype IBM system at the Videotex '82 conference in New York this June.

Using the company's SVS/1 videotex system as a building block, IBM used its own and other manufacturers' terminals to configure its in-house system with about 150 user stations. "Our main goal is to maximize our understanding of the end user," Grimm says, noting that IBM measures the success of the videotex by the amount of increase in system usage.

One objective of the internal system was to avoid creating special videotex databases if the desired information already existed in other file-oriented computerized formats. The system was also designed to access non-IBM databases, as well as internal information. For example, videotex users in IBM can access the Official Airlines Guide. And information entered in script format into IBM's electronic bulletin board is automatically reformatted for the videotex displays.

Users can also access gateways between the Series/1 into 370 systems, Grimm explains. With this capability, users can access IBM's worldwide phone directory of about 160,000 names. The system also links to the Dow Jones service, appearing as a 370 system to Dow Jones. Information requested from Dow Jones is not stored by the IBM systems, but is automatically reformated to videotex standards by the Series/1.

Because of its desire to understand user requirements and problems, IBM has closely monitored its user base. Grimm says the company designed a 90-question user profile to determine demographic, attitudinal and experience information. Objective information is collected automatically as the users interact with the system, and subjective information is obtained through post-use questionnaires.

A "self-usability test" measures the number of screens a user needs to solve a problem, Grimm says. This test also tracks the sequence of screens called by the user and measures the amount of time the user examines each screen. "The faster you can get answers, the more you will use the system," Grimm says.

It may be beneficial to tailor page zero—the first screen the users sees when coming on the system—to the group of users on the system, Grimm says. By using the data collected on individual users, he says, "It could even be possible to dynamically configure the page zero to a specific user's requirements." Grimm admits, however, that IBM has yet to explore the privacy issues involved in collecting and using such information gained from monitored users.

So far, IBM has collected about 200,000 observations on the use of its in-house videotex system, but these statistics might take a backseat to another factor required in designing videotex systems, Grimm says. "The most precious ingredient is a great deal of imagination when you're putting the system together," he says.

videotex as a separate phenomenon will disappear." At Videotex '82, Gaffner said the technology will be absorbed as an integral part of other industries.

Mike Aldrich, chief executive of Rediffusion, says the private market is already divided between vendors that sell dedicated videotex systems solely for information dissemination and those that provide videotex as part of a larger system. "We sell an office system that includes videotex," he says of Rediffusion's R2800 series. IBM's SVS/1 also offers functionality beyond pure videotex, but Aldrich claims such products as Modcomp's ViewMax and Tandy Corp.'s TRS-80 Videotex are dedicated systems.

Popilek refuses to classify ViewMax as a dedicated system, pointing out that Modcomp's videotex, running under the firm's MAX IV operating system, works with applications such as inventory control, process control and word processing. Craig E. Knouf, manager of Tandy Videotex, admits the TRS-80 Videotex is dedicated, but believes it will diversify once the model 16 becomes available to replace the model II as a host computer. He also believes the Tandy product will interface to larger office systems by connecting to Datapoint Corp. Attached Resource Computer networks (MMS, November, 1981, p. 22).

Tandy's reputation in videotex to date is based on its success in addressing the agricultural sector, providing systems to such groups as the Professional Framers of America. Knouf believes the company will be able to jump into other business applications, although Modcomp's Popilek doubts Tandy has the technical expertise to build systems attractive to private videotex customers.

Knouf admits the graphics available on Tandy's system aren't on the same level as Prestel's and other standards'. But he says products such as a new protocol converter that make Tandy products compatible with IBM protocols will widen the market for TRS-80 Videotex. Selling private systems through Tandy's retailers may be difficult, he admits, but Tandy's national accounts sales force will be in a good position to make such sales, he says.

Accessing other databases, programs

One disincentive for companies to add a videotex system to their operations is the large amount of work required to create new databases of videotex page frames. "Say you're a Sears Roebuck, you've got this

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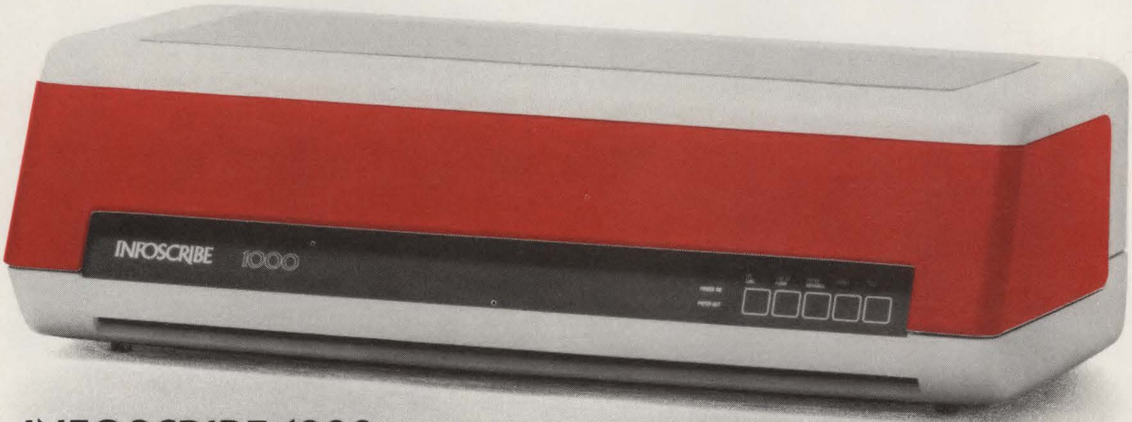

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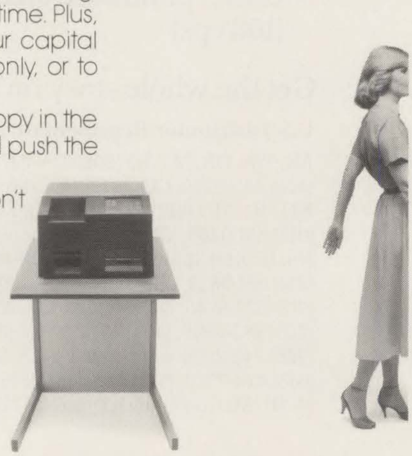

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horrendously big database, and all of a sudden, you decide to go into the viewdata business," Popilek explains. "With almost every system out there today, you've got to sit down and rekey all that information."

Britain's Prestel offers a facility called Gateway to allow conventional user terminals to exchange information with computers outside of the Prestel system, and some private videotex vendors offer their own access and conversion facilities. Popilek says Modcomp's $10,000 ViewTrax software is the most advanced package of its type. It can convert the ASCII-format videotex data into 3270, 2980, SDLC, ISO Async, TU500 and UT200 protocols, and can convert data from these protocols into the ASCII format.

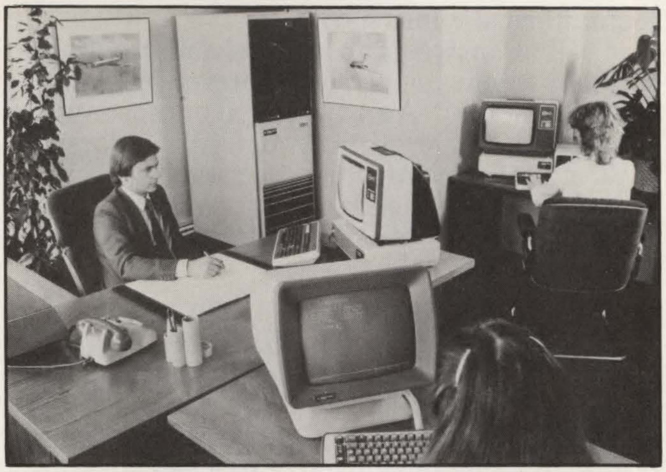
"With ViewTrax, I can convert graphics and text stored in non-videotex databases into videotex pages," he says. "You put all your information on disk or tape and link it to our computer with the ViewTrax program. As you spew your data through ViewTrax, we automatically convert it to our format and put it on our disk."

IBM's SVS/1 videotex system can also access outside computers and databases. SVS/1 runs under the Event Driven Executive (EDX) operating system, and through a User Program Interface, the system can access other Series/1 or mainframe-based applications and databases. IBM's Doolittle admits, "If you have an existing database of 80-character layout (versus the 40-character videotex standard) and a lot of graphics, it could require a total restart." But he doesn't view this as a major problem, "because there will be thousands of new videotex databases that will be developed around videotex standards."

Personal computers the key

Because videotex counts on a large residential market for its future success, the various standards available were all developed to appear on adapter-equipped television sets. Most standards, including those under the CEPT umbrella, are oriented to European television displays, which handle television signals with 625 lines. The screen is divided into 24 rows of 40 characters for videotex operation. In the U.S., the television signal has 525 lines, and videotex systems are sometimes designed—as in the PLP standard—to display just 20 rows of 40 characters.

Despite this television-display orientation—and standards issue—videotex in private systems commonly use other types of adapted terminals and/or personal-computer displays, along with TV displays. Link's Gaffner views the personal computer as the key element in most future videotex systems. "The personal computer will become the terminal of choice," he predicts. "Personal computers will serve in four areas—as videotex terminals, as information provider work stations (frame-creation terminals), as system hosts and, in certain instances, as gateways to other systems."



Operating as a total office system with videotex *capabilities, Rediffusion Computer's R2800 systems operate on the philosophy of placing terminal on the desks of "casual" users not typically interfaced to computerized information. The R2800 central processor (background) is shown supporting various desk-top videotex terminals.*

One company, Wolfdata, Ithaca, N.Y., already offers its Videotex Microsystem based entirely on IBM's Personal Computer. Using four software modules, the Personal Computer functions as a terminal accessing videotex databases, as a frame-creation terminal, as a database emulator for stringing disk-stored pages in a desired sequence, and as a gateway to access remote databases over various packet-switching facilities.

Rediffusion also sells a personal computer-like work station—the Teleputer—for operation with its Corporate Videotex System. Available in five models, Teleputers range from a simple terminal with local page storage to a CP/M-based station with 128K bytes of memory, a 1M-byte disk and an integral video cassette for interactive video applications. Along with the capacity to off-load some of the R2800 Telecentre's storage and processing, the Teleputer handles the system's non-videotex applications such as data and text processing, handprint processing and data capture.

Rediffusion's Aldrich maintains that videotex's greatest selling point is that it can take very complex information-management operations and hide them behind a very simple user interface. "Videotex is also interesting," he notes, "because the technology is not owned by any one group. Computer manufacturers, publishers, the TV industry and others are all active in the market. As such, videotex is the first technology that truly bridges consumer and business applications." ■

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Bar codes: the industrial solution to shop-floor data entry

By Frank Catalano
Associate Editor

As manufacturers look for an inexpensive and off-the-shelf means of interfacing their computer systems to production machinery, bar codes, those little rectangles of lines and spaces found on most items in the grocery store, may soon become commonplace on parts and subassemblies moving through factories.

Besides providing industrial users an automated, labor-free means of inputting shop-floor data into materials-requirements-planning, inventory-control, production-monitoring and quality-control systems, bar codes can also function as command languages that enable computers to dictate the task or process a machine or robot should perform on a part or subassembly.

Edward Anderson, marketing director of Computer Identics Corp., Westwood, Mass., and president-elect of the Automatic Identification Manufacturers division of the Material Handling Institute, Pittsburgh, Pa., estimates that the market for bar-code reading systems falls in the $50-million to $100-million range, but cautions that the size is difficult to gauge because most bar-code-system suppliers are small, privately held companies.

Whatever its size, the industrial market for bar-code systems is expected to grow at a 40- to 50-percent annual rate by 1983, according to projections by Edward Shadd, president of Symscan, Inc., a Rochester, N.Y., consulting firm specializing in bar-code-system implementation. Shadd says that sales of his company's services have skyrocketed 500 percent this year over last, indicating the activity in the market. "In my entire industrial career," he says, "I've never seen a phenomenon like the current level of interest being generated for bar codes."

As a reflection of the growing enthusiasm for bar codes, two newsletters—*Bar Code News*, Peterborough, N.H., and *Scan Newsletter*, Hauppauge, N.Y.—are devoted to the subject, and seminars and conferences—the largest of which is the AIM-sponsored Scan-Tech '82—are being organized.

While much of the interest is from companies wishing to automate their plants and thereby improve their production efficiencies, a large part is from vendors who must either adopt bar-code technology or lose contracts from large customers that require bar codes on the products they buy.

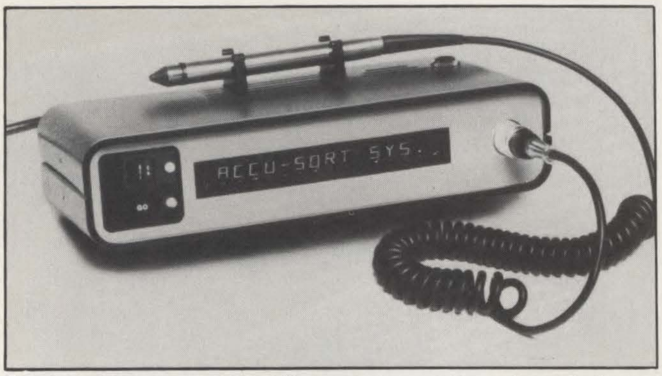
Computer Identics Scan Star 50 noncontact moving-beam scanner *achieves scanning speeds as high as 1200 scans per sec. Intended for material-handling applications, the laser-based unit includes an integrated decoder and a power supply.*

Last summer, the U.S. Department of Defense, which buys parts, subassemblies and complete products from more than 50,000 U.S. manufacturers, adopted a standard bar-code symbol format that must be included on product cartons sold to DOD agencies. A compatible code is expected to be endorsed this fall by the Automotive Industry Action Group, comprising representatives from Chrysler Corp., General Motors Corp., Ford Motor Co., American Motors Corp. and Volkswagen.

"I'm sure that, if left to their own devices, most smaller companies would take a lot longer to incorporate bar-code technology into their plants," says Anderson. "But now, if such companies want to make a sale to the DOD or to an auto maker, it will help to slap a bar code on their product."

Shadd notes that as manufacturers begin to bar-code products for the auto industry and the DOD, the impetus for them to implement bar-code systems for internal use will increase. "As long as Bendix Corp., a major supplier to the auto industry, is putting bar codes on products going to their major customers, they might as well start using the technology themselves," he says. "What that will mean is that all of the companies supplying products to Bendix will also have to start using bar codes. It's the snowball effect."

Donald DuBuc, co-chairman of the bar-code study committee of the AIAG and a representative to the group from GM, says the auto industry pushes the use of bar codes because the technology is easy to implement with off-the-shelf products.



The Accu-Sort model 4510 light-pen bar-code reader *sells for less than $1000 and includes a power supply, a decoder and a 16-character alphanumeric LED display. The unit is intended for factory-floor data-entry applications.*

Much like Morse code, which uses dots and dashes to represent letters of the alphabet, bar codes function by using dark bars and white spaces to represent information. That information may include the identification number of a part, the manufacturer's ID, the date the part was made, the inspector's ID and the destination ID. A number of bar-code formats are available, varying as to the amount of information they convey and whether that information is in numeric or alphanumeric format.

Bar-code scanners initiate the bar-code reading process. Light from a scanner is reflected from the white bars of the code and absorbed by the dark bars. A photodetector within the scanner senses the reflective differences between the bars and spaces and converts those differences into proportional analog signals. Those signals are amplified and then converted into computer-readable digital signals by an external microprocessor-based decoder device. Bar-code system suppliers offer a variety of contact and noncontact scanners.

Contact scanners consist of wands or light pens and must touch or nearly touch the code. Usually substituted for traditional clipboard or keyboard data-entry and -collection methods, contact scanners are best suited for scanning stationary items.

Noncontact scanners, either fixed- or moving-beam, are intended for applications in which the objects to be scanned are on a moving conveyer line. While fixed-beam scanners read a label only once, moving-beam scanners perform as many as 1440 scans per sec.

System prices range from $1000 for a light-pen device to $10,000 for a sophisticated moving-beam

BAR CODES AID IN WAREHOUSE-MANAGEMENT SYSTEM

Bar-code scanners tied into a distributed network of microcomputers are helping Acme Boot Co., Inc., Clarksville, Tenn., boost the productivity of its automated warehousing and distribution center 40 percent over previously used manual methods.

The warehouse, which stores 1.6 million pairs of western boots in 238,000 rack locations, cost Acme $2 million to automate and is expected to pay for itself within three and a half years, says Ross Jackson, director of warehousing and distribution for the company. As many as 50,000 boxed pairs of boots can be picked from storage within the facility each day and shipped to as many as 10,000 customers.

Noncontact laser scanners, supplied by Accu-Sort Systems Inc., Telford, Pa., and contact wand scanners, supplied by Welch Allyn, Inc., play integral roles in the system, which is controlled by two IBM Corp. Series/1 minicomputers.

The Series/1 computers send batch messages to microcomputers assigned to storage and picking activities and on-line messages to systems that direct the sorting of products before shipment. The battery-powered Motorola 6502-based unit used for picking and storage control was designed by Integrated Material Control Corp., Aptos, Calif., and includes a Dotronix CRT display and the Welch Allyn wand scanner. Called the MTS 1 (mobile transport system), the unit mounts on a wire-guided order-picking truck.

Once a message is received from the host, the MTS 1 directs its respective order-picking truck to a designated rack location. There, an operator picks or stores boxed pairs of boots according to instructions displayed on the CRT screen. Bar codes on the boxes represent such data as stock number, size and style of the boots. By running the wand scanner over the codes, an operator verifies whether he is picking or storing the proper items. A bell indicates a correct action.

For items ready to be shipped, a microcomputer-based sorting system routes boxes of boots moving along a 486-ft. conveyer into shipment chutes reserved for customer orders. Moving-laser-beam Accu-Sort scanners mounted above the conveyer read and decode bar codes on the boxes. The decoded information instructs the sorting system about to which chute a box should be routed. As many as 100 boxes per min. can be sorted into as many as 158 chutes.

System software was written by Hochschild and Associates. Since Acme implemented the system last year, the company has reduced order processing time by more than 50 percent. A typical order that once took seven days to process can now be processed in as few as two days.

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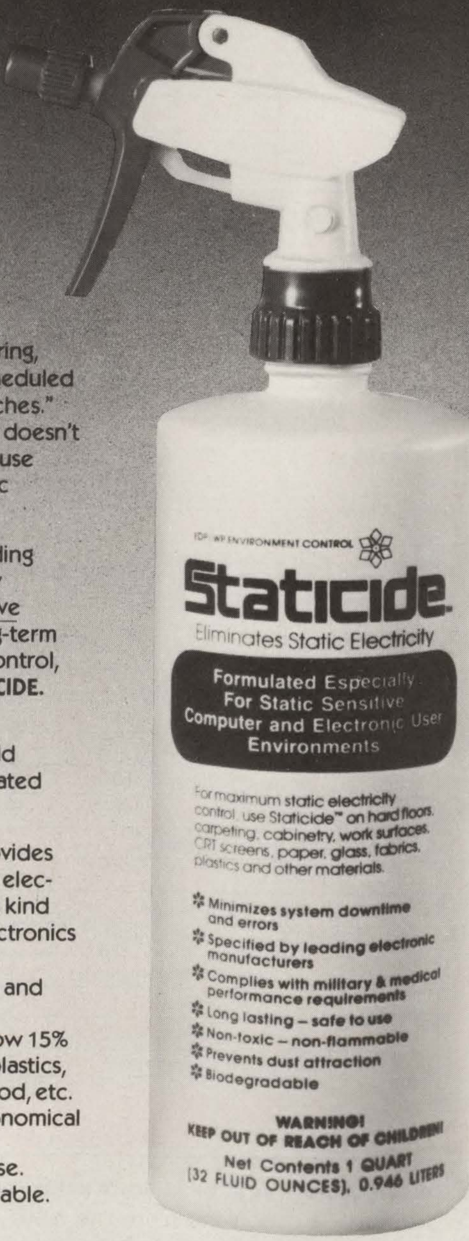

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Bar-code system suppliers

Company	Scanners	Printers	Data-collection terminals	Film masters and printing plates	Labels	Label testers	System design	Seminars and consulting	Database publication
Accu-Sort Systems, Inc.	●						●		
Adolph Gottscho, Inc.		●		●					
Analog Technology Corp.		●							
Azurdata, Inc.	●		●						
Bar Code Associates, Inc.	●			●			●	●	
Bureau of Engraving, Inc.				●					
Burr-Brown Research Corp.			●						
Computer Identics Corp.	●		●				●	●	
Computype, Inc.				●	●				
Conant Corp.	●	●	●		●	●	●	●	●
Control Laser Corp.	●		●				●		
Control Module, Inc.	●		●				●		
Data Composition, Inc.		●			●				
Data Specialties, Inc.		●							
Datalogic Optic Electronics, Inc.		●	●						
Dataproducts Corp.		●							
Dennison Eastman	●	●	●		●		●	●	
Dennison Manufacturing Co.		●			●		●		
Diagraph Bradley Industries, Inc.		●			●				
Doring Labels, Inc.		●		●	●				
Dymarc Industries, Inc.		●							
Electro/General Corp.			●						
J.B. Fredericks Ltd.				●				●	
GGX Associates, Inc.				●					
George Lithograph				●					
Hewlett-Packard Co.	●	●	●				●	●	
ID Recall Systems					●			●	
Identicon Corp.	●		●						
Identiprint, Inc.	●	●					●		
Intermec	●	●	●						
KRG Inc.	●	●	●		●		●	●	
Kanematsu Electronics Ltd.	●								
Kee Bar Enterprises, Inc.	●	●		●	●				
Label-Aire, Inc.		●							
Lord Label Systems	●	●	●		●		●		
Lowell Systems, Inc.	●	●	●		●	●	●	●	
MSI Data Corp.	●		●						
Markem Corp.		●			●				
Marsh Stencil Co.		●							
MEKontrol, Inc.	●						●		
Metrologic Instruments, Inc.	●		●	●					
NCR Corporation Industrial Div.	●	●	●		●		●	●	
New England Data Corp.		●			●				
Norand Corp.	●		●						
North American Technology, Inc.									●
Photographic Sciences Corp.	●			●			●	●	
Printronix, Inc.		●			●				
RJS Enterprises, Inc.				●			●	●	
Recognition Equipment	●		●						
Rexnord, Inc.	●								
Scan Newsletter									●
Sick Optik-Electronic, Inc.	●		●						
Skan-A-Matic Corp.	●		●						
Spectra-Physics	●								
Standard Register Co.		●	●	●	●		●		
Symscan, Inc.								●	
Technical Analysis Corp.		●							
Teknekron Controls, Inc.	●						●	●	
Telxon, Inc.	●	●	●						
VariMark Systems		●					●		
VIDAC		●			●				
Wakefield Software	●	●	●		●		●	●	
Wallace Computer Service	●	●			●		●	●	
Weber Marking Systems		●			●				
Welch Allyn, Inc.	●		●						
Western Computer Systems, Inc.	●	●	●				●	●	
York Tape & Label Corp.	●	●		●	●	●		●	

Source: 1982 Bar Code Manufacturers and Services Directory, North American Technology, Peterborough, N.H.

scanner equipped with a laser light source. Options include multiplexers, which allow several readers to be hooked into a host computer, and alphanumeric keyboard and display terminals, which allow data entry of variable information. Printers that generate bar codes are available from both bar-code-system suppliers and printer vendors. Prices range from $1700 for a thermal printer to $12,000 for a laser printer.

According to a directory published by North American Technology, the publishers of *Bar Code News*, at least 67 companies are in the bar-code market, supplying everything from scanners to labels to database publications. Computer Identics' Anderson says many new companies will enter the market next year as users start complying with bar-code recommendations from the AIAG and the DOD.

Anderson notes that bar-code systems provide more reliable data reading than other input technologies, including CRT terminals, optical-character-recognition systems and voice-recognition systems. "A bar-code system will either read or not read," he says. "It will never misread." While keyboard data entry is slow and allows human error, he says, voice-recognition technology is expensive and limited in its range of applications. OCR systems, he adds, cannot read labels of products moving on a conveyer belt and are susceptible to misreads, especially in a factory where dirt and grease are prevalent.

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Backing Anderson's claims, the DOD estimates that it can save more than $113.9 million annually through the use of bar-code data entry as opposed to other input methods. In a 1261-page report comparing data-entry systems, the DOD noted that: "Intangible benefits that will accrue through the use of bar-code technology include greater accuracy, improvement of production flow, increased asset visibility, reduction in documentation requirements, fewer training requirements, better control and accountability, reduced pipeline time and reduced stockage investment levels."

But as the use of bar codes in industry widens, the need for a standard symbol format becomes more critical. Before the adoption of the DOD standard, a vendor supplying one product to different DOD divisions often had to print a different type of bar code for each division. Besides the expense to the vendor, the tracking of materials through the DOD was also complicated, defeating the rationale behind implementing bar codes.

The situation in the auto industry is similar. AIAG's Anderson says that more than 7300 vendors supply more than 152,000 parts to the various auto makers. A vendor supplying the same part to both AMC and Chrysler, for instance, typically must print different labels for each customer.

In an effort to alleviate that problem, the DOD worked closely with the AIAG study group and the American National Standards Institute to apply a uniform standard—not just within the DOD, but throughout industry. The DOD chose two codes: Code 39 and Code 2 of 5. The same codes are expected to be supported by the AIAG, ANSI and the National Electrical Manufacturers Association, says Symscan's Shadd, an advisor to AIAG.

Shadd adds that the adoption of two codes rather than one will not encumber manufacturers because, with minor software modifications, most new bar-code readers can support both. He says that Code 2 of 5 will be used in applications requiring only the representation of numeric data, and Code 39 will be used in applications that call for both alpha and numeric representations.

"Bar-code technology has been available to manufacturers for 12 years," says Shadd. "But the lack of a standard as well as inertia on the part of management has slowed its implementation. Starting in '83, you'll see the market explode." ■

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CIRCLE NO. 150 ON INQUIRY CARD

GE's CAE International opens 'productivity centers'

By Eric Lundquist
Associate Editor

With an estimated 1986 automation-system market of $4.1 billion at stake, industry giants such as General Electric Corp. and Westinghouse Electric Corp. are trying early to claim a substantial piece of the factory-system market. The latest sales method, joining traveling CAD/CAM road shows and trade-show demonstrations, is from GE. There, at permanent display centers, users can "test drive" before buying. A customer can walk into a center with a product concept and walk out with a detailed plan—on paper or software—for building a part.

In a typical case, a customer would go to a center with a project such as a specialized gas nozzle for a product. The customer would work with GE consultants to design the nozzle using the display center's VAX computers, a Calma CAD/CAM system and a variety of other hardware with Structural Dynamics Research Corp. application software to develop the part.

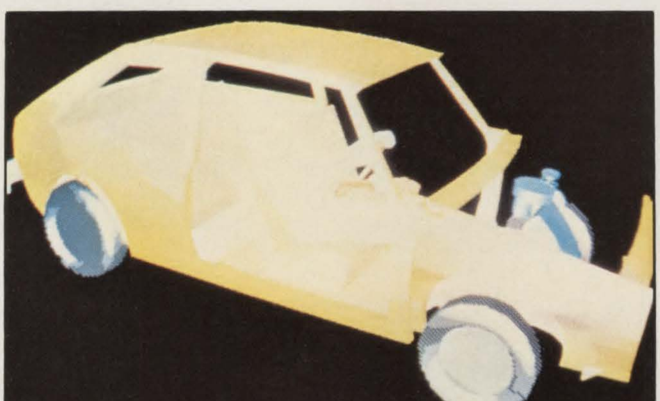
The price tag for a user's first brush with computer-aided engineering varies with a project's complexity. Joseph R. Frazier, president of GE's CAE International Inc., says the price could range from a $500 one-day session to a more typical price of $10,000 to $30,000 for a week-long or longer session. "At the end of the stay, the company walks out with a solution to its design problem," Frazier says. The client would typically approach GE early in the design stage, come to the productivity center, work with a GE application engineer to solve the design problem and become familiar with the GE CAE system.

"GE has clearly recognized the need to demonstrate and show its product in a live situation. The regional demonstration center answers this need," says Maurice Klapfish, an analyst with research-firm Venture Development Corp. Klapfish estimates that the combined U.S. market for industrial robots, CAD/CAM and numerical controllers was $1.1 billion in 1981, and he forecasts an expansion at 30 percent per year to $4.1 billion in 1986. Of that $4.1 billion, CAD/CAM—the market most directly addressed through the GE demonstration centers—is expected to account for 78 percent of the total. While it is difficult to forecast how much of that 78 percent will be GE products, Klapfish expects the amount to be "substantial."

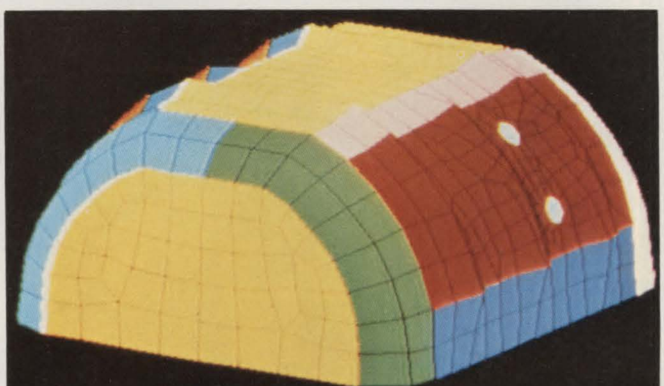
GE has opened productivity centers in Milford, Ohio; San Diego, Calif.; London; Paris; and Wiesbaden, West Germany. The company intends to open centers in Detroit and Tokyo by September. GE's CAE International Inc., a joint venture formed in 1981 by GE and Structural Dynamics Research Corp., Milford, Ohio, operates the centers (MMS, January, p. 57). "CAE methodology is a revolutionary way of engineering and is so different from the way engineering has evolved over the last 50 years that, to get the concept across, you have to demonstrate it," Frazier says.

A productivity center customer could go to a center for projects, to buy a front-end CAE system and time share or, in the case of large companies, have GE install a customized CAE system. To modify a large company's engineering operations to accommodate CAE could take three to five years, Frazier says.

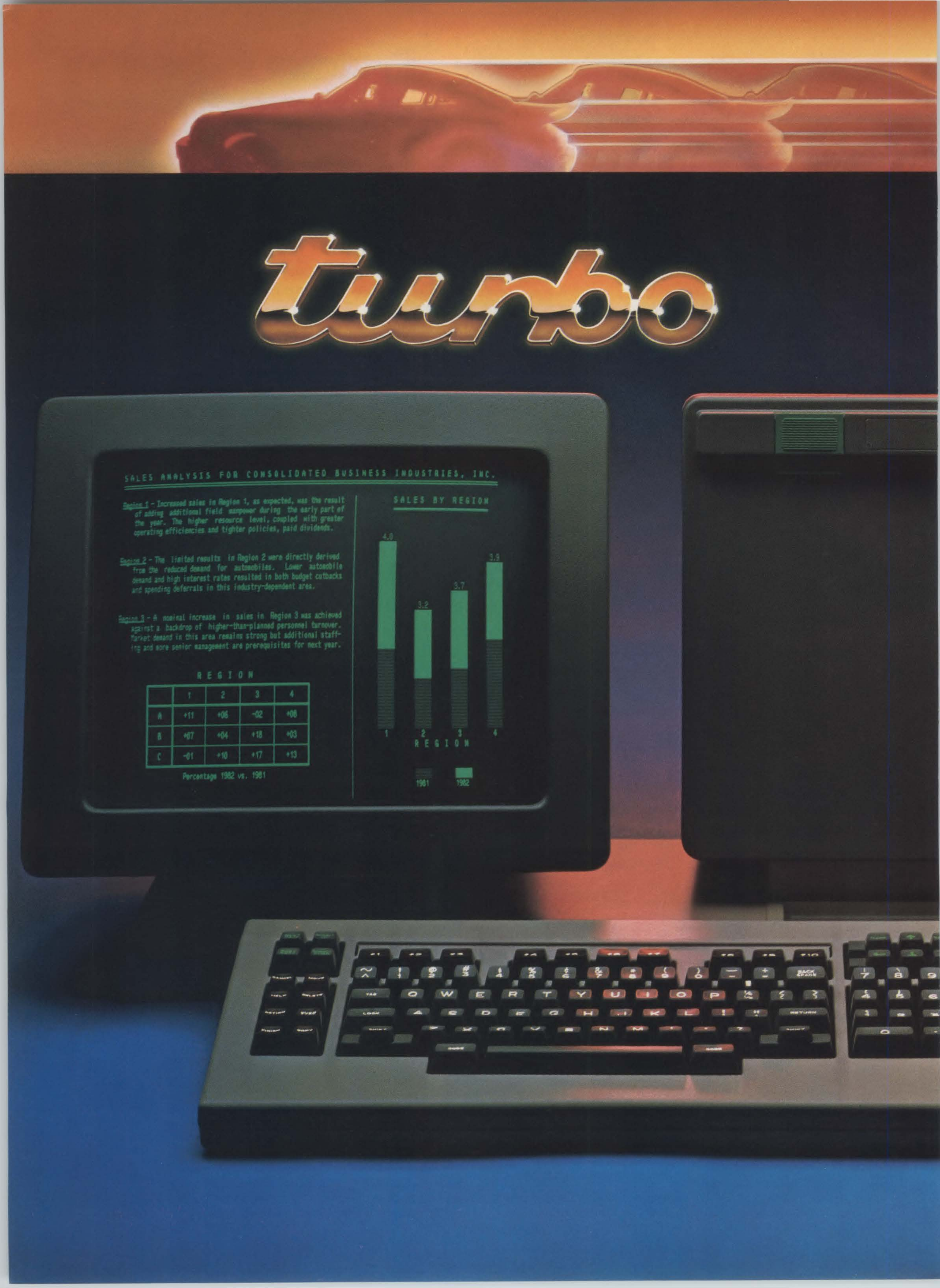
The centers are equipped with SDRC software packages, Digital Equipment Corp. VAX computers and GE-Calma CAD/CAM systems. GE Information Services Co., Rockville, Md., which has been largely a time-



Using system-design software, an automobile can be assembled *and sectioned to investigate mechanical and human interferences.*



By using SDRC's new mesh-generation technique, Triquamesh, *a complex pattern of nodes and elements can be automatically created and refined by moving mesh point locations.*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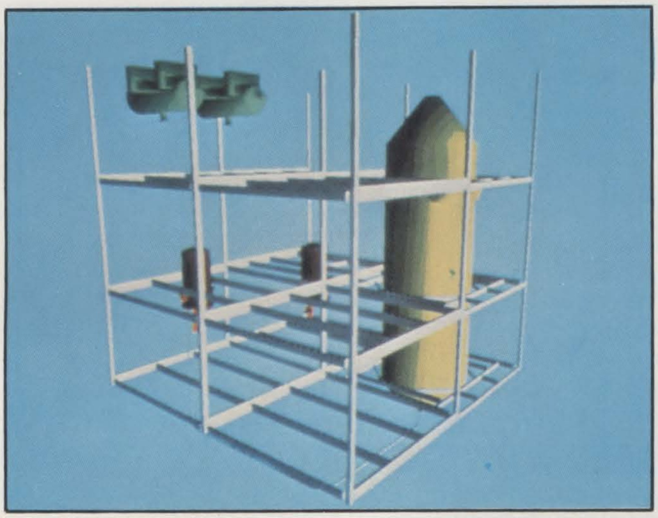
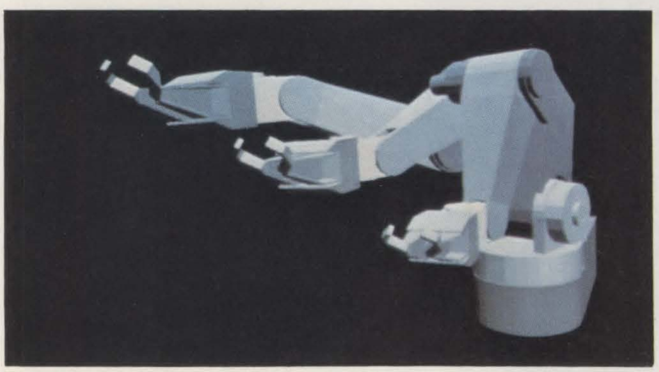
sharing service, serves as the marketing and sales organization for GE's CAE, and will provide the sales and support for CAE International. Michael D. Chamberlain, manager of industrial marketing for Information Services, says the organization will derive about $175 million in revenues from the manufacturing market in 1982. He notes that the affiliation with GE's CAE continues a process begun several years ago that was marked by the 1979 acquisition of Mitrol Corp. and the 1981 acquisition of Software International.

General Electric CAE International Inc. productivity centers *offer customer training in the use of computer-aided engineering and CAD/CAM technologies.*



CAE modeling software *provides a true understanding of an object with tangible properties versus a pipecleaner representation.*



Through animation, a robot assembly can become more lifelike, *and a designer can visualize how the robot will move and where interferences may occur.*

The GE Information Services' field-service force includes more than 3000 people, of whom 300 in the U.S. are dedicated to the manufacturing market, selling and supporting CAE, numerical-control, manufacturing information-management systems and related systems.

GE is not alone in efforts to gain an early place in the factory-automation market. Westinghouse, another huge long-term supplier and user of industrial products, formed an Industry Automation Division to develop factory-automation systems. In addition to the long-term suppliers, computer vendors including IBM Corp., Digital Equipment Corp. and Hewlett-Packard Co., are all making efforts to develop and market industrial systems. Several system houses have also sprung up, tailoring standard systems to specialized applications.

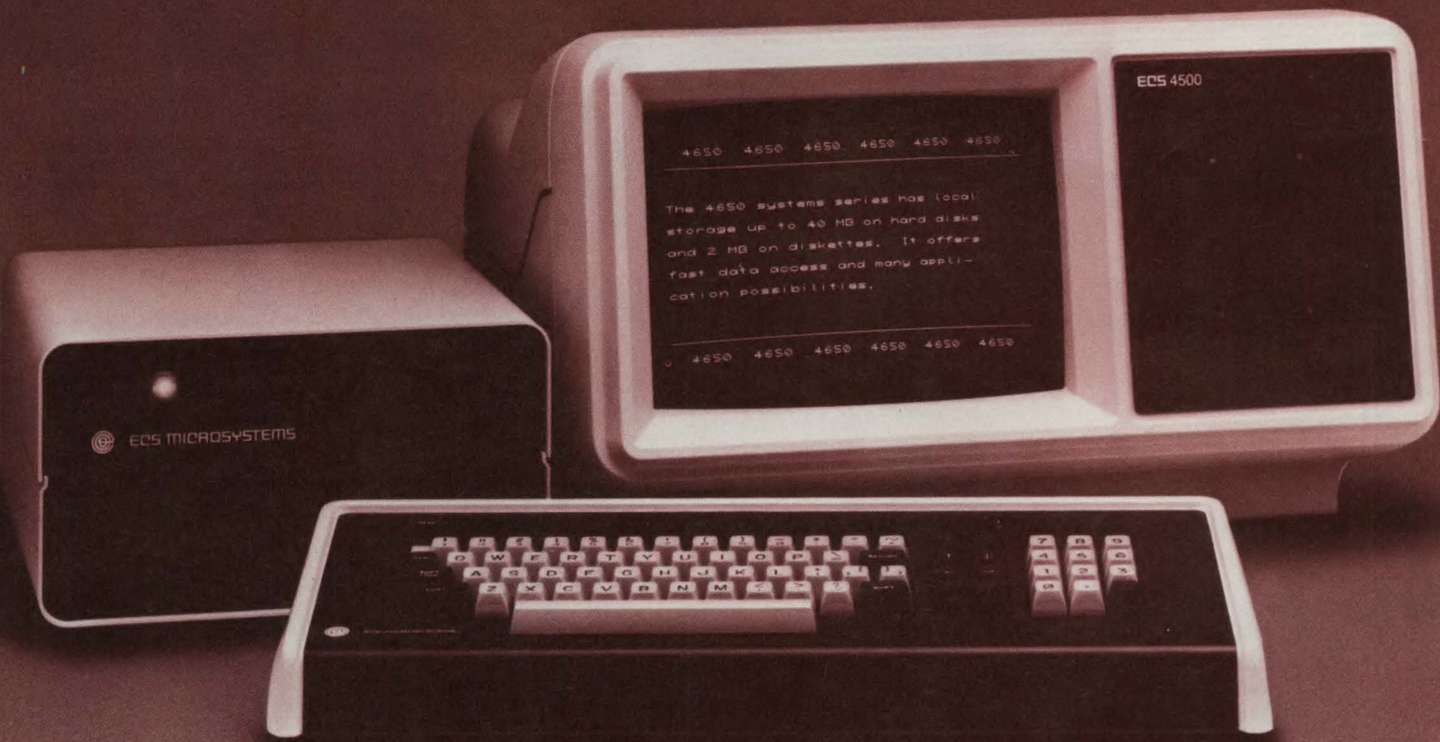
GE's CAE software system is a package of application software to integrate engineering functions and mechanical product development. The SDRC packages include a new 3D solid-modeling program, a finite-element program and a new interactive 3D system-design package.

The Geomod 3D solid-modeling program allows design engineers to develop geometric descriptions of designs. The system-design package allows solid objects to be manipulated and assembled into a total mechanical system. The software is written in FORTRAN and runs on DEC's VAX machines.

Wayne A. McClelland, manager of design software products for SDRC, says, "System is a key word here, because in speaking of these three (new SDRC) products, a main feature is that they fit into the CAE systems approach to design, where mechanical products are simulated in the computer by using a set of integrated software tools. These tools integrate and automate key engineering functions such as design, analysis, test, drafting, documentation and related manufacturing activities. Solid modeling, in contrast to wireframe or surface models, is a solid, true representation of an object with tangible properties."

Frazier claims that bringing CAD/CAM into the design process yields savings of 8 to 10 percent. "The CAD/CAM engineering sequence is essentially the same as the manual sequence, but certain steps are speeded by the automated capabilities of the CAD/CAM system," he says. The CAE process yields even greater savings. The first one or two prototypes are replaced by system models in the computer. ■

ECS MICROSYSTEMS



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Supports its own network. You can cluster up to three additional intelligent terminals (ECS 4200s) to the 4650 system for simultaneous access to both host computer and hard-disk. Each station will execute its own programs independently. Or operate on-line with your mainframe. To match different program needs, you may allot varying amounts of the hard-disk memory to the terminals in any combination. And these allotments can be changed at any time.

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CIRCLE NO. 15 ON INQUIRY CARD

NBS intelligent robot has 'human' limitations

By Eric Lundquist
Associate Editor

An intelligent robot unable to communicate is forced to operate in isolation on the factory floor. Researchers at the National Bureau of Standards recently developed a control system that they believe can help end that isolation through a hierarchical task architecture that breaks information processing for real-time sensory control into manageable pieces. In one laboratory experiment, a robot sysem acquired randomly located blocks and cylinders and moved them to an appropriate pallet.

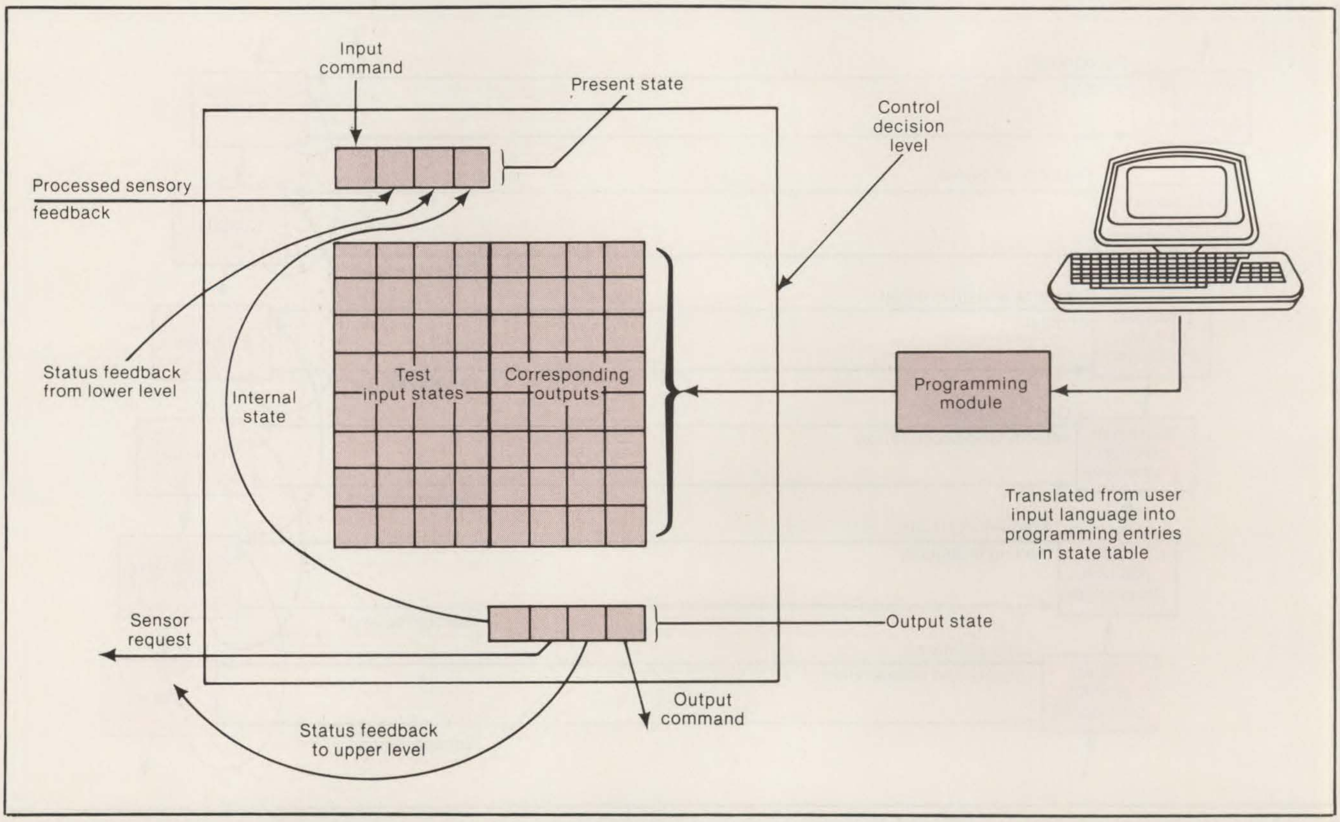
The system—developed by members of the NBS's Industrial Systems Division Anthony J. Barbera, M.L. Fitzgerald and J.S. Albus—uses multiple processors with synchronized communications through a common memory for a real-time response. The access through a common memory allows microprocessor independence and provides a "tremendous diagnostic tool," says Barbera. The system can be implemented on as few as two 16-bit microprocessors using only 30K to 40K bytes of memory, Barbera says.

COMPLEX SYSTEM DESIGN CONCEPTS

1. All systems must be designed to meet the human limitation of not being able to handle more than seven pieces of information at a time.
2. Systems are structured to account for this limitation by modularization into well-bounded, functionally independent components, each of which processes not more than a few pieces of information.
3. Further reductions in complexity are obtained by the use of generic processing structures.

REAL-TIME CONTROL CONCEPTS

1. A control system produces output actions that are a function of both its input command and feedback.
2. A sampled control system must generate an output within a task-dependent time period after an event to provide an effective response.
3. Each response of the control system must be a function of the entire input state.



Each line represents a preprogrammed possible input state condition and a corresponding output *if that state occurs. The control level compares the current input state against the test state in each line. When a match is found, the level sends the output from that line.*

The system at the NBS's labs uses a "Stanford Arm" research robot and multiple Intel processors, but it does not depend on a specific microprocessor or language, the researchers say.

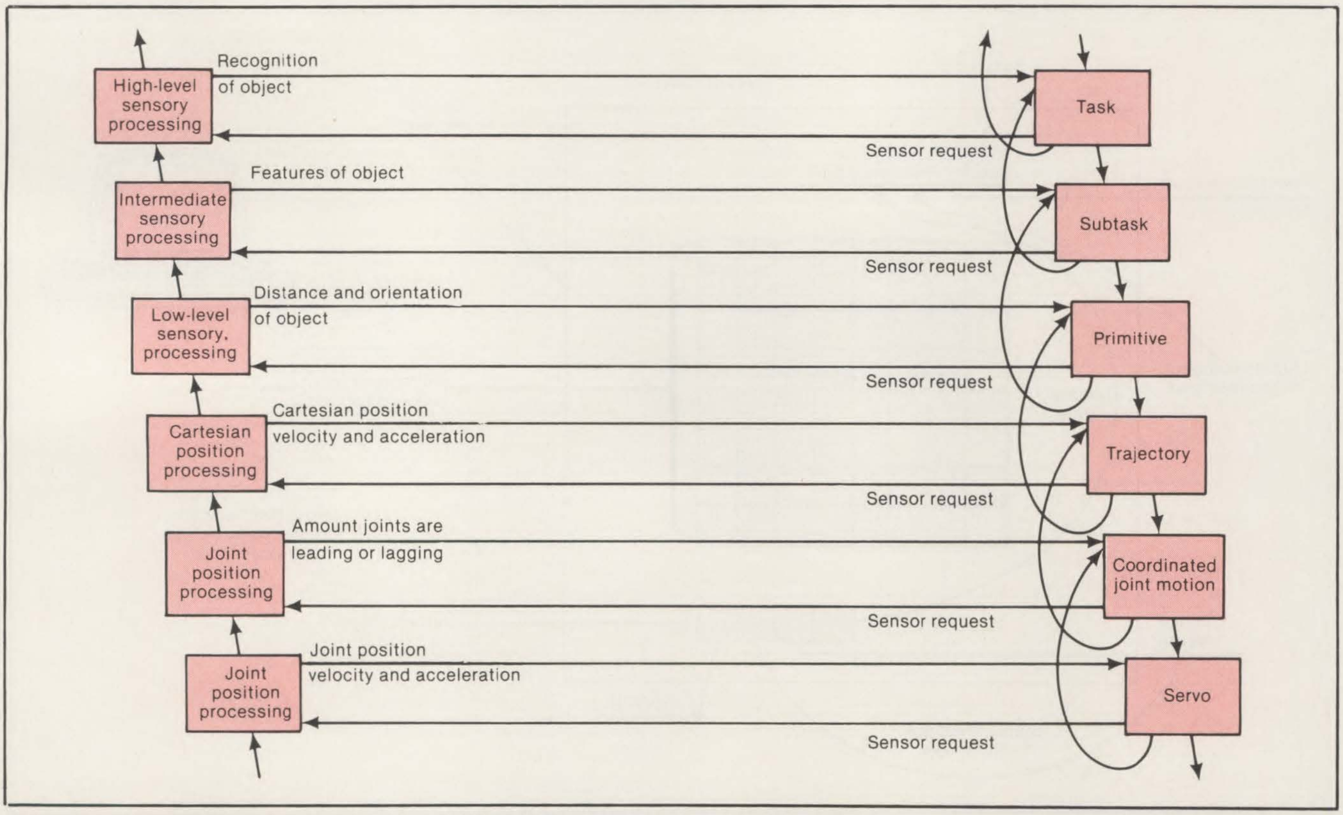
"Due to the complexity of real-time sensory-interactive control, the system must be structured in its design and implementation to keep it comprehensible. The structure must take into consideration human limitations in the management of information. These limitations relate to the apparent inability of people to easily manage more than seven pieces of information at any time," the researchers state in a paper presented at the 14th Southeastern Symposium on System Theory. To deal with the limitation, the system was structured in component parts, each part processing a small set of information, and each having a clearly defined interface.

In one example of a six-level control structure, the task begins with an instruction specified by a user or higher control level that instructs the controller to assemble a motor. That task is immediately broken into a sub-task, such as acquiring a motor shaft. The sub-task is further broken into a command based on information from a vision system to approach the grasping point for the shaft. The controller then computes the goal point for the gripper and the trajectory point for the arm, based on the vision information. The controller then moves the joint values for reaching the motor shaft into the robot's servo mechanisms and initiates and completes the movement. "Each level is executed every 20 msec., and, although the system is operating sequentially down through the levels, all the levels are running at the same time," Barbera says.

The multi-level control system requires feedback to each level. The feedback is "status information from the level below reporting how well the command to that lower level is being carried out. Thus, each level will send status to the level above and receive status from the level below," the researchers state.

In the case of robot control, "the outputs at the bottom level are the drive signals to the actuators of the robot. Each level has a narrowly defined control capability that results in a clear identification of the type of sensory processing required at each level, the type of status feedback necessary and the kind of output commands and status reporting that should be generated," the researchers state.

"The basic control decision level generates three types of outputs as a function of three types of inputs: an input command task, sensory-processing data from the corresponding sensory-processing level and status



The cross-coupling between the sensory-processing and control-decision modules. *A sensory-processing level responds with the feedback information requested by the corresponding control-decision level.*

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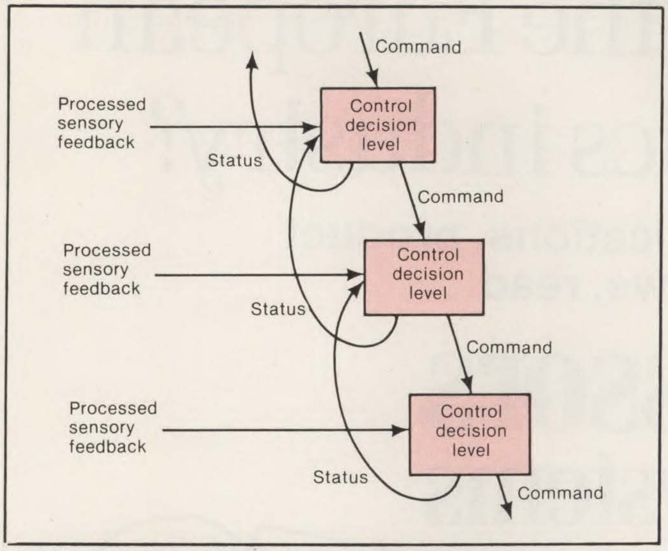
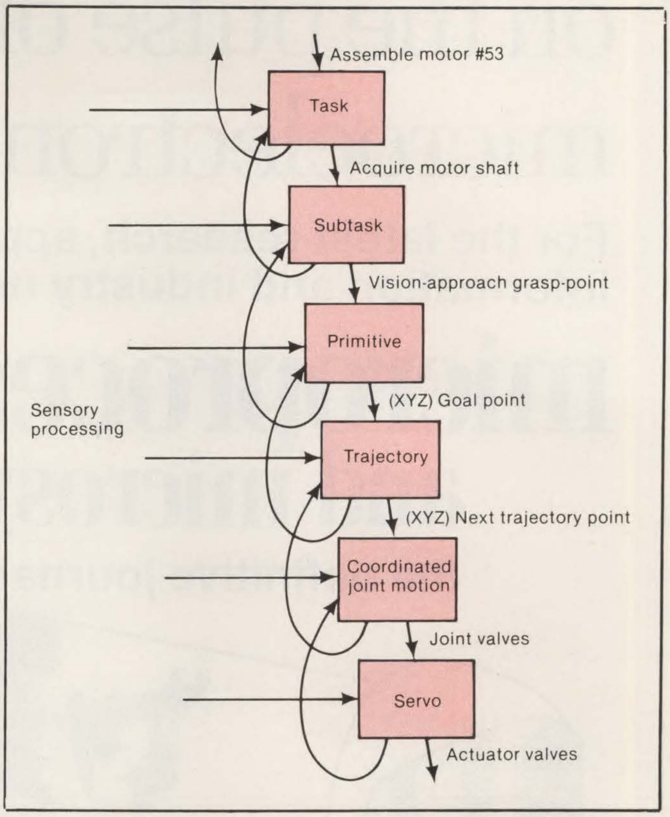


Each level requires feedback status *from the level below, reporting on the progress of the command sent to that level.*



The architecture for this six-level control structure *was designed by considering requirements of the hardware for lower levels and example task decompositions for the higher levels.*

information from the control-decision level below. As a result of these inputs, the control-decision level generates: a control command to the level below, a status report to the next level above and a request to the corresponding sensory-processing level to indicate what type of sensory information is required at this time," the researchers state.

The sensory interactive control must generate an output that is a function of the entire input state. As such, the system is structured so that each control level is a state table process in which all of the inputs are sampled each time an output is to be generated. Each level must also include an internal state variable that encodes the history of how the process arrived at its current condition. "The input values are compared with preprogrammed sets of possible input conditions. If a match is made, then the corresponding output procedures are executed. The output values generated are the output command to the lower level, the request for sensory processing, the status report to the next higher level and the next internal state value. The table-like structure is the format into which a programming system can translate a robot task description. Each line of the table represents a production rule of the type IF 'this input condition' THEN 'generate this output.' It is a straightforward conversion into this table format from a representation of a task description written in an English-like procedural programming language," the researchers state.

