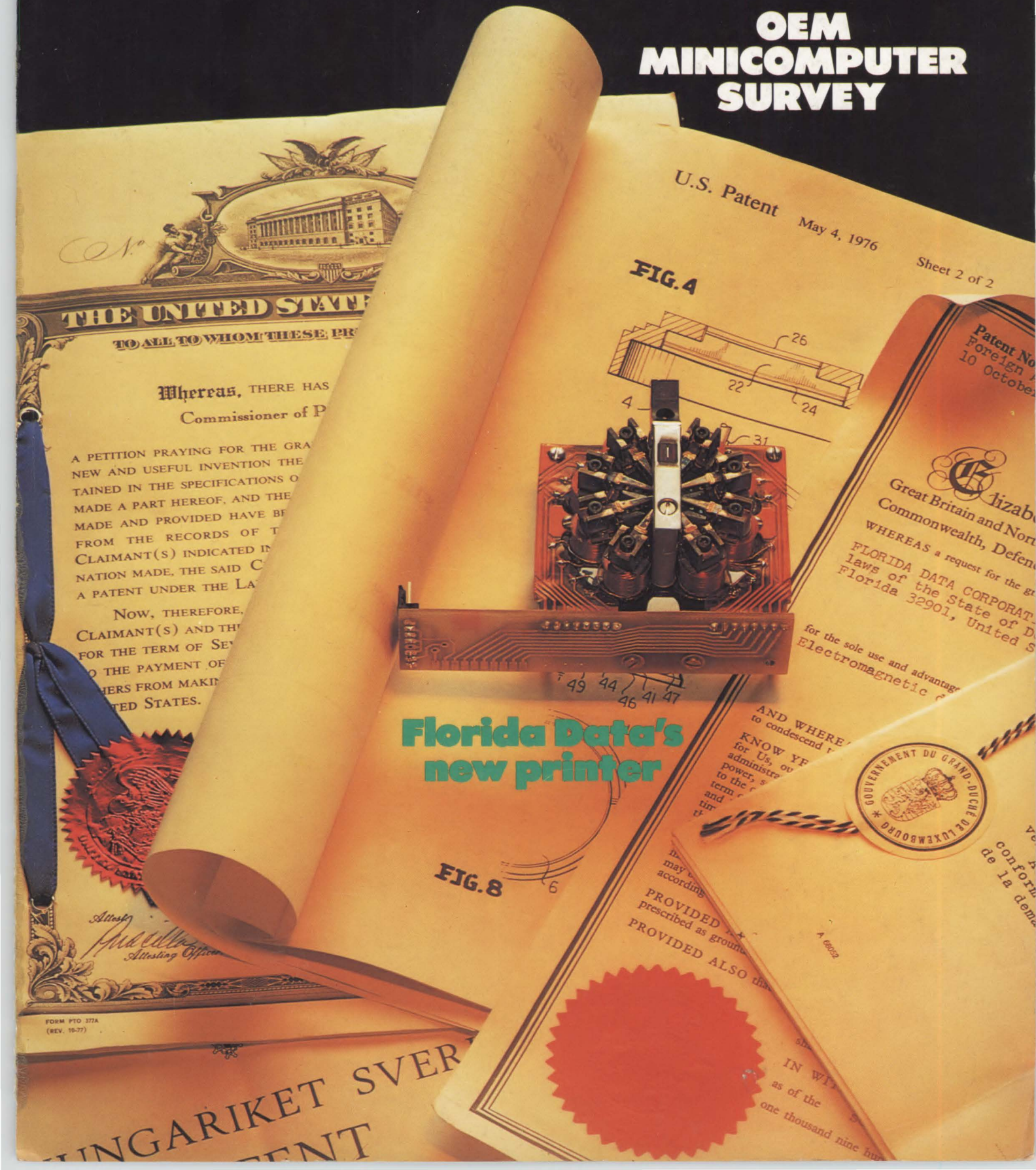
Mini-Micro Systems

A CAHNERS PUBLICATION

MAY 1981

OEM MINICOMPUTER SURVEY



Model 5380–
More bytes for your buck.

Kennedy's Model 5380 Winchester tape drive now packs 80M bytes of unformatted data in just 7" of rack space. Available in a three platter version, Model 5380's sealed disk compartment allows it to be used in environments unsuitable for conventional drives.

Track density of 300 Tpi is made possible by prewritten servo tracks utilizing one disk surface, thus assuring accurate head alignment under all circumstances. High data density results from use of advanced media and write compensated MFM recording.

Maximum seek time is 70 msec, rotational speed, 3000 rpm, and data rate–1.0 MB/sec.

Other series 5300 features include: NRZ-MFM data encode/decode circuits; daisy chaining of up to 4 drives; address mark detection; built-in power supply; small, easily replaced circuit cards and a standard interface.

Kennedy Winchester disk drives pioneered the field of high performance, fixed media data storage. They began as the best in their class–and they're getting better and better.

KENNEDY
Subsidiary, Magnetics & Electronics Inc
1600 Shamrock Ave., Monrovia, CA 91016
(213) 357-8831 TWX 910-585-3249

CIRCLE NO. 1 ON INQUIRY CARD

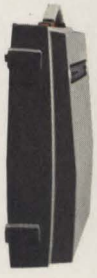
KENNEDY • QUALITY • COUNT ON IT

IMMEDIATE DELIVERY

Network Affiliates.

TI's Bubble Memory Data Terminals extend distributed data entry for business.

TI's *Silent 700** Models 763 and 765 Bubble Memory Data Terminals bring an added dimension to conventional distributed processing networks with off-line data entry capabilities. These memory experts can collect information right at the source to optimize your communications costs.



The lightweight Model 765 Portable Bubble Memory Data Terminal has increased cost efficiency for utilities by allowing them to conduct off-line energy audits for their residential customers. In remote sales order entry applications, salesmen are speeding up sales turnaround time and improving productivity with the Model 765's built-in acoustic coupler for instant data access during sales demonstrations.

The Models 763 and 765 data terminals are ideal for paperless health care claims processing which optimizes office productivity for physicians, dentists and insurance companies, and reduces mailing time delays to increase customer support. Automotive parts manufacturers and distributors are using the Models 763 and 765 for fast, accurate parts ordering, and for managing parts inventories.

Both models offer up to 80,000 characters of reliable bubble memory data storage and a file management system, and can execute user-developed programs to meet individual application requirements.

In a variety of businesses, TI's Models 763 and 765 Bubble Memory Data Terminals are providing powerful, economical extensions to data processing networks.

TI is dedicated to producing quality, innovative products like the Models 763 and 765. And, TI's hundreds of thousands of data terminals shipped worldwide are backed by the technology and reliability that come from 50 years of experience.

Supporting TI's data terminals is the technical expertise of our worldwide organization of factory-trained sales and service representatives, and TI-CARE†, our nationwide automated service dispatching and field service management information system.

For more information on the Model 763 and 765 Bubble Memory Data Terminals, contact the TI sales office nearest you, or write Texas Instruments Incorporated, P.O. Box 1444, M/S 7884, Houston, Texas 77001, or phone (713) 373-1050.

We put computing within everyone's reach.

TEXAS INSTRUMENTS
INCORPORATED

In Canada, write Texas Instruments Incorporated, 41 Shelley Rd., Richmond Hill, Ontario L4C 5G4, (416) 884-9181. In Europe, write Texas Instruments, M/S 74, B.P. 5, Villeneuve-Loubet, 06270, France, (93) 20 01 01. In Asia Pacific, write Texas Instruments Asia Ltd., 990 Bendeemer Rd., Singapore 1233. Telex RS 21399, or phone 2581122.

CIRCLE NO. 2 ON INQUIRY CARD

The DSD 880 can integrate with a VT103 Intelligent Terminal containing an LSI-11/23 to form a complete, powerful table-top microcomputer.

You deserve better data storage than you get from DEC.

For your LSI-11 or PDP®-11, bigger isn't better when it comes to data storage.

DEC® builds great computers. But if you want 7.8 megabytes of data storage, they give it to you in two ungainly boxes 21 inches high. Data Systems Design gives you one compact package 5¼ inches high, with an ultra-reliable 7.8 megabyte Winchester drive *and* a 0.5 megabyte single-sided floppy (or 1 megabyte double-sided) for I/O and integral backup, plus on-board diagnostics and lots of extras.

A superb buy—the DSD 880 DEC-compatible Winchester/ Floppy Disk System.

Offering far better value than RX02 and RL01 combos or dual-RL01 or -RL02 disk drives, the DSD 880 provides more bytes per buck than any DEC alternative. And you save in other ways.

Less rack space means lower cabinetry costs.

The 880 backplane interfaces require 70% less backplane space than a similar DEC configuration.

The comprehensive Hyper-Diagnostics™ panel and library of microprogrammed routines, in conjunction with Data Systems Design's Rapid Module Exchange™ program and HyperService™ service contracts, deliver more uptime for less than half the cost of a DEC service contract.

Fully compatible three ways.

DSD 880 is hardware compatible. It's the *only* high-capacity storage system that integrates with a VT103. And it integrates with any DEC LSI-11 or PDP-11 computer, or any DEC-computer-based system.

It's software compatible. You can use RT-11 or RSX-11 operating systems with RL01 (Winchester) and RX02 (floppy) handlers without modification. The DSD 880 runs all applicable DEC diagnostics and utilities.

And it's media compatible. Its floppies utilize DEC double-density or IBM single-density formats.

Want to know more? For full technical details, contact your regional sales office: Western (408) 727-3163; Eastern (617) 769-7620.

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CIRCLE NO. 3 ON INQUIRY CARD

Florida Data Corp.'s new OSP printers use a proprietary magnetic stored-energy print head to achieve a throughput three to 12 times faster then daisy-wheel printers. See p. 91. Cover designed by John Barthelmy, photographed by Howard Waldron, courtesy of Florida Data.

Page 15 . . . . . Datapoint challenges Ma Bell

Page 195 . . . . . Crisis in DP sales

VBPA ABP

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Mini-Micro Systems

A Cahners Publication Vol. XIV No. 5 May 1981

FEATURES

For feature highlights, see p. 71

MINI-MICRO WORLD

DEPARTMENTS

This terminal will make you feel better in the long run.

When it comes to those marathon performances at the keys, most terminal models can make the going rather rough.

That's why Lear Siegler has developed the ADM-32 Intermediate Terminal™ video display. An ergonomic innovation.

Because using any other terminal for prolonged periods will cause an operator to twist, turn, hunch, bunch, squint and squirm. Which means that fatigue is maximized and productivity minimized. But with the ADM-32 you can do away with terminal torture. Because the 32 is engineered from the human point of view. That's ergonomics.

In the long run, comfort and ease increase productivity. And on the 32 you'll find such comfort-increasing features as a detachable keyboard that eliminates unnecessary twisting and turning. A 12" or 15" screen (30.5-38.1 cm.) that eliminates hunching and bunching. And a non-glare screen with optional tilt that eliminates squinting and squirming. And as a special added feature, you'll find visual attributes with complete editing to highlight and format the display. Plus, two pages of memory that allow you to enter data on one page while transmitting from the other.

What could make more sense? After all you're not paying your operators to train for the Olympic Marathon. So do what'll make everybody really feel better in the long run. Call Lear Siegler today. Ask about the ADM-32 Intermediate Terminal.

INTRODUCING AN ERGONOMIC IT.™

LEAR SIEGLER, INC.
DATA PRODUCTS DIVISION

Lear Siegler, Inc., Data Products Division, 714 North Brookhurst Street, Anaheim, CA 92803 800/854-3805. In California 714/774-1010. TWX: 910-591-1157. Telex: 65-5444. Regional Sales Offices: San Francisco 408/263-0506 • Los Angeles 213/454-9941 • Chicago 312/279-5250 • Houston 713/780-2585 • Philadelphia 215/245-1520 • New York 212/594-6762 • Boston 617/890-7093• Washington, D.C. 301/459-1826 • Orlando 305/869-1826 • England (04867) 80666.

CIRCLE NO. 4 ON INQUIRY CARD

NCC AGAIN FEATURES SEVERAL NEW PRINTERS

For the second year in a row, the National Computer Conference was the showcase for new printers. This year's newcomers are from Epson America, Inc., Integral Data Systems, Inc., and Alphacom, Inc.

Epson introduced its 132-column MX-100, an 80-cps bidirectional printer that retails for $950 to $995. The 9 × 9 matrix produces low-density graphics for business applications. In June, the MX-80 F/T (friction tractor) will be introduced. It differs from the popular MX-80 only in its ability to handle cut sheets for office use, which adds $100 to the price, bringing it up to $745.

IDS showed two prototype units: a high-density, 18-wire print-head unit and a nine-wire multiple-color printer. The color model, a 132-column printer that incorporates the IDS model 560 printer mechanism, includes a shifting mechanism to handle a four-color, vertically striped ribbon. Two modes of operation are available: four colors and a mix of more than eight colors. Both the color printer and the 18-wire printer will be available this fall. Prices are not yet determined. The 18-wire model is a dual-purpose printer prototype for word-processing output at 150 cps bidirectionally, and data-processing output at 200 cps.

Alphacom introduced a $1495 daisy-wheel printer. The San Jose, Calif., company, which has exclusive rights to Olivetti's printer mechanisms, uses the Italian firm's 20-cps daisy-wheel print head in the 132-column device. The printhead is the same mechanism Olivetti uses in its model ET221 electronic typwriter. Alphacom's printer is equipped with RS232C serial, Centronics-compatible parallel and IEEE 488 interfaces.

PORTABLE PRINTING TERMINAL DEBUTS AT NCC

This month's NCC also witnessed the debut of the Miniterm model 2300—the first in a new family of portable printing terminals from Computer Devices, Inc., Burlington, Mass. A slew of enhancements distinguishes the new terminal from CDI's earlier 1200 series models. For one, a redesigned print mechanism that prints bidirectionally and uses a new thin-film thermal head enables the 2300 to operate at 160 cps—three times as fast as earlier models. Supporting the greater print speed is a higher communications rate (1200 baud versus 300 baud) when the terminal is acoustically coupled to a phone line. The 2300 sells for $2785 in single-unit quantities. Delivery will begin in the fourth quarter.

DATA MEDIA UNVEILS COLOR TERMINAL

The first fully assembled VT-100-compatible color terminal was unveiled at NCC by Data Media Corp., Pennsauken, N.J. Designed for office applications in which color line drawings, bar charts and histograms are required, the Colorscan 10 is particularly suited to highlight management, sales and financial presentations and reports, says Frank Zelis, Data Media's vice president of marketing. The terminal displays eight colors on a 12-in. non-glare screen in an 80- or 132-column × 24-line format. A detachable typewriter-style keyboard contains eight function keys and a separate numeric pad. The Colorscan 10 includes all the features found in DEC's VT-100 and Data Media's DT80/1 and /2 terminals, such as split screen, regional scrolling, smooth scrolling and double-height, double-width characters. Delivery is 90 to 120 days, and price is $3795 in single-unit quantities.

LEAR SIEGLER ADDS VOICE, TOUCH-SCREEN INPUT TO TERMINAL LINE

Video terminal giant Lear Siegler Inc. added voice input and touch-screen capabilities to three of its CRT models at NCC. The Anaheim, Calif., company has entered into joint marketing support agreements with voice I/O systems maker Interstate Electronics Corp., also of Anaheim, and touch-screen maker Interaction Systems, Inc., Newtonville, Mass.

Special recognition capabilities will be available for the ADM3A and ADM5 dumb terminals via Interstate's VRT200, a single-board voice-recognition system able to understand 100 words or short phrases. The $2100 VRT200, which includes a preamplifier and microphone, plugs into the CRTs with minor changes. Single-unit prices for the ADM3A and ADM5 are $895 and $995, respectively.

The touch-screen kit will be available for the ADM32, a $2195, 15-in., large-character display. Interaction's TK242 kit includes a Z80-based board, a glass face plate and interconnect capabilities. The screen uses capacitance to determine the area that has been touched. The TK242 is priced at $995.

XEROX UNVEILS STAR OF ITS ETHERNET NETWORK

In late April, Xerox Corp. announced a personal information system—the Xerox 8010 Star—which the company considers the cornerstore of its Ethernet local area network. Rather than position the system as an executive management work station, Xerox is aiming it at "middle professionals," such as engineers, accountants, writers and electronic desginers who create, interpret, manage and distribute information to others. The system includes computing, text editing, graphics creation and communications functions. The Star includes a two-page desk-top display, which can be configured as two pages in a split-screen format or a page with icons along the side; a keyboard; small processor, and a "mouse" control device, which when moved vertically or horizontally on a desk causes similar cursor movement. Price is $16,595, including basic software. The processor, hard-disk and floppy-disk drives are housed in a cabinet that fits under a desk. Thousands of the units can be linked via Ethernet and work with the 8000 series (the first commercial Ethernet system) and model 860 word processors.

FLOATING-POINT PROCESSORS TO BLOSSOM THIS SUMMER

The effort to bring mainframe-like numeric processing power and speed to minicomputer users at low cost is accelerating as the number of laboratory, process-control and robotic applications increase. Beginning this summer, major 16-bit μp suppliers will implement floating-point functions in either hardware or firmware, decreasing the programming burden for users. The major products are from:

Intel Corp.: Availability of the iAPX 86-20 numeric data processor, which will undergo a new round of sampling this month, has been hampered by problems. About 400 of the early devices, which include an 8086 16-bit μp with an 8087 numeric processor extension, have been sent to customers such as IBM and Analog Devices, Inc., since last July, and all have had problems. The most notable problem is an electrical glitch that hampered communication between the 8086 and 8087. Intel says these problems are solved, and 50 to 100 new units will be sampled this month by customers whose prototype development has been delayed.

Motorola Inc.: Motorola plans to add co-processors for the 68000 μp in the future, but in the meantime will implement those functions in firmware packages, says John Stockton, technical manager for the 68000 in Austin, Texas. The first package will be available this summer and is expected to equal the 8087 in performance. Backup documentation is being prepared for the product, which for the first time allows 32-bit multiplication and division on the 68000. The second package, like the 8087, will conform to proposed IEEE floating-point math standards. It is slated for introduction next summer.

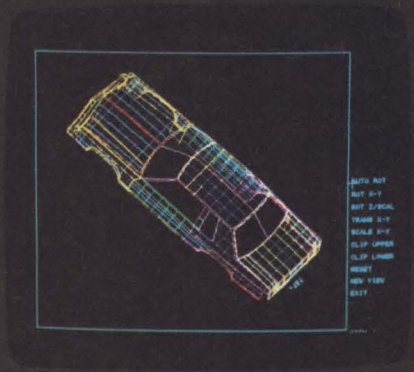
Zilog, Inc.: Sources close to Zilog believe the company is readying a floating-point processor for its Z8000 μp. Scheduled for introduction next winter, the product is expected to equal or exceed the performance of the 8087, but the company declines comment on its plans.

ANOTHER PRINTER MANUFACTURER HAS CHIP PROBLEMS

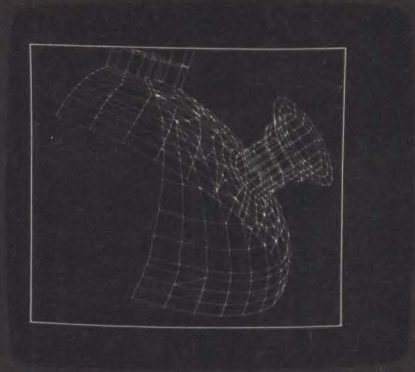
Diablo Systems, Inc., Hayward, Calif., is the latest printer vendor to experience chip problems, following Centronics Data Computer Corp.'s problem with a faulty μp in a printer last year (MMS, May 1980, p. 63). After halting shipments last month because of a contaminated chip, Diablo will resume shipping its popular model 630 quality printer early this month, a company spokesman says. However, he will not comment on the nature of the problem, nor reveal which vendor supplied the chips.

Company distributors say the daisy-wheel print element in some 630s would merely spin, not print. The spokesman says that only a small percentage of the printers were affected. Customers who have faulty printers will get a board swap with an extended warranty for the new part.

Freedom of Expression.

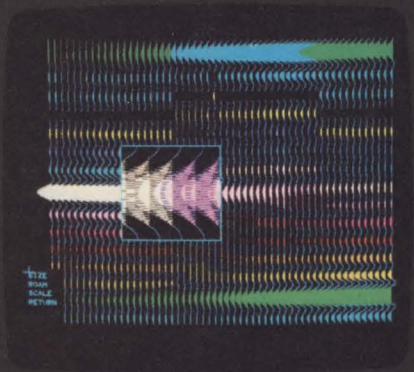


Only Megatek gives you all three, the excitement of dynamic raster color...

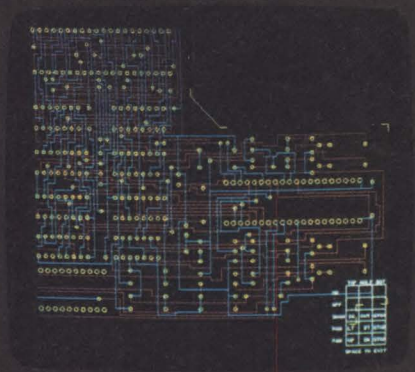


...the precision of 4096 x 4096 high resolution calligraphic Whizzard systems...

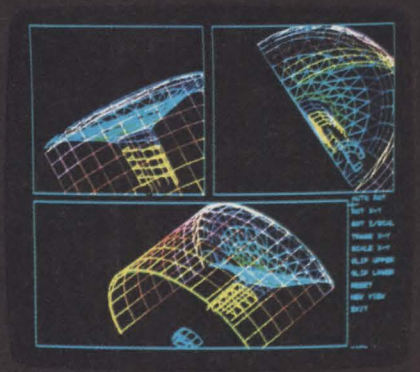
...and user-oriented software to make it easy to implement your application.



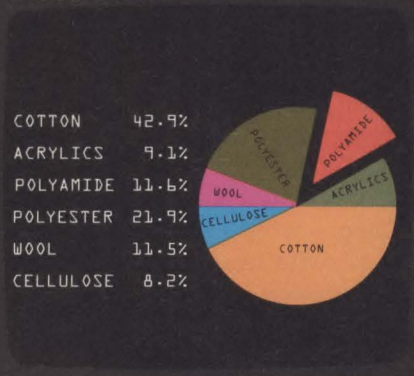
Powerful, real-time dynamics enable you to scan the display then zoom in for added detail.



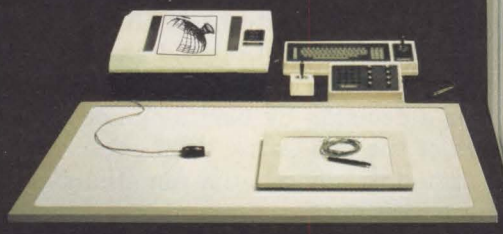
A large virtual display gives you the full picture, with the added information of up to 16 colors at a time.



Rotations mean you can view models from any angle and segment the display into multi-viewports.



It all adds up to the capabilities you need to put your ideas into pictures.



And you get freedom of choice, too, with intelligent interactive peripherals and modular design for easy expansion.

The Megatek Whizzard. It will set you free.

Express yourself with a Whizzard computer graphics system and take advantage of our technological innovations. You get system flexibility. Easy to use, ever-expanding software support. Installation, training and service world-wide. And an inside track on the future.

We're earning our reputation in computer graphics. Count on us. For advanced hardware compatible software. And added value.

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MEGATEK

MEGATEK CORPORATION

CIRCLE NO. 5 ON INQUIRY CARD

Breakpoints

MEMORY EXPANDER BOOSTS PDP-11/34 SPECS

Look for Able Computer Corp., Irvine, Calif., to begin deliveries this month of a memory-expansion system that raises main-memory mapping capabilities of Digital Equipment Corp.'s ubiquitous PDP-11/34 minicomputer from 256K to 4M bytes. Called Enable, the new system boosts 11/34 performance to the level of newer PDP-11/44 machines by permitting all currently executing programs to remain resident in main memory. Sources at the company say that additional performance can be squeezed out of the 11/34 by incorporating an optional 8K-byte cache memory. The Enable system comprises a hex-wide controller, a dual-wide bus terminator board and a quad-wide cache, in addition to the main memory used in the 11/34. All boards fit into the 11/34's Unibus backplane slots. Enable operates under DEC's RSTS-E/Version 7 operating systems and will be available in a packaged version for mounting expansion cabinets later this year. Price is approximately $6000.

WESTERN DIGITAL SYSTEMS TO SPORT ADA

Expect the first product from Western Digital's new Advanced Systems Division to appear by mid-year. The product—a full-scale μc based on the firm's 16-bit Pascal Microengine and a compiler designed to handle a subset of the Defense Department's Ada programming language—is undergoing beta testing, says a source close to the company. The system is being built at the firm's Newport Beach, Calif., headquarters and a newly acquired facility in nearby Riverside. WD's existing distributor network will handle European sales of the as-yet-unnamed system, and a network of systems representatives will handle U.S. sales. Price of the new system will be $5000 to $6000.

RANDOM DISK FILINGS

Six-month old start-up **Amlyn Corp.** will reportedly have its first offering—an 8M-byte, 5¼-in. floppy-disk drive—ready to go in evaluation quantities by the third quarter. The new drive has the same mechanical dimensions as an industry standard SA450 double-sided drive, and will be compatible with controllers used for Seagate Technology's 6M-byte ST-506 5¼-in. Winchester. The new floppy-disk drive is based around a five-disk cartridge and five single-sided read/write heads. It operates at 154 tracks per surface—twice the amount found on a conventional SA850 8-in. floppy-disk drive.

Reports are circulating that three of the remaining co-founders of **Dastek Corp.** will soon leave the company. This follows a decision by media maker **Dysan Corp.**—which already owns more than three-quarters of the Los Gatos, Calif., thin-film read/write head and disk-drive vendor—to exercise its option to buy out the remainder of the company. On the move, says one source, is Dastek chairman Jay Dee Shiverdaker, finance vice president John Middlestead and marketing vice president Jim Koerber. Remaining as president of Dastek is Al Imaya. A spokesman for Dastek neither confirms nor denies the reports.

Now in the works at **Tandon Corp.,** Chatsworth, Calif., says one source, is a plan to supply the company's major OEM customers with complete subsystems based on Tandon's 5¼-in. Winchester-disk drive and double-sided minifloppies. Power supplies, chassis and cabling would come from Tandon facilities overseas, with final assembly carried out at a subsidiary to be set up in Southern California. Pacing factors at this point include controller design and the availability of factory space. A spokesman for Tandon has no comment on the reports.

Look for the co-founders of **Ontrax, Inc.,** which shut down operations last month, to resurface in the San Francisco Bay Area disk-drive industry with a new company later this year. The Sunnyvale, Calif., designer of high-capacity 8-in. Winchesters decided to call it quits after venture capitalists funding the company pulled back their investment in the face of what one Ontrax executive calls the company's overcommitment to the disk-drive industry. Ontrax had earlier announced that shipments of its first product—the five-platter, 136M-byte Series 8 drive, scheduled to begin in the first quarter of this year (MMS, January, p. 39)—would be delayed until late 1981 because of problems with the device's proprietary binary positioning system. The company had planned to begin shipping hardware this quarter using conventional voice-coil motors, however. —John Trifari

LSI-11® AND PDP-11®
DISK STORAGE SUBSYSTEMS

CONTROL DATA®

EMULEX®

COST EFFECTIVE/HIGH PERFORMANCE
First Computer Corporation offers a wide range of CMD/SMD/MMD/FMD disk storage subsystems for PDP-11 computer systems. These subsystems offer users a cost effective—high performance alternative for applications demanding large capacity disk storage.

HARDWARE/SOFTWARE COMPATIBILITY
All disk storage subsystems utilize Emulex microprogrammed emulating controllers which are fully software transparent to both the PDP-11 hardware and software.

INSTALLATION AND SERVICE
First Computer can provide installation and service for end-users desiring on-site warranty. Responsive service can be provided by over forty Control Data field service centers located in most major metropolitan areas.

REPUTATION AS A LEADER IN PDP-11 SYSTEMS
First Computer Corporation has built a reputation based on quality, reliability and service. During the last five years we have shipped over 1,000 PDP-11 systems to satisfied customers worldwide. We continue to protect this reputation by offering only the very best. Disk storage subsystems can be provided to meet most application requirements from the following selection guide:

HIGHEST QUALITY AND SUPER RELIABILITY
The disk drives utilized in these subsystems are manufactured by Control Data Corporation the world's largest independent supplier of peripheral equipment. Control Data builds quality and reliability into its disk drives because CDC designs and manufactures each of the critical components—heads, media and servo.

FULLY INTEGRATED AND TESTED
ALL disk storage subsystems are configured, integrated, and tested by First Computer Corporation to provide you with a totally plug-compatible disk storage subsystem. These subsystems can be installed on your system and be up and running the standard DEC diagnostics and operating systems within minutes.

MODEL	STORAGE CAPACITY		OPERATING SYSTEM EMULATION		MODIFIED HANDLER
	Removable	Fixed	RT-11	RSX11-M / RSTS/E	
9448-32	16	16	2 13.7MB RP02's	2 13.7MB RP02's	YES
			2 13.9MB RK06's	2 13.9MB RK06's	NO
9448-64	16	48	4 13.7MB RP02's	4 13.7MB RP02's	YES
			4 13.9MB RK06's	4 13.9MB RK06's	NO
9448-96	16	80	6 13.7MB RP02's	6 13.7MB RP02's	YES
			6 13.9MB RK06's	6 13.9MB RK06's	NO
9730-80	—	80	3 20.8MB RP02's	3 20.8MB RP02's	NO
				1 67.4MB RM02	NO

MODEL	STORAGE CAPACITY		OPERATING SYSTEM EMULATION		MODIFIED HANDLER
	Removable	Fixed	RT-11	RSX11-M / RSTS/E	
9730-160	—	160		2 67.4MB RM02's	NO
9762	80	—	3 20.8MB RP02's	3 20.8MB RP02's	NO
				1 67.4MB RM02	NO
9766	300	—		1 253.7MB RP06	YES
				1 256.1MB RM02	YES
9775		675		1 552.5MB RP06	YES
				1 552.5MB RM02	YES

CDC-1

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CIRCLE NO. 6 ON INQUIRY CARD

For letters and reports that really matter, you can't beat our D-50. With its superfast hammer and a resolution twice as fine as other daisy wheel printers (over 11,000 points per square inch), the D-50 prints the sharpest characters and clearest graphics in the business.

It's available in KSR (Keyboard/Send/Receive) terminal and RO (Receive Only) printer and terminal models.

Minimum maintenance, maximum productivity.

Thanks to a simplified printing mechanism, the D-50 is extremely reliable. It's designed to operate without adjustments, lubrication or preventive maintenance (other than routine cleaning).

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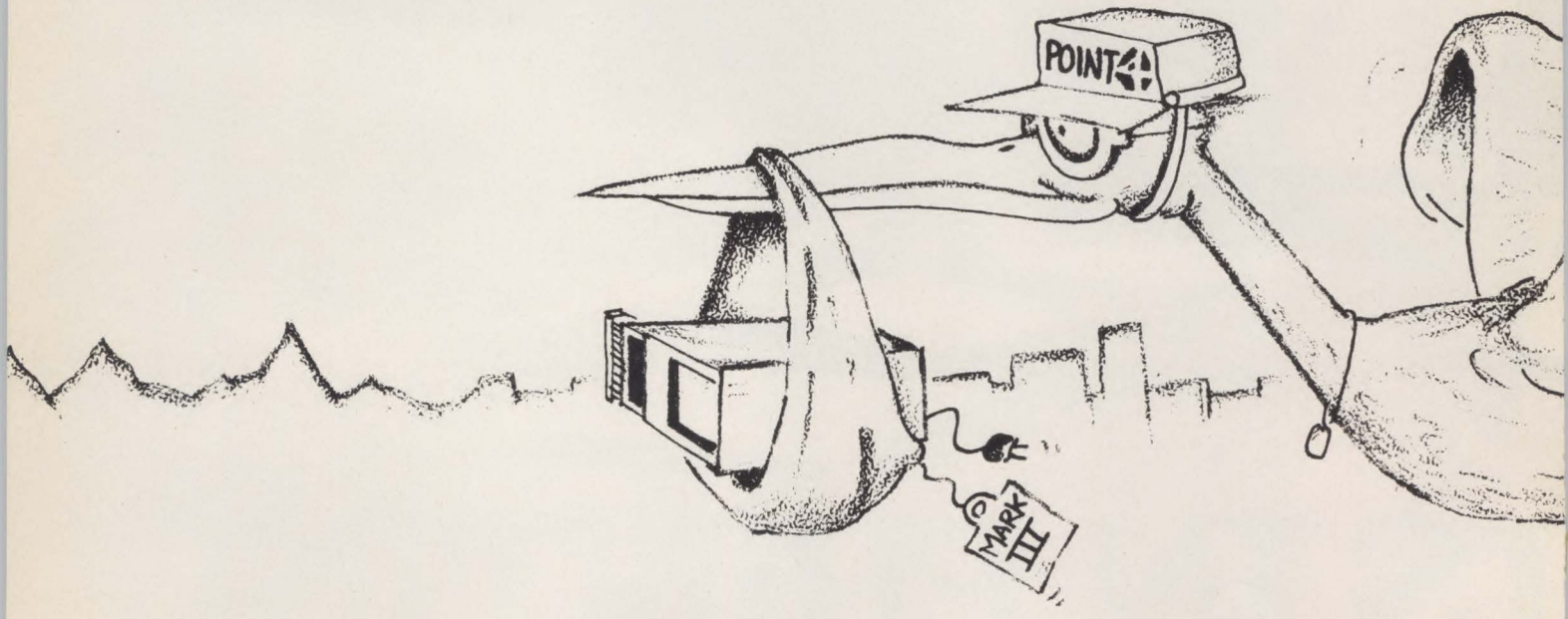

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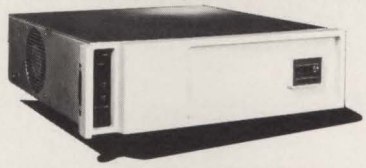

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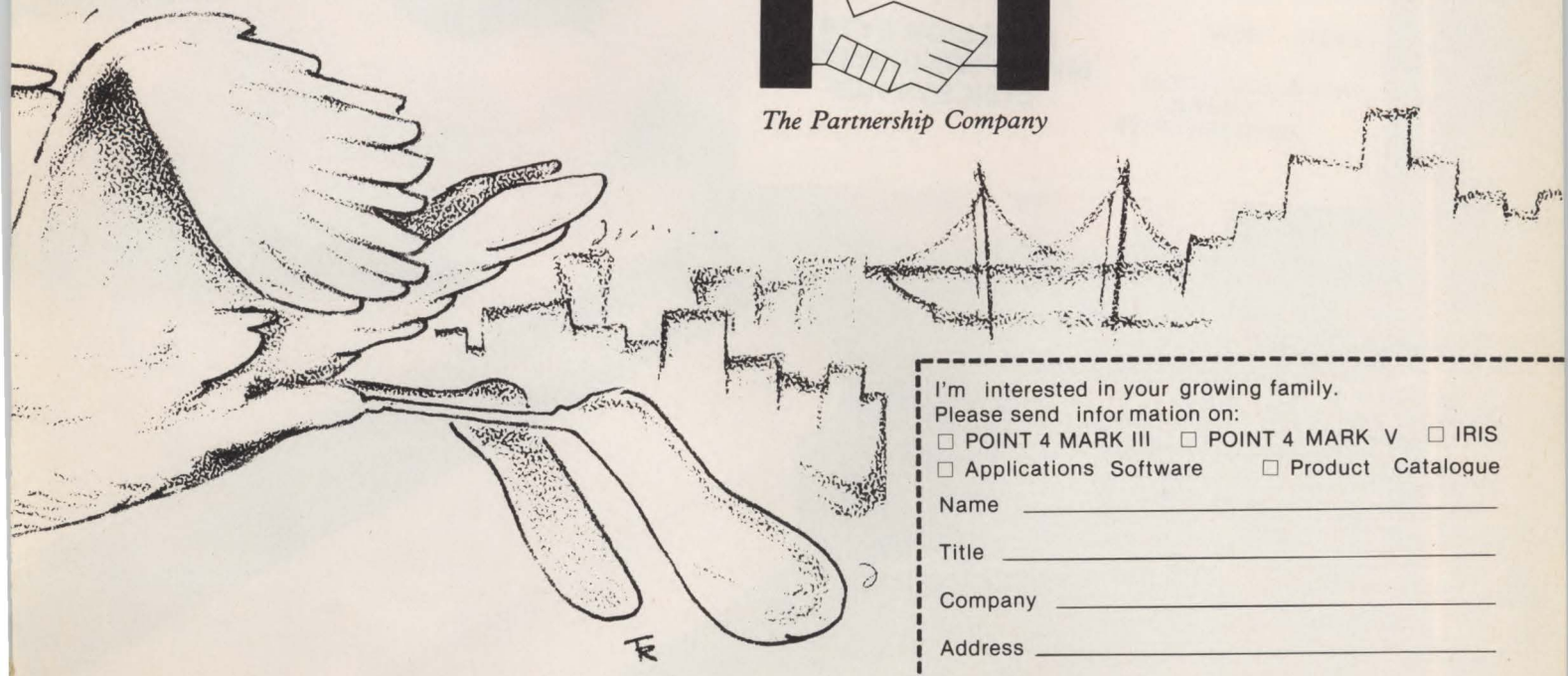

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CIRCLE NO. 9 ON INQUIRY CARD

Datapoint's ISX: Responding to 'technological imperative'

Despite all the hoopla surrounding local area networks, many industry observers believe that the office telephone system will remain the backbone of business communications—even in the electronic offices of the future. That view was strikingly supported last month by the entry of Datapoint Corp.—a leading office automation equipment supplier—into the digital private branch exchange (PBX) business—a market that has been dominated until now by telephone companies.

Datapoint's entry into the PBX business is especially significant, industry observers point out, because the company has been the leading advocate of using coaxial cable-based local area networks for office communications. The San Antonio, Texas, firm's ARC (attached resource computer) system pioneered local networking in 1977, and Datapoint has since delivered more than 1500 ARC systems.

Now, with the introduction of a digital PBX, Datapoint has conceded that local networks are not the answer to all business communications needs—a point that critics of ARC and Ethernet have long maintained. What the digital PBX offers over local area networks is the ability to handle voice as well as moderate-volume data traffic—thus eliminating the need to maintain separate telephone and data networks in many applications.

Datapoint's entry into the market, called the Information Switching Exchange, consists of a central switching unit (CSU) and as many as 60 remote switching units (RSUs), each capable of handling as many as 350 telephones or data terminals. The system can interconnect as many as 21,000 phone or data terminals.

Intended to serve as the hub of an integrated voice and data network within a building or group of buildings, the CSU serves as the central switching facility for communications between in-house phone and data terminals and as an interface to the public telephone network. The RSUs interface the in-house terminals to the CSU, and serve as local switching exchanges. They can be linked to the central switching unit via coaxial cable, microwave or infrared channels carrying digitized voice and data at 4M-bps data rates. Phones and data terminals are linked to the RSUs via standard three-pair twisted-wire

Datapoint's ISX *is a digital PBX that uses dispersed switching technology to integrate voice, data, text, electronic message services and Datapoint's ARC coaxial cable local networks.*

telephone cables at data rates as high as 56K bps.

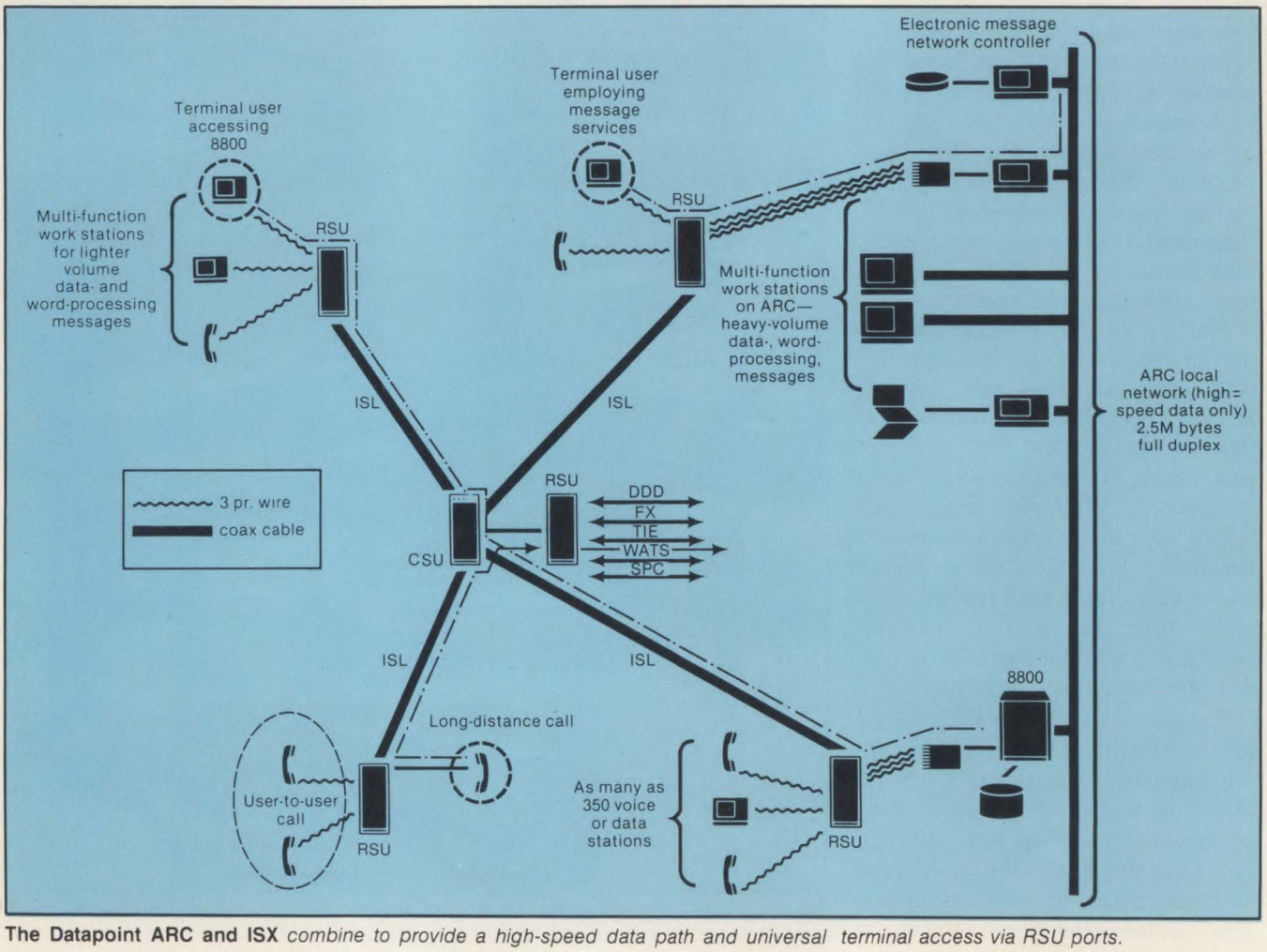
In addition to the switching units, the ISX also includes a data-management system that collects and reports statistics on voice and data traffic, enabling a company to monitor usage of an in-house communications network. Datapoint has also introduced two electronic telephones for use with the ISX system: the INFOSET I, a basic single-line handset that has four special-feature buttons, and the INFOSET II, an executive-oriented unit that has a built-in speaker and 20 special-feature buttons. Both units are manufactured by Datapoint. The system also accepts most industry-standard rotary and push-button telephones, as well as RS232/449 data terminals.

Besides serving as a central switching node for data and telephone terminals, ISX also provides more than 150 enhanced telephone-exchange features. These include least-cost long-distance call routing, speed dialing, call forwarding, conference calling, call waiting and extension-number changes without re-wiring.

Datapoint has targeted the system, which sells for $932,886 in a typical 888-port configuration, including installation and cabling by Datapoint, at large companies that need a data capability and have more than 100 phones to interconnect. For small- to medium-sized companies, Datapoint will market a voice-only system made by Inter-Tel Equipment, Inc., Phoenix, that accommodates as many as 128 phones. Called the Key Switching Exchange (KSX), the voice-only system sells for $34,615 in a typical 40-station configuration.

But the introduction highlight remains the ISX, which marks the first entry by an office-automation equipment supplier into the digital-switching business. Until now, that market has been dominated by telephone switching equipment suppliers, such as AT & T, Northern Telecom, Rolm and InteCom, Inc.

Explaining Datapoint's entry into the business, company president Harold O'Kelley characterizes the move as enabling his company to take advantage of an "immediate business opportunity." Datapoint estimates the demand for digital PBXs to be more than 25,000 systems a year. "We are ideally positioned to claim a significant share of that market," says Data-



The Datapoint ARC and ISX *combine to provide a high-speed data path and universal terminal access via RSU ports.*

point's vice president Dan Hosage, who notes that his company has already received 12 ISX orders, valued at more than $11 million.

But more importantly, O'Kelley views the ISX introduction as responding to a "technological imperative" to integrate voice and data in office-automation systems. Indeed, most industry observers see not only a technological but also an economic imperative to integrate voice and data to avoid the high cost of installing and operating separate voice and data networks.

But industry opinion has been divided on whether the telephone system or coaxial-cable-based local area data networks should form the basis of integrated voice and data electronic office networks. Significantly, Datapoint, which pioneered coaxial networks with the introduction of its ARC system in 1977, has opted for a compromise solution. "We think users need both types of systems," says Hosage.

Hosage sees in-house digital phone systems, such as ISX, serving as the basis of company-wide office systems, handling both voice and moderate data traffic and providing the "critical connection" for linking coaxial cable networks.

This hybrid approach "will provide businesses greater flexibility in building the electronic office, by enabling them to more accurately match their needs," Hosage says. For example, he points out that ISX alone could handle limited word-processing and electronic-mail functions with the addition of intelligent terminals, such as those offered by Datapoint and other vendors.

Hosage also sees ISX as a bridge between local area data networks serving "different communities of interest" within a company. The telephone network is already serving this purpose, but not as efficiently as with ISX, Hosage maintains. For example, ISX would automatically route traffic between two nets along the least expensive long-distance phone line.

Another office systems vendor, Wang Laboratories Inc., feels that coaxial cable networks should form the foundation of the electronic office to minimize the number of wiring systems in offices. Last year, Wang announced that it would develop a broadband coaxial network capable of handling not only phone and data traffic but also closed-circuit TV (MMS, February, p. 40). Wangnet, as the system will be called, would thus replace three wiring systems commonly used in today's office: the in-house telephone system, which cannot handle high-volume data and video traffic because it is based on twisted-pair cable; baseband coaxial cable data networks, such as Ethernet and Datapoint's ARC, which cannot handle voice and video because of bandwidth limitations; and cable TV networks.

But while Wang proposes to go further than Datapoint in responding to the technological imperative to integrate voice and data, industry observers believe getting Wangnet to market will entail a heroic engineering effort on the company's part. "We think they have an incredibly ambitious technological agenda before them with Wangnet," says George Colony, a senior analyst at the Yankee Group, a Cambridge, Mass., telecommunications consulting and market research firm.

Colony sees Datapoint's hybrid approach of combining a digital phone system with local area coaxial cable networks as appealing to customers because it enables them to enter the integrated electronic office of the future in easy stages. "Customers will be able to cost-justify ISX on a voice basis alone, with local networking as an added value," Colony says, adding, "That's the real root significance of the system."

Other industry observers agree. "Companies will be able to justify enhanced phone service systems, such as ISX, on a voice basis, and then be able to add data as their own version of the office of the future emerges," says Tom Aschenbrenner, marketing vice president of InteCom, Inc., a Dallas affiliate of Exxon Enterprises that has been marketing an in-house digital switching system similar to Datapoint's for more than a year.

Aschenbrenner views the ISX introduction as a tacit admission by a data-processing equipment supplier that voice will remain the primary form of communications in the office. "Babies will continue to talk in analog for the next 2000 years at least," he says. For this reason, he believes customers will continue to place primary emphasis on voice when installing building- or campus-wide communications systems.

"Datapoint has made a very pragmatic move," he continues. "Customers have to divorce the wonders of technology from the decision to install a network, to consider the up-front capital and recurring costs of installing a network. Building-wide coaxial cable networks are virtually impossible to cost-justify because they can't handle voice."

Kenneth G. Bosomworth, president of International Resources Development Inc., a Norwalk, Conn., telecommunications marketing research firm, also sees the phone system—in digital form—remaining as the cornerstone of office communications. "Digital private branch exchanges (PBXs) will be at the center of the electronic office of the future," he says.

He thus views Datapoint's entry into the digital PBX business as an astute strategic move. "Any company that wants to be a leader in office automation has to consider getting into the digital-switching business if for no other reason than to prevent a compatibility lock-out," Bosomworth says.

The Yankee Group's George Colony agrees, and adds that the ISX introduction will give Datapoint a competitive edge over companies—notably IBM—that do not yet offer digital PBXs. "It (ISX) will enable Datapoint to make an end run around IBM," Colony says.

But in announcing a digital PBX, Datapoint has moved into a market that has already been staked out by telephone switching equipment suppliers hungry for a piece of the office-automation market. InteCom, for example, has been marketing a digital switching system called IBX, for more than a year. Rolm Corp. entered the market in February with a system called CBX (MMS, March, p. 34). And AT & T is known to be readying a digital switching system, code-named Antelope.

Datapoint's Hosage, however, believes that his company's system will compare favorably, even with the best of the competition. "We're offering a third-generation system that is competitive, and then some, with any other PBX products on the market," he boasts. Moreover, he points out that the system's $1000-per-line cost equals that of voice-only PBXs .

Indeed, industry analysts give high marks to Datapoint's first entry into the digital PBX business. "It (ISX) really is a cutting-edge system," says the Yankee Group's Colony. IRD's Bosomworth agrees: "I'm impressed. ISX not only does everything that the Rolm system does, but has the additional capability of interfacing easily into a local network environment."

—Paul Kinnucan

Hardware vendor offers equity for software

In a move that could set a trend for software houses selling into the personal computer market, three vendors of systems and applications programming have bought into a start-up Bay Area hardware house. But whether other software vendors follow suit depends on what some observers see as a potential conflict-of-interest issue raised by such an arrangement.

The move was prompted by the need for equity funding to generate working capital—funding that has so far been denied software houses for two reasons. First, software vendors' balance sheets show up poorly because of the vendors' minimal fixed assets and inventory. Second, such vendors endure widespread and unauthorized duplication of their products, and lack the legal means of protecting themselves, thus impacting their profit-and-loss statements.

As a result, software vendors are tempted to improve their balance sheets by adding equity in a hardware vendor, and their P & Ls by associating themselves with hardware sales. This has led three software vendors—Compiler Systems, Inc., MicroPro International Corp. and Sorcim, Inc.—to take a position in newly formed Osborne Computer Corp., Hayward, Calif. (see "...Please make sure...," p. 23).

The move to augment software offerings with hardware is not new. National CSS has assembled high-end minicomputer systems using TwoPi Corp.'s IBM 370/138 emulators, and Point 4 Corp., Tustin, Calif., has added 16-bit Nova-compatible minicomputers to complement its IRIS operating system. But equity purchases such as those in the works between the three software houses and Osborne Computer Corp. appear to be unique.

Vector Graphic's Lore Harp: *"Software houses have been independent suppliers to all hardware vendors in the past, and they should stay that way."*

The deal is simple: in exchange for a minority position in the new company—and, the software vendors hope, a soaring equity position as hardware sales take off—each vendor has licensed Osborne to use its product on the newly announced Osborne I, a Z80A-based portable personal computer.

On the other side of the coin, Osborne keeps the software investment typically needed to support hardware of this type to absolute zero and minimizes its design efforts and costs (the system designer reportedly received stock also). As a result, Osborne has been able to drive the single-unit price of its new hardware down to $1795, including a 35 to 40 percent dealer discount. Radio Shack's TRS-80 model III with two minifloppies and 32K bytes of RAM sells for about $2495, and a similarly configured Apple II Plus is about $3000.

"This type of deal is the wave of the future," says Richard Frank, president of Sorcim, Inc., Santa

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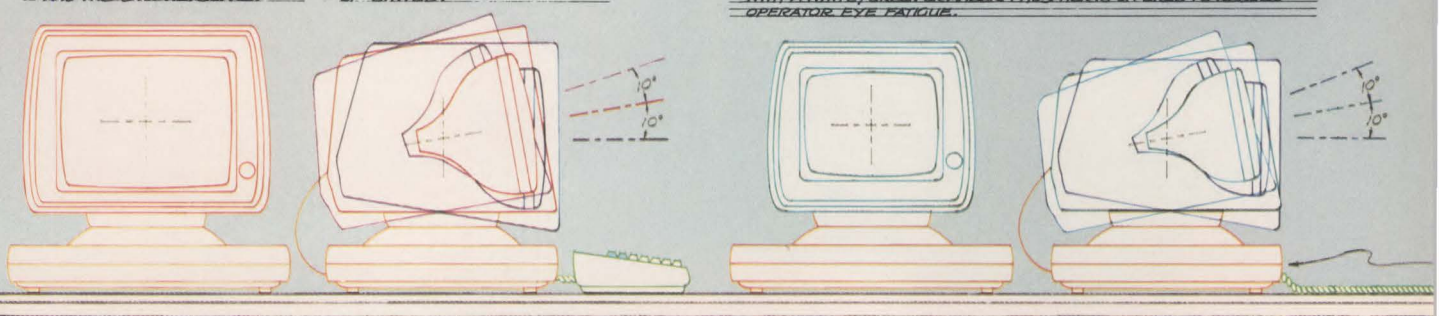

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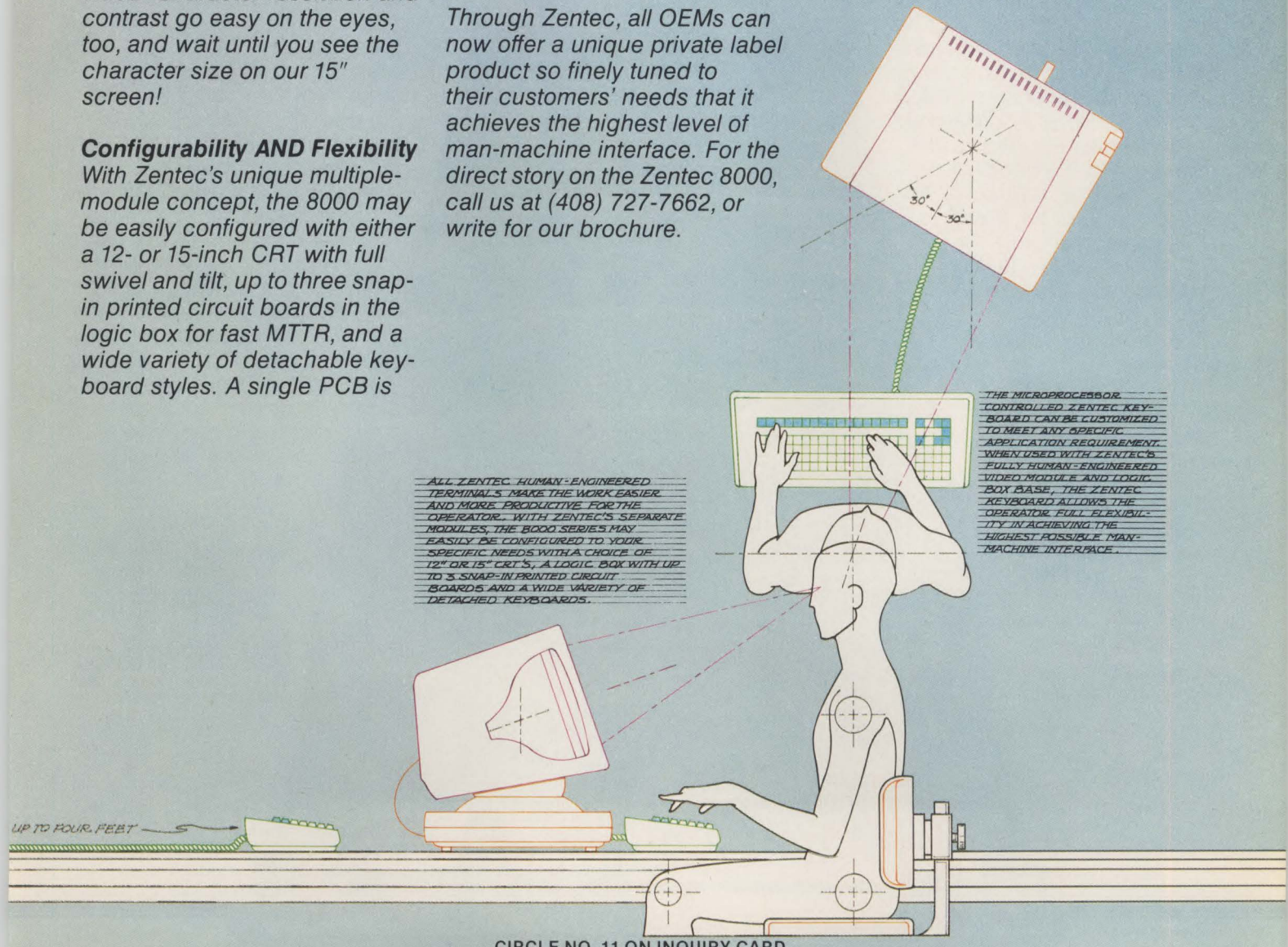

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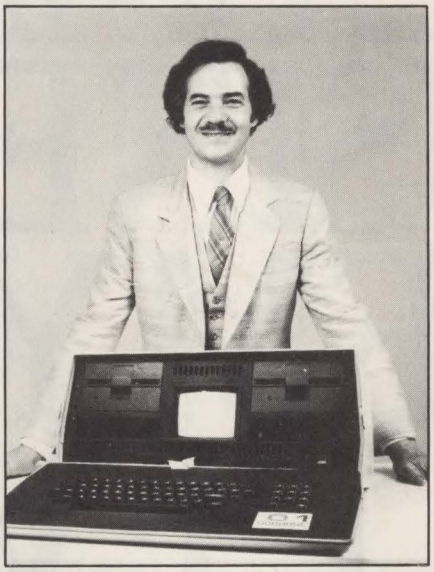
CIRCLE NO. 12 ON INQUIRY CARD

Clara, Calif. "It has to be. Without a tie-in to a hardware company, a lot of software houses could be out of business next year. We have no way to protect our product from being pirated."

Adam Osborne, in his new role as president of a hardware house, feels that the equity-for-paper deal is the only way that small hardware firms can compete effectively in the fast-moving personal computer market. The competition is severe: on one side are large-scale operations, such as Radio Shack and Apple Computer, both of which develop their own software in-house. On the other side, are the rumored low-end personal business computers from industry giants such as IBM Corp. and Hewlett-Packard Co.

Calling his plan "an indictment of the industry," Osborne claims that those hardware vendors that rely on their own programming "will drown in their own overheads." A case in point, he says, is the Apple III. "It cost Apple $1 million to develop the software for that machine," he claims. "The best thing that Apple could do would be to do what I'm doing."



Adam Osborne and the Osborne I: *Standard features of the new computer include two single-sided minifloppy-disk drives, 5-in. screen, Z80A μp and a foldup keyboard.*

But while no one has questioned Osborne's plan to compete with personal computer vendors that have established in-house software capabilities, some observers question the propriety of substituting stock for licensing payments or royalties. This concern has been heightened by the understanding not only that the software houses will have an equity position in Osborne Computer Corp., but also that executives of two of them will participate in Osborne's board of directors.

"These software houses may find that some of their other customers don't like the deal," says Lore Harp, president and co-founder of Vector Graphic, Inc., Westlake Village, Calif. "Software houses have been independent suppliers to all hardware vendors in the past, and they should stay that way," says Harp, citing a potential conflict of interest between their roles as suppliers to hardware houses and as investors in one of those hardware houses.

Harp believes, in particular, that a conflict of interest could arise in the case of products under development. "We have to feel confident that we can talk to these suppliers on a proprietary basis, and, as a result of the arrangements they've made with Osborne, we could become reluctant to do this," she says.

Analyst Bob Wickham, president of Vantage Research, Mountain View, Calif., is pleased by the prospect of software houses developing equity positions through dealing with Osborne. But he warns that "potentially there is a conflict of interest here. This may not show up in relation to existing hardware, but could pose a problem for future systems development."

Osborne dismisses any notion of conflict of interest, pointing out that there is no exclusivity in his dealings with the three software houses.

Seymour Rubenstein, founder

"...Please make sure your personal computer is stowed securely..."

Osborne Computer Corp. is not only venturing into uncharted waters with its equity-for-stock deal involving software suppliers for the recently introduced Osborne I μp, but also taking the first steps into what some feel is the personal computer market of the future—the low-cost portable device. So far, with the exception of a bubble-memory-based system introduced more than a year ago by Findex, the new hardware from Osborne is the first portable personal computer to reach the market.

Key to the design of the new system is a brushed aluminum cabinet that snaps together to form a weatherproof carrying case. Like other hardware offerings, the Osborne I conforms to de facto industry standards. The new system, when packed up, fits under an airline seat.

But aside from what many consider to be a trend-setting price—$1795 to end users—and the weight—30 lbs.—many hardware specifications of the new system are relatively mundane. Processing power is performed by a 4-MHz Z80A 8-bit μp tied to 64K bytes of memory—60K bytes of which is available to a user.

Communication with the system is via a standard business keyboard; output is through a 5-in. CRT monitor configured into a 52-character × 24-row format. Standard video attributes with the system include upper- and lower-case characters, underscoring, dual-intensities and graphics.

Also included are two $5^1/_4$-in. 100K-byte single-sided floppy-disk drives and two I/O ports—an RS232 port and an IEEE 488 interface. Software included in the end-user price comprises the CP/M operating system, the WordStar word-processing package, the SuperCalc electronic worksheet for graphics and the M-BASIC and C-BASIC language compilers.

Options include double-density, double-sided floppy-disk drives, a 9-in. monitor, modem/acoustic coupler and 9- and 12-in. display. First deliveries are set for next month.

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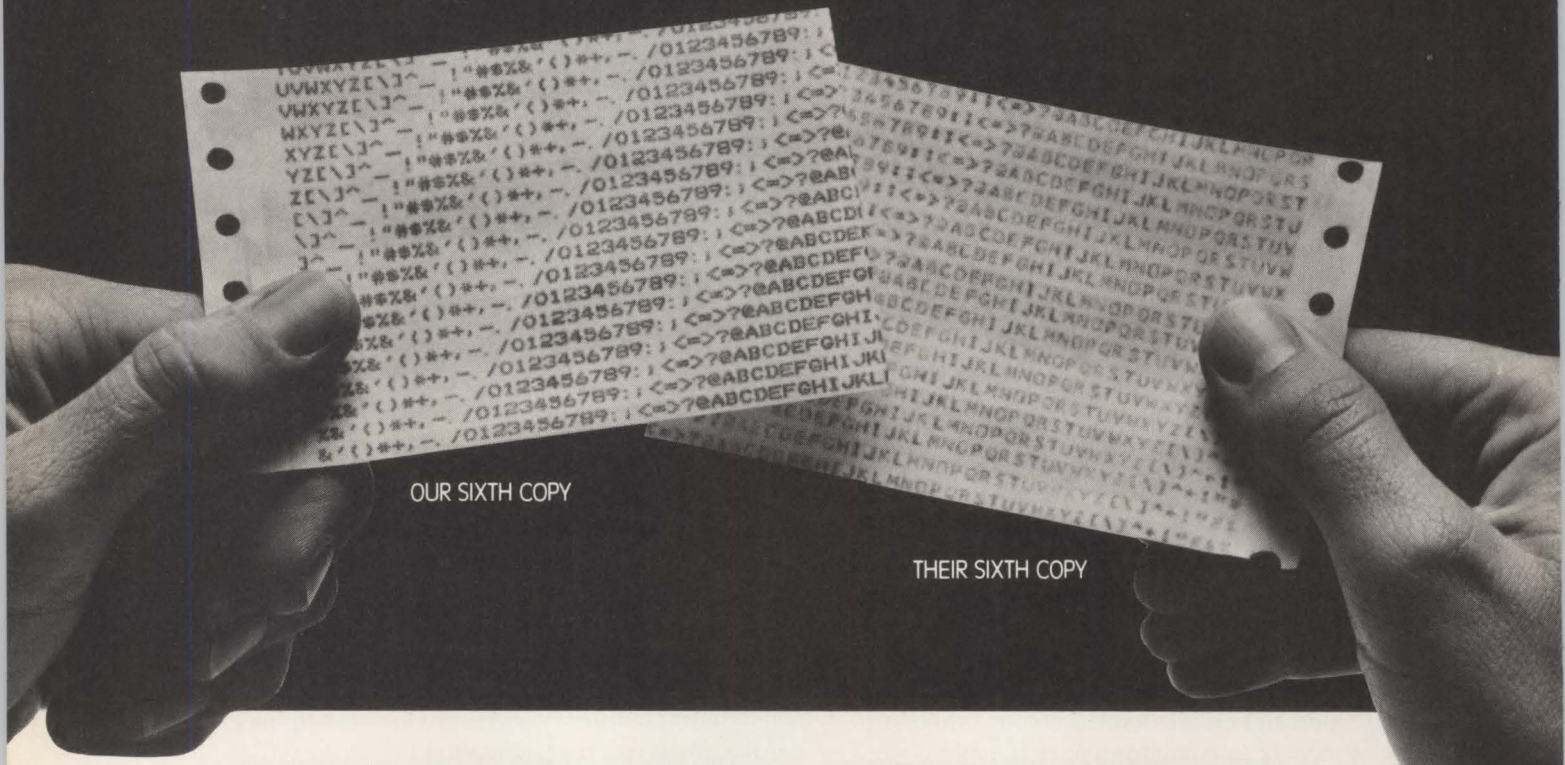

Many printers can give you good print quality on a first copy. The real challenge is to give you that same quality, copy after copy, on multi-part forms.

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CIRCLE NO. 14 ON INQUIRY CARD

and chairman of the board of MicroPro International, San Rafael, Calif., also feels that there is no conflict of interest in his dealing with Osborne because the arrangement is nonexclusive. "It's in our interest to promote the sales of all our customers' systems—not just Osborne's," he says. Rubenstein believes that the need to maintain relationships with other hardware vendors would outweigh any temptation that his company might feel to pass proprietary information about their products to Osborne. Moreover, he points out, his customers are already protected by nondisclosure agreements.

Despite the fact that he has tentatively agreed to serve as Osborne's board chairman, Rubenstein sees no conflict of interest in that area either. "I would serve on the board of any other hardware company if I were invited." Rubenstein says there has been no negative reaction from MicroPro's customers. "If there were, I'd reconsider," he says.

Gordon Eubanks, president of Compiler Systems, Inc., Sierra Madre, Calif., also feels there is no conflict of interest in his dealings with Osborne. "Owning a small portion of a company such as Osborne does not constitute a conflict of interest," he says.

However, he has put some restraints on the company's dealings with Osborne. For example, Eubanks has ruled out serving on the Osborne board. "Other hardware vendors," Eubanks explains, "have told us that participation by my company on Osborne's board would not be in our best interests." "Moreover," he goes on, "Compiler Systems has assured these customers that Osborne will not have access to any information on developments at other customer sites."

Still, the issue of potential conflict of interest has led one software vendor, whose product will be offered as a standard feature on the Osborne I portable personal computer, to reject the equity-for-license offer.

Gary Kildahl, president of Digital Research, Inc., Pacific Grove, Calif., developer of the widely used CP/M operating system, says, "I feel that, as a software company, we should not align ourselves with any one particular vendor, despite the fact that we would have liked a piece of the action." The result is that Osborne, like any other hardware OEM, will pay Digital Research licensing or royalty fees to use CP/M.

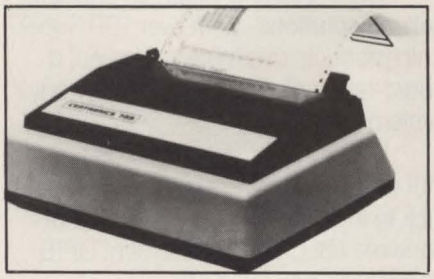
Another hardware vendor, however, applauds the equity-for-software idea. "It's an unusual, creative arrangement," says Alan O'Neill, director of marketing services at Cromemco, Inc., Mountain View,Calif., "and any software company tying up with Osborne will do well as long as he does well." O'Neill adds that "sharing the risk" may be the last growth path left to these software vendors.

—John Trifari

Japanese infiltrate low-end printer market

Within the past two years, the under-$1000 dot-matrix-printer market has been subjected to a flurry of entrants vying for the attention of personal/small-business computer manufacturers. Centronics Data Computer Corp., Integral Data Systems, Inc., and Anadex, Inc., quickly established themselves in the top three slots. Surprisingly, those companies were surpassed even more quickly last year by very low-priced entries from Japanese firms, some observers say.

"The Japanese probably have one-half or more of the U.S. (low-priced printer) market," says Ken Bosomworth, president of International Resource Development, Inc., a Norwalk, Conn., market-research firm. The main Japanese manufacturers in this market are Epson America, Inc., Okidata Corp., C. Itoh Electronics, Inc., and Tokyo Electric. Bosomworth says that even lower priced printers slated to be introduced by the Japanese could increase their market share to as much as 80 percent by next year.

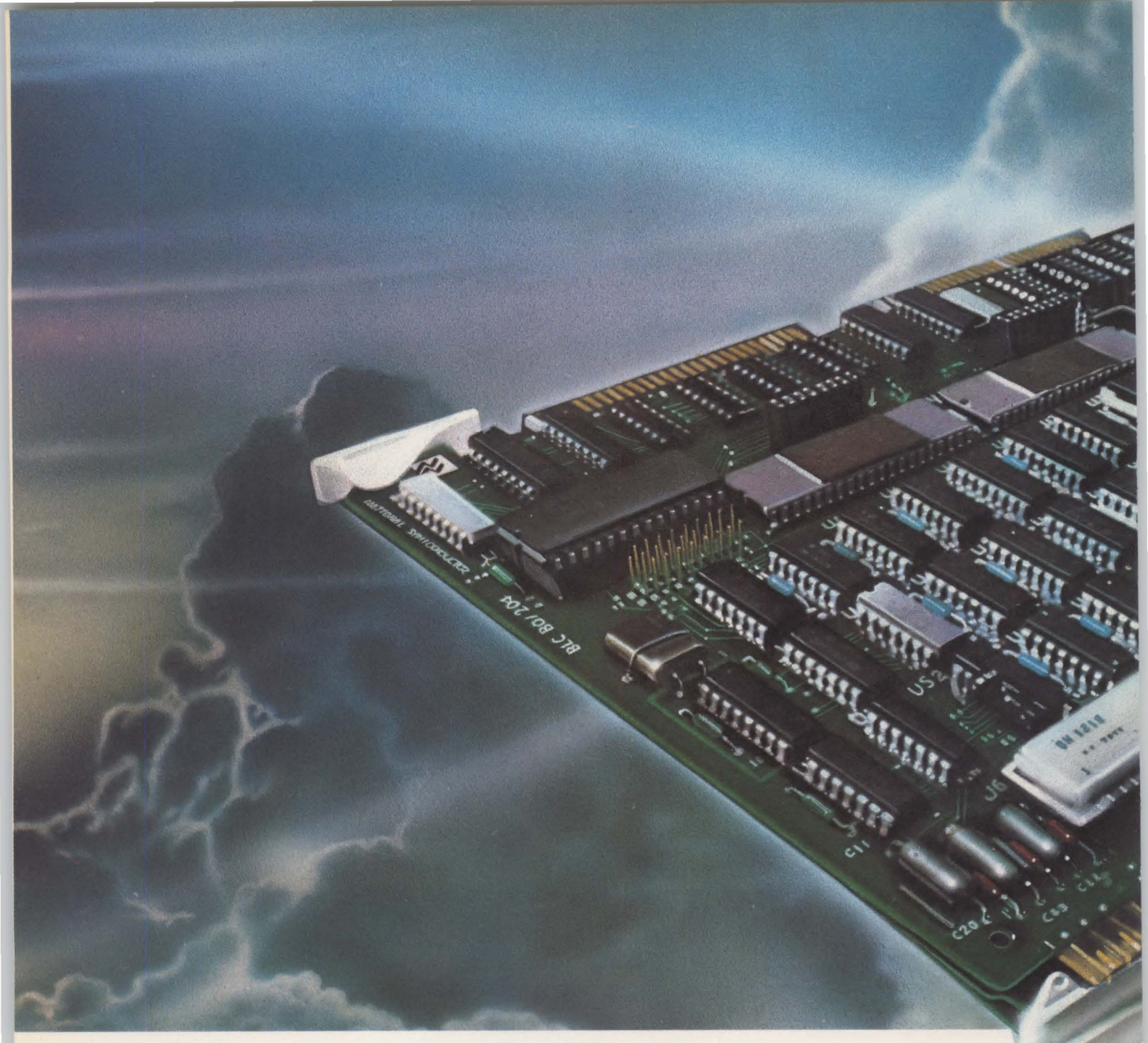


Centronics's new 739 *Miniprinter has graphics capability.*

The strength of the Japanese in the market has gotten a mixed reception among U.S. manufacturers. Some U.S. firms are trying to meet the competition head-on, some are re-evaluating their marketing strategies and others are dropping out of the market.

The U.S. market is holding the attention of the Japanese and U.S. manufacturers alike because of its size. More than 278,000 dot-matrix printers operating at less than 120 cps were shipped in North America last year, according to Dataquest, Inc., a Cupertino, Calif., market-research firm. The market is also expected to grow at a 27 percent compound annual rate over the next four years.

Many companies have looked for an explanation for the rapid



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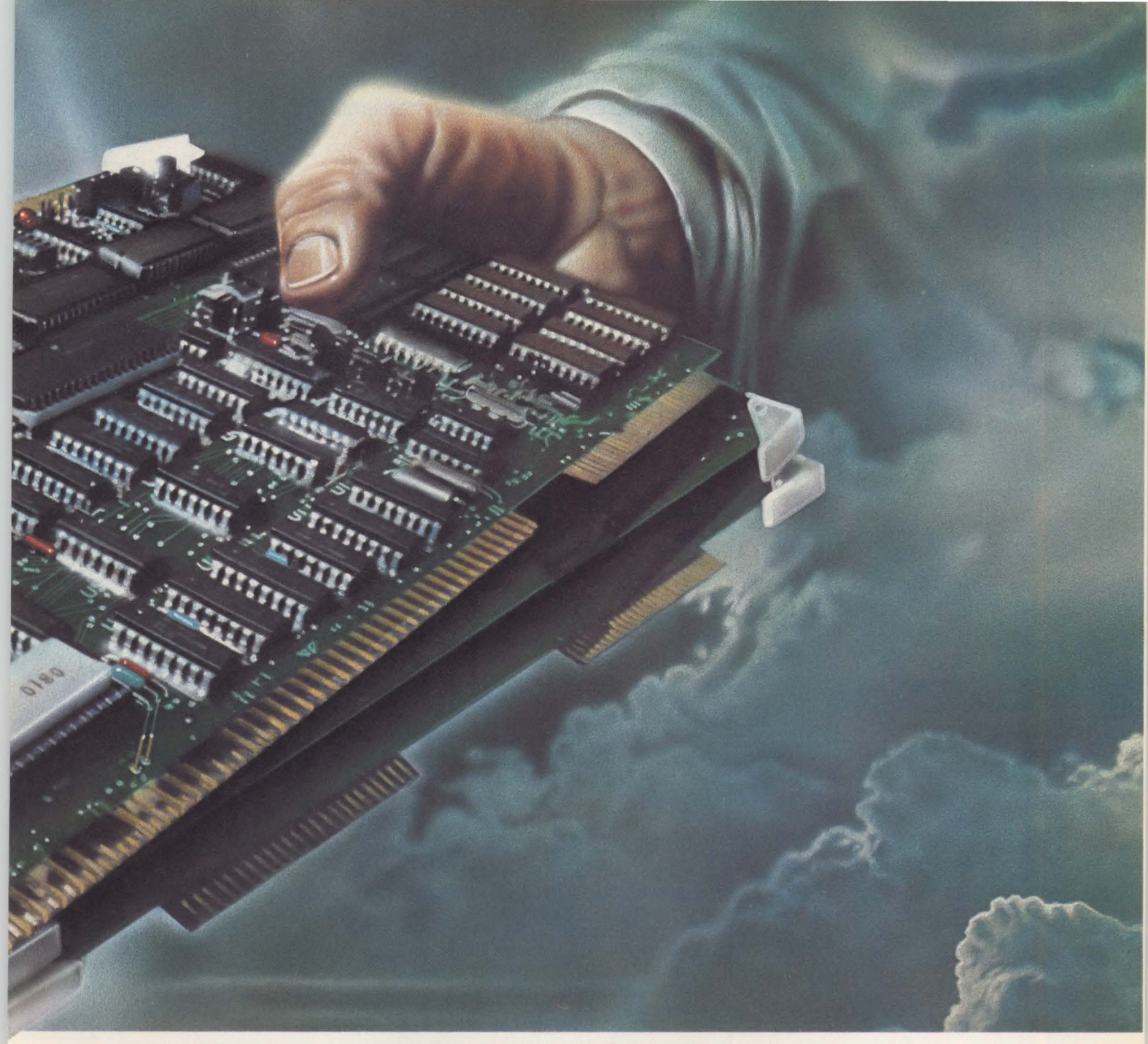

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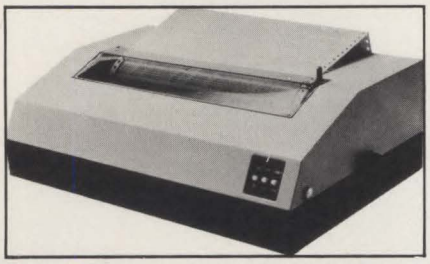
CIRCLE NO. 15 ON INQUIRY CARD

Japanese penetration of the market. The consensus seems to be that the Japanese, while maintaining very high-quality workmanship, have priced their products significantly lower than American products. The Japanese, for example, have made major inroads into the very low-end market with $400 to $500 products that are friction-fed, typically 80 columns wide and that function only as printers. The low prices and the high degree of automation in Japanese plants give them a manufacturing edge.



