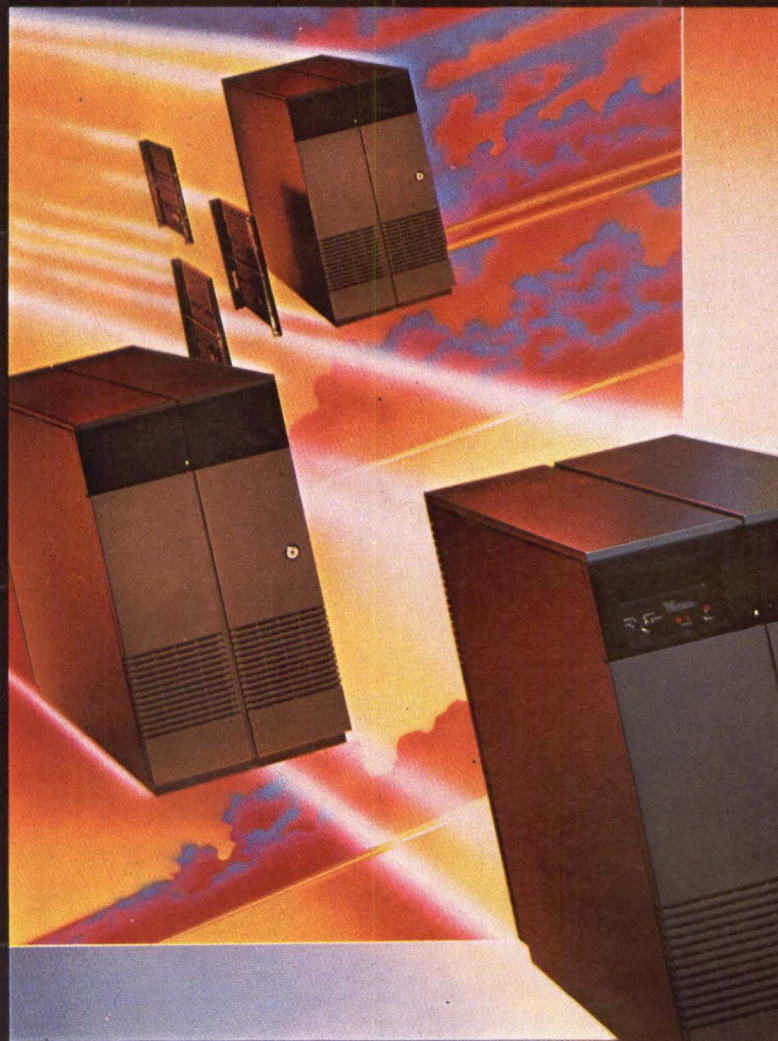


# Mini-Micro Systems

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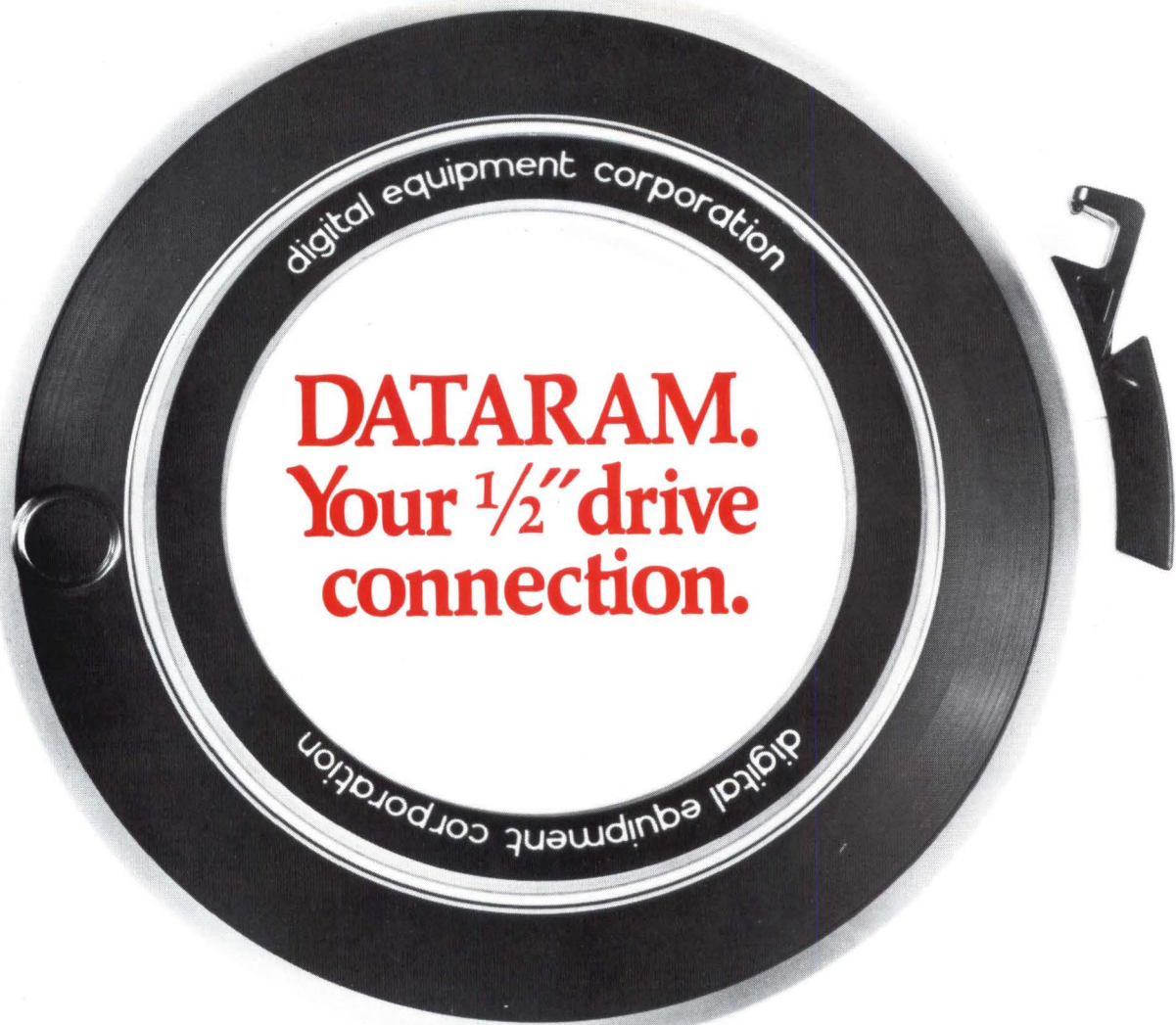
APRIL 1983

Focus on 16- & 32-bit minis  
New fail-safe multiprocessor



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Convergent tries multiple parallel processors



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For more information on the COMPAQ Portable Computer and the location of the Authorized Dealer nearest you, write us. COMPAQ Computer Corporation, 20333 FM149, Houston, Texas 77070. Or call 1-800-231-9966.

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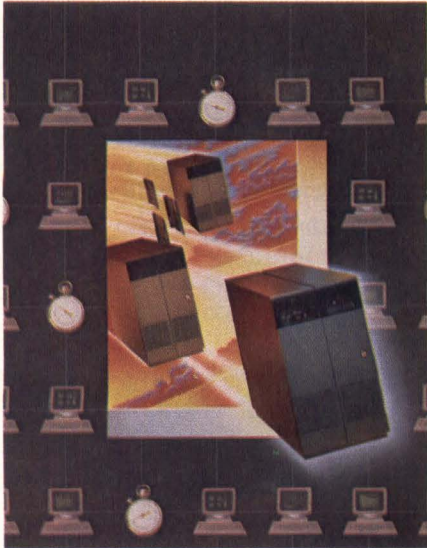


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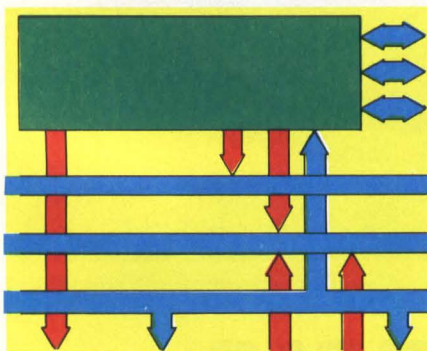
# Mini-Micro Systems



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p. 17... DG claims an advantage.



p. 71... Array processors are gaining ground.

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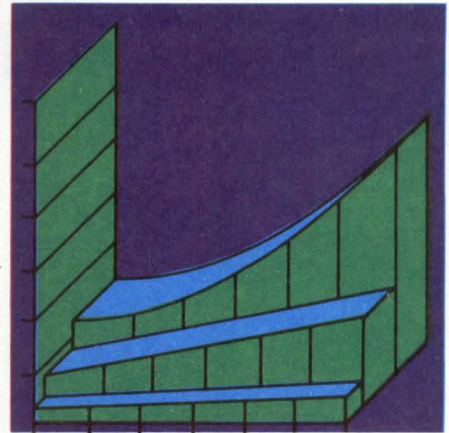
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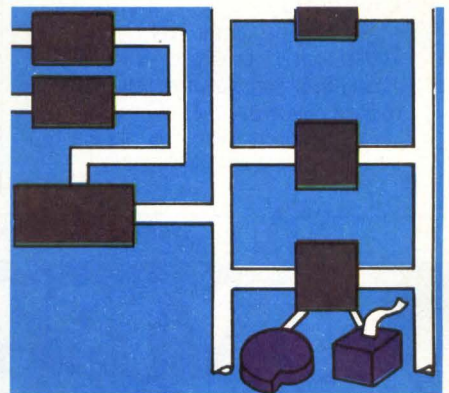
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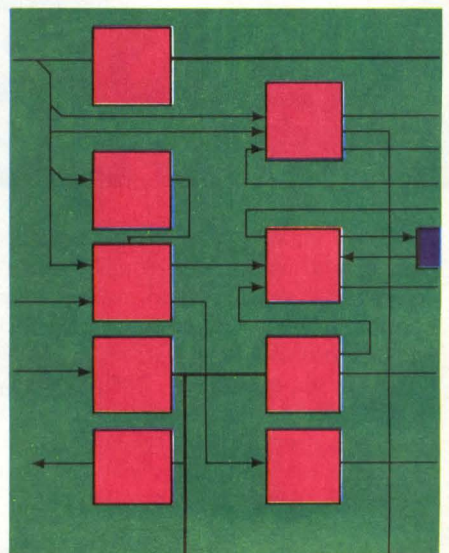
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*p. 145. . . 16-biters hold their own.*



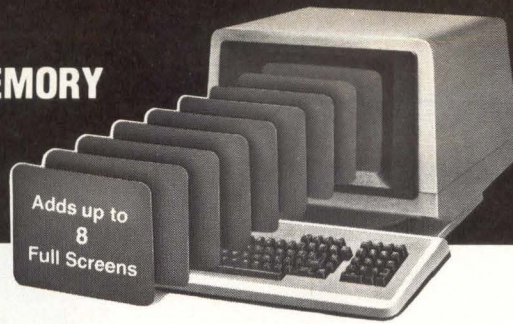
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**Feature:** Hard Read Error Spec. of 1 in 10" bits.

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**Feature:** Cartridge Jam Protection

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**Feature:** High Density Recording

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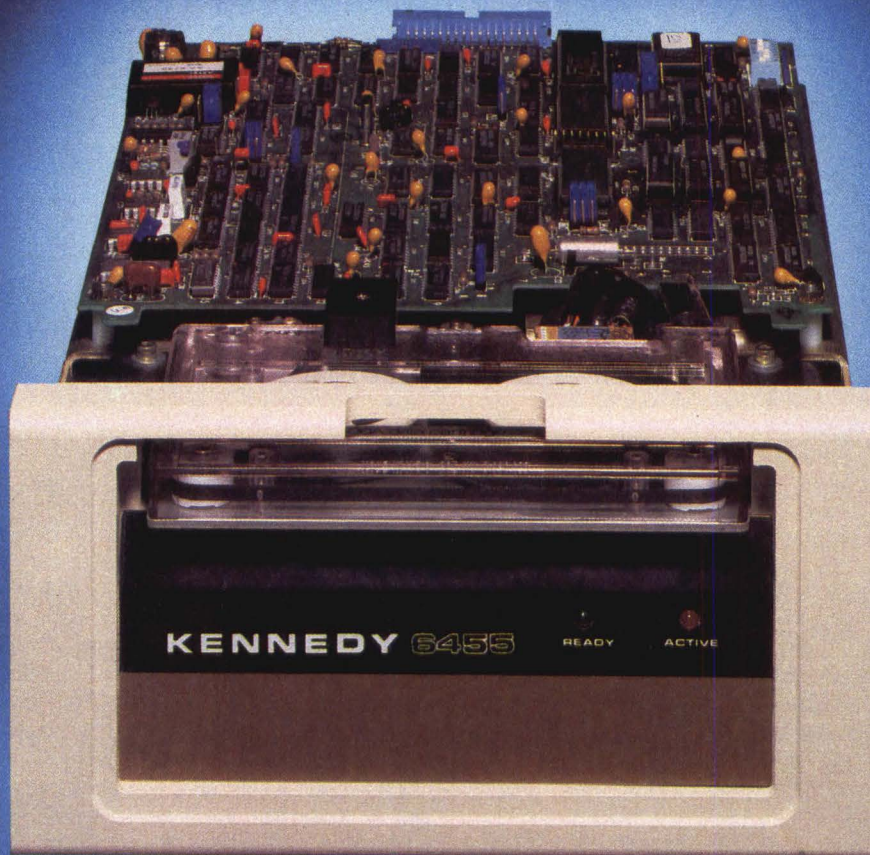
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CIRCLE NO. 8 ON INQUIRY CARD



# Breakpoints

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## **HP READIES INSTRUMENT CONTROLLER, UNIX FOR SERIES 200 MICROS**

The desk-top computer division of Hewlett-Packard Co., Fort Collins, Colo., has packaged a version of its MC 68000-based Series 200 computers as a modular instrument controller designed for harsh environments. The HP model 20 is a rack-mountable box with 15 option slots and an optional 128K-byte bubble memory or 256K-byte EPROM cards. An add-on CRT-terminal keyboard, mass storage and the BASIC and Pascal languages are available for the model 20, as is a custom keypad interface card to facilitate design of simple keypads for unskilled operators. The model 20 is compatible with the entire Series 200 line, and can share data and peripherals with the BASIC operating-system version of the HP 9000 32-bit microcomputer via the Shared Resource Management network. Expected in June for all Series 200 computers is the UNIX operating system, including a real-time version for the new model 20, which will enhance the line's upward compatibility with the HP 9000.

## **DURANGO'S POPPY MICROCOMPUTERS TAKE ON IBM PC**

When Durango Systems Inc. launches its new product line at Comdex this month it will be taking shots at both the IBM Personal Computer and the IBM rose featured in PC advertising. The Durango products, dubbed the Poppy family, are based on the Intel 186 and 286 16-bit microprocessors. A series of teaser ads has sprung up on Silicon Valley billboards in recent weeks showing the orange Icelandic poppy in anticipation of the official introduction. The series will start with a \$3995 dual-floppy disk, stand-alone system based on the 186 and running the MS/DOS operating system. The products will extend upwards to a 12-terminal configuration with 1M byte of main memory, a 60M-byte Winchester disk and Microsoft's XENIX. The 286-based high-end model will be \$35,935 with terminals. The 186-based system can be ordered with XENIX as an option and can support four terminals. The 186-based Poppy can be upgraded to a 286-based Poppy II.

## **DIABLO EXPANDS TECHNOLOGY OFFERINGS WITH THERMAL TRANSFER PRINTER**

Diablo Systems Inc. was scheduled late last month to introduce its first thermal transfer printer. The new printer is said to be able to produce integrated text and graphics on plain paper at a speed as high as 6 pages per min. Resolution will be 200 x 200 dpi, with a virtually unlimited selection of fonts through host controls. The expected end-user price of the unit is less than \$5000. At the same time, Diablo planned to announce enhancements to its existing line of dot-matrix printers and several new paper-handling devices.

## **FOUR TOUCH TERMINALS AVAILABLE FROM ANNAPOLIS START-UP**

Two-year-old Touch Technology Inc., Annapolis, Md. is bringing its first four products to market. Expected to be introduced and available late last month were touch monitors using capacitance technology. The monitors plug into the Apple II, the IBM PC and other microcomputers. A touch monitor with a green 12-in. screen, cables, software, documentation, a demonstration disk, a video-tape interface and an interface card for placement in the microcomputer sells for \$1450 in single-unit quantities and \$999 each in quantities of more than one. A 12-in. composite color monitor with the same components sells for \$1550 in single-unit quantities and \$1300 each in quantities of more than one. A 12-in. RGB screen sells for \$1950 in single-unit quantities and \$1850 each in quantities of more than one. A 19-in. RGB monitor sells for \$1850 in single-unit quantities.

## **BACK TO THE SOFTWARE DRAWING BOARD AT CAPRO**

After a brief fling in the hardware market, Capro Inc. has abandoned plans to sell an Intel 8086-based system with the Pro IV programming system (MMS, December, 1982, p. 21). Citing the flood of lower priced products onto the market since the company began planning its Dimension One two years ago, Capro officials have withdrawn the \$50,000 system. Instead they will concentrate on marketing Pro IV implementations on Intel iAPX family processors and work on a version that will run on Intel and CP/M-86 systems.

# Breakpoints

---

The company plans to offer the program-generating package to hardware manufacturers, system houses and high-volume end users. On the hardware OEM front, Capro is looking at several Intel 186 and 286 implementations. It is also considering expanding its base to systems running XENIX.

## **START-UP OFFERS UNIX PACKAGE FOR IBM PC**

Microsoft's public statements to the effect that it will soon offer its XENIX version of UNIX for the IBM PC has not daunted start-up LANtech Systems Inc., Dallas. The new company expects to beat Microsoft to the market and to underprice XENIX as well. LANtech's Unetics package should be available this month and is priced at \$100 including a PC-DOS emulator. LANtech is concentrating on OEM contracts and is understood to have its foot in the door at both IBM's Boca Raton Fla., PC headquarters and at Texas Instruments Inc., from which an 8088-based PC recently emerged. The LAN portion of LANtech refers to a UNIX local-area networking scheme called Unet that is designed to run with Ethernet and Omninet hardware.

## **TELETYPE INTRODUCES DOT-MAPPED DISPLAY BASED ON BELL 32-BIT CHIP**

Teletype Corp. planned to make one of its most comprehensive product introductions—four CRT terminals—early this month. Perhaps the most noteworthy is a dot-mapped unit aimed at programmers and CAD/CAM applications. It uses Bell's heralded 32-bit single chip. Dubbed the 5620, the terminal has 100 pixels per sq. in., 48K bytes of ROM, 256K bytes of RAM and is compatible with UNIX Version V. The 5620 can run at data rates as high as 19.2K bps, and has as many as seven windows that can function simultaneously.

## **INTERMETRICS PLANS TO ANNOUNCE PASCAL, C CROSS COMPILERS**

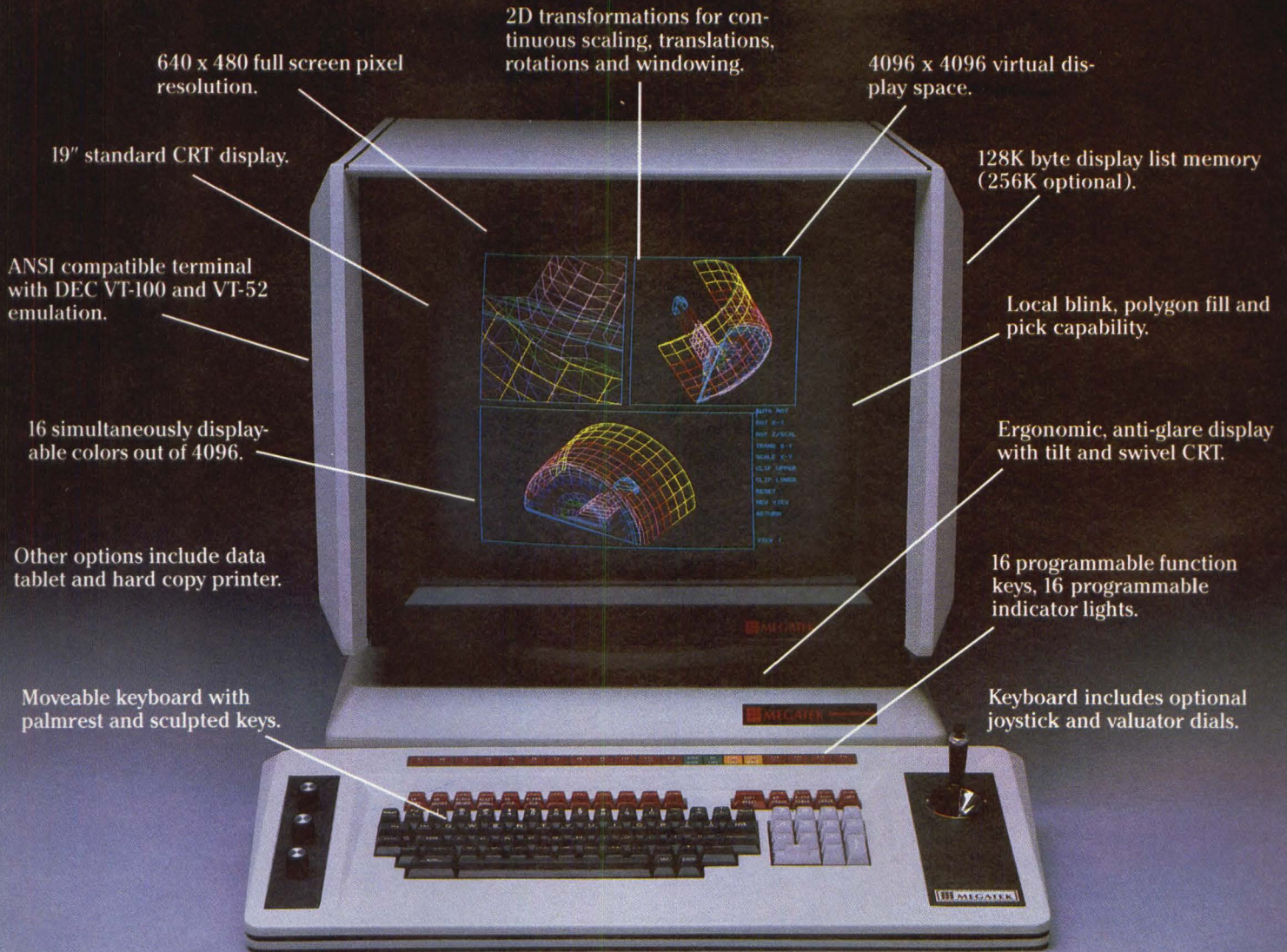
This month, Intermetrics Inc., Cambridge, Mass., plans to introduce Pascal and C cross compilers designed for software development on embedded microprocessor systems. InterPas and InterC, initially aimed at the Motorola MC68000 and Intel 8086 processors and resident on VAX superminis, also will be supported on PDP-11 systems. Soon to come are assemblers for the MC68000 and 8086, as well as extensions of InterPas and InterC to other microprocessor target hosts. Intermetrics' goal is to allow the embedder to change the processor at will without finding a cross compiler in an acceptable language or adjusting code. InterPas and InterC for the MC68000 and the 8086 run on the VAX computer under Berkeley 4.1 UNIX or VMS. They are being scheduled for availability on the PDP-11 under RSX-11M and UNIX this summer.

## **TEKTRONIX TO ANNOUNCE COLOR INK-JET PRINTER**

Tektronix Inc. will announce an ink-jet printer this month that will serve as a low cost alternative to the 4691 color graphics copier. The new model 4695 will be priced at less than \$2000 and will produce color graphics in seven shades. Primarily intended for terminal-dedicated, rather than host-driven use, the 4695 lacks the resolution and speed of the more expensive 4691. Its dot placement will be 120 x 120 dpi at a speed of 2 to 3½ min. per page. The 4695 will have a Centronics-like parallel interface and will be able to produce copies on paper and transparencies.

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

**Graphics Files: Precision Visuals Inc.'s** DI-3000, a full-blown mainframe and supermini implementation of the device-independent CORE graphics system in FORTRAN subroutines, has been transported to run under the UNIX operating system on the MC-68000-based computer due from Cosmos Computer. Thus, object code for complex graphics applications—including 3D transformations, dynamic color selection and use of pick and segmentation functions—can be moved transparently from a company's mainframes to its microcomputers. Precision Visuals is said to be negotiating with OEMs to transport the software to other MC68000-based UNIX machines....**Hewlett-Packard Co.**



640 x 480 full screen pixel resolution.

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ANSI compatible terminal with DEC VT-100 and VT-52 emulation.

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\*Thaumaturgy (thō'ma tūr jē), n., the performance of miracles.

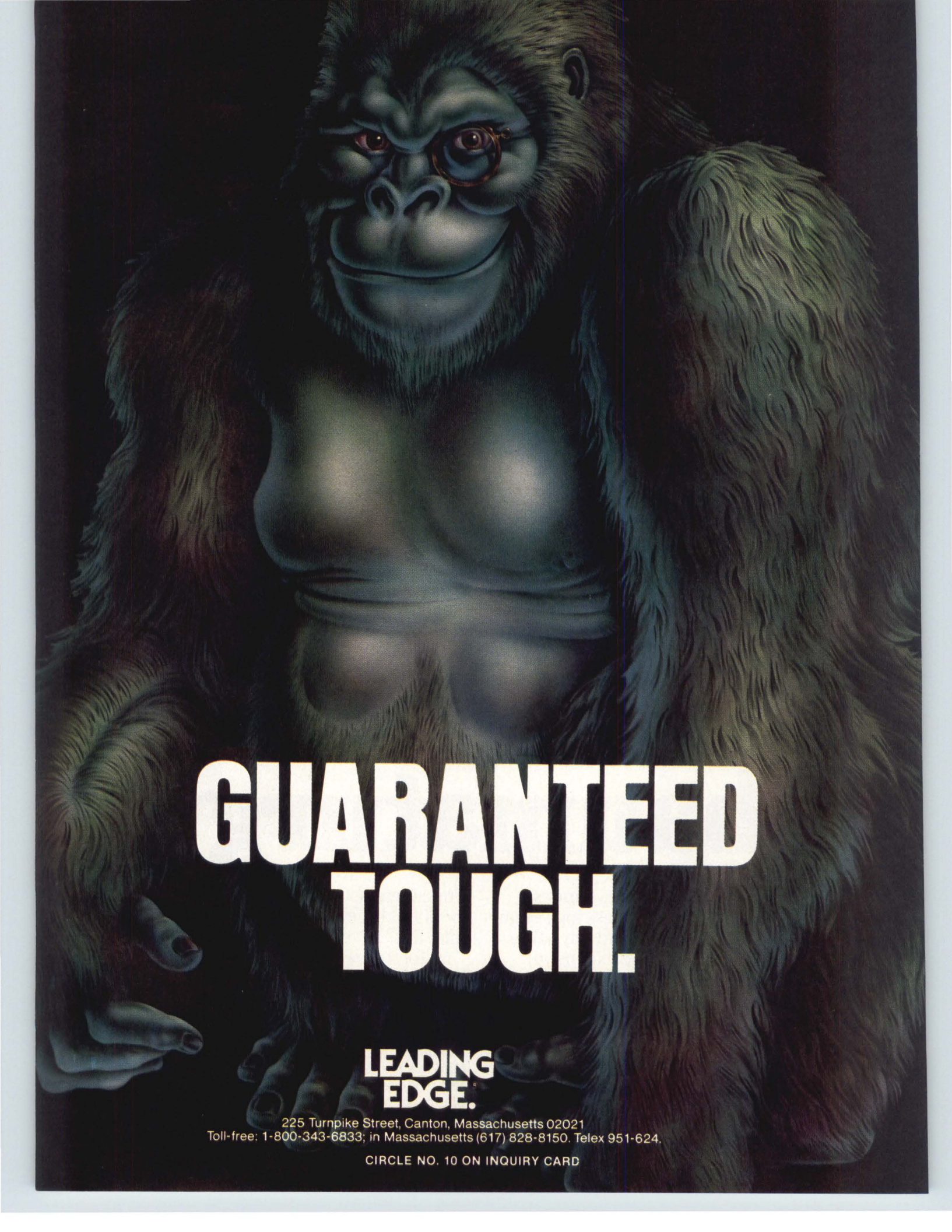
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MINI-MICRO SYSTEMS/April 1983

CIRCLE NO. 9 ON INQUIRY CARD



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CIRCLE NO. 10 ON INQUIRY CARD

# Breakpoints

is adding 512 × 390 resolution, 16-color graphics to its MC68000-based Series 200 model 36 desk-top computer and calling it a computer-aided-design workstation. With HP's BASIC 2.1 and Pascal 2.1, which offer high-level graphics extensions, two 5¼-in. floppy disk drives and 0.5M bytes of main memory, the model 36C is priced at \$17,660, approximately \$3000 more than a similarly configured, monochrome model 36B.

**Random Disk Files: Despite the recent entry of IBM Corp.'s 4-in. form factor microfloppy drive into the sub-5¼-in. controversy, there is strong backing for the industry-committee-proposed 3½-in. floppy drive standard.** The 3½-in. form factor has received the continued support of Tandon Corp. despite efforts by Seagate Technology and Tabor Corp. to convince the industry's largest manufacturer of low-end floppy drives to back the 3¼-in. form factor. The 3½-in. drive has also received the support of Control Data Corp. and is now expected to prevail in a letter ballot being distributed to ANSI's X3B8 committee members. The results of the ballot will be revealed at a meeting to be held during Comdex this spring.... The biggest push for the 3½-in. form factor has come from rigid drive manufacturers. So far, two sub-5¼-in. Winchester drives have been revealed. Both fit the dimensions of the committee's proposed floppy standard. **CDC**—which until now has concentrated on the high-end, high-performance market—is **expected to take off the wraps of a 3½-in. Winchester drive at NCC next month. The 6M-byte drive will have a single platter and reportedly will be the first to use thin-film-head technology on a small drive.** CDC, which uses its own thin-film head on its 3380-compatible drive, expects to have better luck with the new technology than Seagate, which announced a thin-film-head 5¼-in. drive in 1981, only to withdraw it a short time later because it could not obtain heads in production volumes.... With the Reagan Administration, Democrats and others jumping on the high-tech bandwagon, can network television sitcom be far behind? **Access Corp.**, a portable computer start-up in San Jose, has found a marketing gimmick that might push it towards its goal of \$100 million in sales for its first year. **The firm's Access computer, with built-in thermal printers and modems, will be featured along with comedienne Madeleine Kahn in a new "romantic comedy" about computer programmers, scheduled for the ABC television network next fall...** **Andy Roman**, former president of Roman Associates, a Newark, Calif., market research and consulting firm, **has become vice president of marketing for Cogito Systems, a start-up that manufactures half-height, 5¼-in. Winchester drives.** The drive's capacity is 6.3M bytes on one platter and 12.7M bytes on two platters, unformatted. OEM prices are \$725 each in quantities of 500 for the low-end model and \$825 each in quantities of 500 for the high-end model. The three-month-old company is expected to begin shipping evaluation units this spring. The company was privately funded through Ching Fong Investments, a Hong Kong conglomerate that also recently purchased thin-film-head manufacturer Magnex Corp. from Exxon.... **Cybernex Corp.**, San Jose, has denied charges in a suit filed by IBM Corp. that Cybernex stole thin film head trade secrets. Cybernex, which was formed in 1981, claims the technologies it uses for the heads are "public domain."

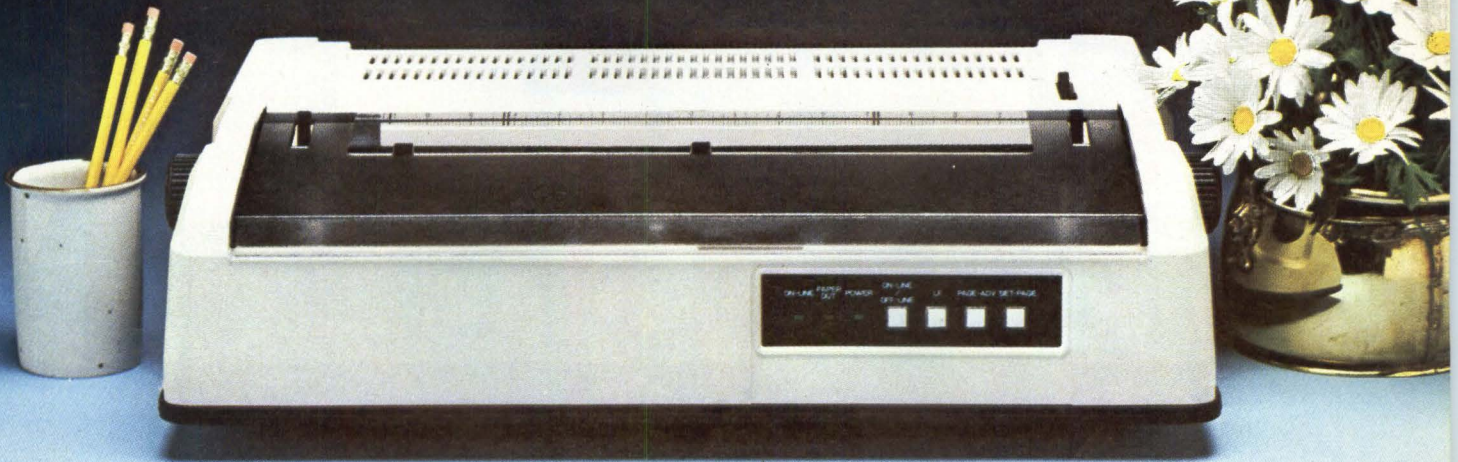
**Printer Files: C. Itoh Electronics** is expected to introduce two enhanced versions of its 8510 Pro/Writer dot matrix printer at this month's Comdex. The 8510S will feature a 160-cps high-speed draft mode and a 30-percent increase in throughput. Another enhanced model, the 8510C, will offer the same speed characteristics as the 8510S plus color capabilities employing a three-color ribbon to produce a seven-color spectrum.

**Micro Files: Altos Computer Systems** is putting its money where its mouth is to support the advancement of UNIX in the 16-bit microcomputer market. Concerned over the dearth of application software in that market, Altos is launching an application-distribution program that will funnel packages to dealers at discount prices. In addition, the company will support software developers with discounts on Altos hardware, UNIX/XENIX licenses and supported languages. The San Jose-based company will also hit the road with monthly training programs for UNIX dealers.

# Breakpoints

**NCC Look Ahead: CompuPro Systems**, which introduced its first packaged Intel 8088/8085-based systems at last year's NCC, plans to expand its line at this NCC with a multi-user office system. The new model, which departs from CompuPro's traditional S-100 bus orientation, will include an Intel 8086 master processor with four 8-bit slave processors, yielding a four-user system. A built-in floppy/hard disk controller supports high-density minifloppies and ST-506-compatible Winchester drives. A basic system will start at \$3000, and a configuration with dual half-height minifloppies, 20M bytes of Winchester disk capacity and 2M bytes of main memory is expected to sell for less than \$7000. Although the 8086- and Z80-compatible, 8-bit processors are installed on a single board, CompuPro says, each 8-bit workstation processor will have its own memory and I/O. This system will run MP/M and MS/DOS....The **Pixel** division of Instrumentation Laboratories plans to use its NCC exhibit to show a new graphics workstation system that is scheduled for introduction at this month's Comdex show in Atlanta. The Pixel 80G is based on the MC68010 microprocessor with virtual memory and features what Pixel officials claim is one of the highest resolutions in the industry—1728 × 2810 pixels. At a list price of \$18,000, the system includes 1M byte of main memory, 38M bytes of 5¼-in. Winchester disk storage and UNIX System III....Expect **Perkin-Elmer Corp.** to feature one or two groups of low-end 32-bit systems....**Cincom Systems, Inc.**, Cincinnati, Ohio should spotlight a database-management system for Digital Equipment Corp. VAX minicomputers. Cincom offers Total, a database-management system for DEC PDP-11s running under R/SX-11M. A Cincom spokesman says the product for VAC may be announced before NCC....**Rosscomp Corp.** expects to highlight a 160M-byte streaming-tape drive called the "Evaluator" that will interface with both SA1000 and SMD controllers....**NEC Information Systems's** 8-in. Winchester disk line should be expanded with a 167M-byte model....**Seagate Technology** should show its three-platter ST 425 drive. The 5¼-in. drive is expected to store more than 18M bytes, unformatted....**Dataram Corp.** is expected to feature its A22 LSI-11/23-based system that includes an 8-in. RX02-compatible floppy disk drive and a 10.4M-byte RLO1/RLO2 compatible Winchester drive. A minimum configuration with the LSI-11/23 microcomputer, 245K bytes of memory, and the two drives is \$9800. ....Although portable computer manufacturer **Compaq Computer Corp.**, Houston, is expected to have a new offering, the company may have trouble getting exhibit space at NCC. At press time, a Compaq spokesperson said the company was number 60 on the waiting list....Look for **Qume Corp.** to have a variety of new printers at NCC. A 70-cps daisy-wheel printer is said to be in the works and will likely be ready for introduction at next month's show. Potential OEM customers may also get a look at a cut-sheet feeder product designed to be built into the printer in an effort to make rapid feeding more affordable in word-processing systems. Certain to be introduced at NCC are a cut-sheet feeder priced at less

than \$1000, and an IBM PC plug-in interface module for the Sprint 11 printer....**Nissei Sangyo America Ltd.**, Wellesley Hills, Mass., is expected to demonstrate several new printers, disk drives and CRT monitors at NCC. The two graphics printers, which are manufactured by Hitachi Koki, can be programmed to overlap dots anywhere on a page to produce logos and bar codes in near-letter-quality, output, according to the company. OEM prices are approximately \$3700 for the 300-lpm printer and \$5000 for the 600-lpm unit. Four Shugart-compatible, 5¼-in., half-height floppy disk drives to be shown have capacities ranging from 250K bytes to 1M byte. Prices for OEM quantities of 500 range from \$112 to \$170 each. Several 3-in. and 2½-in. floppies will also be shown. The line of color and monochrome, medium- and high-resolution CRTs features a high-contrast, "direct-etch" picture tube....**Although next month's NCC once seemed as though it would be a showcase for 3½-in. Winchester drives, most of the expected announcements have been delayed.** Only Scotland-based Rodime Ltd. and Control Data Corp. have confirmed they will show the next generation of Winchesters at NCC. Seagate Technology, and Miniscribe have delayed plans to introduce their 3½-in. Winchesters....**Maxtor Corp.**, a start-up that dazzled last fall's Comdex Show attendees with a 144M-byte, 5¼-in. drive, has planned an encore at NCC with a family of 5¼-in. drives with capacities nearing 400M bytes. Although the company has just begun to ship evaluation units of the 144M-byte drive, **the new drives are a product of the enhanced ST-506 interface recently negotiated by Maxtor and a few other companies.** The enhanced interface will double the data-transfer rate from 5M to 10M bits per sec. The new drives use the same proprietary spindle motor as the original drive and will hold as many as eight platters. By using enhanced recording densities and run-length-limited code, the company hopes to more than double its previous record-setting capacity. Despite Maxtor's continued efforts to make the enhanced small disk interface a universal high-performance standard, skeptics such as Xebec Corp., Micropolis Corp. and ST-506 inventor Seagate Technology hesitate to embrace the interface, which may affect the ultimate acceptance of Maxtor's new products....**Quality Micro Systems Inc.**, Mobile, Ala., is scheduled to show its new intelligent graphics controller for non-impact printers at NCC. The QMS QUIC-RIP System enables non-impact printers to do letter-quality printing, industrial graphics and bar coding, bit-mapped graphics, intermixed fonts, multiple forms printing and line printing at speeds as high as 100 pages per min. Available interfaces include RS232 and current loop with various protocols, Centronics, Dataproducts, IBM System 34 and 38, Wang VS and Ethernet. The controllers will be sold as part of various printer packages. Prices will start at \$24,995 for a Xerox 2700 12-page per min., non-impact printer with the QUIC-RIP controller. Availability is planned for the first quarter of 1984....For a peek at more products expected at NCC, see page 57.



C. Itoh's F-10 Daisy-wheel printer is the compact beauty you can easily get attached to. Just look at all the useful features you get.

1. Small footprint, low-profile design (only 6" high) fits easily into your system.
2. Downloading wheel and impact sequences allow use of a variety of unique wheels and permit OEM's to tune the printer to specific needs.
3. Comes in two Shannon-text-rated speeds. 40 CPS and 55 CPS.
4. Industry-standard parallel or RS 232-C interfaces and ETX/ACK, XON/XOFF protocols provide maximum OEM flexibility and installation ease.
5. Extensive, built-in word processing functions allow easy adaptability and reduced software complexity.
6. Uses mono and dual-plastic wheels. (Unlike metal wheels, dual-plastic provides superior print quality over the entire life of the wheel.)
7. Field proven, firmware intensive technology for increased reliability.
8. Cast aluminum base plate with high quality metal parts provide lasting dependability.
9. Low-noise operation is ideal for office environment.
10. Choice of friction feed or bidirectional tractor feed for precise print positioning of tabular and graphics data.
11. Uses industry-standard wheels and ribbon cartridges available from multiple sources at low prices.
12. Universal power supply is standard and allows worldwide power source compatibility.
13. FCC approved and under 50 lbs. in weight for fast shipments and sales.
14. Easy-to-load wheels with tested and proven method of wheel support (spring loaded with positive detent).

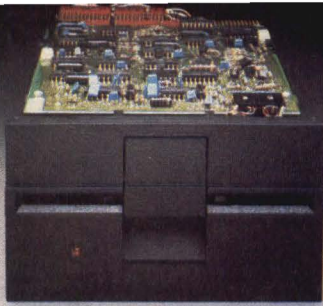
We could go on. But quite frankly, once you see the F-10 perform, you'll never look at another Daisy.

The F-10 is fully backed by C. Itoh's warranty and complete support organization. Contact C. Itoh Electronics, Inc. 5301 Beethoven St., Los Angeles, CA 90066 (213) 306-6700.

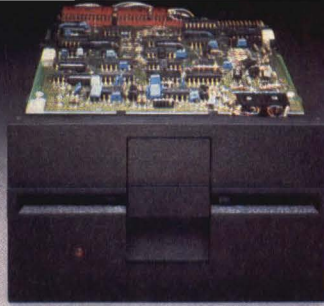
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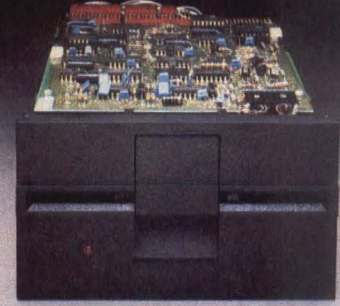
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LET ME COUNT THE WAYS.**



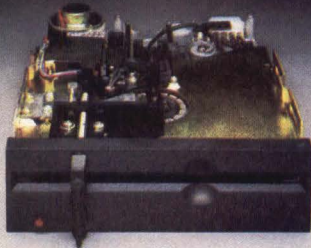
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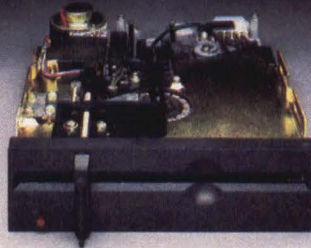
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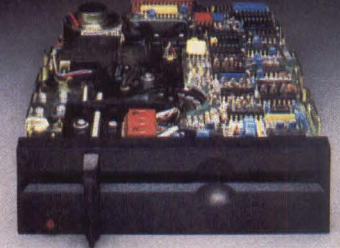
TM100-3/3M 5 1/4" Floppy  
96/100TPI 500KB



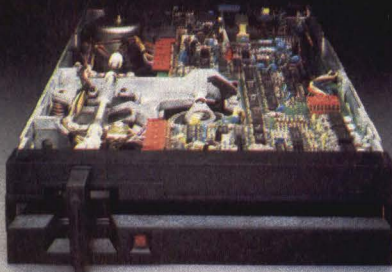
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48TPI 250KB (Mechanics)



TM50-2M 5 1/4" ThinLine Floppy  
48TPI 500KB (Mechanics)



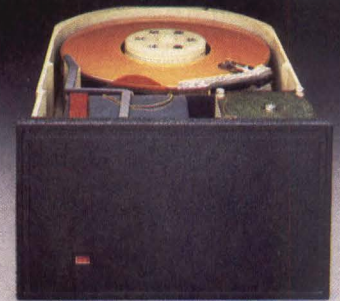
TM50-1 5 1/4" ThinLine Floppy  
48TPI 250KB



TM848-1 8" ThinLine Floppy  
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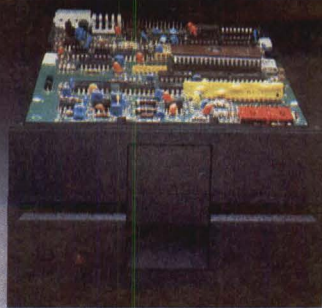
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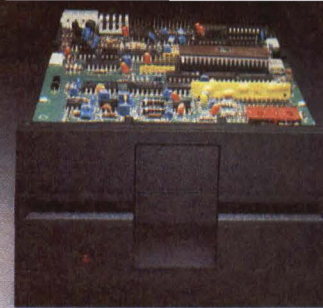




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TM101-4\* 5¼" Floppy  
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TM55-2\* 5¼" ThinLine Floppy  
48TPI 500KB



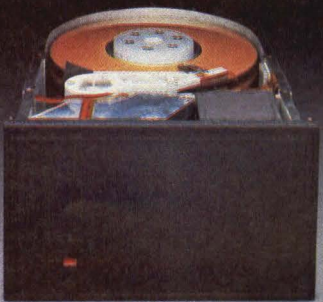
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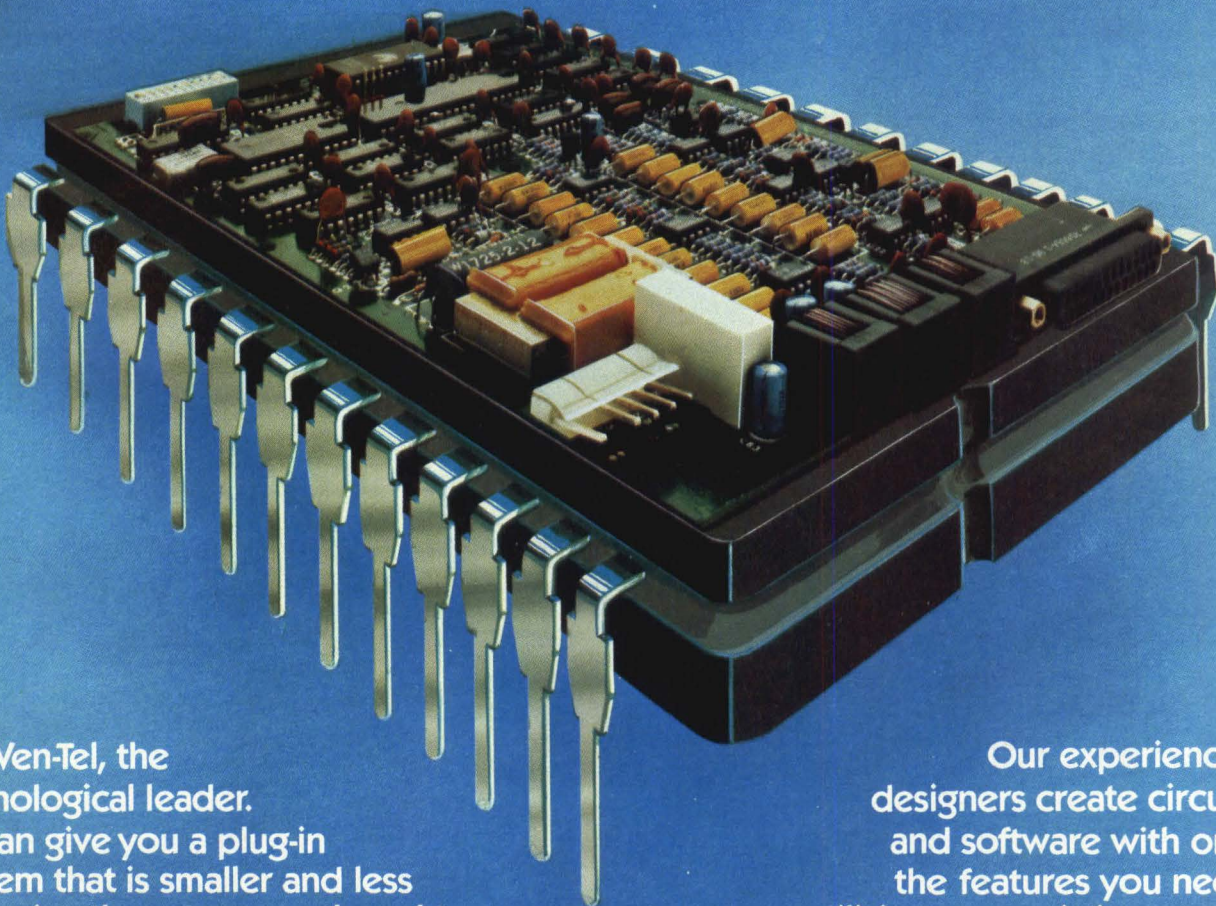
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MINI-MICRO SYSTEMS/April 1983

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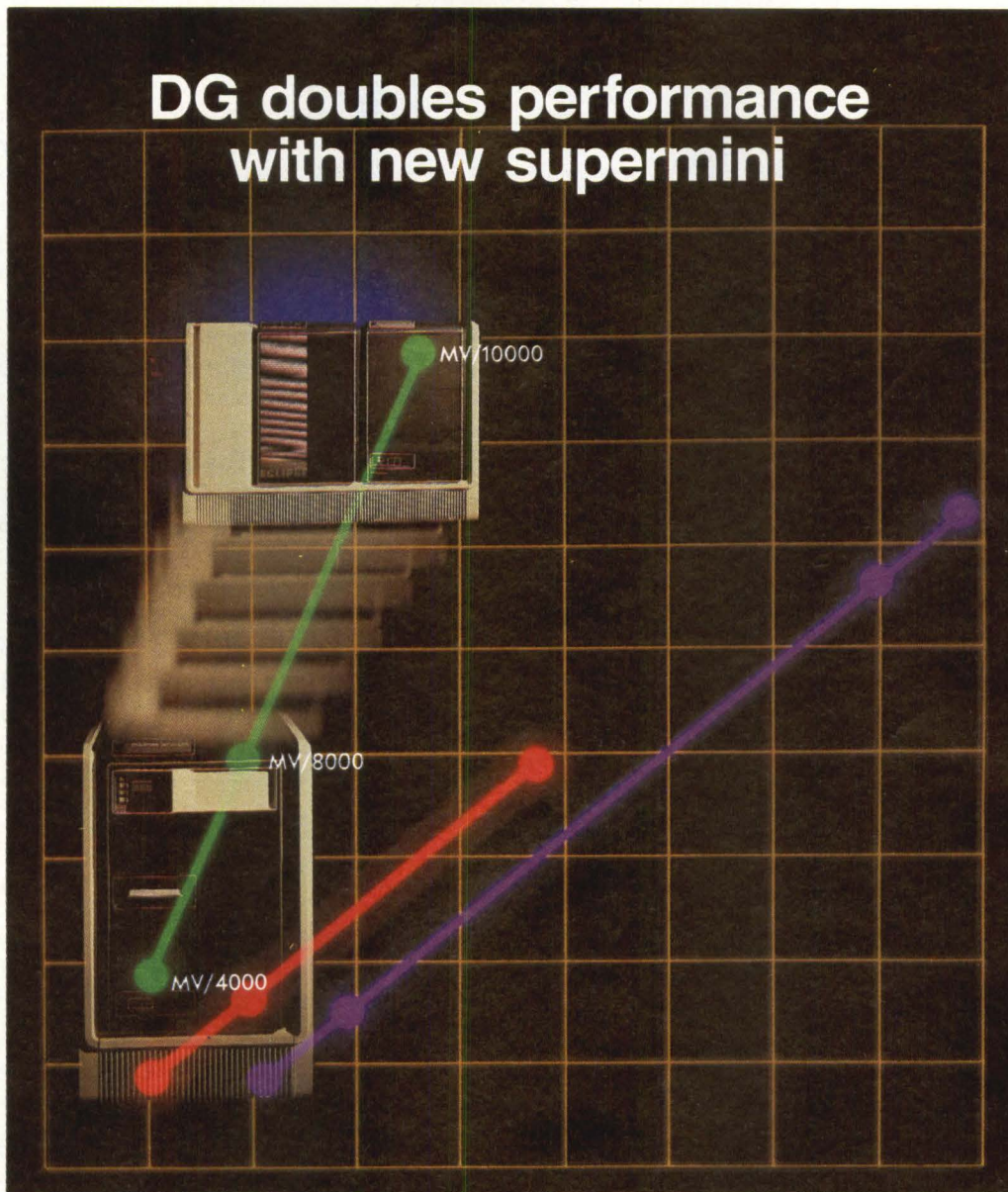


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# Mini-Micro World

NEWS



For the first time since it entered the 32-bit minicomputer market, Data General Corp., Westboro, Mass., has seized the initiative from its rival, Digital Equipment Corp., with a high-end system it claims will deliver twice the performance of DEC's VAX-11/780. The DG advantage may be short-lived with a rumored VAX-11/790 on the horizon, but DG officials hope to carve a permanent position with their MV/10000—especially in technical markets.

The MV/10000 is designed to deliver twice the performance of the MV/8000 by extending the basic MV/ architecture with an advanced Schottky processor, a board-level floating-point processor, an address generator board and faster RAMs in the instruction, data and address translation caches. MV/10000 engineering project leader Bob Beauchamp attributes most of the improvement to the address generator, which enables the system to load and store instructions in one

cycle instead of the two cycles required on earlier MV/ models. The MV/10000 boasts a 140-nsec. cycle time versus 220 nsec. for the MV/8000. The MV/10000 supports as many as 256 simultaneous processes and 196 users. The MV/8000 supports 256 processes and 128 users. The MV/10000 can address 18M bytes of memory compared to 12M bytes on the MV/8000.

Other MV/10000 performance features include the expansion of microcode instructions from 80 to

# Mini-Micro World

NEWS

104 bits each, a dual-ported memory bus with an aggregate bandwidth of 57.2M bits per sec., a burst multiplexer supporting connections of as much as 18.5G bytes of disk storage, a microNova-based intelligent asynchronous communications controller, an Intel 8086-based intelligent synchronous controller and a new two-board floating-point unit. The floating-point unit uses two identical boards, one of which is assigned single-precision operations and the other double-precision operations.

The result is a system DG officials say delivers 2500K single-precision Whetstones and 1988K double-precision Whetstones. This compares with 1240K Whetstones in single-precision math for the MV/8000 and 1133K Whetstones for the VAX-11/780.



**DG's highest performance superminicomputer, the MV/10000, is targeted at industrial automation. A variety of graphics workstations can be used on the system, including a new Dasher G500 medium-resolution terminal (foreground) and a high-resolution GW/4000 workstation (middle and left), which is driven by an MV/4000 supermini.**

A basic MV/10000 configuration including 1M byte of memory, a 147M-byte disk, a tape drive, a 16-line multiplexer, a console and the AOS/VS operating system license is list-priced at \$204,100. In

comparison, a VAX-11/780 with 2M bytes of memory, a 121M-byte Winchester disk drive, a tape drive, a console and an eight-line multiplexer lists for \$189,000. With the MV/10000 introduction, DG has cut the prices of MV/8000 packages by \$20,000 to \$34,000 each for a maximum reduction of about 16 percent. An MV/8000 configuration similar to the MV/10000 quoted above, for example, dropped from \$190,000 to \$157,700.

The basic MV/10000 configuration is implemented on 12 boards including a 1M- or 2M-byte memory board. The system includes an arithmetic-logic unit, an instruction-processor unit, a system-control processor, an address-translation unit, the address generator, a microsequencer, two floating-point processor boards, a

## DG ADDS 16-BIT MINICOMPUTERS

At the same time Data General Corp. was topping off its MV/10000 32-bit minicomputer line, it was also expanding its 16-bit Eclipse line with a high-end model for technical and commercial OEMs.

The system is based on third-generation high-density bipolar Schottky logic components and is said to have a 150-nsec. cycle time. It has a 4K-byte cache, a 288K-bit control store and supports from 0.5M to 2M bytes of main memory. The basic CPU also includes an asynchronous I/O controller and a programmable interval timer.

For technical OEMs, DG's Technical Products Business Unit offers the system as the s/280 with options such as a \$6000 floating-point unit and a \$1500 burst multiplexer channel. With the floating-point unit, the system is said to achieve 900K Whetstones. The s/280, which is said to provide a 50-percent performance boost over the s/250, overlaps the low end of the 32-bit line, the MV/4000, introduced last fall (MMS, December, 1982, p. 17). The MV/4000, which starts at around \$30,000, has a 600K Whet-

stone rating. The s/280 starts at \$30,000 in a 512K-byte version in a 16-slot rack-mount cage. A packaged version with a floating-point unit, a 25M-byte Winchester disk drive, a floppy disk drive and an operating system is \$46,220, and a high-end configuration with 2M bytes of main memory, a 73M-byte disk, a floating-point unit, a 1600-bpi streaming tape and an operating system is \$72,535. The s/280 can be ordered with the AOS, RDOS or MP/AOS operating system.

The commercial version from the Small Business Systems Business Unit is the Series 200C, which differs from the s/280 in the availability of floating-point and burst-multiplexer options, which are not offered on the commercial system. A configuration with 512K bytes of main memory, a 50M-byte Winchester disk, a 1600-bpi tape, a 16-line asynchronous terminal interface, a dual-bay cabinet, a Dasher 200 console and the RDOS operating system license sells for \$57,130.

A high-end package with 2M bytes of main memory, a 147M-byte

Winchester disk, a 1600-bpi tape, a 16-line terminal controller, a cabinet, a D200 terminal and an AOS operating system license is \$83,630.

With the Series 200C introduction, DG cut prices on other commercial systems and upped the memory limit to 2M bytes on the Series 100 and Series 200B. The price cuts, attributed to the introduction of 64K-bit memory technology, amounted to \$3000 for a 100 with 512K bytes of main memory, \$700 on a 256K-byte 100 and \$6600 on a packaged Series 200B with a 1M-byte main memory. Upgrade fees were reduced on the cs/10 model 3, which can be upgraded from a three-terminal system to a Series 100 system supporting 16 terminals for \$9650. A cs/30 can now be upgraded to a Series 100 for \$7750.

The company has also added a 15M-byte cartridge-tape drive and a 50M-byte Winchester disk for the cs line. The tape unit, which is available on the 100 and 200 series, is list-priced at \$5500, and the 50M-byte disk, which is restricted to the 200, is \$10,500.

memory-controller board and an I/O controller board. The system uses the 64K-bit RAMs that were added to the upgraded MV/8000 a year ago. And, in addition to the diagnostic "sniffing" technique pioneered in the MV/8000, the MV/10000 has a "fail-soft" capability intended to disable faulty physical-memory locations. The system control processor, which oversees the internal diagnostics of the system, is designed to continue operating with a minimum of one I/O board functioning.

The optional writable control store, which was expanded recently in the low-end MV/4000 introduction, is being offered with the MV/10000 in a 4096- × 104-bit word package for customers who wish to optimize their systems through custom microcoding.

Although DG officials decline to make direct comparisons with systems designed for real-time applications such as Perkin-Elmer Corp.'s 3200 series and Gould S.E.L.

Concept/32s, the company is pitching the MV/10000 system directly to industrial end users and OEMs. DG officials claim the MV/10000 is the fastest virtual-memory 32-bit minicomputer on the market. Don McDougall, director of DG's Technical Products Business Unit, says, "Industrial automation is our focus with this system." He sees the market divided into end-user sales for computer-aided engineering, system OEM sales for turnkey CAD and CAM products and hardware OEMs for process-control.

With the MV/10000, DG hopes to build on the CAE base that it has been building with the MV/8000. While the MV/8000's biggest industrial market has been time-shared, general engineering applications, says senior marketing specialist Bob Andrews, the MV/10000 will provide the performance for computation-intensive simulation and modeling applications as well. To address the engineering and design

markets, DG has announced the availability of the Anvil 4000 drafting package from Manufacturing Consulting Services and Ease2, a finite-element analysis package from Wessco, Elk Grove, Calif.

"In the design market," McDougall says, "people are moving from turnkey systems to independent software." DG allows customers who develop their own applications to write programs in the AOS/VS environment and run them under the real-time RT/32 operating system.

On the commercial side, Information Systems division vice president J. David Lyons predicts that the MV/10000 will take the CEO office-automation package into large-scale installations in which mainframe-based systems have previously been used. Lyons claims the economies of scale on the MV/10000 will reduce the price per workstation to about \$7500.

—Geoff Lewis

## DG SUPPORTS GKS STANDARD WITH OEM GRAPHICS TOOLS

Shunning the turnkey CAD/CAM systems market for itself, Data General Corp. is offering its technical OEMs a set of tools to configure their own CAD/CAM systems. The company has added a \$70,000 GW4000 design system incorporating the MV/4000 32-bit minicomputer and GDC/1000 workstation, and is offering the workstation separately for incorporation in 16-bit Eclipse systems. The GDC/1000 color workstation, including two Eclipse boards and a data channel interface, is approximately \$19,000 with a 768- × 576- × 8-dot resolution and \$23,000 with a 1280- × 1024- × 8-dot resolution.

Both workstation options support the proposed Graphical Kernel Software standard now before the International Standards Organization and covering two-dimensional graphics subroutines. The GDC/1000 workstation has a bit-sliced display controller and a z8000-based com-



**Data General's high-resolution GW/4000 workstation system, which is driven by a 32-bit MV/4000 minicomputer, can display 256 colors simultaneously.**

mand processor. It is said to provide 40 bits per pixel of information—24 bits for color definition and 16 bits for depth definition. As many as 256 colors can be selected from a 16.7-million color palette. Each of eight planes of memory can be addressed separately. Agnes Imregh, product manager of graphics languages and tools, says the terminal

can draw at 1 million pixels per sec.

Imregh predicts DG will be able to deliver higher performance this year when 60-MHz monitors become available. The current system uses a 30-MHz monitor, but Imregh says DG will sell the GKS graphics controller without a monitor.

In addition to the high-resolution color graphics products, DG has added a Dasher G500 medium-resolution graphics display. The G500 has a 15-in. bit-mapped display, 640 × 480 resolution, a Centronics-compatible parallel printer port and an RGB port. The G500 is controlled by a Motorola MC68000 microprocessor and includes its own 0.5M-byte memory for "displayless" storage, which enables the G500 terminal to draw a shape based on a description of the logical shape transmitted from the host, instead of relying on the host to transmit the entire pattern.

# Mini-Micro World

NEWS

## Tektronix's lower price strategy brings three terminals, graphics microcomputer

With the April introduction of the 4100 "Unicorn" family of three-color raster terminals, anchored by the \$3995 list-priced 4105, as well as a companion less-than-\$6000 4170 local graphics-processing unit and less-than-\$2000 eight-color ink-jet printer, Tektronix Inc. hopes to reestablish a reputation for quality at low prices. Additionally, the 4170 may signal Tektronix's "shy" move into the stand-alone graphics micro-computer market.

In 1971, Tektronix introduced the 4010 direct view storage tube terminal, which at \$3995 was an order of magnitude less expensive than previous graphics terminals of similar resolution. The company thus acquired a reputation for quality at low prices, and that reputation made it a leader in the emerging market for computer graphics. Over the years, Tektronix's reputation for quality rose, but so did prices, until the industry perceived Tektronix's quality to come only at a premium.

Now, the company is focusing on high-volume, price-competitive products aimed at engineering executives and office users. "The low-cost [4105] terminal coupled with the 4695 ink-jet printer bring Tektronix strongly into the high-volume end of graphics," says Gary Laroff, marketing manager for San Diego, Calif., Integrated Software Systems Corp. (ISSCO), a leading vendor of computer graphics software that has written a device driver for its display presentation graphics software to run on the new terminal.

Thomas Clarkson, president of Tektronix spin-off Graphics Software Systems, Wilsonville, Ore., concurs. "The 4105 terminal is a



**Tektronix's \$3995 4105 terminal and the less-than-\$2000 4695 color graphics ink-jet "copier" are intended for technical and professional users. The 4695 provides 120-dot-per-in. resolution and six-color images. The 4105 has a 480- × 360-pixel resolution, a 64-color palette and displays 16 colors simultaneously.**

price/performance breakthrough for Tektronix," he says. "The only near equivalents might be the DataMedia Colorscan with retrographics or Envision Technologies' 220," he says. Both go for about \$1000 more.

The 4105 offers 480 × 360 resolution in a CRT the size of a 15-in. monochrome display. The CRT is built around Intel Corp.'s 80186 16-bit chip, which integrates many on-chip support component functions (MMS, August, 1982, p. 19). Users can define a palette of 64 colors interactively using the hue, saturation and lightness model. Eight separate colors are available for graphics and text annotation, respectively. Refresh is noninterlaced at 60 Hz to minimize flicker, while a finely etched screen and a bright Panasonic shadow mask tube alleviate glare. Primitives for solid and dashed lines, plus polygon fill-in of solid colors, color shading and a variety of patterns, are accom-

plished in firmware, as is support for a variety of text sizes and text rotation in 90-degree increments. A coordinate space of 4096 × 4096 is dot addressable.

The omission of support for local segments, pan and zoom and coordinate transformations is not significant for the low-end market at which the 4105 is aimed, claims Clarkson. "But performance is, and clever firmware and byte-per-pixel architecture make the 4105 fast."

The two other 4100 Unicorn members are the less-than-\$7000 4107, which has the pan and zoom and coordinate transformations omitted on the 4105, as well as 640- × 480-dot resolution, and the top-of-the-line 4109, a 19-in. screen version with the same resolution as the 4107 but with the added graphics capability and more memory and priced at less than \$10,000. All models can run with the 4170 local graphics-processing unit,

## UNICORN: A DESIGN FOR QUALITY AT LOW COST

Dave Squires, who headed Tektronix Inc.'s Unicorn terminal family design team, says the study of Japanese manufacturing methods was a major factor in getting the list price of the low-end 4105 color graphics terminal down to \$3995. One result was the formation of close relationships with suppliers, with particular attention to improving the suppliers' quality-assurance procedures. The result: Tektronix neither inspects incoming parts nor does burn-in of the Unicorn terminals, yet quotes a mean time between failure of 10,000 hours for the 4105.

"A lot goes into that MTBF," says Squires. One key is use of Intel's 80186, a chip that integrates many functions normally performed by a CPU and a number of support components, which results in decreased internal heat buildup. Another bonus is decreased manufacturing costs: Squires estimates Tektronix

saved \$400 per unit by choosing the 186 over the 8086. The 4100 family was designed for automated assembly, Squires says. "There's only 10 min. of labor in each 4105," he claims.

Finally, the team saved money by rejecting Tektronix's typical "Baskin Robbins approach" to marketing in favor of plain vanilla products. That way, no time is spent explaining various product flavors, and standard products need not be removed from the box, opened and retooled to incorporate additional features. If the 4105 does not meet a customer's needs, a salesman merely shows the higher capability 4107 or 4109.

One last key to the 4105's low price is one that involves a gamble. "We're counting on high-volume [sales]," says Jon Reed, general manager of the Interactive Display Division of Tektronix, "and the jury is still out on whether we'll get them."

which essentially turns the combination into a stand-alone, 8086-based graphics microcomputer running CP/M-86.

Another important plus for the new family of Unicorn terminals, observers agree, is their independent alphanumeric dialog area, which uses an SMC 7002 controller to run ANSI X3.64 screen-handling codes at rates as high as 19.2K baud. The dialog area can be expanded interactively from the bottom two 80-character lines to the full 30-line display, and can write over or hide the graphics image.

Achieving a small footprint without sacrificing both graphics and alphanumeric capabilities was one of the goals of the 4100 design team, says Jerry Ramey, general manager of the Unicorn family project. Also important were ergonomic features.

Clarkson and other observers agree that the low-end 4105 will be attractive as a terminal to attach to

host computers, particularly Digital Equipment Corp. minicomputers. Tektronix's product marketing manager for the Unicorn terminals, Bob Anundson, points out that the Unicorn's price is no more than that of the DEC VT125 monochrome graphics terminal. And the availability of 4105 device drivers for ISSCO's Disspla and Tel-A-Graf software and SASgraph software from the SAS Institute Inc., which together account for most presentation-graphics work done in Fortune 500 companies, also indicates the Unicorn terminals will find their way outside of the normal Tektronix sphere of scientists and engineers.

But several observers question whether the Unicorn introduction adequately addresses the trend toward local programmability, despite the importance that an internal study that led to the new Tektronix products attached to off-loading host computers. Graph-

ics Software Systems' Clarkson lauds the presence of the Intel 8087 floating-point co-processor in the 8086-based 4170 locally programmable graphics unit. He says the 8087 improves performance on typical graphics functions such as rotations about 10 times. And Tektronix plans to upgrade the 4170 by replacing the 8086 and 8087 with the faster 80286 and 80287 processors when they are available in volume will make the local programmability unit "a real screamer," he says. "But when you add the cost of the 4105 terminal, you've got a \$10,000 computer, and that might be high."

Russ Weeks, marketing manager for Digital Research Inc.'s graphics products, agrees. He sees the new Tektronix combination competing with microcomputers such as the NEC Information Systems Inc. Advanced Personal Computer, which offers 640 × 480 resolution and eight colors for less than \$5000. "The 4170 runs CP/M-86, and there are a lot of people writing software—graphics and otherwise—for that operating system, but will Tektronix fully leverage it?"

Merle Smith, product manager for the 4170, says Tektronix will do everything possible to encourage the creation and use of third-party software on the new stand-alone graphics processor. He says the greatest strengths of the 4170 are the large base of Tektronix Plot-10 software that runs on the 4170 and the upward migration path available to a 4170 user via a low-level terminal interface the 4170 shares with the earlier Tektronix 4110 line, including the new \$25,000, top-of-the-line, 1280 × 1024 resolution, 256-color 4115. "But it is our intention to add Digital Research's GSX graphics system extension for CP/M-86, thus tapping that growing base of graphics applications as well," he says. —Kevin Strehlo

## TI enters 'professional' CPU market with Intel 8088/MS/DOS system

Texas Instruments Inc. has made its move into the office personal-computer market with a package patterned on the IBM Personal Computer, but with some significant departures from IBM Corp.'s model, such as a voice-recognition/telephone-management option.