To simplify the complex multiprocessor interactions, a common memory buffer communication structure was used. "The addition or deletion of processes is also simplified. This indirect common memory communication link between processors allows the development of each process in isolation by supplying appropriate test values to the proper input common buffers for that particular process. Integration of the tested processes is accomplished by assigning the appropriate common buffers to the processes," the researchers state.

Barbera says that the researchers at the NBS hope to translate the knowledge gained from their work with the robotic architecture into an architecture for overall factory control. ■

NEXT MONTH IN MMS

Two profile surveys will hold the spotlight in the October feature section of Mini-Micro Systems:

- Available add-in memory board products and their vendors will be tabulated and factors analyzed that affect their markets and distribution channels.
- A survey of enclosures will examine this important product sector from an integrator's point of view: what to look for, what to ask for and who to ask.

Other articles will cover:

- Memory technologies
- Vertical magnetic recording
- Optical disks
- Associative memory

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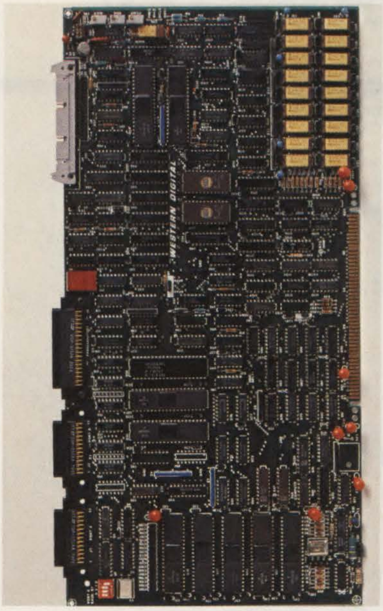
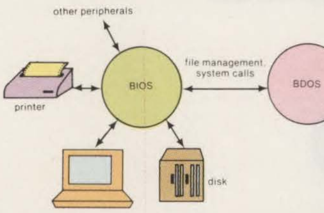
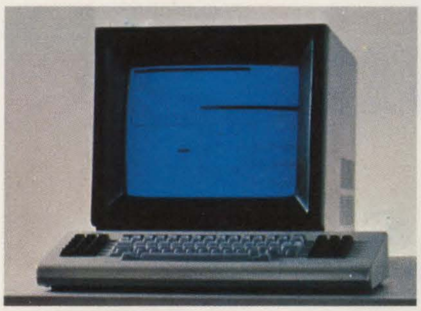
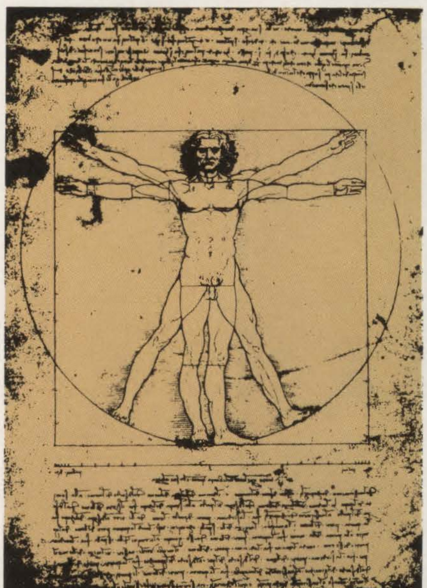
FEATURE HIGHLIGHTS









LANGUAGES: Many languages were developed at a time when punch cards and lengthy turnaround periods were the rule. Although modern computers have reduced turnaround from hours to minutes or even seconds, program development is to some extent unchanged. BASIC and FORTH have demonstrated the advantages of interactive languages, but both these languages are relatively unstructured. MAGIC/L, developed by Loki Engineering, Inc., combines the features of a structured language with an interactive programming environment. For an in-depth look, see **p. 229**. . . . The first complete Ada compiler has not been done by a huge defense contractor on a supercomputer. It's been done by a \$35-million company named Western Digital Corp. on its 16-bit desk-top computer. The cover story begins on **p. 207**. . . . The recent U.S. Department of Defense specification for the Ada programming language provides government, industry and academia with the basis for a highly standardized, efficient language. A language can be far more useful, however, in a software environment specifically designed to support programming efforts in that language. For a closer look at Intermetrics, Inc.'s Ada Integrated Environment, see **p. 223**.

OPERATING SYSTEMS: The proprietary operating system may not be dead, but you'd never know it from the slew of microcomputer introductions hitting the industry. Names such as CP/M, MS/DOS, OASIS and UNIX are the most often heard and, in fact, have become de facto standards by virtue of their popularity. But they are only four of some two dozen portable operating systems from which vendors can choose. A comprehensive survey begins on **p. 237**. . . . The continuing proliferation of new microcomputer models has also made transportability a key software feature. The UCSD p-System uses the code for an intermediary pseudo-machine to provide software transportability between computers based on a variety of microprocessors. For a closer look at the system, see **p. 183**.

DATABASE SOFTWARE: Five years ago, the phrase "microcomputer database software" would have been self-contradictory. Today, it describes one of the largest and fastest growing segments of the software industry. Low-priced memory, powerful microcomputers and increasing user demand have encouraged more than a dozen firms to develop database packages for minicomputers and microcomputers. See **p. 193** for a comparison.

WORK STATIONS: As more executives, professionals and office workers complain about losing work space to machines, and of being subjected to computer-related ills ranging from eyestrain to bruised shins, computer work-station furniture is fast becoming a major sub-industry. More than 50 firms manufacture work-station furniture, and the selection range is enormous. A guide for picking what you might need in your office starts on **p. 275**. . . . Faced with rising design costs and shrinking product life cycles, the electronics industry needs to boost engineer productivity. A new work-station-based system integrates graphics, logic and communications functions to assist engineers in virtually every phase of complex circuit design. For a look at Mentor Graphics Corp.'s IDEA 100, see **p. 287**.

Today's tough business environment demands performance. It demands increasing productivity. It means that you should see the problem-solving capabilities of the new CalComp 4000 family of Vistagraphic™ Display Systems. With unique new features, enhanced technology, increased flexibility and competitive pricing, the CalComp family of displays is a "must to consider" for both OEMs and end users alike.

One unique feature of the 4000 family of compatible displays is the versatility inherent in employing two MC68000 microprocessors. One is devoted to display processing, while the second handles peripherals and communications.

The result is a display workstation that can be configured either as a graphic terminal interfaced to a host computer, or a fully-operable standalone graphics computer.

A performance level to match your need.
There are three Vistagraphic models, all with dual pixel memories. The 4200 has a resolution of 640 x 512 pixels, and is suggested for entry level applications, such as process control. The next level up—perfect for CAD/CAM applications—is the 4300, which has a 1024 x 768 pixel resolution. Top resolution is achieved in the 4400, which features 1024 x 1024 pixels. This model is ideal for applications such as mapping and engineering analysis.

Performance you'll learn to love.
The Vistagraphic system processor has 128K bytes of RAM, 32K bytes of EPROM, and an optional RAM expansion of up to 1M bytes. The dual pixel memory provides real-time updating of screen images without blanking, without flash and without "hole-filling" drudgery. With rapid operator-to-terminal response, continuous interactive graphics processing is simplicity itself.

All Vistagraphic 4000 Displays are available in either color or monochrome. A palette of 4096 total colors is available; up to 256 can be displayed simultaneously. In addition to complex polygon fills, the 4000 family can draw vectors, characters, circles, ellipses and dots. The compact desktop unit also includes a 19″ color monitor, an alphanumeric keyboard with 32 lighted function keys and serial interface ports.

Ask for a display.
As the single source in computer graphics problem solving, CalComp offers a wide range of options. On the input side, we've got joysticks, data tablets, light pens, trackballs and force sticks. Hardcopy output options include monochrome or color screen hardcopy, a full range of pen plotters and electrostatic plotter/printers. Add to this supporting software, including CalComp's VistaDOS™: All this from the company that pioneered computer graphics more than 20 years ago.

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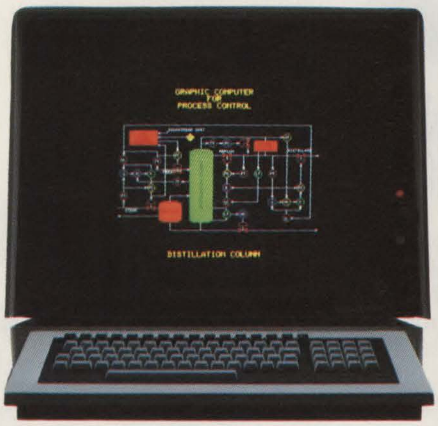
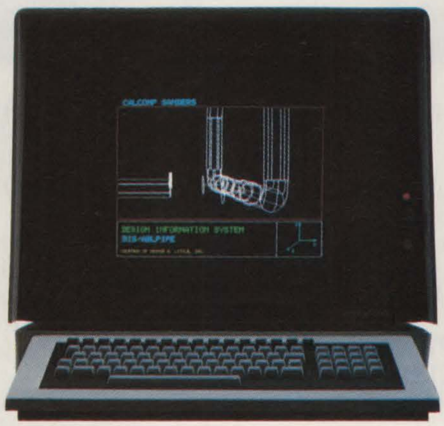


Model 4200



Model 4300

Model 4400

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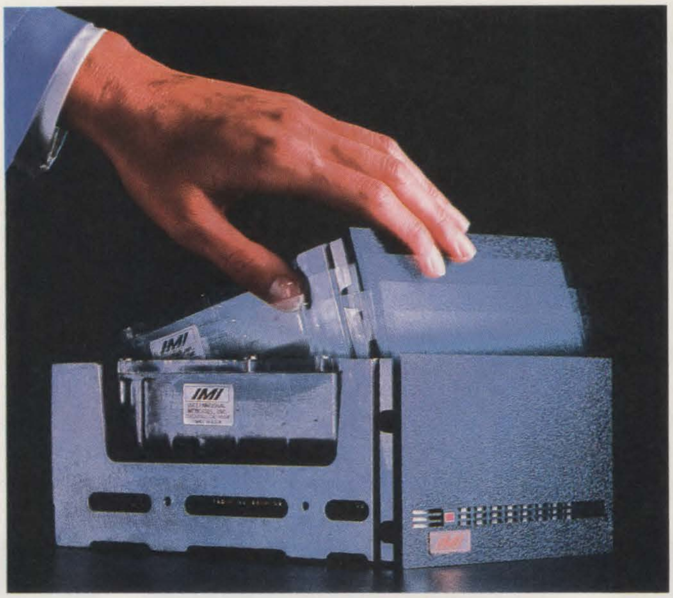


If our new 5000H Series drives weren't the most reliable 5¼" Winchesters ever built, we wouldn't give them an unprecedented 2-year warranty.

Don't expect to use it, though.

5000H Series drives are made to withstand the everyday abuse known as "normal system usage." And to give continuously superior performance in even the most demanding applications.

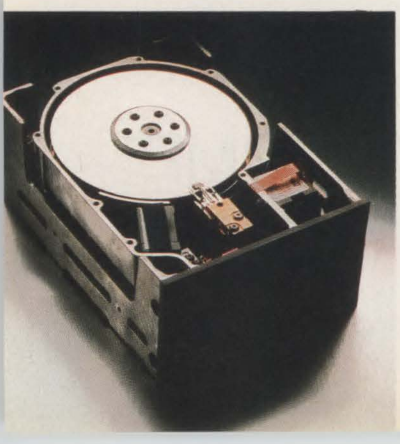
So the overwhelming odds are that the 2-year warranty will expire long before the drive ever does.

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

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

Thin-film plated media also allows greater bit densities, as much as 10,700 bpi. This has enabled IMI to up the unformatted storage capacity of the 5021H drive, for example, to 21 Mbytes.

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



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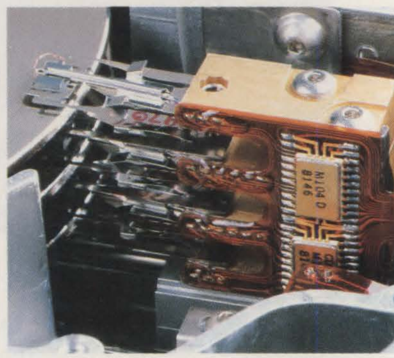

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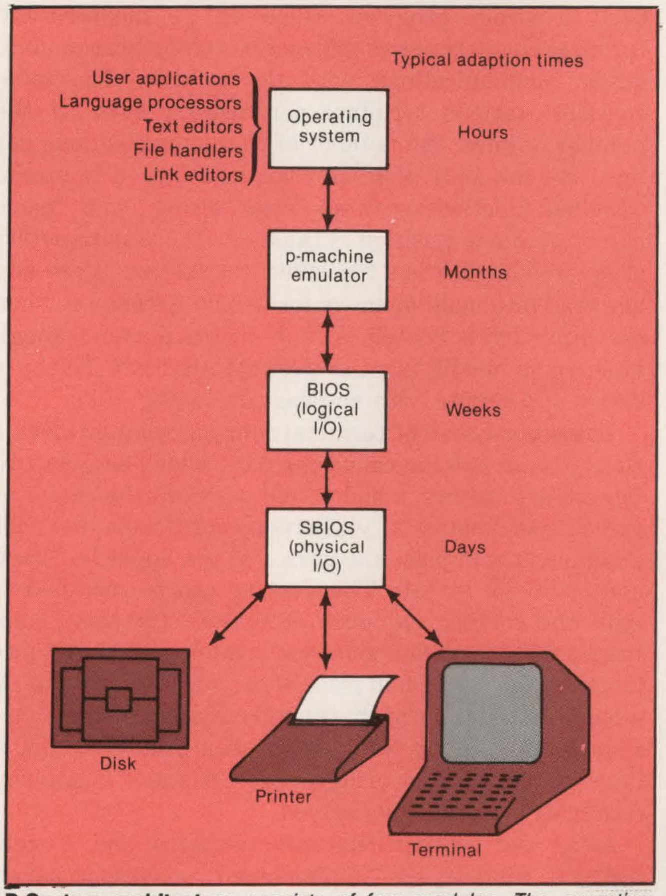
SOFTWARE

Implementing the UCSD p-System

MARK OVERGAARD, Softech Microsystems, Inc.

A standardized intermediate machine code makes this operating system highly transportable

The continuing proliferation of new microcomputer models has made transportability a key software feature. Development costs for a transportable application package can be spread over a larger potential user base, and mature software can follow a user from machine to machine.



P-System architecture *consists of four modules. The operating-system module is written in Pascal, and requires little, if any, adaptation. The p-machine emulator, which translates standardized p-code into native machine code, is difficult to adapt, but is already written for popular microprocessors. The peripheral-independent BIOS module handles logical I/O. Like the emulator, it is written in native code and is adapted for many machines. The SBIOS must be adapted for peripherals, but adaptation is relatively simple.*

One way to achieve application-software transportability is to use a transportable operating system. The UCSD p-System uses the code for an intermediary pseudo-machine to provide software transportability between computers based on a variety of microprocessors. The p-System's modular operating system architecture also allows the vendor to adapt it to a new machine with minimal effort.

P-System structure

The architecture of the p-System consists of four modules: the operating system, the p-machine emulator, the Basic I/O system and the Simplified Basic I/O System.

The **operating system** and utilities are written in Pascal. The Pascal statements are translated into binary machine code for a standardized, hypothetical processor, or pseudo-machine (p-machine). To transport the operating system to a real microprocessor, a p-machine emulator is written in the microprocessor's native code, and the entire software system executes immediately. The operating system and utilities can be transported without modification to any computer that contains a p-machine emulator, regardless of its CPU instruction set, I/O architecture or peripheral devices. I/O requests to the operating system are at the "symbolic" level, specifying such functions as "write n characters to a file called XYZ."

The one operating system component that may require customization to a particular configuration is Screen I/O, which handles interaction with the console terminal. Because the command sequences that cause a terminal to clear its screen or move its cursor can differ substantially among various models of terminal, the p-System includes mechanisms to accommodate these differences. In all cases, all executable code in the Screen I/O component is independent of the underlying processor and the physical terminal interface.

The **p-machine** emulator is written in the native code of the host CPU. Because the intermediate code, or p-code, of the p-machine is a binary code close to the

The p-System directs the user through the process of building the terminal characteristics file with a series of prompts.

native code of many common microprocessors, p-code programs execute on the emulator faster than source-code programs that run under an interpreter—as much as 10 times faster than an interpreted BASIC, for example. The p-code instruction set is compact, so that p-code programs usually use less memory than native code, particularly when the native code is translated from a high-level language.

I/O operations in the emulator are handled at a relatively high level. The emulator considers a disk, for example, to consist of an array of directly addressable 512-byte blocks. Because all device-specific operations are lower level routines, the emulator is independent of the computer's I/O system or peripheral devices. Although the emulator depends on the instruction set of the CPU chip used, it is relatively independent of the system using that chip, performing only arithmetic, logical and memory operations.

Any emulator already designed for a system's CPU chip is transportable virtually unchanged to any other system using that same CPU chip. Emulators exist for the Z80, 8080/85/86/88, PDP-11/LSI-11, 6502, TI9900, 6809 and 68000, and there is a VAX-11 implementation running under Digital Equipment Corp.'s VMS operating system. Emulators for computers using any of these instruction sets do not require rewriting.

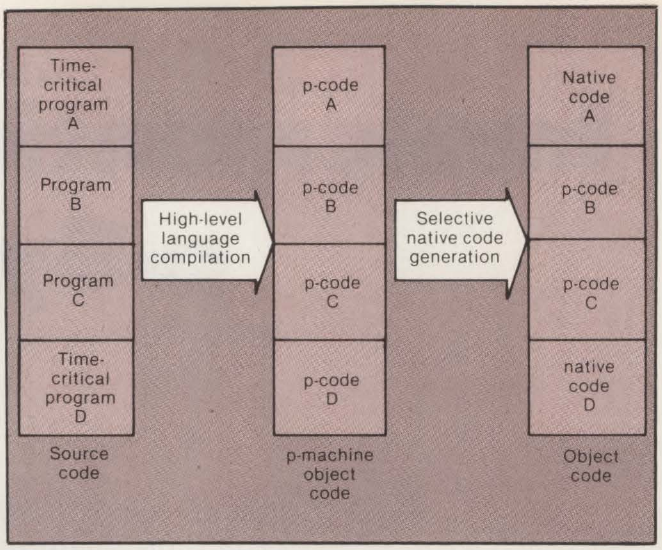
The **Basic Input/Output System** contains all of the I/O services the emulator can call, although the BIOS still handles I/O at a relatively generic level. For example, the BIOS converts logical block addresses into track and sector coordinates and issues a call to lower level routines for writing. The BIOS need not know the mechanisms of writing on the disk.

The BIOS is written in the native machine code of the host computer. BIOS operations, like the emulator's, are strictly logical and arithmetic. It is therefore independent of the peripheral devices, and can be easily transported to computer systems using the same instruction set.

The **Simplified Basic Input/Output System,** the lowest level of routines in the p-System, contains the actual I/O drivers that send and receive data to and from the peripheral devices. The SBIOS routines are written in the native machine code of the CPU, and are rewritten only when peripherals are changed. In some adaptations, the ISBOS is entirely dispensed with, and the BIOS takes direct responsibility for dealing with peripherals.

Console adaptation

The p-System's knowledge of the control sequences involved in terminal communication is localized to the



Selective p-code translation *allows programs to be designated as time-critical through compiler directives in the source program. All programs are translated into p-code, but only time-critical programs are immediately converted to native code.*

screen-I/O component of the operating system; the rest of the system calls routines in Screen I/O to cause actions on the console screen.

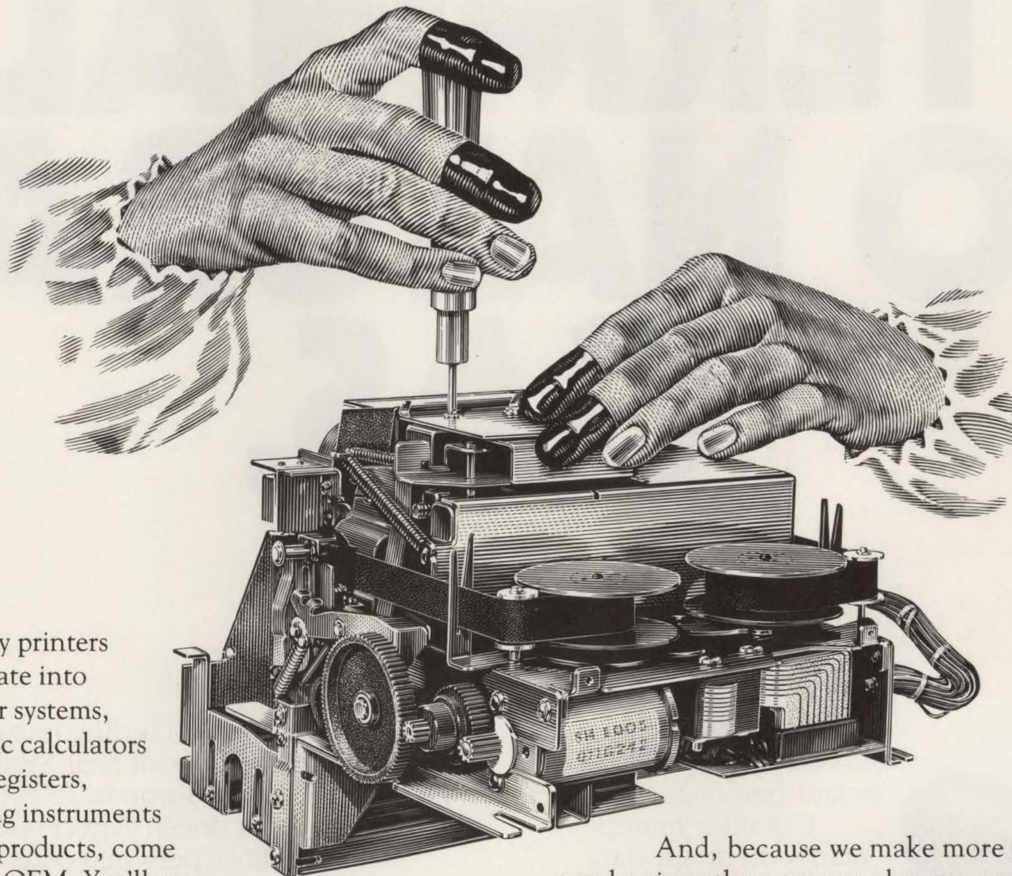
Terminal adaptation proceeds in two steps. In the first, a utility program called SETUP modifies the terminal characteristics table employed by Screen I/O to guide communications with the console. The table contains various terminal parameters, such as the number of lines, the number of character positions per line, and the ASCII character sequences used to invoke terminal functions such as "clear screen" and "move cursor to home position" (Table 2). These parameters are stored on disk in a file called SYSTEM.MISCINFO and are read into main memory for use by Screen I/O when the p-System is booted. SETUP directs a user through building or modifying the SYSTEM.MISCINFO file by a series of prompts with no program coding.

The second step of terminal configuration involves a short Pascal routine called GOTOXY, which accepts two integer arguments, x and y, and positions the cursor at screen coordinates (x, y). Screen coordinates (0,0), for example, would place the cursor at the upper left-hand corner of the screen. This routine can be modified to emit the correct sequence of cursor-addressing commands for a terminal, and then compile and bind it into the operating system in place of the supplied version. A table-oriented approach to customizing this cursor-addressing function would have been preferred, but a table organization covering all protocols used in popular terminals could not be derived.

After the SYSTEM.MISCINFO changes and a new GOTOXY routine are implemented, a utility called SCREENTEST verifies that the terminal adaptation has been done properly.

Computers running Digital Research, Inc.'s CP/M-80 operating system require only a simple terminal adaptation to support the p-System. Because the capabilities of—and interface to—the SBIOS are very

Will build to suit.



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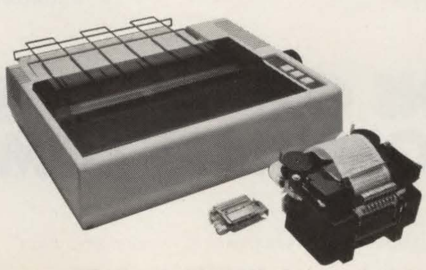

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One version of the p-System BIOS runs on top of the CP/M BIOS.

similar to those of a CP/M "CBIOS," there is a p-System BIOS that interfaces to a CBIOS instead of to an SBIOS. This BIOS allows the p-System to run on top of the CP/M CBIOS. The CBIOS already contains the device-specific interface code to the host computer's peripherals, so that no adaptive programming is necessary. This "CP/M-adaptable system" supports CP/M versions 1.4, 2.0 and 2.2, and is restricted to 128-byte sectors.

P-SYSTEM PROGRAMMING TOOLS

The p-System provides features for both inexperienced programmers and application developers.

A prompt line at the top of the video screen indicates state of the p-System and options a user can select with a single character command. Console input/output can be redirected to disk files or other serial devices.

Peripherals are accessed logically as "volumes." Serial volumes are treated as byte streams, and random-access volumes can have directories of named files. Each volume holds as many as 77 files or subsidiary volumes, each of which comprises as many as 77 files. A file-handler utility supports file management and transfers between random and serial volumes.

Of the two text editors supplied, one requires a CRT console, and the other can use a hard-copy terminal. The video editor maintains a cursor in the edited text file and a window that always shows the current status of the file area on the screen. Commands can move the cursor, find and replace textual patterns and insert and delete text. Special facilities allow document processing. The editor can automatically enforce user-specified left- and right-hand margins, as well as apply new margin requirements to existing texts.

A transfer operation in the file handler can have the printer produce hard copy of the text files, and a print spooler queues files for background printing during text editing or console-based operations. In addition, a text formatter interprets embedded commands in text files.

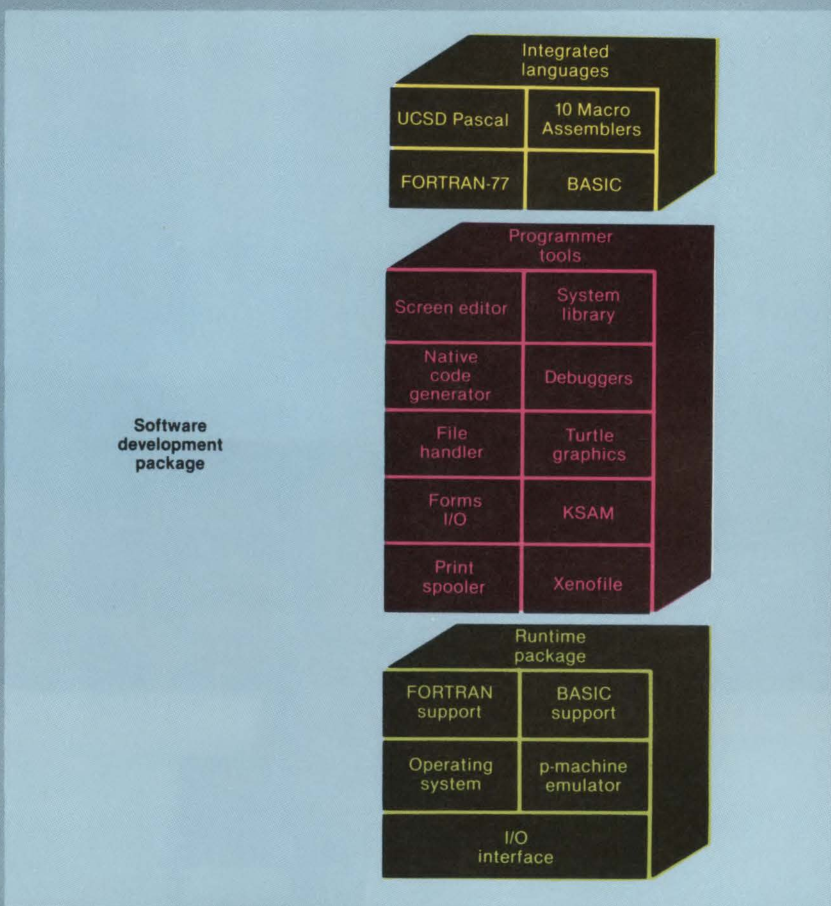
The p-System supports UCSD Pascal, FORTRAN-77 and BASIC. All three compilers produce p-code as outputs and share invocation, syntax error handling and other usage conventions. The system also supports inter-language compilations for all combinations of languages. This facility is most frequently used for accessing utility units (often written in UCSD Pascal) from BASIC and FORTRAN-77.

UCSD Pascal is generally consistent with ISO Pascal and includes various extensions beyond the base language. FORTRAN-77 in the p-System is compatible with the ANSI-standard FORTRAN-77 subset with two exceptions: subprograms cannot be passed as parameters, and INTEGER and REAL data types do not occupy the same amount of storage space. BASIC in the p-System is a superset of ANSI minimal BASIC.

Assemblers are available for the 6502, 6809, 68000, 9900, 8086, Z80, 8080, Z8 and PDP-11 processors. All share common directives and expression syntax, with machine instruction syntax as close as possible to that of the principal processor in the computer. Macro definition and conditional assembly are supported. Any of these assemblers can run on any p-System, regardless of the host processor. When a high-level compiler references an assembly-language routine, a link editor program installs the assembly-language object code into the main code segment of the compiler. The assembly routine is then available for dynamic linking at program-invocation time.

Assembly language can also be used outside a normal p-System environment. Separately assembled components are link-edited together and then processed by a utility that discards the p-System file superstructure and prepares a simple memory image. P-machine emulators can be built with this technique.

Available utilities include Turtlegraphics, KSAM80 and XenoFile. Turtlegraphics produces 2D monochrome or color graphic displays by controlling the activities of a fast-moving "turtle" as it carries a "pen" across a video screen. The KSAM80 file-management system supports sequential and keyed retrieval of data records in p-System files. XenoFile allows p-System-hosted application programs to read and write data on CP/M-organized disks. These utilities can be invoked by an application program.



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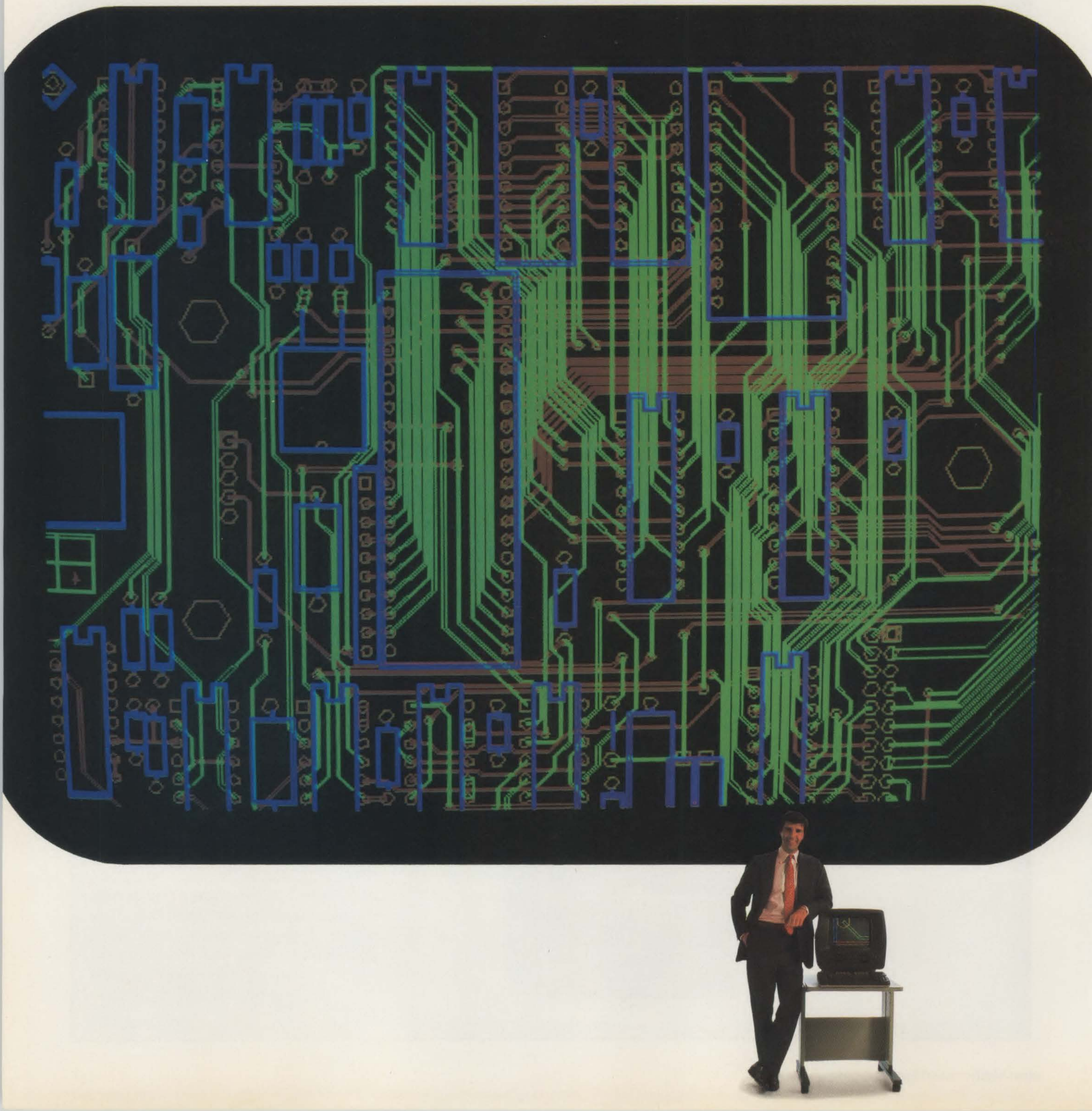

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P-code programs usually use less memory than native code.

SBIOS adaptation

SBIOS routines are written in the assembly language of the target hardware to perform device-level I/O functions. The SBIOS contains two sets of routines: BASIC and Extended (Table 4). BASIC routines interface with the console terminal and disk storage, and must be implemented in every adaptation. Extended SBIOS routines are optional, supporting a printer, a remote serial line and other user-defined devices. The Extended routines are implemented only after the p-System is successfully booted on a new machine with the BASIC SBIOS implementation.

It is useful to test the SBIOS before trying to bootstrap the entire p-System. An SBIOSTESTER program tests only the BASIC SBIOS routines, emphasizing the disk interface code by writing known data patterns on each sector of a disk and reading them back to verify correctness.

The relative simplicity of SBIOS implementation is particularly apparent in the disk-interface routines, which give the SBIOS a track and sector coordinate and then tell it to read or write the designated sector. Above the BIOS interface, all references to disk use logical (512-byte) block numbers. The BIOS converts these numbers into physical track and sector addresses.

CPU	SBIOS	BIOS	CP/M-adaptable	Drivers
Z80	yes	yes	yes	no
8080	yes	yes	yes	no
8086	yes	yes	no	no
9900	no	yes	no	no
68000	yes	yes	no	no
6809	no	yes	no	no
PDP/LSI-11	no	no	no	yes
6502	yes	yes	no	no

P-System adaptations *available for different CPUs include special drivers for PDP/LSI-11 and versions that run on top of CP/M for the Z80 and 8080.*

This approach simplifies the job of an SBIOS programmer, but may adversely affect disk performance. If the disk interface has direct-memory-access capability, for example, it might be possible to read many sectors into main memory from the disk in one I/O operation. Because the SBIOS knows about only one sector transfer at a time, it is difficult for an SBIOS implementation to take full advantage of this kind of hardware capability. In such a case, the BIOS can be modified to achieve full disk performance. The parameters of a disk read request, for example, include the drive number, the drive's logical block number where the read operation should start, the memory address where the data should be placed and the number of bytes to transfer. In a BIOS adaptation, a programmer is free to map these parameters into physical disk areas and to determine how the transfer should occur.

Neither the SBIOS nor the BIOS style of adaptation are supported for the PDP-11/LSI-11 processors. Instead, these machines use a special driver organization, with an ad hoc interface between the p-machine emulator and the I/O drivers. This discrepancy from the normal p-system implementation occurs because the PDP-11 p-machine emulator was the first to be implemented; it predated the BIOS/SBIOS organization, and has not yet been updated. Because SofTech Microsystems, Inc., supplies prepackaged configurations for most of the popular PDP-11 peripheral collections, the need for user adaptation of the PDP-11 system is rather limited.

Installing the p-System on a CPU for which no p-machine emulator currently exists involves a substantial effort requiring detailed knowledge of the internal organization of the p-System. This effort may take a number of months, but still typically takes much less time than required to produce the same software capability from scratch without the p-System approach. Thus, Hewlett-Packard Co. has commissioned the development of a p-machine emulator for the HP87 computer that uses a proprietary CPU chip. Most vendors, however, will find p-System implementation much simpler, often consisting only of adapting the SBIOS to their machines. ■

Mark Overgaard is manager for advanced development programs at SofTech Microsystems, Inc., San Diego, Calif. He participated in the development of the UCSD p-System at the University of California, San Diego, and joined SofTech when it was formed to take over the p-System in an exclusive licensing arrangement.

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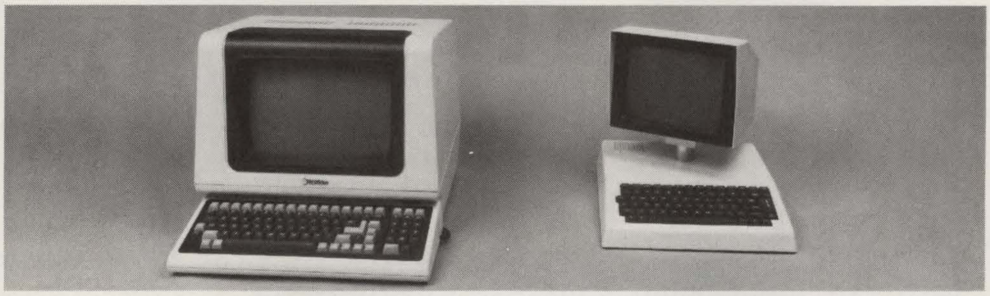

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SOFTWARE

Database software packages for micros

PATRICK KENEALY, Associate Editor

Some are friendly, some are powerful, and some are both

Five years ago, the phrase "microcomputer database software" would have been self-contradictory. Today, it describes one of the largest and fastest growing segments of the software industry. Low-priced memory, powerful microcomputers and increasing user demand have encouraged more than a dozen firms to develop "database packages" for 8- and 16-bit minicomputers and microcomputers. Minicomputer and mainframe software houses have been quick to denigrate the new packages as "mere file handlers" as opposed to true database-management systems, but the new packages are immensely popular. Only word-processing and spread-sheet packages, which sell for roughly half the price of the database packages, are selling faster.

To fill an in-house requirement, *Mini-Micro Systems* recently compared a number of the most popular microcomputer database packages. We were impressed with their capabilities and their friendliness—often at the same time.

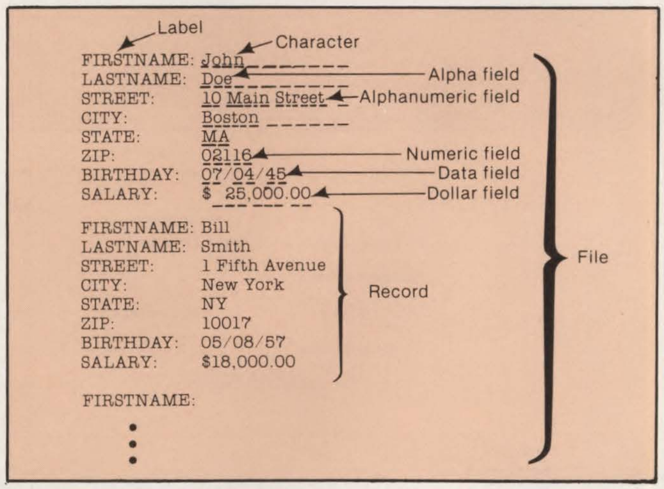

Fig. 1. Database organization *as shown on a data-entry screen. Databases are organized into files, records, fields and characters with simple or complex hierarchical or network relationships between elements.*

Database basics

Software vendors have made "database" a loosely defined term to the horror of those who technically characterize databases as "sequential," "indexed-sequential," "hierarchical," "relational," "shallow-network," "extended-network" and the like. In the face of emphatic but often contradictory definitions from industry experts, *Mini-Micro Systems* has fallen back on a general definition combining those of many microcomputer database vendors: a database manager is a program or set of programs that allows a user to organize, maintain and query data files and to generate custom-designed reports from them.

Database packages are the most expensive kind of microcomputer software, most selling for more than $500, and many selling for more than $1000. They usually require almost 64K bytes of memory and run faster on hard-disk-based systems than on more common dual diskette-based systems. Many packages have been customized to run on a variety of systems, but most packages and the files they create are not easily portable.

Our database software survey did not involve running more than half a dozen packages, and we ran no formal benchmarks. But we did read an amazing number of manuals, and got a good idea of the capabilities, friendliness, documentation and prices of current offerings. Table I summarizes the operating system, media, hardware, main memory, storage and language requirements of each package, and provides end-user prices. Table II specifies size limitations and

How easy any software package is to learn is inversely proportional to how many things it can do.

the availability of selected features. The paragraphs that follow explain the table parameters and the collective features of today's packages.

Database definition and organization

A database package's "power" is abstractly measured by how large and complex the database(s) it creates can be. Most microcomputer-oriented packages can contain only a specified number of records (entries) in each database. Each record can contain a specified number of fields, and each field a specified number of characters (Fig. 1). Some package have only theoretical size limitations, but many are limited by diskette capacities and the capabilities of their host operating systems. A "reorganize" feature on advanced packages allows users to redefine records at any time. It prevents users from having to build wasteful "expansion fields" into their records and can save rekeying.

The number of supported field attributes (analogous to a programming language's data types) is another good gauge of power. Most packages allow or require fields to be defined as alpha, numeric or alphanumeric, but others allow dollar, decimal, date, variable and protected fields. By allowing users to specify acceptable input ranges for fields (e.g., field 6 must contain a numeric value between 100 and 999), systems can keep databases consistent and prevent bad-data-induced crashes.

Key fields are defined to facilitate sorting, selecting and indexing. Simple packages support only one key field per record; most support multiple keys, and many allow selection and sorting on any field. As the number of key fields in a keyed system increases, the speed of sorting and merging decreases.

```
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   CUSTOMER ............... ACCT# ........
   ADDRESS: ............... PHONE ........
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   ORDER DATE ............  CLERK ........

   L# QTY STOCK# DESCRIPTION PRICE AMOUNT.
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+------------------------------------------------------------------------------+

*   MOD-REC.FMT   1/25/82   abg
@ 01,27 SAY mode
@ 02,00 SAY '+-------------------'
@ 02,20 SAY '--------------------'
@ 02,40 SAY '--------------------'
@ 02,60 SAY '-------------------+'
@ 03,00 SAY '!'
@ 03,79 SAY '!'
@ 04,00 SAY '!  ID Number'
@ 04,15 GET mid:no
@ 04,79 SAY '!'
@ 05,00 SAY '!'
@ 05,79 SAY '!'
@ 06,00 SAY '!                  F'
@ 06,20 SAY 'irst'
@ 06,26 GET mfirst
@ 06,41 SAY 'Last'
@ 06,47 GET mlast
@ 06,79 SAY '!'
@ 07,00 SAY '!'
@ 07,79 SAY '!'
@ 08,00 SAY '!                  A'
@ 08,20 SAY 'ddress'
@ 08,28 GET maddress
@ 08,79 SAY '!'
@ 09,00 SAY '!'
@ 09,79 SAY '!'
@ 10,00 SAY '!                  C'
@ 10,20 SAY 'ity'
@ 10,25 GET mcity
@ 10,44 SAY 'State'
@ 10,51 GET mstate
@ 10,59 SAY 'Zip'
@ 10,64 GET mzip
@ 10,79 SAY '!'
@ 11,00 SAY '!'
@ 11,79 SAY '!'
@ 12,00 SAY '!                  P'
@ 12,20 SAY 'hone'
@ 12,26 GET mphone picture '(999) 999-9999'
@ 12,79 SAY '!'
@ 13,00 SAY '!'
@ 13,79 SAY '!'
@ 14,00 SAY '!                  Y'
@ 14,20 SAY 'ear graduated'
@ 14,35 GET myr:grad   PICTURE '99'
@ 14,48 SAY 'Contributions'
@ 14,63 GET mtot:cont
@ 14,79 SAY '!'
@ 15,00 SAY '!'
@ 15,79 SAY '!'
@ 16,00 SAY '!'
@ 16,79 SAY '!'
@ 17,00 SAY '+-------------------'
@ 17,20 SAY '--------------------'
@ 17,40 SAY '--------------------'
@ 17,60 SAY '-------------------+'
@ 18,00 SAY '!'
@ 18,08 SAY prompt1
@ 18,79 SAY '!'
@ 19,00 SAY '!'
@ 19,08 SAY prompt2
@ 19,79 SAY '!'
@ 20,00 SAY '!'
@ 20,08 SAY prompt3
@ 20,79 SAY '!'
@ 21,00 SAY '!'
@ 21,79 SAY '!'
@ 22,00 SAY '+-------------------'
@ 22,20 SAY '--------------------'
@ 22,40 SAY '--------------------'
@ 22,60 SAY '-------------------+'
```

Fig. 2. Screen formatters *can be screen-, menu- or program-driven. On the top is a data-entry form prepared by Applied Software Technology's Versaform package. On the bottom is an Ashton-Tate dBASE II screen format and the code that produced it. The example was taken from Adam Green's* dBASE II User's Guide with Applications, *one of the excellent third-party references for powerful microcomputer DBMS packages.*

```
DP: L66
PD:                                January 5, 1981
PD:
PD:
PD:
PD:
PD:
PD:     @001
PO:     @002
PO:     @003
PD:     #004, #005   #006
PD:
PD:     Dear #007:
PD:
PD:     Thank you for your recent inquiry about available
PD:     homes.  Enclosed you will find a list of properties
PD:     currently for sale that you may find of interest.
PD:     These have been specially selected to meet your
PD:     requirements.
PD:
PD:     Should you have any further questions about these
PD:     homes, feel free to call me at (516) 555-5838.
PD:
PD:                                Sincerely,
PD:
PD:
PD:
PD:
PD:                                George Livingston
PD:                                Continental Realty
PD:
PD:     GL/ss
```

```
Format:format name   Main file=d:mf          Detail file=d:df
------------------------------------------------------------------
GENERAL INFORMATION:     Page length:  l    Page width:  w

Title 1                              Title 2
Title 3                              Title 4
Title 5                              Title 6

------------------------------------------------------------------
MAIN FILE: BF1:bf1  LB1:lb1  BF2:bf2  LB2:lb2  KF:k  Pg/Ln:x  LF:lf

Fields/truncation: f1/tr1 f2/tr2 f3/tr3 ...

Fields totaled:  t1  t2  t3 ...
------------------------------------------------------------------
DETAIL FILE:            Link Field: lf2

Fields printed:  f1/tr1  f2/tr2  f3/tr3...

Fields totaled:  t1  t2  t3 ...
------------------------------------------------------------------
```

```
*  REPORT WRITER  **

'PRESS ENTER' WITHOUT ENTERING DATA TO EXIT.
NAME OF THE FORMAT RECORD > TEST WORK FIELDS
'PRESS ENTER'  -  SIMPLE WRITER.  '1'  -  FULL FEATURES? 1

* DEFINE WORK FIELDS

'PRESS ENTER' - DEFAULT.  '1' - SPECIFY DISPLAY FORMAT? 1

'PRESS ENTER' WITHOUT ENTERING DATA TO TERMINATE.
  WORK FIELD # 1  = N1+2
         DISPLAY FORMAT > ###,###
  WORK FIELD # 2  = >
                 NAME OF THIS WORK FIELD > RATE
         DISPLAY FORMAT > ###,###.##
  WORK FIELD # 3  = W1*W2-1
         DISPLAY FORMAT > ######,###.##
  WORK FIELD # 4  =

* SELECT FIELD (TERMINATED BY 'PRESS ENTER')
30 FIELDS MAXIMUM CAN BE SELECTED.
E.G. S2, N1, W2

'PRESS ENTER' - NO.  '1' - ENTER PRINT COLUMN NUMBERS?
ENTER FIELD ID. >  S1
ENTER FIELD ID. >  W3
ENTER FIELD NAME FOR THE WORK FIELD > CONVERTED VALUE
ENTER FIELD ID. >
* ARITHMETICS SUMMARY:
'PRESS ENTER' - NO TOTAL.         '1' - TOTAL ?
'PRESS ENTER' - NO AVERAGE.       '1' - AVERAGE.?
* FILTER. ('PRESS ENTER' IF NO FILTER OR TERMINATE)
FILTER CRITERIA NO. 1
  FIELD A (E.G. S1, N2, W1) >

* SORT. ('PRESS ENTER' IF NO SORT OR TERMINATE)
SORT KEY NO. 1  >

* FORMATS
'PRESS ENTER' FOR DEFAULT VALUES.

*  UPDATE OR DELETE RECORDS       (USE WITH CARE).
'PRESS ENTER' - NO DELETE.        '1' - DELETE.?
'PRESS ENTER' - NO UPDATE.        '1' - UPDATE.?
A RECORD CAN BE COPIED TO ANOTHER FILE.
'PRESS ENTER' - NO.  '1' - COPY?
'PRESS ENTER' - SAVE TO DISK.  '1' - NO?
ORMAT RECORD:

 NO.            NAME
========================================
ALL FORMAT RECORDS UNUSED.

'PRESS ENTER'  TO EXIT
SELECT UNUSED FORMAT RECORD NO.
ENTER FORMAT RECORD NO. (1 TO 24 )? 1
```

Fig. 3. Report generation, *like screen formatting, is more or less interactive from package to package. Top left is a report format for Micro Applications Group's MAG/base in which a form letter is generated by "painting" it on the screen complete with field numbers. On the bottom left is a menu-driven report generator from Innovative Software's TIM system. On the right is a prompted program-style generator from Micro Architect's IDM package.*

```
                    FMS-80 Main Menu Release 2.21

 1. FILE DEFINITIONS MENU
 2. FILE MAINTENANCE MENU
 3. FILE REPORTS MENU
 4. UTILITY
 5. HELP
 6. BATCH
 7. USER MENU
 8. EXIT FMS-80

What do you wish to do? Enter number:
```

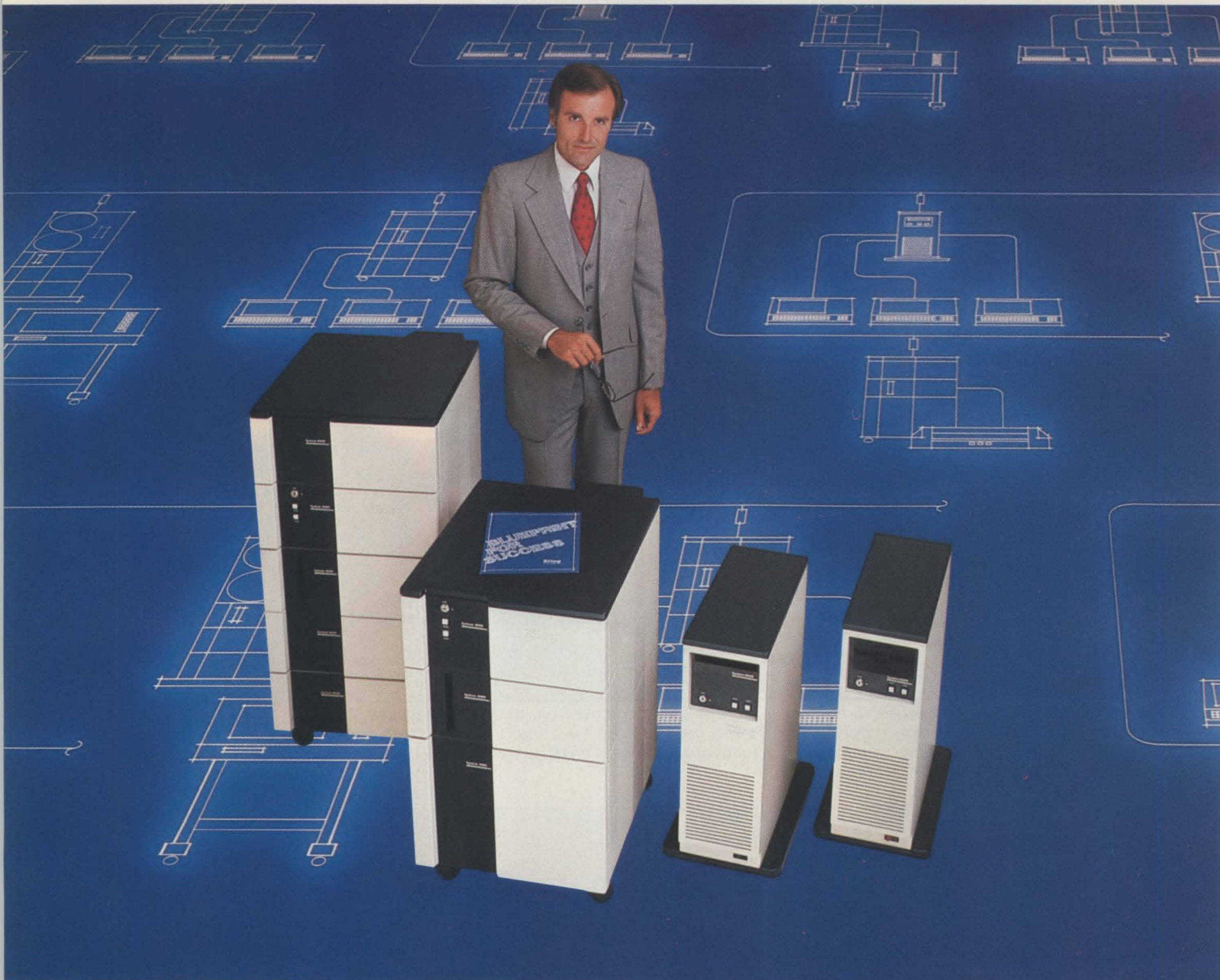
```
                    FMS-80 FILE DEFINITIONS Release 2.21
 1. DEFINE FD
 2. GLOSSARY
 3. DEFINE KEYS
 4. PRINT KEY DEFINITIONS
 5. SELECT
 6. PRINT SELECTION
 7. DEFINE SCREEN
 8. PRINT SCREEN DEFINITION
 9. DEFINE REPORT
10. PRINT REPORT DEFINITION
11. COMPILE EFM REQUEST
12. UTILITY
13. DEFINE MENU
14. PRINT MENU DEFINITION
15. FILE MAINTENANCE MENU
16. FILE REPORTS MENU
17. FMS-80 MAIN MENU
18. EXIT FMS-80

What do you wish to do? Enter number:
```

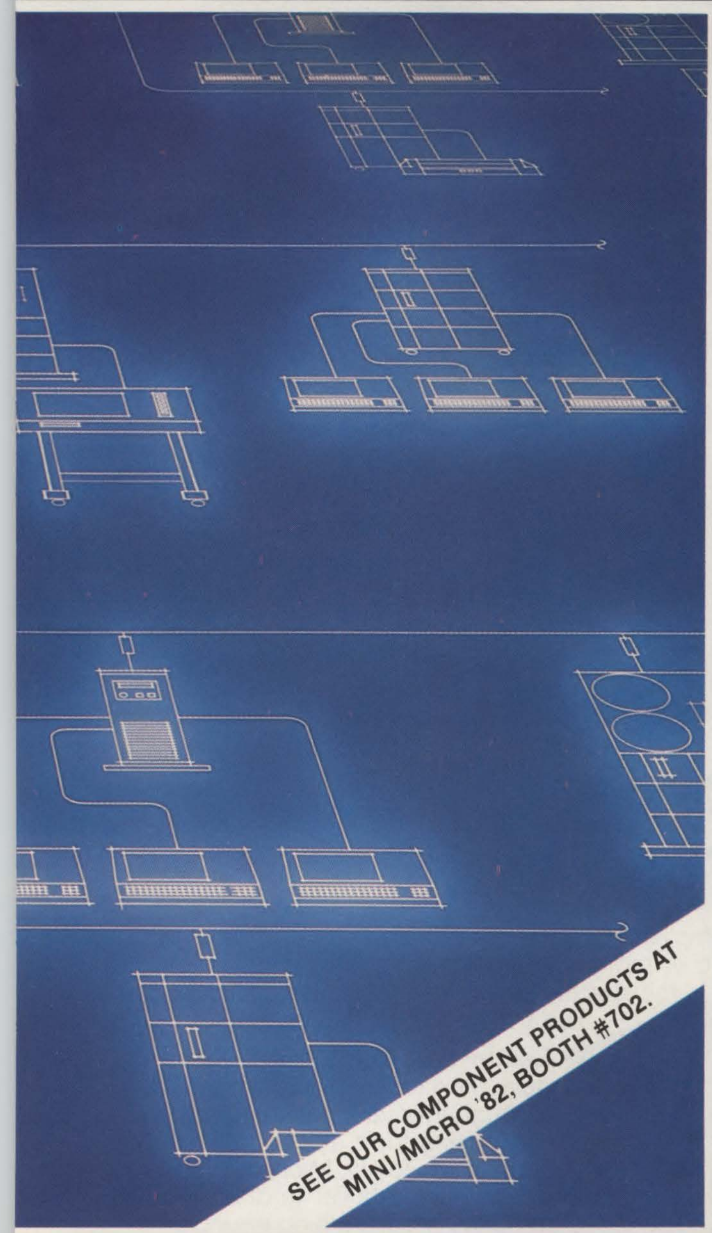
```
A = Add records                  R = Redisplay current record
C = Change current file          S = Search for a record
D = Delete current record        T = Toggle screen
F = go to First record           U = Update current record
H = display Help menu            X = eXit to main menu
K = change Key-field             Return = Step to next record
N = go to record Number          +n = Jump forward direction
P = Print current record         -n = Jump backward direction
```

Fig. 4. Menu-driven database packages *are simple to learn and operate, but simplicity is gained at the expense of time and flexibility. Time is lost when users must move through too many levels of menu too often. Flexibility is lost when a necessary command is not on any menu. Newer menu systems overcome both these shortcomings with user-defined command sequences. Above are two menus from DJR Associates' FMS-80 package. On the right is a menu from Innovative Software's TIM packages.*

Zilog's System



8000 family spells OEM success.