While C. Itoh has done well *with its Comet II dot-matrix printer, it intends to become even more competitive with new low-priced models.*

Perhaps the most aggressive performance by a Japanese competitor came with the pricing of newcomer Epson America, Torrance, Calif. Epson's 80-cps MX-80 printer, introduced last June, has an end-user price of $650 and sells for about $300 in large OEM quantities—a price that is below production costs for some manufacturers.

Chris Rutkowski, manager of market R & D for Epson, claims his company now holds 35 percent of the U.S. low-cost printer market. Key to that success is high-volume manufacturing at high quality, he says. "The MX-80 is designed so that it literally falls together in a plastic-mold case. It's easy to assemble, and the components fit together well with not much extra space between them.

"Given 90 days notice, we could supply 100 percent of the world's needs for 80-column printers," Rutkowski says. He adds that Epson shipped 10,000 printers, most of which were MX-80s, to the U.S. in March alone.

Another Japanese firm, the trading company C. Itoh, is already a strong contender in the U.S. market, selling three printers manufactured in Japan by Tokyo Electric: the Starwriter daisy-wheel printer, and the Comet I and Comet II dot-matrix printers, which sell for less than $800 and $1300, respectively. The company expects to ship 18,000 Starwriters this year, as well as 20,000 Comet I, Comet II and follow-on dot-matrix printers.

Such aggressive competition from the Japanese has domestic manufacturers in a quandary. "Almost every matrix printer is threatened by the

MINIBITS

μC SOFTWARE MARKET TO REACH $2 BILLION BY 1985

Software for μcs could become a bigger business by the end of the decade than μcs themselves. That's the conclusion reached in a report on the μc software market recently published by International Resource Development Inc., Norwalk, Conn. The report forecasts a $2 billion market for μc software by 1985—up from an estimated $600 million in annual sales in 1981. Although the bulk of the sales will initially come from business and educational users, IRD foresees a shift in importance to consumer applications by 1990, when the market is expected to reach a staggering $25 billion in annual sales. "The software-package business will continue to expand even when the hardware market approaches saturation," predicts IRD researcher David Foulger, "because μc users buy software throughout the life of their systems." As a result, Foulger says, the software business will eventually become more profitable than hardware, "just as it's more profitable to sell razor blades than razors."

SIGNETICS BACKS MOTOROLA 16-BIT μC FAMILY

Rather than going it alone in the 16-bit μc market, Signetics Corp. has decided to throw its weight behind another manufacturer's product—Motorola Inc.'s M68000. Under terms of a five-year joint development agreement with Motorola, Signetics will both second-source the M68000 μp and develop new 68000 family products, with an initial focus on communications and memory controller chips. Three Signetics-designed communications chips will be added by year-end, company officials say. Altogether, the two companies plan to develop at least 12 new 68000 products. Software will be developed with the assistance of N.V. Philips, Signetics' Dutch parent company. The nonexclusive agreement allows both companies to arrange alternate sources for the products they design. Signetics has developed its own 16-bit μp, but that chip will be offered only on a custom basis, officials say, with Philips likely to be a prime customer.

TRW/FUJITSU UNVEILS INFORMATION SYSTEM

TRW/Fujitsu Co. has introduced a stand-alone, mid-range computer system, the first hardware to be offered by the seven-year-old Los Angeles-based joint venture. Called the TFC 8500, the new system is designed for distributed data-processing applications. It incorporates a 256K-byte main-storage unit using 64K-bit RAM circuits, and a μp-based CPU. Maximum storage of 800M bytes is possible with eight disk drives connected to any combination of fixed and removable cartridge units. The system includes a work station that is expandable to 80 local and remote work stations. Prices range from $25,000—for a work station processor, CRT terminal, 120-cps printer, 256K bytes of main memory, 25M bytes of fixed-disk storage and a 1M-byte floppy-disk drive—to approximately $200,000 for seven work stations, two 670-lpm printers, 1.280K bytes of main memory and 440M bytes of fixed-disk memory. Deliveries will begin in July.

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CIRCLE NO. 16 ON INQUIRY CARD

Japanese," says Peter Wright, an analyst with the Gartner Group, Inc., Greenwich, Conn.

Perhaps the most telling victim of the Japanese onslaught is former top-seeded Centronics. Various sources estimate that Centronics once held at least 40 percent of the under-$1000 printer market with its models 730 and 737 Miniprinters, but has now been displaced by Epson as the market leader.

Evidence of Centronics's rapidly declining market share can be seen in its relationship with Radio Shack, Tandy Corp.'s Forth Worth, Texas, consumer electronics subsidiary, which was a major customer for Centronics's Miniprinters. Only two years ago, Centronics accounted for 70 percent of the printers sold by Radio Shack, says the Gartner Group's Wright. Since then, he says, Centronics's share has declined to less than half that, with Japanese printer makers accounting for the bulk of the difference.

Some industry sources believe that Centronics may lose the Radio Shack account entirely by September because of negotiations reportedly under way between Radio Shack and Seikosha, a printer maker owned (along with Epson) by the Japanese conglomerate, Seiko. Radio Shack is believed to be negotiating an OEM contract for a 30-cps dot-matrix printer made by Seikosha that will sell for as little as $259 in 1000-unit quantities.

Although he would not confirm reports that the company will go entirely Japanese by September, Radio Shack vice president of computer merchandising Jon Shirley confirms that the company already sells four printers made in the Orient. Industry sources believe that three of those printers are a Ricoh daisy-wheel printer and two dot-matrix units made by Tokyo Electric.

When asked to comment on the Radio Shack relationship, Centronics board chairman Robert Howard would say only that Radio Shack has been a customer for many years and will remain one.

Some market observers say companies such as Okidata and Epson have been able to capitalize on problems Centronics has had with its Miniprinters (see "Centronics loses market momentum," p. 41).

But Howard maintains that Centronics is still a major factor in the low-cost and other dot-matrix markets. "Epson is getting a substantial share of the market from ground zero. But that (move) took a product that sells at half the price," he says, claiming that Epson sells a product similar to its MX-80 in Japan for twice the U.S. price. Although another U.S. manufacturer confirms that report, Epson's MX-80 product manager says that product, called the MP-80, sells for about $645 in single-unit quantities, the same as the U.S. price.

Because of the Japanese onslaught, some U.S. manufacturers are re-evaluating product and marketing strategies, and others are leaving the market.

Anadex is one company that stepped out of the low-end market. "It was a conscious decision not to compete with the Japanese," says Kenneth A. Matthews, vice president of marketing at the Chatsworth, Calif., company. Epson's MX-80 is priced considerably lower than the break-even cost of the Anadex DP8000, he says. Anadex will continue to sell the DP8000, which until last fall sold into the personal/small-business computer market for less than $995. The company, however, will switch its marketing emphasis to OEM sales.

Anadex intends to focus on a medium-priced market for printers with greater speed and more features. Its newer printers, the DP9000 and DP9500, both have graphics capabilities and sell for $1550 and $1650 in single-unit quantities, respectively.

Some manufacturers have chosen to avoid the low-end, high-volume market because the type of tooling required to compete with the Japanese is expensive. One example is Dataroyal, Inc., Nashua, N.H. The company has not faced much competition from the Japanese because its IPS-5000 printer, which sells for $995 in an 80-column version, is sold to commercial users who may want some customization—a low-volume market.

Another U.S. firm feels that it can compete on quality. "We clearly see Japanese competition, but when you have a quality product, you do well," maintains Dr. Peter G. Jessel, vice president of advanced development at Integral Data Systems, Milford, N.H.

"You can compete by doing a good job in what you're trying to do, and not spread yourself too thin. We compete with the Japanese, and we do it successfully." One of the best-sellers for IDS is its model 445, which is priced at $795 without graphics, and $895 with graphics.

The demand for low-cost printers could give U.S. manufacturers a marketing edge, but availability is a problem. For example, the Centronics 737 draft-quality printer has been favorably received by customers, but not enough of the 737s are being produced. "We could sell a lot more (737s) if we got better deliveries," says Stan Goldman, a product marketer for Computerland Corp., a San Leandro, Calif., central processing depot for computer retail stores. From January until mid-March, Computerland sold 500 737s, and in mid-March 115 were on order, with 25 back orders from customers. In the same period, only 20 730s were sold, mainly because of production delays. "We didn't get enough (730s) from Centronics, so the stores sold another product," Goldman says. Even Epson was dropped from Computerland's line because the company could not meet high order

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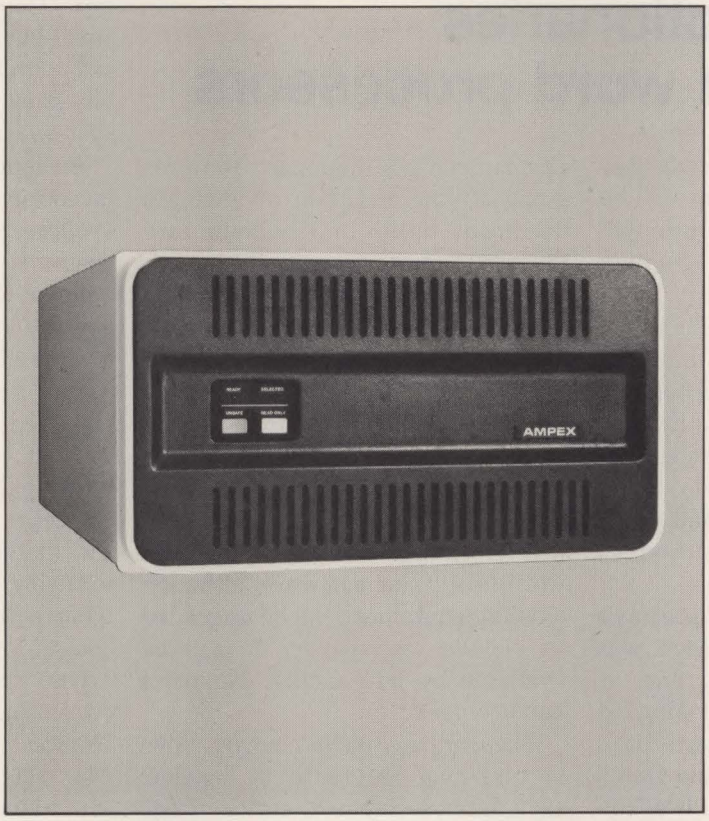

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CIRCLE NO. 17 ON INQUIRY CARD

rates. But great demand may have caught Epson just as it was ramping up for production of its MX-80 printer, introduced last June.

Michael Shane, president of Leading Edge Products, Inc., Canton, Mass., which distributes Centronics, C. Itoh and Tokyo Electric printers, suggests that one way for U.S. manufacturers to overtake the Japanese is to stock printers the way distributors do. Manufacturers should have printers on the floor, ready to ship. The process is not expensive if inventories keep moving. The Japanese are very cautious and would not hold speculative orders in this manner, he says, so that better availability could increase a vendor's market share at least 10 percent. Plus, it would buy extra time before a company must lower its prices to remain competitive.— *L. Valigra*

Spelling dictionaries catch on in word processors

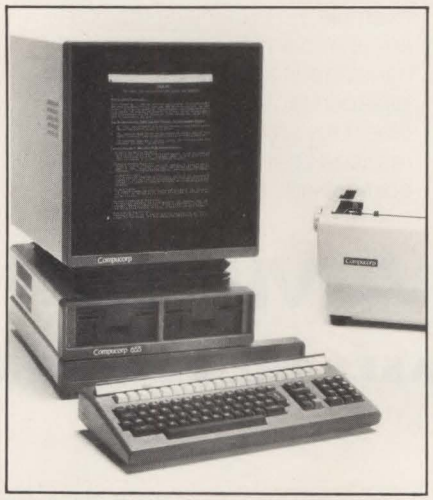
Despite concern about whether the spelling dictionaries that will be available on word processors will aid in proofreading, the idea will probably be adopted by most manufacturers. IBM and Syntrex, Inc., two companies that initiated the spellers, will add international dictionaries to existing English ones. Compucorp, Los Angeles, has added a language dictionary to its Omega word processor, and more manufacturers are expected to follow suit.

IBM's international language diskette, called Languagepack, was announced last October and is expected to be released in May. It adds French, French-Canadian, Spanish, German, Italian and Dutch to the existing 50,000-word Displaywriter dictionary. Languagepack is loaded from diskette into RAM, according to an IBM spokesman, and only one key must be depressed to "change" the speller to another language. Syntrex, Piscataway, N.J., also plans to add an international speller to its 50,000-word dictionary, a company spokesman says.

Compucorp's interactive dictionary, also introduced in October, is easier to use than the Displaywriter dictionary, claims Thomas Budlong, Compucorp's director of product management. An on-line cursor scans at a rate of 15 words per sec. and highlights misspelled words for immediate correction. Using the Displaywriter's dictionary requires going off-line and then reviewing a document after misspellings are identified, he adds.

Compucorp's speller is housed on a 650K-byte system disk, along with the operating system and word-processing and glossary functions. Budlong says the dictionary can accommodate as many as 1 million English and foreign-language words. It will be sold through dealers as part of the Omega word-processing software, although existing equipment can be upgraded to include the speller. It will be available by late spring. No price has been set.

The company made a smart move in targeting IBM with its speller, says Patricia Seybold, editor of *The Seybold Report on Word Processing*. Compucorp is known as a small-business system supplier that sells through dealers, but wants to be known as a word-processing system supplier, she explains.



Compucorp's international spelling dictionary *can include as many as 1 million English and foreign-language words.*

Although there is no way to measure how good or bad the spellers are, because none are in customer use, industry consultants believe that operators should not use the spellers as a substitute for proofreading.

One flaw of the spellers is that they cannot identify words in context, according to Amy Wohl, principal at Advanced Office Concepts Corp., Bala Cynwood, Pa. The dictionary cannot, she explains, identify whether a word is incorrectly typed "pear" rather than "pair," for example.

One company is moving toward correcting that flaw. Proximity Devices Corp., Fort Lauderdale, Fla., this year will offer a VLSI chip that identifies misspelled words and gives an ordered list of suggested corrections, Wohl says. The chip can be built into any word-processing or computer system. Wohl says other vendors will attempt to emulate that chip in their software.

Wohl says users so far are not excited about spelling dictionaries. "A speller is not real proofing, but it's better than nothing." Seybold adds that, although spellers require a lot of memory, they are a useful adjunct to a system and should probably be configured as an option. IBM's Languagepack and Textpack software requires about 224K bytes of memory, says Gene O'Neill, Displaywriter planning manager. —*Lori Valigra*

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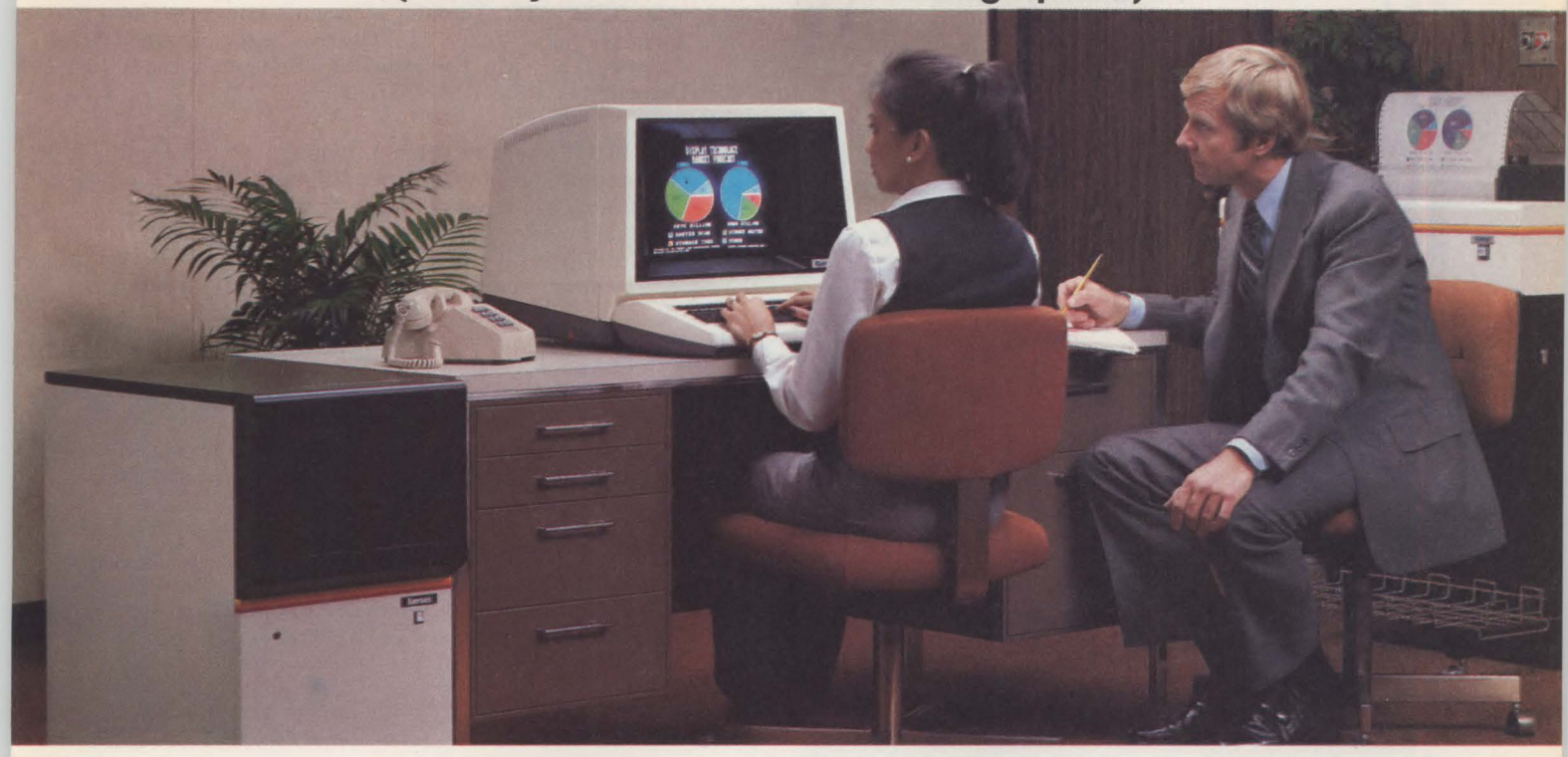

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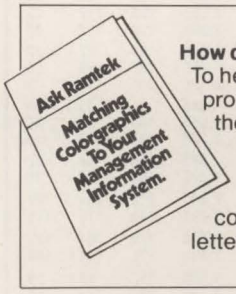

How do colorgraphics fit into your MIS picture? To help you evaluate the business graphics products on the market, Ramtek has prepared the booklet, "Matching colorgraphics to your Management Information System." It's Issue Number 5 of Ramtek's Use Our Experience Series. To get your free copy, write to Ramtek on your company's letterhead.

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CIRCLE NO. 18 ON INQUIRY CARD

Calendar

SHOWS & CONFERENCES

MAY

20-22 VIDEOTEX '81, Toronto, Canada, sponsored by Infomart and Online Conferences Ltd. Contact: VIDEOTEX '81, 316 Lonsdale Rd., Suite 3, Toronto, Ontario M4V 1X4, (416) 598-1981.

20-22 The ISMM International Symposium on Mini and Microcomputers in Control and Measurement, San Francisco, sponsored by the International Society for Mini and Microcomputers (ISMM). Conact: Paul L. Hsu, McDonnell Douglas Astronautics Co., 5301 Bolsa Ave., Huntington Beach, Calif. 92647, (714) 896-3311.

26-29 Korea International Office Management Exhibition & Conference, Seoul, Korea. Contact: Clapp & Poliak, Inc., 7315 Wisconsin Avenue, Washington, D.C. 20014, (301) 657-3090.

28 "Trends and Applications 1981," Advances in Software Technology Symposium, Gaithersburg, Md., sponsored by the NBS Institute for Computer Sciences and Technology, the Washington, D.C., chapter of the IEEE Computer Society and the IEEE Washington Section. Contact: F. Terry Baker, Program Chairperson, IBM-FSD, 10215 Fernwood Rd., Bethesda, Md. 20014.

JUNE

6-9 Atlanta Small Computer Show, Atlanta, Ga., produced by Professional Exhibition Development Corp. Contact: The Atlanta Small Computer Show, 4060 Janice Drive, Suite G-1, East Point, Ga. 30344, (404) 767-9798.

8-10 International Conference on Decision Support Systems, Atlanta, Ga. contact: Pat Van Cleve, Execucom Systems Corp., P.O. Box 9758, Austin, Texas 78766, (512) 345-6560.

10-12 Seventh Canadian Man-Computer Communications Society Conference, Waterloo, Ontario, sponsored by the University of Waterloo and the Canadian Image Processing and Pattern Recognition Society. Contact: Yvonne Fink, Conference Secretary, Department of Computer Science, University of Waterloo, Waterloo, Onatrio N2L 3G1, (519) 885-1211.

10-13 International MOTORCON '81 Electric Motors Convention, Chicago. Contact: Earl Nickel, Program Coordinator, Motorcon '81, P.O. Box 2889, Oxnard, Calif. 93030, (805) 985-1595.

14-18 1981 National Computer Graphics Association Conference and Exposition, Baltimore, Md., sponsored by the Society of Manufacturing Engineers. Contact: Jim McLaughlin, Exhibits Development Manager, SME, One SME Drive, P.O. Box 930, Dearborn, Mich. 48128, (313) 271-1500.

16-18 Nepcon East '81, New York, organized by the Kiver Organization. Contact: Industrial & Scientific Conference Management, Inc., 222 West Adams St., Chicago, Ill. 60606, (312) 263-4866.

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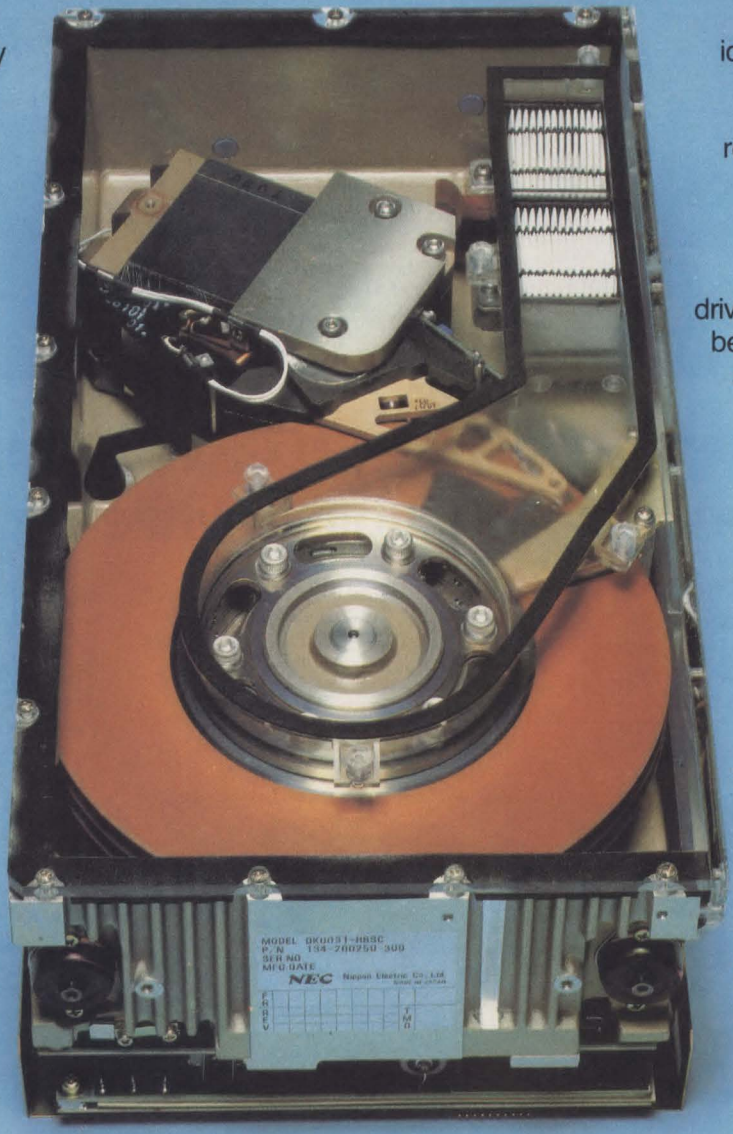
Once again, NEC leapfrogs conventional technology with its new D2200 family of eight-inch Winchester disk drives.

The first models in the series deliver 30-millisecond access time with capacities of 25.5 and 42.5 megabytes, respectively, and use conventional storage module device (SMD-type) controllers for convenient interfacing and formatting.

Sealed-disk Winchester technology is enhanced with voice-coil actuators, direct-coupled DC spindle motors and closed-loop air circulation which reduces parts count, eliminates periodic maintenance and gives the D2200 Series an MTBF in excess of 10,000 hours. When service is required, it's fast: the D2200s have a 30-minute MTTR.



The D2200 family is ideally suited to medium and heavy volume interactive business applications that require frequent disk access, as in virtual memory, database access and data communications operations.

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CIRCLE NO. 21 ON INQUIRY CARD

Charles River Data Systems MF-211 System

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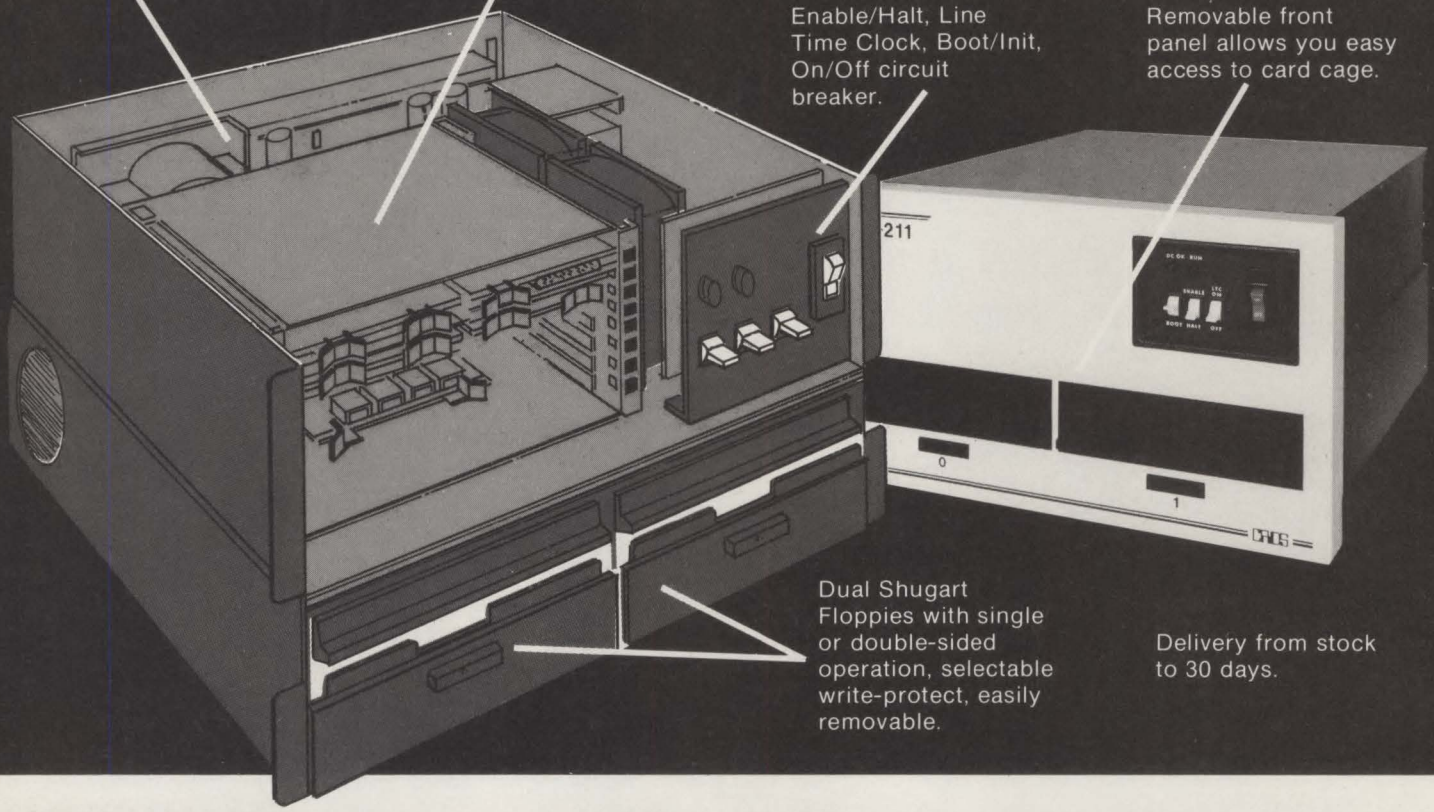

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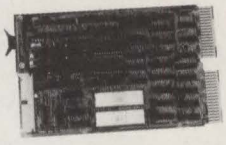

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If double-sided floppy capability is desired, simply ask for the MF-411. This system uses the Shugart SA850 double-sided drives and provides two megabytes of total storage. A diskette with a modified RT-11 double-sided floppy handler is provided with each system, assuring you of software compatibility for both single and double-sided media operation.

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CIRCLE NO. 22 ON INQUIRY CARD

Calendar

18 **ACM/NBS Symposium,** College Park, Md., sponsored by the National Bureau of Standards. Contact: Wilma M. Osborne, NBS, Room B265, Technology Building, Washington, D.C. 20234, (301) 921-3485.

22-24 **1981 National Software Conference (NSC),** Boston. Contact: Charles Bozett, AMR International, 1370 Avenue of the Americas, New York, N.Y. 10019, (212) 974-0800.

23-25 **COMDEX/Spring '81,** New York, sponsored by The Interface Group. Contact: Peter B. Young, The Interface Group, 160 Speen St., Framingham, Mass. 01701, (617) 879-4502.

24-26 **Computer Industry Trade Expo (CITE),** Atlantic City, N.J., sponsored by the Microcomputer Industry Trade Association. Contact: CITE, 110 Charlotte Place, Englewood Cliffs, N.J. 07632, (201) 569-8542.

JUNE 29-JULY 2

1981 Power Electronics Specialists Conference, Boulder, Colo., sponsored by the IEEE. Contact: William B. Collins, General Chairman, Martin Marietta Aerospace, P.O. Box 179, M/S 8130, Denver, Colo. 80201, (303) 977-3962.

JULY

15-17 **1981 Summer Computer Simulation Conference,** Washington, sponsored by the Instrument Society of America and the Society for Computer Simulation. Contact: William E. Buchanan, Co-Chairman, Applied Physics Laboratory, John Hopkins Rd., Laurel, Md. 20810, (301) 953-7100.

29-31 **1981 Microcomputer Show,** London, England. Contact: Jeff Wolf, TMAC, 680 Beach St., Suite 428, San Francisco, Calif. 94109, (415) 474-3000 or (800) 227-3477.

AUGUST

26-29 **Fifth Annual National Small Computer Show,** New York. Contact: National Small Computer Show, 110 Charlotte Place, Englewood Cliffs, N.J. 07632, (201) 569-8542.

28-30 **Personal Computer Arts Festival,** Philadelphia. Contact: PCAF-81, Box 1954, Philadelphia, Pa. 19105.

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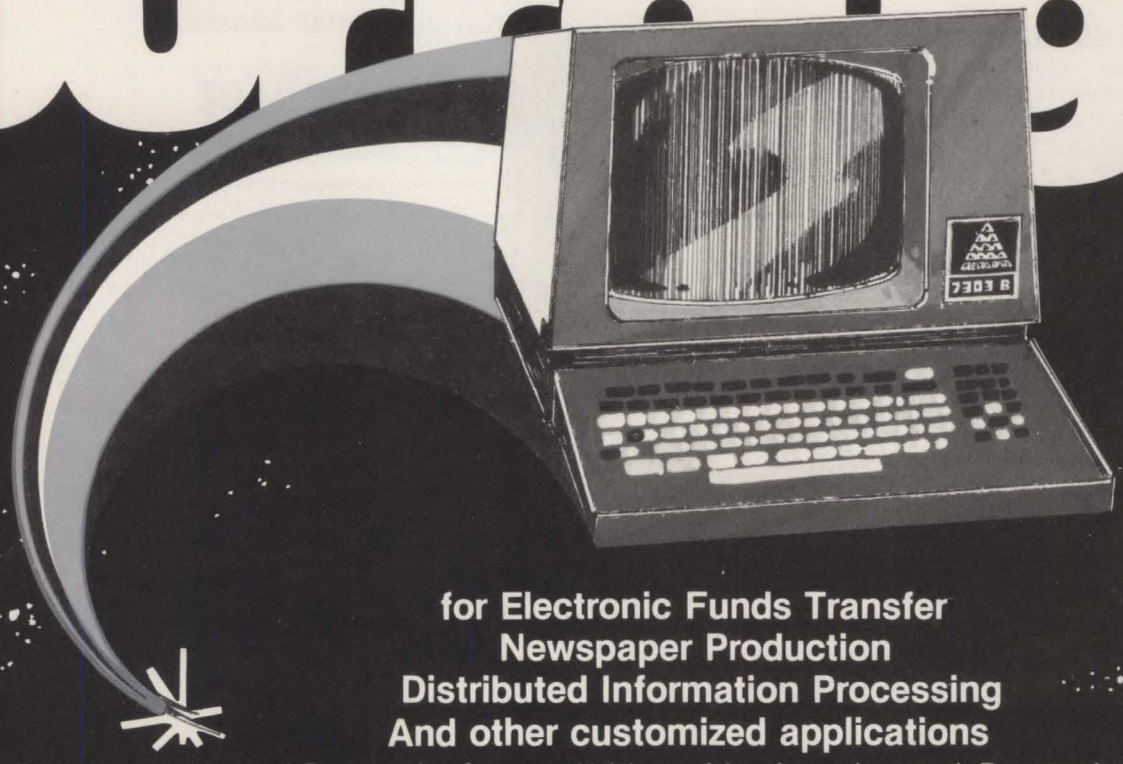

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CIRCLE NO. 25 ON INQUIRY CARD

Centronics loses market momentum

When Centronics Data Computer Corp.—long the bellwether of the dot-matrix printer market—was bumped out of the top spot in the U.S. market by foreign competition, the experience could not be passed off as a typical competitive event.

Centronics lost considerable momentum because of a combination of problems: production of low-end Miniprinters lagged; there were longer-than-expected waits for upgrades to the company's industrial-printer line; and the organization of a new management team slowed product and marketing momentum. Although Centronics is taking steps to alleviate those problems, profits are still slipping.

Company officials admit that Japanese competition—and a sluggish economy—have hurt profits (see "Japanese printers infiltrate low-end printer market," p. 27). The $130.7-million company reported a $9.3-million pretax loss in its second quarter. About $5.5 million of that loss was attributed to write-offs the company took on outdated subassemblies and equipment inventories for the models 100, 300, 500, 779 and 730 printers.

The model 730 Miniprinter, which was plagued by component problems and production delays, is selling poorly compared with its lower cost competitors, says Peter A. Wright, an analyst with the Gartner Group, Inc., Greenwich, Conn. Centronics chairman Robert Howard says sales of the 730 fell off because of the success of the model 737 draft-quality printer—a company-planned succession. Although the company will not disclose production volumes for the two products, senior vice president of finance Robert Stein says 400 Miniprinters a day were manufactured in November.

Stein says the industrial printers—not the Miniprinters—are the heart of the company's business. He contends that new models in the industrial-printer line will enhance the company's competitive position, and that Centronics will improve financially in its fourth quarter. It will not, however, yield a profit this year.

Meanwhile, Centronics intends to remain in the competitive low-end market, although other U.S. manufacturers are shunning it. The company will follow its two Miniprinter models this month with a graphics printer, the model 739.

Centronics is enhancing *many of its product lines, including a new line printer subsystem, which is plug-compatible with DEC, Data General and IBM computers.*

At least one distributor believes staying in the low-end market might not be a bad idea for Centronics, because U.S. companies can compete with the Japanese by accepting lower profit margins. "If they (Centronics) believed they could sell 500,000 units, it would pay for them to do this with lower margins," says Michael Shane, president of Leading Edge Products, Inc., Canton, Mass.

Shane recommends that the low-end products be produced in the Orient. He adds that, despite the problems Centronics has had, the company still has brand recognition—an important selling point.

Other sources contend that Centronics erred in putting so much effort into the risky low-end business—in which retail sellers, such as computer stores, know no loyalty—in favor of its strong base of industrial printers, including the models 701 and 702.

Howard counters that the company is introducing three new matrix printers, at least one of which is part of the company's N × N matrix-printer family and which uses a virtually unlimited matrix print head. Sources close to the company say the printer operates at about 200 to 250 cps, and has better dot definition and a lower price than the printers it upgrades—the models 700, 701 and 779.

Another of the new matrix printers, the model 150, is a 150-cps printer, intended for desk-top μcs, that was introduced in April. That printer is being manufactured by Brother in Japan, a Centronics spokesman says.

The Centronics line-printer family, which has been met with strong competition from Dataproducts Corp., also has new introductions. The most recent addition to that line is a 600-lpm band printer subsystem that is plug-compatible with many Digital Equipment Corp., Data General Corp. and IBM computers.

Other products on the horizon are the much-heralded Quietwriter family of printers, which addresses both the teleprinter and daisy-wheel printer markets (MMS, January, 1980, p.35), and is the company's strongest entry in the office-automation market. A year ago, Howard said the Quietwriter would not be introduced for at least another year. Although company observers speculated that the printer would be exhibited at this

year's National Computer Conference in Chicago, Howard said it would not be. The company has worked on the Quietwriter for two and a half years, but, Howard says, it is still almost a year away from introduction.

That delay might again cause Centronics some pricing problems. "The Quietwriter shoots for the daisy-wheel printer market. Those prices are now decreasing to $2000, and the price will drop further to $1500 by the end of the year," says the Gartner Group's Wright. Howard hinted last May at a price of $1300, but he says he was not associating that price with a specific product. The Quietwriter's price has not yet been set, he says, but the Quietwriter "will compete with any other printing technology with a similar configuration. It will have omni-font capability and no noise."

The delays in product introductions may be a result of Howard's restructuring of company management and reporting lines—a process he began more than two years ago and which is still going on.

Former president Howard was succeeded last May by Michael D. Kaufman, a former Xerox Corp. executive who was brought in to reorganize the company (MMS, August, 1980, p. 47). Sources close to Centronics say that Kaufman and his managers have caused the company to lose its flair for satisfying the demands of its OEMs for high-volume production. Howard denies that claim, saying, "People in large companies know how to handle high volume."

Several key people have left since Kaufman's arrival, including Kendrick Estey, former vice president of field service, who was brought in by Howard to get the Miniprinter line back on track. Estey returned to his former position before leaving Centronics, and was not replaced.

Centronics also lost two of its top engineers: Richard A. Williams, former director of engineering, and James Busse, former supervisor of engineering. They are now working for a Centronics competitor, Integral Data Systems, Inc., and a lawsuit is pending between the two companies.

Centronics's new model 150 μc *printer includes graphics capability for use with small business systems.*

The latest chapter in the restructuring is a reshuffling of top management, completed in mid-March. Most notable are the promotions of John Tincler from vice president of operations to executive vice president responsible for engineering, advance development, manufacturing, materials, facilities and business management; Neil Kleinfeld from vice president of planning to vice president of marketing and planning; and Robert Kilcullen, from vice president of industrial printers to vice president of business management, responsible for product management, business and product planning.

Although the promotions can be viewed as a dilution of presidential responsibilities, Kaufman originally stated he would delegate more authority to his subordinates to develop them into managers. Kaufman was unavailable comment. Tincler says, "The philosophy of growing managers in-house is continuing and is indicated by new promotions. We've created an office of the president. Kaufman is the president, and that's how we're operating." —*L. Valigra*

Xylogics enters packaged controller system market

With hopes of capitalizing on the experience gained over the past five years supplying DEC-compatible disk and tape controllers, Xylogics, Inc., Burlington, Mass., recently entered the packaged system market, at least a year behind its competition.

Incorporating a Digital Equipment Corp. LSI 11/23 μp, a 24M-byte BASF 8-in. Winchester-disk drive and a Data Electronics, Inc., 17M-byte cartridge-tape drive backup, the new XL 2300 uses Xylogics's own disk and tape controller boards. The system provides 96K to 256K bytes of RAM, as many as eight DL-11, RS232 communications ports, a Q-bus-emulating, 12-slot backplane and a choice of either a 110V or a 220 to 240V alternating current.

Packaged in a 10½-×19- × 25-in. cabinet and available in rack-mounted or tabletop formats, the $22,500 system can run all DEC operating systems, including RT-11, RSX-11M and RSTS/E, without modification.

Product manager Louis Finnegan says that Xylogics decided to enter the packaged controller system market to fill the gap in DEC's ability to keep up with demand.

The only comparable DEC system is the PDP-11T23, which includes a 126K-byte μp, an RL02 20M-byte dual-cartridge drive, a controller, a terminal (DEC does not sell the package without the terminal) and a desk. Housed in a 40-in.-high

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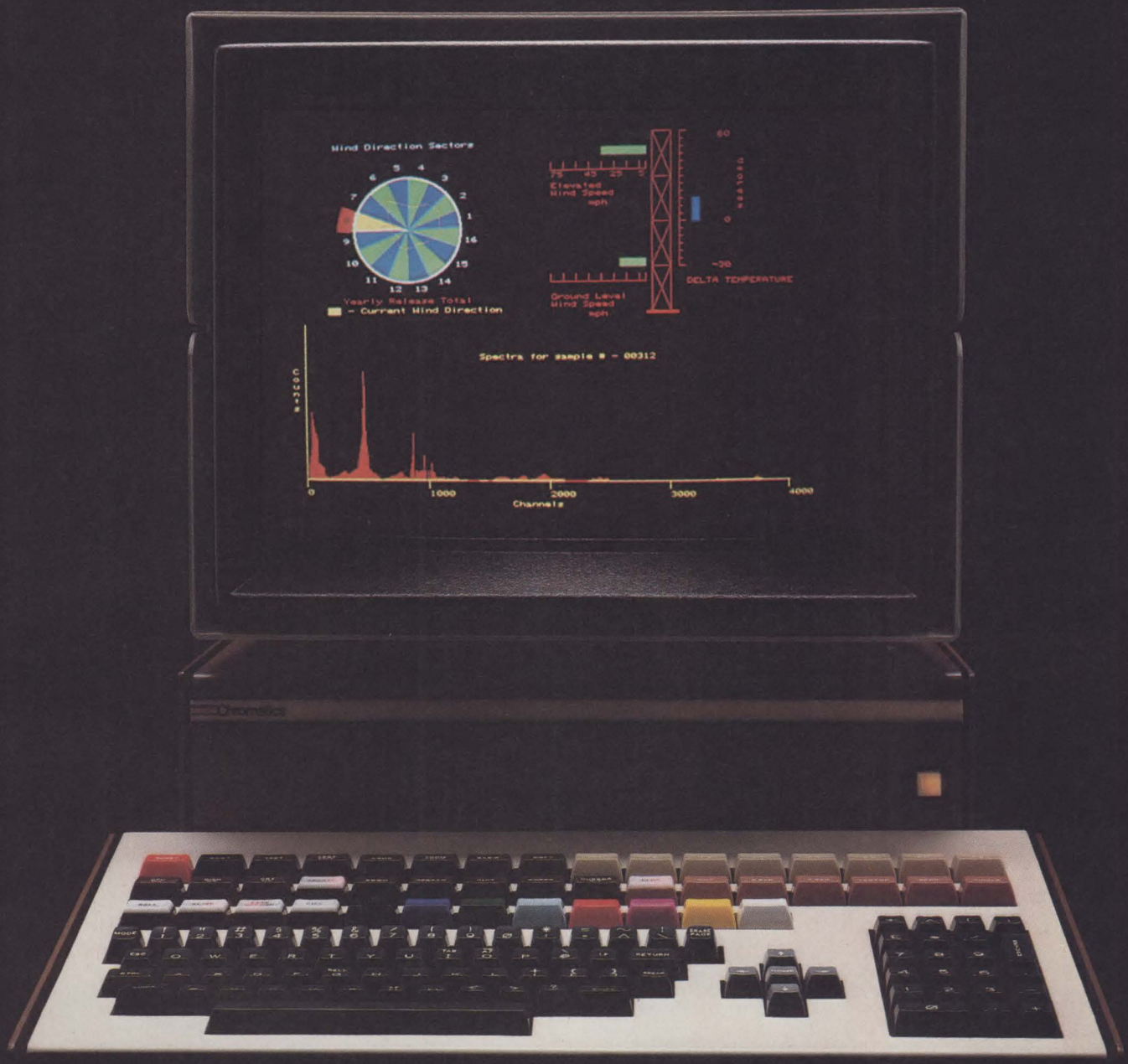

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Select from three packaging options: Rack-mount, table-top or front panel models. All three feature our 20 slot S-100 motherboard with 25 amp power supply and are delivered fully assembled and tested with our Series II™ board sets. Any board configuration you choose works with any DPS-1 version, allowing you to vary your package offering, or develop on one version and market another.

- Front Panel model — a powerful development and diagnostic tool for Z-80† systems, which can be used for prototyping, servicing, debugging, and software or hardware development. Use its features to set breakpoints, trigger scopes, single step, slow step and more.
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- Rack Mount version — features a heavy gauge frame designed to fit into standard 19" racks. CVT power supply for brown out immunity is standard.

*In Calculus, a fundamental statement in the definition of limit; interpreted here to imply: "For your integration problem, Intersystems has a solution."

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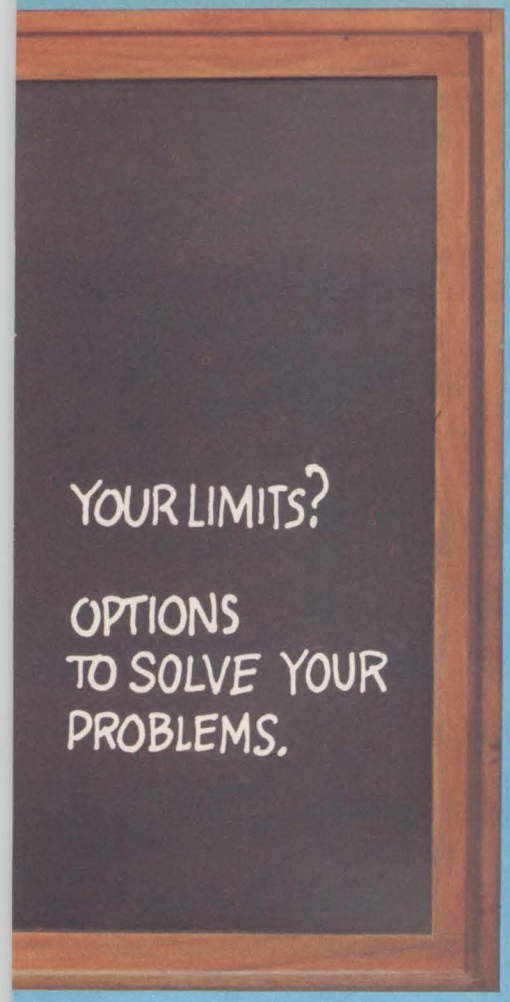
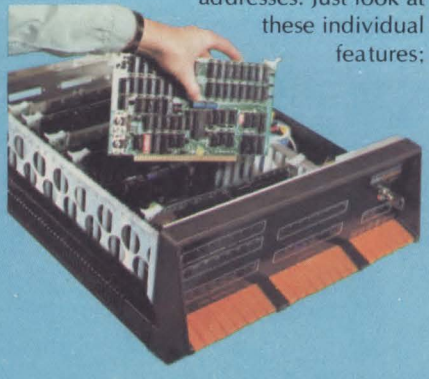


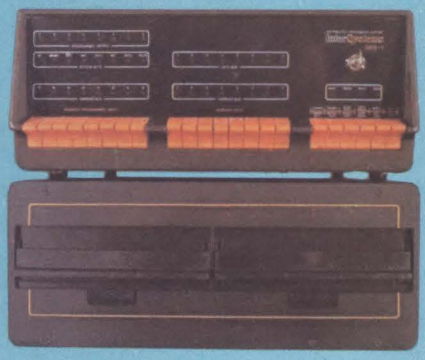
Board level options...

Intersystems mainframe packages, equipped with Series II boards, are operational in both 8 and 16 bit settings and support extended addressing in both I/O and memory space, recognizing 16 bit I/O addresses and 24 bit memory addresses. Just look at these individual features:



- MPU-80—uses a Z-80, 8 vectored interrupt lines and two 4K windows to address up to 1 Megabyte of RAM without bank select.
- 64KDR—sophisticated refresh circuitry allows unlimited DMA and absolutely reliable operation without wait states.
- 6 SI/O — six individually software-controllable serial I/O ports with optional interrupts. Each can run RS 232 at up to 19,200 BAUD, as can our VI/O board.
- VI/O—has two serial ports; two 8-bit parallel output and two 8-bit parallel input ports plus 8 individually controllable command lines and 16 levels of vectored interrupts.
- FDC II—can DMA up to a full track into 16 Megabytes of memory. Optionally generates interrupts and handles up to four 8" floppies.
- MPU-8000 — available with the non-segmented Z-8002†, which directly addresses 64K, or the segmented Z-8001†, which can directly address 8 Megabytes.

Extended systems options...



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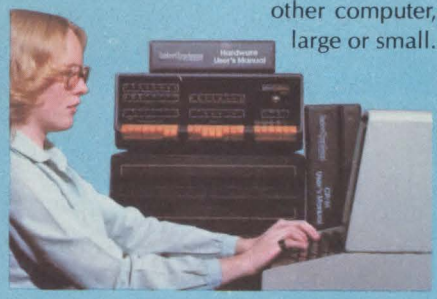

And it's reliable. The Cache BIOS System runs continuous memory tests when idle, and verifies with a Read after Write and Read after Read.

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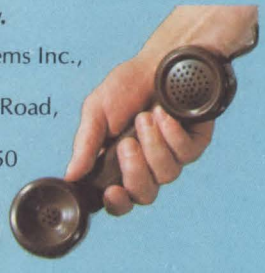

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cabinet, the system sells for $30,750. A separate TU58 tape-cartridge drive sells for $1750.

"We don't offer a product like the Xylogics package," explains a DEC source. "We're in a different market and are limited in the number of products we can develop and sell."

Other companies, however, including Charles River Data Systems (CRDS), Natick, Mass., and Scientific Micro Systems (SMS), Sunnyvale, Calif., have made headway into the packaged controller system market. Charles River Data's package, the HD-11, includes a 14-in. double-platter Winchester-disk drive with 21M bytes of formatted storage and a 15.2M-byte DEI tape-cartridge drive. The system is priced at $8700; a separate 256K-byte LSI 11/23 μp sells for an additional $7500.

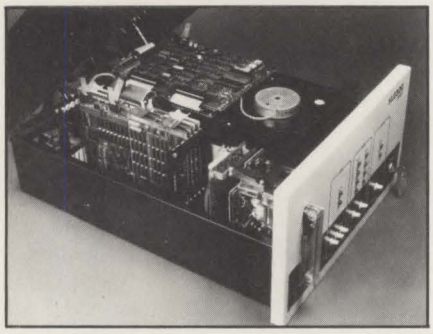
While CRDS plans to offer its package with an 8-in. Winchester by year-end, president Richard Shapiro says his company delayed the offering until the disk was proven and made more readily available.

Scientific Micro Systems' package, the DSX0100, includes an LSI 11/23 with 128K bytes of memory, a 10M-byte, 8-in. Winchester-disk drive and a 1M-byte floppy-disk backup drive. The basic system, priced at $13,500, can accommodate all DEC RT-11 and RSX-11M software.

SMS vice president of marketing Michael Liccardo says his company chose to offer a floppy-disk backup drive rather than cartridge tape because DEC software is distributed on floppies. "Cartridge tape is not yet a standardized software-distribution medium," he says. "With tape, the customer has the added problem of physically moving the software into the system."

Howard Lev, director of software at Xylogics, notes that his company has a licensing agreement with DEC and, thus, can distribute software transferred onto cartridge tape. The software is priced at DEC's list prices. Xylogics's Finnegan says his company decided on the cartridge tapes rather than floppies because they are cheaper and easier to ship and store.

The XL 2300 will be marketed to OEMs and distributed to end users through an independent dealer network. —*Frank Catalano*



Xylogics's XL 2300 packaged μc system *integrates an LSI-11/23 processor, 96K to 256K bytes of memory, Winchester-disk drive, cartridge-tape drive, eight RS232 ports and the support components required for operation in this compact cabinet.*

Printer maker turns to service organization

Small vendors of peripheral equipment often rely on distributors to service and repair their hardware. Now one such vendor—Anadex, Inc., a Chatsworth, Calif., printer maker—has gone one step further and contracted with a nationwide independent service organization (ISO) to repair and maintain its line of dot-matrix printers.

Under terms of a five-year exclusive agreement, the Customer Services Division of TRW, Inc., Fairfield, N.J., will handle all warranty work for Anadex's DP-8000, DP-9000 and DP-9500 series printers. In addition, TRW has established both quarterly and yearly contract rates for ship-in and on-site service of these devices.

The servicing agreement between Anadex and TRW could set a trend for other small peripherals makers selling into the minicomputer and μc market, believes Ken Mathews, Anadex's marketing vice president. "If you plan to be a major factor in the peripherals business, it's something you have to do," he claims.

Previously, Anadex's 16 U.S. distributors handled warranty and other service problems, Mathews says, and that was causing some problems. "The forte of the independent distributor is selling hardware, not maintaining it," he explains. "As a result, the level of service for these products nationwide was inconsistent. Some of our distributors were very good at it; others, very lax."

Now, TRW handles all warranty work, he says, and if a customer chooses to have a distributor perform any of this work, the factory will not reimburse the distributor. Mathews anticipates,

Anadex's DP-9000 80/132-column, *200-lpm dot-matrix printer. Under the firm's agreement with the customer services division of TRW, Inc., on-site maintenance contracts will be offered at $285 a year, $74 a quarter.*

however, that once the warranty period has expired, some customers will continue to have their hardware serviced by local distributors.

One reason for this may be price, and the amount of money the user has to pay up front. "Most distributors don't provide yearly service contracts," Mathews explains. "Instead, they charge on a per-call basis." Typical distributor service charges are about $45 an hour, excluding parts. TRW's charges range from $270 a year ($70 a quarter)—to service Anadex's 80-column, 112-cps DP-8000 9×7 dot-matrix printer—to $285 ($74 a quarter) for the 132/200-column, 150/200-cps DP-9500.

TRW's prices, which include parts and labor, apply to customers located within 25 miles of a service center. Premiums are charged for on-site service as far as 100 miles from a service center, and rates are negotiated for on-site service more than 100 miles away. Ship-in rates are $190 ($49 per quarter) and $205 ($53 a quarter), respectively.

Although users won't get a price break by using TRW, Mathews feels that most Anadex users will switch over anyway. The reason: "Very few of our distributors provide on-site service," he explains, "and those that do don't go out of the local area." Users will also benefit indirectly from the arrangement between Anadex and TRW, he adds. "With TRW, we will get monthly repair reports describing the problems that they've encountered when servicing our hardware," Mathews explains. "This will give us a better insight into any recurring problems we're having," which was not the case under the firm's previous arrangement with its distributors. "Reports that came back to us were inconsistent and infrequent," he says.

Nonetheless, Mathews concedes that a few of Anadex's distributors were not pleased by the decision to go with TRW. "Some felt we were taking a competitive advantage away from them," he says. "These distributors were pushing the idea of sales and service. Whenever you make a change like this you're going to get some complaints," he points out. But those distributors that didn't provide much service to begin with thought the TRW move was a great idea, he says. —*John Trifari*

Start-up firm will market high-end Winchesters

The market for high-capacity 14-in. Winchesters continues to attract the attention of investors. The latest West Coast venture funded to build this type of drive, TECSTOR, Inc., opened its doors last month in Huntington Beach, Calif., and, under a unique agreement with a West German systems vendor, plans to begin initial deliveries of evaluation versions of its first hardware offering by May 1.

The speed with which the new company plans to get its operations off the ground is the result of an agreement with BASF AG, Ludwigshafen. Under terms of the agreement, TECSTOR will have exclusive marketing rights in the U.S. and Canada and exclusive worldwide manufacturing rights to BASF's model 6150 3350-technology 160M-byte Winchester. This drive was announced last fall and has already been marketed on a limited basis in Europe.

BASF will also provide TECSTOR with tooling to build the drives, along with a servo writer and test equipment, and the funding to manufacture the first 60 evaluation units. In exchange, BASF will receive a 5 percent position in the new company, exercise exclusive marketing rights to TECSTOR hardware in Europe and obtain deferred royalties after five years on all non-BASF sales worldwide.

BASF's decision to allow TECSTOR to build and market its hardware in this country, rather than attempting to handle the chore itself, appears to be based on the fact that the German company already may have its hands full in the U.S., as far as disk drives are concerned. "They're heavily involved in getting their 8-in. Winchester operation in Los Gatos, Calif., rolling," says one source close to the industry. "BASF is also dedicating much of its energies to its Bedford, Mass., media operation."

But as a result of the agreement with TECSTOR, this source notes, BASF's hard disk activities in this country will be limited to the manufacturing and marketing

TECSTOR 6150 PRODUCT SPECIFICATIONS

Unformatted capacity	168M bytes
Transfer rate	1 MHz
Positioning times:	
track-to-track	8 msec.
Average	30 msec.
Maximum	65 msec.
3600 rpm	Rotational speed
Track density	600 tpi
Bit density	6400 bpi
Number of platters	4 (data recorded on 6 surfaces)
Dimensions	18.97 × 24.40 × 11.0
Price (250-unit quantities)	$4950 including integral power supply

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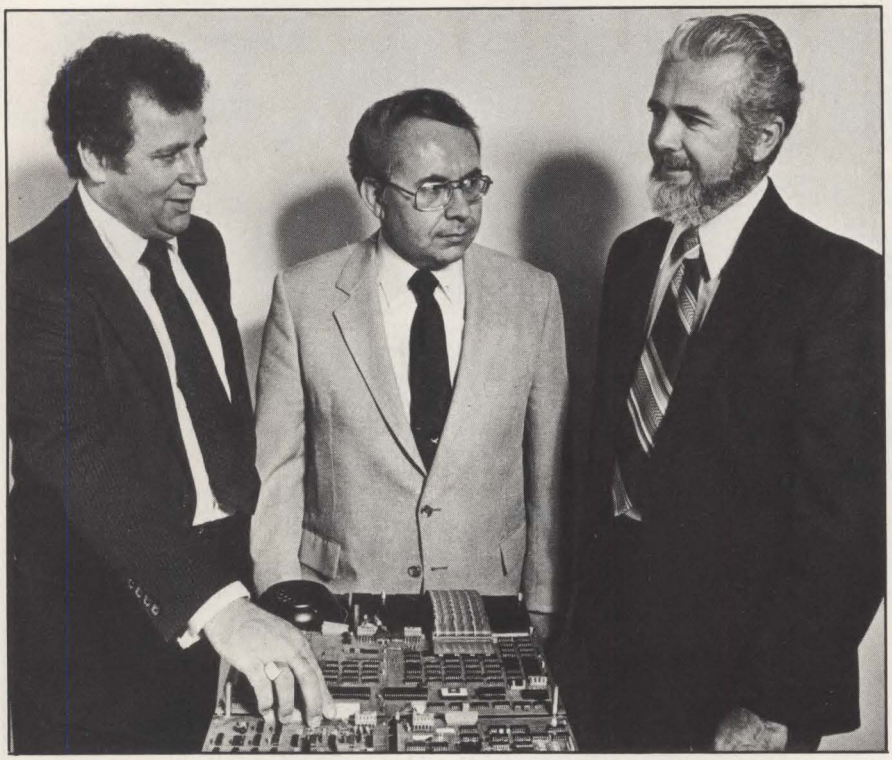

TECSTOR's new 14-in. *Winchester-disk drive is demonstrated by (from left) vice president of marketing Trevor Constable, president L. "Bus" Bleininger and vice president of engineering Bill Zeissner.*

operation set up in Los Gatos.

TECSTOR's business plans center around the 160M-byte version of the 6150 and include marketing the drive to suppliers of peripheral subsystems, as well as to vendors of high-end, 32-bit minicomputers. The start-up is also looking at the market for Digital Equipment Corp.-compatible hardware, specifically the 160M-byte RM80 Winchester announced last fall by the Maynard, Mass., minicomputer maker for its line of 32-bit VAX-11/780 machines.

TECSTOR does not anticipate any legal difficulties with DEC over its entry into the market for DEC-compatible peripherals, however. All drives will be equipped with a storage module drive (SMD) interface, leaving the matter of adapting the new hardware to a specific process up to customers. But the drive's single-board formatter design will expedite the use of other interfacing, says one company source, including emulation of an RM80. "The company is holding off on this step, however," he says. "We're looking into the legal ramifications of such a move."

TECSTOR's plans for 1982 include doubling the track density of the 6150, bringing storage capacities to the 320M-byte level. Plans for 1983 include doubling bit densities using thin-film technology read/write heads, which will boost storage capacities to 640M bytes. The 160M-byte 6150 is priced at $4950 in 250-unit quantities.

TECSTOR principals include Bud Bleininger, president, formerly vice president of peripherals at Microdata; Trevor Constable, vice president, formerly director of peripheral sales and marketing at Perkin-Elmer; Bill Zeissner, vice president of engineering, formerly director of peripherals at Microdata; and Buzz Peters, vice president of manufacturing, formerly vice president of operations at Memorex. —*John Trifari*

BOX SCORE OF EARNINGS

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

Company	Period		Revenues	Earnings	EpS
Advanced Micro Devices	Yr.	3/29/81	309,391,000	24,684,000	1.55
	Yr.	3/29/80	225,593,000	23,277,000	1.53
AMP	Yr.	12/31/80	1,155,382,000	131,274,000	3.65
	Yr.	12/31/79	1,013,241,000	121,286,000	3.36
Computer Devices	Yr.	12/31/80	20,091,000	1,182,000	.42
	Yr.	12/31/79	17,661,000	1,169,000	.48
Datum	Yr.	12/31/80	14,919,000	258,000	.14
	Yr.	12/31/79	15,233,000	200,000	.11
Decision Data	13 wks.	2/28/81	10,554,000	193,000	.07
	13 wks.	2/28/80	10,792,000	306,000	.13
Informatics	Yr.	12/31/80	125,893,000	5,332,000	2.37
	Yr.	12/31/79	112,388,000	4,470,000	2.03
International Business Machines	3 mos.	3/31/81	6,461,000,000	730,000,000	1.25
	3 mos.	3/31/80	5,748,000,000	681,000,000	1.17
Management Assistance Inc.	3 mos.	12/31/80	77,472,000	3,541,000	.43
	3 mos.	12/31/79	70,814,000	3,374,000	.41
Mohawk Data Sciences	9 mos.	1/31/81	211,451,000	13,849,000	1.20
	9 mos.	1/31/80	190,247,000	12,229,000	1.08
Sykes Datatronics	Yr.	2/28/81	24,174,000	3,354,000	.90
	Yr.	2/28/80	12,298,000	1,492,000	.49
Time Sharing Resources	3 mos.	2/28/81	2,002,949	68,873	.06
	3 mos.	2/28/80	1,332,402	90,063	.08

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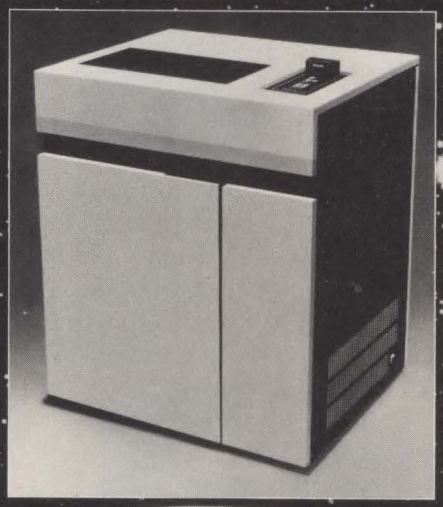

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Artelonics joins ill-defined work-station market

In pursuing a market perceived to be lucrative, manufacturers of management work stations have offered a variety of products that address the need for a system with both data- and word-processing functions. While most agree the terminals must be easy to use and must be networked to enable access to multiple sources of information, there is no widespread agreement on what the mixture of data and word processing, electronic mail and other tasks should be. The work stations and their functions will probably be more clearly defined when Xerox Corp. announces a system for managers. Until then, manufacturers may have to proceed with caution.

One company, aware that the market is not yet defined but ready to enter it anyway, is newcomer Artelonics Corp., Santa Clara, Calif., an affiliate of Shell Canada Ltd.'s new venture group. Artelonics' Series 1000 multifunctional information system, now a stand-alone product, is the first in a family of products that will be networked later this year.

"We looked at companies that have shown the ability to combine data and word processing (in a system), such as Prime Computer, Inc., Digital Equipment Corp. and Data General Corp. on the data-processing side, and Lexitron Corp., Vydec, Inc., and Wang Laboratories, Inc., on the word-processing side. That combination is still in a state of definition," says Arthur W. Odell, Artelonics president. The company describes the Series 1000 as a word processor with data communications, graphics and user-programming facilities.

The base work station, which includes an Intel 8086 μp with 64K bytes of memory, a 15-in. display, detached keyboard and horizontal scrolling to 256 characters per line, is priced at $7900. Configured as a stand-alone word processor with dual floppy-disk drives and a printer, it sells for $15,600. Both are end-user prices.

More complete systems will be configured by systems houses, which also will provide application software. Peripherals and an application development system for the 8086 are available separately. The system's memory can be expanded to include 832K bytes of RAM, two 14-in. Winchester-disk drives for as much as 250M bytes of fixed storage, and as many as eight 8-in., single-sided, double-density floppy-disk drives that yield a total of 4M bytes of storage.

Other features of the Series 1000 include 200-dot-per-in. graphics with bit-mapped memory, user programming in Pascal, the ability to use a CP/M-86 μc operating system, compatibility with the Intel Multibus, mathematics that support the Intel 8087 math and floating-point co-processor under proposed IEEE specifications, the use of multiple μps to control different peripherals and communications capabilities.

These features seem to place the Series 1000 in the minicomputer realm, and some observers are confused as to where the product fits in the market. In introducing the Series 1000, the company focused on the product's word-processing abilities, rather than introducing it as a management work station.

"It's a nice product in terms of features and the amount of information it can display," says Amy Wohl, a principal at Advanced Office Concepts Corp., a Bala Cynwyd, Pa., office consulting firm. "In a way, it competes with Wang. But, I'm having a lot of problems placing it in the market. It's too expensive for a word-processing work station. It does not appear to be entirely thought out, in that different pieces of it address different market segments." She says Artelonics might have introduced a manage-

The Artelonics Series 1000 *is the cornerstone of a family of management-information systems. Although it can be used as a word processor, it includes graphics, a CP/M operating system and the ability to program in Pascal.*

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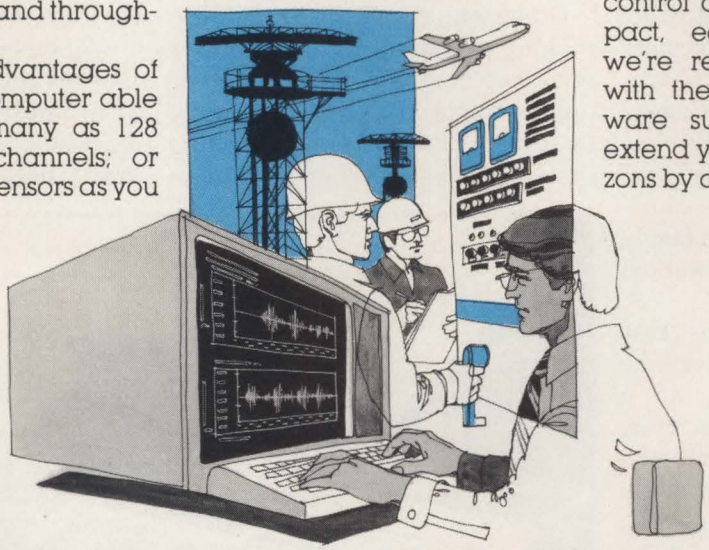

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ment work station without labeling it as one.

She says it is priced too high for a high-volume market, in which she estimates management work stations will be priced at about $6000 each.

Artelonics says the system is geared to the professional word-processor users. "The Series 1000 is truly a multifunctional system designed to serve either as a stand-alone unit or as an intelligent programmable terminal in a network of office-automation products," Ordell says. "The initial markets... are OEMs and commercial systems houses that add customized hardware and applications software, and large end users requiring sophisticated distributed-processing systems." Artelonics officials claim to have interested prospective customers in all of those areas, and say that about 15 systems have been sold in the U.S., Canada and Europe. But the company concedes that the product is expensive when used as a stand-alone word processor.

"It is designed more as a professional work station," concurs Joseph L. Ehardt, contributing editor, *The Seybold Report on Word Processing*. He explains that by using Pascal, the system could run other business- or application-oriented software, which is not typical of word-processing systems. The product's support of Multibus, he says, may be merely a reflection of the company's desire to support a conventional bus architecture. Artelonics stresses the Series 1000's multiple processors, which allow the use of peripherals manufactured by more than 50 other companies. For example, an 8089 multiprocessor acts as a controller for a Priam 14-in. Winchester in the system.

Commenting on the system's ability to use the CP/M-86 operating system, Ehardt says, "It is possible to take the Series 1000 out of its native environment by popping out one disk and putting in the CP/M disk." He says that business or application programs from independent software vendors can be run. Artelonics intends to announce support for the MP/M-86 multiprogramming operating system.

Ehardt feels the product could show promise. "It is now a stand-alone piece of equipment waiting for integration into a larger context (such as a network)," he says. Artelonics plans to unveil its networking strategies in the third quarter.

Wohl is predicting considerable activity in the management work-station market. Part of her prediction might come true in light of the impending Xerox announcement. Sources close to Xerox say that the company is readying a personal work station. Called the Star, the product is to be a commercial adaptation of Xerox's Alto system, an advanced personal computer network with management work stations that suppports Ethernet and is installed in-house and at the White House. The Star's announcement is expected to define more clearly the management work-station market.

Artelonics, however, is confident that it too has a place in that office-automation market, and the company is not afraid of competing with Xerox, IBM and Wang. The Series 1000 will soon run simultaneous electronic mail, text-editing, graphics and printing functions, the company claims. Odell says Artelonics will include a very-high-speed network and may support Ethernet. He says it is also necessary to offer IBM-compatible gateways from the local network to IBM systems. Artelonics will provide support for 3270, 3780, 2780 and bisynchronous protocols, and possibly the X.25 packet-switching protocol.

Follow-on Series 1000 family members, slated for introduction this year, include a lower priced "dumb" work station, the Series 500, which will be used in a clustered system with the Series 1000; and the Series 2000, a high-end system that will be based on Intel's forthcoming 286, a 32-bit μp upgrade to the 8086. —*L. Valigra*

New print-head drive drops Qume's prices

By incorporating a redesigned print mechanism into a new line of 45- to 55-cps daisy-wheel printers, Qume Corp. claims to have taken a major step toward reducing the price of this hardware by as much as 20 percent, while at the same time improving reliability and performance.

Called the Sprint 7 and Sprint 9, the two new printers use a single-belt, direct-drive mechanism called Microdrive to position the print head along the platen. According to David Witkowski, manager of terminal products at the San Jose, Calif., ITT subsidiary, Microdrive replaces the steel cable and pulley drive used in other daisy-wheel printers, including Qume's Sprint 3 and 5 models, and reduces the size, weight and complexity of the new printers.

"Our goal," says Witkowski, "was to bring the per-unit end-user price down to $2500 from the current $3000 per-unit price." In single quantities, an end-user 45-cps Sprint 9 with a limited control panel (form-feed switch and power, ready and ribbon-out indicators) is priced at $2300. A full control panel

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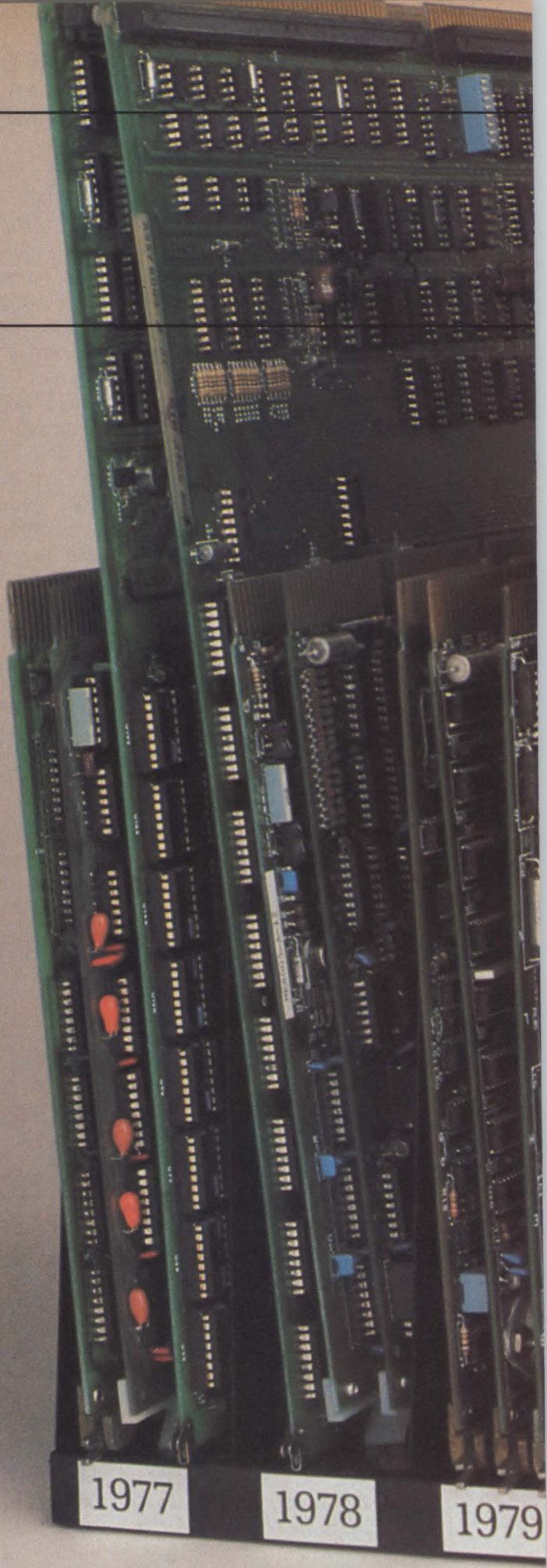

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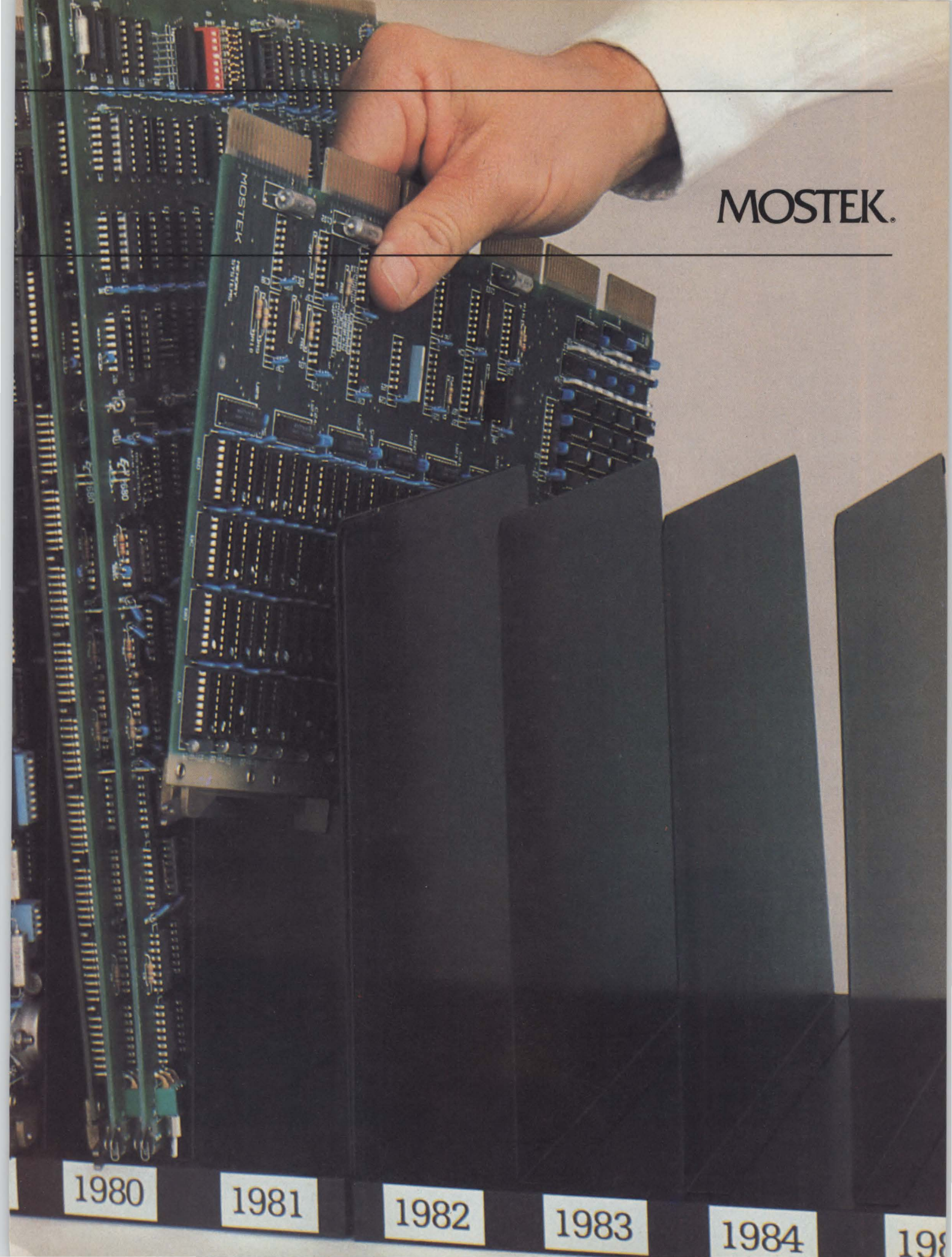
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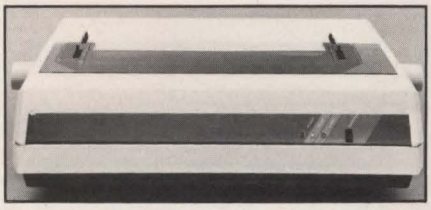
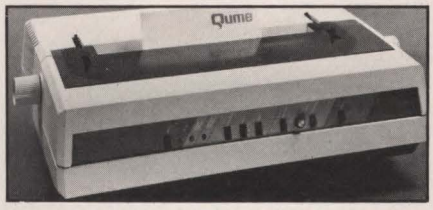
version (controls for pitch, line space, forms length, etc.) sells for $2450. A 55-cps Sprint 9 sells for $100 more in each case.

