Mini-Micro Systems

A CAHNERS PUBLICATION

OCTOBER 1981

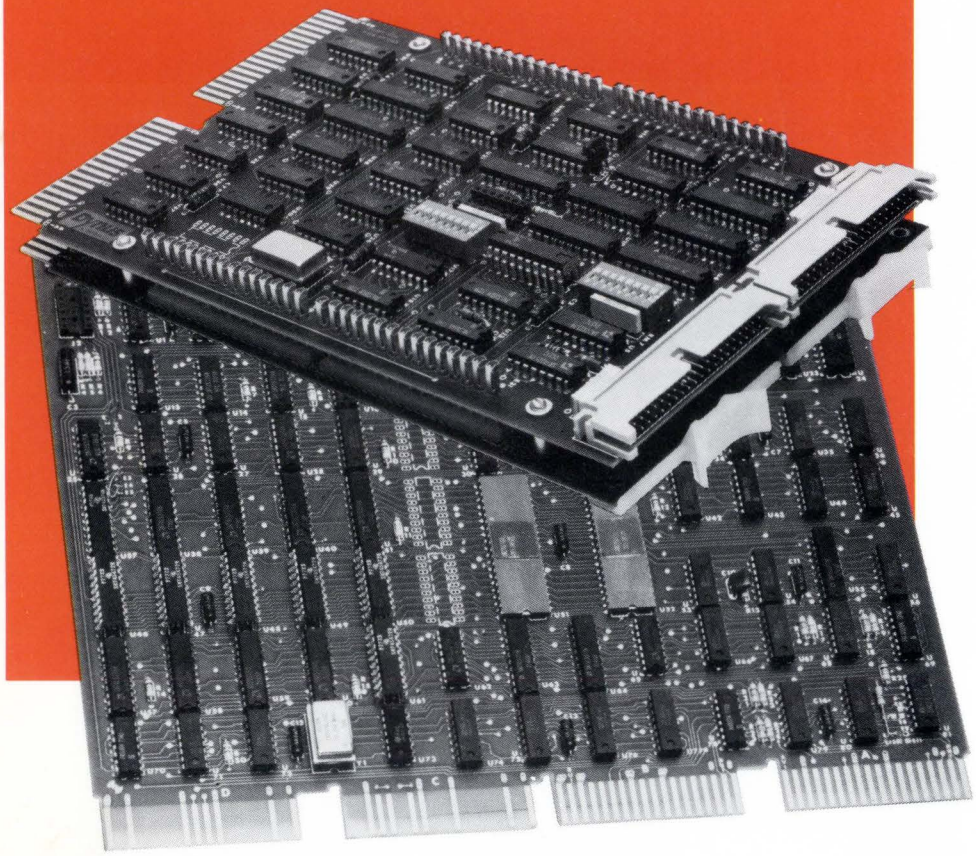
SOFTWARE:

An O.S. directory

A DBMS survey

CSSN's plug-in DBMS concept

DEC®-COMPATIBLE PERIPHERAL CONTROLLERS



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MINI	LSI-11	LSI-11	PDP-11	LSI-11	PDP-11	LSI-11	LSI-11	LSI-11	PDP-11	PDP-11	PDP-11
COMPATIBILITY	TM11/TU10			RK05		RM02	RK07	RP06	RM02	RK07	RP06

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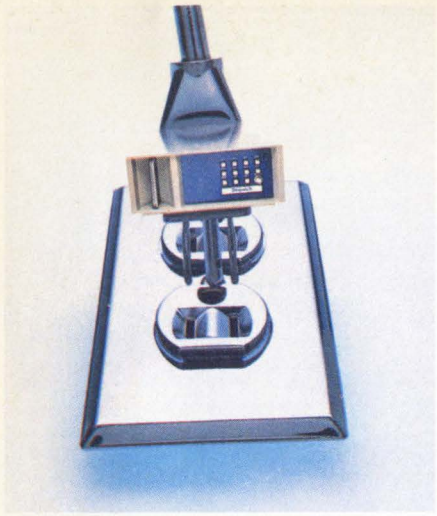
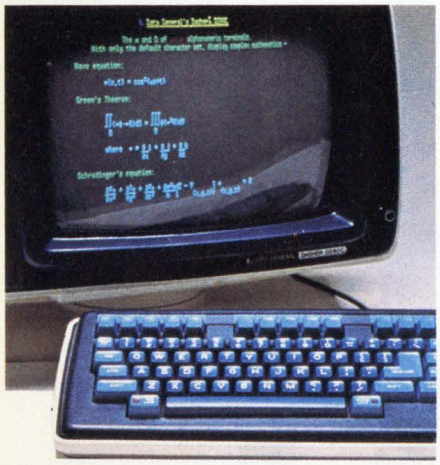


Computer Service Systems Network, Inc., this month became one of the first μc companies to introduce a family of plug-in DBMS machines (see p. 15). Cover designed by George Walsh, the Nigberg Corp.



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Mini-Micro Systems

A Cahners Publication

Vol. XIV No. 10 October 1981

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MINI-MICRO WORLD

DEPARTMENTS

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MINI-MICRO SYSTEMS (ISSN 0364-9342) is published monthly by Cahners Publishing Company, Division of Reed Holdings, Inc., 221 Columbus Avenue, Boston, MA 02116. Norman L. Cahners, Chairman; Saul Goldweitz, President; William M. Platt, President, Boston Division. Circulation records are maintained at Cahners Publishing Co., 270 St. Paul St., Denver, CO 80206. Second class postage paid at Denver, CO 80202 and additional mailing offices. Postmaster: Send Form 3579 to MINI-MICRO SYSTEMS, 270 St. Paul St., Denver, CO 80206. MINI-MICRO SYSTEMS is circulated without charge by name and title to U.S. and Western Europe based corporate and technical management, systems engineers, and other personnel who meet qualification procedures. Available to others at the rate of $30.00 per year in the U.S.; $35.00 in Canada; $65.00 in all other countries (12 issues). Single issues $3.00 in the U.S.; $4.00 in Canada; $6.00 inall other countries.

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CIRCLE NO. 3 ON INQUIRY CARD

DEC PREPARES TO EXPAND ITS LEASING PROGRAM

DECmates for rent? Digital Equipment Corp., which for the year ending June, 1981, derived less than 1 percent of its $3.2-billion in revenues from leases, is about to expand its lease program. The first business segment targeted for increased activity is the low-end commercial-products line, but DEC's leasing ambitions may extend beyond DECmates and low-end data systems. The company wants to fill several lease-related positions, including a marketing manager to handle product groups and sales organizations, a person to develop operating lease programs and a person to aid in creating master lease agreements with national accounts. DEC spokesmen won't comment on leasing plans, but one official says the company is getting "a little more aggressive" in its leasing programs. However, he contends that leasing will never account for a significant portion of DEC's revenues.

Meanwhile, DEC is losing its sole New York retail store, which is falling victim to renovations at the Biltmore Hotel. DEC hopes to have a new Gotham location in early 1982, about the same time its lease at the Biltmore expires in January. The situation is firmer in Chicago, where DEC plans to move its DEC store location to the Merchandise Mart complex.

LMI, WESTERN DIGITAL PLAN LISP-BASED MACHINE

LISP Machine, Inc., has entered an agreement with Western Digital Corp. that will result in the development of an artificial-intelligence system scheduled for production in mid-1982. Under this agreement, WD will provide hardware for the new system, and LMI will provide system and application software, as well as the LISP processor. The system will be marketed primarily by LMI, but will also be available through WD. It is based on the multi-user machine that WD is manufacturing for the Massachusetts Institute of Technology. WD plans to ship the first prototypes of that system to MIT during the first quarter of 1982. The machine is unique in that its bus and chassis are processor-independent and allow 8-, 16- or 32-bit processors to be interchanged. The Motorola 68000-based prototype models will incorporate the UNIX operating system and will be available with floppy- and Winchester-disk storage. WD touts the system's terminal as a major feature because it allows graphics and text to be mixed. Once the machine contract with MIT is filled, WD plans to market the system to OEMs and sophisticated end users for program-development applications.

SMALL SYSTEM TO REPLACE REALITY HARDWARE

Look for Microdata Corp. to unveil a new small-business system this month at the Info '81 Show in New York. According to one report, the new system will directly replace the company's six-year-old family of Reality small computers, and will complement the Irvine, Calif., firm's recently announced Sovereign data-entry hardware (MMS, August, p. 34). A source at Microdata has no comment on the report.

WANG, DEC SET TO BOLSTER OFFICE-AUTOMATION LINES

Wang laboratories and Digital Equipment Corp. will add products to bolster their office-automation product lines over the next several months. Wang officials, who have been vexed as other companies claim to be office-automation leaders, will attempt to secure their hold in the office market with a series of product introductions that began in late September with the release of a database package called Total. This month, CP/M capability will be one of several features added to the Wangwriter. The products will be followed in November by a series of software and hardware products that will probably include an executive-software package called Alliance. Alliance will provide document-retention and filing capabilities.

Meanwhile, DEC is readying the release of two software packages that will make word processing available to PDP-11 users. One, the DECword system, is based on a PDP-11/34. It handles four to eight users and is priced at $50,000, including the 11/34, 256K bytes of memory, four VT-100 terminals, two RL02 disk drives and DECword software and documentation. DEC's commercial group will sell DECword/DP as a layered application-software product with prices starting at $8500. It is available for users of PDP-11/24s through 11/70s.

Breakpoints

H-P RESELLER ADDS DEC TO PRODUCT LINE

The largest reseller of Hewlett-Packard Co.'s 3000-series systems plans to add Digital Equipment Corp.'s 32-bit VAX CPUs to its product lineup. ASK Computer Systems Inc., a turnkey-systems house based in Los Altos, Calif., will offer the VAX-based systems next year, according to a recent prospectus produced in preparation for the company's first public stock offering. ASK, a manufacturing-oriented systems house, has usually used H-P CPUs, but also has a non-exclusive licensing agreement with Sperry Univac, allowing Sperry minis to be marketed under ASK's MANMAN trademark.

For the year ending June 30, 1981, Sperry has paid ASK $357,500 under the license. According to the firm's prospectus, ASK had 1981 (ending June 30) revenues of $13 million and a net income of $1.5 million.

TURNING AN APPLE II INTO A DEVELOPMENT SYSTEM

Start-up Hollister MicroSystems is delivering plug-in boards and software that can turn Apple II personal computers into processor-independent development systems. The Hollister, Calif., company says that with its HMS 6800XA 6800 μp cross assembler and its HMS 1000 EPROM/ROM simulator, programs can be assembled directly into the Apple's memory. The HMS1000 simulates several 16K-, 32K- and 64K-byte devices and is priced at $500. Other Apple plug-ins from Hollister include the HMS3264 EPROM programmer for 2716, 2732, 2732A and 2764 EPROMs and the HMS 2424, a 24-bit parallel I/O card. The devices sell for less than $300 each. Company president Brent Olsen says similar boards are in the works for IBM's new personal computer.

DEC DENIES IT IS PLANNING PRICE CUTS

Despite some outside opinions to the contrary, Digital Equipment Corp. officials are privately asserting there are no plans for across-the-board price cuts. Outsiders have predicted that by year-end, DEC will have to choose between idle manufacturing capacity or price cutting, and would pick the latter. Regarding that prediction, one DEC official says, "there's nothing to it." He contends that pricing discussions at DEC are centered around ways to offset inflation, and to date the answer has been price hikes. What would make DEC cut prices? "If order rates fell off the cliff tomorrow, then we might cut prices," the official answers.

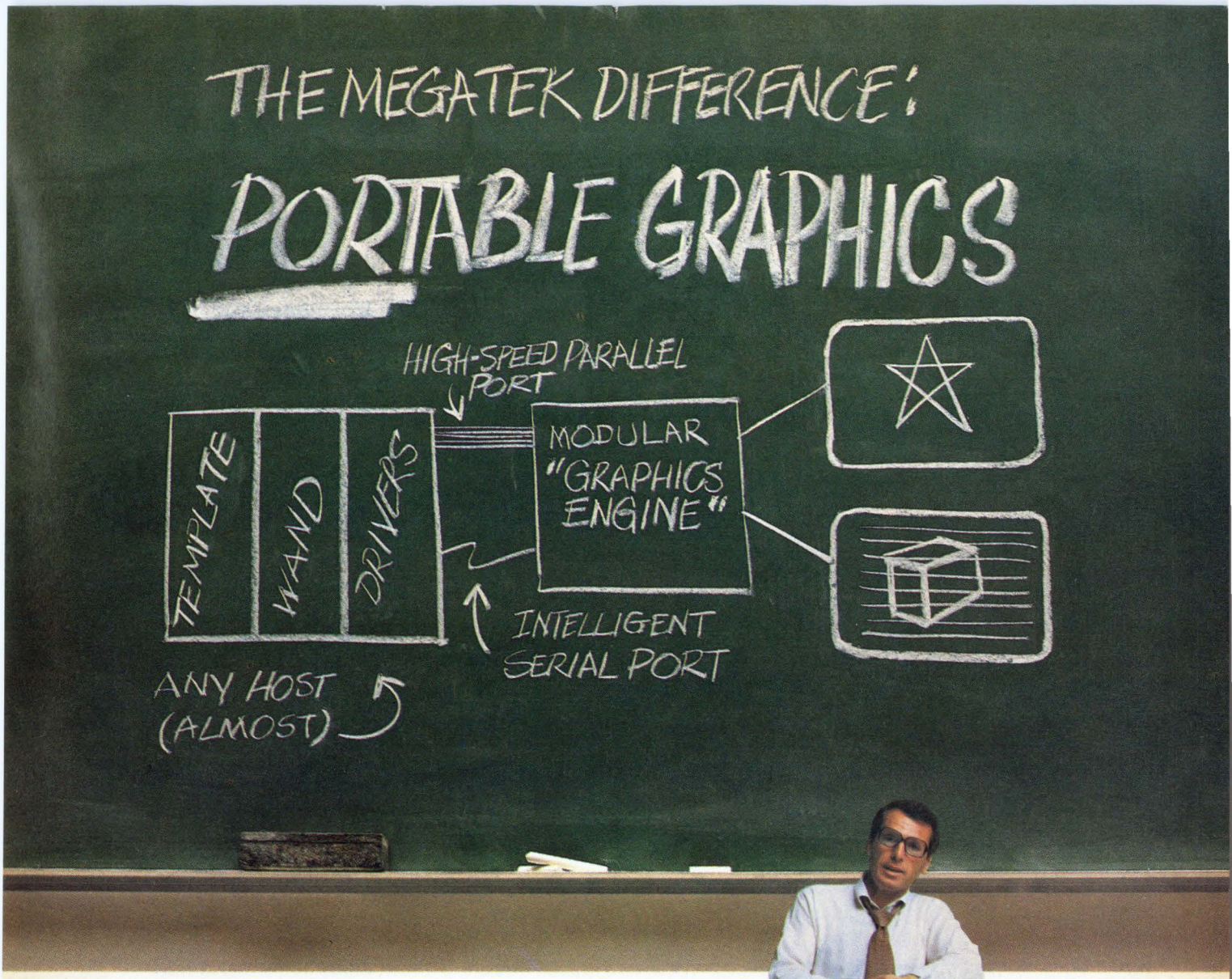
GENERAL INSTRUMENT INVESTS $6 MILLION IN SYTEK

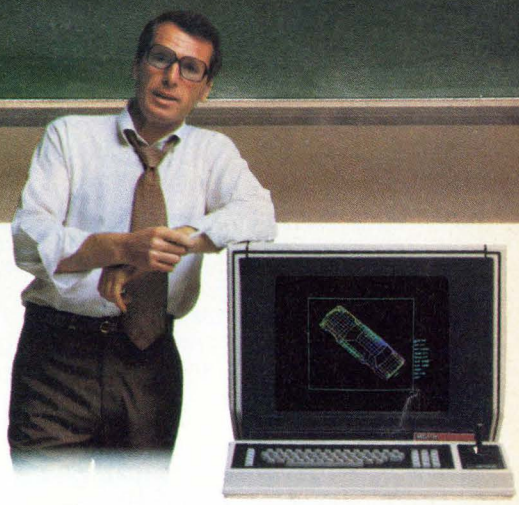
Following three to four months of intense negotiations, General Instrument Corp., New York, and Sytek, Inc., Sunnyvale, Calif., have agreed to affiliation designed to complement the company's respective strengths in the CATV and networking markets. As part of the agreement, GI—the leading U.S. supplier of cable-TV electronics through its Jerrold Division—is investing $6 million in Sytek to help finance that company's growth. (Sytek, which has shipped 35 of its LocalNet broadband-networking systems, is expecting revenues of $8 million this year, compared to $2.5 million last year.) As part of the deal, Sytek will also gain access to GI's Data Systems Group, which will offer nationwide service to LocalNet customers. "Venture capital is easy to get," explains Sytek's president, Michael S. Pliner, "but we needed to gain marketing, distribution and support capabilities quickly. Another incentive for Sytek in the arrangement is GI's strong semiconductor operation. The two companies will use GI's VLSI expertise and mass-production capabilities to produce more condensed and less costly network components.

For its part, GI has secured two seats on Sytek's five-member board of directors, plus the option to acquire as much as 51 percent of the company's equity.

DATAPOINT EXECUTIVES EXPERIMENT WITH TELECONFERENCING

Four executives at Datapoint Corp., San Antonio, Texas, including president Harold E. O'Kelley, are gaining some personal experience with teleconferencing equipment and methods. Emphasizing that the internal teleconferencing work is purely experimental—with no commercial products planned—O'Kelley says he and three vice presidents are testing a prototype work station developed by Datapoint for teleconferencing environments. The work station consists of a high-resolution





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Then there is Megatek's Wand software, which includes drivers for most of the popular mini- and midi-computers. Wand 7200 is a full-capability, SIGGRAPH Core-compatible package for Whizzard 7200 high-performance graphics workstations. Wand 6200 is a serial-interface subset designed for the Whizzard 6200 family of terminal-type workstations.

With a Whizzard 7200 parallel interface, Wand supports multiple workstations. With a serial data link to a Whizzard 7200 or 6200, an intelligent interface supervises all of the display-list memory management. Only segment extensions and attribute changes must be communicated.

You can also take advantage of the upward mobility provided by Megatek's modular 32-bit Graphics Engine™ Rev it up with plug-in microprocessor interfaces for interactive devices; high-speed processors for 2D and 3D rotation, scaling, translation and clipping; and a 3D Surface Processor for real-time area fill of complex polygons. Enrich the output with a digital vector generator to drive 512^2 or 1024^2 raster-scan monitors with real-time "true" scale and translation through the Whizzard's 4096^2 virtual display space. Or a 4096^2 analog vector generator for stroke refresh monitors. Or a rasterizor unit for obtaining quick, full-resolution hardcopy prints.

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CIRCLE NO. 4 ON INQUIRY CARD

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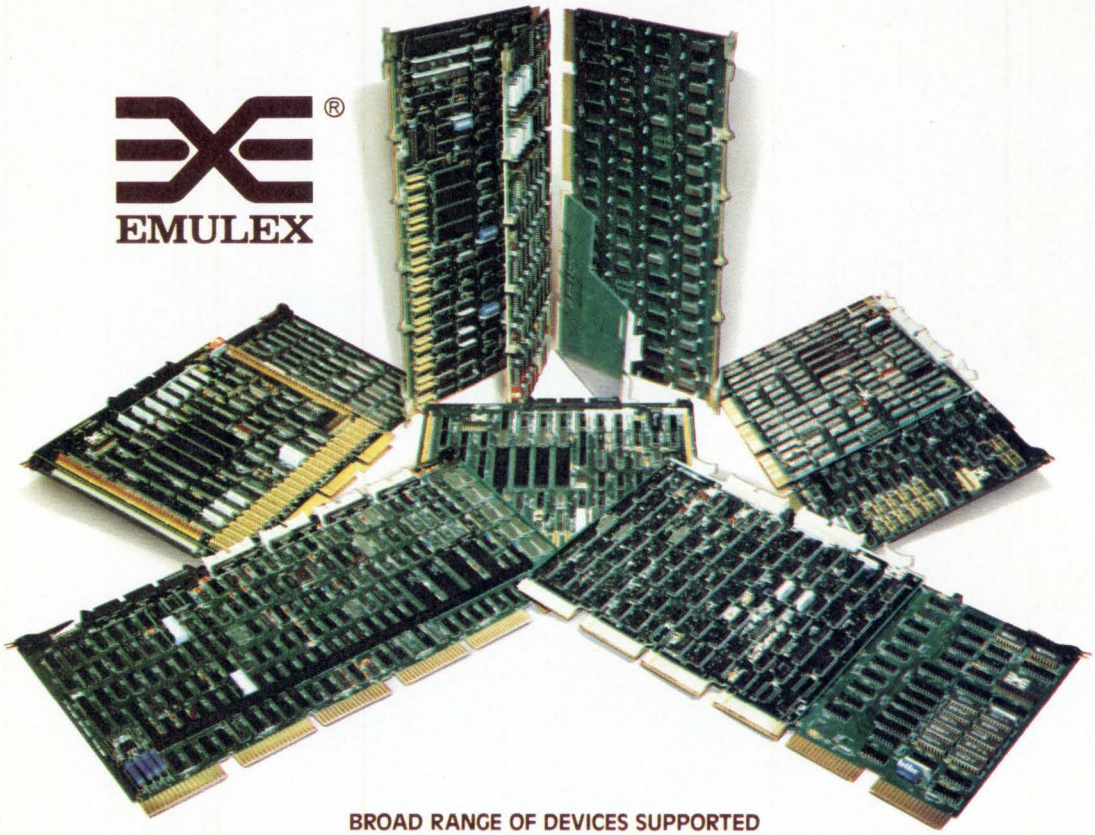

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CIRCLE NO. 5 ON INQUIRY CARD

color CRT terminal, a camera to transmit video pictures of an operator, a small black-and-white monitor that displays the transmitted picture, a keyboard and a microphone for interactive voice communications. Transmission of the voice, video and data traffic occurs over a single CATV-type cable. Victor D. Poor, executive vice president of R & D, says the audio channel can be extended into a voice-command mode. Poor downplays the fact that the company is using a single cable for all teleconferencing traffic, noting, "How you channelize has little to do with the acceptance of the product." He has "serious misgivings" about the use of a single cable for several communications channels, as in Datapoint's ARC system, because of the added cost in interfacing to a multi-channel network. Poor admits the ultimate goal of Datapoint's internal experiment is "to determine if teleconferencing can be made into a viable product."

FORMATION GEARS UP TO BOOST PERFORMANCE OF F4000 MINICOMPUTER

Formation, Inc., Mount Laurel, N.J., which last year joined the minicomputer market with a system that runs IBM 370 software, is gearing up to expand the price and performance of its F4000 family with a series of new products. This month, the company will offer a redundancy feature called Failsoft, which is aimed at decreasing system down time to about 5 min., the company claims. A combination of hardware and microcoded firmware, Failsoft reconfigures a failed system to work around a problem until the system can be repaired. An entry-level Failsoft, including F4000 model 300 hardware, two 100M-byte Winchester-disk drives and a 200-lpm printer, is priced at $140,000.

Formation also wants to secure a bigger chunk of the distributed data-processing market, and recently added IBM 2780 asynchronous communications protocol support, priced at $6000.

RANDOM DISK FILES

The first products from Colorado Springs, Colo., start-up **Brown Disc Manufacturing Co.** will be five-diskette cartridges used in **Amlyn Corp.'s** recently announced A506 6M-byte, 5¼-in. floppy-disk drive (MMS, August, p. 74). The company was formed this summer and expects to have its first products shipped next month. Brown reportedly is backed by Santa Clara, Calif., media giant **Dysan Corp.** (which is also backing Amlyn) and will serve as the prime source of the Amlyn media.

Ampex Corp. reportedly is set to enter the 5¼-in. Winchester market this quarter by licensing hardware from an outside vendor. Several agreements in principle have been signed, say industry sources, one of which is said to involve **Rodime, Ltd.,** Glenrothes, Scotland. An Ampex spokesman has no comment on the reports, but he stresses that his company intends to participate in the 5¼-in. Winchester market.

Look for **Computer Memories, Inc.,** Chatsworth, Calif., to boost the per-disk capacities of its drives by year-end. Capacities on CMI's single-platter CM 5008 drive will go from 5.3M to 6.4M bytes, its two-platter 10.6M-byte drive will go to 12.8M bytes, and its CM17S three-platter, 16M-byte, 5¼-in. Winchesters will go to 20M bytes.

Rumors are flying that **IBM**'s long-awaited "Bright" project, a high-capacity, 4.4M-byte, 8-in. floppy-disk drive using chromium-dioxide-coated media, has surfaced in Japan. Reports are not confirmed, however. . . . Look for **International Memories, Inc.,** Cupertino, Calif., to unveil the first of its higher capacity 5¼-in. Winchesters next month. Called the Series 5012, the drive will pack 12M bytes of data onto two thin-film disks. A data separator will be built in. No pricing has been set.

Specifications for the 5¼-in. disk cartridge planned by **Seagate Technology, Dysan Corp.** and **DMA Systems Inc.** (MMS, June, p.10) may come before the full ANSI X3B7 Cartridge Committee this fall, following the meeting of a special subcommittee last month in Lake Tahoe, Nev. Meanwhile, details of the cartridge continue to surface. Called the MicroDisc, it will store 5M bytes of data on one platter and will accommodate conventional Winchester read/write heads and thin-film components. The cartridge measures 5.51 x 5.39 x 0.74 in. Prices have not been set.

Shugart Associates' 1-millionth single-sided 8-in. floppy-disk drive will roll off the assembly lines at the Sunnyvale, Calif., Xerox subsidiary this month. Destination: **Wang Laboratories**, Lowell, Mass. . . . Reports are circulating in the industry that **Archive, Inc.,** Costa Mesa, Calif., will unveil a 50M-byte version of its ¼-in. Sidewinder tape-cartridge drive at the upcoming Comdex show.