Like the IBM PCs and the raft of IBM-like systems that have appeared on the market in the past year, the TI Professional Computer uses the Intel 8088 microprocessor, 320K-byte floppy drives and Microsoft's MS/DOS operating system. It diverges from the IBM fold in both its higher resolution graphics and in its five-slot expansion chassis, four of which are available even with high-resolution color graphics. Although TI officials have promised to keep the system "open" for TI-compatible third-party add-ins, not all add-ins designed for the IBM bus will fit the TI machine. The TI bus has a card interface similar to IBM's, but the TI cards are slightly longer. "Some option cards (designed for IBM) have been proven to work, and some haven't," a TI spokesman reports. A parallel printer port is standard. An asynchronous/synchronous communications card is available for \$225.

Software compatibility with IBM is also hazy. Like many other 8088/MS/DOS vendors, TI claims its machine is media and data-file compatible with IBM's. This means users can expect to run some IBM programs as-is, while other packages that use system capabilities beyond the operating system must be modified. However, TI has already lined up an array of software that will run on its system including Ashton-Tate, Digital Research, Lifeboat, Micropro, Peach-



*The natural-language package, an option for TI's Professional Computer scheduled for release this year, enables non-programmers to construct database inquiry and other basic applications by selecting appropriate terms from a multi-window screen.*

tree, Softech, Software Publishing, Sorcim and VisiCorp products. Digital Research CP/M packages can run under a Xedex Z80 soft-card option. CP/M-86 is offered as an alternate operating system—along with UCSD p-System—on the 8088. Digital Research's Logo is also supported. TI has agreements to supply VisiCorp's forthcoming Visi<sup>On</sup> package, with Lotus Development Corp. to supply 1-2-3 and with Relational Software to supply the Oracle database-management system.

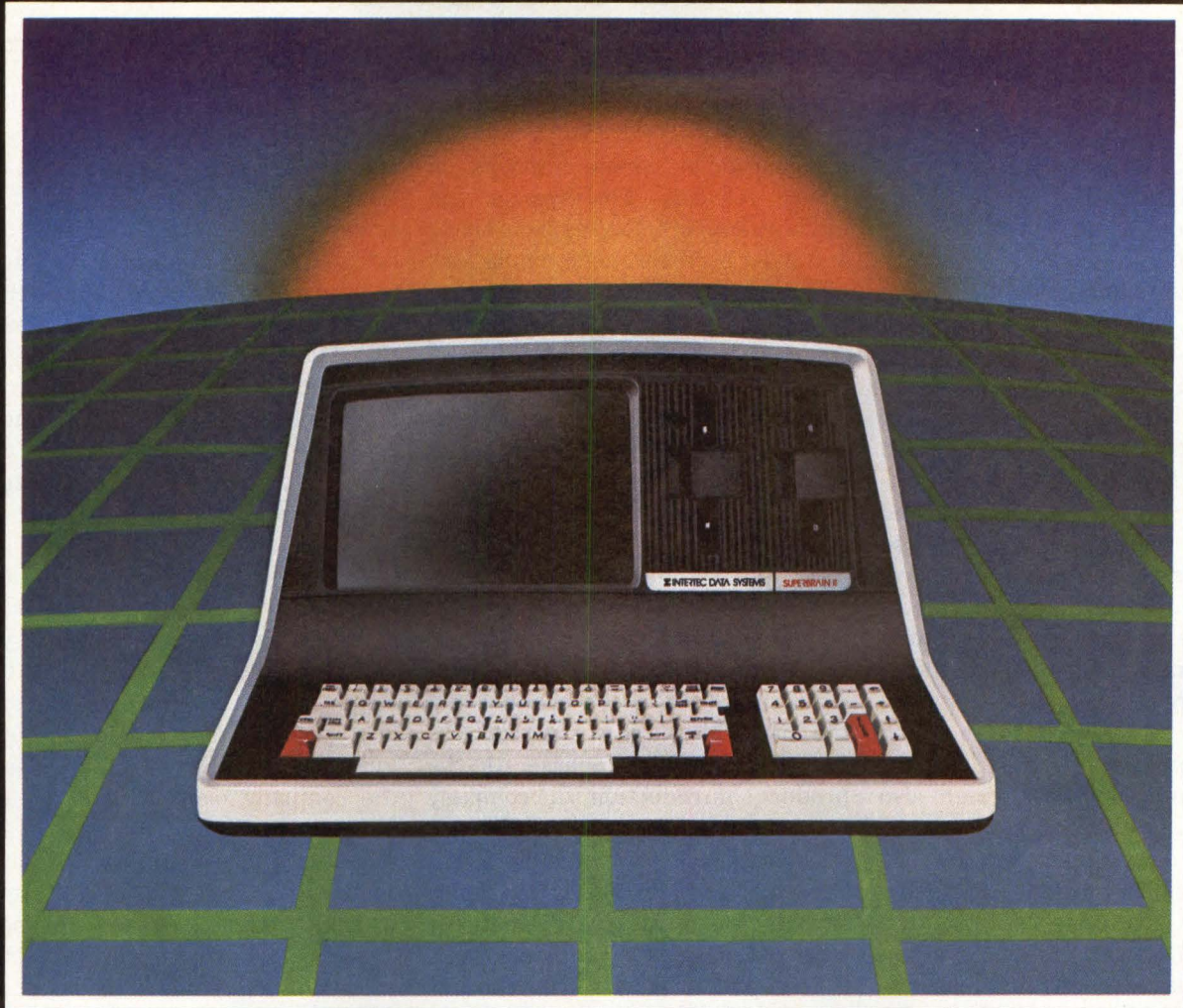
The basic TI configuration is a \$2595 package with 64K bytes of main memory, a single 320K-byte floppy, a detachable keyboard, a 12-in. monochrome monitor and documentation. The same configuration with a 13-in. color display is \$3145. A high-end configuration with TI's Seagate-licensed 5M-byte Winchester drive and 256K bytes of RAM is \$5490, and a similar hard disk model with the 13-in. color display is \$6185.

TI executive vice president Jerry Junkins says, "We believe being a major contributor in this market is strategically critical for TI." He emphasizes the ways in which TI has broken out of the IBM-clone mold. On the surface, the most dramatic departure is in the TI system's graphics capabilities. A single CRT controller has been designed to handle monochromatic or color monitors with a resolution of 720 × 300 pixels. IBM's requires separate controllers for those two functions. The controller has 2K bytes of RAM.

For hard-copy output, TI has introduced a companion low-end, dot-matrix printer that can produce graphics and text at speeds as high as 150 cps. In another departure from IBM, TI provides expansion memory through a separate memory bus that accommodates 64K-, 128K- or 192K-byte boards for a maximum main memory of 256K bytes.

TI hopes to distinguish itself most strongly from the crowd, however, with a voice-recognition/telephone-management option and a "natural-language" programming package, both due this year and as yet unpriced. The voice option is based on a piggybacked, dual-card package that will occupy a single expansion slot in the system. The package includes a TI TMS320 signal-processing chip, a TMS7000 microprocessor with I/O control functions, 32K bytes of RAM and 1K byte of ROM. The option is expected to be used as a telephone-management system for answering-machine, automatic-dialing, dictation and automatic-host-computer dial-up functions. It can also be used to implement voice store-and-forward applications, according to





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TI officials. On the voice-recognition side, it can be "trained" to recognize multiple sets of 36 words each. A "transparent keyboard" feature is designed to enable users to substitute voice commands for keyboard commands without rewriting an application program.

The natural-language option, which was developed at TI on machines running the Lisp artificial-intelligence system, is intended for non-programmers who wish to perform simple application programming. It includes a series of connectors, nouns, qualifiers, comparisons and attributes and features a split-screen format from which users can select words to build programming sentences.

The natural-language system also automatically eliminates syntax errors. The first application for the package will be a database-inquiry facility for extracting data from the Dow Jones News Retrieval system. TI officials expect the natural-language package and the voice options to be used by outside vendors for their applications.

TI plans to release an internal 300- or 1200-bps modem option this year and will have IBM 3270 SNA and

bisynchronous communications in future releases. The system will initially support TTY asynchronous and 3780 bisynchronous emulations written by TI. The company has also disclosed plans to make Corvus's Omninet local network available.

Distribution of the TI Professional Computer, which began in February, will be through retail computer stores, office-equipment dealers, system houses and directly to large end users. In developing the computer retailing channel, TI is going directly to individual stores in a one-step distribution program that thus far circumvents the industrial distribution channel and the national chain stores such as ComputerLand or Sears. At the product's introduction, the company had stocked and trained almost 200 dealers in 25 major cities. Data Systems group president Eric Jones says the TI terms are competitive with other small system manufacturers' and include a flat discount rate (which he declines to disclose), 30-day net payment, training and cooperative advertising.

Beyond the dealer channel, however, TI plans to mount a direct sales campaign to major end users

and will sell the system through its traditional system houses. The system house effort, TI officials say, is geared to specific vertical markets. The first major vertical contract was awarded in a competition with IBM before the Professional Computer's introduction. Farmland Industries Inc., a farmers cooperative, expects to resell the systems with special farm-management packages to farmers in its 500,000-member organization.

While the TI personal computer will act as a terminal for other TI systems, the company has not yet provided software tools to tie the computer to the Business Systems line. Professional Computer program manager Kevin Ellington says the company plans to add the RM COBOL package from Ryan-McFarland Corp. to the personal computer. The UCSD p-System, which is offered on the Business Systems line, can also provide links between the product lines, he notes. Another possible link, he says, is implementation of the UNIX operating system on both lines, which Ellington calls "a future possibility."

—Geoff Lewis

## IBM's 4-in. microfloppy turns heads as standard debate rages

While a Pacific storm ripped up the coastline recently, members of the American National Standards Institute X3B8 committee were treated to a different kind of storm inside a San Diego hotel meeting room, battering the already-cloudy microfloppy standard debate. Committee members who lingered after the meeting's adjournment were given an unofficial presentation by Roger Chenoweth of IBM Corp. on Big Blue's long-awaited OEM entry

into the microfloppy field.

During the meeting, and against the objections of Chenoweth and representatives of Dysan Corp. and others backing a 3¼-in. form factor, the committee decided to poll its members through letter ballots on establishing the 3½-in. form factor presented by an industry committee. The ballot process will take six weeks and requires two-thirds of the pro vote for adoption.

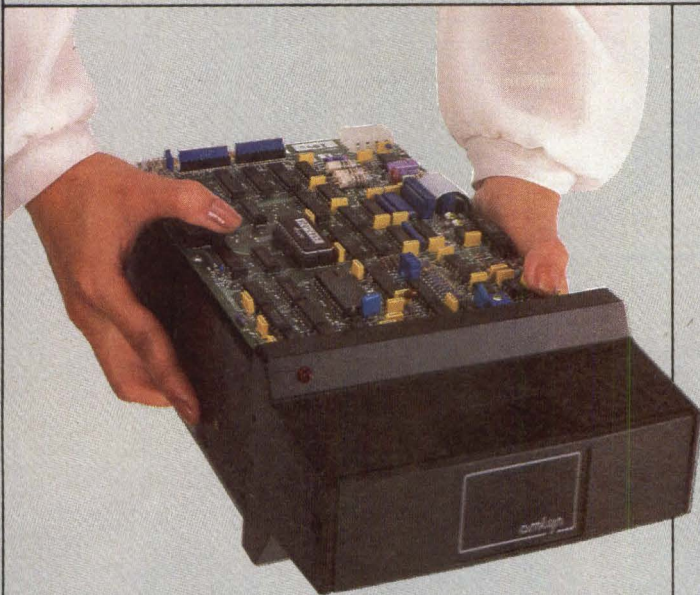
Committee members then lis-

tened in respectful silence as Chenoweth unveiled IBM's 4-in. form factor microfloppy. The media will be housed in a 4-in. plastic case with no shutter. The drive measures 2.6 × 6.7 × 4.5 in. The media inside the plastic case is 102 mm. in diameter and will rotate at speeds from 262 to 415 rpm, to keep a constant recording density on all tracks. While IBM's drive holds 358K bytes of unformatted information on a single side, other small drives hold 500K bytes. Tabor Corp.'s, for

# THE 8MBYTE FLOPPY SURPRISE

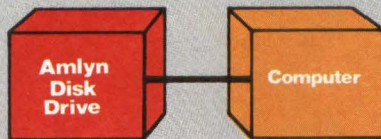
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Optional cartridge or 9-track tape drives

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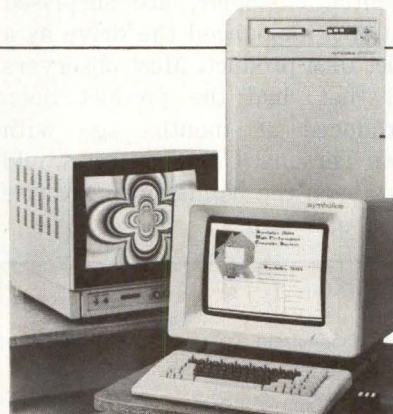
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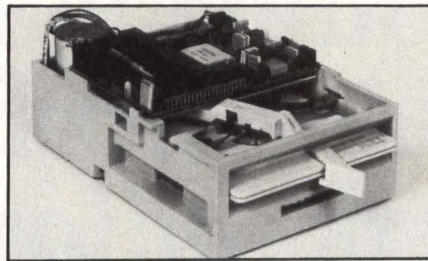
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example, holds 500K bytes in a double-sided version. At NCC, Tabor is expected to introduce a 1M-byte version. In addition to physical dimensions differing from any other microfloppies proposed to date, the IBM drive uses a nonstandard interface. Sub-4-in. drives had all previously used a standard minifloppy interface.

Chenoweth admitted to the committee that "IBM alone will probably not set the standard for 4-in. or smaller floppies. There is likely to be more than one standard."

But as the specifications of IBM's drive ripple through the industry, the response appears to be something less than the spontaneous worship most IBM announcements draw. Most observers, mindful that they would like IBM as a future customer, attempted to find a kind way of expressing that this time the emperor is wearing no clothes. "There is only one thing good about this product—its name," says an executive of a media manufacturer, who wishes to remain nameless for obvious reasons. "The 800-lb. gorilla may be up a tree this time," says disk drive industry analyst Jim Porter. "Until IBM uses the product in a system, thereby creating a market, there will be little call for the drive as an OEM product."

George Sollmon, vice president of marketing for Shugart Associates, which offers a 3½-in. floppy built to the industry committee's specifications, notes IBM's OEM price for its drive—\$165 in quantities of 10,000



IBM's 4-in. microfloppy is throwing yet more confusion into efforts to standardize small drives.

—is "not exactly earthshaking." Shugart's price is expected to be \$135 in similar quantities.

Scott Holt, vice president of marketing at Seagate Technology, notes that, if the market embraces the IBM product, "Seagate and others may be expected to follow suit," but no plans are in the works.

Another industry analyst, Ray Freeman, of Freeman Associates, Santa Barbara, Calif., says the IBM product adds "extra confusion to an already-confused market." Freeman says IBM does not have as much clout at the low end of the disk drive market as it does at the high end. It is not therefore likely to make a contribution—at least with this product—to the eventual establishment of a 4-in. or smaller standard.

Many who refuse to be quoted for fear of losing IBM as a customer or a potential customer, are surprised that IBM announced the drive as a strict OEM product. Most observers feel that, had the product been introduced 18 months ago with IBM's Personal Computer, it would have been the hands-down favorite for a standard.

Not everyone is critical of the IBM drive. Andy Roman of Roman Associates International, Newark, Calif., hails the IBM product as a "rallying point for those manufacturers still undecided about which road to take." Roman believes that IBM still has the resources and market pressure to force a standard on the market, and he feels that it's about time someone did exactly that. "Out of all of the confusion, IBM walked in, opened its kimono and out dropped this little jewel."

Roman says IBM's use of cobalt media, unlike the ferrite media used in competitive products, can eventually be used to increase the drive's capacity. Cobalt allows high flux changes and thus higher recording densities. "I wouldn't be surprised to see a 3M-byte drive within four years," Roman says. In addition, he believes controller manufacturers can easily compensate for the nonstandard interface.

An IBM spokesman says the product was not built with anything else on the market in mind, but for "maximum reliability." He says evaluation units are being distributed to prospective customers. Production quantities will be available this year, but the company cannot be more specific. IBM has not yet negotiated a second source.

The spokesman refuses to speculate on whether IBM will eventually adapt the PC or another product to use the 4-in. drive in the near future. Industry sources, however, say the PC division's objections to using the new drive are much the same as those raised by competitors: lack of standardization.

The floppy drive is the latest offering in an increasingly important OEM sales section. The General Products division section in San Jose offers two 8-in. Winchester drives, including IBM's most popular OEM product, the Piccolo, as well as CRT terminals and a plasma display.

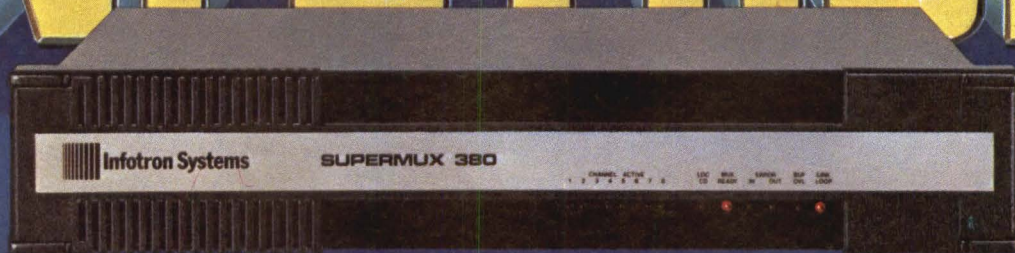
—Robert A. Sehr

## IBM vs. the Competition

	IBM	Shugart (Industry Committee)	Tabor/Seagate
Drive size (in.) H X W X D	2.6 x 4.5 x 6.7	3.25 x 5.75 x 8	1.6 x 4 x 5.50
Cartridge size (in.)	4;	3½;	3¼;
	hard jacket	hard jacket	soft jacket
Capacity (unformatted, single-sided)	358K bytes	250K bytes; 500K bytes (double-sided)	500K bytes
Tracks per side	46	80	80
Tracks per in.	68	135	140
No. of sides	2	2	2
Price (for 10,000 units)	\$165	\$135 (estimated)	\$165 (estimated)
Interface	IBM	5¼-in. standard	5¼-in. standard

# What's Behind the Supermux 380 Multiplexer?

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CIRCLE NO. 18 ON INQUIRY CARD

## TeleVideo seeks to strengthen market leads with two new terminals

TeleVideo Systems Inc., which offering its high-performance, low-gained volume leadership among priced ASCII terminals through a independent VDT manufacturers by dense distributor network, is in

danger of falling behind in the low-end market, some observers say. Even TeleVideo's vice president of marketing and sales for CRTs, Steve Tatum, agrees that the competition is beating the models 910-plus and 925 in price/performance. Some observers believe TeleVideo has been sidetracked by its systems business. But at Comdex Spring this month, TeleVideo may reassert itself with two low-end terminals in a new case designed with European ergonomic requirements in mind: the \$699 915 and the \$895 924.

The 915, built in South Korea, is pitted mainly against other editing, block-mode terminals built in Taiwan—Qume Corp.'s \$695 QVT102, Liberty Electronic's \$595 Freedom 100 and Lear Siegler Inc.'s \$695 ADM-22. The \$695 Visual 50 from Tewksbury, Mass., manufacturer Visual Technology Inc. is the only completely American competitor. The 915 shares a tilt-and-swivel screen and smooth scroll with all of those but the ADM-22. Only the TeleVideo, Qume and Visual entries have low-profile keyboards. The 915 is the only terminal in the bunch to offer eight foreign-character sets and an accounting keypad with double-zero and clear-entry keys. The 915 is also the only one to offer vector graphics, an integral modem and a second page of memory as options.

The new 924, also built in South Korea, will compete with two other \$895 terminals—the Qume QVT108 and Applied Digital Data Systems' Viewpoint. The 924 offers a swiveling screen and a buffered auxiliary port, which the QVT108 lacks, while x-on/x-off and bidirectional communications on the auxil-



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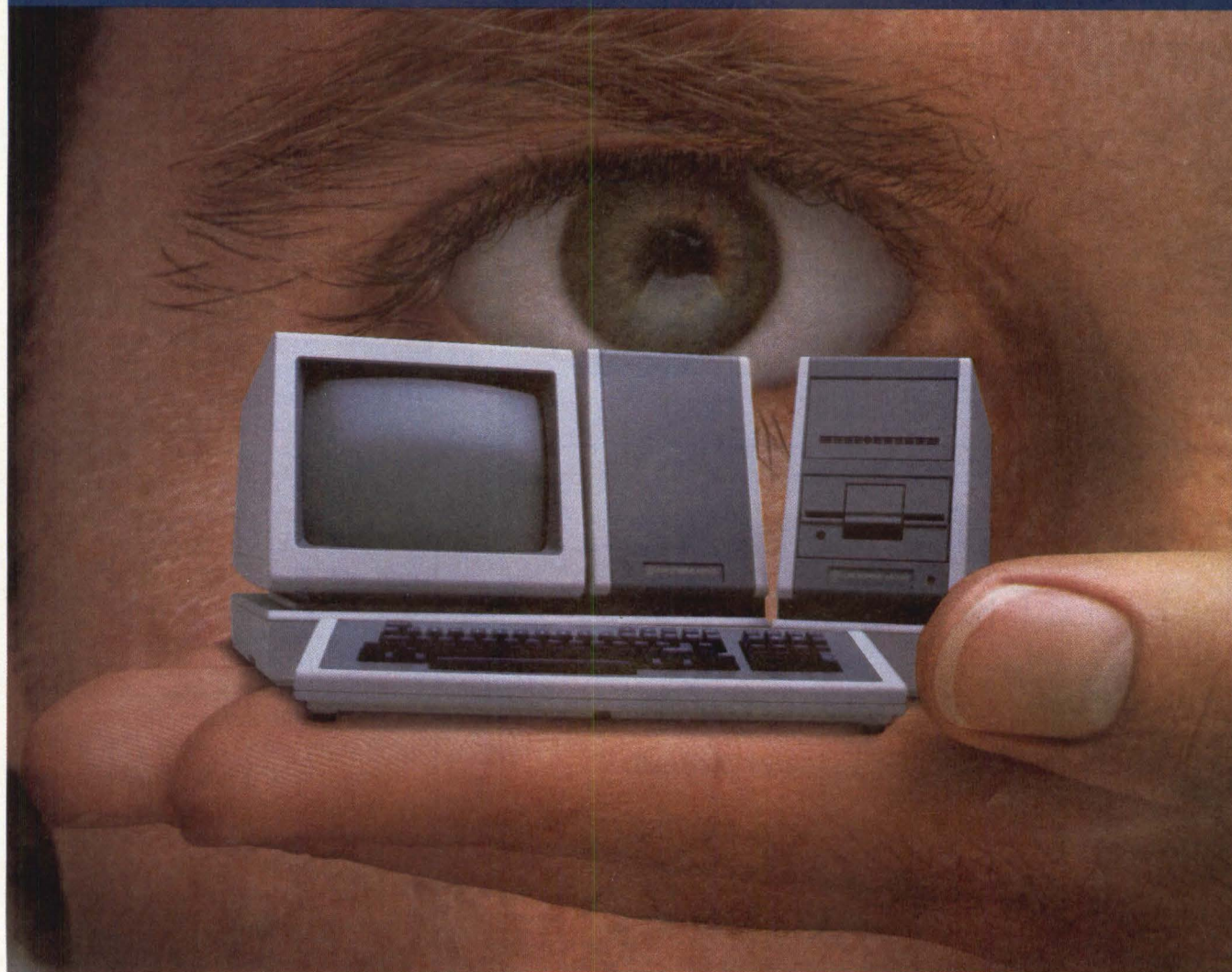
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CIRCLE NO. 19 ON INQUIRY CARD





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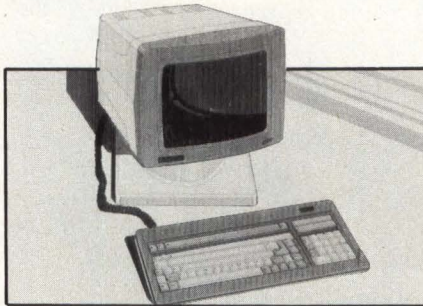
**CIRCLE NO. 20 ON INQUIRY CARD**

# Mini-Micro World

## NEWS

inary port and a low-profile keyboard give the 924 advantages over the Viewpoint. Neither Qume nor ADDS offers the 924's split screen and 32 nonvolatile function keys, a programmable send key, insert wrap-around or an accounting keypad.

Although Robert Sanekoff, head



TeleVideo's model 915 terminal, which is list-priced at \$699, is part of an effort by the company to reassert itself as it gains strong competition for sales in the low-priced terminal market.

of Dataquest Inc.'s terminal market research group, doesn't see the 915 or 924 as having a substantial price/performance edge over the competition, he says just being even puts TeleVideo ahead. He places TeleVideo in a virtual tie with Digital Equipment Corp. in domestic shipments of ASCII terminals and as the undisputed leader among independents, with nearly 11,000 terminals shipped in January. ADDS, TeleVideo's closest competitor, shipped approximately 7000 terminals during January.

Tatum says the new TeleVideo terminals will eventually replace current products such as the 910-plus and 925 because of the new terminals' better value. But Craig Lynar, director of marketing for TeleVideo's new terminals, stresses it won't happen overnight. "A customer cannot take the 925 [off of a system] and put on a 924, for example," explains Lynar. "Their screen-handling codes, though similar, are different because visual attributes in the new terminals do not take up a space." Although such code is deemed an improvement, it means special software must be written to use the new products. Lynar therefore expects most of the demand for the terminals to be new business.

Volume shipments of the new terminals are scheduled for June. Margins will range to 48 percent for the 915 and 66 percent for the 924, both in quantities of 1000.

—Kevin Strehlo

Sritek, Inc., is located at 3637 S. Green Rd., Cleveland, Ohio, (216) 292-0011. The company's address was given incorrectly in the February issue.

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CIRCLE NO. 22 ON INQUIRY CARD



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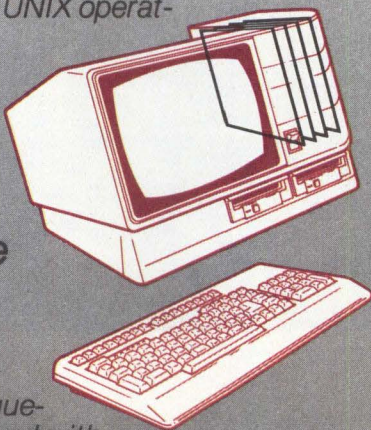
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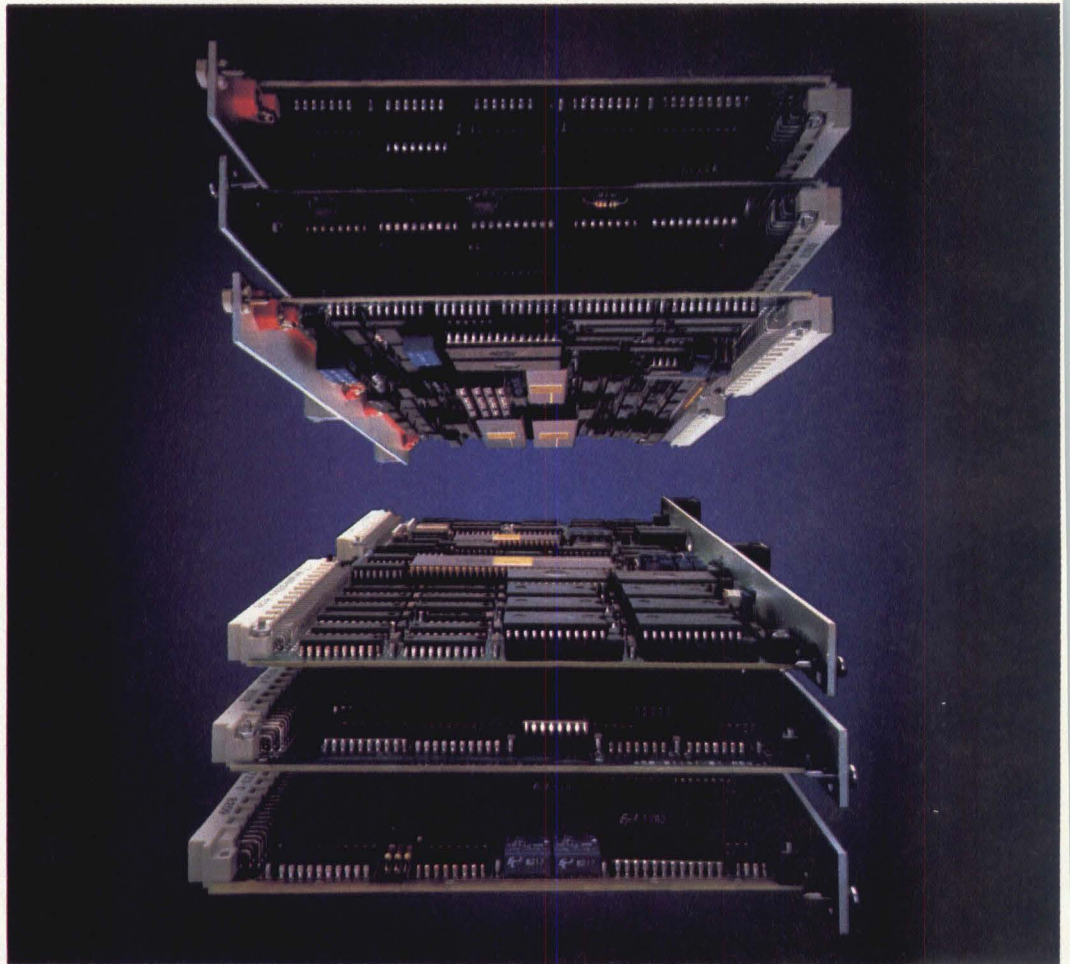
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CIRCLE NO. 23 ON INQUIRY CARD

# SPRING



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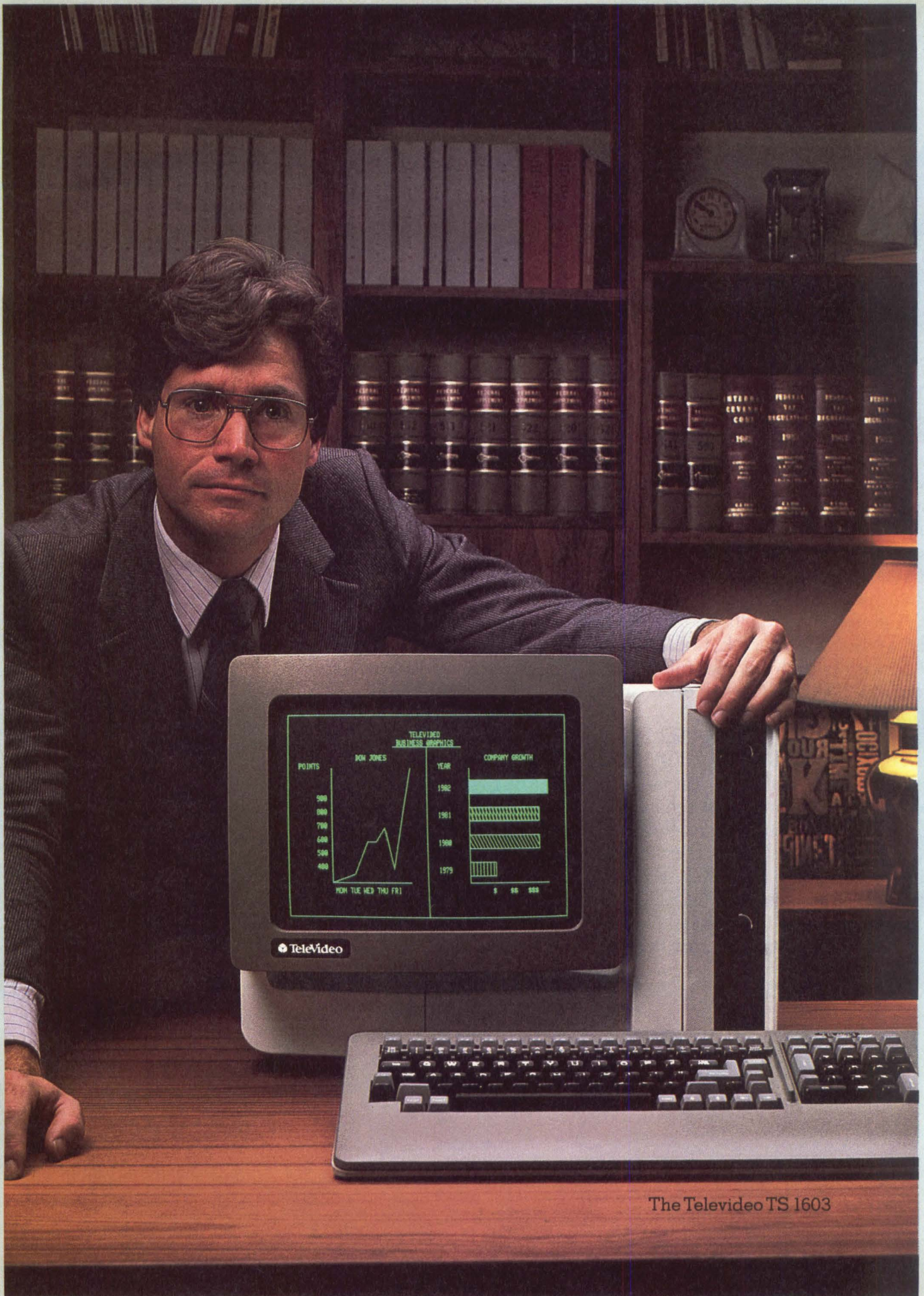
Together, it all adds up to the most powerful and versatile way yet to hit the ground running with a 68000 system solution. To find out more, contact Mostek Corp., 1215 W. Crosby Rd., MS2205, Carrollton, Texas 75006. (214) 466-6000. In Europe, Mostek International (32) 2.762.18.80. In Japan, Mostek Japan KK (81) 3.404.7261. In the Far East, Mostek Asia Ltd. (852) 5.296.866.

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CIRCLE NO. 24 ON INQUIRY CARD



The Televideo TS 1603



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**CIRCLE NO. 26 ON INQUIRY CARD**

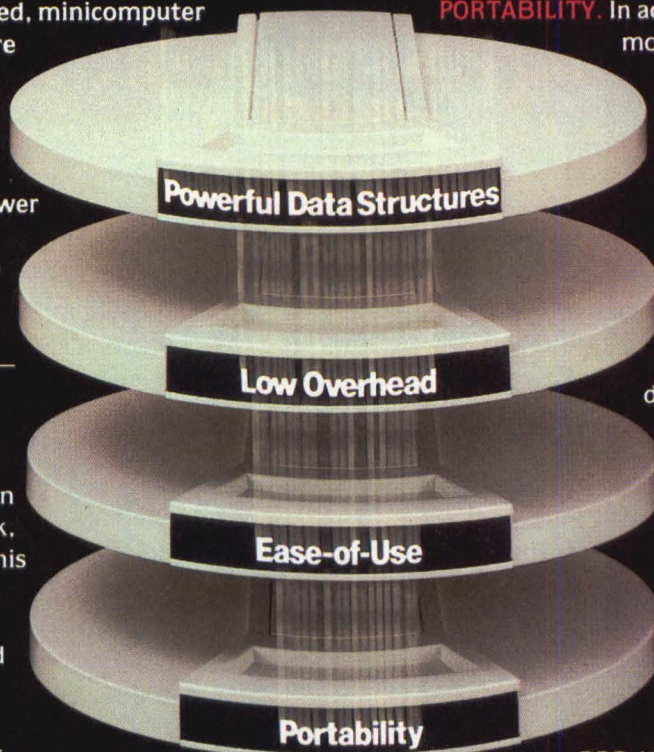
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CIRCLE NO. 27 ON INQUIRY CARD

# Mini-Micro World

INTERNATIONAL

## Software vendor transports accounting packages to P-E and other superminis

The adoption of 32-bit supermini-computers by commercial system integrators is encouraging vendors of powerful mainframe accounting software packages, which typically are operated in batch mode, to transport their products to the real-time processing environment of supermini hosts. For example, the real-time sales and purchase ledger updating packages of Northern Software Consultants Ltd., Manchester, England, are being distributed worldwide by Perkin-Elmer Data Systems, Oceanport, N.J. Northern also plans to transport its software to Digital Equipment Corp.'s VAX, and Prime Computer Inc.'s and Data General Corp.'s MV superminis.

Northern claims that its packages are one of the first of their kind to employ real-time sales and purchase ledger updating, a complete break from the batch updating still used by many mainframe packages.

Northern's packages, which P-E calls General Financial software GFS-32, have been integrated with P-E's Reliance transaction-processing system. Northern managing director Howard Sherrington stresses that the new sales and purchase packages, NOR-SAL2 and NOR-PURLA2 support a hierarchical database, enabling transactions to be recorded in real time on interrelated files. NOR-SAL2 features constant status checking of customer accounts, and NOR-PURLA2 offers control over purchase ledger functions of accounts payable. NOR-FLEX provides user-defined reports from any parts of the database.

Three related packages restricted to on-line operation—stock control, invoicing and general ledger—will



Northern Software Consultants Ltd. managing director Howard Sherrington says Northern's sales and purchase packages for superminis support a hierarchical database, enabling transactions to be recorded in real time on interrelated files.

be available in real-time form within 18 months, according to Northern technical director David Marsden.

To run the real-time packages, the host machine needs a real-time processing monitor, plus either an indexed-sequential-access method or a full database-management system, says Marsden.

Marsden stresses that the deal with P-E is nonexclusive and says there will be no technical problems in mounting the packages on other 32-bit superminis. Marsden explains that the transportability of Northern's packages between machines has been achieved using the NORBOL language tool. It incorporates COBOL instructions common to all environments, but provides special macroinstructions for environment-dependent operations, such as screen and database handling. To mount the packages in a certain environment, a macro translation

library must be created to generate full COBOL coding. Marsden notes the final COBOL coding is typically four times the length of the original NORBOL program. Marsden says it takes three to six months to create the macro library.

Sherrington is optimistic about the prospects for Northern's products in the U.S. He acknowledges competing packages from U.S. vendors are offered with front-end processors that provide on-line input and inquiry facilities, but argues those packages have been added to old file structures requiring batch update runs.

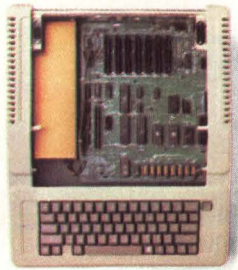
Andy Denver, marketing director with Software International Inc., Andover, Mass., says his company's accounting packages do not offer real-time updating like Northern's. Software International instead uses a holding file for later batch updating. The packages are available on Prime, DEC VAX and mainframe hosts.

Denver reveals that Software International is looking at real-time updating of non-numeric information such as company names. But he sees dangers in updating money values in real time, contending that might hinder the ability to perform audit trials. Northern real-time processing consultant Mike Higham counters by explaining that Northern's packages employ a security log file to facilitate auditing by accumulating pointers as the database is updated. The log file also accumulates batch totals for balancing journal inputs.

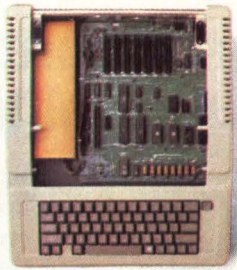
Sherrington notes that Northern plans to open a New York office in July to establish and support a distributor network.

—Keith Jones

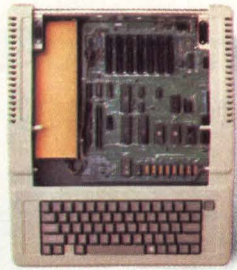
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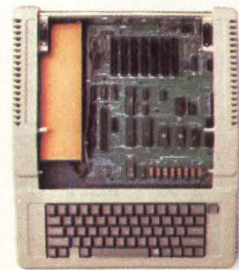
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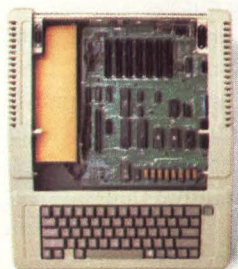
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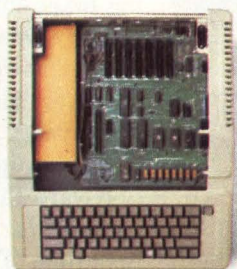
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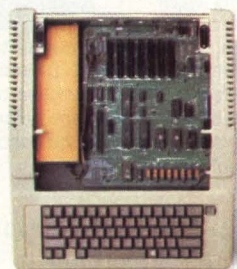
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Sandu  
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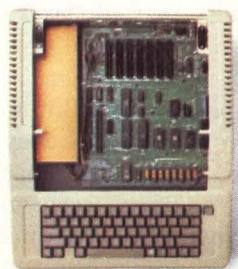
TCD, Inc.  
Life insurance illustrations



Cascade Graphics Development  
Computer aided drafting



CompCoWare Inc.  
Custom instructional software



Autographix, Inc.  
Designs, graph slides



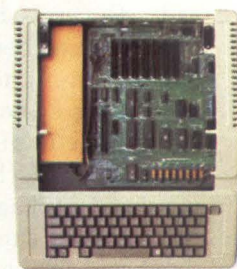
Software Resources  
Financial investment packages



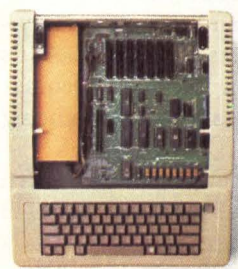
American Zetler, Inc.  
Hospital nursing station



Basic Computer Literacy  
Courseware



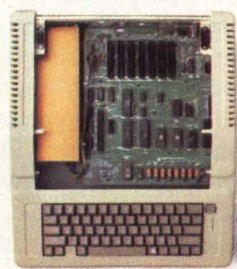
CPHA  
Hospital data entry systems



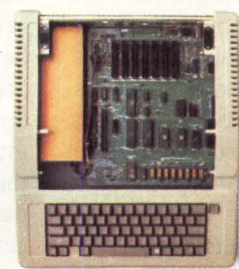
Transportation Concepts  
& Services  
Interstate tariff rates



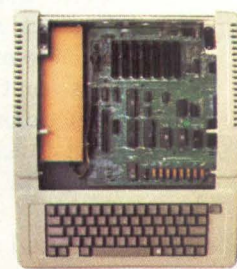
Energy Management Service, Inc.  
Residential/commercial  
energy analysis



Vitalograph Ltd.  
Pulmonary systems,  
on-line spirometer

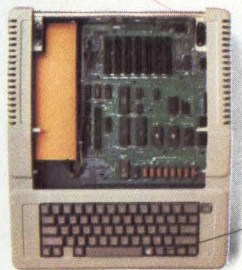


Fisher Scientific Company  
Intelligent color console  
for mass spectrophotometer

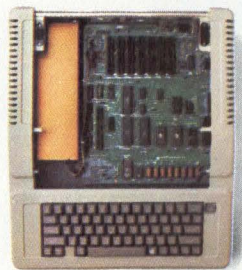


First Software Corp.  
Computer work station  
for children

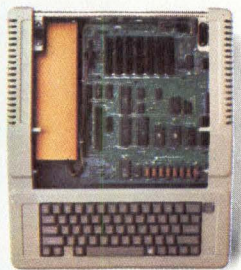
# guts to be successful.



Alltech  
Scientific instrumentation



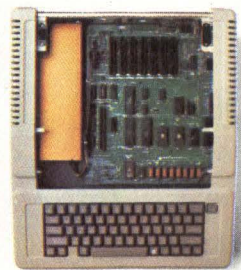
Kwik-Kopy Corporation  
Computerized pricing



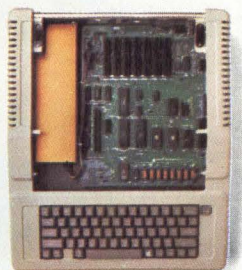
Warren E. Collins  
Medical electronics



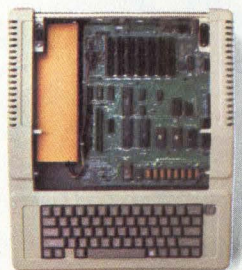
HCI Data  
Agricultural software



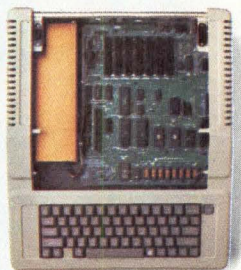
Northwest Instrument Sys., Inc.  
Digitizing oscilloscope



Federal Computer Systems Inc.  
Pharmacy package



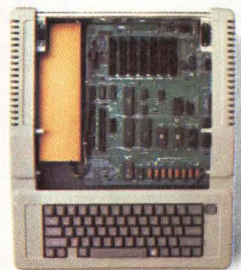
Cyborg Corporation  
Lab data acquisition



Medical Graphics  
Inhalation data analysis



Walman Optical  
Opticians systems



Acroloc, Inc.  
Milling machine control

There are more OEMs in more places doing more things with Apples<sup>®</sup> than with any other personal computer in the world.

Because Apples have more available software. More configuration versatility. And an OEM support program that will provide you with everything from our most basic computer products to complete, ready-to-roll systems.

All backed by technical documentation, software assistance, even hands-on training. And all part of a lasting commitment to this important marketplace.

So if you have the courage to succeed, but lack the guts, contact an Apple OEM Representative.

The most personal computer.  **apple**

Call (408) 973-3152 for more information, or for information regarding corporate purchases through our National Account Program.

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**FOR GENERAL INFORMATION CIRCLE NO. 148 ON INQUIRY CARD. FOR OEM INFORMATION, CIRCLE NO. 60 ON INQUIRY CARD.**

C. ITOH  
ELECTRONICS



**Our parent  
company said  
it's time we  
went out in the  
world and made  
a name for  
ourselves.**

**So we did.**

## ***CIE TERMINALS***

CIE Terminals, Inc., is video display and graphics terminals, line printers and ACRO Corporation all rolled into one new company of C. ITOH ELECTRONICS, INC.

New headquarters and Southern California sales office: 2505 McCabe Way, Irvine, CA 92713. (714) 557-5118. Or call toll-free, 1 800 854-3322. Other regional sales offices: San Jose, CA (408) 977-1146; Cherry Hill, NJ (609) 983-5075; Chicago, Ill (312) 992-2346; Houston, TX (713) 777-1640; Atlanta, GA (404) 257-1814; Denmark (02) 921100.

**SEE US AT COMDEX BOOTH #1512**

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# THE UNPERSONAL

**UNEQUALLED PRICE/  
PERFORMANCE**

**UNLIMITED  
CONFIGURATIONS**

**UNSURPASSED  
RELIABILITY**

**UNMATCHED  
ERGONOMICS**

**AND  
UNIX™-OPTIMIZATION**

Meet the Series 2000 business system. We call it the UnPersonal Computer because it offers you the multi-user, multi-tasking performance and configurability that you can't get from any "personal computer."

The Series 2000 can start out as a powerful, single-user desktop system, and then become very "unpersonal" as you add intelligent workstations to share a common database. UNIX-optimized, this multi-user system streamlines business computing in any environment—from a one-man shop to the busy department of a large company.

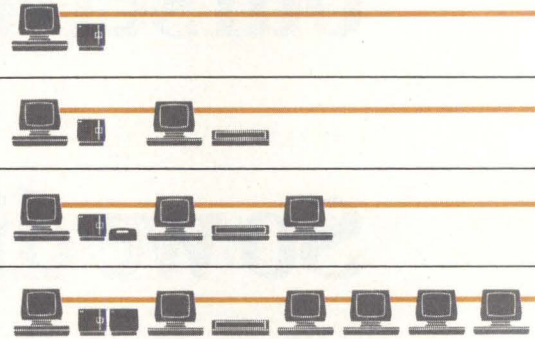
Besides intelligent workstations, the highly-configurable Series 2000 includes optional Multibus™ attachment, and a choice of disk storage modules and high-speed dot-matrix printers.

The Series 2000 gives you, the OEM, many *unfair competitive advantages*:

**PRICE/PERFORMANCE.** Series 2000 costs less per workstation than a multiple configuration of personal computers. And you don't have to worry about incompatibilities, hidden upgrade costs or performance degradation when you need to expand.

**UNIX-OPTIMIZED.** Series 2000 has been optimized for the UNIX operating system. The hardware was designed with overlapped, high-speed disk operation and large memory capacity to run UNIX more efficiently.

**CHOICE OF SOFTWARE.** The UNIX operating system comes with the C compiler and a host of utilities as standard. Language processors, such as COBOL, FORTRAN, BASIC interpreter, and BASIC compiler, are optional.





# COMPUTER.

**HIGHLY CONFIGURABLE.** Series 2000 expands easily—from single-user to multi-user operation. And there's a wide choice of disk storage modules and high-speed printers to optimize the selected configuration.

**FASTER DATA ACCESS.** The Series 2000 main processor breaks the access bottleneck by using tightly-coupled multiple microprocessors for concurrent processing, disk access and workstation access. Totally overlapped data transfer and processing means shorter response times and better throughput. If it's desktop power you want, we can really crunch numbers with our 8-MHz 8086 and its optional 8087 arithmetic coprocessor.

**WORKSTATION POWER.** Series 2000 workstations are available with 16 to 64 kbytes of user memory. Microprocessor-controlled, each station is capable of receiving down-loaded programs from the main processor to further improve response time.

**CHOICE OF DISK STORAGE.** Disk storage up to a total of 60 Mbytes may be attached to the Series 2000 main processor.

**PRINTERS.** Zentec-supplied dot-matrix printers operate at speeds from 180 to 500 characters per second, or, for near-letter quality, from 100 to 125 characters per second. Options include high-resolution graphics, multiple character sets and forms handling capabilities.



## A NAME TO RELY ON.

Our long experience serving demanding OEMs has made us aware of how important it is to maximize system uptime. Zentec has built its reputation as a supplier of reliable, high-quality products with some of the highest MTBF numbers in the business. For more information, contact our headquarters, or call any of the sales offices listed below.

ZENTEC Headquarters,  
2400 Walsh Avenue,  
Santa Clara, CA 95050  
(408) 727-7662.

### Sales Offices:

Fort Lee, NJ (201) 944-0670  
Long Grove, IL (312) 634-9550  
Playa Del Rey, CA (213) 822-0278  
Richardson, TX (214) 690-9265  
Rockville, MD (301) 762-7990  
Santa Clara, CA (408) 727-7662  
Waltham, MA (617) 890-7915  
West Palm Beach, FL (305) 684-8898.

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Multibus is a registered trademark of Intel Corporation.

**CIRCLE NO. 29 ON INQUIRY CARD**



# SUPPORT THIS UNION AND AVOID A WORK SLOWDOWN.



Organize your DP operation around a VAX computer and Direct 831 terminals and enjoy an important benefit of a DEC-Direct union. More power. The kind that gets work done faster.

To the 831's VT100-compatible features you can add an optional integral modem to put the power of your VAX in the hands of anyone with a telephone.

Or add PLOT 10 graphics and deliver the big picture when there's no time to wade through words.

But that's just for starters.

The 831's block mode frees your VAX from the chore of creating and editing data. (That's why many users, including DEC itself, view block mode as an answer for overburdened CPUs.)

And if that's not enough, you can unite host and personal processing by field-upgrading the 831 to our Direct 1031, a self-contained terminal/personal computer. The 1031 makes the entire array of CP/M-compatible software available to off-load your host, leaving you more VAX processing power for the jobs only a VAX can handle.

To further our cause, we're prepared to stage a demonstration at your place of business. Contact us at Direct, Inc., 4201 Burton Drive, Santa Clara, CA 95054. Telephone 800-538-8404 (408-980-1414 in California). Direct and DEC. It's one union that gives you more than you bargained for.

**DIRECT**

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**CIRCLE NO. 30 ON INQUIRY CARD**

# Mini-Micro World

CORPORATE AND FINANCIAL

## MARKET BAROMETER

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

### Europe: an awakening market for business microcomputers

By Gordon Curran

Intelligent Electronics Europe

To a large group of American businessmen, Europe is a difficult place: a fragmented market of 13 countries, all seemingly speaking different languages, all having different standards and restrictions for business microcomputer imports.

All the countries of Western Europe are awakening to the opportunities of the computer age. For instance, the penetration per head of population of home and business microcomputers into the U.K. is already higher than in the U.S. Even in the current difficult economic

conditions, the markets in Europe are expected to increase by 150 percent by units between 1982 and 1986. Although the U.K. is by far the largest market for business microcomputers now, West Germany will take the lead by 1985, with 190,000 units priced at more than \$1000 each. The rate of growth expected in Italy is the most dramatic: 28,000 systems priced at more than \$1000 each last year growing to 110,000 units in 1986.

The market share percentages by units sold in the top three countries are as follows:

	U.K.	W. Germany	France
Apple	20	13	25
Commodore	17	22	21
Tandy	16	12	9

Apple Computer Inc., Commodore Business Machines Inc. and Tandy Corp. are expected to be joined in leadership positions during this year by IBM Corp. Digital Equipment Corp. also will take a significant share.

Japanese manufacturers have had little impact on the European market so far, but their presence and competitiveness this year is expected to increase. Some European manufacturers such as Triumph Adler in Germany, Micral in France, ICL in the U.K. and Olivetti in Italy are also expected to gain significant shares in their domestic markets.

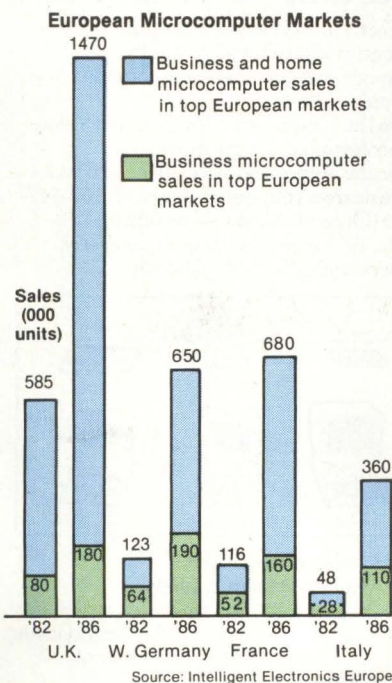
Among the top three European markets, there are some interesting differences in people's attitudes and behavior toward microcomputers. While home use is at a fanatic pace, British businesses are looking ahead for microcomputers. But with Britain's economic environment, financial conditions are often a barrier. For the Germans, economic conditions will not be a barrier, once the market is

ripe. Until now, business users have taken a wait-and-see attitude. They are looking for the right product with good quality/reliability, good after-sales service and, above all, a good solution to their business problems. They are more interested in what a microcomputer can do for them than in how it does it. French businesses show a growing interest in "microcomputer help."

In the acceptability of imported products, the three main countries differ again. The U.K. is a very open market with no restrictions or currency controls. The French are primarily protectionists with import and technical difficulties imposed to protect home industry. (This is not government policy—that would be illegal under the Treaty of Rome). Germany, like the U.K., has an open market, but it also has many technical regulations designed to ensure that



Gordon Curran is director of Intelligent Electronics Europe, Paris, a research organization that has completed a study called "Marketing Opportunities in Europe," which covers business microcomputers, home computers and video games in each European country.



The four countries noted represent approximately 75 percent of total European sales figures. Business microcomputer sales apply to units priced at more than \$1000.

### DEC CUTS PRICES ON LSI 11/23, PDP 11/23 PLUS

Digital Equipment Corp., Maynard, Mass., has reduced prices on its LSI 11/23 CPU boards as much as 36 percent and on its PDP 11/23 Plus packaged CPU assemblies as much as 18 percent. Price for the LSI 11/23 CPU board with a memory-management unit has been reduced from \$2100 to \$1340. Without a memory-management unit, the board is reduced from \$1690 to \$1140. The price of a PDP 11/23 Plus with 256K bytes of RAM and a nine-slot backplane has been reduced from \$6950 to \$5690 for both 120V and 240V AC models. DEC claims the price reductions are made possible through the company's high-volume production of both boards and box assemblies.

# Introducing the portable computer for professionals on the move. Hewlett-Packard's new HP-75.

A decade ago, we introduced the world's first scientific pocket calculator and rendered the time-honored slide rule obsolete.

Now we're introducing the HP-75 portable computer. And if press reaction is any indication, history is about to repeat itself.

## As small as a book. As powerful as a personal.

Desktop-computer power in a handsome 26-ounce package. That's the HP-75. It's just 10 inches by 5 inches by 1¼ inches.

But don't let the compactness fool you. Inside its rugged case lies a 48K-byte, ROM-based operating system. With a comprehensive, 147-command instruction set that helps you write hard-working, memory-efficient BASIC programs.



Plug-in ROM ports let you add up to three 32K-byte software modules—modules that solve tough problems *without* sacrificing user memory.

And that user memory gives you up to 24K bytes of program and data storage.

It all adds up. A fully loaded HP-75 is a 168K-byte computing powerhouse in calculator clothing.

Want more? A built-in magnetic card reader provides a convenient, inexpensive way to store and retrieve programs or data.

The HP-75's typewriter-like keyboard means rapid, accurate entry of text or data. And when we say you can touch type on it, we *mean* you can touch type on it.

Those keys, by the way, can be redefined with your favorite commands or programs. Up to 196 unique key combinations in all.

## Immediate, convenient access to your most frequently used programs.

Thanks to the HP-75's multiple-file

structure, programs, data and text can be named, simultaneously stored in memory, and programmed to interact with each other.

Add continuous memory, and you've got a computer that's designed to solve problems on the go. Simply load your favorite files and enjoy immediate access to any or all of them. The files are retained in memory until you decide to delete them—even when the machine is turned off.

## Time and appointments to keep you on schedule.

The TIME key brings to display the day of the week, date and time to the nearest second.

The APPOINTMENT feature reminds you—an hour from now or a year from now—of things you have to do. You can have a silent message on the display, any one of six alarms, or a combination of both.

Even if the machine is turned off, it will "wake up" and alert you of an appointment. Or it will execute programs or control peripherals according to predetermined schedules.

In an environmental test, for instance, where readings are taken every half hour, the HP-75 can make sure its owner gets the weekend off.

## Software tailored to solve your specific problems.

HP-75 software is now available in areas such as math, engineering, finance, and statistics. With VisiCalc<sup>®</sup>\* on the way.

Our plug-in math module<sup>\*\*</sup> for instance, solves polynomial roots, evaluates integrals, and performs finite Fourier transforms.

With our text-formatter module<sup>\*\*</sup> you'll compose memos, letters, and short documents virtually anywhere; then print them out when you return to your home or office.

In addition, our third-party software program assures you of ever-expanding software variety.

If you're a volume purchaser or OEM, give us a call. We can help you create custom HP-75 systems with special plug-in modules, magnetic cards, digital cassettes, and keyboard overlays.

## Peripherals for a total computing package.

The HP-75 is equipped with the Hewlett-Packard Interface Loop, giving you a choice of 15 peripherals. (And that choice is expanding. The HP-75 can work simultaneously with up to 30.)

In a battery-powered briefcase system weighing about seven pounds, you might have the 24-character printer, digital cassette drive and acoustic modem<sup>\*\*\*</sup>.

A desktop system might include the 80-column impact printer, full-color graphics plotter, and 12-inch video monitor.

And the HP-75 can "talk to" other computers, peripherals, and instruments with our HP-IB (IEEE-488)<sup>\*\*</sup> RS-232<sup>\*\*</sup> and

GPIO interfaces.

In summary, the HP-75 is the heart of an extremely versatile system, in addition to its stand-alone capabilities.



## Manuals to make sure you get the most from your machine.

Chock-full of examples and helpful hints, our owner's manual will get you up and running in short order. And it's organized to help you access the information you need to get on with the job at hand.

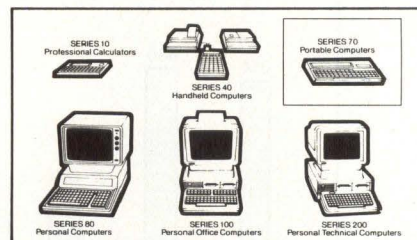
A supplementary reference guide provides a concise summary of the computer's operating protocol and instruction set.

## The value you're looking for.

What is the price of all this power in this compact package? \$995<sup>\*\*\*\*</sup>. A lot less than you might pay for a personal computer you can't take with you.

See the HP-75 today. It's the smart choice for professionals on the move.

For the authorized HP dealer or HP sales office nearest you, call TOLL-FREE 800-547-3400 (Oregon, Alaska, Hawaii: 503-758-1010). TTY users with hearing or speech impairments, dial 503-758-5566.



\* Available May 1, 1983.

\*\* Available March 1, 1983.

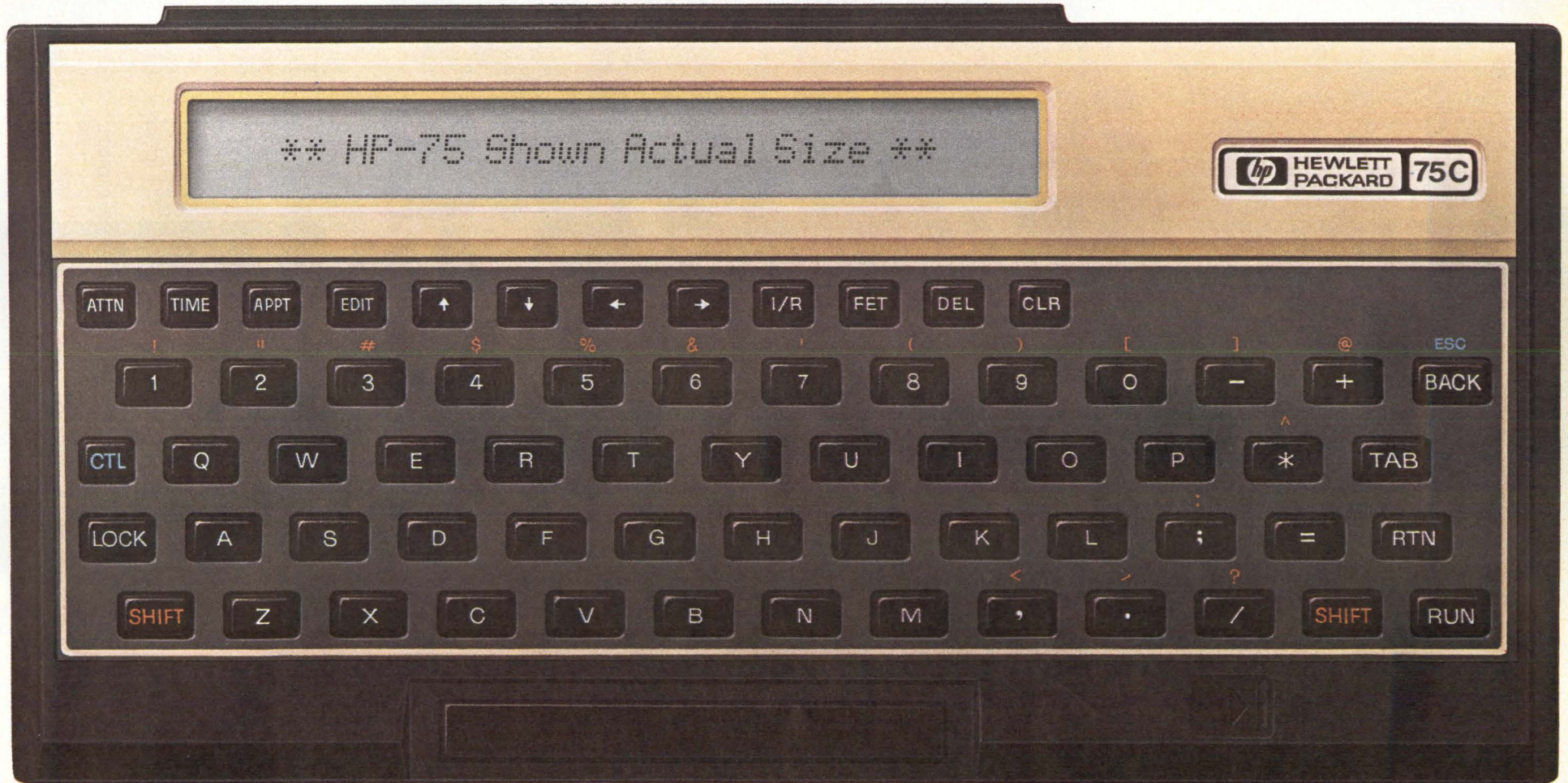
\*\*\* Call our toll-free number for availability.

\*\*\*\* Suggested retail price. May vary outside U.S. Peripherals and software not included.

VisiCalc<sup>®</sup> is a registered trademark of VISICORP.



1 1/4"



**HP-75 SPECIFICATIONS**

**Size and weight:** 10" X 5" X 1 1/4," 26 oz.

**48K-byte, ROM-based operating system:**  
• 8-bit CMOS CPU • Multiple file structure in continuous memory • Instruction set: 52 system commands, 43 BASIC commands, 41 numeric functions, 7 string functions, 6 time-mode commands, 16 arithmetic/logical/

relational operators

**Numeric precision:**

- Real—12 digits ( $\pm 9.99999999999 \times 10^{\pm 499}$ )
- Short—5 digits ( $\pm 9.9999 \times 10^{\pm 99}$ )
- Integer—5 digits ( $\pm 99999$ )

**Time/appointments:**

- Perpetual clock/calendar • 12- or 24-hour format • Appointment control of command/

program execution

**Memory:**

- User (RAM)—16K bytes, expandable to 24K bytes • Operating system (ROM)—48K bytes
- Plug-in software (ROM)—up to 96K bytes (3 32K-byte modules)

**Typewriter-like QWERTY keyboard:**

- 65 keys • 194 redefinable key combinations

• "Hidden" numeric keypad

**Integral mass storage:** hand-pulled card reader (1.3K bytes per card)

**Built-in interface:** HP-IL; choice of 15 peripherals  
**Power supply:** 3 AA NiCad batteries (AC adapter/charger included)

**Liquid-crystal display:** 32-character window on 96-character line

PG02308 287G



# CalComp's \$1 vs. their \$16,0

Why settle for a plodding plotter when you can double your throughput with an all-new Model 945 or Model 965 beltbed plotter from CalComp for approximately the same price?

Productivity gains can range from 25% to more than 500%. It's like having up to two plotters for the price of one.

*CalComp Model 945 beltbed plotter (left) for sheets up to ANSI size D (or ISO size A1), and Model 965 plotter for drawings up to sheet size E (or size A0).*



What's the difference? The basic philosophy behind each plotter design. Their plotters trade off speed for one-time economies of smaller size, lighter weight, less powerful components. *You* pay the price in plotting time with each pen and paper movement (their 24-ips maximum vs. CalComp's 42-ips) and each excursion of the single-pen carriage to a side-mounted carousel.

CalComp's Model 945 and Model 965 plotters, by comparison, allow you to map up to 16 logical pens to four physical pens continuously poised over the plot surface—ready to be activated



# 6,000 plotter 00 plodder.



in a fraction of a second. If more than four pens are needed, the plotter performs an automatic stop and prompts the operator to change pens.

Plus the user-friendly control panel provides local control and plot manipulation with easily understood English language messages.

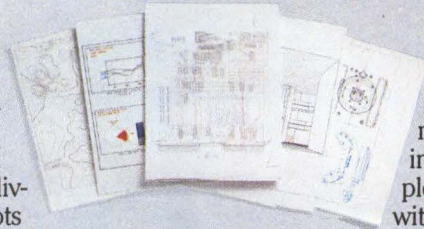
The same interactive firmware gives the operator complete control

over plot parameters. Training time is all but eliminated.

Your CalComp Model 945 or Model 965 plotter starts delivering high-speed plots the day it is installed, without changing a line of industry-standard software. Industry-standard because it was developed by CalComp—world leader in computer graphics and CAD/CAM.

So write or phone today for your illustrated copy of "The Plotter and the

**CIRCLE NO. 32 ON INQUIRY CARD**



Plodder." Compare the performance specifications. Then make your own move into the fast track of plotter technology—with CalComp. California

Computer Products, Inc., 2411 West La Palma Avenue, Anaheim, CA 92801.  
714-821-2011 TWX: 910-951-1154

**CALCOMP**  
A Sanders Graphics Company

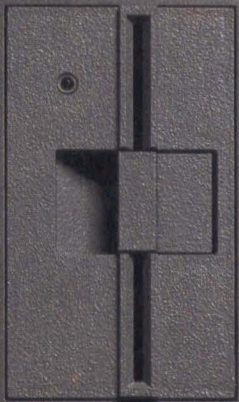


**SANDERS**

NCR

- Disk
- Communications
- Fault
- Battery

On  
Off





# TOWER™ 1632. IF YOU THINK IT'S BEAUTIFUL IN COLOR, LOOK AT IT IN BLACK & WHITE.

---

**PROCESSOR:**

16-bit 10MHz Motorola 68000 processor off-loads I/O functions to as many as six micro-processor-based controllers with Direct Memory Access (DMA) for powerful minicomputer performance. Memory management unit uses full 24-bit addressing. Clear migration path to 32-bit technology.

---

**USERS:**

1 to 16, local or remote.

---

**MEMORY:**

Up to 2 megabytes ECC memory, in 256K increments.

---

**MASS STORAGE:**

10 megabytes to one billion bytes.

---

**OPERATING SYSTEM & SOFTWARE:**

NCR enhanced operating system derived from UNIX.\* Five user personality levels. Dictionary driven applications generator.

---

**LANGUAGES:**

Cobol, Business BASIC, Fortran, C.

---

**INDUSTRY STANDARD INTERFACES:****I/O Bus:**

Multibus\*\* IEEE-796.

**Magnetic Media:**

SA400—5.25" floppy disks, ST506—5.25" Winchester, SMD—high performance  
8" Winchester, QIC II—streaming tape.

**Communications:**

RS232C [ASCII TTY, Bisync (2780/3780)],  
NCR DLC, SDLC/SNA, X.21/X.25,  
Networking.

---

**PRICE:**

Under \$10,000 in OEM quantities.

---

In the foregoing sketch you see the outline of the new shape in computing. Tower™ 1632.

Now that you know what it looks like in black & white, we invite you to see it in action. Call us at (800) 222-1235.



BUILT FOR SYSTEMS BUILDERS.  
TOWER 1632.