"The announcement is a step in the right direction for Qume," says industry analyst Andrew Roman, Newark, Calif. "The printers will improve Qume's competitive position," he says, "but they're about a year late."



Qume's Sprint 9 *is a letter-quality, receive-only daisy-wheel data terminal, featuring the new Microdrive printing mechanism.*



The new Qume Sprint 7 *is an advanced daisy-wheel printer, featuring the Microdrive printing mechanism and improved letter-quality printing.*

According to Roman, Qume shared about 75 percent of last year's $310 million OEM daisy-wheel printer market with Xerox subsidiary Diablo Systems, Hayward, Calif. Diablo, however, has been shipping a Sprint 7 and 9 competitor, the model 630, for almost a year, giving Diablo a substantial market edge, Roman says.

The Diablo 630, says a company spokesman, was introduced in March, 1980; shipments began last fall. According to the spokesman, the 630's print mechanism is a simplified version of the one used in the company's earlier printers. The 630, for example, uses about 50 percent fewer electronic and electromechanical parts than Diablo's HyType II daisy wheel, the spokesman says. The 630 is a 32- to 40-cps device and can use either a metal or plastic print wheel, depending on print quality needed, the spokesman adds.

Roman believes that Qume's Sprint 9 end-user prices are competitive only with Diablo's 630, and not the breakthrough Qume claims. Prices for the 630, which are set by dealers, average around $2700 per unit, says the spokesman.

Roman also expects Qume's OEM prices for the Sprint 7 to be comparable with Diablo's pricing. Neither Qume nor Diablo will release OEM prices.

"Qume is in a catch-up mode," Roman points out, adding that he does not expect the Sprint 7 and 9 to affect Qume's market share significantly. Qume's Witkowski disagrees with that assessment, saying that Qume is not playing catch-up because the Sprint 7 and Sprint 9 are radically different products from the Diablo 630. "We have totally redesigned the products and not just reduced the amount of electronics," he says. Qume has begun delivery of both printers.

Microdrive, according to Witkowski, uses a drive belt made of Kevlar, a DuPont plastic that has been used for timing chains and fan belts in automobiles—applications that attest to the material's reliability. Qume's use of Kevlar is the compound's first application in printer technology, he adds.

Qume is also using a carbon fiber print-head carriage, which reduces the mass of the print-head mechanism. Witkowski says the lighter carriage has allowed Qume to use a high-capacity ribbon cartridge. The Sprint 7 and Sprint 9 will accommodate Qume's new Multistrike IV cartridge. The company says the new ribbon will print 375,000 characters—about 50 percent more than current capacity.

Qume has also been able to cut the electronic parts count by 30 percent because of the new drive mechanism. In the Sprint 9, for instance, says Witkowski, the number of circuit boards has been reduced from four to three, and in the Sprint 7, from three to two.

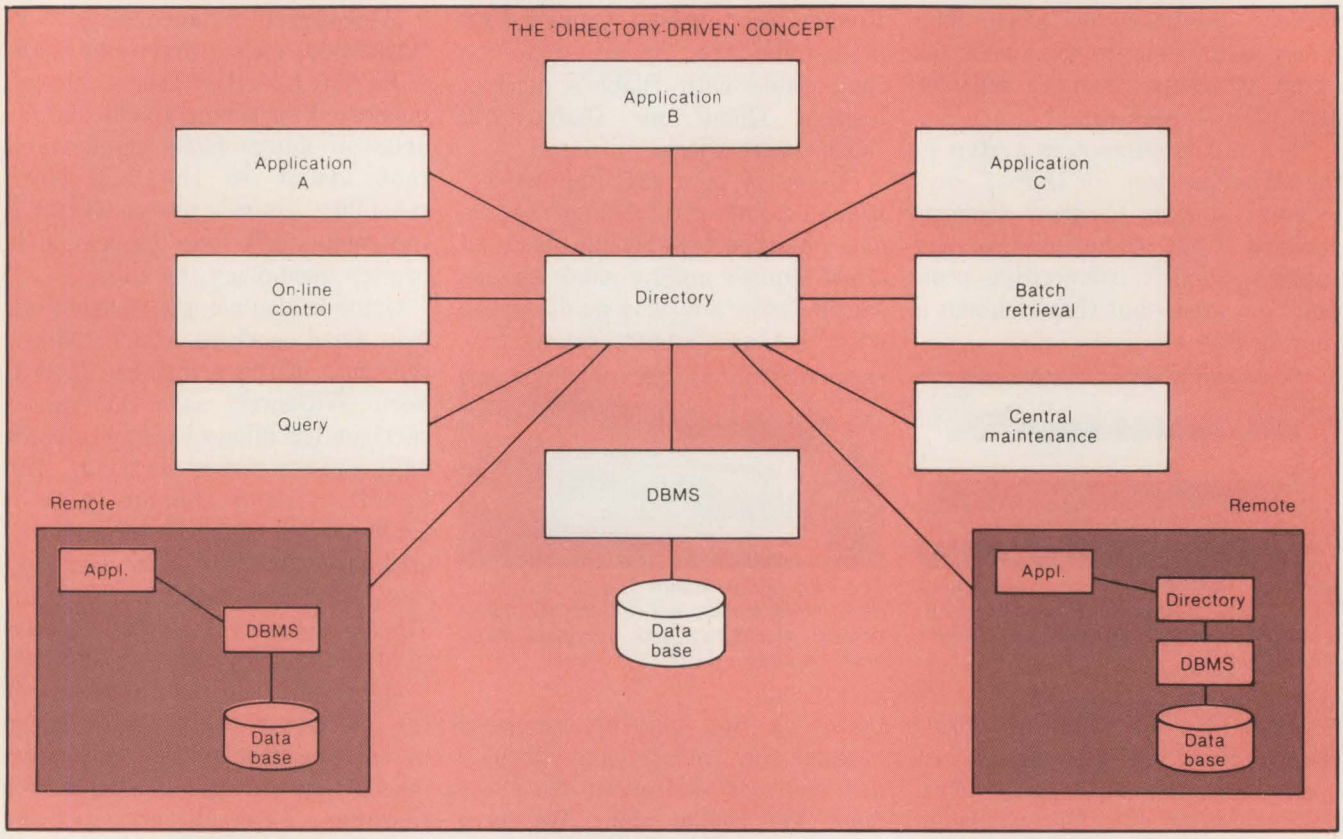
—Larry Lettieri

Mantis development system cuts programming time

Maintenance costs for computer software have soared over the past 20 years, depleting the funds for application-software development. Only 8¢ of each data-processing dollar goes to application development, estimates Thomas M. Nies, president of Cincom Systems, Inc., Cincinnati. Cincom has announced an application-development system—Series 80 Mantis—intended to help redirect some effort into new software development by decreasing programmer training and program writing time.

"More than 90 percent of all data-processing organizations are plagued with a severe application backlog, which, on average, will require 3000 man-hours to overcome," he says. "Fifty percent of these applications will require more than one year to develop. For 90 percent of all programs developed, maintenance costs will exceed development costs."

Mantis can cut development time by eliminating batch programming steps, increasing end-user input during development and incorporating a more efficient data base management structure. Mantis, an



Part of Mantis's efficiency *lies in its use of a new data base architecture.*

English-like, high-level language program, will initially be used for on-line programming on mainframes. It is compatible with the IBM DOS/OS operating system and is available for both IBM CICS and Cincom Series 80 Environ/1 on-line control monitors. Mantis versions for minicomputers are more than a year away. The first offshoot will be developed for Digital Equipment Corp. VAX superminis, says Richard French, minicomputer product manager.

Features of the new program include on-line creation of screens and files, testing and debugging, documenting systems, placing systems on security menus, writing programs and providing on-line aid. An automatic interface to Series 80 Total data base and standard files is provided. Users can be actively involved in developing programs, which makes the final result more accurate, the company claims. System prototypes using Mantis can be built, enabling users to test applications. A major reason that long-term efforts to develop application software fail is lack of user input, Nies says. After a user outlines the desired applications, changes to the software are not typically allowed until the program is installed. Nies says this is where the problems begin and where maintenance costs climb.

In addition to increasing end-user input, on-line programming with Mantis reduces development time. A benchmark study showed that 80 hours were required to develop a program using conventional COBOL programming techniques, IBM's DMS (development management system) required 24 hours, and Mantis required five hours.

Mantis is also said to reduce programmer training time, because it is menu-driven and easy to use. Using a high-level conversational language, programmers can create usable codes while creating screens. An average airline system requires seven weeks of training for an experienced user, claims Merle Parks, Mantis product manager. "The $6000 to $10,000 cost commonly associated with training new programmers can thus be saved," adds Nies.

Part of Mantis's efficiency lies in its use of a new data base architecture. Nies says that data base management systems to date, including Cincom's, have been defective in overall architecture and data structuring implementation.

"Everything (applications, inquiry, report writer, teleprocessing monitor, data dictionary, batch retrieval, on-line control, query, central hardware, etc.) revolves around the data base manager, which is the problem," Nies says. The new architecture employs a directory, driven by the data base manager, to "run" these tasks.

—Lori Valigra

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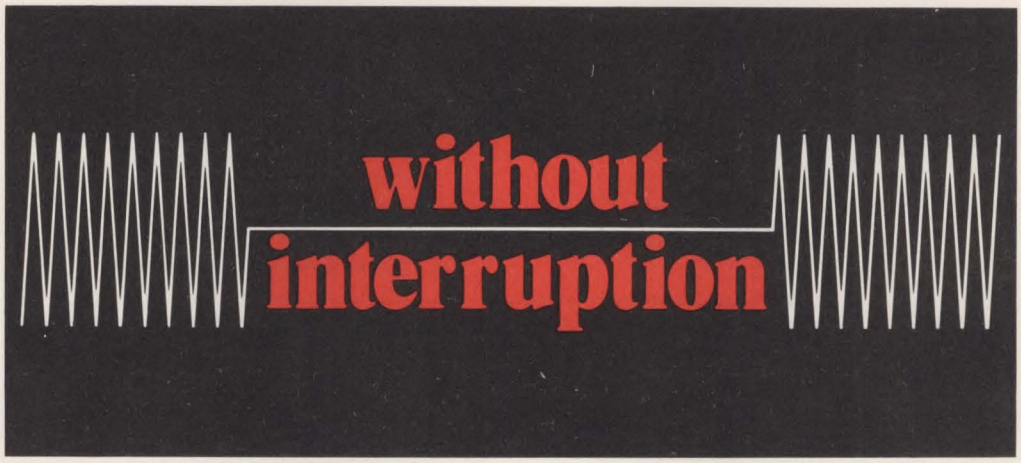

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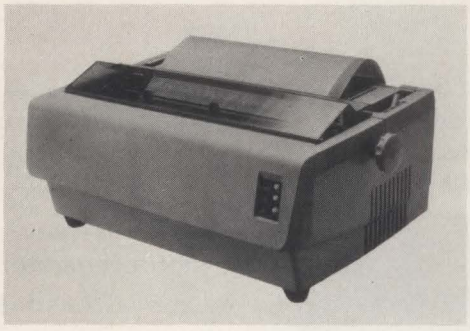

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Circulation Manager
Sherri Gronli
(303) 388-4511

Director of Marketing
Richard B. Dalrymple

Promotion Manager
Susan Rapaport

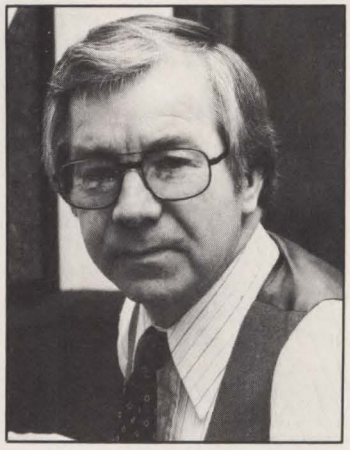
Editorial Offices

Boston: 221 Columbus Ave.
Boston, MA 02116
(617) 536-7780
Paul Kinnucan

Los Angeles: 5670 Wilshire Blvd.
Los Angeles, CA 90036
(213) 933-9525
John Trifari

San Jose: Sherman Bldg., 1 Suite 1000
3031 Tisch Way
San Jose, CA 95128
(408) 296-0868
Larry Lettieri

Office automation and 'micro-mainframes'



Instead of offering editorial opinion this month, I'd like to call attention to two unrelated articles in this issue written about topics we think are especially important: office automation and μps. The first article was written by Paul Kinnucan, our news editor, about Datapoint Corp.'s move into the digital private branch exchange business, and begins on p. 15. The other article, by consultants Jack Hemenway and Bob Grappel, begins on p. 73, and is their evaluation of Intel Corp.'s 32-bit "Micromainframe" μp.

Datapoint's so-called Information-Switching Exchange appears to be the embodiment of a recognition by Datapoint officials that one way to compete for the office-of-the-future market is to tap into it by means of the office telephone system.

That view is shared by Gerard Currie, president of Centigram Corp., a Sunnyvale, Calif., manufacturer of voice-recognition and response systems. Currie is convinced that a battle for the office-automation market is shaping up between traditional data-processing equipment suppliers and companies who have some control over wiring office buildings.

He says the biggest cost in implementing the office of the future will be wiring the building, to the tune of about $1000 per terminal location. Currie believes wire or cable-stringing companies that also have PBX-like products will have the inside track in the office-automation sweepstakes because they have the labor force in place to do it.

Turning to the Intel 32-bit μp, the iAPX 432, Jack Hemenway tells us that the product is as different from previous μps as the horseless carriage was from its predecessors. He says that some of the questions he's heard about the 432 have been senseless, and likens them to asking about the first automobile: "How many bags of oats does it eat?" We hope this article offers more insight into a development that will become increasingly important to systems integrators as Intel begins to deliver the product.

Lawrence J. Curran
Editor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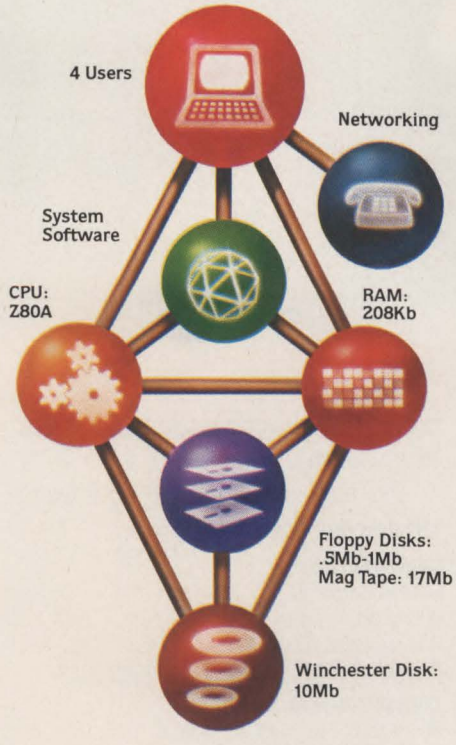

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Letters

SHALLOW SOFTWARE

To the editor:

If any of your readers are interested in μcs from a user's standpoint, you could do them an extremely large favor in three easy steps:

- Save the headline and first paragraph from "An overview of the CP/M software market" (MMS, February, p.167).
- Throw everything else in the article away.
- Do a new article with the same title and first paragraph, but this time with some real meat in it.

As it stands, the article is extremely shallow and, while it will not offend anybody, neither will it do much good.

I'm running four 64K-byte μcs right now: two Altos with IBM 3101 terminals, a TRS-80 model II and a Western Digital Pascal MicroEngine with an ISC 8001G color terminal.

I'll avoid going into the gory details of how difficult it is to buy a μc system from any of the manufacturers whose ads you see all over the place. Because the article was about software, I'll start with CP/M.

I quickly discovered that CP/M itself is only a basic operating system that comes in a wide range of flavors. As a result, I own CP/M systems from Lifeboat Associates, FMG, Pickles and Trout and Altos. The best implementation appears to be the Pickles and Trout version because of the extra utilities and friendlier user interface that they've added to the basic CP/M framework.

As the article said, CP/M has the advantage of having a great deal of software that can be run on it. Unfortunately, there is also a great deal of software that won't run on it, and the warning about bad software wasn't strong enough.

A payroll package I bought comes immediately to mind. After six new patches and diskettes to fix bugs in the start-up procedures, I managed to browbeat the author into refunding my money.

The comments about word-processing systems were too glowing. We've just done an analysis of the real word-processing systems (Lanier, IBM, Wang, Xerox, Olivetti, etc.) for a client, and the CP/M systems don't compare favorably, at least not as word-processing systems.

If you're a computer hacker, you'll love the software I've got sitting in my closet. It'll do just about everything that any of the commercial systems will do, and, in some areas, a bit more. However, there are 101 different

Letters

control and letter codes to learn.

I think you could have saved μc users a lot of grief by naming names and pointing fingers or by applauding where appropriate.

So far, what I've seen reminds me of a "water-walker", a little bug you see skittering around on the surface of a pond without ever getting wet.

H.J. Pawluk
President
Pawluk Advertising, Inc.
Los Angeles, Calif.

LOWERING THE NOISE

To the editor:

Thanks for including NEC Information Systems, Inc., in "Line printers continue their impact" (MMS, January, p. 60). Unfortunately, there was a mistake in the comments section of the table (p. 69). Just for the record, the reference to NEC's noise reduction should be 56 dBA.

Douglas G. Campbell
Manager, Marketing Communications
NEC Information Systems, Inc.
Lexington, Mass.

DISTRIBUTION CHANNELS

To the editor:

I wish to point out an error in "Winchester market shifts to 5¼-in. drives" (MMS, February, p. 84). Fig. 3 (p. 97) should show that distribution does sell to minicomputer/μc manufacturers and OEM system houses.

Hamilton/Avnet, an industrial distributor for Shugart, has been selling the SA1000 series to many of the manufacturers that add value through hardware and software. Seagate and MPI also have industrial distributors that sell to manufacturers for their products.

I believe it is very important that you, as an industry publication, and Mr. Roman recognize the authorized channels and support them. It is needed to mature this part of the industry.

Richard O'Melveny
Vice President
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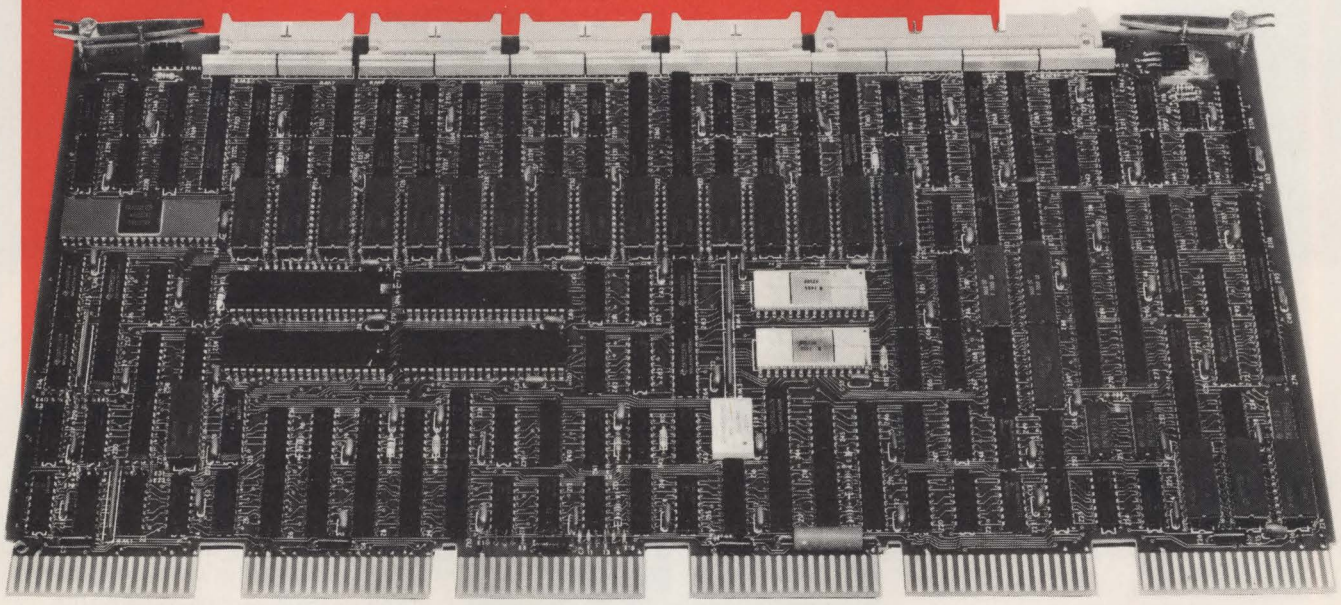

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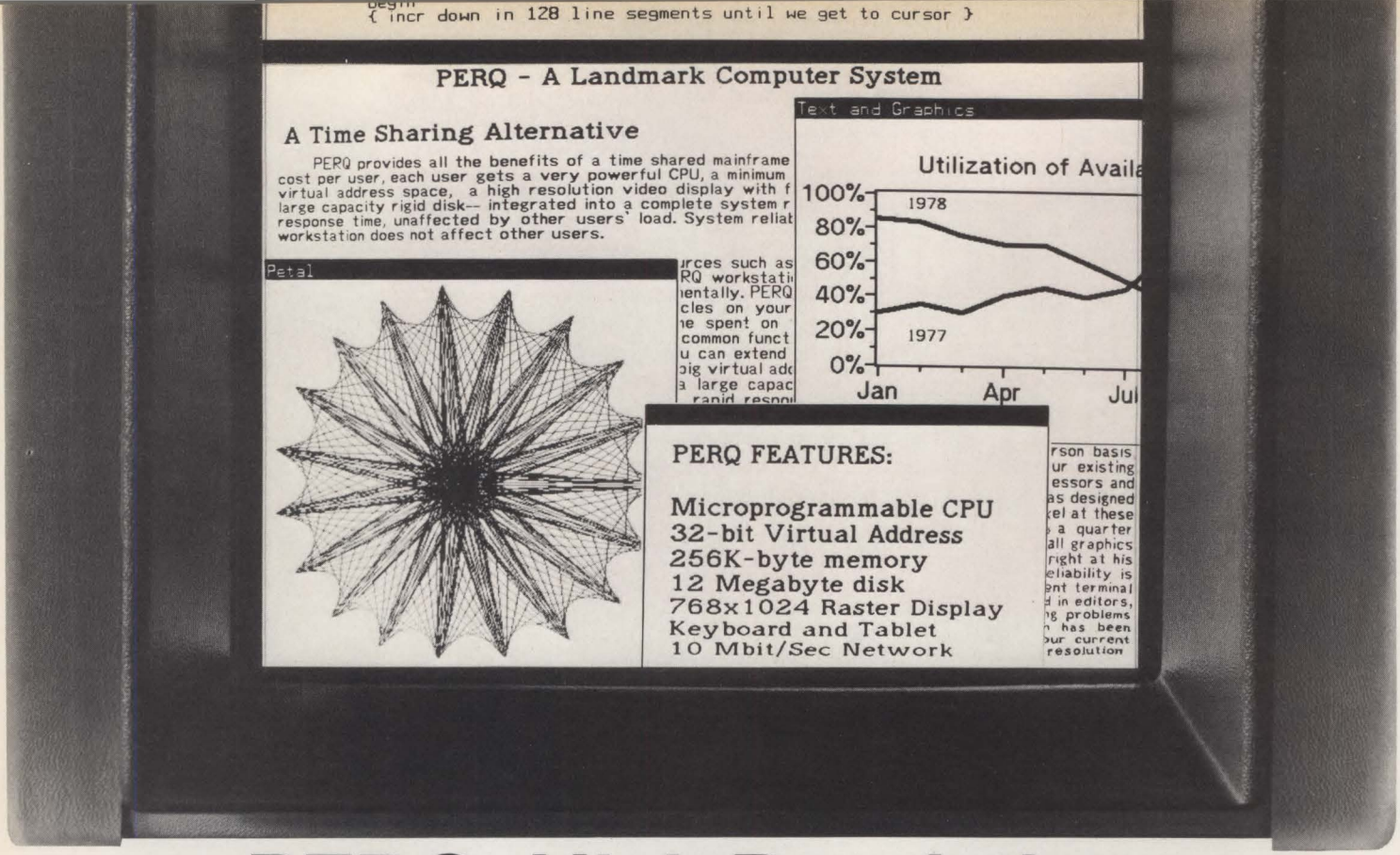

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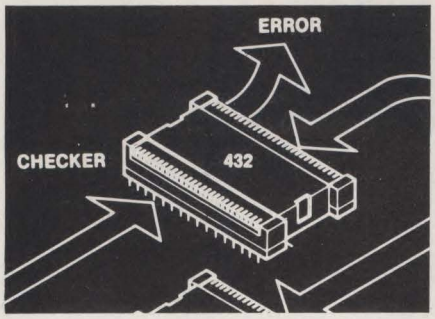
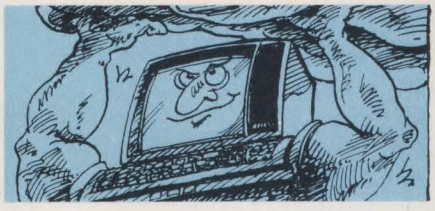
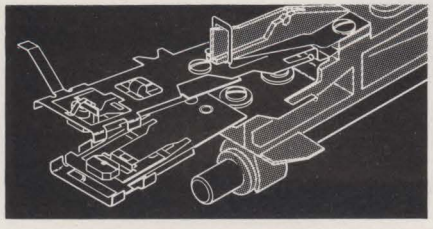


73 When Intel announced its iAPX 432 μp in February, industry attention was focused on word length as the processor's key innovation. And justifiably so. As the first μp to handle data in 32-bit chunks, the 432 promises to open new markets for computer applications. But as the 32-bit market develops, many industry observers believe that other 432 innovations could become even more significant. The reason? It is believed that software development could become the biggest hindrance to the broad development of 32-bit markets. Consultants Bob Grappel and Jack Hemenway take an in-depth look at the 432.

91 Success in the expanding printer market will require the effective combination of data- and word-processing capabilities in one printer. In response to this need, Florida Data Corp. has unveiled the first models in a new series of Office Systems Printers. The high-speed dot-matrix printers offer the throughput of a 300- to 600-lpm printer for data processing, and letter quality as fast as 150 characters per sec. for word processing. And the printers can accommodate virtually any kind of commonly used paper or form in the same mechanism.



119 Is the 16-bit minicomputer dead? Not yet, says Efrem Mallach of Honeywell Information Systems Inc. Mallach analyzes the capabilities of 16-bitters and says that while they will face fierce competition from both μp technology and 32-bits minis in the years ahead, they are far from ready for burial.



159 Worries about the reliability and availability of double-sided floppy-disk drives are a thing of the past. The drive is alive and well at Shugart Associates, and its future as a low-cost system storage technology is secure. The impact of design and manufacturing changes has been dramatic, with shipments jumping 300 percent from 1979 to 1980. Here's a look at the rebirth of the double-sided floppy.

178 Personal computers are getting smarter—and so are their manufacturers, which are paying careful attention to the expectations of users and potential users. EDN magazine Western Editor Carl Warren reports that manufacturers, software houses and marketers now provide greater capabilities in personal computers via software and hardware enhancements such as communications, color graphics and portability.

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The 9915's 16K byte user-addressable RAM can be expanded to 32K with an optional plug-in memory module. And in addition to the available user memory, the powerful operating system (contained in 48K bytes ROM) can be expanded by adding optional ROMs for matrix math, plotter/printer control and mass storage control.

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Intel's iAPX 'Micromainframe'

JACK HEMENWAY and ROBERT GRAPPEL,
Hemenway Associates, Inc.

The 32-bit μp's advanced architecture allows the device in many respects to outperform even the largest mainframes

When Intel announced its iAPX 432 μp in February, industry attention was focused on word length as the processor's key innovation. And justifiably so. As the first μp to handle data in 32-bit chunks, with the vast increase in power that such a development entails, the 432 promises to open new markets for computer applications.

But as the 32-bit market develops, many industry observers believe that other key 432 innovations could become even more significant. The reason? It is believed that software development could become the biggest hindrance to the broad development of 32-bit markets.

Recognizing this potential problem, Intel has included many features in the 432 that are designed to support the modular development of software in a high-level language—an approach that many believe is the key to achieving tolerable software costs and development times. While other computers have incorporated hardware features designed to support high-level modular development, Intel is perhaps the first to incorporate all these features into a single architecture. Those features include:

- **A high-level instruction set.** The 432's instruction set is designed to allow efficient translation of high-level languages into machine-language programs. In many cases, high-level instructions are translated into a single machine instruction instead of six or more instructions, as would be necessary on other machines. Such efficiency allows system designers to work in a high-level language, which cuts development time without incurring a penalty in speed or memory space—a factor that has discouraged use of high-level languages in μps.

Hemenway Associates is a Boston-based system software house specializing in operating systems and languages for μps. This article is based on one that appeared in the April 29, 1981, issue of EDN magazine.

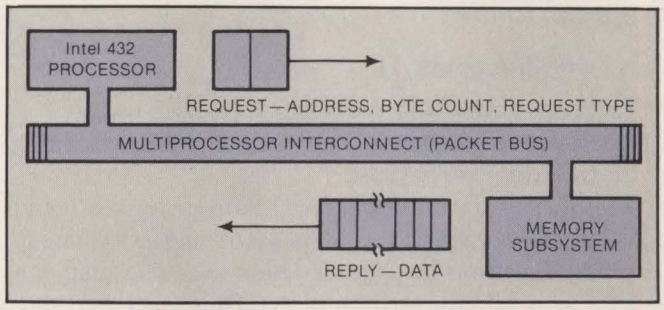

Fig. 1. The 432's packet bus *can transfer as many as 16 bytes of data with a single request.*

- **Ada orientation.** Ada, considered the most sophisticated general-purpose language yet developed, was specifically designed to support modular development for real-time applications, with such features as independently compilable programs and object orientation.
- **Operating system kernel in hardware.** Basic operating system functions, such as task scheduling, are performed in hardware. This not only speeds execution, but also cuts the time to develop specialized operating systems because a developer can build his operating system on top of the basic kernel.
- **A two-level multiprocessor bus structure.** Processors can be added to a processor-processor bus (packet bus) to boost processing power without reprogramming. This supports the idea of modularity by dedicating processors to perform specific functions. The benefits are improved performance and faster development because different parts of the system can be worked on simultaneously.
- **Object orientation.** The 432's instruction set supports the manipulation of high-level data structures, such as records, vectors and arrays, as separate entities called objects. Whole processes can be considered objects. This means that programs can be written

The iAPX 432 system provides a comprehensive set of operators for manipulating several hardware-recognized data types, termed primitive, because they, in turn, form more complex data structures.

independently of the contents of the objects, which shortens development and maintenance time.

- **Security features.** The 432's hardware has built-in functions to protect the integrity of both objects and the programs that manipulate them. This shortens the time required to develop multi-user systems because the software developer does not have to worry about protecting each user's operating environment.
- **Virtual memory.** The 432's hardware allows both main and mass storage to be combined into a single memory space, called virtual memory. This means that a system developer does not have to be concerned about moving programs and data between main memory and peripheral memory.

Start with the chips

The basic iAPX 432 processor/interface consists of three 64-pin IC packages. The three-chip set integrates more than 200,000 devices.

The Micromainframe's general data processor (GDP) consists of two chips, the iAPX 43201 and iAPX 43202. The first functions as an instruction-decoding unit; the second as a micro-execution unit. These devices communicate with one another across a bidirectional "micro-instruction bus;" together they fetch, decode and execute program instructions.

The third device in the set, the iAPX 43203, is the interface processor. It provides a link between the iAPX 432 system and an attached processor, connecting to the attached processor via a subsystem bus and communicating with the GDP via a "packet bus."

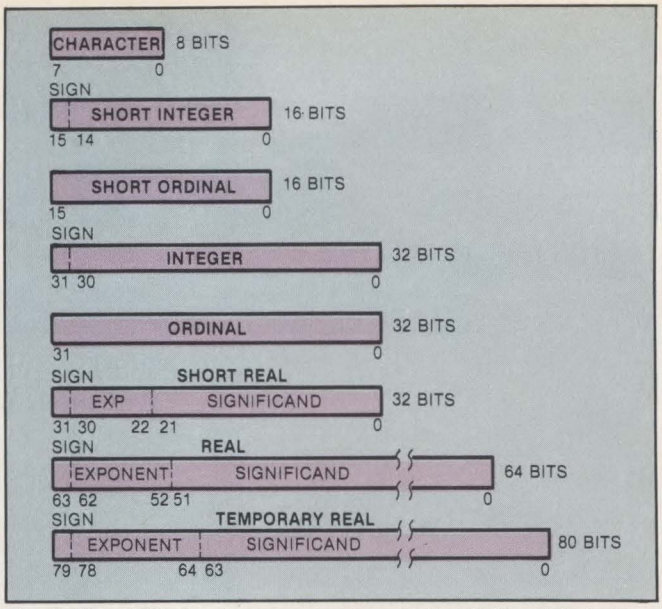

Fig. 2. The 432's hardware *recognizes eight primitive data types.*

The packet bus, a time-multiplexed interface, provides communications between the iAPX 432 processor and memory, as well as between processors. A user can transfer as many as 16 data bytes on it during a request or reply (Fig. 1).

A variety of operators and data types

The iAPX 432 system provides a comprehensive set of operators for manipulating several hardware-recognized data types, termed primitive, because they, in turn, form more complex data structures. All required operators serve eight of these data types, divided into four classes: character, ordinal, integer and real. Fig. 2 shows each type's formats.

A user can divide the operators for these data types into several broad groups: arithmetic, logical, relational, conversion, move and bit-field manipulation. Fig. 3 shows all hardware-recognized data types and all the operators that can be used with them.

WHAT ABOUT FLOATING-POINT NUMBERS?

Consistent with the IEEE floating-point standard, the iAPX 432 allows three floating-point data types: 32-bit short real (single-precision), 64-bit real (double-precision) and 80 bit temporary real (extended-precision). Signed 64-bit arithmetic can be implemented by interpreting only the fraction and sign bits of temporary-real operands with temporary-real operators—an action possible because the mantissa (significant or fraction) of a temporary-real operand is 64 bits wide.

All floating-point operators perform their operations using 80-bit temporary-real data types. Internally, these values are actually 83 bits long (the extra bits are termed guard, round and sticky bits). All results, except those of explicit conversions, reside in temporary-real (80-bit) destinations. The set context operator (instruction) controls precision, rounding and faulting on an inexact result:

- **Precision.** For compatibility with language translators (for example, FORTRAN), the 432 results computes to a programmer-controlled precision (24, 53 or 64 significant bits).
- **Rounding.** If the 432 can't represent a result exactly in the specified precision, it rounds the result to one of four modes specified by the programmer (up, down, toward zero or to nearest).
- **Faulting on inexact results.** A programmer can also specify that a fault should occur on an inexact result—one that can't be represented exactly in the specified precision.

Additionally, the 432's hardware detects several reserved values, termed NANS (not a number); each value produces an invalid operand fault. Similar in concept to trapping, this faulting process invokes user-supplied software to handle the reserved value.

To manipulate floating-point operands, the 432 provides such operators as data-transfer, arithmetic, relational, conversion, square-root and absolute-value instructions.

	OPERATOR	CHARACTER	SHORT ORDINAL	ORDINAL	SHORT INTEGER	INTEGER	SHORT REAL	REAL	TEMPORARY REAL
MOVE OPERATORS	MOVE	X	X	X	X	X	X	X	X
	SAVE	X	X	X	X	X	X	X	X
	ZERO	X	X	X	X	X	X	X	X
	ONE	X	X	X	X	X			
LOGICAL OPERATORS	AND	X	X	X	—	—	—	—	—
	OR	X	X	X	—	—	—	—	—
	XOR & XNOR	X	X	X	—	—	—	—	—
	COMPLEMENT	X	X	X	—	—	—	—	—
ARITHMETIC OPERATORS	ADD	X	X	X	X	X	*	*	X
	SUBTRACT	X	X	X	X	X	*	*	X
	MULTIPLY		X	X	X	X	*	*	X
	DIVIDE		X	X	X	X	*	*	X
	REMAINDER		X	X	X	X			X
	INCREMENT	X	X	X	X	X	—	—	—
	DECREMENT	X	X	X	X	X	—	—	—
	NEGATE	—	—	—	X	X	X	X	X
	ABSOLUTE VALUE	—	—	—			X	X	X
	SQUARE ROOT								X
BIT-FIELD OPERATORS	EXTRACT		X	X	—	—	—	—	—
	INSERT		X	X	—	—	—	—	—
	SIGNIFICANT BIT		X	X	—	—	—	—	—
RELATIONAL OPERATORS	EQUAL	X	X	X	X	X	X	X	X
	NOT EQUAL	X	X	X	X	X			
	EQUAL ZERO	X	X	X	X	X	X	X	X
	NOT EQUAL ZERO	X	X	X	X	X			
	GREATER THAN	X	X	X	X	X	X	X	X
	GREATER THAN OR EQUAL	X	X	X	X	X	X	X	X
	POSITIVE	—	—	—	X	X	X	X	X
	NEGATIVE	—	—	—	X	X	X	X	X
CONVERSION OPERATORS	CONVERT TO CHARACTER	—	X						
	SHORT ORDINAL	X	—	X					
	ORDINAL		X	—		X			X
	SHORT INTEGER				—	X			
	INTEGER			X	X	—			X
	SHORT REAL						—		X
	REAL							—	X
	TEMPORARY REAL		X	X	X	X	X	X	—

NOTES: X = THIS OPERATOR IS AVAILABLE FOR THE GIVEN DATA TYPE.
* = THIS OPERATOR IS AVAILABLE FOR THE GIVEN DATA TYPE *AND* FOR OPERATIONS WHERE ONE OF THE OPERANDS IS A TEMPORARY REAL.
— = THIS OPERATOR IS NOT AVAILABLE AND WOULD NOT BE USEFUL IF IT WERE.
(BLANK) = THIS OPERATOR IS NOT AVAILABLE.

Fig. 3. Operators and data types *for the iAPX 432 provide a variety of manipulation capabilties.*

The iAPX 432's instruction set is completely symmetric: All required operators are available for every data type, and all four addressing modes are available for any instruction operand.

The more complex structured data types comprise two forms commonly used in high-level languages (HLLs): arrays and records. An array consists of several components, each of the same data type. Thus, there are arrays of integers, characters and so on. On the other hand, a record consists of several components (usually termed fields) that can represent different data types. Thus, a record might consist of characters, integers and real numbers. (An employee's work record is one example.)

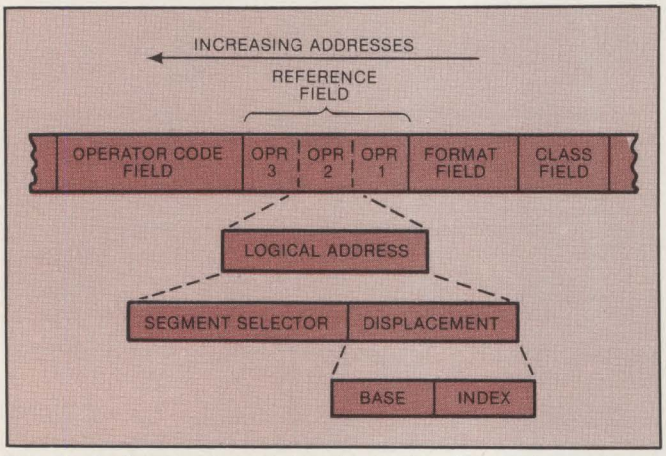

Fig. 4. Instruction-format length *in the 432 varies and can accommodate as many as three operands.*

The iAPX 432 doesn't support these structured types with a set of hardware operations, but it does provide a mechanism that permits their easy manipulation. Access to each of the primitive types is gained through several addressing modes, which facilitate the selection of individual elements from arrays and records. The addressing mode used to reference an operand is determined by the way in which the system forms the logical address in the instruction that references it.

Raising the software/hardware interface

The iAPX 432's instructions specify operators and the operands on which those operators act. Some operators require as many as three operands. Instructions reside in special hardware-recognized instruction segments in memory; the GDP views such an instruction segment as a continuous string of bits, called instruction streams. Instructions can contain a variable number of bits and can begin at any bit within the stream. (In the system's implementation, the GDP reads an instruction segment in units of 32 bits.)

The 432's general instruction format consists of four fields arranged in the format shown in Fig. 4. This format looks like quads—instruction formats composed of an op code and as many as three addresses. Compiler writers use quads as intermediate representations of a compiled program; in traditional machines, the quads are used to generate the object code. A compiler for the iAPX 432, however, wouldn't need this step of code generation; in the 432, the quads are the object code.

The instruction format's displacement consists of two subcomponents: a base value and an index value. Each subcomponent can reference its value either directly (the subcomponent contains the value itself) or indirectly (the subcomponent contains a pointer to the value).

A direct reference by both subcomponents is equivalent to a single-component displacement and can serve to gain access to nonstructured data (scalars). Indirect references can combine with such direct references to gain access to three structured data types. The four combinations of direct and indirect references are termed addressing modes (Fig. 5):

- Base and index direct—used to access scalars,
- Base indirect, index direct—used to access records,
- Base direct, index indirect—used to access static arrays and
- Base and index indirect—used to access dynamic arrays.

The segment selector logical-address component shown in Fig. 4 can also be specified indirectly—simplifying the creation of large multi-segment arrays.

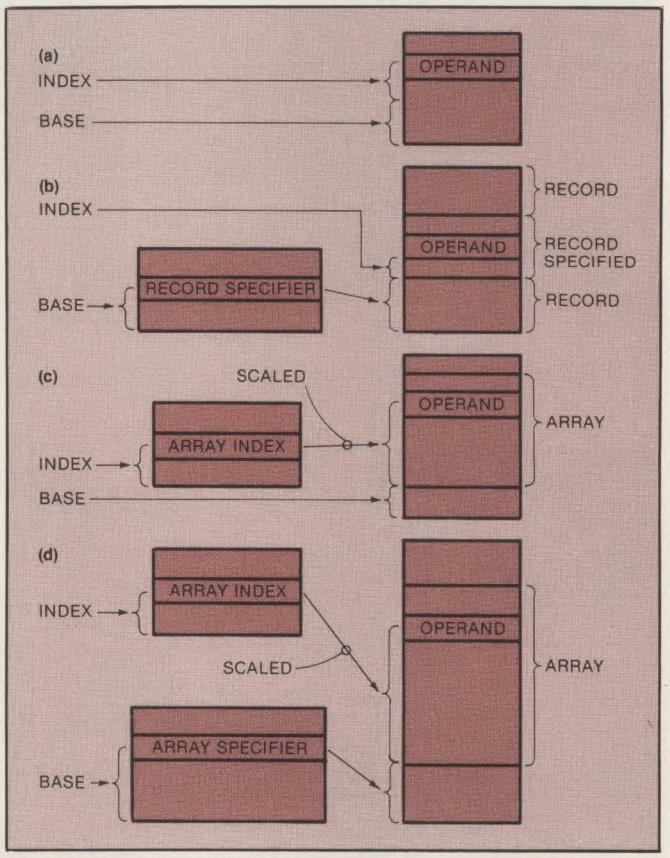

Fig. 5. Direct and indirect references *can combine in four ways: Specify the index and base directly to access scalars (a), specify the base indirectly to access records (b), specify the index indirectly to access static arrays (c) and specify both the base and the index indirectly to access dynamic arrays (d).*

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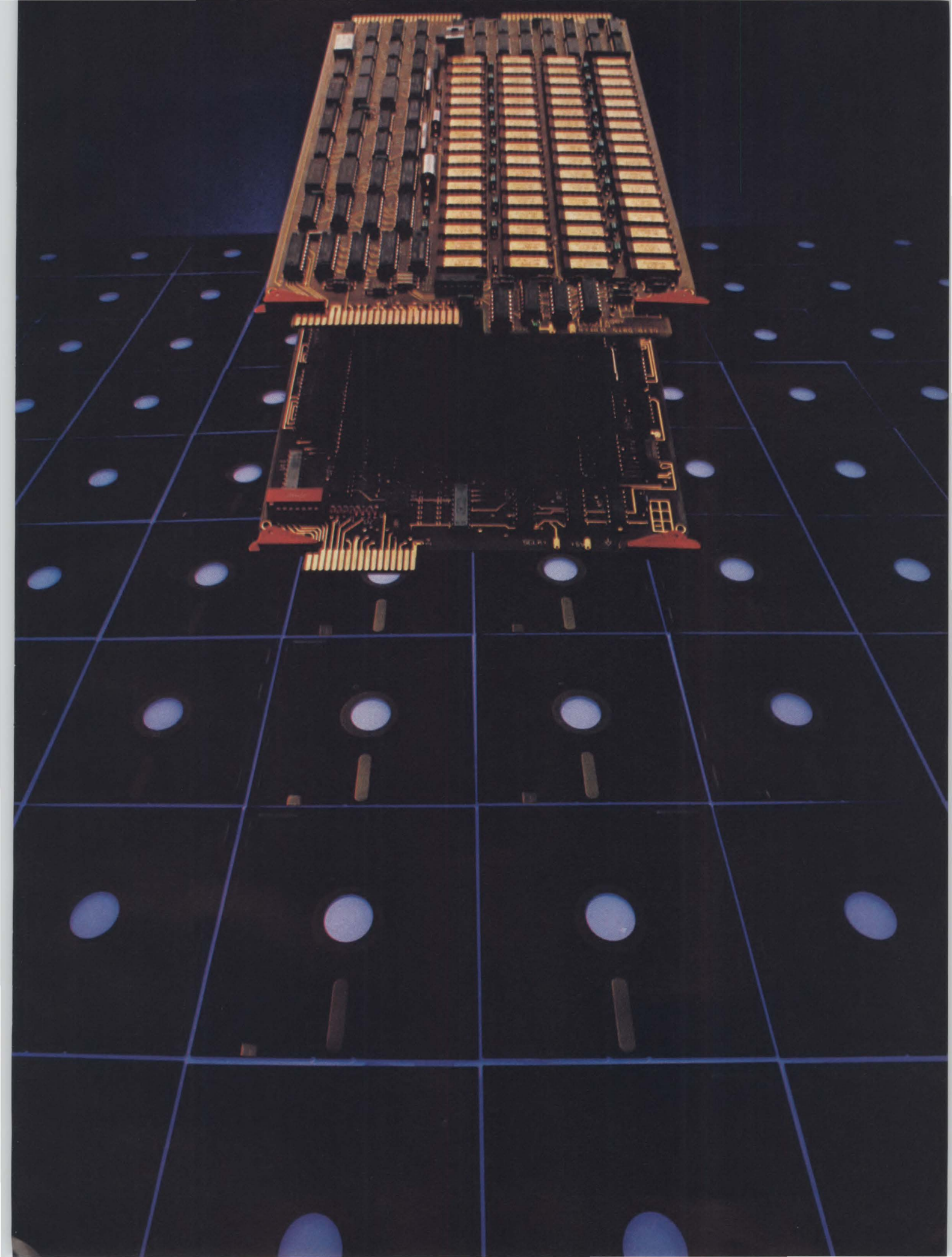

Using implicit stack references rather than explicit memory references to address operands allows shorter and faster instructions.

The GDP automatically scales an index value by multiplying it by one, two, four, eight or 16, depending on whether the operand it points to occupies a byte, double byte, word, double word or extended word. The compiler is thus freed from having to perform this calculation.

The iAPX 432's instruction set is completely symmetric: All required operators are available for every data type, and all four addressing modes are available for any instruction operand. Such symmetry proves especially important for easy translation of high-level language; without it, a compiler writer faces many special cases in which software must make up for the holes in the instruction set. In such a situation, the compiler is difficult to write and more complicated.

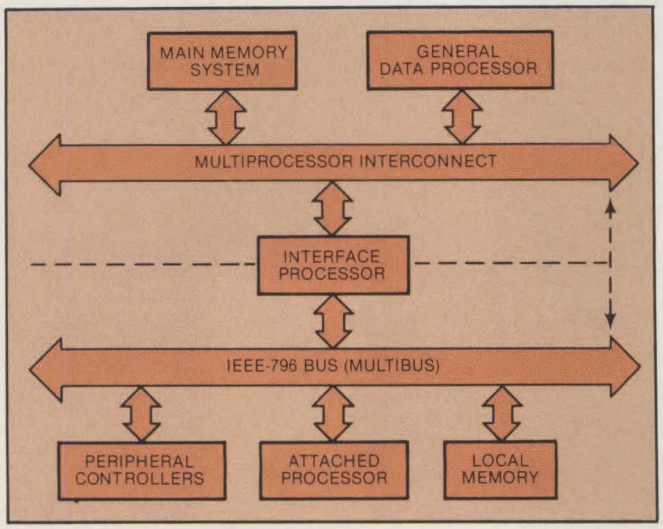

Fig. 6. A satellite subsystem *(attached processor) can independently handle all I/O with the aid of the Multibus.*

As examples of the efficient coding of high-level-language statements possible with the 432, consider the following statements, each of which is encoded by one iAPX 432 instruction:

A=B*C	A three-address multiplication, all scalars
A[I]=B[J]/C[K]	A three-address division, all static-array elements
P.Q=A[I]*C	Three-address, mixed-type, "element Q of record P is assigned the product of static array A, element I and scalar C."

The 432 also provides stack-related advantages. For example, when an instruction references another instruction, the 432 can explicitly specify a logical address or can gain access to the top of the operand stack—a special data segment maintained by the hardware for expression evaluation.

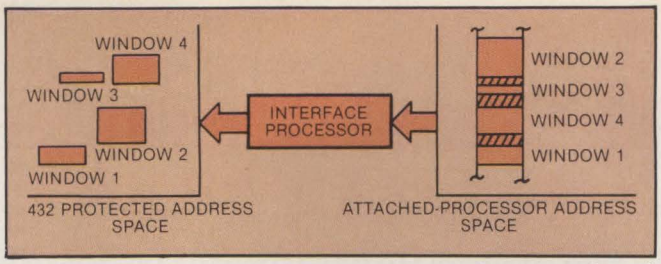

Fig. 7. An attached processor *has access to main memory through windows that protect portions of memory not needed for the processor's operation.*

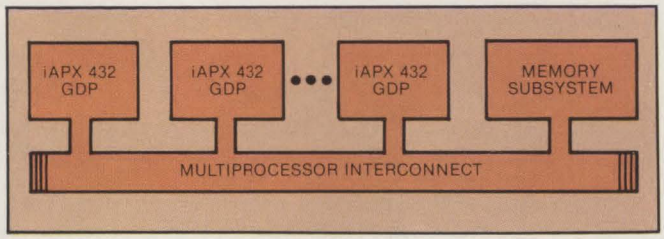

Fig. 8. Transparent multiprocessing *requires no software changes as data processors are added to a 432-based system.*

The act of gaining access to an operand on the stack is termed an implicit reference; it adds or removes items from the "top" of the stack on a LIFO basis. (A hardware-maintained stack pointer points to the current stack top.) Using such implicit stack references rather than explicit memory references to address operands allows shorter and faster instructions. But judicious use of both the 432's stack arithmetic and memory-to-memory arithmetic gives programmers the best of two worlds.

I/O subsystem uses the Multibus

Turning now to the 432's I/O communications, note that the 43203 interface processor (IP) permits a satellite subsystem to act as an attached processor (AP) that independently handles all I/O activity (Fig. 6). Such an AP is an independent μp, configured from Intel's line of mid-range μps, peripheral controllers and Multibus-compatible devices.

The IP provides protected address "windows" between the AP and the iAPX 432 system memories (Fig. 7). It also provides a DMA-like buffering function to lower the Micromainframe's memory-access overhead. Adding more of such AP subsystems or reconfiguring an existing one greatly expands the iAPX 432's I/O capacity. That is, one system can grow from a few CRT terminals, printers and mass-storage subsystems to a fully compatible, much larger system.

For example, consider a manufacturer of intelligent terminals that are used in a cluster in which one terminal acts as a master. The firm acquires a new application that requires intensive computational capabilities and perhaps concurrency. If the firm can't meet the new requirements with its hardware, the manufacturer can configure a network of terminals with an iAPX 432 at the hub providing the intensive computational and concurrency facilities. The beauty of this approach is that almost all the software in the terminals remains usable.

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The central processing system, made up of GDP chip pairs, can be routinely expanded, without software modification.

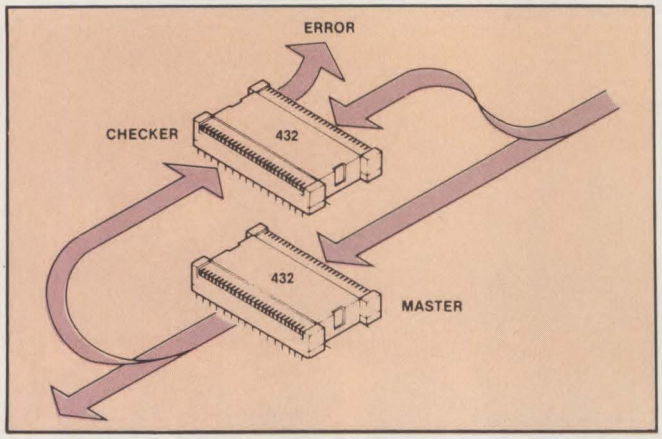

Fig. 9. Functional redundancy checking *allows two iAPX 432s to check one another and flag computational errors.*

The 432 GDP has no interrupt facilities because it is designed so that real-time constraints can't proliferate. It makes no sense to allow the computation-intensive GDP to be interrupted by real-time signal levels. Instead, keyboard interactions, for example, are handled by an AP that gets interrupted by the keyboard when a user depresses a key. The AP then reads the keyboard and stores the corresponding character in a buffer. When the user enters a carriage return, that is also stored. But before executing a return-from-interrupt instruction, the AP sends a message to the GDP informing the GDP that a message is waiting. The GDP can then process the line of text.

Multiprocessing is transparent

The 432 also exhibits other advantages in the area of system expansion. For example, the central processing system, made up of GDP chip pairs, can be routinely expanded, without software modifications (Fig. 9). This consequently increases system performance over a considerable range from 200,000 instructions per sec. to 2 million instructions per sec. Thus, a system can be configured with four socket pairs for the GDPs, but sold initially with only one GDP. A customer could then add GDPs to obtain more processing power.

Hardware failures can also be checked in a 432-based system by wiring any two identical iAPX 432 processors together into a self-checking configuration (Fig. 9). The devices run at full speed and check for on-chip defects as well as connection flaws. If the processors don't agree on a computational result, they stop and alert the rest of the system that they can no longer guarantee correct operation.

For example, this facility can be combined with transparent multiprocessing to provide graceful degradation for systems that must stay on the air at all costs. Such an application could start with four GDPs and four checking GDPs. Then, if a fault appeared in one of them, it could be disconnected from the system. Performance would be impaired, but the system would stay up.

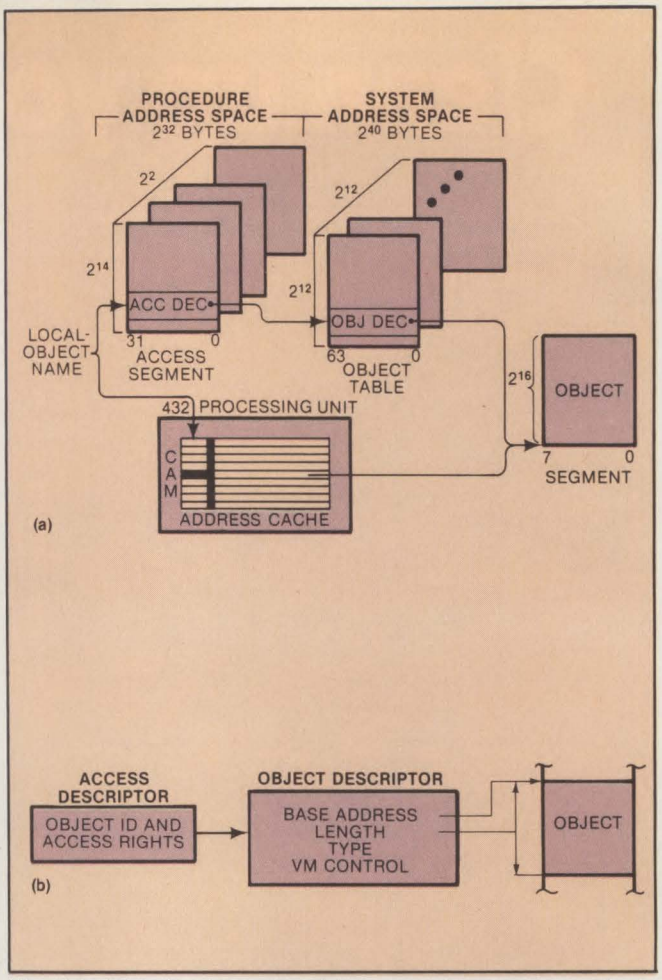

Fig. 10. Object addressing *(a) in the 432 uses a contents-addressable memory (CAM) as an address cache. It requires an access descriptor and an object descriptor that control all aspects of each object's manipulation.*

A gigantic structured memory

The iAPX 432 has a segmented memory. However, the differences between this processor and other segmented machines are great enough to justify the use of the term structured memory to describe the 432's memory architecture.

First, the 432 can address a very large number of segments (2^{24}, or approximately 16 million). Each segment can be as much as 2^{16} bytes long. The total virtual-address space is, therefore, 2^{40}, or more than 1 trillion, bytes.

Second, the 432 uses a two-step mapping process that separates segment relocation from access control. This mapping also divides protection features into segment-specific protection (segment type checking) and user-specific protection (reference rights). The process is unique to the 432 and is responsible for some of its most powerful features.

How can the 432's gigantic memory be used? The machine is designed to accommodate virtual-memory techniques. Virtual memory (VM) is a way of imple-

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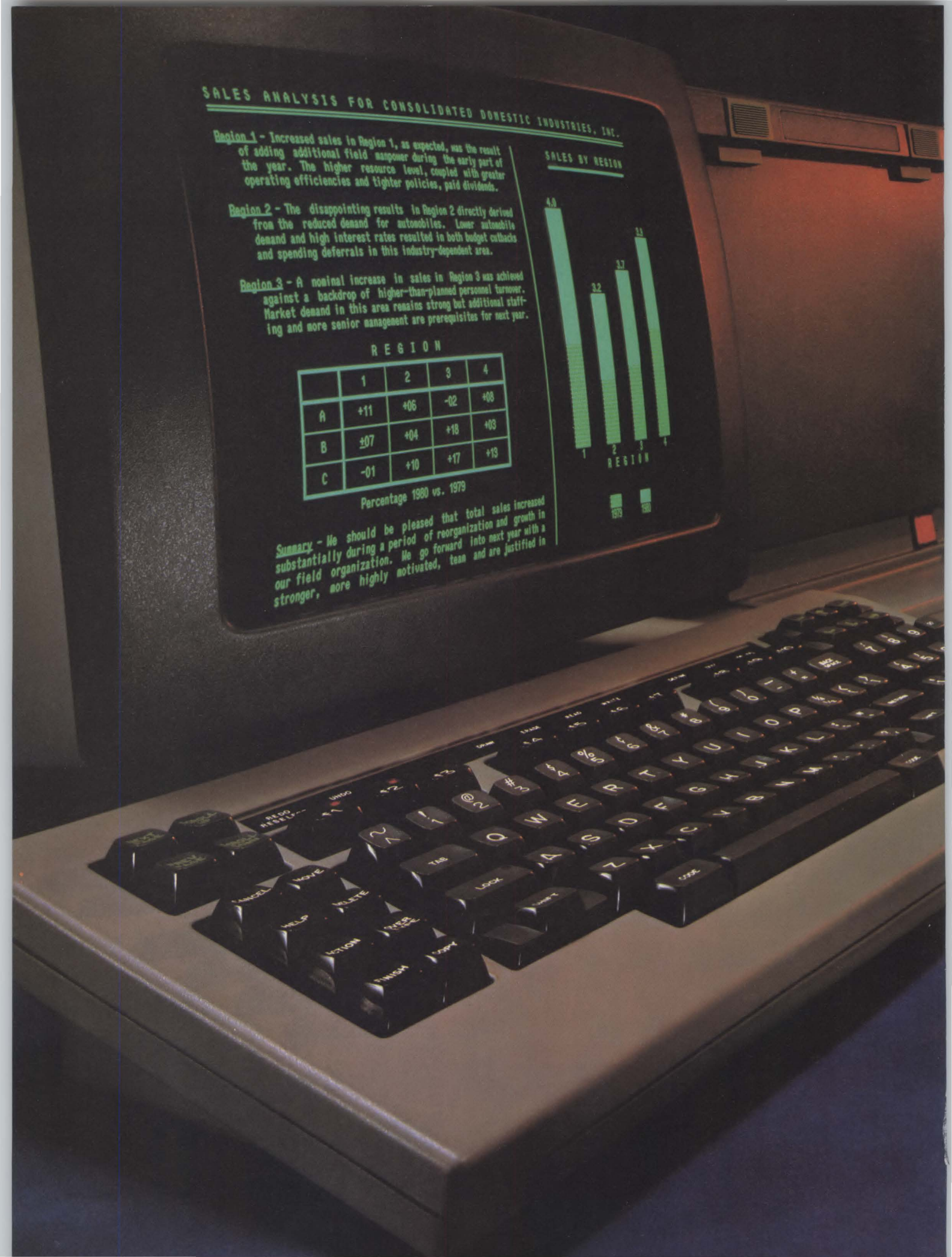
SALES ANALYSIS FOR CONSOLIDATED DOMESTIC INDUSTRIES, INC.
Region 1 - Increased sales in Region 1, as expected, was the result of adding additional field manpower during the early part of the year. The higher resource level, coupled with greater operating efficiencies and tighter policies, paid dividends.
Region 2 - The disappointing results in Region 2 directly derived from the reduced demand for automobiles. Lower automobile demand and high interest rates resulted in both budget cutbacks and spending deferrals in this industry-dependent area.
Region 3 - A nominal increase in sales in Region 3 was achieved against a backdrop of higher-than-planned personnel turnover. Market demand in this area remains strong but additional staffing and more senior management are prerequisites for next year.
REGION
1 2 3 4
A +11 +06 -02 +08
B ±07 +04 +18 +03
C -01 +10 +17 +13
Percentage 1980 vs. 1979
Summary - We should be pleased that total sales increased substantially during a period of reorganization and growth in our field organization. We go forward into next year with a stronger, more highly motivated, team and are justified in
SALES BY REGION
4.0
3.2
3.7
3.3
1 2 3 4
REGION
1979
1980

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The 432 uses a two-step mapping process that separates segment relocation from access control.

menting a large logical address space within a smaller physical space. Because no iAPX 432 user will actually attach 1 trillion bytes of main memory to a system, the 432's VM mechanism permits use of the address space in a virtual manner.

IBM has implied that a paging mechanism is the only way to implement VM, but there are other ways, and the iAPX 432 uses one of them: a segmented approach. Each segment has a segment descriptor containing

Example mechanisms	Example policies
Processors automatically dispatch processes based on: priority, deadline, time slice } parameters	Real time, time-sharing, batch and/or dynamic load sharing can be optimized by software policies setting parameters
Memory allocation total storage, maximum increments } parameters	Memory allocation proceeds automatically until bounds exceeded. Software policies then handle request for more
Protection via "need to know" rights, e.g., read, write, modify, amplifiy copy, delete,no access	Software policies can build range of protected systems from fully open. Shared systems to secure need-to-know protected systems

Fig. 11. Careful separation *of operating-system mechanisms (in silicon) and policies (in software) optimizes applications.*

- Matches design methodology
  - —Based on the concept of objects
  - —Significant support for modularization
  - —Aimed at reducing programming costs
- Constructs map the architecture and OS

Object	Object
Package	Domain
Access	Access descriptor
Subprogram activation	Context

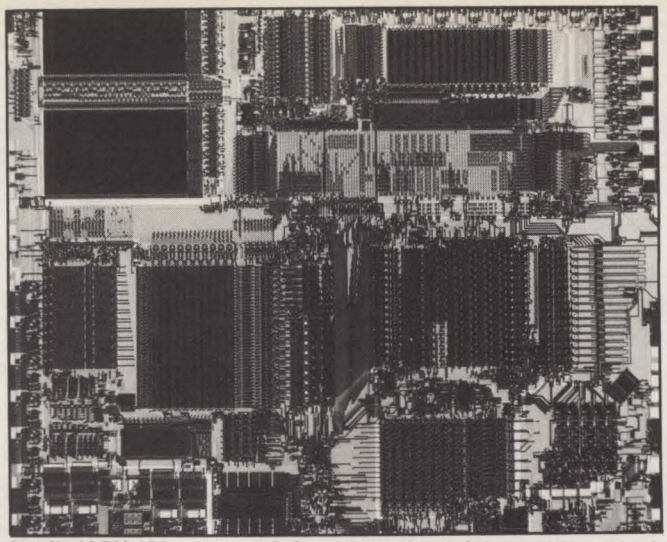
- Features provide direct access to hardware
  - —432 specific operations are in Ada's standard machine access package
  - —Simple 432 extensions to Ada support dynamic systems

Fig. 12. The advantages of Ada *as the 432's systems programming languages are several.*

(among other things) four 1-bit fields. The hardware maintains these fields, which the operating system can use to implement VM:

- The valid bit indicates whether the segment is current in main memory,
- The storage-allocated bit indicates whether any memory has been associated with the descriptor,
- The accessed bit indicates whether the segment has been accessed by some executing process, and
- The altered bit indicates whether the information contained in the segment has been modified by some executing process.

The operating system can use the valid bit and the storage-allocated bit to detect when a physical segment is not present in memory, and it can use the accessed and altered bits to decide which of the currently present segments should be swapped out or merely overwritten by the new segment. In addition, the OS can use several fields in the segment descriptor to record other useful information regarding the segment (for example, frequency of use) that can also be used in the swapping algorithm.



Intel's iAPX 432 *micro-mainframe consists of three chips, which together house more than 200,000 devices. This is the 43203 interface processor.*

An object-oriented architecture

The Micromainframe's hardware, operating system and system programming language all support the concept of "objects"—variable-length data structures that have a higher order than data typically recognized and manipulated by contemporary computer hardware (Fig. 10).

System programmers write program modules based on objects. Each object is typed by a special "object descriptor" and can only be physically addressed by a special "access descriptor" (Fig. 10). What can gain access to the object and what operations can be done to it are inherently controlled. This scheme is the key to the 432's granular data- and program-protection features.

Such an object-oriented architecture supports clean modular programming. A user can break down software systems into modules that permit true isolation of design decisions. These modules are separated from one another by interfaces that define what each module does, hide the module's design details from other modules and define the inter-module relationships to ensure an anomaly-free adaptation.

The operating system kernel is in silicon

The iAPX 432's multiprocessing capability is a product of its silicon-based operating system. That is, operating-system functions, such as process scheduling and dispatching, interprocess communication, processor management, storage allocation, memory management, protected-data sharing, exception detection and the like, are part of the iAPX 432's hardware, but the

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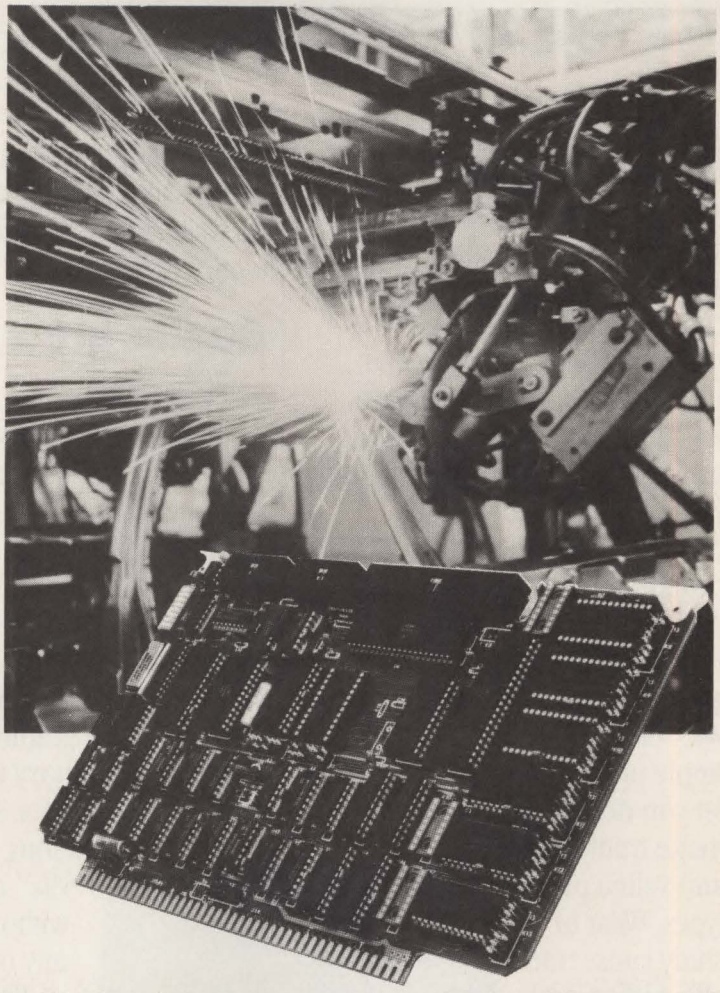

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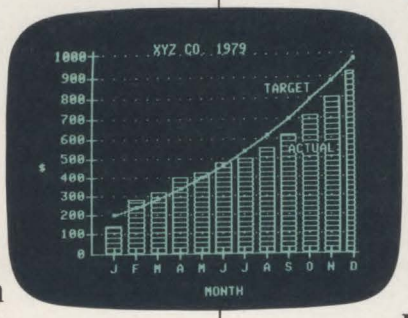

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	Apple II	Apple III
Maximum Memory Size	64K bytes	128K bytes
Screen Display	40 column (80 column with peripheral card) 24 Lines Upper Case	80 column 24 Lines Upper Case/Lower Case
Screen Resolution (B&W)	280 x 192	560 x 192
Screen Resolution (Color)	140 x 192 (6 colors)	280 x 192 (16 colors)
Keyboard	Fixed	Programmable
Numeric Key Pad	Accessory	Built-in
Input/Output	8 expansion slots	4 expansion slots plus built-in: disk interface RS-232 interface Silentype™ printer interface
Disk Drives	Add-on one to six drives	One drive built-in, plus interface to support three more drives
Languages	BASIC Fortran 77 Pascal Assembly Pilot	Enhanced BASIC Fortran 77 Pascal Assembly
Typical Configuration Pricing	CPU, 48K RAM, single disk drive, B&W Monitor (9"), Silentype™ printer, and BASIC. **$3250.00***	CPU, 96K RAM, integrated disk drive, B&W Monitor (12"), Silentype™ printer, SOS, Enhanced BASIC. **$4865.00***
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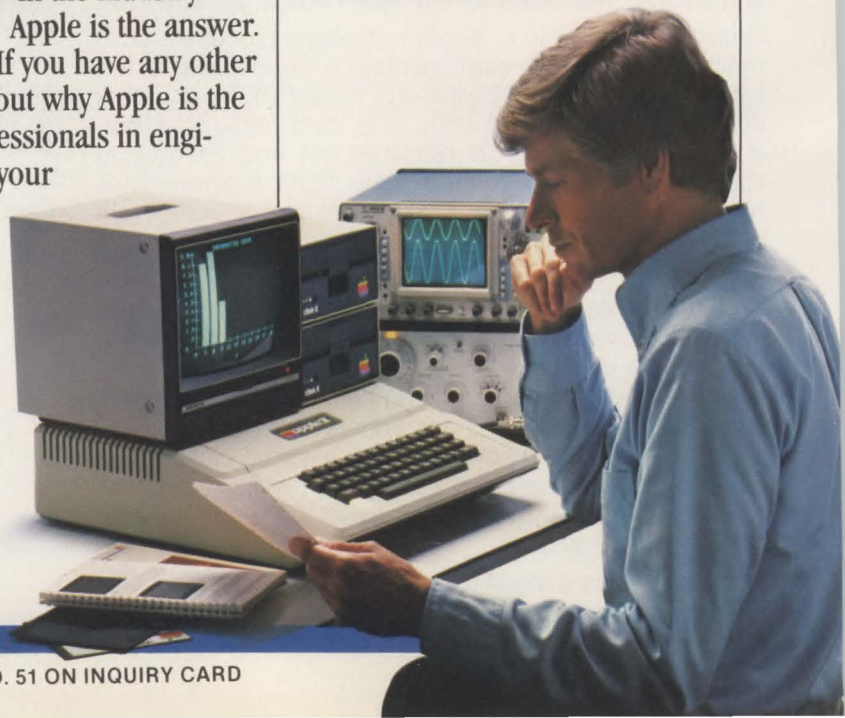

The Micromainframe's hardware, operating system and system programming language all support the concept of 'objects'—variable-length data structures that have a higher order of data than data typically recognized by contemporary hardware.

policies that govern these mechanisms are separated and applied via system software (Fig. 11). As a result, system performance increases with no loss in implementation flexibility.

Additionally, the iAPX 432 hardware can recognize system data structures. The operating-system features thus permit processors literally to find their own work, thereby sharing the workload automatically and dynamically.

Why Ada?

Ada, a programming language developed through cooperation among the Department of Defense, industry and universities, is the Micromainframe's system programming language (Fig. 12). Ada is oriented toward system programming, numerical problem-solving and real-time applications involving concurrent execution requirements. Ada combines Pascal's simplicity and elegance with the structure and expressive capability necessary for multifunctional software systems. It was selected as the iAPX 432's systems programming language because it directly supports object-oriented programming and is expected to further improve productivity for software-development teams.

Ada is the iAPX 432's assembler; the translation from Ada statement to machine instruction is essentially a one-to-one process. As a result, there's no intervening software level to get in the way, as there is in compilers for other machines. ■

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PRINTERS

New series blends data and word processing

Florida Data's dot-matrix devices offer 300- to 600-lpm speed for data output and letter quality at 100 cps

In what seems like a continuous and confusing stream of printing methods, varying technologies and companies competing for a greater share of an expanding market, one fact is clear: success in the market will require the effective combination of data- and word-processing capabilities in one printer.

In response to this need, Florida Data Corp. last month unveiled the first models in a new series of Office Systems Printers, which are high-speed dot-matrix printers. The new printers offer the throughput of a 300- to 600-lpm printer for data-processing applications, and letter quality as fast as 150 characters per sec. for word-processing requirements. In addition, FDC has overcome a bothersome paper block because these printers can accommodate virtually any kind of commonly used paper or form in the same mechanism.

Models OSP/120 and OSP/130, introduced at the National Computer Conference in Chicago, offer the forms-handling versatility of integrated automatic cut-sheet feed, hand feed and tractor feed in one simple mechanism. The new printers' throughput is more than 12 times faster in a draft mode and three times faster in a letter-quality mode than daisy-wheel printers, which translates into a three- to six-page-per-min. page printer for average text.