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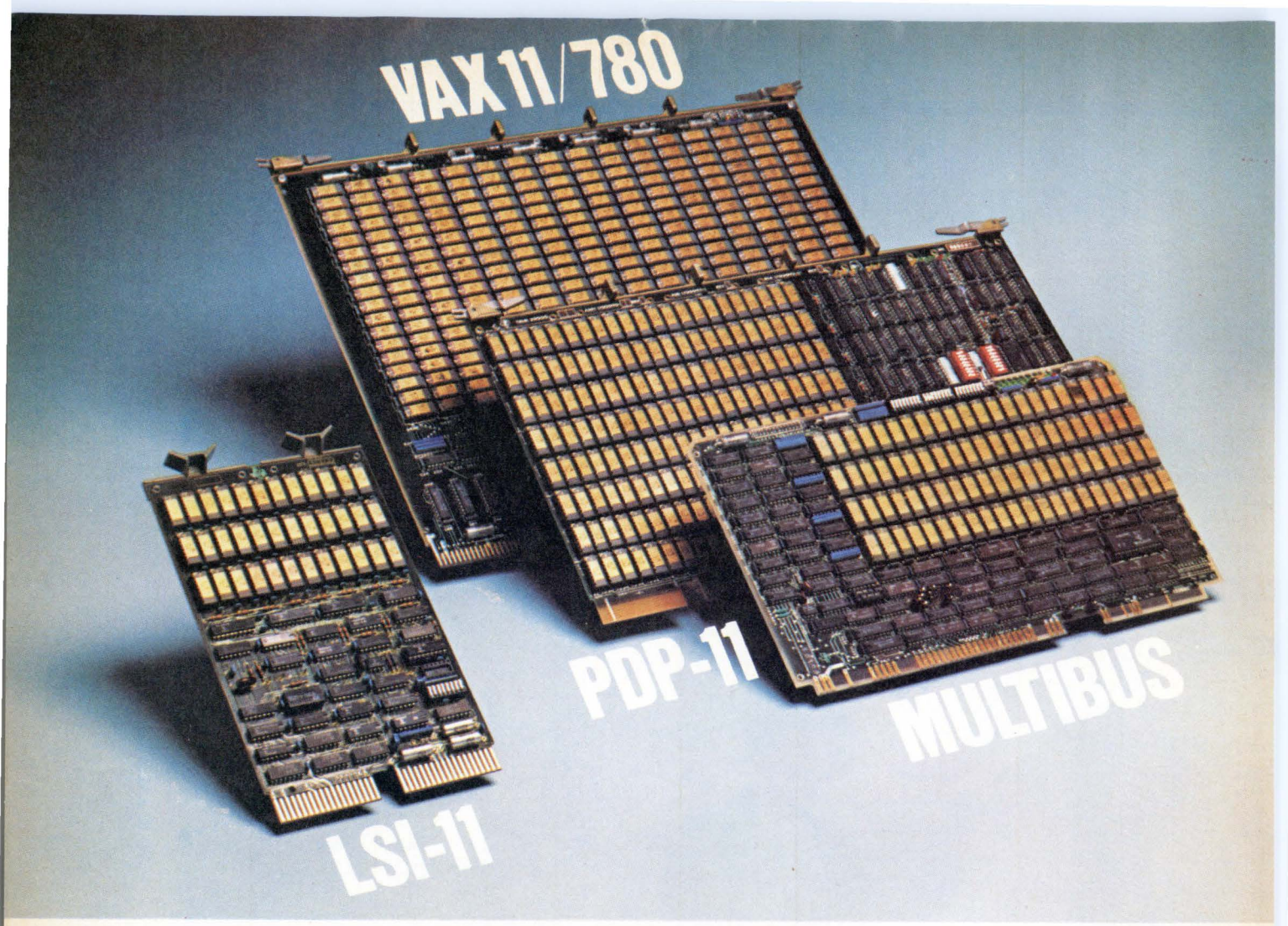
TS IN PRINTING

CIRCLE NO. 6 ON INQUIRY CARD



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System	TI Series	BYTES/BOARD						
		64K	128K	192K	256K	512K	768K	1M
LSI-11†	TMM10010[1]		X	X	X			
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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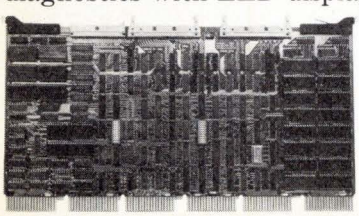

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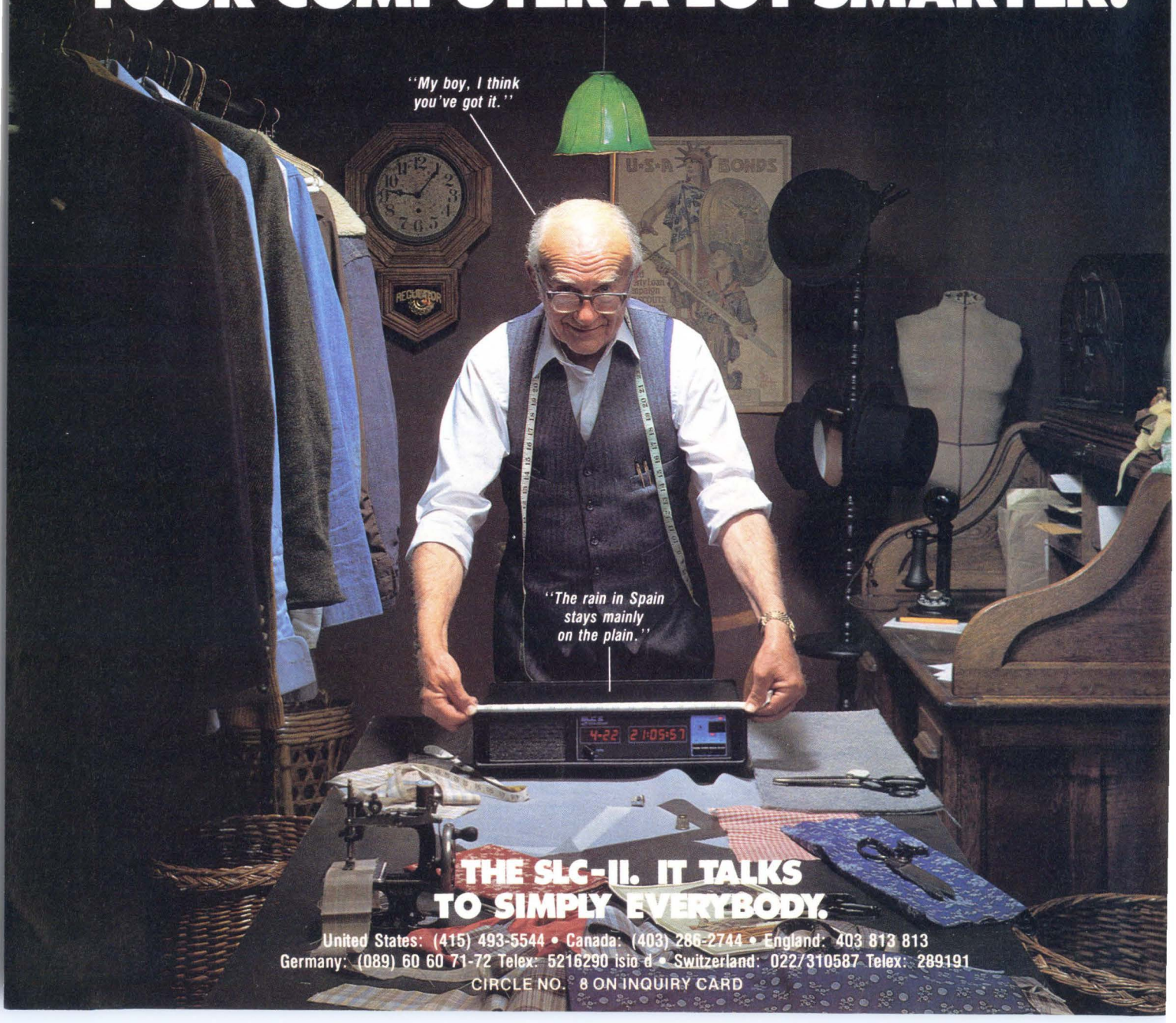

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CIRCLE NO. 8 ON INQUIRY CARD

CSSN plans to offer turnkey database μcs

While database-management systems have been the province of large minicomputer and mainframe users, the expanding on-line applications of μcs are also beginning to require the timely data updates, decreased numbers of files and reduced data-entry overhead for access to information that databases provide. Computer Service Systems Network, Inc. (CSSN), Boston, this month became one of the first μc companies to introduce a family of turnkey database machines.

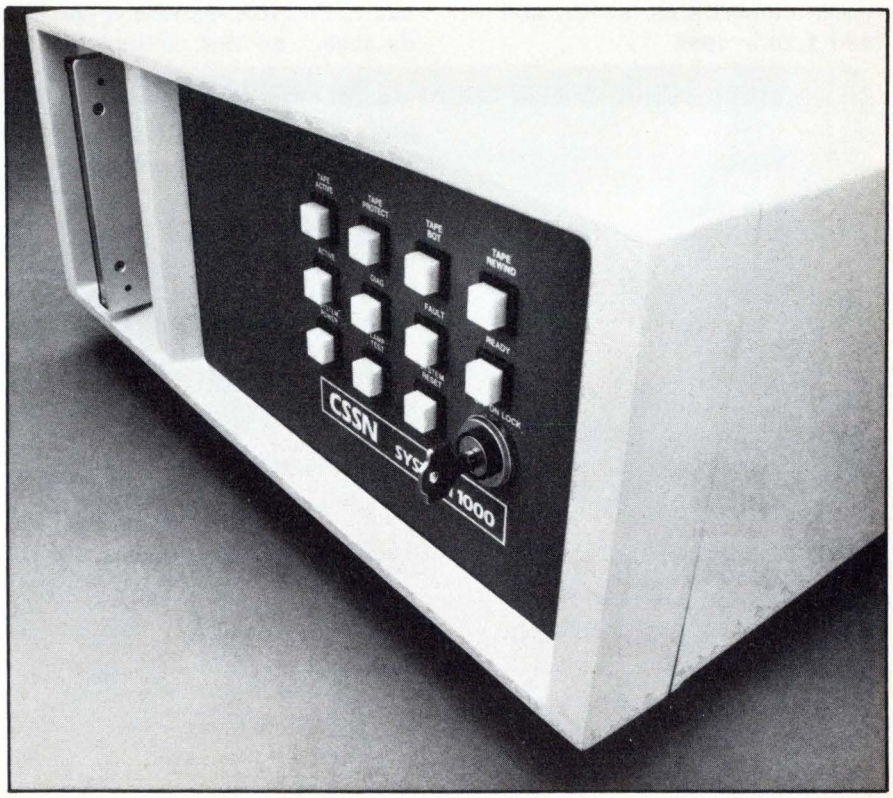
Called Dispatch, the systems will be configured by OEMs to include hardware, software, languages and graphics. OEMs will pay $15,000 to $22,000 in 100-unit quantities for the products, which can be configured as turnkey systems with a $30,000 end-user price tag. Company president David Friesen explains why CSSN made the move to databases: "Users need database systems badly because there is a shortage of programmers. Until now, databases have been an expensive technology."

CSSN's plans include three products priced at $15,000 to $22,000 in 100-unit OEM quantities. The three μcs are based on the Z80 μp and use a superset of the CP/M operating system. The units also include Winchester-disk drives ranging from an 8-in., 10M-byte unit to a 14-in., 169M-byte disk; a 13M-byte cartridge-tape drive; a controller that interfaces as many as four drives; and an IEEE S-100 bus with expansion slots.

The entry-level system, which can function as a distributed processor with a host computer, is based on CSSN's model S-1000 μc. A minimum configuration includes a 10M-byte, 8-in. Winchester-disk drive, tape backup, database-interface software, operating system and hierarchical database-management-system software. It works with Digital Equipment Corp.'s PDP-11/45 minicomputers and other PDP products that run on IAS or RSX-11 operating systems, including the 32-bit VAX minicomputer. CSSN also plans to expand the products' use to other minicomputers supporting the IEEE-488 interface.

An extended processor that can also be used in a stand-alone mode or for OEM program development is priced at about $18,000 in 100-unit quantities. It is based on CSSN's Stretch-1000 μc, an expanded version of the S-1000 that houses 128K bytes of RAM memory, expandable to 1M byte through hardware memory mapping, and slots for as many as 12 boards rather than the eight available on the S-1000. Both systems are available this month.

The high-end multiprocessor system, which can be used as a back- or front-end processor, will be available in December. The multifunction unit accommodates as many as 16 processors, and includes a multiprocessing operating system that runs a multi-thread database-management system, enabling it to perform



CSSN, Inc.'s S-1000 Dispatch database machines *will be configured by OEMs into turnkey systems, including hardware, software, languages and graphics.*

10 to 100 simultaneous transactions. It is based on CSSN's MP-1000 μc with a minimum of two Z80 μps, one of which acts as a master and the other as a slave that accesses shared magnetic-tape and disk drives and printers.

Other features include interrupt-driven concurrent I/O, the ability to use as many as 16 CPUs with the MP-1000, thereby increasing the number of transactions per minute, and the ability to use the system stand alone or with a large minicomputer or mainframe in a distributed data-processing environment.

The MP-1000 system includes an integrated uninterruptible power supply and a terminal multiplexer designed by Wright Marketing, Washington, D.C. Seven terminals can be linked to each multiplexer, and three to 12 multiplexers can be linked to each MP-1000 μc. CSSN or the OEMs supply the terminals at an added price. The company plans to offer bisynchronous communications support this month, and will add X.25 in 1982.

For software, CSSN offers hierarchical-database software developed by Micro Database Systems, Inc. (MDBS), and will offer a relational-database version later. Price for the MDBS software is $1500, and it will be supported by CSSN.

The MDBS software is a superset of the standard CODASYL databases and allows one-to-many relationships typical on CODASYL database systems plus many-to-many relationships, Friesen explains. The company is seeking a vendor for the relational database. A likely candidate is the INGRES system that runs under UNIX. The company plans to offer an IBM Corp. SQL-like Query language for both databases by spring, 1982. In the meantime, a transaction-processing facility, which is similar to IBM's Query By Example, will perform queries against the relational system.

By the end of next year, CSSN plans that both types of databases on two separate processors will be able to communicate—a task that has eluded IBM because of the huge databases on IBM equipment, says Bernard P. Wess, Jr., vice president of product development at CSSN. He says CSSN's μcs pull information from hierarchical files into a flat record via an extraction process in PL/1 code. The information is then reformatted in a CSSN interface program, sent to a host computer—via OEM-supplied host interface software—and then into a μc running a relational database manager for manipulation. Database hardware is language-independent. The system provides backup audit trails on tape of transaction and daily logging on a disk, both of which facilitate system recovery.

The new systems use the FAST OS operating system, which includes a rewritten file-allocation system. This enables faster access to disk and stamps files with time and date during creation and the final modification, Friesen says. In a 64K-byte environment, such as the one in the low-end CSSN system, database software is typically "space-hungry" and slow. The MDBS database software, for example, uses a minimum of 24K bytes of

THE BACK-END AND MAINFRAME DBMS PRODUCTS: A COMPARISON

	ADABAS	DISPATCH	DMS-II	IDMS
Vendors	Software AG	CSSN	Burroughs	Cullinane
Type of DBMS	Host/Back-End	Back-End	Host	Host
CPUs supported	IBM/PCM	Any	Burroughs 700/800	IBM/PCM
Data base structure	Network	Network Hierarchical	Link Ring Network Hierarchical	Network Hierarchical
Multi-thread I/O	Yes	Yes	Yes	Yes
Transactions/minute	100-1000	10-100	100-1000	100-1000
Application languages	COBOL PL/1 FORTRAN	Any	COBOL ALGOL PL/1	COBOL FORTRAN PL/1
Multi-host support	No	Yes	No	No
Host communications	IBM Channel	RS-232 IEEE-488	N/A	N/A
Audit trails	Yes	Yes	Yes	Yes
Maximum data base size	Unlimited	256M	3G	Unlimited
DDP support	No	Yes	No	No
Possible networks supported	N/A	X.25 SNA, etc.	BNA	N/A
Price (single unit) data base processor (paid up licenses except for IBM)	$99,000 to $162,000	$30,000	$27,000	$50,000

Source: CSSN, Inc.

memory, and the operating system uses 38K bytes, leaving little room for applications. To alleviate this problem, the company mapped the operating system from the 128K-byte address on the Stretch-1000, leaving more room for application programs.

Buffers on the Stretch 1000 machine were increased tenfold to 20K to 40K bytes, and in the MP-1000-based system, the operating system is on a board with its own 64K RAM μp. The database manager in that system also has its own 64K μp, and each user processor has a 64K-byte operating system, Wess explains.

The main problem for CSSN may be whether OEMs can handle the needed interfaces, software, hardware, training and support. The company hopes to grow from $4 million in revenues this year to $20 million next year by selling the new machine, but it would be hard-pressed to provide all the necessary software and support. As a result, CSSN is relying on other vendors for much of its high-level language software, and will test the externally supplied COBOL, FORTRAN, BASIC, PL/1 and Pascal on its machines. It expects to provide language-independent database-interface software, leaving the OEMs to provide links to host computers and to perform database-administrator tasks—preparing the user's information so that it can be entered and used on the database machine. CSSN will provide OEMs with programs to define the database on the MP-1000 when used as a back-end processor, Wess says.

CSSN is confident that its OEMs can configure the machines for users and that the market for its machines is lucrative. The company initially plans to invade installed bases of large manufacturers and sell to first-time users. "We have a stand-alone computer, and we will tap into the bases of DEC, Data General Corp. and Prime Computer, Inc., to get the minicomputer sale for a μc. Users thus do not have to give up their software equity," says Lance Hansche, CSSN's CEO.

—L. Valigra

VOICE I/O MARKET TO SKYROCKET BY 1985

The market for voice I/O equipment is expected to skyrocket by 1985, predicts a report by research and consulting firm Strategic, Inc., San Jose, Calif. Speech-synthesis (voice-output) equipment will take the lead, and speech-recognizition (voice-input) equipment will come a close second in market share.

The report says the market for voice-input equipment grew to $15 million this year and is expected to hit $150 million by 1985, an average annual growth rate of 82 percent. Moreover, the report goes on, the market for voice-output equipment will reach $23 million this year and $495 million by 1985, at a phenomenal growth rate of 115 percent.

The reason for the expansion in the voice I/O market, the report states, is a combination of technology and cost effectiveness. In the output segment, algorithms for imitating human speech have been improved and reduced to low-cost LSI packages, so that in the future, high-quality speech chips will sell for less than $15 in large quantities. The impetus for the growth of the input segment, continues the report, is simply a growing awareness by the public of the success and potential of the voice I/O market.

On the other hand, the report also indicates deterrents, including public unacceptance, to the expansion of the voice I/O market.

The report, entitled "Voice Input/Output: Markets, Technologies and Applications, #310," is priced at $950.

—Nancy Love

IDM-500	IMS	TOTAL	SEED
Britton-Lee	IBM	Cincom	International Data Base Management Systems
Back-End	Host	Host	Host
Any	IBM/PCM	IBM/PCM	HP3000, PDP-11, DG, Prime, IBM
Relational	Hierarchical	Network	Hierarchical
Yes	Yes	Yes	Yes
100-3000	100-1000	100-1000	10-100
Any	COBOL FORTRAN PL/1 ASSM	COBOL FORTRAN PL/1 ASSM	COBOL FORTRAN ASSM
Yes	Yes	No	No
RS-232 IEEE-488	N/A	N/A	
Yes	Yes	Yes	Yes
32G	Unlimited	200M	16M
Yes	Yes	No	No
N/A	SNA	N/A	N/A
$50,000	$11,400/yr.	$13,000 to $30,000	$8000 to $12,000

Some of the characteristics of major product database management offerings. *No attempt has been made to include all DBMS products. The products described, with the exception of Dispatch, IDM-500 and Adabas are software-database management systems. However, the CSSN Dispatch, the IDM-500 from Britton-Lee and a version of the Adabas database managment systems include hardware. The Britton-Lee processor includes the database-management system processor hardware and disk controllers, but no disk drives. The CSSN product includes the DBMS processor, serial or parallel controllers, and 24M bytes of mass storage. The Adabas DBMS can include hardware as a back-end processor, with prices beginning at $250,000 for a minimum configuration.*

DG bolsters its position with mid-range supermini

Sixteen months after introducing its first 32-bit minicomputer, Data General Corp., Westboro, Mass., late last month added a mid-range system, the MV/6000. The new product offers 70 percent as much performance as its high-end sibling, the MV/8000, at about half the price, (MMS, May, 1980, p. 11). It is intended primarily for the commercial market. Additional high- and low-end 32-bit systems will be available later.

Although the follow-on appeared faster than Digital Equipment Corp.'s VAX-11/750, which was introduced three years after the VAX-11/780 appeared, DG is still nearly a year behind DEC in selling the MV/6000 versus DEC's efforts with the competitive VAX-11/750. The 750 sells for $120,000, less than half the price of the VAX-11/780 CPU, and is 60 percent as fast as the higher end system. It has one-fourth as much memory—2M bytes —and has a 4.3G-byte address space (MMS, December, 1980, p. 13).

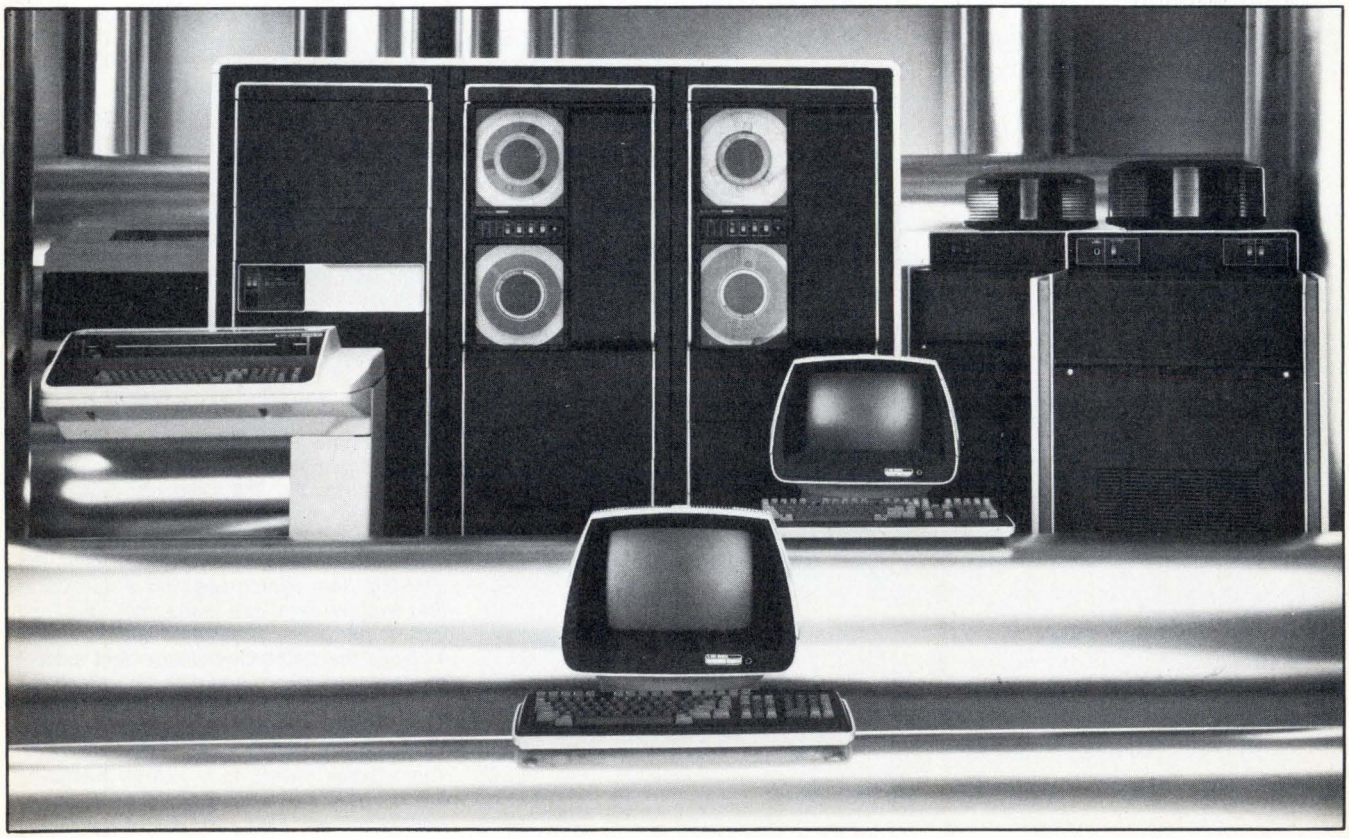
"We did a hell of a job establishing ourselves in the 32-bit commercial and scientific area," says Edward J. Zander, director of marketing for DG's Information Systems Division (ISD), which sells large systems. "We're not behind [DEC] anymore. We're ahead with our breadth of software."

The MV/6000 is intended for use in interactive, multiple-location data-processing applications and in mixed commercial and scientific environments. But DEC appears to be an ominous foe. "DEC is coming on like gangbusters," says Donald H. Brown, director of small systems analysis at the Gartner Group, Inc., Greenwich, Conn. He says that 200 VAX-11/750 units have been shipped since June, and production rates are now 200 units per month.

Lead times for both VAX products have dropped to two to four months since February, Brown says, and the combined effect is an "enormous impact" on the market. DEC is expected to introduce very high- and very low-end superminis by next June.

Industry estimates peg DG MV/-8000 sales at 150 to 200 units. Both MV/ products are expected to meet 90- to 120-day shipment times.

Both DG and DEC have good reasons for gearing up sales efforts: the market is growing rapidly. The number of 24-, 32- and 48-bit minicomputers units shipped in 1979 was 2800 estimated to be worth $314 million, says Bruce Hadburg, research analyst, small computer group, Dataquest, Inc., Cupertino, Calif. Those figures will grow to



The MV/6000 is rack-mounted *and housed in two bays rather than three like the MV/8000.*

Most small system users think all micro-
mputers are created equal. And they're
ht. If you want performance, convenience,
yling, high technology and reliability (and
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You'll also get a full ASCII keyboard with an 18 key numeric pad and individual cursor control keys. Twin RS232C serial ports for fast and easy connection to a modem or printer. Dual Z80 processors which operate at 4 MHZ to insure lightning-fast program execution. And the list goes on! Feature after feature after feature.

Better yet, the SuperBrain boasts modular design to make servicing a snap. A common screwdriver is about the only service tool you'll ever need. And with the money you'll save on purchasing and maintaining the SuperBrain, you could almost buy another one. For under $3,500, it is truly one of the most remarkable microcomputers available anywhere.

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CIRCLE NO. 9 ON INQUIRY CARD

24,700 units shipped in 1985, with an estimated value of more than $2.7 billion, which represents an annual growth rate of more than 30 percent over the six-year period. Laboratory and scientific applications will continue to account for almost half the number of computers in use, while business data-processing applications are slowly increasing.

Creating a family of 32-bit system products is a necessity in the market, says J. Terence Carleton, assistant vice president at Kidder Peabody & Co., Boston, Mass. "The 32-bit machines will be to the first three quarters of the 1980s what 16-bit machines were to the 1970s," he says, in terms of building diverse-performance family members.

An entry-level MV/6000 system is priced at $150,000 to $225,000. A typical $195,000 configuration includes 1.5M bytes ERCC MOS memory, a Dasher D200 system console, two intelligent asynchronous controllers, 20 Dasher displays, one 190M-byte disk drive, a nine-track, 75-ips, 800-/1600-bpi magnetic-tape drive, a 300-lpm printer, AOS/VS, 32-bit CODASYL 1 /DG/DBMS and 32-bit COBOL.

The 32-bit AOS/VS operating system sells for $10,000, including an initial license, installation and a one-year subscription.

The MV/6000 has 2M bytes of main memory—half the amount available on the MV/8000—4.3G bytes of virtual address space and a 512M-byte maximum user program size. The unit supports as many as 64 Dasher terminals.

Like the MV/8000, it is software-compatible on a binary level with earlier 16-bit products, enabling it to use all DG 16- and 32-bit software. The two superminis also can communicate with each other. MV/6000 instructions can operate in 64K- or 512M-byte addressing ranges. The system instruction set supports 8-, 16- and 32-bit fixed-point operands. It performs fixed-point arithmetic; bit, bit-string, byte, word and block manipulations; and single- and double-word binary and hexadecimal shifts.

In apparent preparation for the new supermini's announcement, DG barraged the market in April with software and communications products supported by the 32-bit AOS/VS operating system. New entries include DG/SNA, COBOL, DG/DBMS, APL, Sort/Merge, RPG II, DATAPREP key-to-disk software, Infos II file-management software, a PROXI COBOL generator, X.25-based XODIAC network-management software and RJE80, HASP II and bisynchronous RCX 70 protocols. The unit also supports a SWAT high-level debugger, Trendview graphics software, FORTRAN and 16-bit AZ-TEXT word-processing software. The company intends to announce a local-area-networking strategy this fall.

Because the X.25-based Xodiac software is compatible with SNA, and SNA does not support X.25, the MV/6000 links IBM equipment to public data networks by serving in place of the IBM 8100 and 4331 systems, DG claims.

The company soon will form a marketing group dedicated to recruiting and qualifying independent software for all Eclipse information systems, although DG will not sell the software.

A hardware upgrade for the systems is not available, and the company does not plan to allow trade-ins of MV/6000 for MV/8000 products, says John B. Butler Jr., manager of product planning and management, ISD. The two superminis share some features, including high-performance, high-density

	Feature/CPU	DG Eclipse MV/8000	DEC VAX 11/780	Prime 750	IBM 4341-1	DG Eclipse MV/6000	DEC VAX 11/750	Prime 550-11	IBM 4331-2
HARDWARE	Logical address space (bytes)	4G	4G	512M	16M	4G	4G	512M	16M
	Memory bandwidth (MB/S)	36.4	13.3	8.0	N/A	36.4	5.0	2.5	N/A
	I/O Bandwidth (MB/S)	18.2	9.5	8.0	11.0	18.2	5.0	2.5	6.0
	System cache (bytes)	16K	8K	16K	8K	16K	4K	8K	8K
	16/32-bit compatibility	Yes	mode bit	mode bit	—	Yes	mode bit	mode bit	—
	Maximum no. of terminals	128	96	96	240	64	64	96	120
	Floating-point accelerator	Yes	Yes	Yes	Yes	No	No	Yes	Yes
SOFTWARE	ANSI 74 COBOL (32-bit)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	ANSI 77 FORTRAN 77 (32-bit)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	ANSI BASIC	Yes	No	No	Yes	Yes	No	No	Yes
	DBMS & QUERY	Yes	16-bit only no APL	Yes	Yes	Yes	16-bit only no APL	Yes	Yes
	RPGII, PL/1, APL (32-bit)	All	16-bit RPG	No APL	All	All	16-bit RPG	No APL	All
	SNA networking	Yes	No	No	Yes	Yes	No	No	Yes
	X.25 networking	Yes	No	Yes	Yes	Yes	No	Yes	Yes
	Word processing	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Interactive graphics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Source: Data General Corp.

How the MV/6000 measures up *against the competition.*

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Comparison Table

MV/6000	MV/8000
64 terminals	128 terminals
2M bytes maximum memory	4M bytes maximum memory
2.5G bytes maximum on-line storage	6.6G bytes maximum on-line storage
13 I/O slots	24 I/O slots
5 high-speed burst multiplexer channel slots	12 high-speed burst multiplexer channel slots
19-in. rack mount implementations	Full-bay (30-in.-wide) implementation
No floating-point unit	Floating-point unit optional
No I/O processor	I/O processor
External microcode load	Integral 1.2M-byte diskette for microcode load
Weighted performance index: 70 percent	Weighted performance index: 100 percent
(30.-in.-wide)	

Comparison table: *MV/6000 vs. MV/8000.*

programmable-array-logic chips and single-bit error-detection techniques. Both units' memories are based on an eight-level hierarchical ring structure that corresponds to eight-level segmentation, and each segment holds 512M bytes of information.