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The entry level Models 10 and 11 give you 256 KB of parity memory, and an 18 MB Winchester disk for on-line storage. They support up to eight users, making them the perfect low-cost micros for commercial users.

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Best of all, the System 8000 family has been designed to take full advantage of the powerful UNIX* operating system. System III has been added to further enhance application software development, making System 8000 computers your best choice to run high level languages such as BASIC, COBOL, FORTRAN 77, C, Pascal, PLZ/SYS and Z8000 assembler. All software is code and data compatible, allowing for total portability among all family systems. Inside all System 8000s are the high performance VLSI components you've come to expect from Zilog. The Z8000™ is a 16-bit CPU with 16 general purpose registers, an 8 MB address space and expanded capability to perform 8-bit, 16-bit and 32-bit operations. In addition, each system can communicate via the Z-NET II local area network, and with other UNIX-based systems as well.

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CIRCLE NO. 98 ON INQUIRY CARD

Database packages are the most expensive kind of microcomputer software, most selling for more than $500.

Part of the database definition process is the formatting of records on the CRT screen. Some of the packages have built-in screen generators that allow a user to create a data-entry format on the screen just as he would type it on a typewriter. Other packages require specifying the contents of every location on the

TABLE 1: MICROCOMPUTER DATABASE SOFTWARE SPECIFICATIONS

Manufacturer Package	Host operating system	Minimum memory (bytes)	Menu-driven?	Written in	Price	Notes	Circle no.
Applied Software Technology VersaForm	Apple DOS	64K		Pascal	$389	Pascal interface is $245; hard-disk version is $495	400
Ashton-Tate dBASE II	CP/M	48K	N		$595	various program generator options are available	401
Condor Condor Series 20	CP/M, PC DOS	64K	Y	machine language	$995	available in modules; Condor 1, $295; Condor report writer, $295; Condor index, $195; base price is combined package	402
DJR Associates, Inc. FMS-80	CP/M, TurboDOS, UNIX	48K	Y	8080 assembler	$995	FMS-81 package is a user-friendly menu-driven version for the novice ($495)	403
High Technology Software Information Master	Apple DOS	48K	Y	Applesoft BASIC	$150		404
Innovative Software, Inc. TIM (Total Information Management)		48K	Y	Microsoft BASIC	$400	Wordstar package optional	405
Link Systems Datafax	Apple DOS	64K			$199	interfaces to various Link Systems utility software	406
Micro AP Selector IV	CP/M	56K	Y	C BASIC	$550		407
Micro Applications Group MAG/base	CP/M, CP/M-86, MP/M, MP/M-86, UNIX	48K or 52K	Y		$795	works with MAG/sam, Mag/sort, other company software packages; versions with comprehensive report writers and for application development are available	408
Micro Data Base Systems, Inc. MDBS	PC DOS, CP/M	64K	N	machine language	$900		409
MicroPro International Corp. DataStar	CP/M, Apple DOS	48K	Y		$350	works with Supersort, Mailmerge, Infostar, other MicroPro packages	410
MPSI AutoIndex	BOS/5, MBOS/5		Y		$550, single user; $950, multi-user	interfaces with various MPSI business-software packages	411
Pacific Software Sequitur	UNIX		N		$3495	installed on Onyx, Plexus, DEC PDP/11 series machines	412
Software Publishing Corp. PFS (Personal Filing System)	Apple DOS	48K			$125	PFS:REPORT report writer is $95; PFS:GRAPH graphics package is $125; base price is for Apple II version of PFS; Apple III version is $175 and requires 128K bytes of RAM	413
VisiCorp VisiFile	Apple DOS	48K	Y	Applesoft BASIC		compatible with various VisiCorp business-software packages	414

A database package's 'power' is abstractly measured by how large and complex the database(s) it creates can be.

screen via a long but flexible screen-formatting program (Fig. 2).

Data manipulation

Easy data manipulation is the reward for careful database definition and long hours of data entry. Most of the systems surveyed worked with one file (database) at a time, but the trend is toward multi-file capability, which allows file merging and comparison. All the packages surveyed allow a user to add, delete and edit records. Group editing features allow a user to update numerous records with one command. Sometimes, the system itself updates single or multiple records (e.g., to modify many dates automatically according to predetermined routines).

Every package allows users to find individual records; most allow users to select records using Boolean operators (e.g., IF ZIPCODE > 02000), and many allow multi-level Boolean selections (e.g., IF ZIPCODE > 0200 AND IF CUSTNUMBER < 1000 AND IF DATE = 06/81.....). FIND commands are used in file updating to take users to specific records. SELECT commands build sub-files or indexes that are used for screen and printer output.

Sorting capabilities are similar. All the packages allow single-key sorting (e.g., PRINT FIRSTNAME, LASTNAME, AGE, GRADE BY AGE), and most offer multi-key sorting (e.g., PRINT GRADE, FIRSTNAME,

TABLE 2: MICROCOMPUTER DATABASE SOFTWARE FEATURES

Package	AutoIndex	Condor Series 20	Datafax	DataStar	dBASE II	FMS-80	Information Master
Maximum no. files on-line		2		1	2	19	1
Maximum no. records per file	65,535	32,767	3000		65,535	65,535	1000
Maximum no. bytes per record		1023		4096	1000		1980
Maximum no. fields per record	35	127	60+	255	32	255	20
Maximum no. bytes per field		127		255	254	255	99
Field/data types*		A, N, AN, $, D, C				A, N, V, X, C	A, N, $, C
Record selection	multi-level	multi-level Boolean		Y		multi-level Boolean	6-level Boolean
Sorting	3-level	multi-level			single-level		6-level
Single/multiple keys per record	12		multiple	single	single	multiple	6
Automatic sort/index maintenance	N	N	Y	N		Y	Y
Boolean update of multiple records	Y	Y		N	Y	Y	N
System-generated updates	N	Y		N		Y	N
File merging	N	Y		Y	Y	Y	
User-defined queries/command sequences		Y				Y	Y
Predefined report formats		Y		N	Y	Y	Y
File format revision	Y	Y		N	Y	Y	
Programming language interface	Y	Y		Y	Y	Y	Y
Security passwords	N	N		N	N	N	N
Statistics	N	N		N		N	N

*Field date types
A = alpha; AN = alphanumeric; $ = dollar; K = keyed; X = decimal
N = numeric; D = date; C = calculated; V = variable; P = protected

LASTNAME, AGE, BY GRADE, LASTNAME, FIRSTNAME). Many of the packages automatically maintain sorted files as records are added, changed or deleted. Others require resorting and re-indexing after each round of changes.

Report generation and other features

The report generator is the part of the database package that preselects data to be displayed on the screen or output to a printer. Report generators, like data-entry routines are available in two versions: those that are screen oriented and those that are not (Fig. 3). Screen-oriented packages allow a user to create a screen or printer output format just by painting it on the screen. Non-screen-oriented report generators require users to write output programs and then run them. Some of the non-screen-oriented report writers accept simple commands such as "REPORT 1: FIRSTNAME, LASTNAME, AGE" and then label and space columns automatically. Others allow (or require) a user to specify labeling, spacing and other formats explicitly for every report. Like frequently used queries, frequently used report formats can be stored and then recalled with abbreviated commands. Micro database report generators range from simple table formatters to comprehensive systems with built-in graphics and word-processing capabilities.

The last major group of database-package features is the collection of extension routines that expand a package's non-database capabilities and tie it to a user's other applications. As mentioned above, many packages offer word-processing and graphics capabilities as standard features or options, and mathematical and statistical functions are popular as well. Systems provide security features ranging from simple five-letter passwords for access to files, to 500-level nested security systems that can make files, records, fields, reports or even relationships off limits to unauthorized

MAG/base	MDBS	PFS	Selector IV	Sequitur	TIM	VersaForm	VisiFile
1	8		6				
32,767	65,521	32,000			32,767	30,000	1000
2500	9999		255	unlimited	2400	4950	232
999	255	100	80		40	50	24
		1679			60	78	
AN, N, D, reserved fields	A, N, AN, D, C, binary, synonym		A, N, AN, D, K, C	A, N, $	A, N, $, D, C	A, N, AN, D	
multi-level Boolean	multi-level Boolean	Boolean	10-level Boolean	multi-level Boolean	multi-level Boolean	Boolean	
multi-level	Y	single-level		multi-level		single-level	10-level
multiple		1			multiple	single	
Y	Y	N	Y	Y	Y	Y	
N	Y	N		Y			
N	Y	N	N		Y		
N	Y	Y	Y	Y	Y	Y	Y
Y	Y	Y	Y	Y	Y		
Y	Y	Y	Y	Y	Y	Y	
Y	Y	Y	Y	Y	Y		
Y	Y	N	N	Y	Y	Y	
N	Y	N	N		Y		
N		N	N		N		

Many packages offer word-processing or graphics capabilities as standard features or options, and mathematical and statistical functions are popular as well.

users.

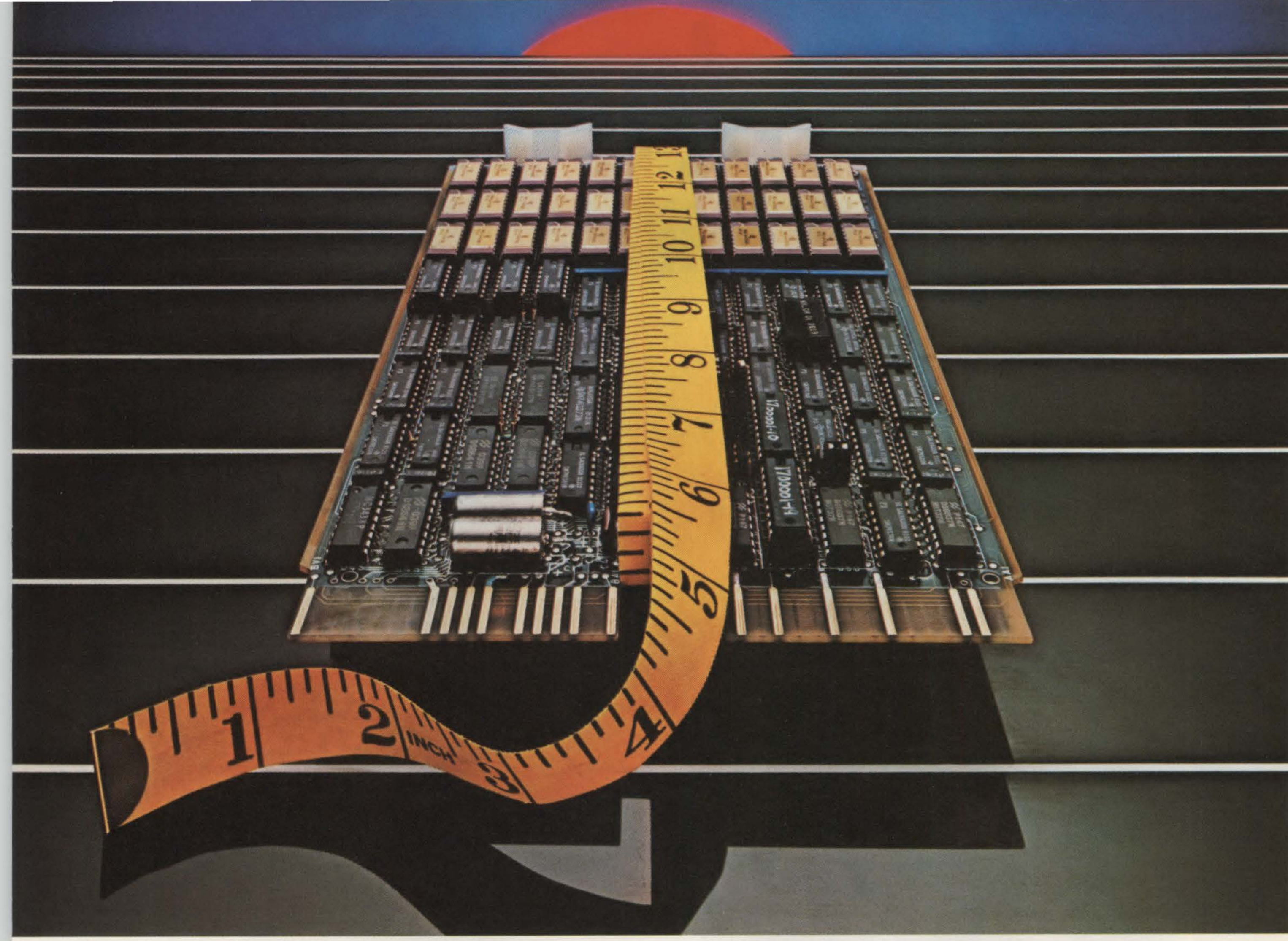
Many of the systems are designed to serve as a base for application development and interface to higher level programming languages. Software houses such as MicroPro International Corp. and Visicorp offer wide lines of word-processing, business-planning and database software packages designed to work together. By virtue of their central function of data organization and manipulation, database packages play a large part in integrating multifunction application systems.

Power and friendliness

How easy any software package is to learn is inversely proportional to how many things it can do. The more there is for a user to learn, the longer it takes. Aware of this relationship, database software vendors have two major kinds of packages: menu-driven ones and language-driven ones (Fig. 4). Menu-driven packages such as Condor, Datastar and Visifile are inherently easy to learn and operate. Language-driven packages such as MDBS, dBASE II and FMS-80 require users to spell out commands rather than select them from menus. These packages are inherently flexible, and are powerful and fast in the hands of experienced users. Most menu-driven packages can be learned in hours; most language-type programs can be learned in days.

The key to learning to use any software package is documentation, and the packages we examined were, as a whole, very well-documented. Vendors offer training manuals for novices, reference manuals for experienced users and technical manuals for expert programmers. Collectively, the manuals are well-illustrated and clear, and typesetting and color are frequently used to separate user input from system prompts, screen output and printer output. Many vendors offer training diskettes or audio cassettes with their packages. One, Innovative Software, offers video cassettes for user training.

"User-friendliness" is not just a buzzword. It's vital to a complex software package's commercial success with non-programmer users. Friendliness costs memory and processing power. Even two years ago, both were expensive and in short supply on microcomputers. Only classic minicomputer and mainframe database packages such as TOTAL, IMAGE and ADABAS were capable and friendly. Today, thanks to sophisticated database software packages and 16-bit microcomputers, powerful, friendly databases can fit on a desk top. ■



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Unique on-board controller makes parity controller boards obsolete.

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TI MEMORY BOARDS

		BYTES/BOARD				
System	TI Series	64K	128K	256K	512K	1M
LSI-11*	TMM10010[1]		X	X		
PDP-11*	TMM20000[2]			X	X	X
VAX*	TMM30000				X	X
Multibus†	TMM40010A[2]	X	X	X	X	

[1]Parity optional [2]EDAC standard

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Nabra Enterprises

"TeleVideo is very responsive to our customizing needs. They're high quality, reliable units."

John Spaulding, Project Manager
Gould Inc.

and satisfaction the best in the industry.

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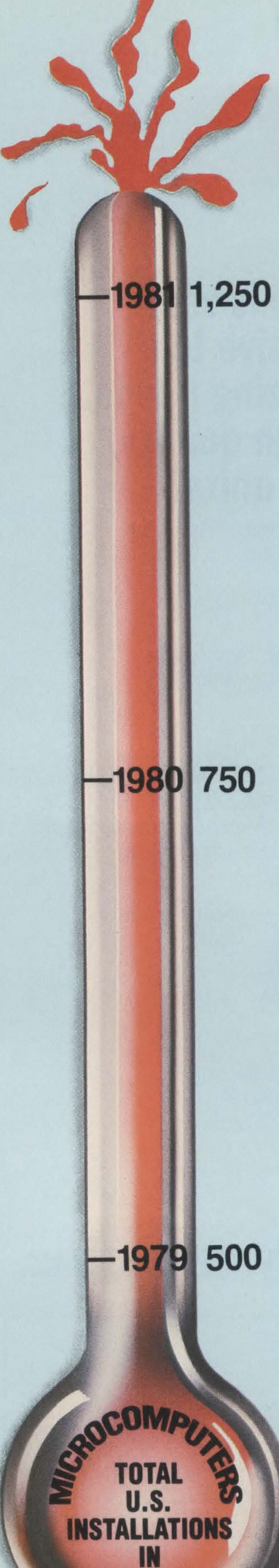

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SOFTWARE

First complete Ada* compiler runs on a micro

WILLIAM E. CARLSON and DR. DAVID A. FISHER,
Western Digital Corp.

Western Digital's compiler brings Ada's advantages to a variety of commercial and military users

Ada has come of age. The first complete implementation of the U.S. Department of Defense language has not been done by a huge defense contractor on a supercomputer, though. It's been done by a $35-million company named Western Digital Corp. on its 16-bit desk-top computer. Implemented in Pascal, the company's Ada compiler should bring the structural programming and real-time control advantages of Ada to a variety of commercial and military users.

Ada applications

Ada was developed by the DOD for military applications including communications, weapon-system control and coordination of operations involving thousands of people and machines (see "An Ada timeline," p. 210). These applications demand real-time control of many concurrent processes, automatic error recovery and fail-safe execution and interfaces to numerous and complex nonstandard I/O devices.

Another DOD goal for Ada was ease of maintenance. The life cycle of military hardware such as airplanes, ships, tanks and trucks spans 10 to 30 years, which represents five to 10 generations of computer technology. Hence, the software in military systems is very long-lived and undergoes continuous change. Many military software systems are also extremely large, requiring tens, hundreds and, in some cases, thousands of man-years to implement.

Ada's adaptation as MIL-STD-1815 guarantees its use within the defense community, but the commercial applications of Ada may dwarf its military use. A number of factors contribute to this nonmilitary interest:

- American and European industries were very involved in the development of the design requirements for Ada and in the review and revision of the language during the past seven years.
- The European Common Market has adopted Ada as its standard language for process control.
- Ada is widely used in universities as a teaching language.
- Ada is the only high-level programming language to combine real-time features with modern structured programming capabilities.
- Ada is designed for ease of maintenance.
- The DOD will enforce standards on Ada developments.

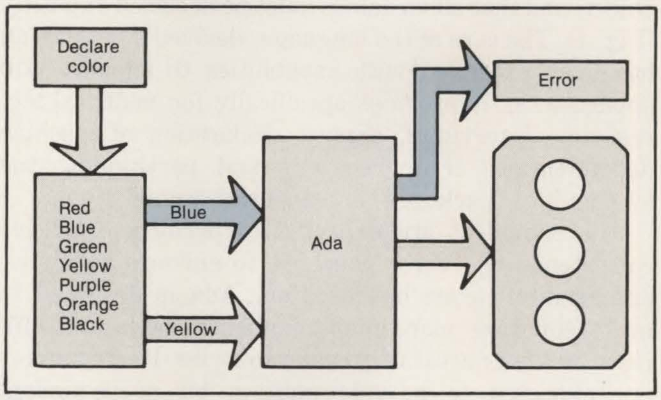

Fig. 1. Ada data- or variable-types *can be user-defined for individual applications. In the example above, a programmer has declared a new type called "color." Variables of type color can take on one of the values RED, BLUE, GREEN, YELLOW, PURPLE, ORANGE or BLACK. Ada also allows programmers to declare subtypes that are constrained to a subset of the values of the parent type. The illustration shows a subtype "STOPLIGHT" that must have the value RED, YELLOW or GREEN. An attempt to assign the value BLUE to the STOPLIGHT is an error, and causes an Ada run-time EXCEPTION. Ada compilers are expected to choose efficient representations for such user-defined types. Programs that use "typing" properly are very easy to read and maintain and are essentially self-documenting.*

**Ada is a trademark of the U.S. government, Ada Joint Project Office.*

Ada is the only high-level programming language to combine real-time features with modern structured programming capabilities.

Many commercial applications have technical characteristics similar to the application for which Ada was developed. Examples include process control, factory automation, word processing and office automation. Any applications in which software is highly replicated or that must respond to fixed real-time deadlines, that are large and long-lived, that must evolve through several generations of computer hardware or that involve the cooperative efforts of large numbers of programmers can benefit from the DOD's investment in Ada.

Getting to know Ada

Ada is a modern language in the Pascal tradition. It is highly structured and explicitly typed, meaning that each variable can denote one and only one type of object, and that all variables must be declared explicitly (Fig. 1). The core of the language, derived from Pascal, has been extended with capabilities to support DOD applications. It provides specifically for multitasking, real-time interrupts, explicit declaration of machine dependencies, error recovery and partitioning the system into "packages" and separate compilations.

Ada compilers are expected to perform extensive consistency and error checking to enhance reliability and facilitate code optimization. Ada is designed to make software more maintainable, reliable and efficient, but not necessarily easier to write. Programmers are expected to provide quite a bit of redundant information that allows the compiler to recognize inconsistencies and to block unmaintainable cleverness (e.g., use of operations inappropriate to a data type, failure to adhere to interface specifications, simultaneous use of the same memory for two purposes).

The primary mechanism for organizing large Ada programs is the "package" definition (Fig. 2). The package augments the more traditional hierarchical visibility rules, improves clarity and allows tight control over the visibility of names. Ada is modular in both a logical and a physical sense. The logical modularity associates specific operations with each data type and tightly controls the visibility of variables, meaning that interface specifications for data and routines can be visible to other programmers, even when the data's and routines' implementations are not accessible. This logical separation ensures that changes to the implementation part of a package does not affect other routines that use that package as long as the package-interface specification remains constant. It also ensures that packages can be recompiled without recompiling programs that use them.

Ada also supports high-level multitasking and real-time interrupt handling. High-level multitasking facilities within the language define and synchronize tasks, protect shared data and supervise communication between tasks. The Ada tasking primitives are high level, yet designed to be efficiently implemented.

In most important cases, interrupts such as terminal and network input, disk transfers and sensor input are anticipated and explicitly programmed for. Ada provides a high-level approach to interrupt handling based on the multitasking mechanisms. Interrupt handlers can be written using the tasking rendezvous feature (Fig. 3) and the standard system scheduler.

Exceptions in Ada constitute the recognition of errors caused by the executing program. Exception handlers are routines used to regain control when a hardware fault or software malfunction occurs. Ada

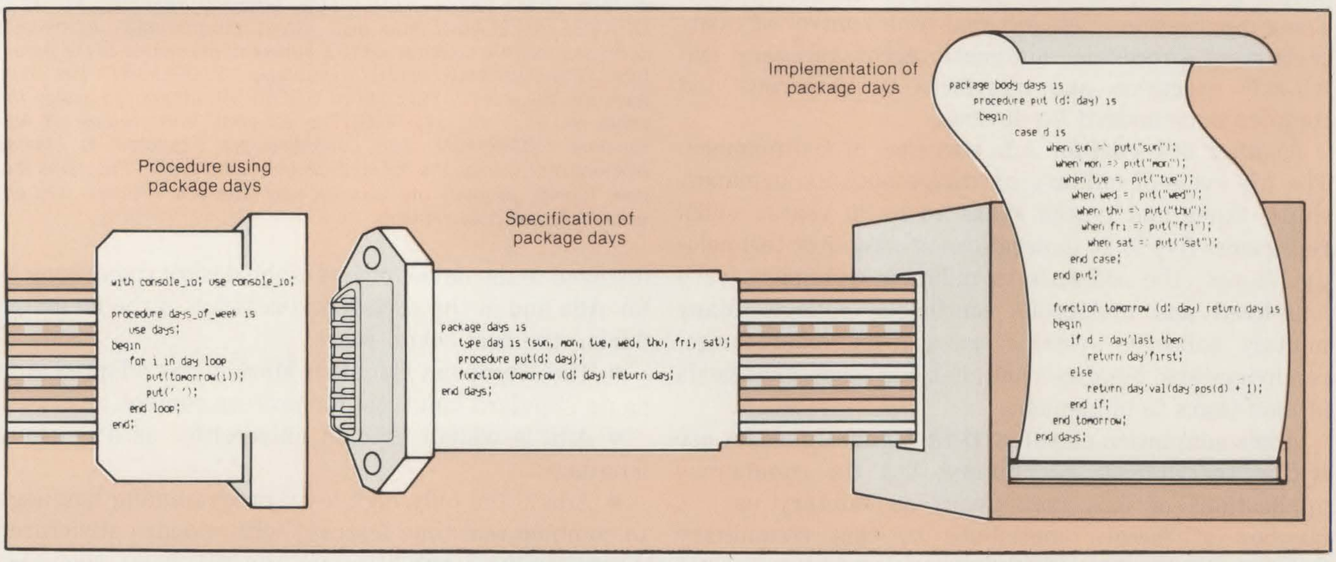

Fig. 2. The Ada "package" *provides a way to partition programs and software systems into understandable components. On the right is the implementation or "body" of a package called "DAYS." The package specification in the center defines a type called "DAY" that can have any day of the week as a value. It also defines a procedure for printing the value of a variable of type DAY, and function TOMORROW for determining the next day of the week. The procedure DAYS-OF-WEEK (left) uses package DAYS through its specification. The details of the implementation of DAYS on the right are isolated from the package that uses it.*

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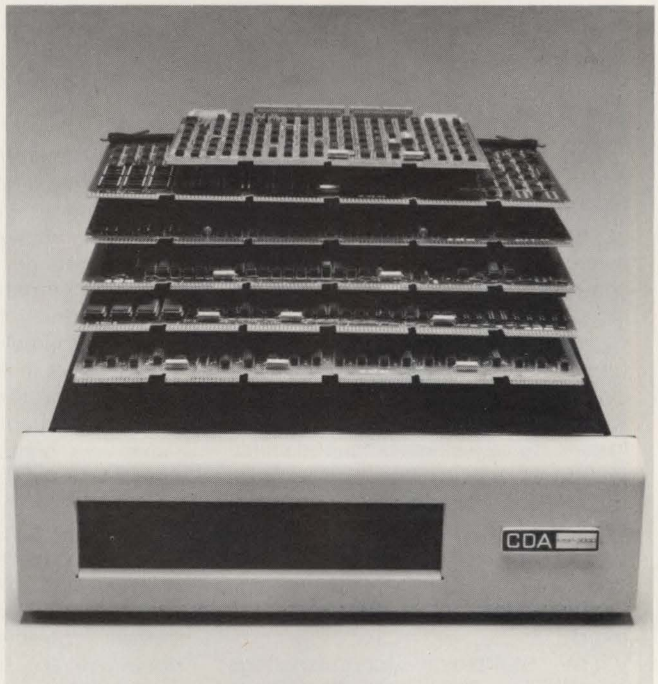

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Software in military systems is very long-lived and undergoes continuous change.

allows exception handlers to be clearly labeled and situated next to the code that is to be protected. This structured approach increases reliability and maintainability by tightly bounding the impact of unexpected events. The intent is that Ada implementations incur a cost only when an exception happens and do not reduce efficiency in the normal case because of the possibility that an exception may occur.

Portability of applications code was a major design goal for Ada. At the same time, Ada applications

1975	1976–77	1978	1979	1980
Undersecretary of Defense for Research and Engineering forms High Order Language Working Group 5000,29 and 5000,31 published	Requirements definition Steelman Ironman Tinman Woodman Strawman Economic analysis Evaluation of existing languages	International design competition Honeywell-green Intermetrics-red SRI-yellow Softech-blue	Public review Language seleciton Authorization to use Ada Byron's name Deputy Secretary of Defense call for comments	Proposed Ada standard document issued Stoneham published MIL-STDp1815

Ada definition phase

AN ADA TIMELINE

The development of Ada was initiated in January, 1975, by the Undersecretary of Defense for Research and Engineering. DOD directives and instructions were issued requiring the use of high-order languages for military systems, designating existing languages (FORTRAN, COBOL, JOVIAL, TACPOL and CMS-2) as interim standards, and stating that the Armed Services should work together in developing a single language suited to military applications and incorporating modern software technology. DOD established a High Order Language Working Group under the direction of Lieutenant Colonel William A. Whitaker to coordinate the effort.

The requirements for a language suitable for military applications were defined in a series of draft specifications developed by David A. Fisher at the Institute for Defense Analyses between 1975 and 1977. The documents, called Strawman, Woodenman, Tinman and Ironman, were increasingly specific and formal, and at the same time more oriented toward language characteristics rather than language features as the HOLWG gained increased understanding of the technical trade-offs and application requirements.

In 1977, DOD issued a competitive request for proposals from contractors to design a language meeting the Ironman requirements. DOD received 17 proposals and selected four contractors to prepare independent preliminary designs. A final updated requirements document, called Steelman, was prepared that incorporated the discoveries of the design contractors in attempting to satisfy the requirements in a practical language. Steelman specifications became the target for the competing contractors.

The four contractors were Honeywell, SRI International, SofTech and Intermetrics. They delivered their preliminary designs in February, 1978, and the designs were distributed worldwide for comment. International military, industry and academic reviews consistently preferred the Honeywell and Intermetrics designs, which were selected for continuation into phase two.

The final designs were submitted in April, 1979. Again, there was extensive worldwide evaluation by potential users in the military, industrial and academic communities. In June, 1979, DOD selected the Honeywell design that had been developed by an international team at CII-Honeywell Bull, Paris. The new language was named Ada.

The Deputy Secretary of Defense reviewed the status of the program and announced DOD's intention to make Ada a military standard, opening the final round of review and comment. The next 12 months were spent exposing the design to the future user community and refining it based on the users' feedback. Several courses were held in the U.S. and Europe. Almost 100 teams of programmers recorded existing tracking, command and control; communication; simulation; and computation systems software and applications in Ada. The proposed Ada Standard Document, dubbed MIL-STD-1815 in honor of Ada's birth year, was published in July, 1980. In December, 1980, DOD created the Ada Joint Program Office under the direction of Lieutenant Colonel Larry Druffel to manage the practical implementation of Ada. Ada was submitted to the American National Standards Institute for consideration as an American standard under the ANSI canvass procedure. Ada has also been placed on the agenda of the International Standards Organization. In September, 1981, an international Ada expert committee was formed in Washington, D.C., to serve as the technical review body for ISO standardization.

Numerous Ada compilers are now under development. The three largest efforts are those funded by the Army, the Air Force and the European Economic Commission (Common Market). All three of these efforts are scheduled to produce their initial products during 1983.

1980–81	1981	1982	1983	1984
Ada joint program office formed Ada compiler validation capability (ACVC) delivered	Commercial standardization ANSI canvass Ada TEC ISO Ada experts	First complete implementation	Wide spread availability Army compiler AF compiler European compiler	International standardization Extensive use in military systems Growing commercial market for Ada components

Ada implementation phase

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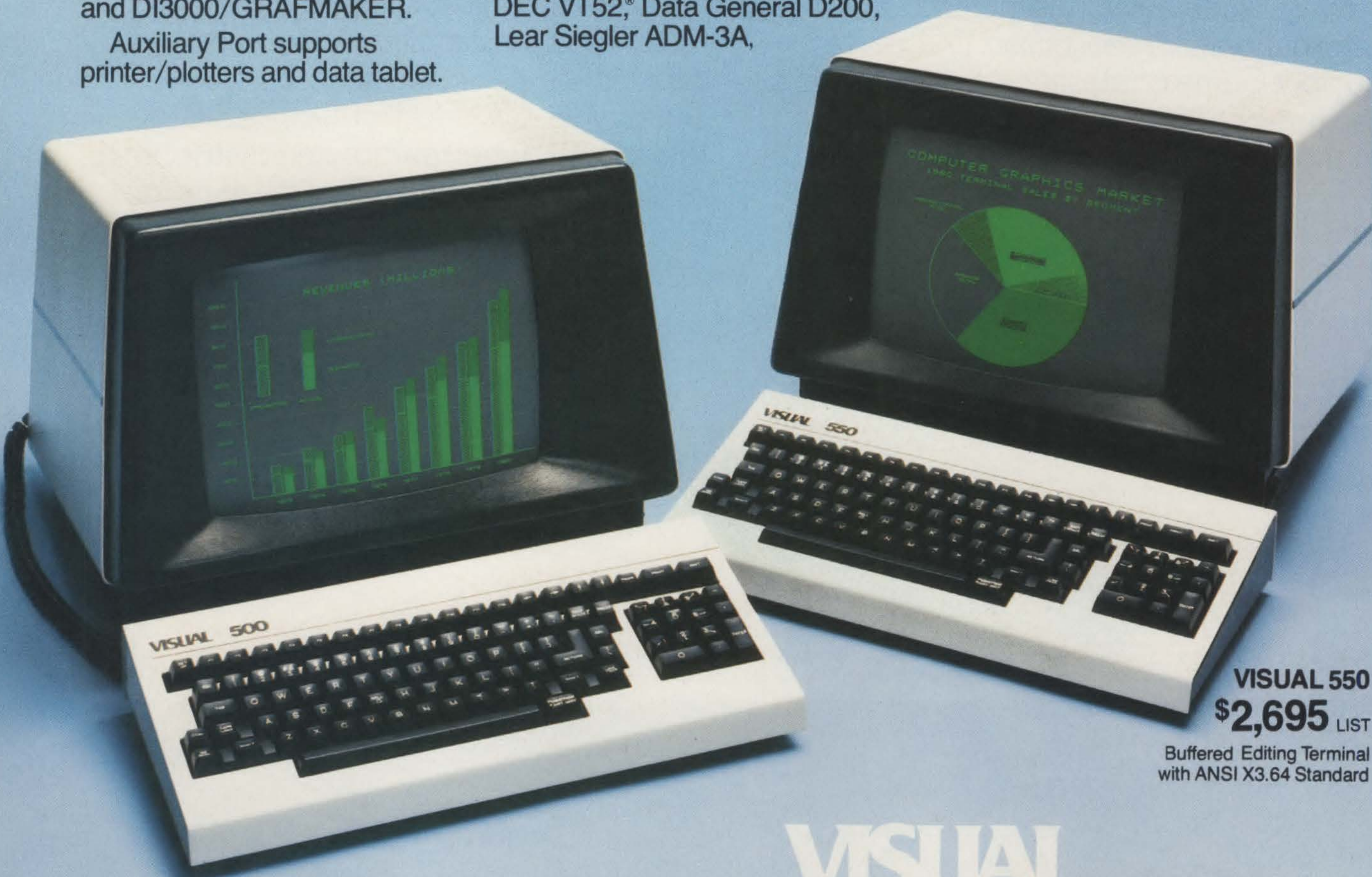

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Interface specifications for data and routines can be visible to other programmers, even when their implementations are not accessible.

require interfaces to diverse real-time I/O devices, so Ada programmers must be able to write hardware-dependent code. Ada achieves these two conflicting goals by providing constructs for formatting data to external devices, by controlling peripheral hardware and by linking to interrupts within clearly demarcated sections of Ada modules. Hence, Ada encourages and, in fact, forces hardware dependencies to be isolated and clearly identified.

Ada has two main features to facilitate the development of reusable software libraries. One is the package concept already discussed. The other is the ability to define generic procedures. A generic provides a high-level semantic macro facility analogous to the syntactic macro facility of many assembly languages. Unlike macros, the types of some or all of a generic's variables can be parameters, and the full set of type-consistency checks can be performed on a generic in the context in which it is used.

In summary, Ada is a powerful modern programming language that supports the clear, simple and efficient implementation of real-time systems. Software implemented in Ada can be extremely reliable and should be much more maintainable than software written in the existing military languages, and very much more reliable and maintainable than software written in assembly language.

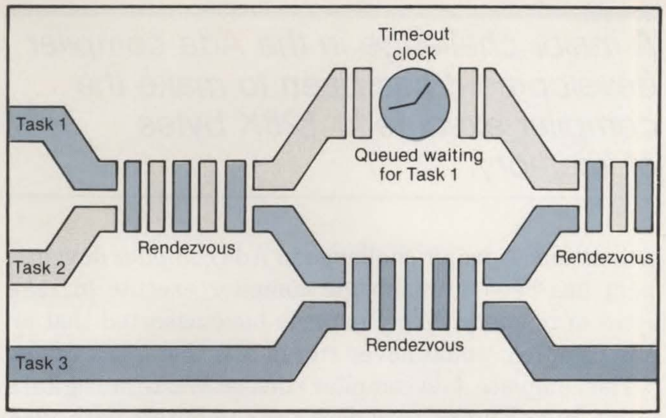


Fig. 3. Two Ada tasks *are said to be in "RENDEZVOUS" while parameters are being exchanged. A task that executes an "ACCEPT," "SELECT" or "ENTRY CALL" statement is placed in a queue until the other task can rendezvous with it. A task that queues for a rendezvous can set a maximum time that it is willing to wait, and tasks can refuse to be queued; that is, they can execute a conditional rendezvous that completes the tasks only if it can do so without waiting.*

Implementing Ada on a micro

Ada compilers must perform a large number of semantic consistency checks to improve the reliability of Ada software. Semantic checking is almost nonexistent in most languages, and requires an additional module in an Ada compiler that is larger and more complex than those for syntax analysis or code

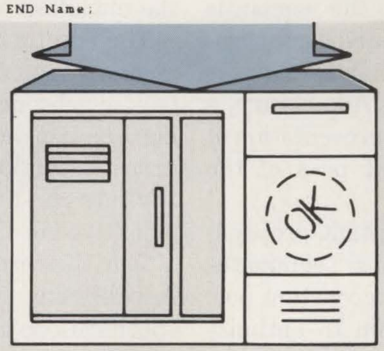
VALIDATING ADA

DOD-supplied compiler-validation tests are brutal. They have been designed to evaluate the correctness of complete implementations rather than to determine which parts of the language are implemented.

The DOD Ada Validation Test Suite contains about 1300 programs. Each program is cross-referenced to a specific chapter, section and subsection of the Language Reference Manual, and has a specific stated objective. If the part of the language being tested has changed as a result of the ANSI review process, there may be multiple versions of a test. There are six major categories of test programs:

- **Class A test programs** are expected to compile and execute without error. There are no run-time checks in Class A tests, so theoretically such tests need not be executed; they can fail execution only by crashing.
- **Class B test programs** are expected to fail compilation. The lines containing errors must be detected at compile time and marked "ERROR:", with an explanation of the error condition. Class B tests are passed if all lines marked "ERROR:" are considered illegal by compiler and if all lines not marked "ERROR:" are considered legal.

```
-- Name-Version.ADA
-- Objective
-- Author
WITH REPORT; USE REPORT;
PROCEDURE Name IS
    ...
BEGIN
      TEST ("Name", "Description ... " &
                    "...      ...");
      ...
      IF ... /= CorrectValue THEN
            FAILED ("Reason");
      END IF;
      ...
      RESULT;
END Name;
```



- **Class C test programs** are expected to compile and execute successfully. All Class C tests are self-checking. They use a reporting package that prints a message indicating what test is being executed, whether it passes or fails the internal check and, if it fails, the nominal reason for the failure.
- **Class D test programs** are capacity tests. There are no firm pass/fail criteria for these tests. All Class D tests are executable and indicate their findings with an appropriate message.
- **Class E test programs** are executable tests that check whether certain implementation-dependent options have been provided or how certain ambiguities in the specification have been resolved.
- **Class L test programs** are expected to fail at link time; that is, an attempt to execute the main program must generate an error message before any declarations in the main program or any units referenced by the main program are elaborated. Such tests need not fail compilation, but may fail to compile for some implementations.

A major challenge in the Ada compiler development has been to make the compiler execute in 128K bytes of memory.

generation. A major challenge in Ada compiler development has been to make the compiler execute in 128K bytes of memory. Many experts have asserted that an Ada compiler would never run in less than 512K bytes.

The complete Ada compiler runs on Western Digital's 16-bit MicroEngine 1676 desk-top computers with 128K bytes of memory and 2M bytes of floppy-disk storage or 10M to 40M bytes of Winchester-disk storage. A complete programming environment including hardware and compiler sells for less than $30,000.

The MicroEngine implements a high-level language instruction set called p-code directly in microcode. P-code was developed at the University of California, San Diego, to provide a portable run-time system for Pascal. An enhanced version of the UCSD Pascal operating system was used as the software-development environment. By augmenting the standard UCSD Pascal operating system with new memory-management capabilities, and exploiting the task management primitives already implemented in the MicroEngine microcode, Western Digital has created a practical Ada run-time system.

The Western Digital Ada compiler

The Western Digital Ada compiler is a four-pass compiler (Fig. 4). The first pass is the front-end, which performs lexical analysis, recognition, parsing, syntax error correction and insertion of specifications for library packages that are referenced with a "with" statement. The front end also separates source text into the smallest possible compilation units and updates the specification library.

The second and most important pass of the compiler is semantic analysis. The semantic analyzer understands Ada's scope and visibility rules, including the "use" statement for importing names from local and separately compiled packages. It performs overload resolution as well as all semantic consistency checking including type checking, matching of formal and actual parameters and identification of ambiguous references. A significant function performed by the semantic analyzer is the instantiation (context-related customization) of generics. The outputs of the semantic analyzer are a package specification for the user's Ada library, a list of semantic errors and an internal representation of the semantic tree for use by the next pass of the compiler.

The third pass of the compiler is constant propagation. This phase evaluates expressions, eliminates unreferenced code, collects constants in a constant pool and runs a reference-counting algorithm to optimize storage allocation. The outputs of this phase are a list of static expression errors and an updated semantic tree.

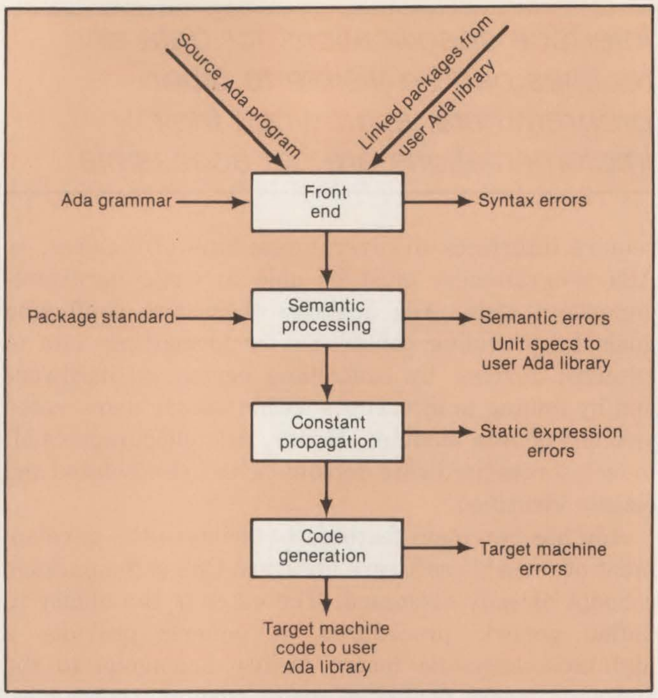


Fig. 4. Western Digital's Ada compiler *is implemented in four passes, three of which are machine independent. Because the first two passes are table driven, Western Digital's development team can track language changes as they are released.*

The final pass of the compiler is code generation. This phase performs the detailed work of code generation, selects the storage to be allocated for types and variables, allocates memory and initializes constants and variables. In an Ada compiler, the code generator must track dynamic use of type and variable attributes while performing its normal job of compiling statements and expressions. It must also insert code for exception handling, run-time constraint checking and multitasking "select" statements.

One especially noteworthy feature of the Western Digital code generator is "dynamic withing." Dynamic withing links library units at execution time rather than having them bound into an object module before execution. This feature substantially reduces the amount of disk storage needed to store a user's Ada library because the object code for commonly used utility packages is stored only once rather than being replicated in every program. The Ada run-time system checks the validity of each library package as it is loaded using a unique time-stamp identifier stored with the modules.

The run-time system for the Ada compiler performs memory management, code installation and release, task synchronization. It supports other run-time tasking functions and propagates exceptions to the appropriate exception handlers. Implementation of Western Digital's run-time system was facilitated by the tasking primitives in the MicroEngine instruction set.

The Western Digital Ada system also provides an Ada library. Entries in this library can be package specifications alone or package specifications with their associated code bodies. Entries that have subordinate

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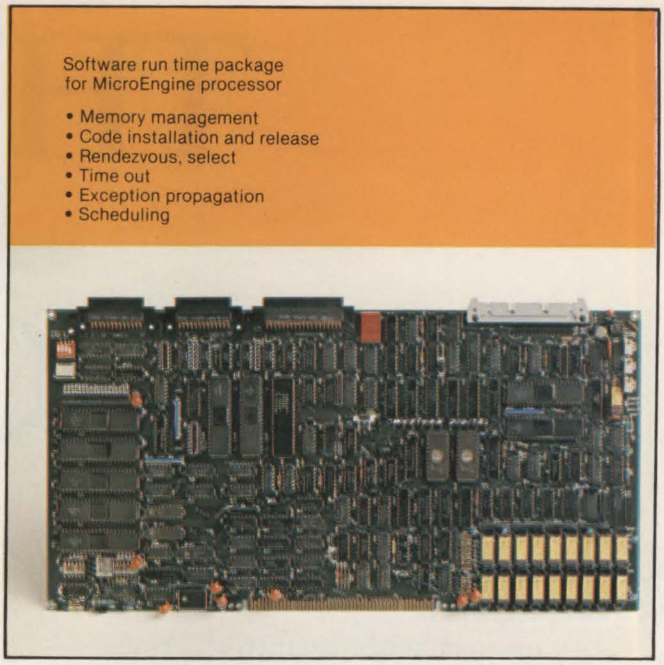
CIRCLE NO. 160 ON INQUIRY CARD

Portability will save money by allowing the 'recycling' of computer programs or routines.

sub-packages are appropriately marked. The library supports copy, delete, list and zero (purge) operations on entries.

Most of the Western Digital Ada implementation is machine-independent and portable to other hardware. Only the code generator (fourth phase of the compiler) and the run-time system are written specifically for the MicroEngine. Nonetheless, many of the algorithms in these two components are applicable to other implementations.

Ada's performance on the MicroEngine is appropriate to production applications. The semantic analyzer, which is the most complicated part of the compiler and received the most attention in the design, operates at about 1500 statements per min. The parser is the slowest part of the compiler, but it will be optimized once the Ada language standard is frozen.



Ada implementation on a microcomputer. *The Western Digital SB1600 single-board computer runs both an Ada compiler (as a "host" programming environment) and Ada application (as a "target" system). The target run-time environment for the Western Digital implementation is the MicroEngine processor instruction set augmented with a software run-time package as shown.*

Ada benefits

DOD initiated the Ada program to save taxpayer money through standardization. The savings will come from the portability and reuse of operational software, more effective use of support software, improved programmer productivity and reduced software maintenance.

Portability will save money by allowing the "recycling" of computer programs or routines at the source-code level. Probably the most important savings associated with the portability of operational software, however, will come when moving software to succeeding generations of hardware. The cost of computer hardware with a specified level of performance has been cut in half every few years since the mid-1950s, and, too often, DOD has been confronted with a choice of using existing software on obsolete hardware or undertaking a large development effort to create equivalent software for modern hardware.

Thanks to Ada, DOD will realize enormous savings in the creation of support software. Fewer compilers will be purchased, a greater variety of applications programs will be available, I/O handlers can be standardized, and DOD libraries of common routines and utilities will get larger and more valuable.

A common standardized language will reduce DOD personnel training requirements, increase proficiency in software-related job skills and give managers a "larger" labor force from which to draw. A common standard language would also cut software-maintenance costs because maintenance personnel could become more familiar with a single language and because there would be a smaller inventory of support software to be managed and maintained.

For DOD to derive these benefits, Ada must be widely accepted and used. DOD contractors can expect increasing pressure to use Ada once compilers are available. When DOD started the program, the policy was that contractors could choose among seven approved languages, and that the new language would have to prove itself before being added to the list. Since then, the U.S. Army has dropped its only entry from the list, and the U.S. Air Force and Navy have each dropped one of their two approved languages. Soon defense contractors will have only FORTRAN, COBOL and Ada to choose from, with Ada the preferred choice for embedded systems.

Standards are as good for business as they are for DOD. The software industry desperately needs a modern, efficient and highly portable system-implementation language. Pascal is the current preferred choice, but there are too many Pascal dialects, and more importantly, Pascal was designed as a research and teaching tool rather than as a system-implementation language.

Ada has the features system implementors need, along with the desirable modern structure of Pascal. Ada's supporters believe it is technically superior to existing alternatives. Nevertheless, technical arguments about which language is "best" miss the point—only Ada will benefit from DOD's investment in standards enforcement, compilers and supporting tools. ■

William E. Carlson is vice president and general manager of Western Digital Corp.'s Advanced Systems Division, Irvine, Calif., and **Dr. David A. Fisher** is director of the company's Systems Technology Center, Pittsburg, Pa.

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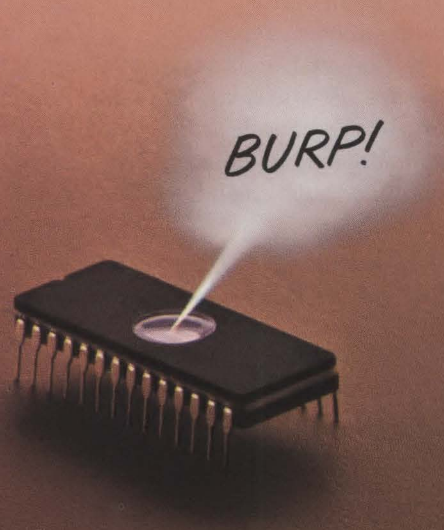

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SOFTWARE

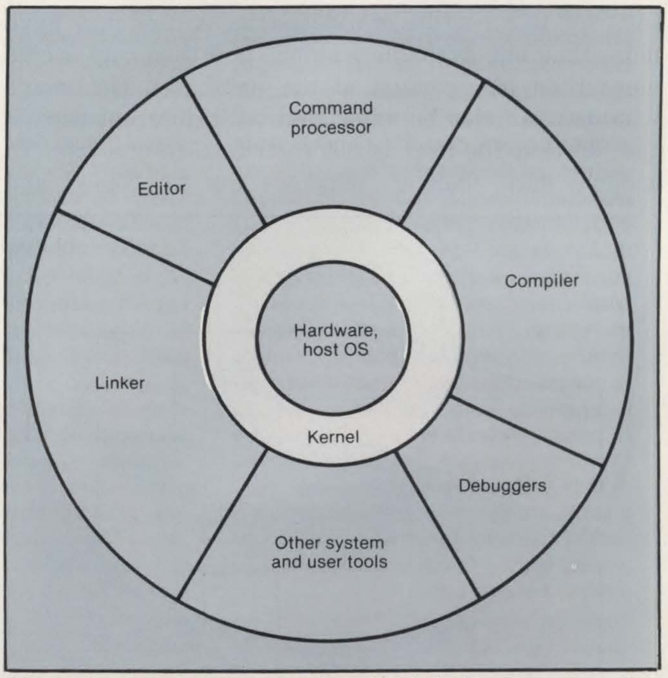
Developing an Ada programming support environment

MICHAEL RYER, Intermetrics, Inc.

Ada system software uses UNIX-like design with n-dimensional file structure and enhanced command processor

The recent U.S. Department of Defense specification for the Ada programming language provides government, industry and academia with the basis for a highly standardized, efficient language. A language can be far more useful, however, in a software environment specifically designed to support programming efforts in that language. Intermetrics, Inc., is developing such an "Ada programming support environment" for the U.S. Air Force.

Intermetrics' Ada Integrated Environment follows the DOD's UNIX-like specification of an APSE. Because UNIX, itself a programming support environment for C, is a powerful, transportable and widely used system, AIE avoids arbitrary differences from UNIX. Thus, AIE shares many of UNIX's basic features, although the two systems differ in file structure, command processor and compiler implementation.



AIE basic structure *includes kernel, which interfaces to a host operating system or directly to hardware, and a shell of utilities accessed by the kernel. Structure is similar to that of UNIX.*

File structure

The AIE avoids many of the UNIX file structure's limitations. The UNIX file system provides only unstructured, random-access, byte-addressable file types. UNIX files are not pre-allocated and can grow dynamically. Access control associated with each UNIX file specifies the rights given to an owner, to an owner's group and to the world at large, and UNIX files can be arranged in any hierarchy. This small set of facilities with its simpler user interface, encourages program compatibility. Complex databases can nonetheless be built from these building blocks.

A large project using sophisticated programs and requiring a long maintenance/enhancement phase needs more than a basic hierarchical file system to manage its database. The AIE database provides these additional capabilities.

A large project using sophisticated programs needs more than a basic hierarchical file system.

The AIE database is built around N-dimensional tables of data, called composite objects, arranged in a hierarchical structure (Fig. 1). Like UNIX, the AIE associates an access-control attribute with each object, which specifies the access rights available to users. Various access rights may be available for an object, depending on a user's capacity. For example, a project manager may define "MANAGER," "DEVELOPER," "TESTER" and "READER." The access-control attribute might specify that the "DEVELOPER" capacity has "ALL" access rights, whereas the "TESTER" capacity has only "READ" and "INVOKE" access rights. Access controls can be specified for a composite object as a whole, and for its component objects. Object space, even if it contains no data, can also be assigned access controls, avoiding UNIX's problem of access-control default on new files.

The user accesses objects through a "window," which is itself a primitive object containing a reference to some part of the database and an associated capacity. When accessing an object through a window, the window capacity determines if the object's access control attribute permits the desired access, limiting the user to a portion of a database. A user may have more than one available window, and thus may access more than one portion of the database. The user's windows can also be associated with different capacities, so that the user is not restricted to one role. To achieve data sharing, windows can be copied and assigned to several users. Windows also can be used to designate responsibility to users for database partitions.

Because windows are themselves database objects, a window can provide access to another window, and the user acquires the new view and capacity of the second window. A reference to an object can pass through several windows, possibly involving changes in capacity at each level. These changes in user capacity can narrow or broaden the user access rights. Like other objects, windows have access controls, preventing unauthorized users from accessing them.

The AIE can also define private database objects, analogous to Ada limited private objects. These private objects contain data and programs to manipulate the data. The data are hidden from users, and access to the programs is subject to the usual access-control mechanisms. The private object capability serves the same role as the UNIX SETUID: it allows programs to have more rights than their users, in that a private object program can access the private object data, while the user cannot. In the AIE, however, programs can be given some or all of the rights of their creator with respect to an object and/or its components, while the SETUID concept allows giving all rights only over the entire database. The AIE uses private objects to implement an electronic-mail system. This mail system, unlike UNIX's, can transmit binary machine code.