**NCR**  
OEM Marketing Division

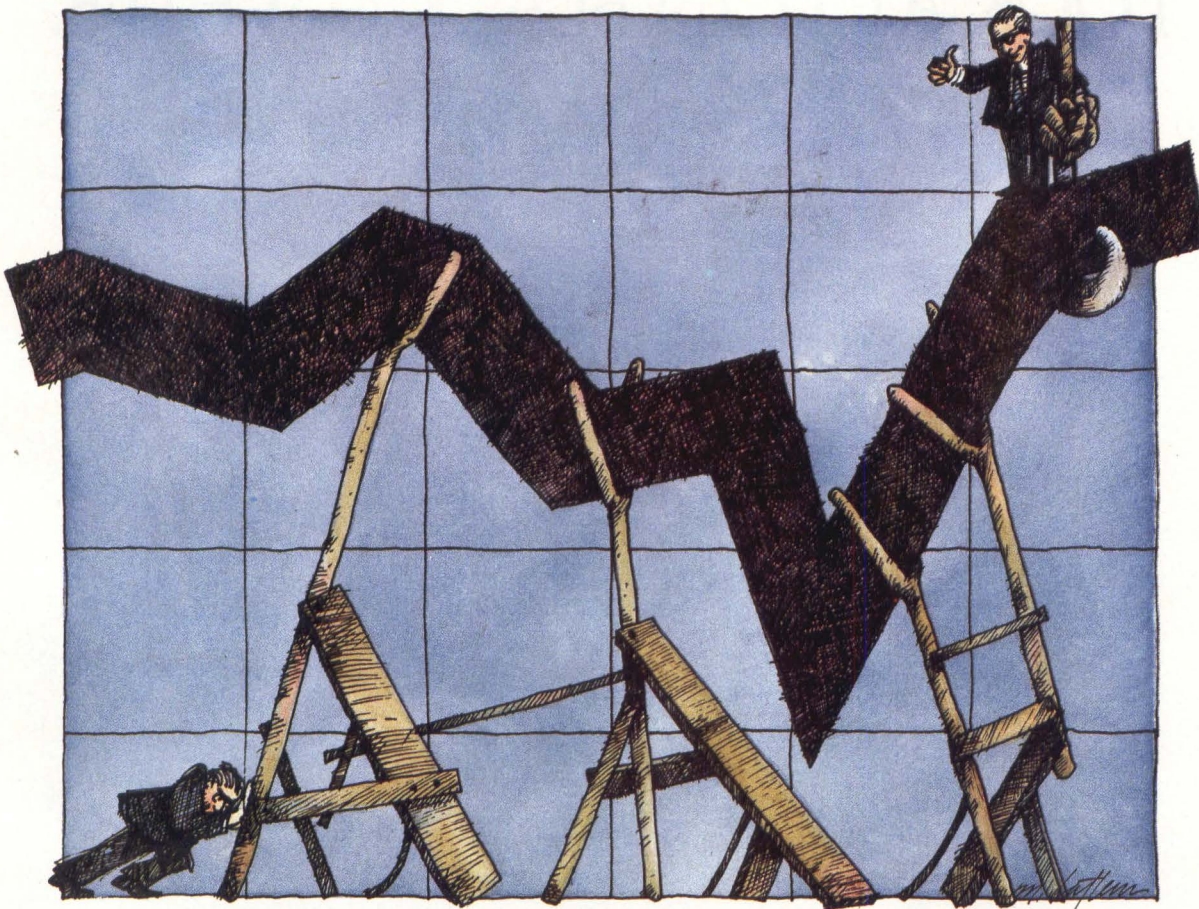
NCR Corporation, World Headquarters, OEM Marketing Division, Dayton, OH 45479. Nationwide (800) 222-1235. In Ohio (513) 445-2380. In Canada (800) 268-3966.

\*UNIX is a trademark of Bell Laboratories. \*\*Multibus is a trademark of Intel Corporation. Products for delivery in U.S.A. will comply with appropriate FCC rules.

CIRCLE NO. 33 ON INQUIRY CARD

# SUPPORT

The Micro Five Dealer Program



*Finally there's a company that supports your sales efforts with more than empty promises.*

As a Micro Five® dealer you can expect what many have promised, but few have delivered...real sales support. Support that is built around a versatile product line and whose aim is specific...to help you sell.

Our aggressive distribution system gives you the profit margins you need. And our marketing advertising and promotion (MAP) program pulls together national and local marketing efforts providing you with sales and training aids that can bolster your sales.

You'll be happy to learn that the Micro Five product line is as solid as our dealer support

program. Our state-of-the-art 16-bit microcomputer product line can help you appeal to a wider range of prospects...from the single station, floppy disk system to multi-user hard disk systems. And because the Micro Five product line supports a wide range of operating systems including CP/M, MP/M, MS-DOS, Business BASIC, MicroCOBOL and our proprietary STARDOS, there are many vertical application programs already available.

But don't just take our word for it. Put us to the test. For detailed information about how we can help you become a Micro Five dealer or distributor, call Paul Mitnick, Micro Five Corporation, at (714) 957-1517.



CIRCLE NO. 34 ON INQUIRY CARD

*Discover the Difference*

**Micro Five Computers**

# Mini-Micro World

SHOWS AND CONFERENCES

1983  
NATIONAL  
COMPUTER CONFERENCE

## NCC to highlight emerging information age

It's fitting that the 1983 National Computer Conference be held within a monorail ride of Disneyland, a legacy of the genius who manipulated technology to create fantastic art forms and new human environments. Walt Disney's fascination with the interplay between man and machine will undoubtedly be shared by the hundred-thousand-plus NCC participants expected May 16-19 at the Disneyland and Anaheim Convention Centers.

Disney would have approved of the conference theme, too. This year's subject, "The Emerging Information Age: Computers, Communications and People," will be explored through an exhaustive array of 84 technical sessions; 22 professional development seminars; and more than 600 computer hardware, software and services exhibits, films and special events. Another event to watch for, although it may be a long shot: Hollywood film crews obtaining "color" shots for the film version of Tracy Kidder's popular *The Soul of a New Machine*.

For the first time in NCC's history, the keynote address will be delivered by a computer software expert. John P. Imlay Jr., chairman and chief executive officer of Management Science America Inc., will deliver the opening address.

The technical program is divided into 11 program tracks, each chaired by a noted authority in the field. The tracks are scheduled so that an ambitious attendee could attend all in a field of interest. The program areas are software engineering; management/education; database/distributed systems; human and social issues; office automation; decision-support sys-

tems, hardware, telecommunications and applications; and personal computers. All technical sessions will be held at the Marriott Hotel. On-site registration is \$125.

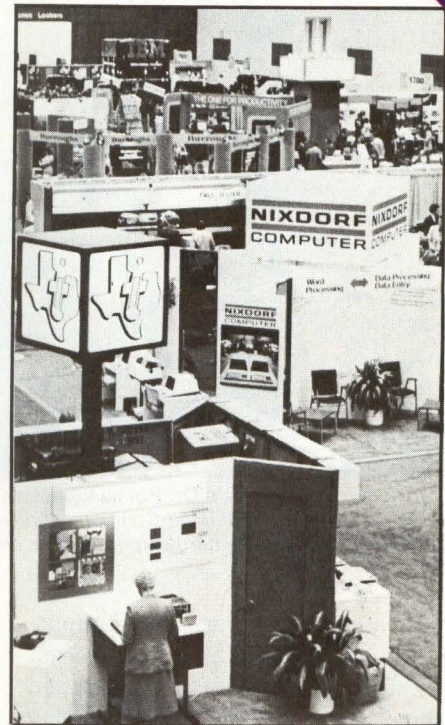
Complementing the technical sessions are professional development seminars that focus on various computer applications and professional enhancement areas. These seminars are individually priced at \$75 per day, which includes a visit to the exhibit floor. Registration is limited to 100 participants per session. The professional development seminars are to be held at the Hilton on the Park.

The 600-plus exhibits are expected to sprawl over more than 313,000 sq. ft. in the two host convention facilities. Last year, the Houston show drew more than 680 exhibitors in 311,000-plus sq. ft. and attracted about 96,000 attendees.

### Technical session highlights

Keynote speaker Imlay promises to take a humorous look at software and the future interactions of people and personal computers. The session is scheduled from 10 to 11 AM on Monday in the Anaheim Marriott Ballroom. Imlay is past president of the American Data Processing Service Organization and, in 1981, was chosen by International Computer Programs Inc. as one of 15 people who will influence computers the most in the next five years.

Artificial intelligence is seen as one way to ease the interaction of machines and humans. That interaction ranges from the computer's input device to more intuitive logical interactions with the computer. The panel "Artificial Intelligence: Blue Sky or Tools of the



Last year's National Computer Conference in Houston had more than 680 exhibitors in 311,000-plus sq. ft. and attracted about 96,000 attendees. Sponsor the American Federation of Information Processing Societies expects more than 100,000 attendees at this year's show in Anaheim. The 600-plus exhibits will sprawl over 313,000 sq. ft. in the two convention halls and six temporary buildings.

Future?" a segment of the software engineering track, will explore the origins of artificial intelligence, look at applications and discuss how research projects will lead to pragmatic applications. Session leader Roy Maxion of Xerox Corp. will focus the session on a comparison of two types of intelligent help systems: natural language or empirical associations and "knowledge-based" systems. Panel representatives include speakers from Xerox Palo Alto Research Center and Carnegie-Mellon University, both locations of artificial-intelligence research. The session is scheduled on Monday from 3:30 to 5:30 PM in Salon 1, which has a capacity of 200 attendees.

A session almost guaranteed to

# Mini-Micro World

SHOWS AND CONFERENCES



Future Computing Inc.'s Dr. Portia Isaacson (left) and Dr. Egil Juliussen will participate in two sessions of "Personal Computer Industry: The Experts Predict the Future." Future Computing projects the hardware market alone will mushroom from \$8 billion in 1983 to \$28 billion in 1988.

draw a crowd is "Personal Computer Industry: The Experts Forecast the Future," which is scheduled from 3:30 to 5:30 PM on both Monday and Tuesday in Salons F and E, respectively. Both salons hold 580 persons. The panel, led by Future Computing Inc.'s Portia Isaacson, also will include Benjamin M. Rosen of Rosen Research Inc. Future Computing projects the hardware segment of the personal computer market, which was \$4.8 billion in 1982, will increase to \$8 billion this

year and to a whopping \$28 billion in 1988. The personal computer software market will grow 700 percent from \$1 billion in 1982 to \$8 billion in 1987. The panelists will elaborate on these projections. Additionally, they will focus talks of computer retailing, international markets and competitors, start-up opportunities and portable computers around the role of IBM's PC as a de facto standard.

## Anticipated product highlights

While last year's NCC could be categorized as the year of disk drive announcements, with activity particularly hot in microfloppy drives and standards thereof, this year's show does not appear to be taking one flavor yet. Most products, however, emphasize more compactness and lower price. Listed below are products tentatively scheduled to be introduced or showcased.

TeleVideo Systems Inc. (Booth A3008) is among the microcomputer suppliers that expect portable personal computers to be in the spotlight at this year's NCC. The Sunnyvale, Calif., terminal and microcomputer manufacturer is readying its first two entries in

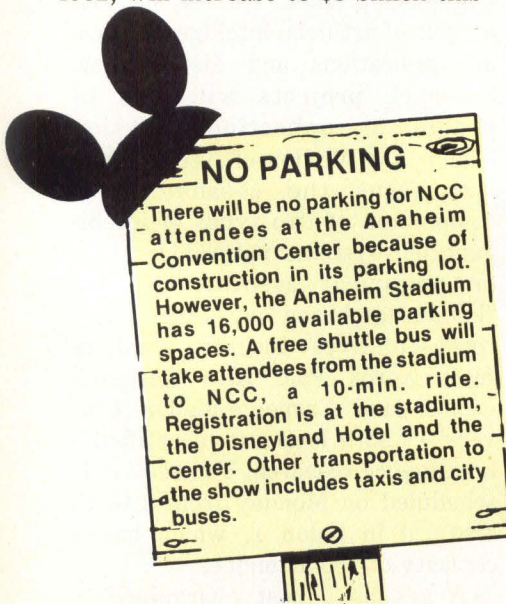
what it hopes will be a high-volume complement to the existing micro-computer market. For the 8-bit market, TeleVideo will show the TeleTote I, priced at \$1795 and including a 9-in. CRT display. For the IBM PC market, the company will offer a TeleTote II version priced at \$2795 and using the MS/DOS operating system and probably based on the Intel 8088.

Plexus Computers Inc. (Booth S5384) is getting ready to extend the "distributed UNIX" concept it developed with its multiprocessor-based supermicrocomputers. Using Ethernet local-area network controllers on its Multibus systems and alterations to the UNIX kernel, Plexus has developed a networked UNIX option.

Digital Equipment Corp., Maynard, Mass. (Booth W6028), is rumored to be working on a new personal computer, which may be featured at the company's booth. Sources indicate DEC's new offering may be an office workstation to compete with Apple Computer Inc.'s Lisa. A DEC spokesman declines comment.

British-owned Torch Computers Inc., with U.S. offices in Boston, hopes to demonstrate Supertorch at NCC. This new machine incorporates the MC68000 processor in addition to the Zilog Z80 CPU in existing Torch computers. Torch spokesman Dick Tammadge, at the company's Cambridge, England, headquarters, notes the MC68000 will enable Supertorch to host the UNIX System III operating system in addition to Torch's own CP/N system. Torch also hopes to demonstrate Econet.

Torch will appear among a group of British firms in a joint exhibit sponsored by the government-run British Overseas Trade Board (S5114). Making its U.S. exhibition debut among that group will be Future Technology Ltd., Beith,



# NoHALT

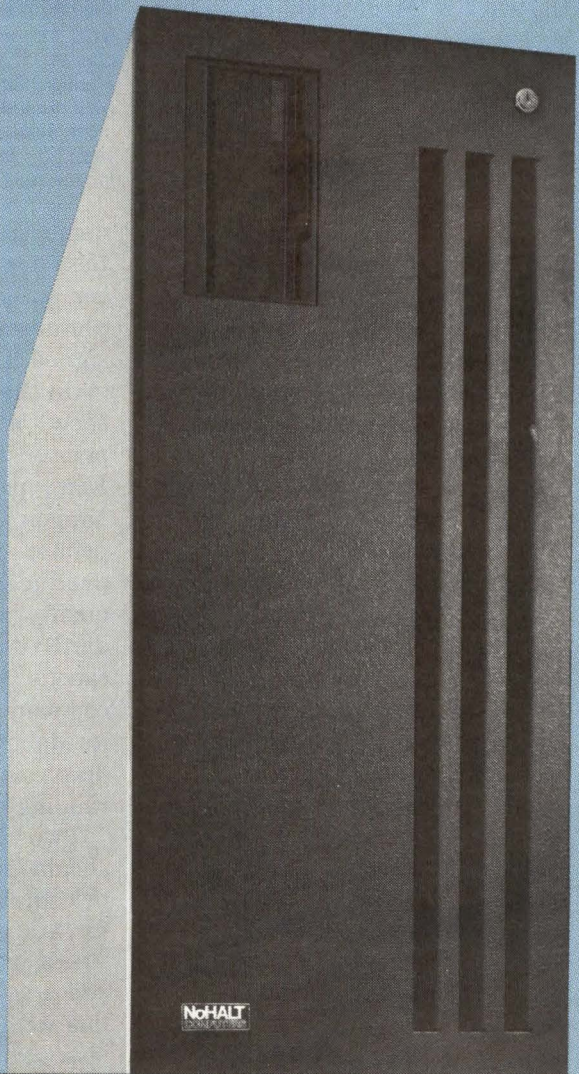
## THE MICROTANDEM COMPUTER.

**YOU CAN'T STOP IT.** NoHALT'S NH-1000 is a totally redundant system with duplicate disc drives, duplicate system control processors, *even duplicate power supplies*. Catastrophic failures can't stop it; won't even cause records in process to be lost.

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See NoHalt at Spring Comdex—Booth 147-149

# Mini-Micro World

SHOWS AND CONFERENCES

Scotland, which hopes to find U.S. computer equipment suppliers interested in its service of designing and building microcomputers on a custom basis.

A new family of MC68000-based computer systems aimed at the business market is expected to be shown for the first time at NCC by Pertec Computer Corp., Irvine, Calif. (Booth N3848). Pertec vice president of marketing Soron Litman says the systems will have a proprietary operating system called the 3700-OS. Models will range from a low-end, desk-top, single-user system with one floppy disk drive to a high-end machine with a Winchester disk drive and multi-user capability.

Convergent Technologies Inc.'s booth should feature a host computer for the company's family of workstations, which is claimed to have 8-million-instruction-per-sec. performance out of as many as 32 MC68000 microprocessors. The system will run Convergent Technologies' CTOS operating system to handle I/O, while UNIX runs in parallel under languages and application-development tools.

Newcomer Pyramid Technology plans to invite potential OEM customers to a secret Anaheim hotel suite for a demonstration of its new TTL-based 32-bit minicomputer during the show. The proprietary architecture was designed to optimize performance of UNIX operating-system software.

NEC Information Systems (Booth S5162) is readying additions to its peripherals and systems lines. On the systems side, a new model of the Astra small-business computer line will be on display. According to NEC officials, the new Astra will extend the family down to the price range of multi-user microcomputers from vendors such as Altos Computer Systems. The company will also



**NCC keynote speaker John P. Imlay Jr.**, chairman and chief executive officer of Management Science America Inc., Atlanta, was named one of the 15 people who will most influence computing in the next five years by International Computer Programs Inc. in 1981.

demonstrate new graphics capabilities for its Advanced personal computer and an Astra-based telephone-management system designed to work with any digital PBX.

On the peripherals side, NEC will show a high-density dot-matrix printer that has been used as a Kanji printer in Japan by parent Nippon Electric Co. Ltd. The printer has an 18-pin head that produces low-speed, near-letter-quality output and graphics. Standard dot-matrix printing is at speeds as high as 180 cps. The company also is expected to make its debut as a 5¼-in. Winchester disk supplier with five models ranging from 6M to 25M bytes.

Two Japanese manufacturers should introduce low-speed, low-priced, daisy-wheel printers in time for NCC. Ricoh of America (Booths P7835, P7837, P7839, P7841) should add a 20-cps machine to its printer line with a target price of \$1200 or less. Prototypes of the new printer have been demonstrated privately by Ricoh, and it is believed that initial deliveries could be as early as May. The previous lowest priced

model was a 35-cps \$1800 machine. Fujitsu America Inc. (Booth W6478) should unveil a new 35-cps, daisy-wheel printer at NCC with an as-yet-undetermined price.

NCC likely will see the U.S. debut of two 80-column matrix printers from Siemens Corp., Anaheim, Calif. (Booth W6458). Both are called PT88. They differ in one fundamental respect—printing technology. One model comes with a needle print head for generating multiple copies and runs at 80 characters per sec., while the other employs non-impact ink-jet printer technology, achieving a speed of 150 cps. Wolfgang Weikl, vice president of the Siemens Terminal division in the U.S., quotes single-quantity prices from \$800 and volume prices of less than \$500.

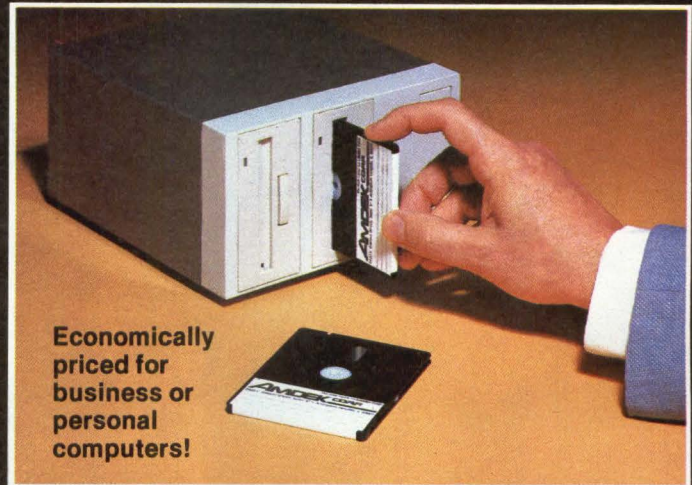
Control Data Corp. (Booth S5428) is expected to become the second major disk drive manufacturer to endorse the industry-committee-proposed 3½-in. microfloppy disk standard started at last year's NCC. Shugart Associates endorsed the standard last fall. CDC's 3½-in. floppy, code-named "Jimminy," is expected to be introduced at NCC along with a companion 3½-in. Winchester code-named "Cricket."

Seagate Technology officials will not comment on reports that the company will show its first 3½-in. Winchester drive at NCC. A prototype of the 5M-byte drive was shown privately at last year's fall Comdex show, shortly after Seagate announced plans to license rights to manufacture a 3¼-in. floppy drive designed by Tabor Corp. Expected from Tabor is a double-sided version of its 3¼-in. drive providing as much as 1M byte of storage. Shugart (Booth N3856), Tandon Corp. (Booths P7057, P7059, P7061) and Miniscribe Corp. (Booths D2118, D2120, D2122) also are expected to show a 3½-in.

# New Amdek 3" micro-floppydisk drive system!

## AMDISK-III . . . the engineer's choice:

- New 3" hard plastic encased diskette.
- Up to 1 megabyte storage. (unformatted)
- Plug-in compatible with 5¼" drives.
- Compatible with - IBM-PC.



Economically priced for business or personal computers!

### Specifications

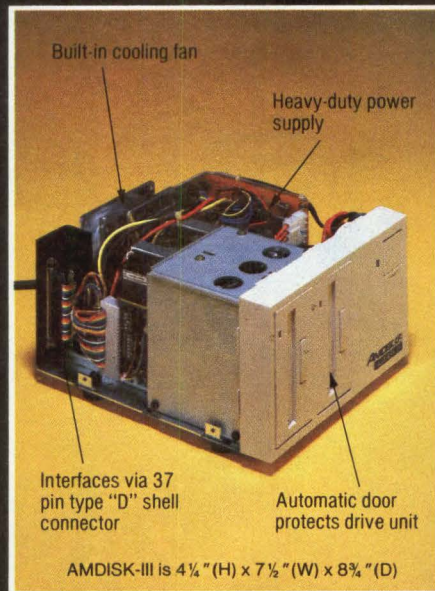
	Unit	Double Density
<b>Capacity</b>		
Unformatted Per Surface	Bytes	250K
<b>Media</b>		
Record Surfaces	2	
Tracks	80	
<b>Recording</b>		
Max Recording Density	Bpi	8946
Track Density	Tpi	100
Transfer Rate	bits/sec	250K
<b>Access Time</b>		
Average Access Time	msec	55
Track to Track	msec	3
Setting Time	msec	15
Average Latency Time	msec	100
Motor Start Time	sec	1
Disk Speed	rpm	300
<b>Reliability</b>		
Error Rates		
Soft Error		10 <sup>-9</sup>
Hard Error		10 <sup>-12</sup>
Seek Error		10 <sup>-6</sup>
<b>Media</b>		
	3 inch Cartridge	
<b>Drive Interface</b>		
	Plug Compatible with 5.25 inch FDD	

### External Interface

Connector: 37-pin "D" shell connector

Pin No.	Signal	Pin No.	Signal
1-5	Unused	13	Write data
6	Index	14	Write enable
7	Motor enable C	15	Track 00
8	Drive select D	16	Write protect
9	Drive select C	17	Read data
10	Motor enable D	18*	Select head 1
11	Direction	19	GND
12	Step pulse	20-37	GND

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Built-in cooling fan

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AMDISK-III is 4¼" (H) x 7½" (W) x 8¼" (D)



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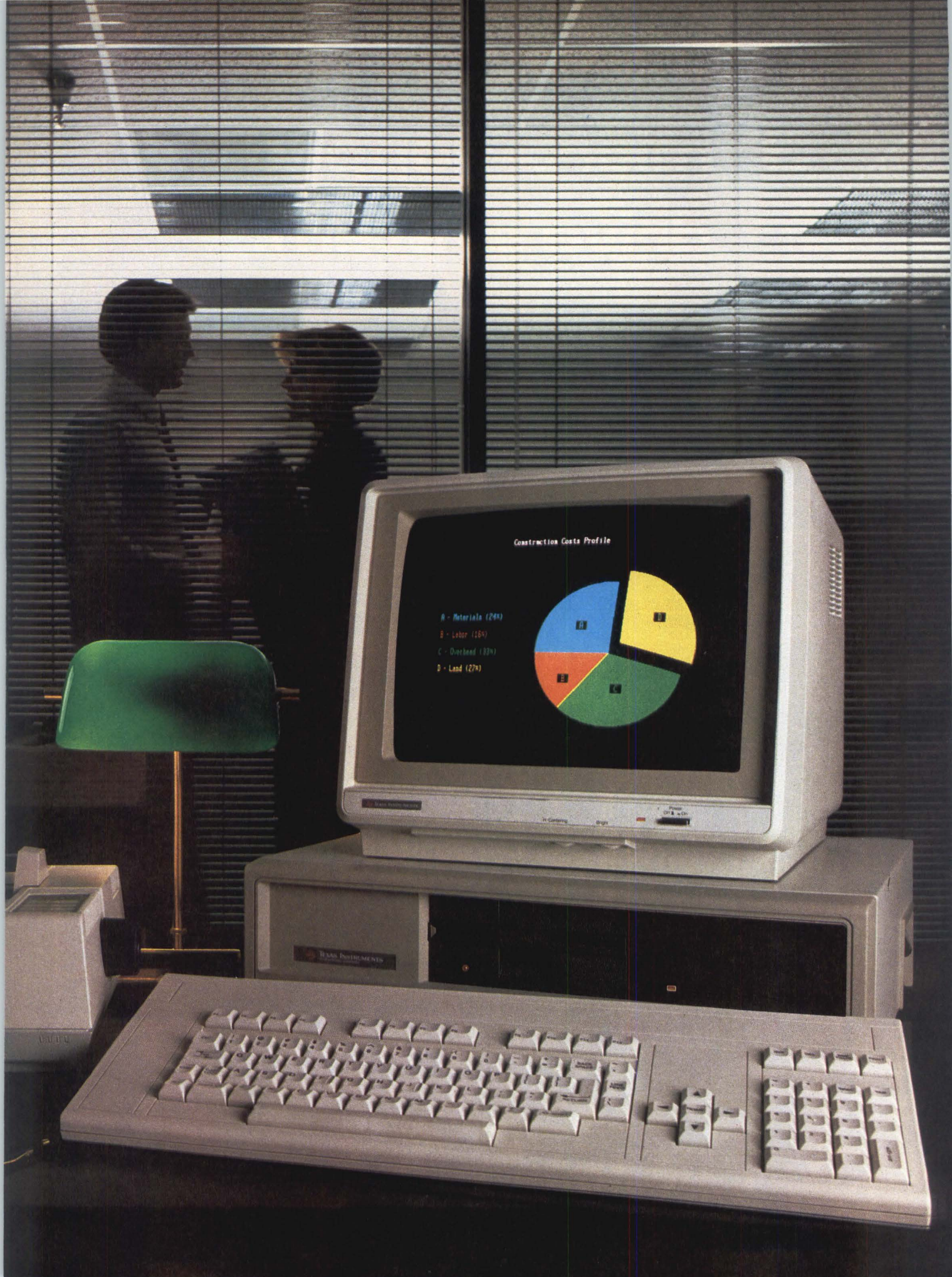
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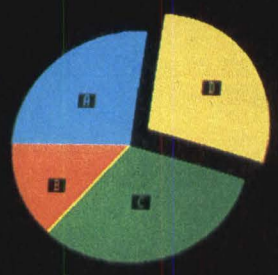
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- A - Materials (24%)
- B - Labor (18%)
- C - Overhead (32%)
- D - Land (27%)





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**It works with you and your system.** The new TI Professional Computer has the memory, the software and the user-friendly design that will quickly help the unsophisticated user become more productive. Its versatile communications capabilities enable it to work well with mainframes and office automation systems.

**High resolution displays with dedicated memory.** You get brilliant full-color or monochromatic graphics and text displayed with extremely high resolution. And

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Future enhancements will include speech recognition, speech synthesis, telephone management, natural language query capability with a true relational data base package. All this means greater productivity in your company today and tomorrow.

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### SPECIFICATIONS

#### System Unit

16-bit, 8088 microprocessor  
64K byte RAM, expandable to 256K bytes  
4K byte graphics display memory  
5-slot expansion bus

#### Keyboard

Specially designed low profile  
Popular typewriter layout  
97 keys, including 12 function keys  
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12-inch monochrome (green phosphor) or  
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3270 BSC and SNA cluster (Fall 1983)

#### Operating Systems

MS™-DOS, Digital Research™ CP/M-86®, and  
Concurrent CP/M-86™, UCSD p-System™

#### Languages

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#### Applications Software

Over 100 programs available from the most  
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#### Printers (Available Spring 1983)

150-cps TI 850 Series for most applications

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DCA31BMY313C

# Mini-Micro World

SHOWS AND CONFERENCES

Winchester drive.

SyQuest Technology is set to introduce a second generation of its pioneer 3.9-in. cartridge drive, doubling the capacity to 12M bytes. The new drives will use the same

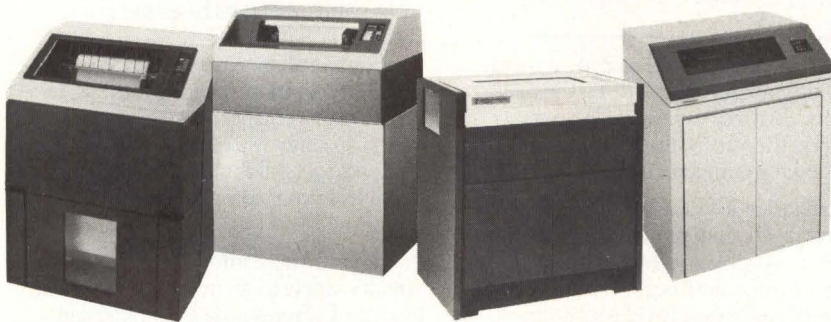
form factor and interface as the original. SyQuest will also introduce its first fixed media drive, a 25M-byte, 3.9-in. product.

Digital Research (Booth w6258) president Gary Kildall confirms that

the company has had a visually oriented user interface program similar to Visicorp's Visi<sup>on</sup> running in-house since January and will introduce it at NCC. The interface allows simultaneous display of several programs running under concurrent CP/M. Kildall says the DRI version, which, like Visi<sup>on</sup>, is designed to provide a common front end to a variety of application programs with an extensive window-management capability, will be slightly less capable than Visi<sup>on</sup>. He says Digital Research's user shell will run on an IBM PC configuration less expensive than required for Visi<sup>on</sup>. One twist to the visual interface is that it will be accessible through the firm's new DR Logo interpreter.

A local-area network product will be on display at the Computer Automation booth (S5340), at which the company's Commercial Systems division will introduce an Intel 8088-based workstation for CA's SyFAnet broadband cable network. In a network with CA's SyFA minicomputers, the new workstations can execute standard CA applications running under the CyCLOPS operating system or can run CP/M-86 applications. The SyFA minis have been adapted to serve as network resource managers for the new desk-top terminals and support IBM SNA connections to remote mainframes and other systems. SyFA customers will be able to upgrade their minis to network controllers with eight workstations for about \$30,000. A new system including the SyFA processor and the eight workstations would be \$51,000.

## SUPER PRINTERS FOR SUPER MINIS AT SUPER SAVINGS.



SYSTEM*	DEC VAX	DG MV	HP 3000/64		PRIME 50 Series	PERKIN-ELMER 3200
Model #	LP-27	4373/4374	2611A	2619A	3166	M46-304
You Save	\$8040	\$9750	\$5605	\$8205	\$4625	\$3495

\* Also IBM, Wang, Honeywell and other high-performance machines.

Mix and match any of our high-performance printer systems with your 32-bit minicomputer and get low price; guaranteed plug-compatibility; 30-day delivery and nationwide service and support.

Digital Associates offers the only complete line of heavy-duty, high-speed line printers capable of multi-shift operation at speeds

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CIRCLE NO. 38 ON INQUIRY CARD

—compiled by Lori Valigra; reported by David A. Bright, Edward S. Foster, Keith Jones, Geoff Lewis, Robert A. Sehr, Stephen J. Shaw and Kevin Strehlo

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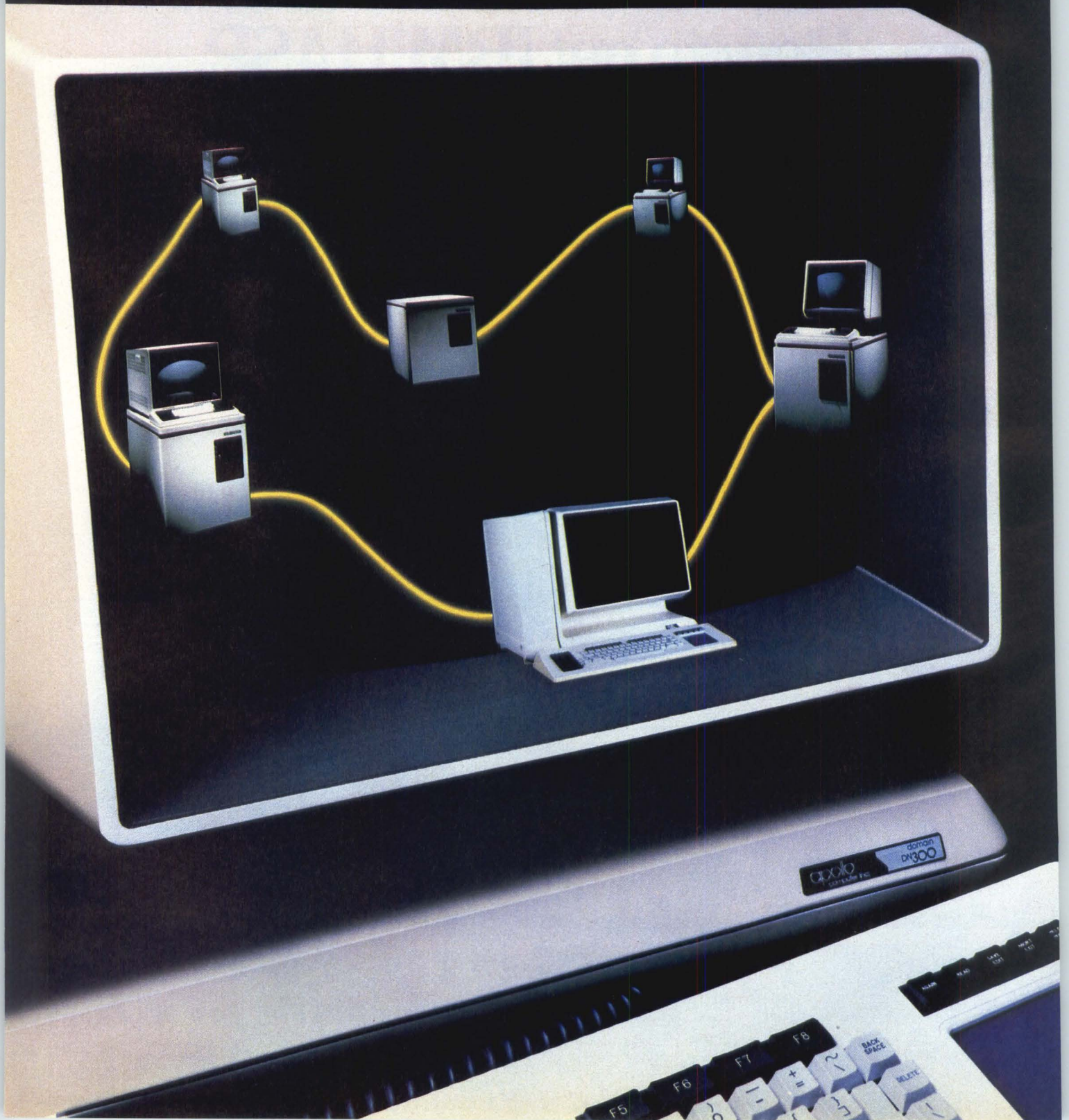
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The DN300 is quite possibly the single most important computer system ever introduced for the technical professional. For the first time ever, these technical professionals have fingertip access to a desktop mainframe, and all the power that goes with it. The power to utilize time in the most efficient possible way. The power to increase technical productivity and innovation. The power to try out and refine new ideas and concepts. The power to reduce design-time cycles. The power to create better, more cost-effective products.

In a unit that takes no more space than a daily newspaper, the DN300 gives you a high performance, 32-bit virtual memory processor, high resolution bit map graphics, and an integrated local area network that provides network-wide virtual memory access.

The DN300, latest in the family of DOMAIN processing nodes, supports up to 1.5 million bytes of main memory and 15 concurrent processes of 16 million bytes each, so you can execute large programs. Its 17-inch 1024 x 800 pixel landscape display provides the high-resolution graphics you need for technical

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The DN300 is fully compatible with Apollo's DN400, 420, and 600 and supports multiprogramming environment, large virtual address space, network communications, multi-window display management, and extensive command library.

## SOFTWARE YOU NEVER THOUGHT YOU'D SEE ON YOUR DESKTOP.

Standard with every DN300 is AEGIS, the only network-wide virtual memory operating system available.

Optional software includes ANSI-FORTRAN 77, Pascal, C, SIGGRAPH Core Graphics, X.25, HASP, 3270, D3M distributed database system and AUX, a software environment based on UNIX™ System III.

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That relieves individual nodes of peripheral support. So nodes have more time and more power to handle applica-

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And you save money by sharing disks, tape drives, printers and plotters. The DSP80 also provides every user with access to communication gateways, large-scale file storage, and print/plot spooling.

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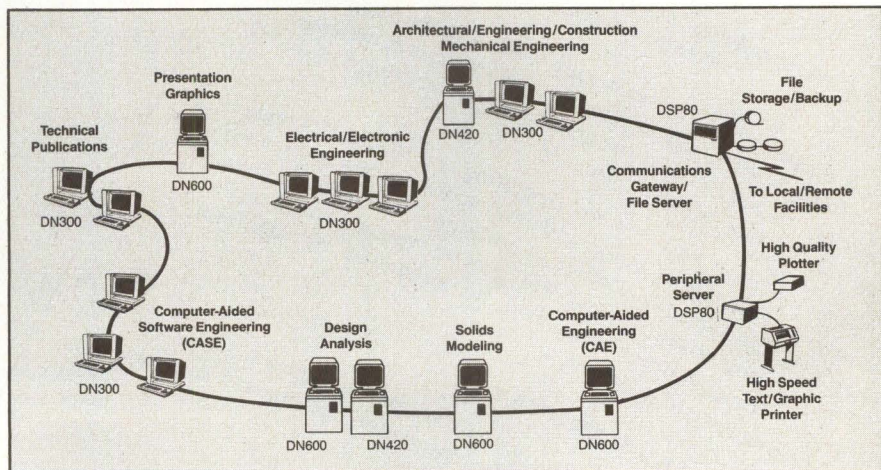
UNIX is a trademark of Bell Laboratories.

USA price \$9,933, system builder, quantity 35 DN300 with .5Mb memory, 17-inch graphics display, network interface, and AEGIS operating system.

## A DOMAIN professional productivity network puts an application specific mainframe on every user's desktop.

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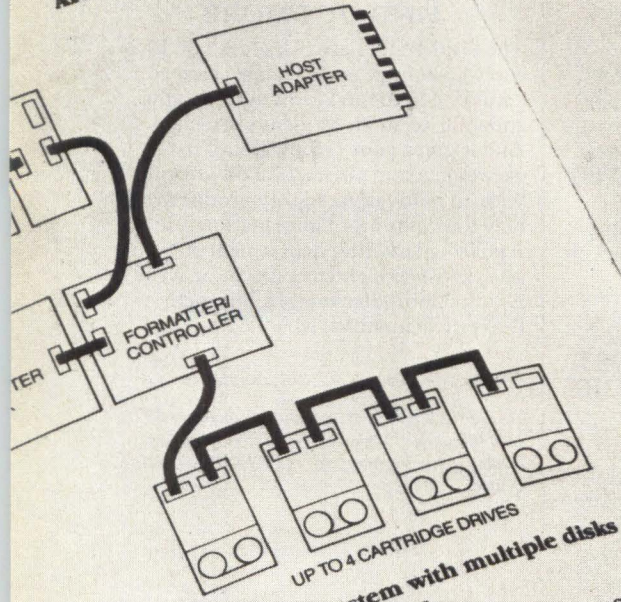


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**Figure 8-1 Mass-storage system with multiple disks and tape drives.**

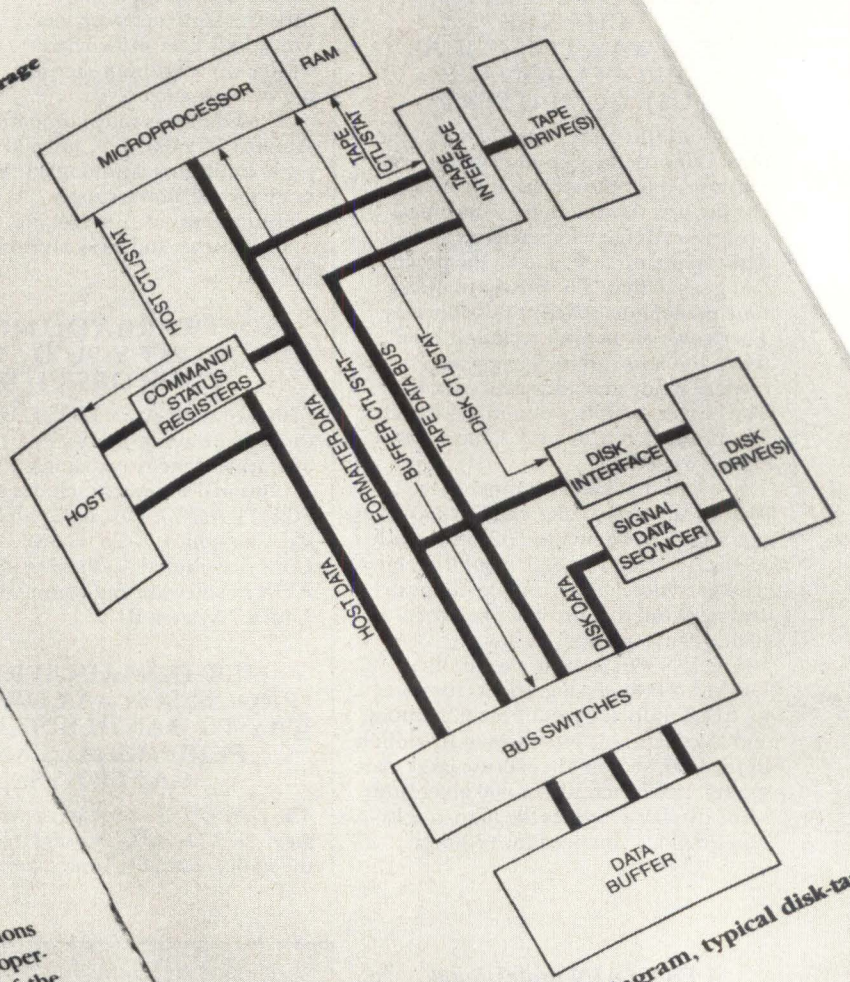
Integration requirements are generally limited to modifications in the existing disk I/O driver and optional changes in the operating system or application programs to take advantage of the combined disk-tape architecture.

Communication between the operating and storage system is through a sequence of commands and status reports relating to both disk and tape. A number of additional daisy-chained disks, in any combination of capacities, can be typically added to the system. Tape storage can also be expanded by additional streaming-cartridge drives.

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The on-board microprocessor shown in Figure 8-2 controls the flow of data through the controller circuitry but does not

**Disk-Tape Storage**



**Figure 8-2 Block diagram, typical disk-tape**

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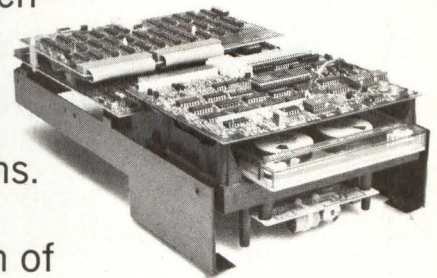
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# Mini-Micro Interpreter

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

## Array-processor vendors calculate on market growth, product diversity

By Dwight B. Davis

Since the mid-1970s, the array-processor market has been relatively small, with respectable growth rates and limited competition. While still small compared to some other computer markets—in the \$125-million ballpark for 1982—the commercial array-processor market has recently become the scene of impressive performance and price breakthroughs. And, with promises of even more spectacular product developments on the horizon, the key vendors of these arithmetic peripherals believe array processors will gain widespread acceptance among customers that previously were ignorant or indifferent about these specialized machines.

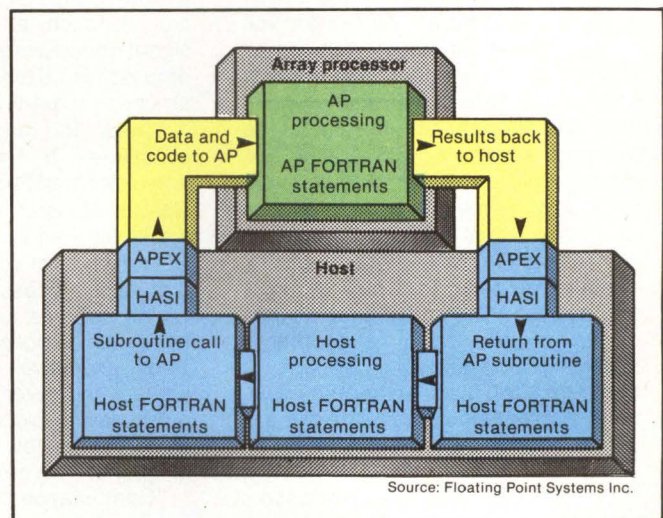
Floating Point Systems Inc., Portland, Ore., has reigned as undisputed leader in the array-processor field for several years, and its products, especially the 38-bit AP-120B, have traditionally been the flagships of the industry and the main targets of competitors. But the array-processor market was never simple, and its makeup is growing more complex. While some vendors focus on making more powerful and less expensive alternatives to the AP-120B, others are pioneering territory not yet conquered by FPS. Still other companies, swayed by neither FPS's product lead nor its name, have avoided the full-floating-point approach, and have built block-floating-point or fixed-point array processors (see "Different approaches to different problems," p. 72).

With its \$86 million in revenues constituting about 70 percent of the array-processor market, however, FPS is still the one to beat. The company's 38-bit processors range in base price from about \$30,000 to \$100,000, and the 64-bit FPS-164 typically sells for about \$400,000. Competing with some of these products are processors from such vendors as CSP Inc., Billerica, Mass., and Analogic Corp., Wakefield, Mass.—both claiming second place behind FPS in the market—and Computer Design & Applications, Newton, Mass. These ensure that no vacuum exists between the Sky and the Star-Sky Computers Inc., Lowell, Mass., which sells board-level, 1-million-floating-point-operation-per-sec. processors, and Star Technologies Inc., Portland, Ore., which has just introduced a 100-MFLOPS machine.

Regardless of product specifications and main market niches, array-processor vendors all sell the same idea:

computational speed far beyond that available from customers' host processors. If the host is a microcomputer, the vendors promise superminicomputer performance through the addition of an array processor. If the host is a minicomputer or a superminicomputer, processing speeds common only in the rarified world of Cray and Cyber machines are sometimes claimed. And, although these quantum leaps in performance are restricted to the complex arithmetic functions array processors address, the gains come at prices much more palatable than those of stand-alone computers that the array processors challenge in speed.

It was only about six years ago that programmable array processors began supplanting their hard-wired predecessors. But if programmability gave the devices newfound flexibility, it also opened a Pandora's box of conflicting opinions. Both sides of the programming dilemma are articulated by David Birkner, vice president of engineering at Computer Design & Applications, which sells array processors as OEM and end-user units and bundles them into systems for sale into such applications as medical image processing. "When you've got an array processor, the whole reason you bought it



**Communications with Floating Point Systems' array processors** occur through the host/array processor software interface (HASI) subroutine, which resides in the host computer, and with an FPS library of host-resident routines called the array processor executive (APEX). These transfer program code and data to the array processor, inform the host program when the array processor has finished a task and return results to the host.

# The Interpreter

is for efficiency and speed," Birkner says. "And you're really fooling yourself if you think you're getting all the efficiency and speed out of it with a FORTRAN or other high-level language compiler." On the other hand, Birkner opines, "The array processor is there for performance, but, at a certain level, it comes down to how much time you are willing to put into programming to get that performance."

The problem reduces either to using a FORTRAN compiler—sacrificing program efficiency while simplifying the programming task—or to programming in a more difficult, but more efficient, lower level language. The options for customers preferring the former route are few—so far, only FPS offers a FORTRAN compiler on some of its machines.

FPS views the FORTRAN compiler as a way to attract less sophisticated customers, but Birkner considers it to be a "crutch" that FPS must supply because of the difficulty of microprogramming its machines. He believes the assembly-language programming available with CD&A's MSP-3000, a task "very similar to programming a PDP-11 in assembly language," represents a good compromise between a FORTRAN compiler and microprogramming.

Several other vendors, however, anticipate customer demand for FORTRAN compilers and plan to introduce them. A recent spin-off of CNR Inc., Numerix Corp., Newton, Mass., plans to add a full-floating-point array processor to its fixed-point line this month. Harold Messias, vice president of marketing and sales at Numerix, says the new machine will have between 200 and 300 math library functions on introduction. "We consider a FORTRAN compiler an absolute necessity for array processors," he says.

Messias admits FORTRAN compilers are rarely used with array processors because of efficiency problems but says it's possible to build a compiler with the required efficiency. For dedicated OEM applications in which an array processor performs just one task, there is no need for such compilers, he says. "But there's a much bigger class of people that wants to do a large number of things with array processors. There, it's more important that they can program in a reasonable amount of time and get a reasonable amount of efficiency. If there's a specific application that they really want to optimize, then they can march on down to some lower level languages."

Along with program efficiency, communications effi-

## DIFFERENT APPROACHES TO DIFFERENT PROBLEMS

The term "array processor" encompasses a diverse product spectrum of parallel architecture, pipelined devices. The best-known representatives of the genre are 32- and 38-bit machines that perform full-floating-point calculations. In floating-point notation, the number 493 might be expressed as  $4.93 \times 10^2$ . Adding two floating-point numbers with different radix exponents requires that the decimal point of the smaller expression "float" to the right until the exponent equals that of the larger expression. Array processors, as their name implies, perform algorithmic operations on arrays or vectors of numbers. In full-floating-point systems, each of the numbers involved in the calculation is represented by an exponential expression.

Full-floating-point array processors are highly precise and serve in seismic-, image- and signal-processing applications. But assigning an exponent to every number in calculations such as complex Fast Fourier Transforms and matrix inver-

sions can slow the processing of these machines. For applications in which high-speed processing is crucial, such as radar and sonar signal processing and video picture processing, fixed/block-floating-point processors are sometimes used.

There is debate as to what constitutes a fixed-point processor versus a block-floating-point machine. Harold Messias, vice president of marketing and sales at Numerix Corp., says his company's MARS-132 and -232 processors are fixed point, as, he believes are the products sold by Signal Processing Systems. SPS chief executive officer Joseph R. Fisher, however, says his firm's products are block floating point and says very few true fixed-point programmable array processors exist.

"Computationally, the machines are fixed point," Fisher says of the SPS line, "but when you do FFTs or other operations, they compute an exponent on each block of data." This single exponent per block—the requirement of a block-floating-point

machine—requires little processing time compared to full-floating-point operations, Fisher says. But it also prevents overflow and underflow problems that could result in a fixed-point machine if the calculated results surpass the word size of the array processor.

Word size is one other fundamental difference among array processors. The machines are traditionally in the 32-bit-word category, although Floating Point System Inc.'s basic product line uses a 38-bit-word configuration. Word size has little to do with speed—32-bit array processors range in speed from 1 to 100 million floating-point operations per sec.—but the length of the word can limit the usefulness of some processors for working on very large arrays that require very high precision. Scientific and simulation applications sometimes demand more than 32-bit machines can supply, and two companies—FPS and CSP Inc.—have introduced 64-bit machines for these markets.

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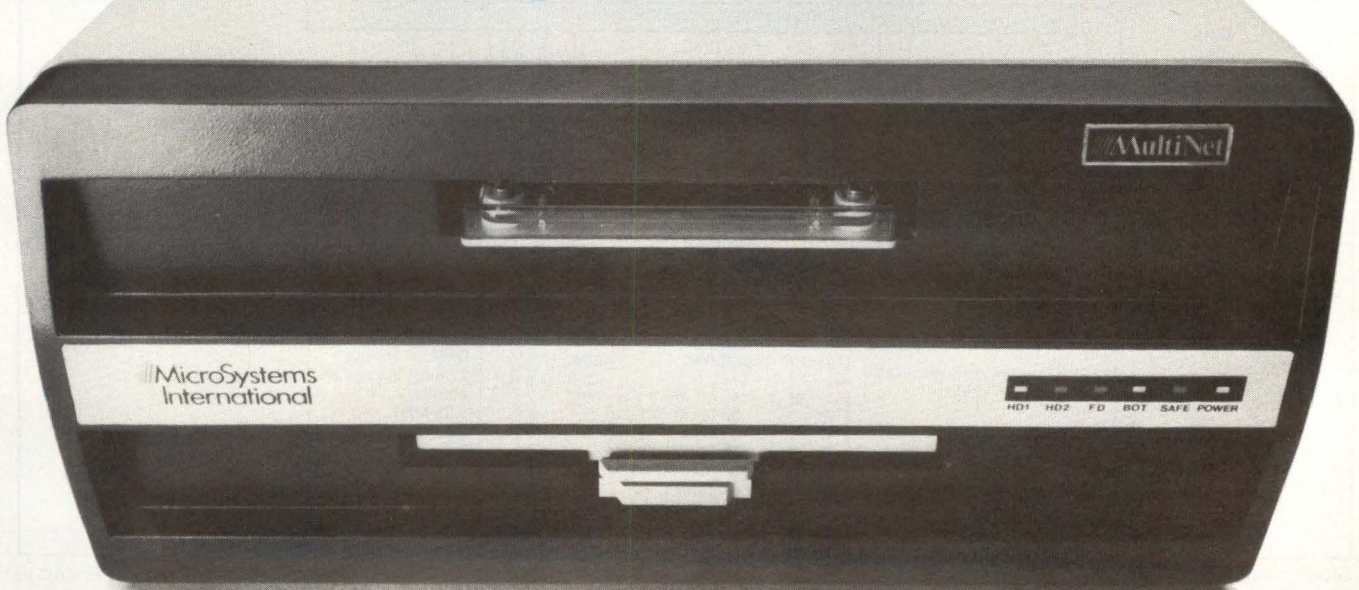
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# The Interpreter

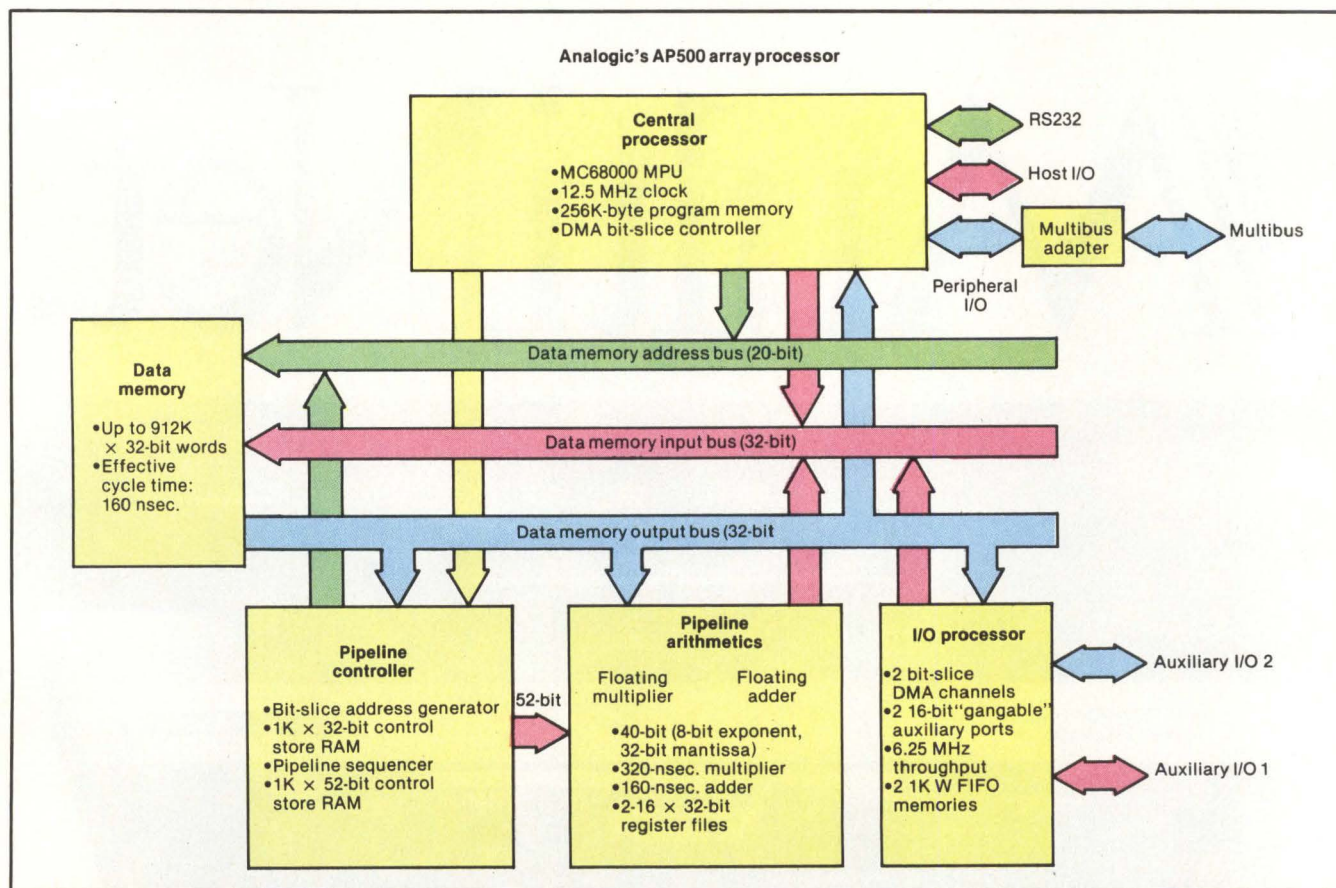
ciency between host and array processors is crucial to good performance. In traditional array processor/host systems, a host-resident FORTRAN program issues subroutine calls to send instructions and data to and from an array processor (see illustration, p. 71). Data can come from the host's main memory or from peripheral storage devices. If communications channels are slow or poorly designed, the inefficient data flow can restrict the array processor's performance.

In a major step away from the traditional programming relationship, FPS designed its FPS-164 attached processor to operate in a highly independent fashion. "The 164 takes the entire program from the host and computes on it," explains Bob Schuhmann, vice president of marketing at FPS. Whereas a traditional subroutine would rarely exceed 2000 words, Schuhmann says, the FPS-164 is ideal for large-batch FORTRAN programs, and, Schuhmann estimates, "80 percent of all the large FORTRAN jobs in the world are still batch."

Some competitors question the FPS-164's usefulness in handling highly interactive real-time applications, which might require substantial host/array-processor interaction. But the FPS-164's high independence from its host represents a growing trend in the industry.

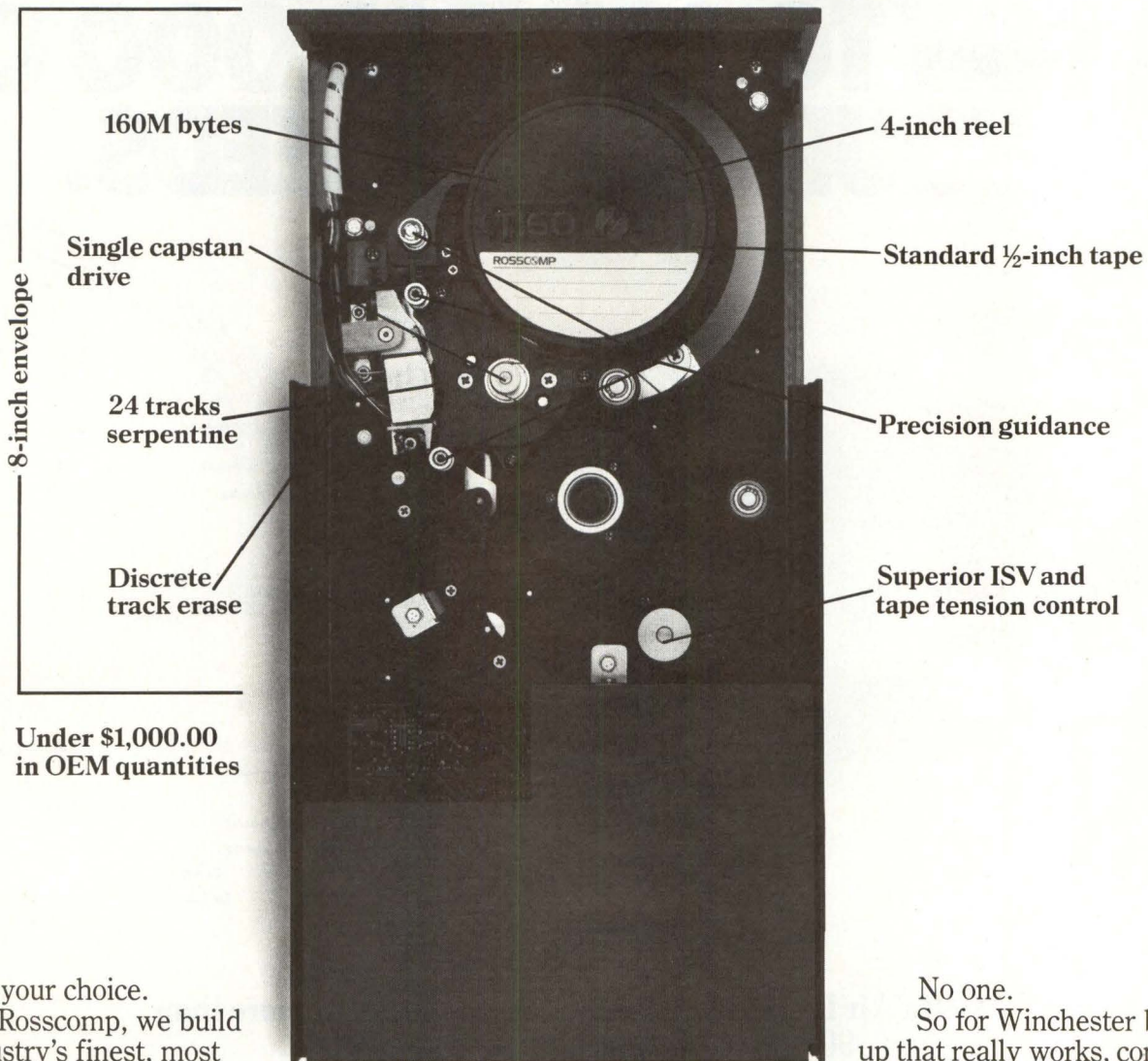
Analogic's AP500, for example, slated for availability last month, was designed to answer two problems common with array processors—overloading the host and a lack of I/O ports—says Roy Clites, Analogic's Computer Systems Division manager. To correct the first problem, he says, "You can block-transfer very large messages down into the array processor and off-load the host." For the I/O limitation, he adds, "In addition to the host port, we put an RS232 port in for remote diagnosis and development programming, two high-speed auxiliary ports, each running at 6 MHz, and a Multibus port for peripheral attachment." (See illustration, below)

The blurring of the host/array-processor relationship—evident in the increased intelligence and indepen-



Block diagram indicates the AP500's parallel architecture, dominated by an MC68000 microprocessor and a 12.5-MHz clock. Priced at \$25,000, the basic AP500 includes 16K words of 32-bit memory, 128K bytes of program memory, 16K bytes of EPROM and an intelligent interface DMA controller.

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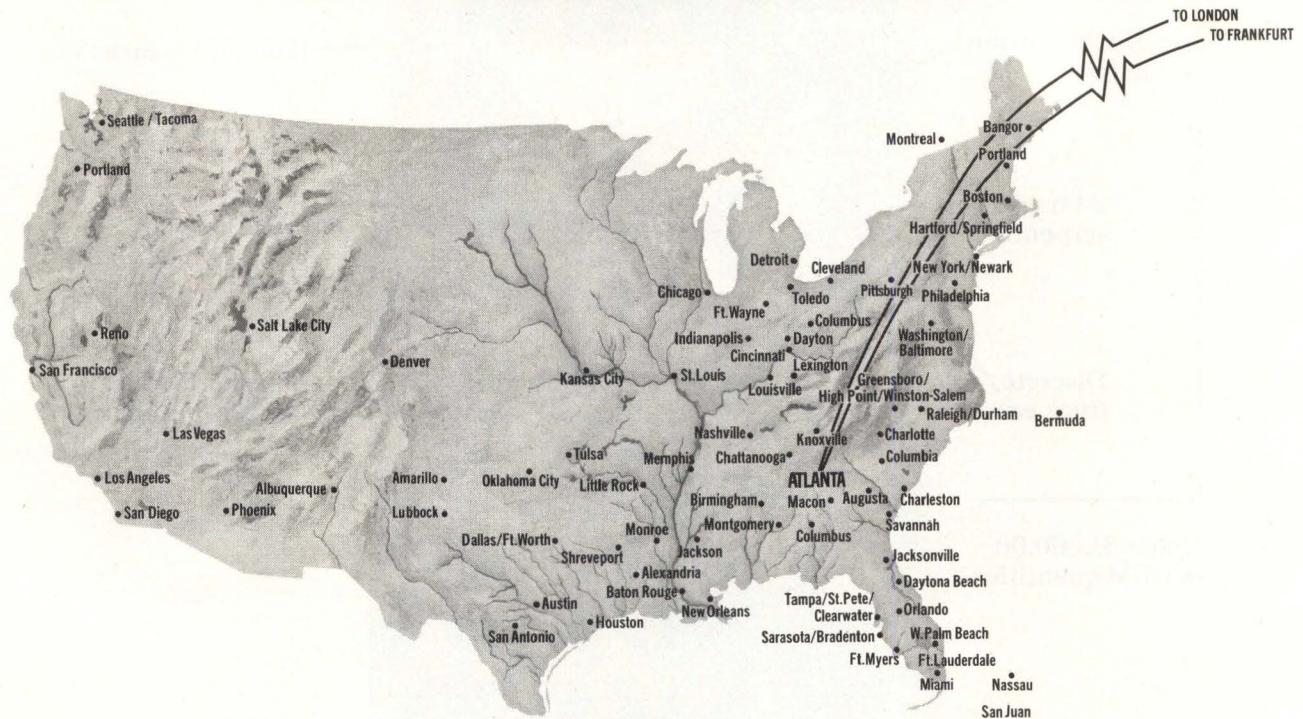
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dence of machines such as the FPS-164 and the AP500—reaches its peak in the block-floating-point devices sold by Signal Processing Systems, Waltham, Mass. Joseph R. Fisher, chief executive officer of SPS, takes the concept of array processors as arithmetic peripherals to host minicomputers and turns it a full 180 degrees. "At the high speeds where we're involved, we really depart from the concept of a host and an attached processor," Fisher says of SPS's block-floating-point products. "Our processors are attached to a general-purpose computer, which supplies various support functions. Our processor does the work and the I/O. The minicomputer, which is really more like a smart controller, is perhaps sending over a few parameters, perhaps monitoring the output, but is very much out of the process."

With SPS's customers, who often want to fill military applications, "It's not an issue of having an XYZ computer and wanting to know what to attach to it to make it go faster," Fisher explains. "Rather, our customers decide they want to buy an SPS processor, and then they might ask us what kind of a minicomputer they should hang on it to support it effectively."

## Keeping memory up to speed

Few other array-processor vendors take as radical an approach to the host/array-processor relationship as Fisher, but all are concerned about optimizing their devices' interaction with the host memory and disk storage. CSP Inc. is a proponent of a shared-memory approach to avoid the delays sometimes associated with direct-memory access, says Martin Schrage, CSPI marketing manager. "With shared memory, the array processor's memory is on the bus of the host computer," Schrage explains, "and either the host CPU or the array processor is able to access that memory as if it were its own." He says this approach cuts 2 to 10 msec. of operating-system overhead associated with setting up a DMA transfer and can reduce the cycles required to move data from a disk to the array processor's memory. "With shared memory," Schrage explains, "you can read the disk directly to the array processor," rather than read data from the disk to the host memory and then into the array processor memory. CSPI's products, ranging from the board-level Mini-MAP to the 64-bit MAP-6400, all offer optional shared memory.

Birkner at CD&A agrees shared memory has some advantages in real-time applications, but notes that setting up shared memory under an operation system "is not a trivial task." CD&A refers to shared memory as dual-port memory, and Birkner notes, "It's not a situation where you just sell somebody an array

processor, and they start using the dual-port memory. Even under a simple operating system like RT-11, you cannot force a FORTRAN program to put a particular data array in a specific address. That means you can't have a shared memory at a specific address and expect to access it in any easy manner." Only about 10 percent of the customers offered shared memory actually implement it, Birkner says, because of the difficulty in programming its use.

In still another approach to memory management, Sky Computers' board-level Skymnk array processors use the host's memory. "Our approach is simpler than shared memory," says John Dunn, Sky's marketing manager, "because we just use whatever memory exists in the host. This approach isn't really a burden on the host memory because whatever data you're operating on is going to be there anyway."

Sky has the low end of the array processor market virtually to itself, and its higher end competitors agree that total dependence on a host's memory is acceptable in the performance range addressed by Sky. As processor speed increases, however, the consensus seems to be, the more array processor memory available, the better.

## Hot issue or nonissue?

Aside from promoting the shared-memory concept, CSPI is also an ardent proponent of the advantages of asynchronous architecture. Aside from Sky, which, Dunn says, also uses an asynchronous approach, CSPI is a lone voice heralding the benefits of asynchronous architecture. Schuhmann of FPS and others claim it was the choice of the uncommon asynchronous architecture that initially caused product reliability and availability problems for CSPI. Both Messiah of Numerix and Birkner of CD&A call asynchronous architecture a "nightmare."

SPS's Fisher, on the other hand, proclaims, "It's time to discard the synchronous/asynchronous comparison. It's totally inappropriate for anyone to categorize processors as synchronous or asynchronous," he says, "and the people who so classify the processors don't really understand the issues."