The two systems also differ in some features. For example, the MV/6000 handles 64 terminals—half the number the MV/8000 handles—and has 2M bytes of main memory, while the MV/8000 has twice that amount. The 6000 also has 2.5G bytes rather than 6.6G bytes of on-line storage. The smaller MV/6000 is rack-mounted in two cabinets, while the full-sized MV/8000 is housed in three cabinets. The MV/6000 has no floating-point processor for double-precision functions, and an intelligent asynchronous controller board (IAC) is used instead of the I/O processor used in the MV/8000.

The IAC is available in a version with eight lines and controls for an external modem, and one with 16 lines for connecting local terminals. Code-named "Wombat," the IAC buffered intelligent controller includes 32K bytes of RAM. It communicates with the CPU on a standard data channel at a slower rate than does the MV/8000's I/O processor, Butler explains. The IAC takes character interrupts from the main CPU and is more flexible in communicating with attached terminals than is the MV/8000's I/O processor, the company claims. The IAC will be priced at a few thousand dollars, Butler says. A user can add increments of eight or 16 asynchronous I/O lines.

The MV/6000 also lacks the floppy-disk unit that loads microcode and facilitates some diagnostic functions in the MV/8000. While microcode is loaded from a diskette into high-speed RAM on the MV/8000, it is loaded from a system tape or disk drive on the MV/6000, Butler explains. As a result, customers save the cost of a disk unit and controller. The same loading procedure is used for some diagnostic functions. Single-bit errors are "sniffed" every 2 sec. per megabyte of memory during memory refresh. While there are eight processor boards on the MV/8000, the 6000 has only five, says Arun Taneja, product manager for processor products, ISD. The functions of three microNovas, each of which previously resided on a 7- × 9-in. board, and a 15- × 15-in. console controller, are combined on one 15- × 15-in. board. Those functions include diagnostics performed using a system control processor (SCP). The MV/6000's CPU is housed in a 16-slot chassis.

Some sales of the two superminis will overlap, says Zander. The outcast product, though, is the M600, the previous high-end 16-bit machine. The company will support the product, but not actively sell it.

—L. Valigra

Shugart expands 8-in. Winchester offerings

Shugart Associates has joined the ranks of Winchester-disk-drive suppliers offering high-capacity—20M-byte and larger—8-in. hardware. The Sunnyvale, Calif., company will begin shipping evaluation units of its new SA1100 drives by year-end.

Product manager John Hagerman says two models of the SA1100 family will be available initially: the SA1104, a 20.3M-byte, two-platter device, and the SA1106, a 33.9M-byte, three-platter drive. Both models are physically compatible with Shugart's popular SA1000 5M- and 10M-byte 8-in. rigid hardware, he adds, although the company has introduced significantly different technology into the SA1100.

Unlike the SA1000, which uses a metal band actuator, the SA1100 uses a voice-coil rotary actuator head positioner with a closed-loop servo system. Besides allowing greater capacity, using the voice coil results in a 35-msec. access time for the SA1100 compared with 70 msec. for the SA1000. Further, a DC brushless motor drives the spindle, which means the SA1100 requires only DC voltages. The SA1000 uses an AC motor, belt-drive mechanism.

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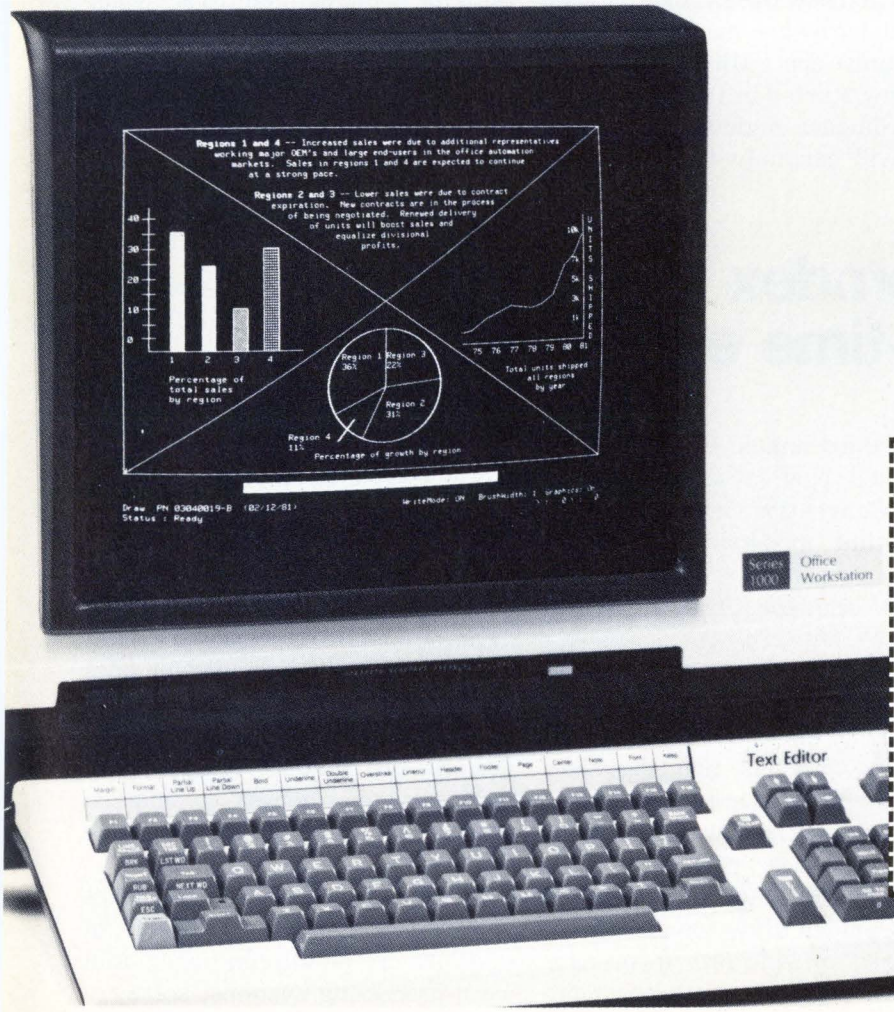

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CIRCLE NO. 12 ON INQUIRY CARD

Shugart has added dedicated head-landing and shipping zones to the SA1100 as well, features that are also included on the company's SA600 5¼-in. hardware.

Although the SA1100 family is plug-compatible with the SA1000 drives, some changes have been made in the interface, Hagerman points out. A head-select line and reset and re-calibrate lines have been added. However, the timing clock and the −5V lines used on the SA1000 have been omitted on the SA1100. Track capacities and data rates are the same as the SA1000's, making software changes minimal and ensuring compatibility with the firm's SA1400 controller.

Hagerman says the new hardware will use custom LSI in its read/write electronics by the end of next year, reducing the number of boards for that purpose from two to one. It's likely that the drive will incorporate an LSI version of Shugart's system interface (SASI) at about the same time, according to one report.

Some industry observers are predicting a fall-off in demand for less-than 50M-byte 14-in. Winchester hardware, and that the market will disappear within five years. That includes Shugart's SA4000 family of 14M- and 28M-byte, 14-in. drives.

Hagerman anticipates that the SA1100 will pick up the slack left by the low-end 14-in. devices as demand lessens. However, he stresses, Shugart does not plan to discontinue the 14-in. hardware, and sales are still strong primarily because the drives are available in large quantities and are cost-effective in certain applications.

Jim Porter, Mountain View, Calif., industry analyst and publisher of *Disk/Trend Report*, believes the market for the high-capacity 8-in. drives "will be a fairly good one for the next few years." He says the products will not be affected by 5¼-in. hardware.

Ironically, the success of Shugart's new entry will depend, to some extent, on how the SA1100 stacks up against hardware manufactured by Quantum Corp., Milpitas, Calif., a company started in 1980 by a group of ex-Shugart engineers. One measure will certainly be price, says Porter. The SA1104 is expected to sell for $1500 to $1600, and the SA1106 for $1800 to $1900, both in 500-unit quantities. Quantum's 500-quantity prices are $1500 for the 21M-byte Q2020 and $1800 for the 32M-byte Q2030. Production of the SA1100 is scheduled to begin in January. —*Larry Lettieri*

Specifications for Shugart's new 8-in. Winchesters		
Model	**SA1104**	**SA1106**
Unformatted capacity	20.3M bytes	33.9M bytes
Transfer rate	4.34M bps	4.34M bps
Positioning time track to track average	 10 msec. 35 msec.	 10 msec. 35 msec.
Rotational speed	3125 rpm	3125 rpm
Track density	500 tpi	500 tpi
Number of platters	two	three
Cylinders (total)	660	660
Platter size	200 OD × 63.5 mm. (ID)	200 (OD) × 63.5 (ID) mm.
Dimensions	4.62 × 8.55 × 14.25 in.	4.62 × 8.55 × 14.55 in.
DC voltages	+24 VDC, +5 VDC	+24 VDC, +5 VDC
Interface standard	SA1000	SA1000

Shugart's SA1100 *8-in. rigid-disk drive is available in 20.3M- or 33.9M-byte versions.*

Comdex will break all-time exhibitor record

The third annual Comdex show, scheduled Nov. 19-22 at the Las Vegas Convention Center, could set an all-time industry exhibitor record, says a representative of the show's sponsor, the Interface Group.

Sheldon B. Adelson, president of the Framingham, Mass.-based conference and exposition management company, predicts that the show will draw more than 560 exhibitors, which will top the National Computer Conference record of 555 exhibitors in 1981. In its second year, Comdex drew 366 exhibitors, compared to 157 in 1979, its premier year. In comparison, NCC is more than 30 years old.

Adelson points out, however, that Comdex is a different type of show in terms of audience size. "Comdex won't have thousands of students and literature collectors," he claims. "The Comdex audience remains strictly limited to independent sales organizations (ISOs)." These include intermediate resellers such as dealers, distributors, computer retailers, systems houses, commercial OEMs and office product/machine dealers.

What Comdex will have, says Adelson, is a large variety of vendors of small-computer and word-processing systems, software

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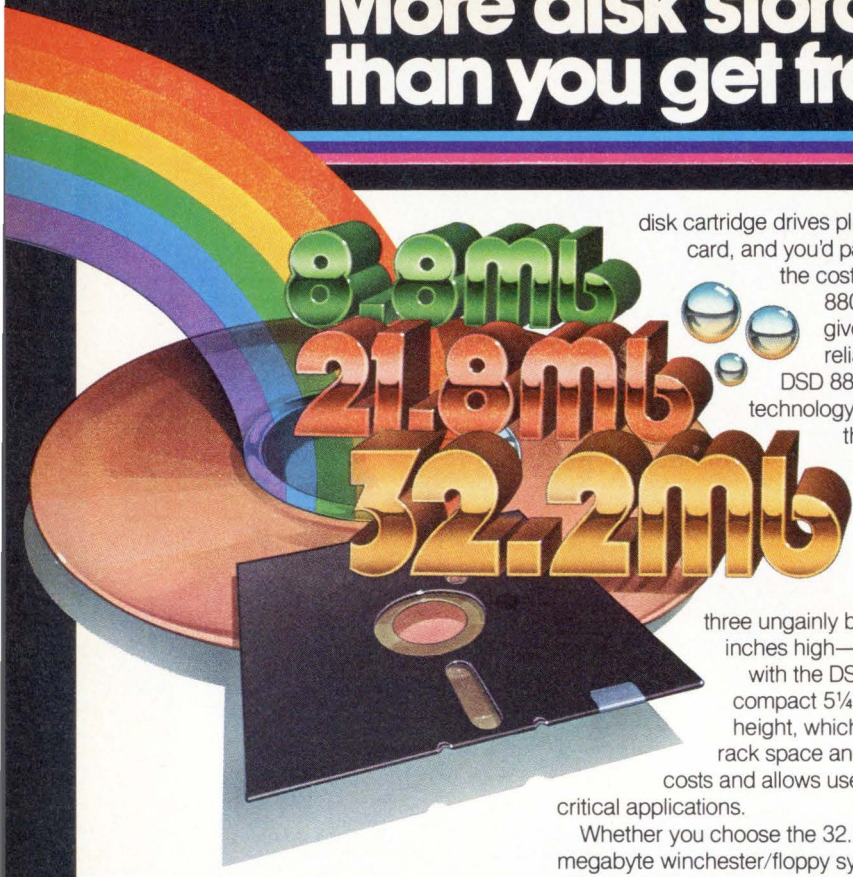

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With the addition of a new DSD 880 version, you now have three choices in winchester disk storage: 31.2, 20.8 or 7.8 megabytes. Each with a choice of 0.5 single- or 1-megabyte double-sided floppy backup. More capacity for less cost-per-megabyte than any comparable DEC alternative.

To match the capacity of the DSD 880's 31.2-megabyte winchester disk, for example, you'd need three DEC RL02 disk cartridge drives plus bootstrap card, and you'd pay about twice the cost of one DSD 880. Plus, you'd give up the high reliability of the DSD 880's winchester technology—a state-of-the-art choice DEC doesn't even offer LSI-11 and PDP-11 users. And you'd have three ungainly boxes over 30 inches high—as compared with the DSD 880's compact 5¼-inch panel height, which saves you rack space and cabinetry costs and allows use in space-critical applications.

Whether you choose the 32.2, 21.8 or 8.8 megabyte winchester/floppy system, your disk system is more cost-effective than any comparable DEC disk drive or combination.

The hardware bootstrap is built right into the interface so you don't have to pay extra for a separate board.

The DSD 880 interfaces require 70% less backplane space than equivalent DEC configurations.

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The DSD 880 is hardware-compatible. It integrates with any DEC LSI-11 or PDP-11 computer-based system. Combine the DSD 880 with a VT103 containing an LSI-11/23 and you've got a complete, powerful table-top microcomputer with up to 32.2 megabytes of storage.

Software compatibility is no problem either. You can use your RT-11 or RSX-11 operating systems with RL01 or RL02 (winchester) and RX02 (floppy) handlers. With no modifications at all. And the DSD 880 runs all applicable DEC diagnostics and utilities.

It's media-compatible, too. DSD floppies can use either DEC double-density or IBM single-density formats.

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DSD 470 gives you low-cost double-sided floppy storage for your LSI-11.

The DSD 470 is software compatible and can be configured for single- or double-sided diskettes. And its single-board controller/interface* has far fewer parts than separate boards for better space utilization and improved reliability.

Choose DSD 440 for single-sided floppy storage with your LSI-11 or PDP-11.

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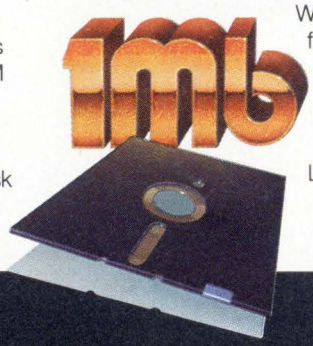

With 2 single-sided floppy drives, the DSD 430 gives you full RX02 compatibility and complete LSI-11/23 four-level interrupt support.

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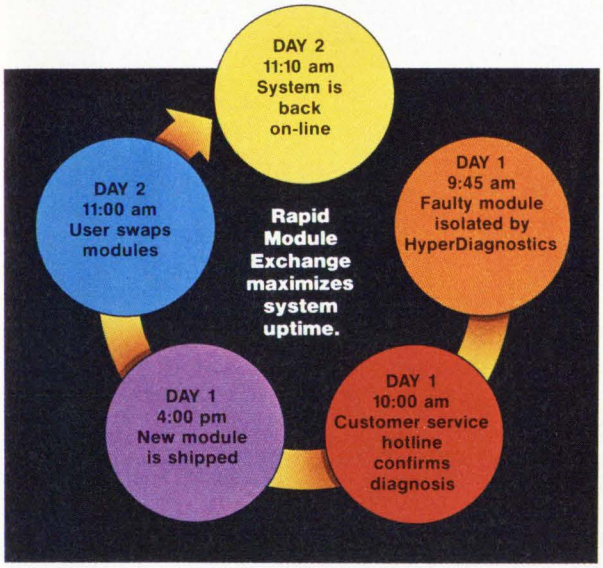

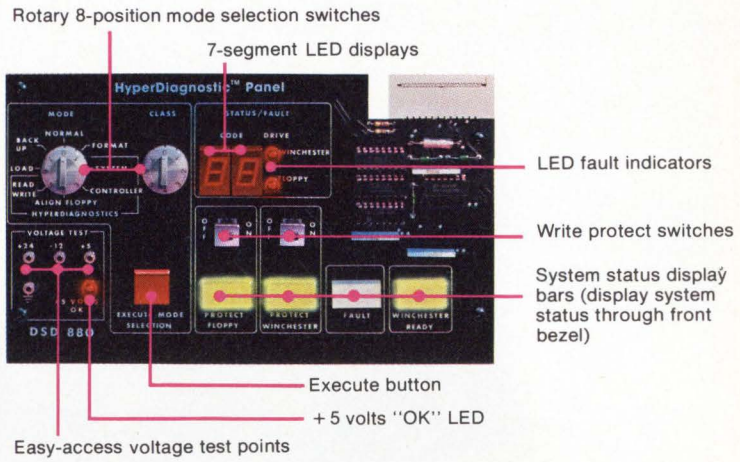

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CIRCLE NO. 13 ON INQUIRY CARD

and ISO services. What Comdex hopes to accomplish, he adds, is to offer significant insights into the emerging market for small computers and word-processing systems via support from vendors. To get that message across, Comdex has arranged 40 separate sessions focusing on business, financial and marketing issues relevant to ISOs. The sessions will be broken down into 13 groups, covering such topics as industry issues, aids for systems integrators, software and services and market growth data.

Included in a series of sessions for systems integrators will be one called "Sweet and juicy 16-bitters," chaired by Tom Hogan, technical editor of *Infoworld*, and a session called "Getting into local-area networks," headed by 18-year LAN-management veteran Dan Zatyko of Zatyko Associates, Santa Ana, Calif. A special-interest session to be chaired by Micronics president Mark Garetz, called "Board-level upgrades and add-ons," will focus on what is available in the board market and how to boost expansion of an existing board.

Five "special-focus" sessions also will be included in the conference, called "Systems integrators," "Computer retailers," "Commercial OEMs," "Office machines/product dealers" and "Establishing international ISO connections." The commercial-OEM focus will be oriented toward Digital Equipment Corp. products and will feature a DEC executive and personnel from one of DEC's commercial OEMs.

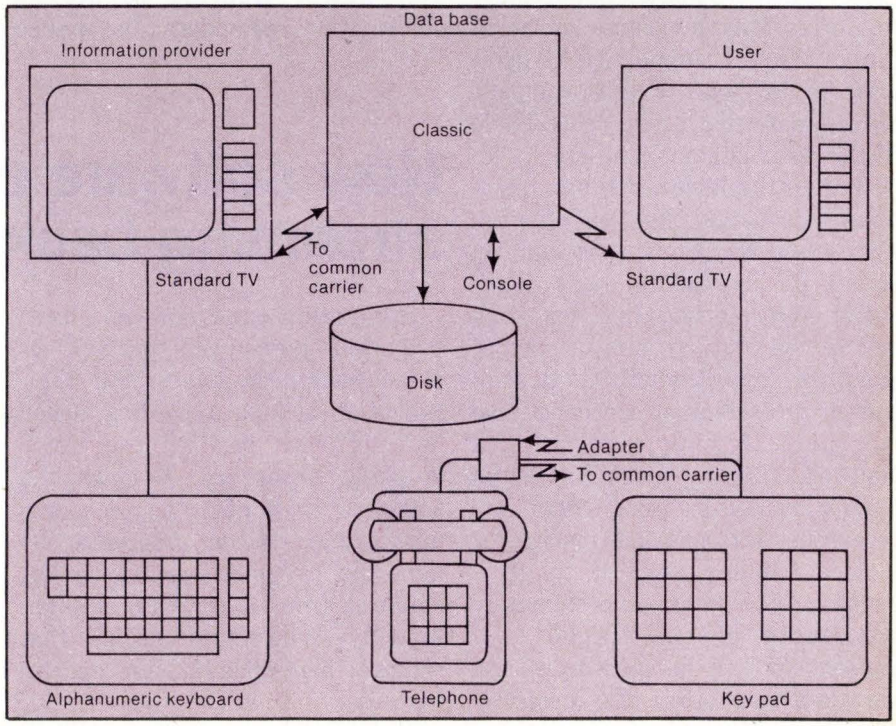
For an international view, a session headed by C. Itoh's vice president of marketing, Bob Cowan, will look at how ISOs are handled overseas and in the U.S. In addition, two "executive-impact luncheons" are on the session agenda, covering the U.S. economy and its impact on ISOs, and the entry of giant office-equipment vendors into direct retailing. —*Nancy Love*

Modcomp explores market for private viewdata networks

Since AT & T's May announcement of its Presentation Level Protocol (PLP) specification for viewdata systems in the U.S., the various worldwide viewdata approaches and their potential for penetration into the consumer market have been widely publicized. A month before the A T & T announcement, however, Modular Computer Systems, Inc. (Modcomp), announced a turnkey viewdata system oriented primarily toward another market segment—private business users, especially multinational corporations. While Modcomp expects to install its first "ViewMax" system by year-end, the potential size and composition of the private viewdata sector is not yet known.

Modcomp chose to make ViewMax compatible with the British Prestel viewdata system (MMS, August, p. 59), which, with about 11,000 users now on-line, is the best-established two-way videotex system. "We have the Prestel mode because the time was right, and we have a customer base and market in Europe into which we can sell," explains Scott McClary, Modcomp's business manager, communications. He notes that Modcomp is basically a minicomputer manufacturer, and is in no way tied exclusively to the Prestel approach. "If a good Telidon (Canadian viewdata technique) or PLP market develops, we can choose to develop packages for those systems," he says.

ViewMax packages come in three versions—ViewMax/M, ViewMax/L and ViewMax/HP—which sell for $40,000, $50,000 and $60,000, respectively. Running on Modcomp



Modcomp's ViewMax *is a turnkey viewdata system aimed at the private business market.*

Classic 7821 or 7840 computers, the M (medium) version supports either 24 or 32 ports; the L (large) version operates on 7840 or 7870 processors and supports 64 or 96 ports; and the 7870-based HP (high-performance) version supports as many as 256 ports.

For information providers—ViewMax users who need to put data into the system's database for general-user access—Modcomp offers an intelligent editing terminal produced by England's Bishopsgate Terminals Ltd. ViewMax allows normal Prestel-type editing plus an extended-feature "Super-Edit" mode. With Super Edit, editing commands appear at the bottom of the screen and are color-coded to match keys on the terminal's keyboard. A variable-sized window can be created on the screen to aid in manipulating text or graphics. Along with editing functions, the ViewMax database provides operational modes for index inquiry, bulk updates and statistics and accounting.

Modcomp's McClary says the most immediate market opportunity for ViewMax systems is with multinational corporations that want to develop a Prestel-compatible database that would be available to the international community. To permit international communications, Modcomp plans to offer an X.25 network gateway capability, slated for availability next year.

But the market size for such private viewdata systems is open to question, says Kenneth G. Bosomworth, president of International Resource Development, Inc., a Norwalk, Conn., market-research and consulting firm. IRD has researched the consumer market for viewdata and expects it to grow rapidly. By 1990, approximately one-fourth of the 80,000 U.S. households will be able to access viewdata networks, IRD projects. However, Bosomworth says, two other technologies could severely limit the demand for private viewdata systems.

"One alternate approach is office automation, such as that used by Datapoint Corp. with its integrated electronic office or IBM with its 5520 system," he says. "The second approach is the general-purpose, relational-database system implemented on standard mainframe computers and accessed by dumb terminals. Private viewdata, a simple database system that is accessed by TV sets, will have to compete with these approaches, and I suspect (viewdata) won't compete effectively."

McClary agrees viewdata will face these other database approaches in the market. "If you take large MIS-database users who are comfortable with such systems, and the systems are satisfying their requirements, then they won't be interested in any kind of viewdata system," he admits. However, he thinks the relatively low cost of viewdata systems will attract some users. He also believes some companies, wanting to act as information providers on public viewdata networks, will buy ViewMax systems to prepare and store their data for access by consumers.

Bosomworth disputes the existence of such systems-oriented information providers. "The information provider won't need his own system because the public networks are going to have to provide simple access by information providers from dumb terminals," he says. "Some providers may eventually get their own systems, but I don't think it will be an exciting market."

If private users for viewdata systems exist in any quantity, they may prove to be in specific industry segments, Bosomworth believes. For instance, about 40 percent of the existing Prestel users in the U.K. are in the travel industry, he says. "There may be specialized industries, such as travel and farming, where viewdata is an appropriate and cost-effective approach," he says. "But in terms of the general office environment, I think companies will follow the relational-database and the integrated-electronic approaches, and will definitely not go the viewdata route." *—Dwight B. Davis*

New software enables streaming backup at 100 ips

Streaming-tape drives have promised high-speed backup for Winchester-disk drives, but their potential 100-ips recording speed has not been realized, say some industry observers, because the software to handle the task was unavailable. Other observers believe the streamer's popularity has suffered from a scarcity of high-capacity Winchester drives that require high-speed, high-capacity backup.

Nevertheless, system builders and disk-controller manufacturers have been supplying software to support ½-in. streaming-tape drives on their hardware. Many of these utilities, however, are not file-dependent; they do not distinguish between used and unused sectors on a disk.

The first such utility to make that distinction is Spectra Logic Corp.'s Spectra Stream RDOS, which enables a streamer to record at 100 ips without repositioning. The utility is being shipped now by the two-year-

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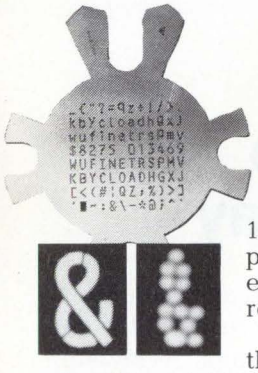

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CIRCLE NO. 14 ON INQUIRY CARD

old manufacturer of multifunction disk- and tape-controller boards.

Aimed initially at Data General Corp.'s Nova and Eclipse systems, the software streams RDOS-compatible disks to 100-ips streaming-tape drives through Spectra Logic's DG-compatible Spectra 20 dual-function controller. Steve Roberts, executive vice president of the Sunnyvale, Calif., company, says Spectra Stream RDOS is the first in a series of utilities designed to run with the firm's controller boards. The RDOS-compatible package, he says, will also run under AOS, DG's multitasking, multi-user operating system.

Spectra Stream is keyed to a disk's file structure, using a sector map to plot only those sectors that have been used, Roberts explains. Those sectors containing data are copied, and empty sectors are bypassed, resulting in a continuous reading process.

Buffers on the controller and those in the host CPU's memory keep data moving to the tape. The software requires about 32K bytes of memory, of which 16K to 20K bytes are used as buffers.

The utility is written in assembly language, "because that language is efficient and has low overhead," says Tom Gilman, vice president of software development. "An instruction must be sent every 3 μsec. to prevent repositioning of the tape, which would stop the streaming," he adds.

Tape drive manufacturers have not provided streaming software even though such utilities would help sell their hardware. The reason for this is obvious, says Roberts. "They have no experience working with operating systems. They want to focus on tape drives," he says.

"We're not in the software or controller business," adds Larry Hemmerick, vice president of marketing at Cipher Data Products, Inc., San Diego, Calif., manufacturer of ½-in. streaming drives. "The resources to solve those kinds of problems are beyond our capabilities. We may understand the problems, but not the operating systems."

A version of Spectra Stream written for the company's Spectra 21 Digital Equipment Corp. RSX-compatible multifunction controller will be available later this month. The Spectra Stream RSX utility will be followed by a VMX-compatible package for DEC's VAX systems, Roberts says. Future releases may include a file-selection feature that would enable users to choose which files are to be backed for specific purposes.

Spectra Stream RDOS runs with any DG- or ANSI-compatible 800- or 1600-bpi tape drive. Spectra Stream packages are available for a one-time fee of $500.

Roberts hopes Spectra Stream will help sell the company's hardware, and reports indicate that his hopes may be realized. One source says Spectra Logic will supply its DG- and DEC-emulating multifunction controller boards and Spectra Stream software to Ampex Corp., Cupertino, Calif., which will incorporate them into subsystems using its own disk drives and its recently announced TMS ½-in. streaming-tape drive. Neither company confirms the arrangement, however.