When executing programs, the user need not be concerned with the internal structure of the composite blocks involved, they can be treated as simple files. More sophisticated users can access this structure (Fig. 2). The composite database object structure also allows the user to load all directory information for an object simultaneously, instead of reading in a directory block

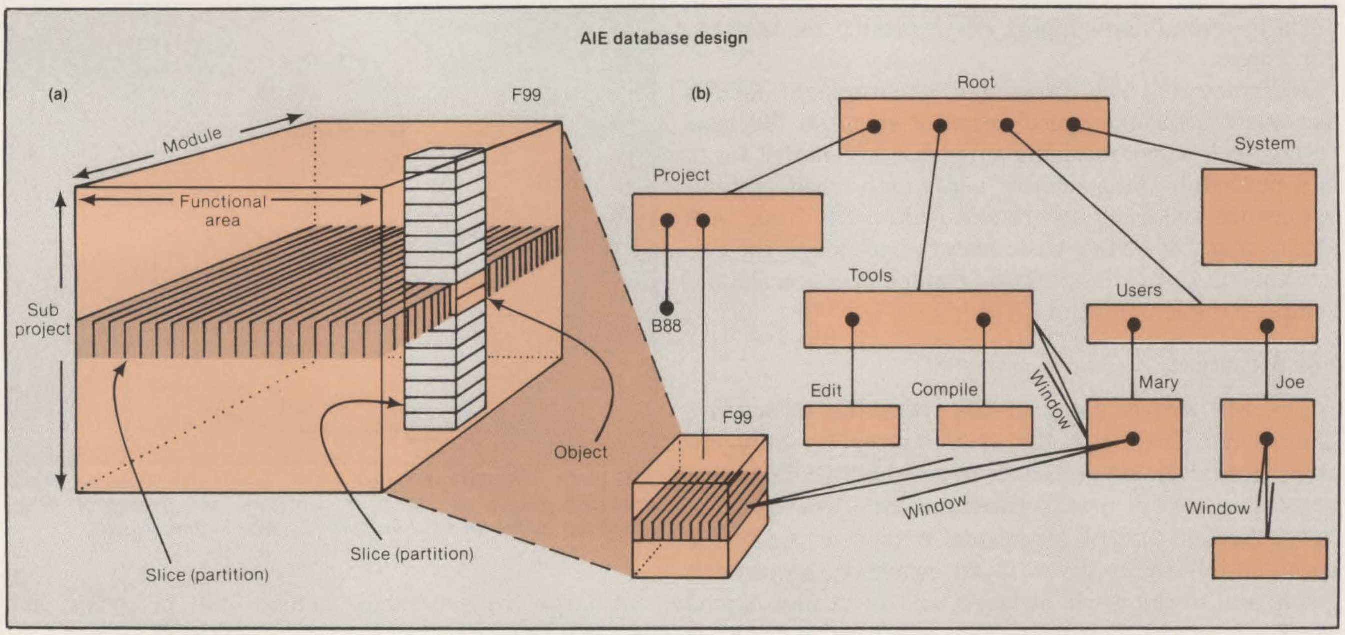


Fig. 1. AIE database structure *is based on concept of "composite object" (left), which comprises a set of related files organized into an n-dimensional table. Composite objects are themselves composed of "component objects," representing the intersection of one-dimensional slices, or partitions, of the composite object. Overall structure of database (right) consists of hierarchical arrangement of composite objects, similar to UNIX's arrangement of files. Unlike UNIX, however, AIE allows user to move directly from one branch to another, through paths linking composite objects. Each user has access to a set of paths, called windows, that determines which parts of the database can be examined.*

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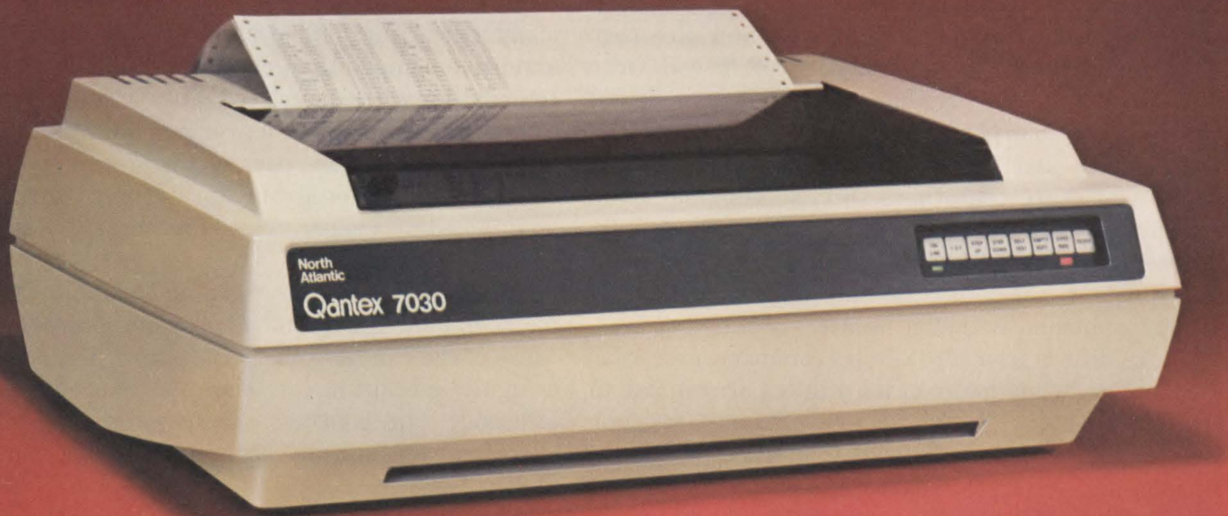

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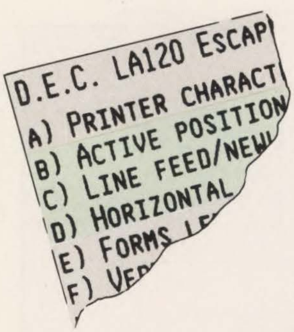

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Windows can provide access to other windows, with the user acquiring new views and capacities.

at each level of the tree. The cost of "walking" an entire directory tree to find a single file makes some UNIX programs slow on a large database.

AIE uses a "virtual copy" mechanism for database objects. To copy a file, it merely creates new directory entries; data from the file contents are not moved. Only when writing into the original or the copy is an actual copying operation performed, and even then, the system copies just the blocks that are changed and continues to share the others. Virtual copying is the only form of copying supported by the AIE, and its implementation is generally not apparent to users. From a user's viewpoint, the only unusual feature of the copy command is that it is fast.

The AIE differs from UNIX in its command processor and compiler, while many of its utilities are similar to those of UNIX.

The command process is used to invoke and control programs and services. Because Ada is an integral part of the system, the command language uses a similar syntax, and includes most Ada flow-of-control constructs in addition to UNIX-like notations for pipes and I/O redirection. It allows both named and positional parameters, and uses headers similar to those in Ada procedures for all system services, shell scripts and Ada and other programs. These headers define the number, names and types of the parameters, with type compatibility across calls enforced by the command processor. Utility interfaces are determined by parameter declarations.

As an aid to unsophisticated users, the AIE takes a more systematic—and verbose—approach to naming commands than does UNIX, and leaves the creation of abbreviations entirely up to the user. Both database and command parameters are "typed" and checked at every opportunity by the AIE for mismatches.

Because of the differences in the source languages, the AIE and UNIX compilers are themselves different in many ways. Ada, unlike C, is strongly typed, allowing extensive compile-time checking. To support separate compilation with interface type checking, the Ada compiler must maintain a program library. The module interdependences are part of the source code and are reflected in the program library, rather than being maintained by a separate mechanism, such as the UNIX "make" program.

Translating Ada into executable code is likely to be inefficient on conventional machine architectures because of the run-time checks required. The AIE contains a highly optimizing compiler that improves execution efficiency. In contrast, C requires little run-time checking, and is thus more efficient but more error-prone.

When possible, the AIE follows UNIX in the design of its utilities. The AIE includes an editor modeled on one available on many UNIX systems. Both systems contain linkers to prepare compiler output for execution. The AIE symbolic dynamic debugger for Ada considerably simplifies diagnosing run-time errors. ■

Michael Ryer is Ada program manager at Intermetrics, Inc., Cambridge, Mass.

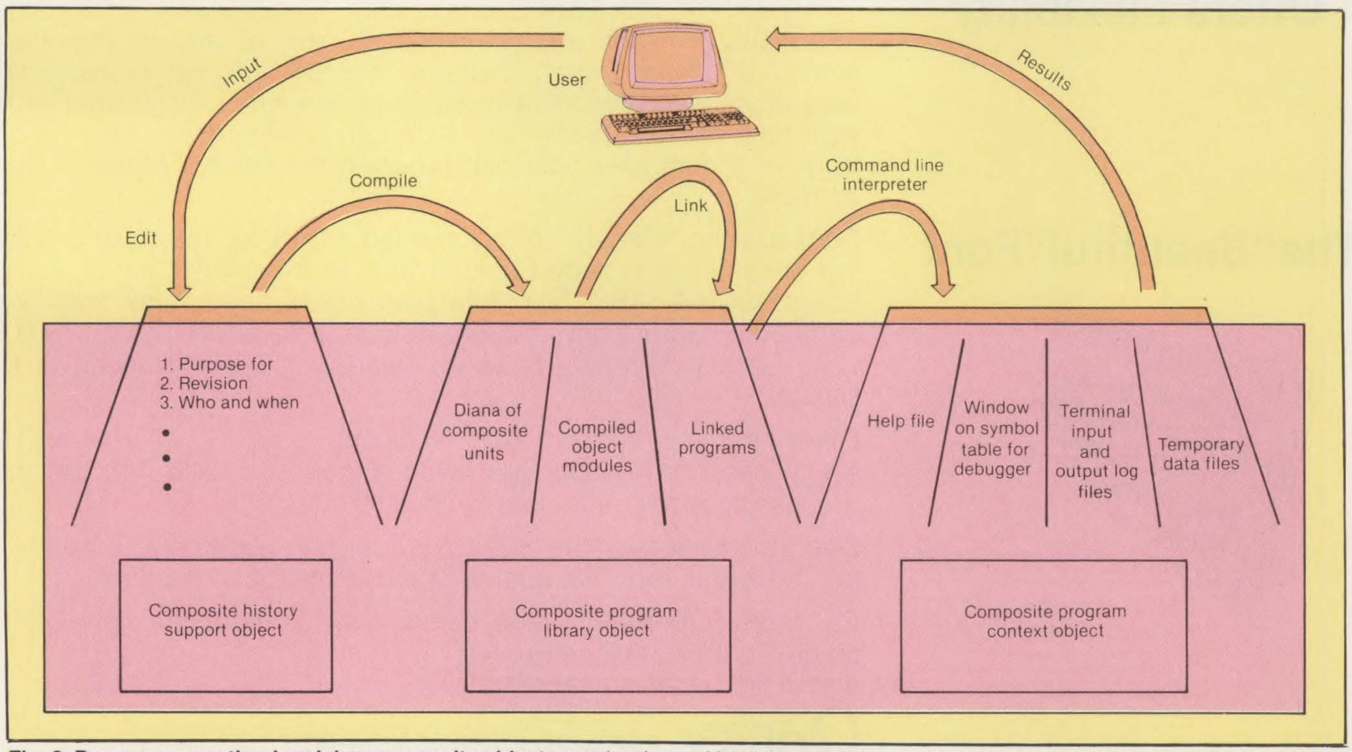

Fig. 2. Program execution involving composite objects *can be done without the user's becoming involved with internal structure of objects (shaded area). Sophisticated users can access internal structure, while unsophisticated users can treat objects as simple files.*

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SOFTWARE

Interactive language combines structured features with broad resources

ARNOLD EPSTEIN and JEFFREY D. MORRIS,
Loki Engineering, Inc.

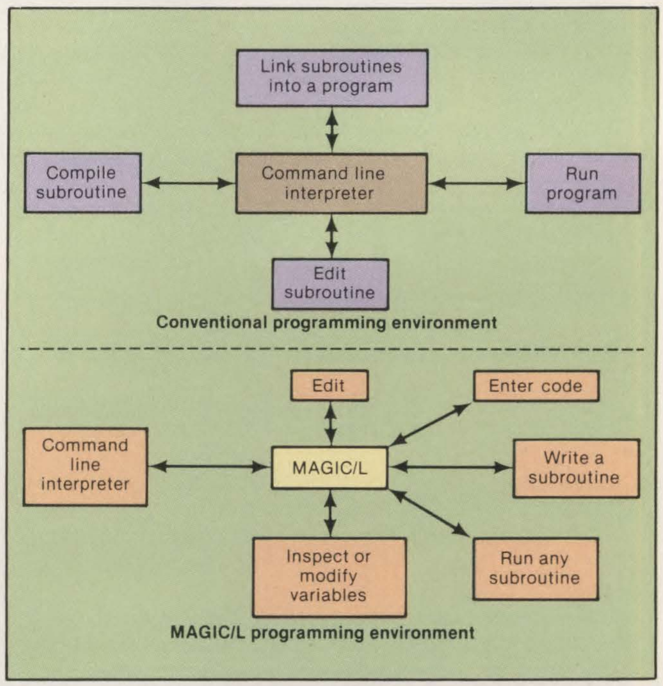
MAGIC/L includes elements of FORTH, C and Pascal

Many languages were developed at a time when punch cards and lengthy turnaround periods were the rule. Although modern computers have reduced turnaround from hours to minutes or even seconds, the process of program development is to some extent unchanged. Instead of submitting a card deck into a batch stream, a programmer now often types a compile and link command into a terminal.

Languages such as BASIC and FORTH have demonstrated the advantages of interactive languages, but both these languages are relatively unstructured. MAGIC/L, developed by Loki Engineering, Inc., combines the features of a structured language with an interactive programming environment. The language allows a programmer to access all the resources of the system without leaving MAGIC/L.

Environment features

MAGIC/L provides an integrated development environment in which a programmer can write, compile and debug a program; examine or modify all variables; and write new routines that test or combine existing code. Because program modules can be run interactively at the keyboard, the programmer has immediate feedback on how the modules interact, an important feature in graphics or robotics applications.



Comparison of conventional and MAGIC/L programming environments *illustrates MAGIC/L's access to all development tools. In a conventional environment, a program is developed, executed and debugged in separate stages. MAGIC/L allows execution of individual subroutines and functions, as well as access to all program variables.*

Variables can be combined through arithmetic and relational operators similar to those available in Pascal.

MAGIC/L generates a compiled threaded-code that has an efficiency similar to that of p-code generated by many Pascal compilers. An on-line editing facility allows the user to retrieve and edit the previous line of input and last definition entered, while keyboard dialogue, or input or output separately, can be saved on disk with a LOGON command. Logged input files are directly usable as source files.

All implementations of MAGIC/L contain an interactive assembler with syntax similar to the vendor-supplied assembler for the host machine. Assembly code can be included in the same source module as high-level code and can access variables and data structures using the same names as the high-level code. Although use of the assembler diminishes portability, it allows optimization of time-critical code, and is useful in hardware interfacing and debugging applications. Because the assembler is integrated into the programming environment, code can be written at a higher level first; when bottlenecks are identified, they can be rewritten in assembly code.

MAGIC/L's command structure facilitates the creation of application programs for nontechnical users. Commands are followed by one or more arguments, which can be strings, numbers or expressions using previously defined functions. The number of arguments specified to a command can vary, and can be used by the command for syntax checking or to vary the function of the command.

Language features

MAGIC/L contains all the elements of a modern structured programming language, with a syntax that is basically a blend of Pascal and C.

Most implementations of MAGIC/L support 8-bit characters, 16- and 32-bit integers and floating-point numbers. Scalars and arrays of any of these data-types can be declared as either global or local to a subroutine, and variables can be combined through arithmetic and relational operators similar to those available in Pascal. RECORDs can contain any of the above or user-defined data-types, a feature similar to C's "struct" or Pascal's "RECORD" constructs.

MAGIC/L's looping and branching structures are also similar to those of Pascal and C, except that each control structure has a unique terminating keyword. The keyword provides a nonambiguous syntax, with no "dangling else." Structures include:

```
IF      ...      ENDIF
IF               ...ELSE      ...      ENDIF
```

USING MAGIC/L

Two examples of MAGIC/L code, an assembly program and a command definition, illustrate the interactive nature of the language.

A function called TRIPLE, returning three times its input value, can be defined using the built-in MAGIC/L assembler for the PDP-11. A declaration specifies the input of a 16-bit integer, and the register is set to contain a pointer to the argument passing stack. The macro NEXT is used to reenter from assembly to high-level MAGIC/L.

When the assembly code has been entered, TRIPLE can be called from high-level MAGIC/L. The string "MGL>" is the MAGIC/L keyboard prompt. The code is as follows:

```
mgl> ENTRY TRIPLE INTEGER  ; Accept 16-bit integer
                             input
mgl> MOV     (MSP) , RO    ; Move the argument to
                             RO
mgl> ADD     RO , RO       ; Double the argument
mgl> ADD     RO , (MSP)    ; Add it back to the
                             original
mgl> NEXT                  ; Reenter high-level MAG-
                             IC/L
mgl> PRINT TRIPLE (5)      ; Use the function TRIPLE
          15                 on the integer 5.
mgl>
```

A typical graphics application might require a command, such as ZOOM, that sets or displays the graphics zoom factor. Typing ZOOM with an argument would set the zoom factor to the value of that argument, while typing ZOOM without any arguments would cause the current zoom factor to be displayed.

The INTEGER variable $ZOOM is defined as the global zoom factor variable. The word COMMAND in the declaration of ZOOM specifies that ZOOM can be called using the command-line syntax. The variable CMDCNT in the definition specifies how many arguments are to be passed to the ZOOM command.

In the code below, ZOOM is defined and then used twice to set the zoom factor and twice to display it. The second time the zoom factor is specified, the argument is an expression using the TRIPLE function:

```
INTEGER $ZOOM               ;Global zoom factor variable
DEFINE ZOOM COMMAND
        INTEGER ZVAL
IF ( CMDCNT <> 0)
$ZOOM := ZVAL               ;If an argument is specified, set
                             the zoom factor to this argu-
                             ment.
ELSE
PRINT   "Current Zoom:", $ZOOM
                            ;If no argument is specified,
                             display the zoom factor.
ENDIF
END

mgl> ZOOM 10                ;Set zoom factor to 10
mgl> ZOOM                   ;Display zoom
Current Zoom:
mgl> ZOOM TRIPLE (8)
mgl> ZOOM
Current Zoom: 24
```

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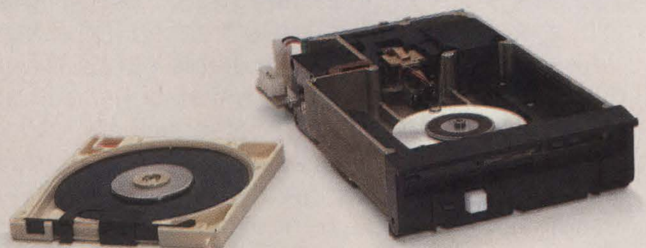

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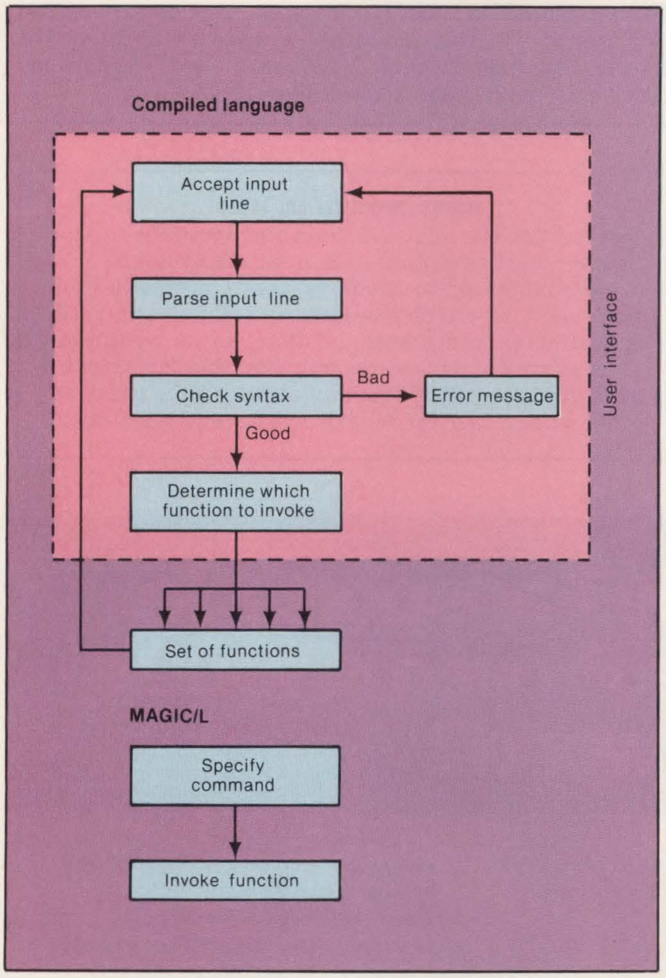
I/O functions have identical calling sequences in all implementations of the language.

DO	...	LOOP
WHILE	...	REPEAT
BEGIN	...	UNTIL AND
BEGIN	...	FOREVER.

THE BEGIN-FOREVER structure is not often found in programming languages, but is useful in the interactive environment of MAGIC/L.

MAGIC/L is machine independent and easily portable.



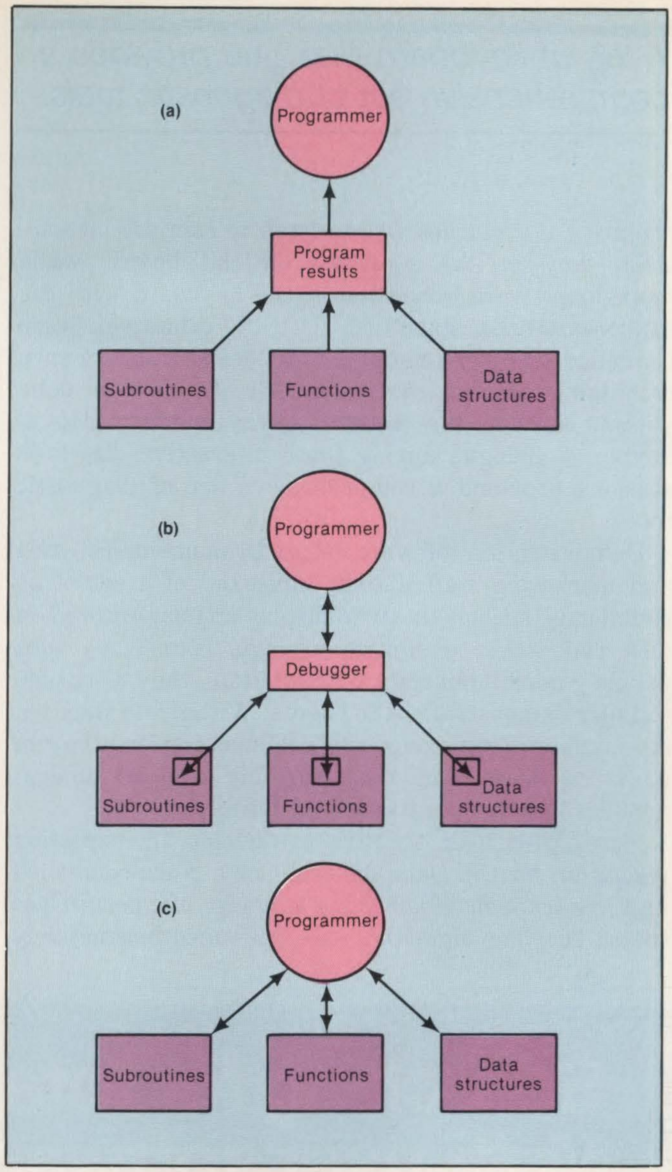
Program-development process *involves combining functions. Compiled languages need user interface to invoke functions interactively; each function often requires a different syntax. MAGIC/L allows user to invoke a function directly by specifying a COMMAND, providing a single, consistent syntax.*

I/O functions, including

- **Open/Close files**
- **Read/Write a line of text**
- **Read/Write a specified number of bytes**
- **Read/Write a physical block**
- **Get/Set random access file position,**

have identical calling sequences in all implementations of the language.

Programs can thus be transported between machines with little or no modification. The MAGIC/L cross-reference program is itself written in MAGIC/L, and the same-source file is supplied with all implementations of MAGIC/L.



Debugging techniques *in conventional programming environments are sometimes limited by lack of access to the program building blocks (a), forcing a programmer to analyze the program through its results. A debugger provides some access to program components (b), but the view is generally limited, and the technique requires learning the debugger syntax. In MAGIC/L (c), debugging is integrated into the programming environment, providing a full view of, and access to, all program components.*

MAGIC/L also provides a complete formatted output facility and a large library of utility subroutines including bit-manipulation, mixed-mode operations, data-type conversion, text parsing and string conversion routines.

Typical application

One company that used MAGIC/L to develop software is Octek, Inc., a Burlington, Mass., robot-vision-system manufacturer. MAGIC/L was first used at Octek for hardware diagnosis during the development of their first video digitizer. A small package of assembly-level

A log of keyboard dialogue provides a comprehensive set of diagnostic tools.

primitive I/O routines was written to exercise interactively any of the circuitry on the board, while scope-loops were generated at the keyboard with the BEGIN-FOREVER structure. The I/O primitives were combined into more complex functions as the hardware debugging process continued. All of this was done without leaving the MAGIC/L environment. A log of keyboard dialogue during these interactive diagnosis sessions provided a comprehensive set of diagnostic tools.

Demonstration software for use by nontechnical sales and marketing staff initially consisted of a set of 30 commands, such as DRAW to display an image stored on disk and GRAB to digitize a single frame. As sales people gained familiarity with MAGIC/L, they were able to tailor demonstrations to clients. Within four months, the number of commands in the demonstration program grew to more than 150, including complex image-analysis and image-processing routines.

Octek then used MAGIC/L to develop an inspection algorithm for the Data General Corp. Nova-controlled digitizer, capable of analyzing an image of a port in less than 1 sec. The algorithm was fine-tuned interactively until it was stable under the various lighting conditions typical at trade shows.

Octek has since announced a digitizer for LSI-11 systems, and much of the Nova software written in both FORTRAN and MAGIC/L is being transported to the LSI-11. Octek found it time-consuming to convert DG FORTRAN to Digital Equipment Corp. FORTRAN because of each version's different extensions. Transporting the MAGIC/L program was relatively simple. ■

Arnold Epstein is president of Loki Engineering, Inc., Wayland, Mass. He holds a Ph.D in physics from the Massachusetts Institute of Technology and was software director for Octek, Inc., Burlington, Mass.

Jeffrey Morris is vice president of engineering at Loki Engineering. He was previously a system analyst at the Smithsonian Astrophysical Observatory, and implemented prototypes for an image-analysis firm.

NEXT MONTH IN MMS

Two profile surveys will hold the spotlight in the October feature section of Mini-Micro Systems:

• Available add-in memory board products and their vendors will be tabulated and factors analyzed that affect their markets and distribution channels.

• A survey of enclosures will examine this important product sector from an integrator's point of view: what to look for, what to ask for and who to ask.

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Our standard 16-Bit 8088 hardware configuration provides 128K RAM with parity, two RS-232 serial ports, Centronics parallel printer port, interrupt and DMA controllers, dual floppy disks with 640K storage, Winchester disk and keyboard interfaces, and eight IBM-PC compatible expansion slots . . . and lists for only $2995. Winchester hard disk configurations, featuring cache buffer controllers for enhanced disk access performance are also available, starting at $4995.

So, when you need to grow, why gamble and hassle with independent third party hardware and operating system vendors which may or may not be compatible . . . not to mention the hidden expense and frustration of implementing peripheral drivers in the different operating systems and upgrades? Who needs the finger-pointing when things don't work out?

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MAIN FEATURES	CDP-MPC	IBM-PC*	OTHERS
Microprocessor	16-Bit 8088 8-Bit Z-80 (Opt)	16-Bit 8088	?
USER Memory	128K-1 Mbytes	16K-256 Kbytes	?
IBM-PC Compatible Expansions Slots Beyond Professional Configuration[1]	8 Slots	0	?
Resident Floppy Disk Storage	Dual 320K (std)	Dual 160K (Opt) Dual 320K (Opt)	?
Resident Cache Buffer Hard Disk Storage	5M/10M	—	?
OPTIONAL OPERATING SYSTEMS (Supported by Company)[2]			
MS-DOS (PC-DOS)	Yes	Yes	?
CP/M 86	Yes	Yes	?
MP/M 86	Yes	—	?
OASIS-16	Yes	—	?
XENIX	Soon	—	?
OPTIONAL HARDWARE EXPANSION BOARD (Supported by Company)			
RS-232 Communications	Yes	Yes	?
B/W and Color Display Controller	Yes	Yes	?
Expansion Memory	Yes	Yes	?
Z-80 CP/M-80 Board	Yes	—	?
Cache Buffer Hard Disk	Yes	—	?
Time/Calendar Board	Yes	—	?
IEEE Bus Controller	Yes	—	?
8" Floppy Disk System	Yes	—	?
8" Hard Disk System	Up to 40 Mbytes	—	?
Tape Cartridge System	Yes	—	?

[1] For comparison purposes, typical professional configurations consist of 16-Bit 8088 Processor, 128K RAM with Parity, Dual 320K 5-inch Floppies, DMA and Interrupt Controller, Dual RS-232 Serial Ports, Centronics Parallel Port and Dumb Computer Terminal or Equivalent.

[2] Columbia Data Products also supports CP/M 80® with an optionally available Z-80 CP/M Expansion Board.

*As advertised in BYTE Magazine, August 1982.

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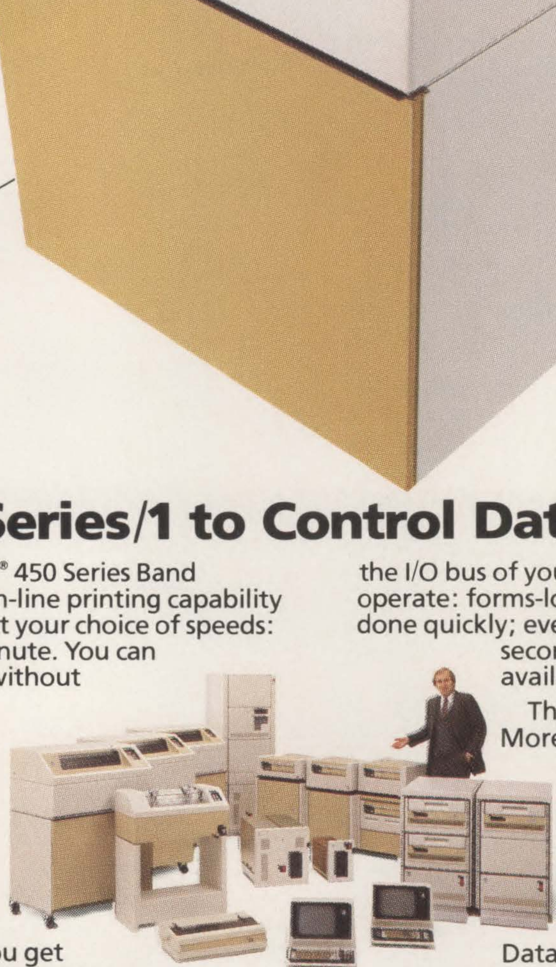

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CIRCLE NO. 42 ON INQUIRY CARD

Portable operating systems fight for 16-bit machines

DAVID FREEDMAN, Associate Editor

There is no clear winner—but plenty of contenders—as 16-bit operating systems battle for dominance

The proprietary operating system may not be dead, but you'd never know it from the slew of microcomputer introductions hitting the industry. Virtually all the new machines support a third-party operating system. Some of these system-independent, or portable, operating systems have become de facto standards by virtue of their popularity with users or support from major vendors. CP/M is such a standard in the 8-bit world, but its domination has not survived the industry's transition to 16 bits. Names such as MS/DOS and OASIS are seen almost as frequently, and for multi-user applications, everyone is looking over their shoulders at UNIX.

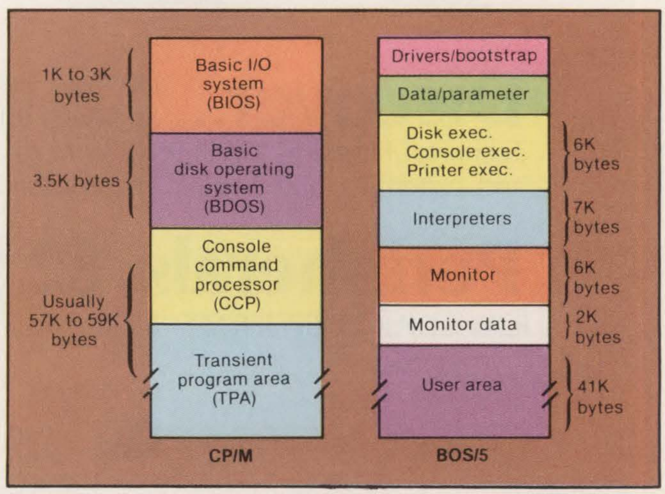
Each of these operating systems is sure to win a large piece of the OEM market, but they are only four of some two dozen portable operating systems from which vendors can choose. The operating systems offer a variety of advantages and disadvantages, and vendors should carefully consider the options.

Why a portable OS?

A portable operating system is one that can be easily adapted to any computer based on a particular microprocessor. The first portable operating system to receive much attention was CP/M, written by Gary Kildall in 1973 for the Intel Corp. 8080. Intel turned it down, but many vendors and tens of thousands of users recognized the advantages of the system, and a new segment of the industry was born.

One major advantage of a portable operating system is that it is basically a prepared product. By purchasing the operating system, a vendor avoids the considerable effort of developing his own system. This is particularly important in view of the increasing sophistication of both hardware and software. Jack Hemenway, of software vendor Hemenway Corp., compares designing an 8-bit operating system to building a garage, and designing a 16-bit system to building a house. Buying an operating system, he claims, "buys painfully gained expertise."

Even if an OEM does set out to design a proprietary system, it is unlikely to come up with something significantly better, or even different, from all the portable products on the market. In many cases, the operating system acquired from a third party has an established reputation of functionality and reliability.



Example of OS memory location *shows where CP/M (l.) and MPSI's BOS/5 (r.) modules reside. CP/M's BIOS module and BOS/5's data and drivers modules are the only machine-dependent sections of each OS.*

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10 Disk Drives, Winchester 5¼"
11 Disk Drives, Winchester 8"
12 Disk Drives, Winchester 14"
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34 Tape Drives, ½" Streaming Tape
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37 Terminals, Dumb
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41 Terminals, Portable
42 Test Equipment, Disk
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By purchasing a portable operating system, a vendor avoids the considerable effort of developing a proprietary system.

"Why reinvent the wheel?" asks Charles River Data Systems' Jim Isaak.

The other crucial advantage to portable operating systems is their compatibility, both with other machines and with application software. Most users will at some point work with a different microcomputer than the one they are buying, and would prefer that the experience they acquire with an operating system be transferable to other machines. More importantly, the most popular operating systems support thousands of independently written software programs and utilities, far more than most vendors could hope to offer with a proprietary system.

Many unsophisticated users—the ones at which the new wave of microcomputers is largely targeted—have no good way of judging the relative merits of operating systems. Most have heard the names of the more popular operating systems, and, right or wrong, may not consider buying a machine that did not support one of them. This herd instinct pressures vendors to support, if not feature, a popular operating system—or even a combination of such systems.

Popular alternatives

Of all the portable operating systems available, Digital Research, Inc.'s CP/M has been the most visible over almost 10 years. The original 8-bit version for the 8080, 8085 and Z80 has been reworked, enhanced and expanded to include versions for the 8086 (CP/M-86), 8- and 16-bit multi-user versions (MP/M), networking versions (CP/ and MP/NET) and, most recently, a single-user multitasking version (Concurrent CP/M-86). As the product line has grown, so has its support: it is now the operating system of choice of more than 500,000 users, almost 100 vendors and more than 500 independent software vendors.

CP/M is a general-purpose operating system. It does not have sophisticated file or memory management, nor does it have a long list of program-development tools. But it is well organized, allowing vendors to modify the BIOS (basic I/O system) module easily to adapt the system to their hardware; it is fairly friendly, providing a relatively easy-to-learn and efficient user interface;

DESIGNING A PORTABLE OPERATING SYSTEM

Portable operating systems are not very different in function from operating systems designed for a particular computer, doing the same things in the same ways. The only difference is one of organization. Portable operating systems separate hardware-dependent components from hardware-independent components, and allow the vendor to adapt the hardware-dependent parts to a system.

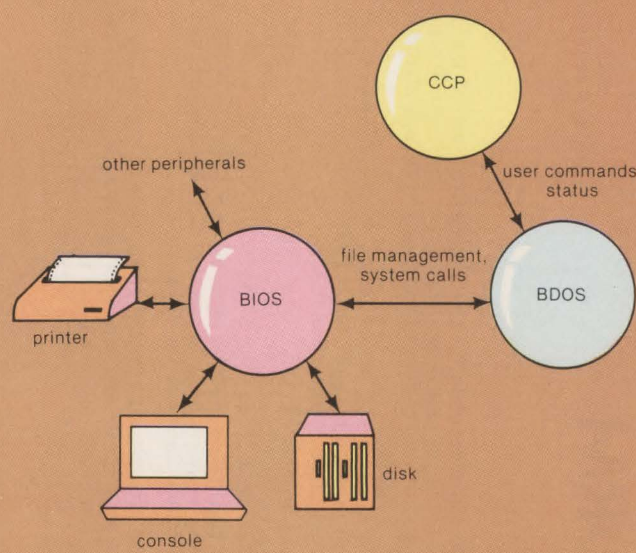
Most portable operating systems can be described in terms of four modules: the nucleus, the disk I/O module, the peripheral I/O module and the user interface.

The **nucleus** works closely with the microprocessor, scheduling tasks, allocating system resources and controlling file management. This module is highly dependent on the microprocessor, but independent of the rest of the hardware, and thus needs no modification when the system is transported to a new machine.

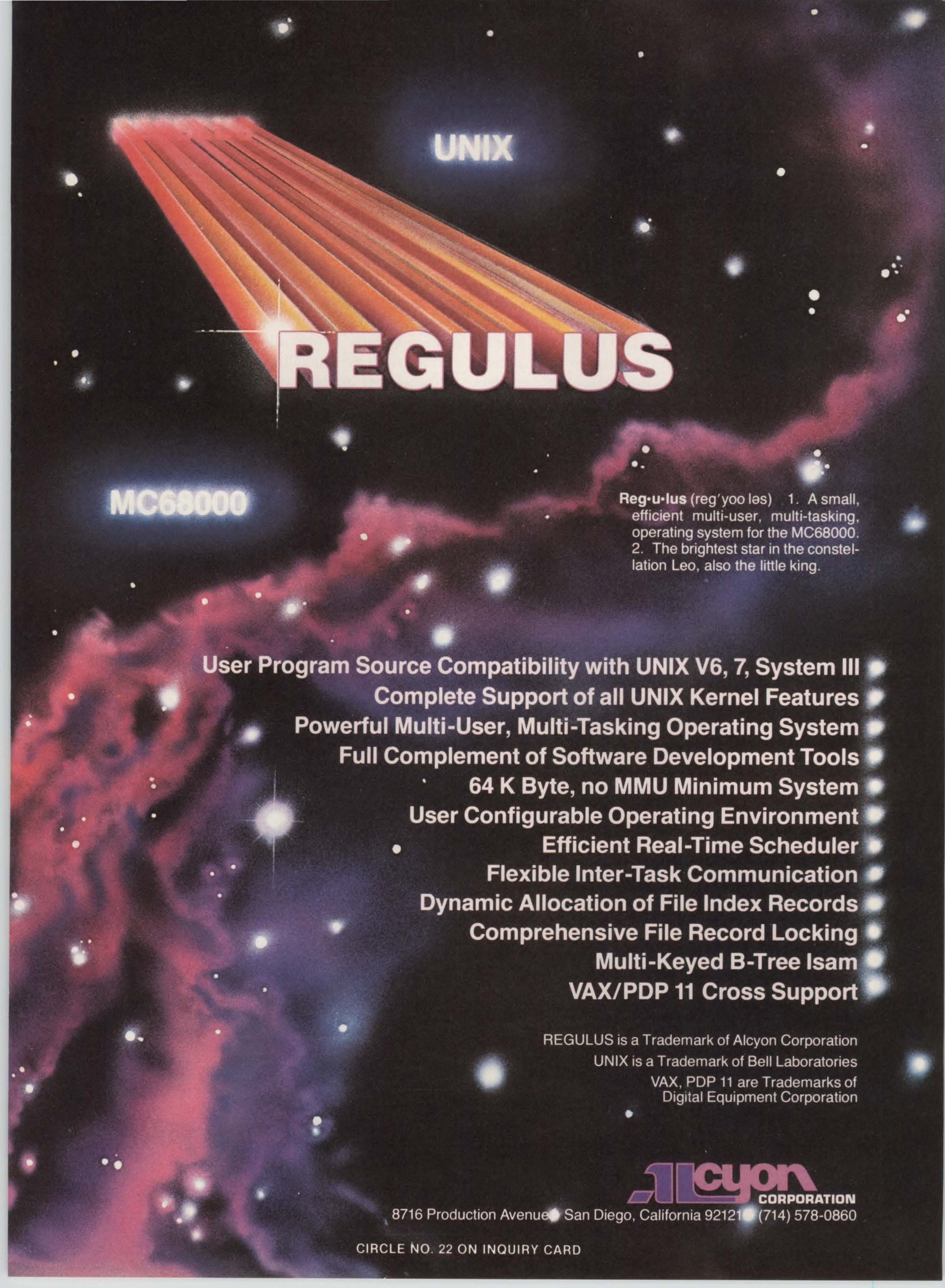
The **disk I/O module** is responsible for keeping track of the way the disk drives access information. Somewhat less complex is the **peripheral I/O module,** which stores the attributes of consoles, printers and other I/O devices. The nucleus accesses these modules when disk or peripheral activity is required; in effect, the nucleus tells them what it wants to do, and they work out the details of interacting with the devices. These modules are the ones that require modification when adapting the operating system to a new machine.

The **user interface** is basically a generalized application program, allowing a user to work with the computer through a set of commands, and providing the appropriate prompts and responses. Other application programs can build on, or replace, the user interface, but it does not have to be adapted to every system.

CP/M is usually divided into three modules, the basic disk operating system (BDOS), the basic I/O system (BIOS) and the console command processor (CCP), while UNIX consists of a kernel and a shell. But these organizations boil down to the same thing: separation of hardware-dependent and hardware-independent elements.



CP/M organization *separates hardware-dependent functions in BIOS from hardware-independent functions in other modules. Only BIOS is modified when moving CP/M to a new hardware environment.*


UNIX
REGULUS
MC68000
Reg·u·lus (reg′yoo ləs) 1. A small, efficient multi-user, multi-tasking, operating system for the MC68000. 2. The brightest star in the constellation Leo, also the little king.
User Program Source Compatibility with UNIX V6, 7, System III
Complete Support of all UNIX Kernel Features
Powerful Multi-User, Multi-Tasking Operating System
Full Complement of Software Development Tools
64 K Byte, no MMU Minimum System
User Configurable Operating Environment
Efficient Real-Time Scheduler
Flexible Inter-Task Communication
Dynamic Allocation of File Index Records
Comprehensive File Record Locking
Multi-Keyed B-Tree Isam
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Unlike the 8-bit market, which CP/M grabbed most of before anyone realized how much there was to grab, competition in the 16-bit market is serious.

and it is compatible with almost everything in the microcomputer industry, reason enough to ensure its continued popularity for a long time. Digital Research has been careful to keep each new version of the product similar to all of its predecessors, and many users have taken CP/M with them in moving to 16-bit and multi-user systems. CP/M-86 cannot be object-code compatible with the 8-bit version (it is file-format compatible), but Dynamic Microprocessor Associates, Inc., New York, offers an 8080 emulator for CP/M-86. EM 80/86 accepts compiled 8080 programs, typically running them on the 8086 at 40 percent of their speed on the 8080.

MP/M supports several features beyond those of CP/M, including shared file management with password protection and file record locking (so that only one user can modify records at a time) and a variably partitioned memory with dynamic allocation that makes the best possible use of the maximum 1M-byte memory. It can comfortably support as many as 16 users and as much as 4G bytes of disk storage.

Concurrent CP/M-86 runs tasks on four "virtual consoles," any of which a user can view in real time or scrolled back from the beginning. The user can switch back and forth between tasks as if accessing four different consoles. The software supports the same file and memory features as MP/M, and allows shared reentrant code, so different processes can access the same program. It also allows the CPU to switch tasks within 600 μsec., enabling real-time applications.

Concurrent CP/M-86 is Digital Research's premier product. Tom Rolander, vice president of operating systems at Digital Research, believes that the market for single-user, multitasking systems is shaping up to

The following chart lists major characteristics of portable operating systems for microcomputers, as supplied by the vendors. An effort was made to give every vendor of such a system a chance to respond to the survey.

End-user, single-quantity prices are given, except as noted. Utilities listed are generally a representative sampling of a longer list. Some listings represent more than one product, as mentioned in notes. For memory and storage specifications, K = kilobytes, M = megabytes, and G = gigabytes.

MICROCOMPUTER OPERATING SYSTEMS

Company	Brown Associates, Inc.	Charles River Data Systems, Inc.	Digital Research, Inc.
Operating system	Series 3	UNOS	CP/M-80 2.2
Year of first/latest version	'78/'82	'81/'82	'74/'79
Microprocessors supported	Z80, 8080	68000	8080/8085, Z80
Applications	general purpose, development	general purpose, development, real time	general purpose, development
Maximum no. of users	1	64	1
Maximum no. of concurrent tasks	N/S	256	1
Multi-processor support?	optional	yes	no
Minimum/maximum RAM supported	48K/64K	256K/6M	20K/64K
Maximum disk storage	5M	320M	8M
Direct memory access supported?	yes	yes	yes, (in I/O module)
Languages supported	CMD BASIC	BASIC, FORTRAN, Pascal, C, MAGIC/L	CBASIC, CISCOBOL, Pascal, PL/1, others
File management	sequential, random, ISAM, VSAM	sequential, random, ISAM (optional)	contiguous
Memory management	overlay	multi-segment mapping with swapping, resident locking	contiguous
Utilities	sort, merge, WP	more than 100; screen editor, sort/merge, electronic mail, backup	rename, debugger, status, erase, file transfer
Price	\$1200; re-seller: \$400-\$600	\$3000; run-time version: \$1500; discounts to 98%	\$150; \$90 quantity 25
Notes	available with medical, manufacturing, student-enrollment, other application packages; supports batch processing; networking available	UNIX Rev. 7-compatible; features enhanced real-time priority, scheduling, disk integrity	CP/M-80 3 will be available at year end
Circle no.	**376**	**377**	**378**

be the major one as processor power grows and memory prices shrink. Near-future products include a 68000 version of CP/M and a new version of 8-bit CP/M.

Unlike the 8-bit market, which CP/M grabbed most of before anyone realized how much there was to grab, competition in the 16-bit market is serious. Most popular among the operating systems that contest CP/M is Microsoft's MS/DOS, designed under contract with IBM Corp. for its personal computer—a significant endorsement, given IBM's impact in the microcomputer industry.

MS/DOS, like CP/M, is based on an 8-bit version and can convert CP/M files into MS/DOS files. It is similar in structure to CP/M, with an I/O module corresponding to BIOS, but I/O is not as easily modified as BIOS. A new, more adaptable version is expected soon. MS/DOS allows unlimited file size of as much as the 1G byte of disk storage supported, and does not limit program space to 64K bytes.

Another operating system receiving considerable attention is Phase One System, Inc.'s multi-user OASIS, with MP/M-86. It, too, is not as easily modified as CP/M or MP/M, but it provides sophisticated application development and database-management tools. File management includes direct, sequential, ISAM (indexed sequential access method) and other keyed file schemes, and a job-control language allows users to restrict applications selectively, so that, for example, a word-processing-only user would not have access to program-development tools.

SofTech Microsystems' UCSD p-System has not achieved the same general popularity as the others mentioned, but has been well-received in the scientific and educational communities. It is based on the UCSD implementation of Pascal, which some programmers prefer for its structured programming constructs. The p-System also supports BASIC and FORTRAN, but all programs, regardless of the language in which they are written, are compiled into an intermediate code ("P-code") that is then executed on an emulator designed for the microprocessor.

Because all code is compiled into P-code, transporting the p-System to a new processor requires only implementing a new emulator; thus, the p-System is available on nine processors, including the Z80, 8086, 68000 and PDP-11. Another advantage of P-code is that users can write pieces of the same program in different languages, and have the pieces compiled as one P-code program. The need to compile all programs in this manner slows processing but, along with flexible memory features, makes the p-System well-suited for development applications.

MICROCOMPUTER OPERATING SYSTEMS

Digital Research, Inc.	Digital Research, Inc.	Digital Research, Inc.	FORTH, Inc.
CP/M-86	MP/M II	MP/M-86	FORTH
'81/'82	'79/'82	'81	'79/'82
8086/8088	8080/8085, Z80	8086/8088	8086/8088, 68000, 8080, Z80, 6800, 6809, 1802, LSI/PDP-11
general purpose, development	general purpose, development, real time	general purpose, development, real time	general purpose, development, real time
1	7	254 (4-16 recommended)	N/S
1	N/S	255	N/S
no	no	no	yes
64K/1M	48K/336K	128K/1M	32K/64K
16 disks, 8M/disk	16 drives, 512M per drive	16 drives	N/S
yes (in I/O module)	yes (in I/O module)	yes (in I/O module)	yes
CBASIC, CISCOBOL, Pascal, others	CBASIC, CISCOBOL, Pascal MT+, PL/1, others	CBASIC, CISCOBOL, Pascal/MT, ASM86, others	FORTH
random	sequential, random; shared file with file, record locking	sequential, random; shared files with file, record locking	optional
partition	as many as 7 banks, OEM-configurable	partitioned, dynamic	partition, overlay
file transfer, editor, debugger, others	debugger, erase, rename, file transfer	debugger, erase, rename, file transfer	disk format/copy, target compiler; math, DB, extended memory-management packages optional
\$250; \$150 quantity 25	\$450; \$270 quantity 25	\$650; \$390 quantity 25	\$1500-\$10,000; volume educational discounts available
concurrent CP/M-86 (4 concurrent tasks) available	file- and program-compatible with CP/M	file- and program-compatible with CP/M	includes 60-day phone support; 5-day on-site course available; Level 2 (\$300) single-user version runs on IBM PC, Apple
378	**378**	**378**	**379**

N/S = not specified

Concurrent CP/M allows the user to switch back and forth between tasks as if accessing four different consoles.

Is UNIX the answer?

The most controversial of all operating systems is perhaps UNIX, Western Electric's powerful multi-user minicomputer-oriented system. Designed for program development in the Bell system on Digital Equipment Corp. PDP machines, UNIX is poised to move down to microcomputers, or at least to meet them halfway as systems become more sophisticated. UNIX has not appeared on many microcomputers yet, largely because of Western Electric's inflexible pricing and support policies. Western Electric plans to "make an increased commitment to UNIX as a microcomputer product," but for now, several vendors have stepped in to fill the gap with their own versions.

The argument about UNIX is straightforward: proponents says it offers the most powerful programming environment available, with a rich command set, versatile file structure and hundreds of useful utilities; opponents say it is too difficult for unsophisticated users in a commercial environment to learn, and that file protection is far too weak.

UNIX does offer much to programmers. It is based on the concept of "pipes," an assemblage of I/O and program modules allowing the flexible use of system resources. Input into and output from the pipe can be from or to any devices a user designates. The pipe directs the input into the first of a series of "filters," or program modules. The results of the first filter are passed on to the second, and so on, until the pipe directs the final results to the output device. All filters can work in parallel, generally without temporary disk storage, so that there is a continuous flow of processing through the pipe. While programmers speak rapturously of all this, a first-time UNIX user is more likely to be speechless with confusion. UNIX offers the uninitiated no clue as to what it is or might be doing. It takes considerable time to learn, and novices may lose files along the way.

Vendors of UNIX-like operating systems claim to have more or less solved these problems. CRDS's UNOS for 68000-based machines offers a more helpfully named command set, improved disk integrity, shared files and more efficient real-time capabilities. Microsoft's XENIX for the 8086 (eventually to be compatible with MS/DOS) offers enhanced file management and data integrity.

Users have shown high interest in these and similar systems, but whether business users will find UNIX's

MICROCOMPUTER OPERATING SYSTEMS

Company	Hemenway Corp.	Industrial Programming, Inc.	Infosoft Systems, Inc.
Operating system	MSP	MTOS	MultI/OS
Year of first/latest version	'81/'82	'76/'82	'81/'82
Microprocessors supported	68000, Z8002	8086/8088, 68000, 8080/8085, Z80, 6800	8086/8088, 8080/8085, Z80
Applications	general purpose, development, real time	real time	general purpose, development, real time
Maximum no. of users	1	255	16
Maximum no. of concurrent tasks	N/S	4096	1
Multi-processor support?	no	yes	yes
Minimum/maximum RAM supported	32K/16M	10K/16M	64K/1.1M
Maximum disk storage	8 drives	N/S	N/S
Direct memory access supported?	yes	optional	yes
Languages supported	BASIC, Pascal, FORTH, Macro Assembler	Pascal, C, PL/M, Assembler	BASIC, FORTRAN, COBOL, Pascal, PL/L, C, Z80 and 8080 assembler
File management	random, sequential, contiguous	sequential, random, ISAM	random, sequential, ISAM
Memory management	overlay, dynamic allocation/deallocation, buffer pool management, bank	contiguous with user-definable pools	contiguous bank
Utilities	test editor, linker/loader/library manager, floating point, monitor	debugger, resource reporter, network manager, overlay manager	same as UNI/OS
Price	\$2210; OEM quantities: \$300 each against \$10,000 prepayment; full licenses available	\$3500-\$9500; PROM version priced from \$20 in quantity	\$900; dealer prices from \$150; high-volume license fee is \$75,000.
Notes	BASIC, FORTH, contiguous files on 68000 version only; bank memory, floating point and monitor on Z8002 only; Z8002 version supports 1M RAM	file system, peripheral drivers, networking not included; hardware requirements, memory support, multi-tasking features vary with CPUs	requires 64K RAM per user; 10-msec. clock; network version, MultI/NET (\$200 per CPU); supports central node, distributed CPUs.
Circle no.	**380**	**381**	**382**

UNIX	UNOS	—Description
adb	—debug	—UNOS debug runs as separate process with many extensions
cat	—cat	—combines multiple files into one output stream
cd	—cd	—change your current working director y
cmp	—compare	—compare two files at binary level
comm	—common	—compare sorted lists on line by line basis
cp	—copy	—copies a file, or set of files
diff	—diff	—compare source files on multi-line basis
du	—diskusage	—display report on disk space utilization
echo	—echo	—put argument data into stream
find	—find	—search directory tree for files that match a template
grep	—match	—extract lines with substrings that match pattern
ld	—link	—combine separately combined modules into a load module
ln	—addname	—add a second name to an existing file
lpr	—lpr	—print stream on line printer
ls	—ls	—list file directory contents
mail	—mail	—electronic mail facility, UNOS has extended facilities
make	—make	—build an execution image, re-compiling modified modules
mount	—mount	—mount a logical file system
mv	—move	—move files to new directory
pr	—pr	—display stream on terminal, with interactive page breaks
ps	—ps	—display report of current active processes
pwd	—pwd	—display pathname to current working directory
rm	—delete	—files (UNOS has 'verify' mode)
roff	—format	—format data for printing: justification, centering, etc.
sort	—sort	—sort stream (fields, numeric, etc.)
sync	—sync	—flush cache of modified disk blocks to disk
tee	—tee	—output to specified file and stream at same time
tr	—translit	—transliterate one character set to another
umount	—unmount	—remove a logical file system
uniq	—unique	—remove duplicate entries (or unique ones) from list
who	—who	—display report of logged on users

Comparison of partial listing of UNIX and UNOS utilities *shows changes Charles River Data Systems has made in names for clarity.*

features useful at the microcomputer level remains to be seen. Even if UNIX does not penetrate the commercial microcomputer market, it will affect application development and the 32-bit supermicro market.

MICROCOMPUTER OPERATING SYSTEMS

Infosoft Systems, Inc.	Lifeboat Associates, Inc.	Mark Williams	Microsoft, Inc.
UNI/OS	SB-80	Coherent	MS-DOS
'77/'82	'81/'82	'81	'81/'82
8086/8088, 8080/8085, Z80	8080/8085, Z80	8086, 68000, Z8000, PDP-11/23	8086/8088
general purpose, development, real time	general purpose, development, real time	development	general purpose, development
1	1	N/S	1
1	2	N/S	2
no	no	no	yes
32K/1.1M	20K/64K	256K/ N/S	32K/1M
N/S	4G	1000G	1G per drive
yes	yes	yes	yes
BASIC, FORTRAN, COBOL, Pascal, PL/1, C, Z80 and 8080 assembler	all CP/M-80-compatible languages	C, BASIC	BASIC, FORTRAN, COBOL, Pascal, C, Ada subset, FORTH
random, sequential, ISAM	sequential, random, ISAM (optional)	tree	sequential, random, ISAM
contiguous bank	contiguous	contiguous, swap	contiguous
38 utilities including edit, copy, spool, memory test	copy disk, debug, batch, background print/suspend, status	almost all UNIX	editor, library, debug, 8080/Z80 to 8086 source translater, linker
$300, dealer prices from $50, high-volume license fee is $35,000	unlimited license: $40,000; limited and per system prices available	$1500, multi-user; $500, single-user; OEM prices go down from $500 (multi-user)	
I/OS ($225) does not support hard disk; 8086/8088 version in development; available for Altos, Superbrain, TRS-80 model II	CP/M-80-compatible; accepts CP/M or enhanced commands; features increased disk capabilities, faster performance	UNIX-compatible system with identical user interface, enhanced file integrity, real-time capabilities; loadable device handler	can support 8080 or Z80 as second CPU emulating CP/M-80
382	**383**	**384**	**385**

It remains to be seen whether business users find UNIX's features useful at the microcomputer level.