The proprietary magnetic stored-energy print-head technology is the result of more than four years of development. It came after a long wait and cost more money to develop than anyone imagined, but according to James Adkisson, president of Florida Data, "it was worth it to realize the final results." The OSP printers are the first to employ the new generation print-head technology, with one-third the number of parts, more speed and longer life than FDC's first-generation heads. The company has been issued or has applied for five major patents on its print-head technology (see "How the head works," p. 92).

The printer uses three μps: an 8085 and two 8041 sub-processors. Each 8041 has 1K byte of ROM; one 8041 is dedicated to paper-control functions, and the other controls pin firing and print-head servo. The print-head servo processor, functioning as a differential-period discriminator, provides wide-bandwidth error information to the motor drive to maintain a speed variation of less than 2 percent. The 8085 operates as a front-end processor, services the communications interface and controls the printer's diagnostic testing as well as the 8041s. Memory can be configured as RAM or ROM with 32K bytes maximum.

Paper-handling versatility

The OSP/120 and OSP/130 are the first to offer built-in forms-handling and cut-sheet paper-handling. The patented triple paper path with automatic bail control provides automatic cut-sheet feed, hand feed and tractor feed. Cut-sheet paper is loaded into a cassette similar to the cassettes used with copy machines. The cassettes are available in various fixed sizes plus an adjustable version that handles 200 sheets with widths from 6 to 12 in. and lengths from 4 to 17 in.

The OSP printers are the first of a new generation of print-head technology, with one-third the number of parts, more speed and longer life than first-generation heads.

Hand-feed paper with widths to 15 in., single- or multi-part, is loaded into the hand-feed slot at the top of the printer and is automatically registered to top-of-form or top-margin setting by pressing the form-feed button. Tractors for continuous-pin-feed paper are optional and can be snapped in place under the printer covers. Tractors are adjustable to accommodate forms 3 to 15 in. wide of one to six parts.

FDC's market research indicated that most users prefer their print output on cut-sheet paper if the output is collated in numerical order simply because this type of output is easier to handle. But FDC claims that many data-processing users intend to use pin-feed paper tractor feed until they are convinced of the reliability of unattended cut-sheet feeders. Many tractor-feed users will probably then switch to cut-sheet feed as their confidence increases. Another benefit of cut-sheet paper is that it costs less than tractor-feed paper, which is why the printer is offered with optional paper tractors.

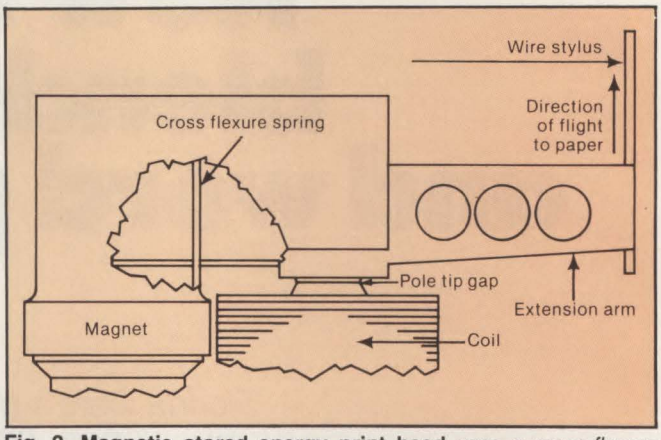

Fig. 2. Magnetic stored energy print head *uses a cross-flexure spring held cocked by a magnetic field at pole tip gap. A coil is energized to cancel magnetic field of gap, releasing spring and allowing wire to impact paper at high speed.*

HOW THE HEAD WORKS

Serial wire-matrix printers use a print head that moves horizontally across the page (Fig. 1). Printing is accomplished through actuation of various combinations of wire hammers. The wires are configured in a vertical column. When activated, each wire drives the end of the associated wire into an ink ribbon and onto the paper to create a dot. Each character is formed by firing the wire at selected intervals, forming a matrix array.

The primary factors determining maximum print speed of wire matrix printers include maximum wire-cycle rate and number of wire sets per print head. Most wire matrix printers use a solenoid wire-actuation technique to drive the wire into the paper. The maximum cycle rate for solenoid actuators is approximately 1000 cycles per sec., or 180 to 200 characters per sec. for standard 10-pitch printing.

Recent developments in Florida Data's magnetic stored-energy wire actuators (Fig. 2) have enabled wire-cycle rates to exceed 3000 cycles per sec. or 600 cps for 10-pitch printing. The stylus wire is attached to a cross-flexure spring that is held in the cocked position by a magnet. A coil is energized that cancels the magnetic field, releasing the spring. The use of more efficient magnetic materials, such as samarium cobalt, has reduced the weight of these print heads, while the use of the efficient stored-energy hammer has reduced the power waste and heat generation, thus extending life.

The throughput of a serial matrix printer is also a function of the line length to be printed. Because the print head is moving at a constant velocity, the time to print a line depends on how long the line is. The curve is not exactly linear because of the additional time required to line-feed the paper and reverse the print head's direction. Fig. 3 compares the print-rate throughput of various-speed serial printers versus 300- and 600-lpm line printers.

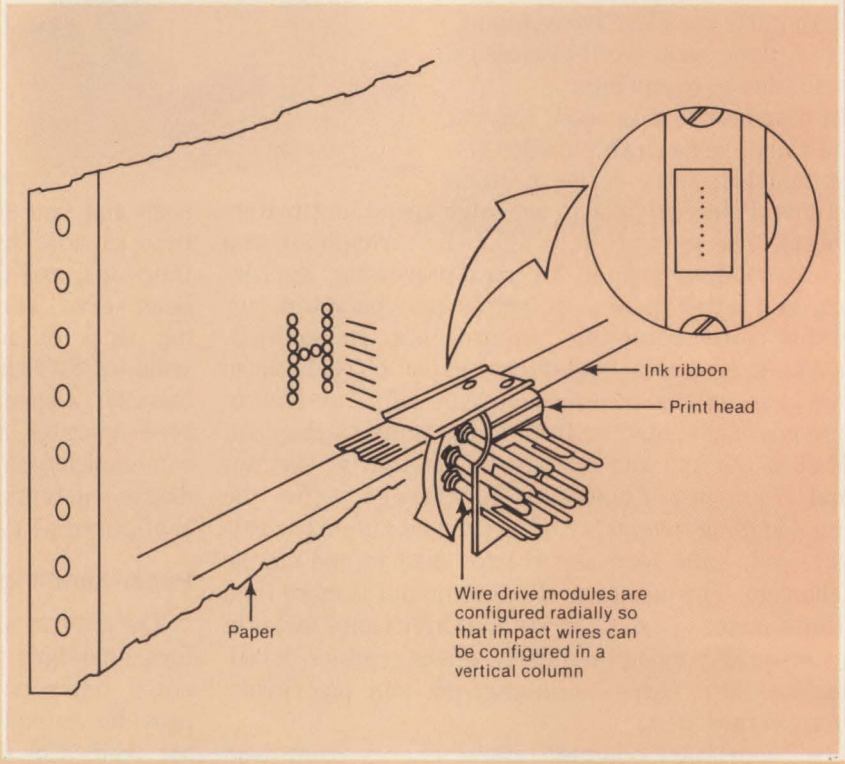

Fig. 1. Serial wire matrix printers *operate by moving print head horizontally across the paper. Wires are configured in a vertical column and are selectively activated by wire hammer drivers to impact paper through an ink ribbon, thereby creating dot-matrix array characters on the paper.*

The printer provides paper-formatting control with form length, top of form, top margin, bottom margin, absolute and normal horizontal and vertical tab and automatic page concatenation under program control. Operator control is with push buttons instead of knobs, levers and other mechanical adjustments.

Because matrix printers use dots to create characters, character fonts may be electronically changed without changing the print element, such as the band or print wheel. Character fonts in the Office Systems Printer are electronically stored in ROM or EPROM. Optional RAM can be used to enable down-line loading of character fonts from the host computer. Graphics and flexibility of character size are inherent capabilities with electronic-dot-created print. The advantage of impact-matrix over electrostatic-graphic printing is that plain, rather than coated, paper can be used.

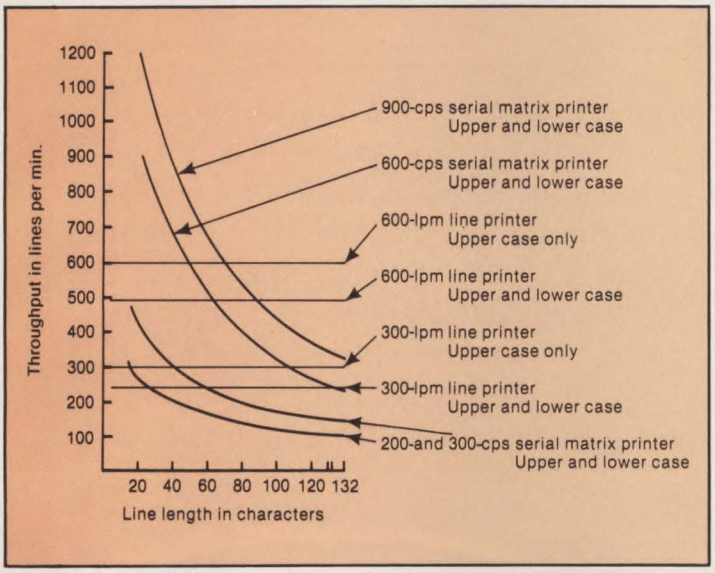

Fig. 3. Throughput comparison *of serial matrix printers with 600-cps line printers.*

Communications and copies

Because of their speed, the Office Systems Printers are well-suited to high-speed communications printing at rates of 2400 baud or higher. This provides for shorter hook-up time in dial-up networks or a greater number of printers on a private multidrop line.

The high speed with collated output also reduces the need for copying or duplicating. Imagine a typical office task in which a user wants six copies of a 10-page report. Because a daisy-wheel printer can take 1½ min. or more to print each single-spaced page, the 10-page report will take more than 15 min. for the first original. The user will then take the original to a copier, make six copies and collate them. This job could take 30 min., with at least 15 min. of labor required for copying and collating. The Office Systems Printer can do this job with all six copies as originals in 20 min., without user involvement.

DEPOSITING THE DOTS

The use of μps and low-cost memory brings the benefit of character fonts that can be stored in ROM or RAM. The printer can change character fonts without changing print elements. Because the characters it deposits are formed by overlapping dots, the matrix printer can vary character sizes and print graphics.

The multi-pass technique "fills in" the vertical dots on each successive pass of the print head as the paper is moved vertically a fraction of a dot-position. A character is generated on two passes within 16 dots overlapped vertically and on three passes with 24 dots overlapping (Fig. 4).

Horizontal dot-spacing is formatted in "dot zones." The OSP printer can use dot zones of 90 or 120 per in. A dot zone can be further divided into one-, two- or three-grid "cells." Thus, horizontal resolution may be selected for 90, 120, 180, 240 or 360 per in.

Character fonts can be programmed for any pitch, if the character pitch is divisible by 120- or 90-per-in. dot zones. For example, using 120-per-in. zones, character fonts with pitches of 8, 10, 10.9, 12, 13.33, 15, 17.2, 20 and more are possible. Using the 90-per-in. zone, character fonts with pitches of 10, 11.25, 12.9, 15 and more are possible. Proportional characters use a variable number of dot zones per character, depending on the width of individual characters.

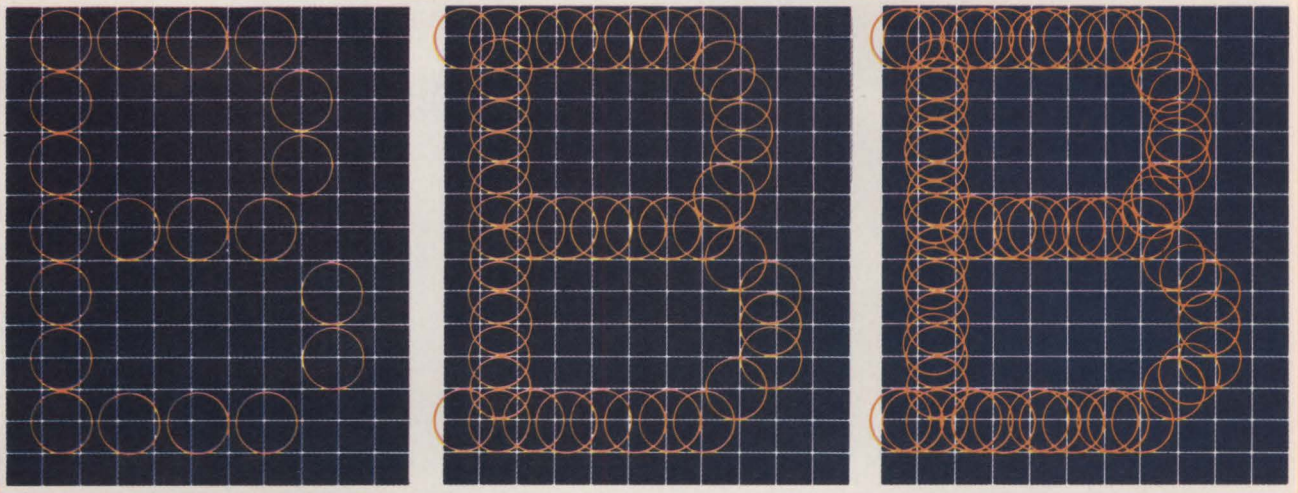

Fig. 4. The multi-pass technique *"fills in" the vertical dots on each successive pass of the print head as the paper is moved vertically in a fraction of a dot-position.*

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There was a time when computer programmers took months to program the simplest tasks. More recently, they were able to respond to simple requests in days or weeks.

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DRASTICALLY CUT MINICOMPUTERS.

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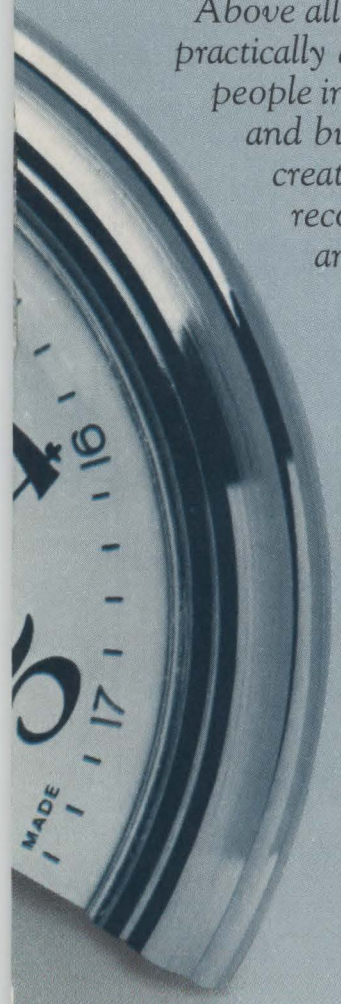

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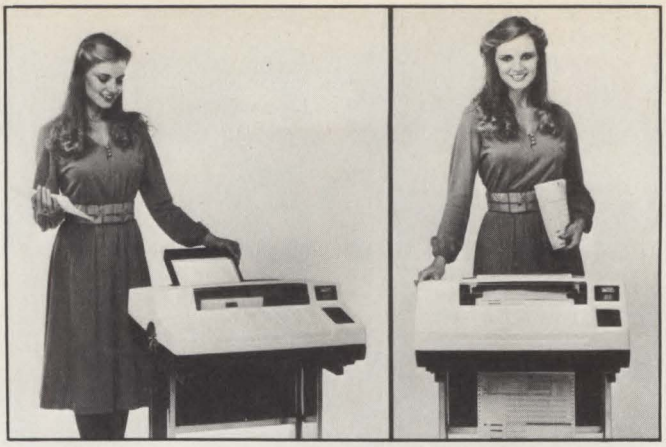
CIRCLE NO. 53 ON INQUIRY CARD

Provision for a comprehensive diagnostic test, governed by the 8085 μp, is standard with the OSP printers and can be initiated remotely or locally.



Florida Data's OSP *series has a patented triple paper path to provide automatic cut-sheet feed, hand feed and tractor feed.*

The OSP/120 provides single- or two-pass printing, while the OSP/130 provides one-, two- and three-pass printing. High-quality printing is accomplished by incremental vertical motion of the paper, while the print head makes multiple passes over the print line, thus interweaving the dot pattern to create solid print characters (see "Depositing the dots," p. 93).

Both the OSP/120 and OSP/130 offer standard RS232 interfaces with optional Centronics, Dataproducts, parallel ASCII, current loop and several communications protocols. Both models are software-compatible with Diablo 1650 and 630 printers. The printers use a Diablo ribbon cartridge supporting cloth and multi-strike ribbon.

Provision for a comprehensive diagnostic test, governed by the 8085 μp, is standard with the OSP printers and can be initiated remotely or locally. A two-digit display indicates the status of the printer, providing the user with information on conditions such as out of paper, out of ribbon, paper jam, invalid commands or printer-failure modes.

The OSP/120 is priced at $2450, and the OSP/130, at $2600 in 100-unit OEM quantities. Delivery is 60 days. Future models will offer additional sheet feed, envelope feed, color graphics and facsimile I/O. ■

THREE PATHS FOR THE PAPER

Printer applications that combine word and data processing impose interesting design considerations for forms handling.

Cut-sheet paper requires precise control with friction rollers and a bail to hold a page flush with a print platen. To automatically feed cut-sheet paper requires a cut-sheet pick mechanism that accurately inserts the page into the friction roller system and a bail system that allows the page to be positioned before the bail rollers are located against the paper. The friction-roller system must accommodate various sizes of single- and multi-part cut-sheet forms.

The continuous tractor-feed mechanism must allow for easy adjustment to accommodate various width forms of single- or multi-part. Tension on the continuous form must be maintained to assure that the form will not jam and that printing is accurately positioned, particularly with preprinted forms.

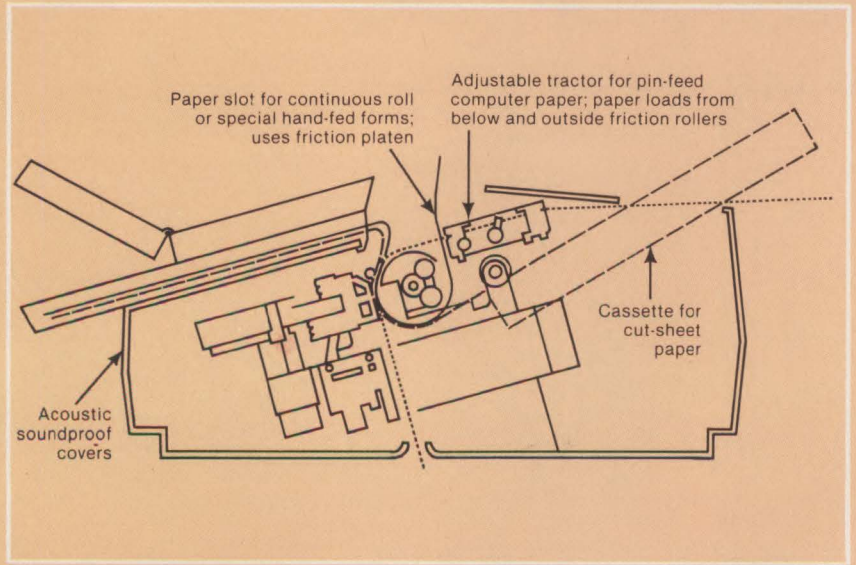


Fig. 5. Patent filings *are in process to cover Florida Data's triple paper path, automatic bail systems and paper-thickness adjustment.*

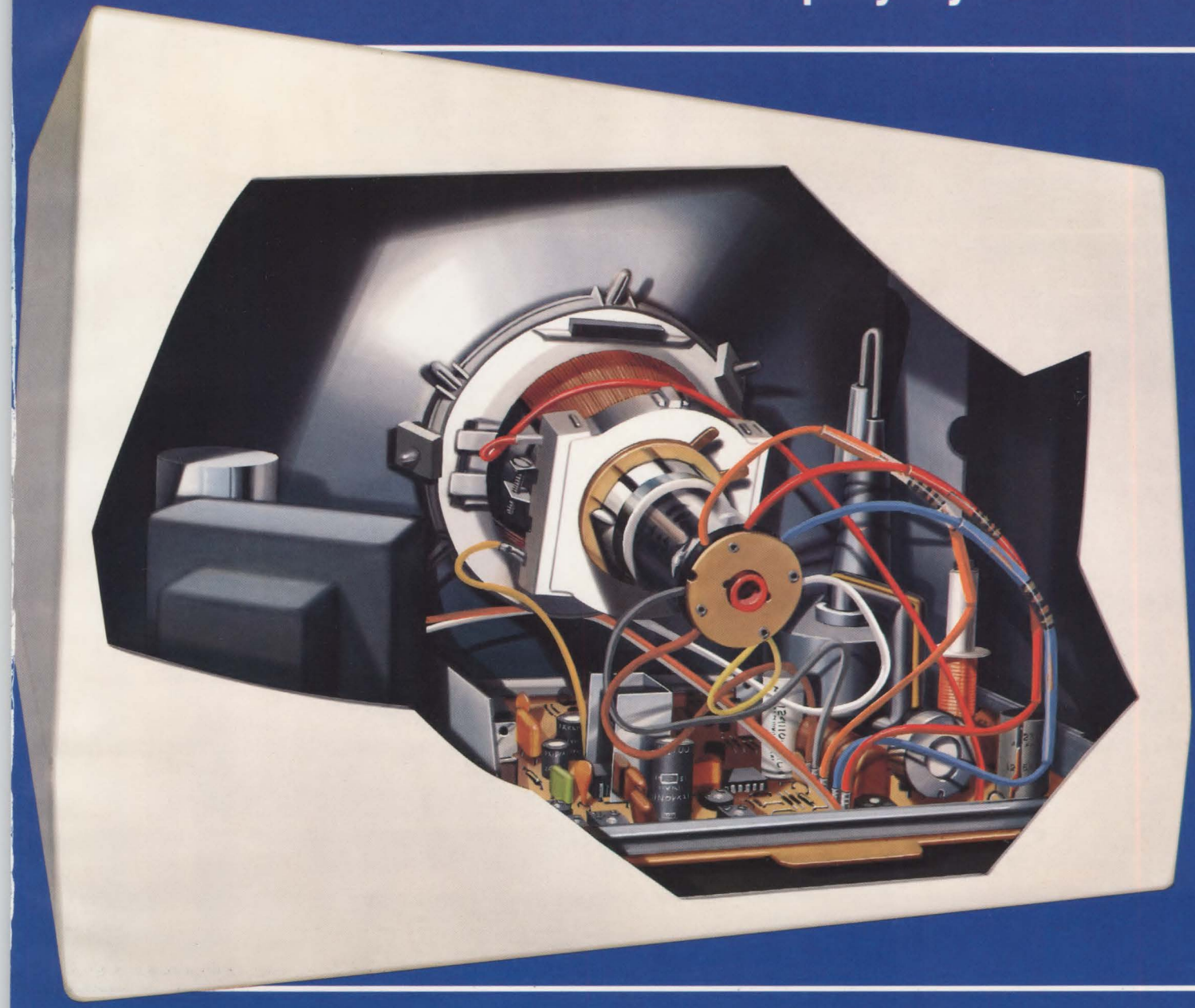
With the new Office Systems Printer, Florida Data has introduced a unique triple paper path with automatic bail control that accommodates automatic-feed and hand-feed cut-sheet forms and continuous tractor-feed forms in one mechanism (Fig. 5).

Cut-sheet paper is loaded in a convenient paper cassette. The cassette is latched into load position by pressing lightly on the cassette's top. Cut-sheet paper is picked from the cassette by two friction rollers driven by a stepper motor. As the form is being picked, the bail rollers will descend to a location below the print platen. As the friction rollers drive the form around the platen, the bail follows just behind the top edge of the cut-sheet form, ensuring reliable control of the form. The form is ejected into an output basket at the front of the printer in collated sequence.

Continuous tractor forms are fed outside the friction roller systems. The forms are fed from below the printer, over the print platen and engaged in the adjustable tractors. The continuous tractor forms exit from the back of the printer.

Hand-fed cut sheets, continuous-roll paper and demand documents can be inserted through the hand-feed slot and through the friction-roller platen system. Forms will emerge from the front exit slot of the printer.

Look into Project Alpha Motorola's new MDS Display System



Uniquely integrated building blocks set new standards in reliability, performance and design flexibility

Motorola's Project Alpha matches advanced technology to human considerations

The new Alpha MDS Series is more than a new generation of 12″ and 15″ display modules. It's a synthesis of innovative CRT display design and human factors engineering by Motorola. Its design, though remarkably simple, redefines the standards by which you measure the performance of your terminals.

Greater Reliability

On-going tests project a dramatic 75% increase in MTBF over even our own most reliable MD series!

Greater reliability is a result of synergistic elements at work at Motorola. Paramount is product design. The MDS Series makes extremely efficient use of fewer components, and incorporates integrated circuits throughout the system.

Advanced manufacturing processes and revolutionary testing equipment at Motorola's unique multi-million dollar facility in Joplin, Mo. are designed to improve the quality and reliability of the MDS Series.

Enhanced Video Performance

Motorola has extended resolution and bandwidth in the MDS Series for sharper alphanumeric presentation. Center resolution has been increased from 1000 to 1200 lines; corners from 750 to 950 (P4 phosphor). Bandwidth has been stepped up from 22 MHz to 30 MHz (−3Db). Compare geometry and linearity specifications and you'll find the Motorola MDS Series ranks among the highest in the industry.

Design Flexibility

Whether your requirements call for composite video, true TTL compatibility or direct drive, the versatile MDS can handle a wide signal input variation. Horizontal scan rate is available at 15.7 or 18.7 kHz. The streamlined chassis of the new display allows you more flexibility in your mechanical design. Ease of access to the controls and **unique** options such as 24 vdc operation and 20 pin ribbon cable add to making The MDS an extremely adaptable display module.

Systems integrity through integration

Totally TTL compatible signal inputs by means of single hex inverter integrated circuit.

Phase lock loop allows display to free-run in absence of horizontal sync or drive.

Fixed Automatic Dynamic Focus electronically optimizes focus as beam sweeps screen improving corner focus and making critical adjustments no longer necessary.

Reduced temperature drift is ensured by means of integrated Horizontal Oscillator circuit.

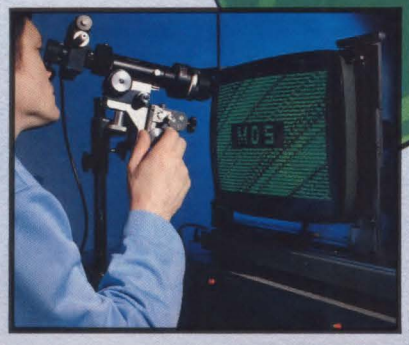
Vertical scan is accomplished by single integrated vertical processor.

Simplified construction improves reliability. Integral base pan with single PC board means fewer sockets and inter-connections.

Our concern for ergonomics

We know that you, as a terminal or systems designer, are concerned with ergonomics (human/environmental aspects). We are concerned, too. That's why we've made a long term investment in trained research technicians and sophisticated equipment to constantly monitor and refine those aspects that affect operator comfort. *Motorola's Electron Optics Lab* is designed to scientifically assure optimum resolution, color, contrast, and phosphor in the new MDS and all of our Display Systems products.

Operator adjusts monochrometer for actual spectral scan of P4 phosphor.



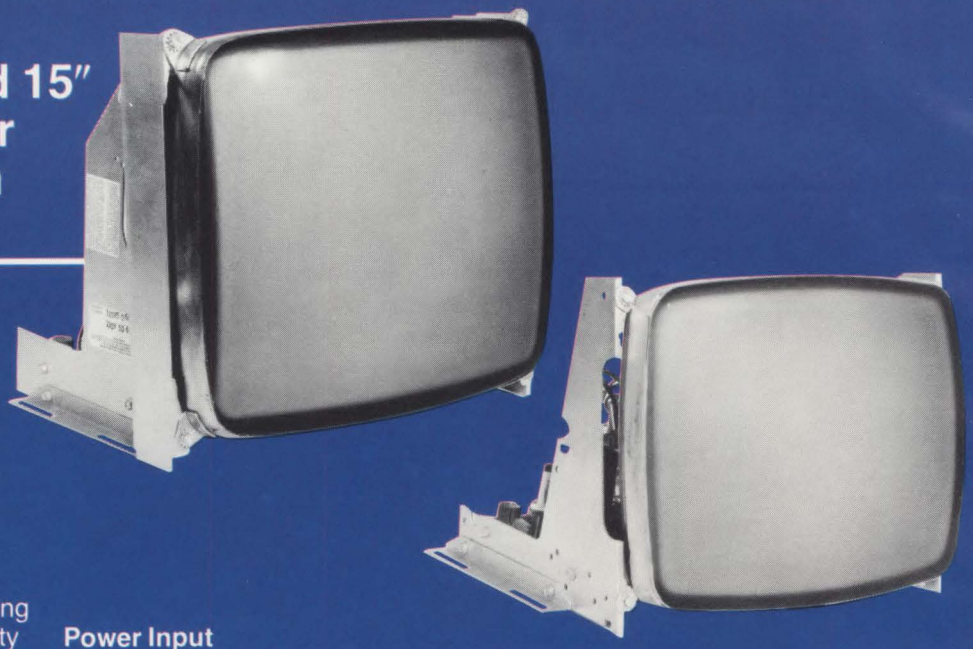
Photometric microscope measures basic resolution.

Computing spectroradiometer readout brings new accuracy to light and color measurement.

Electron Optics operator adjusts focus control.

Motorola's Project Alpha presents a distinctive high performance choice

MDS Series 12″ and 15″ display modules for superior resolution



Key Specifications

110° deflection angle

Video Performance
Resolution: 1200 lines center, 950 lines corners (P4 phosphor)
Bandwidth: within 3 dB, 10 Hz to 30 MHz is typical

Performance Features
StepScan™: Stepped vertical scanning option provides an increased capacity display at any horizontal frequency.
Dynamic Focus: Excellent corner focus.

Synchronization
Horizontal: 15.7 kHz± 500 Standard
18.7 kHz± 500 optional
Vertical: 47 to 63 Hz

Power Input
120/240 V AC (105–135), 50/60 Hz
24V DC optional

Geometry
(Pin & Barrel) Sides equal less than 1% of height. Top and bottom equal less than 1% of width.

Linearity
Character height or width will not vary ±7% from the average character size. Adjacent characters will not vary more than 5%.

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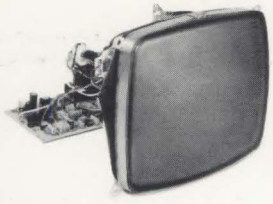

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Please send me the following:

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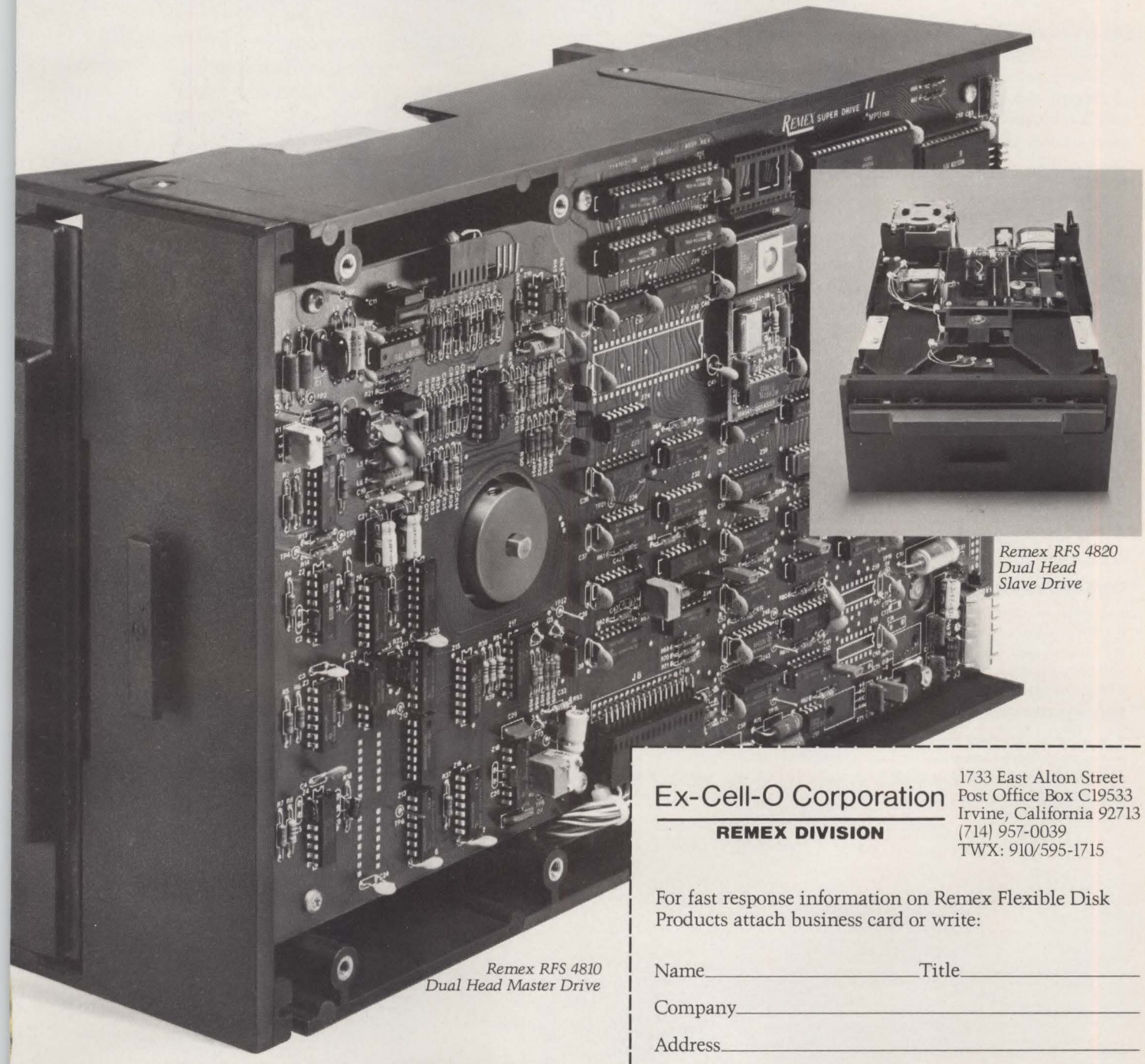

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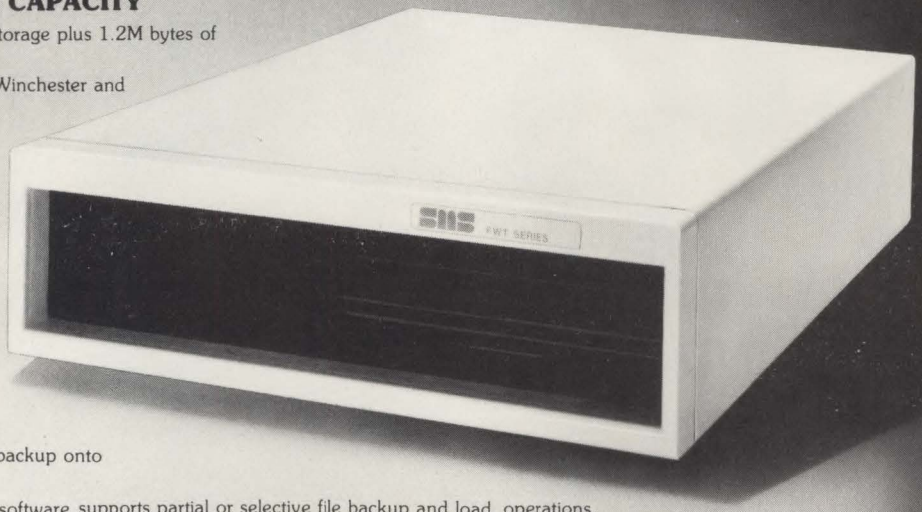
CIRCLE NO. 54 ON INQUIRY CARD

SMS' FLINCHESTER DISK SYSTEM FOR DEC® COMPUTERS

Winchester plus floppy disk storage and latest controller technology establishes new standard for DEC compatible disk storage.

SMS Flinchester peripherals provide 8.9M bytes of 8" Winchester disk storage and 1M bytes of floppy disk storage for DEC's PDP-11 and LSI-11 computers! In only 5¼" of table top or rack space you also get the following benefits:

AVAILABLE SOON!!
Look for 20M byte and 30M byte Flinchester systems in the near future.



MAXIMUM PERFORMANCE AND CAPACITY

- **8.9M bytes** of formatted Winchester disk storage plus 1.2M bytes of usable floppy disk storage.
- Fast data transfer of **427K bytes/sec** for Winchester and 63K bytes/sec for floppy.

INDUSTRY COMPATIBLE

- Automatic recognition of DEC RX01, RX02 and **IBM** diskette formats.
- Plug compatible with DEC PDP-11 Unibus and LSI-11 Q-bus.
- Increases performance of DEC's RT-11 and RSX-11M operating systems.
- Emulates DEC's RX02 floppy disk system.

CONVENIENT "MINUTE-PER-MEGABYTE" BACKUP

- Only **40 seconds** required for Winchester backup onto 1.2M byte floppy diskette.
- Standard RT-11, RSX-11M and SMS utility software supports partial or selective file backup and load operations.

UNSURPASSED RELIABILITY

- Modular construction and minimal parts count insure **long MTBF** and 15 minute MTTR.
- Off-line system and drive test.
- On-board **self test** verifies correct system operation.
- CRT initiated **super diagnostics** ease system test and fault isolation.
- **Automatic bootstrap** tests CPU, memory and DMA operation before software loading.

EXCEPTIONAL DATA INTEGRITY

- Winchester disk **flaw management** deletes permanently flawed disk areas.
- Automatic **error retry** recovers soft or temporary errors.
- **ECC (Error Correction Code)** recovers corrupted data without system shut down.
- Patented PLL circuitry requires no field adjustments and provides maximum margin for worst case bit shifted data recovery.

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CIRCLE NO. 55 ON INQUIRY CARD

Distributed intelligence vs. centralized logic

PAULINE LO ALKER, Convergent Technologies

Look for 'distributed intelligence' to overtake 'shared logic' in the '80s

The multifunctional, "distributed intelligence" system is here, born of necessity and expected to replace early shared-logic systems. It will feature networks of desk-top machines, each self-sufficient in processing capacity, yet able to access common data bases. Distributed intelligence architecture is the economical response (Figs. 1, 5) to the individual user's need for improved processing power in a package no larger than yesterday's CRT terminal.

Among the forces that have been at work to set the stage for the arrival of this new breed of minicomputer are:

- Emphasis on increased productivity, especially in offices.
- Demand for computer versatility—users want systems able concurrently to perform data processing, word processing and program development.
- Breakdown of the traditional data-processing center—it's now distributed.
- Hardware price reductions, feeding demand for more computers.

More and more people are forming the opinion that a large part of the productivity problem rests in the office. Users are concerned with increased productivity of installed hardware, as well as with increasing employee productivity. Aids in the form of multifunctional systems used in a distributed-processing environment (see "What is distributed processing?" p.108) can achieve these goals.

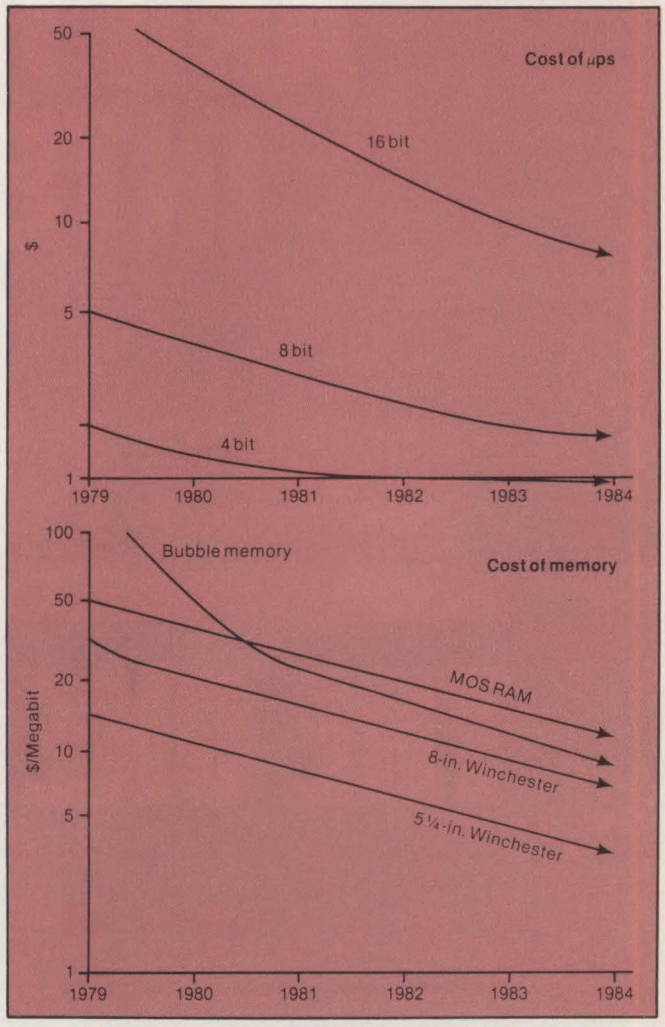

Fig. 1. Cost of computing power *can be expected to continue to decrease during the next few years.*

Shared-logic systems—the traditional approach

The direction of distributed-processing technology and application has been to transfer the processing functions of data collection and retrieval from a central

ONLY ONE OF THESE COMPACT DISK DRIVES DELIVERS BOTH 25 YEARS OF MEDIA EXPERIENCE AND THE ANSI INTERFACE.

THE ONE FROM 3M.

INTRODUCING 3M BRAND COMPACT DISK DRIVES.

A new family of 8" Winchester drives offers you a unique combination of features—features that pay off in high-quality performance, reliability, and product migration. 3M designed and built these drives so that the features would be right for OEM applications—starting with the media itself.

1 WHAT MAKES THESE 3M DRIVES DIFFERENT FROM EVERY OTHER WINCHESTER IN THE WORLD?

Scotch® Brand media. An industry leader for over 25 years. Its proven performance is the cornerstone of our new fixed disk drives. The medium is critical—it's *precisely* where super-reliable data storage should start.

One guarantee of this performance is the thoroughly proven surface lubricant called Lubyte™. Lubyte helps protect against head crashes, loss of data and computer system downtime.

2 COMBINED WITH ANSI INTERFACE: HIGH PERFORMANCE OFF-THE-SHELF.

By using the ANSI interface, these Compact Disk Drives let you take full advantage of state-of-the-art technology for both low-cost design *and* high performance. The standard makes a disk drive's interconnection to its controller easier. 3M has made sure that the new drives deliver the flexibility you need to support specific systems and applications.

The ANSI interface is microprocessor-based, and works efficiently at high data rates. The result: 3M drives are easy on customers' equipment overhead.

3 MIGRATION FROM 10 TO 60 MEGABYTES AND BEYOND.

The third benefit the 3M Compact Disk Drive family gives you is the migration needed to keep up with user demands. Migration that won't dead-end your customers, or cost them an arm and a leg to obtain.

The 3M 8431 drive offers a total unformatted capacity of 10 megabytes on a single disk, with 8649 BPI and an average track density of 219 TPI. The 3M 8432, with two disks, delivers 20 megabytes, with the same bit and track density. The 3M 8533 offers 60 megabytes on three disks, with track density increased to 693 TPI. Modularly expandable, the drives offer you and your customers cost-effective increases in capacity from 10 to 240 megabytes.

4 THE "SUPER-CLEAN" AIR SYSTEM.

Because reliability is so critical to the operation of a sealed-environment disk drive, the drives have a specially-engineered super-clean air system (patent pending). A cast aluminum deck, for example, separates the heads and media from the motors: a feature that helps make 3M's super-clean air system distinct from ordinary systems. Air is cleaned to 10 particles per cubic foot/minute or less.

5 AND OTHER OUTSTANDING FEATURES.

Like microprocessor-controlled rotary actuators (patent pending), drive modularity, data separation and direct track addressing, and low power consumption. Right now, these new drives are the only ones that give you *all* of these features in one 8" Winchester package. It's time to evaluate them against the competition. For complete information write to:

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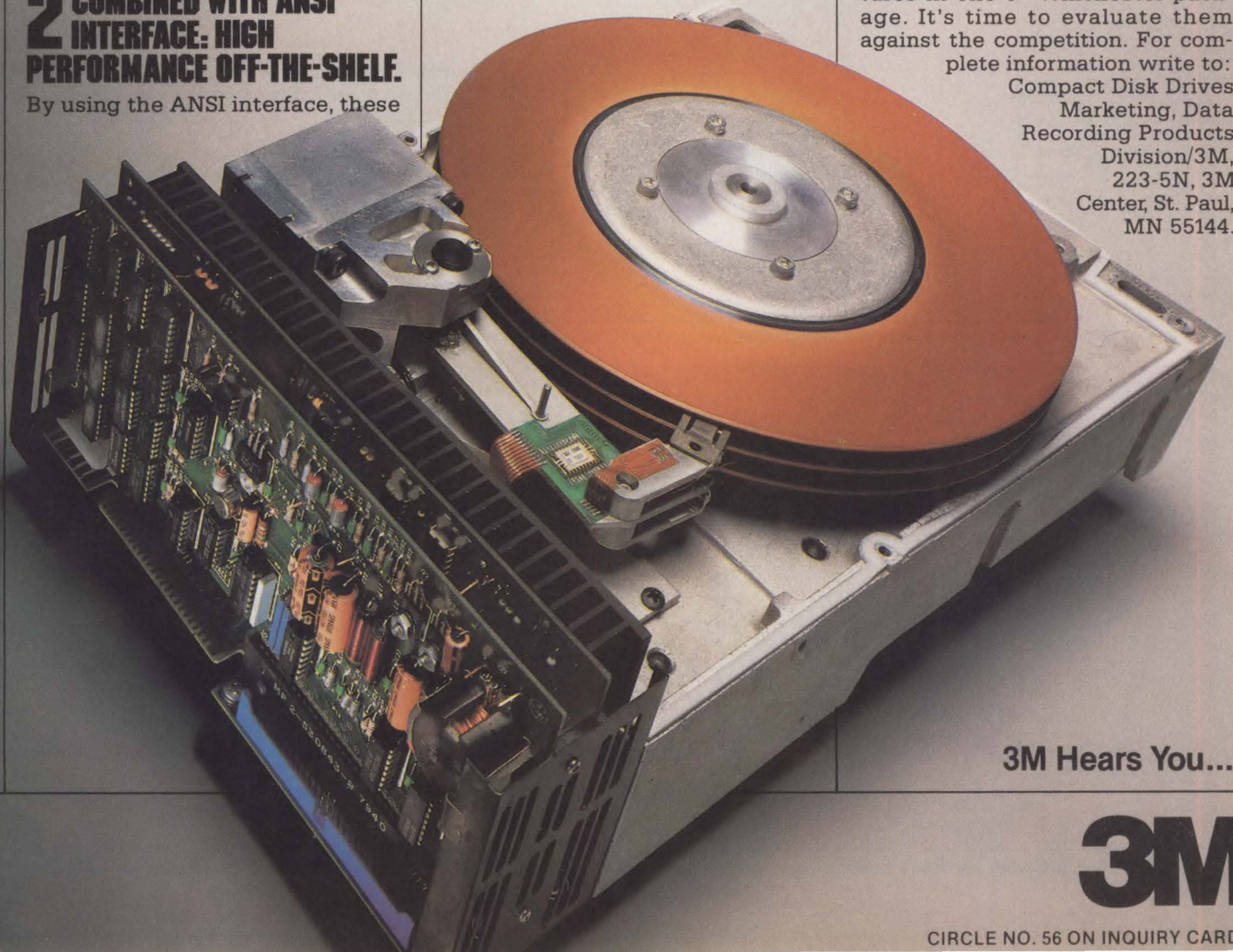

3M Hears You...

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CIRCLE NO. 56 ON INQUIRY CARD

Under the shared-logic concept, low-cost terminals are available for data entry, data retrieval and limited processing within an organization.

facility to the department doing the job. The traditional approach to this decentralized I/O concept is the shared-logic system.

Shared-logic systems were first implemented using large mainframes operated in corporate data-processing centers. Later implementations used mini-computers to place the processing power outside a data center, away from large mainframes.

Under the shared-logic concept, low-cost terminals, ranging from "dumb" to "intelligent," are available for data entry, data retrieval and limited processing within an organization (Fig. 2a). Such terminals rely on a central processor to provide most of the processing and program handling. Storage of programs and data bases is also maintained at a central facility, using large-capacity hard disks and tape drives. The centralized CPU handles external communications, as well as communications among the peripheral terminals.

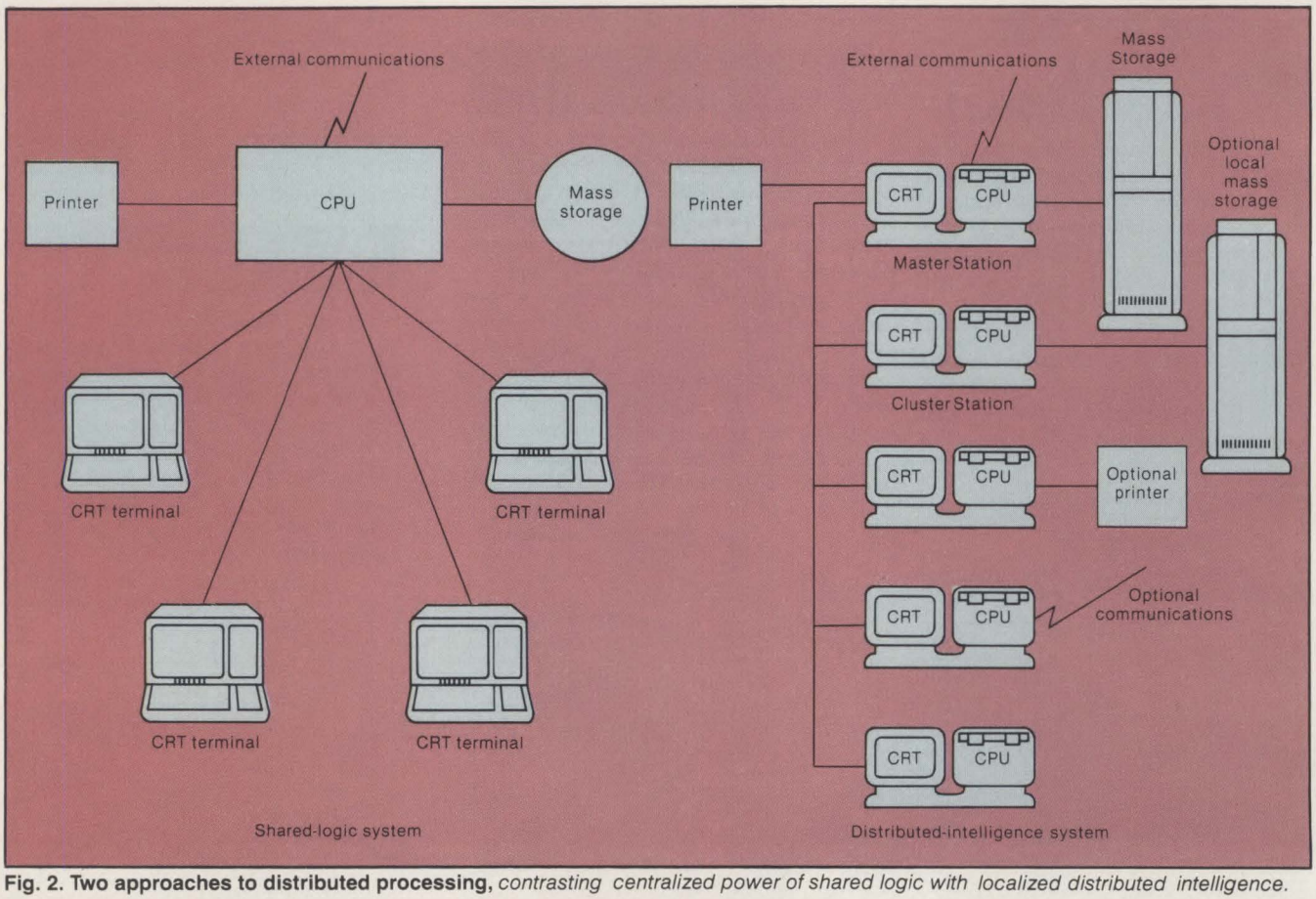

Fig. 2. Two approaches to distributed processing, *contrasting centralized power of shared logic with localized distributed intelligence.*

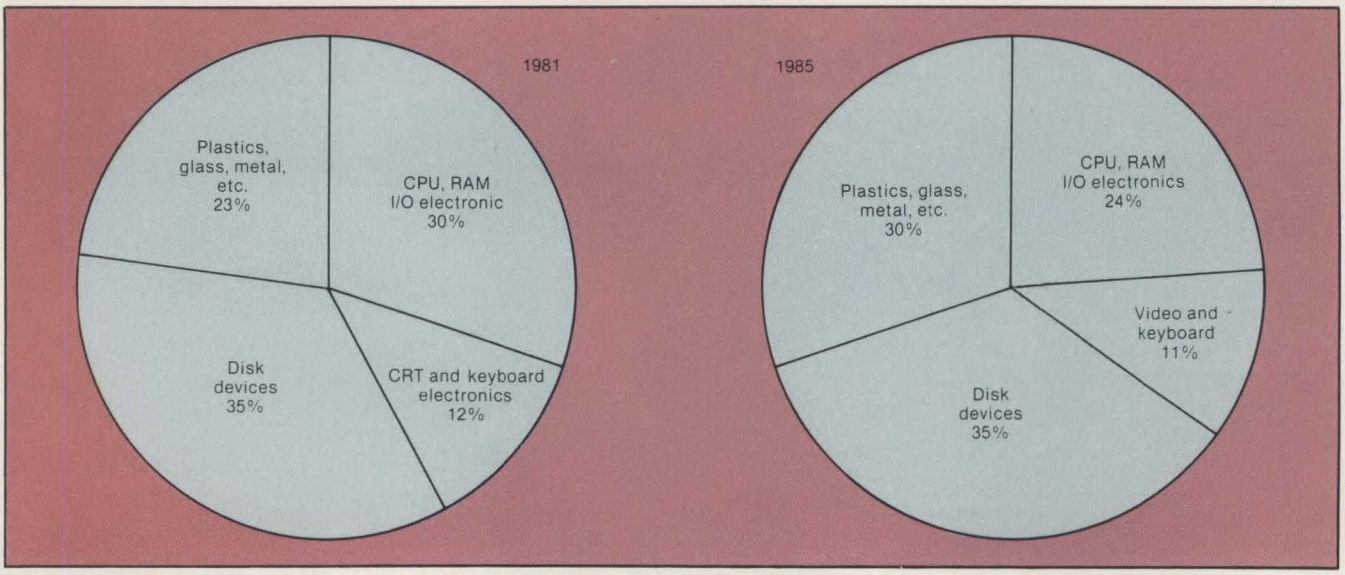

Fig. 3. Desk-top computer hardware cost elements *can be expected to shift during the next few years.*

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Only the most sophisticated and expensive shared-logic systems can simultaneously execute more than a few functions.

The idea behind shared logic is to distribute I/O capability to more users while sharing processing power, on the premise that the cost of terminals is relatively minor compared to the cost of computing power. However, with the introduction of low-cost and powerful 16-bit μps, the argument behind cost saving through shared logic is no longer valid. As semiconductor component prices decrease, the cost of processing power no longer represents a significant portion of the total hardware cost. At the same time, the cost of other materials (the "carcass costs," including plastics, glass and metal) is rising (Fig. 3). With a 16-bit processor chip priced at less than $100, it doesn't make sense to share it among several users.

Another major consideration is performance. In a shared-logic system, processing power is centralized. As terminals are added, the CPU is strained not only by additional access and processing demands, but also by the need to handle all the communications, housekeeping, program storage and loading associated with the additional terminals.

Application functions also reside in the CPU. As new functions are added, the memory capacity and processing capacity of the CPU are taxed further. Additional interactions between functions also cause performance degradation, resulting in slow response time for an on-line user, and system down time caused by system overloading. In multifunctional processing, the shared-logic system's performance is particularly unimpressive. For that reason, many shared-logic systems are single-function devices, typified by today's dedicated word processors. Only the most sophisticated and expensive shared-logic systems can simultaneously execute more than a few functions.

The architecture of these shared-logic systems, then, is most suitable for dedicated-function applications and appliclations that are more I/O- that CPU-intensive.

The major evolution in distributed processing during the '80s will come from a new breed of systems using a distributed-intelligence architecture. Distributed intelligence treats processing power independently of the processing network. In a distributed-intelligence system, the processing power—intelligence—is not centralized. Instead, it resides in each homogeneous module (Fig. 2b). Intelligence, then, becomes totally transparent to the distributed-processing cluster.

With this approach, a user's access to a system's processing power is no longer through a terminal. Instead, each user has a work station—a desk-top

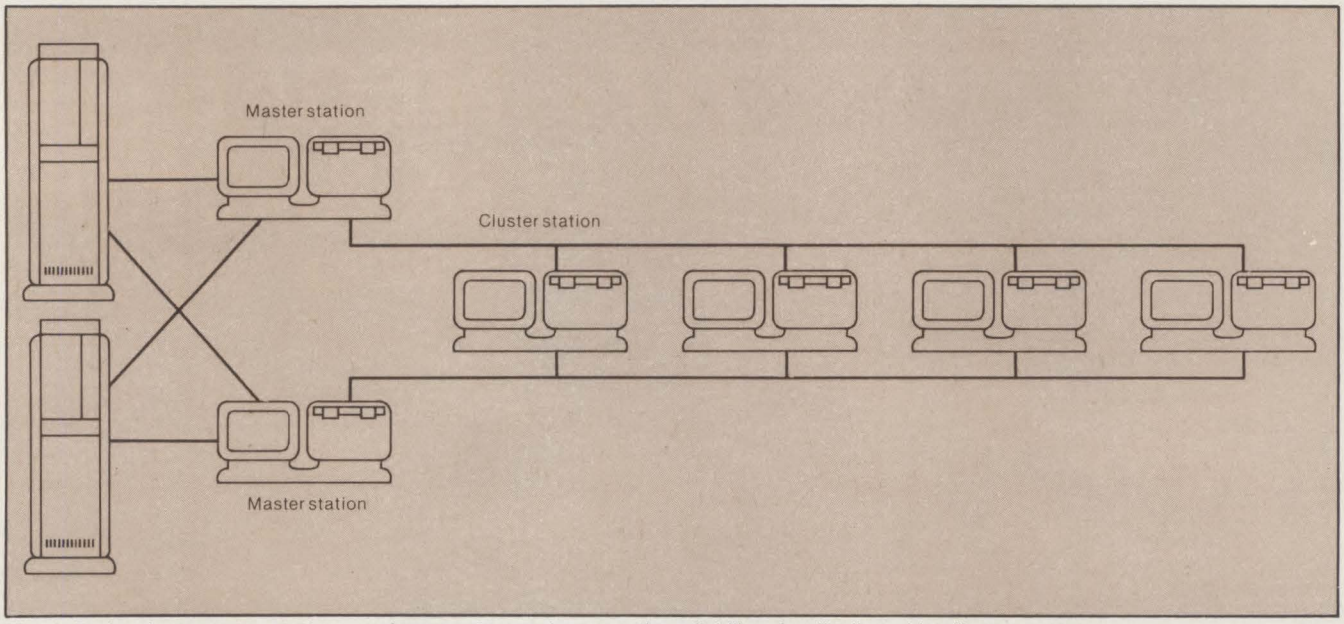

Fig. 4. Redundant master stations and mass storage *increase the reliability of a distributed-intelligence system.*

WHAT IS DISTRIBUTED PROCESSING?

There are probably as many definitions of distributed processing as there are users and vendors involved in it, but generally, it means placing processing power in the hands of a person who needs information. In a distributed-processing environment, processing is spread out, instead of concentrated in a data-processing center. Processing is done on small units, such as minicomputers, small business computers or μcs, rather than mainframes.

Discussions of distributed processing often overlook the fact that some degree of centralized control is required to facilitate the exchange of data between the processors. This control facility, however, is the key to a distributed-intelligence system. Because the centralized facility is not called upon for processing for other stations, it is not as sensitive to increases in the number of users as would be a CPU in a shared-logic, or non-distributed, system.

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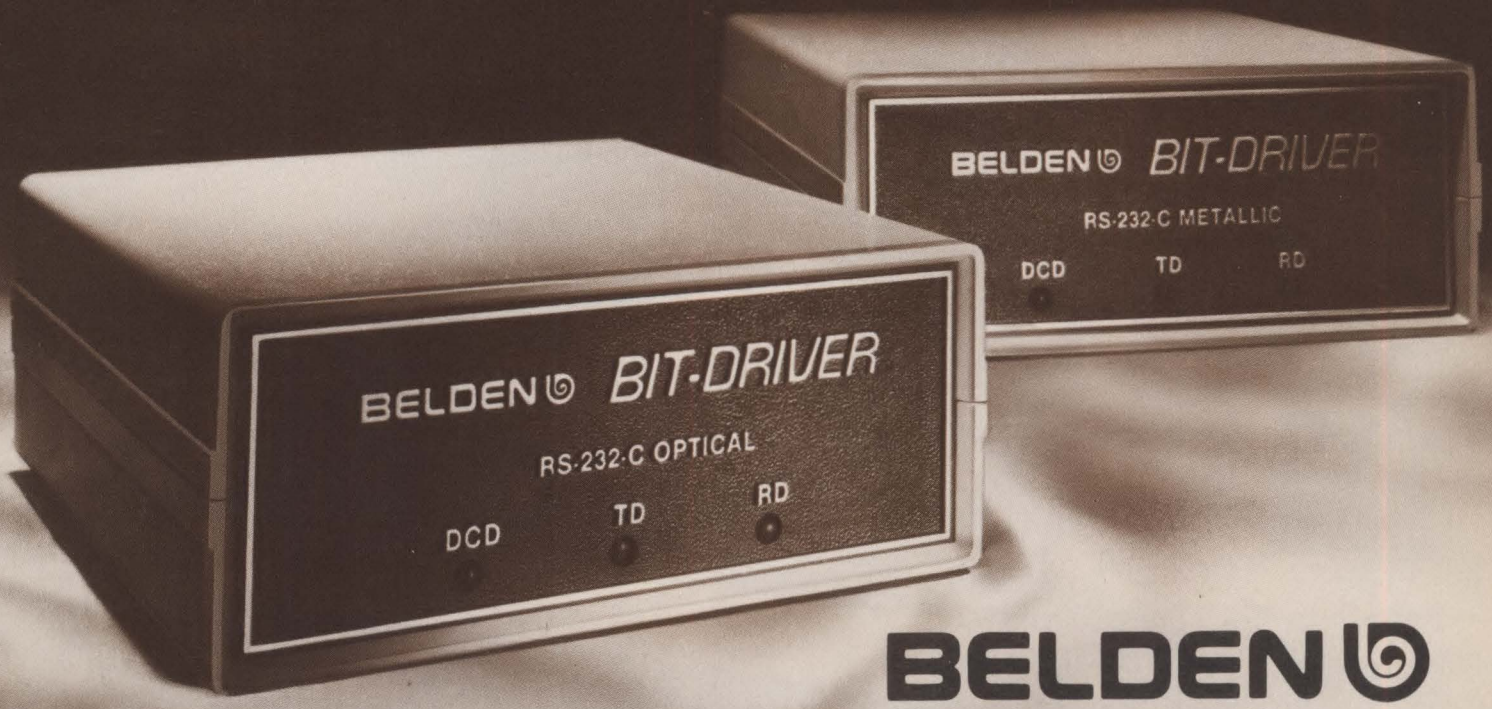

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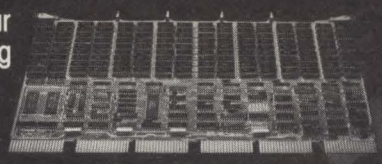

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The distributed-intelligence network's major contribution to white-collar productivity is the multifunctionality of each desk-top computer.

computer—fully equipped with CPU, memory, display and optional local mass storage. Each work station has the processing power of a minicomputer, equally able to perform multiple processing functions on data, text and communications.

While work stations can run independently in a stand-alone mode, they can also be clustered via a high-speed local network, sharing peripherals and data bases, but not processing power. Because of their power and versatility, these distributed-intelligence desk-top devices are often called multifunction work stations.

In a distributed-intelligence system, each user is given his own CPU and memory; only some I/O resources are shared with other users. Each station has dedicated computer power to process its own function without having to contend with other stations for CPU resources, which improves throughput significantly.

The distributed-intelligence network's major contri-

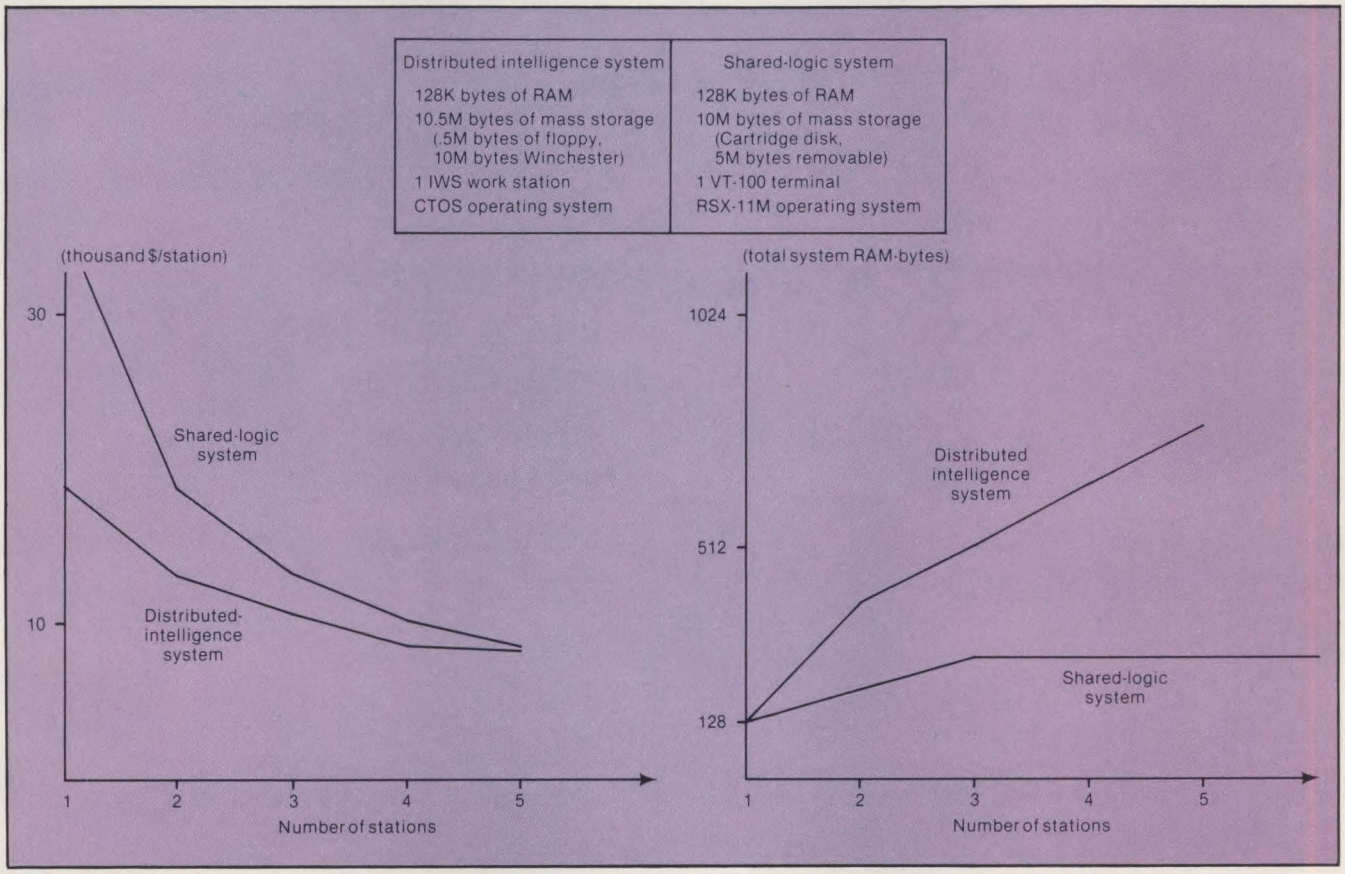

Fig. 5. Price and system capacity comparison *between typical shared-logic and distributed-intelligence systems. As the number of stations increases, the price differential decreases, converging at about five stations. However, system capacity grows faster and more evenly in a distributed system, constantly matching resources to demand.*

PROFILE OF A DISTRIBUTED-INTELLIGENCE SYSTEM

Introduced in October, 1980, and designed specifically for OEM system builders, Convergent Technologies' family of systems is based on multifunctional desk-top minicomputers that operate in stand-alone or network configurations. Using a distributed-intelligence architecture, each Convergent work station provides a 16-bit processor, a 15-in., high-resolution video display, a keyboard and as much as 1M byte of RAM.

Each desk-top unit is connected to a mass-storage station, a high-speed cluster data link or both. Using a combination of Winchester- and floppy-disk drives, mass-storage capacity ranges from 1M byte to 120M bytes.

The Convergent desk-top minicomputers can be interconnected to both local and dispersed networks. A local resource-sharing network that provides controlled sharing of a common data base is called a cluster configuration. Clusters allow several stations to share expensive disks and printers, but not processing. The result is high responsiveness because each station executes its own interactive application program. Each user in a cluster has a desk-top minicomputer and can have his own local mass storage.

Each cluster consists of a master station and as many as 16 cluster stations, connected via a high-speed data link. The data base of the master station is accessible to each cluster station, subject to password protection. In addition, each cluster station can have private files on an optional local disk. Both stand-alone and cluster configurations have access to remote (distributed) data bases through long-haul networks that, will include X.25, SNA and others.

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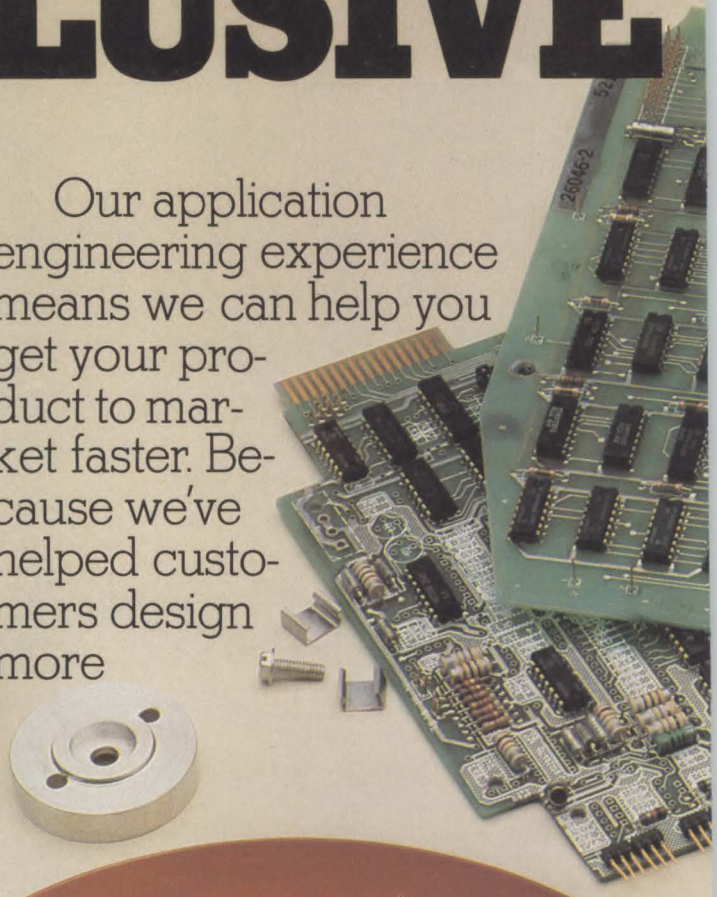

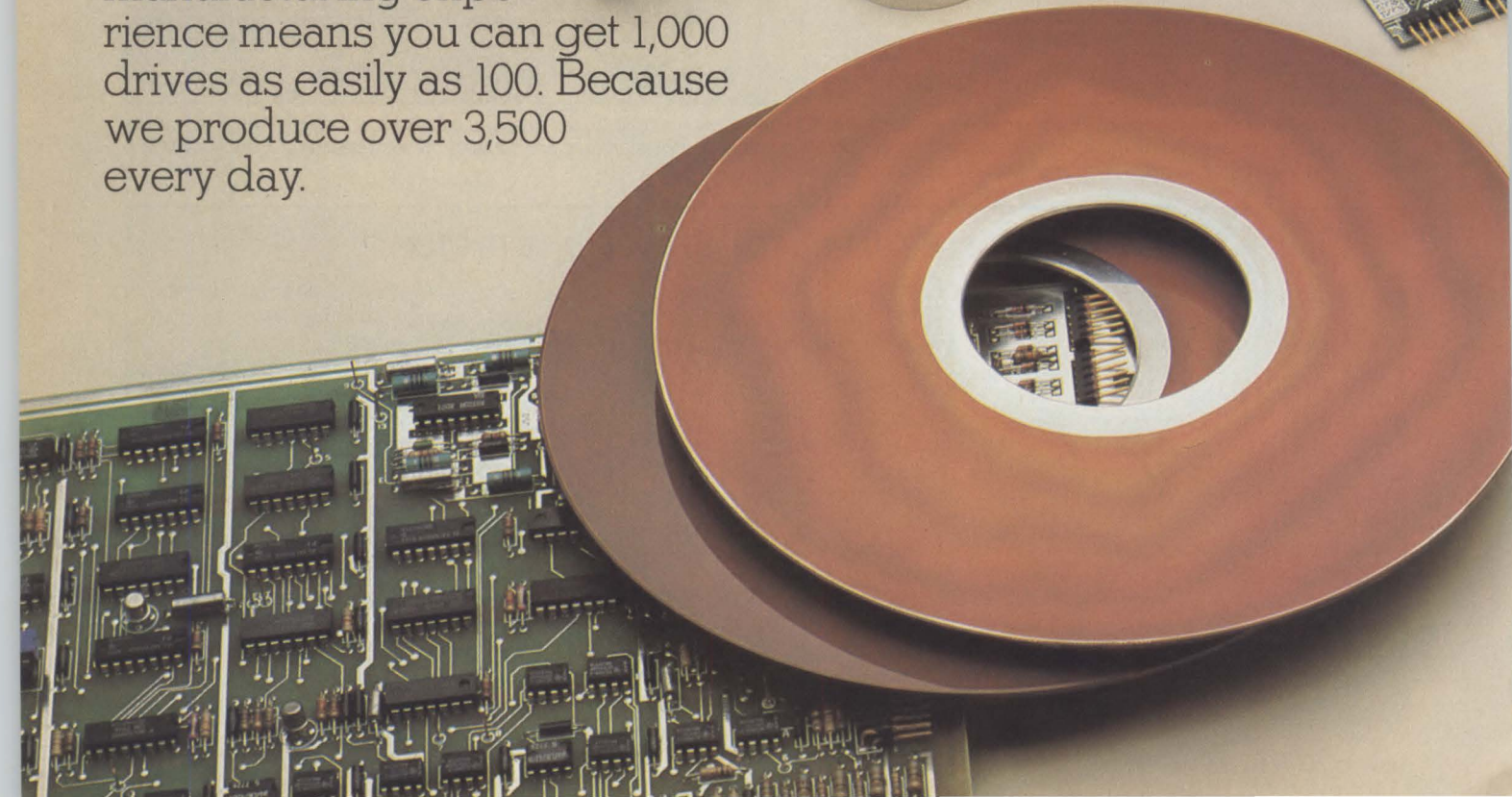

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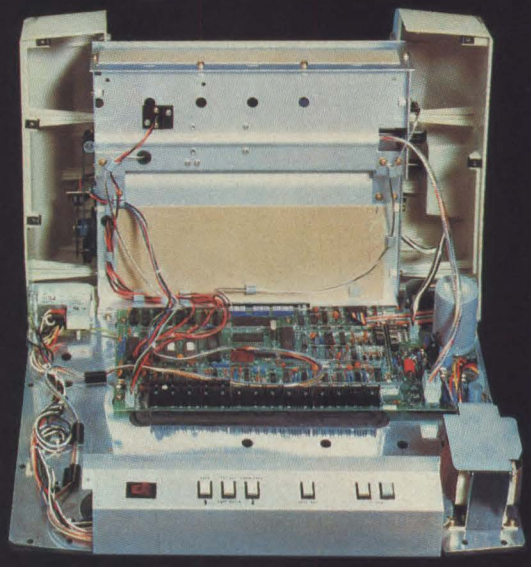

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Reducing the number of centralized system elements makes distributed-intelligence systems more reliable.

bution to white-collar productivity is the multifunctionality of each desk-top computer. Each application function is loaded and executed at a work station. One station may be running word processing, another doing program development and others executing data-processing functions.

The number of applications one can add to the system is not limited by hardware capacity or system throughput, as it is in shared-logic systems. New functions can be added to the network without affecting overall processing capability or performance. As an organization's needs change, work stations can be reassigned or added. Because all the desk-top computers are identical, compatibility is no problem. When a station is added to the cluster, total system power increases.