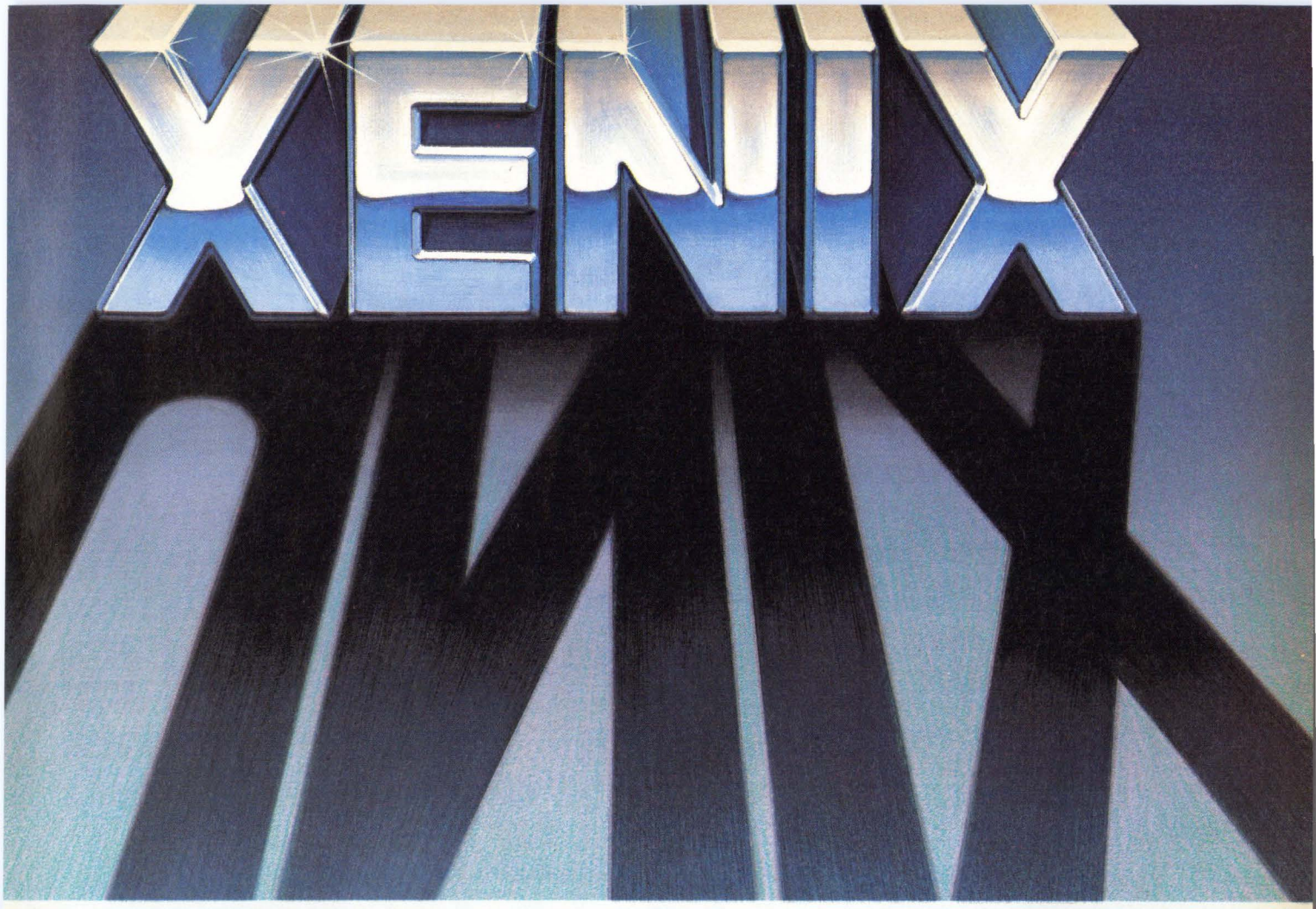
Spectra Logic expects to become more software-oriented over the next five years. The immediate plan is to provide streaming utilities for all systems for which Spectra Logic builds controllers, including DG, DEC and Perkin Elmer hardware. The firm is reportedly eyeing another market with plans for a new controller, but Roberts will not indicate what it will be.

—Larry Lettieri

A data, voice and video network that's here today

With hundreds of man years of development time behind it, The Mitre Corp.'s broadband networking product—Mitrenet—has a substantial head start over most competitors' offerings. The rapidly evolving network operating in the company carries video and voice traffic along with a 1M-bps data channel, and multifunction terminals linked to the network can each access any of three host processors running various application software under different operating systems.

The network already supports electronic mail—a facility that will soon be upgraded by placing Bolt Beranek & Newman Inc.'s InfoMail on the system—and work on an elaborate data-encryption scheme is under way. Costs and complexity are kept low by using standard community antenna television (CATV) equipment. But don't rush out to buy the network; it's not for sale—at least not directly. However, if you're a vendor interested in licensing some of this patented technology, it's a different story. Because Mitre is a federal contract research center, working primarily for Department of Defense clients, the company doesn't build its products in volume to compete with private industry on the open market. Mitre's staff will typically develop and build a few prototype products for a client's application and, if the units need to be produced in volume, will aid the client in selecting a private vendor for



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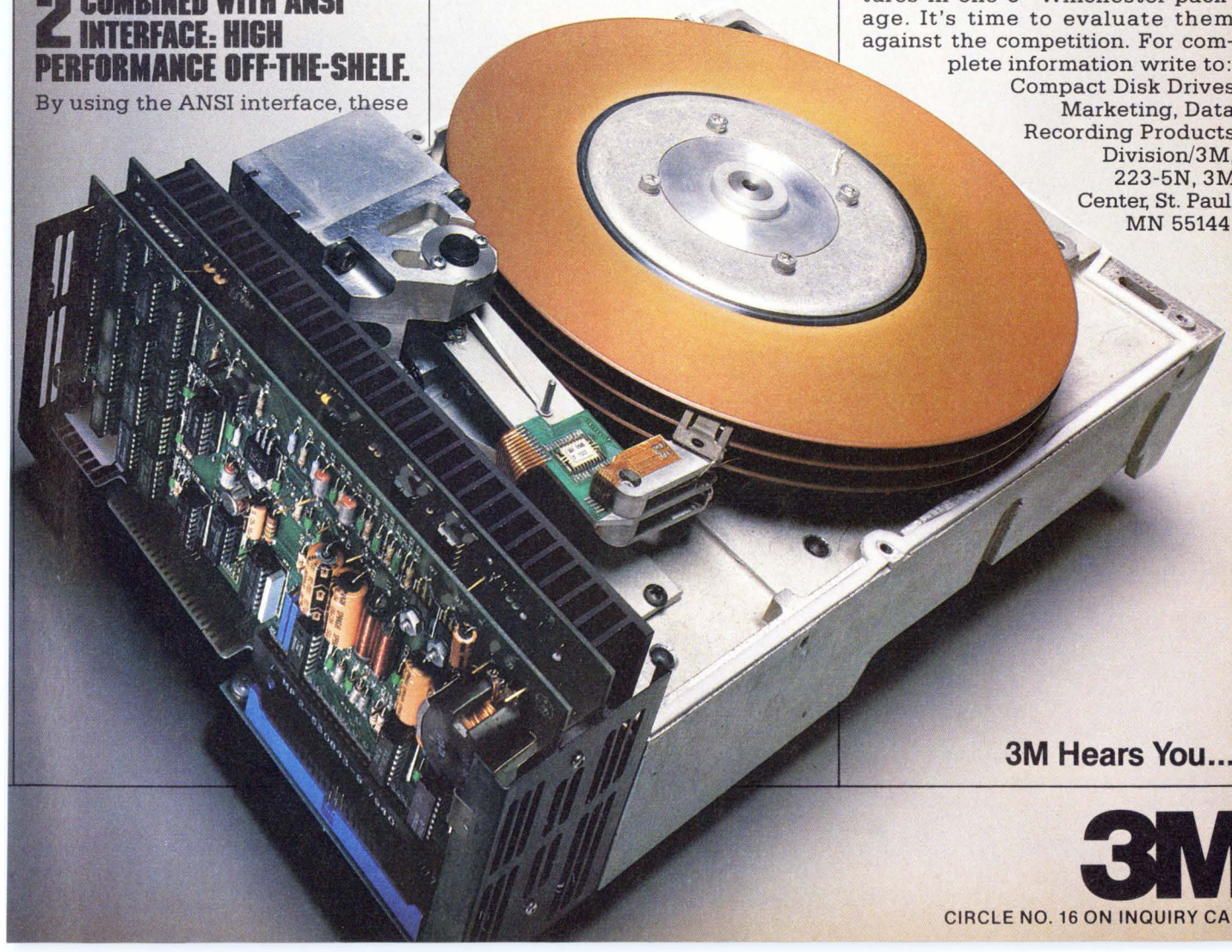

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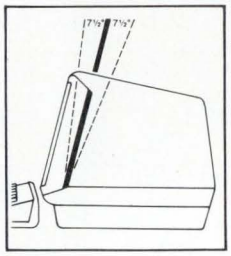

Because the Executive 80 is based on powerful 8088 microprocessor technology, a variety of operating modes can be selected to match the type of work. And there are as many as sixteen programmable function keys which can reduce laborious keyboard routines to a single keystroke. With all these features, we believe the Executive 80 can achieve higher throughput — and therefore lower costs — than any other terminal on the market.

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Hazeltine Executive 80

Answers for the Eighties

CIRCLE NO. 17 ON INQUIRY CARD

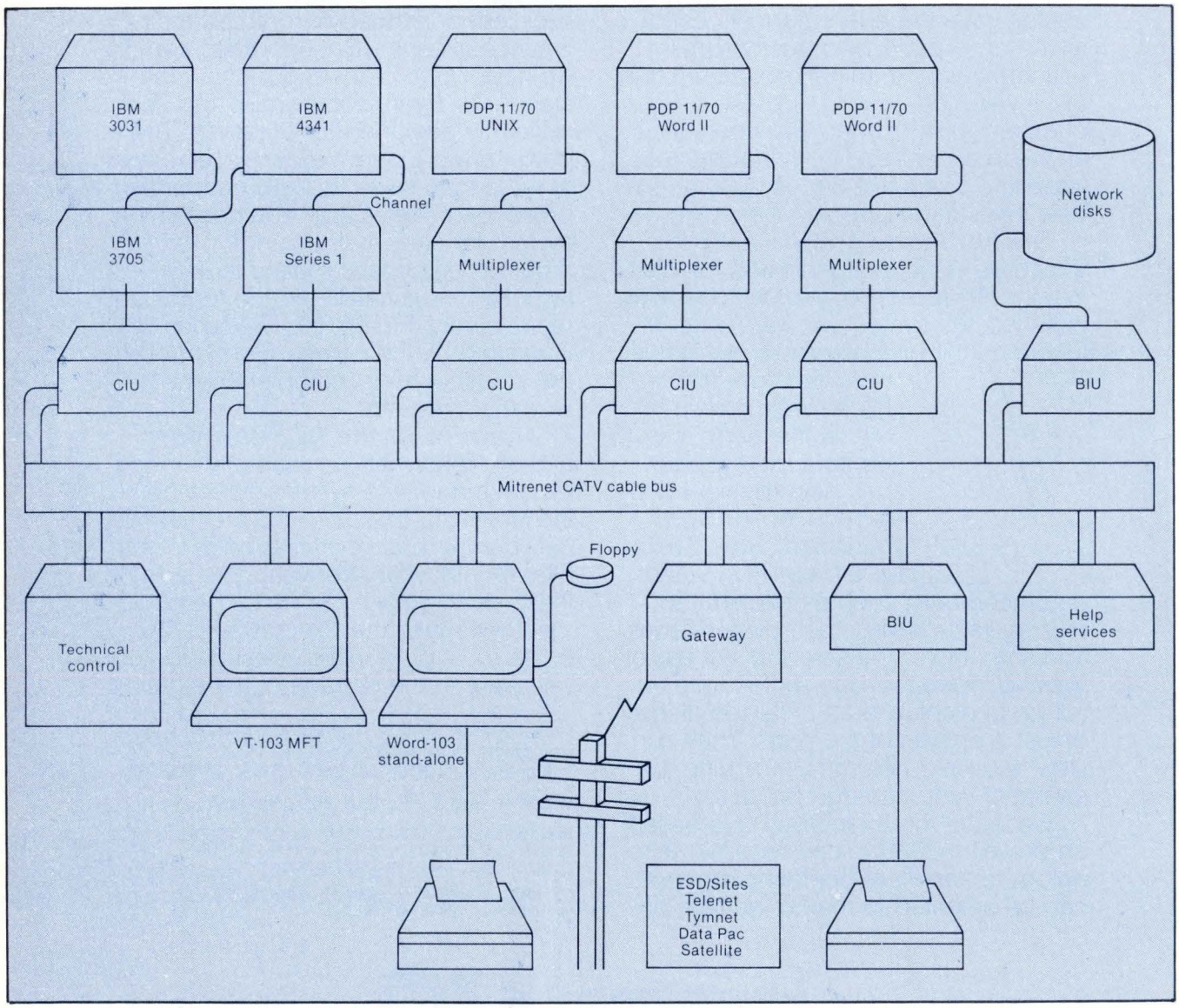
quantity production.

Like other nonprofit institutions that develop new technologies, Mitre also patents much of its work. These patents are available for licensing to companies that believe they can successfully build and market Mitre's technology.

In the case of its broadband local-area network, Mitre holds a patent for Carrier Sense Multiple Access with Collision Detection (CSMA/CD) for use with this type of system. (Xerox uses the same type of access method on its baseband Ethernet network.) In Mitrenet, the device linking terminals to the network cable and performing the patented CSMA/CD function is called a bus interface unit (BIU).

With digital logic, the BIU also incorporates an RF modem, which, in the case of Mitrenet, operates at a 50-MHz center frequency and occupies about 3-MHz of the cable's 5- to 300-MHz bandwidth. The BIU also provides buffering, speed conversion, error detection and correction and protocol support for the connected devices.

Mitre's BIU has taken several shapes over the years, the latest being that of a single board that fits into the Q-bus card cage of a Digital Equipment Corp. VT-103 terminal. Mitre chose the VT-103 because, along with accepting the BIU, the card cage houses additional boards for upgrading into an intelligent work station, explains Frederic M. Cullen, leader of the Bus Application Development Group. Slated for



Mitre plans to add intelligent VT-103 work stations *to its network over the next year, resulting in more distributed intelligence throughout the system. As processors are interspersed along Mitrenet, print servers and disk servers could be added to support the intelligent work stations. Help facilities and gateways to other networks will probably also be incorporated into the system.*

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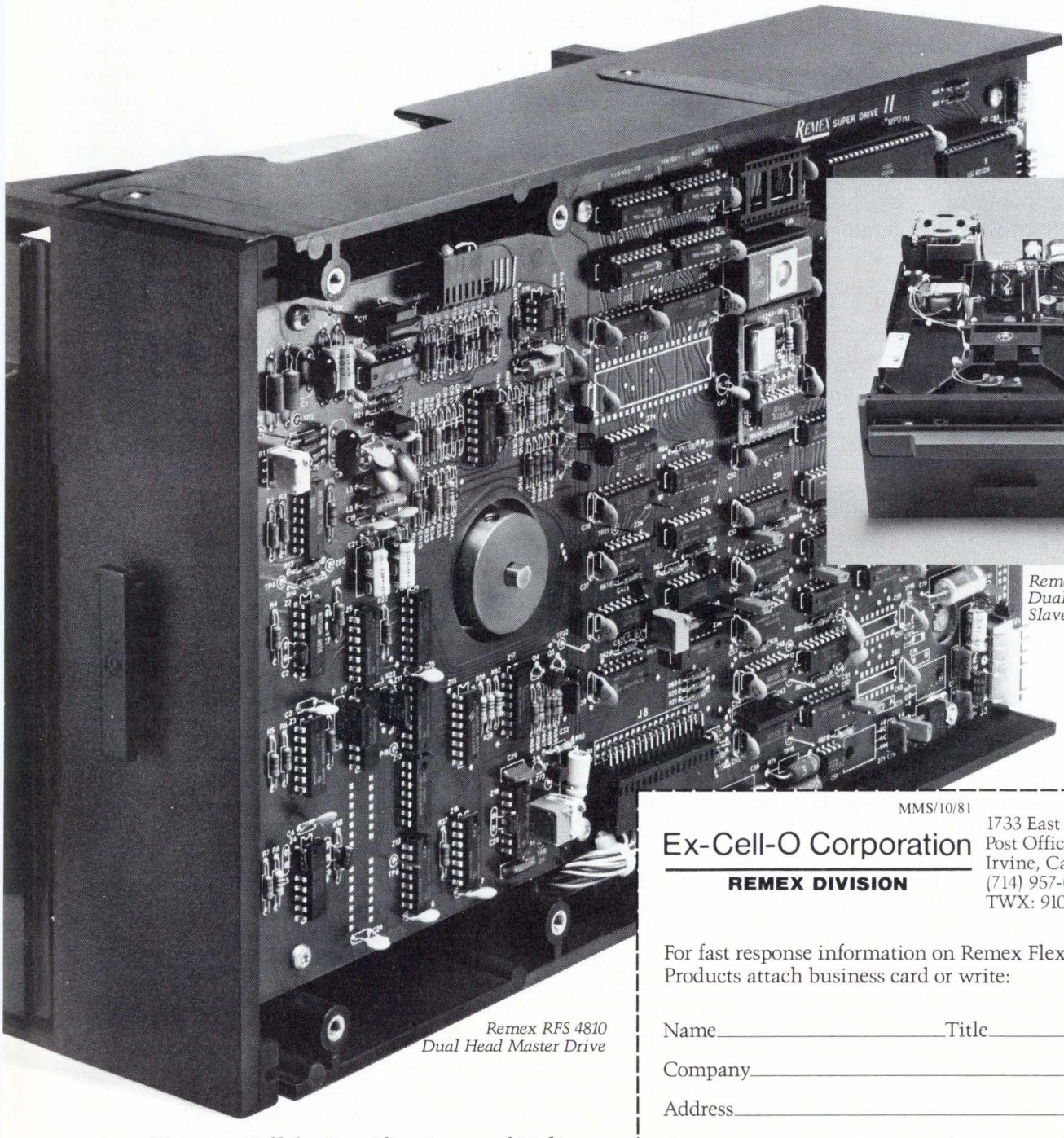

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CIRCLE NO. 18 ON INQUIRY CARD

incorporation in Mitrenet in the near future, such intelligent terminals will give local processing power and increased security for such applications as stand-alone word processing, Cullen says.

Another recent development is that of a specialized BIU called a computer interface unit (CIU). Serving as a port-contention device for all terminal users, each CIU allows as many as 16 RS232C ports for any host processor to be connected simultaneously to the network. Mitre operates three hosts on its internal network: an IBM 3031 running MVS and two DEC PDP-11/70s, one running Bell Laboratories' UNIX operating system and the other running Data Processing Design's WORD-11 word-processing system.

While other broadband networks have been introduced, Mitre's differs from most others by using a dual-cable architecture. Single-cable systems must divide the cable's bandwidth with sub-split or mid-split techniques to establish a receive channel for every transmit channel implemented. The dual-cable approach lets users exploit the full 300-MHz bandwidth by providing separate cables for transmit and receive channels. And, because much of the cost involved in laying cable comes from the labor involved, Cullen says installation of a dual-cable systems costs only about 1.2 times that of a single-cable network.

Mitre is focusing much attention on reliable methods to encrypt data transmissions over the network. With a technique now being developed, Mitre uses a method based on both the data-encryption standard (DES) approved by the National Bureau of Standards and on public-key cryptology. When used, the encryption scheme automatically turns plain text into cipher text. Cullen says the work factor for breaking the public keys is significant enough to ensure privacy for most users, although the method has not been approved for use with DOD classified information.

So far, only two commercial vendors have licensed Mitre's CSMA/CD technology for broadband. One, Computrol Corp., Ridgefield, Conn., already supplies Mitre with the RF modems used in the VT-103 BIUs. However, Garry Stephens, marketing manager at Computrol, says the company has yet to develop a total-interface product using the Mitre approach. Noting the BIU evolution thus far, Stephens says it's possible Mitre's design is not finished. He also questions the commercial viability of the dual-cable approach, saying, "In the commercial world, everybody wants a mid-split, single-wire network, so they can piggyback on all the CATV systems going into the cities." Until such market issues are resolved, "It's best to cover all the bets, for now," he says.

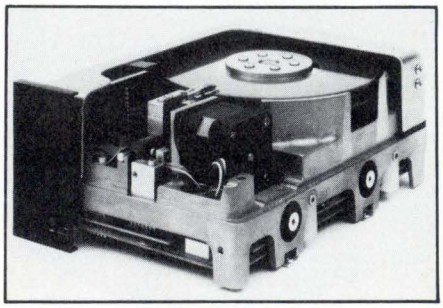
The other CSMA/CD licensee, on the other hand, has already sold its product to both government and commercial users. Digital Communications Corp., a Germantown, Md.-based M/A-COM subsidiary, markets a BIU equivalent under the name Cable Access Processor (CAP). An external unit, the CAP has been installed, via a DCC OEM, in the Securities Industry Automation Corp. (SIAC) network, a subsidiary of the New York and American stock exchanges. Chuck Grutzius, product sales manager for DCC's Data-Communications Division, says the company has also won a joint procurement contract issued by the National Library of Medicine on behalf of several federal agencies in the U.S. Army, the U.S. Air Force and the National Aeronautics and Space Administration. Calling for more than 500 CAP units, the contract is worth approximately $1 million. *—Dwight B. Davis*

5¼-in. Winchester reflects 1982 hardware pricing

Further information detailing the 6M- and 12M-byte 5¼-in. Winchesters planned by MiniScribe Corp. have begun to surface.

In addition to using a head-actuation method that has not previously been employed on a small Winchester-technology drive, the Longmont, Colo., start-up is pricing its first offerings at a volume price lower than that of any 5¼-in. device yet announced. Called MiniScribe I, the new hardware is designed for controllers that are compatible with Seagate Technology's 6M-byte ST-506 and 12M-byte ST-512, the first small Winchesters to be equipped with thin-film read/write heads.

Pricing for the single-platter, 6M-byte MiniScribe drive is set at $745 in 1000-lot orders (compared to $875 for the dual-platter ST-506) and $845 for the dual-platter, 12M-byte drive (compared to $1150 for the dual-platter, thin-film ST-512 in 500-lot orders).



Rack-and-pinion actuator *tied to a stepper motor is visible in this cutaway view of MiniScribe Corp.'s first hardware offering, the MiniScribe I series 5¼-in. Winchester.*

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With a broad range of advanced capabilities (including new options offering three times the computational speed of the basic system), the HP 9845 can be configured to meet your precise needs—from finite element analysis to simulations and modeling. And almost anything in between.

The key is flexibility. You can choose from among 14 different configurations, including a color display and 448K bytes of read/write memory. Then, attach a hard disc, printer, plotter, or other peripherals. And with the 9845's advanced datacomm capabilities, you can even share technical information with other computers in distributed processing environments.

The HP 9845. System prices start at under $20,000. Call us if you've got similar designs.

All of our computers are backed by HP's worldwide service organization. For more information, call your local HP sales office listed in the White Pages. Or write to Hewlett-Packard, Attn: Pat Welch, Dept. 08108, 3404 E. Harmony Rd., Ft. Collins, CO 80525.

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When performance must be measured by results.

HEWLETT PACKARD

CIRCLE NO. 19 ON INQUIRY CARD

"And in conclusion, I'll only use my exceptional powers for the good of mankind."

"That's a vow all we Vector 3005s make. And it's not one we make lightly.

"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.

"Our powers don't stop there, however. Each 3005 also comes with a 32-bit error-correcting code – the first time sophisticated IBM-style technology has been available on a small business system. This lets us detect and correct errors, and almost completely eliminates data loss on disks due to dirt, wear, or damage.

"All this makes us pretty awesome, all right. But there's more. When coupled with Vector's MEMORITE III and EXECUPLAN software packages, we give you a 30,000 word dictionary, the ability to create your own phrase library, a teaching manual right on the screen, pass word security, plus a host of other word processing capabilities as well as financial planning, forecasting and basic accounting.

"And we're reliable. Our powers won't diminish, our abilities won't fade, and dedication to mankind won't weaken.

"For more information and your nearest dealer, call Vector at 800-423-5857. In California, call 800-382-3367. Or write to them at 31364 Via Colinas, Westlake Village, CA 91362.

"Thank you all for coming today. And I hope we'll have the chance to do business together in the future."

VECTOR

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COMPUTERS FOR THE ADVANCEMENT OF SOCIETY.

CIRCLE NO. 20 ON INQUIRY CARD

MiniScribe's pricing is raising some eyebrows, but company president and co-founder Terry Johnson insists that the figures are for real. "There will be an inevitable erosion of prices in the market for small Winchesters," he says. "The prices we've set reflect that." Jim Porter, Mountain View, Calif., industry analyst and publisher of *Disk/Trend Report*, agrees to a point: "MiniScribe's pricing is typical of what OEMs thinking about small drives can expect in 1982," he says.

MiniScribe's prices also reflect a lower component cost," Johnson says. "We're using conventional nickel-ferrite Winchester heads on a standard-grade oxide-coated medium," he explains. "We're not using anything elaborate." Still, the company is packing a lot of data into its hardware. Bit densities, for example, exceed 8000 bpi, a specification that Johnson says the company attains through the use of sophisticated electronics.

Track densities are also higher than those associated with other small Winchesters—402 tpi. To reach this level, the company uses a rack-and-pinion actuator meachanism analogous to the type found on sports cars. These actuators first appeared in the 1960s on IBM's 2311 and 2314 disk drives, but have yet to appear on Winchesters for two reasons. First, access times are slower. However, Johnson believes that this is not an overriding consideration in small-business computer systems and other desk-top configurations, in which these small Winchesters are expected to be heavily used. Second, many Winchester designers have been wary of this type of system because of fears that medium contamination could result as the actuator and the medium gnash. "We have anticipated that people would bring that issue up," Johnson says, "and we've already addressed ourselves to that problem." —*John Trifari*

TWO MORE DATA GENERAL MANAGERS RESIGN

Data General Corp., Westboro, Mass., still seems to be feeling the brunt of a massive reorganization that took place earlier this year (MMS, April, p. 141), as two more vice presidents exited the company in late August. Since the beginning of this year, the company has lost several high-level managers, including vice presidents William D. Jobe, Jeffrey C. Kalb and H.E. James Finke. The most recent departures were Lawrence Seligman, vice president and general manager of the company's small-business systems division, and Paul D. Stein, vice president of manufacturing. Sources close to the company speculate that the recent influx of managers from IBM Corp. and the transformation of DG into a large company are at the root of the changes. Seligman reportedly resigned to start his own company, which will deal with distributed computing or office automation. Recently appointed senior vice president Frank P. Silkman, an IBM veteran, will serve as acting division head. Stein has not made his plans public, but he has been replaced by David L. Chapman, another IBM alumnus who joined DG in July as vice president of U.S. manufacturing operations. Stein and Seligman will be available to DG on a consulting basis.

Manufacturers find TV a boon to sales

What do you get when you combine the famous Stag's Head Pub in Dublin, Guinness Stout beer and Irish soccer players? The answer is not a post-game celebration, but rather a Data General Corp. television commercial about computers.

In July, DG became the latest manufacturer to take its message to the airwaves. Wang Laboratories, Inc., IBM Corp., Xerox Corp. and Apple Computer, Inc., among others, already have used TV as a powerful supplement to print media to gain company and brand recognition among consumers and non-data-processing workers. Wang claims that nearly five years of TV commercials have contributed to revenue growth.

DG can take advantage of the experience its predecessors have had with TV. The company's first commercial, filmed in Dublin, was designed to give DG renown as a major computer supplier to large users and to ease customers' anxiety about buying a computer. The commercial shows a Guinness Group computer application that monitors the sales of Guinness Stout beer in 10,000 pubs across Ireland. It focuses on the person who purchased the DG computer, says William J.P. Smith Jr., corporate director of marketing communications at DG, who helped prepare the commercial, along with a New York advertising agency. The commercial will also give publicity to Guinness and could help sell DG computers to Guinness distributors in the U.S.. The commercial is the first in a series of four that will run in 12 major U.S. cities over the next two years, and for which DG will spend "millions of dollars." The initial commercial was aired in late July. The next commercial will be about a DG computer used in Aspen, Colo., to monitor city utilities and reservations during peak tourist seasons.