A wide selection

There are several reasons to consider other, less well-known, operating systems. Many systems offer features for specific applications, and some provide compatibility with other operating systems in addition to enhancements. Smaller software vendors, furthermore, are often more likely to offer system integrators pricing and support flexibility.

Business-oriented operating systems include MPSI's BOS/5 product line, ranging from single-user to multitasking, multi-user and networking versions. It supports three levels of MicroCOBOL, designed for commercial application development, and a full set of business-oriented utilities. Brown Associates' Series 3 is available with packages for the medical profession, manufacturing, retail and other applications.

Hemenway's MSP operating system for real-time applications, such as process control and communications, features dynamic allocation and deallocation of

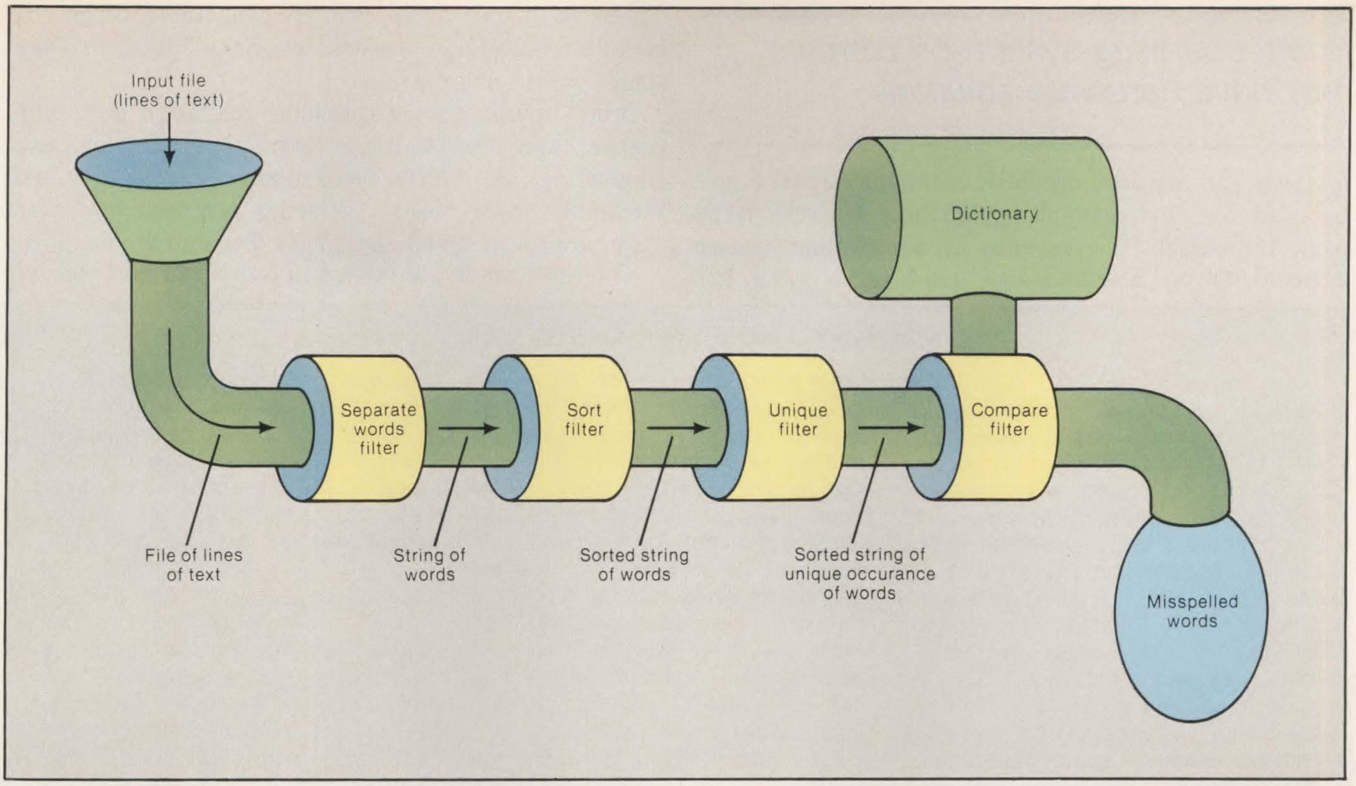
PARTNERSHIPS TO EASE SERVICE PROBLEMS

It is often unclear who is responsible for problems that arise on an operating system licensed by a system vendor. Software vendors can be quick to blame bugs on the hardware or on the system vendor's adaptation of the operating system, while the system vendor may not have the software expertise to find or fix the fault. If the system is already on the market, the user can be the biggest loser.

One way to ensure cooperation between hardware and software vendors is through arrangements that go beyond standard licensing agreements. Zendex Corp., for example, has ensured a high level of software maintenance for its ZX-86 computers by entering a joint venture with Houston software vendor C WARE. C WARE supplies Zendex with Mark Williams Co.'s COHERENT operating system and a C compiler, and will be fully responsible for the products' servicing. In return, the Dublin, Calif., manufacturer is providing C WARE with ZX-86 hardware and technology.

Such agreements can help smaller hardware vendors compete against large OEMs better equipped to customize and maintain software. Smaller software vendors can also offer such joint ventures as an extra enticement to hardware vendors that might otherwise go with a more well-known software product.

Company	Microsoft, Inc.	MPSI	MuSys Corp.
Operating system	XENIX	BOS/5	TurboDOS
Year of first/latest version	'80/'82	'78	'81
Microprocessors supported	8086, 68000, Z8000, LSI-11/23	8086, 68000, 8080/8085, Z80, 6800, MicroNova, PDP-11, IBM Series/1	Z80
Applications	general purpose, development	general purpose, development	general purpose, development
Maximum no. of users	N/S	99	N/S
Maximum no. of concurrent tasks	N/S	2 per user	1
Multi-processor support?	no	optional	yes
Minimum/maximum RAM supported	192K/N/S	48K/1M	64K
Maximum disk storage	2G	4G	16 drives, 1G per drive
Direct memory access supported?	yes	yes	yes
Languages supported	BASIC, FORTRAN, COBOL, Pascal, C	MicroCOBOL, Autoclerk	all CP/M-compatible
File management	sequential, random, ISAM	sequential, random, ISAM	
Memory management	several techniques, depending on hardware	overlay, partition, bank, swap	bank
Utilities	over 200 UNIX utilities	sort, RSAM/ISAM conversion, linkage editor, spooler, security, IBM-CP/M-RT-11 file converters, DB, WP	linker/loader, print spooler, others corresponding to CP/M utilities
Price		$900, single-user, $450, reseller; $1900, multi-user, $950, reseller, replication license available	$250-$750; OEM discounts available
Notes	UNIX derivative; provides automatic disk recovery	available in single, multi-user, network versions and with business-application packages	CP/M program- and data-compatible; available in single-, multi-user, network versions
Circle no.	**385**	**386**	**387**



UNIX "pipe" programming structure *directs results of a programming module, or "filter." A pipe can consists of a number of filters, with input at one end and output at the other. Filters work in parallel, and generally do not require temporary disk storage. Example illustrates a spelling-checking program.*

Panatec, Inc.	Phase One Systems, Inc.	Phase One Systems, Inc.	SofTech Microsystems, Inc.
PANA/BASIC	OASIS	OASIS-16	UCSD p-System
'77/'82	'77/'82	'82	'77/'80
8086, 8080/8085, Z80	Z80	8086/8088, 68000, 16000	8086, 68000, 8080/8085, Z80, 6502, 6809, 9900, LSI/PDP-11
general purpose, development, real time	general purpose, development	general purpose, development	general purpose, development
16	16	32	1
16	16	32	N/S
no	yes	yes	no
48K/512K	56K/784K	128K/1M	48K/128K
8 floppy drives, 8 Winchester drives	8 drives, 16M	4G	N/S
yes	yes	yes	no
BASIC, Assembler	BASIC, FORTRAN, COBOL, Pascal, C, Assembler, EXEC	BASIC, FORTRAN, COBOL, Pascal, C, Assembler, EXEC	UCSD Pascal, FORTRAN-77, BASIC, Assembler
sequential, random, ISAM	sequential, ISAM, keyed direct, relative direct	sequential, ISAM, keyed direct, relative direct	random
partitioned with dynamic allocation, bank, map, overlay	3 overlays, as many as 16 partitionable banks	various schemes supported, each task gets 64K for code, 64K for data	swap
disk reorganize, sort, merge, file protection and securing, word processor	2 editors, debugger, WP, DB, backup, sort, conversion, communications	editor, debugger, WP, DB, backup, sort, conversion, communications	print spooler, graphics, native code generator
$200-$1500	$500, single-user; $850, multi-user	$1495	$375; 35% re-seller discount; various licensing plans
	single-user applications can be run on multi-user version without modification; supports 24 non-disk peripherals	supports single-application processor, multiple I/O processors; 68000, 16000 versions scheduled for 4Q release	64K RAM required for development system; maximum 64K RAM for 8-bit μps; optional features: CAI and CP/M-UCSD p-System
388	**389**	**389**	**390**

Some operating-system problems may have hardware solutions.

memory and mailbox intertask communications. It can be used for development applications as well. MTOS from Industrial Programming is a real-time system accommodating as many as 4096 tasks with 255 dynamically modifiable priority-scheduling levels. It handles as many as 16 processors on the Multibus, using single-processor programs.

Other unique systems include TeleSoft's ROS, supporting Ada; FORTH Inc.'s FORTH operating system, supporting the FORTH programming language; and TurboDOS from MuSys, offering compatibility with CP/M, improved speed and larger disk and file support.

The CP/M family, MS/DOS and OASIS can be expected

MEMORY AND FILE MANAGEMENT

An operating system allocates memory to a user and organizes information into files. These tasks can be accomplished in a variety of ways, depending on the resources available and the needs of the application.

A single-user system with modest memory demands can get by with a contiguous memory scheme, in which memory is allocated into large neighboring blocks. Data are transferred into and out of these blocks when necessary by the user. If the CPU's address space is larger than the physical memory space, swapping and overlaying techniques can be used to transfer segments of data between the disk and memory. In a swap, memory and disk segments change place; in an overlay, the disk segment is simply written over the memory segment, remaining on the disk as well. Memory banks allow memory sizes larger than the address space of the CPU. The CPU deals with one bank at a time, switching to another bank to provide additional memory or to provide a separate memory to another user. Users can share memory through partitioning, with each user's area of memory inaccessible to other users.

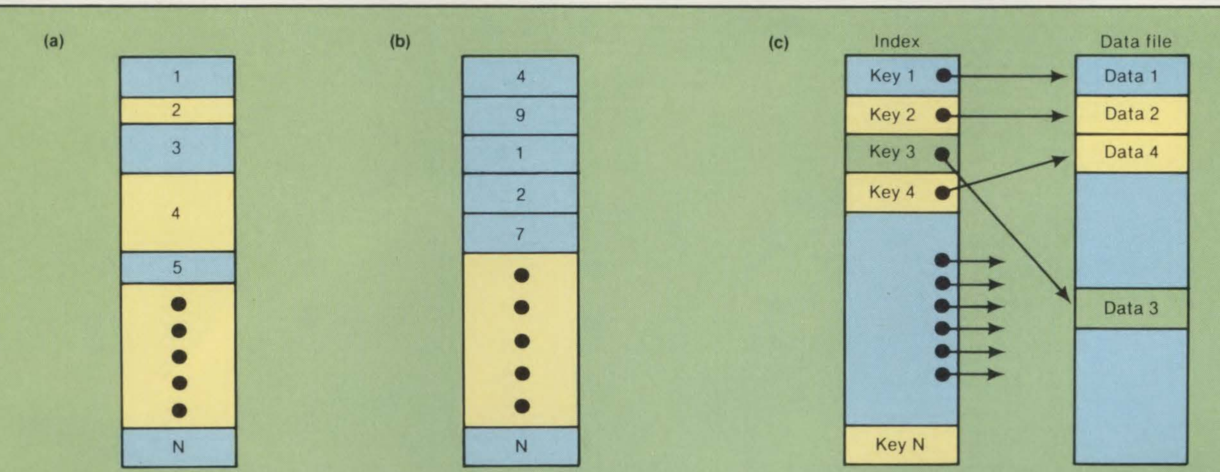
File management can also be approached in several ways. A sequential file stores records in order of record number; records must be accessed by searching through the entire file in order until the right record is found. Random files allow direct access to any record. The technique does not require records to be stored in a particular order, but variable-length records are not as readily supported as in sequential files. The indexed sequential access method (ISAM) provides features of both techniques: records are stored sequentially, while a separate file of keys (such as names or zip codes) allows the direct access of any record. This scheme is more complex, however, and uses more disk space.

Company	Software Dynamics	Technical Systems Consultants, Inc.	Telecomputer International Systems, Inc.
Operating system	SDOS	FLEX	TIS-APL
Year of first/latest version	'78/'82	'77/'79	'76/'82
Microprocessors supported	6800, 6801, 6809	6800, 6809	Z80
Applications	general purpose, development, real time	general purpose, development, real time	general purpose, development, real time
Maximum no. of users	7	1	4
Maximum no. of concurrent tasks	1	2	4
Multi-processor support?	optional	no	no
Minimum/maximum RAM supported	56K/512K	20K/64K	64K
Maximum disk storage	2G	20M per drive	4 drives, 96M
Direct memory access supported?	yes	yes	yes
Languages supported	BASIC, ASM	BASIC, Assembler	APL
File management	sequential, random, tree, hashed directories	sequential, random	direct access
Memory management	contiguous, overlay, bank, page map	contiguous	bank
Utilities	optional: screen and line text editors, file binary inspect/modify, sort	over 50 available	editor, disk backup, DB, communications, machine language interface, graphics
Price	single-user: $230, $172, reseller; multi-user option: $700, $525, reseller, network option: $250, $187, reseller; volume discounts negotiable.	$150; OEM licenses available	$1195; reseller, $836
Notes	network version can be used with multi-user versions; object programs can be encrypted by processor serial number for security; supports hard, floppy, cartridge storage of any format		available without communications and support for $495 (end-user)
Circle no.	391	392	393

to retain the lion's share of the low-end 16-bit market for some time. Enhanced versions will come and go, beefing up multi-user, multitasking and file- and memory-management features, but the three are unlikely to change drastically as they battle for vendor recognition. If UNIX and its derivatives manage to break out of the superminis into direct competition with low-end operating systems, some pressure will be on their developers to adopt UNIX-like features while clinging to compatibility with existing software.

Some operating-system problems may have hardware solutions. Dual-processor microcomputers, such as those introduced by Tandy Corp., DEC and Vector Graphic, Inc., offer 8-bit software compatibility and 16-bit performance to ease the transition.

The availability of memory-management chips will boost the performance of many operating systems without complex software modifications. ■



File-management techniques *include sequential (a), random (b) and indexed sequential (c). Sequential files must be searched through in order, while it is sometimes difficult to construct variable-sized records in random files. Indexed sequential files allow direct access through keys.*

Telesoft	Western Electric Co.	Whitesmiths, Ltd.	Intel Corp.
ROS	UNIX	IDRIS	iRMX 86
'78/'82	'74/'82	'81	'80/'82
8086/8088, 68000	68000, PDP/LSI-11	68000, 8080, Z80, PDP/LSI-11	8086, 8088
general purpose, development, real time	development	development	real time
1	N/S	N/S	4-8
N/S	N/S	N/S	N/S
no	no	no	yes
256K/16M	96K/ N/S	96K/ N/S	0/1M
N/S	N/S	300M	N/S
yes	yes	yes	yes
Ada, Pascal, Assembler	C, FORTRAN	C, Pascal, Assembler	BASIC, FORTRAN, Pascal COBOL, C, PL/1
sequential, random	tree	tree	hierarchical
swap	contiguous, swap	contiguous, swap	dynamic allocation
screen editor, source compare, sort/merge, WP, link editor	over 125	most UNIX	screen editor, debugger, librarian
$175-$4000; 65% discount with quantity 100	$28,000 (version 7)	$2250	$395; OEM license: $600 plus $130 per unit
can run on VAX-11/780, IBM 370, allowing program downloading; available for IBM PC; price varies with utilities ordered	prices drop with volume, rise with number of users per system	UNIX-like system designed for low-end, 16-bit multi-user systems; runs on Z80 with memory banks (2 64K banks minimum); can run on floppies without hard disk; FORTRAN available from OEMs	can be used for commercial control, e.g. database machines; requires 16K RAM; version for 286 available 2/83
394	**395**	**396**	**397**

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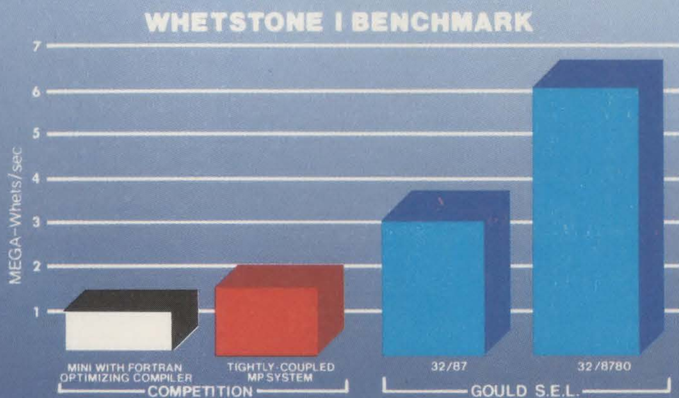

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Logic design systems uses in-house and remote facilities

RON LAKE, Texas Instruments Inc.

Package and vendor support free array developer of many design tasks

A logic-array development system from Texas Instruments Inc. provides users of several 32-bit machines a software and support package for the design, analysis and masking of TI arrays. The transportable design utility consists of TI software run on a client's computer. Actual logic-array fabrication and prototype and mask production are carried out at TI facilities.

The package

The TDU software comes to a user as a set of Wirth-standard Pascal programs integrated into Digital Equipment Corp.'s VAX 11/780 32-bit superminicomputer and IBM Corp.'s 4341 and larger mainframes (Fig. 1). Integration into other machines, such as Data General Corp.'s MV/8000 series, is under development. The heart of the TDU is the hardware description language, a compiled, nonprocedural language that translates a logic description into a machine-readable database at the net-list level. The source code forms a documented design database, with each module of the design coded as an HDL subroutine and subsequently "interconnected" via a master module. Documentation allows tracing errors to a module, which is then checked and verified by simulating the source code of the module itself.

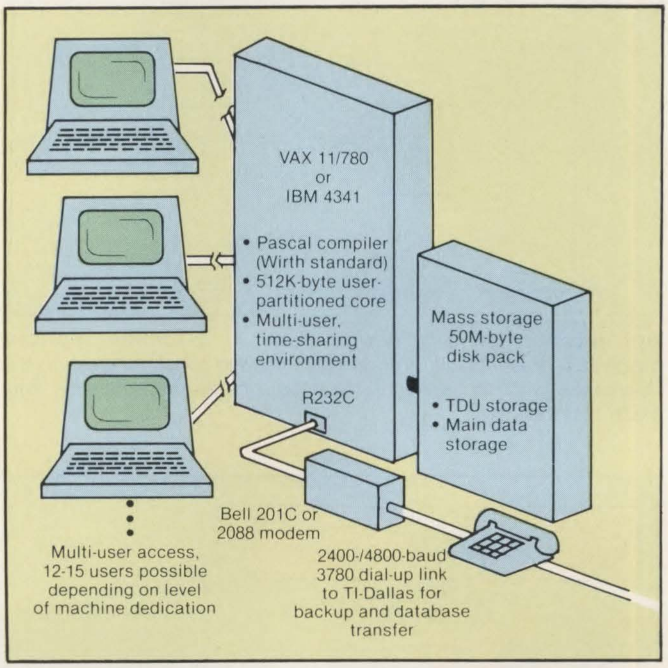


Fig. 1. Hardware requirements *for in-house TDU support include 32-bit computer and 50M bytes of storage. System allows customer to develop design database for remote transmission to TI in Dallas, where design process is completed.*

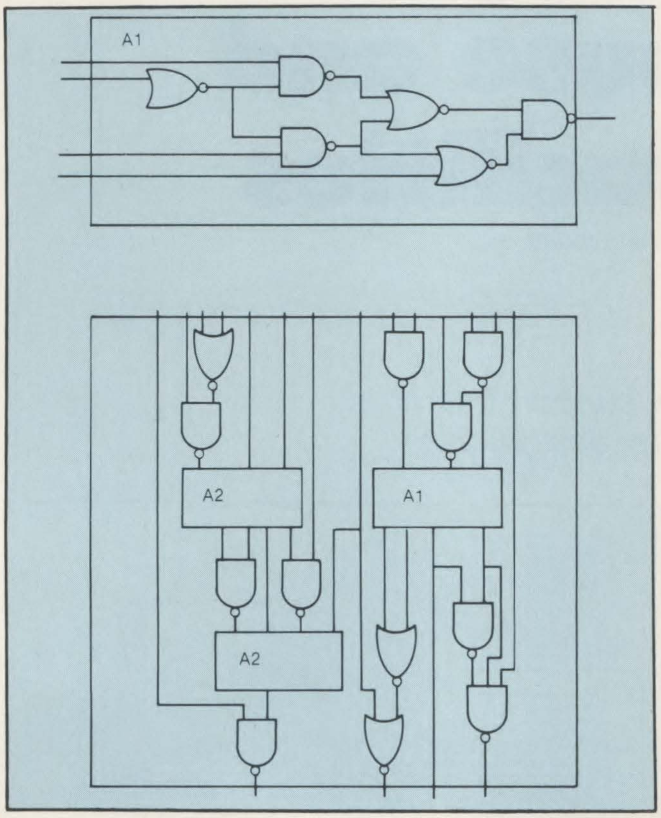
Control over critical gate layout and signal routing is user-defined through the HDL. The HDL's higher-level language control over automated layout and routing constrains the design automation to net critical timing paths without requiring extensive user intervention. It does this by logically grouping critical gates and macros and assigning physical cell locations on the master bar. Signals are then assigned criticality factors to control the remaining auto layout and auto routing.

Test vectors are then generated using TDU's test-description language and the simulation-control language (SIMCL). With TDL and SIMCL, users can specify test conditions appropriate to their designs. SIMCL allows high-level language control to aid in generating input test conditions, while expected output results can be included for verification as part of the TDL format. The event-driven, multivalued logic simulator routine reads these test vectors as input, then presents the user with the logical activity and timing responses of the design in several formats. The circuit's performance can be compared to a user's expectations, and unexpected results can be traced to the offending module in the original HDL logic description for correction and resimulation.

Software provides user-defined control over critical gate layout and signal routing.

In contrast to conventional CAD methods for minicomputers, TDU does not require special hardware such as graphic terminals and light pens, nor the attendant manual placement and layout of the logic schematic. A user can make as many runs as is required on in-house equipment, eliminating the two- to six-hour turnaround time characteristic of queued batch-processing.

HDL can also support a larger database than many CAD systems, able to manage 10,000 gates for multipart systems. This 10,000-gate system could be used to design a mainframe ALU.



HDL program for array design *written in TI software replaces graphics representation. Programs are used to construct an in-house database, which is sent to TI facilities for design completion and mask prototyping.*

```
Block array design;
Inbus (0 to 3, 0 to 7) at input;
Control (0 to 7) at input;
Outbus (0 to 7) at output;
structure
G1: STL 1 Inbus (0),
G2: JKFF
G3: LATCH
G4: LATCH
•
•
•
•
G84: 4 bit Reg
G85: 4 bit Reg
•
•
•
End;
```

Graphic representation of logic arrays *used by conventional CAD systems are entered by light pen, digitizer or keyboard. Some systems allow viewing at different levels of detail as well as design checking and simulation.*

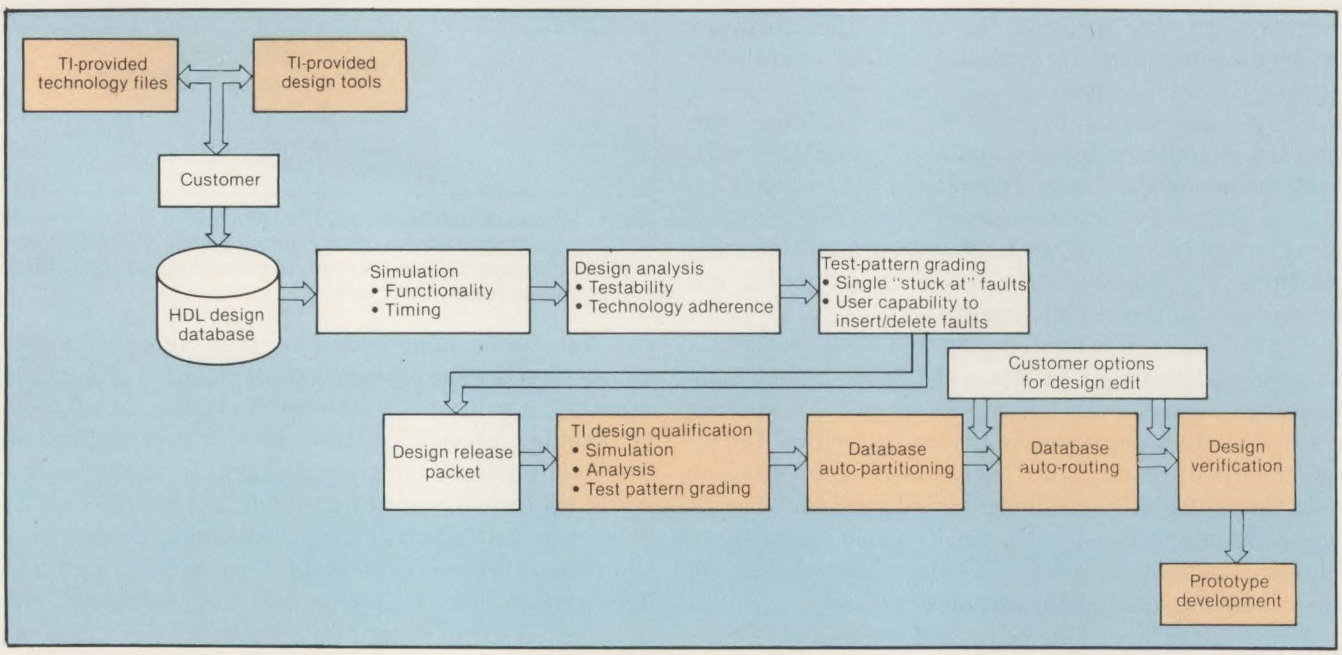


Fig. 2. TDU logic design and prototype development tasks *are divided between customer and TI. Customer develops design release on in-house system, and TI takes design release and develops prototype.*

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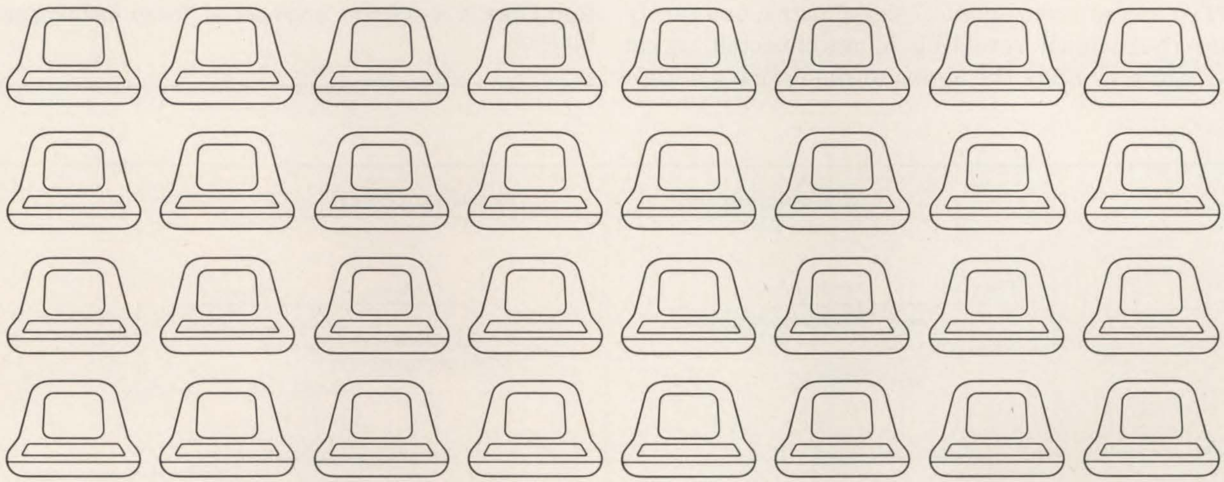

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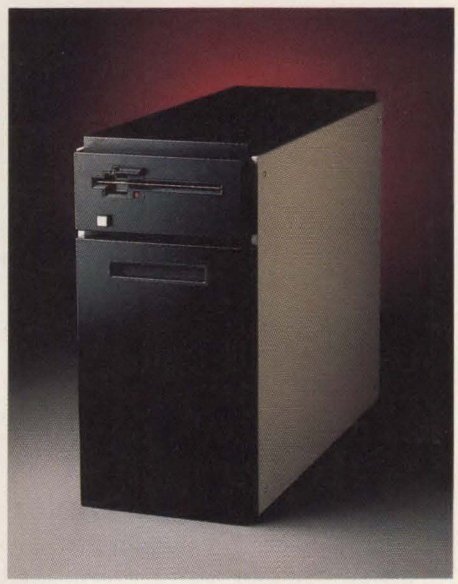

molecular computer

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The 10,000-gate system could be used to design a mainframe ALU.

On to Dallas

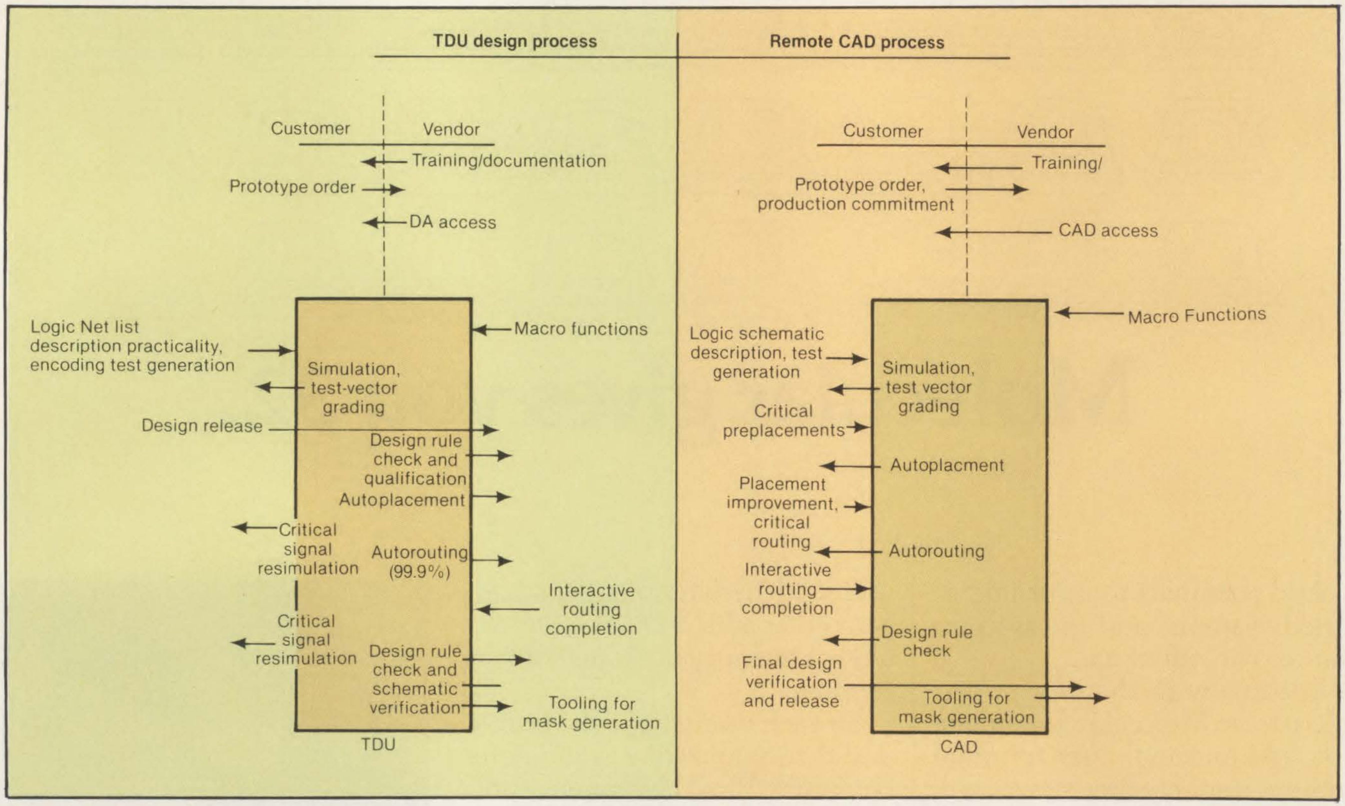
With the HDL-designed logic description accomplished, the database is transferred through dial-up RJE links to TI's central computing facilities in Dallas where the rest of the design, including mask generation and prototyping, takes place within 12 to 16 weeks (Fig. 2). The TI computers route critical signal paths, and rarely require the manual rerouting of unconnected signal paths. TDU also offers the option of simulating a design using actual time delays after auto layout or auto routing.

Prototypes are produced using a direct-write Electron-beam on wafer equipment, controlled by the output of TI in-house computers. After a customer has tested the prototype and given the go-ahead, production masks are generated, again using E-beam lithography equipment to maintain prototype specifications. A planned random test pattern grader will allow test vector grading, modeling only 15 percent of the internal "stuck-at" nodal faults instead of the full 100-percent fault modeling now used.

TDU is compatible with all of TI's families of arrays. Software function macros, logic-simulation models and logic-design rules have been encoded in the TDU to allow STL logic design, analysis and simulation, and the TDU will be upgraded to include new simulation models and design rules for the ASTL family on its release. The TDU will also be upgraded to include simulation models, design rules and a hard-wired macro family for the coming CMOS array family.

The initial year lease of TDU software will cost about $65,000, including on-site installation on the user's computer system, software maintenance, updates for the first year and user support. ■

Ron Lake is a systems engineer at Texas Instruments Inc., Houston.



Comparison of TDU and CAD processes *shows TDU frees customer from several design tasks.*

NEXT MONTH IN MMS

Two profile surveys will hold the spotlight in the October feature section of Mini-Micro Systems:

- Available add-in memory board products and their vendors will be tabulated and factors analyzed that affect their markets and distribution channels.
- A survey of enclosures will examine this important product sector from an integrator's point of view: what to look for, what to ask for and who to ask.

Other articles will cover:

- Memory technologies
- Vertical magnetic recording
- Optical disks
- Associative memory

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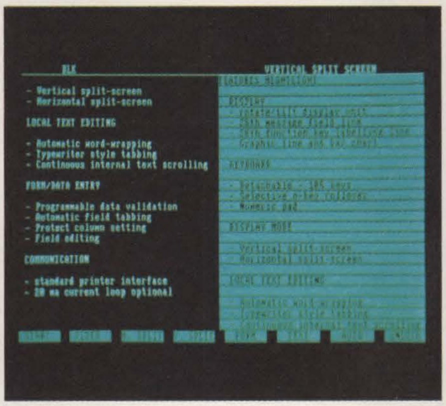

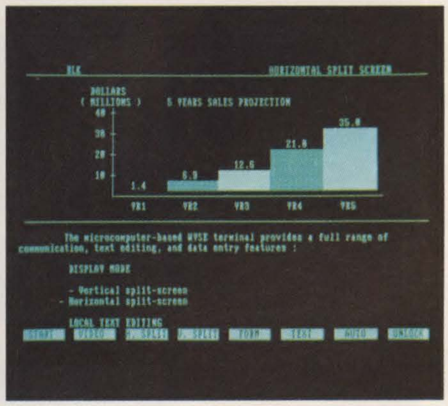

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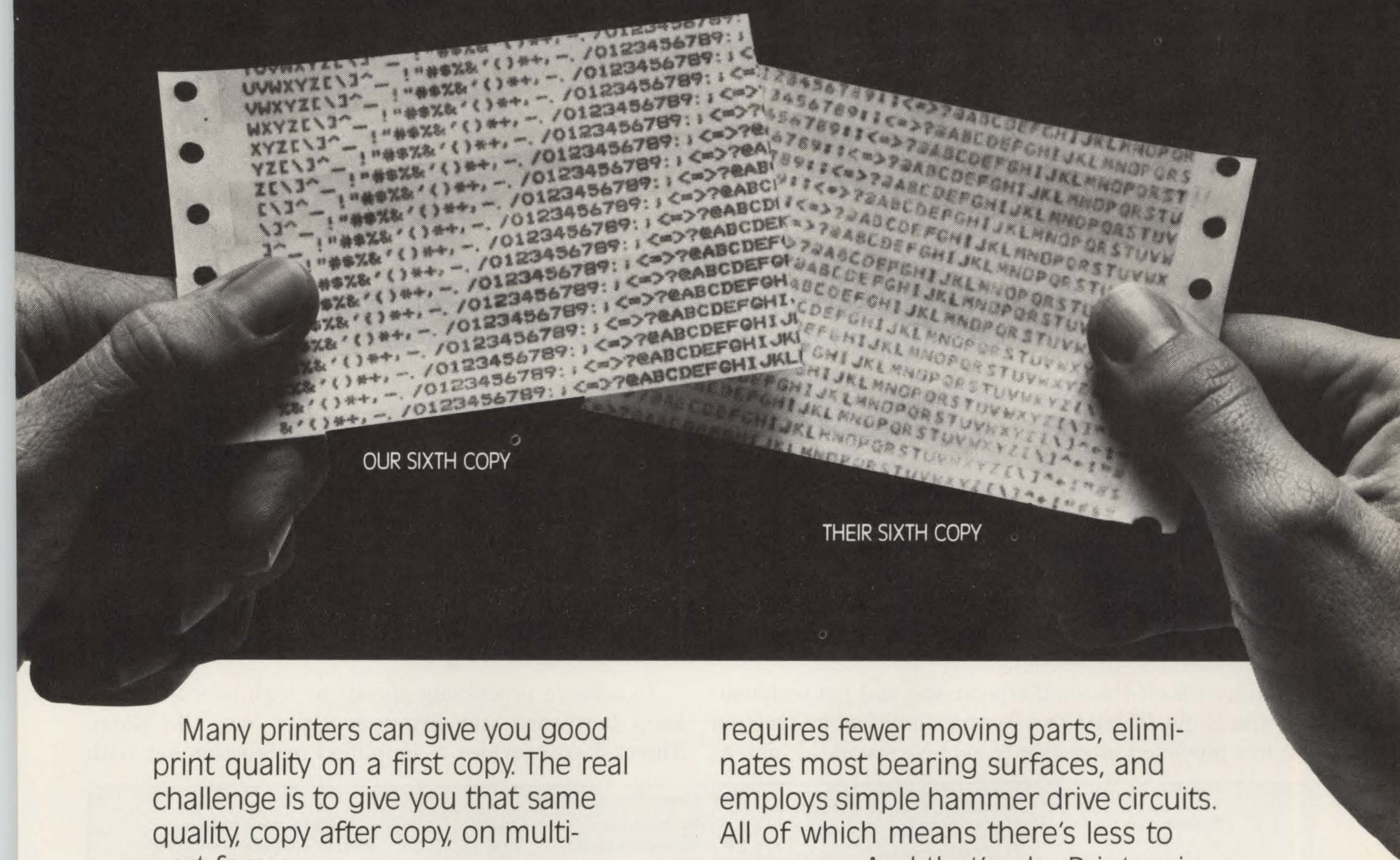

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CIRCLE NO. 90 ON INQUIRY CARD

Pipelining and new OS boost mini to 8 MIPS

ED BASART, DAVID FOLGER and BILL SHELLOOE, Ridge Computers

CAD-oriented supermini uses simplified instructions, bit-mapped graphics and a UNIX-like OS

Although minicomputers are still favored for applications requiring heavy computation, the trend in recent months has been to microprocessor-based work stations. Many manufacturers have avoided the minicomputer arena on the grounds that machines from Digital Equipment Corp., Data General Corp. and others have had the territory well in hand.

In the face of these trends, Ridge Computers is offering a new 32-bit minicomputer for CAD, scientific and engineering applications.

Built with off-the-shelf bipolar MSI and LSI technology, the Ridge Thirty-Two uses a simplified instruction set in a pipelined processor to achieve speeds as high as 8 million instructions per sec. A virtual-memory architecture implementing a private CPU memory bus and a 125-nsec. instruction cache further contribute to the machine's performance, which compares favorably to DEC's VAX-11/780 in some benchmarks. The Ridge Thirty-Two also provides a UNIX-like operating system with an enhanced file structure and virtual-memory bit-mapped graphics displays for as many as four users.

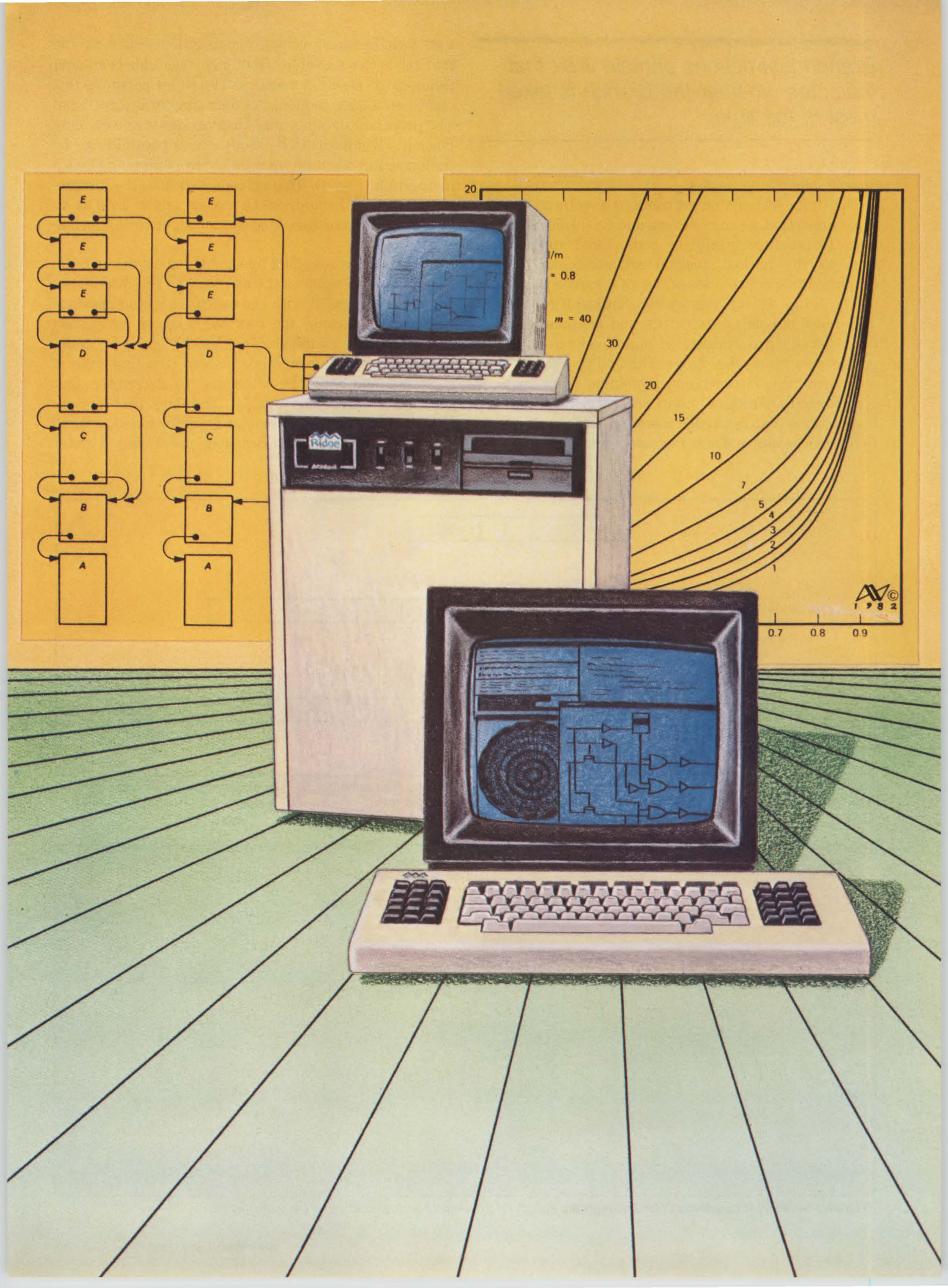
Instruction set design

To achieve processing speeds as high as 8 MIPS and keep hardware and firmware costs low, the Ridge Thirty-Two provides a simplified instruction set with

	Whetstone program results	
System	Performance (1000 Whetstones/sec.)	Performance/price (Whetstones per sec./dollar)
Gould S.E.L. 32/87	3760	14.2
Ridge Thirty Two	1500	25.0
DEC VAX-11/780	1168 (with FPA*)	6.5
DEC VAX-11/780	753 (without FPA*)	4.7
DEC VAX-11/750	331	3.9
	Puzzle program (subscript version)	
System	**Time (sec.)**	
IBM 3081	1.3	
Ridge Thirty Two	2.2	
DEC VAX-11/780	9.4	
DEC VAX-11/750	18.4	
IBM 4331	45.0	
	Ridge instruction times (from cache)	
Function		**Minimum execution time in microsec.**
32-bit register ADD		.125
Shift left 0 to 15 bits		.125
Indexed 32-bit load from memory		.500
Indexed 32-bit store into memory		.375
Conditional branch (predicted correctly)		.250
Unconditional branch		0
32-bit floating point add		1.750

*floating point arithmetic

Benchmark results and instruction times *for Ridge Thirty-Two compare favorably to other minicomputers, and even to mainframes in many cases.*


E
E
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Ridge
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= 0.8
m = 40
30
20
15
10
7
5
4
3
2
1
0.7
0.8
0.9
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Branch instructions contain a bit that indicates whether the branch is taken most of the time.

limited addressing modes.

The Ridge instruction set contains only those instructions important to engineering and scientific computation. Instructions useful to commercial applications, such as the packed decimal arithmetic and COBOL output editing capabilities of the VAX, can be performed on the Ridge Thirty-Two by subroutines if required.

Because simple LOAD, STORE and arithmetic operations usually predominate in high-level scientific language programs, the Ridge Thirty-Two incorporates only such basic instructions, combining them for more complicated operations. LOAD and STORE are the only instructions that reference memory; arithmetic operations such as add and subtract use register format. The VAX includes more complex instructions, such as one that takes two variables from memory, adds them and replaces the result in memory. The Ridge performs this operation with a sequence of four simpler instructions. The processor decodes most instructions in one cycle by placing all information about the operation to be performed in one 8-bit op code at the beginning of each instruction (Fig. 1). This op code indicates the instruction type and the addressing modes, and is used as an index into a microstore ROM containing control information.

Registers are specified by the byte after the op code; the processor examines the op code and pre-fetches the registers in parallel with the execution of the previous instruction. Because the VAX has a larger instruction set with many addressing modes, its op code cannot supply as much information. Instead, the first byte of each operand must be examined to determine that operand's addressing modes. The bits that specify registers, furthermore, cannot be determined until all the operands have been decoded, precluding register

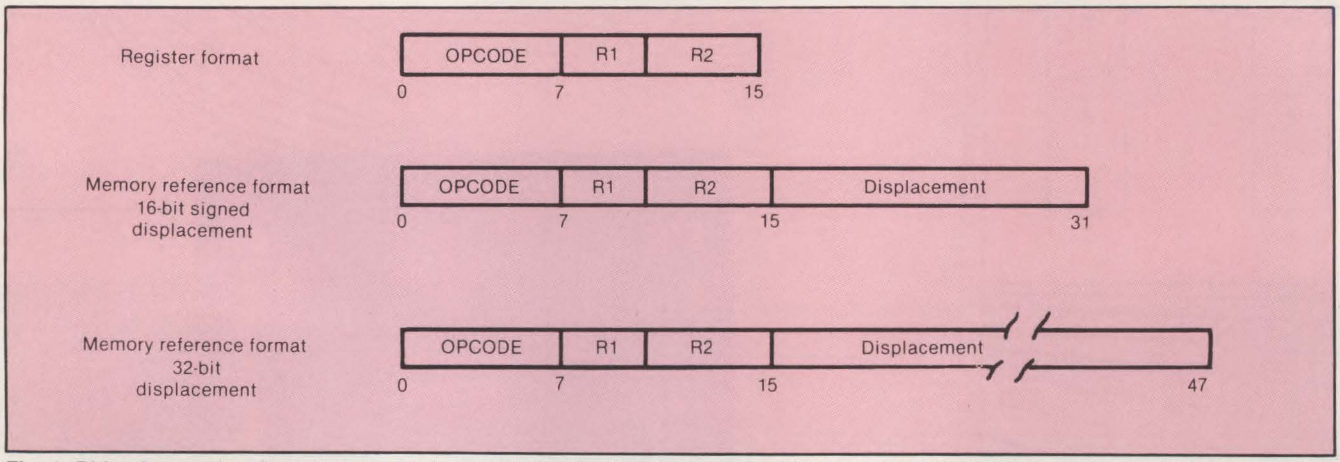

Fig. 1. Ridge instruction formats *completely specify function in 8-bit op code. The same bits (7-15) indicate which registers are involved, regardless of the instruction type. VAX-11 instructions do not have a standard format.*

LOAD	R0, R1, 4096	- Load the 32-bit word at the address specified by the contents of register 1 plus 4096.
	Hex code:	D6 - opcode 01 - register specification 10 - displacement 00 - displacement
STORE	R0, R1, 131072	- Store the 32-bit contents of register 0 at the address specificed by the contents of register 1 plus 131072.
	Hex code:	B6 - opcode 01 - register specification 00 02 00 00 } displacement
ADD	R0, R1	- Add the 32-bit R1 to R0 and place the result in R0.
	Hex code:	03 - opcode 01 - register specification

Examples of Ridge instructions *show that registers specifying operands are located at same bits in instruction.*

pre-fetching. Most VAX architecture implementations thus require at least one cycle to examine the op code and an additional cycle for each operand. A two-operand instruction would run at least three times as fast on the Ridge Thirty-Two as on the VAX if other performance features were equivalent, but the complexity of the VAX instructions reduces the Ridge's speed advantage.

Machines that incorporate operations with special addressing requirements—such as missing addressing modes, limits in address range and specialized uses for registers—pose difficulties for compiler designers because extra tests and case analyses are needed to handle the special situations. Microcomputers in general tend to suffer from these difficulties. The VAX avoids the problem by allowing any addressing mode for each instruction. Ridge takes the opposite approach, providing a single, register-oriented addressing mode for each arithmetic operation.

Pipelining speeds instruction execution

The steps usually involved in processing an instruction include fetching the instruction from memory, decoding it to determine its type, fetching its operands, executing the instruction and storing the result in a register or memory. Each of these operations generally takes at least one machine cycle. Pipelining is a technique whereby some of the instruction-processing operations overlap. While one instruction is executing, for example, the next instruction could have its operands fetched, and the instruction after that could be decoded. By pipelining these operations (Fig. 2), the Ridge processor can execute many instructions at an effective rate of one instruction per cycle, a rate usually attained only on such large machines as the CRAY-1 and the IBM 370-195.

It is difficult to implement pipelining on a machine that allows an instruction to store in the instruction stream because an instruction that is modified may have been pre-fetched. Pipelined architectures that permit this self-modifying code, such as that of the IBM 370, must include expensive hardware to detect its occurrence and provide the correct results. The Ridge architecture avoids the problem by providing each process with 4G-byte linear address spaces for code and data. Because code space is separated from data space, and because STORE instructions cannot reference code space, the Ridge processor need not check for self-modifying code.

The implementation of branch instructions is critical to the performance of pipelined machines. Without special hardware, a conditional branch instruction empties the pipeline because the processor cannot pre-fetch the next instruction until the outcome of the branch has been determined. On high-performance machines, branches can be among the slowest instructions. A technique for predicting branches is sometimes used to allow the pre-fetch unit to assume a path; the pre-fetch unit can then begin fetching and decoding along the assumed path. Only when the assumption proves false does the pipeline have to be emptied and restarted. There are some problems encountered in applying this prediction technique to existing architectures. In the case of the IBM 370 architecture, for example, the target of a branch depends upon the contents of a base register. Because the base register can be modified by instructions immediately before the branch, it is difficult and expensive to predict where a branch instruction will go on the basis of this register. The Ridge compare-and-branch instructions use a nonmodified address in the instruction itself, and can thus be processed by the fetch unit without accessing the registers. These instructions also contain a bit that indicates whether the branch is taken most of the time. For example, the compare and branch at the end of a

MOV	L^4096(R1), R0	- Load the 32-bit word at the address specified by the contents of register 1 plus 4096.
	Hex code:	D0 - opcode C1 - source operand (reg. 1) 10 - displacement 00 - destination operand (reg. 0)
MOV	R0, L^131072(R1)	- Store the 32-bit contents of register 0 at the address specified by the contents of register 1 plus 131072.
	Hex code:	D0 - opcode 50 - source operand (reg. 0) E1 - destination operand (reg. 1) 00, 02, 00, 00 } displacement
ADDL2	R1, R0	- Add the 32-bit R1 to R0 and place the result in R0.
	Hex code:	A0 - opcode 51 - source operand (reg. 1) 50 - destination operand (reg. 0)

Examples of VAX-11 instructions *for same operations show operands are not always located at same point in instructions. As many as 13 types of variable-length operands are supported, so that first byte of each operand must be examined to decode instruction.*

A new software function can be implemented by adding a new service process.

FOR loop will usually be taken and can be marked accordingly at compile time. In addition, the Ridge pre-fetch unit can detect unconditional branches and pre-fetch their target in parallel with execution of other instructions. In many cases, an unconditional branch does not use execution cycles, and does not contribute to program execution time. Because of these techniques, correctly predicted branch instructions execute faster on the Ridge than on large IBM mainframes.