For a highly dedicated application, special hardware such as light pen, plotter or digitizer need only be local devices. The software interface is limited only to that particular application program. Other work stations are not burdened with additional resources that add no value. With the flexibility inherent in the architecture, a user can easily expand an application to include product features without disrupting the processing network.

Reducing the number of centralized system elements also makes the distributed-intelligence system more reliable. A failure occurring in one station need not impair the others, except in a controllable way. If a function breaks down in a "master station"—one that controls the shared resources—the function can be transferred to another station in the cluster. If a failure develops in the shared mass-storage device, any cluster station with local mass storage can assume the role of the master station, or it can operate as a stand-alone system until the service is restored. Should any failure be intolerable, the master station can be duplicated (Fig. 4). The cost of a redundant master station in a distributed-intelligence system would be less than that of duplicating a centralized facility. ■

Pauline Lo Alker is vice president of marketing at Convergent Technologies, Santa Clara, Calif.

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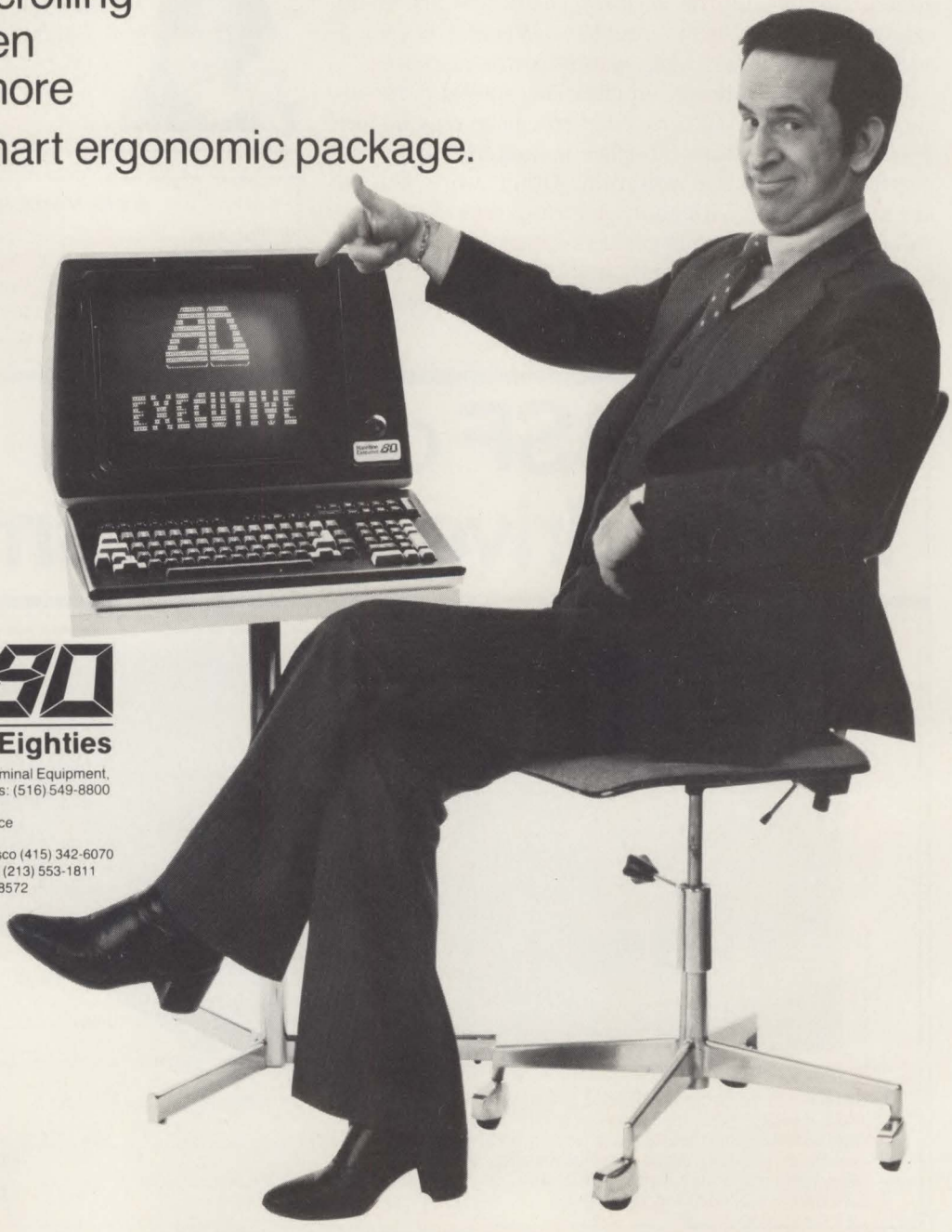

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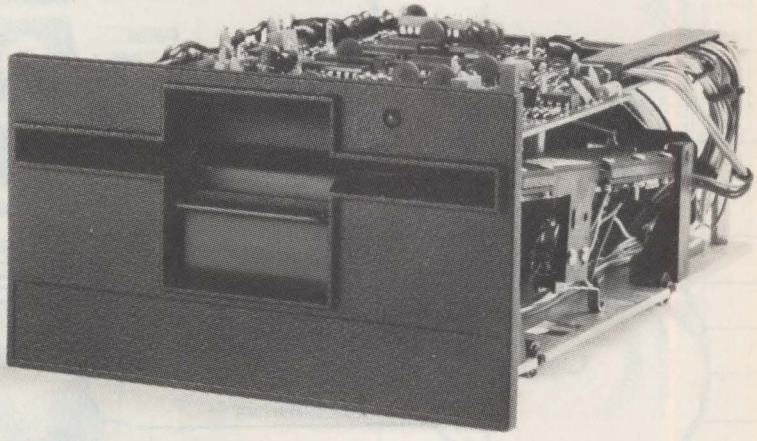
As a result, over 75% of the system manufacturers choose Micropolis. And over 95% of the double track density disk drives installed today are from Micropolis.

Our wide range of drives comes with a precision centering mechanism to insure accurate centering of a disk—every time (four times better than the competition). In addition, we include ceramic/ferrite double density recording heads, 10 msec track-to-track access time, stainless steel precision-ground positioning reference, and the highest quality electrical and mechanical components available. So you get high track storage capacity, fast access, lowest cost per K byte, significantly greater reliability and best of all, 3 years delivery experience of 85,000 high capacity drives.

	Maximum Capacity	# Delivered Through '79	Positioning Mechanism	Track Density	Av. Access Time (msec)
Shugart SA450	437.5K	<5,000	spiral cam	48	440
MPI B91	960K	Evaluation only	steel band and capstan	96/100	240
TEAC 50C	960K	<10,000 Mainly in Japan	steel lead screw	100	865
Micropolis 1016/1015	1,100K	60,000	steel lead screw	96/100	365

Our drive was designed from the ground up for its double density capacity, not merely redesigned from a single density unit. That's one reason we've shipped more high capacity 5¼" floppies by far than anyone else. Another is that no matter how many imitators there are, there's no substitute for the original.



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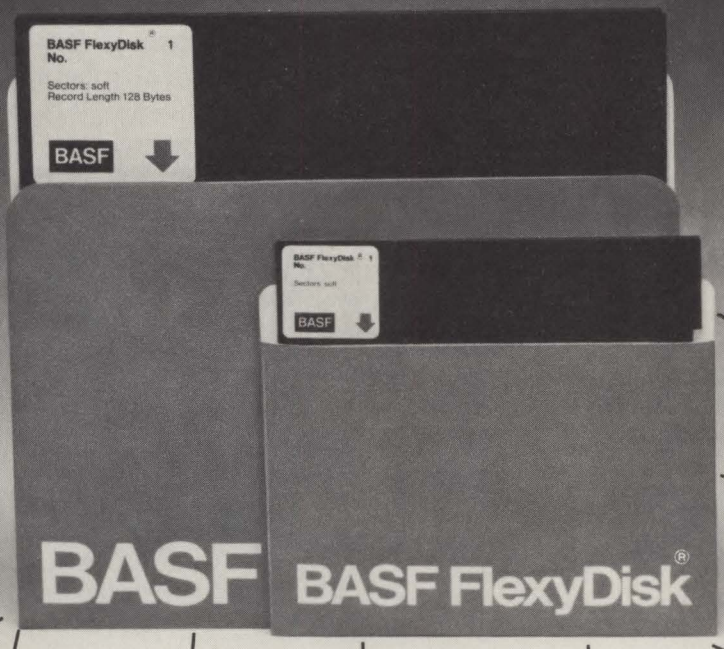

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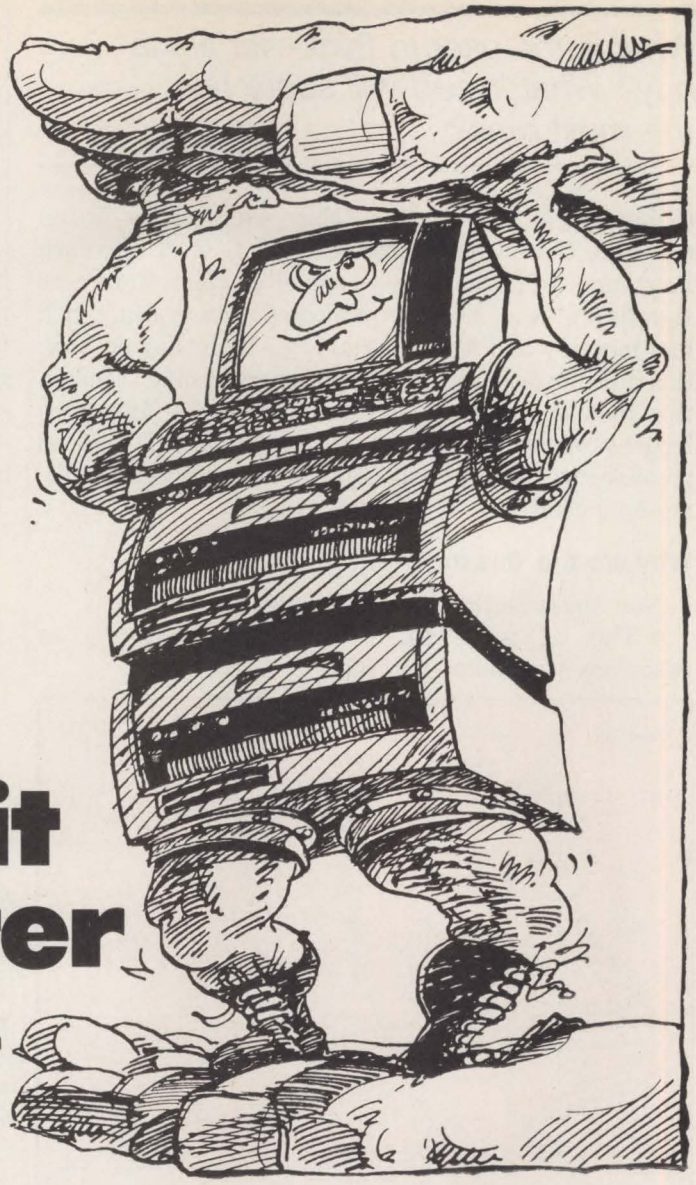


MINICOMPUTERS

Is the 16-bit minicomputer dead?

EFREM G. MALLACH,
Honeywell Information Systems Inc.

Although the 16-bit mini faces fierce competition from μc technology in the years ahead, it is not yet ready for burial

The small-computer hardware world can be a baffling one for the buyer. While companies such as Intel Corp., Zilog, Inc., and Motorola, Inc., herald the arrival of 16-bit μcs as the computers of the future, others, including Prime Computer, Inc., Systems Engineering Laboratories and Perkin-Elmer Corp., forecast the dominance of 32-bit minis. Datapoint Corp. and Hewlett-Packard Co. (judging from product announcements through February) cheer the strengths of 16-bit minis and, to make matters more confusing, Digital Equipment Corp., Honeywell Information Systems, Inc., and Data General Corp. rally behind two, or all three, product types.

What is the user to think—let alone buy? Which lineup will score him the most runs? In the "good old days," the word-width issue was not as emotional; μcs did not exist. As we progressed from discrete transistors to whole functions in a package, the thought of

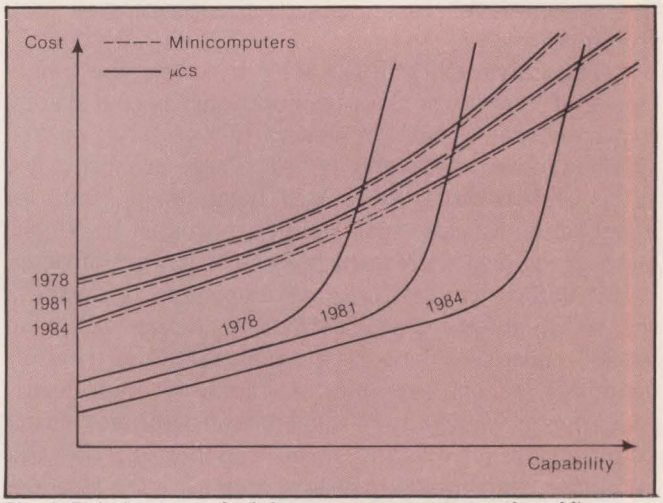


Fig. 1. Relative cost of minicomputer vs. μc operation: *Micros are less expensive to use when the requirements are less demanding; more expensive when the task is more complex.*

Illustration by Jon McIntosh

What is the user to think—let alone buy? What lineup will score him the most runs?

thousands of gates on a chip was science-fiction material. Because so many components went into each functional unit, the added cost of a wider word was significant. And, because minicomputers typically had less memory and fewer peripherals than they do now, this added system-level cost was very visible. Finally, this industry had not yet stabilized on a few word lengths. Words of 8, 12, 16, 18, 24 and 32 bits were all popular, preventing rival camps from readily crystallizing on a choice.

Why are the '80s different?

Now these factors have all changed:

- The μc is a reality, and has the power of yesterday's medium-sized mini.

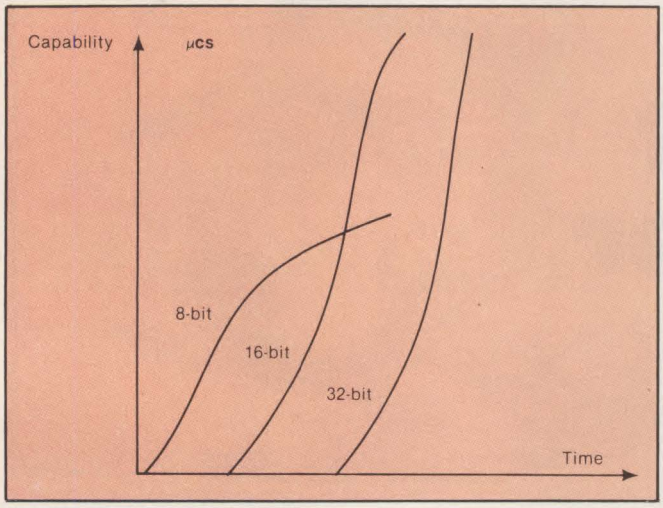


Fig. 2. μC capability soars *with advances in technology because the architectural level of each succeeding generation is much higher.*

- The cost of central-processor electronics has become a smaller fraction of total system cost, reducing the system-level cost impact of sophisticated CPU architectures.
- The universality of the 8-bit byte and the convenience of having the data-element lengths in a system relate to each other by powers of two have pushed systems toward 8, 16 and 32 bits. There are also a few 12-bit and 24-bit systems still being made, but, for many years, all new small computer product lines have been introduced with word lengths of powers of two.

But before we use these developments to decide if the 16-bit mini is dead, we have to define just what "dead" means. There is a wide range of possible meanings. At one extreme, "Is the 16-bit mini dead?" could mean: Would any rational person continue to use a 16-bitter for an existing, useful application? By this definition, the only truly dead systems are the antiques that cost more to power, cool and maintain than to replace. At the other extreme, it could mean: Would any strategic planner conceive a totally new line of 16-bit minis?

MINIS, μCS: HOW DO THEY DIFFER?

Defining "minicomputer" is a continuing source of frustration to industry analysts. For purposes of this article, though, we can distinguish it from a μc quite easily:

- A μc's central processor is built around one (or a very few) circuit chip(s) that has no other practical use. The chip is calles a μp.
- A minicomputer's central processor, on the other hand, uses only much more generally useful circuit elements. At a minimum. they must be useful in a totally incompatible CPU.

The entire spectrum of 16-bit questions more logically looks something like: Should anyone...

- keep using one for an existing application?
- put a new application on one he already has?
- buy another one to expand an application?
- buy another one for a new application?
- buy his first one?
- manufacture new ones?
- market one actively?
- announce a new one?
- design a new model in an existing line?
- plan and develop a new line?

Only the last two activities on this list are kept secret, so we know that all but these last two are being done with 16-bit minis today. Regarding announcements, the end of 1980 and beginning of 1981 saw new 16-bit minis from Datapoint, Hewlett-Packard, Honeywell and IBM. Manufacturers are understandably secretive about design activities, but it is reasonable to expect that some 16-bit mini lines will be extended and some will not. This means that the next-to-last question is border territory. As for the last, it is safe to guess that anyone designing a new product line today would base it either on μc technology or a 32-bit (or wider) architecture. In this last sense then, the 16-bit mini may well be dead.

To most people, the last sense is the least important. Unless your job is long-range planning for a minicomputer vendor, you care much more about the first nine.

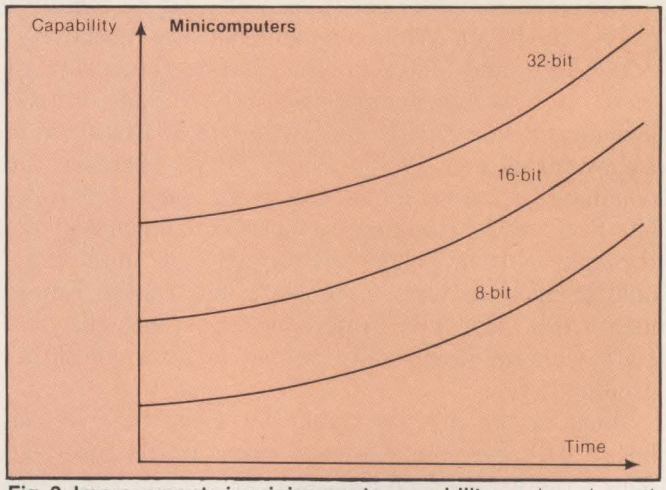
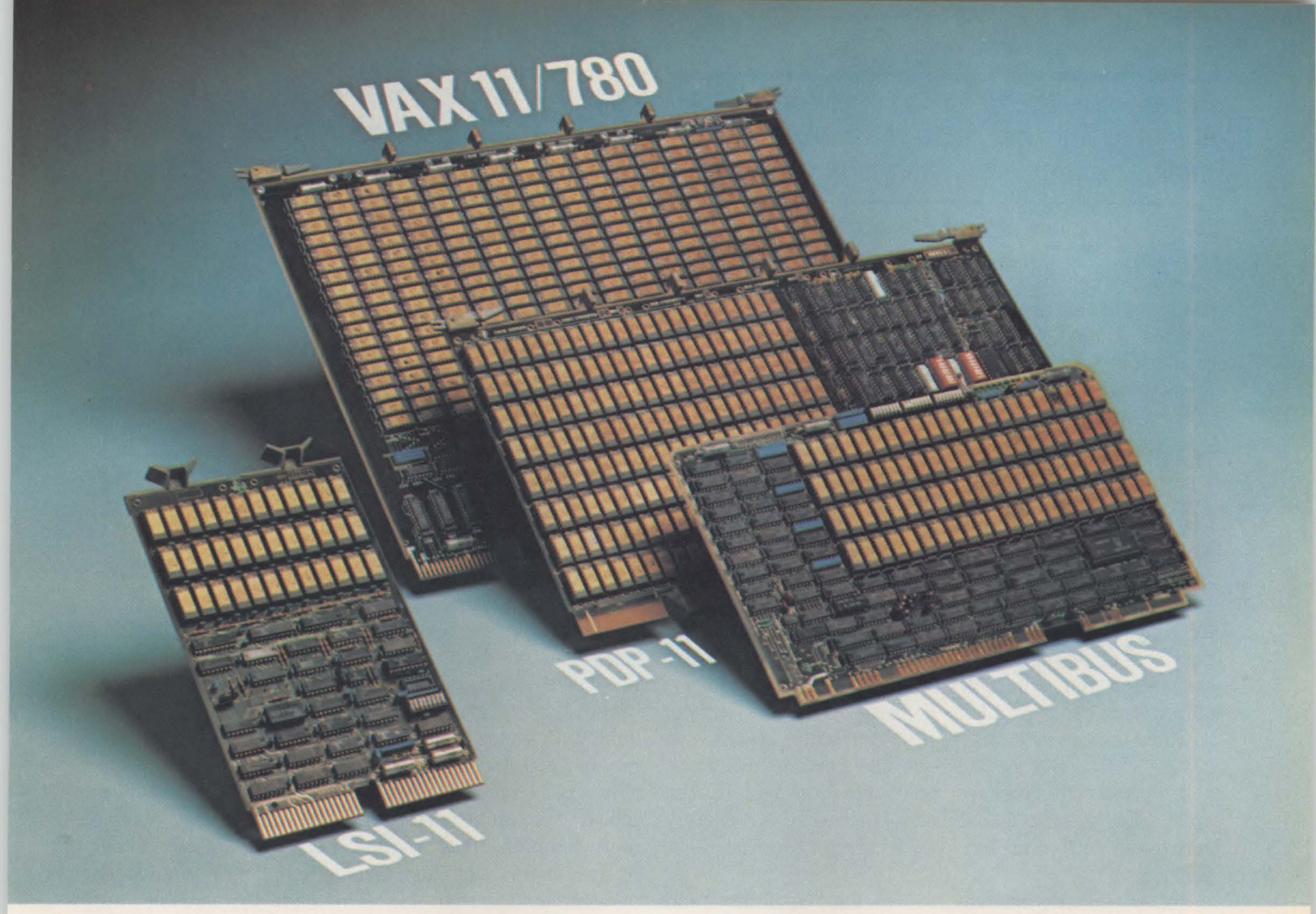


Fig. 3. Improvements in minicomputer capability *are less dramatic because, as chips become more complex, some of their capability is lost to any particular application.*



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PDP-11†	TMM20000[2]		X	X	X	X		X
VAX†	TMM30000					X	X	X
Multibus‡	TMM40010[2]	X	X		X	X		

[1] Parity optional [2] EDAC standard

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For a user, the value of 32-bit features is increasing because the nature of minicomputer applications is changing.

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What will kill the 16-bit mini? Its death will be the result of two distinct forces closing in: The 16-bit mini is under attack by 16-bit μcs at the bottom, and 32-bit minis at the top.

The μc invasion

First, let's look at what's happening at the low end. Fig. 1 shows how the state of the art relates cost and capability in minis and μcs. At the low end of the capability spectrum, μcs can do a job much less expensively than minis, but there is a sharp knee in the μc curve, defined by technology limits. Pushing μcs past this point results in unacceptable costs caused by low yields and a host of other factors. Minis do not suffer from these problems to nearly the same degree, so their curve rises much more gradually. Hence, the curves cross. But because we are getting bettter at making μcs, the crossover point moves steadily to the right. The result: Capabilities that were adequately addressed with minis last year will be μc territory next year.

To see this another way, we can put "capability" and "time" on the two axes of the chart. For μcs, that gives us the analysis shown in Fig. 2. Each class of system starts at a low level, when the technology barely permits building a system. From that point, it rises rapidly. Eventually, it levels off somewhat when the inherent limits of its architecture are approached. By then, the next generation of devices will be on the march. Having a much higher architectural limit, they will soon pass their predecessors en route to a higher plateau.

WHAT IS A BIT SLICE?

Physically, a bit slice is a large-scale integrated (LSI) circuit chip with thousands of transistors on it. Logically, it is to a computer as a slice of bread is to a loaf: You stack several of them together to get a complete object.

Bit slices typically contain circuits for all the arithmetic and logic functions of a central processor. They also contain several registers, perhaps 16. But there are two catches: They are usually just 2 or 4 bits wide, and they are unable to control their own operations.

The first problem is solved by "stacking" several slices. Use four 4-bit slices if you want a 16-bit system, and so on. They are designed to function as a unit when connected. As for the second problem, the usual solution is to provide an external microprogram. Put these together, add some supporting functions such as a clock and a bus interface and *voilà*—you have the modern mini.

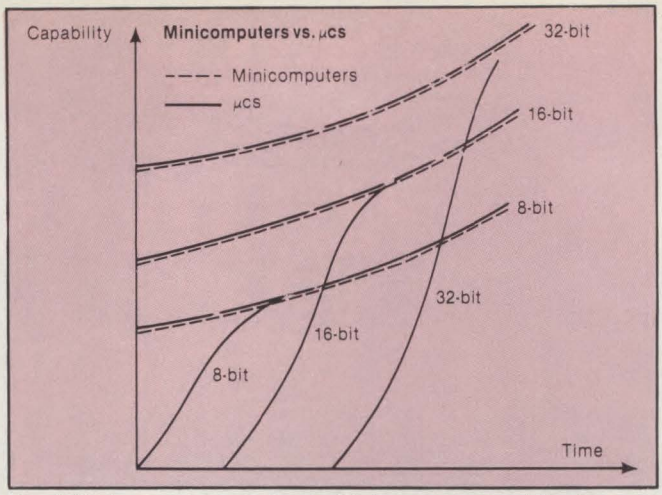

Fig. 4. Minicomputers start out with *far greater capability than μcs, but improve less rapidly.*

The corresponding situation for minis is shown in Fig. 3. The rate of change is not nearly as dramatic because improved technology, meaning more gates per chip, does not have as big a payoff with minis. That's because in designing a μc, engineers can dedicate each of thousands of gates to the task at hand. This cannot be done with general-purpose components. As long as the number of gates on a chip is small and the functions of a chip are simple, the chips are elementary building blocks that can be used to their fullest. As they become more complex, some fraction of their capability will not be used in any particular application. There is a degree of complexity that is technologically feasible but economically impractical in a general-purpose device. Gate arrays are an approach to resolving this conflict, but, even here, the utility drops as the gate count increases.

If we combine these curves, we get the analysis shown in Fig. 4. The 8-bit μcs caught the 8-bit minis where the limitations of 8-bit architecture slowed the μc's rapid advance. At that point, 16-bit minis, which did not suffer from those limitations, had a big lead. However, 16-bit μcs emerged and will soon catch up with their mini counterparts. We will then see this cycle repeated with 32-bit machines.

The neat lines shown in Fig. 4 are easy to follow, but somewhat deceptive. There is no single 16-bit mini; there are dozens. Some are simple; some are sophisticated. Some are general-purpose; some are highly specialized. Some are quite popular; some have a small group of dedicated users. These factors and others affect the point of intersection. The result: The real world has the broad, fuzzy bands shown in Fig. 5.

Meanwhile, back at the ranch...

At the same time that μcs are moving up from the bottom, 32-bit minis are coming down from the top. Here, the reasons are less technological, relating more to user and vendor economics.

For a user, the value of 32-bit features is increasing because the nature of minicomputer applications is changing. The trend toward commercial applications is

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CIRCLE NO. 66 ON INQUIRY CARD

While 16-bit minis will still be manufactured for expanding applications, people will choose them primarily in applications in which compatibility with installed systems is an important consideration.

well-documented. More and more sophisticated distributed systems are being developed. Although assembly language survived longer as a way of life in minis than in mainframes, its use is rare today. Data base management systems, query systems and networking are becoming commonplace. All these trends increase the need for systems that have advanced architectural features and high performance. While there is no single requirement in these applications that a 16-bit machine cannot meet, the sum of them all is an increasingly powerful argument for 32 bits—but one that is convincing today only at the top end of the minicomputer market. A true 32-bit system below that level may arise from a particular design team's set of trade-offs, but such a system isn't a requirement. However, the

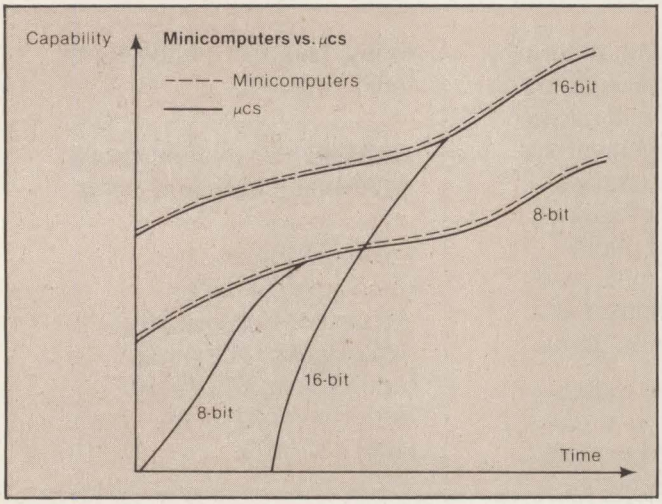

Fig. 5. Minicomputer/μc intersections *are imprecise because of the tremendous variety of minicomputers and μcs.*

trend toward applications placing a premium on the features of 32-bit systems is clear.

At the same time that the value of a 32-bit architecture is increasing, the cost of providing it is decreasing. This is a direct result of declining costs in all segments of integrated-circuit technology. Circuits such as bit slices (see "What is a bit slice?," p.122) make it almost as easy and inexpensive to build a 32-bit system as a 16-bitter of comparable speed.

The conclusion from these two trends is: Manufacturers of 32-bit systems will be able to provide products of greater value to users at little additional cost. By survival of the fittest, 32-bit minis will push their way downward in the size and performance spectrum. The rate at which they push will vary. Advanced 16-bit systems will competitively hold their own for several years. Specialized ones will survive on their merits in their own application areas. Software, support and the like will often justify selecting a 16-bit system over a technologically advanced 32-bitter that offers less to a user's bottom line. All these issues, however, can only postpone the day of reckoning; they cannot prevent it.

The same considerations hold true at the low end of the market, where we saw 16-bit μcs moving up. Advanced 16-bit mini systems will have an edge here as well, because it will take longer for μc technology to reach their level than it will to catch the simpler ones. Specialized systems will likewise survive longer, because a specialized system on its own turf is the equal to a much higher power general-purpose device. And software and support will overcome a cost disadvantage for many users. Yet here, just as at the high end, the handwriting is already on the wall.

When will these events come to pass? The 16-bit mini dominates the $20,000 to $150,000 segment of the mini market. (These are very rough numbers and represent the end-user cost of a complete system.) New 16-bit systems are still being announced, and we can assume they are intended to stay competitive until at least 1984-85. By the last half of the decade, the 16-bit μc will have moved up, and the 32-bit mini will have moved down to intersect each other. While 16-bit minis will still be manufactured for expanding applications, users will choose them primarily in applications in which compatibility with installed systems is an important consideration. And by then, 32-bit μcs, such as Intel's iAPX432, will have started to appear in systems being shipped in volume to end users.

The bottom line

What does all this mean to an end user? Very little. If a system does the job, it should not matter if it uses 16 bits, 32 bits or an abacus. The technology—silicon or peanut butter—should be equally irrelevant. Life-cycle costs for an application should be the overriding consideration.

System builders are in a somewhat different situation. Their own competitiveness is a direct function of the cost-effectiveness of the system they buy. Their software investment means that a system chosen today will be difficult to change tomorrow. System builders should have no qualms about choosing a 16-bit mini, as long as they feel comfortable that their supplier will stay current. Staying current means the supplier will go to 16-bit μcs, compatible 32-bit systems or both, when the need arises.

As for manufacturers, the ones that expect to stay in business have undoubtedly grappled with these issues and have reached their own conclusions. They may be heading downward to μcs, or upward to the 32-bit domain. Resources permitting, some will do both. The ones that do neither are in for a very rough time. ■

Dr. Efrem G. Mallach is manager, market and competitive analysis, for Honeywell Information Systems Inc., Billerica, Mass.

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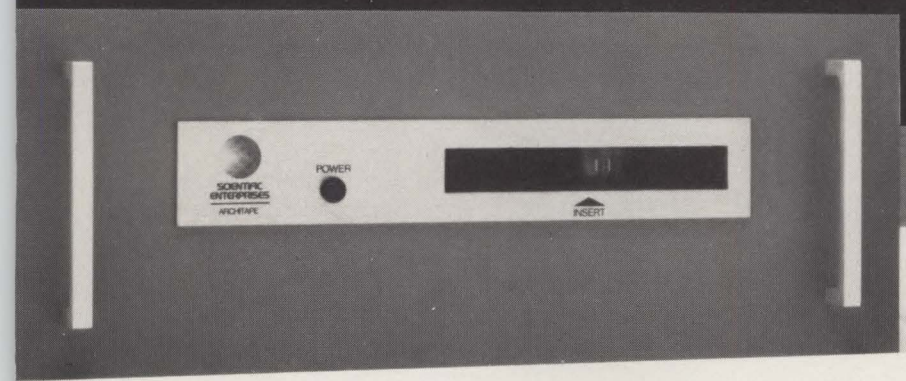

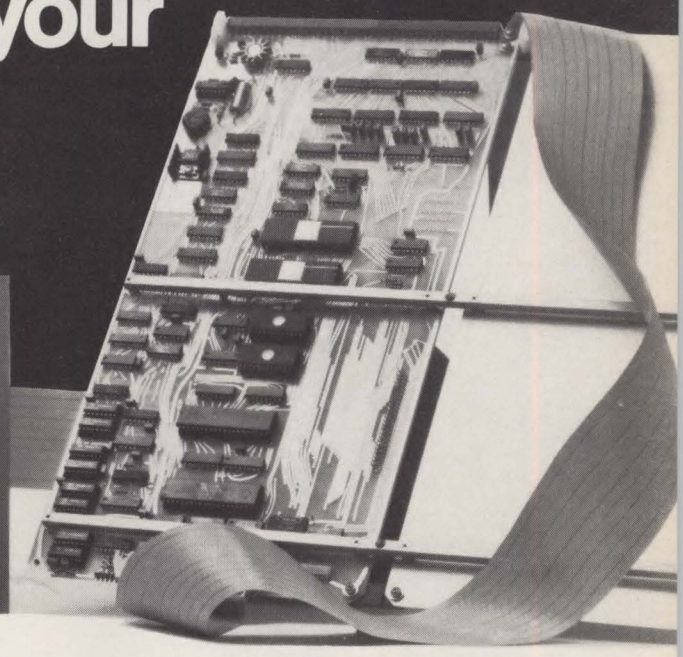

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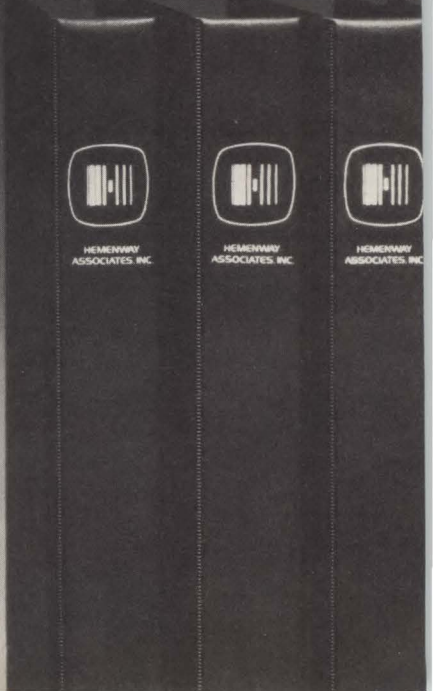

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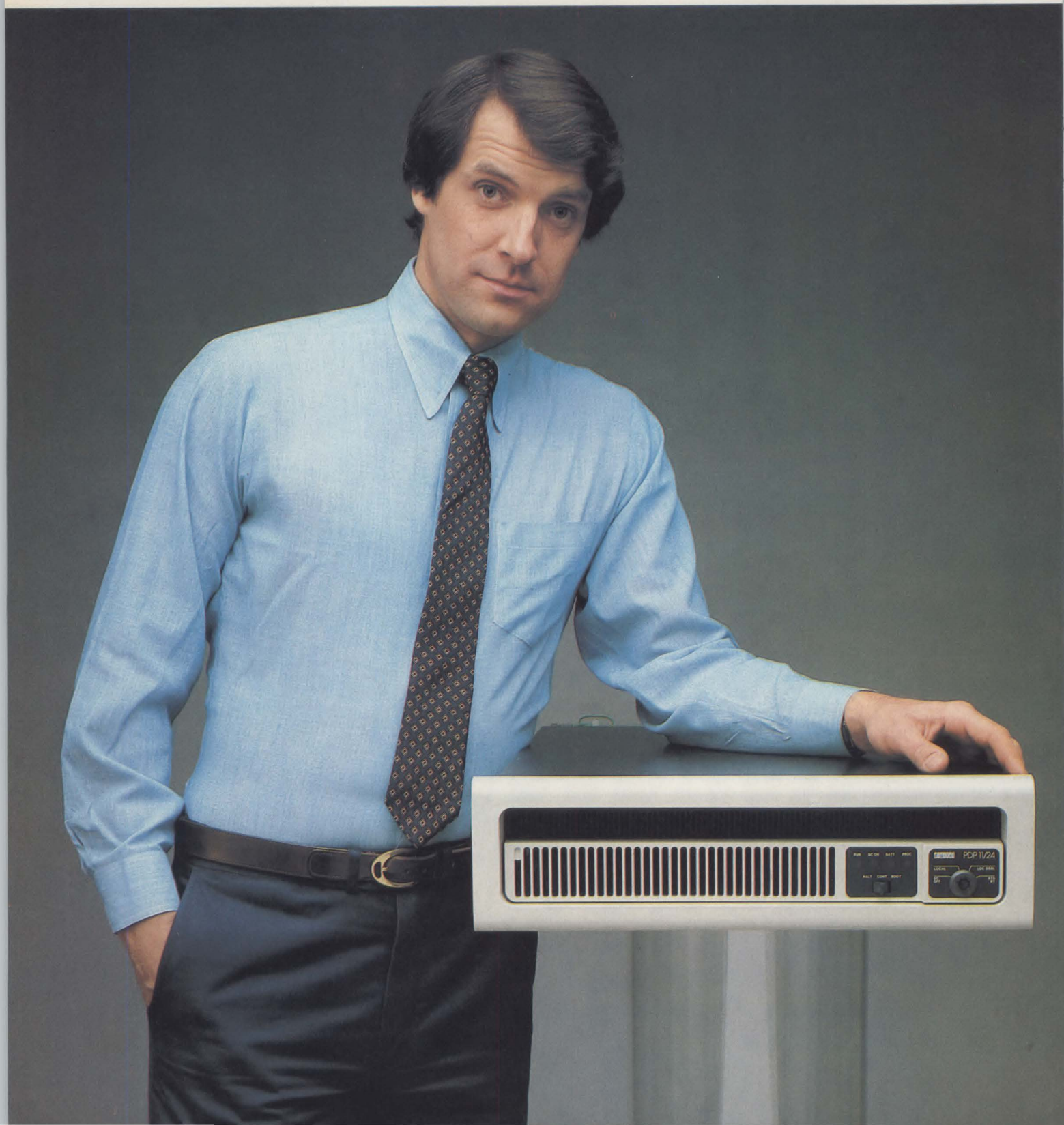

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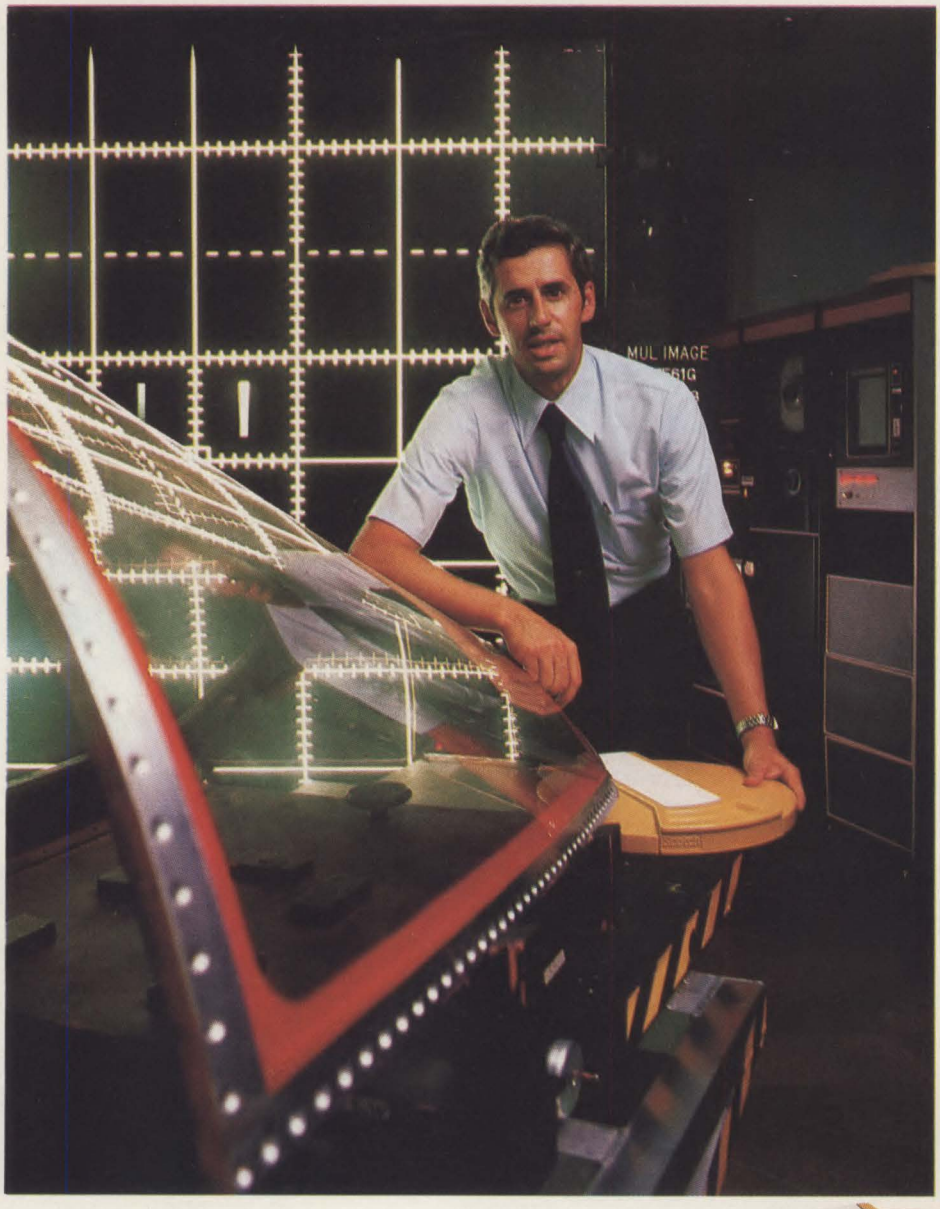

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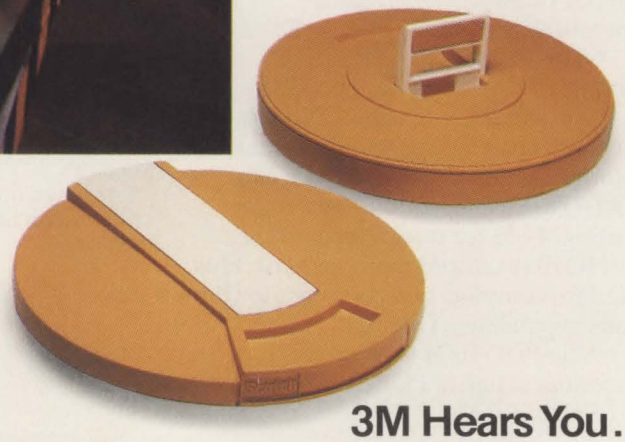

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CIRCLE NO. 71 ON INQUIRY CARD

HARDWARE

A case for 32-bit superminis

GARY J. ELLIS and JIM CHRISTY, Data Decisions, Inc.

As their prices drop, 32-bit minicomputers offer performance advantages over 16-bit minis and larger mainframes

Increased performance compared to 16-bit minicomputers and a price lower than mainframes have generated a significant demand for 32-bit minicomputers. Data Decisions estimates that worldwide shipments by U.S. suppliers of these "superminis" will reach 4000 systems this year.

By comparison, some 3000 32-bit machines were shipped last year, with an average selling price of $200,000. The average price appears to be dropping $10,000 to $15,000 per system, so that 1981 shipments will have an average value of $740 million to $800 million.

Compared to traditional 16-bit minicomputers, 32-bitters provide four distinct performance advantages: more addressable memory, greater precision, increased throughput and ease of programming.

The memory bonus

The primary performance advantage offered by 32-bitters involves memory. Historically, 16-bit machines were single-user, single-function processors whose 16K-byte or -word limit on directly addressable memory was not a major disadvantage. Today, however, more systems are oriented to multi-user, multifunction applications, typically operating concurrently. This demand for versatility—even at the low to medium end of the computer spectrum—has helped spur the development of a 32-bit architecture with a vastly superior direct-addressing range of as much as 16M bytes, plus the ability to efficiently handle almost any reasonable application mix.

Although 16-bit minicomputers have been developed with memory management schemes to overcome their addressing limitations and to meet application requirements, memory-management approaches are often cumbersome and adversely affect both processing speed and ease of programming. Thus, the 32-bit machine's larger direct-addressing capability offers distinct advantages over 16-bit extended-addressing techniques.

A second performance advantage—greater precision—is particularly important for scientific/technical applications. The addition of 16 bits means twice the number of significant digits per word. Using binary-coded decimals, for example, a 32-bit word can represent eight decimal digits, compared with the four provided by a 16-bit word. Software may be employed to extend the basic precision of a 16-bit processor, but again at the cost of processing speed.

Throughput and programming considerations

Increased internal throughput—the third performance advantage—is also a straightforward result of moving from 16- to 32-bit architectures. Wider parallel data paths between memory and CPU can, for example, reduce the number of memory accesses required, increasing processing speed. Under ideal conditions, a 32-bit-wide data path offers twice the throughput of its 16-bit counterpart.

The fourth performance advantage of 32-bit structure relates to the greater ease of programming provided by the enhanced instruction sets made possible by the larger word size. A larger number of instructions permits a greater variety of basic operations to be handled directly by the computer, which aids a programmer working in assembly language in a fashion similar to that of a software macro facility. An enhanced instruction set can also implement a given function with fewer programmed instructions, also increasing processing speed.

How the minicomputer manufacturer handles the question of compatibility between 16- and 32-bit machines directly affects the potential benefits of the 32-bit instruction set. Two of the more frequently used

Software may be employed to extend the basic precision of a 16-bit processor, but, again, at the cost of processing speed.

approaches to such compatibility problems involve using a superset of 16-bit instructions on the 32-bit mini, or using an emulator/simulator to run 16-bit software on the 32-bit processor. Both methods allow 32-bit benefits to be reaped in a native processing mode. The simplistic, though not unheard of, technique of using the same instruction set on both 16- and 32-bit

	Company and model	Data General Corp. Eclipse MV/8000	Digital Equipment Corp. VAX-11	Harris 80/100/300/500/800 Series
SYSTEM SOFTWARE	Operating system environment	AOS/VS multiprogramming, multi-user, demand paging, virtual memory OS supporting multi-user time-shared, multiprogrammed batch, on-line interactive applications	VAX/VMS multiprogramming, multi-user virtual memory OS supporting real-time processing, concurrent multi-stream batch processing, on-line program development	VULCAN multiprogramming, multi-user, virtual OS supporting real-time processing, multi-programmed batch, on-line interactive operations
	Resource management	Supports as much as 2M bytes of main memory • 4.3 bytes logical address space • 128 user application programs of as much as 512M bytes each • as many as 255 users/processes independently, concurrently	Supports as much as 8M bytes of main memory, 4M bytes of shared memory • 4.3G bytes virtual address space, 2G bytes user program space • as many as 96 interactive users	Supports as much as 3M bytes of main memory; 12.5M bytes of logical address space • 128 interactive users; 64-level priority system
	Data-base structure	DG/DBMS based on 1978 Codasyl recommendations • one schema; 192 sub-schemas/schema; 255 set types/schema; 255 record types/schema; 4096 data items/schema	Datatrieve sequential, indexed or relative organization • variable-length records	Cincom Total DBMS supporting network structure
	Access	Supports as many as 16 data bases concurrently • DML reads/writes records • COBOL extended to interpret DML • DG/DBMS IQ read-only interactive query program	Commands for retrieval/update • BASIC, PLUS-2, COBOL, FORTRAN interfaces	T-ASK, AZ7 non-procedural data manipulation for data enquiry, update, reporting • BASIC, COBOL, FORTRAN, RPG-II, assembler interfaces
	Communications terminal protocols	AOS/VS supports local/remote async/sync point-to-point, multipoint communications • IBM 3270, 2780/3780, HASP emulations	DECnet supports local/remote async/sync point-to-point, multipoint communications • IBM 2780/3780, RJE emulations	Supports local/remote async/sync communications • IBM 2780/3780, HASP, CDC, Univac emulations
	Network protocols	None supported	DECnet provides digital network architecture (DMA) facilities	None provided
	Languages	32-bit address-space generators for BASIC, FORTRAN, PL/1 • 16-bit address space generators for COBOL, RPG, DG/L ALGOL, Macro processor	BASICPLUS, COBOL, FORTRAN, Pascal, PL/1, CORAL 66, BLISS-32	BASIC, COBOL, FORTRAN, RPG-II, APL, Macro processor
SYSTEM HARDWARE	CPU architecture	Microcode instruction set • four-instruction pipeline • 1K-byte cache mapped to main memory • four 32-bit registers	Microcode instruction set • 32-bit data word • 16 32-bit registers • 10K, 12K writable control store • floating-point processor	Microcode instruction set • five 24-bit registers; accumulator extension provides 48-bit length • floating-point processor
	Internal transfers	220-nsec. instruction-execution time • 16 priority interrupts • 16-byte block, 29.1M/36.4M bytes per sec. write/read	200-, 320-nsec. instruction-execution time • 32 priority interrupts	48 data and 18- to 20-address line bus • 19M/7.9M bytes per sec. I/O bus rates
	Memory	512K- to 2M-byte main memory • 32-bit word • 16-byte block 880-nsec. cycle time • 16-byte cache memory	256K- to 8M-byte main memory; 256K- to 4M-byte shared memory • 32-bit word • 800-, 640-nsec. read/write 32/bit cycle time • 4K, 8K cache memory	192K- to 3M-byte main memory; shared memory configurations • 400-nsec. read/write cycle time • 6K-byte, 150-nsec. cache memory
	I/O channels	16.2M/14.5M byte-per-sec. I/O burst multiplexer channel • 2.27M-byte-per-sec. data channel • 1.3M-byte-per-sec. I/O processor	5M/13.3M bytes per sec. aggregate on memory/sync backplane interconnect	As many as 31 programmed I/O and/or DMA block channels • 3.2M/7.5M byte-per-sec. I/O rates per channel
	Communications	64K-byte I/O processor interfacing with cache memory • 32K-byte data control units supporting 256 lines • 16-line programmable multiplexer • 1-, 2-, 4-, 8-, 16-line async, 1-, 2-, 4-line sync multiplexers	DMC-11 network link up sync interface with I/O buffers • 1, 4, 8, 16 async/sync multiplexers	DMA communications processor supports as many as 16 devices • eight-line communications multiplexer • async/sync line controllers
	Storage	Supports as many as 24 disk drives • 10M, 20M, 50M, 96M, 190M, 277M bytes per drive • 6.65G bytes total	10M, 38M, 124M, 176M, 256M bytes per drive • 7.2G/9.6G bytes total	11M, 40M, 80M, 300M, 675M bytes per drive • as many as eight drives per subsystem
	Terminals and printers	Supports as many as 128 local/remote terminals • as many as four system printers	Supports as many as 96 interactive terminals	Supports as many as 128 interactive terminals
	Price range	$210,000 to $820,000 (including five-year maintenance)	$135,000 to $1.58 million (including five-year maintenance)	$100,000 to $5 million (including five-year maintenance)

members of a manufacturer's computer family rules out the possibility of instruction-set advantages on the larger mini.

These major 32-bit performance advantages as compared to 16-bit processors, as well as cost advantages when compared to traditional mainframes, are the primary incentives for adopting 32-bit minicomputers. Demand for them has been further bolstered by product offerings that address the specific requirements of users in the business, scientific/technical, industrial-automation and communications markets.

In business processing, 32-bit systems are used both in stand-alone, independent environments and in satellite environments to off-load processing from host

	Modular Computer Classic Series	Perkin-Elmer 3200 Series	Prime Series 50	Systems Series 32 and VPS
	MAX III/IV multiprogramming, multi-user OS supporting real-time processing, multiprogrammed batch, on-line interactive applications	OS/32 multiprogramming, multi-user OS supporting multi-user time-shared, multiprogrammed batch, on-line interactive applications	Primos multiprogramming, multi-user virtual memory OS supporting timeshared, multiprogrammed batch, on-line interactive applications	MPX-32 multiprogramming, multi-user OS supporting real-time processing, multiprogrammed batch, multi-user timeshared, on-line interactive applications
	Supports as many as 4M bytes of main memory • 32 interactive users • 256-level priority system; event-driven tasking	Supports as many as 16M bytes of main memory • 64 user application programs of as much as 1M byte each • as many as 255 users/processes independently, concurrently	Supports as many as 8M bytes of main memory • 128M bytes of logical address space • 128 users/processes independently, concurrently	Supports as much as 16M bytes of main memory • 255 concurrent tasks • 64 interactive terminals
	Cincom Total DBMS supporting network structure • Infinity DBMS supporting relational structure • File manager for sequential, random multi-level files	DMS/32 indexed file structure DBMS • records referenced by one or more indexes	DBMS based on Codasyl recommendations • network, hierarchical, cyclical, ordered, random combination, hybrid • 1024 areas with a total of as much as 128G bytes	Cincom Total DBMS
	Non-procedural data manipulation languages for data enquiry, update, reporting • COBOL, FORTRAN, assembler interfaces	Supports unlimited number of users concurrently • COBOL, RPG-II, CAL assembler interfaces • generate data-base utility • random/sequential access at any file position • full-key, approximate key, generic-key access	Supports unlimited number of distinct/related coexisting data bases • DBACP command processor to define, change, modify, manage base • DML interfaces with COBOL, FORTRAN	Direct, serial, sequential, inverted, related data access • DML read/write; T-ASK query • batch report generator with limited access
	Supports local/remote async/sync communications • IBM 2780/3780, 3270, CDC emulations	OS/32 supports local/remote async/sync point-to-point, multipoint communications • BSC/SDLC protocols • IBM 2780/3780, HASP emulations	Primos supports local/remote async/sync point-to-point, multipoint communications • IBM 3270, 2780/3780, HASP; Univac; Honeywell; CDC; IDL emulations	TSS supports local/remote async/sync point-to-point, multi-point communications • IBM HASP emulation
	Maxnet III/IV OS extensions link multiple systems in distributed network; as many as 16 network interfaces per system	ZDLC manager supports KDLC, SDLC, ADCCP protocols	Primenet CCOTT X.25 protocol	None provided
	COBOL, FORTRAN, Pascal, CORAL 66, Assember	BASIC, COBOL, FORTRAN, RPG-II, Pascal, CAL assembler, CAL Macro processor	BASIC, COBOL, FORTRAN, RPG-II, Pascal, PL/L	BASIC, COBOL, FORTRAN, Pascal, Micro, Macro processors
	15 16-bit registers • floating-point processor	Microcode instruction set • 32-bit data path • 128 32-bit registers • 2K-byte 32-bit writable control store • floating-point processor	Microcode instruction set • 32-bit arithmetic unit • four address, seven index registers • floating-point processor	Firmware instruction set • 1-, 8-, 16-, 32-, 64-bit data word • eight registers • writable control store; floating-point processor; vector-processing unit
	32 data and 18 address lines	Four priority interrupts	64 priority interrupts	26.7M - byte - per - sec. system throughput • 96, 112 priority interrupts
	128K- to 2M-byte main memory; as much as 4M-byte shared memory configurations • 125-nsec. cycle time via four-way interleaving	256K- to 16M-byte main memory • 32-bit word • 750-nsec. access time • 1K- to 8K-byte cache memory	256K to 8M bytes main memory • 32-bit word • 600-nsec. cycle time • 2K- or 16K-byte cache memory	256K- to 16M-byte memory • 32-bit word • 600-nsec. cycle time • 170- to 500-nsec. vector-processor memory
	Multiple I/O processors; as many as 4M bytes per sec. per processor	8M/5.7M-byte-per-sec. burst read/write EDMA bus • 40M byte-per-sec. aggregate on four DMA buses • 400K-byte-per-sec. multiplexer bus • EDMA plus multiplexer or DMA plus multiplexer configurations	2.5M-byte-per-sec. DMA or 8M byte-per-sec. DMA burst mode channel • 960K-byte-per-sec. DMC channel • 2.5M-byte-per-sec. DMT channel • DMA supports as many as 32 controllers	26.7M bytes per sec. for memory, storage, communications tasks • 300K-byte-per-sec. multiplexer controller • 3.2M-byte-per-sec. fast multiplexer subsystem
	DMA communications processors; bit/byte async/sync line controllers	DMA I/O subsystem supports as many as 64 56K-bps lines • async controller supports as many as 23 19.2K-bps lines • 1-, 4-line sync 2-, 4-, 8-line async multiplexers	DMC channel supports as many as 2048 device ports • 2-, 4-line 19.2K-bps DMA link controller • 8M-bps eight-node network controller • 8-, 16-line async or 2-, 4-line sync multiplexers	16-line async/sync multiplexer • 1-, 4-, 8-line async interface
	10M, 21M, 67M, 256M bytes per drive; as many as four drives per subsystem	67M-, 256M-byte drives • as much as 1024M bytes per subsystem • 50G bytes total	12M, 32M, 40M, 64M, 80M, 96M, 300M bytes per drive • as many as two subsystems • 4.3G bytes total	16M, 80M, 300M bytes per drive • 2.4G bytes per subsystem total
	Supports as many as 32 interactive terminals	Supports as many as 64 interactive terminals, 128 work stations • unlimited system printers via multiplexer bus	Supports as many as 63 interactive terminals, 128 users • as many as four system printers	Supports as many as 64 interactive terminals • two system printers
	$40,000 to $1.7 million (including five-year maintenance)	$100,000 to $2 million (including five-year maintenance)	$95,000 to $890,000 (including five-year maintenance)	$25,000 to $3.6 million (including five-year maintenance)

Under ideal conditions, a 32-bit-wide data path offers twice the throughput of its 16-bit counterpart.

mainframes. Business support involves operating system software that manages large numbers of interactive terminal users, data base-management software, transaction-management processors and a variety of business-oriented languages and programming aids.

In scientific/technical applications, 32-bit minis are well-suited for number-crunching and real-time data acquisition. Their ability to handle scientific languages—many of them developed for mainframe computers—their faster processing and data manipulation speeds, greater precision and larger main-memory and mass-storage capacities make them better adapted to such applications than 16-bitters.

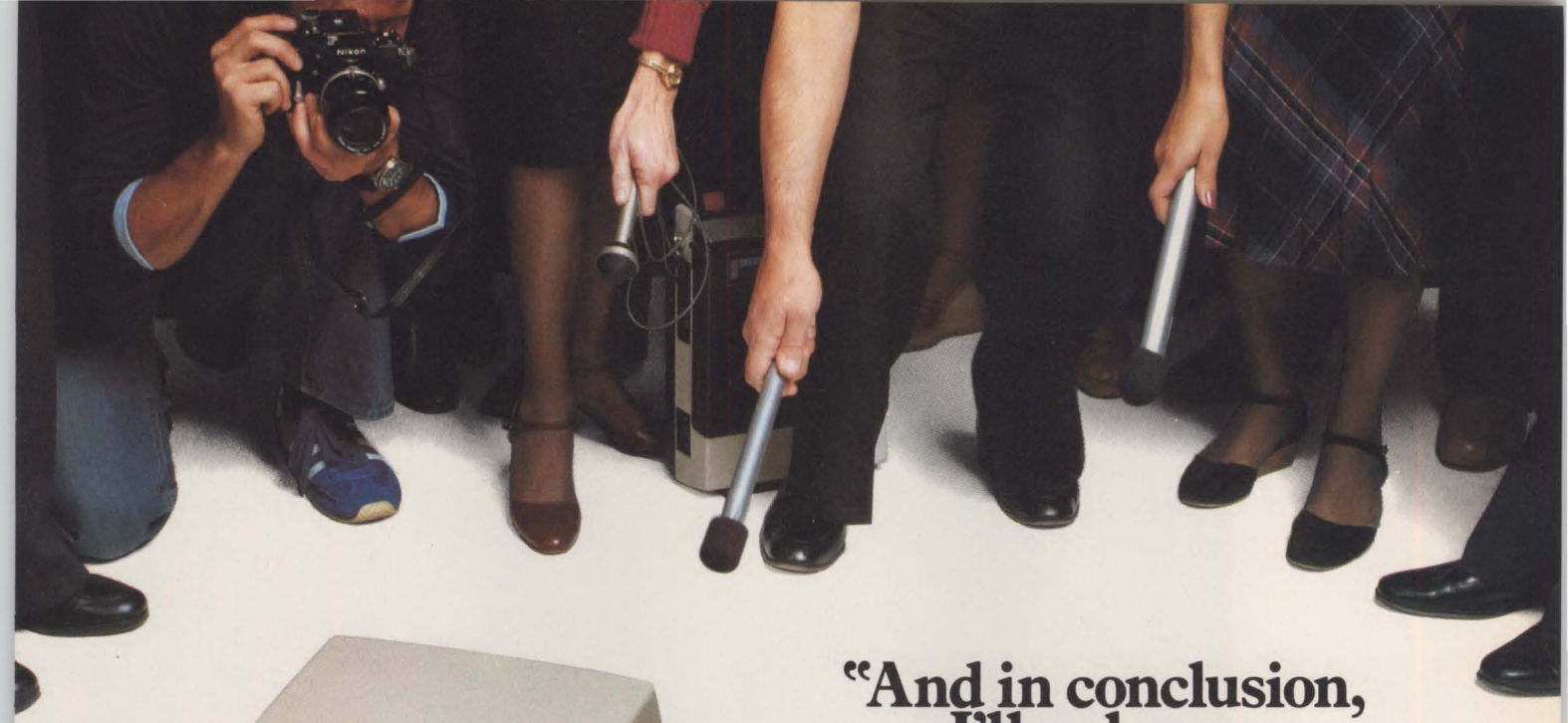
Superminis also provide enhanced monitoring and control functions for industrial-automation applications, such as power generation. Large repertoires of specialized interfaces and peripherals add to the 32-bit appeal here. For communications or networking, the overall price and performance of 32-bit minis make them candidates for nodal processing and distributed networks.

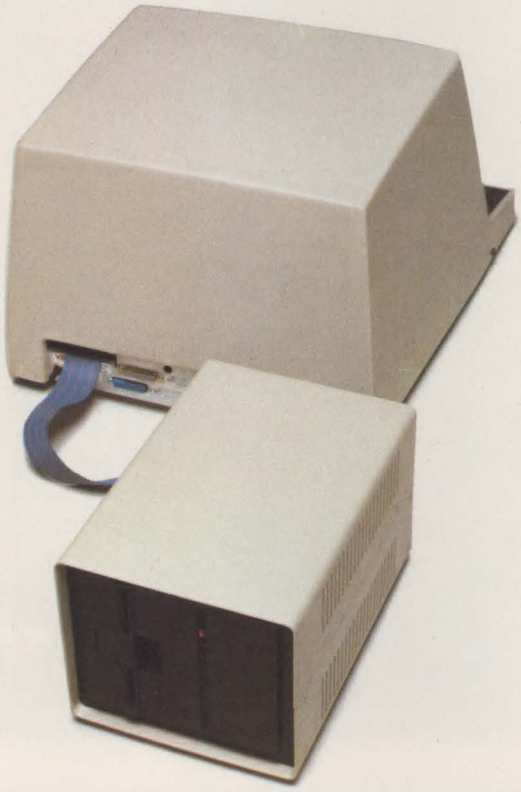
Another fast-growing application for superminis is simulation. As labor and energy costs increase, the simulation of complex and expensive systems, such as aerospace vehicles or naval vessels, becomes more economically attractive.

Contributing to the popularity of 32-bit minis is a widening choice of systems from a growing number of established vendors. Users are not only in a better position to select systems that match their requirements, but are also able to deal with vendors that have expertise in particular applications.

Maturing software for 32-bit minicomputers also contributes to system attractiveness. In addition to comprehensive system software that includes multitasking/multiprogrammed operating systems, data base-management systems, communications/networking managers, terminal emulators, high-level programming languages and transaction executives, a large number of applications packages are available from vendors or independent software houses. Applications software in higher level languages that run on larger mainframes is also being transported to 32-bit minis. The accompanying table outlines the features of major 32-bit (or 32-bit-like) systems on the market. The tabulations are extracts of more extensive reports published in *Data Decisions Computer Systems*, an information service devoted to the analysis of computer systems and their related software, hardware and peripherals. ■

Gary J. Ellis and **Jim Christy** are computer systems editors/analysts at Data Decisions, Inc., Cherry Hill, N.J.





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"After all, being the only product on the market with a Vector 3 terminal, a 5¼" floppy, and a 5¼" Winchester rigid disk drive that provides 5 megabytes of storage is quite a responsibility. It used to take 20 floppies to give you that kind of capacity.

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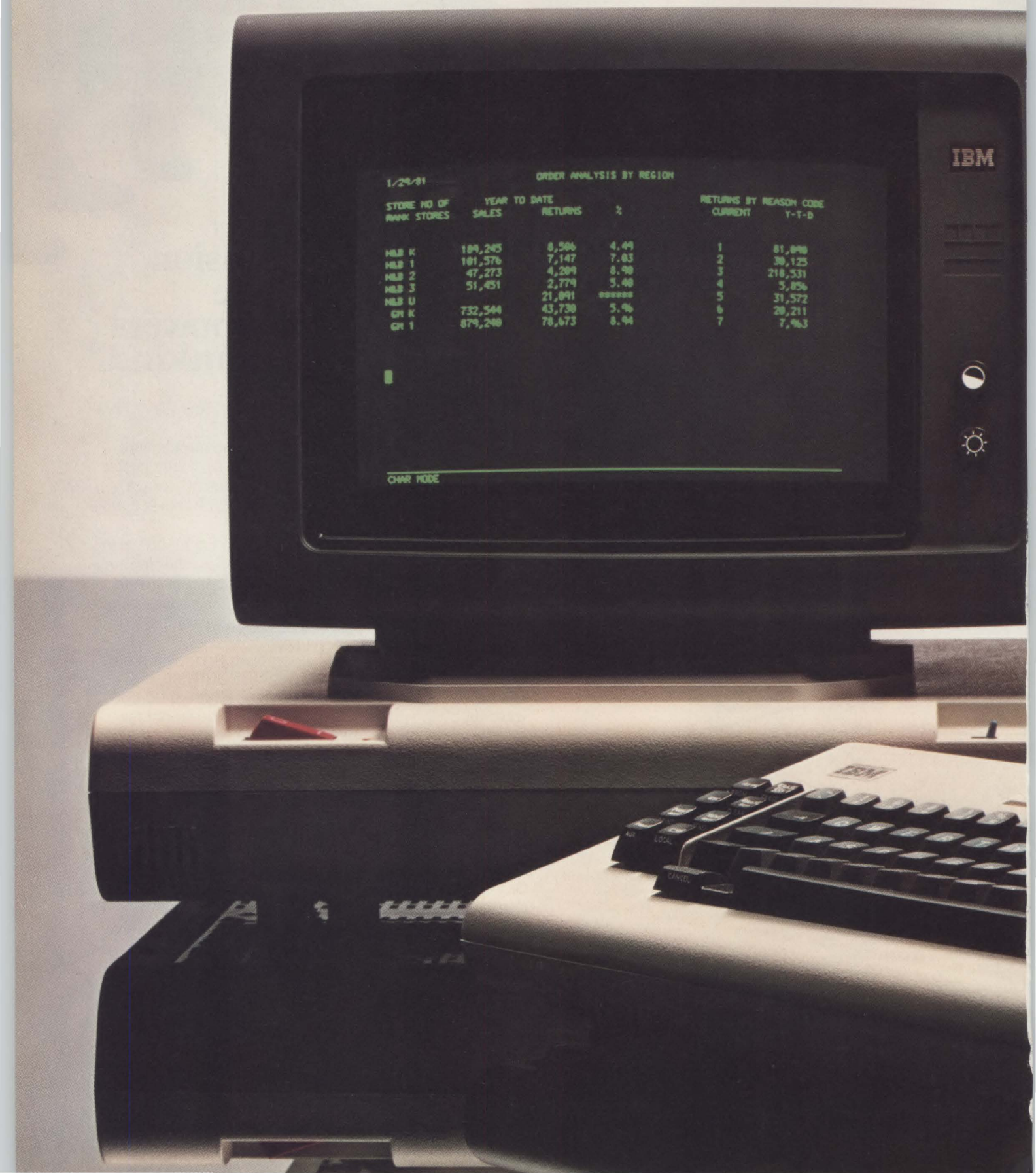

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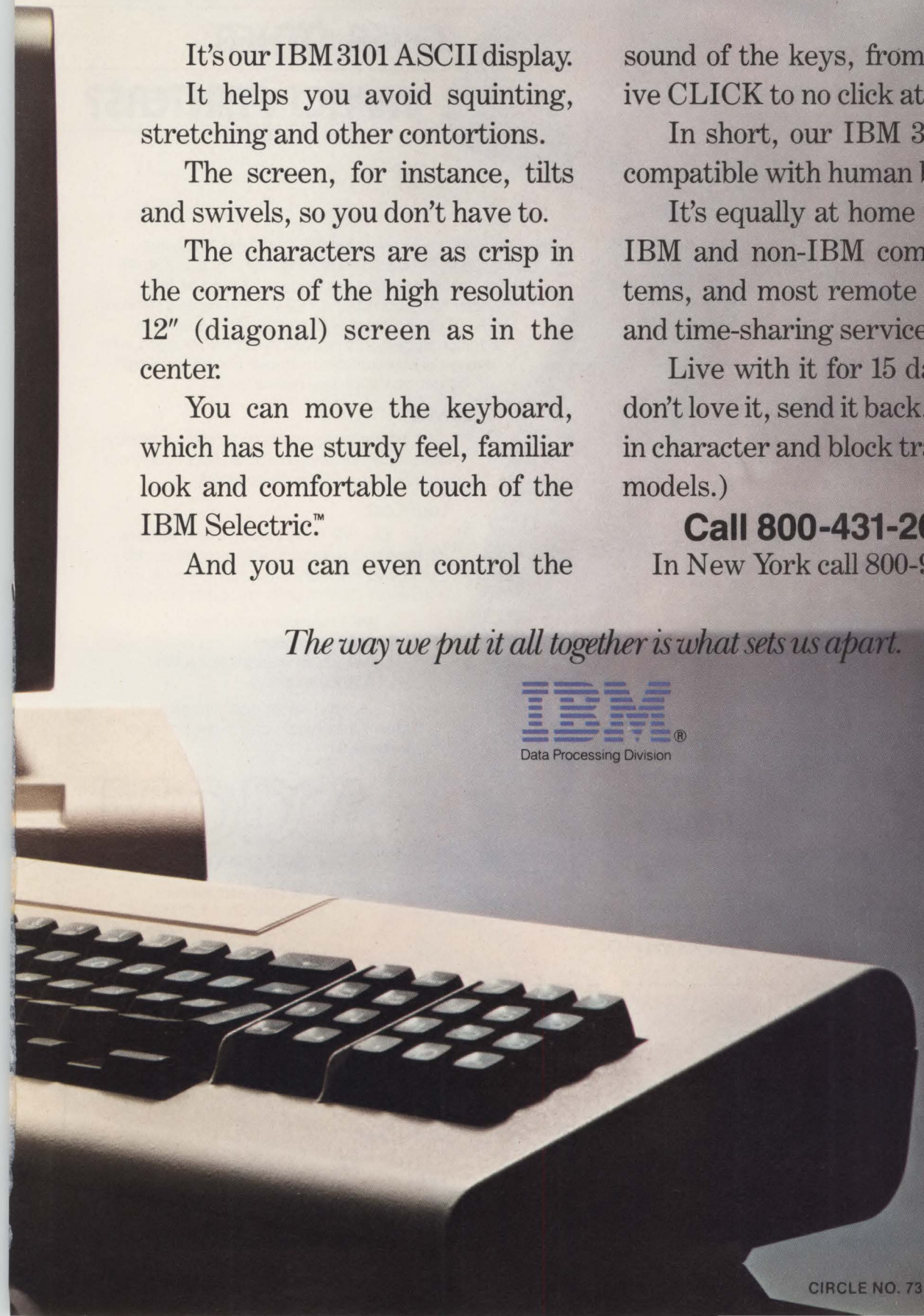

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RELIABILITY
GRAPHICS
FEATURES
SERVICE
LOW COST
CUSTOM INTERFACES
RELIABILITY
GRAPHICS
FEATURES
SERVICE
LOW COST
CUSTOM INTERFACES
RELIABILITY
GRAPHICS
FEATURES

Custom Interfaces

Unlike the competition, Axiom thrives on special interfaces. To start with, we have standard interfaces galore: Centronics parallel, RS232C, serial TTL, 20mA current loop, IEEE-488, Apple, TRS-80, PET, HP-85... and more. But we don't stop there. Our engineering department will work with you to design any custom interface you may need. With fast turn around. And you don't have to buy a huge quantity. As few as 10 per month will do. Which means you can have a dedicated printer for a simple one time engineering charge. We'll also paint it any color you wish, and put your name on it.

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IMP is rugged and simple. Just two stepping motors — one to advance paper and one for print head control. Direct linkage, so not much can go wrong. Our fan cooled mechanism is rated for 100% duty cycle. While others can only print a couple of hundred continuous lines before the thermal switch cuts out, ours can do an incredible 100 million characters without stopping because our fan stabilizes print head temperature at 85°C. That's what we mean by reliability.

Graphics

Here's where we really shine. IMP can handle graphics in 3 different resolutions to meet just about any requirement, with up to 512 dots across the paper. It can mix graphics and ASCII alphanumerics on a single line, which most printers can't do. And our graphics runs from any interface, with simple software control of the raster scan.

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IMP-2 is equipped with both friction and tractor feed, to provide 3-way forms handling, i.e., single sheet, roll paper and fan fold. Tractors are adjustable from 2-1/2 to 9-1/2 inches. If you don't need the tractor feed, you can order IMP-1 and save $40. Using Quick Cancel Bi-Directional printing, IMP knocks out 80, 96 or 132 columns of crisp hardcopy at a speed of 100 characters per second. The 7×7 dot matrix has a standard 96 ASCII character set, with special sets available. In addition to being distinctively styled, IMP is rugged, with heavy duty mechanisms, cartridge ribbon and single snap-out board for easy maintenance.

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Business Data Processing Science

CIRCLE NO. 74 ON INQUIRY CARD

Representative OEM micro-and minicomputers

The staffs of Mini-Micro Systems
and GML Information Services

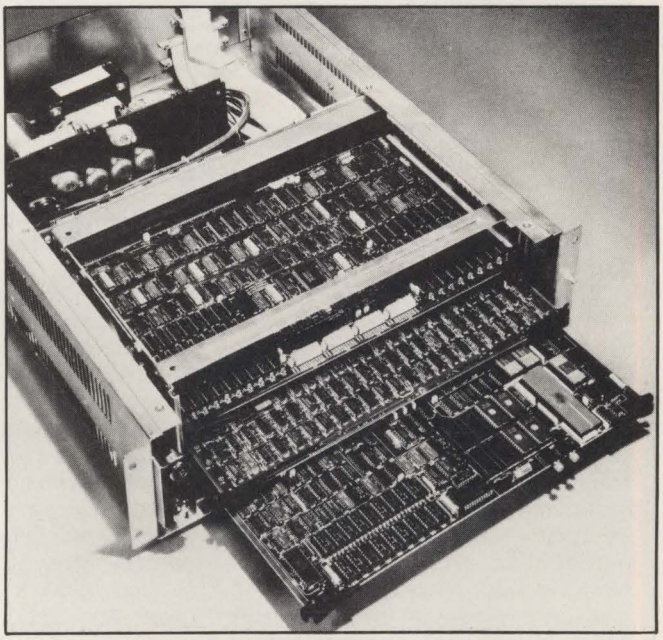
A survey of predominantly small, general-purpose systems for the hardware added-value market

This survey of minicomputers and μcs actually focuses on processing units rather than on computers; on subsystems rather than systems. It examines basic hardware designed to be systematized by the purchaser and then resold—often to another reseller whose contribution will be software-intensive rather than hardware-intensive. It covers general-purpose products rather than application-specific systems. It includes both minicomputers and μcs, the former growing (in units) by about 14 percent annually, the latter at a more than 20 percent rate.

The task of reducing to the space of a few pages nearly 1000 minicomputer and μc offerings from 125 vendors compares in difficulty to performing brain surgery. Pursuing the metaphor, the consequences are nearly as great, and we expect that—our best efforts notwithstanding—some vendors will write us and complain that we gave them a headache. But, for now, it's your turn to learn how we performed this operation.