If one could go back 10 years, one would hardly expect an OEM "iron" vendor such as DG to be promoting a "comfort" sell to small-business executives, such as controllers in Fortune 500 companies, and first-time small-business system users. Smith says data-processing managers already know about DG and its

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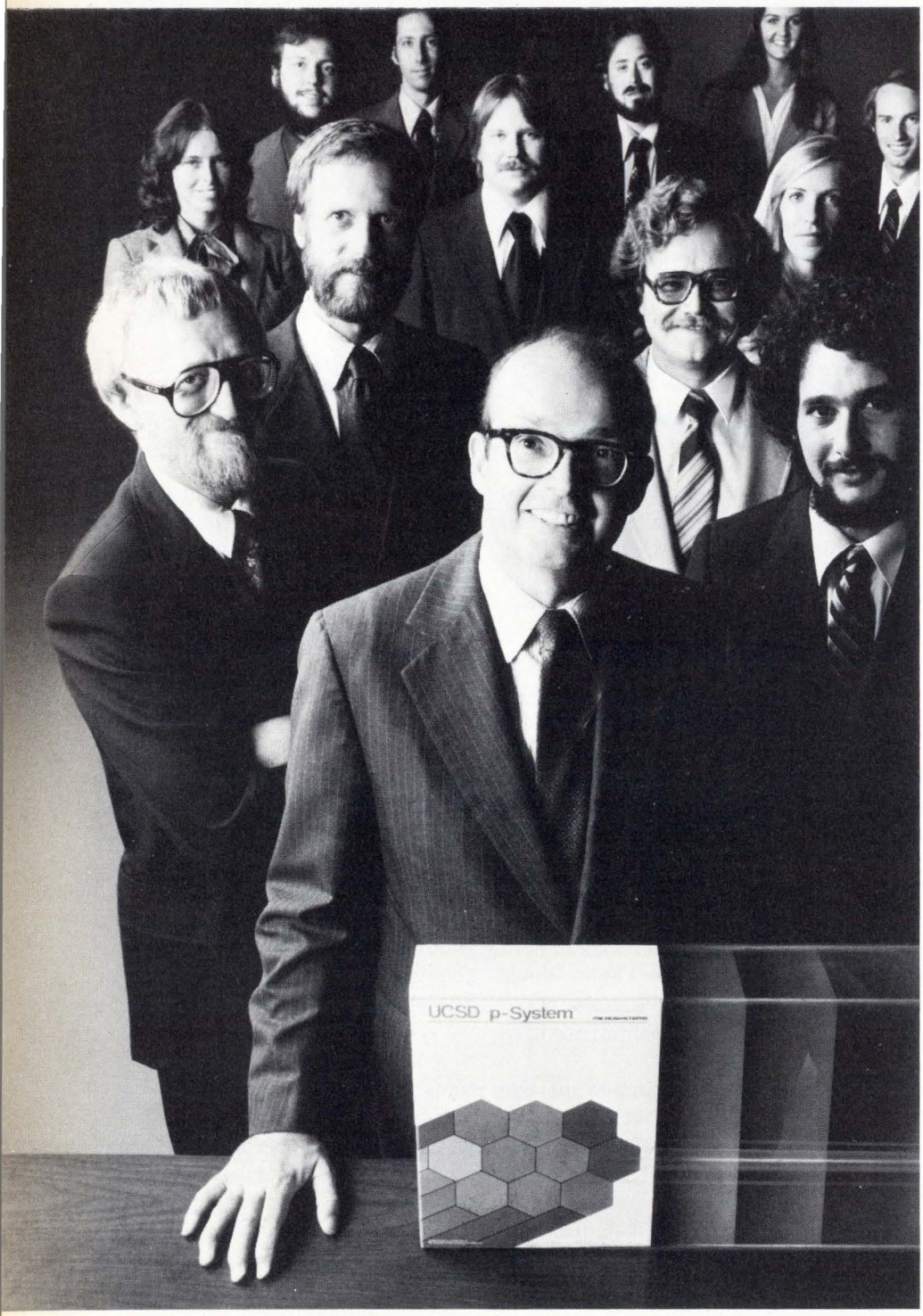
JOHN BRACKETT, President, SofTech Microsystems



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CIRCLE NO. 21 ON INQUIRY CARD

products. Yet, the company views the TV campaign as an extension of its emphasis on end users. Company and market research indicates that users are more likely to team up with a mature company that offers service as well as products.

Concerning DG's use of TV to sell products, company executive vice president Herbert J. Richman says, "Since this approach requires substantially increased awareness and recognition of DG with a general-business management audience, individuals who make the final approval concerning the procurement of data-processing equipment, we have selected television as the way to reach these important decision makers. Television is the one common communication medium that virtually everyone uses." Another DG spokesman points out that, while the printed word creates thousands of impressions, radio and TV create tens of thousands of impressions about their subject matter.

Reaching the TV audience is a very different experience for most manufacturers than is advertising in trade and business publications. A commercial incorporates humor in a serious subject to hold a viewer's attention, explains DG's Smith. It is shown during early-evening and late-news programs, and on tennis and golf telecasts. DG believes many of the viewers it hopes to reach watch these shows. Two versions of the commercial are being run: a ½-min. version and a 1-min. version.

The first commercial cost the company about $200,000. Price to air it is $1000 to $2000 for 1 min. on the early-evening news, depending on the city and the precise time slot, and $1800 to $4000 for the same amount of time on the late news, which has more viewers, Smith says.

The initial investment may seem large, but commercials are cost-effective. That surprises many manufacturers, says Harry Viens, director of corporate communications at Wang.

Wang aired its first commercial in 1977 on network TV and later on some sports programs. Viens says the commercial increased awareness of Wang's name and products 300 percent among professionals and managers.

IBM's name was then the one most frequently mentioned in conjunction with computers, and Wang wanted prospects to consider Wang as well. The company positioned itself as closely to IBM as possible with a commercial depicting Wang as "David," who kills "Goliath."

The 30-sec. commercial shows a company boardroom in which the company president says he'd like to buy from the giant computer company. The president's assistant, David, says the company should go with Wang, after which the room shakes, signifying that Wang has wounded the giant. Viens says the commercial was very successful.

The company followed it with two other commercials with "giant" themes, aired from fall, 1978, through spring, 1979. They were aimed at gaining recognition for Wang as a word-processing computer supplier. Later in 1979, and into 1980, two more of the company's commercials emphasized its other products, such as integrated-information systems and the Mailway electronic-mail system. The first one showed a baby, symbolizing the future; the second depicted an electronic beam that was shot through offices around the world, and showed close-ups of CRT screens. This fall, two more commercials emphasizing office scenes geared to people, problems and solutions, will follow.

Wang has had impressive results. The company conducts studies among managers and professionals of its brand recognition and that of its competitiors in word-processing systems and computers. The studies include questions that ask what name a manager thinks of when the word "computer" is mentioned, and also whether the manager can identify named companies. Wang claims results of such surveys show that it is second only to IBM. In late 1976, IBM's total awareness level in the described audience was about 79 percent, while Wang's was 5 percent, Viens says. In a survey completed in July, IBM had more than 99 percent overall awareness, while Wang's awareness percentage had increased to 79.

He adds some helpful hints to those considering launching a TV campaign. "The bottom line on television is that you can't sell a product, its features and its benefits," he says. A commercial must also be informative and entertaining to catch viewers' attention.

Discussing Wang's impressive results, Viens quips, "If there is one thing I would like to convince other computer companies to do, it would be to stay out of television."

—L. Valigra

CONVERGENT, NCR SIGN OFFICE-SYSTEMS DEAL

Convergent Technologies, Inc., Santa Clara, Calif., and NCR Corp.'s newly formed Office Systems Division have signed an OEM agreement in which Convergent will supply hardware and software for the Dayton, Ohio, company's upcoming line of office-systems equipment. The deal covers Convergent's existing hardware and software and some products still in development. NCR will add proprietary extensions to the word-processing software available with the Convergent product. NCR's office systems will be announced within a few months, says a spokesman for the company. The value of the contract has not been revealed.

Calendar

SHOWS & CONFERENCES

OCTOBER

20-24 Computerized Office Equipment Expo/Southwest, Houston. Contact: Industrial & Scientific Conference Management, Inc., 222 W. Adams St., Chicago, Ill. 60606, (312) 263-4866.

21-23 EFT Interchange Conference, Houston, sponsored by the Electronic Funds Transfer Association. Contact: The EFT Association, Suite 800, 1029 Vermont Ave., N.W., Washington, D.C. 20005, (202) 783-3555.

21-23 Computer Showcase Expo, sponsored by *Business Week* and *Data Communications* magazines, San Francisco. Contact: Peter B. Young, The Interface Group, 160 Speen St., Framingham, Mass. 01701, (800) 225-4620.

21-23 Enterprise Information Systems Forum, Phoenix, sponsored by Enterprise Information Systems, Inc. Contact: EIS, P.O. Box 1154, Greenwich, Conn. 06830, (203) 661-5492.

21-24 COMPUTA '81 Second International Computer Technology Exhibition, Singapore, sponsored by the Singapore Computer Society. Contact: Gerald G. Kallman, U.S. Representative, 30 Journal Sq., Jersey City, N.J. 07206, (201) 653-3304.

22-23 Magnetic Recording Conference, Santa Clara, Calif., sponsored by the University of Santa Clara, Memorex Corp. and the Charles Babbage Institute for the History of Information Processing. Contact: F. Gordon Smith, Memorex Corp., M/S 12-33, San Tomas at Central Expressway, Santa Clara, Calif. 95052, (408) 987-3960.

25-28 1981 Conference on Electrical Insulation and Dielectric Phenomena, Whitehaven, Pa. Contact: Dr. Chatham M. Cooke, Program Chairman, Bldg. N010, High-Voltage Research Laboratory, Massachusetts Institute of Technology, 155 Massachusetts Ave., Cambridge, Mass. 02139.

25-28 Issue '81, San Francisco, sponsored by SPSS Inc. Contact: Steve Hamburg, Issue Inc., P.O. Box 8224, Chicago, Ill. 60680, (312) 329-2400.

25-30 44th Annual Meeting of the American Society for Information Science, Washington, sponsored by ASIS. Contact: Skip McAfee, ASIS, 1010 16th St., N.W.., Washington, D.C. 20036, (202) 659-3644.

26-28 Computers in Aerospace Conference III, San Diego, Calif., sponsored by the AIAA Technical Committee on Computer Systems, IEEE and ACM. Contact: Thomas V. McTigue, McDonnell Aircraft Co., Box 516, St. Louis, Mo. 63166, (314) 232-0232.

27-29 U.S. Department of Energy Contractors Office Automation Conference, San Francisco. Contact: Larry J. Little, University of California, Lawrence Livermore National Laboratory, P.O. Box 808, -1455, Livermore, Calif. 94550, (415) 422-0150.

27-29 Computer Graphics '81, London, England, sponsored by Computer Graphics World and Online

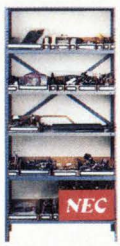
Boost your profits with NEC printers.

NEC

NEC Information Systems, Inc.

They're less expensive going in, and that's only the beginning.

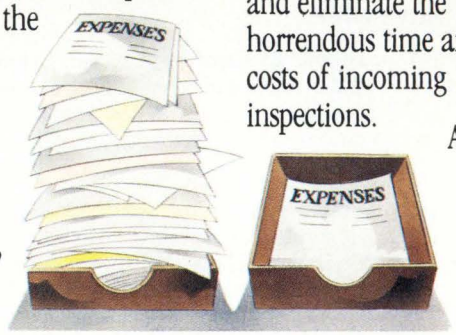
Our printers also give you extra margins which no competitive printers can match. Here's how.



NEC printers have up to 50% fewer parts than competitive printers, so you stock fewer spares.

Built-in quality bolsters profits.

Spinwriter™ letter-quality printers have a mean time between failure (MTBF) of up to 3000 hours (that's about 18 months of normal operation), nearly twice the industry average. We've simplified their design and reduced parts counts by 60%. Result: fewer parts, less costly parts, better odds that the part you need is the part you have. Not to mention lower repair costs and administrative overhead.



Spinwriter printers, with an MTBF of up to 3000 hours, reduce your servicemen's labor and travel costs, administrative overhead and parts costs.

NEC printers have a mean time to repair (MTTR) as low as 20 minutes against an industry average of one hour. Meaning: your service force can become three times as productive.

Next, Spinwriter printers have a dead on arrival (DOA) rate of less than 1%, significantly better than the 5% other manufacturers consider acceptable. So with NEC, you can dock merge with confidence and eliminate the horrendous time and costs of incoming inspections.

All of which translates to the kind of value you take to the bank.

Spinwriter and Trimliner™ models galore

We've got 14 different Spinwriter models, at speeds up to 55 cps with Qume, Diablo, Centronics, or RS-232C interfaces. All use functional, easy-to-service single-board electronics, a one-piece universal power supply, and digital controls that eliminate many moving parts. Plus 10 forms handlers designed and built by NEC.

Our Trimliner line printers print up to 600 LPM. They have a 30-minute MTTR, the industry's best. A 50% better MTBF than competitive models. And a variety of quietized packages.

Because our Spinwriter printers have an MTTR as low as 20 minutes, one-third as long as others, your servicemen can average three times as many repairs per hour.

Take the first step to improving your profits.

Send for information on NEC printers, or call your nearest NECIS sales office.

NEC Information Systems, Inc.
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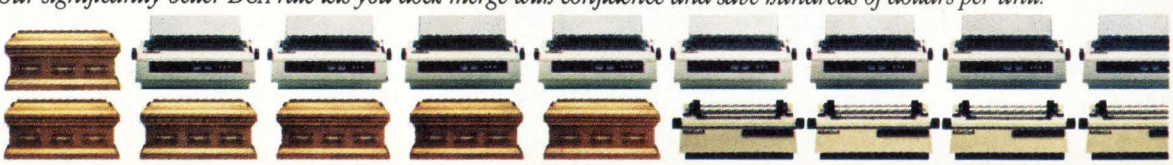
Our significantly better DOA rate lets you dock merge with confidence and save hundreds of dollars per unit.

NEC DOA rate: less than 1%.

Other printers' DOA rate: more than 5%.



CIRCLE NO. 24 ON INQUIRY CARD

Calendar

Conferences Ltd. Contact: Jerry Borrell, Library of Congress, CRS-SPR 1M 413, Washington, D.C. 20540, (202) 287-7062.

27-29 **Cherry Hill '81 International Test Conference,** Philadelphia, sponsored by the IEEE Computer Society Test Technology Committee and the Philadelphia Section IEEE. Contact: Doris Thomas, P.O. Box 371, Cedar Knolls, N.J. 07927, (201) 276-7120.

27-30 **CAD/CAM Graphics Users Expo,** Fort Worth, Texas, sponsored by Computer Aided Manufacturing-International, Inc., Contact: Rhonda Gerganess, CAM-I Inc., 611 Ryan Plaza Dr., Suite 1107, Arlington, Texas 76011, (817) 265-5329.

OCTOBER 29-NOVEMBER 1

Southeast Computer Show & Office Equipment Exposition, Atlanta, produced by The National Computer Shows. Contact: The National Computer Shows, 824 Boylston St., Chestnut Hill, Mass. 02167, (617) 739-2000.

OCTOBER 30-NOVEMBER 1

South Florida Computer Showcase Expo, Miami, sponsored by *Business Week* and *Data Communication* magazines. Contact: Peter B. Young, The Interface Group, 160 Speen St., Framingham, Mass. 01701, (800) 225-4620.

OCTOBER 31-NOVEMBER 1

Joint Annual Conference of the Society for Advanced Medical Systems and the Society for Computer Medicine, Washington, sponsored by the Society for Computer Medicine. Contact: Frederick R. Jelovsek, M.D., Conference Chairman, SCM, 9650 Rockville Pike, Bethesda, Md. 20014, (401) 530-7120.

NOVEMBER

1-4 **DPMA '81 Conference,** San Francisco, sponsored by Data Processing Management Association. Contact: Conference Coordinator, DPMA International Headquarters, 505 Busse Hwy., Park Ridge, Ill. 60068, (312) 825-8124.

1-4 **Satellite Communications Symposium,** Atlanta. Contact: Ray Stuart, General Manager, Satellite Communications Division, Scientific-Atlanta, Inc., One Technology Pkwy, Box 105600, Atlanta, Ga. 30348, (404) 441-4000.

2-4 **CEPA 1981 Fall Conference,** Chicago, sponsored by the Society for Computer Applications in Engineering, Planning and Architecture, Inc. Contact: Joseph P. Harrison, City of Chicago, Bureau of Engineering, 320 N. Clark St., 7th Fl., Chicago, Ill. 60610, (312) 744-7807.

3-5 **Federal Office Automation Conference,** Washington, sponsored by the Federal Office Institute. Contact: Federal Office Institute, P.O. Box E, Wayland, Mass. 01778, (617) 358-5119.

3-5 **NEPCON Northwest '81,** San Mateo, Calif. Contact: Cahners Exposition Group, 222 W. Adams St., Chicago, Ill. 60606, (312) 263-4866.

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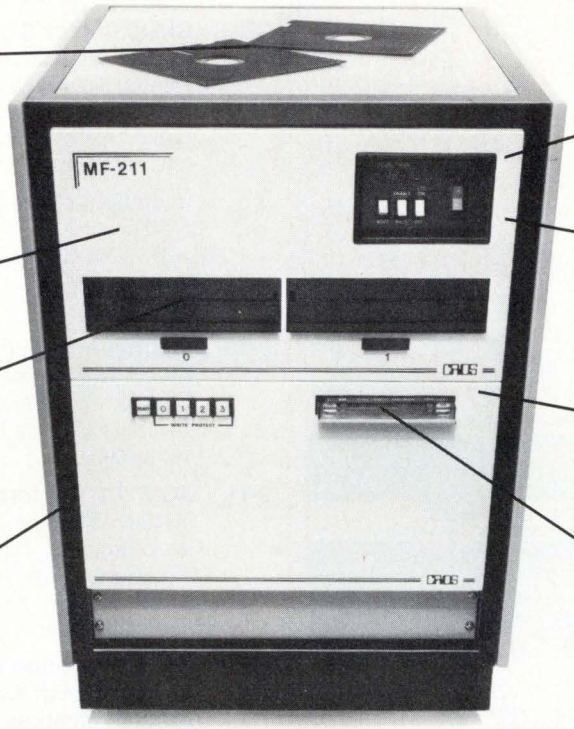
See Us At COMDEX'81



UNIX-compatible Idris operating system, or DEC-licensed RT11V4

LSI-11/23 central processor with 128 kbytes of memory

Chassis with eight-quad-slot backplane and power supply

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CIRCLE NO. 26 ON INQUIRY CARD

Calendar

3-5 **COMPEC (Computer Peripheral and Small Systems Exhibition),** Olympia, London. Contact: British Information Services, 845 Third Ave., New York, N.Y. 10022, (212) 752-8400.

3-13 **China Comm '81,** Beijing (Peking), China, sponsored by the communications division of the Electronics Industries Association and the National Council for U.S.-China Trade. Contact: Clapp & Poliak International, 7315 Wisconsin Ave., Washington, D.C. 20014, (301) 657-3090.

5 **Invitational Computer Conference,** Amsterdam, The Netherlands. Contact: B.J. Johnson & Associates, Inc., 2503 Eastbluff Dr., Suite 203, Newport Beach, Calif. 92660, (714) 644-6037. Other dates and locations available.

9-10 **International Electronics Packaging Society National Convention,** Cleveland, sponsored by the IEPS. Contact: William Jensen, Methode Electronics, Inc., 7444 W. Wilson Ave., Chicago, Ill. 60656, (312) 867-9600.

9-11 **ACM '81 Conference & Exposition,** Los Angeles, sponsored by the Institute of Electrical and Electronics Engineers, Inc. Contact: Toni Shetler, Chairman, Association for Computing Machinery '81, P.O. Box 24059, Village Station, Los Angeles, Calif. 90024, (213) 536-9735.

9-11 **The Association of Data-Processing Service Organizations 55th Management Conference and 21st Annual Meeting,** Las Vegas, Nev. Contact: Tom Farewell, ADAPSO, 1300 N. 17th St., Suite 300, Arlington, Va. 22209, (703) 522-5055.

9-12 **Isratech '81,** Jerusalem, Israel. Contact: Shmuel Ben-Tovim, Israel Trade Commissioner, Government of Israel Trade Center, Empire State Building, 350 Fifth Ave., New York, N.Y. 10118, (212) 560-0660.

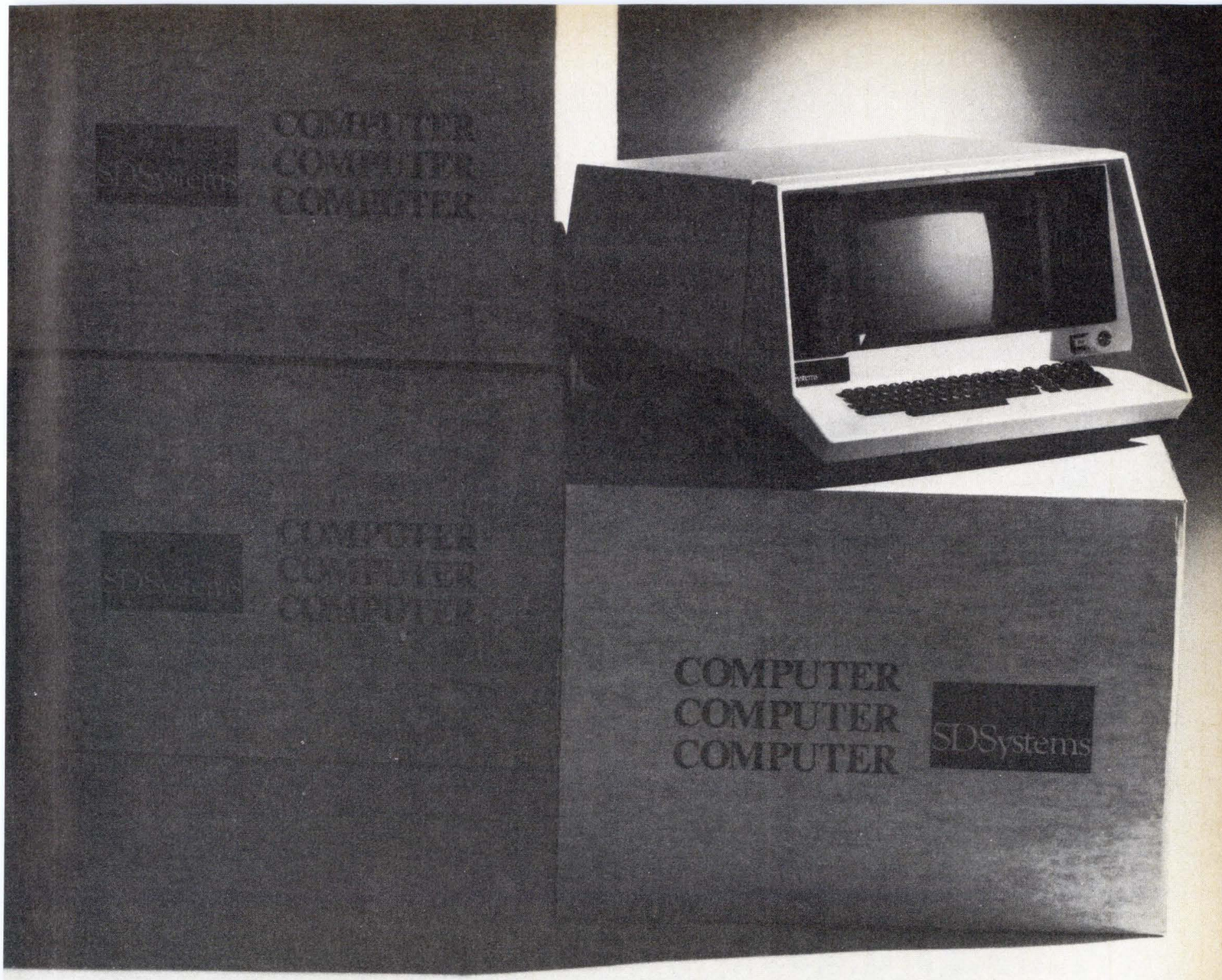
9-12 **IECI '81 Seventh International Conference and Exhibition on Industrial Control and Instrumentation,** San Francisco. Contact: LeRoy Bushart, FMC, 328 Brokaw Rd., Santa Clara, Calif. 95052, (408) 289-3871.

9-12 **Eighth Annual Computer Security Conference,** New York. Contact: John C. O'Mara, Executive Director, Computer Security Institute, 43 Boston Post Rd., Northboro, Mass. 01532, (617) 393-3663.

10-12 **Midcon/'81 Show and Convention,** Chicago, sponsored by Regions 4 and 5 and Chicago and Dallas Sections of IEEE and Chicagoland and Southwest Chapters of the ERA. Contact: Robert Myers, Communications Counsel, Electronics Conventions, Inc., 999 N. Sepulveda Blvd., El Segundo, Calif. 90245, (213) 772-2965.

11-12 **14th Annual Connector Symposium,** Philadelphia, sponsored by the Electronic Connector Study Group, Inc. Contact: Electronic Connector Study Group, Inc., P.O. Box 167, Fort Washington, Pa. 19034.

13-15 **Los Angeles Computer Showcase Expo,** Los Angeles, sponsored by *Business Week* and *Data Communications* magazines. Contact: Peter B. Young, The Interface Group, 160 Speen St., Framingham, Mass. 01701, (800) 225-4620.



They promise. We deliver. Multi-user. Winchester. Hard Disk.

We're complete.
Small to medium-sized businesses get their data processing needs met by SDSystems computers. Flexibility is the watchword with this product range:

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- ☐ The SD-605/610. A single/multi-user system (1-5) with 5/10 Mb Winchester storage.
- ☐ The SD-700. A single/multi-user system (1-5) with 32-96 Mb hard disk storage.

You won't spend much time or money expanding your computer capabilities. From single to multi-user, from floppy to hard disk storage — modular additions eliminate costly system replacements. Now. And in the future.

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With years of experience, over 25,000 computer boards and hundreds of computers installed worldwide, SDSystems has answers that streamline data processing needs.

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Delivery time for any of our products is 30 days or less from date of purchase. They're all available. Today.

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CIRCLE NO. 29 ON INQUIRY CARD

WHILE OUR COMPETITORS TALK ABOUT PRINTER RELIABILITY,

DATAROYAL PROVES IT.

Many printer companies talk about how reliable their products are. But very few can publish hard evidence supporting those claims.

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Dataroyal tests our IPS-5000 printers non-stop at 100% duty cycle and page density. These printers have now surpassed an MTBF (mean time between failure) figure of 2000 hours-*without failure, maintenance, or any special treatment.* Under normal conditions, this performance rating means years of reliable operation between service calls.

And our printhead life now exceeds 500 million characters. All of this reliability spares you the time and expense you might now be spending on your existing printers.

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INCORPORATED

CIRCLE NO. 30 ON INQUIRY CARD

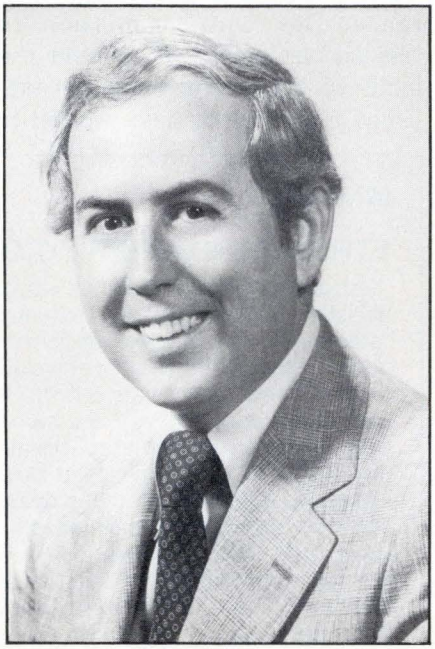
The RFI affair—new deadline, new uncertainties

Much of American business stands to benefit from the Reagan Administration's concerted effort to "get government off the backs" of the American people. But this month, in a significant departure from Administration policy, computer manufacturers find themselves facing a heightened federal profile in their business lives. Oct. 1 was the deadline by which all new equipment lines had to conform to rigid radio frequency interference (RFI) standards dictated by the Federal Communications Commission (FCC).

The Oct. 1 date is the second of three included in the commission's policy adopted late last year. Since Jan. 1, equipment lines that entered production before the standards' initiation and that do not meet the new standards have had to carry a label stating that fact. And on Oct. 1, 1983, all equipment, regardless of when it went into production, will have to meet the FCC standards.

The regulations divide computers into two groups: Class A computers are those used in commercial markets; Class B computers are those purchased for home use and include electronic games. Before the date of initial production, manufacturers are required to file a report with the FCC, verifying that they have tested the Class A computers and that they conform with the standards. Class B equipment can't be sold until a grant of certification is received from the FCC.

In the sometimes curious mindset of federal regulatory agencies, the FCC regards its RFI policy as a natural extension of its legal responsibility to referee the use of the electromagnetic spectrum, no matter where that responsibility may take it in the private sector. Indeed, few could argue that interference-free communications is a legitimate role for government in a society that has become increasingly dependent on the telephone, television and business radio. But the timing of the FCC's decision on RFI and the computer industry strikes some as being haphazard and even unjustified.