Despite Fisher's condemnation, the synchronous/asynchronous debate still has its vociferous participants. Schrage at CSPI admits the MAP processor's asynchronous architecture is difficult for some programmers to adopt, but he denies that the product line's early problems were related to the asynchronous design. He notes that CSPI has installed 600 to 700 MAP processors since the "ancient history" of the products' problems, and claims the benefits of asynchronous

# The Interpreter

architecture are real and very important.

In synchronous machines, Schrage says, arithmetic and addressing operations are typically coupled by one microcode field. "With asynch, we decouple that," he says. "The arithmetic operations are controlled by one assembly language field, and the addressing is controlled by another assembly language field. Programmers write them independently of each other, so programming is simpler." Schrage says this decoupling also permits CSPI to make system component swaps, such as adding a faster multiplier, without changing other system components.

Another advantage of asynchronous architecture, he says, is constant run times for any algorithm. "If you examine a standard software library from FPS, you will notice they give run times that vary—best case, worst case, normal case," Schrage says. "This arises from the fact that, on a synchronous machine, the memory system is interleaved, and the performance you get on any given algorithm depends on where the arrays are and how they line up in memory." In CSPI's asynchronous machines, Schrage says, "We isolate the arithmetic unit from the memory with data queues, so the run times are always the same." This regularity simplifies a programmer's task of writing software for optimum performance, he says.

But Birkner of CD&A points out that almost all processors have some asynchronous architecture and the proper mix of synchronous and asynchronous is the best of both worlds. CD&A's MSP-3000 is synchronous on the gross level, he says, in that it operates under the control of a common clock. But, he says, the processor is asynchronous in that it has different memories that operate at different speeds. With this combination of synchronous and asynchronous operation, "The programmer never has to worry about basic hardware pieces of timing or basic memory-sequence timing, yet the stacks and the FIFOs will try to keep everything as busy as possible," Birkner says.

## Stretching the limits

Architecture questions aside, all competitors in the market envision more processing speed for customers in different niches—both the microcomputer users addressed by Sky and the superminicomputer users targeted by FPS, CSPI and others. A recent entrant in the market, tracing its management roots to FPS, is Star Technologies. Star, with its 100-MFLOPS ST-100, has bounded past the former performance leaders. Targeted at the seismic and image-processing markets, the \$250,000 ST-100 incorporates dual MC68000 microprocessors, as much as 8 million words of main memory,

a 48K-word cache memory and a 100M-byte DMA channel.

Bob Hausman, vice president of engineering at Star, says the ST-100 can be accessed by multiple hosts—a virtual design requirement, he says, since few single hosts could keep the array processor fully occupied. "On previous machines, the I/O-to-compute ratio was balanced," he says. "But on our machine we might put three or four VAXs on it to keep the ST-100's utilization rate up." Hausman agrees with most in the industry that caution is necessary when using million-floating-point-operation-per-sec. ratings for comparison. "But we are even better from a throughput standpoint than would be indicated by our clock-rate improvement," he says.

Market leader FPS has been exploring a different high-end market with its 64-bit FPS-164. The only other 64-bit competition is CSPI's MAP-6400. The two machines rarely compete, however, because of the MAP-6400's lower memory capacity—64K words versus the FPS-164's 1856K words—and considerably lower price of \$89,000. Although much of FPS's attention has recently been devoted to this large-array/large-program, 64K-bit market, Schuhmann says, the company will eventually introduce 38-bit products "that will be higher megaflops than Star on one end and lower in megaflops and cheaper than Analogic's 9-MFLOPS AP500 on the other end." FPS hopes to introduce a 38-bit array processor indicative of this expansion at this year's National Computer Conference, Schuhmann says. □

*continues on page 83*

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And to make that performance easy to perform with, the ECLIPSE MV/4000 has virtual addressability, 16 KB of user microcode space, nine I/O slots, and a rack-mountable OEM chassis version. As well as the ability to handle up to 8MB of memory, 4.7 Gigabytes of on-line storage and 64 terminals. All of which you don't usually find on a low end 32-bit computer.

## THE SOFTWARE YOU NEED.

Unlike most low end 32-bit computers, the ECLIPSE MV/4000 gives you a choice of compatible operating sys-



tems: AOS/VS (our interactive advanced operating system with virtual storage). Or AOS/RT 32 (our lean, deterministic, real-time operating system). Plus a wide variety of industry and international standard communication protocols. As well as our XODIAC™ network management system, SNA, CEO™ (office automation) and data base management software. And an array of commercial and technical languages, productivity tools, and third party software packages.

### THE COMPATIBILITY YOU EXPECT.

Should you one day need even more of a computer, you can take all your code (and all your peripherals) onto the bigger members of the ECLIPSE family. Because the ECLIPSE MV/4000 is fully compatible with the entire Data General ECLIPSE MV product line.

Should you find yourself staying with the ECLIPSE MV/4000 system,

you'll find it stays with you. Partly because of our worldwide network of field service engineers. And partly because of some inherently reliable design considerations. Like extensive self diagnostics on power up. The simple, two board implementation. And

the 55°C burn-in test it goes through. In fact, we're offering an uptime guarantee of 96 to 99%. And a remote diagnostic program.

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Want to discuss the only little 32-bit computer worth discussing? Call your local Data General office. Or write us TPD, F134, 4400 Computer Drive, Westboro, MA 01580.

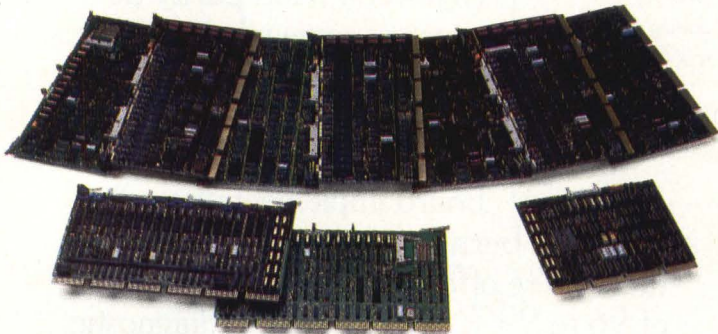
600K-Whetstone	✓
8MB Maximum memory	✓
5MB/sec I/O	✓
Virtual addressability	✓
Real-time operating system	✓
4.7 Gigabytes of On-Line Storage	✓
Multiple I/O slots	✓
User microcode space	✓
Low Price	✓

## Data General



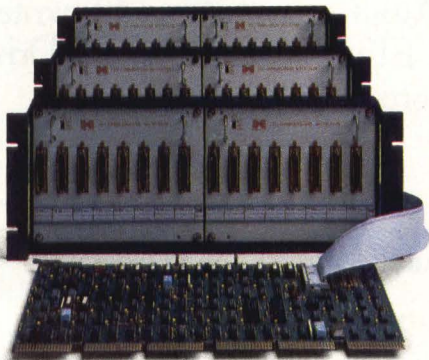
CIRCLE NO. 46 ON INQUIRY CARD

# Five reasons why DEC users should buy Emulex communications controllers.



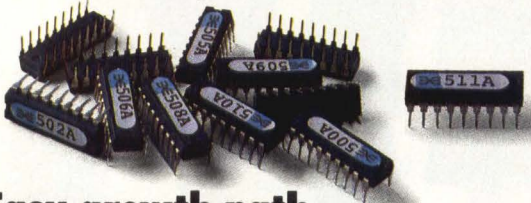
## Broad product line featuring our new DMF-32 emulation.

Nobody covers LSI-11, PDP-11, and VAX-11 users' needs like Emulex. More than 15 software-transparent controllers emulating DH11, DZ11, DV11 and DMF-32. All deliver improved line-handling capabilities, in a smaller package, at lower costs.



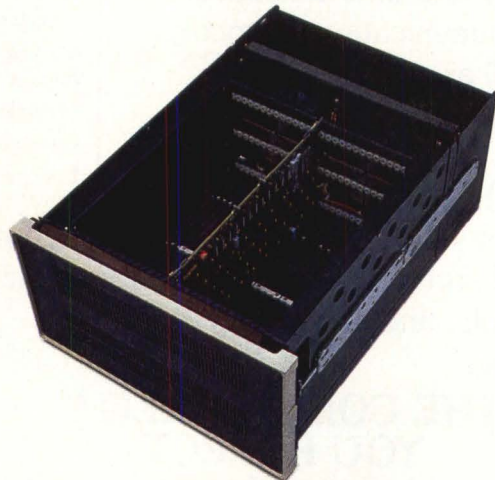
## More channels.

Emulex's new DMF-32 emulation is typical. One controller board handles up to 64 lines, vs. only eight per DEC module. And Emulex offers *all* lines with modem control, not just two. For even more lines, Emulex's Statcon Series is the answer. We simply add a low-cost port concentrator, so that with one controller board you can connect up to 256 remote *and* local terminals.



## Easy growth path.

As your system grows, upgrading is simple with Emulex controllers. Just change PROM sets. Example: DH to DMF for \$350. In addition, Emulex's advanced microprocessor architecture is consistent throughout the product line. Think of the inventory savings.



## Fewer backplane slots.

Emulex communications controllers pack so much capability onto each board that fewer boards are needed. Take a 64-line DH11 emulation. Emulex does on one board what it takes DEC to do on 36. Think of the savings in rack space, to say nothing of price.



## Lower prices.

For instance, a DEC DH11 controller lists at \$8,950 per 16 lines, with expansion chassis costing \$3,000 or more. Compare that to Emulex's CS11/H at \$4,500 for the first 16 lines and \$3,000 for each additional 16 lines. At 64 lines, you suddenly have savings of about \$23,000 and a lot of extra slots to boot.

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**The genuine alternative.**

CIRCLE NO. 47 ON INQUIRY CARD

# The Interpreter

continues from page 78

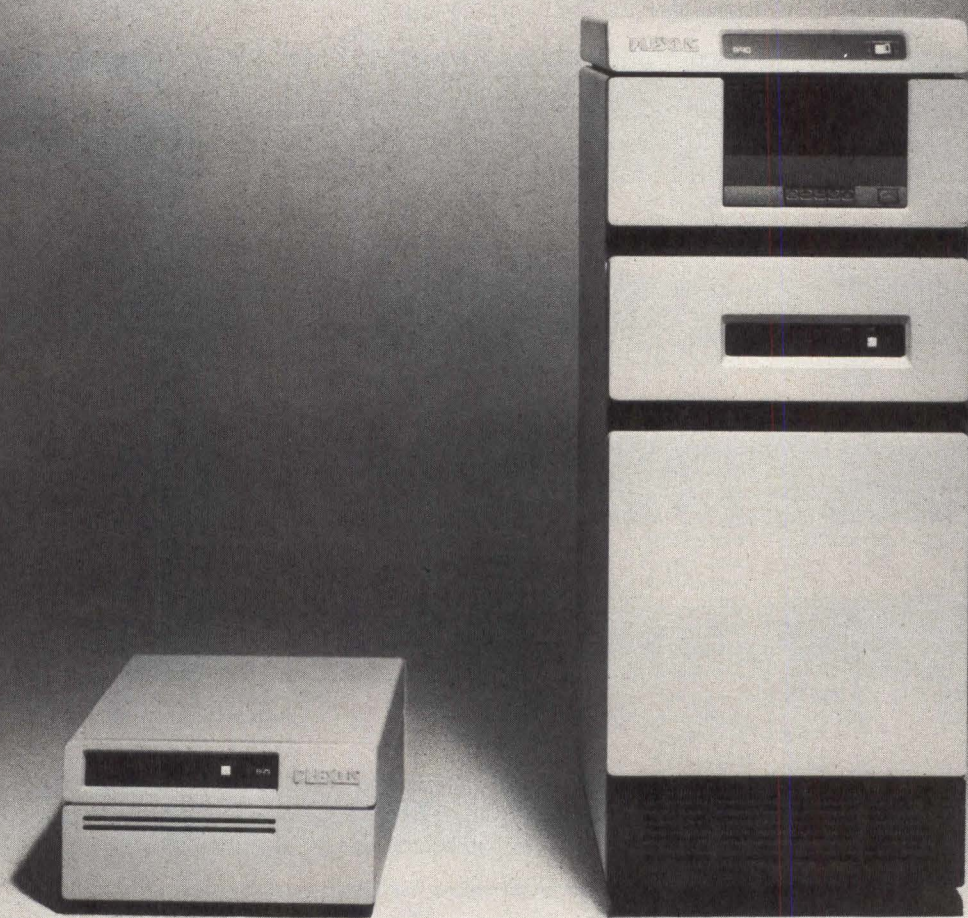
## Representative array processors

Array processor	Base price	Speed (Mflops)	Architecture and computation	Main data memory (maximum)	Host interfaces	Memory access method	Performance 1024-point complex FFT	Performance 100 x 100 matrix inversion
<b>Analogics AP400</b>	\$14,500	8 MOPS <sup>1</sup>	24-bit synch, block floating point	64K words	PDP-11, Nova, Eclipse, HP21MX	DMA	7.4 msec.	NA <sup>2</sup>
<b>Analogics AP500</b>	\$24,000	9.3	32-bit synch, full floating point	528K words	PDP-11, VAX-11, Nova, Eclipse, HP1000	DMA	4.7 msec.	649 msec.
<b>CD&amp;A MSP-3</b>	\$6500	4 MOPS	24-bit synch, block floating point	4K words	PDP-11	DMA	13 msec.	NA
<b>CD&amp;A MSP-3000</b>	\$29,500	5	32-bit synch, full floating point	64K words	PDP-11, VAX-11	DMA	15 msec.	3.1 sec.
<b>CSPI MAP-200</b>	\$25,000 and up	6	32-bit asynch, full floating point	184K words	PDP-11, VAX-11, P-E 3200, HP1000, Eclipse	DMA; shared	16 msec. (170-nsec. memory), 23 msec. (500-nsec. memory)	1.6 sec.
<b>CSPI MAP-300</b>	\$30,000 and up	12	32-bit asynch, full floating point	184K words	PDP-11, VAX-11, P-E 3200, HP1000, Eclipse	DMA; shared	5.3 msec. (170-nsec. memory), 11.2 msec. (500-nsec. memory)	1 sec.
<b>CSPI MAP-400</b>	\$60,000 and up	24	32-bit asynch, full floating point	312K words	PDP-11, VAX-11, P-E 3200, HP1000, Eclipse	DMA; shared	2.7 msec. (170-nsec. memory), 5.6 msec. (500-nsec. memory)	0.5 sec. (performs two inverses per sec.)
<b>CSPI MAP-6400</b>	\$89,000	4.3	64-bit asynch, full floating point	64K words	PDP-11, VAX-11, P-E 3200, HP1000, Eclipse	DMA; shared	22.9 msec.	1.15 sec.
<b>CSPI Mini-MAP FPS-100</b>	\$30,000 \$40,500	7 8	32-bit asynch, full floating point 38-bit synch, full floating point	4M words 64K words	PDP-11 PDP-11, VAX-11, Nova, Eclipse, P-E 3200, SEL 32xx	DMA; shared DMA	7.8 msec. 7.13 msec. (not in-place)	NA 1.77 sec.
<b>FPS AP-120B</b>	\$59,700	12	38-bit synch, full floating point	448K words	PDP-11, VAX-11, HP1000, PE-3200, Prime, SEL	DMA	5.95 msec. (in-place); 4.75 msec. (not in-place)	1.18 sec.
<b>FPS-164</b>	\$210,000	12	64-bit synch, full floating point	7.25M words	VAX-11, IBM 370/303x/308x/4341	DMA	NA <sup>3</sup>	See note 4
<b>Numerix MARS-232</b>	\$50,000	50-300 MOPS	16- or 32-bit synch, fixed/block floating point	168K words (16-bit)	LSI-11, PDP-11, VAX-11, Multibus	DMA	1.05 msec.	NA
<b>Sky Skymnk-Q, -V, -M</b>	\$3990 (qty. 100)	1	32-bit asynch, full floating point	Uses host's memory	Q — LSI-11, PDP, MINC; V — MC68000; M — 8086, MC68000	DMA	Q — 53.1 msec.; V — 53.6 msec.; M — 53.9 msec.	Q — NA; V — 13.9 sec.; M — 13.9 sec.
<b>SPS-21</b>	\$35,000	20 MOPS	16-bit synch, fixed/block floating point	64K words	PDP-11	Shared (host memory)	7 msec.	NA
<b>SPS-61, -81</b>	\$31,000— \$51,000 (61), \$45,000— \$65,000 (81)	24 MOPS (61), 32 MOPS (81)	16-bit synch, fixed/block floating point	512K words	PDP-11, Nova, Eclipse	Shared (host memory)	61 — 4.85 msec., 81 — 2.93 msec.	NA
<b>SPS-1000</b>	\$60,000— \$89,000	60—300 MOPS	8-, 16-, 24-, 32-bit synch, fixed/block floating point	4M-plus words	Variable	DMA; shared (AP memory)	0.15—1.5 msec., (16-bit)	NA
<b>Star ST-100</b>	\$250,000	100	32-bit synch, full floating point	8M words	VAX-11, P-E 3200; SEL 32/40, 32/50; IBM 4331, 3081	DMA	0.864 msec.	84.28 msec.

Notes:

1. Million operations per second. Fixed/block floating point machines aren't measured in million floating point operations per sec. (Mflops).
2. Not applicable.
3. Although the FPS-164 can perform FFTs, the manufacturer prefers not to release performance figures for that algorithm, saying that the simulation applications in which the 164 serves have no need for the signal-processing oriented FFT.
4. Floating Point Systems says the FPS-164 typically deals with matrices much larger than 100 x 100. The FPS-164 uses a technique called the tri-diagonal matrix solution to solve a 10,000 x 10,000 matrix with 30,000 non-zero elements in 33 msec. A banded symmetric 10,000 x 10,000 matrix with a bandwidth of 200 elements (4 million non-zero elements) requires 36.4 sec. to solve.

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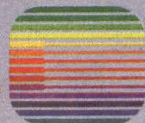
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## Start-ups rush to establish high-capacity 5¼-in. drives

By Robert A. Sehr

In typical Silicon Valley entrepreneurial fashion, start-up companies are rushing in where their established competitors fear to tread to meet an apparent demand for higher capacity in smaller rigid disk drives. The start-ups, offering 5¼-in. drives with capacities from 30M bytes to more than 100M bytes, surfaced last summer at the National Computer Conference in Houston, and were joined by others at Comdex in Las Vegas later in the year.

Like the personal computer industry it serves, the 5¼-in. rigid disk industry has been fueled by the office-automation explosion. Multitasking, multi-user operating systems, such as Bell Laboratories' UNIX, and the requirements of local-area networking between computers within an office have increased capacity demands. "It's just like at home—the more closet space you have, the more you need," says one disk drive engineer.

Because the start-ups are still in the evaluation stages, no firm prices have been established. Prices are expected to range from \$50 to \$100 per megabyte in OEM quantities of 1000.

Independent disk drive authority James Porter, editor of *Disk Trend/Report*, predicts that manufacturers of high-capacity, 5¼-in. Winchester drives will sell 164,000 units by 1985. Only 1900 5¼-in. Winchester drives between 30M and 100M bytes were sold in 1982, and most were closer to the 30M-byte end.

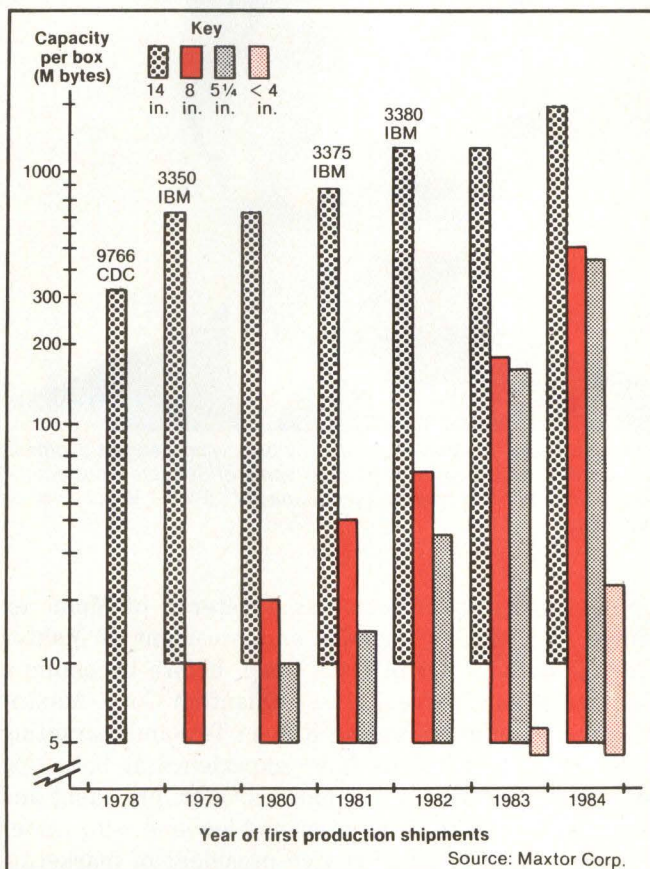
Boosted by the improved availability of components and electronics in smaller packages and the improved outlook for the availability of plated media, manufacturers of high-capacity, 5¼-in. Winchesters are working on "closet space" that can hold as much as 144M bytes.

Just five years ago, a 144M-byte, 14-in. Winchester would have been considered a very high-capacity drive. Even today, few 8-in. drives with capacities higher than 100M bytes are available.

To meet these capacities in the limited space of 5¼-in. drives, manufacturers can no longer rely on traditional open-loop positioning systems and stepper motors that served low-end pioneers such as Seagate Technology.

### Scaling down technologies

The start-ups working to meet the demand for high

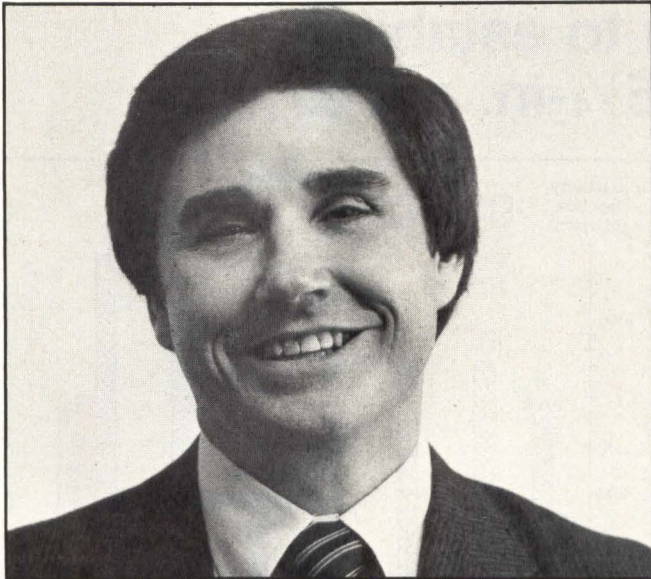


**Disk drive market shares.** Until International Memories Inc. announced the first 8-in. Winchester drive at the 1978 National Computer Conference, 14-in. Winchesters had the market to themselves. Now, 14-in. Winchesters have been forced out to applications requiring gigabytes of storage. Today's 8-in. Winchesters are being pushed into the 300M-byte and higher range as the new generation of high-capacity 5¼-in. Winchesters take over in the 30M- to 100M-byte range. By next year, high-capacity, sub-4-in. Winchesters may take over the 5M- to 10M-byte market that is now dominated by 5¼-in. Winchesters.

capacities and higher performance are for the first time bringing technologies from the 14- and 8-in. markets to the 5¼-in. market. These technologies include closed-loop servo motors instead of stepper motors and voice-coil actuators. It's not too surprising, therefore, that the start-ups are manned with talent from traditional 14- and 8-in. Winchester drive makers.

Atasi Corp. founder and president Frank Gibbeau is a veteran of IBM Corp., as is company vice president of engineering Donald R. Lundell. Evotek founder and

# The Interpreter



**Frank Gibbeau of Atasi** hopes that by borrowing Seagate's formula for success, Atasi can also "borrow" some of Seagate's customers. Atasi was the first with a high-capacity, 5¼-in. Winchester in production.

president George Brennan is a veteran of Memorex Corp.; Jim McCoy, founder and president of Maxtor Corp., was at Control Data Corp. before becoming a founder of 8-in. drive start-up Quantum Corp. Maxtor vice president of marketing Robert Teal and marketing manager Skip Kilsdonk have experience at both CDC and Quantum. Vertex Peripherals Corp. president and founder Joe Booker is a veteran of low-end 8-in. leader Shugart Associates, as is vice president of marketing Jim Adkisson.

"They all have very technically competent people," says Porter, referring to the organization of the start-ups. "I don't expect a lot of fumbling around." He expects it will be a while before a leader emerges in this market. "It's still a bit too early to call a winner; most shipments have been only evaluation numbers."

Atasi, the first of the four start-ups formed, is also the first to begin production shipments. Perhaps because of its preponderance of ex-IBM employees, the company is also the most conservative, using only tried and true technologies in its drives.

Don Pate, Atasi's vice president of marketing, says his company hopes to emulate Seagate and become a "blue-chip" company in the near future. "Our aim is to get our foot in the door with a very conservatively produced product and make a name for ourselves, then continually increase its performance," he says.

Pate says Atasi's emphasis is not necessarily on high capacity, but on high performance. The company's

products include 20M-, 30M- and 46M-byte drives with closed-loop servo motors to achieve an average 30-msec. access time. In keeping with its philosophy, the company began shipments of its lower end drives last October and has only recently begun evaluation of its high-end 46M-byte drives. Its low-end 19.84M-byte drive uses two platters, its 33M-byte drive uses three platters, and its 46M-byte drive uses four.

Evotek, on the other hand, uses a five-phase stepper motor and a linear actuator to achieve capacities ranging from 7.1M bytes to 51.6M bytes. Unlike Atasi, however, Evotek began production in January with its high-end drive. James Lawson, Evotek's vice president of marketing, says the 7M-byte drive is meant only as an option and does not figure heavily in the company's production plans.

Unlike the other start-ups, Evotek has a crutch in case the high-capacity, 5¼-in. market doesn't take off—the company has begun to manufacture plated media of its own design, primarily to serve its own needs. The media will not initially be sold outside the company, to protect Evotek's market advantage of having a secure media supply. "It would be ridiculous for us to make such a huge investment in plated-media technology and then sell it on the outside," Lawson says.

Although Evotek manufactures its own media because of a concern for "reliability management," the move also reflects an industry-wide distress about the availability of plated media. Because of its durability and structure, plated media allows higher track densities. Ampex, the chief supplier of plated media, has been able to supply only limited quantities in the past because of manufacturing limitations. To solve this problem, the company has opened its new San Jose manufacturing plant, which will allow production of 300,000 disks this year and will eventually supply as many as 2 million disks per year. Evotek, however, plans to use as many as 300,000 platters per year itself in its drives and consequently cannot depend on Ampex and its few competitors.

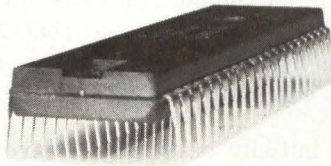
## Stalking lucrative IBM contracts

Sources say Evotek and Atasi have the inside line on supplying the industry's highest volume customer, IBM. The same sources say IBM has about 1000 Evotek drives under evaluation in various divisions. IBM theoretically could use such high-capacity 5¼-in. drives with its minicomputers and with future generations of its Personal Computer.

Evotek's Brennan remains noncommittal on negotiations with IBM, but says his company is preparing to

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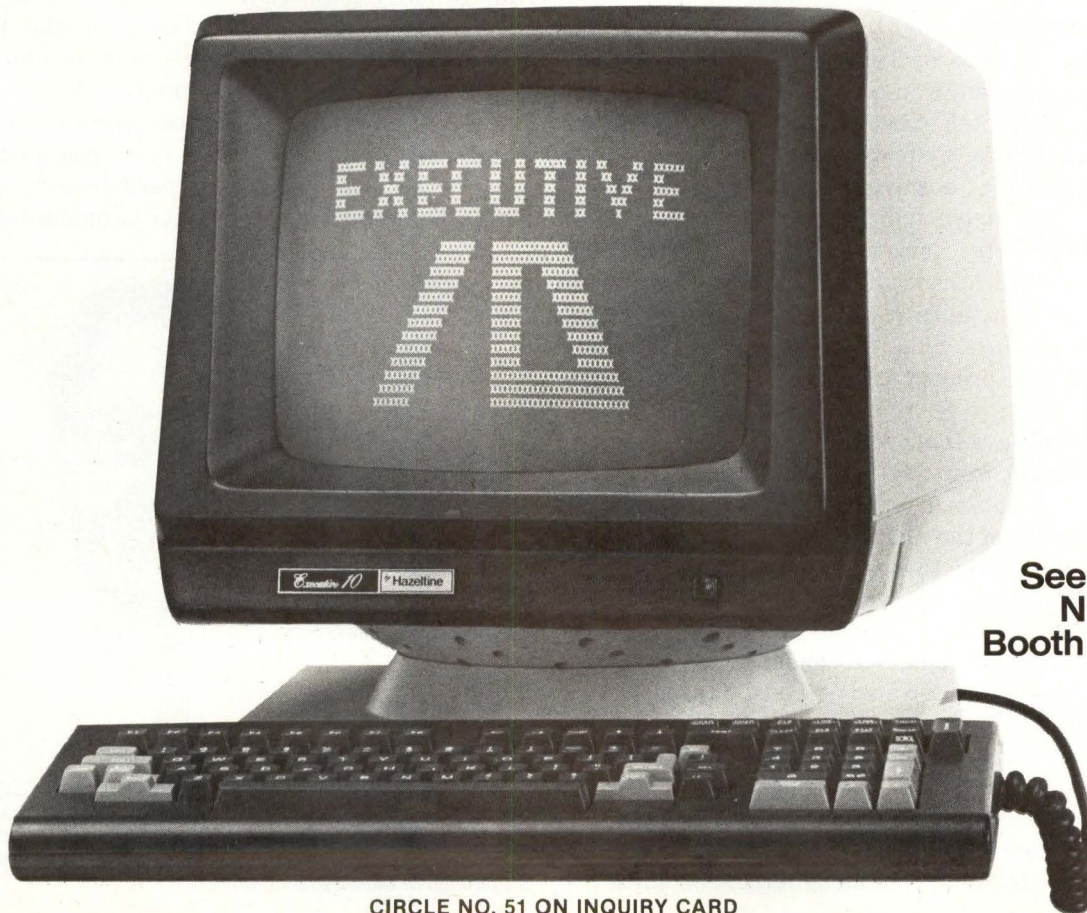
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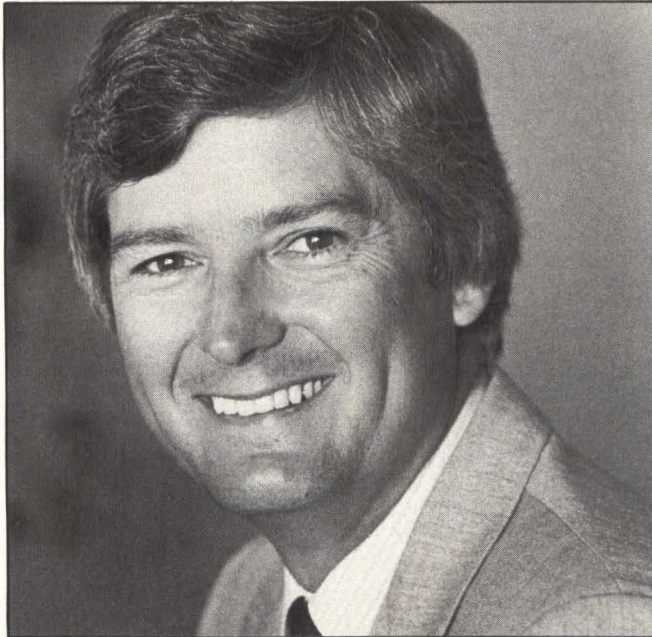
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CIRCLE NO. 51 ON INQUIRY CARD

# The Interpreter



**Bob Teal of Maxtor** plans for the company to follow its eight-platter, 144M-byte, 5¼-in. Winchester with a half-height, four-platter, 72M-byte version this year.

meet the volumes required by IBM. The company will achieve these volumes by ramping up two production lines in the company's new 50,400-sq.-ft. plant in Fremont, Calif. Evotek expects to be ready to manufacture in high volumes by midyear.

Maxtor's McCoy, however, hopes that Evotek's 51.68M-byte disk drive will pale in comparison with Maxtor's 144M-byte voice-coil-actuator drive. The Maxtor drive, which caused a sensation when it was introduced at last fall's Comdex show, uses eight plated-media platters. Skeptic competitors at the show doubted that the product could ever be produced in volume, however.

Maxtor's Teal says that, while his company's product may look different from anything else on the market, it is not that revolutionary. "The only thing different about it is the use of the motor within the spindle of the drive," he notes. Even that is not entirely different, he adds, because IBM sold a two-platter, 14-in. drive with a spindle motor during the '60s. "It's just creative packaging, not revolutionary technology," Teal says.

Industry analyst Porter also defends Maxtor, calling the drive's design "very conservative." He says the only problem that he could envision in the drive was a heat rise between platters. However, Porter says he is assured, after studying the drive, that the heat-rise problem has been conquered. "That's not to say some other problem couldn't come along later," he adds.

Teal also admits that there will be some problems when the drive enters production in June. "Some of them could even be catastrophic to some companies, but I believe we have assembled the kind of team here that can overcome anything," he says.

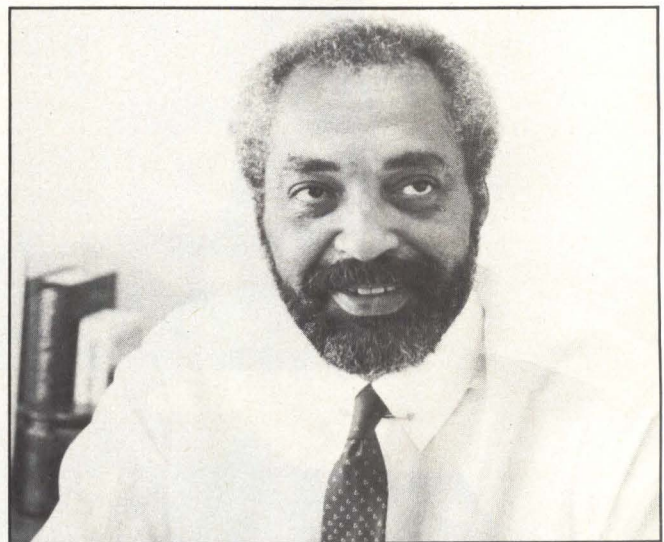
Among the skeptics, however, is Booker, Teal's former colleague at Shugart and now a competitor at Vertex, San Jose. "I'm sure glad that Maxtor came around with its 144M-byte drive because now we don't look so radical anymore with our 71M-byte drive," he says.

Vertex will initially offer three drives in its V100 series, beginning with the 31M-byte V130. Above this model is the 52M-byte V150 and the 71.6M-byte V170.

Vertex was scheduled to begin shipments of production units in January and to be in full production by the second quarter. The company purposely delayed announcement of its products until just before shipments were available to maintain its credibility, Booker says.

Industry sources earlier believed that Vertex had planned a smaller Winchester drive—in the 3½-in. range. However, Booker denies that such a drive was under consideration. "When I first left Shugart, we frankly didn't know what we were going to do, although there was a lot of speculation in the press and elsewhere," he says. "It wasn't until we assembled the people that we decided on a product."

The Vertex drives will have an average access time of 30 msec. and a dual-frequency servo-positioning system that Vertex's Adkisson says permits continuous sampling while remaining insensitive to media defects. Like



**Joe Booker, president of Vertex** and former executive vice president of Shugart Associates, expects his high-volume experience at the Xerox subsidiary to give Vertex a competitive edge in volume production of high-capacity drives.



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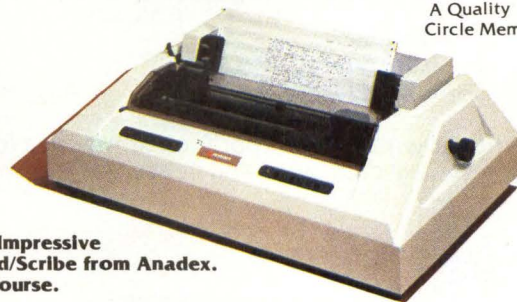
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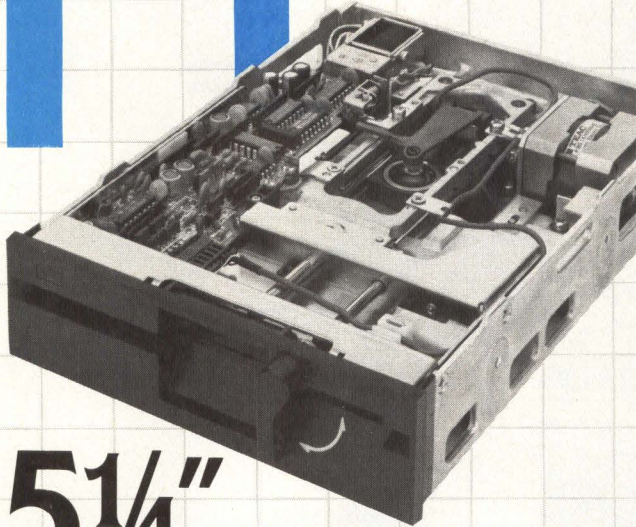


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CIRCLE NO. 53 ON INQUIRY CARD

## The Interpreter

all of the other start-ups' drives, the Vertex product will have a Seagate interface and will be compatible with most industry controllers for 5 1/4-in. drives.

Maxtor, however, is organizing an industry committee including drive and controller manufacturers to update the Seagate ST506 interface. The updated interface would allow higher transfer rates that will bring the drives to their optimum efficiency.

### Avoiding the low-end clutter

All four start-ups opted for the high-end market after determining there was no chance of success in the cluttered low-end Winchester disk market dominated by Seagate Technology, Tandon Corp., Shugart Associates and International Memories Inc.

Now, however, some of the high-end pioneers are concerned that all of the companies at the low end will make a move into the higher capacity market. Indeed, Seagate is preparing a high-capacity product for this year's NCC, and Tandon is working on a 31M-byte drive.

Seagate executive vice president Finis Conner says OEM customers are loyal and are more likely to get their high-end products from their established sources than from start-ups. But, if Conner's sentiments are traditionally on target, start-ups can take comfort in the fact that Seagate itself managed to succeed against established competitors in the 8-in. market when it introduced 5 1/4-in. rigid drives in 1980.

Seagate and Tandon may have their hands full taking care of the customers they now have without taking on new problems, says disk drive authority Porter. He also notes that Seagate and Tandon customers are more "price sensitive than performance sensitive."

One established company that already has its hands full is Priam Corp. The company recently announced that it is delaying its entry into the high-performance, 5 1/4-in. market because of the demands for its 8- and 14-in, high-performance drives. "We want to make it perfectly clear that we are not abandoning that [5 1/4-in.] marketplace," says Ben Taneguchi, Priam's vice president of marketing. "We've already poured millions of dollars into research, which is still ongoing." Priam expects to reenter the 5 1/4-in. market early in 1984, with a much higher capacity drive than the 30M-byte drive it prematurely announced last year.

Priam president William Schroder notes that caution may be called for in the disk drive industry. He recalls that the ranks of high-performance 8-in. disk drive manufacturers once included many big names, such as Pertec Computer Corp. and BASF Systems Corp., and have now dwindled to a precious few. "History may be repeating itself," he suggests. □

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- multi-user capability
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  - 1 MIPS performance
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- 4.27 Mbytes/second I/O bandwidth
  - 12 interfaces
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  - powerful networking capabilities
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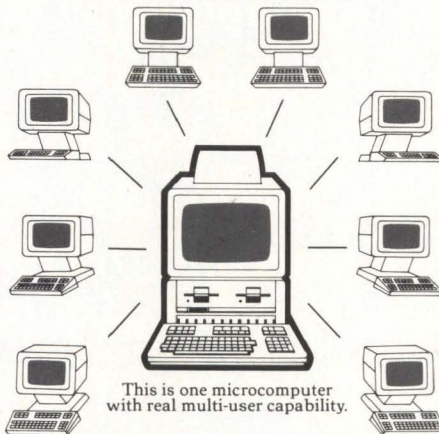
By using our range of plug-in cards, you can easily put together a wide variety of configurations. You could, for example, plug in 8 terminals, 12 instruments, a plotter, printer, hard discs, machine tools and communications links with other computers—and have them all running at the same time. Mostly because of the way our multi-tasking operating system—RTE—takes advantage of the hardware, and delivers big system power. As a result, we can give you virtual memory capability. Dynamic memory positioning. And multiple real-time ways to schedule programs—by event, time, or operator. Not bad for a system that starts at only \$8,021.

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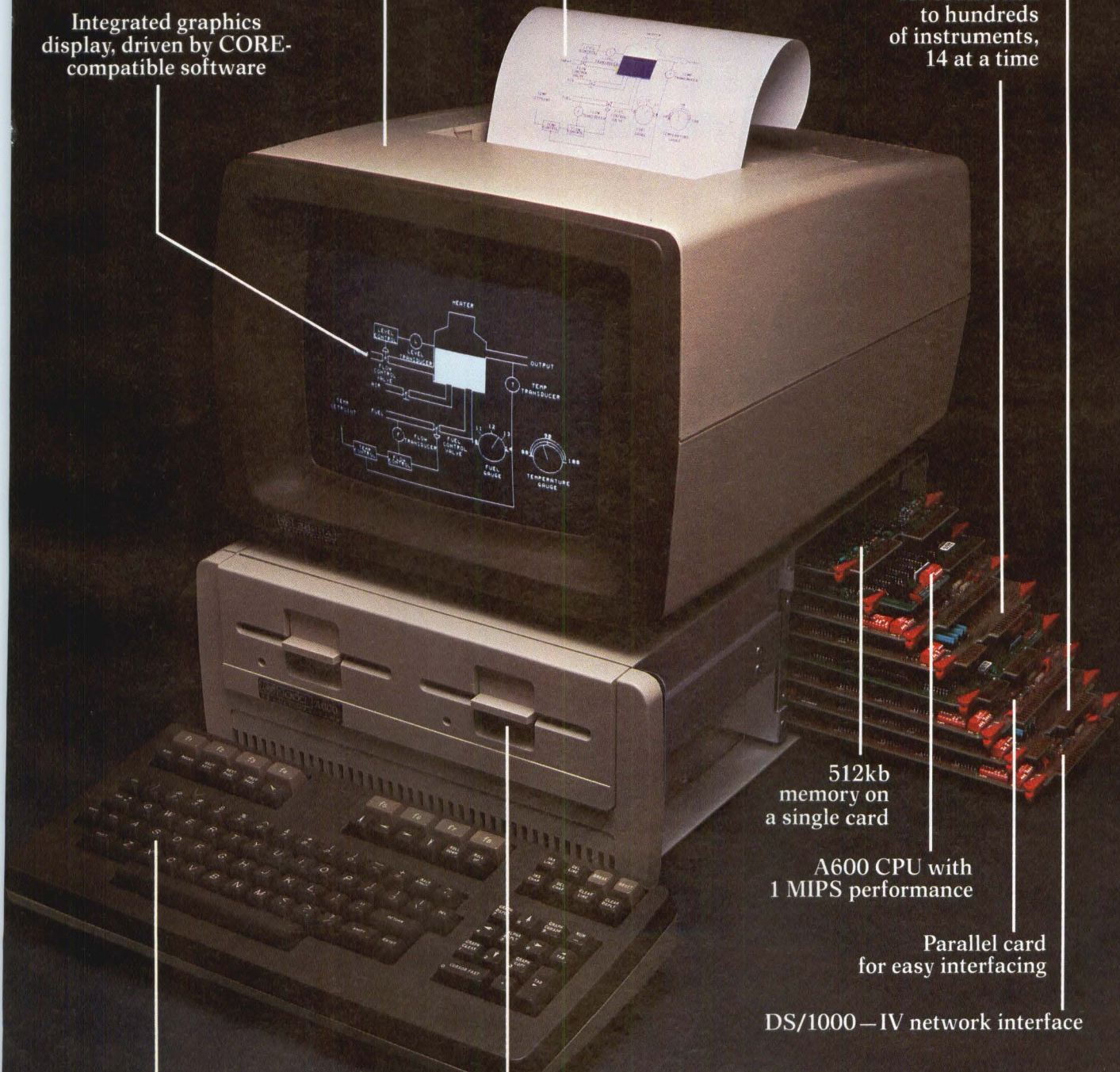
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CIRCLE NO. 54 ON INQUIRY CARD



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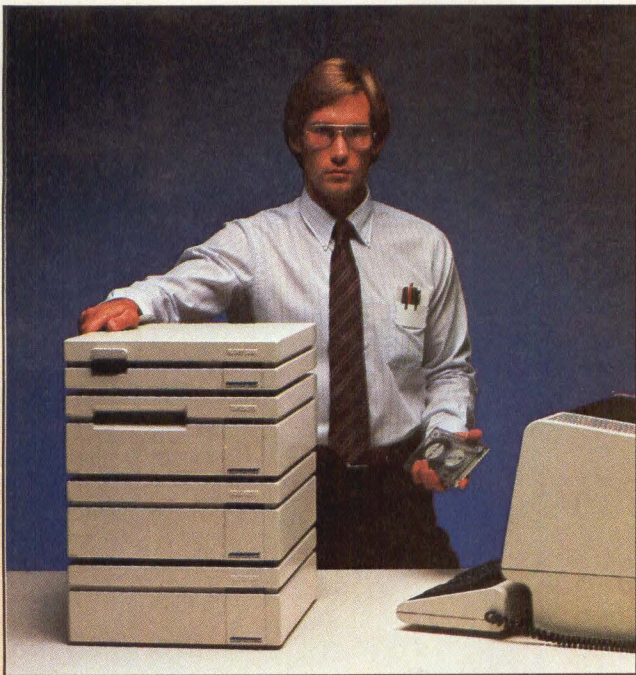
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# 0 to 60 without shifting



Alpha Micro introduces its 68000-based line of systems.

A line that provides a growth path from a one-terminal system to a system that supports over 60 terminals.

And it's growth that doesn't sacrifice your software investment because software developed for our one-user system can run on our 60-user system.

**The AM-1000. A 10 MB, multi-user system that fits on a desk.**

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Alpha Micro 68000-based computers move from the micro through the mini and even the mainframe categories. You can go from a one-user system with 128 KB of memory and 10 MB of disk storage to a 60-user

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2. AM-1000W (winchester; choice of floppy or VCR backup)	10MB	40MB	128KB	256KB	3	3	A	B	AMOS*
3. AM-1042 (winchester)	32MB	2.4GB	512KB	3MB	2	26	A	B	AMOS*
4. AM-1062 (winchester)	60MB	2.4GB	512KB	8MB	2	68	A	B	AMOS*

A AlphaBASIC,\* AlphaPASCAL,\* AlphaLISP,\*\* AMOS,\* Macro-assembler, Word Processing, 150 subroutines, utilities and diagnostics

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B Programming languages FORTRAN and COBOL, in addition to over 100 AlphaBASIC\* turnkey applications are available from third-party sources.

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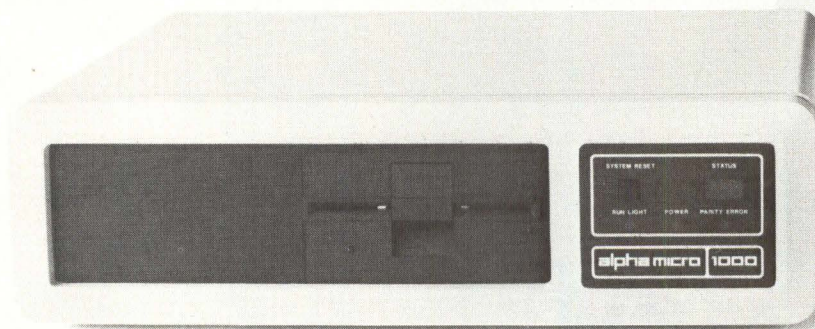
Finally, AMOS is proven and field-tested, running on over 7000 Alpha Micro systems installed since 1977.

- Service — International service and support.
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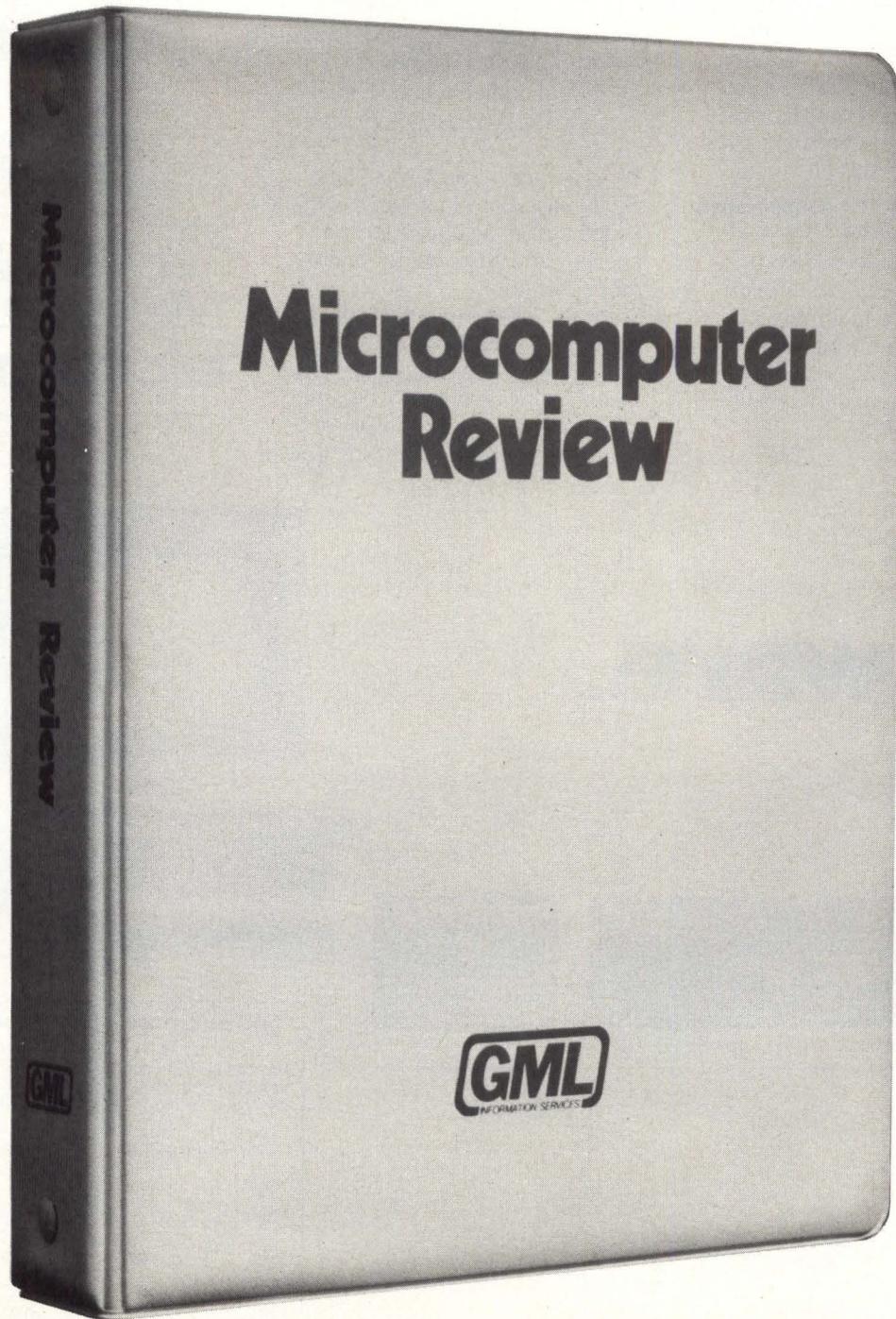
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# Systems in Manufacturing

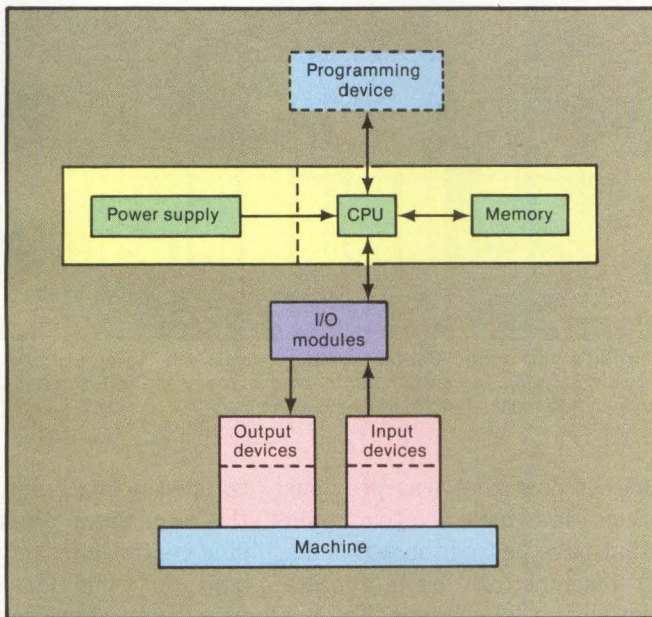
Exploring the use of computers in the factory

## Programmable controllers take on new role in automated factory

By Frank Catalano

Ask someone what the factory of the future will include, and nine times out of 10 you'll hear talk about robots, CAD/CAM systems, Manufacturing Resource Planning packages and maybe Issac Asimov. Mention programmable controllers, however, and you might hear talk about the factory of the past.

Although programmable controllers have been around since the mid-'60s and used by both discrete and process manufacturers to control simple machining tasks and regulate temperature and pressure variables,



**A typical low-end programmable controller** has enough I/O modules to address all the control parameters of a single machine. A high-end system has enough I/O capability to control an entire production line.

they have taken on a more important role of late—interfacing shop-floor machines to one another and to central factory computers. “As the role of the computer is increasing in the factory, so is the role of the programmable controller,” notes Cliff Young, an analyst with Arthur D. Little Inc., Cambridge, Mass.

Equipped with network interfaces and math-solving capabilities, programmable controllers are giving users closed-loop control of their production processes and serving as sources of machine data for quality-control, machine-maintenance, inventory-planning, labor-

reporting and production-status monitoring applications.

As programmable controllers' importance increases, however, their prices are on the decline. A low-end system that sold for more than \$10,000 10 years ago could be purchased today for as little as \$400. New lower priced devices are being installed by first-time users who previously could not afford programmable controllers and by traditional users who are finding new applications for the products.

Young estimates that the programmable controller market was worth \$250 million in sales in 1982 and will be worth \$2 billion in 1992, reflecting a 20-percent annual growth rate. Although 26 vendors supply programmable controllers, John Davis, a market researcher with Creative Strategies Inc., San Jose, Calif., says that three vendors—Gould Inc.'s Modicom Division, Allen-Bradley Co. and Texas Instruments Inc.—control approximately 88 percent of the market. Davis lists Gould as the leading supplier with a 48-percent market share, Allen-Bradley as number two with a 29-percent share and TI third with an 11-percent share.

### The programmable alternative

The first programmable controllers were designed to replace electromechanical relay switches that controlled machinery at General Motors Corp.'s transmission-assembly plant. Those electromechanical devices were wired together by production engineers so that an event would occur at a machining center depending on whether a relay switch was open or closed. At a drilling station, for example, a proximity sensor would detect that a part was in place and would trigger a relay switch to send a current through a wire connected to a clamp. A relay switch connected to the clamp would then energize the clamp, causing it to close. Another relay switch would turn on the drill motor, and still another might cause the drill head to be lowered onto the part. When a hole was drilled to a specified depth, a limit switch would activate another relay to raise the drill off of the part.

Such a controller for a single machining center often encompassed a 30- × 40-ft. wall and consisted of a maze of complex wire connections. Not only were such controls difficult to troubleshoot, they were also inflexible. If a sequence of events had to be altered, an entire relay panel was rewired or replaced. “Every

# Systems in Manufacturing

model year when GM changed the specifications of a part, they had to throw out millions of dollars' worth of relay panels, even if they only wanted to make minor modifications," notes Rob Loomas, product group marketing manager for Gould programmable controllers. "The PC was designed to allow GM to accommodate changes in assembly operations with a minimum of effort and expense."

Like electromechanical relay controls, PCs control machining operations sequentially and depend on the open/closed status of relay switches connected to points of a machining center. Programmed in ladder logic, a language designed to emulate the wiring diagrams of electromechanical controls, programmable controllers cause events to occur through a series of if/then statements: if a part is in place, then close the clamp; if the clamp is closed; then start the drill motor; and so on. Input to the programmable controller is the open/closed status of a relay connected to the clamp, for instance, and output is the action that causes the clamp to close. "Not only did PCs make machine control more flexible by providing programmability, they were also easy to integrate into factories," notes Charles Juda, product marketing supervisor of Allen-Bradley's Programmable Controller Business Systems Division. "If a production engineer knew how to wire an electromechanical control together, he could program a PC. The program is simply a graphic illustration of wiring diagrams. But rather than physically connecting wires to relays, the engineer pushes a button on a keyboard and represents the wire connection in a programmed statement," says Juda.

## The product spectrum

While the three leading vendors supply a wide range of products, each programmable controller typically consists of the same basic components—a microprocessor, CMOS memory, I/O devices and a power supply. Available options include graphics terminals to program the controllers and monitor the status of a machine during operation, as well as network interfaces. Products differ in terms of memory size and in the number of machine parameters that a system can control.

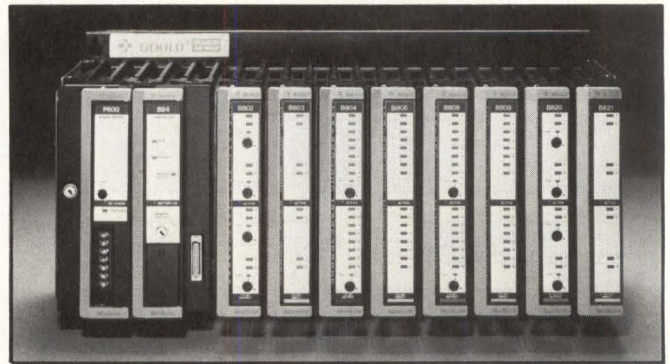
Gould's low-end offering, for instance, the Micro 84, sells in the \$700 to \$1000 range, is based on the 4-bit Zilog Z8 microprocessor, provides as much as 8K bytes of user storage and can address 32 I/O points. On the opposite extreme, selling for around \$60,000 is the Gould 584 programmable controller, which uses the 16-bit AMD 2901 microprocessor, provides as much as 32K bytes of user storage and can handle as many as 8000 I/O points. "The Micro 84 is geared to handle the

various control parameters of a single machine," notes Loomas. "The 584 could handle all the parameters of every machine on an entire production line."

Similarly, Allen-Bradley's systems range from the Intel 8031-based Microtrol, which can handle 32 I/O points, to the AMD 2901-based PLC 3, which can handle as many as 4000 I/Os. TI's systems, based on its own microprocessors, range from the model 510 with 2K bytes of user memory and 20 I/O points to the PM 550 with 1023 I/O points and as much as 7K bytes of user storage.

## Data access and networking

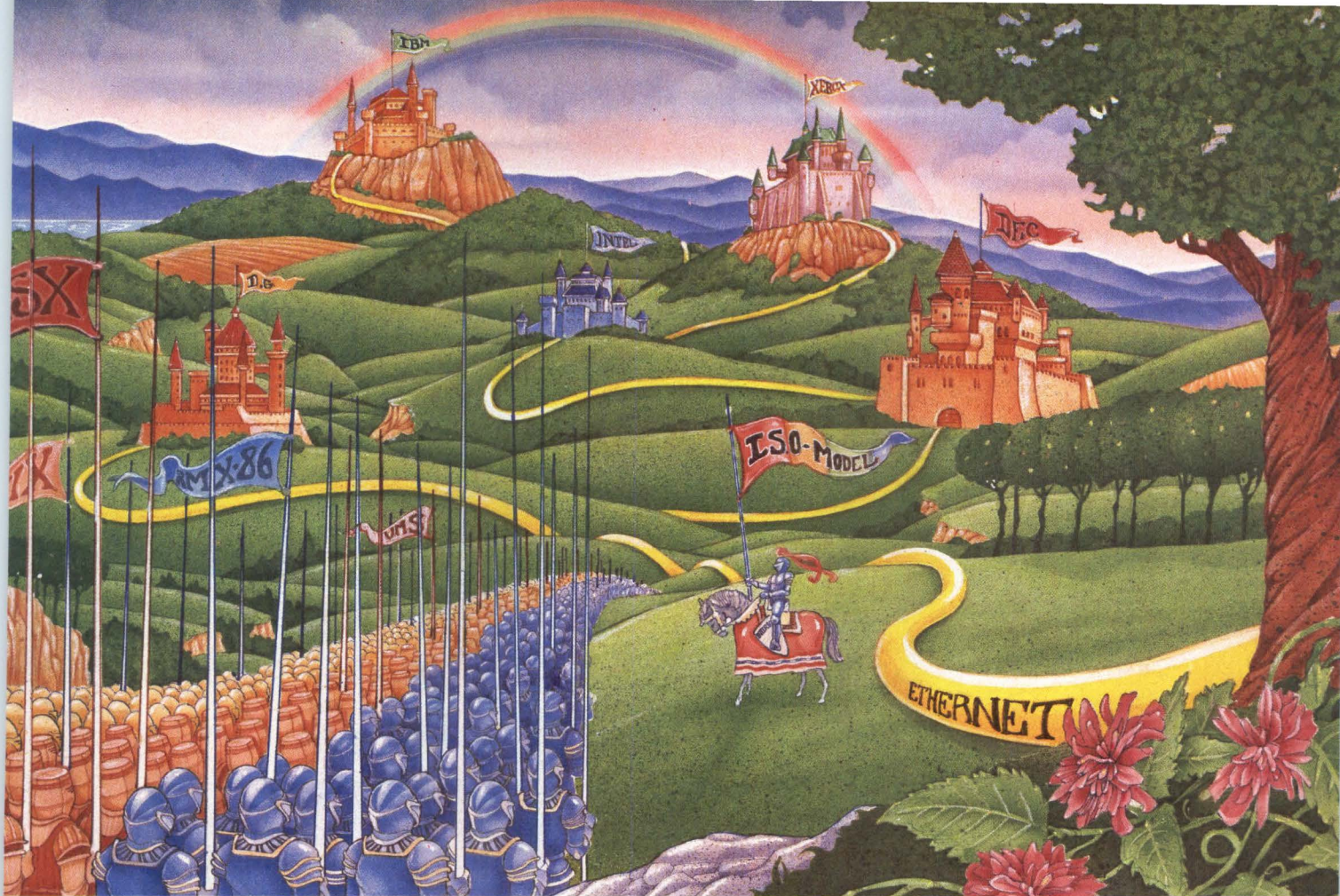
Besides providing users with a programmable alternative to electromechanical controls, both large and small programmable controllers also allow users to



Gould's mid-range 884, announced last month, has a base price below \$10,000. The system can handle as many as 256 discrete I/O points and more than 16 analog I/O channels.

access data that was previously trapped in machines. Such data include cycle counts, the number of parts that have passed through a machining center, how long a machine has been operating and the time lapse between tool changes. To enable users to extract such data from machines, however, suppliers added higher level languages to their systems. "Relay ladder logic might be a convenient language with which to program a PC to control a machine," says Juda, "but it doesn't lend itself well to report generation or arithmetic functions." Most suppliers use BASIC to format production reports and FORTRAN to perform arithmetic functions such as calculating production efficiencies.

Although programmable controllers gave plant-floor personnel access to data from their machining centers, that data could not be stored in a central database or transferred from one programmable controller to another. Over the past year, all three of the top programmable controller vendors have addressed that problem by introducing networks. "PC vendors are recognizing the role of their products within the factory



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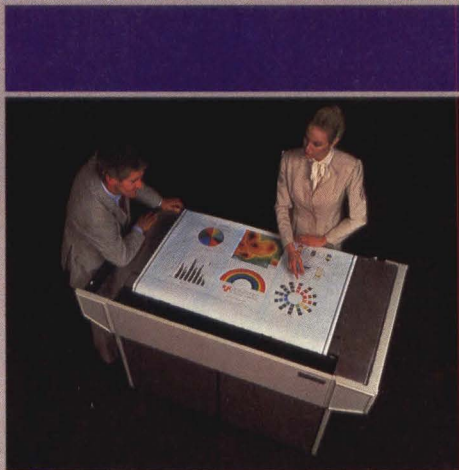
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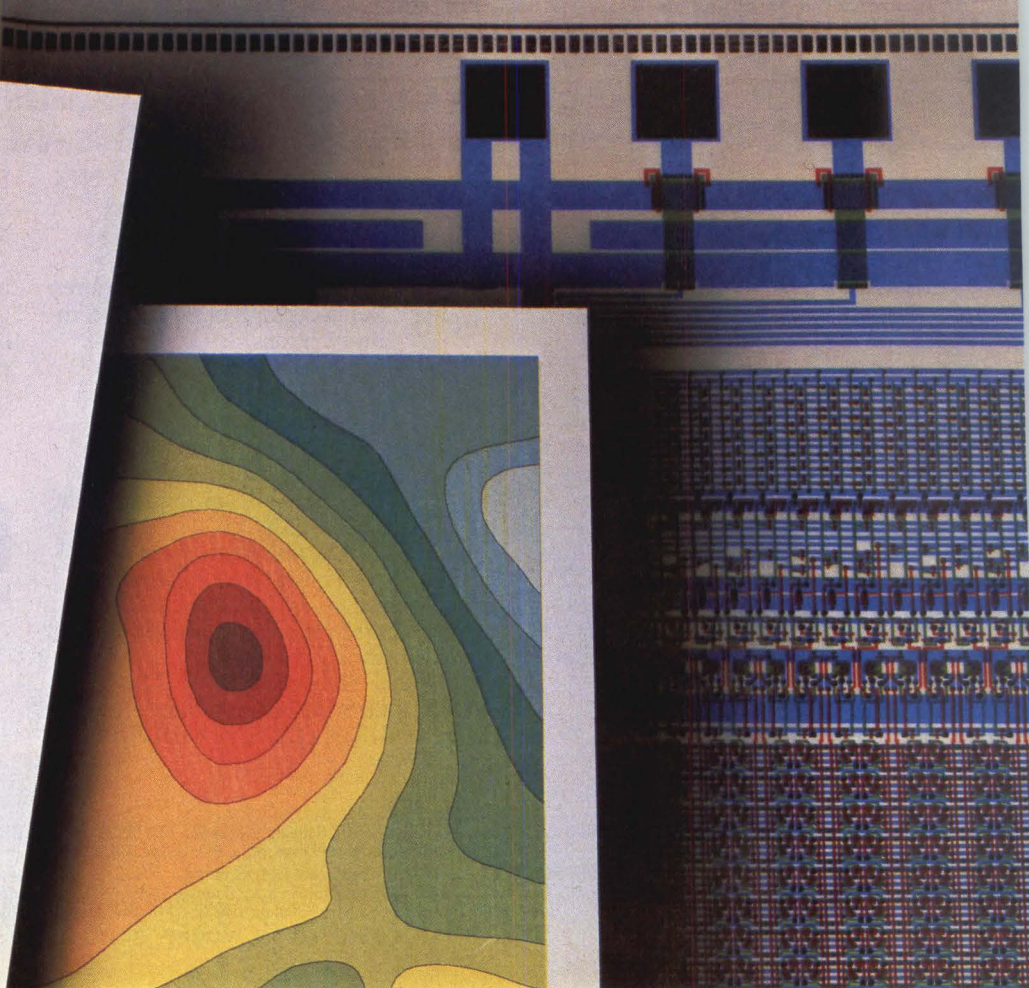
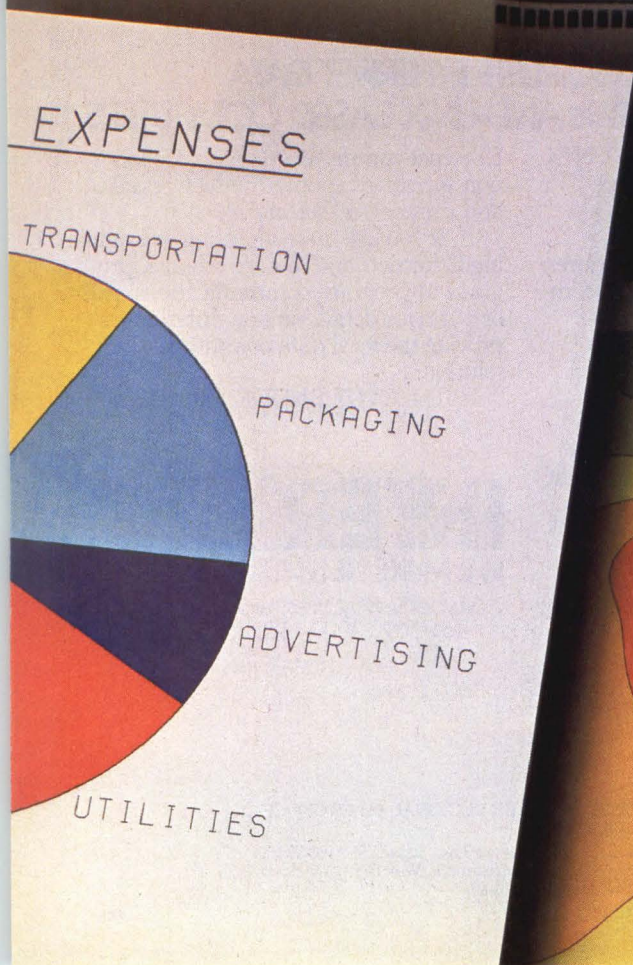


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# Systems in Manufacturing



Allen-Bradley's new low-end system, the Microtrol, is available with an LCD terminal, which can be used as a programming device or a permanent data monitor. The system sells for less than \$1000.

and are taking the systems approach to integrating PCs with other factory systems," notes ADL's Young.

Last year, Gould announced a supervisory master/slave network called Modbus and a peer-to-peer network called Modway. Modbus allows a central computer, whether it be a high-end Gould programmable controller or an S.E.L. minicomputer, to store programs for as many as 30 programmable controllers on the factory floor. Any program changes are generated at the central computer, which downloads programs or program changes to the programmable controllers in the shop. Machine data accessed by the programmable controllers on the floor, conversely, are sent up-line to the supervisory computer for central storage.