Defining the OEM universe

The μcs and minicomputers described in the tables are basic OEM "iron" products. They are intended primarily to be resold by the purchaser after adding value to them. Most of these products come from companies such as Digital Equipment Corp., Hewlett-Packard Co., Data General Corp. and Microdata Corp., which originally supplied only minicomputer iron—circuit boards and/or boxed processors—to systems builders like Basic Four, which in turn sold them to end users. Today, however, most former iron-only manufacturers have themselves become systems builders, and many early systems builders manufacture their own iron. For example, Microdata, once Basic Four's exclusive iron supplier, now produces its own end-user systems as well as iron, and Basic Four now produces its own iron. Products primarily intended for direct sale to end users are excluded from the tables.



Motorola's VERSAmodule *Monoboard μc features modular elements in a pre-wired chasses.*

This survey of minicomputers and μcs actually focuses on processing units rather than on computers; on subsystems rather than systems.

Also excluded are μcs and minicomputers that, although intended for resale by value-added OEMs, are essentially "configured;" they are complete hardware packages for which the added value is in the form of software. Because nearly all computer vendors add or provide software, only products for which additional hardware must be provided are covered in the tables, and the additional hardware must be available from sources other than the original iron manufacturer.

The term OEM product is often misinterpreted to mean "products available with discounts for quantity purchases," or "intended only for resale." Neither definition is correct. Almost all products are available with quantity discounts, and lower prices for products intended to be resold are called "wholesale" prices. The qualifying distinction of "OEM product" involves the requirement for "significant added value." Resale is closely related but secondary, and quantity discounting is related only peripherally. Thus OEM discounts can be and are received by resellers who add value to unit purchases, and end-users may be entitled to OEM discounts if they add significant hardware value, although usually only if they also purchase in quantity.

The tables include several products that are frequently sold in units or small quantities and many that are offered to end-users as well as resellers. All, however, either require or are expected to be enhanced by significant added hardware value provided by the purchaser.

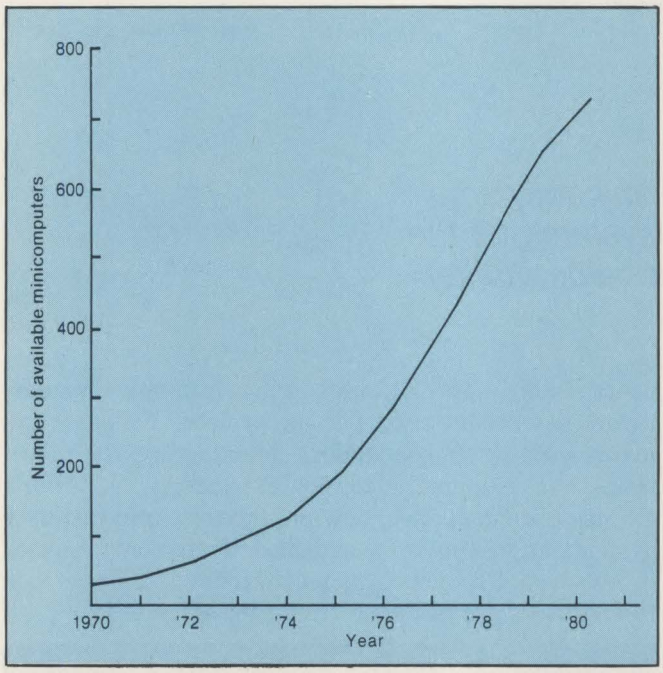


Fig. 1. There were 716 distinct minicomputers *on the world market in December, 1980—81 more than were offered in 1979.*

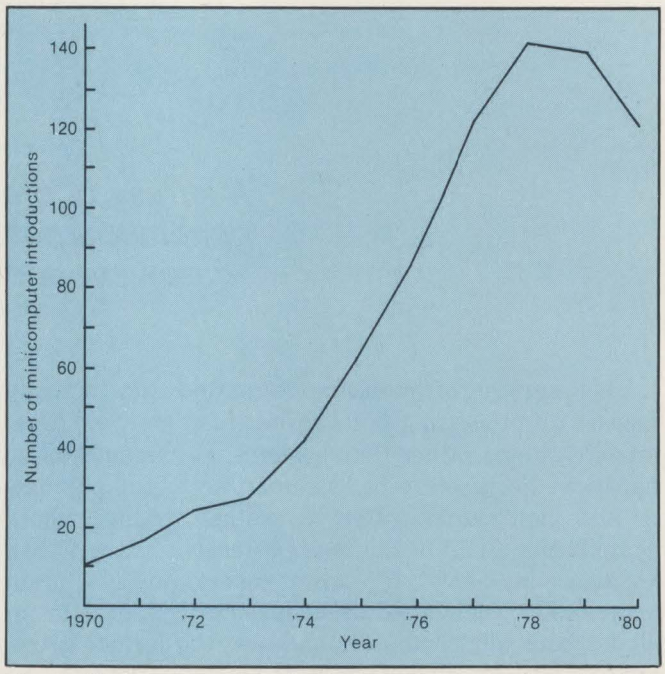


Fig. 2. Minicomputer introductions, *which had fallen slightly in 1978, and more noticeably in 1979, fell 13 percent in 1980.*

THE MARKET IMPACT OF μCS ON MINICOMPUTERS

Introduction rates have been declining for "traditional" minicomputers, defined as selling for between $15,000 and $75,000. According to GML Information Services, there were 716 distinct minicomputers on the world market in December, 1980—81 more than were offered at the same time in 1979 (Fig. 1). This 13 percent increase in the number of available models was lower than the 1979 growth rate of 24 percent, which was, in turn, lower than the 1978 introduction rate of 35 percent. Minicomputer introductions, which had fallen slightly in 1978 and more noticeably in 1979, fell 13 percent in 1980. As Fig. 2 shows, 18 fewer new minis were offered during 1980 than during 1979.

The 121 minicomputers introduced during 1980 replaced 40 minis discontinued that year for a new-to-discontinued ratio of three-to-one. The new-to-discontinued ratio for 1979 was seven-to-one, and the 1978 ratio was 15-to-one.

The minicomputer industry seems to be following in the footsteps of the more mature large computer industry, which, after a similar evolution, settled at an 8 percent introduction rate and a one-to-one new-to-discontinued ratio.

Behind this decline is the improved price/performance ratio brought about by the new technology. Prices drop at the top end of performance, and low-priced machines increasingly compete for the higher performance slots occupied by larger machines. Thus, μcs are moving into the territory previously staked out by minis, just as minis displaced mainframes.

Based on the apparent stabilization of mini-to-mainframe incursions, the impact of micros on minis should, over the next two years, result in a stable mini introduction rate of 100 new systems annually and a like number of discontinuances.

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TABLE OF GENERAL-PURPOSE MINICOMPUTER SUPPLIERS

Manufacturer Model	Word size (bits)	Memory (K bytes)		Speed (nsec.)		Price		Notes
		Minimum	Maximum	Cycle time	Register-register add	Basic	Typical system	
Alpha Micro AM-100	16	64	256	500			16,000	Dual-board; S-100; price is for 64K
Ampex 12-C/M	16	32	128	1200			3920	
Analog Devices Macsym II	16	64	128		1200		8990	
Analogic AP-400	24	12	14		160	9500	12,500	Array processor
Bendix BDX-6200	20	9K W	16 KW	2000	4000			Process control systems; controls as many as 512 devices
BDX-800	16	8	32	1000	2000			Core memory for aerospace applications
BDX-900	16	8	64	3000	6000			Designed for aerospace applications
BDX-9000	16	8	64	1000	2000			Designed for process and test applications
Charles River Data MF-11	16	32			3800		5930	Based on LSI-11
Computer Automation								
LSI-2/10	16	8	512		4120	1500		
LSI-2/20	16	8	512		2060	1900		
LSI-3/05	16	2	32		6250	825		
LSI-4/10	16	8	128		4000	520		
LSI-4/30	16	8	128		1600	1395		
LSI-4/90	16	64	128		1450	2040		
Megabyter	16	128	1000		2060	6950		
NM 4/95	16	128	256	600		8500		Recently introduced; features 2K-byte cache
NM 4/97	16	128	256	600				Recently introduced; features memory management
Scout 4/04	16				3400	675		
Scout 4/10S	16					1990		
Computer Hardware 3230	16	32	256	1600	3600	18,000	50,000	
CSPI								
MAP-200	32	16	768	170	250	15,580	31,000	Array processor
MAP-300	32	16	768	170	250	20,640	36,000	Array processor
Data General								
CS/20	16		64				10,945	
CS/30, CI	16		128		840		15,500	
Eclipse S/200	16	32	512		800	19,300	77,550	
MBC/1	16	16				725		
MBC/2	16	8	8			1200		Recently introduced
MBC/3	16	32	32			1700		Recently introduced
MP/100	16	8	128		2400	1700	12,350	
MP/200	16	8	64		840	3700	13,900	
NOVA 1200	16	16	64	1200	1350	5100	43,750	
NOVA 2/4	16	8	32		800	3500	42,150	
NOVA 3/12	16	8	256		700	3600		
NOVA 3/4	16	8	64		700	2600	42,350	
NOVA 4/C	16	16	64	400	1600	2950	17,500	
NOVA 800	16	16	128		800			

Manufacturer Model	Word size (bits)	Memory (K bytes)		Speed (nsec.)		Price		Notes
		Minimum	Maximum	Cycle time	Register-register add	Basic	Typical system	
Dataram								
Bulk Mini	16	32	256				9865	LSI-11-based; emulates DEC's RF-11 fixed-head disk
Datel-Intersil								
Intercept Jr.	12	1	1		8000	281		Uses PDP-8 instruction set
Intercept II	12	4	32		1142			
Digico								
MI6E	16	8	64	1000	2000	3300	15,360	System price includes 32K, floppy, CRT
Digital Equipment								
LSI-11/2	16	8K	64	380		900	2290	Recently introduced
LSI-11/23	16	64	256	290	1700	3000	24,400	
PDP-8A/205	12	16 KW	32 KW	1500	7800	4200		
PDP-8A/425	12	16 KW	128 KW	1500	7800	5600		
PDP-8A/625	12	16 KW	128 KW	1400	7800	6450		
PDP-11/04	16	16	64	725	3170	4600	17,000	
PDP-11T03L	16	32	64	500	3500	4400	19,350	
PDP-11V03L	16	32	64	500	3500	3900	11,350	
ECO-Computer								
S/7700	16	48	2000	250	5500	7554	21,000	
Elbit								
Anat I	32	256	4000	500			35,000	
Anat III	32	512	4000	500			43,000	
Anat V	32	1000	4000	500			63,000	
Electronic Association								
Pacer	16	16	64	1000	2000		15,200	
Ferranti								
Argus 700E	16	32	128	670	3300	5655		300K instructions/sec.
Argus 700F	16	32	512	270	900	5460		570K instructions/sec.
Argus 700G	16	32	512	270	900	11,700		2.2M instructions/sec.
Floating Point Systems								
FPS-100	38		64 KW	250			16,728	Arithmetic processor
Fujitsu								
Facom R	16	8	64	1500	6000			
PFL-16A	16	8			3000	1600		
GEC Computers								
GEC 4062	16	64	1000	800	2300	10,000		
GEC 4080	16	64	256	550	1200			
General Automation								
GA-16/110	16	8	128	2100	20,000	790		
GA-16/220	16	8		2100	20,000	1020		
GA-16/330	16	64	128	780	20,000	3750		
GA-16/460	16	64	512	500	1200	11,000	35,900	
General Robotics								
Gemini	16	64	512		3500	9500		
GRC II/X3	16		160		3800	4450		
Hercules	16	64		380	3500	4250	30,000	
GRI Computer								
99/10	16	32	64		3520	5115		
99/30	16	32	64		3520	5505		
99/40	16	32	64		3520	6170		
99/50	16	32	64		3520	6410		

Manufacturer Model	Word size (bits)	Memory (K bytes)		Speed (nsec.)		Price		Notes
		Minimum	Maximum	Cycle time	Register-register add	Basic	Typical system	
Harris								
Slash 6	24	48	768	300	600	17,900	60,050	
Heath								
WH11A	16	32				6289		Uses LSI-11
Hewlett-Packard								
2100A	16	8	64	980	1900	11,000		
2105A	16	4	64	650	1900	4150		
2108A	16	4	512	650	1330	5300		
2108K	24	4	512	325		1475		
2109B	16	4	512	650	1330	5850		
2112A	16	4	1000	650	1900	6200		
2113B	16	4	1000	650	1330	6850		
HITAC E-800	32	256	2000	440				
Honeywell								
DPS 6/23	16	32	128	500	3500	4800	18,110	
IBM								
System/1	16	16	256	660	2650	4800		Basic price covers processor and 16K only
Intel								
SBC 86/12	16	256	1000	5000		2140		
Keronix								
IDS-16	16	4	1000	800		3950		DG-compatible
Megadata								
MC 77	12	4 KW	8 KW				31,000	
Microdata								
32/5	16	8	256	135	470	10,980		
Mini-Computer Systems								
MICOS 100	16	64	64	750		7300	28,600	
Mitsubishi								
MELCOM 70/20	16	16	64	500	1300			
MELCOM 70/25	16	16	128	500	1300			
MELCOM 70/35	16	32	256	500	1100			
Modular Computer								
Classic 7810	16	64	128	600	2700	7500	23,000	
Motorola								
VERSAmodule	16	16	64			3000		Recently introduced; uses M-68000 up; price is for 64K
National Semiconductor								
IMP-16L	16	64	128	7000	8400	675		Features 2K bytes of cache
Nippon Electric								
NEC MS/10	16	64	128	700	3100			
NEC 3200/70	16	16	128	850	1700		20,530	Price includes ASR-33 Teletype
Nixdorf Computer								
280	16	48	64	1200		19,970	22,214	
380	16	48	64	1200		13,228	37,616	
480	16		64	1200		19,968	44,356	
Onyx								
C 8002	16	128	512	250	1000		16,000	Software available includes UNIX and CPM; IBM 2780/3780 emulation

Manufacturer Model	Word size (bits)	Memory (K bytes)		Speed (nsec.)		Price		Notes
		Minimum	Maximum	Cycle time	Register-register add	Basic	Typical system	
Perkin-Elmer								
Sixteen 10	16	16	64	660	1000	4800	11,200	
Sixteen 20	16	32	256	850	850	9900	26,675	
Sixteen 30	16	32	256	660	750	11,500	12,500	
7/32	32	16	1000	750	3250	12,900	49,950	
Plessey Microsystems								
Miproc 16	16	8	128		250	13,750		price is for 16K with program loader and DMA interface
PM-1150/RP	16	32	256			19,500		
Point 4 Data								
Point 4	16	32	128	400		8300		
Prime Computer								
150	32	256	1000	1000		49,000		Discounts to 40 percent for OEMs
RDA								
RD-11A	16	64	512		3800	4295		
Rolm								
1603A	16	32	64	1200		13,000		Militarized Nova
1650	16	32	128	1000	1050	12,750		Does not include control panel
SCI Systems								
Mercury 3	16	256	512	800		8500		Nova-compatible
SEMS								
Mitra 115	16	32	64	600	1750	8500	17,500	
Solar 16-04	16	32	128	700	5500	3465	15,500	
Solar 16-40	16	64	512	700	2300	6500	65,600	
Siemens								
300/R10	16	16	64	450	2900			
Sperry Univac								
V 72	16	16	512	660		11,850		
V 73	16	16	512	330	1320	15,350	71,600	
V 77-200	16	16	64	660	1320	5350	13,900	
V 77-400	16	16	2000	660	2640	10,100	46,700	
Systems								
32/27	32	256	1600	600		25,000		$15,000 in 40 = unit Quantities
Teledyne Systems								
TDY-52B	16	16	64	4200	5700	1895		
Telefunken								
AEG 80-20/2	16	32	64	650	2800	10,290	20,360	
AEG 80-20/4	16	32	128	650	2700	14,420	31,445	
Texas Instruments								
960B	16	128	128		3500	6130		Process control system with RT clock, TTY interface, DMA, control panel
990/4	16	64	64	3000	7700	575		Single-board 9900
990/10	16	16	2000	825	3650	14,675		System price includes 64K bytes
Western Digital								
Pascal Engine	16		64					

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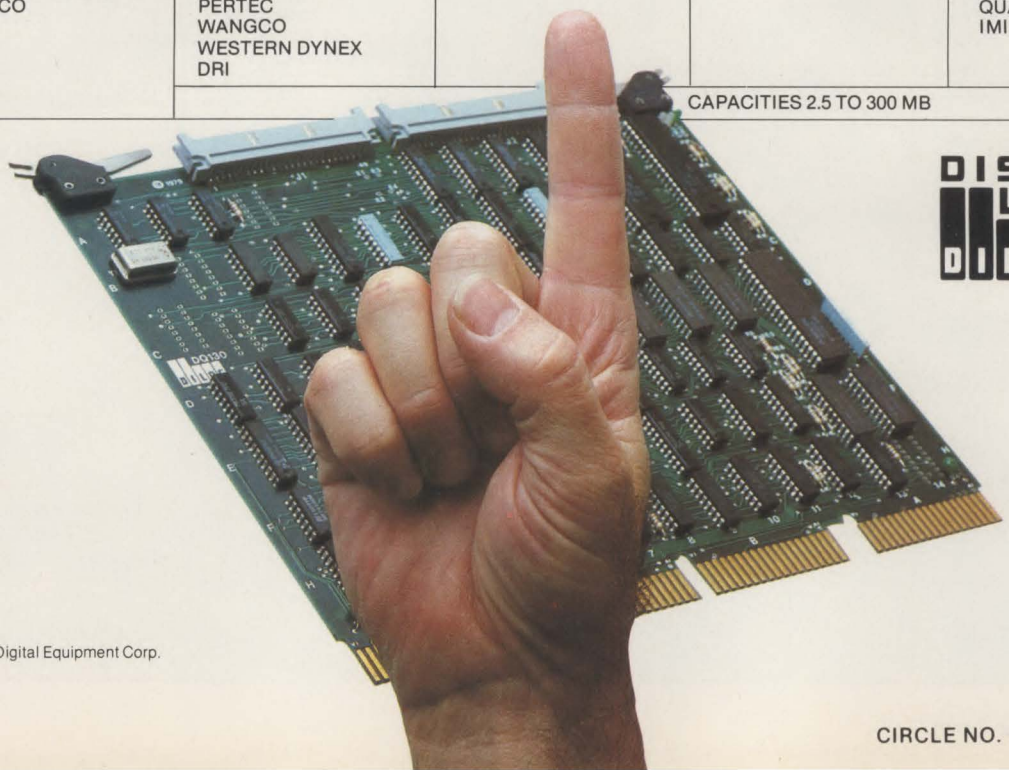

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CIRCLE NO. 76 ON INQUIRY CARD

The term OEM product is often misinterpreted to mean 'products available with discounts for quantity purchase,' or 'intended only for resale.' Neither definition is correct.

We did not distinguish between μcs and minicomputers in the strict sense—i.e., μcs use processors implemented in one or a few chips; minicomputers are all other computers smaller than mainframes—preferring instead to lump together all computers with word lengths larger than a byte and no larger than four bytes.

We arbitrarily selected price cutoffs of $20,000 for a minicomputer "basic system" (processor; minimum memory and I/O; cabinet, bus and connectors; and power supply) and $40,000 for a "typical system" (usually more memory and some peripherals). The definition of basic system was relaxed to include "unboxed" single-board μcs because it is in that form that they are of greatest interest to systems integrators.

Applying these criteria to GML Information Services' extensive computer data bases of minicomputers and μcs, we generated a printout of nearly 400 products from just under half as many manufacturers before we eliminated end-user systems. We trimmed further by deleting all "pure" end-user computers and most with minimum memories greater than 32K bytes. The memory restriction was made on the assumption that larger memories indicated insufficient potential for added hardware value, particularly because memory usually represents the largest variable cost element in a basic (or board-level) computer. We did, however, permit larger minimum memories when word size was greater than 16 bits, when the basic price hovered around $15,000, or when we felt that the system was of special interest.

Special cases required individual judgment calls, but in each we tried to lean on the side of the angels. The product lines of several companies, notably DEC, DG and H-P, were too extensive to permit a listing of each model and submodel. Consequently, we selected only those we felt most representative of their class. Conversely, we occasionally stretched our requirements to include products from companies that would otherwise have been left out entirely, or that were representative of a series (e.g., DG's Eclipse).

We deleted products available but not actively marketed in the U.S. (e.g., Hitachi HITAC), but went out of our way to include some that, while rarely seen, are of special interest (like the Bendix line of aerospace computers).

Doubtless, some products that should have been represented were not. Products have a way of being announced after deadlines have passed. ■

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CIRCLE NO. 77 ON INQUIRY CARD

SOFTWARE

DBMS challenges file management

ROY SCHULTE, Data General Corp.

Users with complex applications will benefit from DBMS

With the introduction of data base-management software designed specifically for superminis, large commercial users of distributed data-processing networks are looking for the first time at DBMS products as a long-term approach to meeting their information-management needs. In addition, small- to medium-sized commercial users are pondering the advantages and disadvantages of DBMS versus traditional file-management methods for their smaller and less complex needs.

A comparison of the manpower required to develop and maintain software under DBMS with that required under file-management software is vital to an understanding of the cost and usefulness of the two methods. Such a comparison will enable users to quantify their data-processing costs over an application's useful life. Depending on corporate structure and the nature of information-management needs, a comparison will reveal the scope and cost of the development cycles, and should lead to selecting the more cost-effective method.

But before developing the step-by-step comparison, some conclusions are provided:

A DBMS reduces data redundancy, provides a consistent organization-wide view of data, provides greater control over application development, increases programming productivity and, most importantly, reduces maintenance costs over the life of a system. These advantages benefit users who have highly complex applications, but the benefits do not necessarily apply to organizations with relatively stable and simple data bases. Because program maintenance is usually very

In a typical commercial environment, about half of the applications may use data base management. This illustration includes this fact in its cost estimates. The remainder of the applications running on the same processor use non-data base files. This illustration includes cost for all applications—those that access data bases and those that do not. The expected life span for computer hardware and applications software is normally five to eight years. Five years—used in this illustration—minimizes development and maintenance costs and is, therefore, a conservative estimate.

	Hardware and non-DBMS system software	DBMS software	Application software
Initial price:	$250,000	$12,000	N/A
Development:	N/A	N/A	$700,000 (20 man-years* at $35,000 a year)
Maintenance over 5 years:	$150,000	$2000	$1,400,000 (40 man-years** at $35,000 a year)
Cost subtotals:	$400,000	$14,000	$2,100,000
Total life cycle cost:		$2,514,000	

*20 people for one year, 10 people for two years or five people for four years, etc.
**Eight people working over the five-year maintenance period

Fig. 1. Life-cycle costing for typical applications. *DBMS reduces cost of maintaining application software, which is 55 percent of total life-cycle application system expense.*

The cost of system software—DBMS or file-management—is miniscule compared to the cost of developing and maintaining applications.

important, there are often substantial financial benefits in choosing the data base method over traditional file management.

Where the costs lie

The costs of developing and maintaining application software represent the bulk of system cost over the life of an application—if a commercial user uses a life-cycle-costing (LCC) approach and determines all costs. The hardware component is relatively small and simple to determine because some traditional LCC items, such as installation, which is generally free, can be omitted, and others that are usually hard to quantify—such as the cost of spares—are immediately quantifiable under maintenance contracts. Also, minicomputers are usually purchased outright, rather than leased, which simplifies return-on-investment calculations. But complete software costs may surprise users just beginning to develop their applications.

Fig. 1 shows that for a typical hypothetical application, the cost of system software—DBMS or file-management—is miniscule compared to the cost of developing and maintaining applications. Application software may cost more than five times as much as hardware, and software maintenance alone may cost twice as much as application-software development. (For simplicity, this analysis ignores costs such as floor space, special environmental requirements and supplies.)

The most important point is that 55 percent of the total life-cycle cost in this example is in maintaining application-software code, and it is here that cost savings will have the most benefit. Hardware accounts for only 16 percent of total cost. As hardware costs continue to decline, cost savings for hardware will be even less significant to the total. Software development accounts for 28 percent of total costs. Cost savings in application development have some impact on life-cycle cost but less impact than do maintenance costs.

Comparing the cycles

Application software development costs under DBMS may be lower than related costs with file-management methods that provide only some DBMS capabilities, particularly where data relationships are complex and DBMS capabilities are needed. Comparisons can be made by separating the application software development cycle into five stages. An analysis of total system complexity as it affects each stage will yield a bottom-line figure. The five stages are: identifying user needs, system analysis and data-base or file design, data-base definition (for DBMS applications), program coding and program testing.

These stages may occur at different times and involve different tasks in each method, or may be absent. But comparing the two methods stage-by-stage results in a clearer understanding of similarities, differences, capabilities and total costs.

User needs. The first stage—identifying user needs—is generally shorter and, therefore, less costly with file management because usually only near-term user information needs are considered. Typical tasks include specifying report formats and establishing data fields. In-depth planning seldom occurs in file-management application development, a task that would help to provide a longer view of a user's needs and business organization.

A user's business functions are usually studied on a more fundamental level when a DBMS is being implemented. A conceptual data model is built to reflect the structure of an entire organization, implying a long-term horizon. Queries and report formats can be determined or modified later. The design stage with a DBMS is often longer because more thorough design considerations are required.

Systems analysis. During the systems-analysis stage, an analyst selects either the data-base or the file-management method. He must consider whether:

- The user's company is willing to make its data base an organization-wide resource. This is a big step, which some firms choose not to take. DBMS software is designed to tie multiple users into common data bases. File-management software typically supports applications with dedicated data files.
- The user wants to minimize use of extract, sort/merge and report programs, and to maximize on-line access to data. If so, DBMS with the query facility is the method of choice. There will generally be fewer application programs under the DBMS approach and more under the file-management approach. Also, application programs will often have fewer job steps under the DBMS approach and more under the file-management approach.

Beyond these considerations, physical data-base design must reflect the intrinsic data relationship in the original conceptual design. Data-base design is more application-generalized and flexible, but often more complex than file design.

With file-management software, expansion is limited to adding new files. DBMS software enables the addition of new data fields and logical interrelationships to existing data bases at any time during the life of the application data base. File design is usually fixed and straightforward, but several iterations of data-base design may be necessary.

Performance depends almost entirely on file or data-base design. With either method, programs can run many times faster if data base or file design is efficient. With either method, an application program that runs like a finely tuned sports car on a small test sample in the laboratory could turn into a resource-grabbing, system-stalling "garbage truck" in a user's environment.

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CIRCLE NO. 79 ON INQUIRY CARD

The data base administrator is concerned with a data base that many users will employ for many tasks, while a system analyst designing a file is typically concerned with one user and one task.

System analysts typically design files, but a DBMS usually requires a data-base administrator (DBA) working with analysts to decide usage and access issues with a data base. During application design, the DBA must accommodate a user's sense of data field relationships. The DBA is concerned with a data base that many users employ for many tasks, while a system analyst designing a file is typically concerned with one user and one task.

The complexity of the DBA's task depends solely on an application's complexity. But, as the complexity of relationships between data items rises, DBMS-supported data structures become far more powerful and easier to use than the techniques used with file-management methods.

Defining data base. At stage three—defining the data base—the philosophies of the two methods present an additional task in implementing DBMS, but it isn't expensive. An interactive, menu-driven data-definition capability, such as that supported by DG's DG/DBMS—(Fig. 2) lets users configure needed data bases quickly. It leads the DBA at a CRT terminal through the on-line definition of schemas and subschemas, records and set types, security options and other system parameters. It also automatically allocates system storage space and generates documentation. The equivalent function with file-management software would be handled within the source code of each application program.

Program coding. At stage four—program coding—the data-base method nearly always saves programming time. This saving is enhanced if the data-base commands (the data-manipulation language) are integrated with a widely used business language, such as COBOL. A sample command written for DG/DBMS is:

OBTAIN this-customer-address WITHIN all-customers'-records USING this-customer's-name.

When choosing between DBMS and file-management software to do similar tasks, users should remember that the algorithms (in the application program code) for locating and updating data in a data base will often be simpler and require fewer lines of source code than the corresponding algorithms for updating data in a file.

Programmers face different tasks with a DBMS. A data-description language is used to describe the schema and subschemas, allowing common data definitions throughout an organization—rarely the case with file-management software.

If an organization needs the more powerful and sophisticated data-management features, a data-base system provides them inexpensively. If not, data-base software saves nothing. These capabilities include: multi-user transaction control, automatic logging, easier restart and easier file synchronization.

Data integrity is a prime concern with either method. Multiple users working on-line inherently impose the risk of concurrent or conflicting updates.

A DBMS addresses this situation in a comprehensive and virtually transparent way. DG/DBMS, for example, includes a full set of transaction-control facilities that solve this problem. Internal procedures stop one user's transaction update from overlaying another's, and prevent deadlocks that could otherwise result from multiple update requests on identical resources.

Internal procedures store before-and-after images of the data-base for protection against software and hardware failures. If a transaction is interrupted before all the data fields that should be affected have been changed, DG/DBMS automatically "rolls back" the attempted transaction, returning the data base to pre-attempt status.

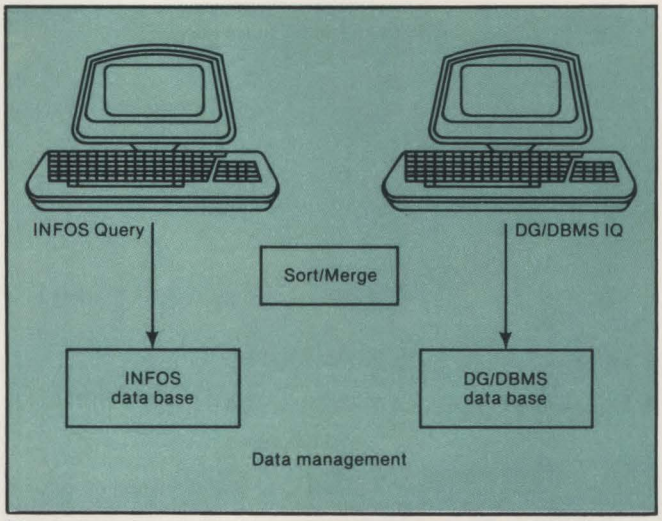

Fig. 2. Data General's data-management systems—INFOS II and DG/DBMS—*each has an interactive query program, Query and DG/DBMS IQ.*

An optional after-image log of all updates may also be used to rebuild the data base in the event of a major software or hardware crash. Without such facilities, data can be lost or difficult to recover, and restart can depend on determining exactly where the transaction was interrupted. These kinds of facilities are not generally available with file-management software.

Program testing. The efforts and costs of the program testing stage depend on an application's complexity. If application files are very simple, testing will be less costly than with the more complex data bases. The bottom line is that if a user attempts to provide data base-like capabilities with file management software, sophisticated user-written routines are necessary—even when files are compatible and a computer's operating system is powerful enough to accommodate these routines. Testing application programs that access a data base can be faster in some cases, because more logical errors can be detected during compilation rather than execution.

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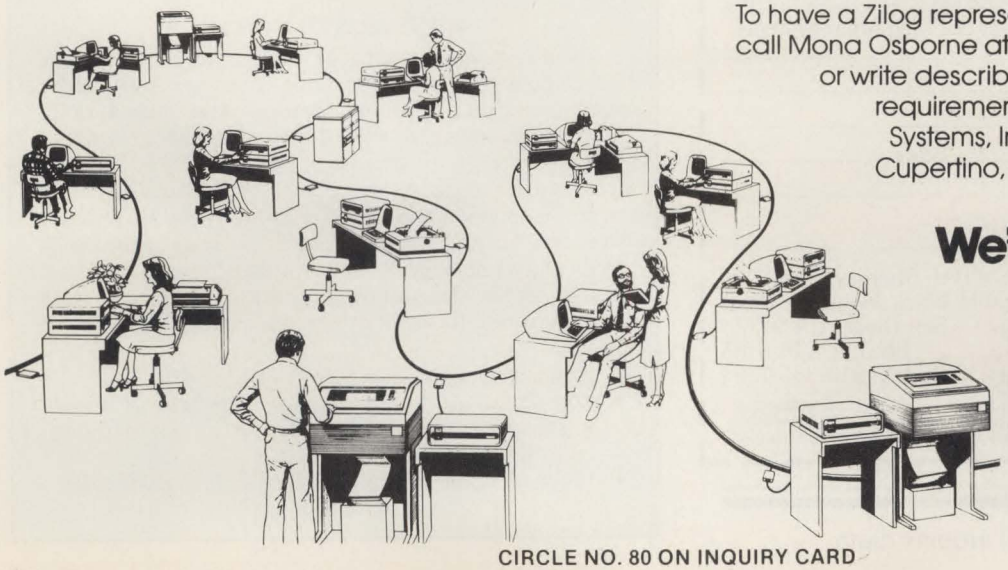

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CIRCLE NO. 80 ON INQUIRY CARD

The algorithms in the application program code for locating and updating data in a data base will often be simpler and require fewer lines of source code than in a file.

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The greatest difference in cost and effort between the two methods can appear in program maintenance. The maintenance costs for an application using data-base software are generally lower for complex or rapidly changing organizations. Maintenance accounts for about twice the cost of all five stages of system development combined. Thus, program maintenance savings are critical.

For most organizations, these savings will be the determining factor between the data base and file-management methods. File-management software will cost less only if the application is not expected to change much or if the application is simple in the first place.

A data base's data independence pays off when a user adds new programs to use existing data or modifies old programs to use expanded data. It also pays off when the data base must be redesigned or new types of information are added to it. Existing programs need not be changed with a DBMS, but many programs may require costly modification with the file-management method. ■

Roy Schulte is marketing manager for file and data base management software, Data General Corp., Westboro, Mass.

NEXT MONTH IN MMS

The June issue of Mini-Micro Systems will offer a wide variety of feature articles, anchored by a major survey of small-business systems. The main article, including extensive tables and trend information, will be done by Contributing Editor Malcolm Stiefel, who cautions that he's applying some qualifications in order to make the list only moderately Herculean in scope. To qualify, the systems must accommodate more than one user, offer a minimum main memory of 24K bytes and sell for $50,000 or less, and field service must be offered by the vendor or a third party.

Other articles will focus on:

- Communications security — the first of a two-part primer on security for both voice and data communications.
- More on coaxial cable and local data networks.

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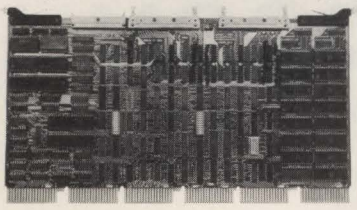

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CIRCLE NO. 81 ON INQUIRY CARD

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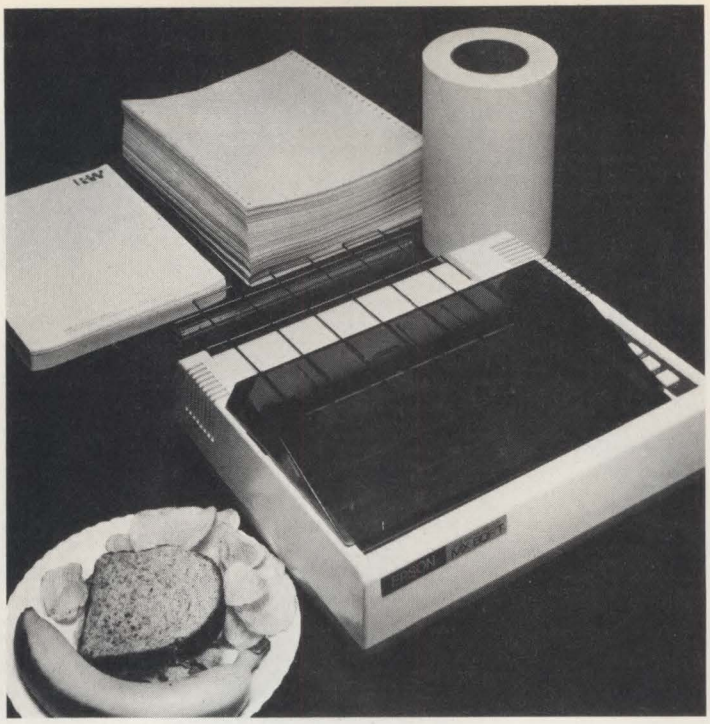

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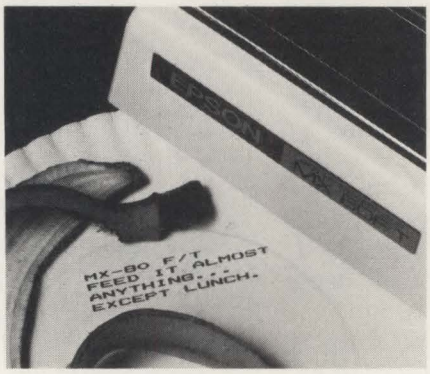

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CIRCLE NO. 82 ON INQUIRY CARD

The double-sided floppy is reborn

BILL KLEVESAHL and ROGER STROMSTA, Shugart Associates

Shugart solves earlier production problems by simplifying and stabilizing head assembly

Worries about the reliability and availability of double-sided floppy-disk drives are a thing of the past. The drive is alive and well, and its future as a low-cost system storage technology is secure. Concerns about double-sided floppies developed during recent years after Shugart Associates and other suppliers were unable to mass-produce the drives because of problems with an earlier read/write-head design. Shugart has since redesigned the entire head and actuator mechanism, and in the past year has delivered more than 50,000 drives incorporating the new design.

The impact of product design and manufacturing changes by OEM vendors has been dramatic. According to industry observer James Porter's *1980 Disk/Trend Report*, worldwide OEM shipments of double-sided 8-in. drives in 1980 were nearly three times what they were in 1979. This growth was partly spurred, Porter says, by the rapidly growing small-business system market with its requirement for high-capacity floppy-disk drives.

Still remaining from the early problems, however, is some skepticism about the viability of double-sided recording. But Shugart, for one, can point to many customers who have expressed satisfaction with the new Bi-Compliant disk drives. Owing to their inherent simplicity and ruggedness, the drives will easily withstand any buffeting they may meet in shipment.

The tools and processes being used in the Bi-Compliant design are more similar to those that had been used all along in the manufacture of single-sided floppy drives, than to those developed from scratch for the original tri-compliant head actuator carriage (HAC). An interesting conclusion can be drawn from this. In developing their new double-sided drives, Shugart and other OEM vendors created new tools, processes and designs for the new concept. However, Shugart eventually resorted to refining and enforcing its own single-sided processes—processes that have successfully produced more than 1 million units—and would probably have made quicker progress by choosing that course sooner.

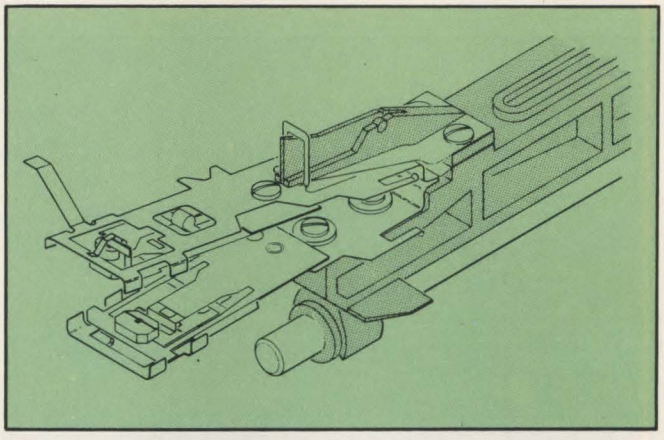

Fig. 1. Original tri-compliant *double-sided floppy technology uses two gimballed heads.*

Evolution of the double-sided drive

A brief review of the development of double-sided technology will provide a basis for understanding the issues involved and the reasons double-sided problems have been surmounted.

IBM Corp. was the first company to design a workable 8-in. double-sided floppy-disk drive. Like other IBM products, it was intended for a captive market of IBM systems and customers. Within this market, the new drive was to be used primarily as a program-loading or I/O device, with either application requiring relatively low duty rates.

The OEM industry subsequently came out with its own version of the double-sided floppy. Shugart introduced the first such drive for OEM use in 1977, and other vendors soon followed. These drives were

The tools used in the Bi-Compliant design are more similar to those used in single-sided floppy drives than to those developed for the tri-compliant head actuator carriage.

intended for highly duty-intensive applications such as system disks—the primary storage media in OEM system products.

A number of problems surfaced early, caused directly or indirectly by the design of the tri-compliant head assembly, which had three movable components: the disk itself and two gimballed read/write heads—one fixed to the lower carriage; the other hooked to a pivoted swing arm (Fig. 1). The problems in this design were: the instability of the head's amplitude, excessive media wear and inability to mass-produce the device.

Problems of tri-compliant design

To understand the double-sided evolution, each of the functions affected by this design should be examined.

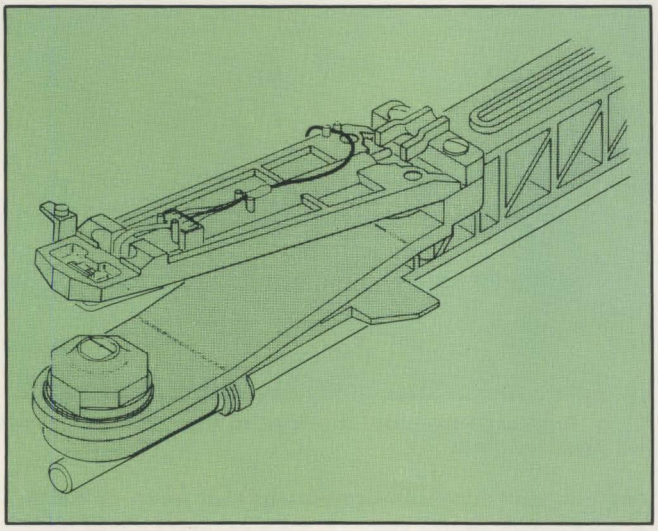

Fig. 2. New Bi-Compliant *double-sided floppy technology uses a fixed lower head and a gimballed upper head.*

The first problem is head-amplitude instability. Some users of the first double-sided drives found that the signals from the disks were weak or inconsistent. The reasons for this can be traced to the disk itself. Because it is not rigid, its amplitude constantly undulates about ⅛ in. above and below the horizontal as it revolves, much like a 45-rpm record rotating on a turntable. Shugart's original tri-compliant design, with its twin gimballed heads, attempted to compensate for the undulation.

One possible solution to the problem would have been to fix the floppy disk in a rigid plane, an effort reportedly now under way at other drive manufacturers. For Shugart, however, such a move would have required completely redesigning and retooling the drive—an effort calculated to take at least a year.

The other solution—and the one ultimately adopted by the company—was to use a head assembly that more adequately compensated for the undulations of the disk.

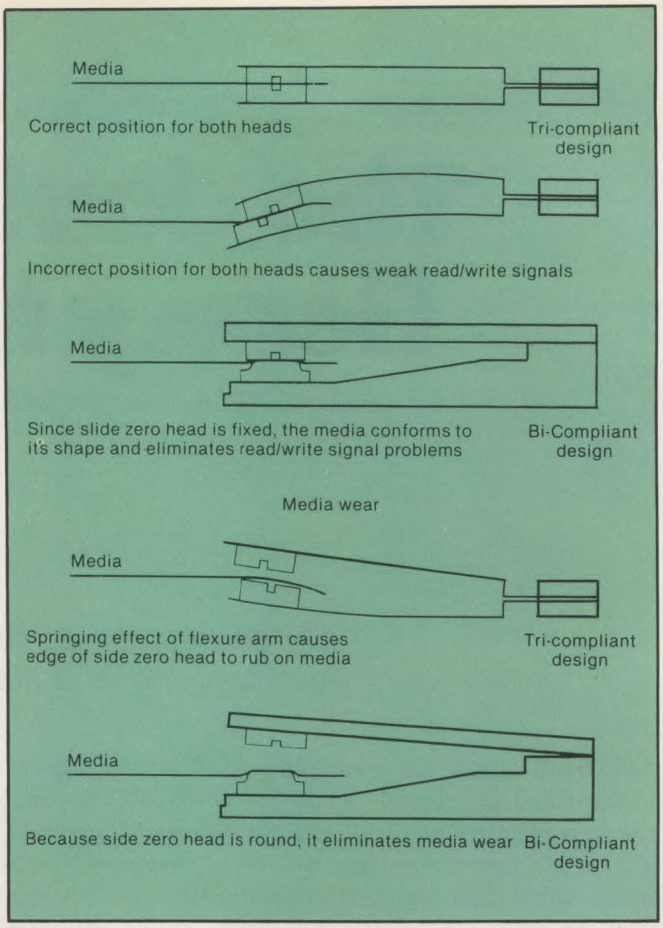

Fig. 3. If one of the head actuator *carriage's flexures is bent at the wrong point, the head would not be parallel to the disk, causing media wear.*

The Bi-Compliant design, which Shugart began using in late 1979, has only two moving parts—the disk and a pivoted, gimballed upper head. The lower of the two heads—the "side 0" head—is nonmovable. Therefore, the disk gains stability and is forced into a more rigid plane as it is pushed down onto the lower head by the spring-loaded arm attached to the upper "side 1" head. The result is that the head location in the Bi-Compliant design achieves a head-to-media dynamic accuracy within several millionths of an in., despite the ⅛-in. undulation characteristic of the media.

The second area of concern relating to the older tri-compliant design was media wear caused by the drive's double-sided design. Even while the drive was not in use, the disks apparently were being subjected to wear. The reason was that rather than being retracted from the disk when the heads were unloaded, the movable side 0 head was left in place, scratching the disk with its sharp edges.

This problem could have been solved in several ways. First, both heads could have been made to retract while the drive was not in use—an approach that IBM took in designing its original double-sided drive. Second, the head's sharp edges could have been eliminated and the head angled away from the disk so that the flexure on which the head was mounted would be parallel to the

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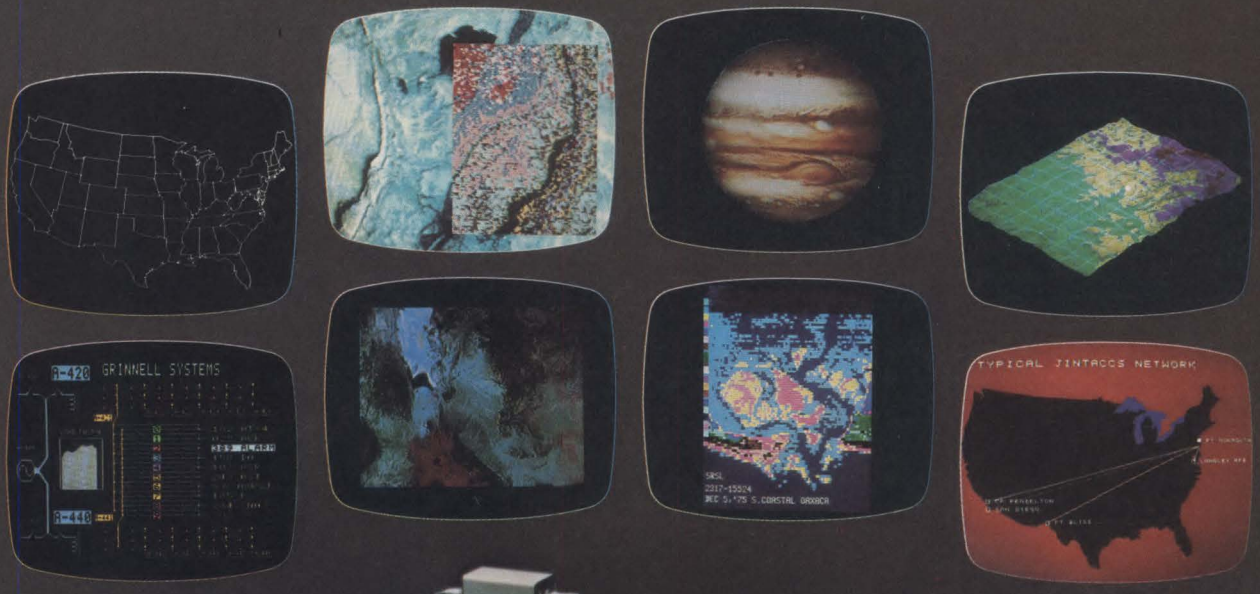

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CIRCLE NO. 84 ON INQUIRY CARD

The modular approach used to mount the HAC in the drive mechanism prevented Shugart from measuring and controlling the depth of the head's penetration into the media.

disk. Both were tried, but with limited success. The third solution was found in the Bi-Compliant's design, which not only eliminated the lower head's sharp edge (via a new head design and manufacturing technique) but also fixed the side 0 head firmly and accurately in place so that it would not present any edges to the disk.

The final problem, and one of special importance to OEM vendors that buy large quantities of drives, was that the double-sided drive as originally designed could not be produced reliably in high volume. The original dual gimbal-mounted head-actuator carriage was fragile, and could tolerate only minimal movement and handling without damage. This is not a desirable characteristic in products that must be shipped worldwide.

The design could be manufactured relatively problem-free in small quantities, with highly technical engineering expertise at every stage of the process, including assembly. The complex assembly process could then be carefully monitored, and the necessary controls instituted. But when the design was produced in very high volume by semi-skilled workers on assembly lines, the required controls and expertise were not efficiently or economically available.

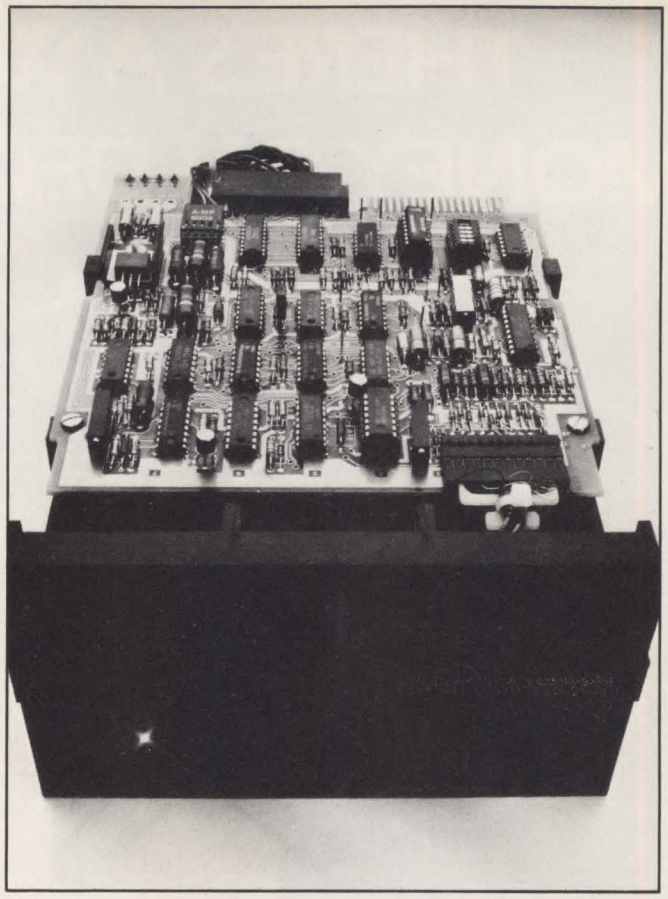
Furthemore, the modular approach used to mount the HAC in the drive mechanism itself prevented Shugart from measuring and controlling the depth of the head's penetration into the media. Although the Bi-Compliant design still uses this modular approach, its fixed and stable side 0 head facilitates easy measurability and, therefore, excellent control.

The Bi-Compliant solution

At no time during Shugart's evaluation of the problem was the flexure-mounted or tri-compliant design considered unworkable. The opposite is instead true: many drives based on this design are still performing successfully for customers. Shugart made that design work but it was clear that continuing to do so would be impractical in the long run. A simpler, more rugged design that would be easier to manufacture and maintain was required. Almost three years of effort went into developing that design—the Bi-Compliant HAC (Fig. 2).

The Bi-Compliant HAC offers a head-actuator design that is easy to build, more reliable and more durable than any design previously available. Its fixed side 0 head is part of a sturdy carriage assembly constructed of a single piece of material, much like the carriage used in Shugart's single-sided SA801 floppy-disk drive.

In addition, the new head-manufacturing technique reduced both the process time and the complexity of the



The 300 percent growth *in shipments of 8-in. double-sided floppy-disk drives from 1970 to 1980 was spurred partly by the rapidly growing small-business systems market.*

equipment required. The tools used in the original design were more expensive than those necessary with the Bi-Compliant design, and their complexity was a potential problem-causer in high-volume manufacturing. For example, if a certain combination of tools was slightly out of adjustment, one of the HAC's flexures could be bent at the wrong point. As a result, the head would not be parallel to the disk, and this, in turn, would cause media wear (Fig. 3). This cannot happen in the Bi-Compliant design because the use of the flexure that caused the problem is eliminated and replaced by a fixed side 0 arm.

The key was design simplification. With the Bi-Compliant HAC, Shugart reduced the number of process steps almost 50 percent—from 19 to 10. And the more rugged design that resulted does not require a high degree of engineering-level monitoring in day-to-day assembly. The Bi-Compliant HAC lends itself well to the same mass-production techniques successfully used to make single-sided drives.

Today double-sided floppy drives are being produced in large volume and a number of vendors are successfully pursuing the Bi-Compliant approach. ■

Bill Klevesahl is marketing manager, double-sided products, and **Roger Stromsta** is director, flexible-disk product engineering, Shugart Associates, Sunnyvale, Calif.

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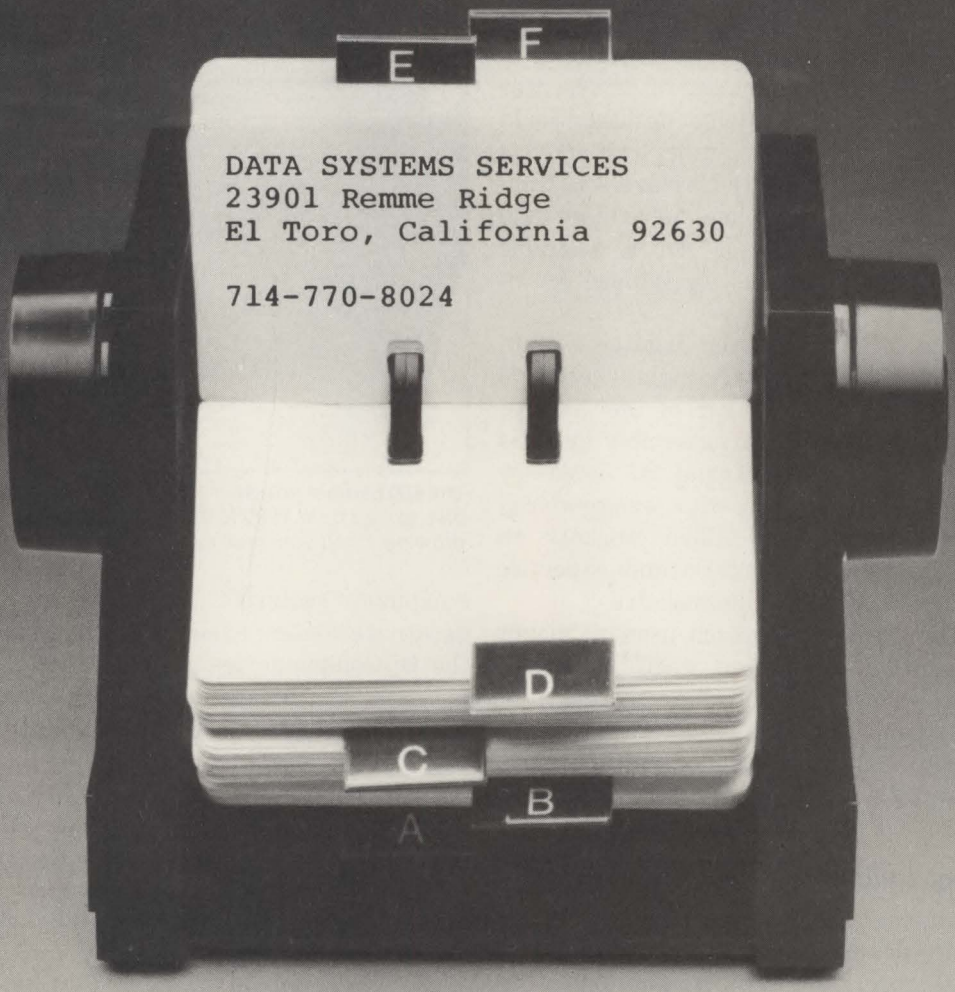

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CIRCLE NO. 85 ON INQUIRY CARD

Making high-level systems with board-level products

JEFF GORIN and LOTHAR STERN,
Motorola Semiconductor Products, Inc.

Understanding the structure and features of Motorola's VERSAmodule series of monoboard μcs

VLSI technology has elevated single-chip μc component capabilities to a point where OEM system designers now have a greater opportunity for involvement in hardware implementation for complex, high-performance computer systems. This can be done on two levels: the component level, for greatest contributed value; and the board level, which still offers considerable flexibility but greatly reduces the required design and manufacturing time and costs. In some instances, where the end product is required only in small quantitites, the board level may also permit substantial savings in overall costs.

The information provided here outlines some of the important aspects of implementing such high-performance systems with today's state-of-the-art components, and should prove useful whether the design involves basic components or board-level products.

In two previous articles (MMS, November, 1980, p. 81, and March, 1981, p. 127), the architectural requirements for high-performance μc systems were discussed, with the principal features described as including a high-level (16-bit or better) processor and a highly versatile system bus. These features are available from a number of manufacturers, whose offerings differ considerably in architecture and capabilities. This article does not attempt to draw direct comparisons, but rather investigates the basic requirements of high-performance μc systems as implemented in Motorola's new VERSAmodule board-level product line. Nevertheless, for system designers, this information will be applicable whether a system is implemented with basic "chips" or with higher-level computer modules, regardless of manufacturer.

VERSAmodule system: laying the groundwork

The VERSAmodule system of products includes a carefully planned family of circuit boards, system software products, packaging and accessories needed to build a high-performance μc system. The system is headed by a monoboard μc based on the 16-bit MC68000 μp technology and architecture, but is designed to lay the groundwork for an easy transition to the next generation of 32-bit machines.

Other hardware modules in the system include high-density RAM expansion boards and several I/O support boards incorporating intelligent peripheral controllers. Motorola intends to offer a sizable family of VERSAmodule products and accessories, with the more specialized products to follow in the later phases.

Early in the planning of the VERSAmodule family, it became clear that the "common denominator" would be a high-performance system bus that could meet the requirements of both the present and future generations. This advanced interconnect structure is called the VERSAbus, and its architecture is the keystone of the VERSAmodule product structure.

VERSAbus versus EXORbus

The VERSAbus interconnect structure can best be appreciated by comparing its functions with those of simpler 8-bit machine buses, such as the EXORbus for the widely used M6800 processor family (Fig. 1).

Motorola intends to offer a sizable family of VERSAmodule products and accessories, with the more specialized products to follow in later phases.

The EXORbus, for example, has 16 address lines, which give it a maximum address range (non-multiplexed) of 64K addresses or bytes. Eight data lines comprise the customary byte-wide data organization. Additional lines supply sufficient control capabilities for three interrupt-priority levels, control of data transfers under a synchronous scheme and a very basic bus request/grant protocol for DMA-type devices.

Overall, the EXORbus is adequate for the vast majority of 8-bit board-level μp applications, principally in the control system arena. Its major limitations for application in high-performance systems are that it:

- has a limited addressing and data range,
- is not a true multiprocessor architecture,
- is limited in speed (2 MHz is its maximum data-transfer rate) and
- has no special reliability/maintainability features.

How the VERSAbus structure overcomes these limitations is described by the additional functional groupings of the VERSAbus lines.

Address bus. Thirty-one address lines comprise the VERSAbus address bus. For 32-bit systems, all 31-word address lines are implemented. For 16-bit systems based on the MC68000 (or other μps with similar addressing schemes), only 23 address lines are used. The address bus may be used to address memory in terms of 16-bit "words" or 32-bit "long words."

Data bus. The VERSAbus provides 32 data lines in its data bus section, compared with the usual eight for an 8-bit system. For MC68000-based systems, 16 of the 32 lines are implemented. Additionally, there is one parity line for each of eight data lines so that, in very high-reliability systems, parity can be carried along in bus data transfers to improve data integrity.

Control bus. While the lines added to the address and data bus (compared with an 8-bit system) elevate the VERSAbus architecture to accommodate 16- and 32-bit transfers, the expanded control bus gives it the versatility required for highly complex system operation. The overall VERSAbus control structure includes sub-elements for asynchronous data transfer, priority interrupt and bus arbitration.

Asynchronous data transfer control. Eight-bit processors usually employ synchronous data-transfer methods. For the M6800, two clock phases are used (Fig. 2). During phase 1, an address is placed on the address bus. During phase 2, the data bus is enabled to transfer data between the μp and a peripheral device until data from the peripheral is latched into the μp. The time required for this data transfer is always the same, because of the constant time differential between phase 1 and phase 2 signals.

Asynchronous data transfer is more versatile. Rather than depending on a constant-phase clock, it uses three separate signal lines—address strobe, data strobe and data transfer acknowledge (DTACK)—in a

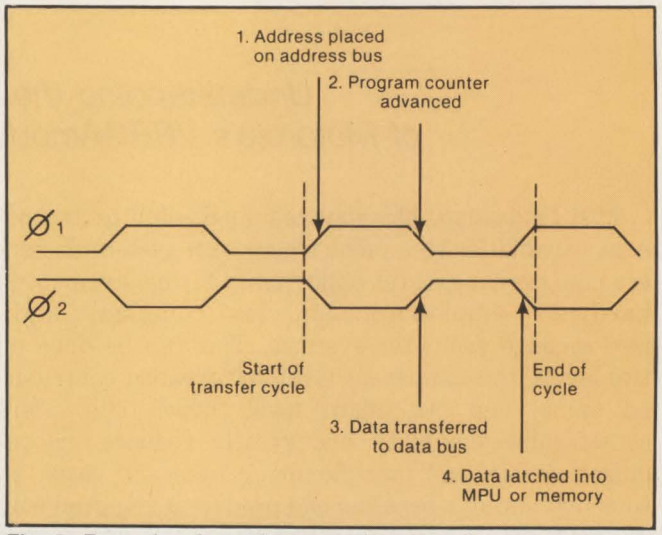

Fig. 2. Example of synchronous data transfer *as used in 8-bit M6800-type μcs. A synchronized two-phase clock is distributed throughout the system and establishes the timing relationships for all data transfers.*

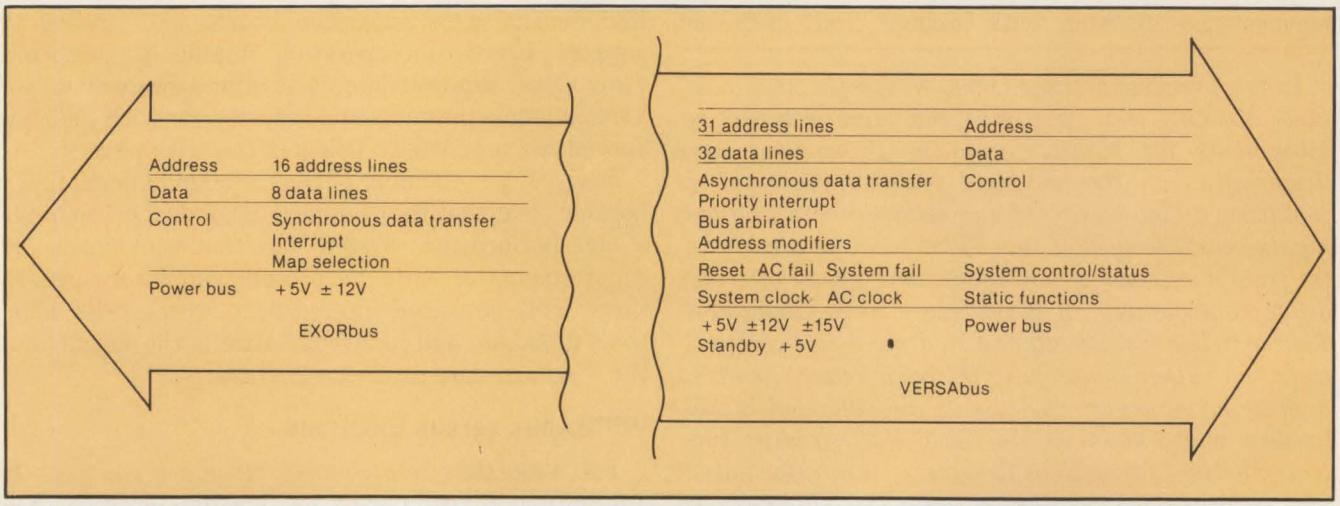

Fig. 1. Comparison of basic functions *in a system bus serving the simpler 8-bit systems, and an advanced asynchronous bus serving higher performance 16- and 32-bit systems. The greatly expanded control functions of the 16/32-bit bus permit more efficient communications at a higher speed between independent computer elements sharing the common system bus.*

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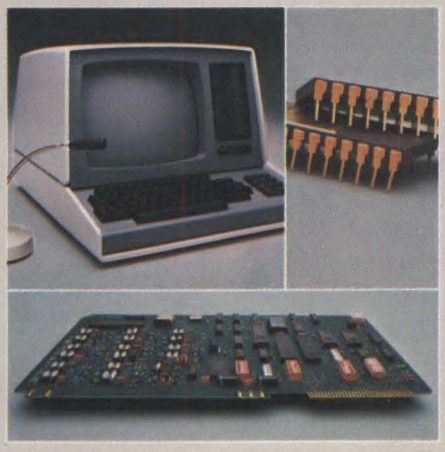

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CIRCLE NO. 86 ON INQUIRY CARD

Early in the planning of the VERSAmodule family, it became clear that the common denominator would be a high-performance system bus that could meet the requirements of both the present and future generations.

sequence (Fig. 3). Communication is initiated by the master station with a signal on the address strobe line, which causes the slave device to place the data from the requested address onto the data line. The slave then enables (asserts) the DTACK line, causing the master to latch the data into its registers and, at the same time, remove the address strobe signal that started the sequence. This removal causes the slave to clear the data lines and negate the DTACK signal in readiness for the next cycle. The entire cycle depends only on the time required by the master and slave devices to complete their operations and, therefore, is compatible with peripheral bus devices having a wide range of speed characteristics.

Occasionally, either the master or slave may determine that a data-transmission error has occurred and then assert the "bus-error" line in the VERSAbus. The bus-error line could signal and request for a retry of the same bus cycle, or for some sort of diagnostic activity. This feature provides an additional measure of data integrity, and, therefore, enhanced system reliability.

Priority-interrupt control. An important aspect of μp control is the ability to interrupt the main program and cause the μp to switch to an alternate routine. A typical 8-bit μp (such as the MC6800) has two external interrupt lines, a "maskable interrupt" (IRQ) and a "non-maskable interrupt" (NMI). A signal by a peripheral on the NMI line interrupts the normal μp routine immediately; a signal on the IRQ line leaves it up to the μp to decide when it wishes to honor the interrupt request.

A high-performance system requires a more sophisticated interrupt capability. The VERSAbus features seven interrupt-request lines, which are used for different assigned priority levels. The highest level is non-maskable. Moreover, each interrupt line may accommodate any number of devices, with the particular unit closest to the interrupt handler having the highest priority in the chain.

Just as important as the particular bus lines that make up the priority-interrupt control function is the protocol for the entire interrupt-request/acknowledge sequence. (The protocol is the specific sequence of activities that occurs within the bus structure in response to an interrupt request.) The normal sequence of VERSAbus interrupt protocol is:

- interrupt request (requester),
- interrupt acknowledge (handler),
- provide vector number (requester) and
- acknowledge vector number (handler).

One of the important benefits of this type of protocol is that it allows an interrupt-vector number (an 8-bit byte) to be presented by the interrupting device. The interrupt vector may identify to the servicing processor the particular interrupt service routine that is to be executed, or it may indicate the source of the interrupt.

Arbitration control. VERSAbus provides 13 lines to arbitrate requests from various potential bus masters for control of the bus. The arbitration functions are:

- accept bus requests,
- resolve request priorities,
- clear the current bus master from the bus when a higher priority request is pending and
- grant bus mastership.

Multi-level bus-request priorities are crucial, because higher performance μc systems tend to have a large number of bus masters. The priority required may be related to the urgency of the request or to the relative importance of the requester to system performance. This requirement implies a need to establish a separate priority level for each device that can become a bus master. Through five priority bus-request lines and the ability to assign priority to each master along each of the five lines, VERSAbus allows practically innumerable bus-request priority levels.

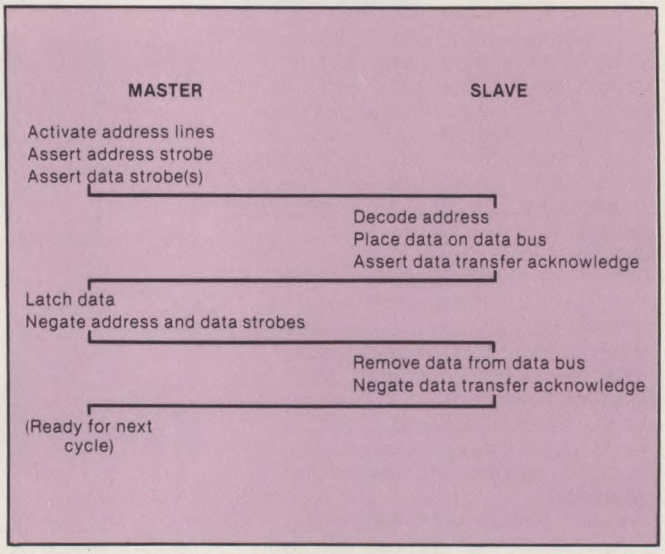

Fig. 3. Diagram illustrates the prescribed sequence *of activities, or protocol, required to complete a single "memory read" transaction on a high-performance asynchronous bus, such as VERSAbus.*

Another system-wide benefit results from a two-line "bus-clearing" approach, with different priority levels for each line. In the normal sequence of bus arbitration activities, the arbiter asserts the bus-clear line to direct the current bus master to complete its activities when a higher priority device wishes to assume control. There is no specified time limit for a bus master to retain bus control after receiving a bus-clear signal, but the remaining activity is normally limited to 100 to 200 bus cycles. However, there are situations, such as power failures, in which bus mastership must be transferred quickly. Under these conditions, the bus arbiter may assert the bus-release line to request that the current bus master clear the bus within no more than 16 bus cycles. In the case of a power failure, this capability

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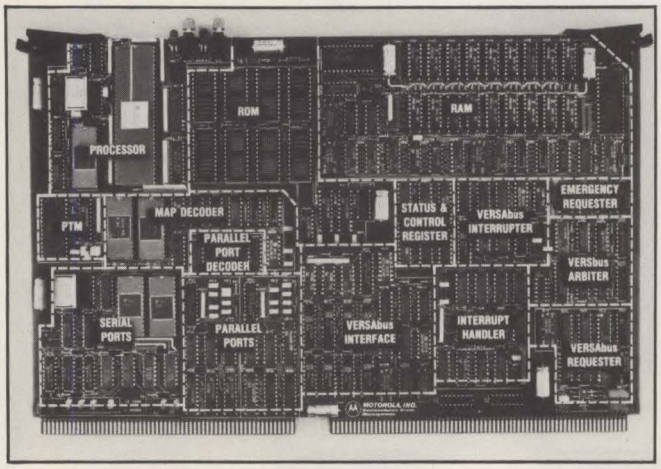
CIRCLE NO. 87 ON INQUIRY CARD

The VERSAbus provides 32 data lines in its data bus section, compared with the usual eight for an 8-bit system. For MC68000 systems, 16 lines are implemented, and there is a parity line for each data line.



allows a master to access the bus rapidly enough to preserve some data in nonvolatile RAM prior to system shutdown.

System-control status bus. Three functions are provided for overall system-control and status-reporting activities. The first, a system-reset line, transmits a general reset request to all devices on the bus, establishing a known logical state following a power-down condition. The remaining two lines enhance system integrity by reporting status. An AC fail line is asserted by a system power monitor upon sensing that the AC power source voltage is missing or below a request threshold. System elements that execute a power-down sequence can thereby be notified. The last of the three lines, system fail, reports a negative result from a self-test and diagnostic activity so that the system controller element can take appropriate action.

Static functions. Two continuous clock functions are provided on separate lines in the VERSAbus. The system clock, a square function with a 50 percent duty cycle at a 16-MHz frequency, can be employed for various counting and synchronizing tasks within different system elements. The "AC clock," also a square

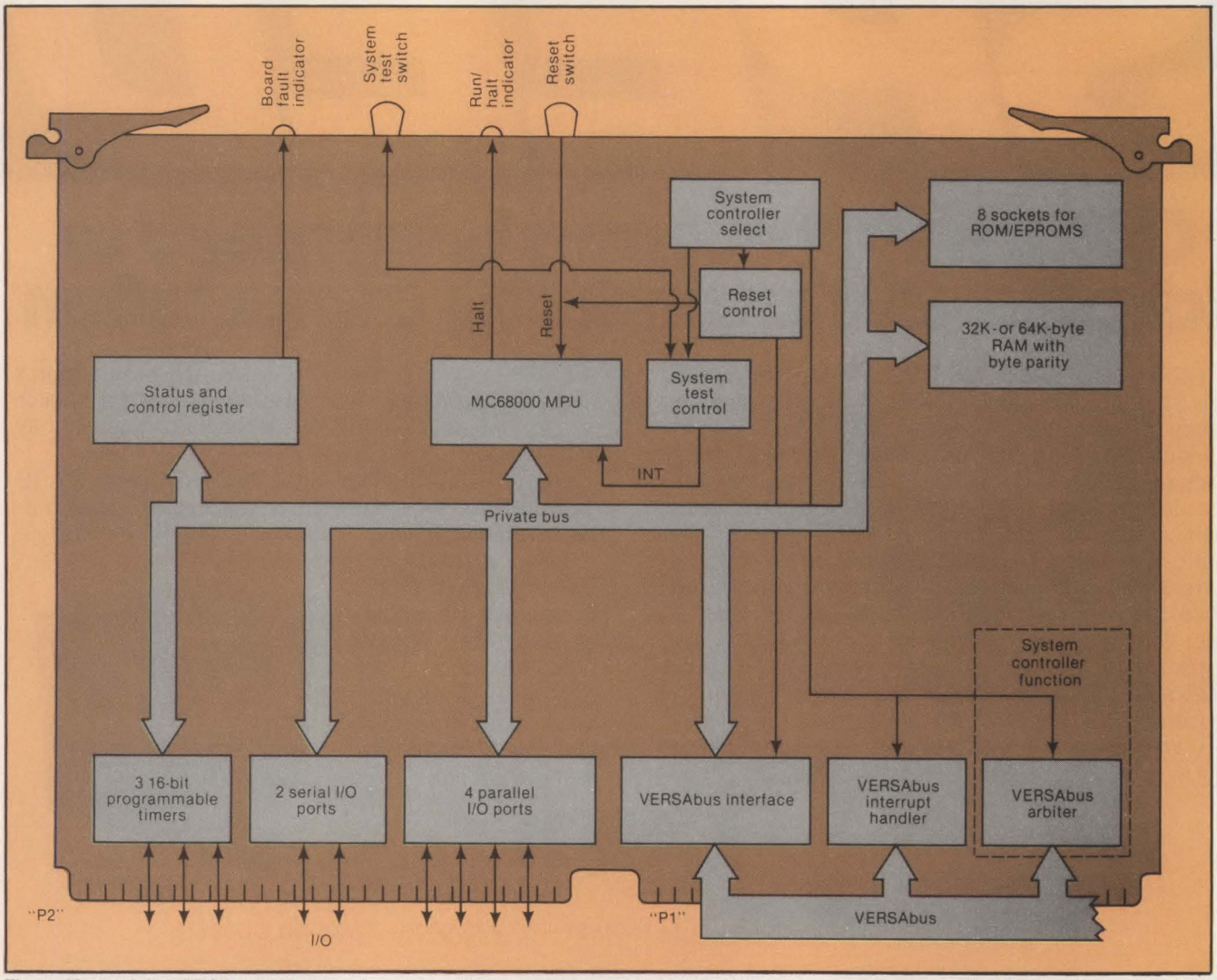


Fig. 4. Motorola's VERSAmodule monoboard µc *offers a high degree of on-board 16-bit performance capability. The number of individual packages used (A) gives a clear indication of system design complexity, even with basic components of VLSI stature. Block diagram (B) illustrates functional capability.*

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CIRCLE NO. 88 ON INQUIRY CARD

Multilevel-bus-request priorities are crucial, because higher performance μc systems tend to have a large number of bus masters.

function but synchronized to the power-line frequency, can be used as a stable time base or as a means of syncrhonizing switching functions to the actual zero crossings of the AC line.

Power bus. VERSAbus distributes +5V, ±12V and ±15V. The 5V bus supplies power to most of the system logic and memory devices, and the 12V sources are useful for certain types of memory devices and for RS232C interface requirements. The ±15V lines power high-level analog voltage conversion modules. A standby 5V line is available to distribute a secondary source (perhaps battery supported) that could power volatile semiconductor memory through a general power outage.

VERSAmodule μc: product specs

The major elements of this μc are:

Processor. The central processor is Motorola's MC68000 μp, an advanced 16-bit device operating at an 8-MHz clock rate. The MC68000 is more powerful than many minicomputers and offers the following principal features:

- 15 general-purpose data and address registers (32 bits wide), plus two stack pointer registers, a program counter register and a status register,
- 16M-byte direct addressing range,
- 56 variable-length instructions,
- operations on five main data types,
- memory-mapped I/O addressing,
- both user and supervisory modes of operation,
- architecturally optimized for efficient support of high-level languages, such as Pascal.