"The market *is the best regulator," says industry representative Ron Wheatley in response to new FCC regulations.*

The commission's initial foray into computer RFI came in 1976, about the same time the FCC was making similar efforts to regulate RFI in other kinds of equipment, such as cash registers and cable television hardware.

But after an initial "notice of proposed rulemaking" was published, which sought comment on a list of proposed regulations, the FCC abandoned the project for three years. Finally, in 1979, the commission announced a complete set of standards to go into effect in July, 1980.

FCC spokesmen claim the reason for its go-slow-then-fast policy was due to fears that the growing home computer business might cause serious interference problems, not only with broadcast television, but also with more critical modes of communication. These officials cite examples of interference with police communications and at least one instance of interference between pilots and ground controllers at a U.S. Air Force base outside Washington. "We caught it before it became a really big problem," says Herman Garland, an FCC engineering adviser.

But industry representatives offer a different explanation. They believe that the commission, stung by criticism of the way it handled the citizens'-band radio craze, feared a similar rush of complaints caused by massive radio communications disruptions as computers proliferated, particularly in homes. Industry sources say the FCC, at the expense of industry, used isolated RFI examples to justify a wholesale federal intrusion into a process that was already evolving well.

The proposed regulations stirred considerable controversy. Some 25 parties responded to the 1976 FCC proposal, with most opposing the commission's tilling of these previously unplowed grounds. Some groups, including the Computer and Business Equipment Manufacturers

Association (CBEMA), said they opposed the regulations, but suggested a set of standards if the FCC insisted on pursuing its goal of regulation.

"We were moving in the direction of self-regulation," notes Ron Wheatley of CBEMA's council for regulatory affairs. "I think that if computer manufacturers were going to succeed, they would have to have their own standards. The market is the best regulator."

In its haste to adopt its regulatory policy, the FCC accepted most of the suggestions CBEMA had offered, a concession that somewhat softened the blow to an industry unaccustomed to federal supervision of its technical achievement. But industry insisted that the commission's original compliance deadline of July, 1980, was impossible to meet. After another round of legal filing and counterfiling, during which industry argued in vain for a seven-year adjustment period, the commission finally ordered the series of deadlines currently imposed.

Regardless of when the regulations went into effect, there can be no doubt that they will have a significant impact on the industry and its customers. While he hesitates to cite specific figures, CBEMA's Wheatley believes the policy will have a "tremendous impact" on computer manufacturers. "Suddenly, we are being asked to comply with a whole new set of regulations that were not around before," he says. "There is bound to be an impact on our marketing and on our costs. We are going to have to build test sites, buy testing equipment and deal with a new environment of deadlines, definitions and paperwork."

Such factors, says Wheatley, have caused uncertainties in the industry that can only intensify as manufacturers watch potential markets slip away while waiting for a certification from the government. In fact, the dynamics of the industry were a concern in the FCC's order implementing its RFI standards. The order stated that changes in technology, marketing and its own "increased familiarity" with computer products might be sufficient reason for the commission to "revisit" its policy. To monitor the industry, the commission has established a computing device panel to examine the effectiveness of its policy periodically, its enforcement and complaints about it.

But it is far too early to know what impact the policy has had on the industry or its markets. Nor are there any early indications that the government, unlike its efforts to get government off the backs of numerous other industries, is prepared to allow the industry to police itself. *—Arthur Hill*

MINIBITS

ETHERNET STARTER KIT OFFERED

Interest in Ethernet and UNIX is spawning a variety of products. The latest is available from 3COM Corp., Mountain View, Calif., which has introduced a "starter kit" for Ethernet aficionados and networking software for UNIX. 3COM's Ethernet transceiver and starter package includes a designer's guide, a set of three transceivers with the required interconnect cables, terminators and a two-page summary of Ethernet's specifications and Digital Equipment Corp.-Intel-Xerox Ethernet specifications. Larry Hartge, 3COM president, says the starter kit will help speed design of Ethernet-compatible devices by answering questions about the design of line-driver/line-receiver circuits that link the transceivers and controllers. The kit sells for $2600. 3COM has also introduced what it claims is the first commercially available networking protocol software for the UNIX operating system. Aimed at large and small machines, UNET is said to run with any system using version 7 of UNIX. Written in C, UNET enables users to build virtual terminals, and features automatic pass-through and remote file-transfer capabilities. A program license fee of $7500 includes the license and one binary copy.

INTEL CUTS BUBBLE MEMORY PRICES

Following last year's 40 percent price cuts for the 7220-1 bubble-memory controller and the BPK70 1M-byte bubble-memory subsystem, Intel Corp., Santa Clara, Calif., again slashed bubble-memory prices more than 40 percent this year. The BPK72-2 prototype-kit price has been lowered to $995, with off-the-shelf availability. The volume price of the BPK70-1 and 7220-1 is now $595 for 5000-unit orders. The company attributes the price reductions to an increase in volume orders for 12- to 24-month periods and a move down the cost/volume learning curve as the company accumulates manufacturing experience. The company claims this year's $50-million magnetic-bubble-memory market will double to $100 million in 1982 and the number of units sold will quadruple. While the 7220-1 and the BPK70 are used primarily in industrial control, avionics and military areas, Intel expects markets for bubble memories to expand to such commercial areas as numerically controlled machine tools, industrial-control and geophysical applications.

ASSOCIATION FOR SOFTWARE PROTECTORS FORMED

Software piracy is a growing problem for developers, OEMs, consultants and end users. Software protectors don't usually get the chance to meet to share common problems and solutions. However, an Association for Software Protection, Inc., has recently been formed as a first step toward eliminating black marketing and the ignorance surrounding software licensing. Those interested in supporting or participating in the organization should write to: Robin Robinson, 2441 Honolulu Ave., Montrose, Calif. 91020 or Dale Coleman, S & H Computer Systems, Inc., 1027 17th Ave., S., Nashville, Tenn. 37212.

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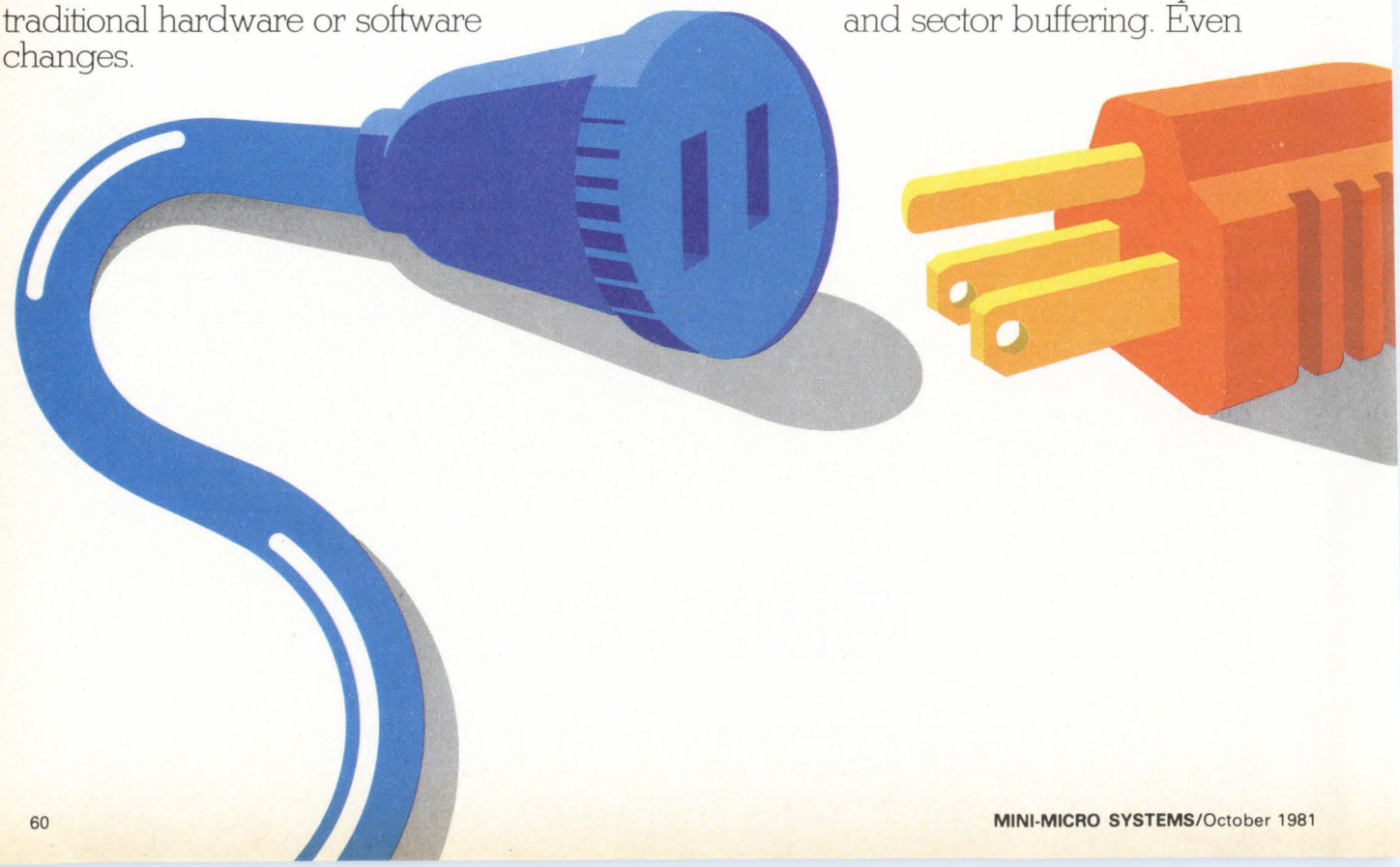

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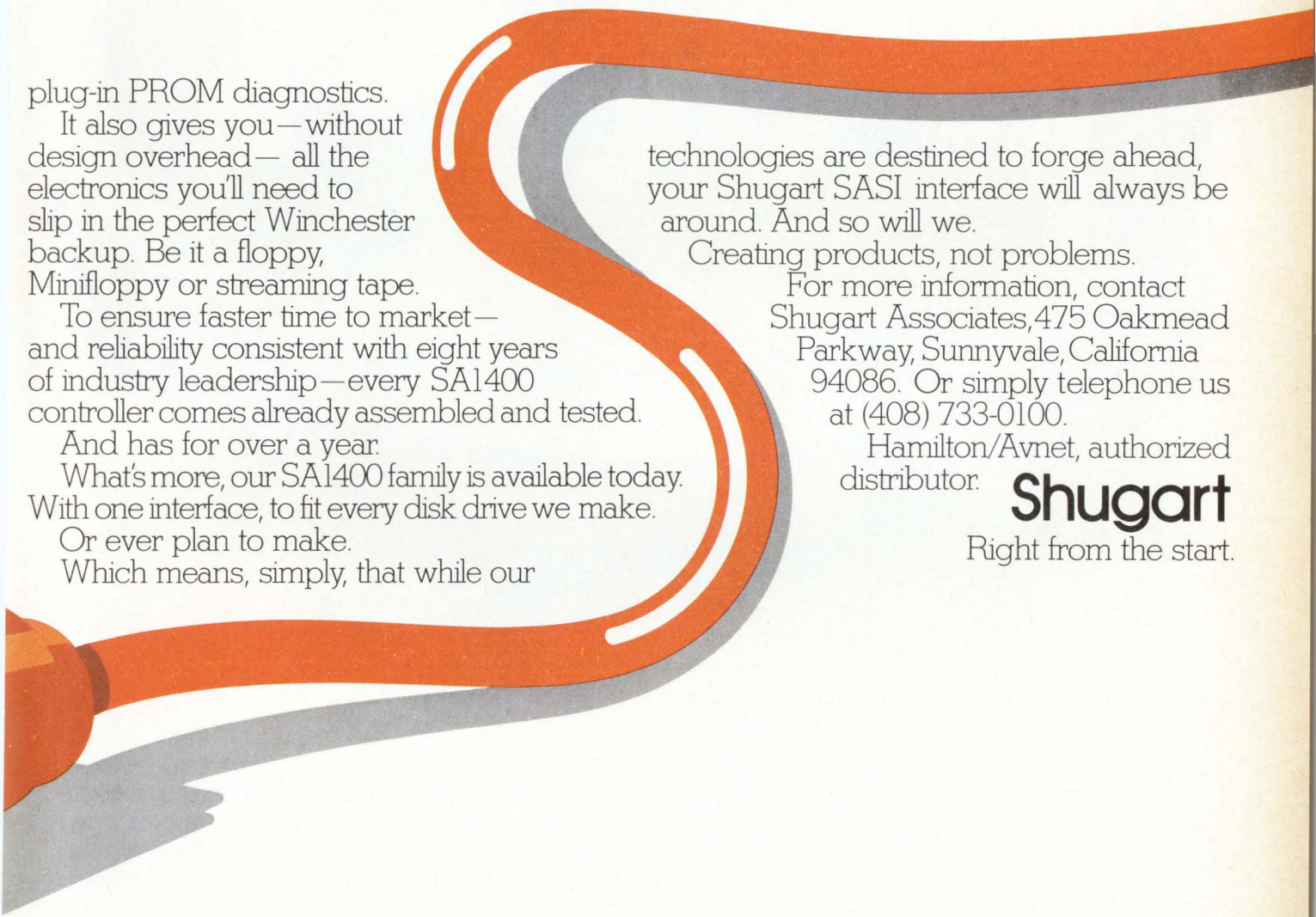

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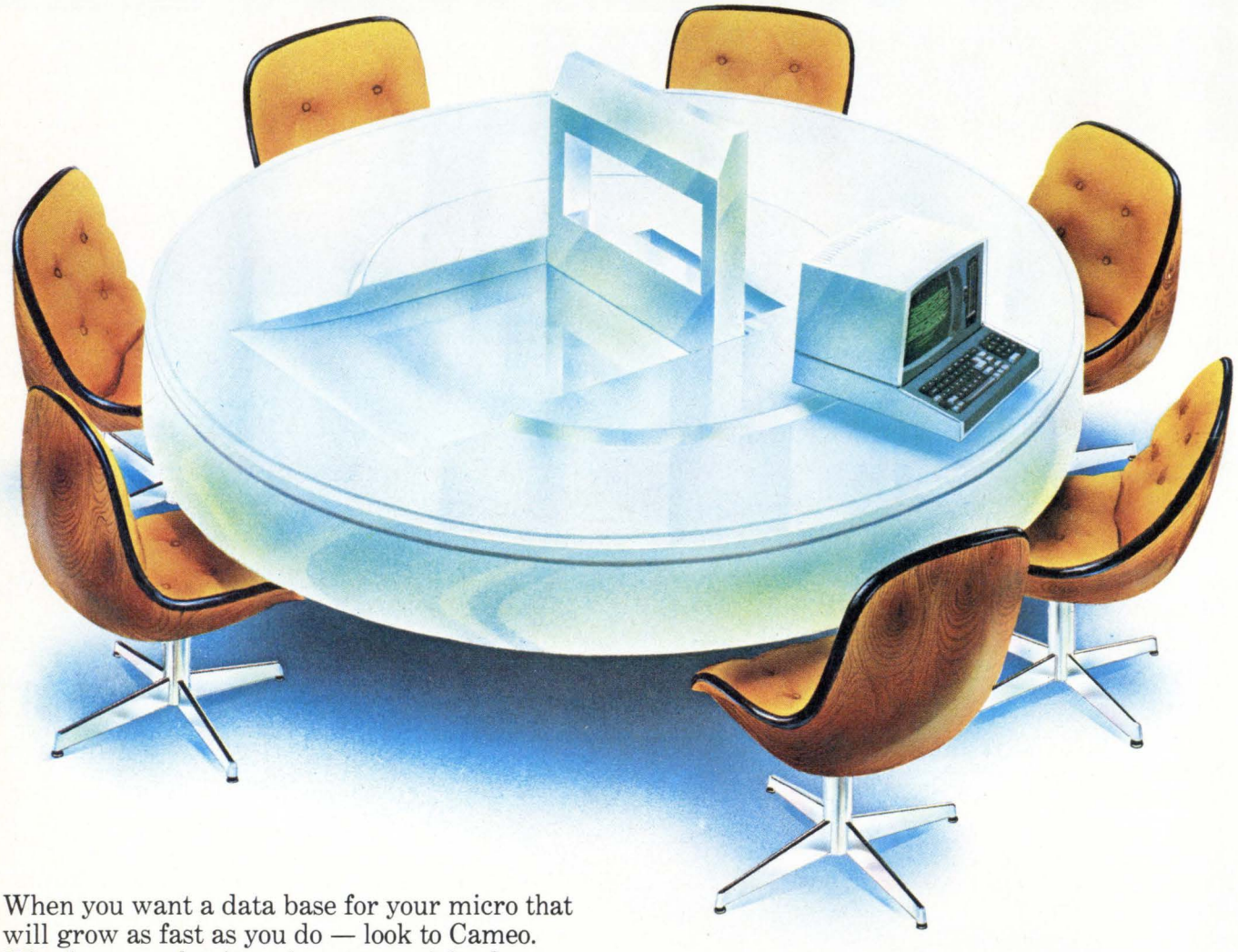

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CIRCLE NO. 33 ON INQUIRY CARD

IBM personal computer may be boon to service revenues

Should IBM Corp.'s new personal computer win big in the personal- and small-business-computer markets, independent software suppliers, distributors, retailers and potential plug-compatible system manufacturers will not be the only ones with dollar signs dancing in their heads. Organizations providing service—including IBM and Sears, Roebuck and Co.—will be able to fatten service coffers, aided by the fact that both companies are household words.

IBM, intends to support any product displaying its logo, including hardware and software. Non-on-site service charges will average 10 to 15 percent of purchase price annually, which is in line with charges of other major manufacturers. If estimates made by various industry groups hold true, some of these charges could be applied to retail sales, which will exceed $1 billion in 1984, according to a projection by Future Computing, Inc., Richardson, Texas.

Neither IBM nor Sears has the overhead entailed by starting a service organization from scratch. IBM will service the products through its product centers under a 90-day warranty. An element-exchange program will cover post-warranty maintenance. IBM will pick up any part, excluding the CPU, within a 30-mile radius of a product center, and give the user a replacement until the original is repaired. The CPU is taken to the production center for repair. Rates are 10 to 15 percent of purchase price, and the cost of the 90-day warranty period is deducted.

Sears views service as key in merchandising a computer. "We intend to be premiere in servicing this type of product," says John M. Purtell, national manager of Sears Business Systems Centers, who expects service operations to be profitable within one year. The five centers are a new effort by Sears, and are being established in Boston, Chicago and Dallas. They are fashioned after IBM and Xerox stores, and are distinct from regular Sears retail outlets, some of which sell Atari, Inc.'s personal computer. The centers cater to the small-business user who will buy an IBM computer for $3500 to $5000, including software. The centers will handle other office equipment, word processors and personal computers.

Purtell stresses that one supplier for all needs—hardware, software and service—will attract customers. He admits that Sears will compete with IBM somewhat in servicing customers, but expects that the competition will be viewed as helpful by IBM. "The people who sold the machine to the customer are at the local store, which will be convenient," he says.

Sears has a large service network for its retail-store products, and can use its technician-training centers and inventory-control procedures.

Several service offerings are waiting in the wings. For example, a customer can take the product to the store or receive an on-site visit. Charges for each service are not set, but are expected to be competitive with IBM's. After the 90-day free parts and labor warranty expires, the customer can choose a flat-fee maintenance agreement or service on a time and materials basis.

—L. Valigra

DEC INSTITUTES 'WAREHOUSE ON WHEELS'

Digital Equipment Corp., a veteran in the service business, has examined a number of ways to maintain low-end products and to continue making money. Machines should be built so that they do not break, because more money is made when fewer machines break, says Henry Ancona, corporate marketing manager for DEC's Customer Services Organization, Maynard, Mass. The company offers a maintenance contract that is inexpensive to the user and meets the user's needs.

DEC has instituted a program, including hardware and software maintenance and instructions on using equipment, that is priced at less than $100 a month. Ancona says the service includes a toll-free hot line that can solve many problems. It also includes a "warehouse on wheels" program, in which hundreds of vans worldwide carry spares and a complete unit. Each van is manned by a field-service engineer.

The company has also lowered customer-service costs, and last month began a carry-in program, with a pilot project in Washington, D.C. Customers can save as much as one-third of maintenance costs by carrying portable computers and word processors into DEC service centers. The company plans to open such programs nationwide, Ancona says.

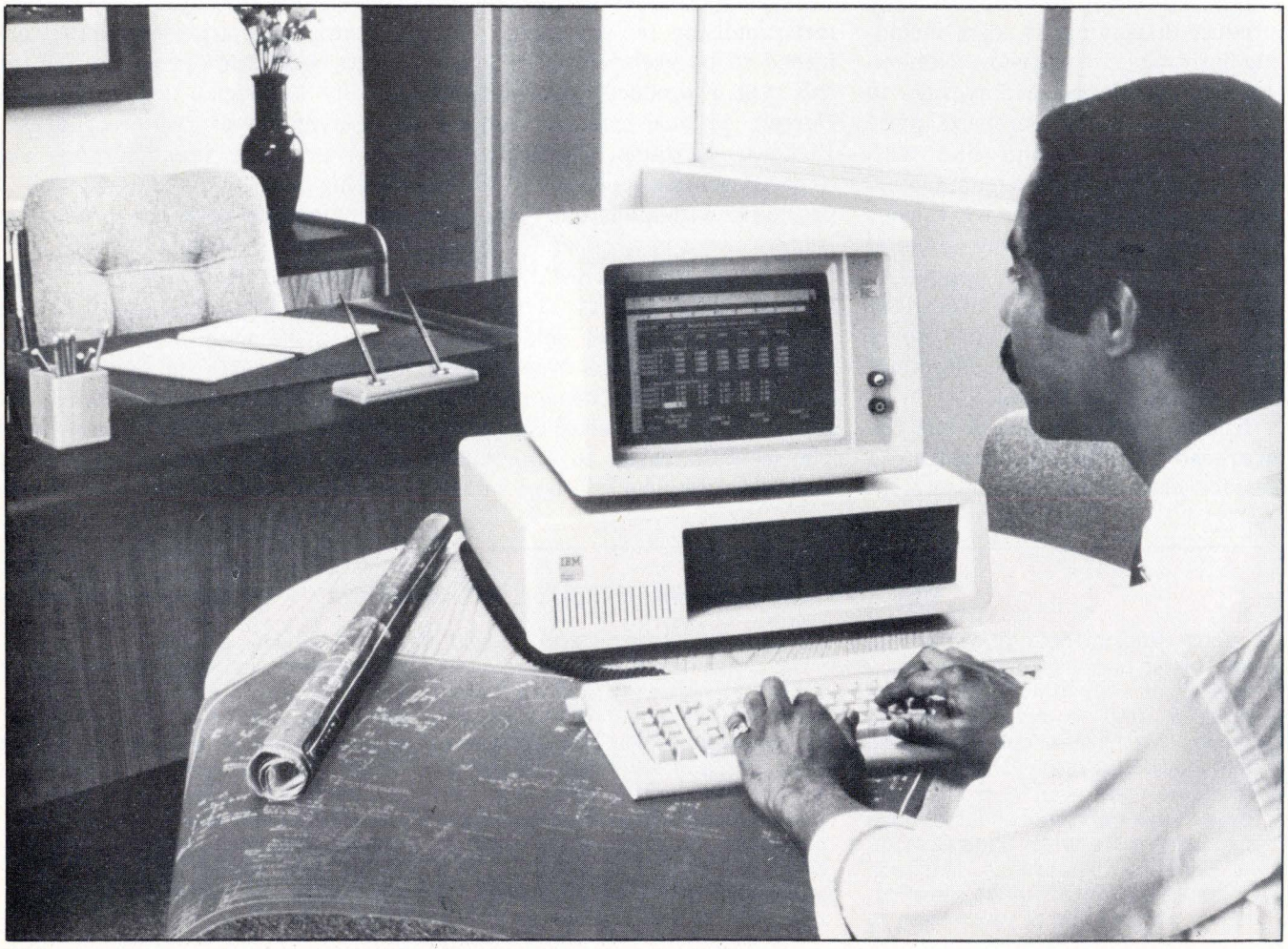
Gaining market share is IBM's challenge

IBM Corp.'s personal computer, a "market-share" product that some researchers project will achieve retail sales as high as $1 billion by 1984, has set some new patterns, even within IBM. The giant's high degree of vertical integration reversed itself when the company turned to outside sources to provide hardware, software, distribution channels and service. Many industry observers term the moves necessary if IBM wants to gobble market share and climb to the top slot.

"IBM wants the personal computer to be the most accepted IBM product ever," says C.B. Rogers Jr., vice president and group executive, General Business Group. GBG announced the company's lowest priced, low-end computer in mid-August. Prices for the personal computer, which is intended for use in homes, educational facilities and small businesses, start at $1565 (see "A glance at IBM's personal computer," p. 66).

The company is on its way to becoming an even more widely known household word than it is now because the product's introduc-

IBM's personal computer *is positioned between the Apple II and III, models that have helped place Apple Computer in the top market slot.*



IBM's personal computer, *priced at $1595 to $6000, is expected to gain significant market share.*

tion resounded among consumers and the computer industry. Even *Time* magazine included an article about the product, in which computer-industry observers speculated about the creation of new businesses, such as software houses and plug-compatible vendors, all based on IBM's new product. Those observers expect top-seeded Apple Computer, Inc., which holds about 25 percent of the market, to be bruised most by the newcomer. IBM claims it has adequate facilities to support the big demand, but will not comment on manufacturing volumes at its Boca Raton, Fla., plant.

The personal-computer market is huge, according to figures from Venture Development Corp., Wellesley, Mass. VDC projects that 2 million personal computers priced at less than $10,000 will be shipped in 1985, an increase from less than 400,000 units in 1980. The fastest growing user segment will be business users, a category that is expected to increase 52 percent annually. Shipments of small-business computers priced at $5000 to $20,000 will increase about 33 percent annually in the four-year period until 1984, reaching almost 130,000 units in 1984, which represents about $2 billion.

IBM's most formidable challenge may be to gain market share quickly and carefully among established competitors. To do this, the company has solicited outside help. "IBM has recognized that the third-party community is absolutely essential to success," says a report by Future Computing, Inc., Richardson, Texas. Although typically the source of all things to its buyers, IBM has turned to outside distributors, software suppliers and service people for this product. The personal computer will be sold through ComputerLand dealers; Sears, Roebuck and Co.'s new business-machine stores (see "IBM personal computer may be a boon to service revenues," p. 63); the three IBM Product Centers in Baltimore,

A GLANCE AT IBM'S PERSONAL COMPUTER

Even though IBM Corp. does not employ new technologies in its new personal computer, the product does include some impressive specification. It features total user memory that can be expanded to 256K bytes, a 16-bit Intel 8088 μp, and a price competitive with similar computers on the market.

The entry-level system, priced at $1565, includes 40K bytes of ROM, Microsoft, Inc.'s BASIC interpreter, 16K bytes of user memory with 9-bit parity check and power-on diagnostics. An RF modulator for links to a television and an audio tape-cassette player must be purchased separately.

A business sytem with color graphics, two diskette drives and a printer is priced at $4500. Volume discounts ranging from five to 15 percent, depending on volume, are available.

"The 256K bytes of user memory is somewhat unique in this machine's price range," contends P.D. Don Estridge, director of entry systems business, IBM Information Systems Division, Boca Raton, Fla. The personal computer's price ranges to $6000, and will not compete with the model introduced about a week earlier, the System/23 Datamaster, which is priced at more than $9000 and sold through 200 IBM branch offices.

The personal computer has a detachable keyboard with a flexible 6-ft. cable. The 256-ASCII-character keyboard is unique to this IBM product, and includes 83 function keys with 10 keys for numeric entry and cursor control and 10 keys for scrolling and editing.

The basic system console includes sound and speakers, five expansion slots for added memory, a display, a printer, communications and game adapters. Two 5¼-in. floppy-disk drives, probably from Tandon Corp., can be used, each having 160K bytes of memory.

An 80-cps dot-matrix printer, believed to be an Epson America, Inc., MX-80, has a Centronics parallel interface, enabling printers such as a letter-quality NEC Information Systems, Inc., Spinwriter to work with the system. An RS232 interface is also available. Two computers cannot share a printer. The monochrome display with a 25-line × 80-character screen is manufactured to IBM specifications by an unspecified vendor in Taiwan.

IBM chose the 8088 μp with an 8-bit bus rather than the 8086 partially because it is economical to attach low-cost features to an 8088-based system, says William L. Sydnes, engineering manager for entry-level small systems, ISD, Boca Raton.