Modway enables programmable controllers on the plant floor to talk and exchange information with each other. For example, once a machine on a production line performs its designated function on a part, Modway allows the programmable controller for that machine to tell the controller on the next machine to prepare to perform its operation on the part. If a machine breaks down, the programmable controller for that machine can signal the other programmable controllers in the plant to slow their machining operations to avoid building a backlog of parts or subassemblies within the factory.

Allen-Bradley's networking capability consists of a supervisory approach—the Data Highway. Unlike Gould's supervisory network, the Data Highway allows any network-compatible computer or programmable controller in the factory to serve as the master or

supervisory computer. As many as 64 PCs can be tied into the system. Should the programmable controller or computer performing the supervisory function break down, the function is automatically passed to another programmable controller or computer in the plant. Allen-Bradley's Juda says the approach alleviates the problem of an entire factory's closing because of a central computer breakdown.

TI offers a supervisory network called TIWAY I and has announced plans for the TIWAY II peer-to-peer network. All three companies offer gateways that enable their networks to be linked to other networks within a factory.

## Role of low-end systems increasing

ADL's Young notes that as more users install networks and distribute control functions in production facilities, low-end sales are increasing. Rather than controlling a large factory section with one high-end programmable controller, users are controlling machining stations with several smaller programmable controllers.

TI was first on the market with a small programmable controller system—the model 5TI—in 1974. It sold for \$1000—10 times less than any other system then available. TI's latest low-priced offering, the model 510, sells for prices starting at \$400. Allen-Bradley and Gould only recently introduced their low-priced systems selling for \$700 to \$1000. "TI identified a segment of the market early on that wasn't being addressed by the larger vendors," notes Michael Bradley, marketing manager of TI's industrial control division. "We sold primarily to first-time users who needed a PC to control a single machine in a small shop. Now, with network communications, larger users are installing the low-end systems as well."

To accommodate the sales of low-priced products, suppliers are turning to distributors rather than their traditional direct sales forces. "We'd have to sell as many as 60 Micro 84s to generate the same sales revenues as one 584," notes Gould's Loomas. Gould sells the Micro 84 through the company's network of 86 industrial distributors, while marketing its larger systems directly to OEMs and large end users. End users include companies such as GM and Ford Motor Co., and OEMs include machine-tool builders that integrate programmable controllers into their products.

TI also uses distributors to sell the company's low-priced systems and direct-sales channels to sell its larger systems. Allen-Bradley, however, sells the whole spectrum of its product line through a network of 206 distributors. □

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MINI-MICRO SYSTEMS/April 1983

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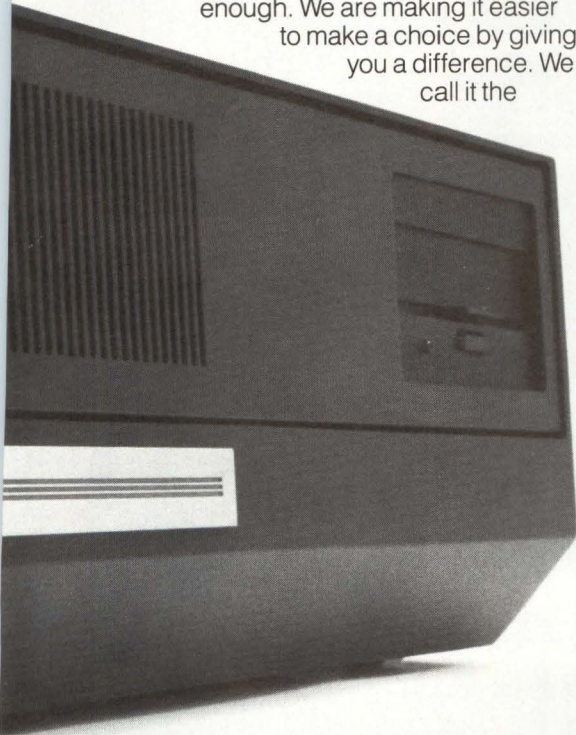
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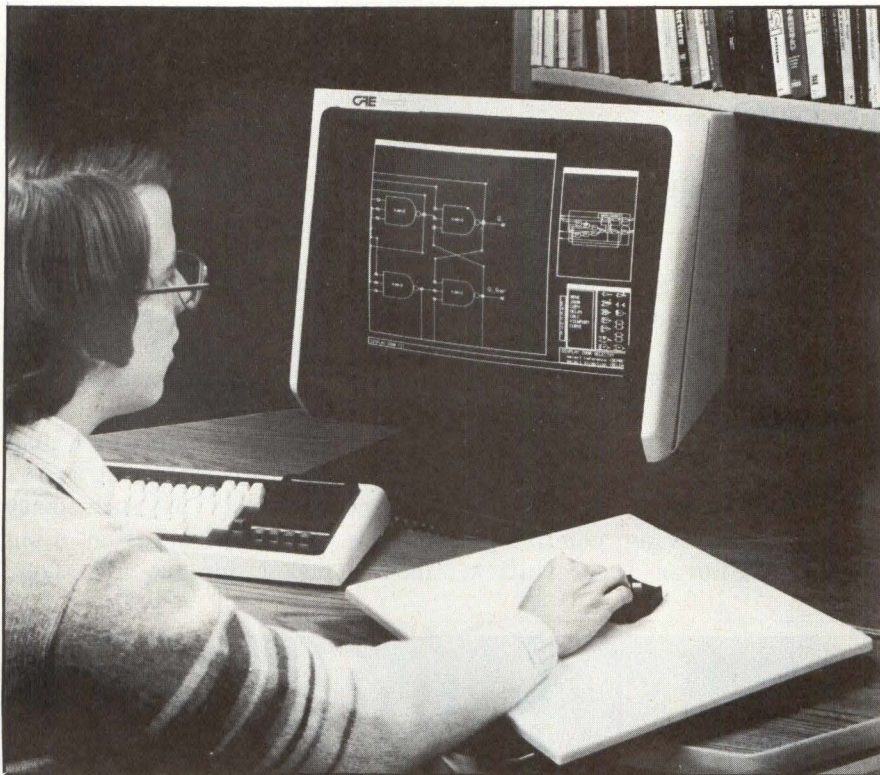
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# Systems in Manufacturing

## CAE system combines layout, simulation functions



CAE's 2000 workstation is available with software to document IC or PC-board designs during layout, verify timing, analyze designs and simulate design functionality.

A system that reportedly allows engineers to design integrated circuits and printed-circuit boards as well as test the functional capabilities of those designs has been announced by CAE Systems Inc., Sunnyvale, Calif. Al Frugaletti, vice president of marketing at CAE, says the CAE 2000 will enable companies to save time and money in product design by integrating layout and simulation capabilities in a single local workstation.

Research firm Dataquest Inc., Cupertino, Calif., estimates that the market for IC-design workstations totaled \$21 million in sales last year and projects that the market will reach \$450 million by 1987.

The CAE Systems entry in that market is based on Apollo Computer Inc.'s 32-bit Domain, which incorporates a Motorola 68000 dual microprocessor and the UNIX operating system. A single workstation sells for \$39,900 and includes a 17-in. monochrome display, 1M byte of main memory, a 34M-byte Winchester disk, a bit pad and schematic capture software. A system that includes software for engineering documentation, timing verification, local analysis and local logic simulation sells for \$88,690. Options include a 1.2M-byte floppy disk drive, a 19-in. display screen, a 300- or 600-line-per-sec. letter-quality printer, one or two 300M-byte removable disk pack drives and a 25-in.-per-sec. tape drive. A

12M-bit-per-sec. local-area network available from CAE links the workstations with shared peripherals, and an RS232 interface provides access to a host computer.

Frugaletti says that the CAE 2000 is targeted for users who can't afford large mainframe- or minicomputer-based design and simulation systems as well as for users of more expensive equipment. "Most CAD systems on the market help engineers only in the drafting or layout stage of their work," notes Frugaletti. "The output is only a geometric model of the final IC or PC board and has no electrical meaning."

He adds that, although software to allow engineers to simulate their designs is available, it runs only on large minicomputers such as Digital Equipment Corp.'s VAX. Using such simulation software, he says, an engineer must first format a graphical design into computer-readable code and then reserve time on his company's central computer to run the simulation program. "What happens is that small companies can't afford to buy \$250-million minicomputers on which to run the simulation programs, and large companies can't provide their engineers immediate access to the central computers," notes Frugaletti. "And whether a company is large or small, engineers shouldn't have to take time to rework their geometric designs into a format that a computer can simulate."

By combining the design and simulation databases, the CAE 2000 avoids those problems, Frugaletti says. The system formats a PC board or an IC layout into computer-readable code that can be simulated locally at the CAE workstation or on a company's larger minicomputers using previously purchased simulation software. Frugaletti lists CAE's competition as Mentor Graph-

# Systems in Manufacturing

ics, Portland, Ore.; Daisy Systems, boro, Ore.; and Valid Logic, Sunnyvale, Calif.; Metheus, Hills-Sunnyvale, Calif. —Frank Catalano

## Workstation optimizes plant-design software

A software system dubbed the Plant Design Management System, long popular in Europe, is getting a boost in the U.S. by a Sunnyvale, Calif., company that has designed a graphics workstation to optimize the PDMS software. The Design Station One (DS1) workstation from Cadtrak Corp. includes a raster graphics engine and monitor along with ease-of-use software to exploit the power of PDMS, which has typically been accessed through a

dumb Tektronix Inc. storage tube display.

The PDMS software, targeted at users who design the piping, structural and equipment locations for process plants, is available for licensing or as a time-sharing service. Cadtrak has exclusive rights to offer PDMS as a time-sharing service in North America—a service it offers through established time-sharing companies. Prime Computer Inc., Natick,

Mass., gained the right to offer licenses to PDMS in the U.S. by acquiring the British firm Compeda Ltd. late last year. James Callan, Cadtrak's director of marketing, says his company and Prime are discussing the possibility of joining forces to market the DS1 to PDMS licensees.

Callan says the PDMS software commonly runs on Prime 750 computers, although it can also operate on VAX computers from Digital Equipment Corp. and on IBM mainframes. More plant owners are retrofitting and expanding their plants themselves, rather than going to outside builders, Callan says, and Cadtrak is focusing its DS1 marketing efforts on such plant owners. "Time sharing is not a big money maker for us," he says.

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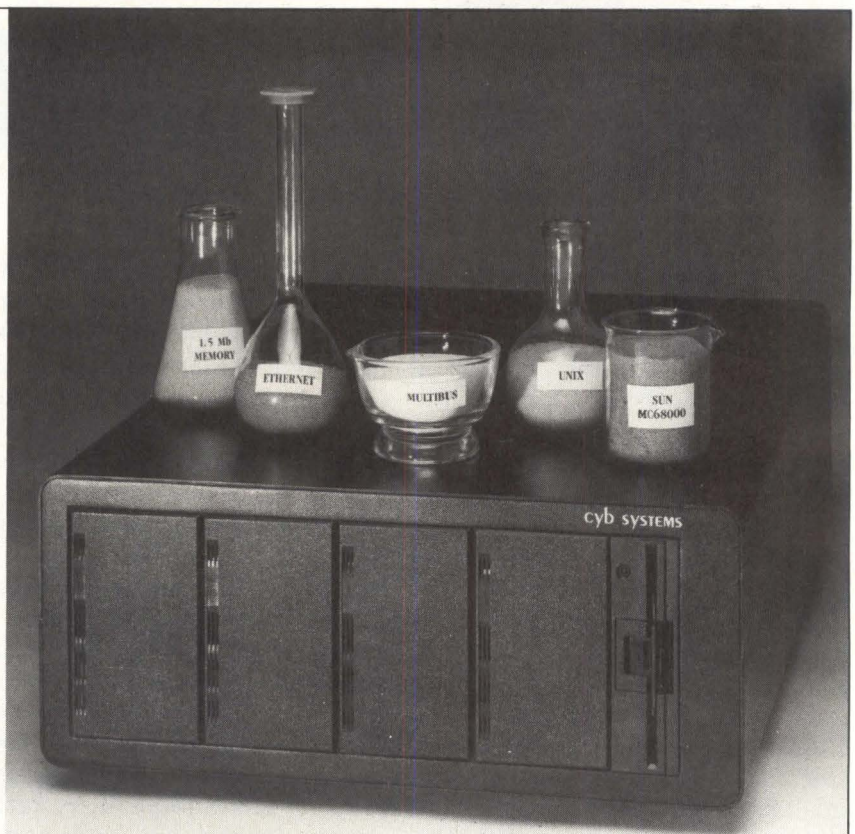
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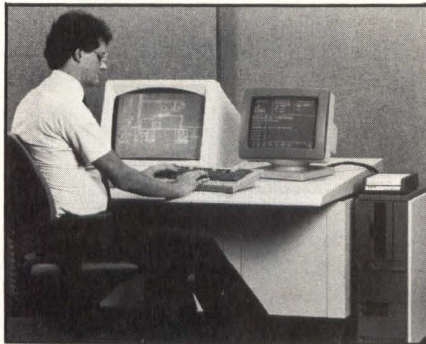
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# Systems in Manufacturing

"Mainly, we're out to sell workstations."

Built using components from Convergent Technologies Inc., the DS1 also includes a raster display and the Cadtrak-developed graphics engine and software. The DS1 displays plant views in full color, and the displays can be rapidly moved, rescaled and, via multiple viewports, viewed simultaneously from several directions. High-resolution drawings of floor areas greater than 100 sq. ft. can be stored in the workstation and displayed on the 660- × 480-pixel monitor.

At the beginning of a session, database information is downloaded from the PDMS host to the DS1 memory. This information includes legal component libraries,



**Cadtrak's Design Station One** adds color displays, high-speed interaction, user friendliness and functionality to the Plant Design Management System software. Among other information, the alphanumeric monitor displays the legal components available to the designer in creating piping layouts on the raster graphics monitor.

which ensure that only compatible parts are used. As designers add and change piping components, the PDMS software monitors piping

alignment and connections. According to Cadtrak, correcting piping-design errors costs about \$1 billion a year. PDMS, which can aid in designs entailing more than 1 million components, can sharply reduce such errors and the resulting costs, Callan says.

The basic DS1 includes five 8086 microprocessors, a virtual database memory, pixel memory of 2M bytes (expandable to 16M bytes), 0.5M-byte floppy and 10M-byte Winchester disk storage, a 19-in. color monitor that displays 256 colors from a palette of 16 million colors, a data tablet, a trackball, a keyboard and function buttons and a monochromatic, 15-in. alphanumeric display. Price for this basic system is \$89,500, with volume discounts available.

—Dwight B. Davis

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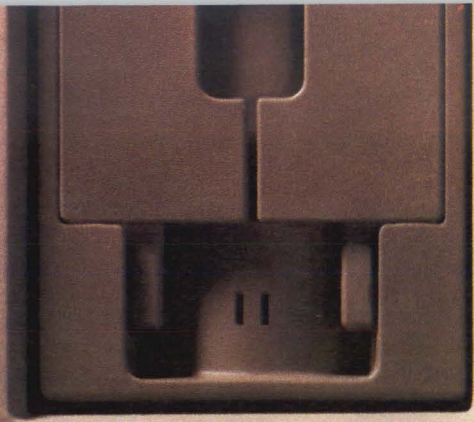
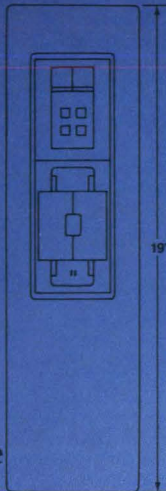
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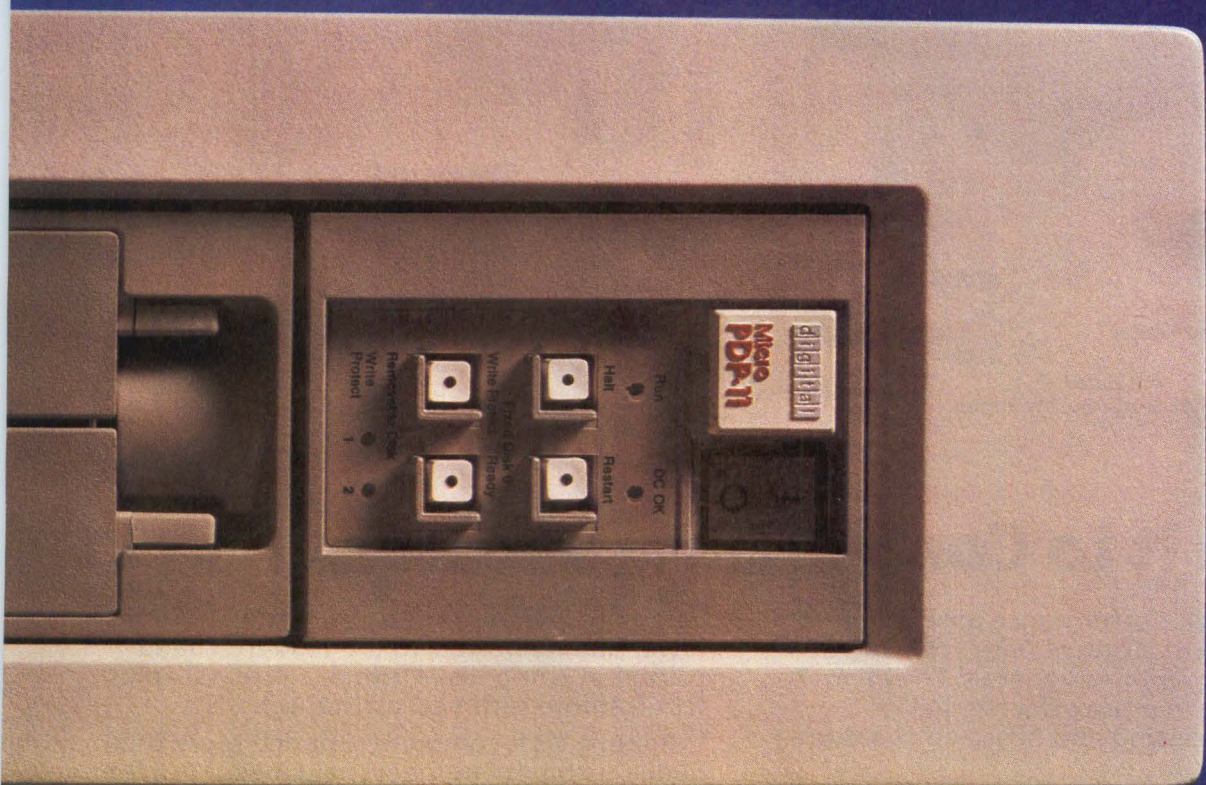
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\*Quantity one, U.S. Prices only  
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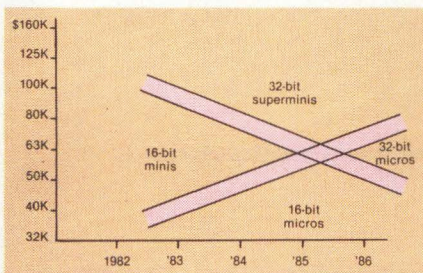
Shape also makes Line Tamers™ in the sizes needed for small computers, office automation, electronic cash registers and other computerized equipment.

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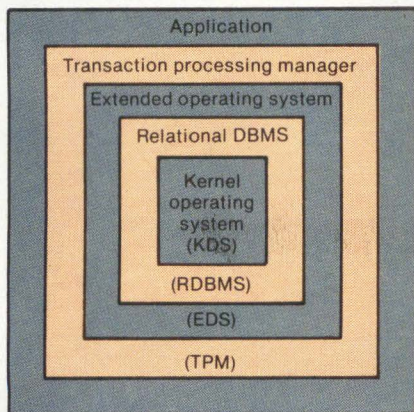
**Shape: The Solution to Power Pollution**

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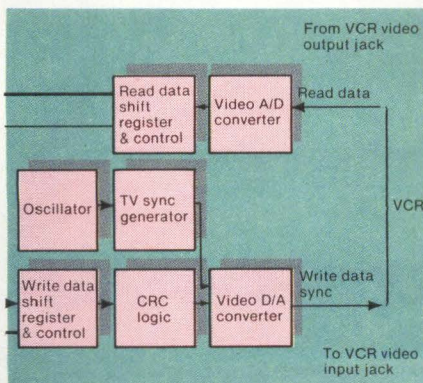
# FEATURE HIGHLIGHTS



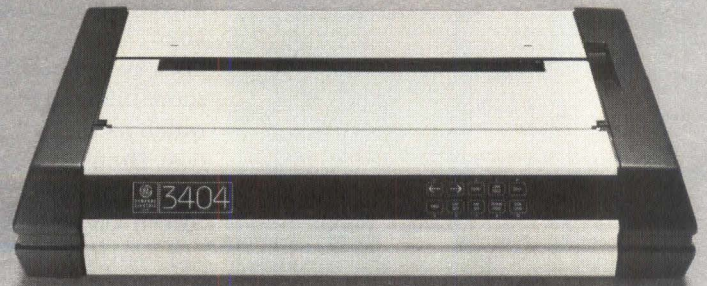
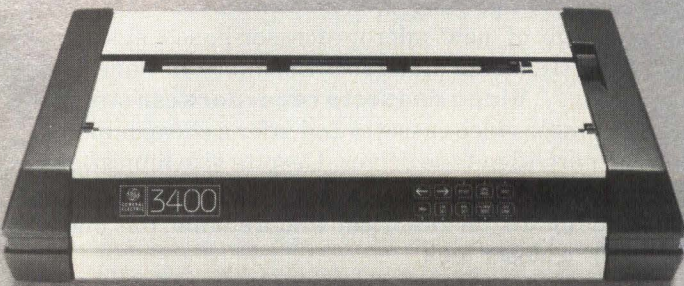
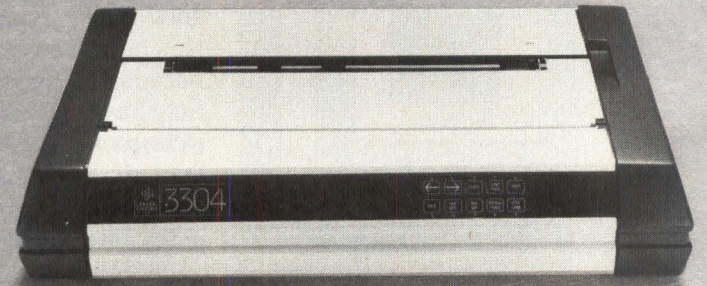
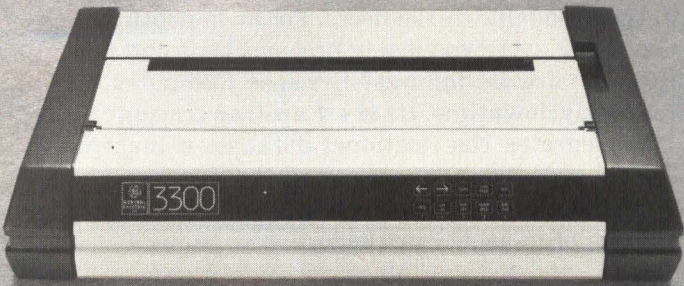
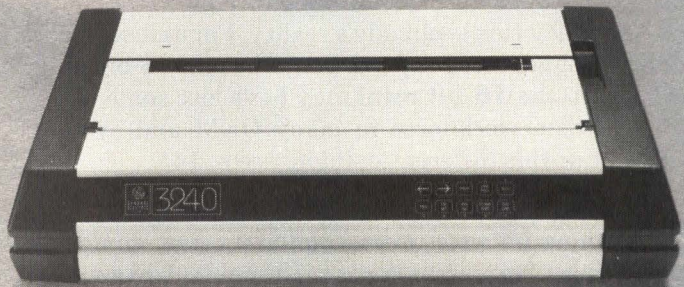
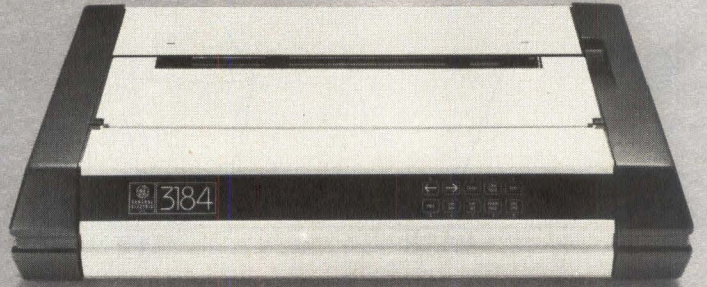
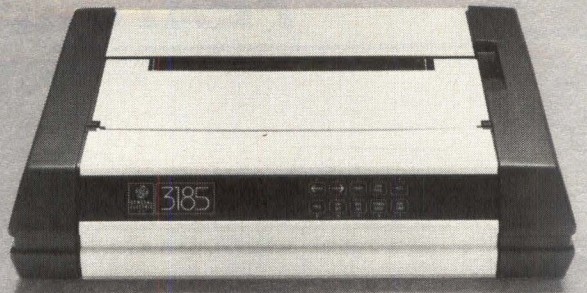
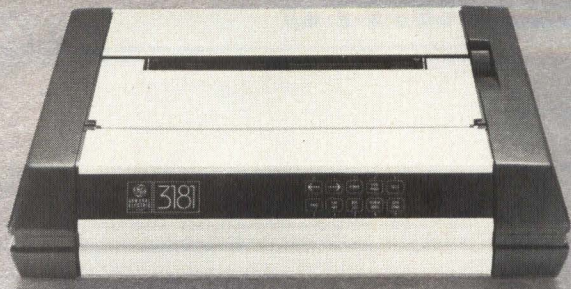
**MINICOMPUTERS:** For more than five years, industry pundits have predicted the demise of the traditional 16-bit minicomputer; that micros from below and **32-biters** from above would squeeze 16-bit minis out of the market. Some say the prediction is already a reality. For a closer look, see p. 133. . . On the other hand, some experts deny that the 16-bitter is already outdated. Although the **16-bit mini** may have lost some of its glamor, they say, it is still a workhorse in many OEM and system integrator product lines. For this different opinion, see p. 145.



**SYSTEMS:** The distinctions between microcomputers and minicomputers have blurred in the past few years almost to the point of disappearance. Convergent Technologies Inc. has introduced the **Megaframe system** which now aims its sights at mainframe performance. Based on Motorola Inc.'s MC68000 family processors and Intel Corp's 186 processors, the system is field-upgradable to 128 users. For an in-depth look at this new system, see p. 157. . . Are you losing precious time and money because of hardware and software failures? Synapse Computer Corp. may have a solution to costly downtime. Its **N + 1 on-line transaction-processing system** integrates the relational database-management system, the transactional processing manager and the Synthesis operating system into a set of protection spheres. See p. 165 for a look at this entry into the "continuing processing" market.

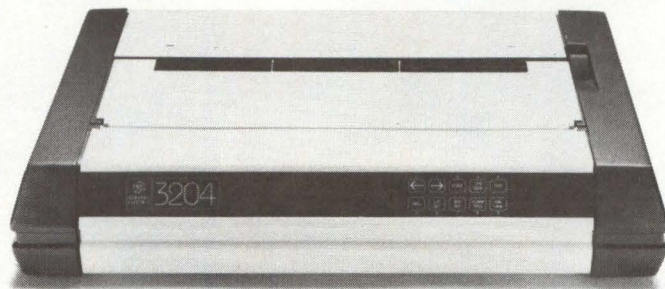


**DISK DRIVES:** Along with processors, printers and tape drives, **disk drives** continue to shrink in size. With current media at less than 5¼-in. sizes and 5M- to 10M-byte storage ranges, Winchester will soon find their way into a wide range of new microprocessor-based systems. However, the issue of diskette media standards remains a hot one. For more information, see p. 175. . . **Video cassette recorders** can store as much as 100M bytes on a single video cassette and offer a cheaper media cost than even streaming cartridge-tape drives. Despite size limitations and some time restrictions, VCRs, including a new offering from Alpha Micro Systems, are proving to be practical and reliable for many applications. See p. 179 for a closer look.



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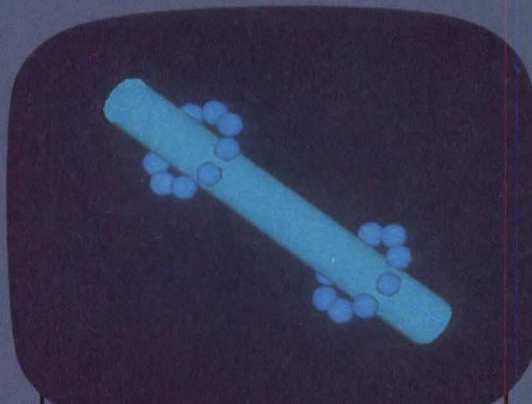
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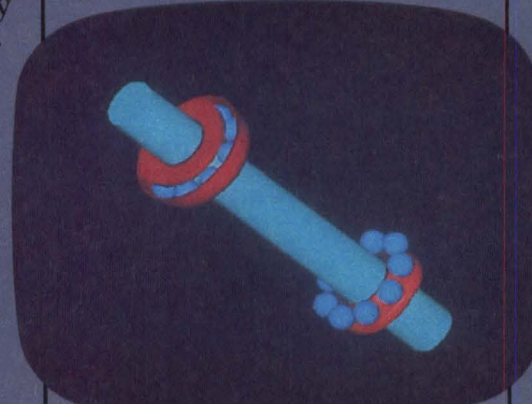
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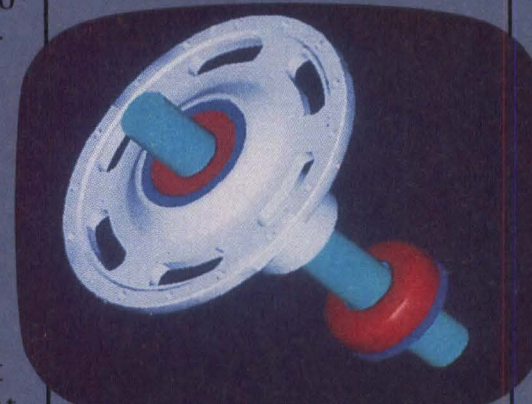
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## MINICOMPUTERS



# 32-bit minis press down from above

EFREM MALLACH, Contributing Editor

### *Superminis clash with micros and 'traditional' minis for price/performance dominance*

For more than five years, industry pundits have predicted the demise of the "traditional" 16-bit minicomputer, reasoning that it would be squeezed between increasingly sophisticated microcomputers from below and 32-bit minis from above. For this to happen, it was assumed that 32-biters would come down from their \$150,000+ heights. In recent months, they have been doing just that.

A "32-bit mini" is:

- a system intended, as indicated by its architecture, software and marketing emphasis, for on-line, interactive use. (This excludes mainframes.)
- a system in which the central processor is not based on a microprocessor chip or chip set.
- a system in which the dominant data lengths, buses, registers, etc. are 32 bits long.

There are probably about 20,000 systems shipped in 1983 that fit these criteria, with a market value in excess of \$2 billion. For people to spend this much on a product, it must have something to recommend it. The 32-bit superminis do. Their popularity is due to two factors: the perceived value of 32-bit capabilities is increasing, and the cost of providing these capabilities is decreasing.

#### **Value**

The value of a 32-bit system has been both pumped up and deflated over the past few years, mostly by people with an ax to grind, such as vendors of 32-bit systems and firms that don't have one. One way that 32-bit systems have an edge over 16-biters is in capability. A 32-bit system has a richer instruction set

than does a 16-bit system. It enables users to count higher, address more memory, index into larger arrays and specify a record in larger files. In short, it enables them to implement more sophisticated software. These statements aren't absolute. A user could string shorter data elements together and get the equivalent of a long one. But doing that can be awkward and isn't always practical. Using a longer word gives the user a head start.

Second, 32-bit systems have an edge in performance. For a given circuit technology, the more bits processed in one cycle, the fewer cycles an operation takes. This point is related to capability. If 32-bit data elements are common, 32-bit data paths and functional elements are useful. Designers tend to use 32-bit circuitry when there's a good deal of 32-bit software visibility, although the reverse is not necessarily true. Many firms have built low-cost, lower performance 16-bit hardware implementations of 32-bit instruction sets.



Honeywell Information Systems' DPS/6 32-bit models can be built up from 6-bit models in the field.

Going to 32 bits isn't the only way engineers can make a computer fast. They can use high-speed logic, pipelined instruction execution, cache memories and more. The decision on when to use 32 bits for performance is personal. A lot depends on what a design team is familiar with. That's why the performance of 16- and 32-bit systems overlaps. For instance, Hewlett-Packard Co.'s 16-bit 3000 Series 64, the top of that line, is much faster than Digital Equipment Corp.'s

## 32-BIT MINICOMPUTER COMPARISON CHART

Vendor	Canaan Computer	Data General Corp.	Digital Equipment Corp.
Product line	Fred	Eclipse MV	VAX-11
Line announced	5/83	4/80	10/77
Smallest model	Fred	MV/4000	VAX-11/730
Model announced	5/83	11/82	4/82
Packaging	24-in. cabinet	Rack or 40-in. cabinet	42-in. cabinet
Performance <sup>1</sup>	—	600(a), 0.6(c)	—
Main memory (M bytes)	1-4	1-8	1-5
Mass storage (M bytes)	40-160	15-4,700	20 up
Maximum workstations	1 (initially)	64	96
Software <sup>2</sup>	DP, WP, EM	All	All except TP
Networking	SNA, LAN	SNA, X.25, XODIAC	DECnet, X.25
Languages <sup>3</sup>	B, C, CB, F, L, P	APL, B, C, CB, F, L, P, RPG	B, Bliss-32, C, CB, Coral 66, F, L, MUMPS, P
16-bit compatibility	n/a <sup>5</sup>	Eclipse <sup>6</sup>	PDP-11 <sup>12</sup>
Purchase price <sup>4</sup>	\$55,000 <sup>11</sup>	\$92,700 <sup>9</sup>	\$98,825
Comments	Runs System/370 applications; includes 1024 x 1024 high-resolution graphics.	Broad range of software, peripherals available.	Information obtained from industry reference sources and not verified by vendor.
Vendor	Prime Computer Inc.	Pyramid Technology	Tandem Computers Inc.
Product line	50 Series	Pyramid	NonStop II
Line announced	1979	Summer 1983	3/81
Smallest model	2250	Pyramid	NonStop II
Model announced	8/82	Summer 1983	3/81
Packaging	30-in. cabinet	46-in. cabinet	Cabinet
Performance <sup>1</sup>	0.5(c)	—	—
Main memory (M bytes)	0.5-4	1-8	2-128
Mass storage (M bytes)	68-632	80-1,500	—
Maximum workstations	32	128	—
Software <sup>2</sup>	All	All	All but TS, DP
Networking	Primenet, X.25	SNA	SNA, EXPAND
Languages <sup>3</sup>	B, CB, F, L, P, RPG	C, F, P	CB, F, MUMPS
16-bit compatibility	n/a <sup>5</sup>	n/a <sup>5</sup>	NonStop
Purchase price <sup>4</sup>	\$84,160 <sup>13</sup>	TBD (over \$100,000)	n/a <sup>10</sup>
Comments	Designed for modern office environment; plugs into wall socket, does not require special air conditioning.	Designed for high-level scientific applications; features 32M-bytes-per-sec. bus, 528 programmable registers.	Systems provide high availability for on-line transaction processing.





The Wang VS 100 can be field-upgraded from the VS 90 and can be expanded further to 8M bytes of main memory.

32-bit VAX-11/730—the slowest and least expensive VAX-11. All other things being equal, though, the performance of most modern minis benefits from 32-bit hardware.

### Cost

At the same time that the value of longer words is rising, the cost of providing them is dropping. Electron-

*Going to 32 bits isn't the only way engineers can make a computer fast.*

ic logic, in the form of integrated circuits, costs less each year. This has a snowball effect on overall design costs. As more chips of a given type are produced, they become less expensive due to economies of scale in production and to the learning curve of experience. As denser chips with more capabilities become available, fewer chips are needed to implement a design. That reduction, in turn, affects printed-circuit-board area and the cost of power supplies, connectors, cooling, cabinetry and so on, further reducing the cost of a system.

This combined cost/value trend has dramatically changed the price/performance range and availability of 32-bit systems. The versions built during the 1970s sold for \$100,000 to \$150,000 for a CPU, 8192 words of memory and a console printer. DEC's VAX-11/780, announced in late 1977, provided more performance, eight times the memory, a disk drive and eight

Gould, Inc. (S.E.L.)	Harris Corp.	Honeywell Information Systems	Perkin-Elmer Corp.
Concept/32	Harris <sup>6</sup>	DPS 6/92-96	Series 3200
1/75	1975	12/80	2/79
32/27	H-700	DPS 6/92	3210
5/80	2/82	12/80	10/81
Rack or 63-in. cabinet	Rack or 72-in. cabinet	60-in. cabinet	30-in. cabinet
600(a)	0.65-0.85(c)	1200(a), 636(b)	1012(a)
0.25-16	0.384-12	1-4	0.5-4
32-675	80-6,000	67-2,048	32 up
64	128	64	32
TS, DB, WP, EM	All	All except DP	TS, TP, DB
—	SNA, X.25	DSA, SNA, X.25	PENnet
Ada, B, CB, F, P	B, C, CB, F, P	B, CB, F, P, RPG	C, F, P, Coral 66
n/a <sup>5</sup>	n/a <sup>5</sup>	DPS 6/30-76 <sup>8</sup>	Series 16 <sup>8</sup>
\$108,700	\$104,000 <sup>7</sup>	\$162,300	\$87,000
Family offers compatibility over performance range of 600 to 6600 Whetstones/sec.	The Harris line of 24/48-bit systems competes with 32-bit mini and superminicomputers.	Uses same CPU as DPS 6/94, 96; 16-bit DPS 6 models can be field-upgraded to 32-bit models.	

Wang Laboratories, Inc.
VS
1978
VS-90
1/82
30-in. cabinet
0.77(c)
1-4
as much as 2300
48
All but TS
Wangnet
B, CB, F
VS-25 through 80 <sup>8</sup>
\$122,500

### NOTES

- As supplied by vendor. (a) — single precision Whetstones (FORTRAN); (b) — U.S. Steel COBOL Productivity Index; (c) — millions of instructions per sec.
- TS — time sharing; TP — transaction processing; DP — demand paging; DB — database management; WP — word processing; EM — electronic mail.
- A — APL; B — BASIC; C — "C"; CB — COBOL; F — FORTRAN; L — PL/1; P — Pascal. Other names/acronyms are spelled out.
- Hardware purchase price for system with 2M-byte main memory, 80M-byte mass storage, 300-lpm printer, and 8 workstations. Major additions/exceptions to this configuration are noted.
- Vendor has no 16-bit product line with which to be compatible.
- These are 24/48-bit systems.
- With 1.5M-byte main memory.
- Instruction set of vendor's 16-bit line is subset of 32-bit line's native mode.
- Includes 1600-bpi tape drive.
- Not directly comparable as Tandem does not offer single-CPU systems.
- With one workstation.
- Via compatibility mode; some restrictions apply.
- Includes 158M bytes mass storage.

workstation ports for a comparable price. Today's entry point for useful configurations is around \$50,000. This decline is especially impressive when the fact that the CPU is only a small part of system cost is considered.

The drop means that 32-bit architectures are being built and bought to serve smaller applications than ever.

### Some specifics

During the past 18 months, six supermini vendors have extended their product lines downward. In the same period, not one has announced a new CPU at the

### WHERE ARE THE 32-BIT MICROCOMPUTERS?

The 32-bit microcomputers are coming, and coming fast. A variety of micros with some 32-bit characteristics is available. Many micro-based systems are aimed at the same markets as the 32-bit superminis. Because of the limits of micro power, all 32-bit micros can use multiple microprocessors to handle demanding jobs. Some examples include:

- Apollo Computer Inc.'s Domain system, which uses the Motorola 68000. Domain links powerful, individual workstations into a resource-sharing network. Using the Domain provides each of a group of engineers that would have to share a large VAX-11/780 with a dedicated, 68000-

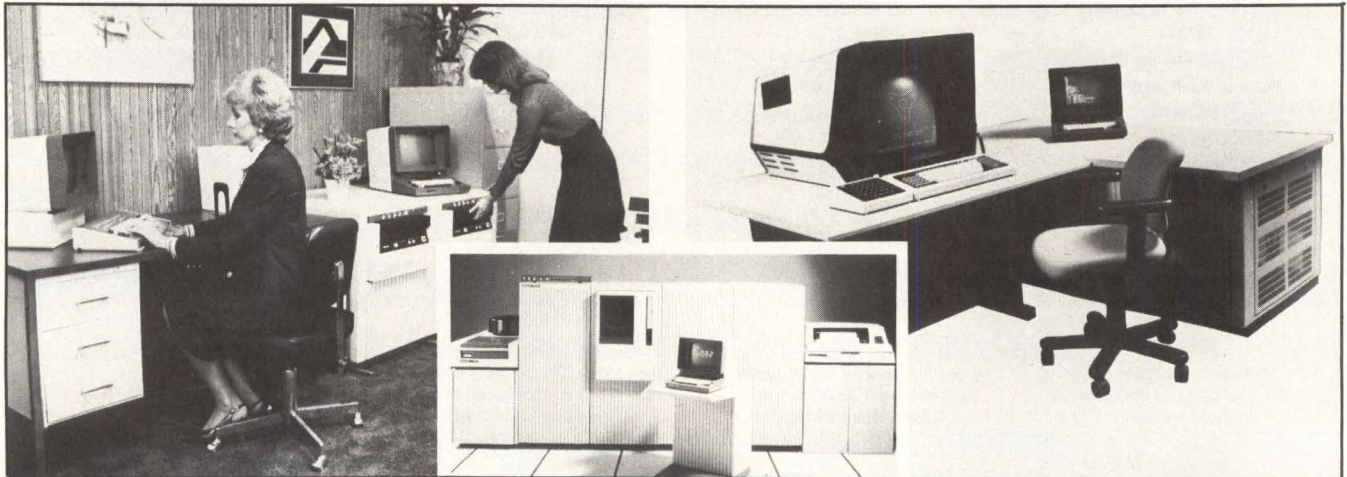
based network node with its own high-resolution graphics display.

- Hewlett-Packard Co.'s 9000 series supermicro, which was announced in November, 1982. It uses proprietary NMOS III technology. HP's "engineering productivity network" approach to R&D applications is similar to Apollo's. In addition, HP can upgrade a 9000 with as many as three processors and can support a small design team on a single system.

- Stratus Computer Inc.'s and Synapse Corp.'s arrangements of multiple microcomputers, which provide high availability via immediate replacement of failed units. Their approaches feature modular expand-

ability, which involves the use of as many 68000s as a job requires, plus as many more for backup as an architecture needs. With 68000 chips selling for less than \$100 each (or a little more for the fastest versions), this approach is affordable.

- Intel Corp.'s iAPX-432 microprocessor, whose innovative, object-oriented architecture appeals to leading-edge technologists and computer scientists. Performance, however, is seen as somewhat slow. Multiprocessor capabilities were designed into the 432, and its successors will appear in commercially viable systems.



The Perkin-Elmer 3200 MPS (inset) was designed for high-speed real-time applications. Its smaller members include the 3210 commercial system (left) and a system for distributed CAD/CAM applications.

### IS 32 A MAGIC NUMBER?

Despite all the hoopla, there's nothing magic about the number 32. Honeywell Information Systems, Sperry Univac and Digital Equipment Corp. all market large-scale 36-bit systems. Harris Corp. has a 24-/48-bit line that does 32-bit applications, even though it doesn't have today's popular word length. And there's no reason why a system with data

elements of 29, 34 or any number of bits can't be built.

However, there is a reason why most superminis have settled on 32 bits. Today's systems generally process character data in the form of 8-bit bytes. So a word length that is a multiple of 8 bits makes sense. If the multiple is a power of 2, accessing individual bytes in the word is most

efficient. That's why virtually every new system uses data elements from the 8-/16-/32-/64-bit family. With today's microprocessor technology, the big capability jump comes in moving from 8 to 16 bits. With minis, it's in moving from 16 to 32. In either case, the value of the longer word length is significant for more and more applications.

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top of its supermini line. (Such high-end models as the DEC VAX-11/782 and Prime Computer Inc.'s 850 are essentially multiprocessors based on existing CPUs.) Among the new products are:

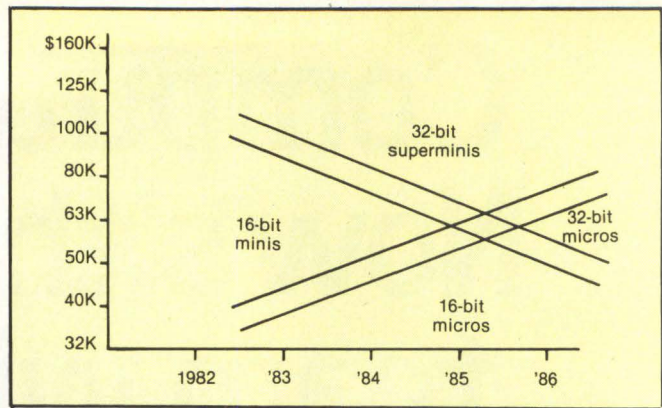
- the Wang Laboratories Inc. VS-90, which is an excellent example of how to take advantage of an existing design. By removing the cache memory from the VS-100 and making other changes, Wang got a processor at a lower cost/performance point without a full-scale design project, with the ability to be field-upgraded to the VS-100 itself.

*The value of a 32-bit system has been both pumped up and deflated over the past few years, mostly by people with an ax to grind.*

- the Data General Corp. Eclipse MV/4000, which is, on the other hand, a new design. It was needed because the larger MV/6000 is based on the high-end MV/8000 design, which couldn't effectively be reduced further. The MV/4000 is a potent performer for its price.

- the DEC VAX-11/730, a new design developed for a reason different from DG: with DEC's larger production volumes, the savings of a design optimized for each performance point outweigh the engineering investment.

- the Canaan Computer FRED, which appears to be the first full-scale supermini designed specifically for one user; support for additional workstations will follow, however. Its scientific orientation shows in its standard high-resolution graphics display. At an entry price of less than \$50,000, it should be able to compete



**Price ranges are dominated by architecture-technology pairs.** The 32-bit minis' prices will decrease for another two or three years, and then be pushed back up by the relentless advance of the supermicro.

effectively with microprocessor-based systems such as those from Apollo Computer Inc. FRED and a new system from Pyramid Technology prove that microcomputers aren't needed to start a computer company this year.

### Where next?

How low can 32-bit minis go in price and performance? Although there's no lower technological limit, there is an economic one: how low is it cost-effective to go? You don't need 32-bit capability to do single-user word processing. Trend lines and their causes provide a clue to the answer. Today's 32-bit superminis dominate the system price range from about \$90,000 (until mainframes take over), a figure that is dropping by about 15 percent annually. At the same time, microprocessors dominate the range from about \$40,000 and less, and this limit is rising. Traditional 16-bit minis are in the middle.

Because the lines are approaching each other, it is expected that the price range dominated by 32-bit minis will continue to extend downward only for another two or three years. At that time, their lower limit will be around \$50,000 to \$60,000. Below that, microcomputers

## WHERE IT ALL STARTED

The philosophical ancestors of today's superminis started to appear in the late 1960s. They were 32-bit systems, with clean, simple architectures, and were fast for their day. The first two were the Honeywell Information Systems' 632 and S.E.L.'s System 86. Interdata Corp. got into the act in 1974 with its 732.

The Honeywell 632 (not related to Honeywell's current DPS 6 line) was used primarily as a high-performance front-end processor in applications such as airline reservation networks. A virtual-memory version, the 832, was delivered to the National Aeronautics and Space Administration's

Electronics Research Center. The center had very sophisticated real-time software under development in 1970. The series was dropped following a merger of Honeywell's and General Electric Co.'s computer operations, before the 832 was announced commercially.

The S.E.L. System 86 and its virtual-memory cousin, the 88, were extremely fast machines for 1970. Most instructions executed in one or two 600-nsec. memory cycles. They were used in demanding applications such as pilot training simulators. S.E.L., now a division of Gould, is in the same markets today, and claims

to offer the highest raw speed of any supermini.

The Interdata 732 was a hybrid—a 32-bit architecture implemented with 16-bit hardware. It was quickly followed by the 832, which was much faster because it used 32-bit-wide hardware internally. Interdata became part of Perkin-Elmer Corp. in the late 1970s and no longer uses the Interdata name. Like S.E.L. (Gould), demanding, high-performance, real-time jobs have been P-E's major market, but the company has recently addressed commercial transaction processing as well.

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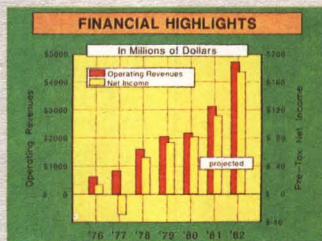
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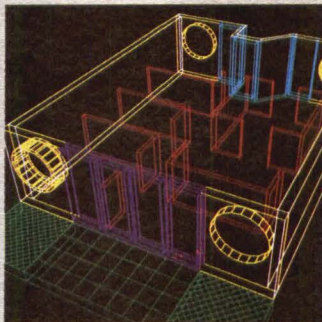
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Vendor Addresses

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**Data General Corp.**  
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CIRCLE NO. 855

**Digital Equipment Corp.**  
146 Main St.  
Maynard, Mass. 01754  
CIRCLE NO. 856

**Gould Inc.**  
S.E.L. Computer Systems Div.  
6901 W. Sunrise Blvd.  
P.O. Box 9418  
Ft. Lauderdale, Fla. 33310  
CIRCLE NO. 857

**Harris Corp.**  
2101 W. Cypress Creek Rd.  
Ft. Lauderdale, Fla. 33065  
CIRCLE NO. 858

**Honeywell Information Systems**  
200 Smith St.  
Waltham, Mass. 02154  
CIRCLE NO. 859

**Perkin-Elmer Corp.**  
2 Crescent Place  
Oceanport, N. J. 07757  
CIRCLE NO. 860

**Prime Computer, Inc.**  
Prime Park  
Natick, Mass. 01760  
CIRCLE NO. 861

**Pyramid Technology**  
2471 East Bay Shore Rd.  
Palo Alto, Calif. 94303  
CIRCLE NO. 862

**Tandem Computers Inc.**  
19333 Vallico Parkway  
Cupertino, Calif. 95014  
CIRCLE NO. 863

**Wang Laboratories, Inc.**  
1 Industrial Ave.  
Lowell, Mass. 01851  
CIRCLE NO. 864

will have taken over. The 16-bit mini will have been virtually eliminated as a factor, except when compatibility with earlier systems remains a major consideration. After that, the lower cost-effectiveness limit of the 32-bit mini will rise again, forced up by the increasing power of the supermicro.

*As more chips of a given type are produced, they become less expensive due to economies of scale in production and to the learning curve of experience.*

This doesn't necessarily mean that today's product lines will disappear. Many minicomputer lines from the mid-1970s are now largely microcomputer based: DEC's PDP-11, DG's Nova, HP's series 1000 and others. The same will happen with the 32-biters. A microprocessor version of DEC's VAX-11 has been widely discussed in the press, and others are sure to follow.

Upward extensions aren't dead either. The recent activity has been downward, but that is not permanent. High-end extensions of several supermini lines will move more and more into "mainframe territory." As this happens, 64-bit hardware can't be far behind, ensuring the minicomputer designers of continued work for many years. □

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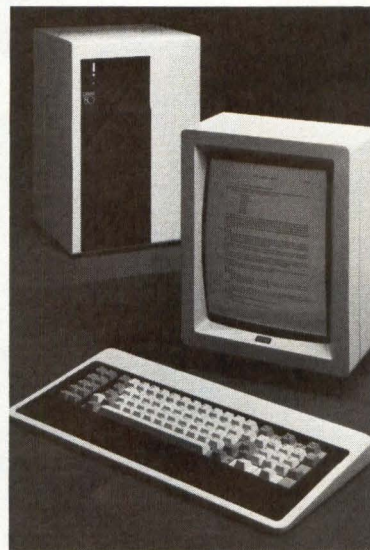
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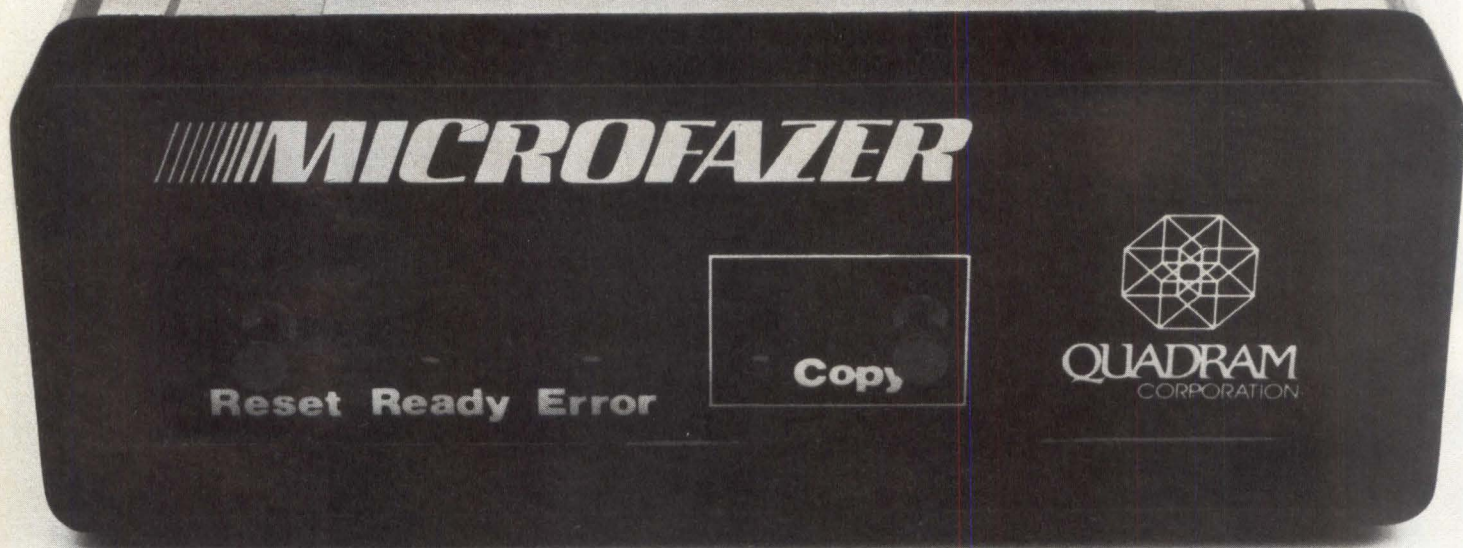
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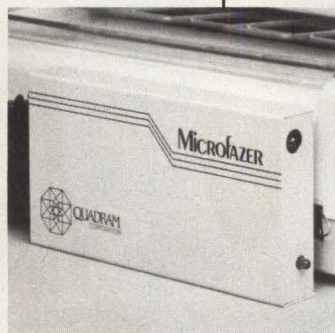
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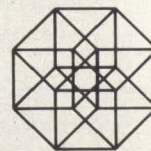


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## MINICOMPUTERS

# The 16-bit mini holds on

DAVID H. FREEDMAN, Associate Editor

*Despite the micro challenge, the aging 16-bit mini still packs an OEM punch*

Although the 16-bit minicomputer has lost much of the glamour it achieved in the late '60s, it is still a workhorse in many OEM and system integrator product lines. There are no immediate signs that this situation is changing, as the 16-bit mini industry continues to churn out a range of machines boasting features that could hold the supermicro at bay for a few more years.

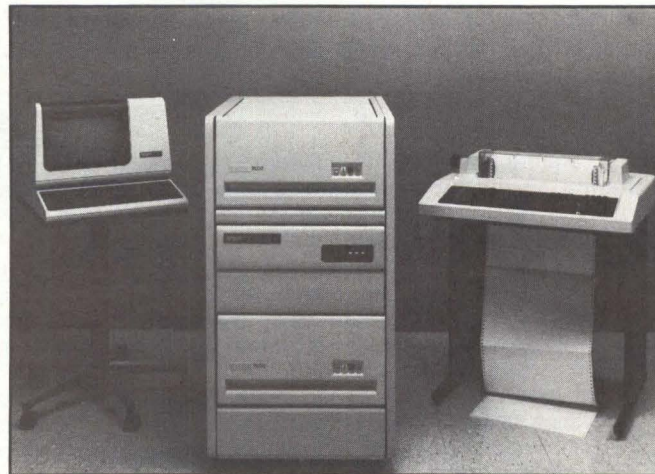
### The industry

The 16-bit minicomputer industry hasn't changed a great deal in the past few years. Vendors offer the same product lines as they have in the past, give or take a few machines. Compared to the progress of the microcomputer and superminicomputer industries, the 16-bit mini industry seems to be moving backward. But many OEMs argue that there is no sense in changing something that works, and, despite its age, the 16-bit mini still works quite well.

The list of major 16-bit OEM mini vendors has for

years and in some cases, decades included Digital Equipment Corp., Data General Corp., Honeywell Information Systems and Hewlett-Packard Co. Each of these manufacturers offer broad, established 16-bit product lines that emphasize flexibility in configuring hardware and software and the ability to be upgraded. Customers of most of these vendors can follow upgrade paths that start with single-user desk-top computers and continue up through 32-bit systems supporting hundreds of users. Other 16-bit OEM system vendors include IBM Corp., whose value-added remarketing program accounts for 20 percent of all Series/1 sales, and Datapoint Corp., offering a desk-top mini and a more powerful mid-range processor.

System vendors are not restricted to selling systems. Most offer minicomputers as boxes or even boards, competing against box-level products such as Computer Automation Inc.'s Naked Mini and Bytronix Corp.'s DG Nova-compatible series. Minicomputers from these



DEC PDP 11 minicomputers are available in board-, box- or system-level packaging. Shown are a PDP 11/24 (left) and a PDP 11/23 Plus system.

smaller companies generally boast architectures that are easily adapted to a variety of hardware and software modifications, and are often available only in stripped-down versions without such basics as disk controllers and operating systems. The bare-bones nature of these products is reflected in prices that start at less than \$1000. Such inexpensive boxes give a system integrator willing to develop software and configure peripherals a chance to undercut system manufacturers.



**Datapoint 8600** is a desk-top 16-bit minicomputer supporting as much as 256K bytes of memory. It can be used as a stand-alone machine or as a node in an ARC network.

Some manufacturers optimize their minicomputers for certain applications. Thus, HP's 1000 series offers its best price/performance profile in engineering applications that take advantage of its fast vector-processing capabilities, while Honeywell's DPS 6 machines are particularly effective in business applications calling for fast COBOL program execution. System integrators developing database-management systems for vertical markets often find box-level minicomputers provide sufficient performance at a low price. A number of vendors include industrial control in the markets at

which their 16-bit minis are aimed, and a few, such as Analog Devices Inc., design their products specifically for this application. But because machines installed in smaller companies—major users of 16-bit minicomputers—must often perform a variety of functions, most mini vendors have avoided overly narrowing their products' capabilities.

### Features

The 16-bit minicomputers range from desk-top units supporting a few megabytes of disk storage to large floor-standing units supporting gigabytes. In addition to such differences, these machines offer a range of characteristics and features that could affect an OEM's decision to choose a product.

Minicomputers vary more widely in processor characteristics than microcomputers (see "What is a mini?" below). Overall processor performance is an elusive quantity dependent on many variables, including application, but some features can provide a rough indication of the processor's ability to manipulate data. Processor cycle time, for example, measures how long the machine takes to perform a single stage of one instruction. This time ranges from less than 200 nsec. to more than 800 nsec. for most 16-bit minis, but short cycle times can be diluted by complex instruction sets and long memory cycle times.

The nature of an instruction set determines a processor's relative ability to perform processing. Machines with large instruction sets, such as the IBM Series/1, with more than 160 instructions, are generally well-suited for commercial or general-purpose applications, while smaller instruction sets are more effective for the simple, repetitive processing demands of engineering and control applications. This effectiveness is greatly increased by floating-point instructions, able to handle numbers as separate mantissas and exponents. Such instructions are standard with the HP 1000 model A9000, and are available as options with many other 16-bit machines. Instruction-set flexibility is improved through the use of microcoding, with which individual instructions are broken into microinstructions stored in ROM. Updating or modifying an instruction set then requires only swapping ROMs. Pipelined

### WHAT IS A MINI?

There are few problems in differentiating 16-bit minicomputers from mainframes, but distinguishing them from 16-bit microcomputers is another story.

Most 16-bit minis are based on processors that incorporate bit-slice technology, in which 2- or 4-bit-wide chips are stacked to yield full 16-bit-wide data paths. Other, older machines use proprietary integrated circuits. In either case, such machines are different from microcomputers based on single-chip processors. But

dealing with 16-bit minis in which proprietary ICs have been incorporated onto a few chips becomes ambiguous. This is the case with the Digital Equipment Corp. LSI 11 minicomputer. Such machines can be considered either microcomputers or minicomputers. Indeed, many manufacturers switch back and forth in labeling their own products, and the offer of "minicomputer power for microcomputer price" serves both microcomputer and minicomputer

vendors equally well.

As supermicro vendors incorporate more powerful chips into parallel architectures, and mini vendors place PDP 11/24-sized processors on a single chip, the difference between small minicomputers and large microcomputers will fade. Many people find the entire issue irrelevant. "The question is not one of architecture, but of capability," says Jim McCabe, product marketing manager at Hewlett-Packard Co.

When was the last time you felt like doing this?



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In addition, CPX is renowned for locating hard-to-find and discontinued parts for all types of drives. We stock parts and subassemblies for almost every disk drive manufactured in America since 1961. And we offer repair on all of those same subassemblies.

CPX provides the same services to non-DEC-compatible peripherals, as well. You know you can rely on CPX to keep your system running.

CIRCLE NO. 81 ON INQUIRY CARD

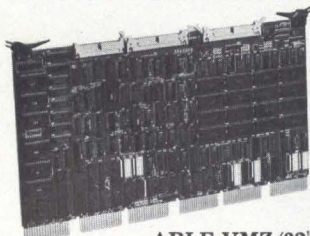
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## INCREASED VAX THROUGHPUT.



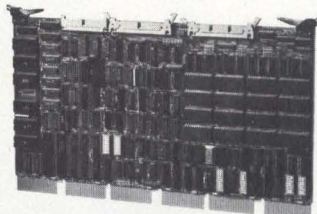
ABLE VMZ/32\*  
16-line DMF/32 subset

Here's an asynchronous microcontroller with programmable DMA, fully transparent to VAX/VMS as two 8-line DMF 32's and contained on a single board. Priced

below the DZ11-E, it outperforms DZ or DH devices under VMS v.3, has interrupt-driven modem control on every line, and includes an output throttle which lets peripheral devices optimize their own data rate.

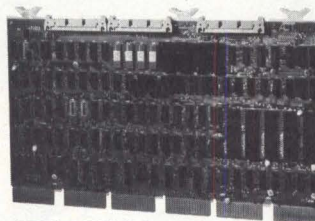
## #1 UNIBUS DMA.

Then there's our DH/DM, the original multiplexer which puts 16 lines with modem control on a single board. This popular device meets UNIX VAX system needs for DMA communications requirements, serves UNIBUS systems equally well, and beats them all for MTBF, throughput and



ABLE DH/DM\*  
16-line combination DH11  
& DM11 replacement

price. Other features include on-board diagnostics, modem control on all lines, superior on-board silo depth and variable prom-set. **SYNC/ASYNCH FLEXIBILITY.**



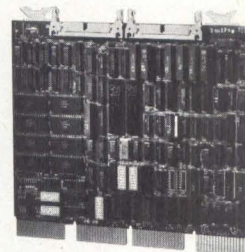
ABLE DV/16  
16-line DV11 replacement

A controller for the PDP-11 user, the DV/16 contributes microprocessor-derived flexibility, which permits mixing of sync and async lines in combinations

of 4 or 8 lines with modem control and full system software compatibility. It takes less than half the space of a DV11 and uses word transfer instead of byte DMA to gain a 2 to 1 speed advantage or permit operation in half the bandwidth required for data transfers.

## Q-BUS DMA.

The Q/DH is an asynchronous controller which makes DH-class performance possible on PDP-11/23 and LSI-11/23 Q-BUS systems. It connects the standard Q-BUS to as many as 16 async lines with DMA output capabilities and allows optimum Q-BUS utilization. Features include software compatibility with RSTS/E and RSX operating systems, large input silo, modem control on all lines.



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8 or 16-line DH/DM  
for Q-BUS

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**CIRCLE NO. 82 ON INQUIRY CARD**

## MINICOMPUTERS

microcodes, such as that in the Datapoint 8800, speed execution by concurrently finding, fetching and executing microinstructions. User-programmable microcodes implemented in RAM allow modifying machines such as the HP 1000 model A700 without changing ROMs.

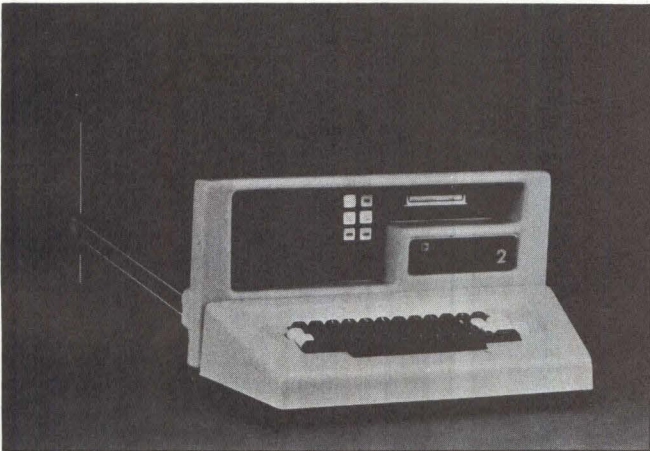
Other processor features that can improve performance include multiple hardware interrupt levels for fast response to high-priority data such as power-fail warnings and an ample set of registers to reduce memory operations. A number of minis, such as the NPL Series S from Evolution Computer Systems Corp., incorporate microprocessors to off-load I/O chores from the CPU.

Memory capacities vary greatly from machine to machine. Smaller processors typically provide only 128K-byte capacities, as do the IBM Series/1 and most of the Computer Automation Naked Minis, or 256K bytes in the case of the PDP-11/23 and 34A and the Datapoint

8600. Many minis increase memory capacity to several megabytes through memory mapping, by which memory addresses can specify areas of memory rather than just words. The DEC PDP-11/23 Plus and 44 processors use extended address word sizes of 22 bits to support as much as 1M byte of memory, while virtual-memory schemes allow machines such as the HP 1000 series to address 12M bytes or more of disk storage as memory by swapping segments in and out of main memory.

Memory access times can be an important factor in processor performance, ranging from 50-nsec. times obtainable with static RAMs to 1000 nsec. and more with slower dynamic RAMs. Some minis improve performance with memory pre-fetching, or locating a word in memory while the previous word is being read, while the DG Eclipse S/140 has an interleaved memory with a dual bus, allowing overlapping operations in different areas of memory. Cache memories can also shorten access times. These smaller (typically 2K to 8K bytes), faster memories retain the most frequently used data from main memory. The processor checks the cache first when looking for a word; in most schemes, the word is there more than 90 percent of the time. Other useful memory features found on many 16-bit minis include memory protection and segmentation. Memory protection prevents unauthorized users from reading and writing or just writing in specified areas of memory, while segmentation allows allocating areas of memory to users.

Communications capabilities of 16-bit minis range from a handful of asynchronous serial lines to an



Analog Devices Macsym 2 is designed for industrial or laboratory control applications.



Hewlett-Packard 1000 model A700 is one of the more powerful 16-bit minicomputers with features such as user-microprogramming, 4M bytes of main memory and 12.6M bytes of virtual memory. Its high speed and vector instruction set make it well-suited for engineering applications.



Data General Eclipse S/20 (left) and S/140 use compatible instruction sets and operating systems, allowing users and system integrators to upgrade without changing software. The S/140 is about 40 percent more powerful than the S/20.

extensive selection of protocols. The Honeywell DPS 6 machines support remote job entry, batch, SDLC/HDLC, SNA, synchronous, binary synchronous and RS232C communications, while HP and Datapoint minicomputers can be configured in proprietary network schemes. Most larger 16-bit machines support direct-memory-access channels, providing disk-to-memory data-transfer rates of 2M bytes per sec. or higher.

Most machines are available with operator panels or consoles from which diagnostics can be run, and many execute self-test routines at power-on. A number provide for virtual consoles, allowing configuring a terminal as a temporary control console for diagnostics. Computer Automation's Naked Minis facilitate fault isolation with board lights that indicate failing modules. Disk crashes can be avoided and data loss can be minimized through power-fail sensing features avail-

able on many minis that shut down the computer in a noncatastrophic fashion when line voltage drops below a specified value.

Operating systems are less easily evaluated than hardware, but most of those available with popular 16-bit minis have been fine-tuned through years of use. An OEM with a box-level mini can generally obtain a basic operating system from the vendor or an independent software house, or develop its own. System-level 16-bit minis, on the other hand, are usually purchased with the system manufacturer's operating system. Vendors such as DEC and DG offer a variety of multi-user, multitasking operating systems for real-time, interactive and time-sharing applications. Many such operating systems extend across product lines; Honeywell's GCOS 6 runs on all the DPS 6 processors from the entry-level 6/30 to the 32-bit 6/96.