Local memory. Semiconductor RAM is offered in 32K or 64K bytes. It is implemented as dynamic RAM using 4116-type parts with on-board automatic refresh control, plus byte parity with automatic retry. The memory-parity generation and checking feature can be optionally activated or deactivated by a somewhat greater memory access speed than if the parity feature is not used. Because the on-board RAM array is not accessible from other devices on the VERSAbus, local data in the on-board RAM are not subject to accidental disturbance by other processors in a multi-processor system.

Eight IC sockets are provided for user-supplied 5V-only ROM, PROM or EPROM, with as much as 64K-byte capacity. A user can specify by strap option whether 2K-, 4K- or 8K-byte ROM devices are being used. Practically all applications will require some ROM, if only to supply interrupt-address vectors and a small initialization and self-test program used by the MC68000

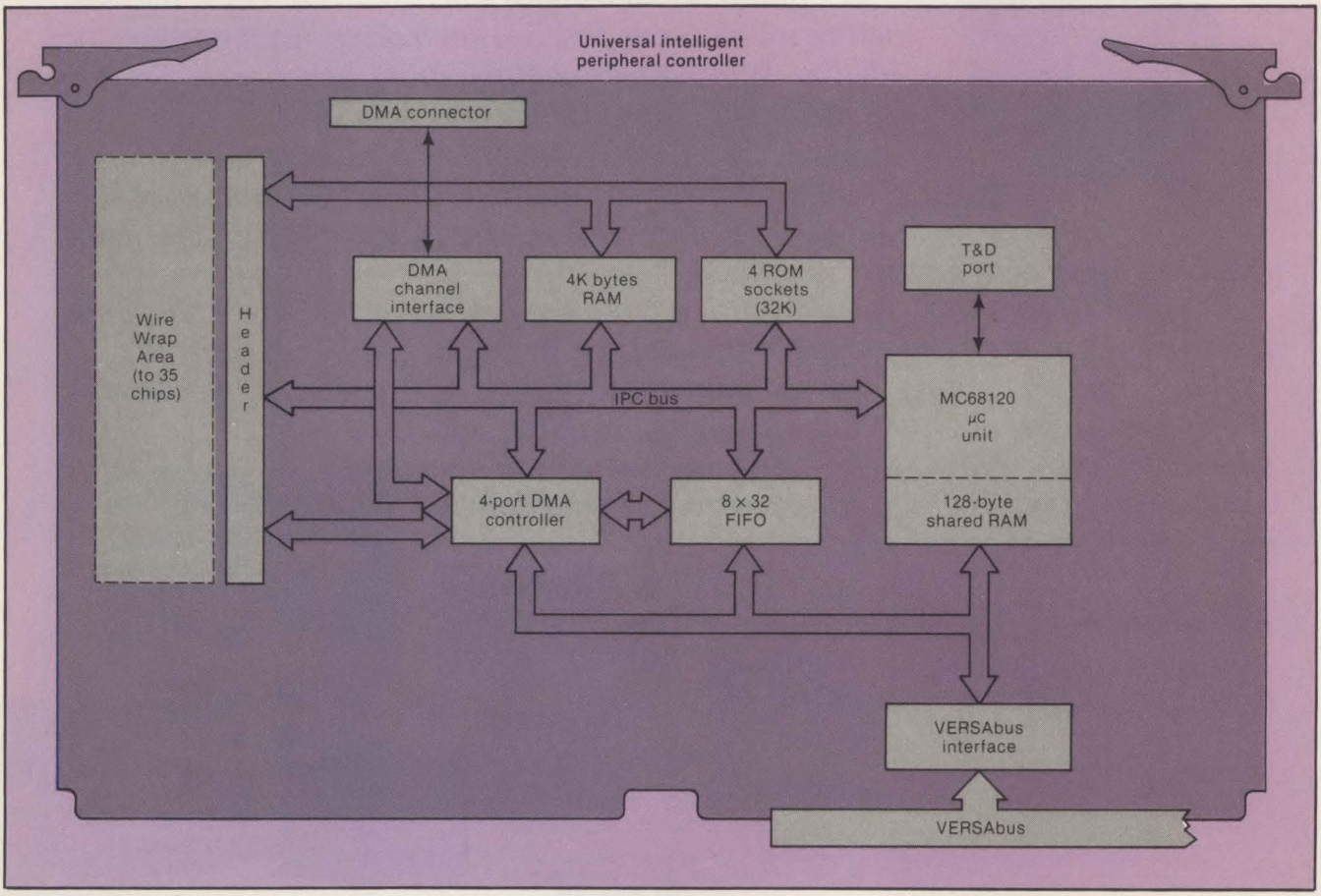

Fig. 5. As a specific example of an intelligent peripheral *controller (IPC) board, this universal IPC block diagram illustrates the principal IPC components, including the interface to the high-speed system bus, the 8-bit μc unit with its dedicated ROM and RAM elements and "private" bus, and DMA controller elements to handle the high-speed data exchange.*

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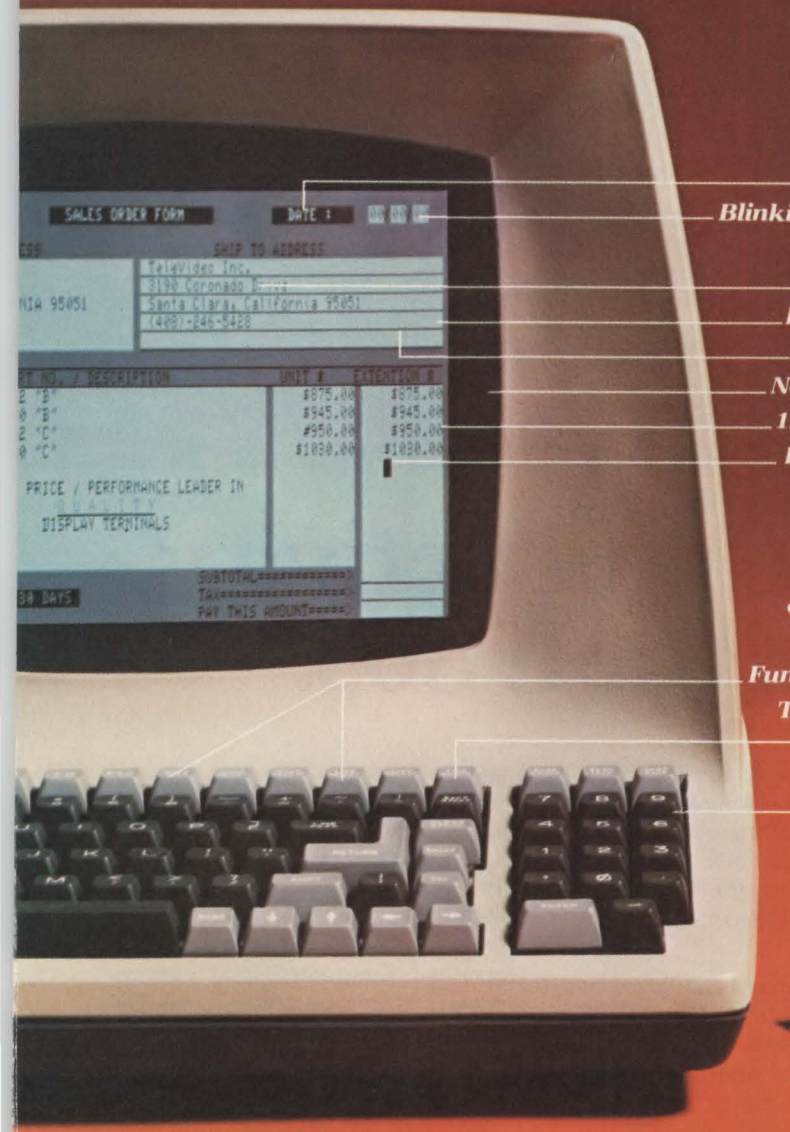

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A dynamic RAM expansion module is available in three memory population sizes: 32K, 64K and 128K bytes.

following a power-up reset sequence. Beyond that function, the on-board ROM space is sufficient for a reasonably sized application or, alternately, for the non-changing system multitasking executive firmware. That firmware could be linked to several application task modules loaded into RAM for execution from an off-board device.

Serial input/output. Two independent serial ports are provided, each capable of several programmable modes of operation with an RS232C terminal or modem interface, and with asynchronous operation as fast as 19.2K baud. In addition, one of the serial ports can be user-configured for synchronous operation with byte-oriented communication protocols, such as IBM's bisynchronous standard. That same port can be alternately used with the RS422 standard interface to give longer transmission distance. These serial port features could support two high-speed user video terminals, for example, or a single video terminal plus a high-speed synchronous communication link to a larger mainframe computer.

Parallel input/output. Parallel I/O is implemented as four independent bidirectional ports, each having eight general-purpose data lines and two "handshake" lines. The MC68000 μp can read or write each byte-wide port individually, or can access each of two pairs of ports with a 16-bit write or read. This high-speed parallel I/O capability would allow, for instance, two high-performance line printers to be driven simultaneously or as many as four byte-wide I/O channels to be connected to other remote processors.

Expansion modules enhance memory

Several high-performance support modules are available to complement the VERSAmodule monoboard μc in system configurations.

Dynamic RAM expansion module. A dynamic RAM expansion module is available in three memory population sizes: 32K, 64K and 128K bytes. It offers a byte-parity generation and checking feature for error control, which can optionally be enabled or disabled. When enabled, a single parity bit is stored in the memory array with each byte. A parity error occurring during an attempted memory read will cause an immediate single retry of the read to be attempted on the board. Two sequential read errors result in a "bus-error" indication being placed on the VERSAbus by the RAM board to notify the bus master of the hard failure condition.

Intelligent peripheral controller modules. VERSAmodule device interfaces are available, based on intelligent peripheral controller (IPC) architecture. The interfaces enhance the overall performance of systems based on one or more of the VERSAmodule monoboard μcs. The IPC architecture (Fig. 5) offers the following features in each of these modular system elements:

Peripheral processor. Peripheral device control is performed by a dedicated 8-bit μp unit optimized for peripheral control tasks. It communicates with its own RAM, ROM and I/O resources through a private bus on the IPC board. Additionally, it employs a 128-byte shared RAM to pass control and status messages back and forth through the VERSAbus to other system processors.

Direct memory access control. Each IPC VERSAmodule incorporates a DMA controller function for high-speed access to global RAM located elsewhere on the VERSAbus. Transfer rates through the DMA function are approximately 4M bytes per sec. The combination of the overall IPC architecture and the DMA function allows the IPC module to intercommunicate in a simplified command and data packet format with other system resources accessible from the VERSAbus.

Self-test and diagnosis. Self-test and diagnostic routines are provided as part of the standard IPC firmware. Self-test can be initiated upon the occurrence of specified internal conditions on the IPC module, or on request from another device on the VERSAbus. These features are consistent with an overall plan for high levels of reliability and maintainability in these higher performance μp systems.

The available IPC VERSAmodules include two rotating mass-memory controllers, a multichannel serial communications controller and a general-purpose IPC module that can be adapted to different types of high-speed I/O devices. A floppy-disk controller VERSAmodule can interconnect as many as four double-sided, single-density 8-in. drives for a total storage capacity of 4M bytes. The universal disk controller (UDC) is implemented as a 2-board set offering both floppy- and hard-disk control capabilities simultaneously. In addition to 4M bytes of floppy-disk storage, the UDC can control one or two hard-disk drives through the SMD disk interface.

Besides the basic IPC features, the universal intelligent peripheral controller (UIPC) VERSAmodule provides a parallel interface plus a DMA channel interface to a user-provided device. Appropriate devices include mass memories, graphics processors and communication concentrators. The IPC firmware in the UIPC is implemented in the form of a multitasking executive, to which the user can add firmware to customize the UIPC to the specific device being employed.

Finally, the multichannel communication controller VERSAmodule provides four standard RS232C interfaces for connection to video terminals, modems or other serial devices. The baud rate on each channel is programmable from the main processor to any of several standard rates to as much as 9.6K baud. ■

Jeff Gorin is manager, product applications, and **Lothar Stern** is manager, technical communications, for Motorola Semiconductor Products, Inc., Phoenix.

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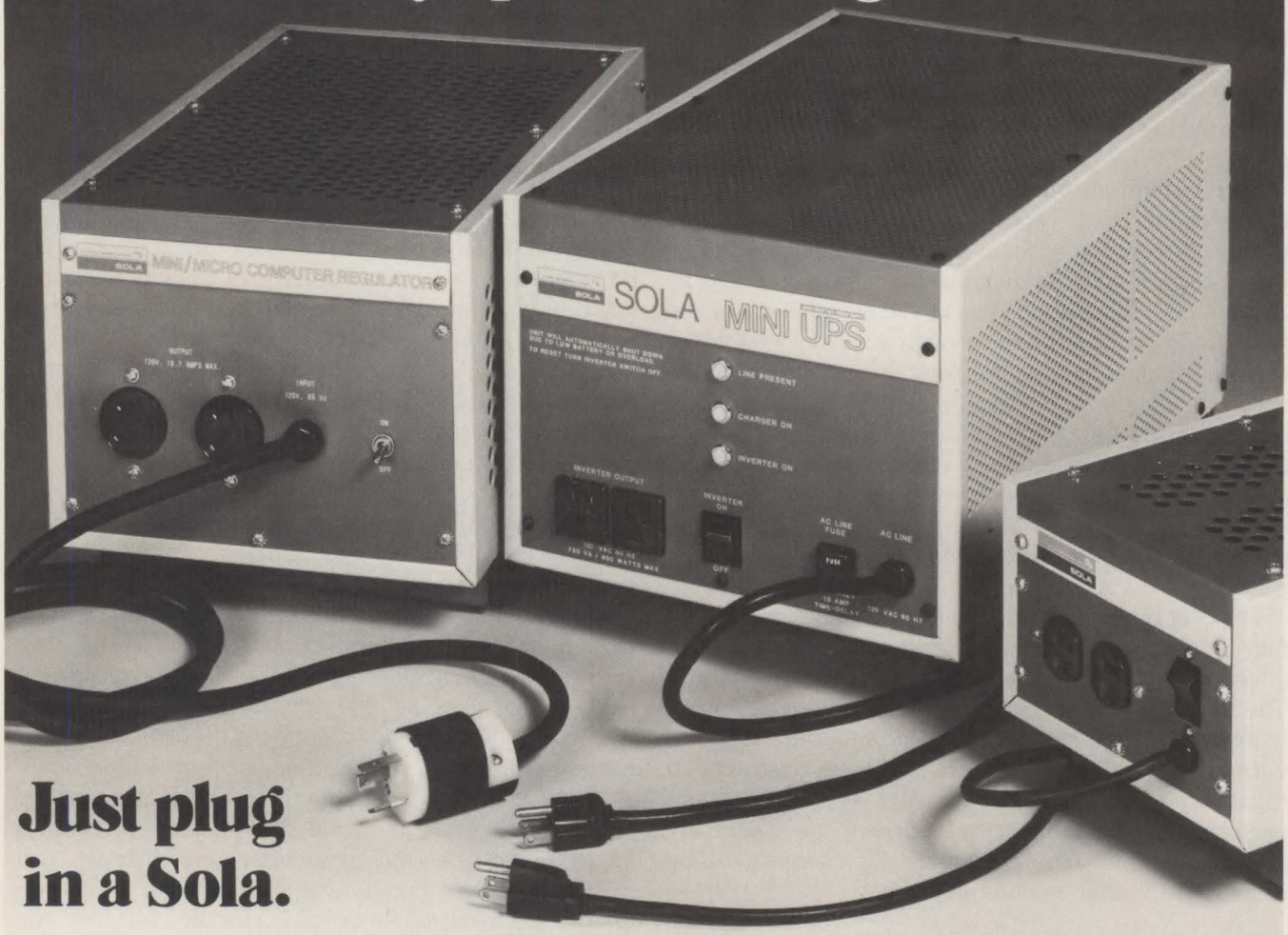

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CIRCLE NO. 91 ON INQUIRY CARD

Personal computers are smarter...

CARL WARREN, EDN magazine

...and so are their manufacturers, who are expanding the devices' capabilities with hardware and software enhancements

Personal computers are getting smarter—and so are their manufacturers. The firms are paying careful attention to the expectations of these machines' users and potential users.

Specifically, manufacturers, software houses and marketers now provide greater capabilities in personal computers via software and hardware enhancements such as communications and color graphics. Moreover, portability has become the watchword of many recently introduced designs and of those planned for introduction later this year. The direction that personal-computer manufacturers are taking in software is not new, however; it represents a rekindling of the expectations expressed by mainframe and minicomputer users during the past 20 years. Typically, users ask for three things that manufacturers are attempting to deliver:

- Ease of use. Personal computers are becoming more friendly with the incorporation of function keys, ROM-resident diagnostics and better written documentation.
- Flexible application software. According to every manufacturer and numerous computer-store operators, today's average user does not intend to become a programmer; he wants application packages that meet most of his needs. And he's willing to change his method of operation to comply with a well-written package.
- A greater variety of system languages. Although this factor isn't crucial to the typical business user, it is to the software designer. By having a choice of languages, application engineers have virtually no limitations on their creativity.

Users' expectations spurred development

Early in the development of personal computers, one question that was almost always asked was: "Now that you've got a personal computer, what will you do with it?" Quickly, entrepreneurs and other future-oriented individuals began developing business applications for use on the less-than-optimal machines. As a result, users' expectations spurred the introduction of systems that offered better screen displays, higher capacity storage and—most importantly—more functional software.

According to Jon Shirley, computer products merchandising vice president for Tandy Corp.—maker of the ubiquitous TRS-80 μc—the firm found a major trend toward small business. Consequently, Tandy introduced the TRS-80 model II to meet the growing demand for a larger machine that could handle larger amounts of data and fit well in a small-business environment.

Tandy isn't alone in such observations. Heath Co., now part of Zenith Radio Corp., has reconsidered its μc products along the same lines as Tandy. Joe Schulte, Heath's vice president for retail marketing and president of Veritechnology Electronic Corp. (the exclusive marketing arm of Heath products), explains that market research indicates several key elements that potential μc buyers look for. Among these are service, complete turnkey operation and a wide variety of software packages.

Small-business market most promising

Although small-business computing is the most promising area for μc systems, Schulte points out that Heath isn't abandoning hobbyists. The firm is one of the few companies still providing kits—the cornerstone of Heath's success.

Tandy's Shirley agrees that the hobbyist market is important, but his firm serves it from a different angle. Rather than offer kits, Tandy provides complete integrated systems for just about any level of computing power. For example, last summer the firm introduced its model III, a repackaging of the popular model I

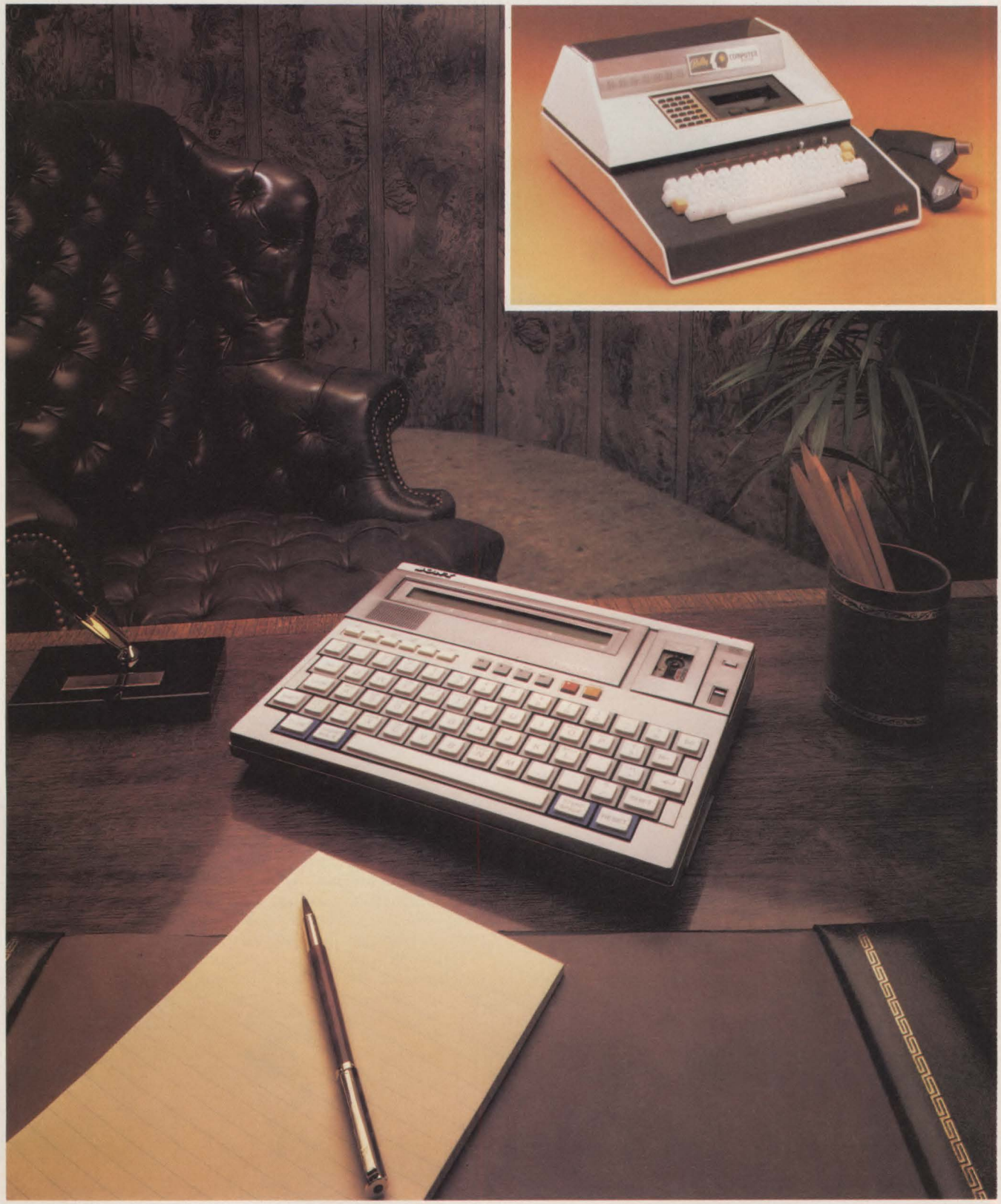
Designed for portability, *Sony's Typecorder (right) uses an LCD display. It can store as many as 120 standard pages of typing on its integral microcassette system. The Bally Z Grass μc system (inset) sports a 256-color palette and a music synthesizer with a three-octave range.*

that eliminates the earlier machine's familiar modular-add-on "bailing-wire" effect.

Although the model III basically addresses hobbyists' and engineers' requirements, as does the model I, several enhancements other than the packaging broaden the model III's potential uses.

To make the model III more enticing as a desk-top tool for a variety of applications, for example, Tandy's Radio Shack stores offer it with two built-in 5¼-in. double-density floppy disks, 32K bytes of RAM, a more powerful operating system than the model I's and BASIC, all for $2495. Furthermore, the stores offer several applications packages ranging from word processing to data-base management.

To further enhance this product line, Radio Shack sells an inexpensive version of the model III as the TRS-80 color computer. A basic 4K-byte version of this 6809 μp-based system sells for $399, and can include



THE SMART SET

Members of this exclusive circle of PRIAM Winchester disc drives have several uncommon things in common. With database capacities from 10.8 to 158 megabytes, they all have the same interface. And they all connect quickly and easily to the typical microprocessor I/O bus through PRIAM's SMART Interface.

A simple adapter, added to the SMART Interface, is all you need to provide your system with the remarkable reliability of Winchester disc drives. And PRIAM's DISKOS drives have the broadest available capacity range, with the lowest cost-per-megabtye, for microprocessor-based systems.

How Smart Is SMART?

With its own sophisticated preprogrammed microprocessor, PRIAM's optional SMART Interface gives you these disc subsystem functions:

- Controls any combination of one to four PRIAM Winchester disc drives.
- Serializes and deserializes data and formats disc with selectable sector sizes of 128, 256, 512 or 1024 bytes.
- Full sector buffering permits data transfers at any rate up to 2 megabytes per second, with programmed I/O or DMA.
- Automatic alternate sector assignment makes disc defects transparent to the host processor.
- Overlapped-command and implied-operations capability improves system throughput in multiple-drive systems.

The single 8″ x 14″ SMART Interface printed circuit board mounts on the PRIAM disc drive and draws power from the drive; or it can be mounted separately to maintain the basic drive size envelope.

Meet The Elite! PRIAM's High-Capacity, Cost-Effective 14-Inch Disc Drives

PRIAM's high-technology 14-inch Winchester disc drives are available with capacities of 34 and 68 megabytes, with a 158-megabyte version on the way. And they all fit in the same 7″ x 17″ x 20″ package, including optional power supply. Fully servoed linear-voice-coil head positioning provides fast, precise and reliable data retrieval. Average positioning time is only 45 milliseconds, and track-to-track is a fast 8 milliseconds for high throughput.

Use of a brushless DC spindle motor assures mechanical simplicity, positive disc speed control, and operation of PRIAM drives with power sources anywhere in the world without change. No relays, no mechanical brakes, no brushes, belts, or pulleys. Pure, reliable electronic control. Elegantly simple!

The Talk of the Town: PRIAM Eight-Inch Disc Drives

When you want to debut a Winchester disc drive where you now have an 8-inch floppy disc, PRIAM's DISKOS 2050 and 3450 fit right in. And they give race-horse performance to your system by expanding your database to 21 or 35 megabytes, with head-positioning times of only 45 milliseconds average and 8 milliseconds track-to-track.

From the same technical family tree as their bigger brothers, PRIAM 8-inch drives use linear-voice-coil positioning and brushless DC motors. In the next generation, they will permit database expansion to 70 megabytes, in the same small, interface-compatible package.

If a simpler, even lower-cost drive will serve your purpose, the DISKOS 1070 gives you 10.8 megabytes of capacity, with stepper-motor positioning for seek times of 73 milliseconds average and 23 milliseconds track-to-track. Not as fast as other PRIAM family members, but still just as SMART when used with PRIAM's SMART Interface.

Other Interface Options!

Is SMART too smart? PRIAM also offers a lower-cost serial-bit NRZ data interface for the OEM who wishes to design the complete controller or to purchase one. This interface, similar to the evolving ANSI standard, has an 8-bit bidirectional microprocessor interface for all spindle motor and head positioning controls.

And if you have an existing storage module controller, PRIAM offers an SMD interface to extend the life of your controller and software and put Winchester disc drive benefits into your system quickly and easily.

For complete information about the SMART Interface and the members of the SMART SET of PRIAM Winchester disc drives, RSVP by telephone or mail to:

PRIAM

3096 Orchard Drive San Jose, CA 95134
Telephone (408) 946-4600 TWX 910-338-0293

The Apple III was hampered by delivery problems, and the machine is just now impacting the personal-computer market. But the Apple II continues to be popular with businessmen and educators.

options that permit telephone communications and can be upgraded to 16K bytes. Designed to be connected to TVs, the computer includes an NTSC-compatible composite video signal.

Radio Shack also sells an extended-graphics BASIC for $99 that compares favorably with the benchmark-quality software offered by Hewlett-Packard Co.

Increased memory and power

Apple Computer Corp., which manufactures another popular personal-computer line, offers additional software capability for its Apple II. President Mike Scott says the company is opening a new world with the Apple III. Scott refers specifically to the Apple III's increased memory size and processing power compared to its predecessor. Moreover, he points out, the less-than-$3000 Apple III gives business users a machine that can grow as their needs change.

The Apple III was hampered by delivery problems (partially related to an on-board real-time clock chip, which was eliminated), and the machine is just now impacting the personal-computer market. But the Apple II continues to be popular with businessmen, who select black-and-white displays to avoid the fringing problem associated with color sets, and with educators, who like the machine's color capability. Scott points out, however, that business users are becoming more sophisticated and realizing the importance of color—particularly for making presentations.

To support better color displays, therefore, the Apple III includes both a direct NTSC black-and-white video jack and an R6B jack for higher quality color monitors.

Regardless of the hardware enhancements offered by

Patterned after another computer series—*the Radio Shack TRS-80 Level I and II μcs—Personal Microcomputers' PMC-80 (right) employs a built-in cassette and 128×48 graphics resolution. The Apple III μc (below) supports as many as 128K bytes of memory, three graphics modes, a 74-key keyboard (including a 13-key numeric keypad), NTSC and RGB video outputs and a built-in 5¼-in. floppy-disk drive.*

Commodore's VIC 20 is a Japanese design and could represent the first wave of such products to hit the U.S.

the Apple III, however, software remains a problem—at least for the short run, explains Scott. Apple programmers, however, are working both internally and with software houses to develop software that operates in the model III's native mode. For example Pascal, FORTRAN, BASIC and a variety of application software, such as Personal Software's VisiCalc, can be expected within a few months.

An increasingly popular personal-computer trend is toward small, almost hand-sized, portable units. Among the first companies to offer a unit in this class is Sinclair Research. Its $199.95 ZX80 employs a Z80A 8-bit μp, a 40-key pressure-sensitive keyboard, 4K bytes of ROM-resident BASIC and 1K byte of user RAM.

The ZX80 measures 6½ × 8½ × 1½ in., weighs 12 oz. and connects to a TV. The machine's 24 × 32 monochrome character display includes 24 graphic symbols and inverse video.

Unfortunately, the ZX80 operates on channel 4 (67.25 MHz) and thus creates some problems on domestic sets due to interference from TV stations operating on that channel.

Sony has taken an interesting approach to small personal computers for professionals with its Typecorder. The 8½- × 11- × 1½-in. unit includes a standard-sized keyboard, an LCD and a micro-cassette drive for storing as many as 120 standard typed pages. The Typecorder sells for $1400, plus $475 for an acoustic coupler and $800 for a portable printer.

Also hoping to claim a share of the rapidly developing low-end portable-system market is Commodore International. Its 5K-byte VIC 20 sells for $299.95 and features color graphics, sound, expansion to 32K bytes and programmable function keys.

The VIC 20 comes in a keyboard enclosure and employs ROM expansion cartridges. It also connects to a TV and incorporates an RF modulator. The system has not yet received FCC certification for meeting RFI and EMI emission standards, however. The VIC 20 is a Japanese design and could represent the first wave of such products to hit the U.S.

Another personal system that bears watching is Osborne Computer Corp.'s Osborne 1, a Z80-based system introduced earlier this month at the West Coast Computer Faire (see "Hardware vendor offers equity for software," p. 18). It includes 64K bytes of RAM (4K of

Something for everybody *is available from Hewlett-Packard as shown here with the HP-85 (upper left), the HP-83 (upper right) and the HP-41CV calculator (center).*

GAMES OR COMPUTERS?

A class of personal systems that mystifies many are the so-called add-on, or game, machines, such as Mattel Electronics' Intellivision. A user can connect this $300 master component unit to a TV and use it to play games. Mattel also plans to sell a keyboard component for $700 that will give the system a more traditional personal-computer look.

Another game machine, the $599 Z Grass computer, is built by Bally and marketed by Astrovision. The computer's Bally Arcade module connects to a TV; its keyboard system contains 32K bytes of RAM and a sophisticated graphics system.

Texas Instruments, Inc. continues to market its TI 99/4 system, but now sells it for $649.95, for a basic console unit, including processor, BASIC and keyboard. This unbundling of the 99/4's console from its display monitor was prompted by lagging sales.

The 99/4's hallmark is its ability to incorporate high-quality (understandable) speech synthesis for $149.95. Moreover, TI is attempting to entice prospective buyers by offering a fairly comprehensive line of software in ROM packs, tape and diskette for $14.95 to $69.95. Even so, computer retailers predict rough seas ahead for the unit, especially since the introduction of less-than-$500 machines.

The personal computers manufactured by Atari Inc. also employ ROM-based software. In both the models 400 and 800, a ROM-cartridge system keeps users away from the unit's backplane. Electrically tight covers house slots that accept additional RAM and ROM. Another ROM slot, accessed via a flip-open door, enables users to insert game or language cartridges.

Atari offers two levels of machines, providing users with a relatively wide range of capabilities. The 16K-byte version of the Atari 400, which sells for $630, employs a membrane keyboard. It is essentially a high-level game module. The 800, on the other hand, priced at $1080 for a 16K-byte version, features a typewriter-style keyboard with full bounce and tactile feedback. It is geared more toward users who want greater functionality and the ability to add peripherals.

A relatively unknown machine, the Z80-based PMC-80, manufactured by Personal Micro Computers, is designed to emulate the popular Radio Shack TRS-80 model I. Priced at $645, the basic 16K-byte unit runs any software developed for the TRS-80. But the unit is currently the subject of a legal dispute with Radio Shack. Radio Shack claims the PMC-80 is a direct copy of its now discontinued model. Neither side will comment on the legal battle.

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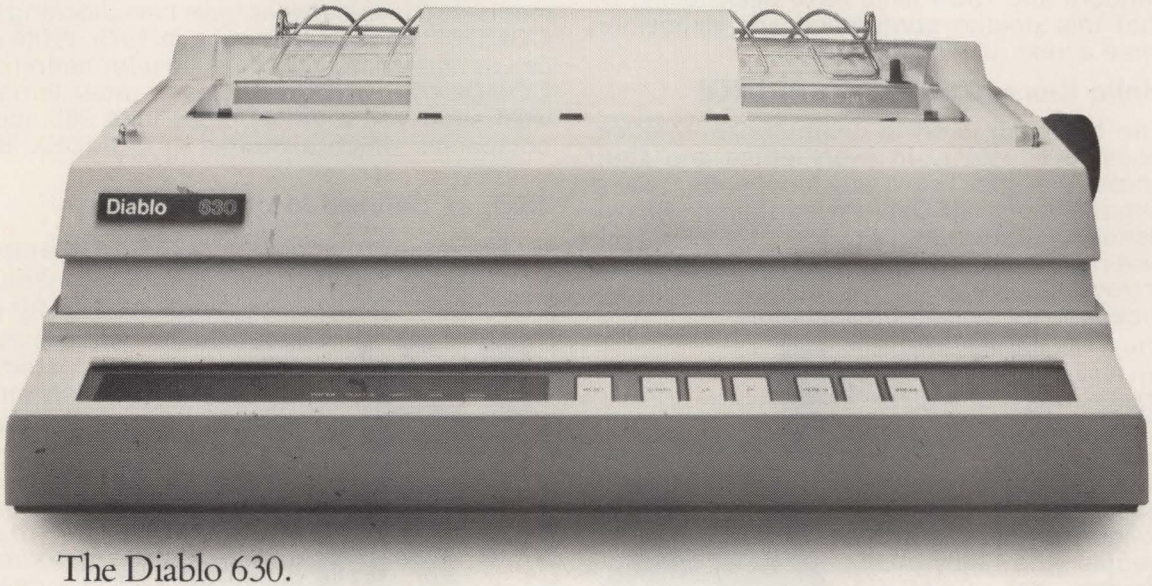

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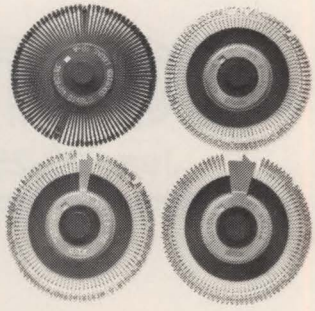

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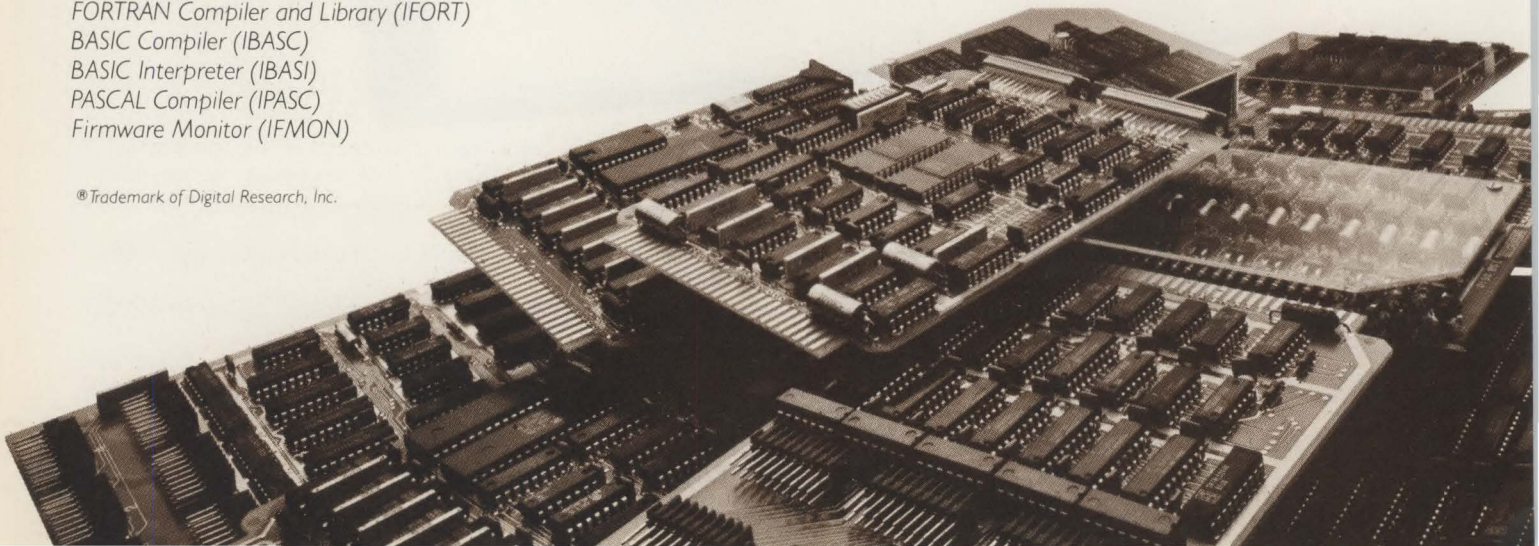

Although this year's personal-computer offerings include a host of features from slick packaging to dazzling color displays, all is for naught without a high level of software support.

which serve the display), a built-in 5-in. diagonal monitor that supports a 52 × 24 character display, two 5¼-in. single-sided, single-density floppies, a full-sized typewriter keyboard with a 10-key numeric keypad and IEEE-488 and EIA RS232C interfaces. The machine comes in a brushed-aluminum, weatherproof suitcase that fits under an airplane seat.

The Osborne-1 sells for $1795, including Digital Research's CP/M operating system, Compiler Systems' C BASIC, Microsoft's M BASIC, Micropro's Wordstar word-processing package with a Mailmerge option, and a Sorcim package, called Supercalc, that is under development. Supercalc will act as an electronic work sheet, much like Personal Software's VisiCalc. Also in the planning stage are hardware options, such as a modem, an acoustic coupler, double-sided, double-density disks and a choice of monitor screen sizes from 9 to 12in. The company plans to begin production this month, but will avoid direct sales and deal solely through distributors.

Taking a professional approach

Three manufacturers—Exidy, Hewlett-Packard and Kontron—have carved out a unique niche in the personal computer field by offering professional machines with a personal touch. Hewlett-Packard enjoys a leading position with three machines. Two of these, the HP-85 and HP-83 look like desk-top computers with integrated CRTs and keyboards. The 83 is priced at $2250 and offers all the functional features of the 85 except for an integrated thermal printer and a tape-cartridge drive.

The third computer, the HP-41CV, looks like a calculator. The $325 unit accommodates a variety of peripherals, including printers, plotters and magnetic-card readers. It can be programmed to perform the functions usually associated with its desk-top cousins. More importantly, the 41CV fits into an attaché case and works at the flick of a switch.

Kontron's PSI-80 μc controller is aimed at OEMs who want to tailor a system to unique requirements. The system is priced at $4430 for a 32K-byte, 1-disk configuration and supports the Kontron Operating System (KOS), which permits foreground and background operations, and the use of CP/M. It runs all Microsoft system software, including BASIC, FORTRAN and COBOL.

The PSI-80 also uses Europe cards and includes dot-addressable graphics on a P-31 green-phosphor display. The machine is aimed at industry-control and real-time data-acquisition applications.

Targeted for a much broader audience than the PSI-80, the Exidy Sorcerer 2 is designed to be upgradable. Company president Paul Terrell says that the unit lets buyers choose the lowest level machine available and familiarize themselves with it. The Sorcerer operates with either a TV or a 20-MHz, 12-in., P-31 green-phosphor display and sells for $499. Users can add additional memory and disk drives for a full-blown system as requirements change.

Software proves a key element

Although this year's personal computer offerings include a host of features from slick packaging to dazzling color displays, all is for naught without an extremely high level of software support. The necessary software divides into two main classes: system and application.

Among system software entries, Digital Research's CP/M and MPM operating systems and PL/1 and Microsoft languages rank as undisputed leaders. But because the trend points more toward small-business and self-help applications, numerous companies—including Microsoft's Consumer Products Division—are jumping on the application bandwagon. Consequently, μc users are encountering everything from sophisticated graphics games to information-handling systems.

One company that can be credited with developing high-level software for professionals is Personal Software. Its mainstream product, VisiCalc, runs on a

NO REGULATION

If you're afraid that Uncle Sam will stick his nose into the sale and use of personal computers, Sen. Barry Goldwater (Rep, Ariz.) says you can put your fears to rest. He believes the government has no business regulating these aspects of the machines, and he opposes any legislation intended to do so.

Goldwater does state, however, that manufacturers should be forced to comply with Federal Communications Commission regulations governing RFI and EMI emissions. But he notes that such regulations are almost unenforceable because of a lack of manpower and funds available to the watchdog agency.

In regard to personal-computer factors, though, Goldwater not only opposes regulating the machines, he greatly favors their use in all aspects of American life.

In fact, he predicts that in five years one household in 10 will use a μc for entertainment, education or some form of business. Furthermore, he expects schools to employ the machines in concert with large data bases made available by the federal government to enhance the educational process.

Although Goldwater supports personal-computer use, he quickly points out that he doesn't condone federal funding of projects aimed at encouraging their use—other than to make available, via timesharing, information held in federal data banks.

The senator owns a μc—one he built himself for controlling his ham-radio station in Arizona.

VisiCalc enables users to develop tabular displays, perform arithmetic and logical operations on data and perform projections.

variety of machines including the Apple II and III; Commodore Pet and CBM; Atari 800; Radio Shack models I, II and III; and the HP-85.

This $150 to $200 visual-calculator program enables users to develop tabular displays, perform arithmetic and logical operations on data and perform projections. Company chairman Dan Flystra, says that VisiCalc and associated products let users do all the things on a computer that they would normally do with paper and pen.

Flystra takes an innovative approach to software by using no buzzwords such as bit or byte as part of marketing strategy. He opts, instead, for an almost Digital Equipment Corp.-type approach to selling solutions. The strategy apparently works: an estimated total of more than 50,000 copies of VisiCalc are in use, serving as the industry benchmark.

Another firm, Organic Software, supports the same general market as Personal Software with business-oriented products. Company president and chief designer Mike Posehn creates software using modular sub-packages that provide standard displays and entry methods.

Using a Z80A μp, *the Kontron PSI-80 μc/controller supports foreground and background operations. It is designed for OEMs who require a system they can tailor to specific applications.*

FOR MORE INFORMATION . . .

For more information on the personal computers or software described in this article, contact the following manufacturers directly or use the appropriate reader circle numbers.

HARDWARE

Apple Computer, Inc.
10260 Bandley Dr.
Cupertino, Calif., 95014
(408) 996-1010
Circle No 440

Astrovision
6460 Busch Blvd., Suite 215
Columbus, Ohio 43229
(614) 885-0130
Circle No 441

Atari
1265 Borregas Ave.
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(800) 672-1404
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Kontron Electronics, Inc.
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Osborne Computer Corp.
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Tandy Corp./Radio Shack
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Fort Worth, Texas 76102
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Circle No 453

Texas Instruments Inc.
Consumer Relations
Box 53 (Att TI 99/4)
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Circle No 454

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San Ramon, Calif. 94583
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Microsoft Consumer Products
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Bellevue, Wash. 98004
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Circle No 458

Organic Software
1492 Windsor Way
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Or one mini floppy and one Winchester rigid disk. Disk controller (user selected) is located in rear card cage.

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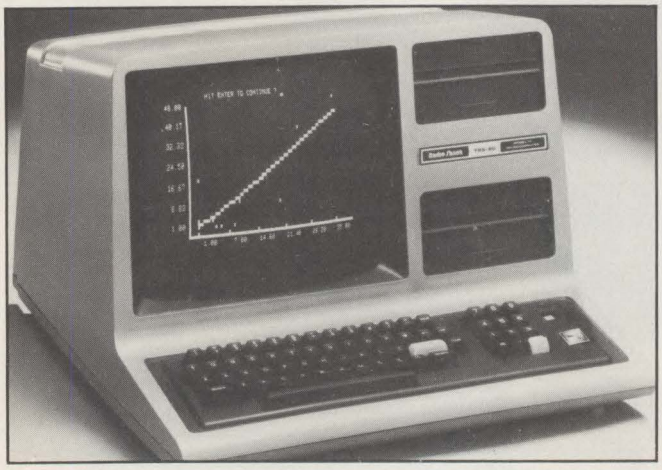
Organic's Textwriter supports dynamic indexing and subheads and provides for a variety of printer controls.

Specifically, Organic sells programs that help users keep appointments, manage projects and perform word processing. The firm's $295 Datebook sets up a date ledger book that keeps track of appointments by date, time and name. The $295 Milestone performs a similar function for projects and permits critical-path analysis.

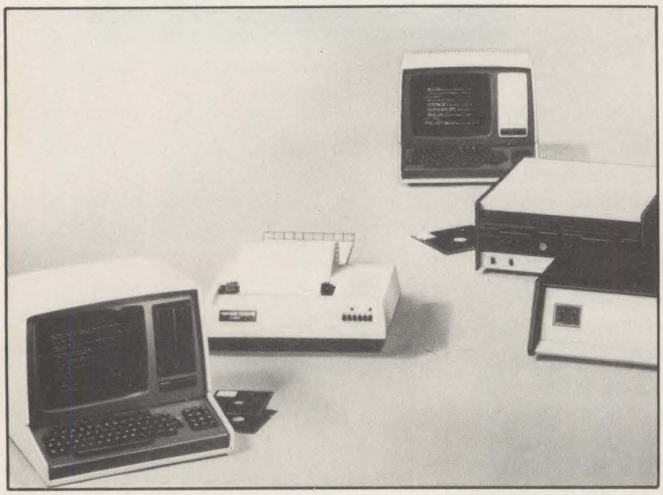
Because word processing is a major element of most businesses, Organic markets Textwriter software, which is patterned after DEC's RUNF10 post processor. This $125 package supports dynamic indexing and subheads and provides for a variety of printer controls. The software comes on 8-in. IBM-compatible floppy-disks for the CP/M operating system.

Information handling is also an important aspect of business, and data-base management is often requested for personal computers—needs that Micro-AP fills with its Selector IV. Written in C BASIC and running under CP/M, this data-base manager provides flexibility in setting up data fields and report definitions for the system printer. It sells for $550, or $367 in OEM quantities.

As an expansion *of its electronic-game series, Mattel Electronics sells the Intellivision as a master stand-alone component. It also sells an optional keyboard component used to expand the unit into a full μc system.*



With two 5¼-in. floppy-disk drives *and a full typewriter-like keyboard with upper- and lower-case characters, Radio Shack's TRS-80 model III replaces the firm's model I component system with a unitized package.*



The dual Z80 μp-based *WH-89 integrated machine (left) and the LSI-11-based 16-bit WH-11A systems come from Heath/Zenith either in kit form from the firm's Heathkit Division or assembled from the Zenith Data Systems Group.*

Diversity causes problems

A major gap in the market has resulted from the diversity in machine architectures (even for the same μp), size of disk drives and differences in operating systems. Consequently, independent software vendors find it difficult to furnish products for a wide range of machines.

To fill this gap, Lifeboat Associates offers a configuration service that adapts the firm's products to a variety of μc configurations. For example, although Organic's packages are primarily available on single-density 8-in. diskettes for standard CP/M, Lifeboat offers the same products on 5¼-in. diskettes for standard and 4200-hex-based CP/M systems.

Lifeboat president Tony Gold points out that a software package can be the best in the world, but if it's not portable and flexible enough to meet today's needs, you might as well forget it.

The Japanese connection

With an eye toward competing in both the hardware and software areas, Japanese firms are preparing for a major invasion of the personal-computer field. Note, for example, Sony's and Commodore's hardware products.

What about software? This remains a major unanswered question, but early reports seem to indicate that Japanese companies will seek compatibility with popular U.S. software products. Industry sources report that NEC and Hitachi have already signed contracts with Digital Research and Microsoft for systems software, for instance. Whether a large variety of applications will be available, though, is anyone's guess. ■

Carl Warren is Western Editor of EDN magazine, which published this article in its April 29 issue.

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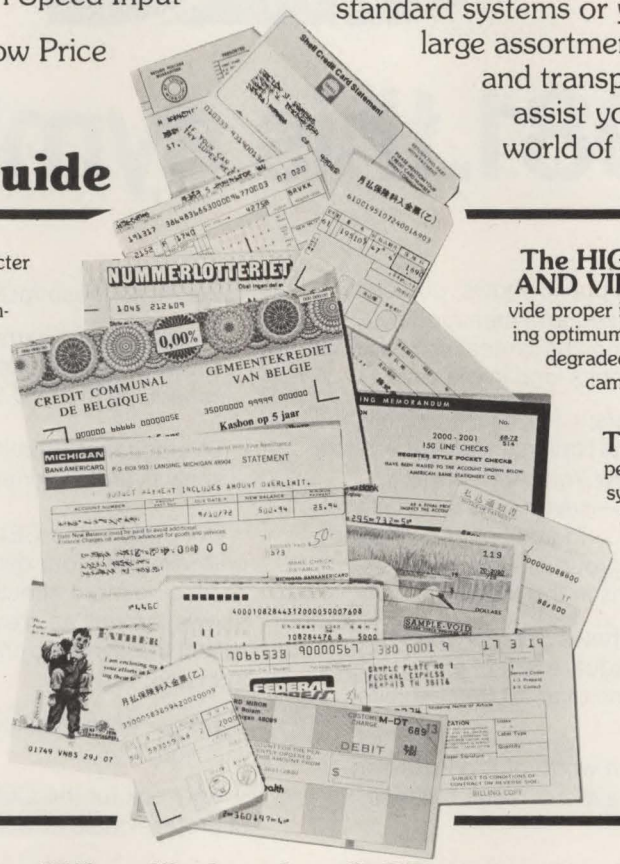

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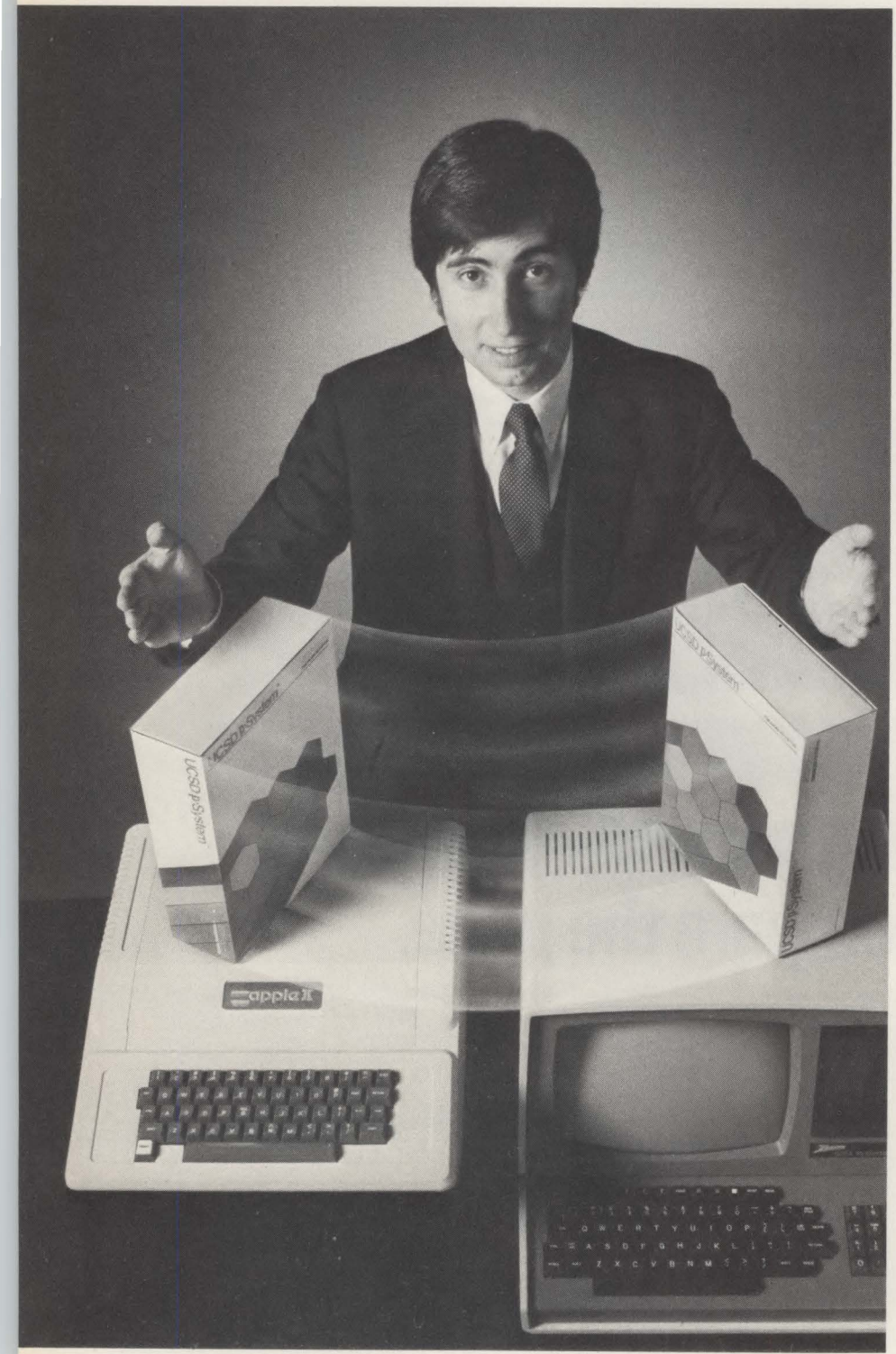

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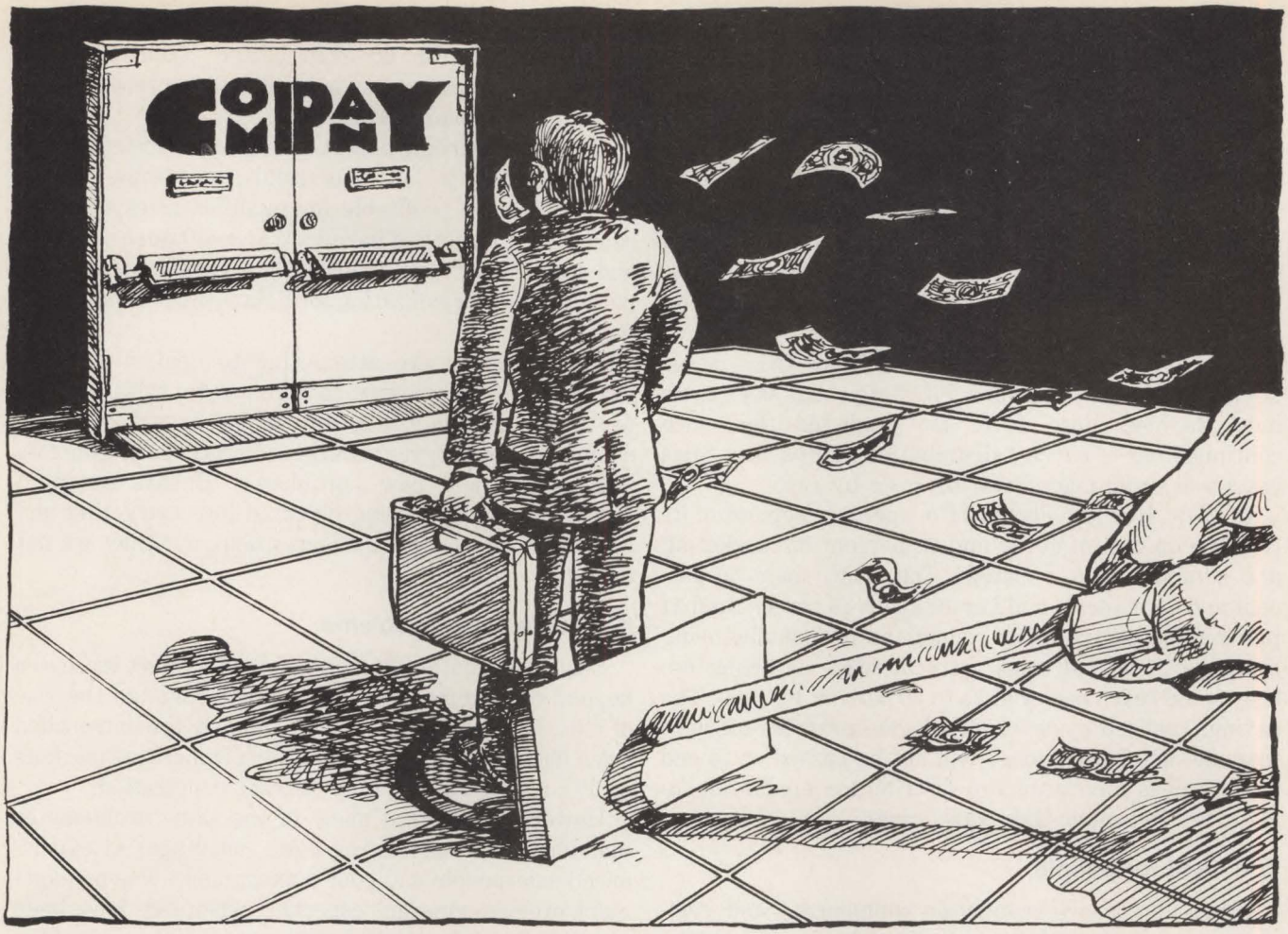

DISTRIBUTION

The crisis in DP sales

GENE R. TALSKY,
Professional Marketing Management, Inc.

Too few qualified people and too many products add up to rising sales costs

Rapid sales growth and the start-up of new computer manufacturers every month have created a scarcity of experienced salespeople. Add to this the increased costs associated with marketing and selling—and a crisis emerges.

A recent McGraw-Hill Research study indicates that the cost of a sales call is now $92.13 for large companies and $195.80 for small firms. The use of re-sellers, distributors and dealers—independent sales organizations (ISOs)—reduces that cost 42 percent, to $113.54 per sales call for small companies. But even concluding a sale at a trade show costs $57. Sales costs have increased 40 percent in the past three years.

All costs associated with sales activities are on the rise. A report by the brokerage firm of Donaldson, Lufkin and Jenrette reports a 30 percent increase in air fares during 1980. Current forecasts are projecting an additional increase of 18 to 27 percent in 1981.

The magnitude of the crisis was evidenced during the ISO-vendor round table at Comdex '80 last November. The first concern for the '80s is rising sales costs, says William Jobe, former vice president and general

Illustration by Jon McIntosh

ISOs face many of the same problems as manufacturers—escalating costs, shortages of experienced salespeople and poor management.

manager of the General Distribution Division of Data General Corp., and Dennis Cagan, president of the David Jamison Carlyle Corp., a large data-processing distributor.

Manny Fernandez, president of Zilog Inc., in his keynote address at Comdex '80, stated that sales costs have doubled since 1970. He predicted that with continued use of current distribution approaches, sales costs will equal manufacturing costs by 1990.

In 1979, Hewlett-Packard Co. spent 47 percent of its revenue on cost of goods and 28 percent on marketing and administrative expenses. Datapoint spent 50 percent and 20 percent, and Pertec spent 48 percent and 21 percent, respectively. If reductions in manufacturing costs continue and sales costs increase as projected, they could reach parity at 35 to 40 percent by 1990. The savings realized by new technologies and more efficient manufacturing techniques will not be passed on to end users unless innovations in distribution enable manufacturers to control their sales costs.

The need for people

New, inexpensive computer components and complete μc systems have significantly increased the number of companies manufacturing their own hardware, fabricating systems from components and integrating hardware and software. These start-ups have created a demand for marketing and sales managers. Turnover rates of vice presidents, directors and managers have reached unprecedented levels. A recent issue of an industry newspaper included seven articles on marketing vice presidents who resigned to accept management positions with other data-processing firms or to start their own companies. One result of such departures is that successful salespeople are prematurely elevated into management to fill the new positions. The competition for experienced people has become even more intense than that for sales.

Computer companies that prematurely elevate top-producing salespeople to management positions face two risks. First, relatively few salespeople can successfully make the transition to management. Second, sales volume is likely to be lost while new salespeople develop experience. Neither risk is attractive.

Top salespeople have many other opportunities to better their earnings. Last year, the average salary and commissions of experienced salespersons in all fields was $28,456. A sampling taken by *Computer Marketing Newsletter* indicates that the median base sales compensation in the computer field ranged from $16,100 to $18,000. A Fox-Morris survey documents an average $45,000 to $55,000 base in a $75,000 total earnings package for national data-processing sales managers with 16 to 20 years of experience. But manufacturers' representatives can do even better. Salaries of the heads of the 1200 largest independent representatives averaged $94,000 in 1979.

These high earning potentials stimulate the entrepreneurial spirit in all successful salespeople. It is becoming more profitable for qualified salespeople to represent a variety of hardware and software products and support services than it is for them to manage a national sales organization for a data-processing manufacturer.

Manufacturers are attempting to deal with these challenges in many ways: comprehensive sales training for inexperienced people, more creative sales-compensation programs, larger allocations for contests and awards and new perquisites. Dollars saved in manufacturing are being diverted into marketing and sales activities. These measures help, but they are not enough.

ISOs face many problems

Basic distribution decisions forced by cost increases beyond management's control have promoted the rise of ISOs. New companies need to employ the entrenched sales forces of ISOs to enter highly competitive markets earlier and to gain broader market penetration.

However, ISOs face many of the same problems as manufacturers—escalating costs, shortages of experienced salespeople and poor management. The management problem emerges especially when ISOs have been started by salespeople who have had inadequate managerial experience.

Years of trial and error were required before technical managers came to understand the compromises required to transform technological expertise into entrepreneurial success. Salespeople are now confronting a similar challenge.

Manufacturers that distribute through ISOs should understand the best use of their ISOs' capabilities. Success depends on finding the proper balance between what manufacturers should offer and what they can expect from ISOs. Manufacturers should continue to provide all marketing functions—advertising, trade show exhibitions, lead generation and technical support. They should expect their ISOs to provide them with a local presence for prospects, to close sales, to integrate the manufacturers' products with peripherals and software provided by independent developers and to provide local after-sale support services.

The relationship between a manufacturer and its ISOs is a subject that merits a more detailed review. ISOs do not solve the sales crisis confronting data-processing manufacturers. However, the development of complementary relationships between manufacturers and ISOs, mutually committed to succeed in their common markets, is the first step in dealing with that crisis. ■

Gene R. Talsky is president of Professional Marketing Management, Inc., Gales Ferry, Conn.

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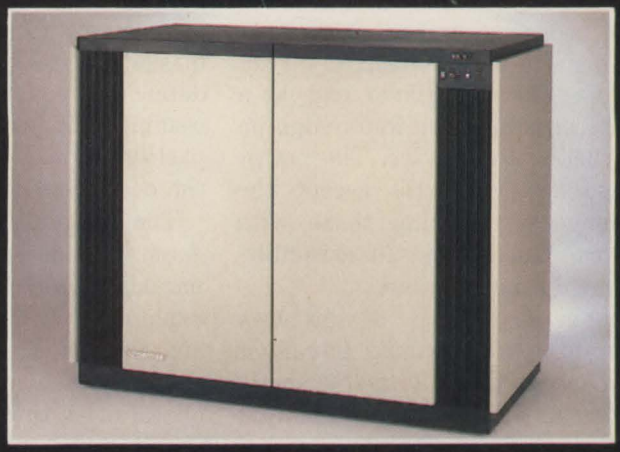

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Assembly language for the Z8000

This book accepts the challenge of teaching those with minimal background in assembly language programming

Z8000 ASSEMBLY LANGUAGE PROGRAMMING, by L.A. Leventhal, A. Osborne and C. Collins, Osborne / McGraw Hill, Berkeley, Calif.

Reviewed by
Robert D. Grappel

Each new μp has spawned a family of how-to-program-it books. Some of these books take the "programmer's cookbook" approach; others try the "beginner's guide to assember programming" route. Some are scarcely more than a collection of the manufacturer's data sheets and application notes; others are excellent teaching and learning tools. The new programming books dealing with 16-bit μps tend to a middle course. Authors of these books recognize that the task of using a 16-bit μp effectively is not a subject for a beginner and, as a result, assume more knowledge on the part of the reader. The better books, however, still accept the challenge of teaching those with minimal background in assembly-language programming.

Among the finest of this new group is *Z8000 Assembly Language Programming*, a lengthy study divided into three parts. The first part describes the Z8000 processor and its assembly language—a task complicated by the fact that the Z8000 is really two μps. The Z8001 and Z8002 are dissimilar enough to cause confusion. The assembly language conventions used by Zilog and AMD (a second source for the Z8000) complicate matters further. This book precisely illuminates these complexities. The authors chose to work with Zilog assembler syntax, but avoided many incompatible statements that would cause trouble on other assemblers. They also tried to select illustrations that are compatible with both the Z8001 and Z8002.

The Z8000 μp has survived several early production problems. Depending on the particular chip used, many perplexing bugs can appear with certain instructions. The book lists the offending instructions for each of the early masks, and tells the reader how to determine which mask he has by reading the coding on the μp package. Touches like this separate the book from others of its kind.

The second section of *Z8000 Assembly Language Programming* provides a generous set of program examples. Some simple examples are used primarily for teaching how the powerful and complex Z8000 operates. A thorough discussion of the instruction set is provided. Many examples of I/O rely on Z80 peripheral parts because there were no available Z8000 peripherals when the book was written. Several pages are devoted to an examination of the Z8010 memory-management unit, which is used with the Z8001 to control large memory spaces. This section comprises a set of floating-point subroutines—which is probably worth the price of the book—and discusses multi-μp systems and real-time processing. Examples show how to write interrupt-driven serial-line handlers and timers, which can save hours of cut-and-try programming.

Section three details program design and debugging, including program redesign, the trade-offs involved in optimizing for size or speed, troubleshooting hints and sample problems to help the programmer through "rough spots."

Z8000 Assembly Language Programming is not light reading, and, therefore, should probably not be used as a programmer's first assembly-language book. It is, however, full of useful information, and should be most helpful to programmers wishing to climb the learning-curve on the Z8000. ■

Robert D. Grappel is vice president of Hemenway Associates, Inc., a Boston-based system software house specializing in operating systems and languages for μps.

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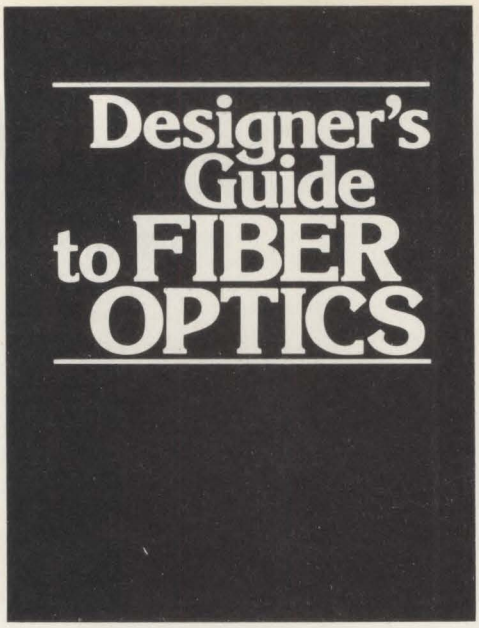

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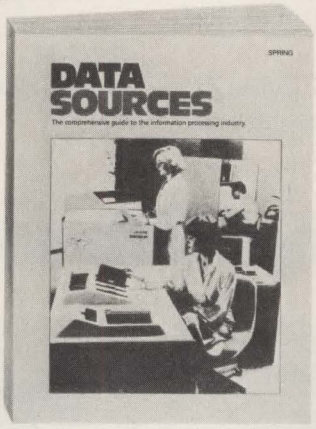

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CIRCLE NO. 104 ON INQUIRY CARD

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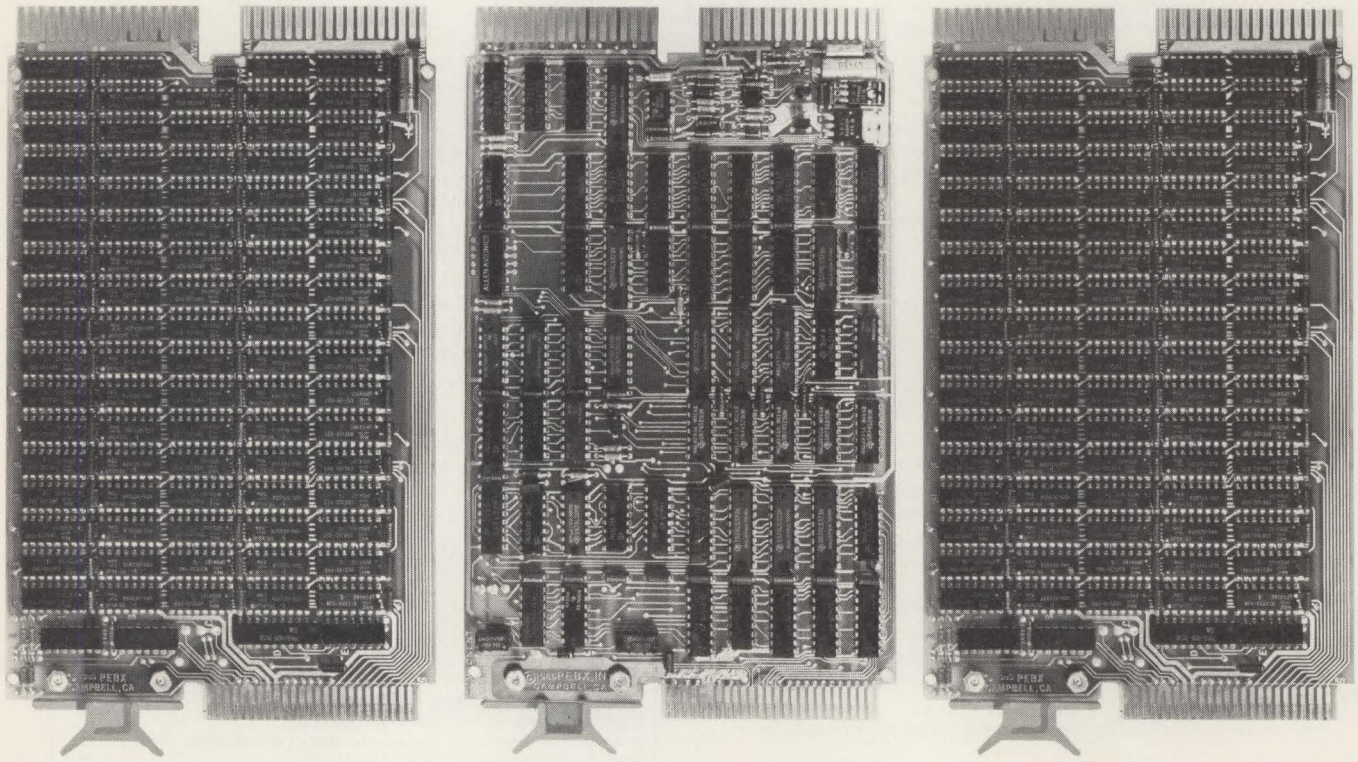
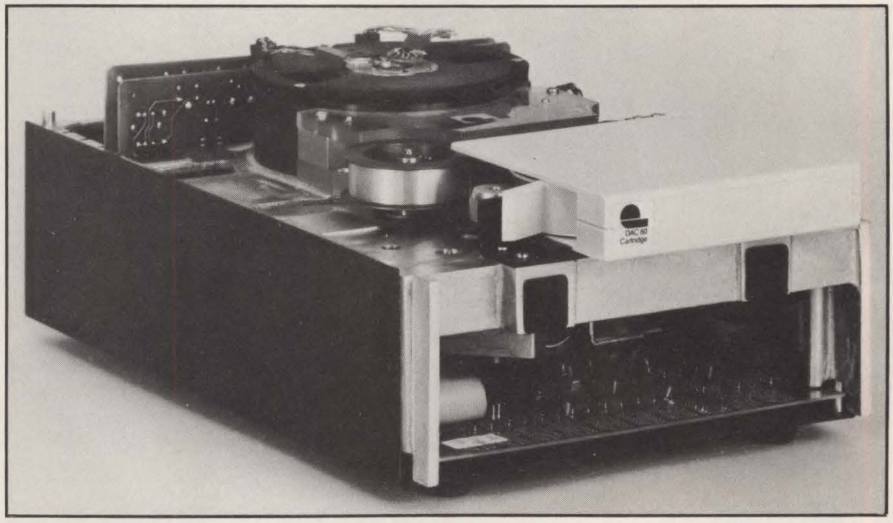


*LSI-11 is a registered trademark of Digital Equipment Corporation.

½-in. tape drive acts like Winchester; stores 80M bytes

A new ½-in. cartridge-tape drive, unique in that it operates like a disk drive, has been announced by Sunnyvale, Calif., start-up, Pragma Data Systems, Inc. Rather than record data in parallel, as do conventional ½-in. streaming-tape drives and reel-to-reel hardware, Pragma's model 2000 records track-by-track on discrete 5-in. segments of 32-track tape. Pragma executives say the technique simplifies controller design.

The new tape drive is designed specifically as backup for large-capacity 8- and 14-in. Winchesters, and is modeled around the envelope dimensions of the SA850 1M-byte double-sided floppy-disk drive—the mechanical standard used by many vendors of 8-in. fixed-disk drives.



Pragma Data Systems model 2000 *with cover removed shows proprietary ½-in. tape cartridge (foreground), immediately to the right of the rake-up reel. Read/write heads are mounted 180° apart in the drum to the rear. The entire package fits into the space required for an SA850 1M-byte double-sided floppy-disk drive.*

Pragma, formerly known as Datadyne, Inc. (MMS, March, p. 67), is ready to roll with evaluation versions of the 80M-byte drive, which uses conventional ½-in. oxide-coated tape packed into a proprietary cartridge.

In operation, the tape self-threads around a recording drum and onto a self-contained take-up reel. Two read/write heads are mounted 180° apart on the recording drum, offset from each other by 16 tracks. Data to be backed up are then read off the Winchester as if it were being transferred cylinder-by-cylinder to a floppy-disk drive.

When an IBM extended format is used, each floppy-disk drive cylinder contains 8K bytes. On the model 2000, 8K bytes of data are written serially in two passes by each of the two read/write heads. A total of 4K bytes of data are stored on track 1 of the tape, and the next 4K bytes are stored on track 16. Once cylinder 1 of the disk has been copied, the model 2000's head is stepped up one track-position. Cylinder 2 on the disk drive (or the continuation of cylinder 1 if the Winchester has data stored on more than one platter) is then recorded on track 2 of the tape, followed by track 17.

A total of 131K bytes can be stored per tape block. When this amount has been recorded, the stationary tape is advanced 5 in., and the process is repeated. Total recording time per block is about 1 sec.; total time to transfer 80M bytes of data is 6 to 7 min., with 45 sec. more required to rewind the cartridge. Transfer rate of the drive is 4.34M bits per sec., a specification that matches the transfer rates of an SA1000 Winchester and some of the 5¼-in. devices that have been announced in the past year.

"Essentially, the model 2000 records data as if it were a disk drive," says Tom McCrystal, marketing vice president at Pragma. "In this case, however, the media is stationary and the heads move."

As a result, he says, Pragma's new hardware is compatible with the controllers used for Shugart Associates' SA1000 8-in. Winchesters, although some additional lines are required for tape-only control functions such as rewind and tape advance.

But the OEM market for ½-in. tape-cartridge drives is evolving cautiously as vendors await word on what impact—if any—IBM's high-capacity "Ocotillo" drive, now under development at the mainframe giant's Tucson, Ariz., tape facility, will have on media standards.

"From the point of view of drive hardware, what IBM does or does not do has no impact on the market for low-cost Winchester backup," McCrystal says. "Media standards are another matter, however."

Price of the 80M-byte model 2000 is $3000 in single-unit quantities and $1985 in 100-unit quantities. Production versions are planned for the third quarter of this year.

—John Trifari

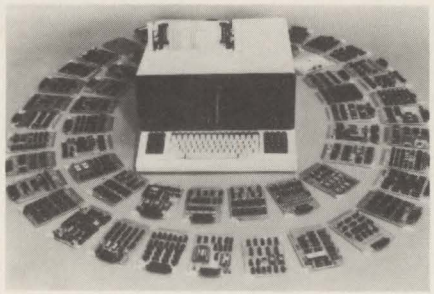
CIRCLE NO. 175 ON INQUIRY CARD

New Systems

Minicomputer system manages bank data

The Optima 300 minicomputer-based departmental data network system for thrift institutions and banks includes a DEC Datasystem 358, 256K bytes of main memory, dual disk drives with combined storage of 56M bytes, two VT100 video-display terminals, an SA180 line printer, operating system and three software packages, including customer information, credit history, and loan control. The system is priced at $80,000, including installation, on-site training and a 90-day warranty. **Planning Research Corp., Commercial Products Group,** Manchester, N.H.