Line and point graphics can be programmed into the computer by using the BASIC interpreter. As many as 16 colors can be used during 640- × 200-dpi medium- and 320- × 200-dpi high-resolution graphics modes. A plug-in card with the graphics and color capabilities has 16K RAM, and can be linked to a color monitor using standard composite-video or direct-drive techniques. For example, a $1000 Hitachi color monitor was hooked by direct-drive monitor at a press demonstration given by IBM.

The operating system was developed by Microsoft, Inc., and is called IBM personal computer DOS. The BASIC interpreter is available in cassette, diskette and advanced versions. The cassette version is included in the 40K ROM in every system; the two other versions are optional. IBM intends to offer UCSD P-System and CP/M-86 operating systems in the near future. A Microsoft Pascal compiler will be available this month.

Communications include Teletype links to pair the system with a mainframe and forthcoming extended-bisynchronous 3270 emulation using EBCDIC. It probably will require a translation table to the ASCII personal computer, a spokesman says.

Detailed specifications on the product, bus interfaces and additional cards are expected to be offered with deliveries this month, enabling other manufacturers to supply products for the system, possibly based on the Intel co-processors.

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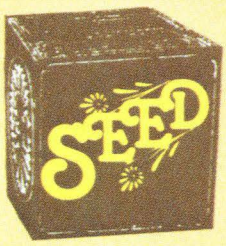

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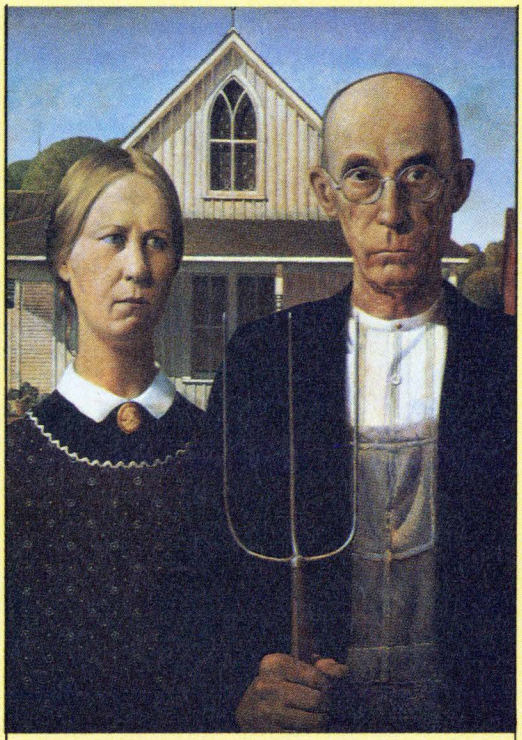

- SEED minimizes the memory requirements for storing and manipulating your data base, so it will cost less to maintain and may be accessed more quickly.
- SEED runs on a variety of hardware, including DEC® VAX®, DECsystem-10®, DECSYSTEM-20®, PDP®-11; IBM 370/3000/4300; CDC 6000 and Cyber series; HP3000; Prime 50 Series; Perkin-Elmer 3200; and MODCOMP IV and Classic.

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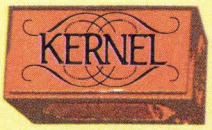
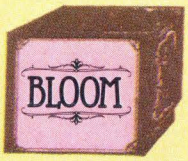
The central part of the SEED DBMS is the SEED KERNEL — a CODASYL-compliant Data Description Language and Data Manipulation Language, enhanced by a group of utilities that help measure and improve performance.



HARVEST is an exceptionally easy-to-use query language that provides a relational-like interface to a SEED data base. HARVEST automatically navigates the data base, quickly locating and retrieving information.

BLOOM is a non-procedural report writer that produces detailed, attractive output from a few simple instructions. You can specify report formats without concern about how to locate the data, and store and reuse such formats as desired.



GARDEN is an interactive Data Manipulation Language that serves as an applications development tool. You can update or verify the contents of the data base, or test the validity of a program procedure, without having to write a host language program.

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CIRCLE NO. 115 ON INQUIRY CARD

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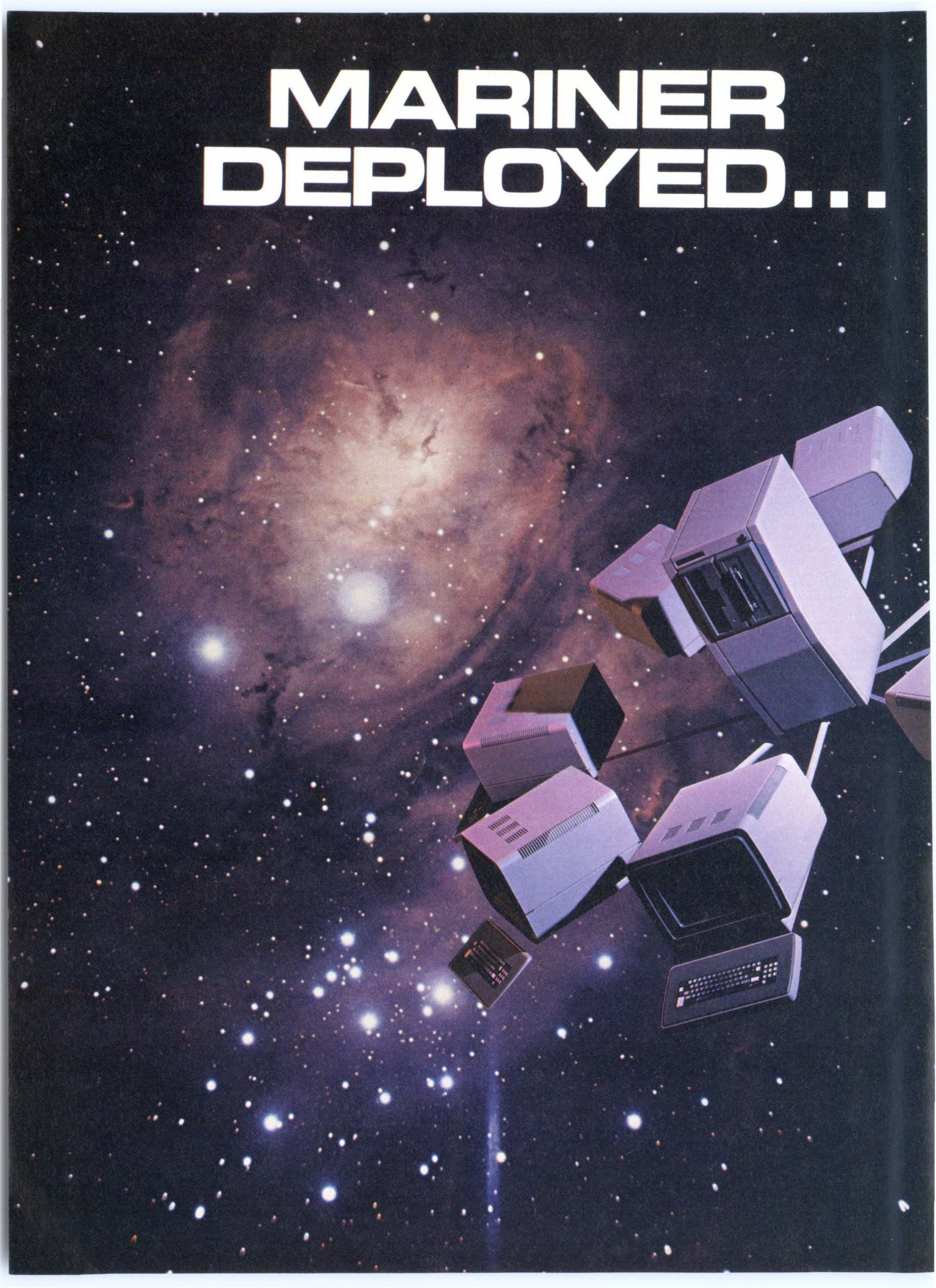

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Each user has his own processor and 64K bytes of dynamic RAM, keeping MARINER performance up under loads that make single-processor systems sag. A separate 4-MHz Master processor and memory hold costs down by managing the sharing of MARINER's built-in 22M-byte Winchester disk drive, 8-inch floppy disk and 1/4-inch streaming tape drive.

There's nothing nebulous about MARINER's flexibility. Operate with CP/M, MP/M, or the new, high-speed DBOS (CP/M compatible) and you'll have a galaxy of software available for applications.

Program satellites with BASIC, COBOL, or FORTRAN, use them for word processing, general accounting, any of a multitude of tasks, each with complete independence. And MARINER's M/LINK modem communicates at 2400 baud on standard voice-grade phone lines, using SDLC, BI-SYNC, or X.25. Sounds universal? MARINER is.

MARINER's attractive, freestanding cabinet houses the Master and up to eight Satellite processors. And it's only 14″ x 20″ x 29″ in size, so it fits in beautifully, quietly, anywhere!

Get a world of additional information about MARINER now by calling your MICROMATION dealer. If you need help in locating the dealer nearest you, or if you would like to hear about our special support program for systems integrators and OEM manufacturers, call MICROMATION now!

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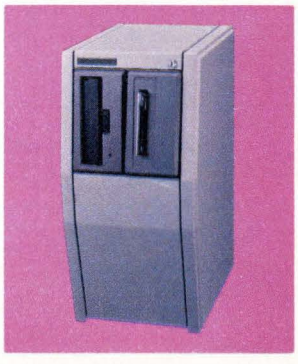
The background to the MARINER system on the facing page is a photograph of the Lagoon Nebula, which can be seen with the aid of binoculars in the constellation Sagittarius.



MICROMATION

CIRCLE NO. 116 ON INQUIRY CARD

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Introducing the RM 65 line of microcomputer boards.

The RM 65 line gives you the options and flexibility to design precisely the microcomputer systems you need.

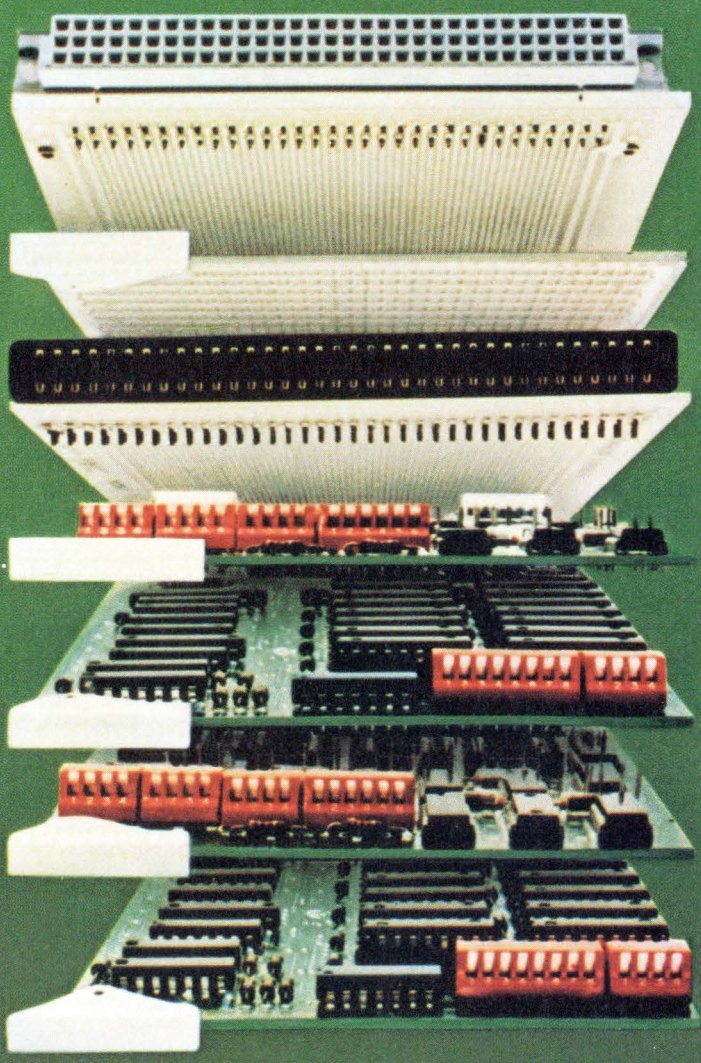
And you can do it quickly and economically. Because you're offered so many design alternatives.

Application software for the RM 65 line, for example, can be programmed in a number of languages: BASIC, PL/65, FORTH and Assembly Language.

RM 65 uses a motherboard interconnect concept so any card will fit any slot.

You can choose either edge connector or Eurocard versions.

And a set of card cages allows a broad variety of packaging options.



Single Board Computer Module
R6502 CPU, 2K bytes static RAM, 16K bytes PROM/ROM capacity, an R6522 VIA and support circuitry on a single RM 65 module.

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- *32K Dynamic RAM*
- *16K PROM/ROM*

Input/Output Modules
- *GP I/O and Timer*
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Intelligent Peripheral Controller Modules
- *IEEE-488 Bus Interface*
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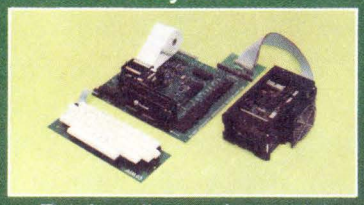

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II. Better profit margins. The System 311 and its big brother, the 312, are available to you at savings of up to 50% of the comparable IBM 370/138, 4331-2 and 370/148 mainframes. That kind of math is easy to understand.

III. A complete integrated system – not a PCM. The 311 and 312 have integrated controllers, so you don't have to use expensive IBM peripherals. Four-Phase ships the systems with disc and tape drives, communication devices, printers, card readers and a console CRT. All that adds to your profit margin.

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CIRCLE NO. 166 ON INQUIRY CARD

San Francisco and Philadelphia; and a Data-Processing Division sales unit for large-volume orders. IBM and the distributors will service the product and offer warranties.

Microsoft, Inc., developed the operating system, which is unique to this IBM product. IBM has also contracted with Digital Research, Inc., and SofTech Microsystems, Inc., to add the CP/M-86 and UCSD P-System operating systems. IBM will offer some basic, but not extensive, application programs, including VisiCalc; EasyWriter word-processing software; Peachtree Software, Inc.'s general ledger, accounts payable and accounts receivable; and games. IBM is also looking for software from independent authors, who can submit programs to the company's new Personal Computer Software Publishing Department, Boca Raton. Authors will receive royalty payments on approved programs.

Although the moves toward outside sources surprise some industry watchers, they are frequently heralded as wise decisions. "The companies that get into trouble are the companies that don't recognize their limitations," says Peter Lieu, an analyst with Arnhold and S. Bleichroeder, Inc., New York. "I give IBM a lot of credit for getting outside expertise, and doing it carefully," he adds. He says IBM will employ the strengths of its name, manufacturing capabilities and and large-contract-negotiation skills as well. Part of the personal computer's competitive price stems from good prices allowed through large-volume contracts with outside suppliers, such as Epson America, Inc., and Tandon Corp., which are believed to supply the printer and

WHAT YOU GET FOR THE MONEY

Company, Model Number	Processor, Operating System	Removable Storage; Hard Disk; Printer	Internal Memory	Display; Color Display
Apple Computer, Inc., Apple II	8-bit 6502A, DOS	One 5¼-in., 140K-byte floppy-disk drive* ($645); N/A through Apple; RS232 serial*	16K bytes of dynamic RAM, two 16K-byte segments totaling as much as 48K bytes* ($100 each), one 16K-byte segment (totaling 48K to 64K bytes) plus card* ($200)	24-line x 80-character; 16 low-resolution colors and 6 high-resolution colors (280 x 192 dots)
Apple III	8-bit 6502A, SOS	One built-in 5¼-in., single-sided, single-density, 143K-byte floppy-disk drive, can daisy-chain as many as three additional 5¼-in. floppy-disk drives* ($545 each); N/A through Apple; thermal or serial I/O*	128K bytes of RAM	24-line x 80-character; yes
Data General Corp., Enterprise 1000	16-bit MicroNova MN602, Enterprise OS (MP/OS subset)	Two 5¼-in. dual-density, floppy-disk drives with 358K bytes of storage each; N/A; 150-cps dot-matrix	64K bytes of dynamic RAM	24-line x 80-character; N/A
Hewlett-Packard Co., HP125, model 10	Two 8-bit Z80As, CP/M	Two 5¼-in. double-sided, double-density floppy-disk drives, with 256K bytes of formatted storage each, two 8-in. double-sided, double-density floppy-disk drives with 256K bytes of formatted storage each, instead of 5¼-in. drives* ($4330); N/A; 120-cps thermal* ($1210), 180 cps dot-matrix* ($3900), 40-cps daisy-wheel (32-cps for metal print wheel)* ($3900)	64K bytes of RAM	24-line x 80-character; N/A
IBM Corp., Personal Computer	16-bit Intel 8088, IBM PC DOS and BASIC extension, CP/M-86 and UCSD* to come	Two 5¼-in. floppy-disk drives, with 160K bytes of storage each* ($570), adapter* ($220); N/A 80-cps dot-matrix* ($755), adapter* ($150)	16K bytes of RAM, 40K bytes of ROM, 16K-byte memory expansion* ($190), 32K-byte memory expansion* ($325), 64K-byte memory expansion* ($540)	25-line x 80-character* ($345); user can add his own color monitor*
Xerox Corp., model 820	8-bit Z80; Level 2.2 CP/M* ($200), word processing CP/M subset Wordstar* ($500)	Two 5¼-in., single-sided floppy-disk drives with 94K bytes of unformatted storage each, two 8-in. single-sided floppy-disk drives with 300K bytes of unformatted storage each* ($3975, with display processor and keyboard); N/A; 40-cps daisy-wheel* ($2900)	64K bytes of RAM, 4K bytes of ROM	24-line x 80-character; N/A

floppy-disk drive, respectively.

IBM, though, is making its takeover bid in an established market. "IBM will have to strengthen its position with regard to distribution before Radio Shack and Apple will have anything to worry about," says Karen Horowitz in a report by Venture Development Corp., Wellesley, Mass. She says it will take time for IBM to ensure that the quality of service and support in its dealer and distributor network is up to IBM standards. It has taken Apple and Radio Shack several years to establish extensive distribution channels, and she expects the same will be true of IBM.

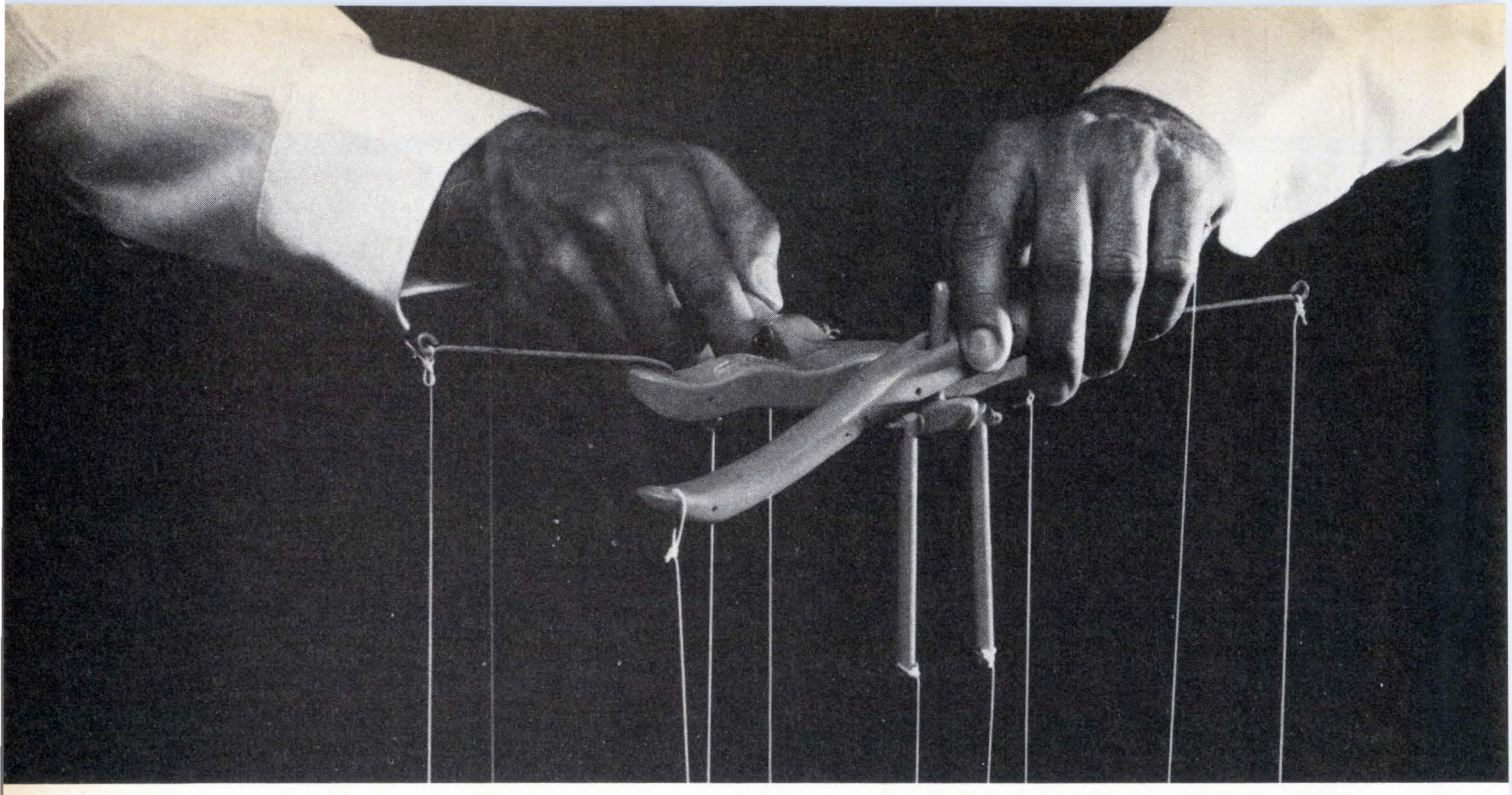
One of Apple's strengths is that it has 2500 authorized dealers that service its products and 300 companies that have built hardware and write software for the computers. Apple has supplied schematics to help outside vendors enhance its product, which, in turn, has helped increase its market penetration. "We think we have the best record player, and we're glad there are so many record companies out there," says an Apple spokesman. He says the IBM product falls between the Apple II and III. IBM also intends to supply detailed specifications on most parts of the machine when it is shipped.

The spokesman views entries from IBM and Xerox as devices to expand the market. He says that 750,000 personal computers are installed worldwide, and that there are 3.5 million small businesses in the U.S. and 95 million households, so the market has barely been touched. He adds that the main task in selling computers now is educating users.

—L. Valigra

Ports; Bus	Programmable Languages	Graphics Software; Word-Processing Software; Applications Software	Ability to be Upgraded	Distribution; Service and Support; Training; Communications	Price
Eight I/O slots (address decoded), four channels A/D conversion, three TTL inputs, four TTL outputs, sound output; 16-bit address, 8-bit bidirectional data	BASIC, Pascal,* FORTRAN,* COBOL,* PILOT,* Assembly	Apple Plot* ($70), languages have software command; Apple Writer* ($75); The Controller (accounts receivable/payable, general ledger)* ($625), Dow Jones News & Quotes Report* ($95), Tax Planner* ($120)	Cannot be upgraded to Apple III	2500 authorized retail dealers; user-installable, handled by dealers*; operator manuals, VT100 emulator* ($75)	$1330
RS232 serial I/O; enhanced Apple standard	BASIC, FORTRAN*, (Pascal available this month)	No, languages have graphics commands; Apple III Word Processor* (available in December), VisiCalc III, Mail List Manager* (available by year-end)	Can be linked by user to any system through RS232 port*	2500 authorized retail dealers; user-installable, handled by dealers*; operator manuals; N/A through Apple, VT100 emulator to come	$4690
One printer, one RS232; standard MicroNova	Business BASIC* ($500)	Graphics/125* ($200); Word/125* ($500); VisiCalc* ($200)	Can be linked to HP3000 with Link/125* ($150)	Direct sales, OEMS, dealers, computer and office-equipment stores; user-installable, monthly maintenance contract* ($27 per month), monthly on-site maintenance* ($48 to $68 per month); operator manual; N/A	$6250
Two RS232; HP-IB-compatible (IEEE-488)	BASIC/125* ($325)	N/A; N/A; order entry* ($1000), accounts receivable* ($1000)	Business BASIC, can also run on MicroNova, Nova, Eclipse, MV/8000*	Six distributors, 130 retail stores; user-installable, 90-day maintenance, monthly on-site service call* ($84); operator manual, video-disk training at dealer site; N/A	$7195
Five expansion slots*, RS232 adapter*, ($150), Centronics parallel printer* ($150); enhanced 8088 (Intel 8K bus)	Pascal compiler* ($300), BASIC interpreter with DOS	N/A, user-programmable in BASIC; Easy Writer* ($175); general ledger, accounts payable, accounts receivable* ($595 each)	Company provides 3270 bisynchronous EBCDIC link*	Computerland, Sears, three IBM product centers, quantity discounts available; user-installable, warranty*, service by dealer varies with equipment, software service is 10 to 15 percent of purchase price per year; reference manual for BASIC, guide to operations; Teletype 3270 to come, asynchronous* ($40), adapter* ($150)	$1565
Two serial, two parallel; N/A	C-BASIC-2* ($125), Microsoft BASIC*, COBOL 80 available on 8-in. disk only* ($700)	N/A; Wordstar* ($500); SuperCalc* ($200 to $300), CP-M-based*	Can be upgraded through 860 software, Ethernet compatibility to come	16 retail stores, more than 20 new dealers and distributors, direct sales, user-installable, annual service and maintenance* ($480); operator manual; TTY, 3270 to come	$2995

*Separate pricing in single-unit quantities



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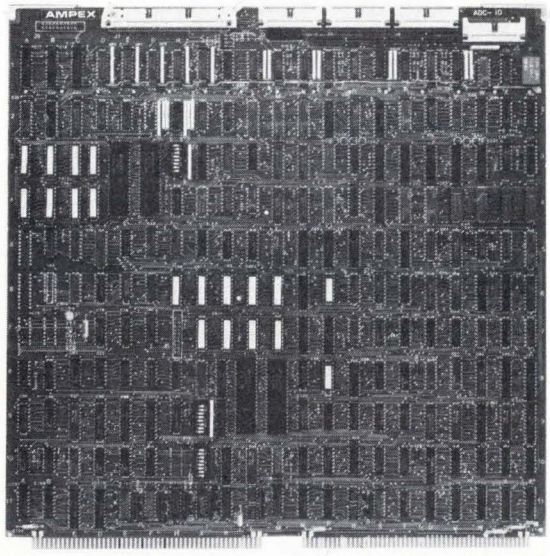

Ampex has a simple solution to your need for either separate disk or multifunction disk/tape controllers. We give you full emulation on a single embedded board.

Result: greater flexibility, lower costs, more control. That's because our new Constellation Series DEC and DG controllers are part of the Ampex "Subsystem" concept. It provides single-source buying for controllers, disk and tape units, so you're assured full compatibility and efficient performance.

DG EMULATION. The ADC-10 and ADC-20 are designed for Data General Nova* and Eclipse* systems. The ADC-10 attaches SMD or CMD disk drives with full emulation. The ADC-20 supports both streaming and start/stop tape drives, as well as attaching SMD disk drives. Dual microprocessor design provides high performance control of all interfaces.

DEC EMULATION. The ADC-11 and ADC-21 are both single-board DEC PDP-11 controllers with the ADC-11 attaching SMD drives with full emulation. The ADC-21 supports both streaming and start/stop tape drives, and also attaches SMD disk drives. Specify our Constellation Series. Control your costs as well as your design.

For more information contact Gary Owen, Ampex Memory Products Division, 200 N. Nash St., El Segundo, CA 90245. (213) 640-0150.

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CIRCLE NO. 118 ON INQUIRY CARD

Rotating-memory devices move to optical reading

By 1990, a surprising 39 percent of all information available on-line in rotating memory devices—2000 trillion bytes—will be read optically rather than magnetically. The lion's share of this capacity, about 1700 trillion bytes, will be found in office systems, in which laser-based optical-disk units will account for at least two-thirds of all information held in rotating memory. This move to optical storage will dramatically reduce the relative importance of magnetic-storage devices as office systems proliferate. Floppy-disk drives will provide only 3 percent of rotating memory capacity by 1990 in office systems, compared with 71 percent in 1980.

These predictions are among the most startling made in a report on the worldwide market for electronic and electromechanical memories published by British consultancy MacKintosh International, which also has an office in San Jose, Calif. The report points out that the value of optical-disk drive sales will not grow as spectacularly as their storage volume because of the enormous low-cost capacity provided by each unit. MacKintosh says that even in 1990, fewer than 1 million optical drives will be shipped with a total value of less than $1.6 billion, only 2 percent of all rotating memory sales.