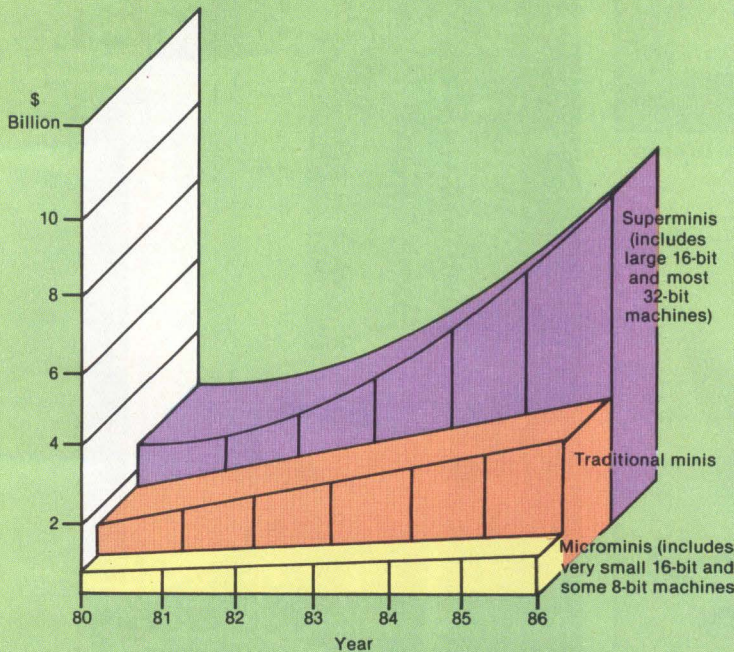
**16-bit mini versus microcomputer**

Rumors of the death of the 16-bit minicomputer are premature by several years. Sales of 16-bit minis still comprise a significant, if shrinking, share of the

**THE 16-BIT MINI MARKET**

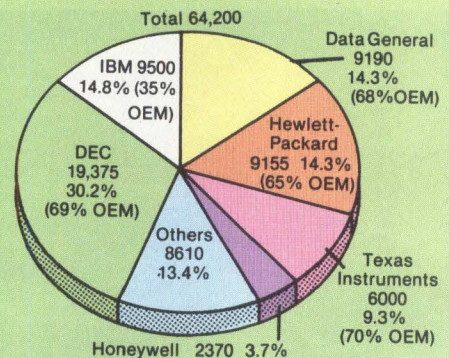
The market for 16-bit minicomputers will continue healthy, although perhaps not as healthy as the 32-bit mini market, according to a study by International Data Corp., Framingham, Mass. The study divides minicomputers into three categories: "micromini," typified by Digital Equip-

ment Corp.'s board-level LSI 11, "traditional," exemplified by the DEC PDP-11 series through the 11/40 and including most 16-bit minicomputers, and "supermini," which includes machines such as the DEC VAX 11/780 as well as powerful 16-bit machines such as the PDP 11/70.

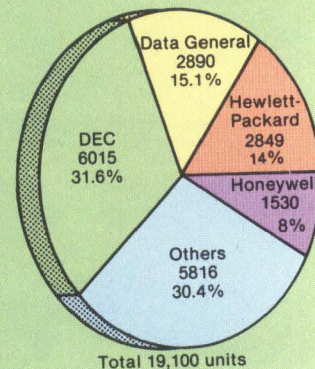


Source: International Data Corp.

The growth of the minicomputer market will be strongest for superminis, but the traditional mini market will more than double to almost \$4 billion by 1986.



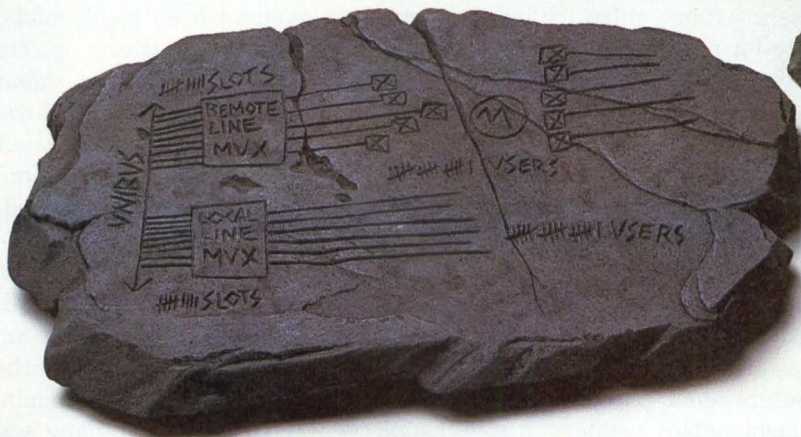
Worldwide traditional minicomputer shipments are dominated by a handful of system vendors, most of which do more than half their shipments through OEMs. The OEM percentages given above refer to shipments of all types of minicomputers.



Shipments of 16-bit superminis are led by most of the same vendors, reflecting their broad 16-bit product lines.



# Emulex solves the age-old problem of communicating with a DEC computer.

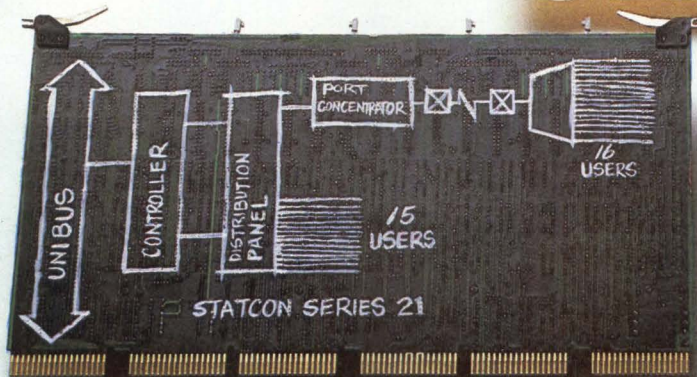
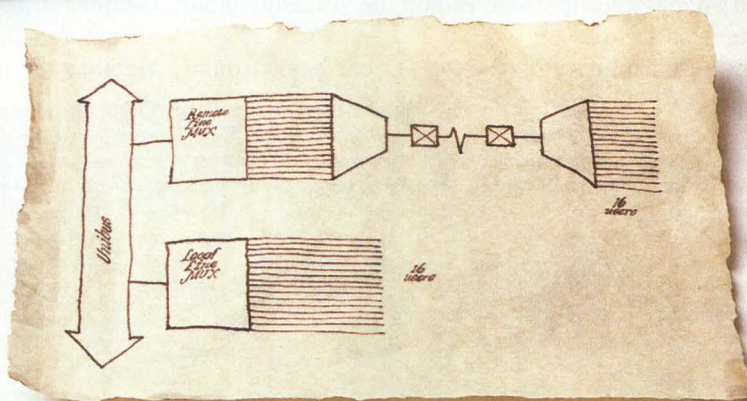


## The Stone-Age Way.

One line per remote terminal. Slow, noisy voice-grade lines, open-ended costs. Port-consuming, slot-consuming controllers for both local and remote terminals. Expensive custom software.

## The Middle-Ages Way.

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## The Emulex Way.

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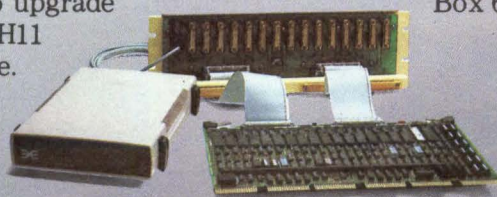
Emulex announces two complete, software-transparent packaged solutions: STATCON Series 11 and 21.

Now you can connect up to 64 remote *and* local terminals through just one single-slot communications controller. No expansion chassis. No extra power supplies. No upgrade to a new computer needed. DH11 and DZ11 emulations available.

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The genuine alternative.

CIRCLE NO. 83 ON INQUIRY CARD

computer market (see "The 16-bit mini market," p. 149) and major manufacturers continue to profess a strong commitment to their 16-bit mini lines. The 16-bit mini industry, however, faces a major challenge in the coming years from increasingly powerful microcomputers.

Microcomputers from vendors such as Charles River Data Systems and Plexus Computers Inc. that are based on the 68000 processor chip rival low-end minicomputers in performance at prices that are lower by as much as 40 percent. In addition, many of these systems are or soon will be available with popular industry-standard operating systems such as UNIX or Pick. By comparison, many 16-bit minicomputers seem outdated, nonglamorous and reliant on unfashionable proprietary software.

But the 16-bit mini's age (the PDP-11 has been around

some 15 years) is one of its greatest strengths. The hardware has had years to build a reputation of reliability, while software libraries have been expanded and refined by thousands of OEMs and system integrators. Many OEMs are not anxious to abandon the software investments they have made in 16-bit minis, and thus will slow any industry trend to micros, points out International Resource Development president Ken Bosomworth. "The 16-bit minis have a loyal customer base, not out of emotional attachment, but out of business sense," Bosomworth says. In addition, many users feel more comfortable with established, familiar products.

Minicomputers are also popular for the quality of the support available from well-established vendors. Microcomputer vendors have not yet earned a reputation for high-quality service, while price competition in the micro arena makes it difficult for vendors to match mini vendors in such supplemental services as training and documentation. Some OEMs even worry about the viability of microcomputer vendors. "A lot of these

### Representative 16-bit OEM minicomputers

The following table lists vendor-supplied data on a number of 16-bit OEM minicomputers. Machines based on single-chip processors have been excluded, as have minicomputers based on other manufacturers' processors and those not intended for the OEM market. The basic configuration price is for OEM single units for a processor with 128K bytes of memory, an operating system and minimum disk storage, without terminals or other peripherals and software, except as noted.

Company	Model	Year introduced	Minimum/maximum memory (K bytes)	Maximum number of concurrent users	Minimum/maximum disk (M bytes)	Applications
Analog Devices Inc.	Macsym 2	1978	128	1	0.32	Industrial and laboratory automation
BBN Computer	C60, 70	1980	256/2048	64	62/1200	General purpose
BTI Computer Systems	5000	1978	64/64	32	10/468	General purpose
Bytronic Corp.	500, 550, 600, 1000, 4000, 5000	1978	64/512	32+	0/4 x 96	Business
Data General Corp.	NOVA 4/C, X	1978	32/256	5	5/588	General purpose
	Eclipse S/120	1982	128/512	16	5/588	General purpose
	Eclipse S/130, 140	1977, 1979	16/2000		0.315/277	General purpose
	S/250, 280	1979, 1983	64/2000	NS	0.315/277	General purpose
Digital Equipment Corp.	Micro/PDP-11	1981	256/1000	4	10/50+	General purpose
	PDP-11/23, 23 plus, 23 S, 24, 34A	1980	64/4000	14	0/100	General purpose
	PDP-11/44	1980	256/1000	32	0/121+	General purpose

\*Processor with 128K bytes of memory, operating system and minimum disk storage NS = not specified

guys keep reading about the upcoming shakeout in the microcomputer industry," says International Data Corp. consultant Aaron Goldberg, "and OEMs expect some of their systems to last 30 years."

One of the major advantages of 16-bit minicomputers over microcomputers is minis' ability to be upgraded. Users of DEC, DG and Honeywell machines can often stay with the same software from a low-end, \$20,000, 16-bit system to a high-end supermini, with many upgrades requiring only the addition of a board. The microcomputer user who outgrows his machine, on the other hand, could be forced to break in a new set of hardware and software. Janpieter Scheerter, marketing manager of technical products at DG, says that the ability to be upgraded is particularly important to system integrators implementing new products. It allows the system integrator to increase or decrease power without abandoning development efforts.

Time is probably on the side of the microcomputer. Microcomputer vendors are quickly moving to establish reputations for reliability and support, expand soft-

ware offerings and provide for potential growth paths through operating systems such as UNIX. In addition, new chips will boost microcomputer performance to the 32-bit mini range. Minicomputer vendors, however, say they will not sit still and relinquish the 16-bit mini territories. "The microcomputer industry is moving fast," says Jim McCabe, product marketing manager for HP's 1000 series minicomputers, "but we have a head start." McCabe claims that mini vendors will be able to retain a performance edge over microcomputers while keeping prices competitive by incorporating new processor architectures onto a few chips: "There's no reason in the world why we can't take advantage of microcomputer technology," he says.

The pressure to keep 16-bit mini prices competitive will come as much from the lowering of 32-bit mini prices as from the increase in microcomputer performance. But whether they retain a separate niche in direct competition with microcomputers or evolve into proprietary chip-based microcomputers, 16-bit minis are likely to remain viable for years. □

Operating systems	Languages	Basic configuration price*	Typical configuration and price
	Mac BASIC	\$17,710	320K-byte printer, 16 digital inputs, 10 digital outputs, 4 analog outputs, 32-channel analog input: \$20,500
UNIX	C, FORTRAN 77, CBASIC-16, CDIBOL, COBOL Level II	C/60 with 256K-byte memory	C/70 with 1M-byte memory, 16 terminals, 160M-byte disk, magnetic tape, BBN-UNIX: \$83,050
proprietary	BASIC-X	\$29,950 with 64K-byte memory	CPU, 27M-byte disk, 3 terminals; \$41,650
IRIS, BITS, BLIS/COBOL (not from manufacturer)	Business BASIC	\$3600	Model 600 with 128K bytes of memory, 4-channel multiplexer, disk controller: \$5000
MP/OS, RDOS, RTOS	FORTRAN, BASIC, Pascal, Assembly	\$7947 (model 4/C with 64K-byte memory)	Nova 4X, terminal, 15M-byte disk, RDOS: \$18,364
RDOS, MP/AOS, AOS, RTOS	FORTRAN, BASIC, Pascal, Assembly	\$12,375	15M-byte disk, terminal, MP/AOS: \$16,470
AOS, RDOS, MP/AOS	FORTRAN IV/V/77, PL/1, Business BASIC, Extended BASIC, DG/L COBOL, Pascal, MP/BASIC	\$23,836 (S/140)	S/130, 25M-byte disk, 128K-byte memory, terminal, cabinet, language, RDOS: \$41,800
AOS, RDOS, MP/AOS	FORTRAN IV/V/77, PL/1, BASIC, DG/L COBOL, SP/Pascal, MP/Pascal, Extended BASIC, MP/BASIC	\$44,385 (S/250)	S/280, 1M-byte memory, 50M-byte disk, streaming tape, floating-point processor: \$56,500
RT-11, RSX-11M+, RSX-11M, Micropower/Pascal, CTS-300, DSM-11	BASIC, FORTRAN, COBOL, Pascal, MACRO-11	\$10,000	11/23 Plus CPU, 10M-byte Winchester 800K-byte floppy disk, VT100, 256K-byte main memory: \$12,000
RT-11, RSX-11M, RSX-11M+ Micropower/Pascal	BASIC, FORTRAN, COBOL, Pascal, MACRO-11	\$15,000 (11/23)	11/23 CPU, LA38 terminal/printer, 128K-byte memory, RSX-11M operating system, 2 10M-byte disks: \$20,900
RT-11, RSX-11M+, RSTS/E, Micropower/Pascal	BASIC, FORTRAN, COBOL, MACRO-11, Pascal	\$50,000	11/44 CPU, 512K-byte main memory, LA120 terminal, dual TN58 tape-cassette drives, 10M-byte disk, floating point processor, RSX-11M operating system: \$56,300

Company	Model	Year introduced	Minimum/maximum memory (K bytes)	Maximum number of concurrent users	Minimum/maximum disk (M bytes)	Applications
Hewlett-Packard Co.	HP 1000 S, G	1982	128/2048	NS	0.27/528	General purpose
	HP 1000 Model 17, 19	1982	128/6144	NS	16.1/528	General purpose, scientific, engineering
	HP 1000 60, 65	1983	256/2048	NS	16.1/528	General purpose, scientific, engineering
Honeywell Information Systems Inc.	DPS 6/30 series	1980	128/1024	24	13/1024	Business, office automation
	DPS 6/48, 54, 74, 76	1980	256/1024	64	67/1024	Business, office automation
	DPS 6/92, 96	1980	1024/1638	128	67/3072	Business, office automation
IBM Corp.	Series/1	1976	16/512	64	9.3/1024	General purpose
Texas Instruments Inc.	600 Series	1982	256/2048	16	10/127	General purpose
	800 Series	1982	512/2048	40	43/476	General purpose

### THE TOP 10 OEM MINICOMPUTER VENDORS

The health of an industry can often be gauged by the health of its leaders. In the case of the OEM minicomputer industry, such an examination should not be restricted to 16-bit machines.

The 10 companies listed below led the industry in 1981 revenues from the sale of all types of minicomputers and related supplies and services to OEMs. The OEM minicomputer revenue and shipment figures, supplied by International Data Corp., include sales to system houses and internal sales, but do not include distributor or high-volume end-user sales.

A comparison of 1981 and 1982 total revenues and earnings provides a rough indication of how these companies are faring in adverse economic conditions. The picture is somewhat mixed: there are many heavy gainers and losers, leading to an average increase in earnings among the top 10 companies of 2.7 percent.

Company	1981 minicomputer revenues* (\$ millions)			Total '81 minicomputer revenues	1981 minicomputer unit shipments		
	OEM	OEM %	End user		OEM	OEM %	End user
DEC	1336	40	2004	3340	50425	69	22655
HP	592	48	641	1233	7803	65	4201
DG	420	55	344	764	13348	68	6282
TI	257	64	145	402	7637	70	3273
Honeywell Information Systems	161	32	342	503	1640	41	2360
P-E	128	57	97	225	1193	65	642
IBM	89	25	267	356	3325	35	6175
Gould S.E.L.	74	61	48	122	420	60	280
Tandem	58	24	185	243	420	30	981
Computer Automation	43	60	29	72	3523	83	722

Source: International Data Corp. (minicomputer data). Total revenues and earnings are from annual reports.

\*Minicomputer revenues are for calendar year '81, and thus may exceed total company revenues for fiscal year '81. These revenues include those from minicomputer-related peripherals, service and software.

\*\*1982 figures are preliminary.

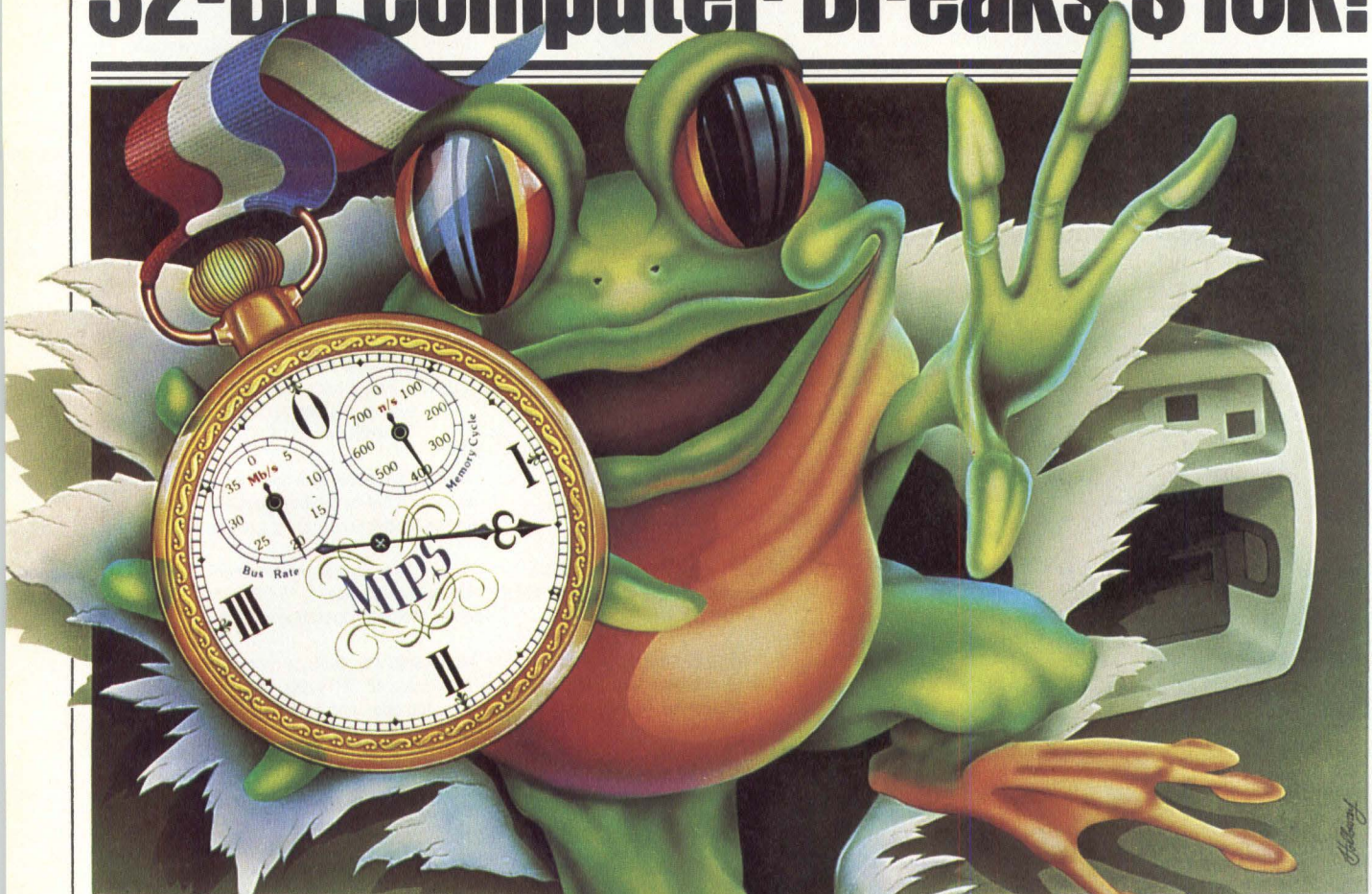
\*\*\*Includes revenues from all continuing Gould operations.

Operating systems	Languages	Basic configuration price	Typical configuration and price
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RTE-A1, RTE-XL	FORTRAN 77, Pascal, BASIC, Macro assembler	\$9980	Model G with graphics terminal, 2D and 3D software, FORTRAN 77 compiler, 4.6M-byte Winchester disk, 270K-byte microfloppy disk: \$27,020
RTE-A1	FORTRAN 77, Pascal, BASIC, Macro assembler	\$32,990 (model 17 with 256K-byte memory, floating-point processor)	Model 19 with 3M-byte memory, color graphics terminal, 132.1M-byte disk, 400-lpm line printer, 2-pen plotter, FORTRAN 77 database-management system, 2D and 3D software: \$103,130
RTE-6/VM, RTE-6/RM	FORTRAN 77, Pascal, BASIC, C, Macro assembler	\$38,500 (model 60 with 256K-byte memory)	Model 65 with 2M-byte memory, black-and-white terminal, color graphics terminal, 132.1M-byte disk, 1600-bpi magnetic tape, 400-lpm printer, 8-pen plotter, FORTRAN 77, Pascal, Image data-base-management system, 2D and 3D graphics software: \$115,575
Mod 400	COBOL, BASIC, FORTRAN, RPG II	\$26,000 (model 6/32 with communications control, 26M-byte disk)	Model 6/31: 256K-byte memory, 13M-byte disk with 6.5M-byte cartridge, CRT, 100-cps printer, Mod 400 operating system: \$25,571
Mod 400	COBOL, BASIC, FORTRAN, RPG II	\$52,381 (model 6/48 with 256K-byte memory, communications control)	Model 6/74 with 1M-byte memory, 3 80M-byte cartridge disks, 16 CRTs, 600-lpm printer, Mod 400 operating system: \$162,001
Mod 400	COBOL, BASIC, FORTRAN, RPG II	\$149,881 (model 6/96 with 512K-byte memory, peripheral communication control)	Model 6/96 with 4M-byte memory, 2 256M-byte disks, 48 CRTs, 900-lpm printer, Mod 400 operating system: \$322,046
RPS, EDX, CPS	FORTRAN, COBOL, BASIC, EDL, Pascal, Assembler	\$13,123 (model 4952 CPU, quantity 50)	286K-byte 4954 CPU, 1.2M-byte diskette, 29M-byte disk, 2 communications adapters, 6 terminals, 2 printers, rack: \$31,293 (quantity 50)
DX10, DNOS	COBOL, BASIC, FORTRAN, Pascal, RPG II	\$20,200 with 256K-byte memory	Model S672 with 256K-byte memory, 43M-byte disk, 1 terminal, dual controller: \$30,950
DX10, DNOS	COBOL, BASIC, FORTRAN, Pascal, RPG II	\$46,650 with 512K-byte memory	Model S884 with 512K-byte memory, 476M-byte disk, 2 terminals, dual controller: \$86,000

Total company revenues (\$ millions)		Total company earnings (\$ millions)		% change in earnings	Period, ending
'81	'82	'81	'82		
3198	3881	343	417	+22	Fy, June
3578	4254	305	383	+26	Fy, October
737	806	51	25	-51	Fy, September
1039	1048	27	37	+36	9 mos., September
1774	1685	158	80	-49	12 mos., December
1116	1037	83	63	-24	Fy, July
29070	34364	3308	4409	+33	12 mos., December**
1562	1643	87	91	+3	12 mos., December***
208	312	27	30	+13	Fy, September
76	68	1.7	2.0	+18	12 mos., December

# 32-Bit Computer Breaks \$10K!

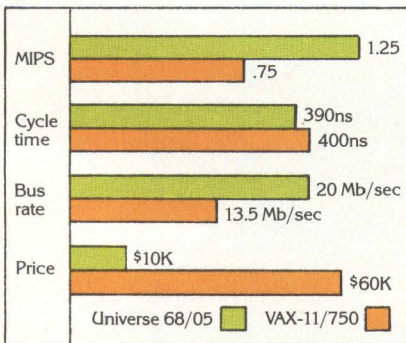


## Universe 68/05 First to Smash Price Barrier

The new Universe 68/05 is the first true 32-bit computer priced under \$10,000 (OEM quantity one). "True" because, unlike other 68000-based systems, the Universe 68/05 handles 32 bits in parallel on its VERSAbus.

## Outperforms VAX\*

Its price is even more impressive when you look at Universe 68/05



performance versus that of 32-bit "superminis" several times more expensive, like the VAX-11/750.

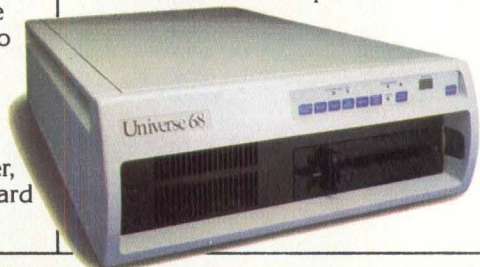
## High-Speed 68000, 4Kb Cache, 32-Bit Bus

The key to that performance is a 4Kb cache that eliminates processor wait-states and takes full advantage of a 12.5MHz 68000 processor. Also included are a separate 68000 I/O processor, four serial I/O ports (expandable to 64), 256Kb RAM (expandable to 3Mb), 20Mb/sec, 32-bit VERSAbus, 10Mb Winchester, 1.25Mb floppy disk, and 5-slot card cage. All in a 7-inch enclosure.

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## SUPERMICROS

# 'MegaFrame' aims at mainframe performance

JONATHAN HUIE, RICHARD LOWENTHAL and STEVEN BLANK, Convergent Technologies Inc.

*System based on Motorola MC68000 family and Intel 186 processors allows field upgrades to 128 users*

The distinctions between microcomputers and mini-computers have become blurred almost to the point of disappearance. Now Convergent Technologies Inc. hopes to extend that blurring to mainframes with its "MegaFrame" system.

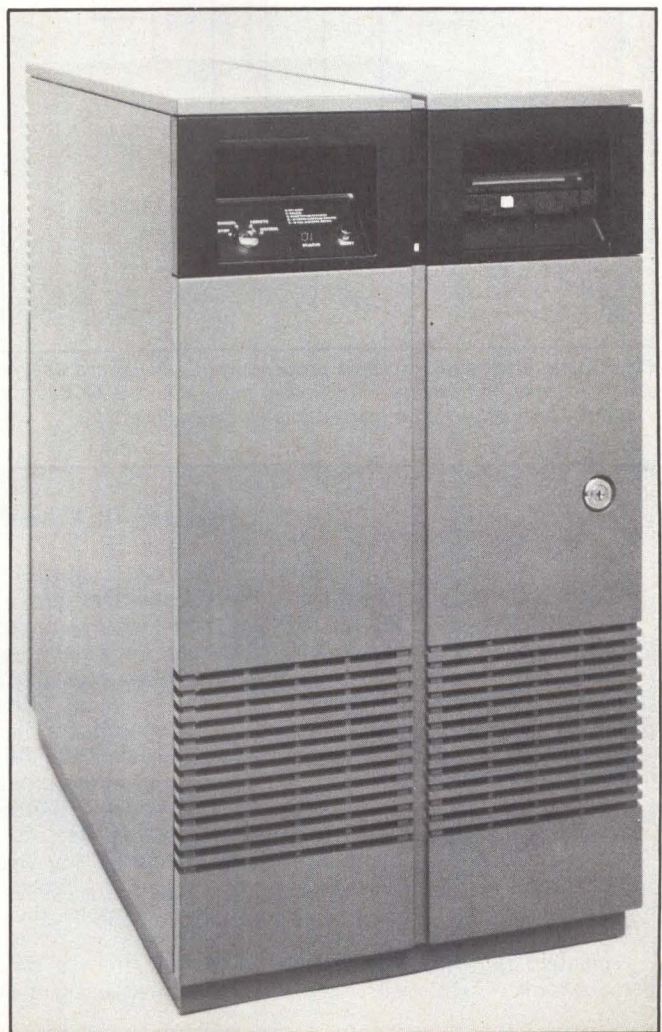
The MegaFrame is based on Motorola Inc.'s MC68000 family processors and Intel Corp.'s 186 processors, and it sells for less than \$20,000 in a basic eight-user configuration. It can be upgraded in the field to accommodate 128 users without software modification. Its architecture allows both Convergent Technologies' CTOS proprietary operating system and a virtual-memory version of UNIX to share resources, letting users run applications at workstations or terminals without knowing which operating system is in use.

Convergent attempts to transcend the limitations of shared-logic machines through the use of multiple parallel processors.

### Limitations of shared logic

Shared-logic architecture has dominated computer system design for 30 years. A drawback of this architecture is its inability to grow as users are added. New users draw against a single CPU with finite computing power. System growth thus has been constrained by three architectural bottlenecks: terminal and communications I/O, disk and file bandwidth and—most important—finite application-processing power.

Mainframe vendors recognized the first system bottleneck was terminal I/O. Terminals interrupting a CPU one character at a time drastically slowed the system. A partial solution was provided by dedicating a



front-end processor to off-load communications overhead from the main CPU.

The second bottleneck, file I/O, involves file access, which requires that the CPU spend time handling the disk and file system rather than executing main code. Dedicating back-end processors to off-load the file-processing overhead from the main CPU helps.

Finally, many large-scale minicomputers and mainframes are limited to a fixed amount of processing power in a single CPU executing the application code, in turn limiting the amount of application processing available to a user.

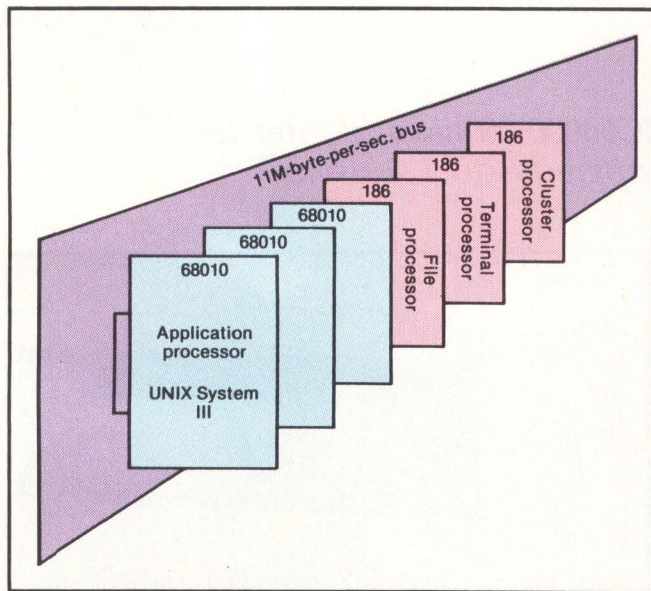


Fig. 1. One enclosure, multiple processors. Convergent's design allows multiple processors—in this case, three Motorola MC68010s and three Intel 186s—to be housed in a single enclosure.

Improving on shared logic

The MegaFrame reflects Convergent's belief that dependence on a single CPU is an inherent weakness of all shared-logic computers from IBM Corp.'s 3083 to the new supermicros. The MegaFrame uses multiple concurrent VLSI processors to permit expansion of file, communications and application processing power. As many as 36 independent processing units, each containing a CPU and memory and most having I/O interfaces, are linked by a high-speed, 32-bit-wide asynchronous bus (Fig. 1). The bus can be extended across multiple enclosures, each with a six-slot backplane to a maximum of six enclosures or 36 slots (Fig. 2). Each enclosure supports as much as 200M bytes of integral mass storage.

The MegaFrame's hardware and software is entirely modular, designed to provide OEMs with multiple entry points and upgrade paths. The systems support a mix of dumb terminals and Convergent workstations and high-speed intelligent terminals.

The key to this flexibility is the 11M-byte-per-sec. asynchronous backplane that lets all the system's processors operate in parallel and permits hardware and software to be bundled as subsystems. The processor boards can communicate without using the interrupt structure of conventional single-processor systems. The hardware provides a "doorbell" interrupt, enabling one processor to pass requests to another, separate hardware mailboxes for local and system bus memory access and dual- and triple-ported shared memory. Each processor board gains the attention of another as if it were accessing memory rather than interrupting an external processor. Bus traffic between CPUs consists of request and response blocks to and from processor boards and DMA transfers to and from the disks.

Processing elements operate in parallel

The MegaFrame consists of three main processing elements: the file, the application and the cluster

HOW DEMAND PAGING WORKS

Demand paging is a memory-swapping process based on the concept that only those program segments required for execution at a given time need reside in main memory. The set of segments, or pages, that resides in main memory for any process is called the process working set.

As a process executes, it may need to reference a page that is not in main memory. When this happens, a page fault occurs, and the operating system must bring the required page from the disk into memory, removing an unneeded page from main memory to make room. The MegaFrame's virtual

address space—that is, the total space available in main memory and on those segments of the disk that can be paged into main memory—is 4M bytes per processor.

On some virtual systems, each process has a maximum working set size, limiting the total number of pages of the process that can reside in physical memory at once. Such systems use "paging against the process," in which the least-used pages of a process are discarded to make room for new pages. The MegaFrame avoids taking pages away from a process' resident set, instead using a system-wide paging

technique called "paging against the system." When a page fault occurs, the system scans all its processes, not just the one executing, to find a page to discard.

The MegaFrame uses the Berkeley UNIX demand-page virtual-memory system integrated into UNIX System III. Under this system, pages allocated to a program can be thought of as arranged in a circle. When a page fault occurs, a pointer advances around the circle, selecting for replacement the first page that has not been referenced during a given number of memory accesses.



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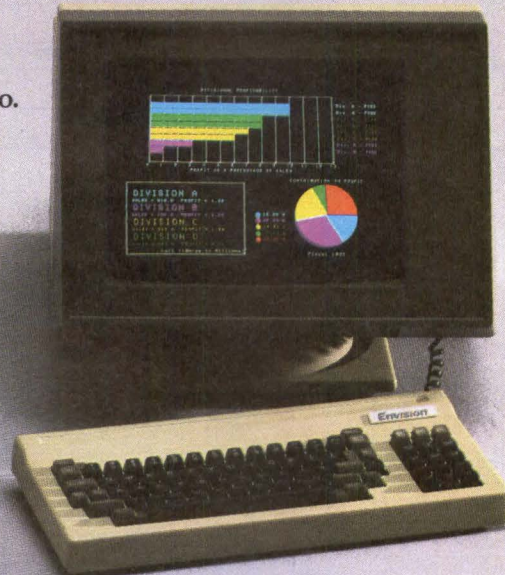
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processors. Optional elements include the SMD and terminal processors.

The heart of the MegaFrame is the application processor. Running both the UNIX kernel and UNIX applications, it contains a 10-MHz Motorola 68010 CPU, memory-management hardware to support a two-level virtual-paging scheme and 512K to 4M bytes of dual-ported, error-correcting RAM. The memory-management unit provides a high-speed, two-level paging scheme with 4M bytes of virtual address space per board and no wait states. The system handles multiple-processor addressing—as many as 16 CPUs are supported—via an extended address. When addressing off-board memory, the processors issue a 5-byte address. The appropriate CPU recognizes its number and uses the address as input to its map. The entire system, including the MMU and all data and address paths, is designed to accommodate the Motorola MC68020 32-bit processor when it becomes available.

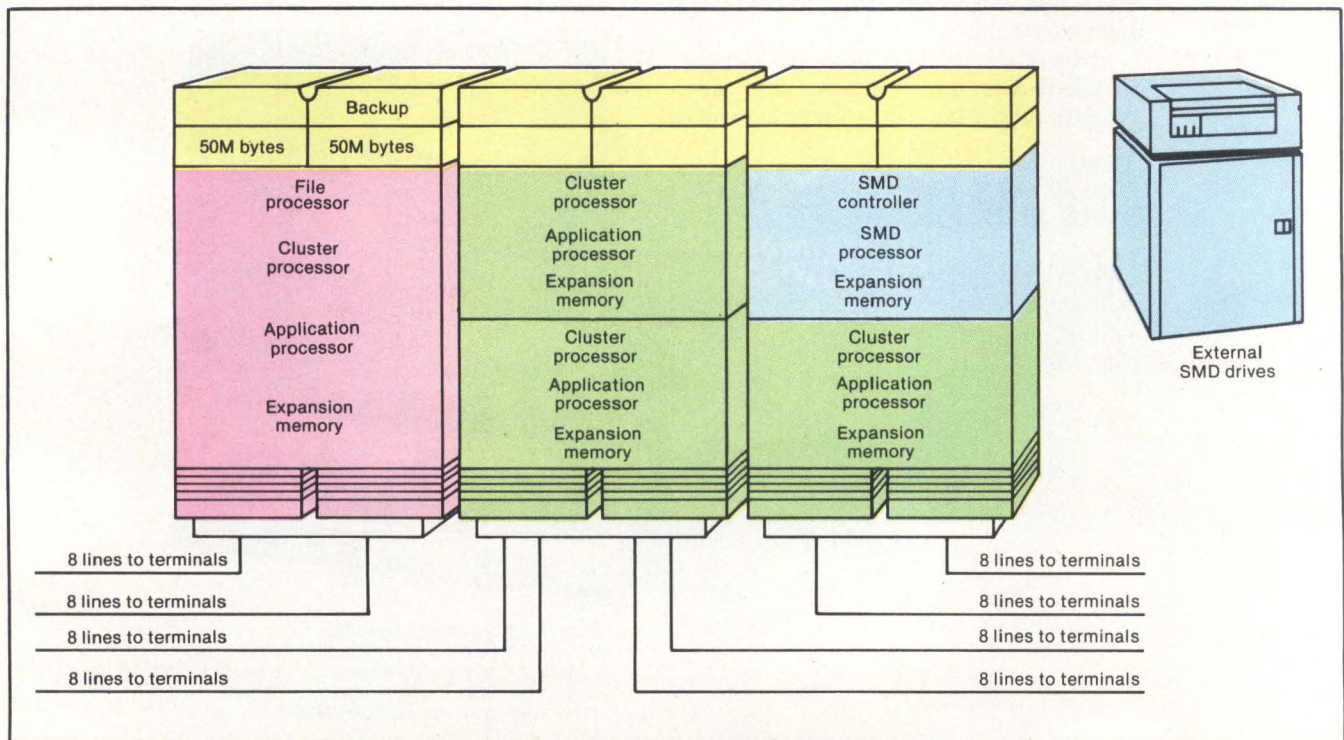
The file processor, functionally equivalent to a back-end database processor, runs the UNIX file system while the application processor is executing applications; it also runs data-management tools such as ISAM programs and a relational database-management system. It contains an 8-MHz Intel 186 processor with 256K to 768K bytes of triple-ported error-correcting-circuitry RAM and the WD-1010 LSI Winchester disk

drive controller. The high-speed system bus and memory allow direct memory access to and by other processor boards.

The file processor supports as many as three 5¼-in., 50M-byte Winchester drives (100M- and 145M-byte drives will be supported later) and a removable, 5M-byte cartridge in the first MegaFrame enclosure. Additional file processors support as many as four drives in each expansion chassis (23 drives total), off-loading disk and file system overhead from the first file processor. A maximum of 6 file processors are supported.

*As many as 6 file processors and 16 terminal processors run under CTOS.*

The cluster and terminal processors, the functional equivalent of front-end communications processors, are dedicated to running dumb terminals and Convergent workstations and intelligent terminals. Both are based on the 8-MHz Intel 186 processor, contain 256K to 768K bytes of ECC RAM and run communications-oriented products under such protocols as SNA, 3270, X.25 and 2780/3780. The terminal processor contains 10 RS232 ports, four supporting synchronous or asynchronous operation and six supporting asynchronous only. Each RS232 line operates as fast as 19.2K bits per sec. As many as 16 terminal processors are supported. The cluster processor controls two RS422 ports and can run terminals at 307K bps and workstations at 1.8M bps.



**Fig. 2. A system to serve 64 users.** A master chassis (left) and two expansion chassis, plus external mass storage, can be assembled into a system that supports 64 users. Such a system can be expanded to accommodate a maximum of 128 users, 28M bytes of ECC RAM and 1.5G bytes of integral Winchester disk storage.

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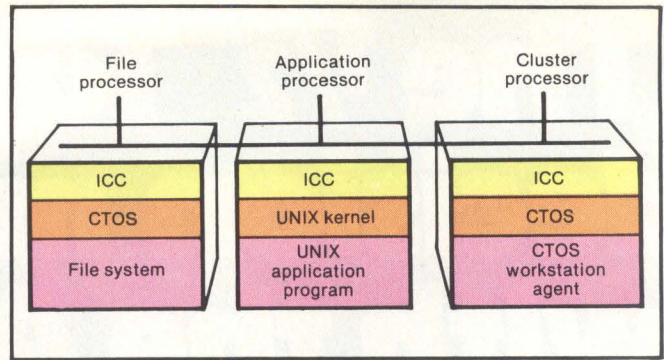
This processor also supports three RS232 ports—two synchronous or asynchronous and one asynchronous-only serial-printer interface.

Several other hardware options are available for expansion. An SMD controller handles as many as six 600M-byte SMD drives, memory boards add memory in 500K- or 1M-byte increments, and a Multibus adapter allows incorporation of as many as six interfaces for custom equipment in each enclosure.

**Multiple operating systems for multiple processors**

Convergent combined its proprietary CTOS message-passing operating system with a virtual-memory version of UNIX fully compatible with UNIX System III, with System V availability planned in the near future. UNIX and CTOS run concurrently and are virtually transparent to a user and the application. The virtual-memory hardware on the MegaFrame's processor—an MMU with a high-speed, two-level paging scheme and 4M bytes of virtual address space per board—permits a demand-page virtual memory system closely approximating the global LRU algorithm.

As many as 6 file processors and 16 terminal processors run under CTOS. Each application processor,



**Fig. 3. MegaFrame software organization.** To an application running on a MegaFrame, the computer appears as totally UNIX System III compatible. For example, if an application written in the C programming language were to require some file-system service, the application would make a system call that would be handled by the UNIX kernel. Then the inter-CPU communication module translates UNIX systems calls into CTOS messages, which are passed to the file processor. The file processor retrieves the file and passes it back through the ICC on the application processor, which responds to the systems call.

to the maximum of 16, runs its own copy of the UNIX kernel. To facilitate message-passing, Convergent has distributed UNIX functionally across multiple processors. Basically, UNIX is distributed in the following manner:

- a copy of the UNIX kernel runs on each application processor in the system,
- UNIX terminal-handling codes such as TermCap, TermLib and Curses use a separate processor running the CTOS operating system,
- the UNIX file system is built on the CTOS file system, which is running on the file processor, and
- all processors and applications communicate over the 11M-byte-per-sec. bus.

Each parallel processor communicates via short messages. Disk data are transferred via DMA into the memory of other processors. The only connection between the UNIX kernel and the other boards is the UNIX inter-CPU communication agent (Fig. 3), which provides request and response blocks to the kernel and all processes. Software running on the application processor communicates with the file system, paging and terminals via the ICC.

Convergent has decentralized UNIX's tree file structure and distributed it across multiple file processors. CTOS also offers multiple-sector data transfers, information kept in memory on open files, asynchronous process execution and redundant volume control structures.

The MegaFrame off-loads UNIX terminal-handling chores from the main processor to multiple independent front-end processors, each running its own operating system. This allows addressing one device, character, line or page at a time without main-CPU intervention. □

**Jonathan Huie** is manager of software engineering, **Richard Lowenthal** is manager of hardware engineering, and **Steven Blank** is marketing manager at Convergent Technologies Inc., Santa Clara, Calif.

## Single Board Computer



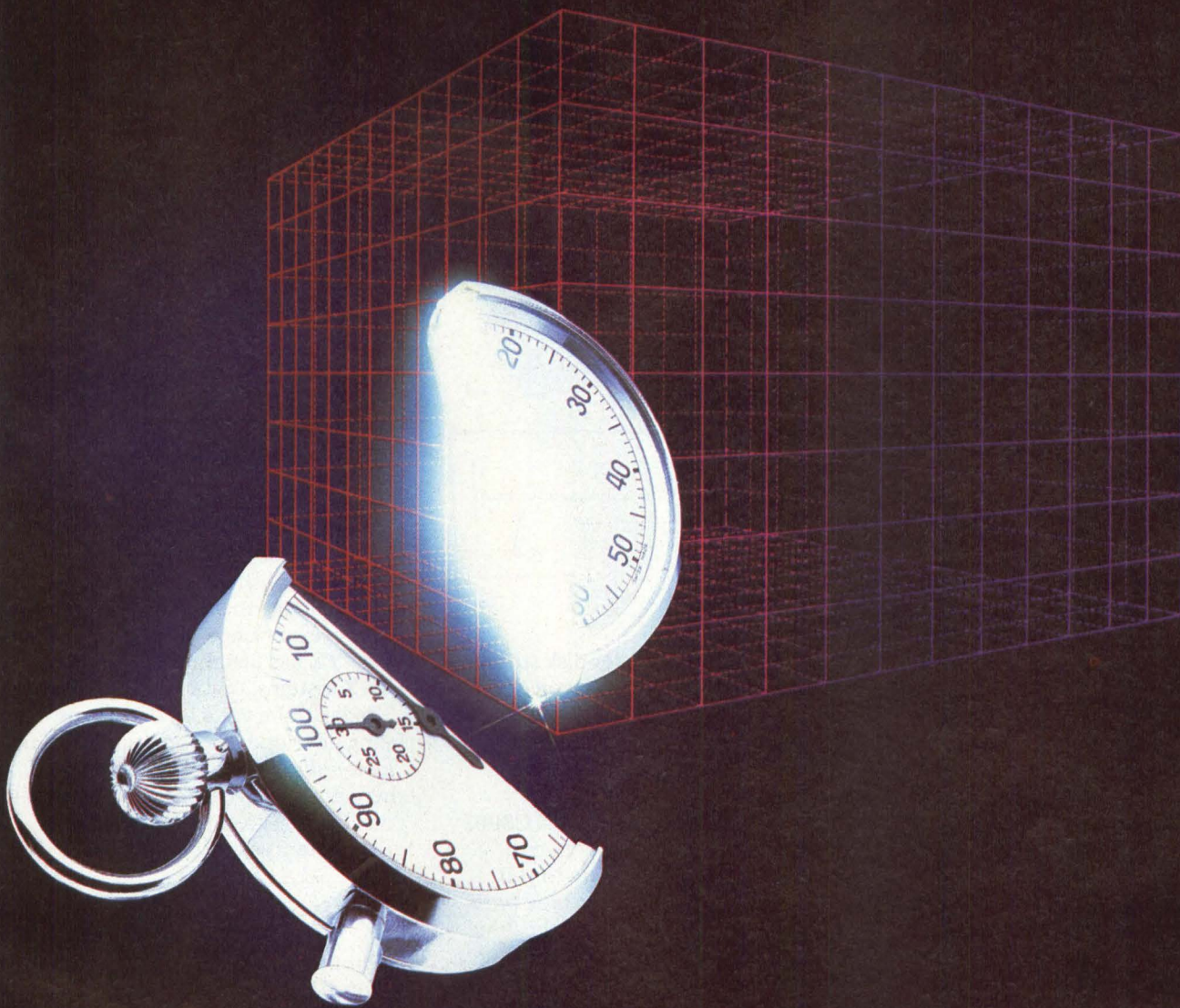
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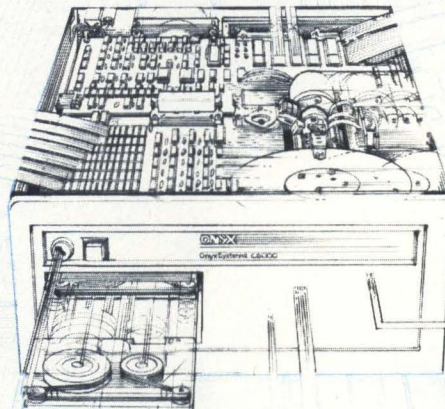
To achieve the ultimate flexibility, simplicity, efficiency and productivity, the UNIX operating system will incorporate a file system of highly uniform sets and sub-sets of directories, arranged in a tree-like hierarchical structure.

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increases the number of operations that can run concurrently. ONYX's memory management system utilizes "scatter" instead of "contiguous" allocation, and the more efficient swapping minimizes demand on the disk channel. That's why ONYX assures a highly efficient environment for the UNIX operating system.

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# Multiprocessor architecture ensures fault-tolerant transaction processing

ARMOND D. INSELBERG, Synapse Computer Corp.

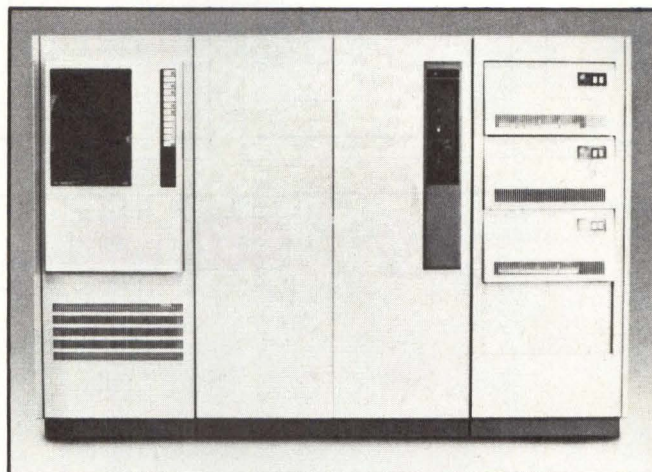
*Synapse N+1 uses redundant hardware modules and software-protection spheres to achieve fault tolerance*

Hardware and software failures in transaction-oriented applications can cause severe losses of time and money. A recent entry in the expanding market for "continuous-processing" systems is a fail-safe computer comprised of tightly coupled general-purpose processors and specialized input/output processors. The processors in Synapse Computer Corp.'s N+1 on-line transaction-processing system use a proprietary non-write-through cache memory and can access reconfigurable, shared main memory over dual 32M-byte-per-sec. buses. Access protection is achieved by integrating the relational database-management system, the transaction-processing manager and the Synthesis operating system into a set of protection spheres. Synchronization of the database and transaction-processing systems provides automatic application checkpointing and recoverability.

## The Synapse expansion architecture

The basic Synapse expansion architecture (Fig. 1) consists of as many as 28 tightly coupled multiprocessors centered around the Synapse expansion bus. The processors can be either general-purpose or input/output processors, each of which incorporates a Motorola 68000 microprocessor. The Synapse expansion bus consists of two independent buses that provide a combined data-transfer rate of 64M bytes per sec.

The GPPs execute user programs and Synthesis operating-system software that reside in shared main memory. The IOPs use direct-memory access to access



The Synapse N+1 on-line transaction-processing system is software- and hardware-designed for fault-tolerant operation. A minimum configuration is priced at \$340,000 and consists of two general-purpose processors, three input/output processors, 6M bytes of main memory on two main-memory controllers, two 151M-byte disks, a magnetic-tape subsystem and system software.

shared main memory for data transfers. Each IOP accesses its operating system software from its own 128K bytes of local memory. Each IOP supports as many as 16 I/O adapters that can be either:

- disk controllers, which interface to 151M- and 413M-byte disks,
- advanced communications subsystems, which handle terminal and communication lines or
- multipurpose controllers, which interface to mag-

netic tape, line printers, power systems and system clocks.

There are two paths to each I/O adapter via separate IOPs. The path to be used under normal circumstances is software selected, and the secondary path is automatically used in the event of a failure.

The N+1 system requires no more than one additional hardware component of each type beyond the number that is necessary for a specific level of performance. This scheme ensures fault tolerance and provides the additional performance contribution of the extra resource in a fully operational system. No single hardware failure renders the system inoperative.

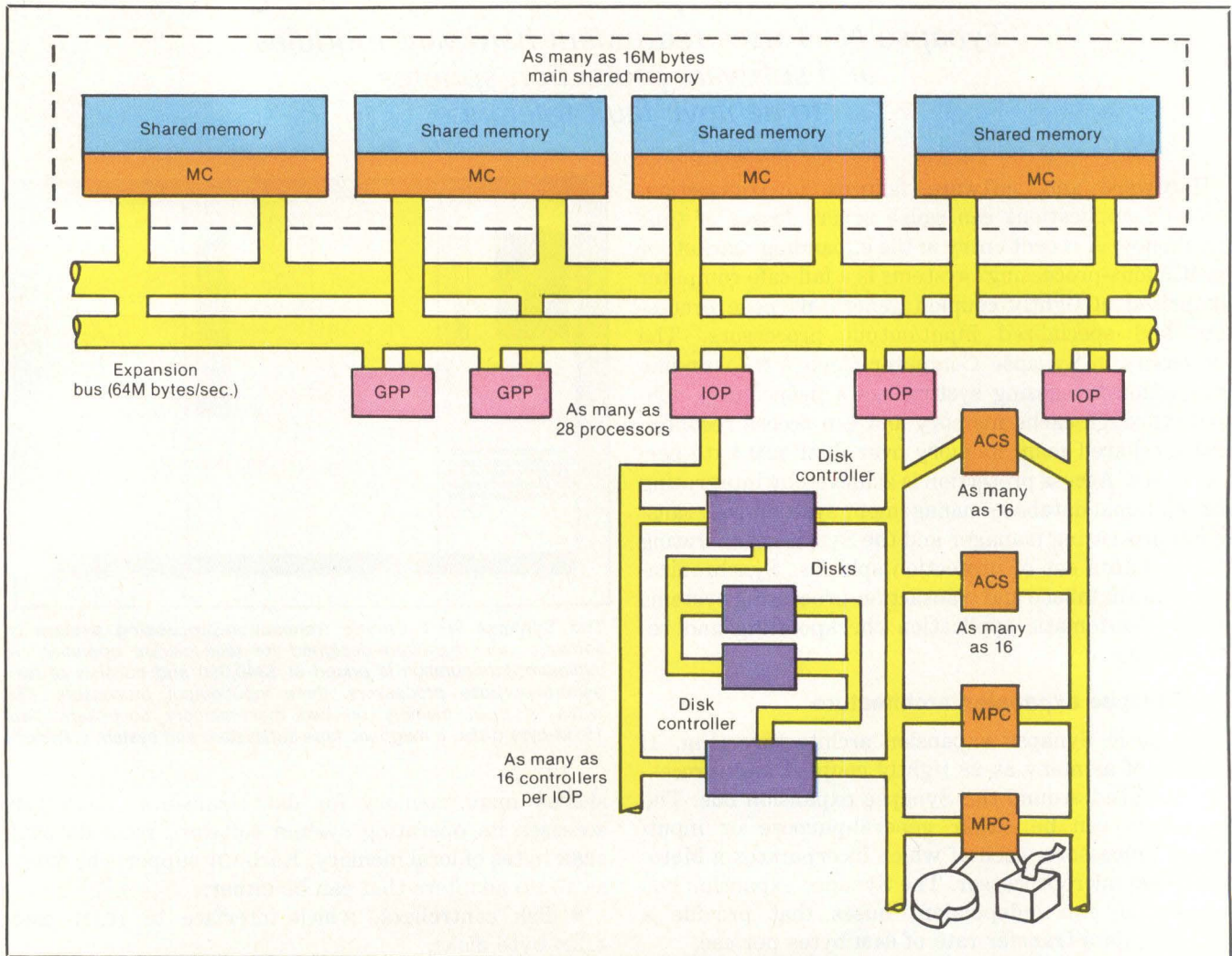
**Tightly coupled multiprocessors**

The GPP (Fig. 2) is a single-board processor based on the 16-/32-bit, 10-MHZ Motorola 68000. The GPPs serve as execution units for the system software and

application programs. Interconnection with the Synapse system is made through the expansion bus. The GPP contains 16K bytes of memory cache. There are 32K bytes of EPROM for a bootstrap loader, diagnostics and a maintenance debugger. The 68000 operates at full speed with no wait states.

The IOP provides an intelligent connection between the expansion bus and the I/O devices (Fig. 3). The main data flow is between the expansion bus interfaces and the I/O bus interface through the DMA controller. The expansion bus interfaces connect the IOP to the expansion bus and the remainder of the Synapse system. The IOP is the master of the I/O bus, initiating all transfers with the adapters. The IOP manages as many as 16 I/O adapters including device controllers and communication subsystems. The adapters can report events to the IOP by generating an interrupt and waiting to be serviced by the IOP. Data are transferred between memory on the I/O adapter cards, IOP local memory and main shared memory. All adapters can transfer concurrently and asynchronously.

The IOP performs the scheduling and dispatching of processes at the completion of a process I/O activity. By



**Fig. 1. The Synapse expansion architecture consists of general-purpose processors (GPPs), input/output processors (IOPs), shared main-memory modules and memory controllers (MCs), disk controllers and advanced communications controllers (ACPs). The processors access the main memory via dual 32M-byte-per-sec. buses.**



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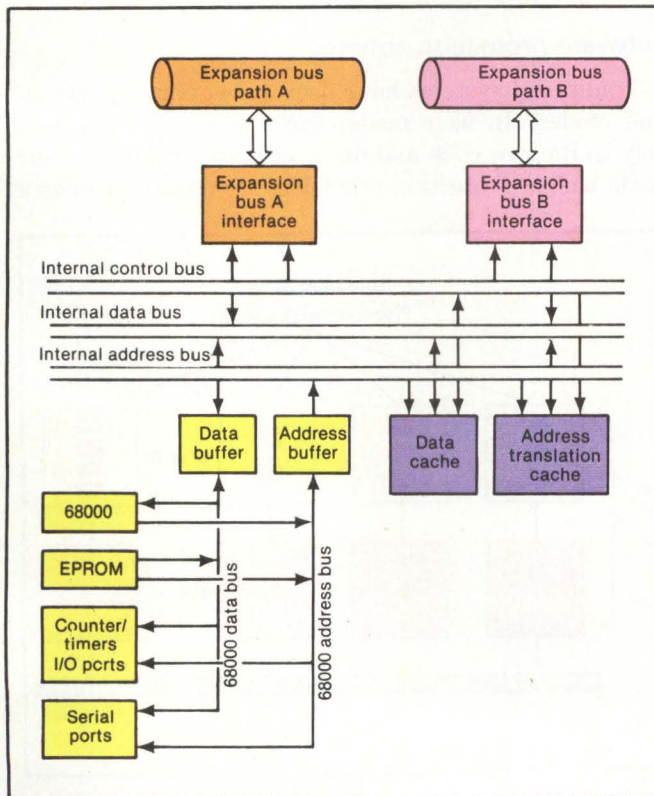
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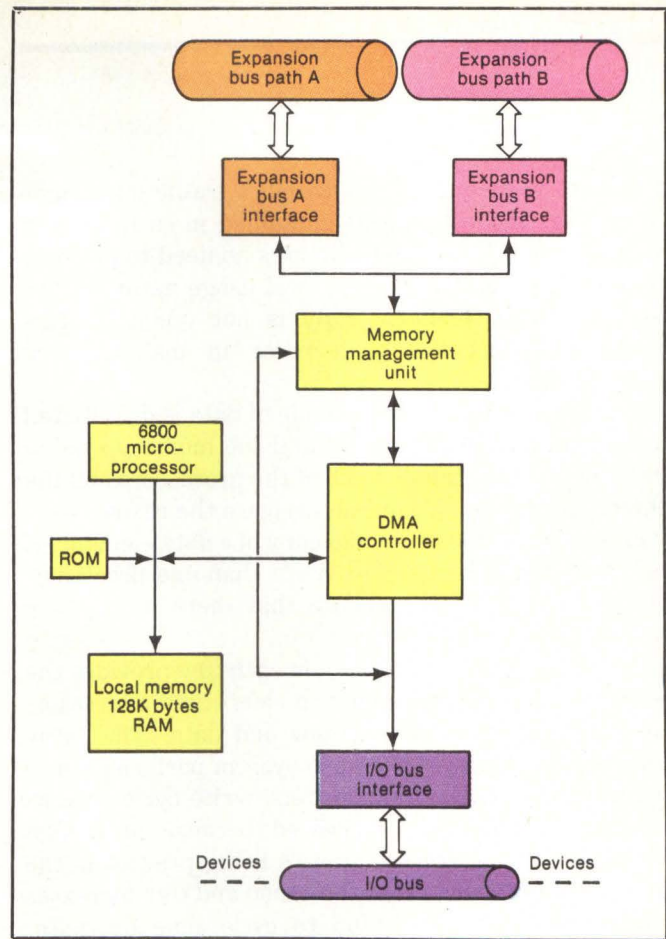
taking this responsibility for preparing a process to run, the IOP need not interrupt a GPP at normal I/O completions. The IOP includes 128K bytes of local dynamic RAM for storing IOP operating software and data. The memory has single-bit error correction and double-bit error detection on each 16-bit half-word.

The modularity of GPPs and IOPs allows Synapse systems to be expanded according to the number and types of processors needed. As transaction-processing demands increase on the system, additional GPPs or IOPs can be added on-line to an executing system. A minimum configuration consists of three IOPs and two GPPs.

The work queue containing the list of all processes awaiting a processor is a single queue serving all the tightly coupled processors. Processes are scheduled on a first-in-first-out basis within the context of a priority system. The processors are considered tightly coupled because they collectively share main memory, in contrast to loosely coupled architectures that require each process to be preassigned to a processor's work queue. Processes must be preassigned in loosely coupled architectures because each processor is paired with its memory, forming a multicomputer architec-



**Fig. 2. The GPP executes user programs and most Synthesis operating software.** The expansion bus connects the GPP to the Synapse system. Each GPP includes a 16-/32-bit 68000 micro-processor, 16K bytes of memory cache, counter/timers, I/O ports and 32K bytes of EPROM.



**Fig. 3. The IOP serves as the intelligent gateway between I/O devices and the Synapse expansion bus.** The DMA controller manages the data flow between the expansion bus interface (via the memory-management unit) and the I/O bus interface. The IOP is driven by a 68000 microprocessor and has 128K bytes of local dynamic RAM.

ture. By automatic load balancing, the Synapse approach provides higher throughput and facilitates concurrent software development (Fig. 4).

When I/O is required in a process, the I/O request is dispatched to the appropriate I/O processor, and the executing GPP goes to the work queue for another process. Because of the use of symmetric processors and a single work queue, adding a processor directly improves performance by accelerating the speed with which the single work queue is served. Using shared main memory allows all of the processors to have direct shared access to the entire Synapse relational database, eliminating cross talk and complex configuring.

**Non-write-through cache memory**

In the past, contention among processors and bus resources has plagued multiprocessor architectures. The recognition that not all data are required by all of the processors and their executing programs led Synapse to improve the typical cache write-through technique. In a write-through operation, any write to a local cache results in the updating of main memory at the time of the write. Synapse uses a proprietary

method to reduce the write-through traffic by assigning a usage mode to words contained in cache and in main memory. If the mode dictates no need to perform write-through because of the local usage nature of the data, the main memory copy is not updated. This results in a significant decrease in main-memory system usage.

The tracking of the usage mode of data is distributed throughout all the processors and the memory system itself. Logic is contained in all of the processors and the memory system to acquire and release the responsibility for the latest and only valid copy of a data element. If such data might be used by more than one processor, guarantees and checks ensure that there is only one copy of the latest valid data.

The 16K-byte cache memory in each GPP provides the 68000 with high-speed access to referenced addresses, page table entries, instructions and data. The cache significantly improves Synapse system performance in two ways. First, the average read/write cycle time as seen by the 68000 is decreased because of a high percentage of the accessed data's being present in the cache. The performance of the 68000 and GPP increases approximately in proportion to cycle time decrease. Second, the number of GPP requests to shared memory is significantly decreased, allowing additional GPPs to use the expansion bus and to share memory with minimal contention. Performance is further enhanced by the GPP cache memory using the non-write-through strategy that reduces bus contention and memory usage.

**Shared main memory**

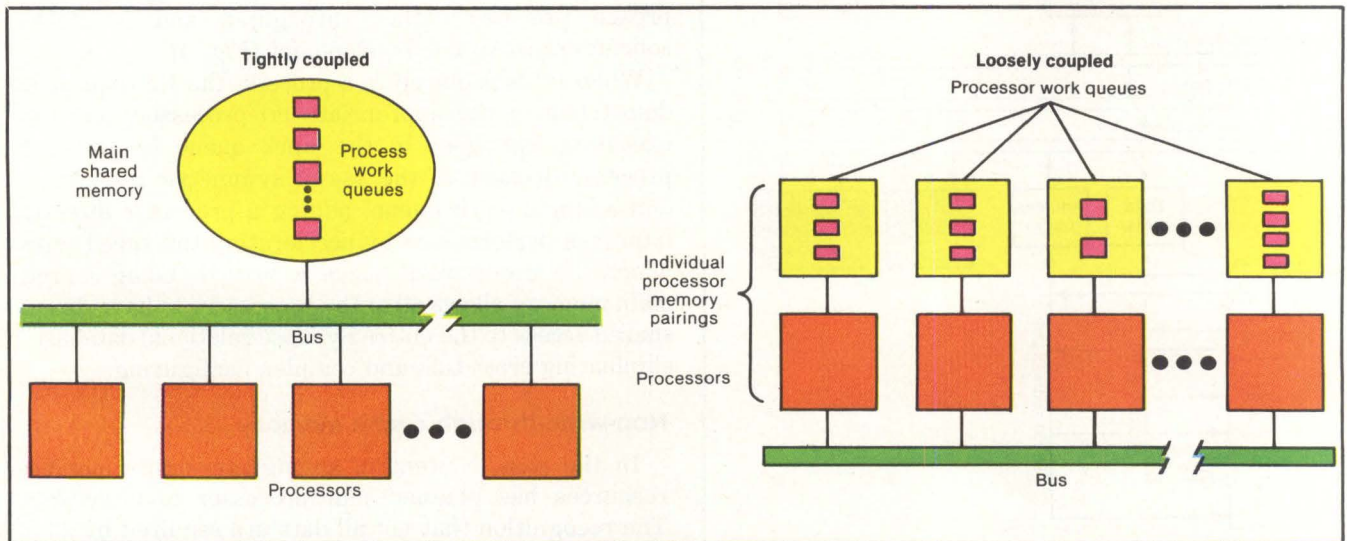
The shared main memory provides as much as 16M bytes of common storage among all processors connected to the expansion bus. All user processes are contained in the main memory. As many as four shared main-memory controllers can operate in non-interleaved, two-way-interleaved or four-way-interleaved mode. Interleaving is software determined by the Synthesis operating system and can be mixed to allow for reconfiguration of a failed memory component.

The memory subsystem consists of reconfigurable multiple components with the same N+1 fault tolerance found throughout the system. Address ranges are loaded into registers on the memory boards at initial program load or at the time of a reconfiguration. A memory board can be configured to cover any part of the physical address space of the machine. Shared-memory controllers are likewise soft configurable relative to address ranges and interleaving. In the event of a failure on a memory board or controller board, Synthesis readdresses and reinterleaves the remaining resources to create a new, optimal configuration.

It is important to recognize that recoverability is a separate issue from memory failures and reconfigurability. In recovering from memory failures, Synthesis automatically routes around the defective component and then recovers the database and restarts all users. Recovery is always based on mirrored disks, never on memory contents.

**Software-protection spheres**

Traditional systems have user and supervisor execution modes. In user mode, each program has access only to its own code and data, whereas the supervisor mode has no protection provisions. Synapse provides a



**Fig. 4. Two types of processor configurations and work-queue arrangements can be used in a transaction-processing system. Tightly coupled processors serving a single work queue, as employed in the Synapse N+1 system (left), share a common main memory and operate on a first-in-first-out basis. This arrangement allows any GPP to serve process needs, increasing throughput by quickly emptying the work queue. Loosely coupled processors serving multiple work queues (right) have dedicated pairings of processors and memory. This arrangement requires portions of the database to be committed to a particular processor/memory pair. When a processor needs data not resident in its memory, inter-processor communications must take place.**

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more general and well-protected approach in which there are five protection spheres or system levels (see "Synthesis software organization," below).

An execution mode exists for each level of the system, providing a protected execution context. Each system layer manages its own data, making it inaccessible to "higher" layers except through predefined "cross-sphere" calls. A lower level may not "call out" to a higher level. Each process has a 16M-byte address space separated into 1M-byte code and data segments assigned to the various system levels. The access rights to each segment at any time are determined by the level that is currently executing. When a level is entered through a cross-sphere call, the process is given access to all appropriate segments at that level. When the level is exited, the accessibility is removed.

The access protection on a per-process basis is implemented in memory-management hardware in each GPP. Page tables of mapping information are maintained, tracking the location of each logical 2K-byte page in shared main memory. A segment mask register provides access protection for each segment, whereby each register bit indicates whether application access is permitted to the referenced segment. A segment-protection fault is initiated when an access is attempted to a protected segment. Also associated with each page table entry are protection flags, which describe the accessibility of each page as a function of read/write/execute and instruction/data. These are the flags used to permit the proper functioning of the non-write-through cache.

**Synchronizing database, transaction processing**

The relational DBMS enables transactions to access data associatively from data stored logically in tubular

form. The transaction is the unit of both recovery and concurrency. Transaction recovery requires that all updates associated with a transaction be applied or removed as a group. Transaction concurrency requires that other transactions do not see data from an uncompleted transaction.

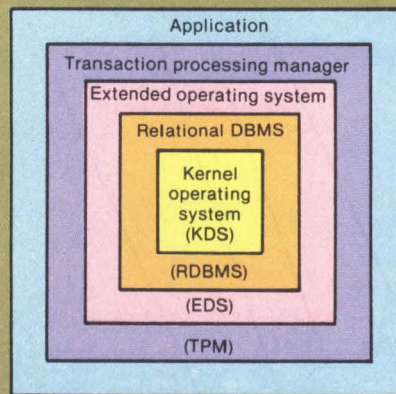
Shared or exclusive locks can be placed on the data at record, block or table level of granularity to allow a high degree of concurrency. To ensure database integrity, any executing programs are restartable by providing database recovery and concurrency. To provide restartability of a program, points of database consistency must be achieved. This involves not only bringing the database to a known point, but also reestablishing the program and screen states so that the users can continue their work. This collection of information is known as a checkpoint.