Circle No 176



Cybersystems offers desk-top system

The model 9910 desk-top computer features a double-sided, double-density 5¼-in. floppy-disk drive, an 80-column, 133-cps matrix impact printer, a 9-in. CRT, a 24-slot dual-expansion card chassis, 1K-byte RAM and a 2K-byte EPROM. The 9910 sells for $5011 in 10-unit quantities, and $3619 in 100-unit quantities. **Cybersystems, Inc.,** Huntsville, Ala. **Circle No 177**

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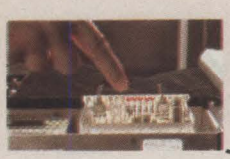

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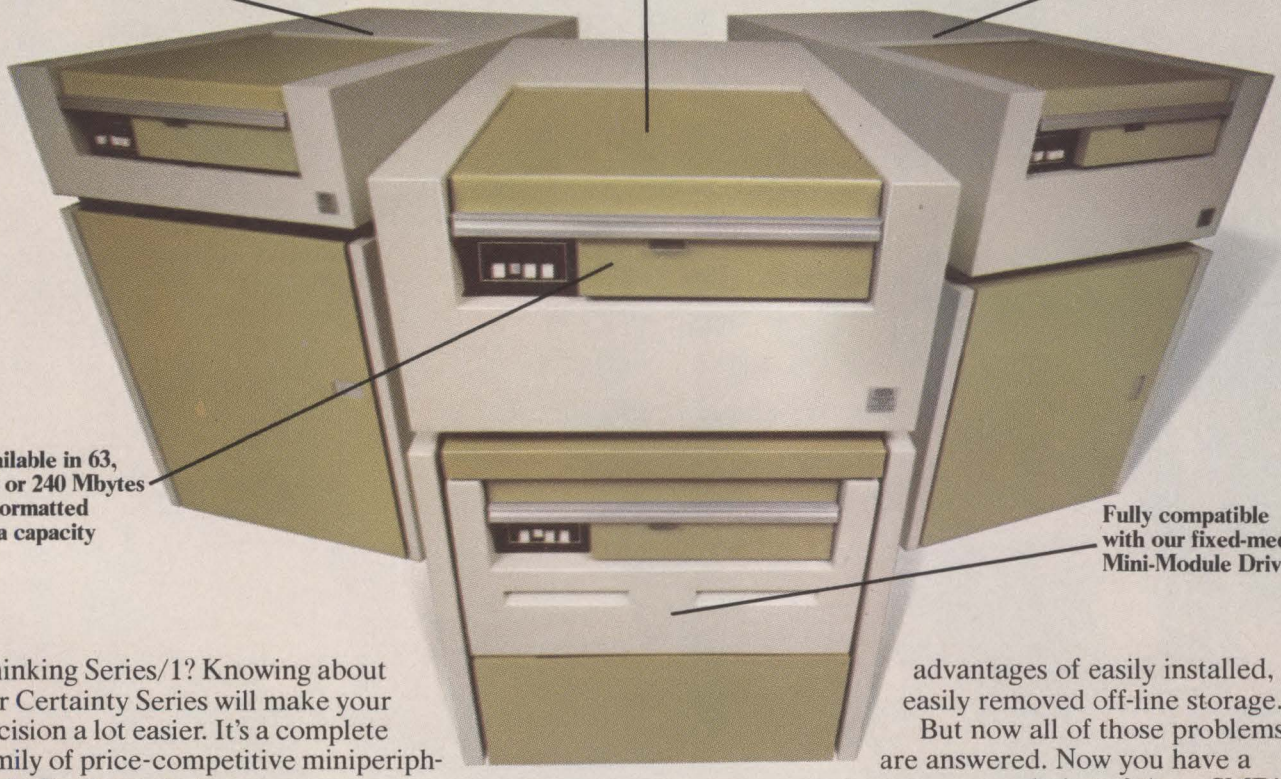
Removable media
Gives you off-line storage and back-up advantages over fixed disk

Proven head technology
Low mass design and rigid quality controls bring you high storage density and exceptional reliability.



Available in 63, 126 or 240 Mbytes of formatted data capacity

Fully compatible with our fixed-media Mini-Module Drive

Thinking Series/1? Knowing about our Certainty Series will make your decision a lot easier. It's a complete family of price-competitive miniperipherals. Products that go beyond mere plug compatibility—with added features to give you added performance.

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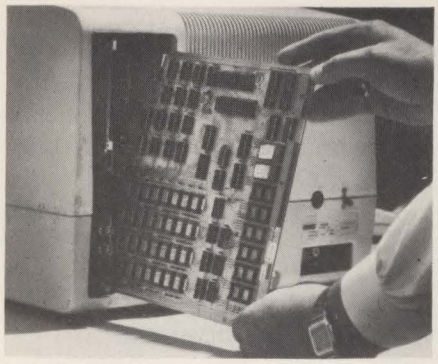


VT100 conversion kit has 32K-byte ROM/PROM

This VT100 conversion kit allows users of DEC's VT100 video terminal to convert their terminals into full μc systems by installing an INT/200 μc board. The kit includes a 64K-byte Z80 μc board with 32K bytes of ROM/PROM, an installation manual, a Node BASIC software license and CP/M or MP/M licenses. The kit sells for $1850, including Node BASIC; CP/M and MP/M are priced at $120 and $300, respectively. **Data Node, Inc.,** Sunnyvale, Calif. **Circle No 178**

Burroughs introduces bank-document processor

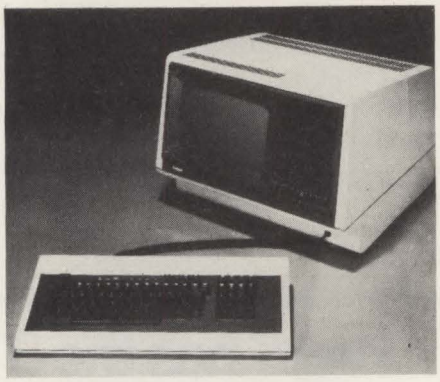
The B 9190 MICR/OCR document processor for banks and thrift institutions feeds, routes and tracks MICR- and OCR-encoded documents. Options include four to 32 sorting pockets, a double-read E13B MICR station to reduce misreads and rejects, automatic non-impact document endorsing, microfilming capability, multiple-size document handling, off-line sorting and the ability to read multiple OCR fonts. A typical configuration sells for $224,350 and can be leased for $7865 per mo. on a 3-yr. lease. **Burroughs Corp.,** Detroit, Mich. **Circle No 179**

Comshare announces employee benefit system

Digithrift, a minicomputer-based system for employee-benefit record-keeping, features a menu mode that prompts users for all the information needed to operate the system, a quick mode that allows experienced users to bypass the prompts and enter data more quickly, an automatic error-correction device, a snapshot capability that allows users to review the results of their work and certificate printing. Digithrift runs on DEC's Datasystem 538, including a PDP 11/34 processor with 256K-byte main memory, video display terminals, disk drives, a line printer and an optional tape drive. **Comshare, Inc.,** Ann Arbor, Mich. **Circle No 180**

New Products

interactive terminals



DEC announces terminals for news, ad entry

The VT173 video display terminal for newspaper and classified ad entry applications contains an LSI-11/2 μc and features pan scrolling, split-screen capability, automatic text insertion, variable scrolling and cursor speed and special keys for user-defined functions. The VT173/R reporter terminal, with 32K bytes of internal storage and a 105-key keyboard, is priced at $5195. The VT173/C classified terminal, including 32K bytes of internal memory and 123 keys, is $5995. **Digital Equipment Corp.**, Maynard, Mass.

Circle No 181

GDS announces 132-cpl terminals

The 132/C and 132/M Z80-based terminals use a 13- × 7-in P31 green phosphor CRT tube. The terminal includes 132- and 80-character line length, 24-, 27- or 30-line display, 16 programmable function keys, a separate numeric keypad, screen highlighting, an addressable cursor and 128 ASCII characters. Transmission rate is 19.2K baud. The unit includes a 16K-byte display memory. **GDS, Inc.** Seattle, Wash.

Circle No 182

ASCII terminal is IBM 2741-compatible

The AJ510 CRT, an IBM 2741-compatible terminal, offers full graphics and APL character sets with switch-selectable communications in ASCII, or IBM 2741-compatible EBCD or CORRESPONDENCE transmission modes. Other features include, pre-set, on-line operation at power on, pre-set terminal status indicators on the display, 15-min. display screen time-out, pre-set tab settings, form-feed recognition, page data protection and programmable page field delimiters. **Anderson Jacobson, Inc.**, San Jose, Calif.

Circle No 183

RCA introduces CRT emulators

The Dataspeed model 40 CRT emulators can enter, display, modify, print, send and receive messages in a dial-up or private-line communication system. Models 40/1 and 40/2 are dial-up CRTs with a printer option and speeds as fast as 1200 bps. The 40/3 is a multipoint private-line terminal operating within 8A1 store-and-forward communications systems. **RCA Service Co.**, Cherry Hill, N.J.

Circle No 184

Terminal features selectable baud rates

The TransTerm 1 uses a 64-character, 5 × 7 dot-matrix LCD and a 96-character ASCII set. The unit communicates in full-duplex RS232 asynchronous ASCII with optional 20-mA current loop or RS422. Other features include

switch-selectable baud rates of 300, 1200, 2400 and 9600; and switch-selectable block send mode or polled multidropping operation of as many as 16 units. The TransTerm 1 sells for $449 in single-unit quantities. **Computerwise, Inc.,** Grandview, Mo. **Circle No 185**

Datamedia announces 80/132-column terminal

The DT80/3 terminal features operator- or host-selectable 80-column or 132-column-wide display. The 132-column display enables a user to scan data in the format that will appear on hard copy. A user can select the terminal's configuration via keyboard. Selectable communications parameters include baud rate, parity and character bit-length. **Datamedia Corp.,** Pennsauken, N.J. **Circle No 186**

CRT terminal has 9-in. screen

The model 401 CRT terminal includes a 9-in. screen, an 80-column display and a 128-character, upper-and-lower case ASCII character set. Other features include format protection, security blank fields, automatic character repeat, windowing, scrolling, eight two-level function keys, a two-page memory, an addressable/readable cursor with optional blink and full cursor control keys. **Informer, Inc.,** Los Angeles, **Circle No 187**

Scanner/laser recorder writes 1500 lines per min.

The model X2430 digital argon laser recorder/scanner writes as many as 1500 lines of data per min., or 25 lines per sec. Maximum resolution is 25 microns, with as many as 64 gray levels. The system handles reflective material in either black-and-white or color, line-art or continuous tone, and includes 256-step gray-scale modulation with 64-step repeatability. Price is less than $200,000. **Optronics International, Inc.,** Chelmsford, Mass. **Circle No 188**

New Products

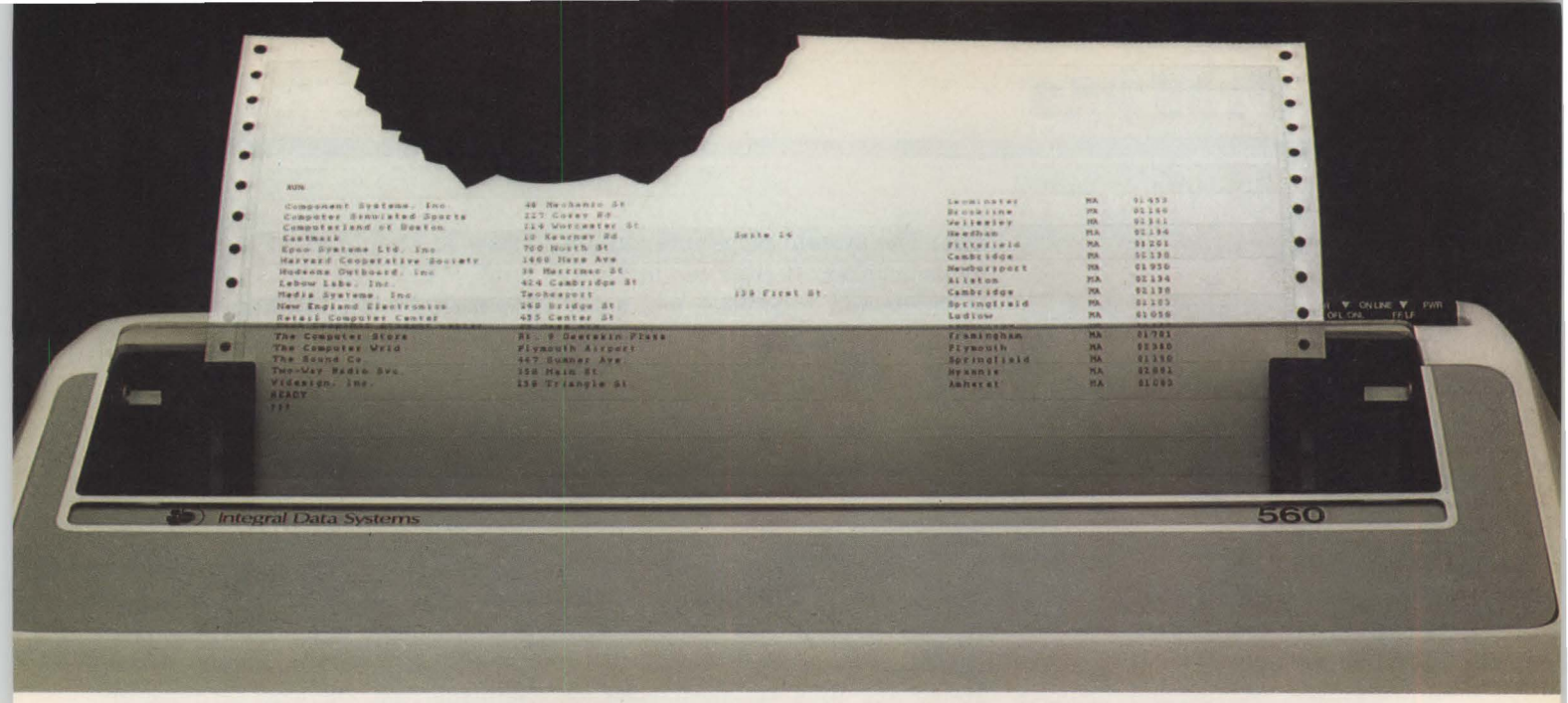
interactive terminals

Trendcom announces desk-top teleprinters

This line of desk-top teleprinters uses telephone lines to communicate with more than 1 million TWX and Telex terminals, direct-dial terminals and computer systems. The teleprinters, which are offered with 40 or 80 characters per line, transmit messages as they are typed, or prepare and edit them off-line and transmit them via a push button. The unit includes a 4000-character memory and auto-answer and answer-back features. Single-unit prices are $595 and $695 for the receive-only 40- and 80-cpl versions, respectively. **Trendcom,** Sunnyvale, Calif. **Circle No 189**

HDS offers two display terminals

This series of 132-column display terminals is available in two models—128-character upper/lower case ASCII (concept 108) and APL/ASCII with full, true overstrike (concept APL8). Features include a 132-column display that uses a 5 × 9 dot matrix within a 7 × 10 dot array, or an 80-column display that uses a character generator with a 7 × 11 dot matrix within a 10 × 12 dot array; eight pages of display memory; and a create-screen function. The 108 sells for $1440, and the APL8 sells for $1575. **Human Designed Systems, Inc.,** Philadelphia, Pa. **Circle No 190**



Meet the Tiger with a bigger bite.

Introducing the remarkable 132-column Paper Tiger™ 560. The first full-width matrix printer to give you fully formed characters for a low $1695.*

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red column" head manufactured by Integr
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Paper Tiger 560 Print Sample

as spool and cassette ribbons, separate heavy-duty stepper motors to drive the print head and advance the paper, plus true tractor feed.

And famous Paper Tiger performance comes with every new 560. Like fixed or proportionately spaced text, programmable tabbing and business forms control, automatic text justification, print formats to 220 columns, parallel and serial interfaces, self-diagnostics, and more. All inside the most compact printer of its kind.

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Integral Data Systems, Inc.

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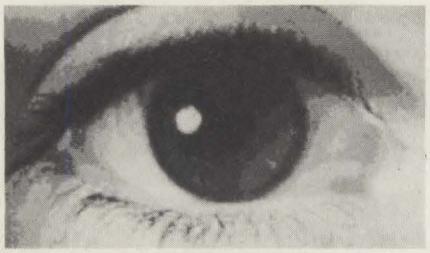
graphics



Graphics generator digitizes live pictures

The model 2000 graphics generator digitizes, stores and displays live video pictures in 1/60 sec. Features include high-speed random pixel access, block fill, vector generation, multi-font character generation and DMA block transfers. Flicker-free displays are presented on standard video monitors in color, gray-scale or black-and-white format. The system plugs into any DG minicomputer. It is priced at $9400 in single-unit quantities and $4900 in 100-unit quantities. **Octek Inc.,** Boston, Mass. **Circle No 191**

Color graphics memory interfaces with LSI-11

The model VCG-Q color graphics add-in memory for the DEC LSI-11/2 or 11/23 is packaged on a dual-height module that plugs into the Q-BUS. The unit comprises all hardware necessary to connect the 16-bit μcs to a standard color or monochrome CRT monitor and produce a color or gray-scale graphics impage. The image can be accessed one raster line at a time through data registers located in the I/O page, or the entire frame buffer can be addressed directly as 64K words of memory. Price is $2200 in quantities of one to four, with OEM discounts available. **Peritek Corp.,** Oakland, Calif. **Circle No 192**

Printer/plotters make hard copies from terminals

The model 240 hard-copy controller enables hard-copy production from as many as four Tektronix 4025 refresh-raster computer display terminals. The controller generates graphics and text data, and samples a 640 × 462 area. Copy requests can be made from the 4025 terminal or via the controller's copy-request switch. A selectable priority system enables the printer/plotter to be switched from computer-directed printing or plotting to hard-copy output. The model 240 is priced at $2500. **Versatec,** Santa Clara, Calif. **Circle No 193**

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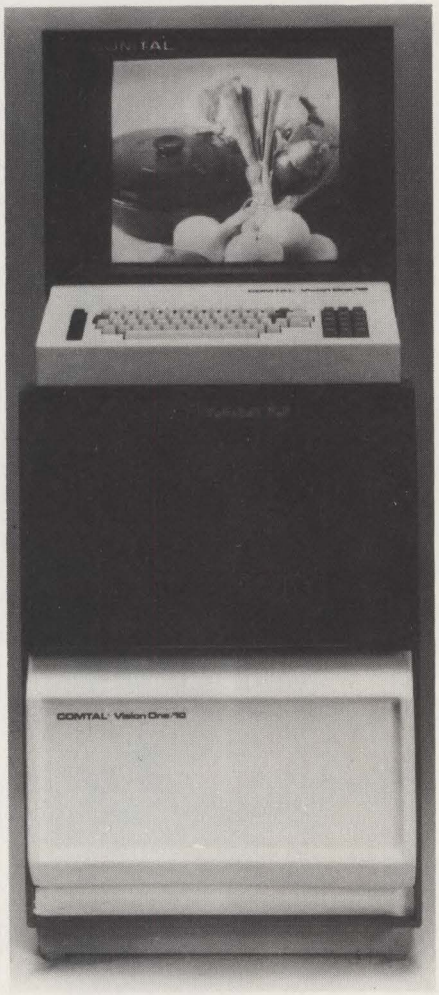
CIRCLE NO. 116 ON INQUIRY CARD

New Products

graphics



Comtal unveils image system

The Vision One/10 interactive stand-alone image-processing system operates in real-time 1/30 sec. and offers memory with a capacity of as many as four 512 × 512 8-bit images and as many as four 512 × 512 1-bit graphic planes, an LSI 11/02 computer controller with PROM operating system and RAM space for user code. Other features include an in-line, real-time pipeline processor for brightness enhancement and color modification, a pseudo-color processor, a zoom capability, a software-operated histogram and a software bilinear zoom. Price is less than $55,000. **Comtal,** Altadena, Calif.

Circle No 194

Hitachi announces color monitor

The model HM-1719 color monitor for computer graphic displays features a 19-in. convergence-free screen actuated by a proprietary in-line gun. It provides a dot shadow mask of 0.47 pitch for clarity, 512 × 512 pixels, built-in high-voltage regulator, 25-MHz video bandwidth and long-persistence phosphor. Price is $1600 in quantities of 100 or more. **Hitachi America, Ltd.,** San Francisco, Calif. **Circle No 195**

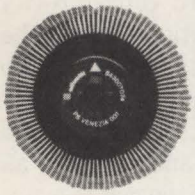
Comtal introduces video input processor

This digital video input processor acquires and digitizes images from film. It compensates for variations and noise that are normally introduced during image acquisition by integrating each pixel to maximize its own signal-to-noise ratio. The DVIP captures 512 × 512 pixels. Images can be transferred to a digital image-processing system or host computer at 10M bytes per sec. Other features include a video camera, a light table with camera stand, the CRT monitor and system electronics. **Comtal,** Altadena, Calif. **Circle No 196**

HP graphics display system is suited for CAD/CAM

The HP 1351S graphics display for CAD/CAM applications consists of a graphics generator and a 14-in. directed-beam electrostatic display. The unit addresses and displays 1020 × 1020 points on an X-Y CRT display using both alphanumeric and vector presentations. The system also has a 32K-byte memory that can be divided into 64 files for selective erase, viewing, flashing and three levels of highlighting. Prices, including the graphics generator, X-Y display and connecting cable, start at $10,450. **Hewlett-Packard Co.,** Palo Alto, Calif. **Circle No 197**

With OPE behind the wheel, you've got a choice of speeds.

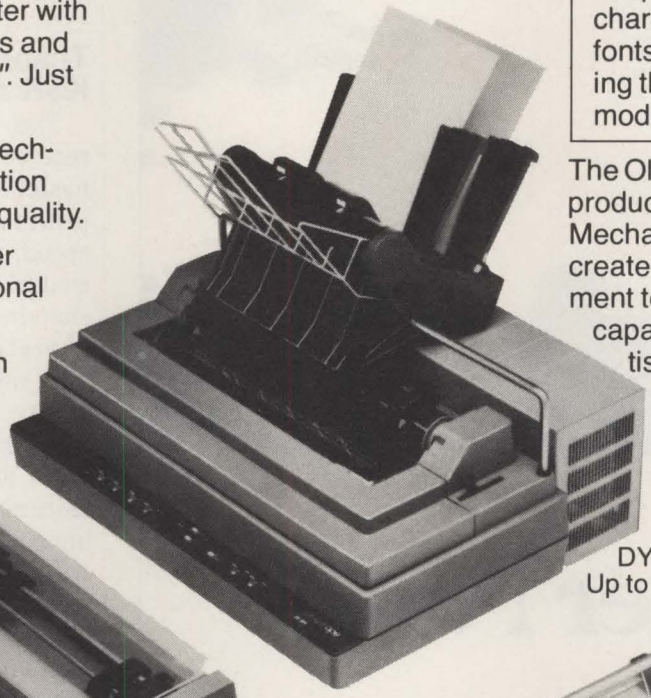


Olivetti Peripheral Equipment offers the OEM market a selection of Daisy Wheel Printers: There's the DY 211, a 20 cps printer for low-end applications; the DY 311, with 34 cps for mid-range applications; and for high performance, the DY 811, a 65 to 80 cps printer with high throughput capabilities and vertical tabulation to 1/264". Just look at what they feature:

- A hammer positioning mechanism which reduces vibration and ensures the best print quality.
- Four selectable character pitches, including proportional spacing.
- Bidirectional printing with shortest path seeking.
- Paper handling up to 17 or 17¼ inches wide.
- Low-cost automatic sheet feeders and adjustable forms tractors.
- A wide choice of easily changed dual-plastic proprietary design daisy wheels and ribbon cartridges.
- High-speed multimode horizontal tabulation.
- Industry standard interfaces.

For mixed application environments, we offer the DM80/180 dual-speed/dual-definition dot matrix printer; for business applications, a document can be printed at 180 cps with an 8 × 7 matrix; for word processing applications, you can use the correspondence quality 16 × 32 matrix at 80 cps. It will provide you with five character pitches, 8 standard fonts and the option of expanding the memory to accommodate your own fonts.

The Olivetti Group has been mass-producing Daisy Wheel Printing Mechanisms since 1975, and has created Olivetti Peripheral Equipment to offer its mass-production capabilities, reliability and expertise to the OEM market. Write or call OPE for more information on our printers or other high-performance products.



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Up to 80 cps

DY 311
34 cps

DY 211
20 cps

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CIRCLE NO. 118 ON INQUIRY CARD

printers

Data impact printer offers six character sizes

The model 85 data impact printer has a 7 × 7 or 14 × 7 dot matrix, six character sizes, 100-cps bidirectional print speed, selectable tractor or friction paper feed and "finger-clean" ribbon-cartridge loading. It has variable line density and continuous form-length controls. The unit is priced at $625 in 100-unit quantities. **DIP, Inc.,** Boston, Mass. **Circle No 198**

Printer offers screen-to-hard-copy printing

The model 1300 screen printer, which attaches to a Memorex 1377 display station terminal, allows users to obtain hard copy directly from the display station without the intervention of the CPU or the terminal controller. The printer accommodates cut sheets, fan-fold or rolled paper and prints an 80-character line at 100 cps in a 7 × 7 dot matrix. Price is $1400. **Memorex Corp.,** Santa Clara, Calif. **Circle No 199**

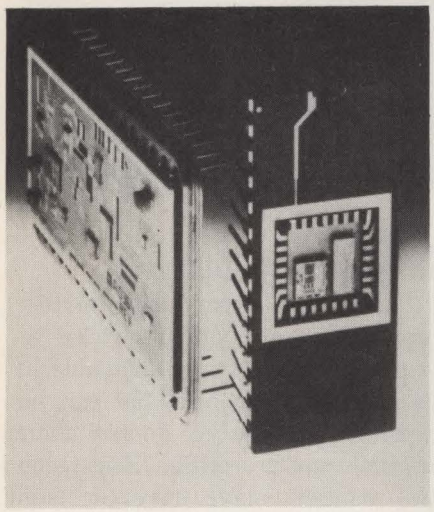
TI announces KSR and RO terminals

The model 840 keyboard send-receive (KSR) data terminal and the model 840 receive-only (RO) impact printing terminals include 75-cps speed, a full ASCII character set, 33 control-character print symbols, a snap-in ribbon cartridge and an operator-programmable answer-back memory able to store as many as 32 characters in nonvolatile memory. Standard transmission rates are 110 to 600 baud. Other features include a 9 × 7 dot-matrix impact print head and a 132-column-wide friction-feed carriage. The 840 KSR sells for $1345, and the 840 RO sells for $1195, in single-unit quantities. **Texas Instruments Inc.,** Dallas, Texas. **Circle No 200**

Westrex announces dot-matrix printer

The model 880 80-column dot-matrix journal printer with a seven-needle print head can output as many as 96 characters per line at 12 characters per in. The unit accommodates three-ply paper, top loaded, as much as 9.6 in. wide. It has standard and graphic feed and an 8-million-character ink ribbon. Price is $290 in single-unit quantities. **Westrex OEM Products,** West Caldwell, N.J. **Circle No 201**

data acquisition



16-channel system uses single-ended signals

The AD364 16-channel, 12-bit IC data-acquisition system enables users to mix single-ended and differential signals. Features include a differential amplifier, a sample-and-hold circuit, a latched channel address register, an input mode control, control logic, a 12-bit A/D converter and a 20-KHz throughput rate. The AD364 is packaged in two hermetic DIPs. Prices start at $139.50 in 100-unit quantities. **Analog Devices Semiconductor,** Wilmington, Mass.

Circle No 202

D/A converter features 64 output channels

The model SB-64 S100-compatible D/A converter board has 64 output channels. Each output drives a 1K-ohm load, and has ±.4 percent absolute accuracy from 0V to 10.625V. Address decoding allows memory-mapped I/O to any 256-byte sector in the 65K. Options include 10 digital outputs, fast 12-bit DAC with 3-μsec. settling time, a ±15V tracking regulator with 60-mA output and 24-bit address decoding. The SB-64 sells for $514. **Digital Multi-Media Control,** Eugene, Ore.

Circle No 203

Data spooler intended for PDP-11

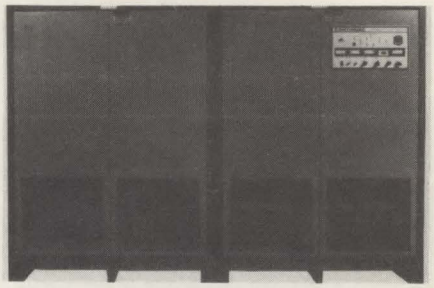
This data spooler for the vendor's MIP-3/A input processor spools data continuously onto a PDP-11 system disk at 100,000 samples per sec. An on-board, bit-sliced μc switches between buffers in the dual-ported memory. Data enters the spooler on 16 analog data lines connected to a BNC panel. Price is $7320, including software on magnetic tape, documentation and a one-year warranty. **Computer Design & Applications, Inc.,** Newton, Mass.

Circle No 204

power supplies

Printer power supply has overvoltage protection

The NP630 power supply for the Diablo model 630 line printer features linear regulation with better than 50 percent efficiency. The unit features built-in overvoltage protection on a +5V output, with all outputs current limited and short circuit protected. Price is $182 for quantities of 100 to 249, higher quantity discounts available. **National Power Technology,** Anaheim, Calif. **Circle No 205**



UPS allows easy expandability

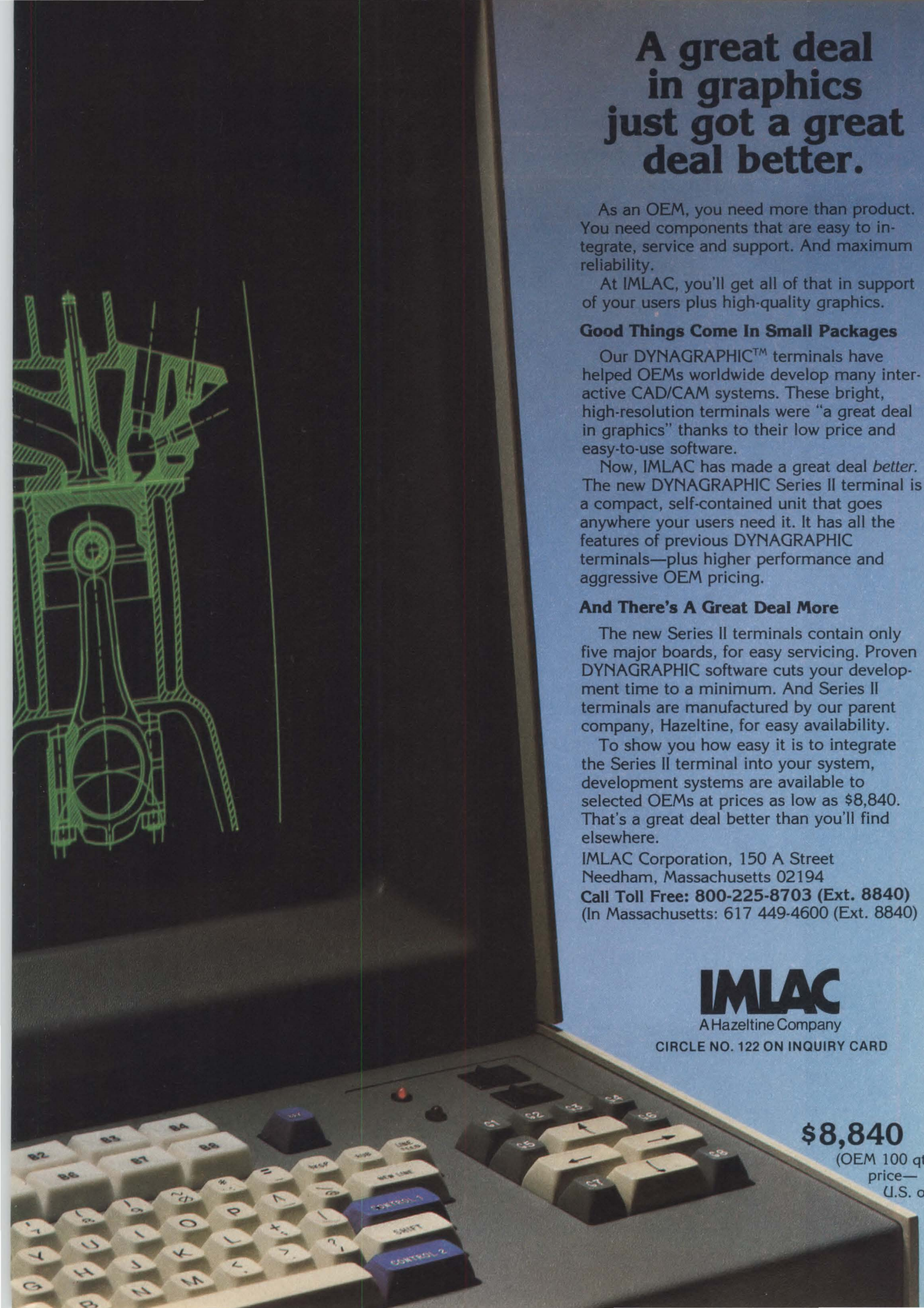
This line of expandable uninterruptible power systems, rated at 12.5 kW to 60 kW, are available in 50- and 60-Hz models and can be expanded on-site to double their original power rating. Expansion kits contain slave inverter and rectifier cabinets that are controlled by existing UPS units. **Lortec Power Systems, Inc.,** N. Ridgefield, Ohio. **Circle No 206**

Todd announces 150W open-frame switcher

The MOS series open-frame switching power supplies, available in four 150W models, include current limit on all outputs. Each model also features a single-stage regulator scheme that enables 75 percent minimum efficiency and elimination of 60 Hz magnetics, thus preventing interaction with CRT systems and other flux-sensitive devices. Prices range from $198 to $215 in 100-unit and larger quantities. **Todd Products Corp.,** Brentwood, N.Y. **Circle No 207**

UPS provides power for 120V load

The model E UPS provides power for any single-phase, 120 V load with a 10.0-K VA requirement. The system features a solid-state switch that provides transfer to a standby line in the event of an inverter or charger failure. The system allows sensitive equipment to function without interruption. **Instrumentation and Control Systems, Inc.,** Addison, Ill. **Circle No 208**



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Our DYNAGRAPHIC™ terminals have helped OEMs worldwide develop many interactive CAD/CAM systems. These bright, high-resolution terminals were "a great deal in graphics" thanks to their low price and easy-to-use software.

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CIRCLE NO. 122 ON INQUIRY CARD

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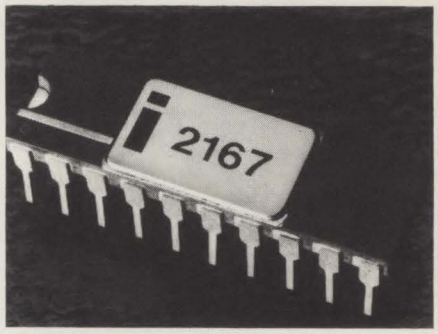
memories

Memory module has 16K static RAM

The CM-92 high-speed static RAM system incorporates the 2167 static RAM chip and provides 100- and 140-nsec. cycle times and 70- and 95-nsec. access times. Maximum capacity is 128K words, 22 bits unidirectional and 64K words, 44 bits bidirectional. A typical system, including power supply, sells for $28,395. **Intel Corp.**, Santa Clara, Calif. **Circle No 209**



Intel debuts 16K × 1 static RAM

The 2167 16K × 1 high-speed static RAM is said to provide four times the density of available static RAMs. A redundant design enables the chip to contain three memory rows not needed for basic functions. The device uses the vendor's double poly HMOS II process technology. Maximum access time is 55 nsec., maximum active current is 125 mA, and maximum standby current is 40 mA. Price is $68.55 in 100-unit quantities. **Intel Corp.**, Santa Clara, Calif. **Circle No 210**

RAM card provides byte swapping

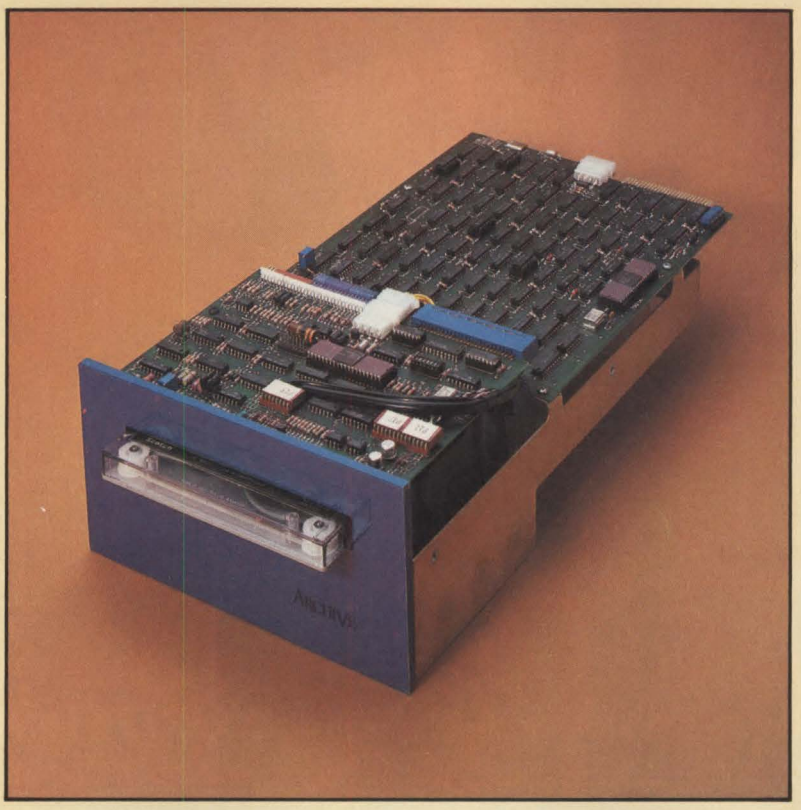
The ZX-028 fully populated, Multibus-compatible 128K RAM card comes with memory chips soldered directly to the board. Features include byte swapping and a 450-nsec. access time. Price is $1280 in single-unit quantities. **Zendex Corp.**, Dublin, Calif.

Circle No 211

AMD offers 2K × 4 bipolar PROM

The IMOX II family of 2048- × 4-bit bipolar PROMs have maximum access times of 35 to 60 nsec. The units employ the vendor's proprietary platinum-silicide fuse, which results in a 97 percent programming yield. All units require a single +5V supply and come in an 18-pin 300-mil thin DIP. Prices start at $23.35 in 100-unit quantities. **Advanced Micro Devices Inc.**, Sunnyvale, Calif. **Circle No 212**

What Makes Archive Streamers The Intelligent Backup Choice?



For one thing, they're the only intelligent ¼" streaming tape drives available today.

But there are plenty of other smart reasons for choosing Archive Sidewinder streamers over other types of Winchester backup.

Such as greater capacity and faster transfer rates. You can store up to 20 megabytes of formatted data on one standard cartridge in just over 4 minutes.

That's about 5 times as fast (and one third the media cost) as using 8" floppy disks, for example.

And speaking of floppy disks, the Sidewinder just happens to be the same package size as an 8" floppy.

The intelligent Sidewinder handles tape formatting, error and file mark processing, tape positioning, automatic read-after-write error correction, block buffering and read retries without host intervention.

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The new Dual-Mode 200 brings speed and uncompromising print quality to business and professional applications.

Financial statements, inventory reports, labels and more are printed at data processing speeds from 165 cps to 250 cps.

Fully adjustable tractors and a friction feed platen provide precise forms handling for pinfeed and single sheet paper.

Complete "Dot Control" graphics is standard with resolution to 120 x 144 dots per inch.

Interfacing is easy with both E.I.A. RS-232C serial and an ASCII parallel port.

LETTER QUALITY WORD PROCESSING

The Dual-Mode 200 also features letter perfect print you will be proud to use for business letters and reports. Letter Mode speeds range from 42 cps to 60 cps.

The standard Titan 10 pitch font is complemented by an array of optional fonts including Elite 12 pitch, italics, proportionally spaced, OCR-A, scientific and foreign character sets.

Up to 12 font selections may be stored in the printer and interchanged while printing.

The Dual-Mode 200 accepts standard daisywheel print commands for word processing system compatibility.

It's the perfect solution for the two printer problem.

The Dual-Mode 200 Printer for the one printer office.

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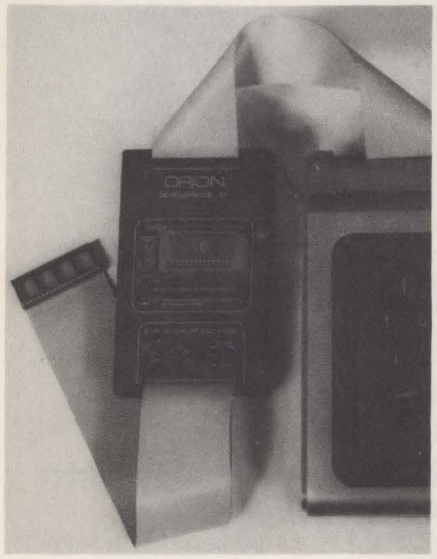


Development system upgrades TRS-80

The Developmate 81 upgrades the TRS-80 personal computer to a full development system by adding Z80 in-circuit-emulation and EPROM/EEPROM programming capability. The system, which plugs into the expansion connector of a TRS-80, includes a universal personality module that handles 2758, 2508, 2716, 2516 and 2532 EPROMs and 2816 and 48016 EEPROMs. The system, including programming software, a power supply, emulation cable and TRS-80 cable, sells for $329. **Orion Instruments,** Woodside, Calif. **Circle No 213**

Prototyping card is Multibus-compatible

The ZX-905 prototyping board includes layout pads printed with the board top on one side and the bottom on the other, enabling an engineer to pass his design layout on to a technician for wire wrapping. Compatible with the Multibus card cage, the ZX-905 has five edge connectors and room for 84 14-pin IC packs. Price is $118 in single-unit quantities. **Zendex Corp.,** Dublin, Calif. **Circle No 214**

Card cage accommodates four μc systems

The CCK-80 card cages mount standard 6¾- × 12-in. Series 80 boards, 5.3- × 10-in. S100 cards and 6- × 9¾-in. boards used in Motorola's EXORciser and Micromodule and Rockwell AIM65 and expansion systems. The card guides and structural members are positioned for Series 80 cards on 0.6-in. centers, in a horizontal configuration. Price is $79 in single-unit quantities. **Vector Electronic Co., Inc.,** Sylmar, Calif. **Circle No 215**

Wintek announces EROM programmer

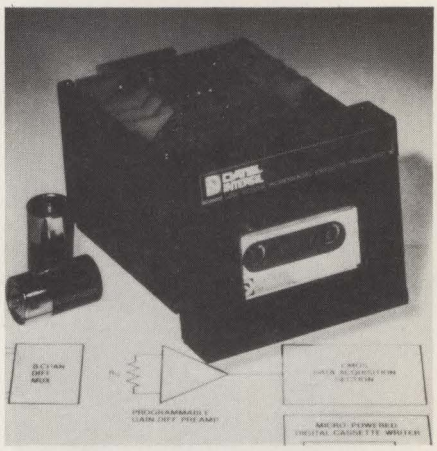
The ROMMR universal EROM programmer for 2708, 2758, 2516, 2716, 2532, 2732, 2564, 2764 and 68764 EROMs is available as an option to the Sprint 68 μc development system. It allows programs developed in 6800 assembly language, BASIC, C, PL/W, Pascal and FORTRAN to be burned into EROM. Price is $299, plus $29 for each personality module. **Wintek Corp.,** Lafayette, Ind. **Circle No 216**

Motorola Microsystems unveils bus state analyzer

The real-time VERSAbus state analyzer for use with μps consists of two EXORmacs-resident modules. The master module contains hardware-controlled software and I/O ports. The personality module interfaces to selected signals. Features include 79 channels × 128 states of trace memory, tracing and comparison of traces with previous traces, a seven-step qualifier sequence for trigger, restart trigger qualifier sequence on a given address state and trigger pulse output. Price is $3600 in quantities of one to five. **Motorola Semiconductor Products Inc.,** Phoenix, Ariz. **Circle No 217**

New Products

disk/tape



Pollution monitor includes scan-start clock

The LPS-16 cassette data logger, intended for long-term applications, such as pollution monitoring and control, records data for months using +12v flashlight batteries. The unit achieves a 120,000 16-bit sample-per-cassette capacity. Other features include an automatic scan-start clock, 16 high-level single-ended analog input channels, recording of as many as five samples per sec. and an optional instrumentation amplifier. The unit sells for $1360, plus $100 for the scan-start clock and $165 for the pre-amplifier option. **Datel-Intersil,** Mansfield, Mass. **Circle No 218**

Magnetic-tape peripheral is HP-85-compatible

The model GPIB-3000 magnetic-tape peripheral, which is compatible with Hewlett-Packard 85 computers, reads and writes ANSI, ECMA and ISO-compatible ¼-in. digital cartridge. A built-in μp controller supports three slave drives via a dual buffer front-end. Average transfer rate between the HP-85 and the cartridge drive is approximately 6K bytes per sec. Prices start at $4080 for a single-drive subsystem and $5580 for a dual-drive version. **Innovative Data Technology,** San Diego, Calif. **Circle No 219**

Micropolis offers mass-storage subsystems

The Metafloppy series of double-track 5¼-in. minifloppy-drive subsystems and the Microdisk 8-in. rigid-Winchester-disk subsystems provide formatted capacities of 315K to 2.4K and 6.2M to 31.2M bytes, respectively. The Metafloppy subsystem series includes a power supply, a desk-top case, an S-100-, 8080- or Z80-compatible controller and a disk-based operating system with BASIC language. Prices start at $751. The Microdisk subsystem series includes the OSM-10 multiuser operating system, an intelligent controller, an S-100 interface, a power supply and desk-top or rack packing. Prices start at $4929. **Micropolis Corp.**, Canoga Park, Calif. **Circle No 220**

Olivetti introduces 5¼-in. hard disks

The three-model HD 500 series 5¼-in. fixed-disk drives have unformatted storage capacities of 6.38M to 11.7M bytes, 254- to 600-tpi track density and 7690- to 8500-bpi bit densities. Average access time is 170-, 35- or 21-msec. depending on model. Prices range from $700 to $1200 in OEM quantities. **Olivetti Peripheral Equipment S.P.A**, Elmsford, N.Y. **Circle No 221**

Winchester package has 10.8M-byte drive

The Smart Start Winchester-disk package contains a Diskos 1070 8-in. Winchester-disk drive with a capacity of 10.8M bytes, an interface that permits connection of as many as four drives, a disk-drive terminator and an interface manual. The Winchester has a 53-msec. average head-positioning time and 0.9M-byte-per-sec. transfer rate. The package sells for $1995; an optional power supply sells for $295. **Priam Corp.**, San Jose, Calif. **Circle No 222**

Burroughs introduces mini-cartridge drive

The TM 110 mini-cartridge drive transport for DC100A-type data cartridges can be used in applications such as paper tape replacement, program loading, data collection, data entry, volatile memory backup, data logging and data file storage. The unit, with a 3M DC100A, has a 1.34M-bit unformatted capacity or 120K bytes formatted and an 8000-bps transfer rate. Price is $160 in OEM quantities. **Burroughs Corp.**, Detroit, Mich. **Circle No 223**

Fixed-head disk replaces Honeywell H 316 computers

The model 316 nonvolatile disk replacement for Honeywell H 316 computers is available in 512K- and 1M-byte capacities. The unit operates through direct multiplex control or as a program I/O device. Other features include write lockout with 16 switches and indicators and the ability to protect a group of tracks from being written. The 512K-byte version is priced at $11,000, and the 1M-byte version sells for $18,000, with OEM discounts available. **Ampex Corp.**, El Segundo, Calif. **Circle No 224**

Tape system offers 6250-bpi density

The model 3000 6250-bpi tape system for HP 3000 users incorporates group coded recording (GCR) and a 125-ips transport speed. Other features include ANSI and IBM compatibility, a radial interface for as many as eight drives per controller, plug- and program-compatibility with HP 3000 series II and III, auto thread/loading for open reel and cartridge and switch-selectable dual or triple density (800, 1600 or 6250 bpi). Prices range from $34,000 to $52,000. **Qualex Technology, Inc.**, Westlake Village, Calif. **Circle No 225**

Tape transport has 1M-byte capacity

The double-track model 453 digital tape transport automatically switches between sides without operator intervention, and performs read-after-write checking. The unit features 1M-byte storage capacity, ANSI/ECMA-compatibility and an optional drop-in cassette loader that automatically aligns the cassette. Price is $339 in single-unit quantities. **MFE Corp.**, Salem, N.H. **Circle No 226**

DG announces streaming-tape drives

The model 6123 and 6125 provide backup for microNova, Nova and Eclipse computer systems. The drives have a 1600-bpi recording density and enable users to back a 25M-byte disk on an 8½-in. reel of tape. The model 6123 (for microNova computers) sells for $6600; the model 6125 for Nova and Eclipse computers sells for $6800, with quantity and OEM discounts available. **Data General Corp.**, Westboro, Mass. **Circle No 227**

Zenith introduces 2M-byte floppy

The Z-47 8-in. dual-sided, dual-density floppy-disk system, designed for use with the vendor's Z-89 μc system, provides as much as 2.5M bytes of storage, when used with the μc's built-in 5¼-in. disk drive. Other features include 1951-msec. average access time, and CP/M and HDOS operating systems. The Z-47 sells for $3695. **Zenith Data Systems Corp.**, Glenview, Ill. **Circle No 228**

Time manager runs on IBM System 34

The Job Time Manager allows a data-processing manager or a system operator to control the time when any job is to be run. An OCL-like statement is entered to prevent any job from being run within or outside of a specified time. The utility is intended for installations at which nonessential jobs must be run at off-hours to improve response time of crucial jobs. Price is $50, including diskette and mailing. **Info III,** Woodland Hills, Calif. **Circle No 281**

Screen editor runs on Datapoint systems

This CRT screen editor assists in development of display formats under the Datashare time-sharing system on a Datapoint minicomputer. The user defines or changes the format directly on a CRT without programming. CRT screen editor generates a hard-copy screen map showing the description, length and cursor position of each field on the screen and an INCLUDE file containing the display logic. Price is $650. **Trace Information Services,** King of Prussia, Pa.

Circle No 282

AIS announces PL/I for PDP-11

Programs can be developed using the AIS-PL/I compiler on a DEC processor under RSTS/E, RSX-11M, RSX-11D, IAS or VAX/VMS, and then executed on a PDP-11 running under RT-11. The AIS-PL/1 language, a subset of ANSI standard X3.1976, is suited for applications with file processing and nonnumeric data, such as text processing, data base systems, simulations, graphics and transaction processing. A single-machine run-time license sells for $1500. **Applied Information Systems,** Chapel Hill, N.C.

Circle No 283

Tektronix develops PLOT 50 software

PLOT 50 products use graphics created by the vendor's 4050 series desk-top computers. For example, plotting routines included in the statistics packages analyze and represent small-sample statistical data. New offerings in the PLOT 50 software library include graphing, drawing, document preparation, statistics, planning, management, and digitizing programs. Programs are sold separately for $800 to $4000. **Tektronix, Inc.,** Beaverton, Ore. **Circle No 284**

NOW YOU DON'T HAVE TO CHOOSE BETWEEN THE BEST PERFORMING 132-COLUMN DISPLAY TERMINAL AND THE BEST PRICED 132-COLUMN DISPLAY TERMINAL.

HDS MAKES THE CHOICE FOR YOU.

The choice is the concept 108, the newest display terminal from Human Designed Systems. And this one has the best of everything you always hoped for in a 132-column display terminal. Great price: $1230 in OEM quantity 75. Great features: □ switchable 80/132 column format (132 columns is provided without sacrificing high-resolution 80-column character display □ ASCII or APL/ASCII models □ four full pages of display memory standard (eight pages optional) □ non-volatile memory for permanent configuration storage □ windowing □ programmable function keys □ multiple user-selectable character sets □ I/O capability for networking between multiple communications lines □ large buffer for high-speed operation and buffer overflow control □ self test □ advanced text editing, data entry/retrieval and business graphics functionality □ ...and many more user/human designed features providing everything you need for optimum versatility and flexibility in applications development.

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THE 132-COLUMN CHOICE.

CIRCLE NO. 132 ON INQUIRY CARD

*OEM quantity 75

New Software

Info III offers System/34 job scheduler

SMARTQ, a time-dependent job scheduler program for the IBM System/34, allows a data-processing manager or system operator to control the time when any job is to be run, as many as four days in advance. The routine can be used in a procedure or through a HELP-like display. The price is $195, including diskette and mailing. **Info III,** Woodland Hills, Calif.

Circle No 285

Polling package supports POS terminal

AUTOPOLL/1, a retail POS data-collection package for IBM Series/1 and Honeywell Level 1 computers also works with NCR 2140 POS terminals. AUTOPOLL operates in mixed-vendor networks, interfacing with host computers that support communication. The package contains more than 80 routines, including three main tasks that can run concurrently. Support programs include a file and catalog system and a set of queueing routines. License fees start at $7000. **JEM Associates,** Herndon, Va. **Circle No 286**

Subsystems provide management, accounting

This menu-driven interactive management and accounting system for TI 990 computers is written in ANSI 74 COBOL. Subsystems include order processing (with invoicing, back-order control and sales analysis), inventory control (with a single-level bill of material capability), accounts receivable, accounts payable, general ledger and payroll. The system, with more than 250 COBOL programs, is licensed for $12,000, including source programs and all procedures. **Great Lakes Information Systems Ltd.,** Ann Arbor, Mich. **Circle No 287**

Organic introduces project management

MILESTONE, an interactive project management package is designed to operate on computers using the CP/M or USCD Pascal operating system. Input is defined as a series of distinct tasks, each with a duration, a level of manpower and a cost. Using critical path networking analysis techniques, the program lays out each job against a time scale showing which tasks are critical and which can be delayed. Price is $395. **Organic Software,** Livermore, Calif. **Circle No 288**

Alpha Micro introduces programming language

AlphaPascal release 2.0, a programming language for the Alpha Micro Business Computer that is integrated into a multi-user, multitasking, time-sharing Alpha micro operating system (AMOS), supports both sequential and random data files. It is also compatible with the AlphaBASIC programming language. AlphaPascal can separately compile and link Pascal modules to form one program. **Alpha Micro,** Irvine, Calif. **Circle No 289**

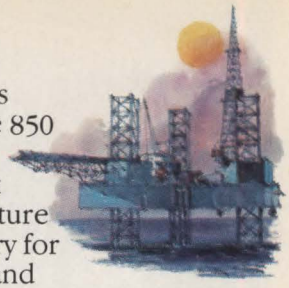
Plessey announces COBOL, DIBOL systems

PCS-100 and PCS-200 accommodate COBOL and DIBOL on the vendor's SYST-13V or DEC's LSI-11/23 systems. PCS-100 and PCS-200 feature TSX-Plus, a multi-terminal time-sharing operating system intended for business applications. PCS-100 includes a DIBOL-11-compatible language processor (DBL) with TSX-Plus and RTSORT capabilities; PCS-200 combines COBOL, TSX-PLUS and RTSORT. PCS-200 sells for $3358. **Plessey Peripheral Systems,** Irvine, Calif. **Circle No 290**

Introducing the most powerful minicomputer ever.

The new Prime 850 multi-stream processor is the most powerful mini system ever made for multi-user environments. It sets a new standard of technological leadership for our family of high performance 32-bit systems.

The Prime 850 has ultra high density MOS memory that stores 64K on a single chip. This new system supports up to 128 interactive user terminals for outstanding cost effectiveness. And it's right at home working simultaneously on such diverse applications as energy development, product analysis and design, office automation, and general business computing.



Like all 50 Series systems, the Prime 850 combines power with ease of use. It has 32-bit architecture and virtual memory for speed, efficiency, and economy. Industry standard software for convenient program development and data management. Networking that can extend your system across the office or around the world. And the PRIMOS® operating system that makes the entire 50 Series totally compatible.

If you'd like to sample the most powerful Prime system ever made, you can see it at the National Computer Conference show, May 4-7 in Chicago. If you miss the show, then contact the nearest Prime office, or write to Prime Park, MS 15-60, Natick, MA 01760. In Europe, write Prime Europe, 6 Lampton Road, Hounslow, Middlesex, TW3 1JL, England. Telephone: 01-570-8555.

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New Software

Package provides μc communications

ASCOM, running on computers such as the TRS-80 model II, Ohio Scientific, North Star and Cromemco, includes features to receive and transmit data files, various communication protocols, conversational mode, batch mode for automatic processing with command files and system-level commands for displaying directories and typing files to the screen or printer. In a typical application, ASCOM is used to log onto a timesharing system to retrieve stock exchange data for storage and analysis on a personal μc. Price is $125. **Westico, Inc.,** Norwalk, Conn. **Circle No 291**

OASIS version offers multi-user spooler

Version 5.5 of the OASIS operating system provides a printer to be shared among as many as 15 users, media-independent backup capabilities and keyed file access for Z80 μcs. The system enables 26 user-defined queues to be used to prioritize waiting jobs or to execute special forms, such as checks or invoices. Automatic reprints and multicopies or special alignment parameters can be specified. Retail price is $500 for single-user and $850 for multi-user versions. **Phase One Systems, Inc.** Oakland, Calif. **Circle No 292**

Financial accounting available for TI computers

The Software Fitness Program, written in RM/COBOL, runs on TI DS990 computers under the COS990 operating system. The package, designed for small- and medium-sized business users, includes sales order processing, accounts receivable with billing and sales analysis, accounts payable, general ledger, inventory, payroll and job cost applications. Features include open item and balance forward accounting; LIFO, FIFO and average cost methods of inventory valuation; financial statement report generator; revenue and expense accounting by job or phase; and interactive operation. **Open Systems, Inc.,** Minneapolis, Minn. **Circle No 293**

Tarbell introduces CP/M Database System

The Database System, running under the CP/M operating system and CBASIC, features variable-length fields with names that can be of any length and can include spaces. Other features include sequential or random files and an optional index file. The system also provides interactive programs, such as DBSETUP, which creates a file; DBENTRY for entering data; DBUPDATE for changing files; DBQUERY for accessing data; DBLABEL, which prints mailing labels; and DBLETTER for printing letters. The system sells for $50 including sources on disk. **Tarbell Electronics,** Carson, Calif. **Circle No 294**

HDP offers software tools for Pascal

Three Pascal tools are intended to simplify common I/O programming tasks. A Screen Handler incorporates error checking and a system for storing and changing user prompts without reprogramming. The Output Formatter, a report generator, includes tab functions, automatic page and line counter during program execution and a top-of-form routine. The Forms Generator includes the Output Formatter and software that allows a user to redesign reports without programming. Prices are: Screen Handler, $75; Output Formatter, $37.50; and Forms Generator, $49.50. **Health Data Products, Inc.,** Santa Barbara, Calif. **Circle No 295**

SOFTWARE BRIEFS

Mini-Micro Systems receives dozens of news releases each week about new software products that may not warrant the detail included in the foregoing New Software section. Nevertheless, we don't want to deny readers the opportunity to get more information about the latest software trends. Toward that end, we offer the following brief entries, compiled and edited by Malcolm L. Stiefel, contributing editor.

OPERATING SYSTEMS, COMPILERS AND DEVELOPMENT TOOLS. American Micro Products, Inc., Richardson, Texas, has a software development tool for TI 58 and 59 calculators. **Circle No 409...Intel Corp.,** Hillsboro, Ore., announces an executive program for its iAPX88 and iAPX86 μcs. **Circle No 410...Ralph Kenyon Jr.,** Virginia Beach, Va., has an Ada compiler for Polymorphic 8813 computers. **Circle No 411...Lobo Drives International,** Goleta, Calif., unveils an operating system for Radio Shack TRS-80 computers. **Circle No 412...Phase One Systems, Inc.,** Oakland, Calif., announces an operating system for North Star Horizon computers. **Circle No 413...Silverman Associates,** Oakland, Calif., has a new timesharing feature for North Star computers and disk operating systems. **Circle No 414...Whitesmiths, Ltd.,** New York, releases C language compilers for Motorola 68000 and DEC VAX-11 computers. **Circle No 415.**

UTILITIES. Aaxco Inc., West Palm Beach, Fla., introduces a performance-analysis package for DEC VAX-11s under VMS and for DEC PDP-11s under RSTS/E. **Circle No 416...Advanced Computational Technology, Inc.,** West Redding, Conn., announces an overlaying linker for μcs under CP/M and MP/M operating systems. **Circle No 417...Data General Corp.,** Westboro, Mass., has a business graphics display for its Eclipse MV/8000 and AOS and AOS/VS operating systems. **Circle No 418...Giordano Associates Inc.,** Midland Park, N.J., introduces a virtual memory-management package for DG Eclipses under AOS and DEC PDP-11s under UNIX, RSX-11 and RT-11. **Circle No 419...Hewlett-Packard Co.,** Palo Alto, Calif., unveils a statistics library for its 9800 desk-top computers. **Circle No 420...Muse Software,** Baltimore, announces an editing and plotting package for Apple computers. **Circle No 421.**

WORD PROCESSING AND DATA MANAGEMENT. LJK Enterprise Inc., St. Louis, has a word-processing package for the Atari 800. **Circle No 422...Charles Mann & Associates,** Yucca Valley, Calif., announces a text-processing package for Apple II and Apple II Plus computers. **Circle No 423...Micro Architect, Inc.,** Arlington, Mass., unveils a data base management package for μcs under CP/M. **Circle No 424...Muse Software,** Baltimore, introduces a form-letter generator for Apple II and Apple II Plus computers. **Circle No 425...Relational Software Inc.,** Menlo Park, Calif., has a data base management package for DEC PDP-11s under RSTS. **Circle No 426.**

New Literature

Data sheet features edgeboard connectors

The series M and series S selectively plated edgeboard connectors are detailed in a data sheet. The publication describes mounting styles, gold-plating of contact areas, center spacing and dual-contact positions. The bulletin also provides diagrams; electrical, material and mechanical specifications; dimensional data; and ordering information. **Stanford Applied Engineering,** Santa Clara, Calif.

Circle No 296

Bulletin covers micro-Winchester

The model 510 5¼-in. micro-Winchester-disk drive is detailed in a brochure. The illustrated publication describes the system's disk-storage density, access time, tape storage density, dump-restore time and size. The brochure also provides charts and tabulations and lists available backup. **Irwin International,** Ann Arbor, Mich.

Circle No 297

Pamphlet features PC connectors

A line of PC connectors is detailed in a catalog. The six-page, illustrated brochure describes the Erik series of selectively-plated PC connectors and a selective gold-plating process. The pamphlet also details contact centers and contact positions. **Viking Connectors, Inc.,** Chatsworth, Calif.

Circle No 298

Booklet features design instruments

A line of bench-top instruments, frequency counters, logic probes and solderless breadboards is detailed in a catalog. The publication examines the 4401 bench-top frequency standard, the CTB-2 bench-top case and the "Idea Box," an aid in designing prototype circuits. **Global Specialties Corp.,** New Haven, Conn. **Circle No 299**

Handbook describes power conversion

The electrical and mechanical parameters of AC-DC and DC-DC power supplies are detailed in a handbook. The 32-page booklet examines case, pin and socket configurations and specifications. The handbook also outlines modern power supply principles, practices and terminology. **Power General,** Canton, Mass. **Circle No 300**

Pamphlet details forms-handling equipment

A line of forms-handling equipment is detailed in a brochure. The six-page pamphlet covers decollators, imprinters, detachers and forms processors. The brochure also explains the vendor's equipment service agreement. **Moore Business Forms, Inc.,** Glenview, Ill.

Circle No 301

Bulletin details infrared analyzers

The models 864 and 865 non-dispersive infrared analyzers are detailed in a brochure. The 12-page pamphlet describes the systems' principles of operation, explosion-proof cases, liquid cells and precision recorders. The brochure also includes diagrams, photos, an outline and mounting dimensions, and lists options and applications. **Beckman Instruments, Inc.,** Fullerton, Calif.

Circle No 302

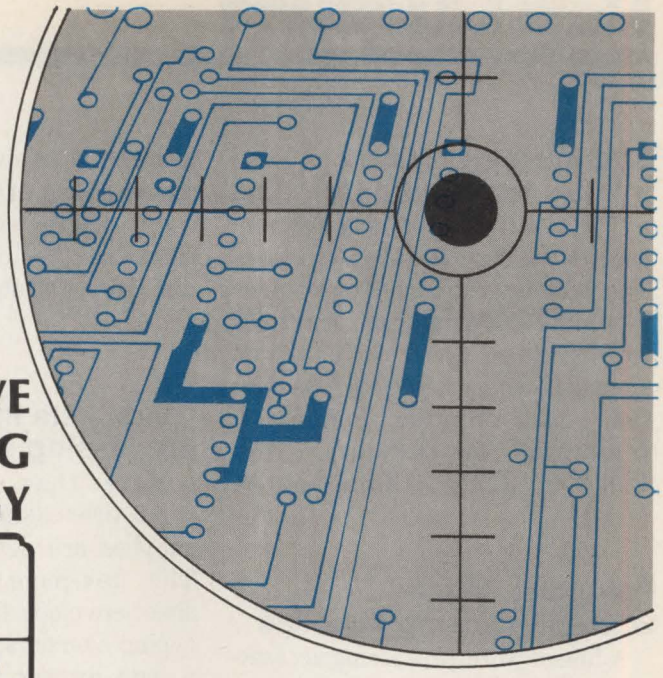
6-page pamphlet examines thermal print head

The LM152 thermal print head is described in a six-page pamphlet. The bulletin details print-performance verification and traceability and test information. The pamphlet also includes a functional diagram, an outline drawing and ordering information. **Gulton Industries, Inc.,** Metuchen, N.J.

Circle No 303

Booklet examines data-communication devices

A line of data-communication devices is described in a catalog. The 44-page publication covers protocol converters, interface converters, EIA and coaxial switches, modem eliminators, short-haul modems, current-loop devices, line- and modem-sharing units, answer-back units, line use measuring devices, cables, connectors and test sets. **Expandor Inc.,** Pittsburgh, Pa. **Circle No 304**



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New Literature

Literature describes inkless trend recorder

The model 8750 six-channel trend recorder is described in a brochure. The bulletin explains the system's recording and operation principles. The brochure also includes dimensional drawings, electrical specifications and ordering information. **Beckman Instruments, Inc.,** Fullerton, Calif. **Circle No 305**

Pamphlet details word-processing supplies

A line of word-processing accessories and supplies is detailed in a brochure. The six-page pamphlet describes mobile and stationary work stations, floor-model and tabletop sound enclosures, cables, connectors and carrying cases. The brochure also describes an energy-saver console, which connects four word-processing units, modems or printers to a work station. **Terminal Data Corp. of Maryland,** Rockville, Md.

Circle No 306

Thermal print head examined in pamphlet

The SM20100 20-column print head is described in an engineering bulletin. The six-page publication details the system's memory and drive circuitry, heat sink, thermistor preheater and connector-terminated cable. The bulletin contains diagrams, mechanical outline drawings and charts. **Gulton Industries, Inc.,** Metuchen, N.J. **Circle No 307**

Pamphlet details black-box switches

A line of switches is detailed in a 12-page brochure. The pamphlet describes EIA RS232 and coaxial switches, an ABC Centronics switch and an ABC IEEE-488 interface switch. The brochure covers ABC-25 and ABCDE-25 switches, an X switch for reversing EIA RS232 devices and a CRT-printer switch. The publication also provides prices. **Expandor, Inc.,** Pittsburgh, Pa.

Circle No 308

Guide lists information-processing supplies

More than 2200 data- and word-processing accessories and supplies are detailed in a catalog. The 104-page guide covers a sheet/envelope feeder; 96-character typing elements; a forms caddy and a data drawer for printouts, data cartridges or cassettes. The catalog contains compatibility and cross-reference charts and lists available furniture, continuous form stands, print wheels, thimbles and ribbons. **American Word Processing Co.,** Tarzana, Calif. **Circle No 309**

Catalog details peripheral devices

A line of terminals and hard-copy peripheral devices is described in a product guide. The 16-page publication includes alphanumeric, graphics and data-capture terminals; alphanumeric and graphics printers; graphics plotters; and graphics-input devices. The guide also provides a selection guide, photos and illustrations. **Hewlett-Packard Co.,** Palo Alto, Calif.

Circle No 310

Booklet describes timing relays

A series of pulse-counting time-delay relays is detailed in a 16-page catalog. The publication describes dual-function repeat-cycle timers and in-line timing modules. The catalog also includes a selection guide, a wiring diagram, dimensional drawings and photos and a glossary. **Amerace Corp.,** Union, N.J. **Circle No 311**

Pamphlet examines digital switching systems

The D1200 digital switching systems are described in a brochure. The pamphlet details private network automatic number identification, security/account code identification, automatic route selection, call-back queing, reverse signaling, tandem switching, detailed station message accounting and remote editor. **Harris Corp.,** Novato, Calif.

Circle No 312

Brochure covers data terminals

A line of computer hardware for sale, rent or lease is described in a catalog. The 24-page booklet details CRT terminals, word-processing printers, thermal and matrix printers, line printers, data-communications and terminal accessories and supplies. The catalog also lists options and financing rates. **Continental Resources, Inc.,** ford, Mass. **Circle No 313**

Bulletin describes μc system

The Q1 Microlite μc business system is detailed in a brochure. The four-page booklet describes the system's plasma display, software, keyboard, floppy-disk drives and integral printer. The publication also examines cost-effectiveness, power availability, compactness and expandability. **Q1 Corp.,** Hauppauge, N.Y. **Circle No 314**

Booklet lists information-processing products

A line of information-processing accessories and supplies is detailed in a 64-page catalog. The illustrated publication lists storage-retrieval and security systems for magnetic media, printout and microfiche, computer room furniture, cleaning supplies, interface cables, labels and DEC terminals. **Source System, Inc.,** Chicago, Ill. **Circle No 315**

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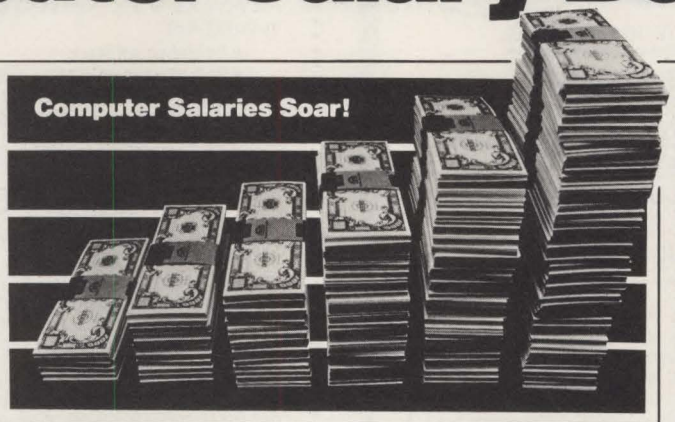

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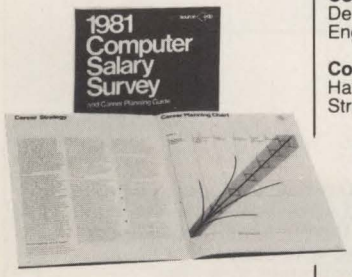

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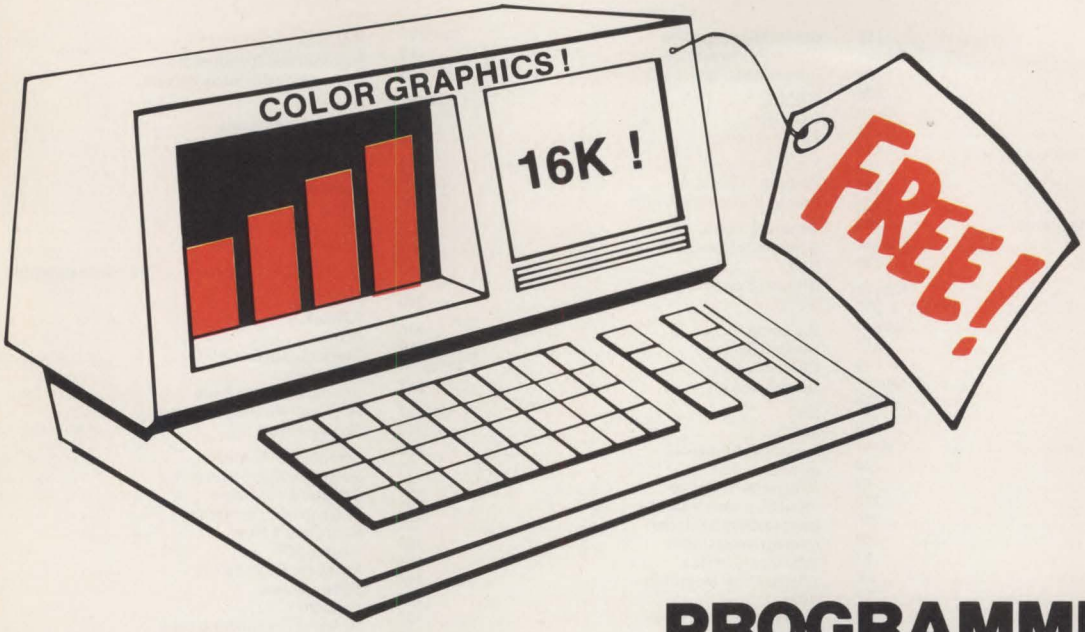

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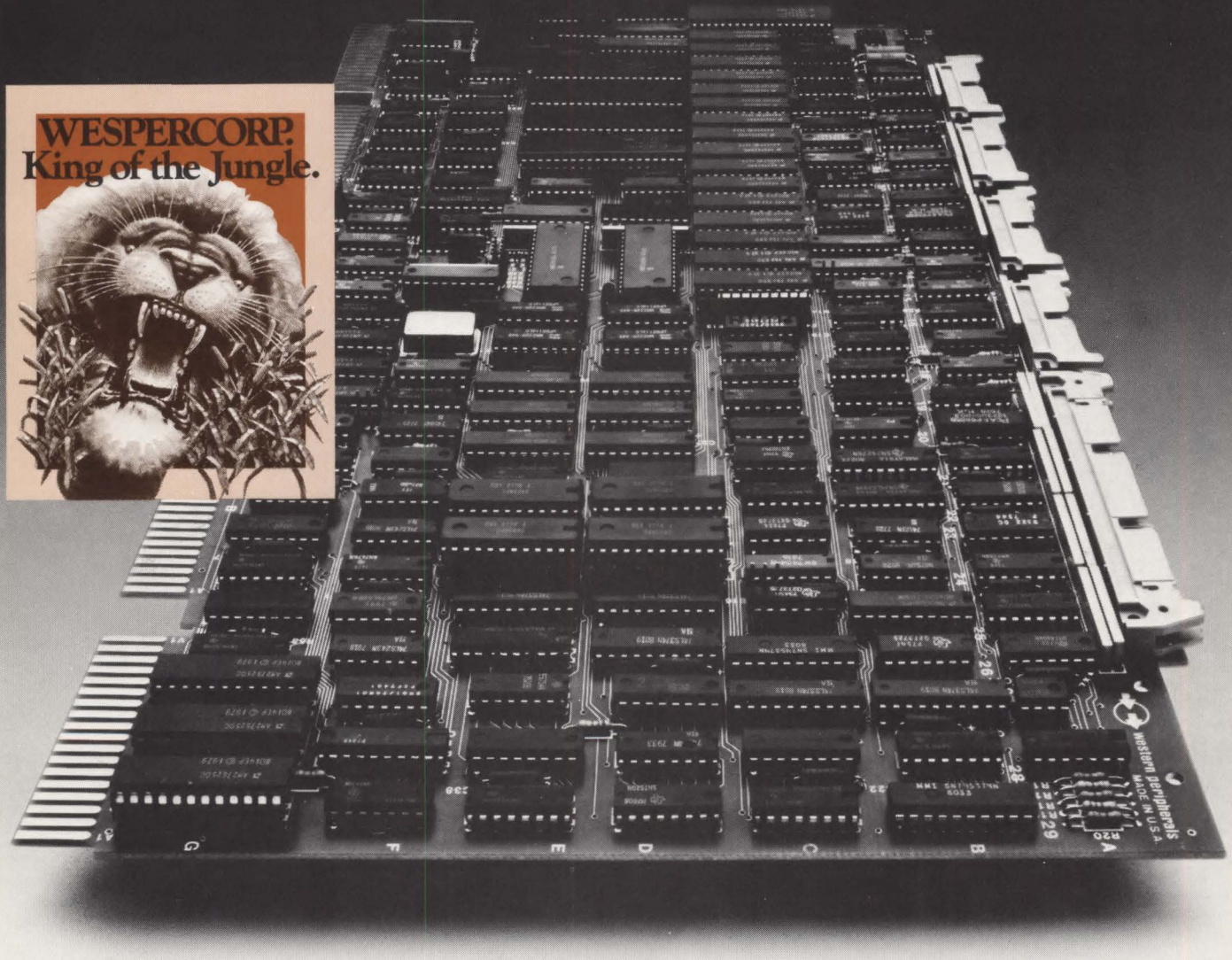

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