The Ridge Thirty-Two pipelined architecture results in relatively fast benchmarks (see table). In programs dominated by array referencing, testing and procedure calls, the Ridge Thirty-Two achieves an average execution rate of about 4 MIPS, or one instruction every

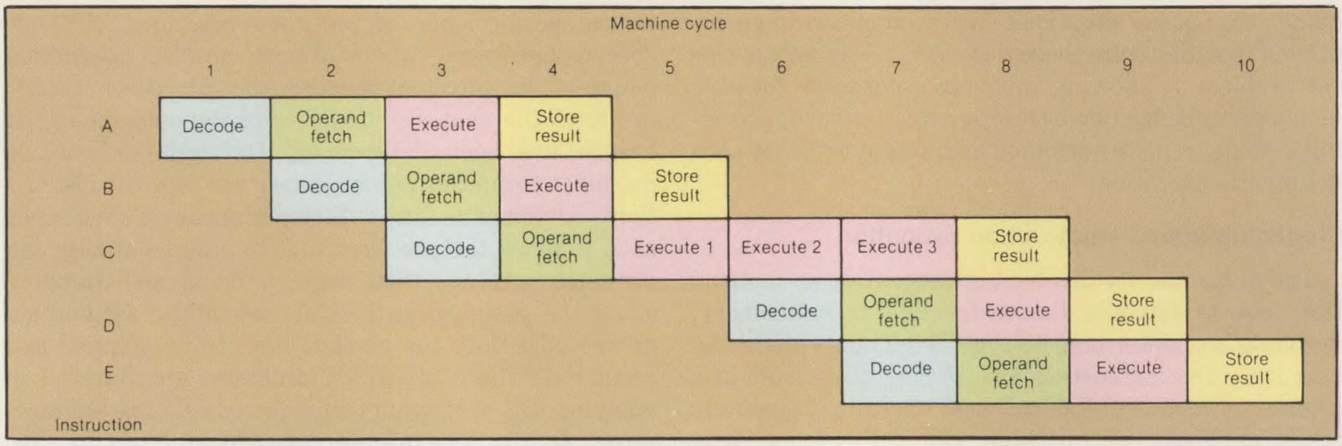

Fig. 2. Instruction pipelining in Ridge CPU *overlaps decode, operand fetch, execute and store result operations. In this example, instruction C has three execution cycles, which partially empty the pipeline; the other instructions all have single-execution cycles.*

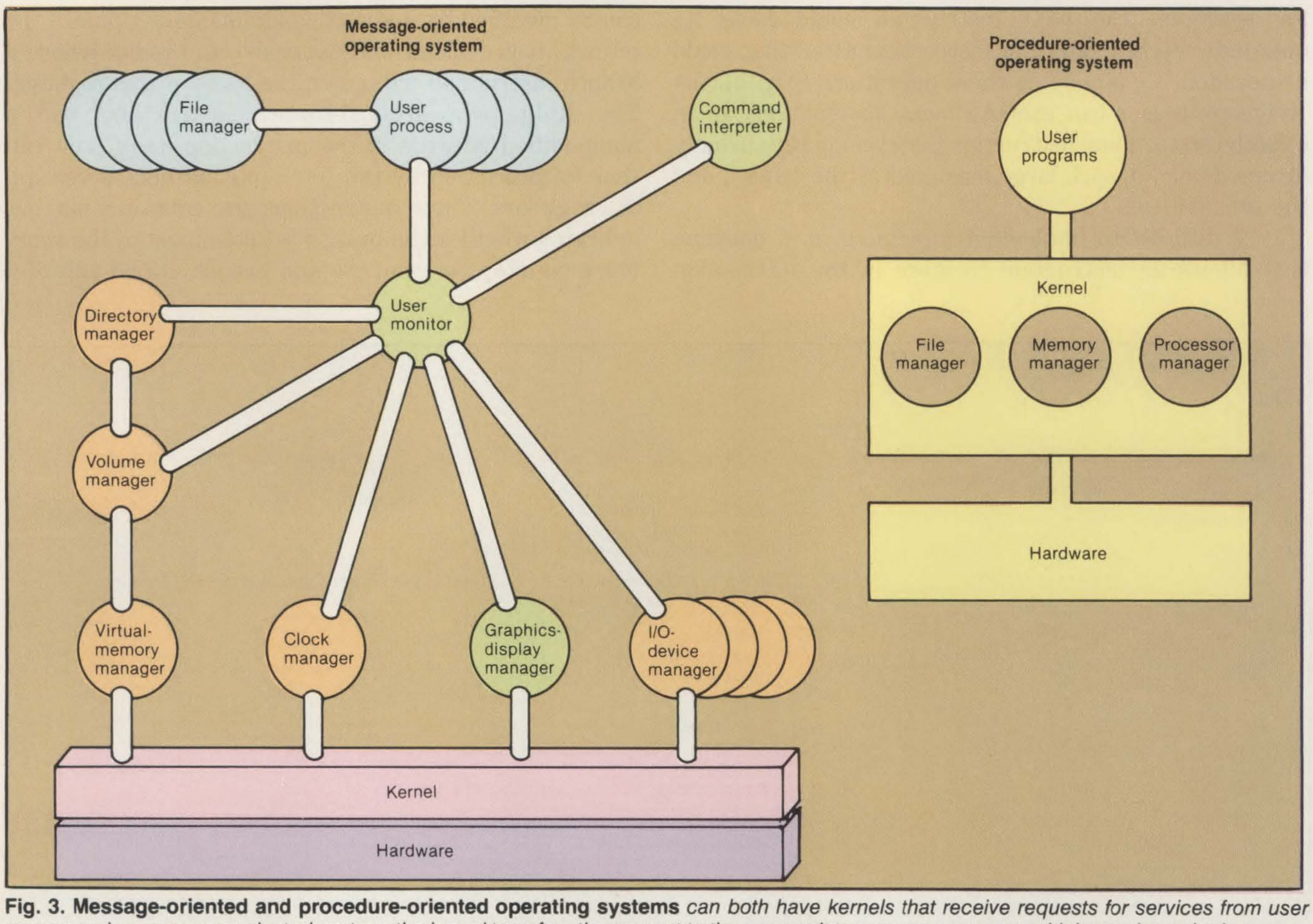

Fig. 3. Message-oriented and procedure-oriented operating systems *can both have kernels that receive requests for services from user programs. In a message-oriented system, the kernel transfers the request to the appropriate process manager, which may be a single system process (red), a single process per user (green) or a multiple process per user (blue). In a procedure-oriented system, the kernel itself performs the required services.*

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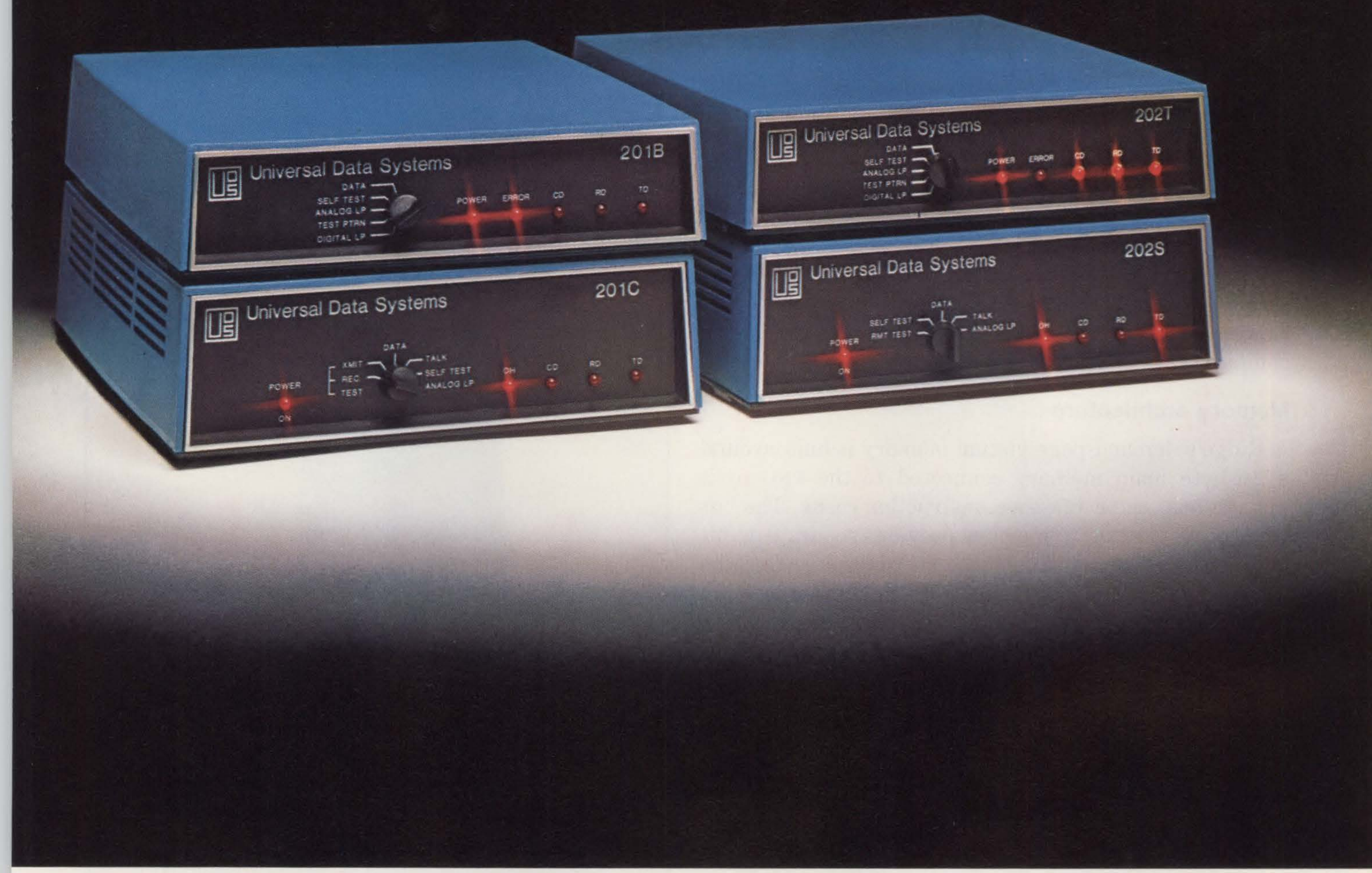

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CIRCLE NO. 152 ON INQUIRY CARD

Created by Dayner/Hall, Inc., Winter Park, Florida

LOAD and STORE are the only instructions that reference memory; arithmetic operations use register format.

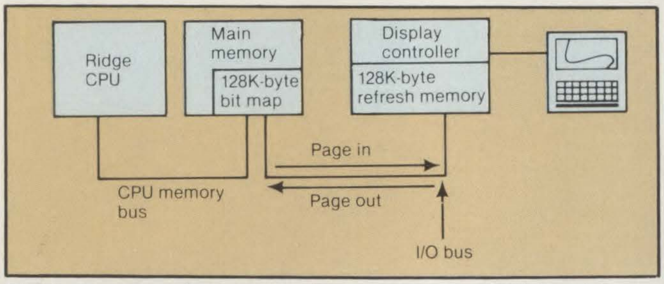

Fig. 4. Graphics display refresh process *uses 128K-byte bit map kept in each user's virtual-memory address space. Bit map is paged into display controller refresh memory from main memory, so that only pages that have been modified need be transferred.*

two machine cycles (Fig. 3). Such programs are fairly representative of CAD programs that manipulate geometric structures such as VLSI masks. The Ridge Thirty-Two achieved a lower MIPS rate on the Whetstone benchmark because this program is dominated by slower floating-point instructions representing analysis computations.

Memory architecture

Ridge's demand-page virtual memory is built around a 2M-byte main memory connected to the CPU by a private bus, and a 125-nsec. instruction cache. The bus connecting the CPU to memory provides separate 32-bit data paths for virtual addresses and data, allowing the CPU to send an address to memory while it is receiving data from the previous memory operation. The CPU can thus receive one 32-bit word from memory every 375-nsec. memory cycle. And, because the CPU is the only node on its memory bus, arbitration overhead is minimal.

The VAX-11/780 CPU communicates with its memory through the synchronous backplane interconnect. The SBI has a 32-bit data path multiplexed between address and data. Memory-cycle time on the VAX-11/780 is 600 nsec., but, because the SBI is shared by multiple I/O adapters and memory controllers, the memory access time at the processor, including SBI overhead, is 1800 nsec. The VAX-11/780 does, however, get 8 bytes of data on each access as opposed to 4 bytes for the Ridge Thirty-Two. The maximum memory-access bandwidth between the CPU and memory is, therefore, 10.7M bytes per sec. for the Ridge and 4.4M bytes for the VAX-11/780.

The VAX-11/780 provides a large instruction and data cache to shorten average memory-access time. This cache can provide a maximum of one 4-byte word every 200 nsec. The Ridge memory system's faster access time warranted a smaller, less costly instruction cache. Because of its simplicity, the Ridge 256-byte instruction cache can deliver one 4-byte word every 125 nsec. Assuming an average instruction size of 4 bytes, the Ridge Thirty-Two can theoretically execute 8 MIPS compared to the VAX-11/780's 5 MIPS. The Ridge Thirty-Two can achieve this theoretical maximum in many cases, but the VAX-11/780 cannot.

One challenge of implementing virtual memory is providing a clean instruction abort for when an instruction references a missing page. The abort procedure must restore the CPU to the state it was in before beginning the instruction. It can be difficult to undo all the effects of a partially completed instruction that makes multiple references to memory and registers, and extra hardware may be necessary to save the information for restarting such complex instructions. Because the Ridge architecture allows only load and store instructions to reference memory, implementation of virtual memory is simplified.

The Ridge operating system is a multitasking virtual memory system similar to UNIX in its system interfaces and in other features. ROS differs from UNIX and operating systems such as IBM-MVS and HP MPE/3000, however, in that it is message-oriented rather than procedure-oriented (Fig. 3).

Ridge Thirty-Two minicomputer and graphics displays *are designed for CAD, scientific and engineering applications.*

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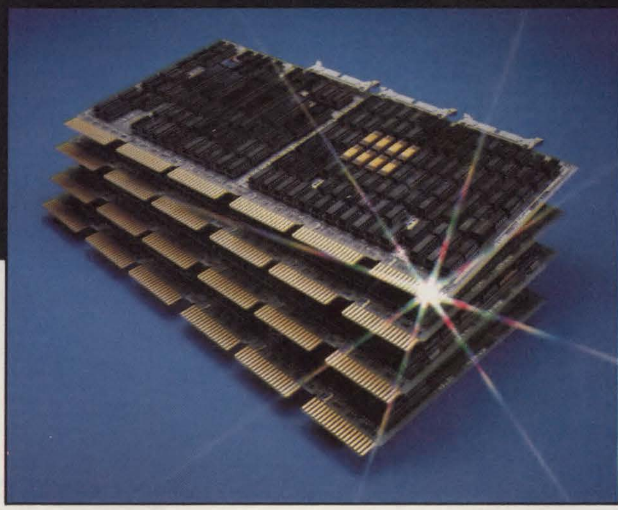

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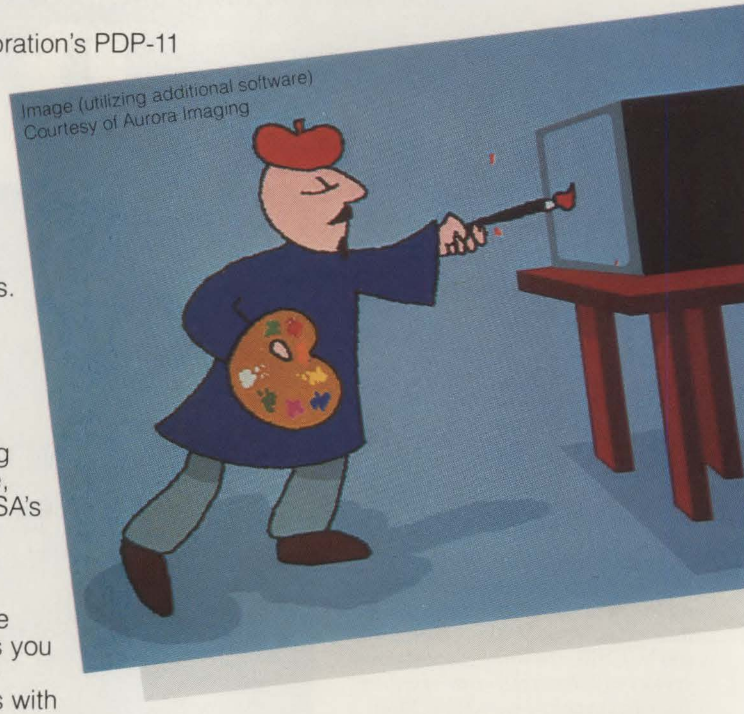
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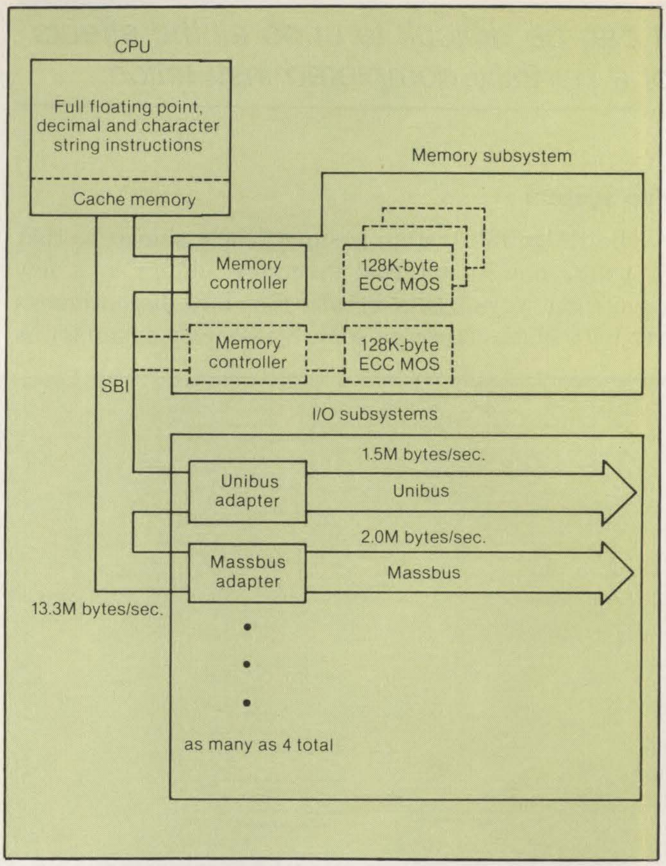
CIRCLE NO. 162 ON INQUIRY CARD

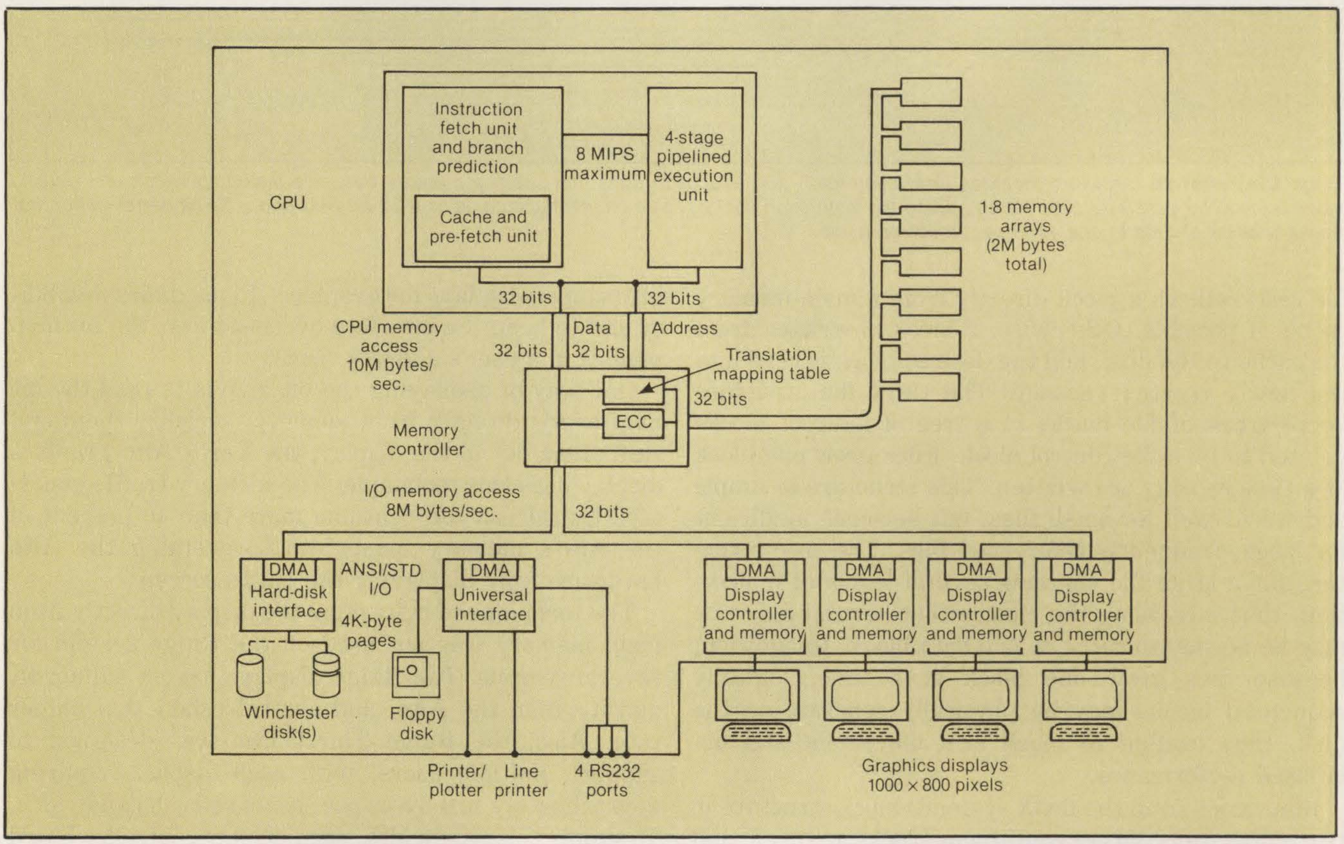
By pipelining, the Ridge processor can execute many instructions in one cycle.



VAX-11/780 hardware architecture *includes a 32-bit Schottky TTL processor with a code and data cache. The CPU accesses memory through the synchronous backplane interconnect, which it shares with I/O adapters and memory controllers.*

In a procedure-oriented system such as UNIX, a user program issues a system call to the kernel to invoke an operating service. The kernel, which runs in a privileged mode and accesses all of memory, then performs the requested operation. A message-oriented system performs system service operations through processes rather than by kernel routines. A user program requests a service by sending a message to a system process that receives messages in a work queue, and responds when the process is completed. The kernel transfers messages between processes, but does not itself perform the system services.

Message-oriented systems provide better modularity and functional isolation because critical system services are performed by processes that are protected from each other by memory-management hardware. These systems are usually easy to extend, because a new function can be implemented by adding a new service process that is independent of other service processes. In a procedure-based system, on the other hand, adding a new function generally means modifying and extending the kernel. Because the kernel is usually a complex program that runs with little hardware protection, bugs are easily introduced and can be hard to find.



Ridge hardware architecture *includes a 32-bit processor, a dual-port ECC memory system and peripheral controllers that share a 32-bit I/O bus. The processor is built with MSI and LSI Schottky TTL components.*

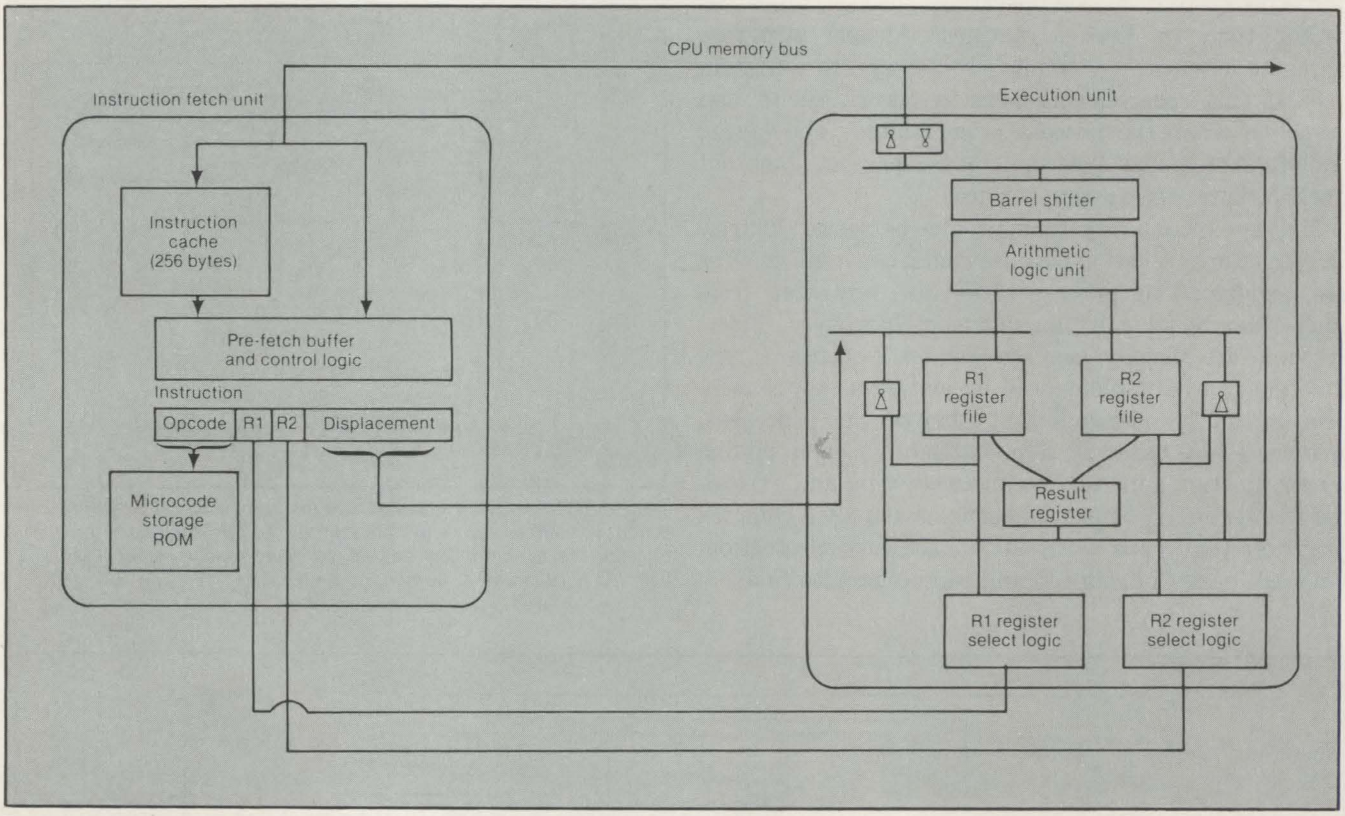
It can be difficult to undo all the effects of a partially completed instruction.

File system

The Ridge file system is superficially similar to that of UNIX, but its internal structure differs in a few significant ways. UNIX breaks files into discontinuous 512-byte blocks (1024 on some VAX-11/780 systems). A file read returns a block directly from a main memory cache, if possible. Otherwise, a block is written from the cache to the disk, and the desired block is read into the newly created vacancy. The UNIX file structure keeps track of file blocks in a tree of indirect blocks pointed to by a file-control block. Files grow one block at a time as they are written. This structure is simple and works well for small files, but becomes inefficient for large, frequently referenced files. The tree structure for a large file contains several levels of indirection, thus increasing the chance that several disk I/Os may be needed to retrieve one data block. In addition, because files grow one block at a time, logically sequential blocks may be physically separate on the disk, thus leading to much arm movement and decreased performance.

ROS varies from the UNIX system's block structure in two major ways: larger contiguous blocks are used, and the caching of file blocks is handled in virtual memory. The Ridge Thirty-Two uses a 4096-byte page as a file block, and files are allocated in extents that are contiguous disk areas. The larger block size improves file system throughput because overhead to write or read a block is usually independent of block size, and more data are transferred in a single file I/O. Using extents to keep sequential data in order reduces disk latency. And by incorporating the caching of disk blocks into virtual memory, the entire main memory can be used as a global buffer pool for file pages.

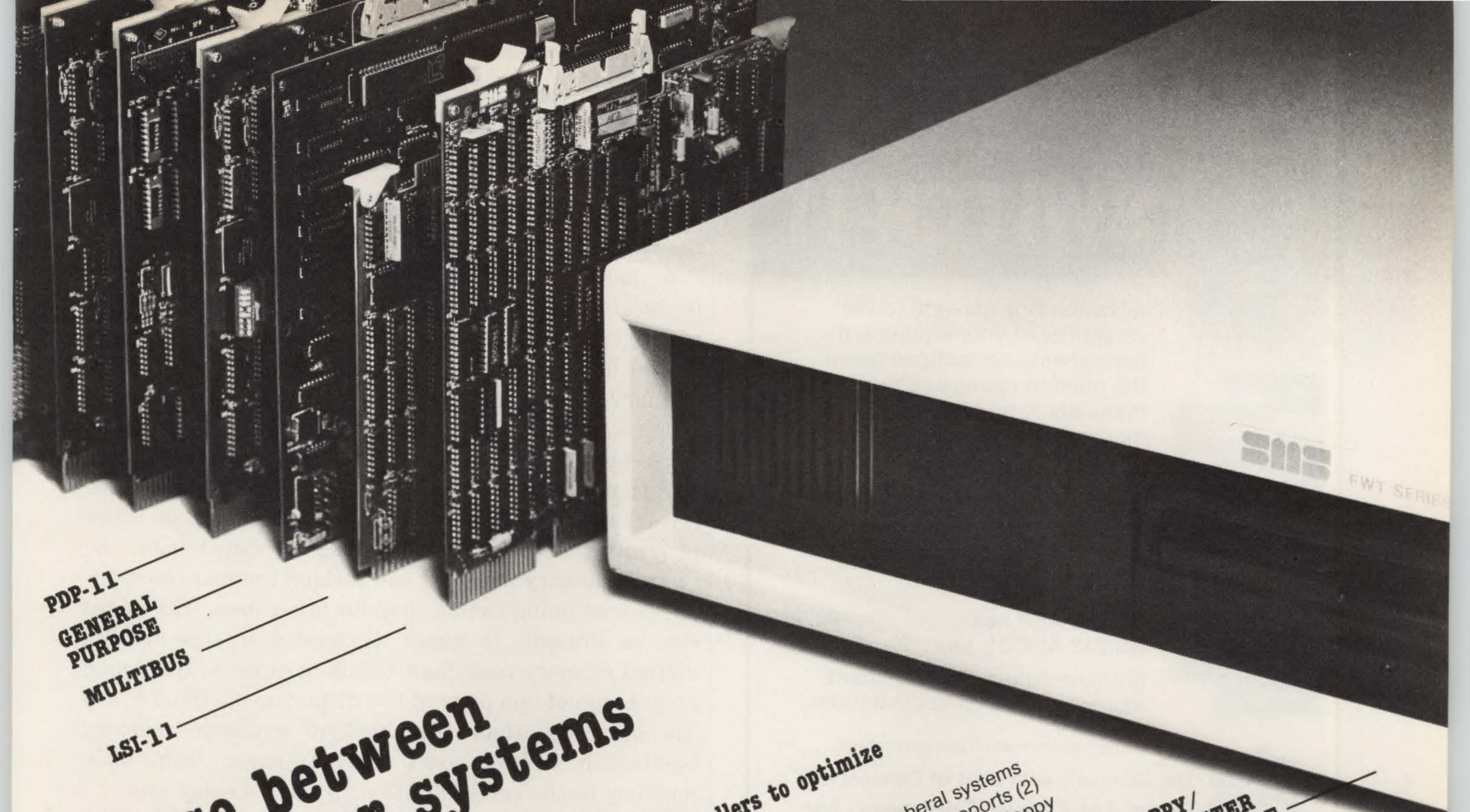
The Ridge computer system uses raster-scanned bit-mapped displays for graphics. To maximize flexibility and to keep the interface overhead low, the bit map resides in a user's address space.



Ridge CPU internal structure *includes instruction-fetch and execution units that share a memory bus. The instruction-fetch unit obtains instructions to be executed over the bus, filling the instruction cache. The execution unit contains a 32-bit ALU and a 32-bit barrel shifter that moves a block of data in one 125-nsec. machine cycle.*

One way of displaying the bit map is to read the bit map words directly from memory, serialize them and shift them out to the display; the Xerox Alto graphics display uses this technique. The memory traffic generated by refresh can consume more than 40 percent of the Alto's memory bandwidth, preventing the Alto hardware from displaying the entire screen.

The technique of refreshing the display directly from main memory was not used on the Ridge system for several reasons. The Ridge displays have a higher bit density than the Alto, and are refreshed at a higher rate. Also, the Ridge Thirty-Two was designed to support multiple users, with each display requiring approximately 10M bytes per sec. of refresh bandwidth. To supply this bandwidth, each display controller board contains its own 128K-byte refresh memory. Data can



Choose between Winchester systems or controllers

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All controllers used in SMS disk peripheral systems are available separately. Each controller supports (2) Shugart/Quantum Winchester and (2) Shugart floppy disk drives, utilizes patented PLL circuitry to provide maximum margins for worst case bit shifted data recovery, incorporates ECC (Error Correction Code) and includes on-board self test! Additional features are:

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INTEL MULTIBUS

- Single Multibus compatible PC board requires only 5A (max.) @ 5 volts.
- Direct connection to (2) Shugart/Quantum and (2) Shugart floppy disk drives. Eliminates external data separator board.
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- Supports IBM and INTEL iSBC 202 diskette formats.

GENERAL PURPOSE

- Single board controller requires only 5A (max.) @ 5 volts.
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- Direct multi-sector disk transfer of up to 543K bytes/sec.
- Easy to use byte parallel general purpose interface.

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CIRCLE NO. 137 ON INQUIRY CARD

Pages that have been changed will show up on the screen within 33 msec.

be moved between this memory and main memory at the rate of one 32-bit word every 750 nsec. (Fig. 4).

A 128K-byte portion of a user's virtual address space is reserved for the display bit map. This virtual-memory area is divided into 4K-byte pages that are moved into and out of the display controller's refresh memory, just as normal memory is paged to and from the disk. The user's display address space is checked 30 times per sec. to see if any pages have been modified; any pages that have been changed will appear on the screen within 33 msec. If a long simulation or other program that does not touch the bit map is run, the virtual-memory manager can reclaim the main memory pages containing the bit map for other uses. The pages can be brought in again as needed by the normal virtual-memory page fault-handling process. Assuming an average of one page of the display is modified every 1/10 sec., less than 1 percent of available memory bandwidth will be used to copy pages from main memory to the refresh buffer for each display unit.

The Ridge Thirty-Two with 256K bytes of memory and 32M bytes of disk storage sells for $52,000. A system with a single-user display and 1M byte of memory sells for $62,000, and a four-display version with 2M bytes of memory, is $105,000. Quantity discounts bring the four-user price down to $75,000. ■

Ed Basart is vice president, **David Folger** is president and **Bill Shellooe** is vice president of marketing and sales for Ridge Computers, Sunnyvale, Calif.

Peripherals '82

The International Peripheral Equipment and Software Exposition, "Peripherals '82", co-sponsored by Mini-Micro Systems magazine and the Cahners Exposition Group, will be held at the Convention Center in Anaheim, Calif., Sept. 29, 30 and Oct. 1.

This specialized conference, the first show devoted solely to peripherals for minicomputers and microcomputers, will include displays by more than 100 companies and will feature daily technical sessions.

For more information, on Peripherals '82, contact Janet Schafer, Cahners Exposition Group, 222 West Adams St., Chicago, Ill. 60606, at (312) 263-4866.

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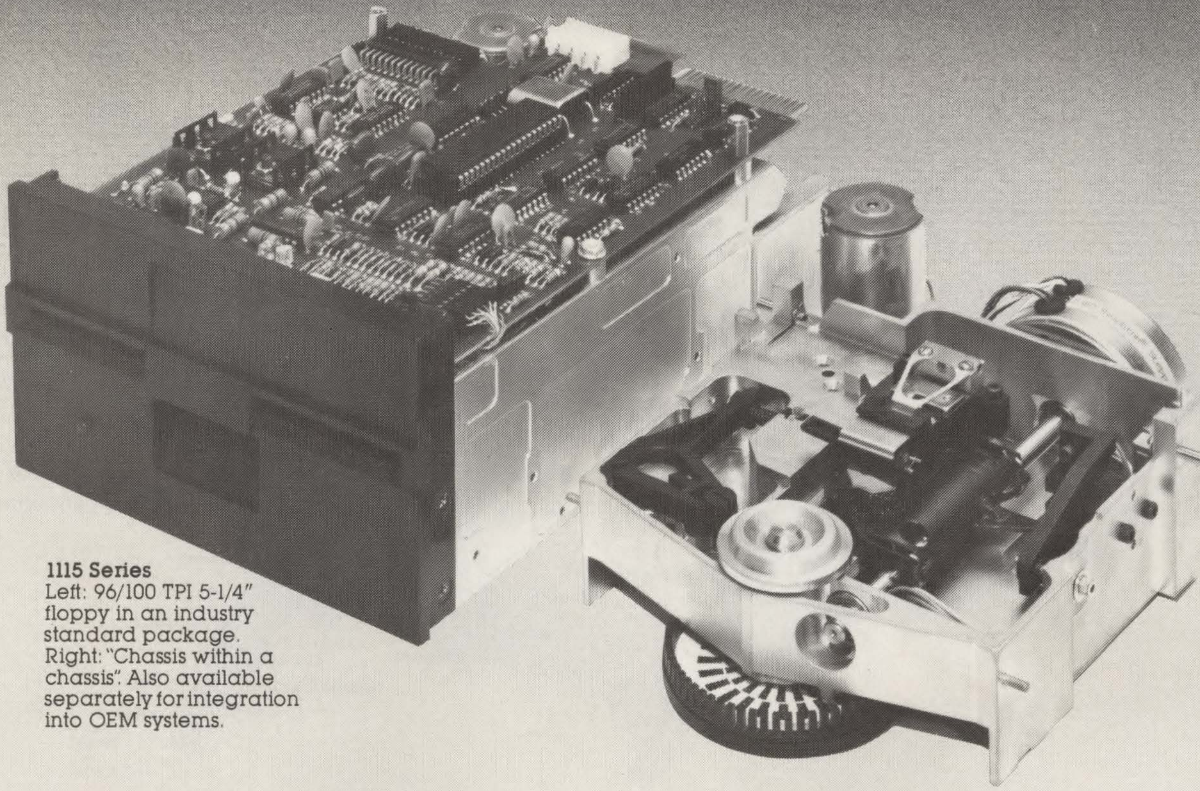

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CIRCLE NO. 63 ON INQUIRY CARD

Work-station furniture: sitting pretty

DAVID FREEDMAN, Associate Editor

Ergonomics is bigger than ever among vendors vying for the exploding electronic-office furniture market

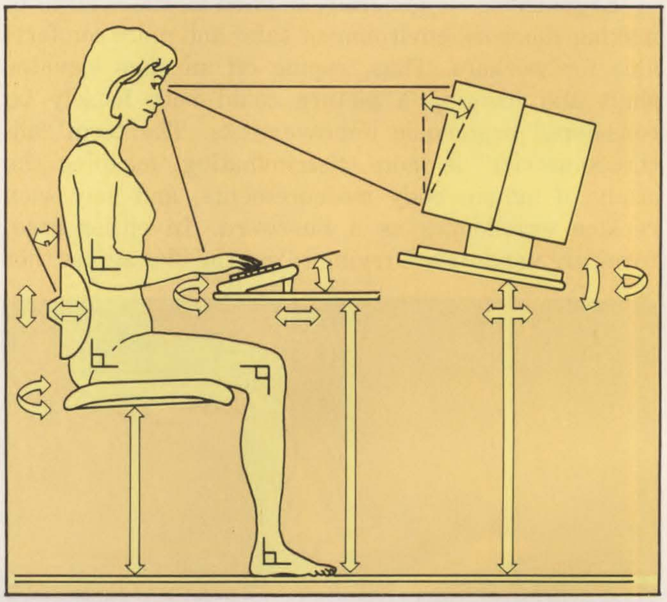
Many microcomputers and terminals have been ending up on ordinary desks and tables. But as more executives, professionals and office workers complain about losing work space to machines, and of being subjected to computer-related ills ranging from eye-strain to bruised shins, computer work-station furniture is soon to become a major sub-industry.

Most OEMs, dealers and system integrators have not yet made furniture part of their product lines. Those that do so, however, find a selection of furniture ranging from simple stands to multilevel, electrically adjusted work stations.

The market

More than 50 firms manufacture computer work-station furniture. Almost all do most of their business through office-furniture dealers and direct sales, with orders often specified by contract office designers. The computer OEM is generally completely omitted from the process—aside from the fact that its equipment will end up on top of the furniture.

This situation may be changing, however, as more OEMs consider offering work-station furniture as part of integrated packages, as IBM Corp. has already done. There is a lot to gain: profit margins are high in the furniture industry, with dealer discounts of 50 percent and more. A well-integrated furniture/terminal package, furthermore, can provide much-needed product differentiation, and encourages buyers to see the vendor as a complete source of equipment. And because the computer or terminal OEM knows what equipment will be used with the furniture, it can choose or modify furniture to complement the design of the equipment. Furniture vendors, on the other hand, must offer designs able to handle different machines, often at the cost of functionality and aesthetics.



Work-station adjustments *allow terminal and microcomputer users to achieve low-strain positions or to vary their positions during the day to avoid fatigue. (Diagram from Facit, Inc.)*

While many OEMs and system integrators choose to stay out of the furniture business, they may not be able to avoid risks associated with the furniture on which their equipment is used. Someone who finds a terminal physically uncomfortable to use or even aesthetically displeasing is unlikely to buy from the same vendor again—even if the problem lies with the furniture and not the terminal. "If you're not happy with your equipment," says Facit Furniture Division manager Alan Morse, "you're going to feel someone hasn't taken care of you—and that someone is usually the person from whom you bought the computer." Facit is one of a number of furniture manufacturers seeking to widen their distribution channels through computer-

Profit margins are high in the furniture industry, with dealer discounts of 50 percent or more.

equipment dealers, OEMs and system integrators.

Ergonomics

Computer and terminal vendors may be slow to enter the work-station furniture business, but the furniture industry knows when it has a hot item. Manufacturers are trying every new twist possible on an old product—the office desk—to grab a piece of the electronic-office market. The twist that seems to be working for almost everyone is ergonomics.

The concept of ergonomics is almost a cliche in the VDT industry and is even more overworked among work-station furniture vendors—not that there isn't a real need for ergonomics, or that this need isn't being met. But one man's ergonomics is another's useless gimmick, and it is worth understanding basic principles to decide what is worth paying for.

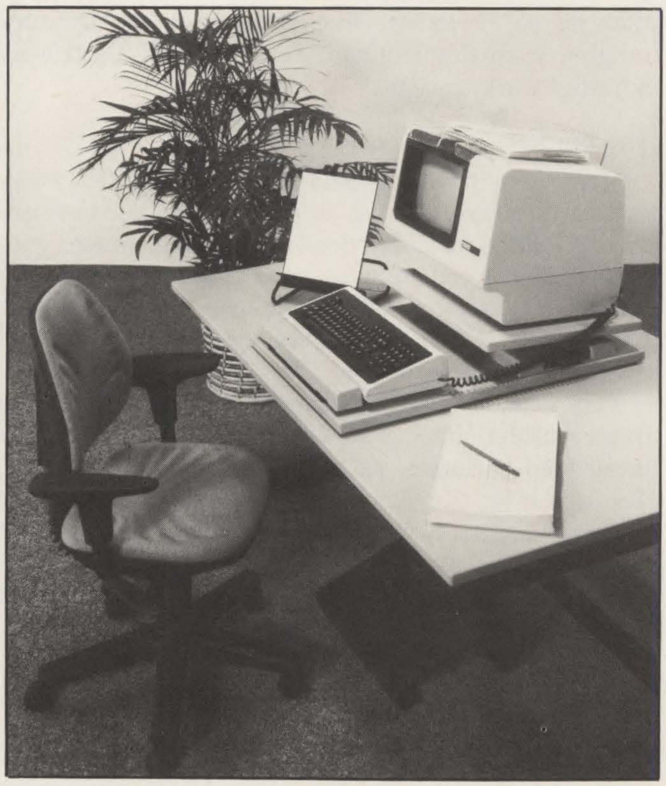
"Ergonomics" is generally defined as the science of making the work environment safer and more comfortable for workers. Thus, roping off an open elevator shaft and hanging a picture could both loosely be considered ergonomic improvements. The term "anthropometrics" is more discriminating, meaning the study of human body measurements, and may soon replace ergonomics as a buzzword. In either case, furniture vendors are trying to get the idea across that their products help prevent physical and even mental stress for computer users.

Data-entry operators have known for years that working at a terminal can cause severe eye, neck and back problems, sore arms and thighs and a host of miscellaneous aches and pains. Only in the past two years, however, after observing the success that European vendors were enjoying with ergonomic products, have U.S. furniture and terminal manufacturers begun to roll out their own ergonomic guns. Purchasers of furniture equipment can't get enough of it. Many are genuinely concerned about operator comfort, but it probably has not hurt to have several labor unions and a handful of state legislatures considering action against non-ergonomic employers.

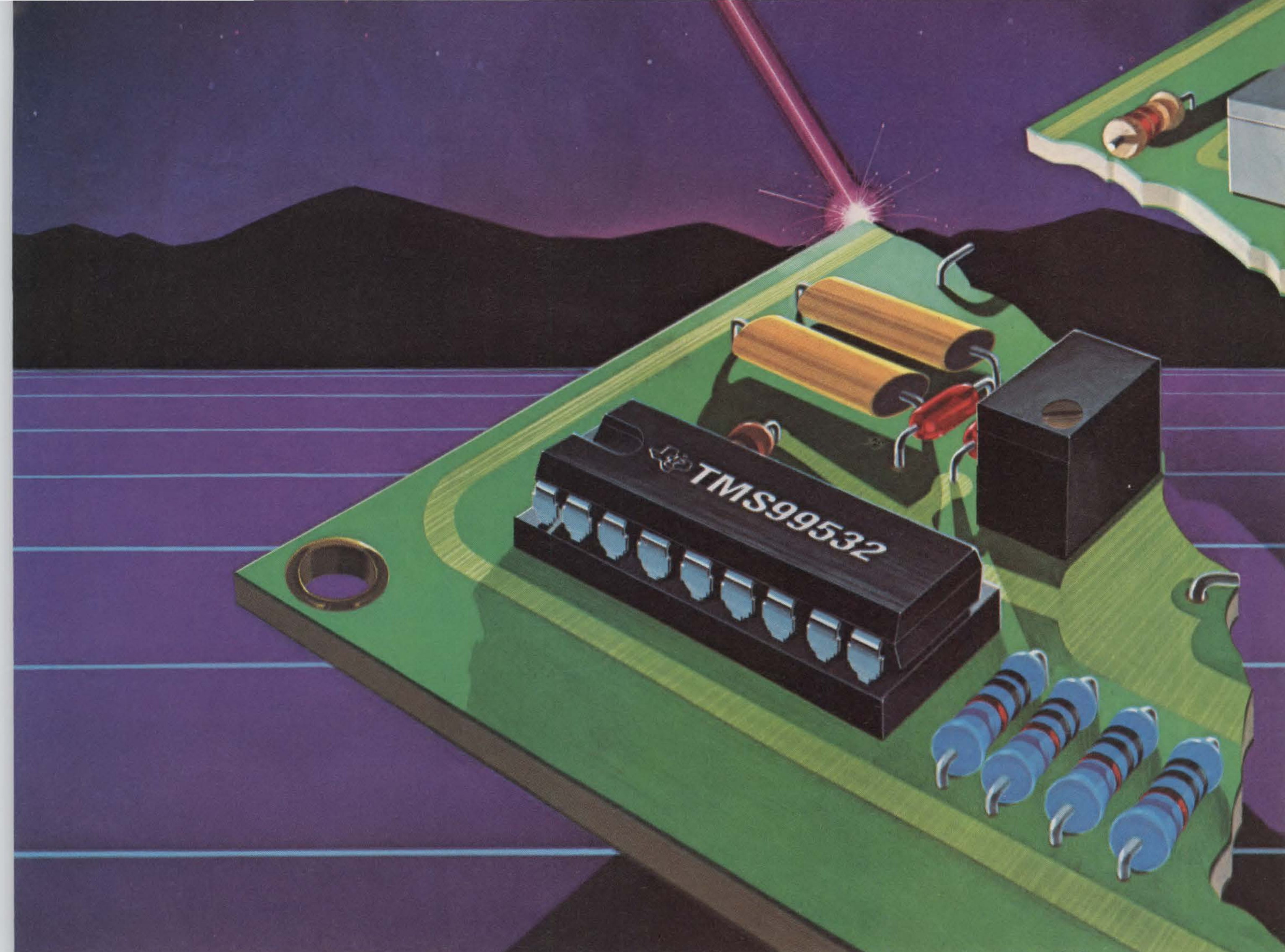
The two most important considerations in terminal ergonomics are lighting and body position. Lighting is generally not a factor in work-station furniture design, aside from the preferred use of soft, neutral colors such as putty, off-white and beige to minimize glare on furniture surfaces. More importantly, CRTs should provide crisp but not overly bright characters, and harsh overhead lighting should be avoided.

Work-station furniture shoulders the responsibility in the area of body position. With an appropriate desk and chair, even the most slump-prone, oddly built operator has a good chance of achieving comfort. Many experts speak of an ideal position to minimize stress and strain on muscles and bones: eyes pointed 10° to 40° below the horizontal, back relatively straight with firm support at the lumbar region, arms bent 90° at the elbow, forearms and wrists horizontal with the fingers resting on the

Chair with locking variable tilt *from Steelcase locks in any position as user leans forward and back. Five-pronged base increases stability.*



Fixed-height work station *from the Wright Line can be used with add-on platform for screen tilt and swivel and wrist support. Chair features pneumatic stem for cushioning and easy height adjustment.*



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TI's new "single-chip" modem drastically reduces the number of parts, compared to standard, discrete modem design. Result: Reliability is increased. And system cost is also decreased. In addition, the TMS99532 comes in a space-saving 18-pin package.

The TMS99532 has a TTL compatible digital interface. It can be connected electronically through a Data Access Arrangement (DAA), or acoustically via a microphone and speaker. Interface to a handset requires only a few op amps.

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And coming soon from TI: A companion dual tone/pulse dialer. The TMS99531 is the only single-chip dialer that has both Dual Tone Multiple Frequency (DTMF) and pulse dialing capability. On-chip diagnostic mode provides for quick verification of all digits. And the TMS99531 is compatible with Bell 103J specifications.

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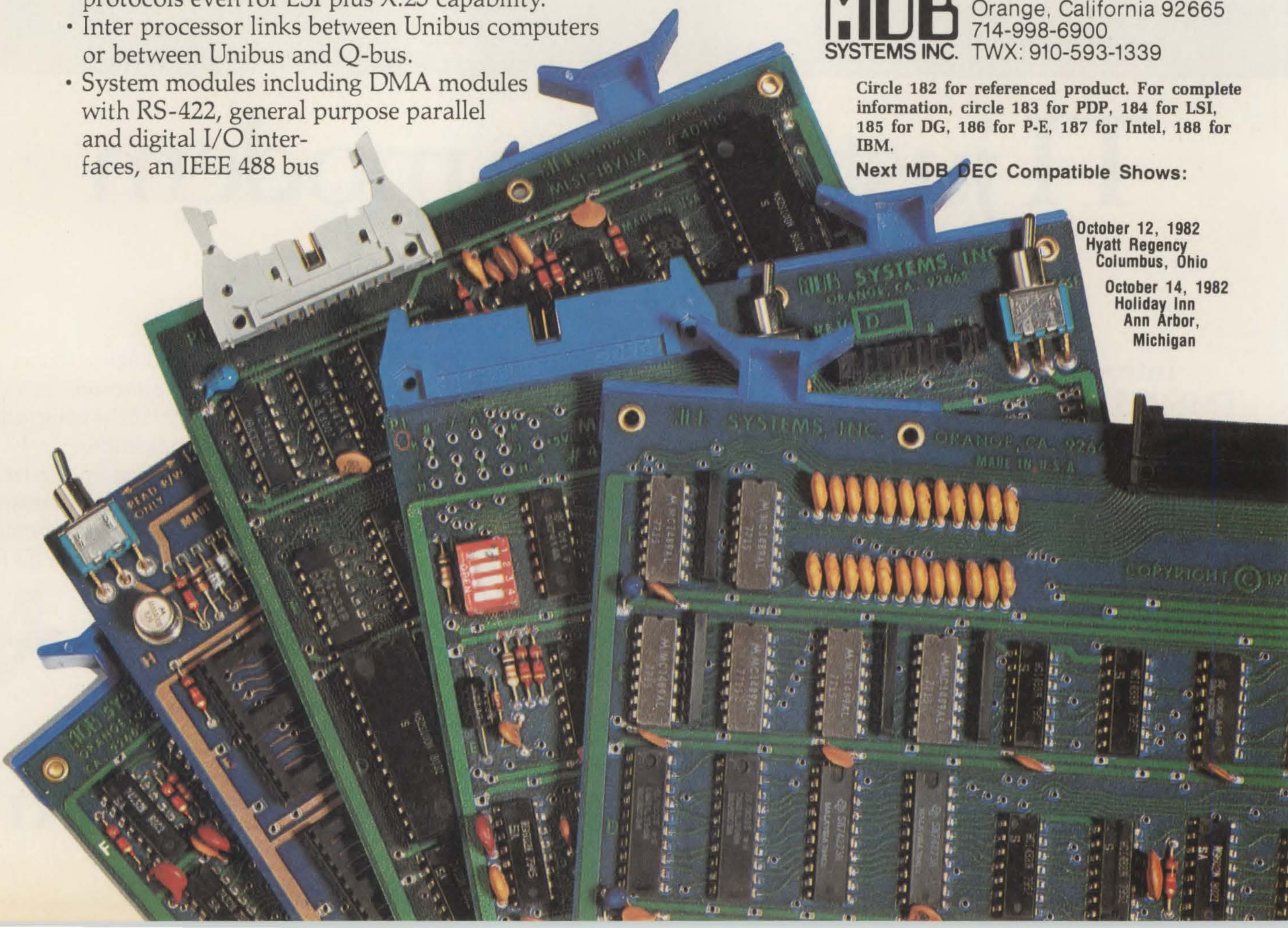


With an appropriate desk and chair, even the most slump-prone, oddly built operator has a good chance of achieving comfort.

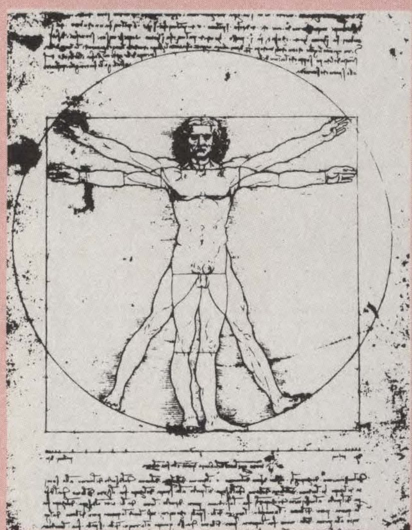
second row of keys, legs bent 90° at the knee, thighs horizontal and one-quarter of the way off the edge of the chair and feet flat on the floor.

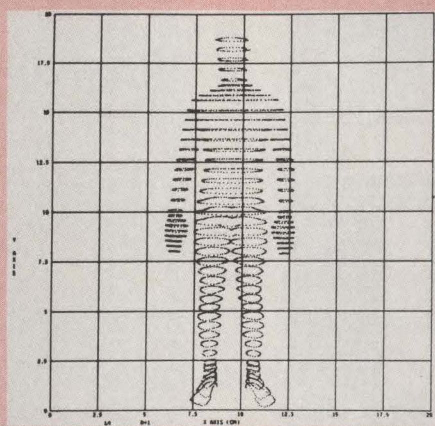
Industrial design consultant Gordon Perry, who has been designing ergonomic furniture for more than 15 years, doesn't think in terms of an ideal position. Instead, Perry believes that the ability to change position during a long day at a terminal is more important than achieving one position. He also points out that even though many programmers and executives spend a relatively small part of their day at a VDT, their comfort is crucial—a cramped programmer is unlikely to be productive.

Whether aiming for flexibility or an ideal position, the key to success is furniture adjustability. Many components must be individually adjustable, including the seat, the seat back, the keyboard and the CRT. These should be adjustable for height, tilt and depth, resulting in as many as 13 adjustments. These requirements are made more complex by the range in shape and size of the human body—a 4-ft., 10-in. person should be able to get a comfortable as a 6-ft., 5-in. person.

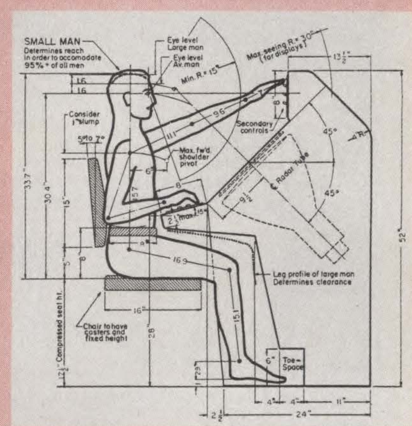
The basic approach to work-station adjustability involves a table with two separately adjustable levels, one for the CRT and one for the keyboard. This feature is useless if the terminal does not have a detached keyboard. Most terminals and microcomputers sold today do have separate keyboards, but a large number of old, integrated units are still in use. Bi-level adjustability is wasted on such units, and until they become completely obsolete, there will still be a market for simpler tables. "When you have DECscope terminals with attached keyboards in the same environment as VT-100s," says Facit's Morse, "you have to sell furniture

ERGONOMICS: NEW APPLICATIONS FOR AN OLD SCIENCE





Anthropometric studies date back to Leonardo da Vinci, *and continue through NASA's computer-generated stereophotograms.*



1950s CRT work station from Bell Telephone *was designed with ergonomics in mind.*

Although many terminal and furniture manufacturers have only recently incorporated ergonomic features in their products, almost all the basic concepts on which these features are based date back decades—and many go back hundreds of years.

The first accomplished ergonomist may have been Leonardo da Vinci, who in the early 16th century applied his detailed anthropometric studies to both art and engineering. It wasn't until the 1930s, however, that a young American industrial designer named Henry Dreyfuss convinced manufacturers that product safety and utility were desirable, and even profitable, features. Dreyfuss, who added human engineering to everything from jet interiors to alarm clocks, influenced a generation of designers and pioneered many of the ergonomic principles used today with computers.

Bell Telephone was one of the companies most eager to incorporate these principles, realizing in the 1950s that the rapid advances in electronics would bring with them new dangers and stresses for their employees and customers. By 1955, Bell had designed ergonomic CRT work stations for radar installations, and electrically adjustable, rotating work surfaces for wiring operations. The stresses of the factory and office, however, paled next to the challenges of outer space, and in the '60s, the National Aeronautics and Space Administration began commissioning massive anthropometric studies. The agency collected data ranging from pages of thigh-clearance heights to computer-generated representations of the human body, information used to design the tiny, equipment-packed cabins in which men lived weightlessly for days.