The Synapse N+1 has automated the facility for checkpointing and the restartability of user applications. Automatic checkpointing occurs at the point in a process when a program invokes another program to continue processing of a transaction. These "commit points" considerably reduce the amount of checkpoint data needed for a restart. The recovery implementation is based on all changes to the database being recorded in a log file. The log files are mirrored to protect against disk failures. When a transaction is committed, a commit record reflecting all of the recorded changes is added to the log file. This synchronization of the relational database and transaction-processing manager activities enables uncommitted transactions to be removed from the system and committed transactions to be applied when recovery must be performed. □

**Armond Inselberg** is product manager at Synapse Computer Corp., Milpitas, Calif. He was previously manager of strategic planning at Boole and Babbage and has a Ph. D. in computer science from Washington University.

**SYNTHESIS SOFTWARE ORGANIZATION**

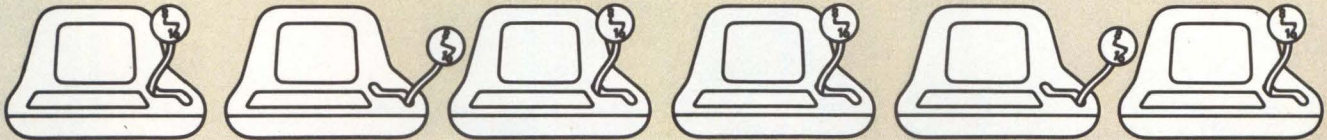
The Synthesis software is divided into five hierarchical layers, with the innermost layers being those of highest priority. Each of these layers, or "protection spheres," is protected from other layers by hardware. The innermost software layer, the kernel operating system, is responsible for process and memory management, processor queue and I/O queue management and reconfiguration management. The next most privileged layer is the relational DBMS, whose capabilities include relational database access, database integrity and deadlock protection, data validation and on-line backup/restore. The extended operating system maintains



a hierarchical directory of all system objects, such as tables and forms, and provides device-independent I/O and other user services. The transaction-processing manager performs screen-forms management, screen-input validation and application management/recovery. The user's programs execute at the application level, manipulating the database as a set of related data elements, with integrity, recovery, concurrency and input validation automatically handled by Synthesis.

The protection spheres of the Synthesis operating software consist of several functional levels, protected from each other by protection mechanisms residing in hardware. Any sphere not within a process calling sequence remains protected from even the most privileged inner levels.

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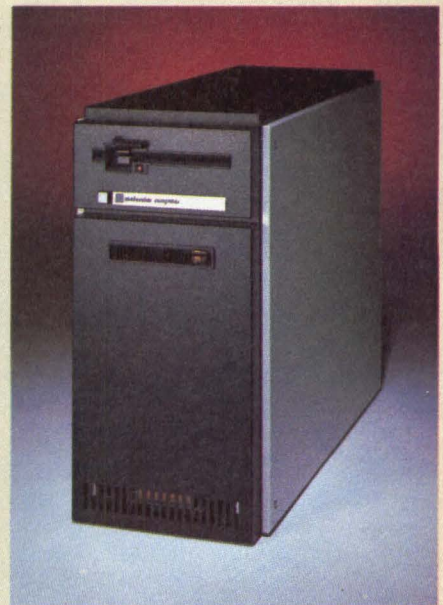
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## DISK DRIVES

# Micro-Winchester market awaits micro-diskette standards

DAVID KALSTROM, Seagate Technology

*Upgrading to hard disks can't happen before manufacturers agree on sub-5¼-in. floppy standards*

Winchester disk drives using media less than 4 in. in diameter and capable of handling formatted storage capacities in the 5M- to 10M-byte range will soon find their way into a wide range of new microprocessor-based systems, but not until the issue of diskette media standards for companion sub-5¼-in. floppy drives is resolved and this media becomes available in volume.

### What's needed

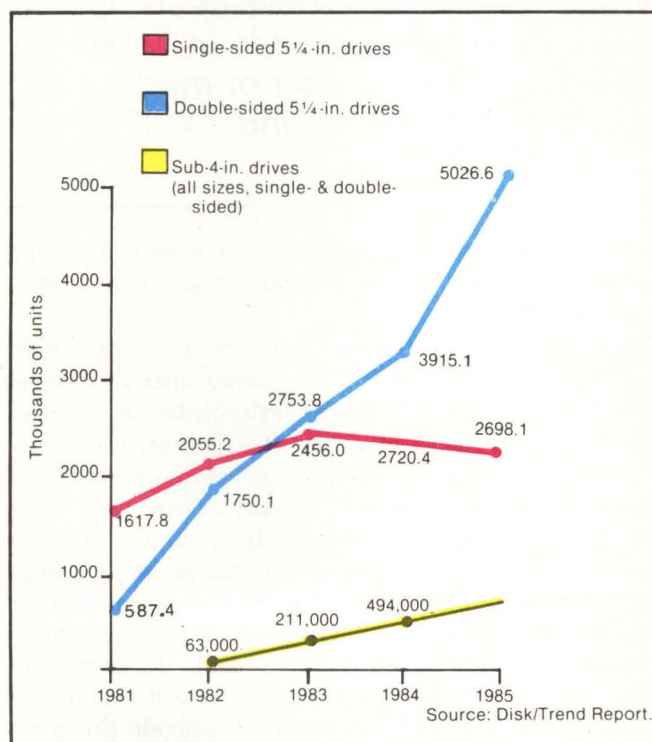
The merchant market for sub-5¼-in. Winchester has yet to be fully defined. But given the packaging requirements of some system designers, particularly those planning down-sized desk-top and portable systems in which even greater reductions in disk drive volumes than those now possible through the use of half-height, 5¼-in. Winchester are required, their advent will be inevitable.

The relationship between micro-diskette media standards and micro-Winchesters can be seen in the parallel relationship between 5¼-in. floppy disk drives and 5¼-in. Winchester. The market for 5¼-in. Winchester disk drives was initially defined as an upgrade market for the lower capacity floppy disk drives widely used in desk-top systems.

The market for these Winchester continues to be driven principally by the need to upgrade floppy disk drive capacities, and it is this upgrade market that is responsible for the large volumes now characteristic of the business. Seagate Technology, for example, builds 1000 Winchester disk drives per day. For sub-5¼-in. fixed out line disk drives to be produced in the volumes needed to make them competitive, it will be necessary that they be marketed under the same premise—that is, as upgrades to existing sub-5¼-in. microfloppy disk-based systems. This presumes that a broadly based market for microfloppy disk drives is in place. For this market to be established, low-cost diskettes

must be readily available. This requires the establishment of a diskette media standard, but drive vendors, especially those in a position to consider the large-scale production of microfloppy disk drives and Winchester, have differing opinions about what this standard should be.

Five different types of diskettes for sub-5¼-in.



Floppy drive market will continue to be fueled by rising sales of desk-top systems, with shipments of single-sided drives peaking in 1984. The market for sub-5¼-in. floppy disk drives will not reach full potential until the issue of media standards is fully resolved, however. Also impacting shipments of these drives will be significant competition from half-height 5¼-in. floppy disk drives that offer many of the space savings of sub-5¼-in. drives while allowing the use of media designed for standard-height drives.

drives have been proposed.

- Sony Corp.'s plastic-jacketed 3½-in. diskette,
- a 3-in. plastic-jacketed diskette proposed in late 1981 by a consortium of Japanese companies,
- a 3½-in. plastic-jacketed diskette developed by a committee of drive and media vendors established at last year's National Computer Conference in Houston and
- a soft-jacketed, 3¼-in. design developed by Dysan Corp. and incorporated into a drive announced by Tabor Corp., and most recently, the 102mm (4.015-in.) diskette used on IBM's new OEM drive.

### Soft-jacketed media are more producible

Drive and media vendors are already considering which standard serves them best. Seagate has an agreement to second-source Tabor's drive, a decision that reflects the concern Seagate has for the stunting impact that the nonavailability of large quantities of low-cost diskette media would have on the establish-

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*The Dysan diskette is simply a scaled-down version of the soft-jacketed media developed by IBM Corp. and made available in enormous quantities by a number of media vendors with both 8- and 5¼-in. drives.*

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ment of a broadly based market for microfloppy disk drives and hence on the market for sub-5¼-in. Winchester.

Seagate believes that the design of the Dysan media used in the Tabor drive overcomes many of these concerns. Instead of using plastic-jacketed concepts that have yet to be proven in the market, the Dysan diskette is simply a scaled-down version of the soft-jacketed media developed by IBM Corp. and made available in enormous quantities by a number of media vendors with both 8- and 5¼-in. drives. As a result, even though this media is not in wide-scale production, Seagate anticipates that should demand for microfloppy disk drives suddenly explode as a result of a large-scale systems order, it would be the media most rapidly and readily producible. This alone may provide the confidence that system builders need to develop products based on the drive (Tabor has since signed a multi-year contract for these drives with Soroc Inc.)

### Other standards

In addition to a media standard, other considerations

must be addressed before a broad-based market for micro-Winchesters can be realized. Because the initial market for micro rigid disk drives will be a floppy-upgrade market, the form factor of both the Winchester and the floppy disk drive should be the same—a consideration dictated to a certain extent by media size. This is one of the major lessons of 8- and 5¼-in. Winchesters. Equally important are controller and data format standards. Given the amount of software that has been developed for small systems based on 5¼-in. Winchesters, system vendors planning to use sub-5¼-in. rigid disk drives must have the opportunity to leverage the investments made in industry-standard 5¼-in. Winchester controller and format designs. This will permit stored data and programs developed for one drive to be mapped over to another.

This will impose some constraints on micro-Winchesters. The controller design that was developed for Seagate's ST506 conventional-height 5¼-in. drive and that has come into almost universal use at the desk-top system level accommodates the MFM recording scheme and handles 10,416 bytes per disk track, divided into 32 sectors. Transfer rate is 5M bits per sec.

Based on these figures, it is possible to bring the per-platter capacities of a sub-5¼-in. drive up to the

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*The form factor of both the Winchester and floppy disk drive should be the same—a consideration dictated to a certain extent by media size.*

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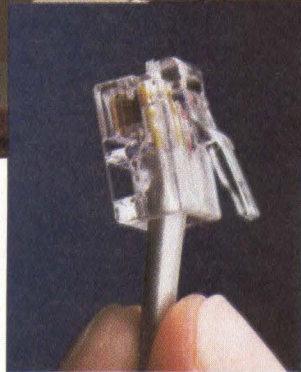
5M-byte level without pushing the magnetic technologies involved. These drives would operate at slightly higher flux densities to maintain the 10,416-byte-per-track specification because this is calculated from the innermost track. Track densities will be in the 500-tpi range. Seagate proposes to use a disk with an 80-mm. outside diameter and a 40-mm. inside diameter.

The market for sub-5¼-in. Winchester disk drives will develop strongly as a natural complement to the 5¼-in. full- and half-height drives now on the market in volume once the overriding issues relating to diskette standards are resolved. The extent of this market is difficult to predict, and Seagate expects that this class of fixed-disk drives will be shipped only in evaluation quantities this year. Microfloppy disk drive shipments will be higher, however. According to Jim Porter's *Disk/Trend Report*, more than 200,000 drives of this class will be shipped this year, with almost 500,000 being shipped in 1984 and 952,000 in 1985. □

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**David Kalstrom** is director of marketing, Seagate Technology, Inc., Scotts Valley, Calif.

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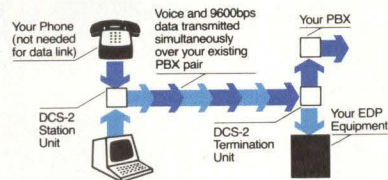
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# Video cassette recorders for disk backup

JOHN PROPER, Alpha Micro Systems

*Easily interfaced VCRs can provide slow but reliable backup for 5¼- and 8-in. Winchesters*

Video cassette recorders are being used for disk backup at nearly 1000 computer installations around the world, but their computer-related capabilities are still not generally known. Mass-market VCRs can store as much as 100M bytes on a single video cassette, yielding a media cost of 12¢ per megabyte and an equipment cost of 50¢ per megabyte, both equal to or better than corresponding costs for other backup devices, including streaming cartridge-tape drives (MMS, August, 1982, p. 213). VCRs have serious limitations as well. They are bigger and heavier than diskette, Philips cassette and tape-cartridge drives and, more importantly, can take hours to save or restore a complete video cassette's worth of data—with all users denied disk access while backup is in progress. Despite these limitations, Alpha Micro Systems has combined video interfacing, redundant recording and special software to create VCR disk-backup systems that are practical and reliable for many applications.

## The video connection

To the host computer, the VCR subsystem appears to be a comparatively low-performance but high-capacity disk. To the VCR, the host computer appears to be a TV camera that is generating a standard black-and-white video signal—including the usual horizontal and vertical synchronization signals (Fig. 1). The fact that a digital data stream is being reliably recorded in essentially analog form separates the VCR backup system from all other magnetic-tape applications.

The backup-and-restore data path between disk and cassette includes the host computer. During backup, selected files are read from disk stored in computer memory and transferred to the VCR at a rate that will sustain continuous "streaming" of the video tape. The process is reversed during a restore operation.

To achieve maximum data storage per cassette, data

must be transferred to the VCR at a rate of 60K bytes per sec. (If data are not available for recording, the video tape continues to stream, but without recording any data.) Assuming a 6:1 copy ratio, this is equivalent to 10K bytes of new data per sec.

The same figures apply to a restore operation. In most cases, therefore, host and disk can stay comfortably ahead of the VCR. To make disk-host and host-controller transfers more efficient, however, the controller is equipped with a 4K-byte RAM and is designed to accept and transmit data at rates as high as 43K bytes per sec.

VCRs are designed to store a video signal that represents (by U.S. standards) a series of television "fields" with a repetition rate of 60 fields per sec. and approximately 240 visible raster lines within each field. Assuming that, even with marginal performance, a VCR can record at least 200 distinguishable pixels (bits) along each raster line, the potential capacity of a two-hour video cassette is more than 2G bytes—far beyond the backup requirements for most microcomputer applications.

The VCR subsystem sacrifices potential capacity and performance for reliability. Instead of storing 20 or more bytes along each 200-bit raster line, only 5 bytes (separated by start and stop bits) are recorded. Most importantly, however, stored data are organized into 512-byte blocks, and each block is recorded six or more times to ensure that at least one copy of each block is error free. Two cyclic redundancy check characters at the end of each block validate the record during the restore operation.

## Reliable, redundant recording

The six-times redundancy results from extensive testing and field experience with dropouts and other types of media-related faults that can be encountered

with consumer-grade cassette tape. These faults tend to be randomly distributed along the length of the tape and are rarely concentrated within the span of a few contiguous blocks. Statistical analysis indicates that with just one repetition of a block record, the frequency of "hard" errors (all copies in error) drops below the equivalent figure for flexible disks. With three copies of each block, data integrity exceeds that of the Winchester itself. Doubling this number to six virtually eliminates any chance of a tape-fault error. Capacity of the tape is reduced to one-sixth its potential, but a single cassette still provides more than enough backup capacity for most applications.

This assumes that the tape has not been severely worn by repeated store-and-retrieve operations. To track this deterioration, common to all magnetic-tape media, the VCR controller monitors every read operation, counts the occurrence of "soft" CRC errors (when one of the copies is in error) and reports on demand the ratio between the total number of copies that have been read and the error count. A typical value for this soft-error "confidence test" is 300:1. When a cassette demonstrates a confidence-test value below 100:1, system software automatically sends a warning message to an operator.

The corrective action is to replace the worn cassette, but the user has other options. For added capacity, for

**Fig. 1. The VCR-to-computer interface** is a plug-in controller board that combines controller functions with a signal interface. The host computer sees the VCR as a low-performance disk, and the VCR sees the host computer as a video camera.

example, the tape speed of the VCR may have been set at "long play" or "extended long play." A new backup operation with the VCR switched to a "standard" tape-speed setting can enhance the reliability by spreading the data and blocks further along the tape.

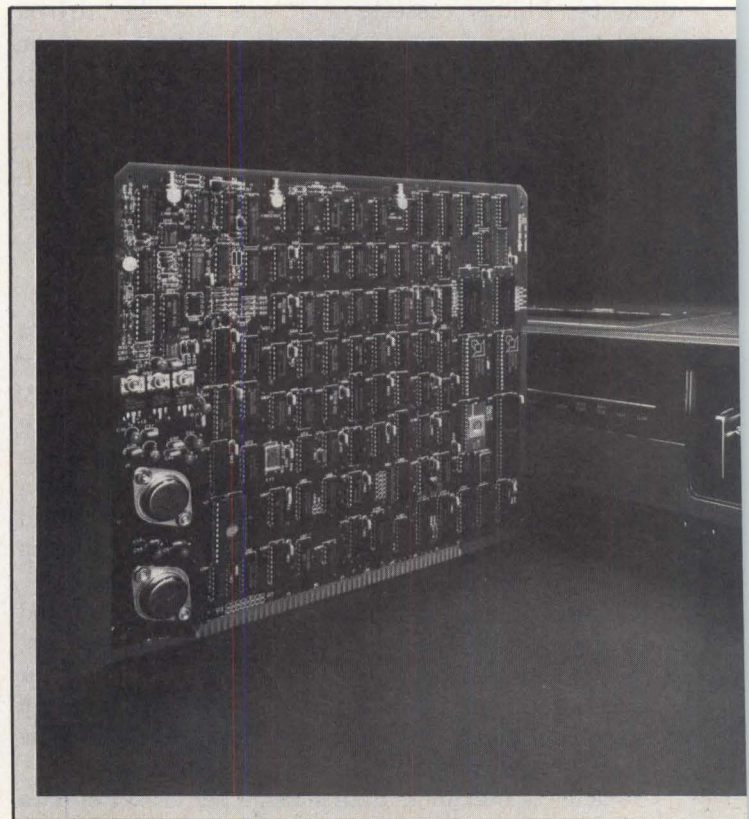
Another alternative is to increase the number of copies of each block. The user can select any number as high as 255—escalating the theoretical integrity of the data toward infinity (except for equipment failure or physical destruction of the video cassette). Tape-speed setting and number of copies can be traded to meet special system requirements. For example, the user can increase the capacity of cassettes by switching to a longer playing mode and maintain data integrity by using a part of the added capacity to store extra copies of each block. Controller firmware prevents the user from decreasing redundancy below the six-copy minimum to expand capacity.

During normal operations, the fact that extra copies of each block have been recorded is completely transparent to the host computer but gives the user added interfacing flexibility. Each recorded data block

is prefaced by a sync byte and a 6-byte header containing a sequential identification number (Fig. 2). Only the first error-free copy containing the expected sequential number is transferred to the host and disk when the cassette is read. Preceding copies in error and all subsequent copies, with or without errors, are "discarded" by the controller's microprocessor. The CRC calculation that validates each block includes the header data to ensure that an incorrectly recorded identification number does not confuse the block count.

The controller's on-board RAM stores as many as seven unique data blocks (not copies) to buffer small mismatches between the data transfers and the rate at which data are being recorded or read. Larger differences can be accommodated by using extra copies of each block as "padding" to lower the rate at which "new" data are being written or read. In a "verify" restore operation, for example, the host reads and verifies blocks of data as they are stored on disk, significantly reducing the effective host-disk transfer rate.

Added padding is particularly important when data are backed up from one disk and restored on another, slower disk or are transferred to another system with an unknown disk. The number of copies, in this case, should reflect the worst-case condition. For reliability reasons, the same rule applies when cassette-stored data are to be read by another VCR, perhaps from a different manufacturer. A video cassette that is acceptable on one VCR may be marginally acceptable on another VCR with slightly different operating characteristics. Added redundancy usually compensates for

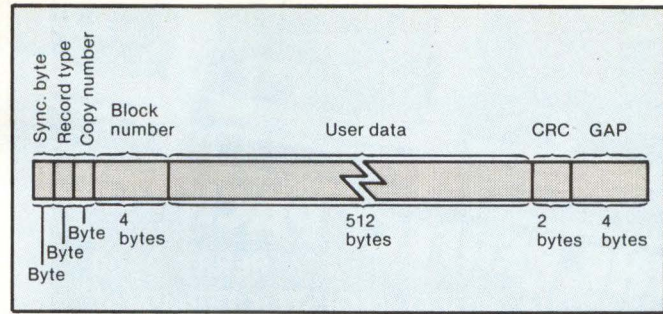


any increase in the soft-error rate that might occur.

### VCRs in action

Backup operations are initiated by a single host-computer command. Arguments included in this command specify the source disk, destination VCR and all the disk files that are to be transferred. The disk-file list serves as a directory, or "table of contents," for the backup video cassette and is automatically recorded at the beginning of each cassette. Subsequently, the system can read and display the contents of the cassette. The directory lists the number of blocks of data occupied by each file, allowing users or application programs to access a file or a file record by instructing the VCR subsystem to advance to a specified block number before transferring the data to the host. Moreover, the header at the front of each block (Fig. 2) also includes a "type" identification byte so that, by appropriate commands, the controller can be directed to search for and restore not only a selected group of files, but also files of a specific type. The controller reads intervening files and blocks of data but does not transfer them to the host. Data are transmitted to the host only when the desired files or blocks have been reached.

VCR tapes can also include warm-start data, allowing the VCR to be used as a system booting device. The controller (Fig. 1) includes a PROM containing the VCR controller firmware that can include an optional cold-start boot. In addition, standard system software permits the user to define a warm-start boot and store it on cassette tape immediately after the file directory.

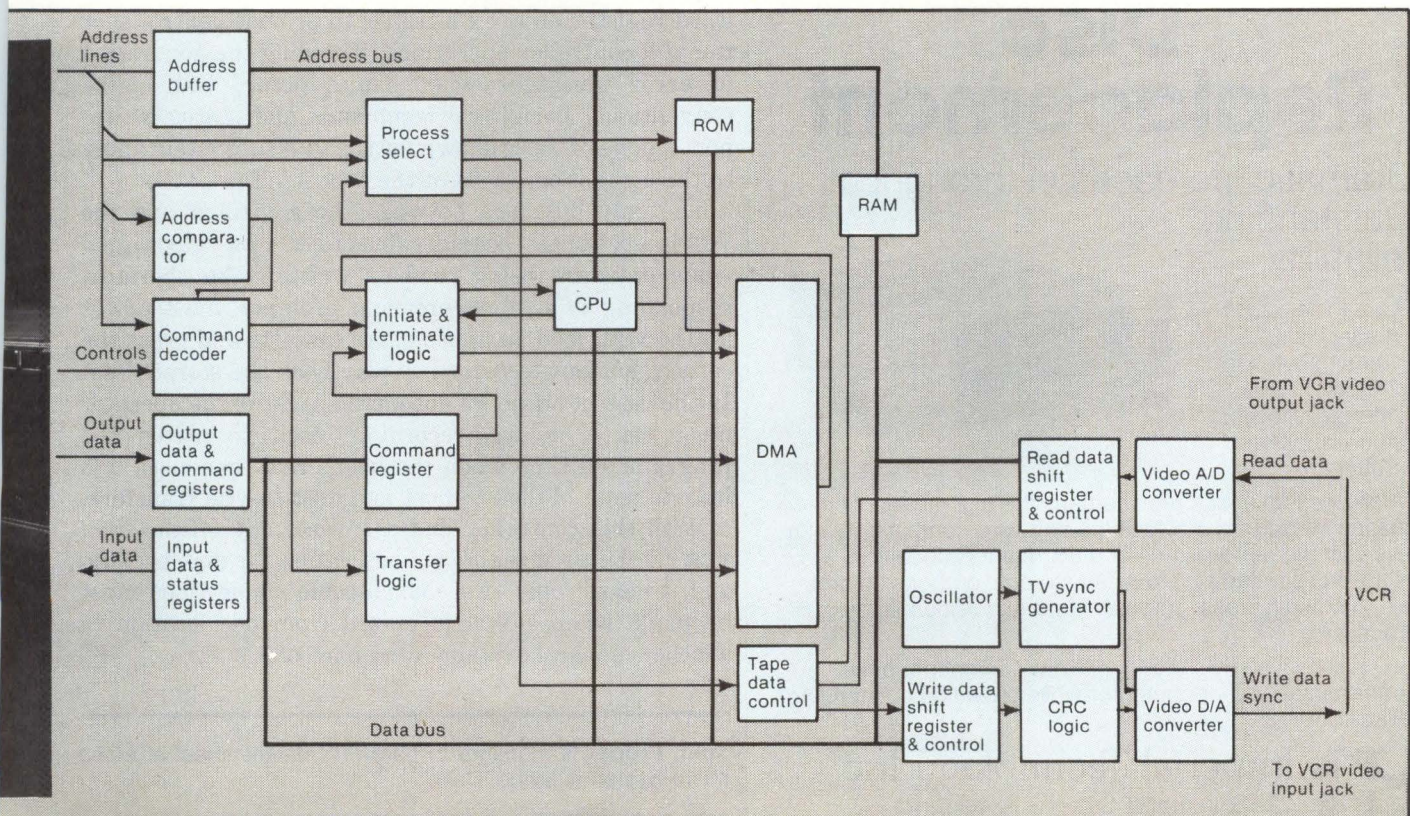


**Fig. 2. A VCR data block** combines 0.5M bytes of user data with 13 bytes of synchronization, address and error-correction information. Data blocks are recorded repeatedly in sequence for reliability through redundancy. During tape read operations, only the first error-free copy containing the expected block number is read. All subsequent copies are ignored.

To assure near-absolute integrity of this boot program, all of its data blocks are copied 16 times—independent of the number of copies the user specifies for the balance of data on the tape.

The user controls the VCR with Alpha Micro-supplied subroutines, including:

- **CRT610:** checks and verifies the quality of video cassettes for use as disk file backup media and optionally creates a warm-boot monitor cassette using a warm-boot monitor file built by WRMGEN.
- **SLEEP:** allows automatic file backup using a VCR that can be programmed to record at a specified time.
- **VCRDIR:** displays a list of the files on a video tape cassette and can create a disk file containing the video tape directory.
- **VCRRES:** writes files from video cassette tape to disk and allows a user to restore file-oriented disk





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## DISK DRIVES

backup from video cassette to disk.

- VCRSAV: writes copies of disk files to video tape cassettes.

- WRMGEM: creates a warm-boot monitor file on disk for transfer to a video tape cassette.

The six acronyms are part of the AMOS system-command language and can be entered at the keyboard in an interactive mode with prompts and help responses or incorporated into an application program.

The VCR system commands facilitate backing up and restoring data. Special training and programming techniques are not required. The characteristic file structures of AMOS are preserved intact, independent of whether the data are on disk, in host-computer memory or on video-cassette tape. The VCR controller responds to 17 single-byte commands that are used by the operating-system device driver to transfer data to and from the video cassette. These include: read tape record, read tape continuous, write tape record, write tape continuous, reset controller and parameters, read the user RAM pointer, load the user RAM pointer, read RAM indirectly via user RAM pointer, write RAM indirectly via user RAM pointer, execute RAM indirectly via user RAM pointer, turn off buffered tape-read flag, turn on buffered tape-read flag, read RAM current buffer - start at header area, read RAM current buffer - start at data area, read RAM parameters, write RAM parameters and abort read/write tape operation. The device-driver VCR commands interact with information stored in a status-word register on the controller to provide control over the VCR controller operations, including the generation of error messages when faults occur. But unlike conventional peripheral commands and status-bit reports, none of those shown for the VCR subsystem apply to the control or status of the VCR itself.

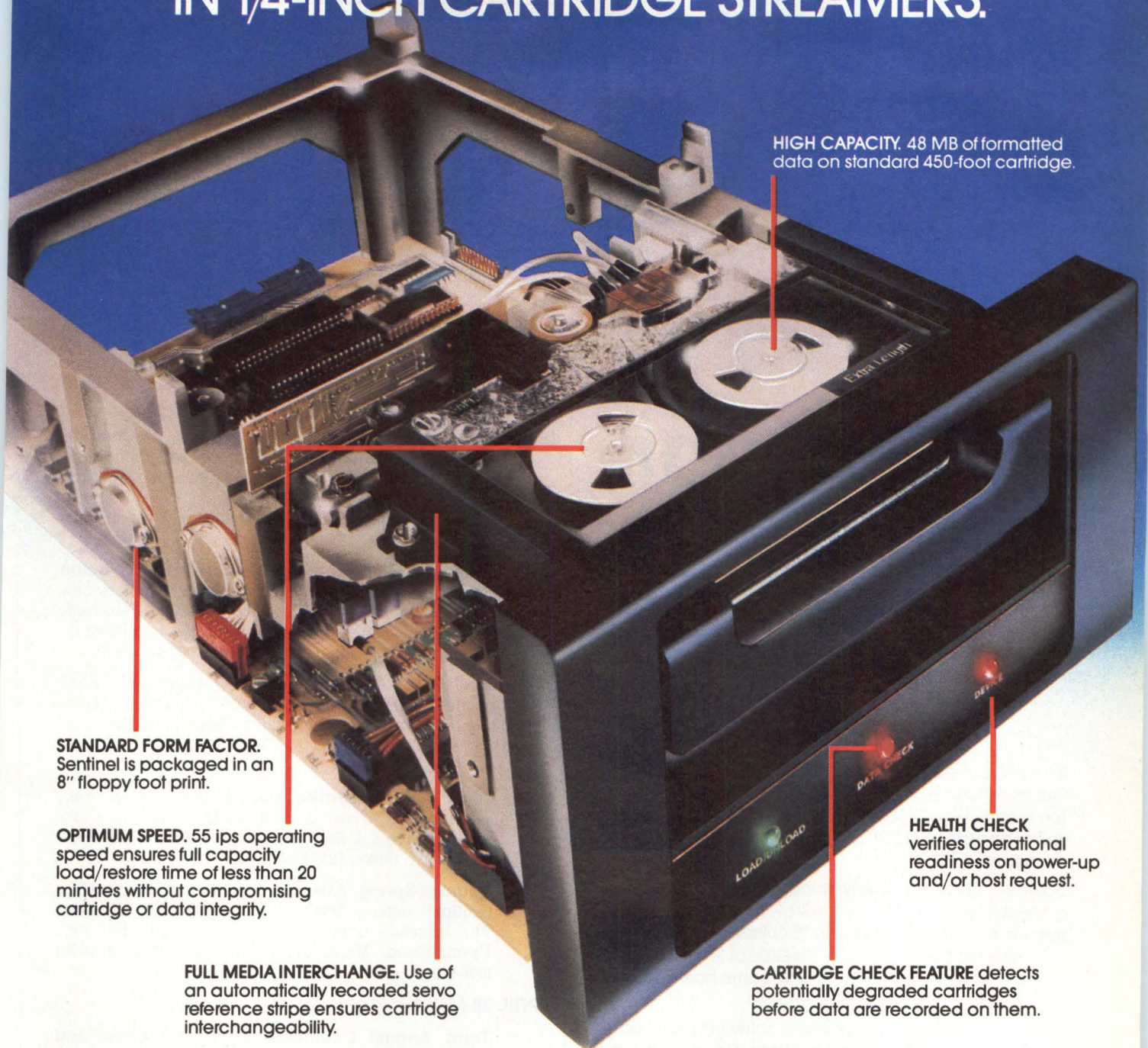
The only interface between the controller and the VCR is a set of two coaxial cables to carry a video signal when data are being read or written. An operator, responding to system-command prompts, must power up the VCR, load an appropriate cassette and press the correct buttons to record or play back the stored data. In the case of off-hours automatic backup, the operator must set a delayed-recording clock to match the programmed time when the host's real-time clock will initiate a set of disk-to-host and host-to-VCR transfers.

With this controller and software, any off-the-shelf VCR can be used without modification for disk backup, and, because only two coaxial-cable connections must be made when a VCR is moved from one location to another, several systems can share one VCR. □

**John Proper** is manager of hardware development at Alpha Micro Systems, Irvine, Calif.



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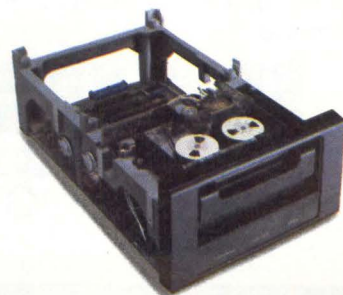
## T H E S E N T I N E L

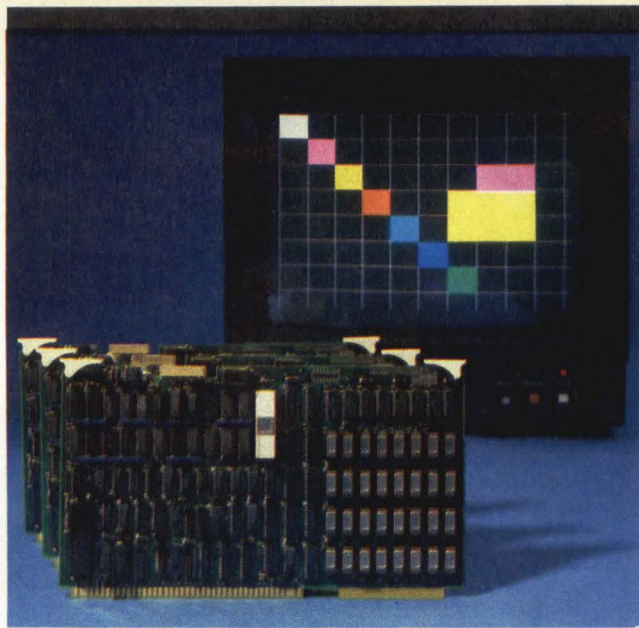
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## Calendar

### APRIL

- 13-20 Hanover Fair '83**, Hanover, Germany, organized by Hanover Fairs Information Center. Contact: Hanover Fairs Information Center, P.O. Box 338, Whitehouse, N.J. 08888-0338, (201) 534-9044 or (800) 526-5978.
- 14-17 Second Annual New York Computer Show and Software Exposition**, Nassau, Long Island, N.Y., sponsored by Northeast Expositions. Contact: Deborah C. Harkins, Northeast Expositions, 822 Boylston St., Chestnut Hill, Mass. 02167, (617) 739-2000.
- 18-21 IEEE Infocom '83**, San Diego, Calif., sponsored by the Computer Communications Committee of the IEEE Computer and Communications Societies. Contact: IEEE Infocom.
- 18-21 Fifth Annual International Conference on Computer Capacity Management**, New Orleans, sponsored by the Institute for Software Engineering. Contact: Institute for Software Engineering, 510 Oakmead Parkway, Sunnyvale, Calif. 94086, (408) 749-0133 or (800) 538-1872.
- 19-21 Electro '83 High-Technology Electronics Exhibition and Convention**, New York, sponsored by Electronic Conventions Inc. Contact: Jerry Fossler, Electronic Conventions Inc., 999 N. Sepulveda Blvd., El Segundo, Calif. 90245, (213) 772-2965 or (800) 421-6816.
- 19-21 Mini/Micro-Northeast**, New York, sponsored by Electronic Conventions Inc. Contact: Jerry Fossler, Electronic Conventions Inc., 999 N. Sepulveda Blvd., El Segundo, Calif. 90245, (213) 772-2965 or (800) 421-6816.
- 21-22 Local Area Networks '83**, St. Petersburg, Fla., sponsored by Frost & Sullivan Inc. Contact: Carol Sapchin, Frost & Sullivan Inc., 106 Fulton St., New York, N.Y. 10038, (212) 233-1080.
- 26-29 Comdex Spring**, Atlanta, organized by The Interface Group. Contact: Irwin Stern, Marketing Director, The Interface Group, 160 Speen St., P.O. Box 927, Framingham, Mass. 01701, (617) 879-4502 or (800) 225-4620.

### APRIL 28-MAY 1

**Third Annual Southwest Computer Show and Software Exposition**, Dallas, sponsored by Northeast Expositions. Contact: Deborah C. Harkins, Northeast Expositions, 822 Boylston St., Chestnut Hill, Mass. 02167, (617) 739-2000.

### MAY

- 4-6 Sixth Annual Rocky Mountain Data Processing Expo and Conference**, Denver, sponsored by the Mile High Chapter of the Data Processing Management Association. Contact: Mark Cramer, Show Manager, Industrial Presentations West, 3090 S. Jamaica Court, Suite 304, Aurora, Colo. 80014, (303) 696-6100.

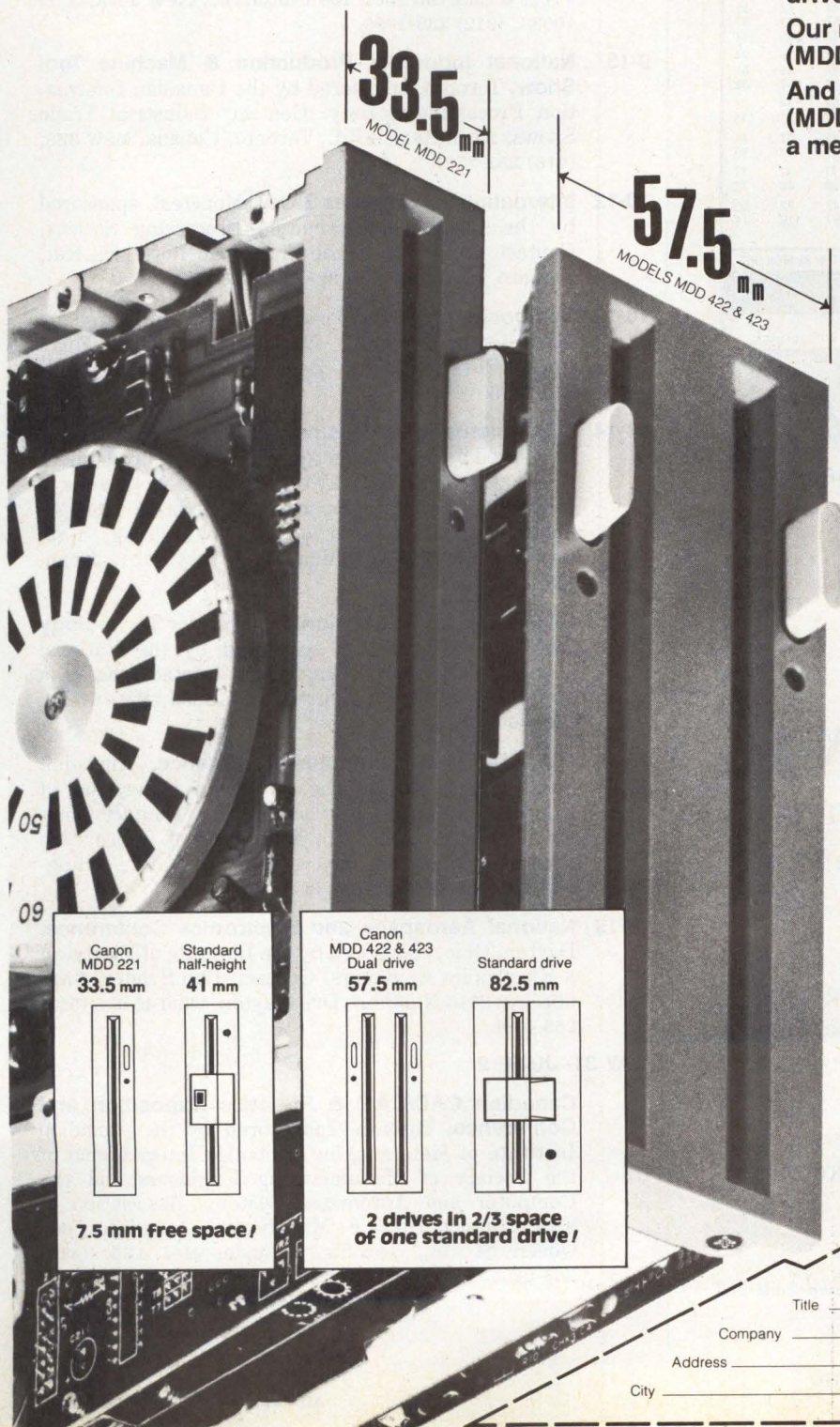
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	925 CRT Terminal. ....	850	82	46	31
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	Letter Quality, 7725 KSR. ....	3,195	307	171	115
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	2120 KSR Printer 120 CPS. ....	2,195	211	117	80
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# Calendar

**5-8 FutureWorld Expo '83**, Los Angeles, sponsored by FutureWorld '83. Contact: Todd Easton Mills, 5455 Castle Knoll, La Canada, Calif. 91011, (213) 957-3328.

**9-11 "Designing Advanced Production Machines" Seminar**, Atlanta, sponsored by Frost & Sullivan Inc. Contact: Carol Sapchin, Account Representative, Frost & Sullivan Inc., 106 Fulton St., New York, N.Y. 10038, (212) 233-1080.

**9-13 National Industrial Production & Machine Tool Show**, Toronto, sponsored by the Canadian Information Processing Society. Contact: Industrial Trade Shows, 20 Butterick Rd., Toronto, Canada, M8W 3Z8, (416) 252-7791.

**10-12 International Computer Show**, Montreal, sponsored by the Canadian Information Processing Society. Contact: Industrial Trade Shows, 20 Butterick Rd., Toronto, Canada, M8W 3Z8 (416) 252-7791.

**10-12 Symposium '83**, Boxborough, Mass., sponsored by Mitre Corp. Contact: Edward M. Sullivan, Mitre Corp., Burlington Rd., Bedford, Mass. 01730, (617) 271-7369.

**11-14 58th International Business Show**, Tokyo, Japan, sponsored by the Nippon Administrative Management Association and the Tokyo Chamber of Commerce & Industry. Contact: Nippon Administrative Management Association, Seikyo Kaikan Building, 1-13, Sendagaya 4-chome, Shibuya-ku, Tokyo 151, Japan, (03) 403-1331.

**11-15 COMPUTA '83 International Computer Technology Exhibition**, Singapore, sponsored by the National Computer Board of Singapore. Contact: Kallman Associates, 5 Maple Court, Ridgewood, N.J. 07450, (201) 652-7070.

**16-19 1983 National Computer Conference**, Anaheim, Calif., sponsored by the American Federation of Information Processing Societies Inc. Contact: Ann-Marie Bartels, American Federation of Information Processing Societies Inc., 1815 N. Lynn St., Arlington, Va. 22209, (703) 558-3612.

**17-19 National Aerospace and Electronics Conference**, Dayton, Ohio, sponsored by the Institute of Electrical & Electronics Engineers. Contact: Dan Synder, NAECON '83, 2046 Northern Dr., Dayton, Ohio 45431, (513) 255-4709.

## MAY 31- JUNE 2

**Canadian CAD/CAM & Robotics Exposition and Conference**, Toronto, sponsored by the Canadian Institute of Metalworking, Robotics International of the Society of Manufacturing Engineers and the Computer and Automated Systems Association of SME. Contact: Hugh F. Macgregor & Associates, 662 Queen St. W., Toronto, Canada, M6J 1E5, (416) 363-2201.

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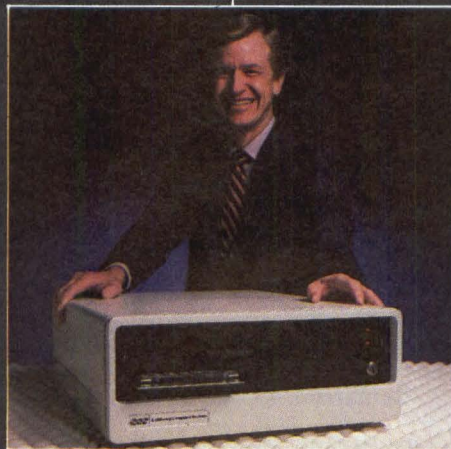
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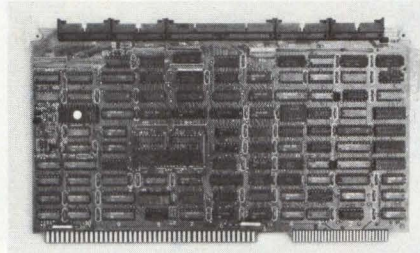
# Peripherals

NEW PRODUCTS

## Peripheral controllers provide high-performance Multibus capability

Xylogics Inc., a manufacturer of high-performance peripheral controllers for the OEM and system integrator markets, has introduced two intelligent controllers for Multibus-based applications: the model 450 disk controller for SMD-compatible disk drives and the model 472 tape controller for streaming and start-stop tape drives.

Each controller resides on one single-height Multibus PC board,



Xylogics Inc.'s model 450 disk peripheral controller is packaged on one IEEE-796 Multibus standard PC card and requires +5V and -5V power from the backplane. It meets all IEEE-796 environment specifications.

addresses as much as 16M bytes of memory and controls as many as four drives per board. The model 450 supports data-transfer speeds as high as 1.8M bytes per sec. When attached to four disk drives, it can access as much as 2.4G bytes of disk storage. The model 472 supports tape drives running at speeds from 12.5 to 100 ips with recording densities of 800, 1600 or 6250 bpi.

Because the model 450 has the SMD interface, it is compatible with a wide range of disk drives offered by Ampex Corp., Control Data Corp., Fujitsu America Inc., NEC Information Systems Inc. and Priam Corp. Software drivers for the model 450 include CP/M, RMX-86 and UNIX. The model 472 can interface to any tape drive that

conforms to the Pertec interface including drives from Pertec Computer Corp., Kennedy Co., CDC and Cipher Data Products Inc.

The controllers also feature 16-, 20- and 24-bit addressing, on-board diagnostics, programmable throttle and support for 8- and 16-bit microprocessors. The model 450 also features automatic error correction and has a 2K-byte FIFO buffer. The model 472 has a 1K-byte FIFO buffer, and its DMA circuitry can transfer data at speeds as high as 2M bytes per sec.

For optimum Multibus system performance with 16/32-bit processors, such as the 8086, 68000, 16032 and Z8000, the controllers use a channel-control technique. Channel control permits command chaining without operating-system intervention between commands and so allows concurrent processor and peripheral operation.

Prices for the models 450 and the 472 are less than \$1500 and \$1400, respectively, in quantity. Xylogics Inc., 144 Middlesex Turnpike, Burlington, Mass. 01803.

Circle No 300



### Interface ties instruments in a common bus

The models Q1488 microprocessor-based intelligent interfaces provide the ability to connect RS232 or 20-mA current-loop serial instruments to an IEEE-488 general-

purpose interface bus. Model Q1488S provides GPIB talker/listener capability and generates and accepts all required IEEE-488 data transfer and handshake signals. A 480-byte buffer is provided for each input. The Q1488S serial data rate is user-selectable from 110 to 9600 baud. The model Q1488C, RS232-to-IEEE-488 controller, includes all the features of the model Q1488S, but also allows a user to perform all GPIB controller functions except passing and receiving control. Each of the units includes LED status indicators for talking, listening, buffer three-quarters full, ready and power on. Prices are \$1250 for the model Q1488S and \$1500 for the model Q1488C. Quasitronics, Inc., 211 Vandale Dr., Houston, Pa. 15342.

Circle No 301

### Streaming-tape controller interfaces LSI-11 drives

The STV11 streaming-tape controller interfaces the Archive and Cipher ¼-in. streaming-tape drives to the DEC LSI-11 Q-bus. The controller is packaged as a dual-height LSI-module and emulates the DEC TM11 for full software compatibility with all DEC operating systems. A single 50-conductor ribbon cable connects the controller to as many as two Archive or Cipher streaming-tape drives with two or four recording tracks. From 10M to 45M bytes of data can be stored on a single 450-ft. tape cartridge, depending on the tape-drive model used. Data can be recorded at rates as fast as 87.2K bytes per sec. on 90-ips drives. Prices start at \$1500. General Robotics Corp., 57 N. Main St., Hartford, Wis. 53027

Circle No 302

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All the Plessey Series/6000 computers support whatever you're doing (or will be doing) in software: DEC operating systems like RSX-11M/M+, RSTS/E™ and RT-11™ or TSX-Plus™. UNITY™ (System III UNIX) and the new crop of software. M-11 (MUMPS) and hordes of public domain applications. And even CP/M and all those low-cost programs.

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[A1] DTL: Net Profit Analysis  
Entry or / █

row:	A	B	C	D	E	F
1:	Net Profit Analysis	January	February	March	Total % of Gross	Margin
2:						
3:	Domestic Sales	900,000	927,000	954,810	2,781,810	
4:	Foreign Sales	300,000	309,000	318,270	927,270	
5:	Total Sales	1,200,000	1,236,000	1,273,080	3,709,080	
6:	Cost of Goods Sold	624,000	635,030	646,267	1,905,297	
7:	Gross Margin \$	576,000	600,970	626,813	1,803,783	
8:						
9:	Operating Expenses					
10:	Sales Expense	149,000	150,490	151,995	451,485	25.0
11:	Marketing Expense	142,000	143,420	144,854	430,274	23.9
12:	Admin Expense	99,000	99,990	100,990	299,980	16.6
13:	Total Operating Exp	390,000	393,900	397,839	1,181,739	65.5
14:	Interest Expense	21,000	21,000	21,000	63,000	3.5
15:	Fed and State Taxes	80,000	90,000	95,000	265,000	14.7
16:	Net profit	85,000	96,070	112,974	294,044	16.3

## The bottom line.

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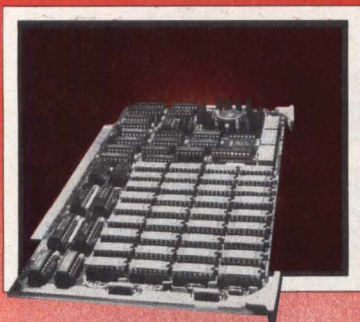
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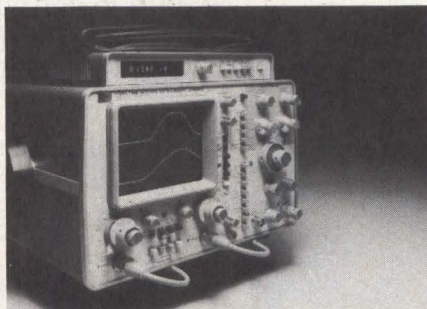
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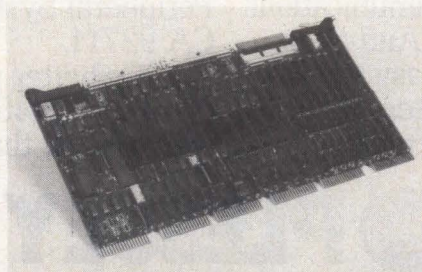
# Peripherals

NEW PRODUCTS



### Hybrid test device performs time-interval measurements

The model HP 1726A time-interval oscilloscope combines the crystal-referenced time base of a time-interval counter with the stable triggering circuits of high-performance oscilloscopes. The device can measure time intervals as long as 1.2  $\mu$ sec. with  $\pm$  10-picosec. resolution and 50-picosec. accuracy. The HP 1726A can be operated in two timing measurement modes, the overlap mode and the triggered mode. Both operating modes incorporate time-interval averaging that is automatically controlled through the Main Time/Div switch on the unit's front panel. Time-interval averaging allows the HP 1726A to measure any repetitive signal that can be displayed on an oscilloscope. A standard HP-IB interface can output data for production and record keeping. Single-quantity price is \$7675. **Hewlett-Packard Co.**, 1820 Embarcadero Rd., Palo Alto, Calif. 94303. **Circle No 400**

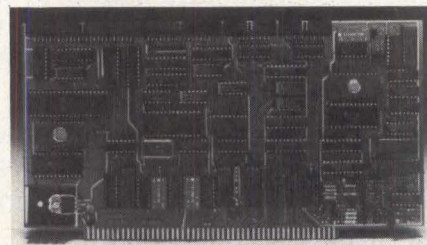


### Tape controller has on-board memory

The TS-6251 controller for DEC PDP-11 and VAX-11 Unibus comput-

ers can be used as a DEC TS11 or TM11 emulator, a 6250-bpi (GCR) controller, a software-compatible streamer controller, a 6250-bpi streamer controller or a single-board embedded stop/start controller. The TS-6251 features a 64K-byte on-board memory configured as a multi-block staging buffer that enables a user to run 1/2-in. streaming 1600- and 3200-bpi drives with unmodified software in a streaming mode. The controller also has a DMA auto-throttle feature that optimizes its use with GCR and tri-density drives at speeds as fast as 125 ips at 6250, 1600 and 800 bpi. Price is \$2250 in single-unit quantities. **Western Peripherals**, 14321 Myford Rd., Tustin, Calif. 92680.

**Circle No 401**



### Disk/tape controller works with S-100 bus systems

The model HD/CTC controller interfaces two ST506-compatible 5 1/4-in. hard disk drives and a Data Electronics Streaker cartridge-tape drive to an S-100 bus system. The intelligent controller features a Z80A CPU, 8K bytes of RAM, 16K bytes of ROM and a 2K-byte FIFO buffer. Different-sized hard disk drives and different cartridge-tape drives can be accommodated with minor alterations to the on-board hardware and firmware. Software support includes drivers for Teletek's CP/M, TurboDOS and Micro Mike's MDZ/OS. Price is \$461.10 each in quantities of 100. **Teletek Enterprises Inc.**, 9767F Business Park Dr., Sacramento, Calif. 95827.

**Circle No 402**

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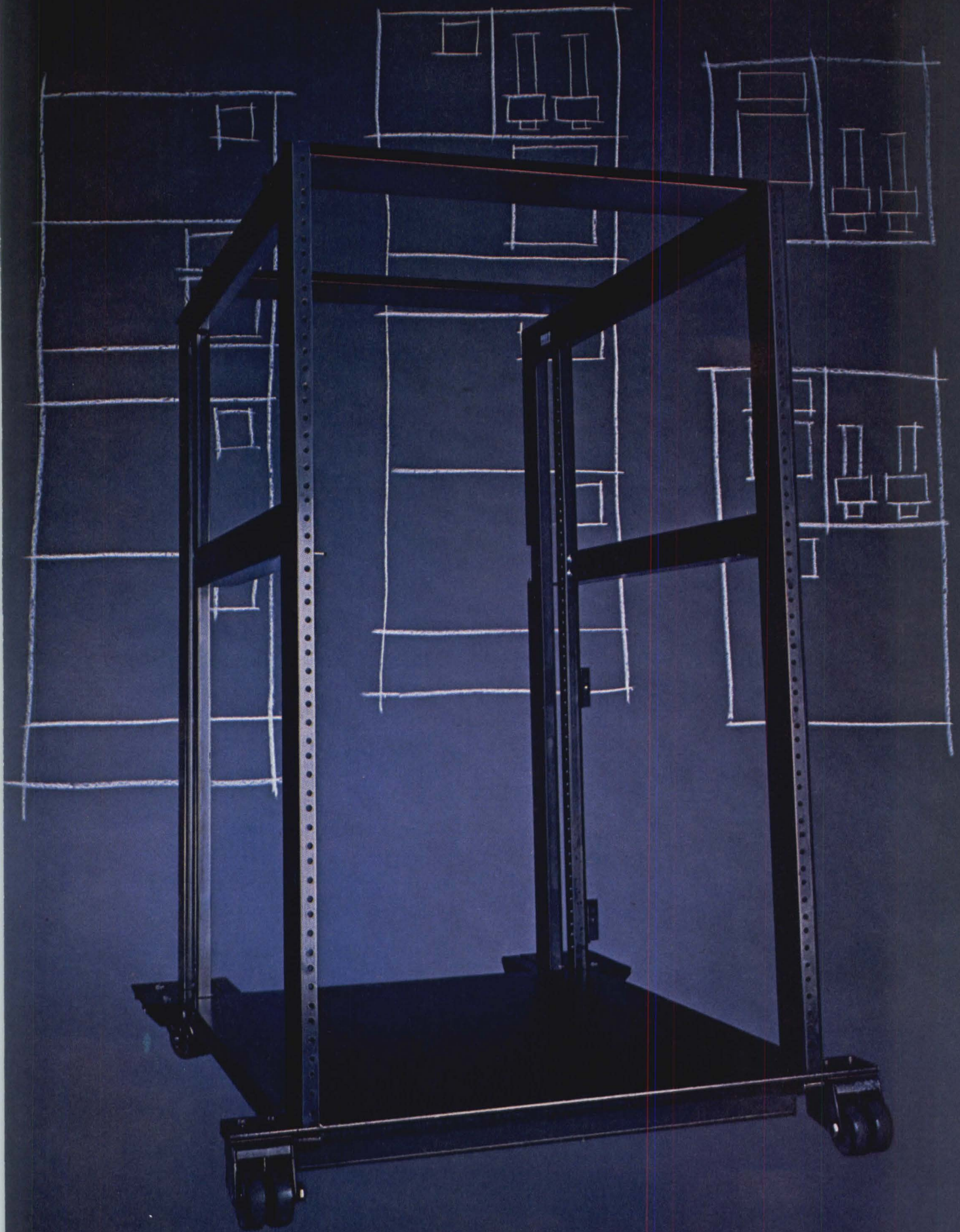
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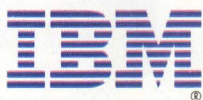
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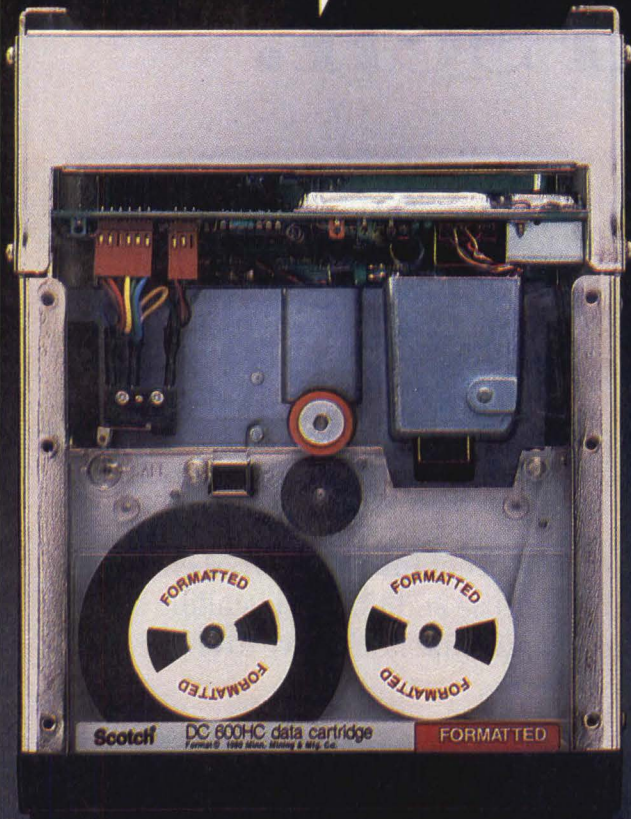
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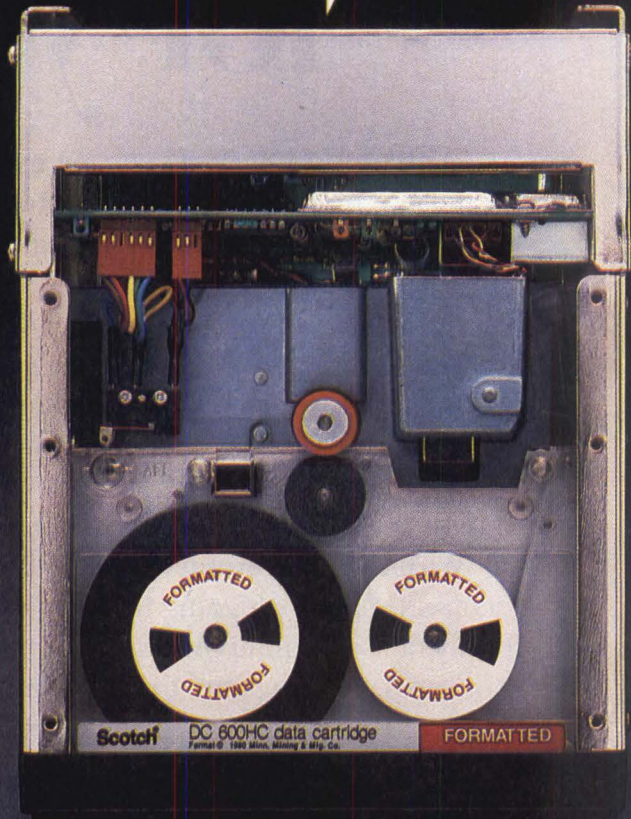
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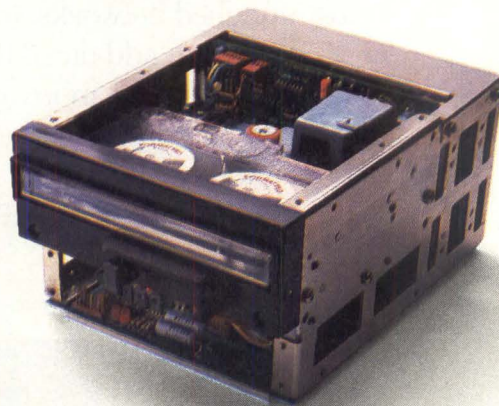
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# Peripherals

NEW PRODUCTS

## Adaptable terminals are Bertone-styled, customizable

The Vision series of adaptable CRT terminals features a proprietary, customizable, multiprocessor architecture that allows changes in protocols, data handling and CRT functions to be programmed in high-level languages without costly reengineering.

The Bertone-styled terminals have tiltable, low-profile keyboards that provide palm support and maintain full-depth key travel. The self-storing keyboards also offer programmable rollover, seven programmable LED indicators, 16 programmable function keys, serial output and built-in speakers. The volumes of the audible key click and bell are programmable. The vendor plans to sell the keyboard separately.

The Vision series incorporates a 12- or 15-in. video screen in amber, green or black on white. An electronically controlled tilt screen allows an operator to adjust the viewing angle without changing body position. The screen features a

24-line  $\times$  80- or 132-column display with a 25th status line, programmable brightness control and enhanced character formation using a dot-stretch and dot-delay technique to produce 512 character symbols.

The Vision series terminals are also equipped with as much as 48K bytes of combined RAM/ROM, high-level language function definition and 2K to 4K bytes of nonvolatile memory. As many as four RS232 communications ports supporting synchronous/asynchronous bit-oriented (HDLC, SDLC, X.25) protocols are available. Vision series terminals can handle as many as four DEC quad-sized boards, enabling the units to accommodate independently developed hardware such as graphics intelligence and cluster controllers.

The Vision 2000, a customized DEC VT100-compatible unit, is priced at \$1595 in single-unit quantities. **Northern Technologies Ltd.**, 85 Torbay Rd., Markham, Ontario L3R 1G7. **Circle No 303**



Northern Technologies' Vision series terminals have a casing of high-impact structural foam that can be custom painted. Hidden intake and exhaust vents provide cooling for the power supply and circuit boards.

MINI-MICRO SYSTEMS/April 1983

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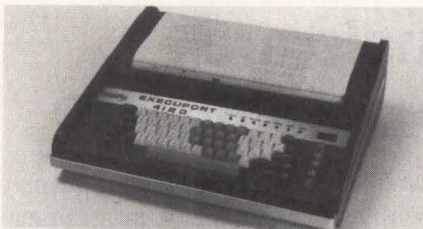
197

# Peripherals

NEW PRODUCTS

## Portable terminal has editing capability

The Execuport 4120 BSR is a 1200-bps/120-cps portable teleprinter with buffering and editing. The terminal's memory can store 43,000 characters. The terminal has a

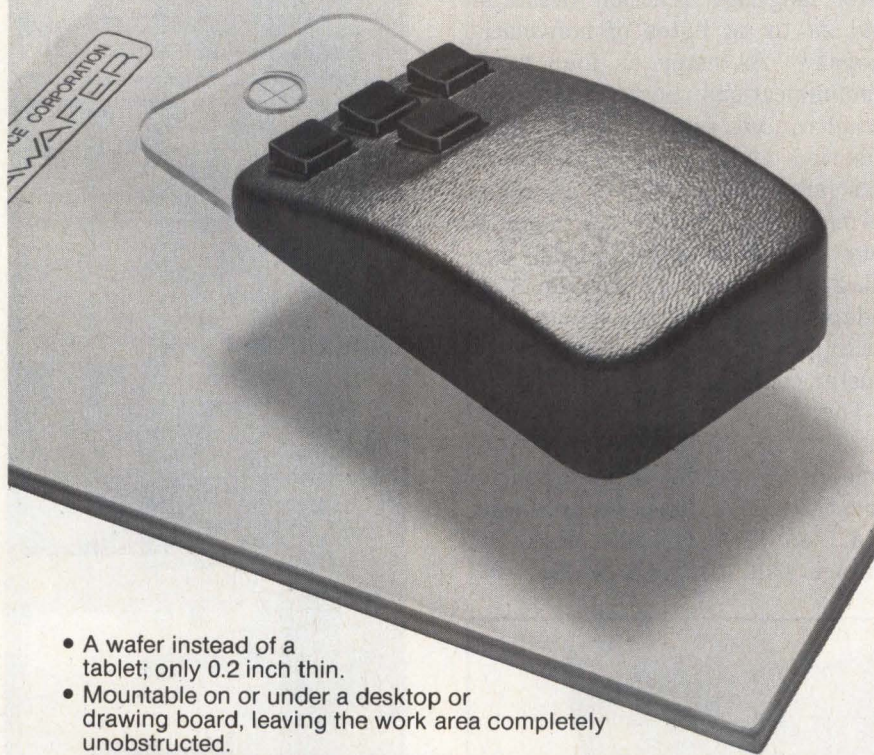


16-element columnar print head that produces two character fonts. With the  $9 \times 11$  font, the 4120 BSR prints standard and high-resolution copy at 10 cpi. The  $5 \times 7$  font produces  $16\frac{3}{4}$ -cpi compressed print that fits full 136-cpl printout on standard  $8\frac{3}{4}$ -in.-wide paper. The 4120 BSR is available with a choice of modems. The 3400/103 modem, acoustically coupled or hard-wired through a modular jack, operates only in the originate mode. The 212/103 modem, direct connect only, works in originate and answer modes. The 103 modem, acoustic only, operates at low speed (300 bps) in the originate mode. These built-in modems permit communication at 300 or 1200 bps, but the terminal communicates at rates as high as 9600 bps through the RS232 port. Single-quantity price is \$3995. **Computer Transceiver Systems, Inc.**, P.O. Box 15, E. 66 Midland Ave., Paramus, N.J. 07652.

Circle No 304

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CIRCLE NO. 110 ON INQUIRY CARD



## Terminals are 3278-, 3270-compatible

The 178 3278 plug-compatible display station features a 12-in. diagonal tilt screen with a 15-degree upward adjustment and an optional narrow movable keyboard. It operates in a 3270 cluster-controlled environment and attaches to a Telex 174 or 276 controller or an IBM 3274 or 3276 control unit. The terminal is designed for displaying alphanumeric data and for entering data into and receiving data from an IBM



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# Peripherals

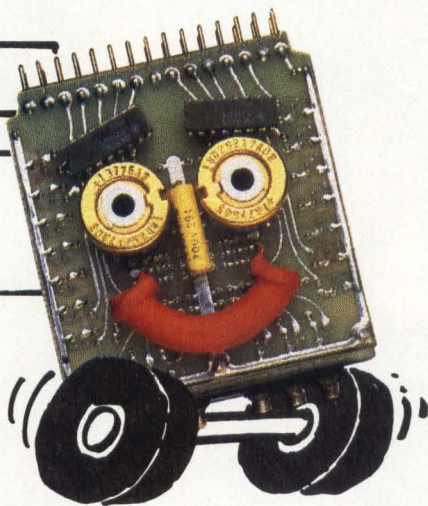
NEW PRODUCTS

S/360-370-303X-4300 or equivalent system. Display characters are formed with an 8 × 8 dot matrix on a non-glare screen. The screen accommodates 1920 characters with status indicators displayed on the screen's 25th line. A Telex 281B

message-printer attachment, a light pen, a response-time indicator and a security lock are optional. The 178 display is priced at \$2750. The Telex 279 model 4 color terminal attaches to a Telex 174/276 or an IBM 3274/3276 controller. It features a

14-in. diagonal screen that displays 3440 characters and a detachable keyboard with as many as 30 layouts. Options include a row and column indicator, a keystroke counter, a response-time indicator and a message printer. Price is \$4250. **Telex Computer Products, Inc.**, 6422 E. 41st St., Tulsa, Okla. 74135. **Circle No 305**

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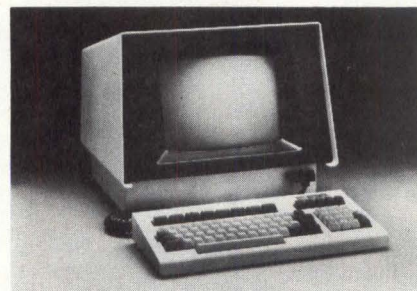
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## **Terminals feature detached keyboard**

The Avant 250 and 251 terminals feature a movable keyboard and a green or white phosphor monitor that can be placed on the vendor's video tilt-turntable. The keyboard has editing keys, a 14-key numeric pad and eight (16 with shift) user- or host-programmable function keys (48-character capacity per function). The monitor displays 1920 characters on 24 lines, and a 25th status line displays messages from the host. The terminal also features a 10K-byte storage capacity, a bidirectional printer port, RS232C and 20-mA current-loop interfaces, and 16 independently settable baud rates on printer and main interface ports. The Avant 250 displays and transmits 18 video-attribute combinations using the reverse-video, half-intensity, underline, blinking and security (blanked) attributes. The Avant 251 is a hidden-attribute terminal using half-intensity as its hidden attribute. Single-unit price of either unit is \$1095. **General Terminal Corp.**, 14831 Franklin Ave., Tustin, Calif. 92680.

**Circle No 306**

# Want reliable power for office electronics without costly special wiring?



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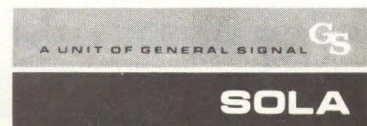
With minicomputers, terminals, word processors, disk memories and high-speed printers, you often get instructions to put in a "dedicated" power line. But, instead of breaking through walls, cutting trenches in floors, laying special conduit, pulling lots of wire and adding more breakers and switchgear to get reliable power, why not simply plug a portable Sola Power Protector into the outlet that's already there?

Dedicated lines can add anywhere from \$1200 to \$8000 or more per machine, even in new construction. For a fraction of that cost, a Sola Micro-Minicomputer Regulator not only replaces the dedicated line but does what dedicated lines can't do. It raises and lowers voltage to compensate for line fluctuations and brownouts. It blocks out electrical noise, and destructive power dips or surges. Our new Mini-UPS goes one step further. Its built-in battery maintains power when your electric utility fails. This keeps your electronics running smoothly until your generator comes on line. Both units are available in 60 Hz or 50 Hz.