With the decline in activity of the space program, the responsibilities for ergonomic research have fallen back on industry, but this time with help from universities. Research programs such as that of the human engineering laboratory at the Massachusetts Institute of Technology are finding ways of making computer and other equipment safer and more comfortable to use, as well as trying to identify problems that might arise with future generations of machines.

The term 'anthropometrics' is more discriminating and may soon replace ergonomics as a buzzword.

for both of them."

Table heights are generally adjustable in one of four ways: push/pull, crank, pneumatic and electric. A push/pull adjustment involves loosening a locking lever or bolt and then manually moving the surface to the desired height. Crank units are the most popular and are easier to operate. Pneumatic units have gas cylinders that allow surfaces to be moved with fingertip pressure, while electric units—the Cadillacs of work stations—require the user only to press a button or two.

Many work stations place adjustment mechanisms within easy reach of the operator so that adjustments can be made quickly from a comfortable sitting position. If someone must leave his chair or spend more than half a minute or so to adjust his position, he probably won't do it.

Most chairs adjust manually by unlocking a lever and adjusting body position. Seat height must sometimes be adjusted by trial and error from off the chair, but crank versions allowing on-seat adjustments are becoming more popular, and some companies, such as Royal Seating Corp., have chairs with pneumatic mechanisms.

Adjustable chairs and bi-level tables enable a terminal or microcomputer user to vary the relative positions of arms, legs, back, CRT and keyboard. Additional features—such as keyboard angle and CRT tilt and swivel adjustments, copy holders, wrist supports and footrests—are available with many work stations to fine-tune the physical man-machine interface. Some of these features are built-in, as in Biotec's furniture, and many are available as add-ons, such as the tilting turntable from Marvel Metal.

18th-century highboy replica *is designed for terminals in elegant office settings. Manufacturer Twenty-first Century Antiques offers custom-designed pieces in a variety of woods and styles.*

The ABC's of PDP's

PDP-11 based systems, compatibles and system software from A to Z. You can choose from a wide variety of DEC PDP-11 compatible systems which meet your needs at Cambridge Digital Systems. Complete Winchester-based systems start at $7,350.

System 58 series, 5¼″ high, features a fully-packaged DEC LSI-11/02, 21 or 23 with internal RAM memory of 32KB up to 1 Mb. The 11/23 based system directly addresses up to 4MB of memory. The attractive desk top enclosure contains an RLV12-compatible Winchester disk with either 5.2, 10.4, or 15.6Mb usable capacity. The double-sided, double-density floppy drive boasts a capacity of 1024Kb.

The Cambridge Digital System 94 series, 10½″ high, is based on a DEC PDP-11/23 processor with internal memory from 32Kb to 4096Kb all directly addressable. The desk top enclosure includes either 41.7Mb or 69.5Mb Winchester compatible with DEC's RK07/RK711. A 20Mb, ¼″ streaming tape subsystem emulates DEC's TU10/TM11 for *individual file* backup and high capacity storage. The expanded LSI-bus backplane permits easy expansion so you can choose among two different floating point processors, the SKYMNK array processor and many other products.

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The System 58, complete with LSI-11 processor, 5 to 15Mb Winchester, floppy and serial I/O, ranges from $7,350. The System 94, with 11/23 processor, Winchester, Streaming Tape and serial I/O is priced from $16,995.

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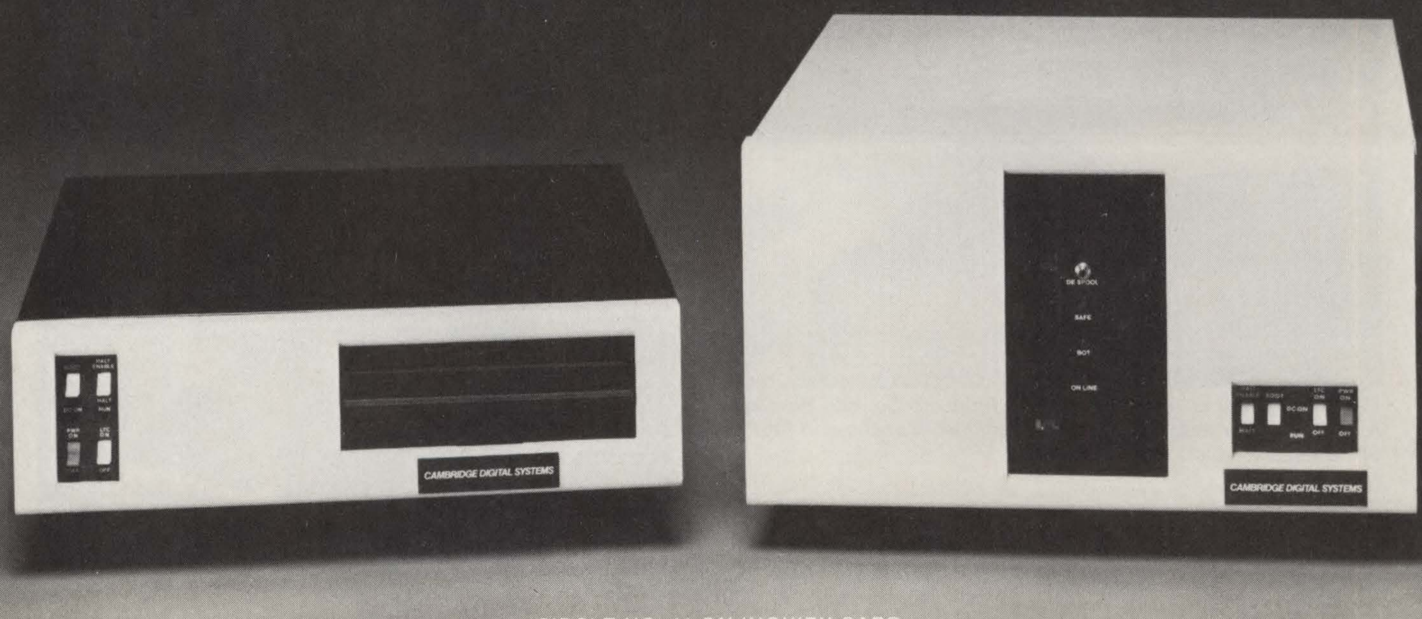


CIRCLE NO. 41 ON INQUIRY CARD

Computer and terminal vendors may be slow to enter the work-station business, but the furniture industry knows when it has a hot item.

Some vendors warn against too much adjustability. Laila Mohr of Howe Furniture recommends that users go with the simplest design that will meet their needs.

Printer work station *from Tab offers optional wire bins to feed and catch forms.*

"Some gadgets confuse more than help," says Mohr.

Other ergonomic features turning up on work-station furniture include rounded edges, wire and cable channels, widely spaced pedestals to allow room for the user's legs when shifting or swiveling and a variety of panels for privacy, noise reduction and even a touch of beneficial to everyone involved: Perry claims a well-designed work station can pay for itself two to three times in increased operator productivity.

Modular furniture *from James Metal Products Co. can be easily reconfigured for multiple users, additional work space and flexible office layouts.*

Features and pricing

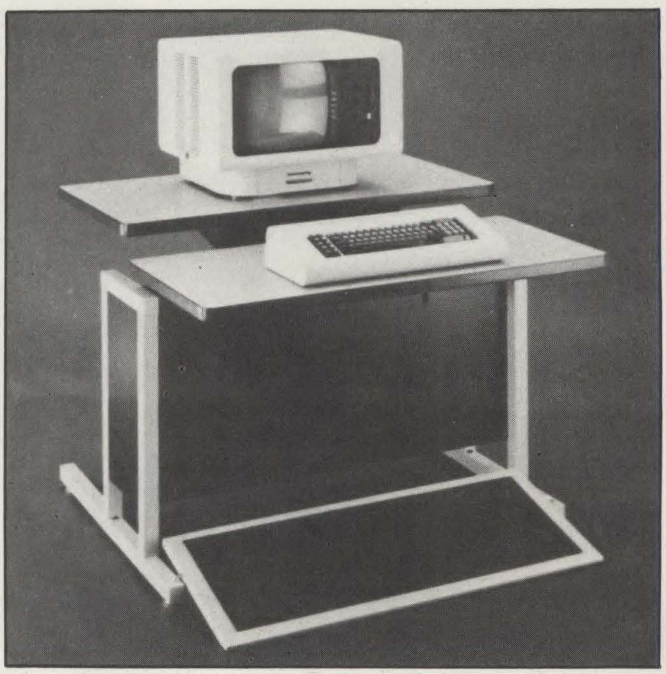
Ergonomic features are not the only means by which furniture vendors distinguish their products. Most companies offering ergonomic work-station furniture were selling office furniture before anyone had heard of a VDT, and products still compete on more traditional terms such as quality, flexibility and style.

Many work-station units ship flat, assembling quickly with a screwdriver and wrench; Dennison KYBE Corp. has a product line that assembles without any tools. Yet units are typically rated to support 200 to 400 lbs. of equipment, with maintenance low to nonexistent on all but the most complex pieces.

Because office furniture arrangements are subject to change, it is no small advantage to offer units that fit together in different ways. Several vendors offer modular work stations that can be rearranged into different shapes, expanding for additional users or to provide a larger work surface.

Contemporary styling dominates work-station furniture. Some furniture vendors seem to be trying to out-"high-tech" the equipment their products will be supporting. But a few vendors hope to appeal to users that would like to reconcile traditional tastes in decor with the electronic office. Twenty-first Century Antiques offers a replica of an 18th-Century highboy in cherry wood designed to hold a VDT or microcomputer. "It's intended for the elegant office," says craftswoman Judy Camber.

Like most industries, the full-function ergonomic work-station industry is competing on the basis of style and personalization. "A work-station area may not be like home," says consultant Perry, "but if it's done right, you can feel good about it." Such feelings can be features. Prices are high now, ranging from $300 for a simple desk to $2000 and more for top-of-the-line units. But most vendors agree that prices will start to fall



Bi-level table from Structural Concepts Corp. *provides separate, electrically adjustable surfaces for CRT and keyboard.*

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Our 84 Mbyte Winchester disk drive is a work of art.

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This Guarneri violin was built in the city of Cremona in 1739. The physics of the bowed string were first investigated in the 1850's by Hermann von Helmholtz, who attached a grain of starch to a black string and observed its motion through a microscope mounted on a tuning fork.

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CIRCLE NO. 68 ON INQUIRY CARD

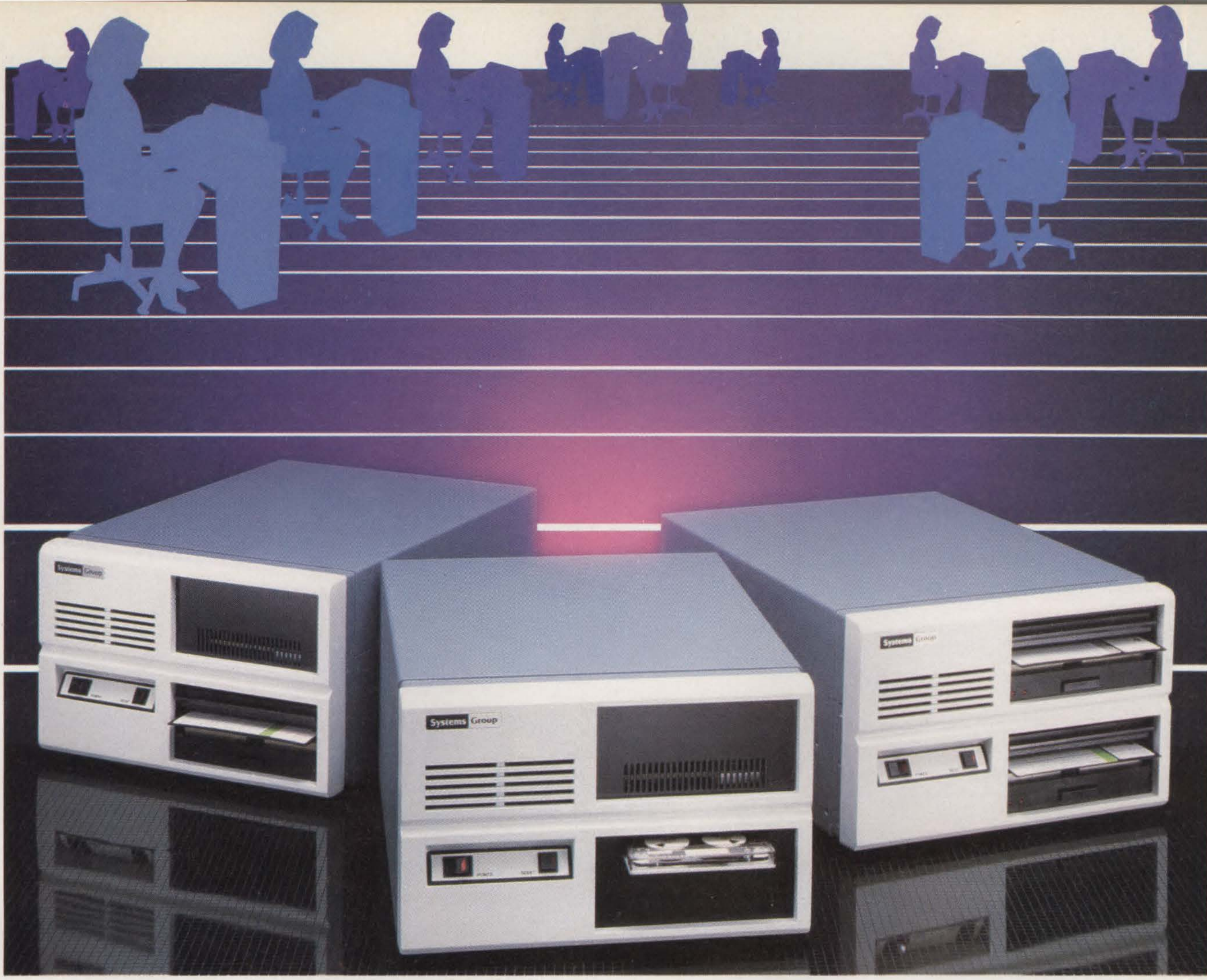
One man's ergonomics is another's useless gimmick, and it is worth understanding basic principles to decide what's worth paying for.

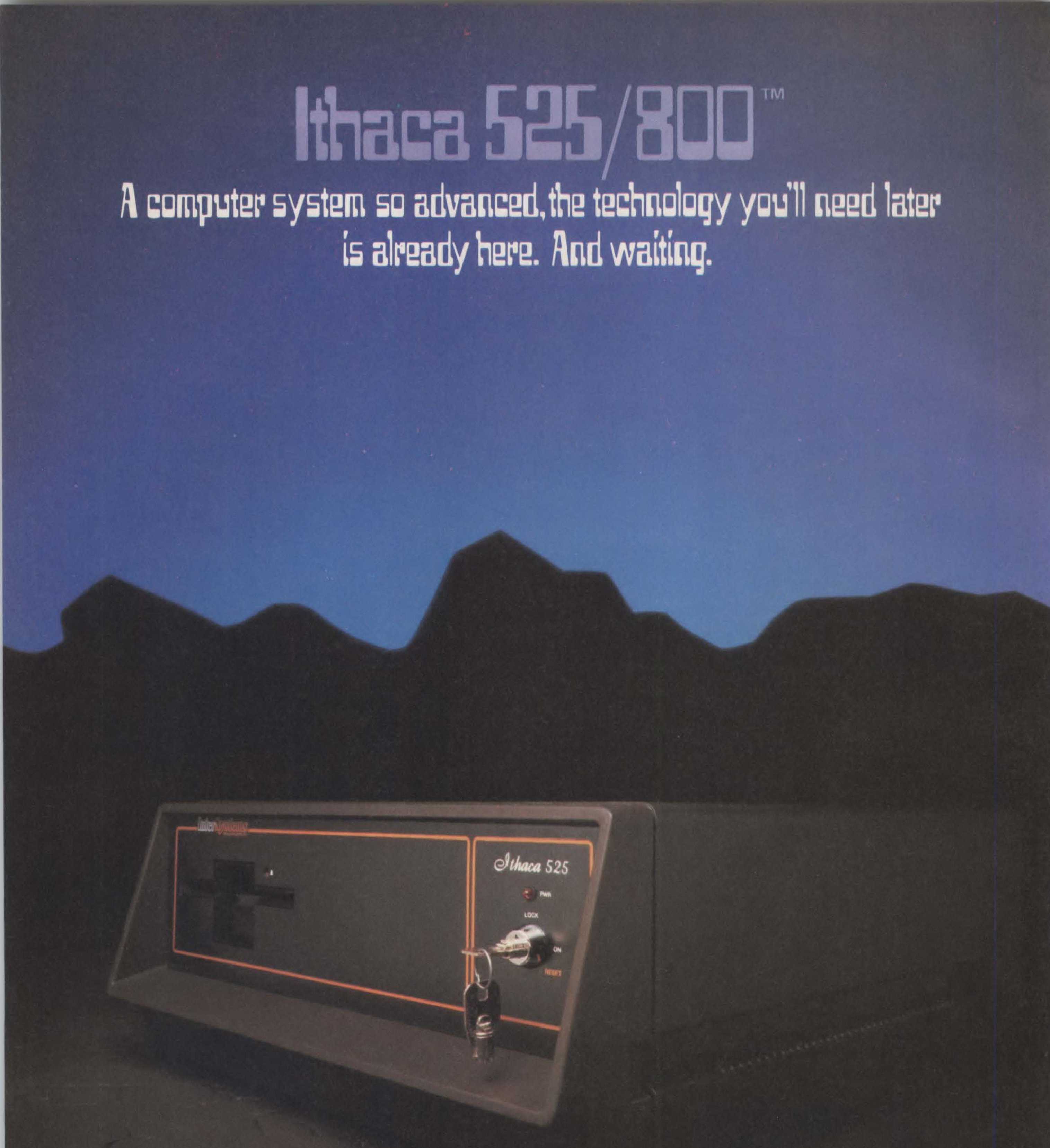
within the next two years. For now, purchasers are likely to spend on an individual piece of furniture in proportion to the amount spent on associated equipment and personnel. Thus, a top design engineer working with a $250,000 CAD system has a good shot at an electrically adjusted work station, while an accounting clerk who uses a personal computer five or six times a day will most likely be told to clear a space on his desk. ■

WORK-STATION FURNITURE VENDORS

This list of furniture vendors includes those companies that make units specifically designed to be used with terminals or microcomputers. A reasonable effort was made to ensure the completeness and accuracy of the list.

Company	Circle No.
Acme Visible Records, Inc., Crozet, Va.	374
Amco Engineering Co., Schiller Park, Ill.	415
Aspects, Inc., Sun Valley, Calif.	416
Atlantic Cabinet, Inc., Williamsport, Md.	417
Atlantic Datafurniture Products, Inc., Tampa, Fla.	418
AVM Data Products, Inc., Rockville Ctr., N.Y.	419
Biotec Systems, Inc. (division of Hamilton Sister Co.), Fairfield, Ohio	420
Bretford Manufacturing, Inc., Schiller Park, Ill.	421
Bud Industries, Inc., Willoughby, Ohio	422
Borroughs Division of Lear Siegler, Inc., Kalamazoo, Mich.	423
Charvoz-Carsen Corp., Fairfield, N.J.	424
Computer Accessories, Inc., Dallas, Tex.	399
Contemporary Computer Cabinets, Inc., Sunnyvale, Calif.	398
Data-mate, Inc., Nashua, N.H.	425
Dennison National, Inc., Holyoke, Mass.	426
Devoke Data Products, Inc., Palo Alto, Calif.	427
Donmark Graphics/Business Products, Inc., La Canada, Calif.	428
Emcor Products, Inc., Rochester, Minn.	429
Executive Concepts, Inc., Plainfield, N.J.	430
Facit, Inc., Greenwich, Conn.	431
Furn-wood Manufacturing, Inc., Lake Oswego, Oregon	375
Gusdorf, Inc., St. Louis, Mo.	432
The Hon Co., Muscatine, Iowa	433
Howe Furniture, Inc., New York, N.Y.	434
HSP Computer Furniture, Birmingham, Ala.	435
Input-ez Corp., Englewood, Col.	436
James Metal Products Co., Chicago, Ill.	437
Luxor, Inc., Waukegan, Ill.	438
Marvel Metal Products Co., Chicago, Ill.	439
M & J Desk Manufacturing Co., Pacoima, Calif.	440
M & M Industries, Inc., Bensenville, Ill.	441
Monarch Computer Products, Inc., New Windsor, N.Y.	442
Ring King Visibles, Inc., Muscatine, Iowa	443
Royal Seating Corp., Cameron, Texas	444
Samsonite (Contract Furniture Division), Denver Col.	445
Smith System Mfg. Co., St. Paul, Minn.	446
Stantron (division of Wyco Metal Products), North Hollywood, Calif.	447
Steelcase, Inc., Grand Rapids, Mich.	448
Structural Concepts Corp., Spring Lake, Mich.	449
Systems Furniture Co., Torrance, Calif.	450
Tab Products Co., Palo Alto, Calif.	451
Tiffany Stand and Furniture Co., St. Louis, Mo.	452
Toor Furniture Corp., Los Angeles, Calif.	453
Trimm Industries, Inc., North Hollywood, Calif.	454
Twenty-first Century Antiques, Andover, Mass.	455
Virco Manufacturing Corp., Conway, Ark.	456
Vogel-Peterson, Inc., Elmhurst, Ill.	457
Wilson Jones Co., Chicago, Ill.	458
The Wright Line, Inc., Worcester, Mass.	459
YBI Office Furniture Systems, Inc., Lititz, Pa.	460





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CIRCLE NO. 33 ON INQUIRY CARD

Work stations aid system design

Engineers working with complex logic designs get a hand from an integrated multi-node system

Faced with rising design costs and shrinking product life cycles, the electronics industry needs to boost engineer productivity. Computers have begun to play a role in this quest, with circuit design computer-aided-engineering packages emerging as a valuable tool for engineers. Now, a new work-station-based system integrates graphics, logic and communications functions to assist engineers in virtually every phase of complex circuit design.

Work-station nodes

Mentor Graphics Corp.'s IDEA 100 is based on the Apollo DOMAIN system, comprising coaxially connected work-station nodes (Fig. 1). Nodes perform local 32-bit processing via dual 68000 microprocessors, with as much as 66M-bytes of Winchester storage and 3.5M bytes of virtual memory. Any number of nodes can be added without degrading system performance, and users can access information at any node.

A UNIX-like operating system integrates a database manager with a series of application programs, helping bench-level engineers create, capture, analyze, verify and document logic designs.

Engineers can use the design generator and graphics

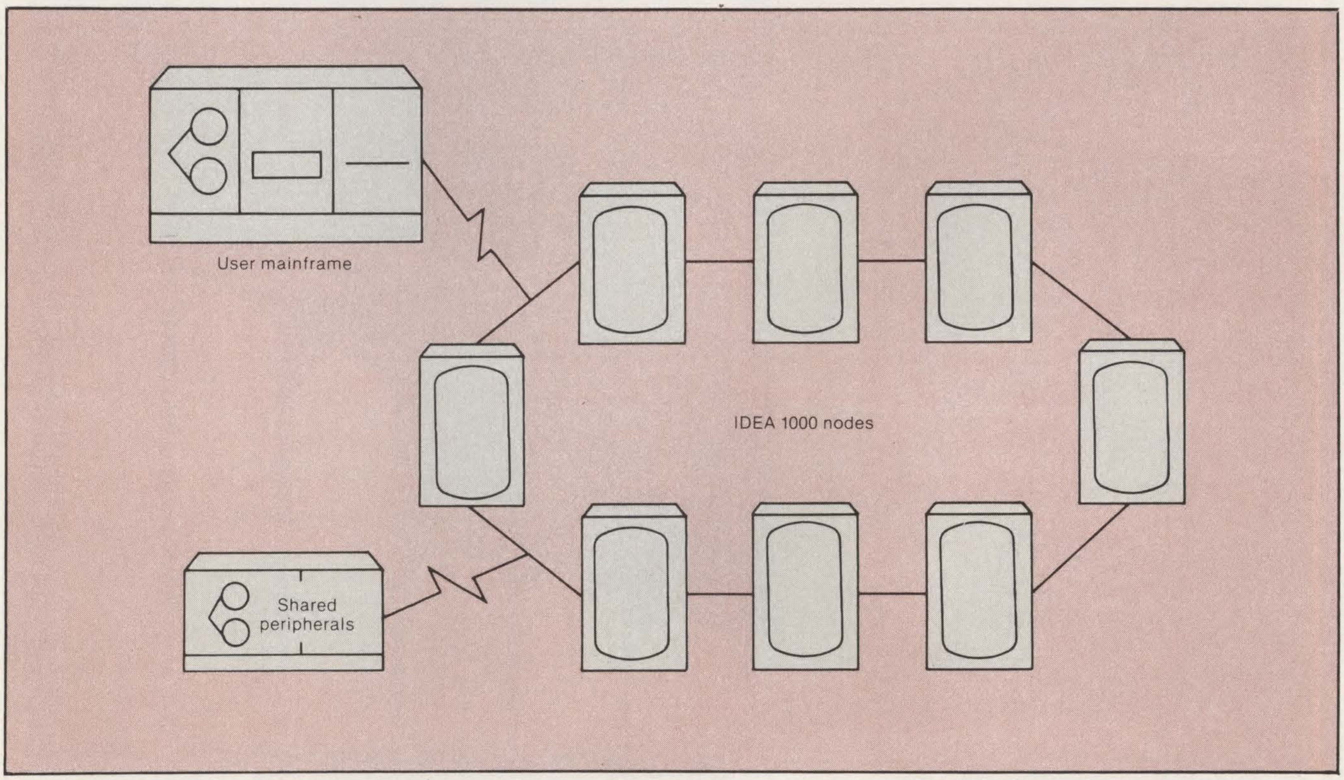


Fig. 1. Typical configuration of IDEA 1000 *connects network of IDEA 1000 nodes to host. Nodes share peripherals and can be configured without host as single- or multiple-station systems.*

MANPOWER PROBLEMS IN THE ELECTRONICS INDUSTRY

The increasing sophistication of products and the rapid succession of product generations pressure electronics companies to turn out more complex designs in less time. As development times drag and product life cycles shrink, more companies could find themselves in the position of having products on a designer's bench longer than they last on the market (Fig. 1). In such a situation, a design team may not be able to develop a replacement product in the time it takes its predecessor to become noncompetitive.

Hiring more engineers is a straightforward solution, but given the gap between electrical-engineer demand and supply, a gap that is likely to widen in the near future (Fig. 2), many companies will be unable to get the people they need. The other option is to increase the productivity of an engineering staff.

Mentor Graphics Corp. sees CAE work stations as one possible productivity tool for engineers. Because design tasks take only a portion of a design engineer's day (Fig. 3), Mentor includes communications and documentation capabilities on their circuit-design work stations.

The electronics industry is relatively labor-intensive (Fig. 4). Other industries have used heavy capitalization to boost productivity, and CAE systems may give electronics firms a chance to bridge the gap.

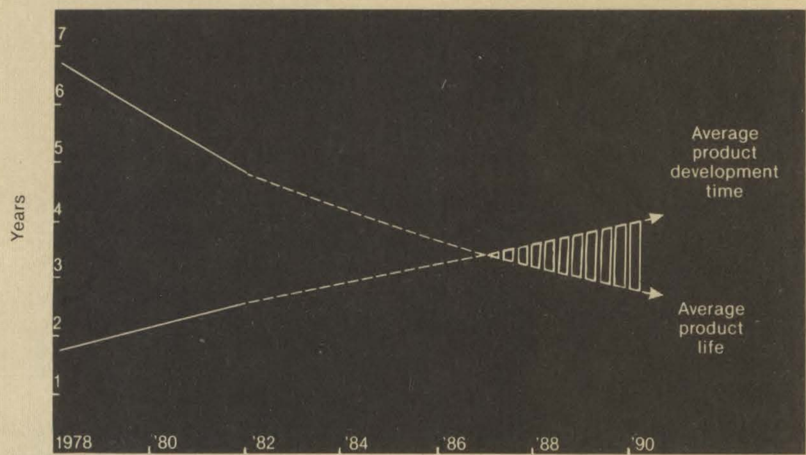


Fig. 1. Growing development and shrinking product life cycles *could lead to a situation in which it takes longer to develop a product than the time during which it is competitive.*

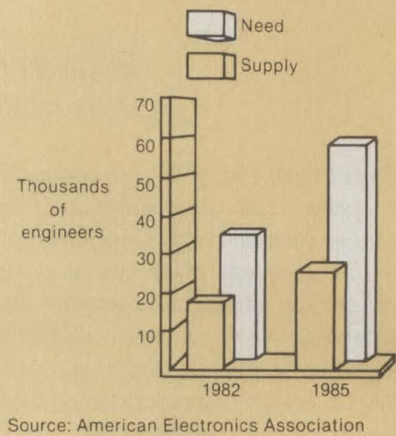
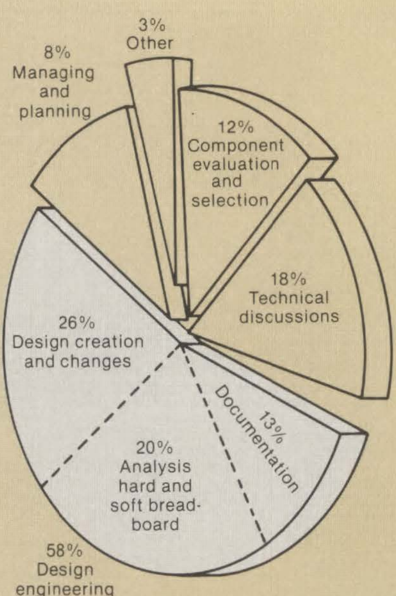


Fig. 2. The engineering manpower shortage *in the electronics industry is likely to worsen in the near future.*



Sources:
Electronic Design Audience Survey—1979
Mentor Graphics estimates

Fig. 3. A design engineer's day *is typically spent on a number of tasks other than actual designing.*

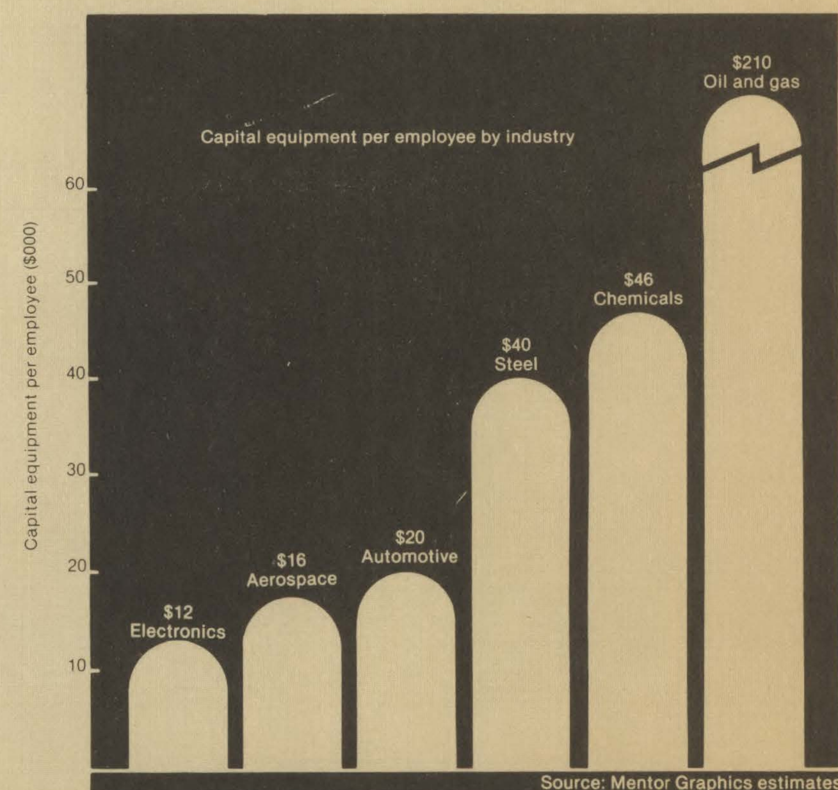


Fig. 4. Industry capitalization *is higher for most large industries than in electronics.*

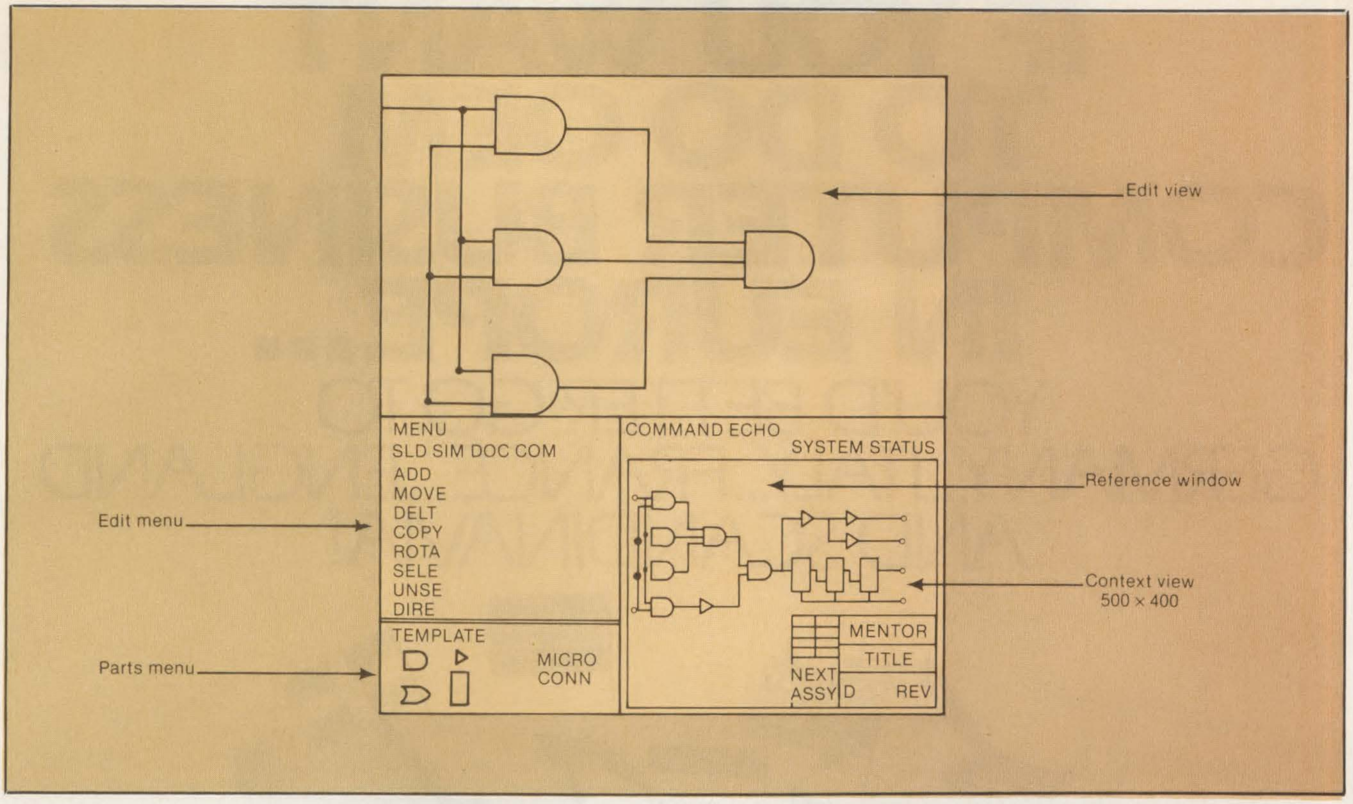


Fig. 2. Representation of edit mode screen *shows expanded view of gate-level circuitry accompanied by view of overall design to help engineer keep track of location. Symbol and edit commands are menu-driven.*

editor to describe circuits as a hierarchical set of components. In this mode, the circuit can be analyzed from the overall design down to the gate level. Expanded views of circuit components are displayed with a window showing the location of the component in the complete design (Fig. 2). A circuit can also be portrayed as interconnected, rather than hierarchical, segments, which can be windowed or overlaid. Each component is associated with a list of attributes, such as power consumption and timing information, with symbol and command menus facilitating editing.

An interactive logic simulator simulates MOS and TTL logic for conventional gates, RAM, ROM and programmed logic arrays. A design can be simulated during its construction by functionally defining components. Thus, a designer need not off-load his design, enter it on a separate system for simulation and then reenter it for modification.

The IDEA 1000 can output information in textual form for transportation to physical design systems, or in graphical form for plotters. The system also provides text editing and internode communications, including electronic mail capabilities. Application programs can be written in FORTRAN and Pascal.

A typical four-station IDEA 1000 system sells for $83,000 per station, and stations are $69,000 each in quantities of 10. The Portland, Ore., firm has scheduled deliveries for October. ■

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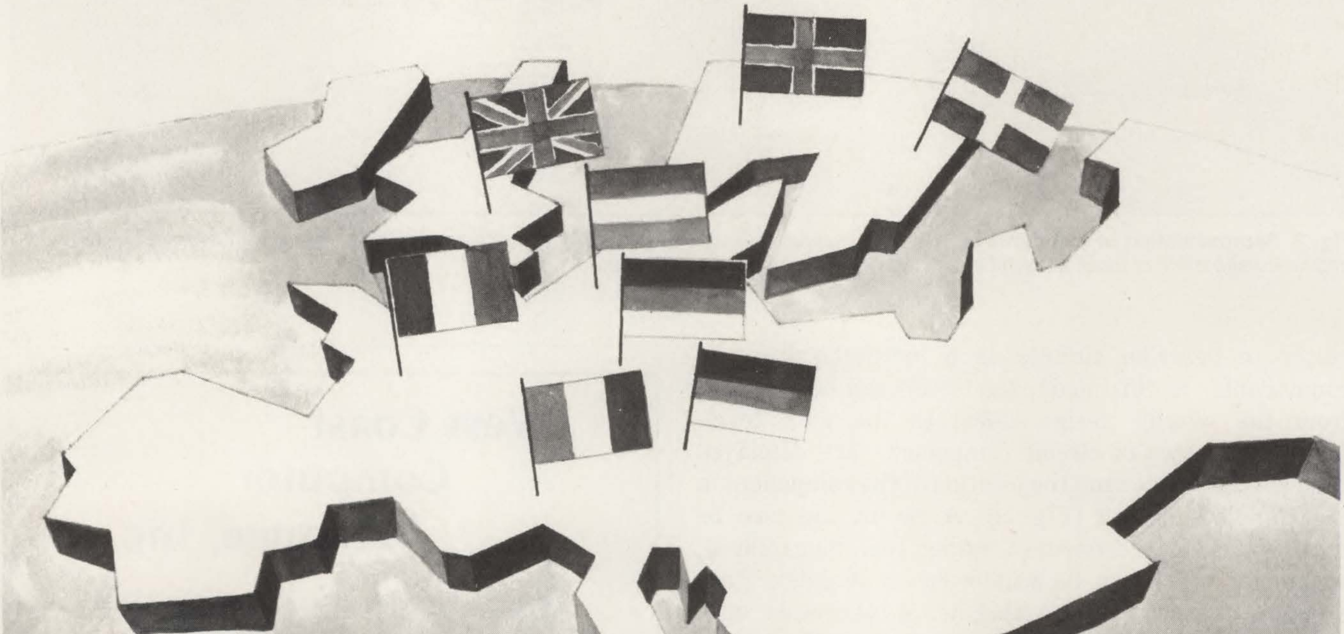

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THE HARDWARE

An On-Board Memory Management Unit and a scatter-loading technique are used to allow efficient processing for multiple users performing multiple tasks. An interrupt-driven DMA disk controller speeds the system's throughput with up to 80MB's of Winchester storage. An intelligent interrupt-driven I/O controller (with a 256 Byte FIFO buffer on input, and a DMA channel on output) takes the strain off the CPU for I/O, and eliminates any danger of lost characters. The 20-slot bus allows for expansion; • up to 3.3 MB's of directly addressable RAM • Multiple SIO4-DMA boards add four users per slot • Other S-100 peripheral cards may be added for system flexibility.

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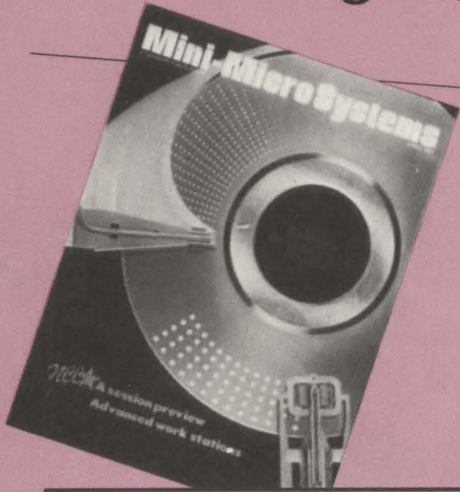

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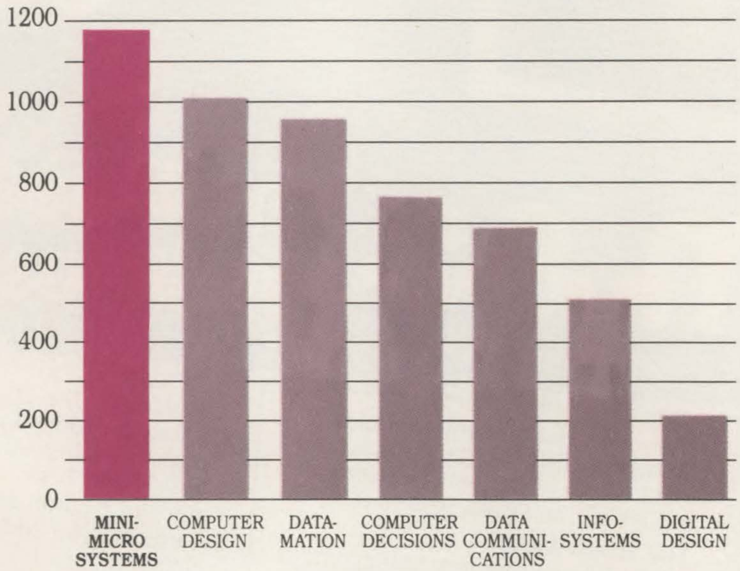

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**From the C Systems Report—total advertising pages, 1st half, 1982.*

Data-acquisition system is LSI-11-based

ADAC's BASYS data-acquisition and -control system *is designed around a DEC LSI-11/2 or LSI-11/23 processor and is fully LSI-11 bus-compatible. The system works with ADAC's line of LSI-11, low-level and high-level analog I/O, discrete digital I/O and signal-conditioning devices.*

ADAC Corp.'s new BASYS system is an integrated data-acquisition and -control system packaged with its own Extended BASIC software, called I/OBASIC. The system consists of a Digital Equipment Corp. LSI-11/2 or LSI-11/23 minicomputer, a VT-100 terminal, one of several ADAC high-density bus enclosures with or without additional storage and the I/OBASIC software package. BASYS is the first low-cost data-acquisition system based on a fully standard bus.

BASYS is designed for ease of use by inexperienced users in batch production, testing, laboratory, scientific and medical applications. The BASYS software contains 19 built-in subroutines for performing analog and digital I/O with a wide range of ADAC I/O boards. BASYS is a self-teaching system with built-in "prompted tutor" for teaching the system programmer the I/OBASIC language on the system terminal. In addition, BASYS contains a complete menu of "help" files designed to assist inexperienced users at various programming levels. Users familiar with BASIC can plug the system in and start programming immediately.

The powerful I/OBASIC software package developed by ADAC for BASYS incorporates DEC's run-time RT-11 operating system. Because commands need not be interpreted, the BASYS system can perform as many as 100,000 A/D conversions to memory per sec. Using a macro assembler or RT-11SK provides even faster processing.

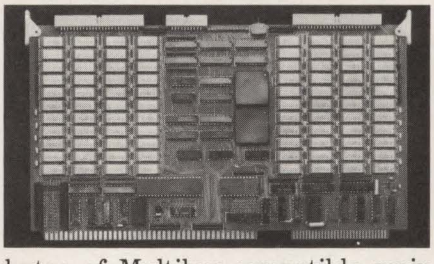
Slave bus enclosures (11 full-quad, 13 half-quad, 22 half-quad) and cartridge tape, floppy disk and Winchester disk storage drives are optional.

Prices start at less than $9000, but can top $50,000 with extensive I/O. BASYS operates with ADAC's full line of LSI-11 I/O boards, modules and wiring devices for low-level, high-level and discrete I/O.
ADAC Corp., 70 Tower Office Park, Woburn, Mass. 01801

Circle No 300

Single-board memory addresses 16M bytes

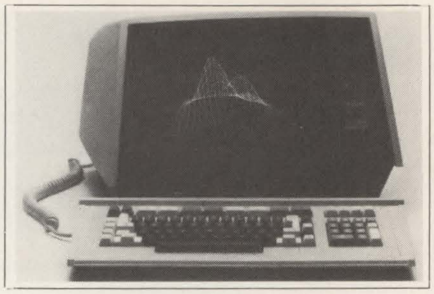
The single-board VLS series provides users with as much as 1.5M



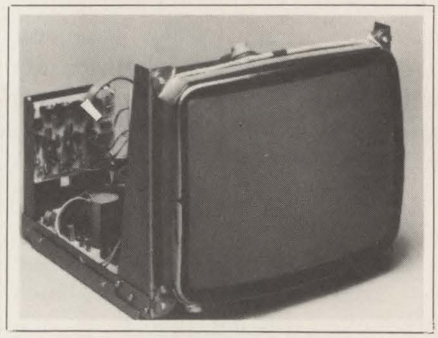
bytes of Multibus-compatible main memory in 128K-byte increments. The memories are available in eight versions, starting at 128K bytes, and are compatible with 16-, 20- and 24-bit address buses and with 8- and 16-bit data buses. The memories feature access times of 250 nsec. and cycle times of 440 nsec. and are designed for multi-user, multitasking applications. Other features include the ability to swap 16K-byte segments dynamically, correction of all single-bit errors and detection of double-bit errors using a modified hamming code. The 1.5M-byte board is priced at $5795 in OEM quantities.
Advanced Digital Technology, 696 Trimble Rd., San Jose, Calif. 95131.

Circle No 301

Graphics display terminal features vector drawing



The TAB 132/15-G graphics terminal features multiple character size, dot-dashed lines, point-plotting, vector and art drawing, area filling, selective erase and a cross-hair cursor. The terminal, which has Tektronix 4010 emulation and 4027 graphics commands, is compatible with software packages such as Plot 10, Disspla, Telegraph, IGP, DI3000, ILS, Template and Plotpak. The unit offers a 15-in. screen, 132-column display and alphanumeric capabilities. Single-unit, end-user price is $3295. **TAB Products Co., Electronic Office Products Division,** 1451 California Ave., Palo Alto, Calif. 94304. **Circle No 302**



Color graphics chassis have high resolution

The CF-33HRA and CF-33 HR TTL high-resolution scan display monitor chassis for OEM graphics applications incorporate analog video input and TTL video input, respectively. Both include an in-line-gun, 0.31-mm., delta-dot shadow mask picture tube. Bandwidth is 15 MHz with horizontal scanning available at rates as high as 25 KHz. CRTs with long-persistence RGB or standard-persistence phosphors and a medium-resolution 0.43-mm.-pitch picture tube are optional. Prices begin at $618, depending on quantity. Complete chassis/monitor units are also available. **Elector,** 5128 Calle del Sol, Santa Clara, Calif. 95050. **Circle No 303**

Cursor control pad is multifunctional

This cross-hair cursor control pad for compatibility with the vendor's graphics enhancements for the VT-100, CIT-101 and TeleVideo 950 and 925 terminals consists of a 4- × 6-in. pressure-sensitive keypad with eight directional arrow keys, six mode-selection switches and two

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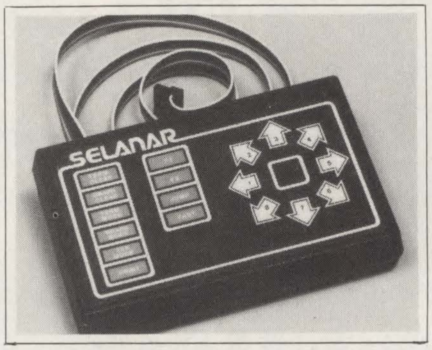
CIRCLE NO. 99 ON INQUIRY CARD

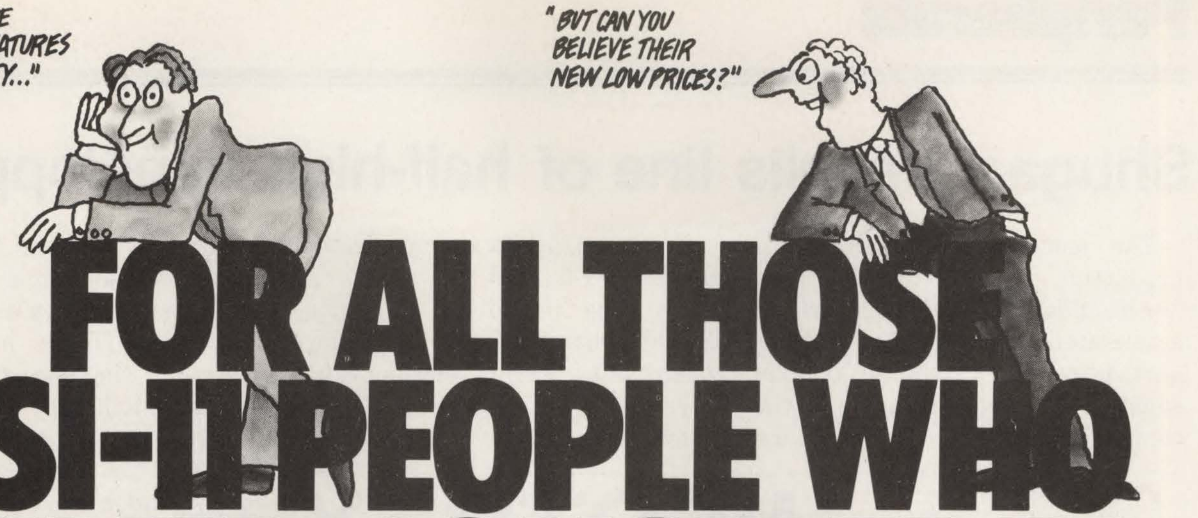
Systems



user-definable function controls. An attached 36-in. cable connects the controls to the graphics board through the terminal's rear cover, letting the user place the controls next to the keyboard. The cursor operates in the Tektronix emulation mode and responds to Plot 10 commands. A fast and a jump switch increase cursor speed in any of the eight directions. Price is $250 in single-unit quantities. **Selanar Corp.,** 437-A Aldo Ave., Santa Clara, Calif. 95050. **Circle No** 304

Color graphics controller features eight bit planes

The Ω440 is available as a display controller only (Ω440/DC) or as a complete graphics subsystem (Ω440/GS) that combines the controller with a color video monitor that employs a precision in-line electronic gun for image-production. The Ω440 features eight bit planes yielding 256 displayable colors dynamically selectable from a palette of 16.7 million. Two refresh options include a 1024 × 768 display refreshed at 33 Hz and a 736 × 552 display refreshed at 60 Hz. The Ω440 is supported by the Axia graphics package. Prices range from $16,400 each in single-unit quantities to $12,300 in quantities of 25. Single-quantity prices of the Ω440/GS range from $21,600 to $24,800, depending on monitor choice; 25-unit prices range from $16,632 to $19,096. **Metheus Corp.,** 5289 N.E. Elam Young Parkway, D-600, Hillsboro, Ore. 97123. **Circle No** 305



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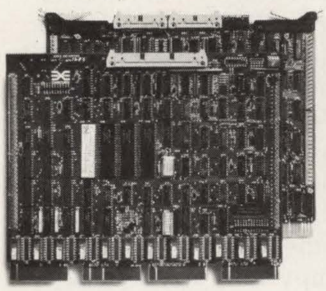
All Emulex Q-bus tape and disk controllers have the same microprocessor architecture and all the key features of our PDP-11 and VAX-11 products, including error correction, microdiagnostics, and software transparency. Price our performance. Write or call: Emulex Corporation, 2001 Deere Ave., Santa Ana, CA 92705; (714) 557-7580; TWX 910-595-2521. Outside Calif.: (800) 854-7112.

For immediate off-the-shelf delivery, call our national distributor: First Computer Corporation, 645 Blackhawk Dr., Westmont, IL 60559; (312) 920-1050. In Europe: Emulex Corp., 10th floor, Cory House, The Ring, Bracknell, Berkshire, England. Telephone: 0344-84234; Telex 851-849781.

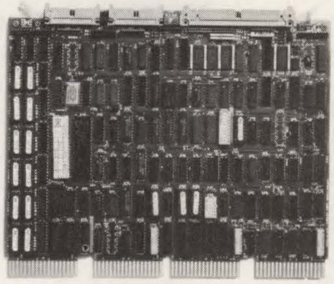
SC01 (RM02/05, RP06)



Put big SMD drives on your LSI-11.

Links Q-bus with 1-2 SMD-type drives. Software transparent & media compatible with DEC RM02, RM05, RP06. Features 3-sector data buffer, 32-bit ECC, up to half a billion bytes capacity. Over 1500 units in service!

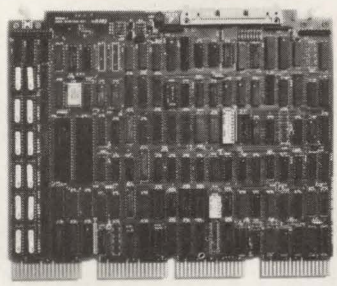
SC02 (RL01/02, RP02/03)
SC02 (RK06/07)



Low cost for smaller-sized disks.

Single quad-board interfaces LSI-11s to 8" & 14" SMD hard disk drives. Same great SC01-level performance in most applications. Software transparent. Full 32-bit ECC, self-test, 512-word bootstrap, real-time clock control, and bus terminators. Mix and match drives on one controller. 72,000 hours MTBF!

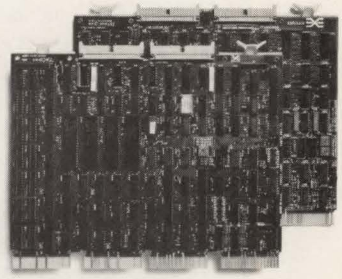
SC04 (RL01/02)
SC04 (RK06/07)



New! ANSI interfacing for 8" Winchesters.

Supports up to 8 drives per single quad-board controller. Fits into any single LSI-11 back plane quad slot. Same design, performance, and high reliability as the SC02.

TC01 (NRZ)
TC01 (PE)



Q-bus embedded dual-density tape controller.

Handles all open-reel half-inch tapes – 800/1600 bpi, operating at 12.5-75 ips. Compatible with DEC's TU10/TM11. Daisy-chain up to 4 drives. Firmware includes a self-test and extended diagnostics. Fully embedded.

CIRCLE NO. 65 ON INQUIRY CARD

EMULEX

The genuine alternative

Shugart unveils line of half-high minifloppies

The move toward high-volume production of lower cost half-high 5¼-in. floppy-disk drives will be accelerated this month when Shugart Associates unveils two double-sided devices built in Japan by the company's long-time Yokohama associate, Matsushita Communication Industrial Co., Ltd.

The unveiling of half-high, double-sided hardware by the Sunnyvale, Calif., Xerox subsidiary follows by three months announcements by Chatsworth, Calif., rival Tandon Corp. (MMS, July, p. 9) and Sunnyvale, Calif., rival Qume Corp. (MMS, August, p. 263). In June, Tandon began building 250K-byte, single-sided, lower performance minifloppy drives that sell for than $100 in 100,000-lot quantities ($50 for mechanics-only versions). Tandon also recently showed higher performance, higher capacity, half-high minifloppy drives priced in the same range ($245 in 1000-lot quantities) as its standard-height, 500K-byte TM-100, for shipment this year.

In June, Qume announced its 500K-byte Qumetrack 142 priced at less than $150 in OEM quantities.

Use of two half-high floppy-disk drives in the slot designed for one standard-height drive has the immediate effect of doubling a system's storage capacity without changes in volumetric dimensions. The storage per cubic in. and storage per oz. savings provided by the half-heights are particularly attractive for portable-computer and other space-sensitive applications.

According to Shugart, the smaller drives also consume less power and dissipate less heat. Wide-scale incorporation of half-height floppies into portable computers, intelligent typewriters and home computers, desk-top microcomputers and word processors will have a dramatic impact on the overall market for 5¼-in. floppy-disk drives, says Andrew Roman, Newark, Calif., industry analyst and publisher of The *OEM Disk Drive Pricing Report*. "Prior to the introduction of half-high hardware, we projected that sales of 5¼-in. floppy-disk drives would plateau in 1985 at a shipping rate of 4 million units per year," he says. "But the half-high drive will act as a mid-life kicker for this class of device and extend its growth rate another two years at

A terminal so smart, it meets your need from every angle.

Epic's 14E is everything you expect in a smart terminal. Plus full ergonomic movement to assure optimum operator comfort and productivity.

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- CRT saver with continuously displayed real time clock
- Dual, independent, bidirectional ports
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- 25th status/message line
- Set-up mode
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See the smartest and newest angle on superior price/performance, the Epic 14E Call or write for details now.

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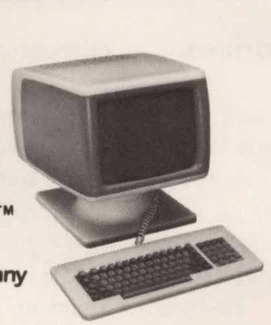


14E

Epic Computer Products, Inc. 18381 Bandilier Circle, Fountain Valley, Ca. 92708 714/964-4722 Telex 692-355

CIRCLE NO. 66 ON INQUIRY CARD

least."

From Shugart's point of view, drives with higher performance than the company's existing standard-height line may extend the market for 5¼-in. floppy disk hardware even further. Both of Shugart's new half-high minifloppies—the 48-track-per-in., 500K-byte SA455 and the 96-tpi, 1M-byte SA465—operate at average access times of 94 msec. using split-band actuators. The company's older split-band SA450 operates at 275 msec. Its newer 1M-byte SA460 standard-height 5¼-in. drive operates at 173 msec. using a lead-screw positioner. All figures include settling time.

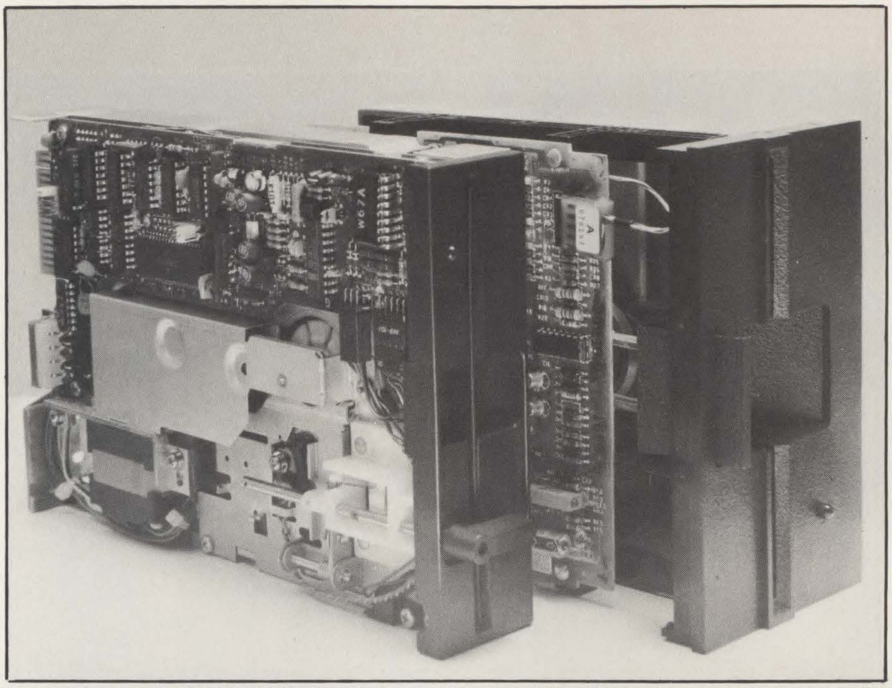
The new Shugart drives use the same number of cylinders (40), recording method (modified FM), bit densities (5876 bpi for 48-tpi hardware; 5922 bpi for 96-tpi devices) and track capacities (6.2K bytes per track) as the company's standard-height hardware, eliminating the need for new controllers and ensuring interchangeability of media from one drive to another.

Pricing for the new drives is set at $185 for the SA455 and $225 for the SA465 (both in 500-lot quantities). Evaluation versions of Shugart's SA455 and 465 are due this quarter. Production hardware will be available next quarter.

—John Trifari

Shugart Associates, 415 Oakmead Parkway, Sunnyvale, Calif. 94086.

Circle No 306



Shugart's new SA455 and SA465 5¼-in. minifloppy-disk drives *are exactly half the height of standard minifloppies (right). Available only in double-sided versions, the SA465 offers as much as 1M byte of unformatted capacity, and the SA455 offers as much as 500K bytes. The two drives use brushless, direct-drive DC motors and are media and interface compatible with the industry-standard SA400 family.*

Shugart's new drives in context

	Shugart SA 455/465	Shugart SA 450/460	Tandon TM-50	Qume QumeTrack 142
Total capacity (bytes)	500K/1M	500K/1M	250K	500K
Capacity (bytes/surface)	250K/500K	250K/500K	250K	250K
Transfer rate	250K bits per second			
Bit density (bpi)	5876/5922	5876/5922	5536	5876
Track density (tpi)	48/96	48/96	48	48
Access times (msec.) track/track	6/3	20/6	20	12
average	94/94	275/173	287	
average latency	100 msec.			
Disk speed (rpm)	300			
Dimensions (in.)	1.62 × 5.75 × 8.46	3.25 × 5.75 × 8.25	1.62 × 5.75 × 8.0	1.62 × 5.87 × 8.0

Winchester, floppy drives intended for OEMs

These 5¼-in. floppy- and Winchester-disk drives include model TM50, a 250K-byte, 48-tpi floppy in half-height configuration. A mechanics-only version sells for $50 in large OEM quantities. Model TM101, a microprocessor-based, 1M-byte, 96-tpi floppy, sells for $260. Model TM102, a 2M-byte, fast-access, microprocessor-based, 96-tpi floppy, is priced at $325. Series TM500, a 6.4M-byte, 345-tpi Winchester-disk drive, expandable to 12.8M and 19.1M bytes, sells for $400, $550 and $700, respectively. Model TM703, a 31M-byte, 600-tpi, closed-loop Winchester, is priced at less than $1000. **Tandon Corp.,** 20320 Prairie St., Chatsworth, Calif. 91311.

Circle No 307

3-in. floppy offers capacity of 5 in.

This 80- × 100- × 5-mm., 3-in. floppy disk offers a single-side capacity of 125K bytes, a data-transfer rate of 125K bps and a 4500-bpi, 100-tpi, 40-track-per-side recording density. **Panasonic Industrial Co.,** One Panasonic Way, Secaucus, N.J. 07094.

Circle No 308

Compare

Victor's Desktop Business Computer System.

Businesses today face a basic dilemma when it comes to selecting a computer.

So-called "personal" computers have limited power and capacity. They're just too small to be useful to most businesses.

And the larger mini computers are more expensive.

Victor has a solution to that dilemma.

The Victor 9000 Business Computer is priced under $5,000. Like a "personal."

Yet the Victor 9000 has a capacity that rivals the expensive minis.

A close look at the chart shows you just how the Victor 9000 compares.

The Victor gives you the kind of memory and storage capacity business applications demand. Much more than the IBM Personal Computer, the Apple III or their competitors.

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MAKE & MODEL	Victor 9000	IBM PC	Xerox 820	Apple III	Radio Shack TRS80 Model II
Processor Type	8088	8088	Z80A	6502	Z80A
Word Length	16 bits	16 bits	8 bits	8 bits	8 bits
Memory Size (Internal)	128-896KB	16-256KB	64KB	96-256KB	32-64KB
Storage Capacity on 2 Floppies	2400KB (5¼")	640KB (5¼")	160KB (5¼")	280KB (5¼")	960KB (8")
CRT Display Standard Format	80 x 25	80 x 25	80 x 24	80x24	80 x 24
Alternate Format	132 x 50	None	None	None	None
Graphics Resolution	800 x 400	640 x 200	None	560 x 192	None
Communications Built-in Serial Ports at no extra cost	2	0	2	1	2
Built-in Parallel Ports at no extra cost	1	0	2	0	1
Human Factors Keys on Keyboards	94-104	83	96	74	76
Detached Keyboard mechanism	Yes	Yes	Yes	No	Yes
Tilting Display mechanism	Yes	No	No	No	No
Swivelling Display	Yes	No	No	No	No
Desk Area Required (Approx. Square In. with 2 floppy disks)	310	420	470	361	500
Operating System Supplied Standard	CP/M-86* MS-DOS	None	None	Apple DOS	TRS DOS

NOTE: Chart based on manufacturer's information available as of April 4, 1982.
*CP/M is a registered trademark of Digital Research, Inc.

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CIRCLE NO. 155 ON INQUIRY CARD

Peripherals

Document printer handles five-part forms

The model 159 transaction document printer for OEM applications handles five-part forms and allows tear-off within 1 in. of top of form. The 80-column unit also features 150-cps, bidirectional, logic-seeking, impact-matrix printing; variable forms-length control; and ribbon cassette reloading. **Centronics Data Computer Corp.,** Hudson, N.H. 03051. **Circle No** 309

Five-mode printer is multi-functional

The Variflex intelligent printer, based on the infinite-matrix principle, uses a seven- or nine-pin print head to generate copy in one of five quality levels on plain paper. The unit prints at 30 to 54, 65 to 195 and 130 to 390 cps. It offers various text formats and page layouts, font-to-font dynamic switching, more than 100 type styles and as many as 32 type sizes using the same printing

element. Price is $2860 each in OEM 100-unit quantities. **Santec Corp.,** 9 Columbia Dr., Amherst, N.H. 03031. **Circle No** 310

Matrix line printer is IBM-compatible

The 6703-25 dual-head matrix line printer is compatible with IBM's System 34 and 38 and 5251-12. The unit prints compressed- and normally spaced characters with as many as six copies and offers speeds as high as 300 lpm, character density from 10 to 15 cpi and forms-width capability from 4 to 16¼ in. Other features include an illuminated print area and precise vertical and horizontal head alignment. Single-unit price is $6995, with discounts available on orders for six or more. **Decision Data Computer Corp.,** 100 Witmer Rd., Horsham, Pa. 19044-2282. **Circle No** 311

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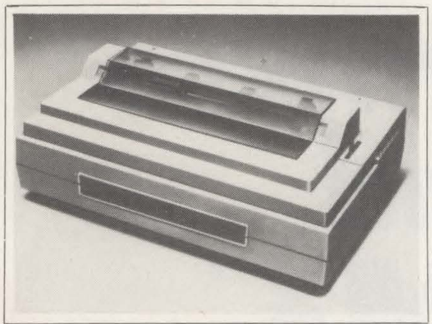
CIRCLE NO. 81 ON INQUIRY CARD

Peripherals



Printers produce 65, 80/180 cps

The DM 5180 and the DY 821 are new models of the DM 80/180 dot-matrix and DY 811 daisy-wheel printers, respectively. The DY 821 prints at 65 cps, and the dual-mode DM 5180 prints at 80 or 180 cps. The printers sell for $3400 each in single-unit quantities and $1760 each in quantities of 500. **Olivetti OPE,** 505 White Plains Rd., Tarrytown, N.Y. 10591.

Circle No 312

Printer produces bar codes, labels

The IPS-5000-V bidirectional, intelligent printer produces 72- × 120-dot resolution graphics, 11 bar codes, labels and matrix characters. The unit operates at 165 cps or 285 cps, accommodates five copies and features a 96-character ASCII set, a 2K buffer and standard parallel versions of the RS232 interface. A 136-column version sells for $1425 in 100-unit orders, and an 80-column version sells for $1360. **Dataroyal, Inc.,** 235 Main Dunstable Rd., Nashua, N.H. 03060.

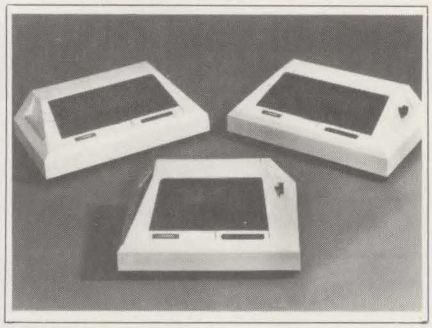
Circle No 313

Daisy-wheel printer has universal interface

The Daisywriter 2000 intelligent daisy-wheel printer retains the features of the Daisywriter 1000 and offers a 16K-byte buffer and an

optional 48K buffer. The unit emulates Diablo, Qume and NEC letter-quality printers. The printer also features a three-chip microprocessor, a magnetically driven linear motor, 12 fonts in 15 languages and 10-, 12- or 15-cpi operation. Baud rates range from 50 to 19.2K bps. Price is $1495. **Computers International, Daisywriter Division,** 3540 Wilshire Blvd., Los Angeles, Calif. 90010.

Circle No 314

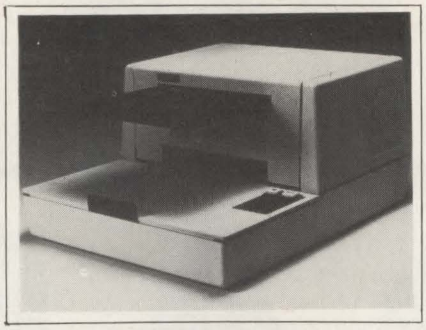


Receive-only unit prints near letter quality

The DP-9620A stand-alone, receive-only printer provides alphanumeric speeds ranging from 200 cps for a 7 × 9 dot matrix to 100 cps for a 13 × 9 dot matrix that produces near-letter-quality characters. Other character densities are 12, 15 and 16.4 cpi, and a 96-character ASCII set is included. Horizontal and vertical graphics resolutions are 72 dpi. The device operates in logic-seeking mode and includes Centronics bit-parallel and RS232C interfaces and eight serial protocols. Price is less than $1100 each in quantities of 1000. **Anadex, Inc.,** 9825 De Soto Ave., Chatsworth, Calif. 91311.

Circle No 315

Peripherals

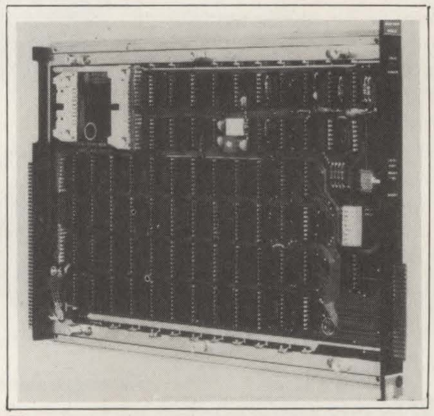


Document-entry terminal fits on a desk

Models 201 and 202 WorkLess Stations automatic document-entry terminals each fit on a desk top and require almost no operator assistance. The 17- × 21- × 10-in. microprocessor-based units, which combine OCR techniques with VLSI technology, enter text from typewritten pages into word processors at 25 sec. per page, and can be used to read archived paper files and to transfer data from one word processor to another. Features include an automatic 75-page sheet feeder and self-diagnostics. The terminals connect to standard RS232 ports. Model 201 reads Courier 10 typeface; model 202 reads Courier 10 and seven other typestyles. Model 201 sells for $6995, and model 202 sells for $7995. **DEST Corp.,** 2380 Bering Dr., San Jose, Calif. 95131. **Circle No** 316

VDT has ergonomic features

The New Range intelligent, Z80-based video display terminal has a screen that swivels 180 degrees left-to-right and tilts 15 degrees up or down. The unit has a detached low-profile keyboard with palm rest and features editing capabilities, user-selectable video attributes, 14 programmable function keys, a 25th status line, block and conversational modes, a printer port, an auxiliary RS232 port, selectable transmission rates from 110 to 19.2K bps and line graphic functions. Single-unit price is $845, with OEM quantity discounts available. **Soroc Technology, Inc.,** 165 Freedom Way, Anaheim, Calif. 92801. **Circle No** 317



Dual-port memory supports DEC LSI-11, PDP-11

The LS-060 dual-port memory for DEC LSI-11 and PDP-11 computers provides 4K of 16-bit static RAM and supports 18-bit memory addressing. Two computers can write into or read from the unit as if the full RAM resided in each, so that both share a program or access common data. The LS-060 is available on a DEC dual-width module and sells for $2035 in single quantities. **Standard Engineering Corp.,** 44800 Industrial Dr., Fremont, Calif. 94538. **Circle No** 318

Dynamic memory board stores 256K bytes

The DMEM/256KP memory board stores 256K bytes on a single IEEE 696/S-100 bus-compatible board. Extended 24-bit addressing provides 8- or 16-bit memory transfers. The board is organized in two independent 128K-byte regions. Access time is 230 nsec., and cycle time is 580 nsec., including transparent

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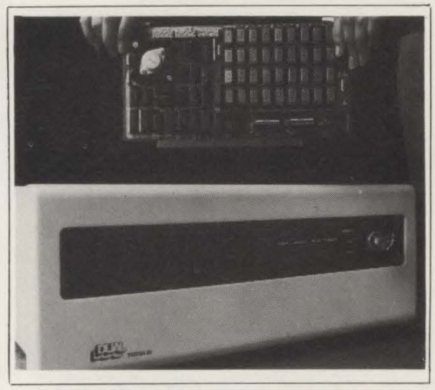
CIRCLE NO. 53 ON INQUIRY CARD

Peripherals



refresh. Parity is checked on every byte transfer to protect against error. The DMEM/256KP sells for $1495. **Dual Systems Control Corp.,** 720 Channing Way, Berkeley, Calif. 94710. **Circle No** 319

32M-byte memory emulates ModComp minis

The BS-410 rack-mounted bulk semiconductor memory system emulates ModComp's 4100 series of fixed-head disks and stores 32M bytes. It is software compatible with existing ModComp operating systems and FHD diagnostics, but minor patches to the FHD I/O handler and diagnostics are required for BS-410 capacities higher than 8M bytes. Maximum data transfer rate is 1250 KW per sec., and average access time is 2.5 msec. In single-unit quantities, the 7-in.-high, 8M-byte and 15¾-in.-high (expandable to 32M bytes) BS-410 sell for $8930 and $11,000, respectively. Each 2M-byte module is $12,650, and battery backup sells for $2400. **Dataram Corp.,** Princeton Rd., Cranbury, N.J. 08512.

Circle No 320

DILOG... GREATEST DATA STORAGE CONTROL FOR LSI-11*

You can't find a better selection of high-performance, low cost, single board disc/tape controllers for LSI-11, 11/2, or 11/23 CPUs. Nearly 30 different controllers in all...(thousands in use)...every one DEC software transparent and I/O compatible with every popular drive.

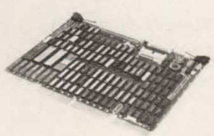
Each controller offers you easy interface, lower power requirements and numerous self-test, error correction and other time/data base saving features...all built into each uP based intelligent controller. And DILOG's automated design techniques and proprietary architecture assures you of highest quality and best price/performance...today, tomorrow and for years to come.

DISC CONTROLLERS

DILOG's disc controllers are for 5¼", 8" or 14" WINCHESTER/SMD/CMD drives. Emulations offered are RK, RL, RP and RM. The following lists only a few of the controller/drive combinations:

SMD INTERFACE COMPATIBLE—Model DQ202A—Exclusive universal formatting—switch selectable RP02/RP03—two drives—capacities to 300 MB—no drive parameters in on-board PROMS.

NEW—SMD INTERFACE COMPATIBLE—Model DQ215—Exclusive universal formatting—switch selectable RK06/RK07—56-bit ECC—22-bit memory addressing—two drives—capacities to 300 MB each—no drive parameters in on-board PROMS.

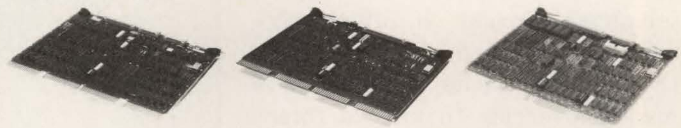


ST506 INTERFACE COMPATIBLE—Model 60X

PRIAM INTERFACE COMPATIBLE—Model 41X

CDC FINCH INTERFACE COMPATIBLE—Model DQ444

RL01/RL02 or RP02/RP03 emulations—each controller will handle two disc drives.



¼" AND ½" TAPE CONTROLLERS

DILOG tape controllers for ½" Streaming/Start-stop or ¼" cartridge offer TM and TS emulations.

½" STREAMING/START-STOP COMPATIBLE—Model DQ130—handles up to eight NRZI/PE drives—emulates TM-11/TS-03—nine-track 800/1600 bpi industry standard—12.5 ips to 125 ips.

¼" 3M CARTRIDGE TAPE—Model DQ320 Controller and Model DQ330 Coupler—TM-11/TS-03 emulations.

Contact your local DILOG sales office for complete details on specific models offering Greatest Data Storage for LSI-11.

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NUMBER 1 FOR DEC-11

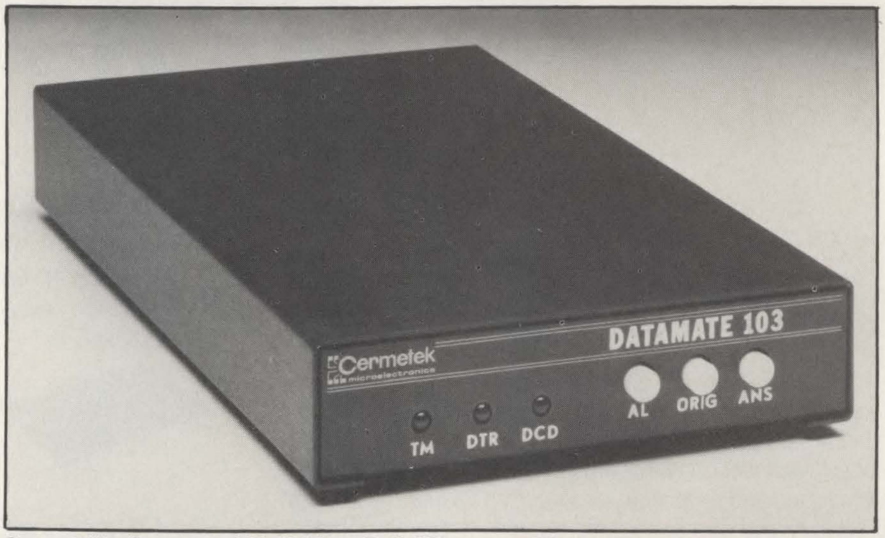
CIRCLE NO. 114 ON INQUIRY CARD

*Trademark Digital Equipment Corp.

Five-chip, 300-bps modem priced at less than $200

What could be the first intelligent modem priced at less than $200 in large quantities will be unveiled this month at the Wescon show by Cermetek Microelectronics, Sunnyvale, Calif.

Called the Datamate 103, the five-chip device uses frequency shift keyed modulation, emulates a Bell 300-bps 103 Dataset and operates half- or full-duplex over voice-grade telephone circuits. It offers automatic rotary/touch-tone selection in the autodial mode as well as a manual override to force a rotary connection if dial frequencies vary—a problem that can occur in non-Bell systems, says Cermetek marketing director Steve Durham.



Cermetek's Datamate 103 300-bps Bell 103-compatible intelligent modem *is priced at less than $200 in large orders, and is based on four hybrid chips and one monolithic autodial circuit. The unit also contains additional control logic and 72 bytes of RAM.*

The Datamate 103 can store as many as six 11-digit telephone numbers (including last number dialed) in its 72 bytes of RAM, and offers a number of in-call monitoring features, including the ability to detect voice communication on a data link. Voice detection is very handy in computer-to-computer communication if a wrong number gets dialed. The modem is supplied with RS232 cable and two RJ-11 clip connectors, and accepts a series of keyboard-driven commands including "HELP" and "PAUSE." The latter is useful if the first digit of a telephone number is used to get an outside line.

The modem functions of the Datamate 103—direct-access arrangement circuit, two filters and a signal processor—are implemented on four thick-film chips. The autodialer chip is implemented using monolithic chips. Cermetek sells the DAA chip to outside modem vendors, Durham says, and plans to offer the other chips as well at an undisclosed date.

Durham also says that Cermetek plans to use its thick-film hybrid expertise to combine the DAA, filters and signal processor onto one circuit. "This is rapidly becoming a component business as modems go inside terminals and even onto system boards," Durham continues. "Ultimately, a two-chip modem for less than $50 could evolve, and by 1985, box-level, low-speed modems will be sold mostly to retrofit the existing installed terminal base."

Cermetek plans to sell the Datamate 103 through distributors and OEMs, and has priced the device at $295 in single-unit quantities. Evaluation hardware is being shipped now.

—John Trifari

Cermetek Microelectronics, 1308 Borregas Ave., Sunnyvale, Calif.
Circle No 321

Voice/data modem 'speaks' intelligibly

The Adas VIII voice/data modem can communicate by standard data-link or voice-synthesized messages. Through an RS232 interface, the modem lets a host computer place or receive phone calls, transfer data bidirectionally at 300 bps, "speak" in unlimited vocabulary of synthesized voice and receive Touch-Tone information from distant phones for control or data retrieval. If 110V power is lost for 15 sec. or longer, the unit reports the problem to a pro-

grammed phone number for repair. The Adas VIII sells for $2000 to $5000, depending on configuration, with quantity discounts available for 11 or more units. **Butler National Corp.,** 8246 Nieman Rd., Lenexa, Kan. 66214.

Circle No 322

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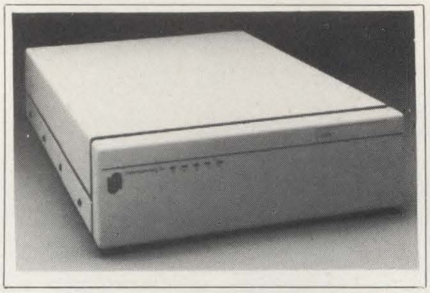
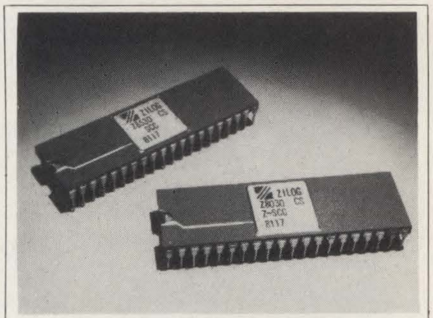
CIRCLE NO. 175 ON INQUIRY CARD

CMX lets 32 IBM 3270s share one cable



The CMX series of coaxial cable multiplexers allows 32 IBM 3270 terminals in a remote location to connect to an IBM 3274 device control unit using one RG-62A/U cable rather than individual cables. The system is transparent to IBM user software and terminal operation, and the multiplexed link can be as long as 4950 ft. Transmission speed is 2.358M bps. One CMX unit operates at either end of the cable and attaches to the 3274 control unit or to individual devices. The system operates with all IBM type A display terminal devices, including the 3278, 3279 and 3287 printer, and can be used with equivalent Memorex products. Four versions are available, including the CMX-32, for 32 terminals, which sells for $4200; the CMX-24 for $3700; the CMX-16 for $3200; and the CMX-8 for $2700. **Ungermann-Bass, Inc.,** 2560 Mission College Blvd., Santa Clara, Calif. 95050. **Circle No** 323



Communication controller performs 1M-bps transfers

The SCC multi-protocol serial communication controller performs data transfers as fast as 1M bps and works with any CPU. It offers the same features as Zilog's SIO serial I/O chip. Each serial channel has its own control, status and transmitter and receiver buffer registers. The SCC is available in two versions. The Z8030 Z-SCC interfaces directly with Z8000 CPUs and other multiplexed address/data-bus CPUs. The Z8530 SCC works with non-multiplexed address/data-bus CPUs. In 100-unit quantities, prices are $38.30 (plastic) and $53.40 (ceramic) each for the SCC Z8030/Z8530, and $21.40 and $36.60 for the ASCC Z8031/8531. **Zilog, Inc.,** 1315 Dell Ave., Campbell, Calif. 95008.

Circle No 324

Components

Power supply has overload protection

This 5V, 3A general logic board power supply with overload protection offers input voltage of 115/230V AC, 47 to 63 Hz, line regulation of ±0.02 percent for a 10-percent line-voltage change, load regulation of ±0.02 percent for a 50-percent load change, peak to peak output ripple of 3 mV and transient response of 30 msec. for a 50-percent load change. Case size is 4.9 × 4.0 × 1.6 in. The unit sells for $24.95 each in orders of one to nine and $19.95 in quantities of 100. **Cougar** DC Power Supply Co., 2111 Barnett St., Oxnard, Calif. 93033.
Circle No 325

Z80 processor is STD compatible

The crystal-controlled CPU-Z80 STD-bus-compatible microprocessor card provides four 2K allocatable segments of 2716-type ROM/RAM on-board and power-on jump. A bootstrap device permits users to select one of 15 power-on, reset starting locations, eliminating the need to store bootstrap loaders in lower memory. Single-quantity price is $190, with OEM discounts available. **Quasitronics, Inc.,** 211 Vandale Dr., Houston, Pa. 15342.
Circle No 326

Board uses three processors in parallel

The Lightning One processor board uses the Intel 8086, 8087 and 8089 processors in parallel. For 8-bit systems, the 8086 can be unplugged and replaced with an 8088. The board also offers jump-selectable 4-, 5-, 8- or 10-MHz operation, 16K bytes of on-board EPROM with monitor, diagnostics and disk utilities and CP/M-86 and MS/DOS software support. Prices start at $395. **Lomas Data Products, Inc.,** 729 Farm Rd., Marlboro, Mass. 01752. **Circle No** 327

Software

Package provides virtual terminal for PDP-11

The Virtual Terminal establishes a virtual connection between a user terminal and an input port of a remote computer, permitting the user to communicate with local and remote computers concurrently without special software on the remote system. Commands are provided to transfer text files between systems and to control line characteristics including baud rate, echo and XON/XOFF sequences. VT, running under DEC PDP-11 computers under the RT-11, TSX or TSX+ operating system, supports the DEC DF03 auto-dialing modem, allowing the user to initiate and terminate calls to remote computers from the terminal without physical access to the modem or a telephone. **Zia Corp.,** P.O. Box 351, Morris Plains, N.J. 07950. **Circle No** 328

Apple II emulates a terminal

Emulator II allows the Apple II microcomputer to act as a conversational display terminal with Microdata Reality computers and other processors that run the Pick operating system. Features include full x-y cursor addressing, input speeds of 110 to 9600 bps, use of an internal 30K-byte memory buffer, a slave printer option, upper and lower case, "caps lock" and an 80-column display. The memory buffer permits input from the host computer to run faster than outputs to the slave printer. Introductory price is $250. **Standard Computer Systems, Inc.,** 10300 Sunset Dr., Miami, Fla. 33173. **Circle No** 329

File librarian runs under CP/M, MP/M

The MicroLIB disk-file librarian runs on microcomputers under the CP/M and MP/M operating systems. It allows a user to store many files in a single larger file (library) that reduces the total space needed and is claimed to reduce running time. Security features include password protection, by itself or with encryption. MicroLIB maintains a 50-character description with each file, for display and inclusion in reports that describe the contents of a library. An optional feature saves the date of each transaction against a file. Price is $295 for single copies, with quantity discounts available. **Advanced Micro Techniques,** 1291 E. Hillsdale Blvd., Foster City, Calif. 94404.

Circle No 330

Forms editor operates on HP-1000 computers

QFORM, an interactive forms-building package that includes an editor and programmer support subroutines for HP-1000 computers, operates on HP block-mode terminals. The full screen can be used for form layout. Fields can be declared as alphabetic, numeric or alphanumeric, and can be labeled to permit subsequent form changes without reprogramming. Highlighting attributes, justification and conversion of integers and real numbers can be specified. Subroutines can be used to read function keys and to load function-key definitions and labels. Price is $995. **Combs & LaRobardiere Systems, Inc.,** 55 Peach Tree Court, Hawthorne, N.J. 07056. **Circle No** 331

Productivity tool runs under CP/M, MP/M systems

Display Manager is intended to facilitate design and integration of screen displays with flashing, reverse video, underlining and highlighting attributes into application programs. A user enters the type of terminal used, and the program incorporates its attributes into each display. The package includes a full screen editor and a run-time library. Display Manager, running

on 8080-, 8085-or Z80-based microcomputers under CP/M Version 2.+ or the MP/M II operating system, is said to be compatible with the PL/I-80, Pascal MT+ and CB-80 languages. Single-user price is $400. **Digital Research, Inc.,** 160 Central Ave., Pacific Grove, Calif. 93950. **Circle No** 332

NEC 7500 cross-assembler runs under CP/M

The System-75 cross-assembler for the NEC 7500 microprocessor runs on microcomputers under the CP/M operating system. The package includes a macro assembler, an interactive editor/assembler, a text editor, a cross-reference generator and off-loading facilities. The macro assembler provides macro and conditional assembly functions, and can chain several source files into a single assembly. The interactive editor/assembler is intended for rapid creation, modification and test of program modules. Facilities are furnished for down-loading programs to a target processor for testing. Price is $150. **Allen Ashley,** 395 Sierra Madre Villa, Pasadena, Calif. 91107. **Circle No** 333

Tools for HP 41 calculators support numeric constants

The HP-41UCC cross compiler for HP-41C/CV calculators runs on microcomputers under the CP/M operating system. A pre-defined set of keyword tokens is used in the source text for the calculator keystroke symbols. Entry of alpha mode text, numeric constants and comments is supported. Symbolic names can be assigned to labels in programs and to HP-41 memory registers. The binary output can be transferred to the calculator for test via the HP interface loop hardware or can be burned into an EPROM. One-time lease fee is $395. **Hand Held Products,** 6201 Fair Valley Dr., Charlotte, N.C. 28211.

Circle No 334

Educational tool catches Ada errors

AdaSynch, a Pascal program that checks the grammar and format of Ada programs and identifies errors, is intended to familiarize programmers with Ada syntax before compilers become available. Output is a line-numbered listing of an entered program, showing the types and location of errors within each line. A cross-reference listing shows where each programmer-defined name appears. User-controlled options trace lexical and syntactic action, with results shown in the program listing. The $900 price includes the package on tape, along with a sample Ada program. **Intermetrics, Inc.,** 733 Concord Ave., Cambridge, Mass. 02138.

Circle No 335

Word processor DBMS runs under UNIX

Sequitur, written in C, combines a relational DBMS with word processing. Data organized into rows and columns are displayed in tabular or page format. A full-screen editor is used for all interactions, including entering or editing data, modifying the data dictionary, entering queries, specifying reports or form letters and giving commands. Integrated utilities provide for system file backup, batch exchange of data with other systems and recovery of unused disk space. Sequitur runs under UNIX 7 on Plexus, Onyx and DEC PDP-11 and VAX-11 computers. Prices range from $3495 to $5500. **Pacific Software Manufacturing Co.,** 2608 Eighth St., Berkeley, Calif. 94710. **Circle No** 336

Electronic-mail system operates on Apple II

The Transend 3 electronic-mail system with a built-in editor runs on Apple II computers, and can exchange information with as many as 100 Apples and 10,000 addressees. Features include verified file transfer, data compression and decompression and maintenance of a tickler file and phone-number list. With a privacy option, data can be transmitted securely and retrieved only by password holders. **SSM Microcomputer Products Inc.,** 2190 Paragon Dr., San Jose, Calif. 95131. **Circle No** 337

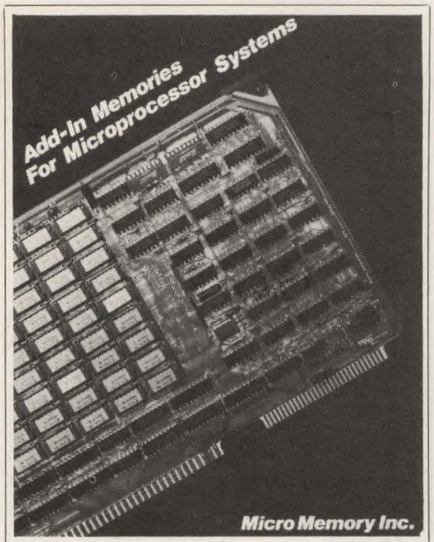
APL system runs on TRS-80 model III

APL*Plus/80, running on the Radio Shack TRS-80 model III microcomputer, consists of an APL language processor with vendor-supplied enhancements. Features include formatting, exception handling (error trapping), a shared file system, all APL language primitive functions and operators and system functions for work-space management and for interface with non-APL programs. The package operates as a stand-alone processor or communications terminal to a remote computer, using the APL or ASCII character set. **STSC, Inc.,** 2115 E. Jefferson St., Rockville, Md. 20852.

Circle No 338

Package provides statistical analysis

Statpack, an integrated package of statistical-analysis programs for NorthStar computers, includes routines for creating and modifying data sets and for maintaining files. Descriptive statistical analysis functions include frequencies, histograms, breakdowns, cross-tabulations and plots. Multivariate analysis functions include multiple regression with statistical and residual analysis capability, factor analysis with principal components and rotated factors, multiple discriminant analysis and time-series analysis. Statpack requires double-density diskettes with 32K bytes of main memory. The price is $150. **Tipco,** 1135 McClumpha, Plymouth, Mich. 48170. **Circle No** 339



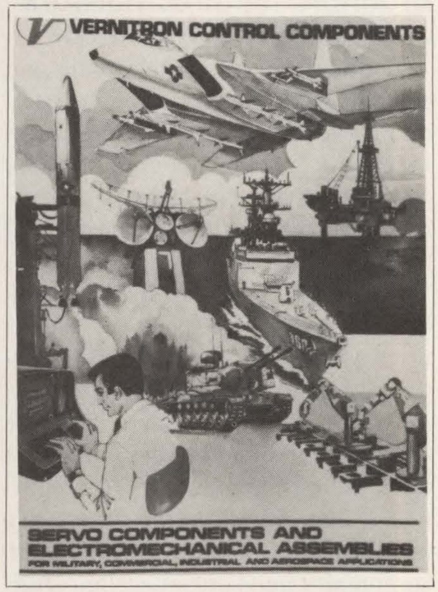
Catalog describes add-in memories

The vendor's add-in memory boards are featured in a six-page, color catalog. The publication details memories for Multibus, EXORciser and LSI-11 microprocessor systems, and lists features of each type. Parameters include cycle time, access time, storage capacity, power monitoring and write-protect control. The catalog also briefly describes 48-hour dynamic burn-in and temperature cycling. **Micro Memory Inc.,** 9436 Irondale Ave., Chatsworth, Calif. 91311.

Circle No 340

Catalog describes control components

Features and specifications for pancake synchros and resolvers are described in a 40-page catalog. The catalog covers components with accuracies ranging to 10 sec. of arc, limited angle brushless-DC torque motors, gearless direct-drive servomechanisms and electromechanical assemblies and indicators. It also details synchro signal converters, special brushless devices and standard MIL-spec synchros and resolvers including a line of 20-sec. accuracy units. **Vernitron Control Components,** 1601 Precision Park Ln., San Diego, Calif. 92073.



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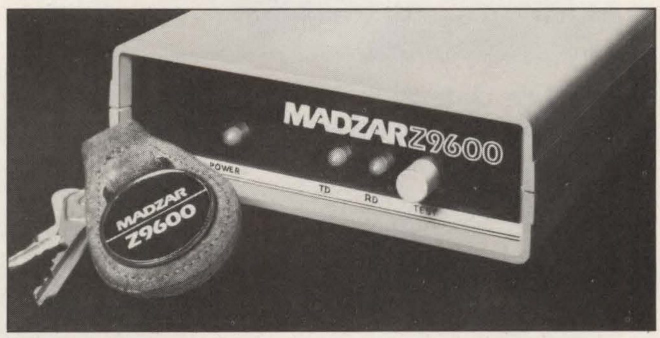
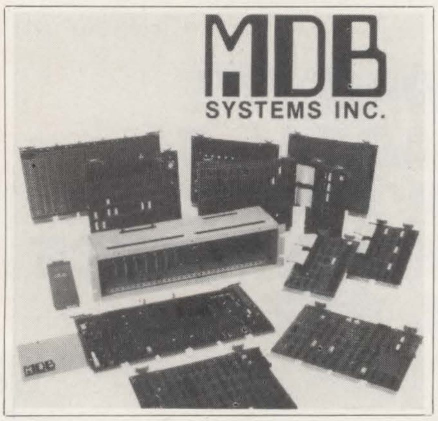


Literature

Brochure features network control, diagnostic needs

Requirements for diagnostic and control capabilities that help communications users assess needs are featured in a brochure. The publication presents representative tech control, network control and network-management solutions. The 10-page brochure includes block diagrams that show how to configure a system solution using diagnostic modems, remote or local protocol monitors, automatic alarms, remote or local data switches, storage devices and command microcomputers. The block diagrams are arranged in order of system complexity and sophistication. **Digi-Log Inc., Network Control Division,** 1370 Welsh Rd., Montgomeryville, Pa. 18936. **Circle No** 342



Literature details PDP-11 and VAX interfaces

Interface products for DEC PDP-11 and VAX computers are described in a brochure. The brochure covers synchronous and asynchronous communications/terminal interface modules, multiplexers, interprocessor link subsystems, peripheral-device controllers, system modules, PROM modules, foundation modules, special performance products and accessories. The 16-page, illustrated brochure provides interface data and I/O-connection details. **MDB Systems, Inc.,** 1995 N. Batavia St., Orange, Calif. 92665.

Circle No 343

Micro600 port selector described in brochure

The Micro600 port selector digital PABX is featured in a 12-page brochure. The brochure outlines the device's symbolic class names, statistics log output, monitor port, access security, welcome message and matrix switching. Illustrated with photographs and block diagrams, the publication explains the history of port selectors. **Micom Systems, Inc.,** 20151 Nordhoff St., Chatsworth, Calif. 91311.

Circle No 344

Brochure describes semi-custom ICs

The vendor's Genesis line of digital semi-custom ICs is described in a six-page brochure. The brochure includes charts and diagrams illustrating the basic I^2L gates, input-output interfaces, components available and basic layout rules for the three digital chip types, the 1200, 1300 and 1400. A chart of all Genesis circuits gives condensed data for seven linear circuits as well as the three digital types. **Cherry Semiconductor Corp.,** 2000 S. County Trail, East Greenwich, R.I. 02818.

Circle No 345

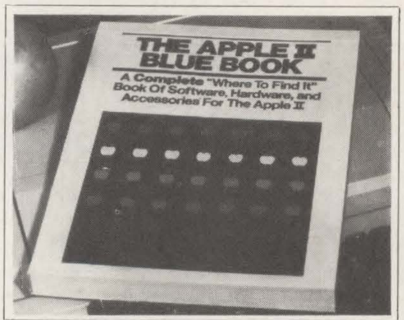
Brochure features EDP reports

Electronic data-processing information from 52 objective feature reports is described in a brochure. The reports include specifications, prices, characteristics, user ratings, comparisons and selection guidelines. Reports featured include: "All about CAD/CAM," "All about Electronic Mail" and "All about Personal Computers." The brochure also describes the contents of two recent user ratings surveys. They are the "User Ratings of Computer Systems" and "Copier User Ratings." **Datapro Research Corp.,** 1805 Underwood Blvd., Delran, N.J. 08075. **Circle No** 346

LITERATURE THAT COSTS

Local-network design featured in handbook

Local network specification and design is featured in a 224-page handbook. The "1982 LOCALNetter Designer's Handbook" describes products for local-network systems and accessories; includes articles on local-network standards; discusses major design issues; and provides sample specifications for a local network RFP, equipment comparison charts, manufacturers listings and cross-references and a bibliography. U.S. price is $65, and foreign price is $90. **Architecture Technology Corp.,** P.O. BOX 24344, Minneapolis, Minn. 55424. **Circle No** 347



Directory lists Apple II software, hardware

Software, hardware, peripherals and information for the Apple II personal computer are covered in a master directory. The 464-page *Blue Book* lists more than 2350 software and hardware products and more than 450 producers. The software section is divided into 57 alphabetically arranged subject categories from accounting to word processing. The hardware section lists hundreds of devices that interface with the Apple II. The book also includes product information, photos and descriptions. The hardware section is arranged by function, and includes boards, peripherals and storage. Each listing has a reference number. Price is $24.95. **WIDL Video,** 5245 W. Diversey, Chicago, Ill. 60639. **Circle No** 348

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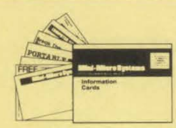

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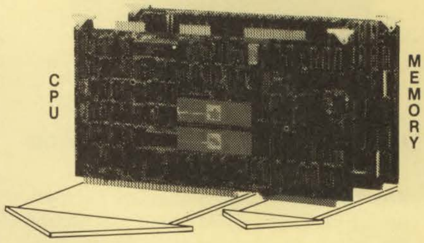

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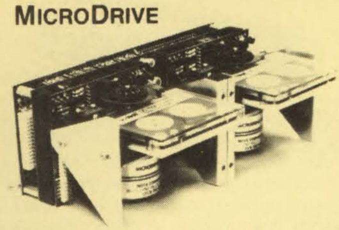

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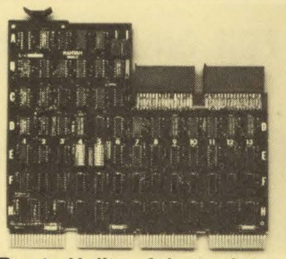

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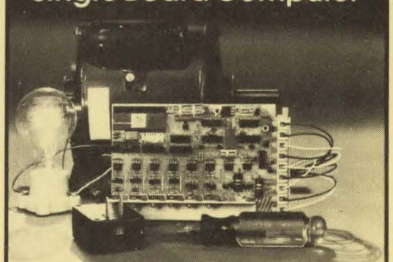

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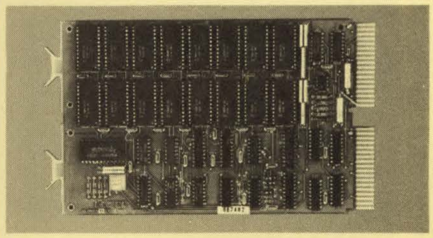

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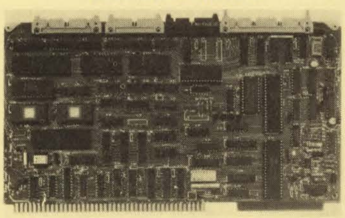

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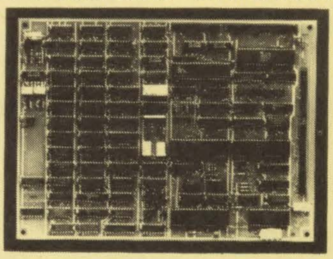

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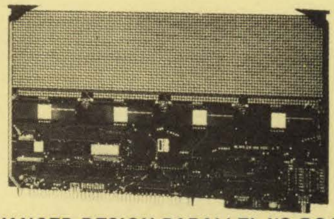

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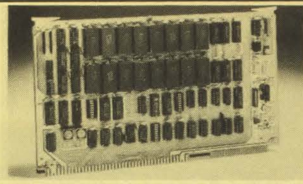

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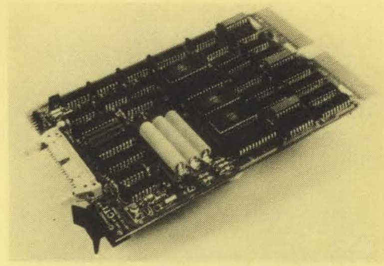

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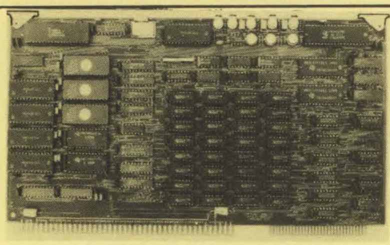

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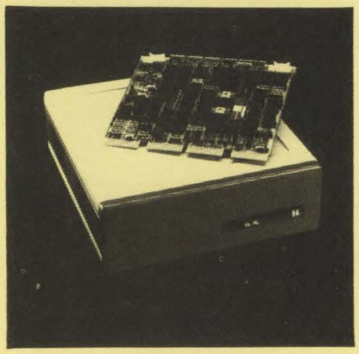

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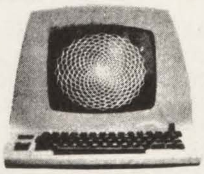

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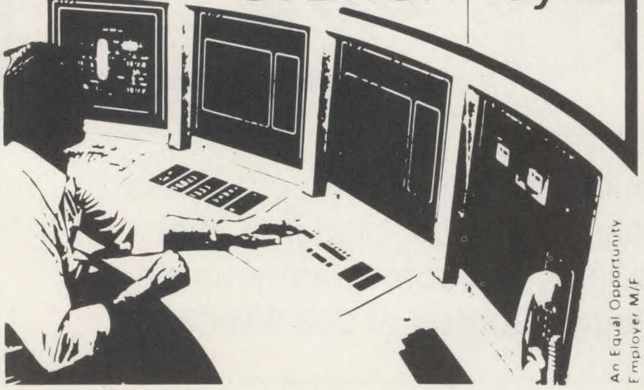

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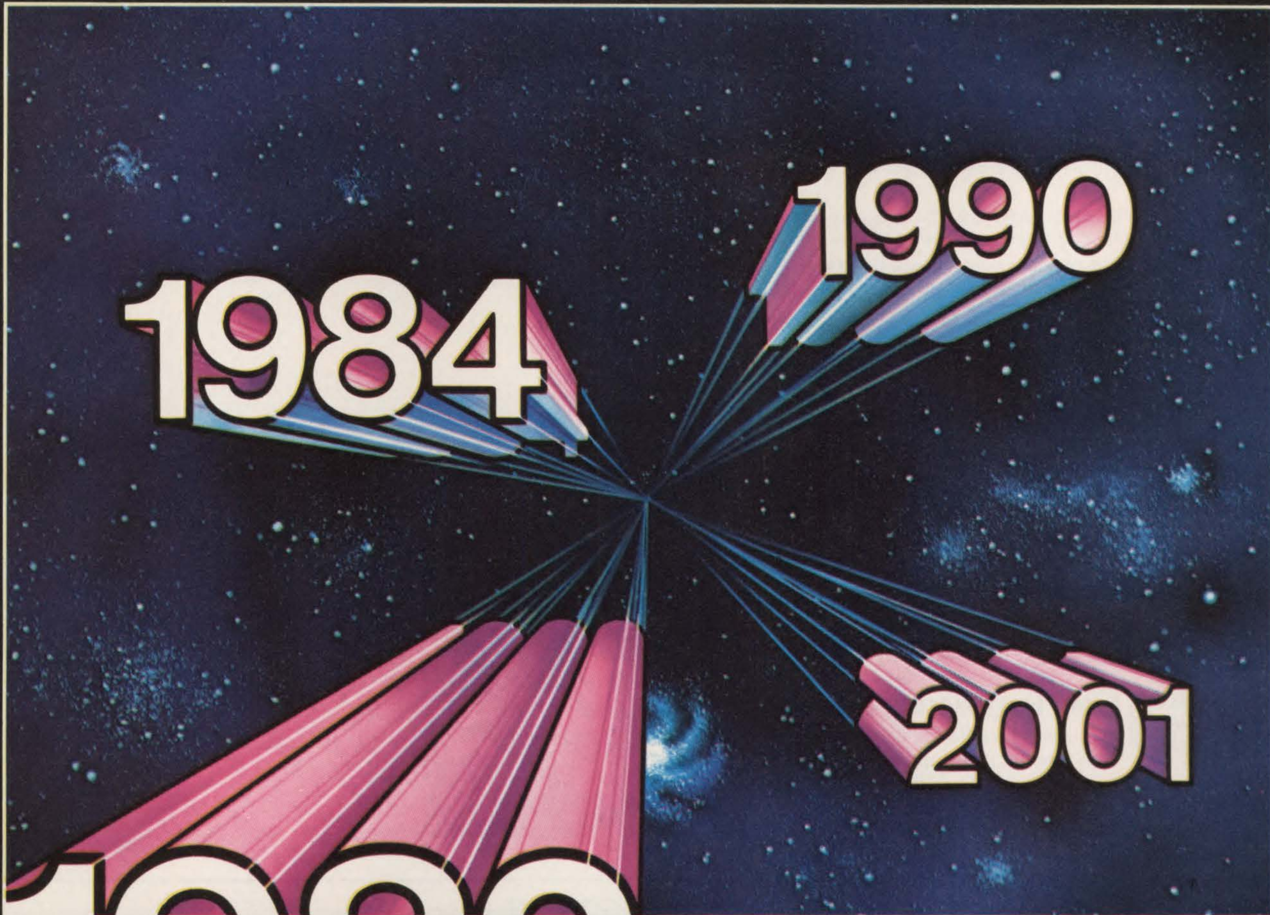

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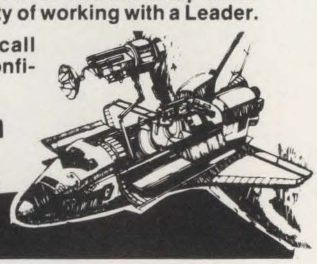

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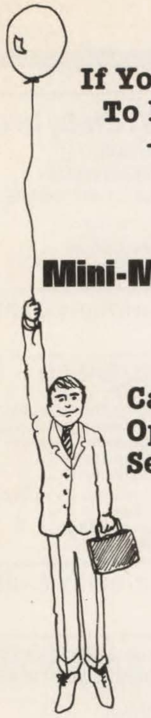

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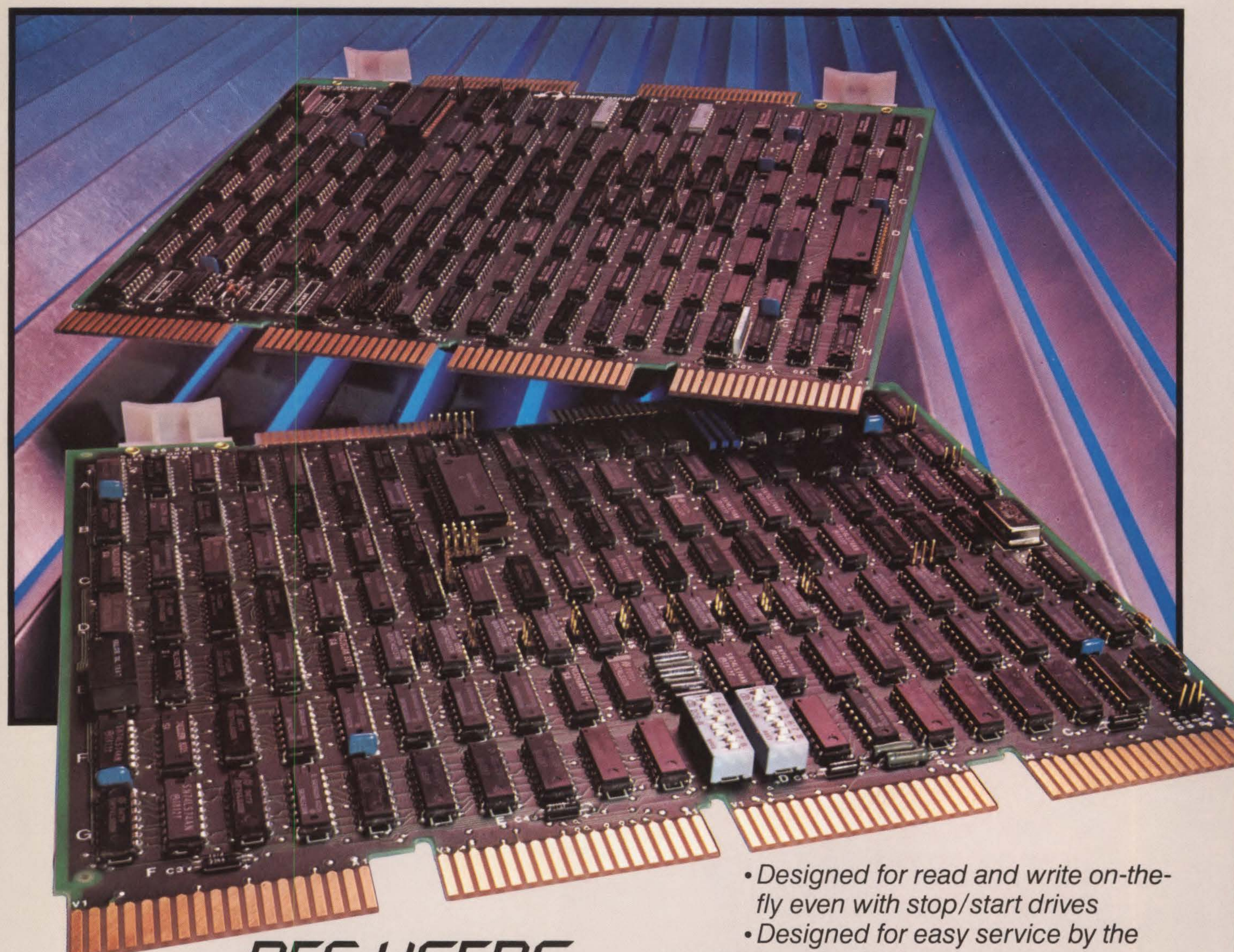

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