Dedicated lines, at best, minimize power disturbances that are caused by other equipment in your building. Sola Power Protectors guard you against all kinds of power line disturbances regardless of where they originate. Check this chart to compare effectiveness.

	spikes and faults	dips and surges	line noise		Brownout	Blackout
			common-mode	transverse mode		
	momentary sharp voltage peaks or split-second power outages	short-term high or low voltages due to load start-up or shut-down	Unwanted voltages or frequencies due to bad grounding, switching, or radio-type interference	line-to-ground interference	Planned voltage reductions in response to high demand	Total loss of line power
Dedicated Line (with dedicated ground)	some, internal only	some, internal only	some, internal only	some, internal only	No	No
Isolation Transformer	No	No	Yes	No	No	No
Sola Micro-Minicomputer Regulator	Yes	Yes	Yes	Yes	Yes	No
Sola Mini-UPS	Yes	Yes	Yes	Yes	Yes	Yes

Don't go through another day risking electronic malfunction due to unreliable power. Talk to your local Sola Electric representative or distributor. Or contact Sola Electric, 1717 Busse Road, Elk Grove Village, IL 60007. (312) 439-2800. We're the people who invented power protection 50 years ago.



**The Power Protectors**

CIRCLE NO. 117 ON INQUIRY CARD

# Peripherals

NEW PRODUCTS

## Display terminal is IBM-compatible

The model P3278 display station operates in IBM 3270 networks as a



plug-compatible replacement for the IBM 3278 model 2 display station. The foundation for a family of IBM-compatible computer display stations, the P3278 attaches to a variety of IBM terminal controllers and computers through the IBM

3270 coax protocol. The P3278's three-piece modular design includes a detached low-profile keyboard and a 12-in., tilt-and-swivel, non-glare green screen. The display features 7 × 14 character matrix cells, reverse video and blinking fields. The keyboard features 24 program function keys and a 12-key numeric keypad. Its angle can be continuously adjusted from 5 to 11.5 degrees. Price is \$1995 in single-unit quantities. **Phase Information Machines Corp.**, 7650 E. Redfield Rd., Scottsdale, Ariz. 85260.

Circle No 307

## Display terminal features IBM look-alike keyboard

The model ADM 361 terminal is designed to be used with a protocol

converter to comprise an alternative to an IBM 3277 terminal. The ADM 361 features an IBM look-alike keyboard, a 2K-byte input buffer and a 25th status indicator line. It is also DEC VT100 compatible. Other features include an 80- or 132-column display, nonvolatile setup mode using English prompts, non-embedded visual attributes, protected fields, a serial printer port, seven selectable international character sets, 132 × 120 dot graphics, business graphics, a detached keyboard, four function keys and a 12- or 15-in. non-glare green screen. Options include an integral modem or vector-drawing graphics capability. Single-unit price is \$1800. **Lear Siegler, Inc./Data Products Division**, 714 N. Brookhurst, Anaheim, Calif. 92803.

Circle No 308

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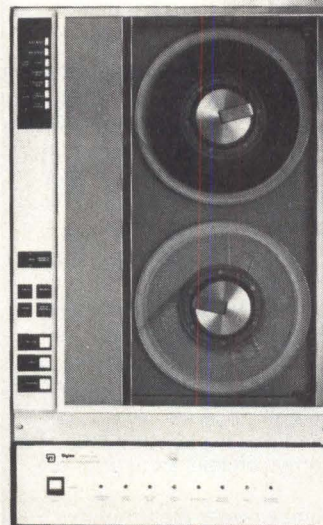
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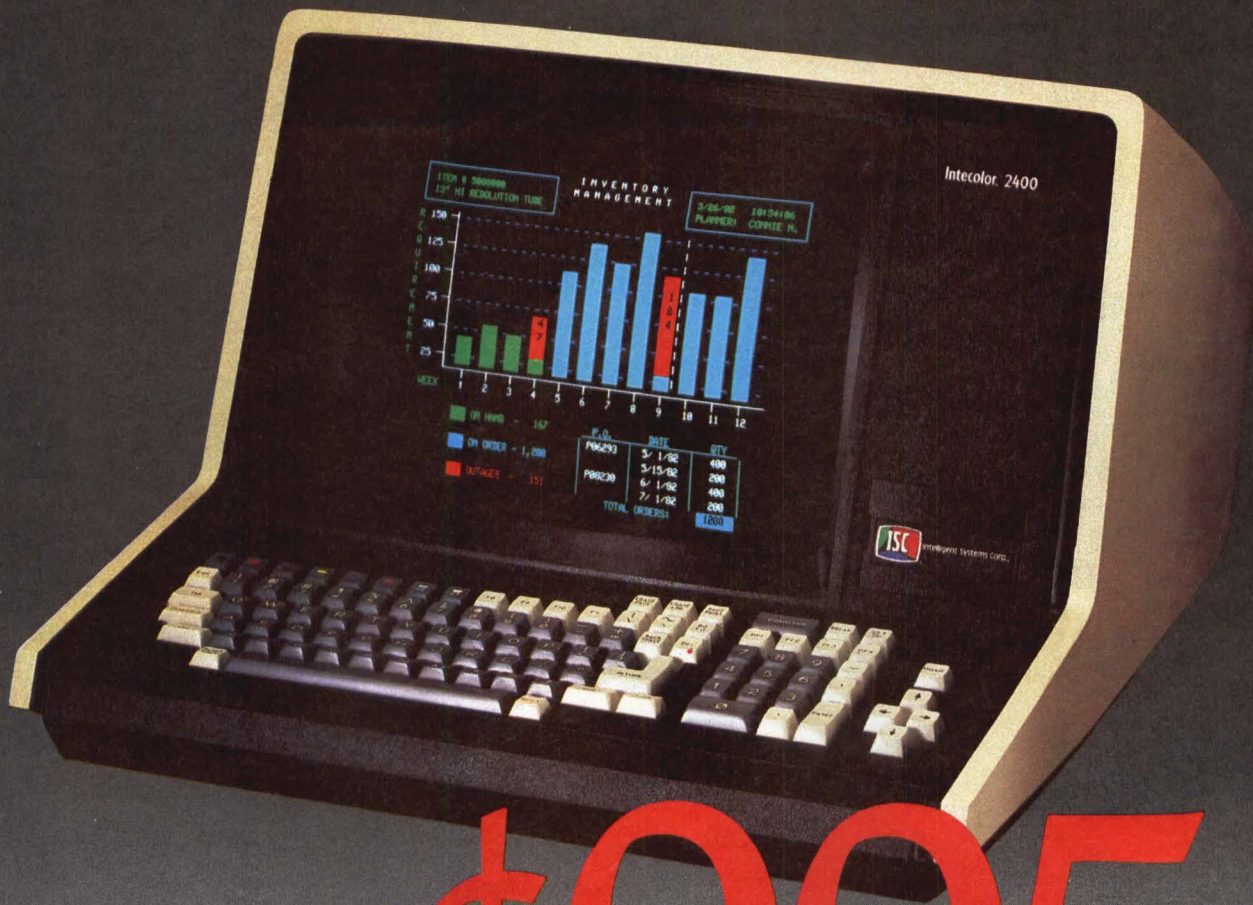
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MINI-MICRO SYSTEMS/April 1983



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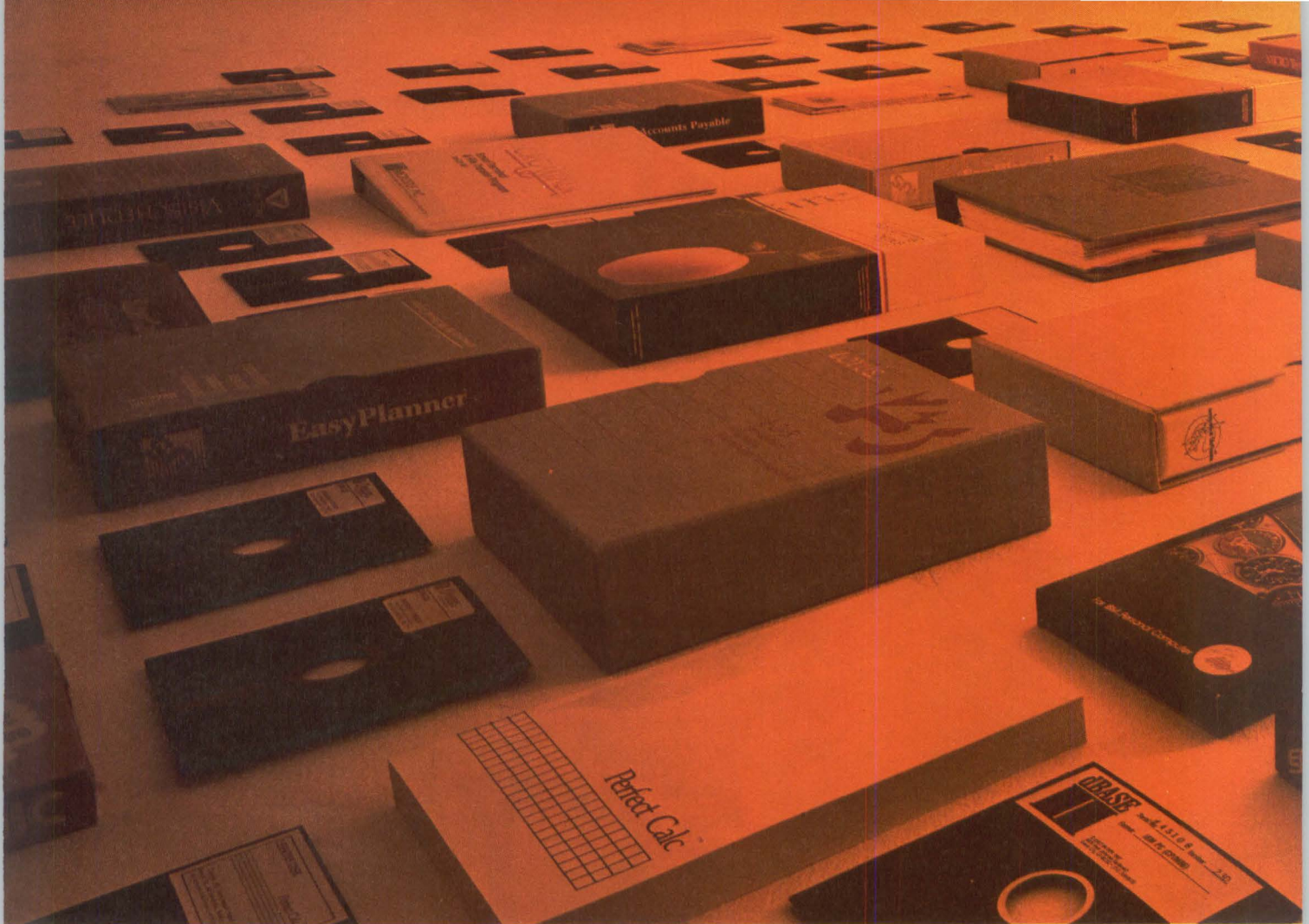
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MINI-MICRO SYSTEMS/April 1983

CIRCLE NO. 112 ON INQUIRY CARD

204



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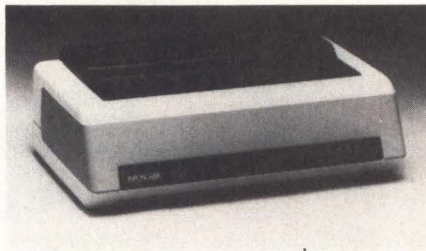
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# Peripherals

NEW PRODUCTS

## Printers have structural foam chassis

A family of impact serial matrix printers features multi-mode printing and a one-piece structural foam chassis that gives lower noise levels and better print quality than metal-chassis printers. The models 1100 and 1200 operate at 200 cps in a draft/data-processing mode, 100 cps in a correspondence mode and 40 cps in a near-letter-quality mode (optional on the model 1200). Both printers produce dot-addressable graphics with a resolution of 72 × 72 or 144 × 144 dots per in. In addition, the model 1200 uses a four-color ribbon to produce as many as eight colors for text highlighting and graphic presentations. The model 1500 prints at 400 cps in the draft/data-processing



mode and 200 cps in the correspondence mode. It also provides dot-addressable graphics with a resolution of 72 × 72 dpi. Other features include a 96-character ASCII set; bidirectional printing; double-width printing; 10-, 12- or 16.5-cpi pitches; superscripts and subscripts; a 3500-character input buffer; self-test; and parallel and serial interfaces. Prices are \$1285, \$1396 and \$1676 for the models 1100, 1200 and 1500, respectively, in 100-unit quantities. **Infoscribe,**

2720 S. Croddy Way, Santa Ana, Calif. 92704. **Circle No 311**

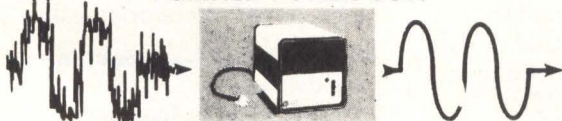
## Dot-matrix printer uses dual-pass technique

The DP-9625A dual-pass dot-matrix printer has a maximum print speed of 200 cps in its data-processing mode and 50 cps in its near-letter-quality mode. Intermediate speeds of 150, 120 and 100 cps provide correspondence quality. The printer has graphics capabilities with a resolution of 72 or 144 dpi horizontally and vertically. Other features include double-width printing, horizontal and vertical tabbing and Centronics parallel and RS232C interfaces. Single-unit price is \$1995. **Anadex, Inc.,** 9825 De Soto Ave., Chatsworth, Calif. 91311.

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**CIRCLE NO. 118 ON INQUIRY CARD**

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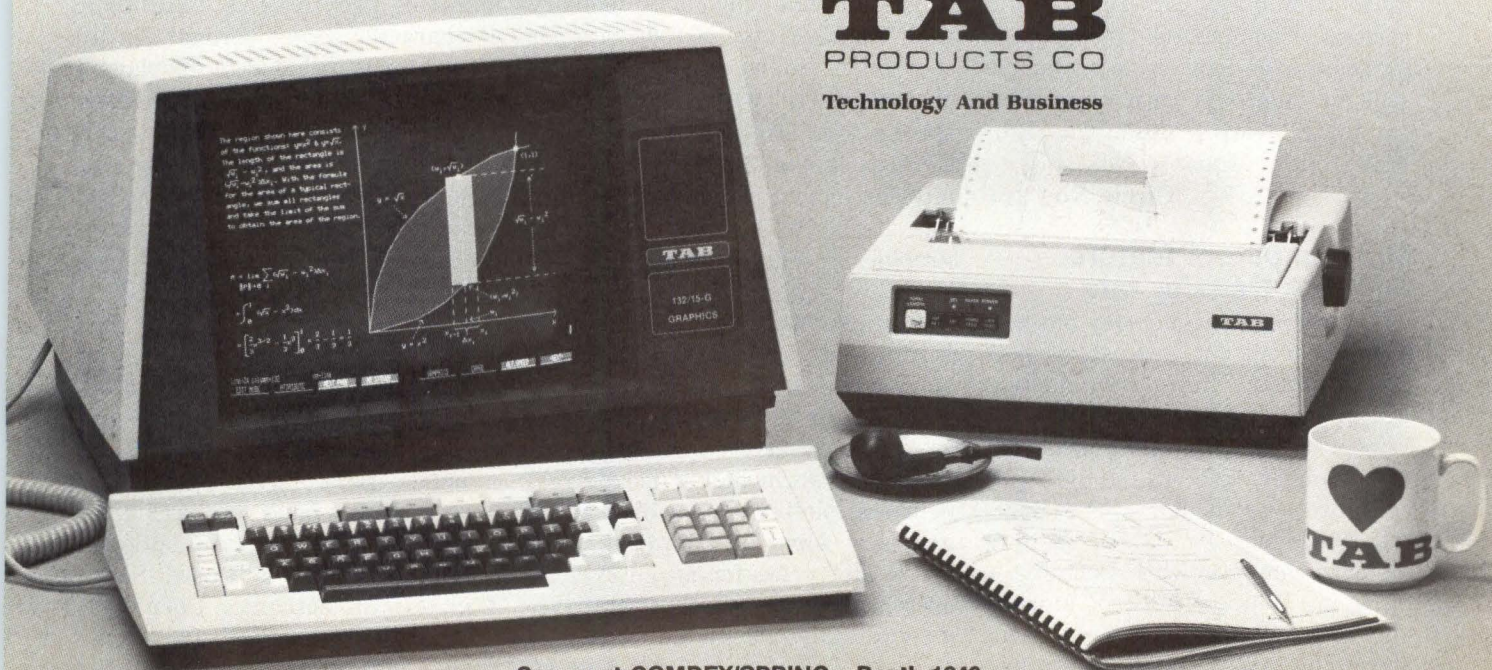
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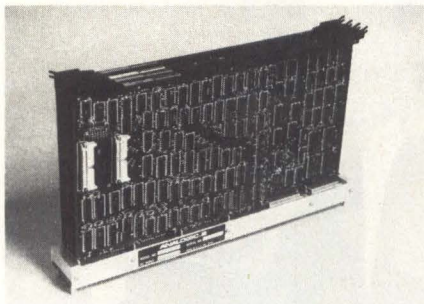


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CIRCLE NO. 121 ON INQUIRY CARD

# Systems

NEW PRODUCTS



## Array processor performs 6.3 million adds per sec.

The AP490 array processor performs 6.3 million adds per sec., 2.1 million multiplies per sec. and 1 million I/O operations per sec., all of which can occur simultaneously. The AP490's basic configuration includes 2K of program memory and 4K × 24 bits of data memory and is expandable to 4K words of program memory and 64K words of data memory. Interfaces are available for the Hewlett-Packard 1000 series; Digital Equipment Corp.'s PDP-11, LSI-11 and VAX; and Data General's Nova/Eclipse. Software support is included for the host operating system as are a host function library, an AP executive, an AP function library, diagnostics and utilities. The four-card set with a DEC card-cage-mountable backplane sells for \$6450 in OEM quantities. **Analogic Corp.**, Audubon Rd., Wakefield, Mass. 01880.

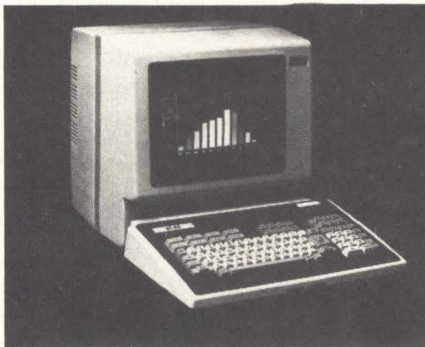
Circle No 314

## Minicomputers feature fast disk-transfer rate

An independent memory bus and a transparent I/O processor allow the Spectrum Eleven JM and GCC LSI-11-based minicomputers with Winchester disk drives to achieve a disk-transfer rate of 1M byte per sec. direct to memory. The Spectrum Eleven JM is a 1M-byte memory computer with 132M bytes of 14-in. Winchester disk storage and 40M bytes of removable ½-in. streaming magnetic-tape storage

packaged in a waist-high system cabinet. The Spectrum Eleven GC desk-top minicomputer has a 30M-byte, 8-in. fixed Winchester disk and a 1.26M-byte, 8-in. floppy disk drive. Prices of the Spectrum Eleven JM range from \$31,000 to \$33,000, and prices of the Spectrum Eleven GC range from \$16,700 to \$18,700. **Saturn Systems**, 6875 Washington Ave. S., Suite 218, Minneapolis, Minn. 55435.

Circle No 315

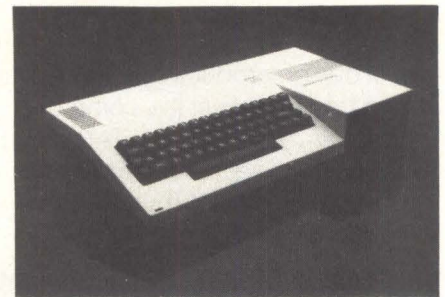


## Microcomputer features removable bubble memory

The BC-80 small-business computer system offers removable 32K- or 128K-byte bubble-memory cartridges that provide nonvolatile memory with transfer rates of 100K bits per sec. Built around the Z80A microprocessor with 64K bytes of RAM, the system also features RS232C, Centronics, light-pen and joystick interfaces; a 12-in., eight-color RGB CRT display with a 160 × 100 pixel graphics resolution; and full ASCII keyboard with numeric and user-programmable function keys. Operating under CP/M, the system supports extended versions of Microsoft BASIC and CBASIC, as well as COBOL and FORTRAN. A variety of peripherals including disk drives, printers, plotters and a bit pad for graphics input is optional. The single-unit price for an entry-level system including one bubble drive, a CRT display, a keyboard console, a 1M-byte floppy disk drive and an

80-cps dot-matrix printer is approximately \$6000. **South Coast Computer Systems**, 1116 W. Collins, Orange, Calif. 92668.

Circle No 316



## Portable computer includes application software

The Pied Piper Communicator I CP/M-based portable computer features 64K bytes of RAM, weighs less than 15 lbs. and includes a full ASCII keyboard. Built around the Z80A microprocessor, the Pied Piper I has an integral 256K-byte, slimline minifloppy mass-storage unit and provides a connector for a second floppy disk drive. A 5M- or 10M-byte hard disk subsystem can also be added. For video display, the system can interface a standard CRT monitor providing a 24-line × 80-character screen format. An RF modulator is included for display on a television set. A Centronics-type parallel printer port is standard. Software provided with the system includes the CP/M operating system, WordStar and Mail Merge word-processing and mailing-list programs, an electronics spread-sheet program and CP/M utilities. The system is STD-bus compatible and has two free card slots for expansion boards. A 2-line × 80-character LCD, a thermal printer and an RS232C port with software-programmable baud rates as high as 19.2K bits per sec. are optional. Single-unit price is \$1299. **Semi-Tech Microelectronics Corp.**, 525 Middle Field Rd., Suite 130, Menlo Park, Calif. 94025. Circle No 317

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## Application, financial packages run on Prime minis

Software Management Systems, Inc., has introduced two new programs, ESCAPE and Cybil, that run on Prime Computer, Inc., minicomputers. ESCAPE (English sentences creating application programs easily) reduces business-application development time by 10 to 100 times over development in high-level languages. Designed for multi-user, interactive environments, it automatically translates English statements into Prime InfoBASIC code. The program uses simple English-like sentences for data entry, file maintenance, inquiry and menu processing. The package features an on-line help facility, self-documentation, automatic screen generation, unlimited multiple-file validation, unlimited pre-defined field names or simple variables, a data dictionary and

automatic report formatting. End-user price is \$35,000, and dealer and OEM pricing are available.

The Cybil financial-modeling package is geared to profit-and-loss analysis, pricing studies, costing studies, cash-flow management, budgeting, market planning, forecasting and tax planning. The system uses "what if" questions to generate reports from spread sheets as large as 702 columns  $\times$  9999 rows. The reports can be based on any combination of columns and rows. Cybil includes a status-line display to indicate position on the spread sheet, an on-line help facility and a variety of algebraic and trigonometric functions. Cybil is priced at \$5000. **Software Management Systems, Inc.**, 84 Inverness Circle, E., Englewood, Colo. 80112.

Circle No 318

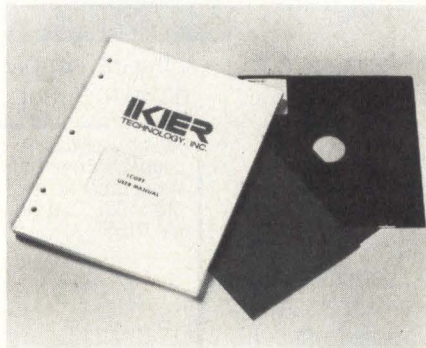
## Electronic card file kept on microcomputers

Cardfile is intended to store, retrieve and display information that is typically kept on index card files. Entries are created with a user-furnished text editor, such as Wordstar or Superwriter. Each record contains as many as 21 lines; the first three lines are treated as a key field that contains words or phrases to be searched for. The user can specify one or more phrases as arguments; the program displays each record that contains all specified words. It can also print selected records, write them to a disk or delete them. Cardfile runs on microcomputers under the CP/M or MP/M operating system. Price is \$89. **Digital Marketing Corp.**, 2670 Cherry Ln., Walnut Creek, Calif. 94596.

Circle No 320

## Graphics package has 260 functions

The iCORE graphics package, based on the George Washington University implementation of the SIGGRAPH 1979 Core Graphics proposal, has 2D and 3D and retained-segment capabilities. The iCORE package is implemented in FORTRAN 77 and can be linked to user programs written in FORTRAN. Its 260 functions provide the ability to create, view and store images. Graphic objects are formed with graphic primitives including lines, markers, polygons and text defined in world coordinates. Primitives have various attributes of color, line style and shade. A collection of graphic primitives, called a picture segment, forms the basic unit of modification for interactive applica-



tions. Picture segments can be translated to different screen positions, rotated, scaled and made visible or invisible. They can be stored in memory or on disk. The package is priced at \$2000 per copy, with quantity discounts available. **Ikier Technology Inc.**, 7 Oak Park, Bedford, Mass. 01730.

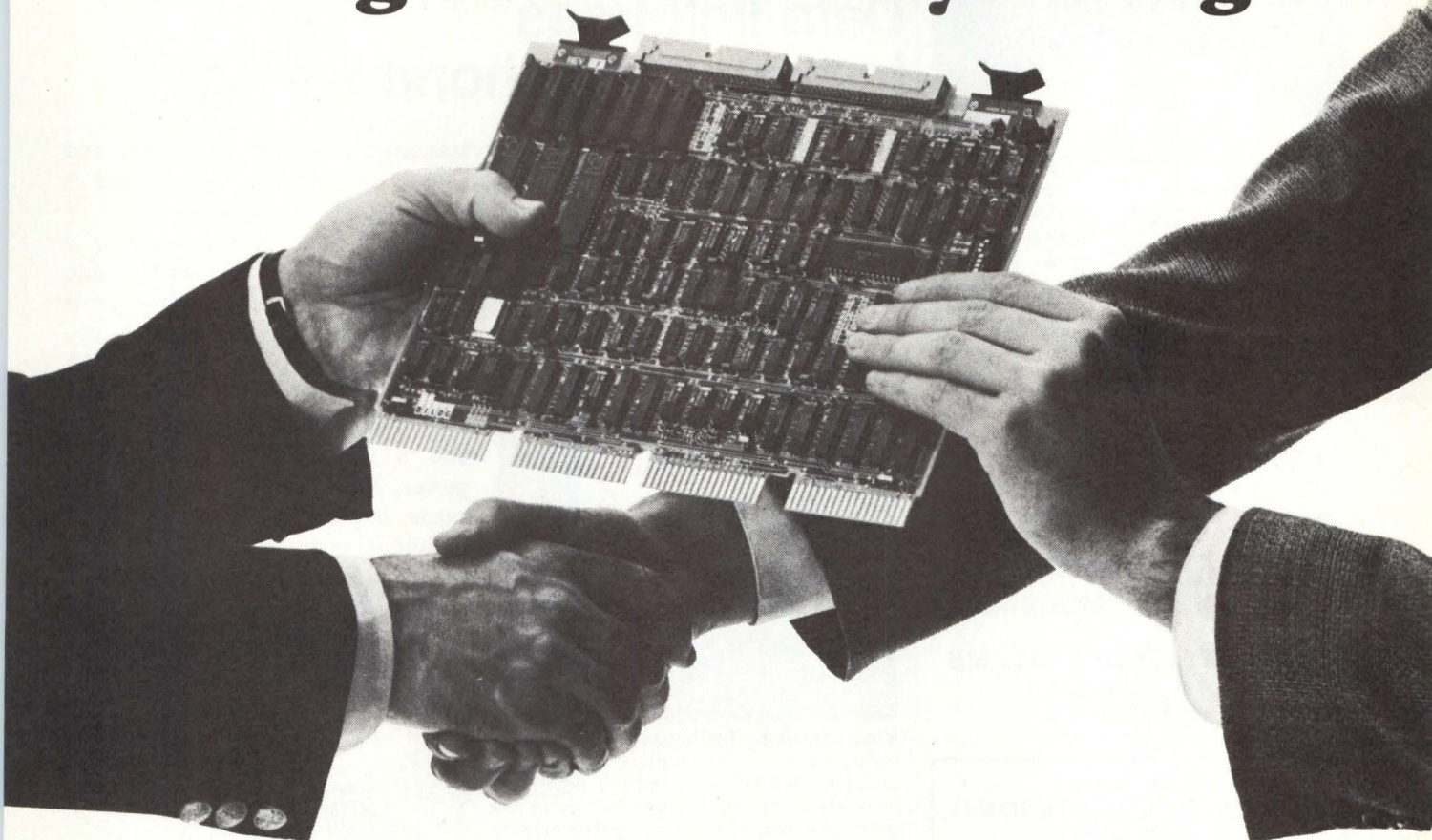
Circle No 319

## Package helps programmers learn Pascal

SofTech, a computer-aided instruction package that runs on microcomputers to help programmers learn UCSD Pascal, provides quizzes and programming exercises. In a quiz, questions on a topic, such as syntax or identifiers, are displayed in random order. A student is told immediately if the keyed-in answer is correct; if it is wrong, the desired answer is displayed. The student is also asked to write a procedure to perform a task. The procedure is then executed in a special test environment; SofTech reports the errors it discovers in this testing. The price of \$125 includes the "UCSD handbook." **SofTech Microsystems, Inc.**, 3187-C Airway Ave., Costa Mesa, Calif. 92626. Circle No 321

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DEC™ Users

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## DILOG introduces 22-bit Q-Bus controllers with Universal Formatting.™

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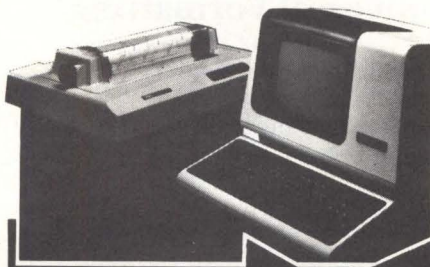
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CIRCLE NO. 120 ON INQUIRY CARD

## Datacomm

NEW PRODUCTS

### Data link uses in-house telephone wiring

The Instalink460 is designed to save users from needing extra sets of wires or cables when installing a local data-communications network. It allows users to use their existing in-house telephone network to connect asynchronous terminals to computers, data PABXs or devices with RS232C interfaces.



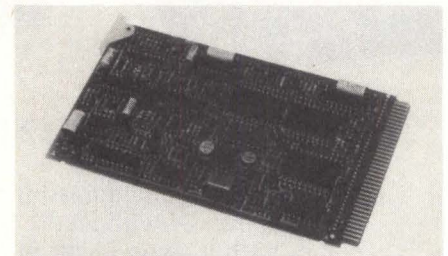
*Micom Systems' Instalink460 terminal unit measures 5½ × 1¼ × 8½ in. and can fit under a telephone. It is used to piggyback local data-communications transmissions over voice transmissions, converting existing in-house telephone wiring into data-communications lines.*

The Instalink460 plugs in between a terminal and a telephone; no additional wires are needed. The device piggybacks data transmissions onto voice lines by exploiting the unused high-frequency bandwidth above an average person's hearing. It neither interferes with nor alters the frequencies (less than 4000 Hz) that the telephone system uses for conversations, dial tones, busy signals and ringing. An Instalink central unit removes data from the line before it reaches a user's PABX or the outside telephone system. The data can be routed from the central unit to a computer port or other device.

The Instalink terminal unit transmits data at rates as fast as 19.2K bps full-duplex over 6000 ft. It is

transparent to the data rate and character code of the terminal it supports.

Central units, which consist of a chassis with power supply into which four-channel interface cards are inserted, are available in 12-, 24-, 36- and 48-link capacities. A 12-channel Instalink configuration, including 12 desk-top terminal units and a central unit chassis with power supply and three interface cards, is priced at \$5915. Prices of individual components start at \$250 for each terminal unit, \$1000 for a 12-channel capacity central unit and \$675 for each four-channel terminal card. **Micom Systems, Inc.**, 20151 Nordhoff St., Chatsworth, Calif. 91311. **Circle No 323**



### Single-board modem operates at 2400 bps

The R24LL serial, synchronous, DPSK modem is intended for design-in as part of data systems, box- or rack-mount modems, statistical multiplexers, error correctors, terminals or other data-communication products. It features 2400-bps operation on leased lines or the dial-up, switched network. It can operate in full-duplex (four-wire) or half-duplex (two-wire) modes. The modem is compatible with Bell 201 B/C, CCITT, V.26 A/B and V.26 bis standards. The unit is housed on a single 100- × 160-mm. PC board and uses MOS/LSI technology. Price is

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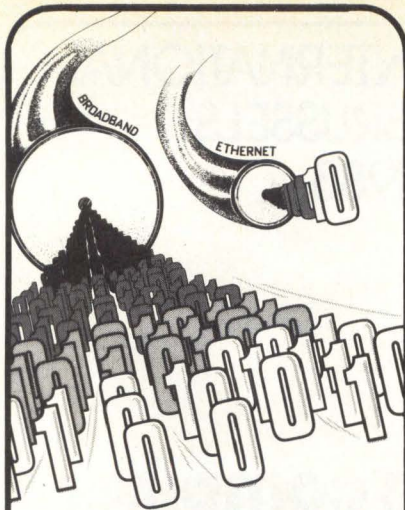
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Company .....

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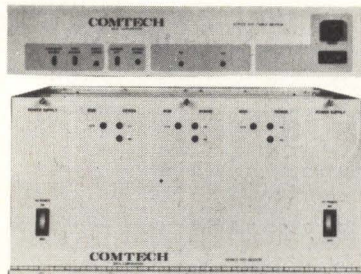
## BROADBAND VS. ETHERNET

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So, if you're installing coax, why not go with the technology that gives you room to grow? With broadband you'll have an actual aggregate data capacity of over 350 MBS compared to Ethernet's much less than 10 MBS. You'll have a multi-drop capacity of up to 24,000 compared to Ethernet's 1,024. And, broadband gives you voice and video capability you just can't have with baseband.

Unlike other technologies, broadband equipment is readily available now. Over the past four years Comtech has delivered hundreds of broadband modems into networks around the world. Comtech is committed to broadband technology. We are continually enhancing our broadband product line.

Comtech's engineering excellence is helping networkers find solutions to their data communications problems. For help with yours, call Comtech. Applications notes, specifications, prices and delivery sent on request. Call or write Comtech Data Corporation, 350 North Hayden Road, Scottsdale, AZ 85257, (602) 949-1155 or TWX 910-950-0085.



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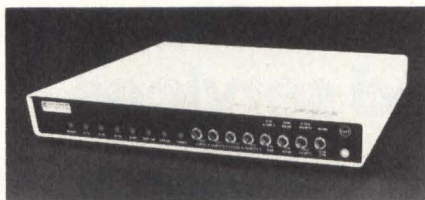
CIRCLE NO. 122 ON INQUIRY CARD

# Datacomm

NEW PRODUCTS

less than \$250 in 100- to 500-unit quantities. **Rockwell International, Electronic Devices Division**, 4311 Jamboree Rd., P.O. Box C, Newport Beach, Calif. 92660.

Circle No 324

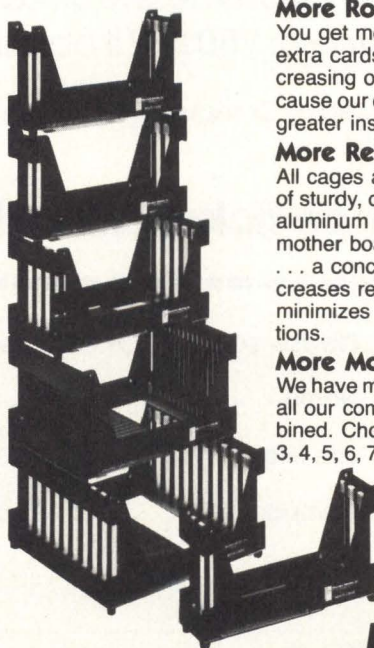


### Add-on upgrades data-comm networks

The turboMUX multiplexer is designed for use with the Bell 212A modem and attaches, via standard RS232C interfaces, between a modem and a data terminal. Combined with a turboMUX unit, the 212A's data-communications

rate is doubled to 2400 baud in full-duplex operation. The increased data speed can be used in two ways: as two separate 1200-baud, full-duplex channels or as a single 2400-baud, full-duplex channel. Both capabilities are provided and are selectable via front-panel switches. The device compacts the data for transmission over dial-up telephone lines by means of a proprietary data-compaction algorithm. For phone-line inconsistencies, the unit provides error detection and retransmission facilities. Self-diagnostics by means of front-panel switches and LED status indicators are also provided. Prices start at \$995 in single-unit quantities. **Chung Telecommunications Inc.**, 4046 Ben Lomond Dr., Palo Alto, Calif. 94306. Circle No 325

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CIRCLE NO. 123 ON INQUIRY CARD



# **"Okay, IBM, you're smart. But you're not smart enough."**



**"Your 3278 terminals have a lot on the ball. But."**

"Now don't get us wrong. We know your 3278's have local storage. Cursor editing. Line delete. Not bad, IBM. But not up to where they could be.

Because our new AVATAR TC3278 can take any 3278 or any IBM plug-compatible terminal and move it up past smart, past intelligent and turn it into a functioning standalone interactive workstation with personal computing capability. For not much money. And it only takes five minutes to install. How's that for smarts?

**"Look at these plusses, IBM."**

"This TC3278 gives you all that power with your existing terminal. So it takes less space, requires less maintenance. There's no retraining because people work on their familiar IBM equipment.

Your terminal will be able to communicate with your main database, with other non-IBM host computers in your organization, even with public databases, to ensure you're using consistent and accurate information.

Our TC3278 comes complete with its own word processing and electronic spreadsheet software, fully functional on your existing 3278 terminal.

**"We're going to make you more productive."**

"The name of the game is that this AVATAR TC3278 is going to increase your productivity, IBM. For not much money and no trouble at all.

Contact one of our guys for more information. Write 3R Computers, 18 Lyman Street, Westboro, MA 01581. Or call us at (617) 366-5300.

## **AVATAR™**

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### Application notes cover speech-output device

Four application notes detail applications for the vendor's VoiceWare Development System, LISA speech-output device and VOPAC speech digitizer for the telecommunications industry. Applications include data entry and retrieval via Touch-Tone response, computer-aided instruction, voice mail and voiced annunciator systems. **Centigram Corp.**, 1153 Bordeaux, Sunnyvale, Calif. 94086.

Circle No 326

### Large-screen electrostatic CRT displays described

The vendor's large-screen electrostatic CRT displays for instrumentation and design graphics are described in a six-page, color brochure. The brochure lists specifications for displays and graphics-generator systems and includes pictures and descriptions of applications in design graphics, instrumentation systems, military/aerospace and radar training/simulation. The brochure has a product table listing type of interface, resolution, screen size, spot size, character generation and writing speeds. **Hewlett-Packard Co.**, 1820 Embarcadero Rd., Palo Alto, Calif. 94303.

Circle No 327

### Catalog describes Multibus-compatibles

The 28-page Multibus Data Mini catalog contains ordering information, dimensional drawings and specifications for the vendor's line of Multibus-compatible products and services. The catalog includes a six-slot version of the Multibus backplane and card-frame series, socket boards with the continuous groundplane on the wiring side, extender cards for testing and debugging and related accessories and services including customer

pinning and wire wrapping. **Hybricon Corp.**, 410 Great Rd., Littleton, Mass. 01460. Circle No 328



### Catalog covers data converters

The vendor's lines of data converters, hybrid modules, synchro instruments and data bus products are described in a 386-page application and product catalog. The catalog includes general technical and detailed product information and a description of the company's engineering, product assurance and manufacturing capabilities. Nine product categories contain summary tables, background information, technical data, features, applications, block diagrams and outline drawings for each product in that category. Categories include A/D and D/A converters, sample/hold and track/hold amplifiers, S/R-to-D and D-to-S/R converters, synchro instruments and SEM and MIL-STD-1553 data bus products. **ILC Data Device Corp.**, 105 Wilbur Place, Bohemia, N.Y. 11716.

Circle No 329

### Short-form catalog lists business, comm software

The vendor's microcomputer software for business and communications is described in a brochure. The catalog features invoice-driven, coordinated accounting systems that require no changes in data or procedures and communications systems that interface most microcomputers with any time-sharing computer with ASCII capability. The catalog also details various program

packages for electronic bulletin boards, electronic mail and remote-computer typesetting. **Small Business Systems Group**, 6 Carlisle Rd., Westford, Mass. 01886.

Circle No 330

### Catalogs list test equipment

Aimed at four of the vendor's vertical markets, a series of industrial catalogs introduces test-equipment rental to the electronics segment of the industrial market. The publications divide the products into four groups: data loggers and recorders, power-line recorders, sound and vibration equipment and temperature-measuring equipment. The catalogs list specifications for oscillographs; light-beam and magnetic recorders; data loggers; stress and motion recording devices; and sound, real-time and structural analyzers. **Leasametric Inc.**, 1164 Triton Dr., Foster City, Calif. 94404.

Circle No 331

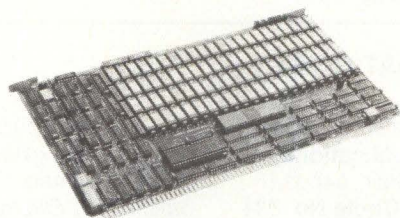
### Directory lists software for Intel iAPX

The Intel Yellow Pages is an annual directory that lists software programs developed for all Intel iAPX microprocessors and industry consultants selling services to Intel customers. Modeled on a telephone book, the Intel Yellow Pages is divided into two sections. The first section (white pages) contains alphabetical corporate listings with a background paragraph about each supplier. The second section (yellow pages) contains product listings and advertisements of the various companies under approximately 450 headings. The directory lists system software, compilers and operating systems and application software written for IBM PC-DOS, XENIX/UNIX and CP/M. **Intel Corp.**, 3200 Lakeside Dr., Santa Clara, Calif. 95051.

Circle No 332

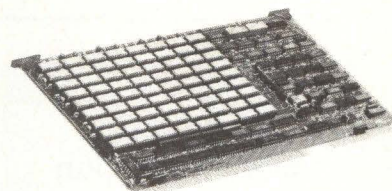
# MULTIBUS\* MEMORIES

## DYNAMIC RAM (IEEE P796-COMPATIBLE)



### MM-8086E

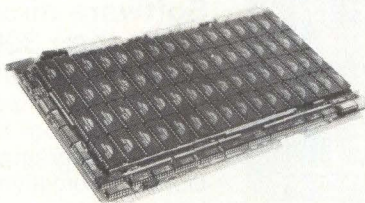
- 512K, 256K bytes
- Error detection and correction
- 1000<sub>H</sub> boundaries/16 Mbyte address
- Access/Cycle: 300/500 nsec
- CSR/ESR for EDC control and LED error correction indication
- Battery backup option



### MM-8086D

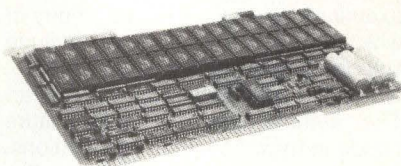
- 512K, 256K, 128K, 64K bytes
- For 8 and 16-bit processors
- 1000<sub>H</sub> boundaries/16 Mbyte address
- Even parity with output selectable to any of bus interrupts
- ACCESS/Cycle: 250/400 nsec

## NON-VOLATILE CMOS RAM (IEEE P796-COMPATIBLE)



### MM-8000C

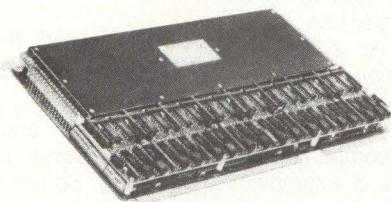
- 128K, 64K bytes
- Data retention (on-board batt.):  
2 weeks rechargeable batteries
- 4000<sub>H</sub> boundaries/16 Mbyte address
- Access/Cycle: 220/220 nsec
- Battery status line allows monitored battery condition
- Redundant batteries provide improved reliability
- Accommodates 2716 EROM



### MM-8086C

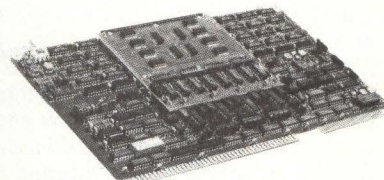
- 64K, 32K, 16K bytes
- Data retention (on-board batt.):  
3 weeks rechargeable batteries  
2 yrs. non-rechargeable batteries
- 1000<sub>H</sub> boundaries/16 Mbyte address
- On-board calendar/clock
- Access/Cycle: 250/250 nsec
- Redundant batteries provide improved reliability
- Accommodates 2716 EROM

## NON-VOLATILE CORE MEMORY



### MM-8086

- 32K bytes
- For 8 and 16-bit processors
- 1000<sub>H</sub> boundaries/1 Mbyte address
- Access/Cycle: 375/1200 nsec
- Power monitoring for data protection



### MM-8086/16

- 16K bytes
- For 8 and 16-bit processors
- 4000<sub>H</sub> boundaries/1 Mbyte address
- Access/Cycle: 280/800 nsec
- Power monitoring for data protection

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## Guide provides consumer information

With the information in the book *Database Management Systems*, readers can decide how to buy and use microcomputer database-management software for business needs. The 256-page publication defines the abilities of three categories of database-management systems: file, relational and network/hierarchical. Author David Kruglinski provides standards for evaluating database-management software and examines several packages, many of which run under CP/M. They include Condor Series 20, dBASE II, FMS-80, MDBS III, Pearl Level 3 and DataStar. The author also discusses future trends in microcomputer applications. Single-copy price is \$16.95. **Osborne/McGraw-Hill**, 630 Bancroft Way, Berkeley, Calif. 94710.

Circle No 333

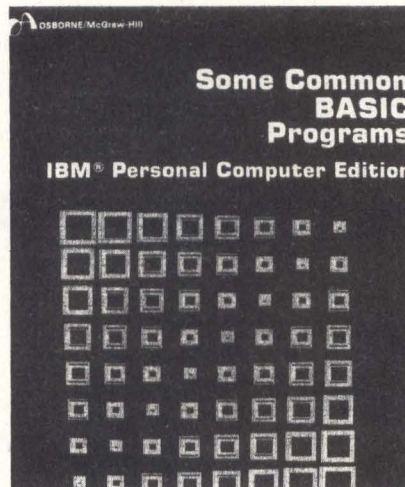
## Guides offer advice on structuring networks

Written for those who need a working knowledge of design alternatives for efficient data-communication systems and networks, two books, *Packet Switching: Tomorrow's Communications Today* and *Distributed Telecommunications Networks via Satellites and Packet Switching*, are self-instructional and feature an application-oriented approach. *Packet Switching*, priced at \$34, describes packet-switched networks, how packet networks operate, how to choose a network configuration, topological designs, the x.25 protocol, switching technologies and the use of satellites and how they operate in a packet-switched network. *Distributed Telecommunications Networks*, priced at \$31.50, discusses the roles of satellite broadcasting and packet switching; necessary components, facilities and services for arranging modern networks; protection devices for maintaining the security of information in networks; and techniques for integrating voice, data, video and facsimile into common networks. Economic, market and regulatory trends affecting

## LITERATURE THAT COSTS

design decisions are also discussed. **Lifetime Learning Publications**, 10 Davis Dr., Belmont, Calif. 94002.

Circle No 334



## Programming handbooks list math applications

IBM Personal Computer users and others can enlarge their software libraries with two 195-page books. *Some Common BASIC Programs, IBM Personal Computer Edition* and *Some Common Pascal Programs* contain 76 programs for business and home management written in IBM PC BASIC and standard Pascal, respectively. All programs have been tested and debugged and are ready to use. Each program in the IBM PC edition is presented with a functional description, BASIC source code and operating instructions. In the Pascal edition, program listings are accompanied by program descriptions and examples that aid users in following the logic of Pascal programming. Users can modify the programs to meet their needs. The books are priced at \$14.99 each. **Osborne/McGraw-Hill**, 630 Bancroft Way, Berkeley, Calif. 94710.

Circle No 335

## Glossary translates from English to Spanish

A glossary of electronic data-processing and computer terms for students, teachers, translators, interpreters, employees and computer

retail sales personnel has both Spanish-to-English and English-to-Spanish formats. The 205-page *Bola Glossary of Electronic Data Processing and Computer Terms* contains more than 10,000 terms, including "gate current," "terminal trunk," "dos," "optimized assembly language" and "user-oriented error message." Single-copy price is \$29.95, with discounts available for volume purchases. **Bola Publications**, 8769 Devon Ave., Hesperia, Calif., 92345.

Circle No 336

## Software directory lists more than 3000 packages

*The International Software Directory, Volume 2: Minicomputers* contains information on more than 3000 software packages for minicomputers. Each program is cross-indexed by subject, computer, operating system, language, vendor and price. Each program is also listed by International Standard Program Number, the industry standard used to identify software. Price is \$69.95. A companion volume containing information on more than 7000 software packages for microcomputers sells for \$59.95. **Imprint Software**, 1520 S. College Ave., Fort Collins, Colo. 80524.

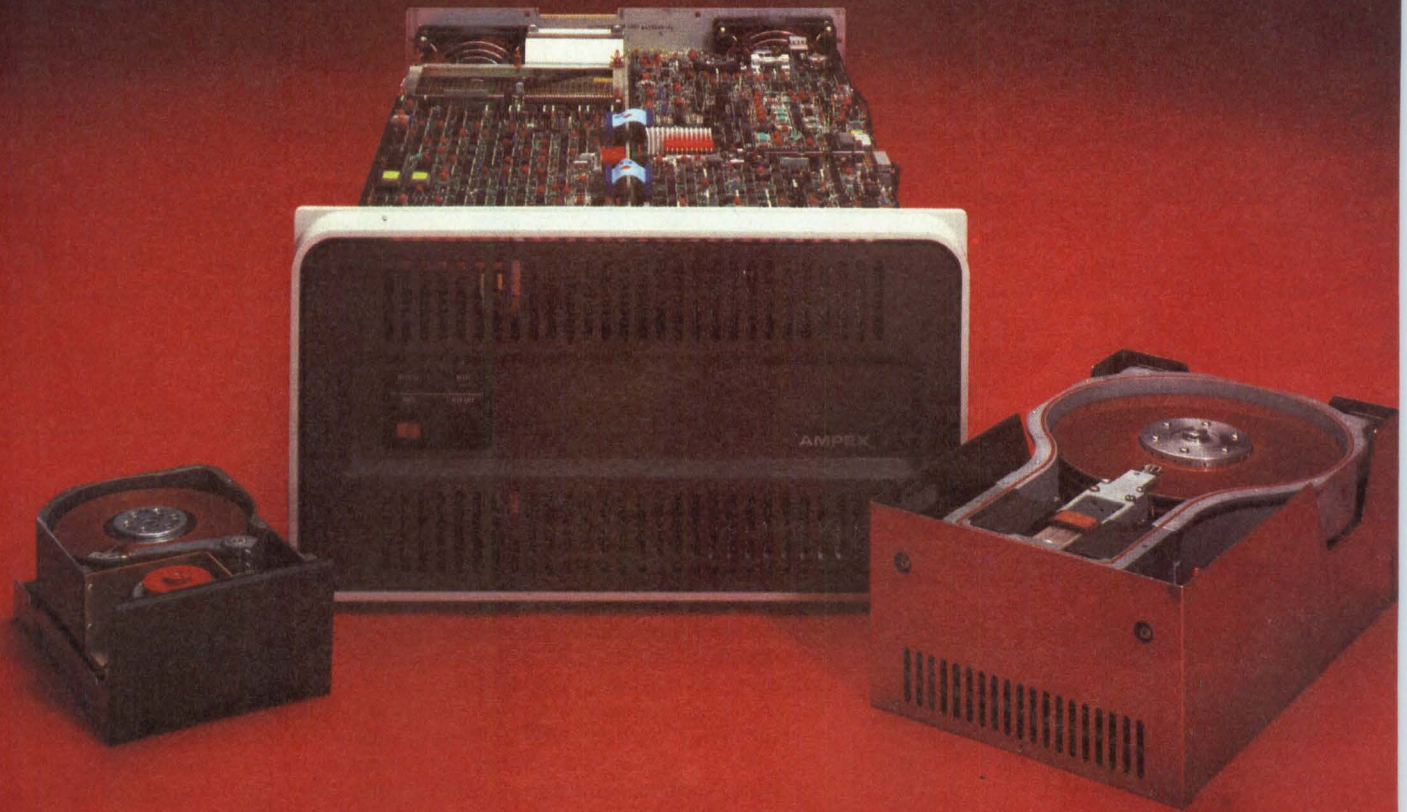
Circle No 337

## Guidelines aid software acquisition

Aimed at both data-processing professionals and computer users, *The Guidelines for Evaluating and Selecting Software Packages* show how to determine user requirements, perform a make-versus-buy analysis, determine the major software contenders, evaluate operational performance and interface a product with other systems. The *Guidelines* complement whatever system development methodology is in place or planned in an organization. Published in a looseleaf format, *The Guidelines* are priced at \$95. The text is also available on 8-in. floppy disks for \$500. **Elsevier Science Publishing Co. Inc.**, 52 Vanderbilt Ave., New York, N.Y. 10017.

Circle No 338

# WE'VE GOT IT ALL



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

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


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

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

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

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

# AMPEX

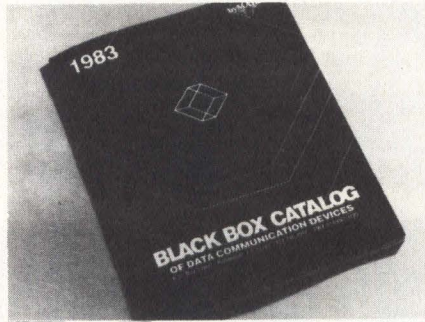
Ampex Corporation • One of The Signal Companies   
CIRCLE NO. 128 ON INQUIRY CARD

# Literature

## NEW PRODUCTS

### Information guide describes print wheels

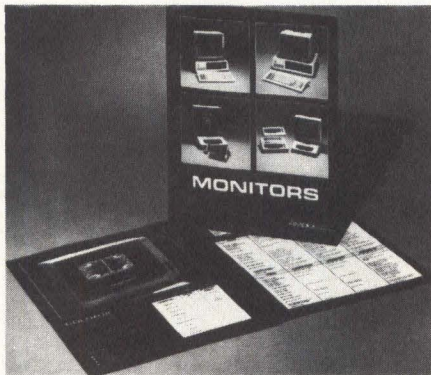
An eight-page print-wheel information guide helps readers select the correct print wheels for their printers. The guide has sections on print-wheel characteristics, how to identify compatible print wheels, daisy-wheel types and how to care for and handle the print wheels. **AGT Computer Products Inc.**, 20675 S. Western Ave., Torrance, Calif. 91335. **Circle No 339**



data switches, cables and cable parts, tools, test sets, protocol and

interface converters, printer adapters, concentrators and statistical multiplexers as well as short-haul and limited-distance modems, modem eliminators and modem-control devices. The catalog also includes hexadecimal and RS449, RS232C and CCITT V.24 equivalency charts. **Black Box Catalog Inc.**, Mayview Road at Park Drive, P.O. Box 12800, Pittsburgh, Pa. 15241.

**Circle No 341**



### Catalog describes six video monitors

Six video monitors with special interface cables are featured in a color, 10-page catalog. The monitors are designed for use with most personal computers including the IBM PC, Apple II, Apple III, Atari 800, VIC-20, TRS-80, Osborne, TI-99 and Commodore-64 models. The catalog includes compatibility charts and specifications for all the monitors. **Amdek Corp.**, 2201 Lively Blvd., Elk Grove Village, Ill. 60007. **Circle No 340**

### Catalog lists data-comm devices

The 80-page 1983 edition of the Black Box Catalog of Data Communications Devices contains 282 data-communications-oriented products. Every product is described and illustrated with photos, diagrams, specifications and price information. The catalog covers

## LITERATURE THAT COSTS

### Users guide lists resources

The 44-page *Watchmakers Guidebook to the Timex/Sinclair Computers* lists approximately 120 software suppliers, 50 hardware suppliers and 20 ancillary suppliers with a brief description of their products for use with the Timex/Sinclair family of computers. The guidebook also contains directories of user groups and Timex/Sinclair books and magazines and an index to articles appearing in general personal-computer magazines about the Timex/Sinclair computer. The guidebook also includes a chapter about writing a program in BASIC. Quarterly updates are available. Single-copy price is \$3.95. **TSG Enterprises**, 54 Richwood Place, Denville, N.J. 07834. **Circle No 342**

### Pocket guide is reference for Pick system users

*The Pick Pocket Guide* for users of Pick Systems' database-management operating system is an easy-to-use reference to the Pick operating system's verbs, syntax requirements, command formats and options. The guide can be used with all computer systems operating with Pick/Release 80, regardless of equipment manufacturer or vendor. The guide contains the latest Pick/Release 80 enhancements, and the publisher provides an update option. Single-copy price is \$50. **Pick Systems**, 17911 D Skypark Circle, Irvine, Calif. 92714. **Circle No 343**

### Handbook chronicles growth of Ethernet

The 408-page *Ethernet Handbook* explains what Ethernet is, who created it, which vendors support it and how information is passed along the network. The handbook also includes product descriptions for more than 40 vendors, Ethernet specifications, a designer's handbook, articles, company contacts and three case studies of Ethernet installations. Price is \$125. **Shotwell & Associates**, 680 Beach St., Suite 481, San Francisco, Calif. 94109. **Circle No 344**

### Reference details designing a system

*Real-Time Computing: with Applications to Data Acquisition and Control* includes everything a user must know to specify a real-time system, start it and keep it running smoothly. The 464-page book explains the fundamentals of computer systems for non-experts and compares real-time computing to data-processing applications. It explores multitasking programming, multitasking real-time operating systems, multiple computer systems and hierarchical configurations. Basic data-communications, analog and digital interfacing techniques, measurement and signal-handling practice and mathematical techniques for sampled-data control systems analysis design are discussed. Single-copy price is \$39.50. **Van Nostrand Reinhold**, 135 W. 50th St., New York, N.Y. 10020. **Circle No 345**

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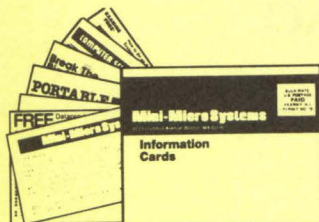
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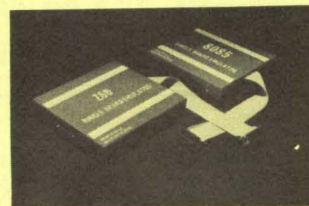


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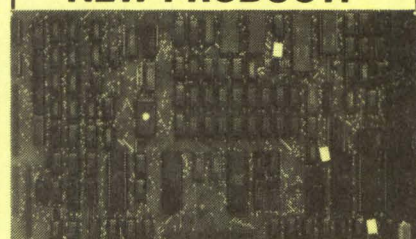


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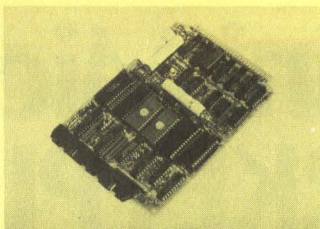


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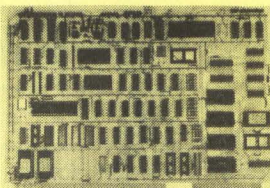
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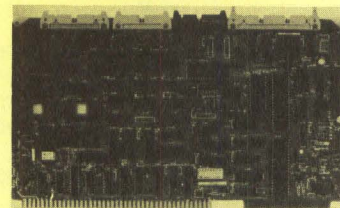
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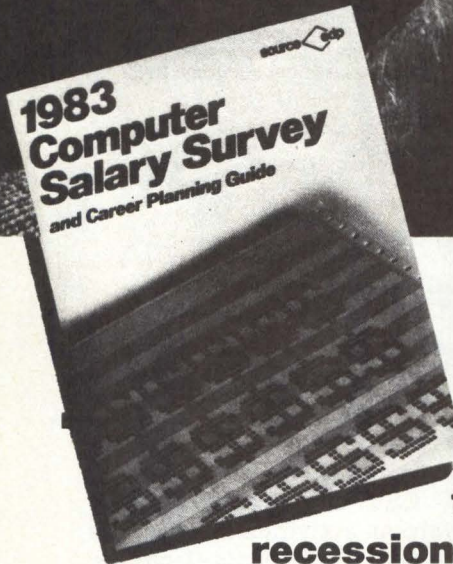
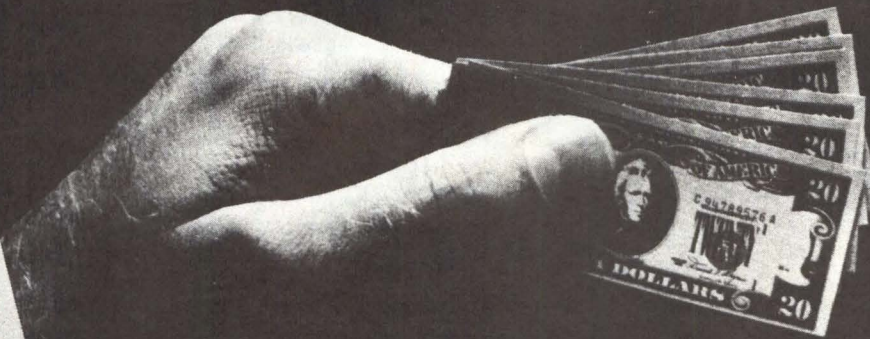


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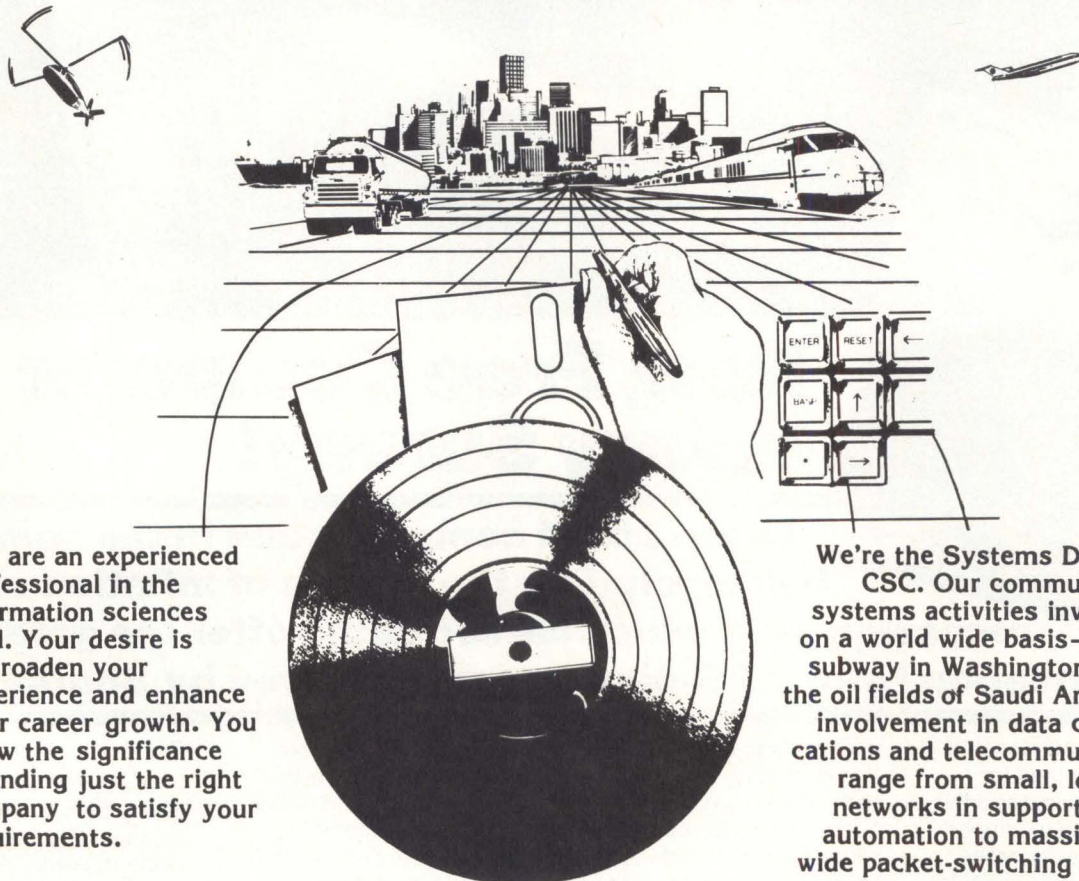
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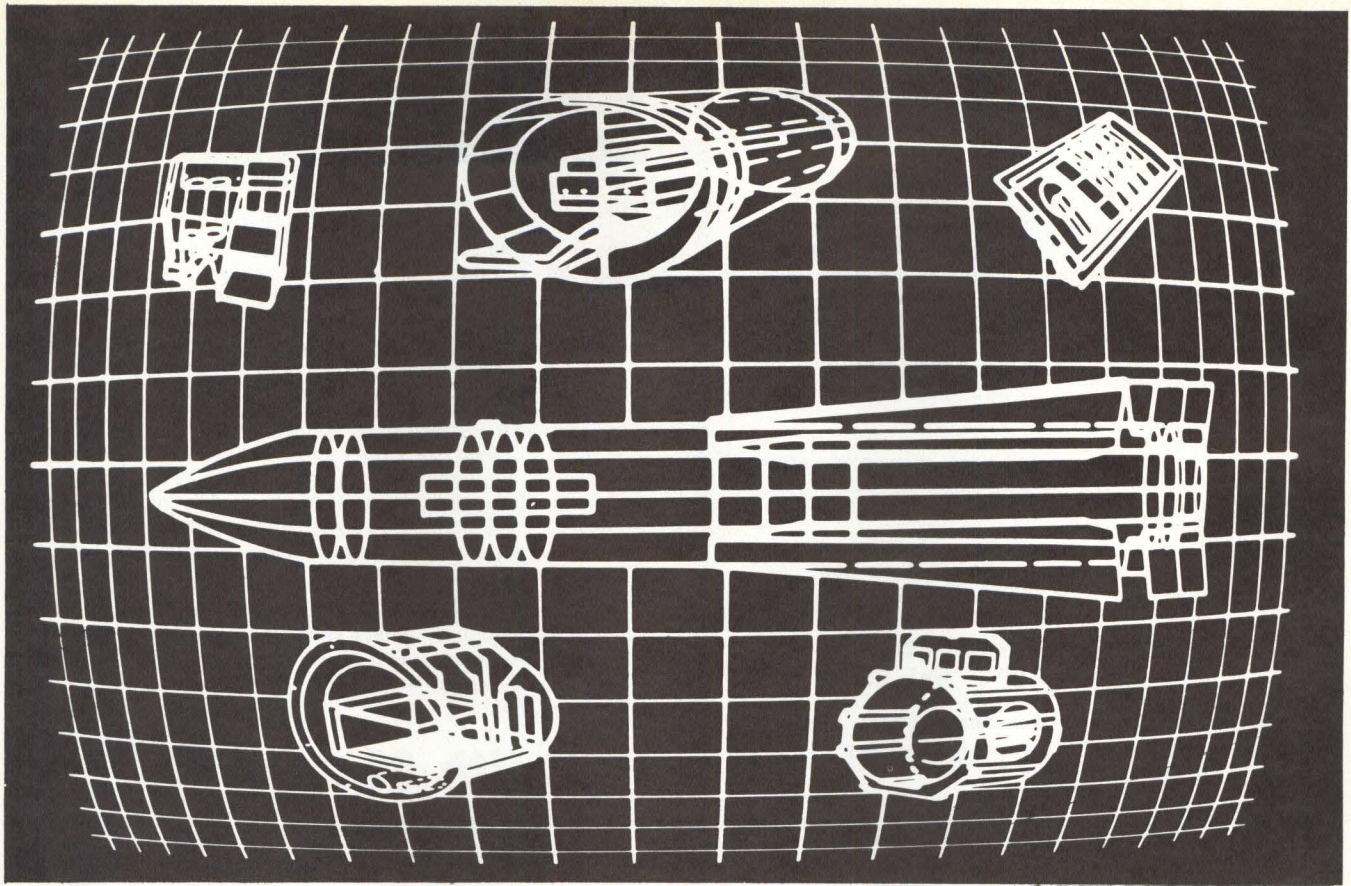
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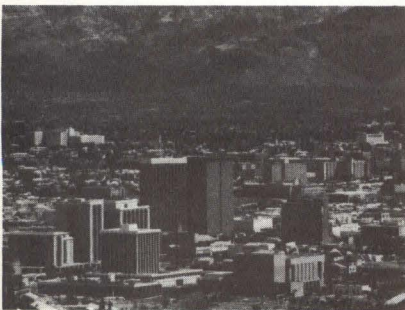
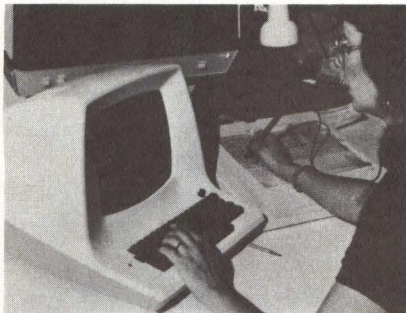


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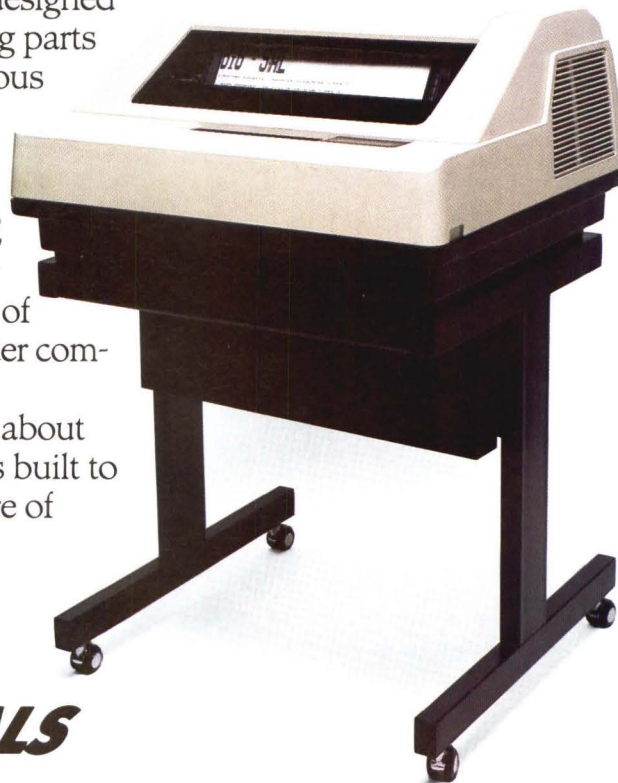
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