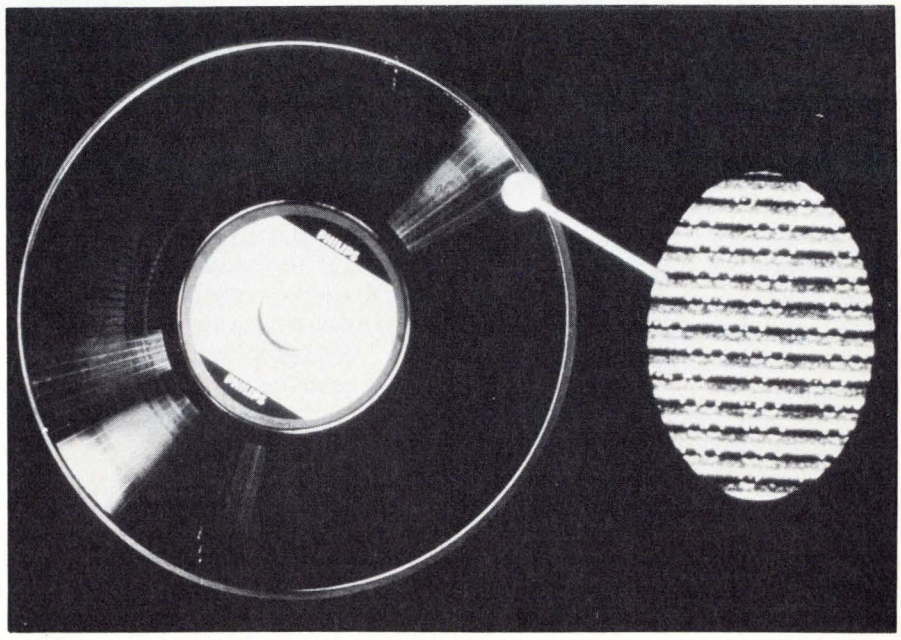
In contrast, more than 100 million floppy-disk units will be delivered in that year, with a total value of nearly $25 million. But most of these floppies will be used in peripherals, terminals and small computers rather than office systems.

In Europe, optical-disk systems are being developed by Netherlands-based Philips NV and Thomson-CSF, which is part of France's biggest electronics manufacturer, Thomson-Brandt SA. Both companies plan to start selling their systems in 1983, both are developing drives providing an on-line capacity of 10G bits on one 12-in. exchangeable disk, and both have their sights firmly set on the North American market as well as Europe.

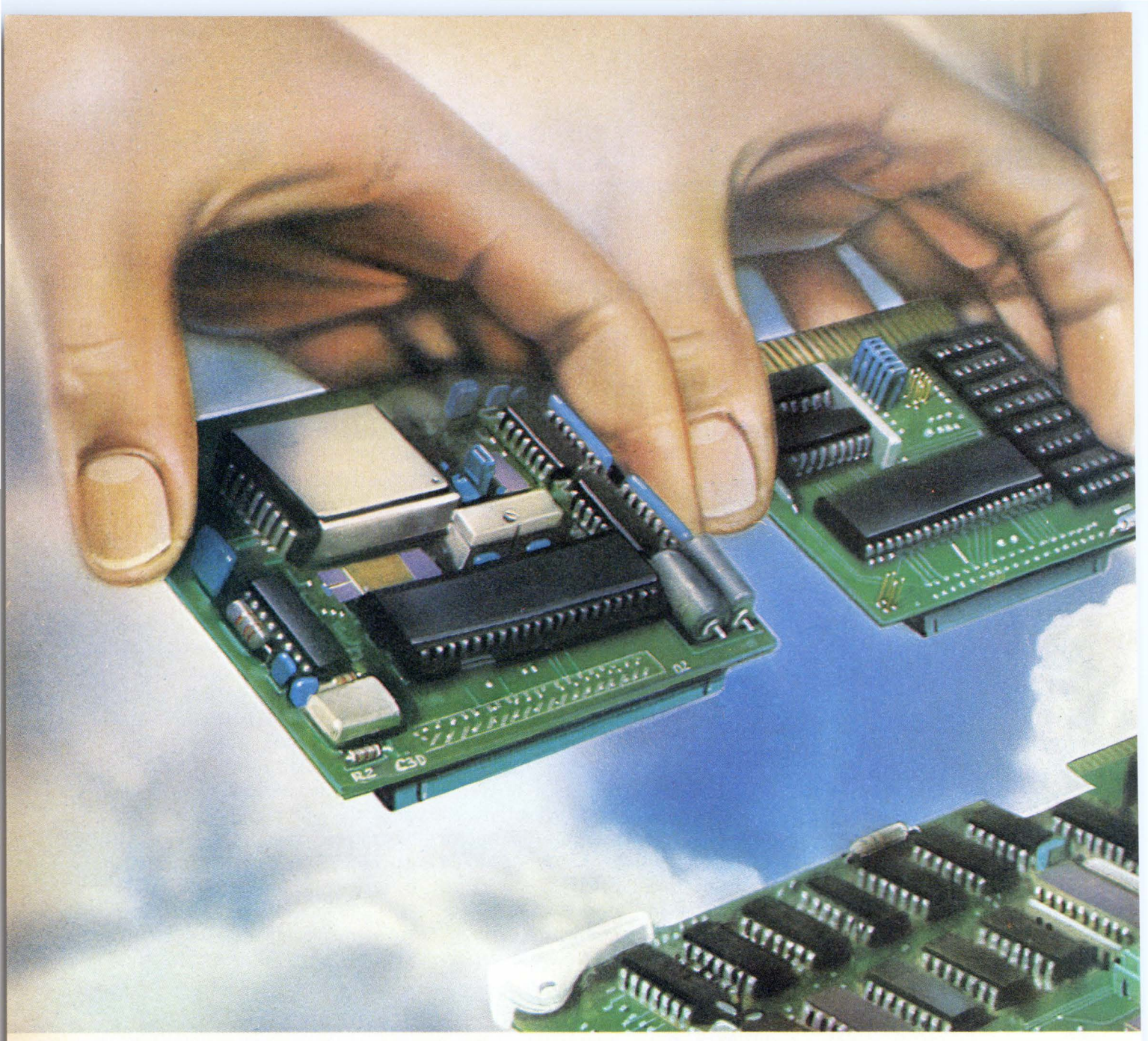
The Thomson product is being developed jointly by the French company and the San Jose firm, Optimem, which is part of Xerox Corp. subsidiary Shugart Associates. A spokesman for Thomson in Paris says both companies would manufacture the drives and act as a second source to each other. Asked about the MacKintosh predictions, he said they were too conservative. Thomson sees small computer systems as a major application area for optical-disk drives, in addition to office systems.

A spokesman for Philips at the company's Eindhoven headquarters says his company is talking to U.S. firms about OEM deals and joint-marketing agreements. The Philips drive is called a digital optical reader (DOR), and the company is developing an archival storage system linking with a 64-disk magazine. Philips is also working on a smaller version of DOR, accommodating a minidisk with a diameter of 10 cm. But the Philips spokesman says this project is still in the laboratory stage. The 12-in. disk drives are being used in applications in various departments of Philips.

Thomson estimates OEM prices for the 12-in. disk to be $3000 to $4000, while Philips is more



A 12-in. disk *used on the Philips digital optical reader, showing enlarged section. Each drive holds 10G bits.*



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The BLX solution—our low cost board level expansion for BLC users brings total versatility to SuperChip board system designs.

On-board function expansion is accomplished by plugging any BLX module directly into sockets on SuperChip host boards (BLC 80/11A, BLC 80/116, BLC 86/12B). Each host board can accept any two expansion modules.

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Broad line innovation from chips to boards. Our established manufacturing capabilities and technical innovation from the chip up make us the logical choice for board level designs.

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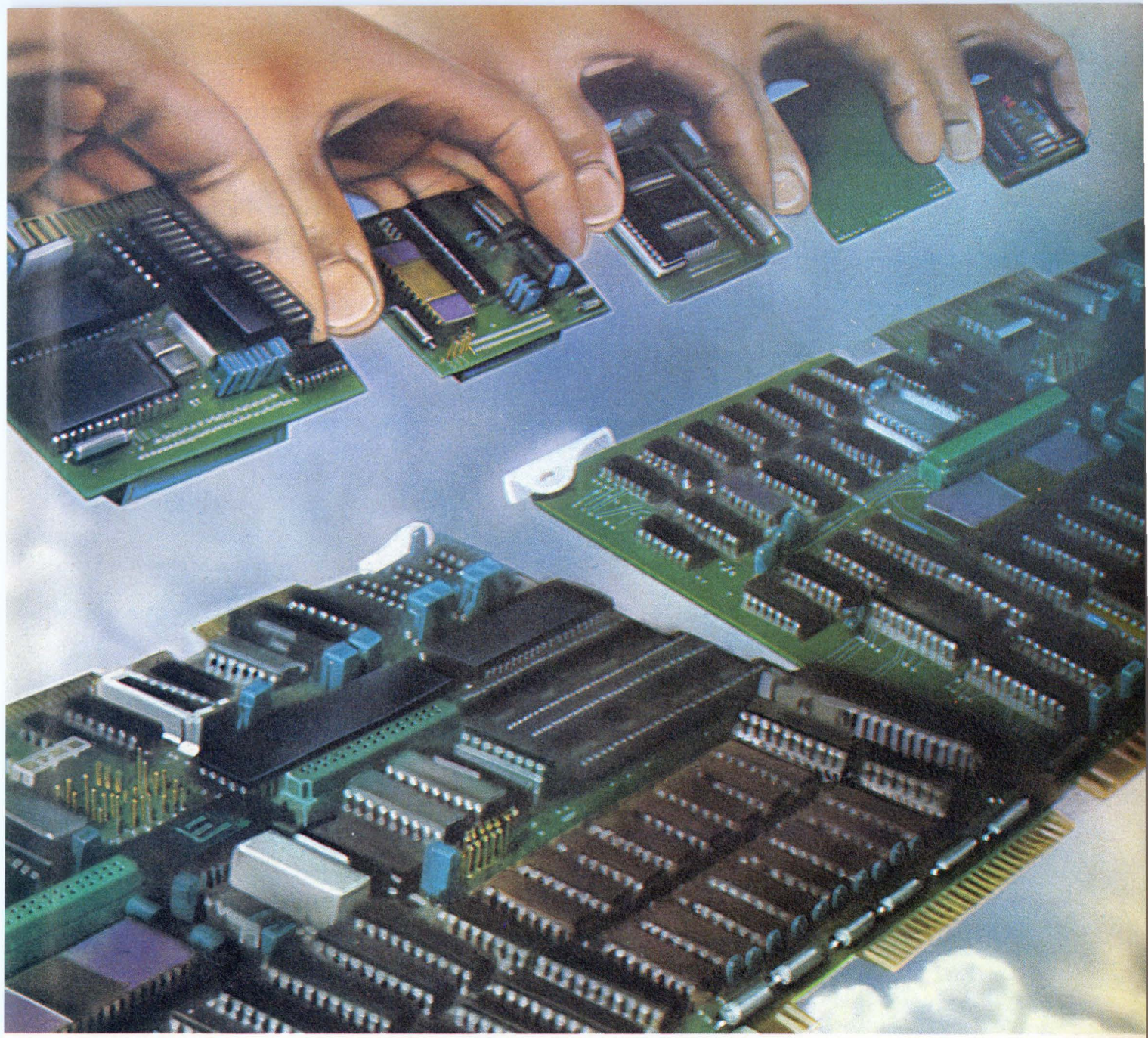

level versatility no one else could.

board level expansion either.

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CIRCLE NO. 119 ON INQUIRY CARD

uncertain, suggesting about $10,000. Even at $10,000, the cost per bit would be dramatically lower than magnetic-disk storage.

The enormous capacity provided by optical-disk drives will be soaked up by high bit-density information, such as facsimile and other digitized images and by archival data and text. The one big drawback with optical systems is that information cannot be erased after being written because the writing process involves the punching of tiny noles about 1 micron in diameter in the disk surface. But advocates of the technology point out that the enormous capacity makes it feasible to write an updated record on another part of the disk.

The Philips DOR is a development of the company's video long-play system, aimed at the audio and video consumer market. One major difference is that DOR comes with a compact but very powerful diode laser head that can write and read information. The long-term importance of optical-disk systems was underlined earlier this year when one of the world's biggest magnetic disk-drive manufacturers, Storage Technology Corp., took over Star Systems, the optical-disk development venture of Exxon Corp. IBM Corp. is also involved with optical-disk technology through Discovision, its joint venture with MCA Corp. —*Keith Jones*

DJ 'AI' Systems promotes 'The Last One'

"It will be six months before people realize why our product is called The Last One," says Raymond George "Scotty" Bambury, chairman of DJ "AI" Systems, a tiny British software company that claims to have received at least $6 million worth of advance orders for its μc BASIC code generator. Moreover, the U.S. has provided most of these orders.

Advertised as "a computer program that writes computer programs," The Last One is "the last program you'll ever need," Bambury says. It asks programmers questions in English and uses the answers to generate "a totally bug-free" program in BASIC, according to ads that appeared widely in the computer and general press for months before The Last One was formally unveiled in London in August.

Bambury received thousands of advance orders as a result of his $1-million pre-announcement advertising campaign. He justifies his promotional policy on the basis that it has removed the need to incorporate physical anti-copying devices in the product. Many users who want it will buy it before software pirates will be able to make multiple copies. At the same time, the legitimate customer benefits because he can make two backup copies of the product, saving himself the trouble of going to a dealer when a replacement copy is needed.

DJ "AI" Systems, Ilmister, Somerset, threatens strongly to take legal action against any customer who makes more than two backup copies; runs The Last One on any system other than the one for which it was purchased; or lends, hires or sells copies. Moreover, the product's user manual states that the company will "cheerfully and promptly" pay a reward of $5000 for information leading to the successful prosecution of any person infringing its rights to The Last One. The customer has to sign a user-registration card at the time of purchase to become a legitimate user and to receive any updates or newsletters.

Chairman of DJ "AI" Systems, *Raymond George "Scotty" Bambury: The Last One is "the last program you'll ever need."*

The company's U.S. marketing office in Los Angeles will enforce these rules in the U.S. And U.S. general manager Larry H. Downing says he is seeking dealers for the product. Dealers will be required to attend classes on the product and to sign an agreement laying them open to fines if they misrepresent The Last One.

Bambury won't reveal how many copies of the product were ordered in advance of first delivery, except to say that the figure was well in excess of 10,000. Single-copy price in the U.S. is $600, plus local tax, with quantity discounts available. Bambury points out that DJ will demand payment only if a customer has received his copy or copies and has verified that the product does what is is supposed to. While standing by claims that The Last

"As OEMs discover the advantages of Quantum 8-inch Winchester drives, the demand grows daily. In Manufacturing, we're prepared to meet high-volume OEM commitments."

A very manufacturable disk drive.

Quantum's 10, 20, 30 and 40-megabyte Q2000 disk drives were designed to be built in high volume at low cost.

Working as a team, Quantum design and manufacturing engineers created a drive that gives you better performance than the industry-standard 8-inch Winchester, yet can be manufactured with simple, low-cost parts and fast, efficient production methods.

Low-cost, high-volume production.

To meet your low-cost, high-volume delivery requirements, we designed our manufacturing process as carefully as we designed the drive itself.

Our unique conveyorized "clean-air tunnel" combines the best of proven techniques for Winchester drive assembly. The drive is assembled on a conveyor line, so production is more efficient than with independent assembly stations. And the laminar-flow clean-air tunnel completely eliminates the need for a large, expensive "clean room," cutting production costs and increasing worker efficiency.

Specially-designed automated testing equipment thoroughly exercises each drive through all its functions, to assure highest quality while keeping labor costs down.

Every manufacturing operation is planned for easy, smooth expansion to meet growing OEM requirements.

In short, we're geared for low-cost, high-volume production of quality disk drives that we're proud to deliver to you.

Get to know Quantum now.

From manufacturing and engineering to marketing and customer service, Quantum has the very best people in the disk drive industry today. People who can help you plan an affordable growth path for your small computer systems.

For details on Quantum's low-cost 8-inch Winchester drives, call our Western Region Sales Office at (408) 262-1100, or our Eastern Region Sales Office at (603) 893-2672. Quantum Corporation, 1804 McCarthy Blvd., Milpitas, CA 95035.

See us at COMDEX, Booth 191.

QUANTUM ***Driving down the cost of quality.***

CIRCLE NO. 120 ON INQUIRY CARD

LAST ONE REDUCES CODING TIME

The Last One does not remove the need to construct a program logically, but it does reduce coding time dramatically. The product's instruction manual requires considerable study, even for someone well-versed in programming. But once the programming approach has been mastered, a programmer can find out if it reduces BASIC coding time to one-half the time needed when writing lines of BASIC instructions—a claim that DJ "AI" Systems makes.

The programmers' manual points out that the heart of The Last One is the flowchart-creation menu (FCM). The flowchart is not a diagrammatic representation of a program's logic but a series of one-line descriptions defining the programmer's requirements. The FCM presents the programmer with a list of as many as 19 optional programming tasks, including programming for handling input from the keyboard, data output, calculations and branching to other parts of the program. Seven file-processing modes can also be selected, including set-file pointer, input from file, write to file and search file.

With the branching option, for example, a programmer is presented with branch on match, branch on error and conditional branch on yes/no—in which the operator answers a yes or no question and determines if a branch is executed. On selection of the option, the programmer is presented with the question "message required?" to which he responds by entering the prompt that should be given to the operator and also should be incorporated into the finished flowchart. The program then asks "branch on yes or no Y/N?" to which the programmer answers by simply entering a Y or N, according to which response causes the branch to operate. If N, the flowchart line created by The Last One would be Ask user (followed by the prompt If NO branch).

The number of the line in the flowchart being branched to is unspecified until an FCM optional, code program, is activated. This leads the program to ask the programmer to complete missing parts of the flowchart, such as branch destinations. The programmer will be asked "In line N I should branch to?" to which the programmer responds with the destination line number.

File selection and creation require the user to respond to messages such as "Do you want a new file for this program?" and "How many files do you want to build?" For each file required, the programmer will then be asked to provide information, such as a label; the number of fields per record; the label for each field; whether the field is the date, alphanumeric or numeric.

One generates error-free BASIC coding, Bambury admits that an unskilled user could make a mess of a program. He recognizes a big difference between an error-free program and error-free code. The Last One generates lines of BASIC coding, which can be printed or displayed, but the company plans a direct machine-code-generating version. The Last One product line includes versions for Tandy Corp., Apple Computer, Inc., Commodore Business Machines Corp., Ohio Scientific, Inc., and Sharp Inc. machines, and is compatible with the ubiquitous CP/M operating system. It requires a 32K-byte or larger capacity machine, and all modules occupy 110K bytes of floppy disk.

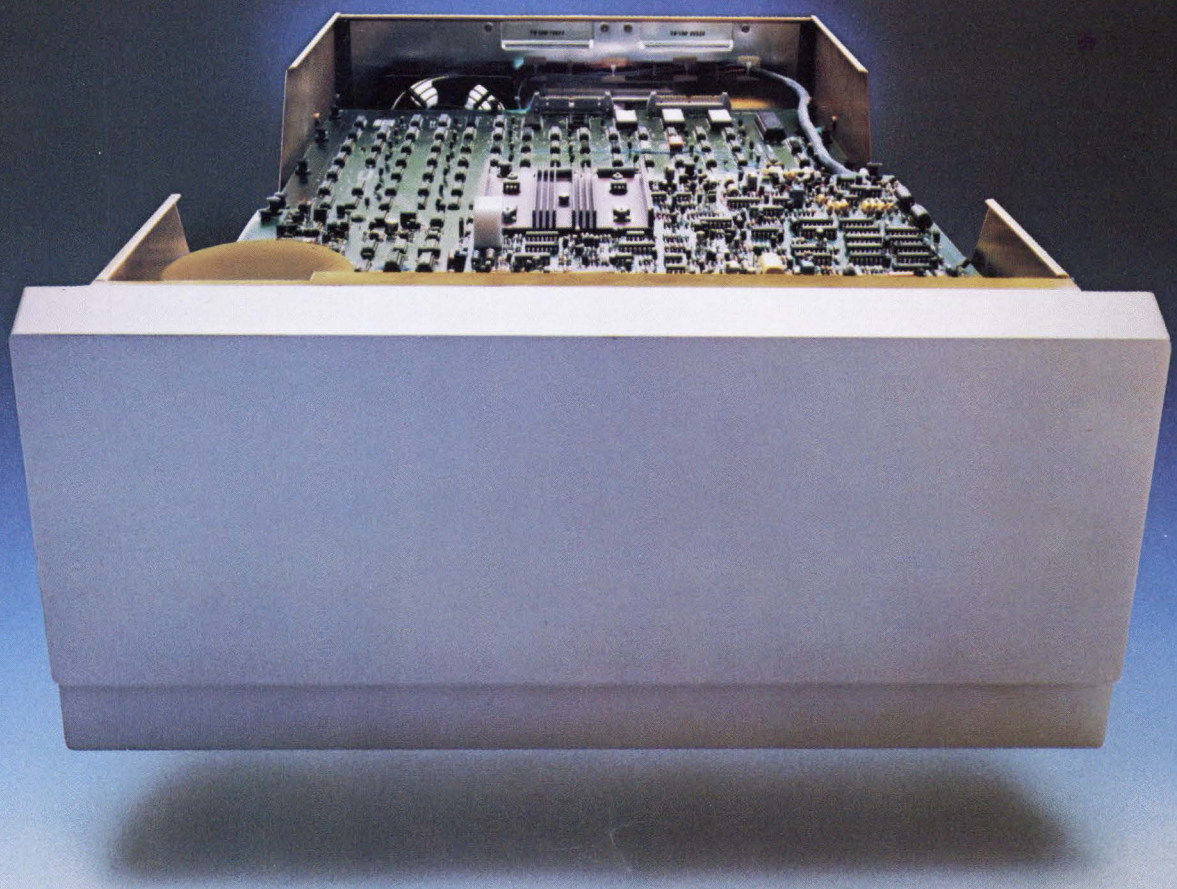
David James, developer *of The Last One, demonstrates the product at its introduction.*

Bambury's large car-tire distribution business yielded the money he needed to develop and promote The Last One. He became involved with computers about four years ago when he installed a small system to run his company's accounts. Frustrated by the costs and complications involved in applications programming, he became interested about two years ago in the work of another entrepreneur, David James. James had become so engrossed in the development of an artificial-intelligence system that most of his own business interests had collapsed. Bambury liked the program-writing routines constructed by James as part of his AI experiments, and Bambury decided to support him in their further development. Bambury established the company, and The Last One is its first product. Future enhancements will include continuous voice-recognition facilities to save programmers from having to key responses.

—Keith Jones

Century Data Systems
A Xerox Company

Drives for the 80's



Century achieves a new milestone in space.

The 160MB Marksman.

Planned evolution: a logical, cost-effective extension of a complete line of Marksman Winchester disk drives.

In just over two years, Century Data has boosted capacity of the Marksman eight-fold while cutting per-megabyte costs by a factor of three.

Like the 80MB model introduced at this year's NCC, the new Marksman 160 incorporates an improved head positioning concept developed in conjunction with the Xerox Advanced Development Laboratory.

A new torque motor and closed-loop servo system increases track density and improves data reliability. This motor boosts performance by 23 percent, yet fits in the same physical space as a stepper motor.

Remarkably easy to interface.

SMD or Marksman interfaces are standard.

It's also available with an embedded intelligent formatter

Continued on next page.

Century Data Systems
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You finally found a supplier that can deliver 40MB Winchesters now.

Century Data Systems.

And what we'll deliver is disk drives. Not promises.

In fact, Marksman 20 or 40 MB Winchesters can be in your hands—in quantity—in a matter of weeks from your order. It takes that long for some other suppliers to send you a letter saying your order's in backlog.

Where time is of the essence, Century can go further. Not only will we deliver fast, we can ship intelligent Winchesters that can cut system integration time from months to days.

And don't think you have to pay a stiff price for a proven product that's available now. The 20 and 40MB Marksman drives go head-to-head on costs with similar-capacity disks of any size.

In fact, you won't find a better cost per MB. Anywhere. Your

Century representative can tell you more.

Highlights:
Capacity: 20 and 40MB
Transfer rate: 960KBS
Avg. Seek Time: 65MS
Error rates:
Recoverable: <1 in 10^{10} bits
Nonrecoverable: <1 in 10^{13} bits
Positioning: <1 in 10^{6} seeks
MTBF: >8000 hours
MTTR: <30 minutes

Space

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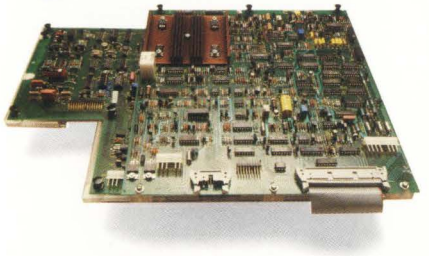


that typically enables systems integrators to interface to mini/micro bus structures in less than a week.

No more suffering through six months (or more) of in-house controller/formatter design time and the resultant hidden costs. Most of the difficult work is already done.

Century also provides the hardware application information and support to make your software job quick and inexpensive.

The result: Your systems can be sent to market that much faster for a competitive leg up.

Upward growth path... the story of the Century.

Start your customers out with 20 or 40MB drives. Solid, proven products available in OEM quantities now. Then integrate Marksman 80s and 160s as their storage needs grow.

With Century, an upper limit will be hard to find.

Cost/performance ideally suited to minis and micros.

Marksman 160 is a fixed Winchester disk with *significant* cost advantages. It will be available in various interfaces, with or without cabinets, embedded controller/formatter, and power supplies.

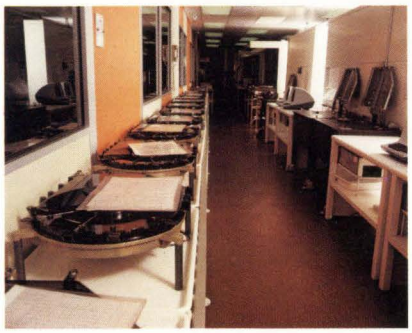
Call us now to reserve your evaluation unit.

Highlights:
Capacity: 160MB
Transfer rate: 1280KBS
Avg. seek time: 50MS
Error Rates:
Recoverable: <1 in 10^{10} bits
Nonrecoverable: <1 in 10^{13} bits
Positioning <1 in 10^{6} seeks
MTBF: >8000 hours
MTTR: <30 minutes

The million dollar clean room.

At Century Data, one particle of dirt a fraction of the diameter of human hair is considered absolute filth. So we spent a million dollars to make sure that kind of mess never contaminates our Winchesters.

First, we built a clean room with two sections, each wrapped in a bubble of intensively filtered air flowing in a laminar pattern. In one section, we degrease disk, head and enclosure materials with freon.



In the main clean room section, the actual assembly takes place on six clean benches. Each engulfed in its own additional bubble of even cleaner air.

Our next task: making sure the people who assemble the Winchesters are clean enough. A surgical nurse would be too dirty.

The only people that get into our clean room are professionals who have just been scrubbed and scoured. They wear surgical clothing, masks, hoods and special shoes. And they don't eat, chew gum, drink coffee, smoke or even sweat.

The total effect duplicates the zero-error concept of manufacturing used in manned space flight.

Without that kind of clean on top of clean, you just can't be confident of a sealed disk drive. Especially when you think of that flying head, 80 atoms of air away from the whirling high-speed disk. Let just the tiniest fragment of a particle in, and it will not only threaten the data's integrity, it could even damage the components.

Impressive as it is, our million dollar clean room is just one of many quality assurances that goes into a Century drive.

We've put another three million dollars into the most sophisticated automatic test equipment, fixtures and software you'll find anywhere.

It's all part of a continuous commitment to quality like nothing else you'll find in the industry.

Century ready with SMD drives.

Some manufacturers can keep you waiting a year or more for removable-pack disk drives. Especially if you need SMD interface capabilities.

But not Century Data.

Our removable-pack Trident drives are available now. With SMD interfaces, as well as DTL/TTL's. From our 50 and 80 megabyte table-top and rack-mountable models to our 300 megabyte free standing models.

Tridents are dependable, too. Our fully enclosed, specially sealed contamination control system protects your data's integrity, even during preventative maintenance.

We could go on. But the big plus is that you can get our Tridents. Fast. Which means you can start pushing sales out the door. Instead of stalling your customers with some story about how long it takes to get a drive with SMD.

So don't risk your sales by waiting around for a disk drive. Talk to Century about Tridents, today. And get your systems up, running and out to your customer.

Century goes for a quiet drive in the office.

Computer systems were once confined to the computer room, along with all of the other devices that went with them. Tape drives, disk drives, printers and terminals were free to whirr, buzz, click and tap at will.

But this is the age of office automation, when computing equipment is liberated from the computer room for face-to-face contact with secretarial offices and even executive suites. The problem: the clicks and whirrs and buzzes have to be left behind.

Dedicated DP systems. Word processing. CAD/CAM in engineering and design offices. Locally networked data bases. All of these applications give Century Data a mandate to design and manufacture Winchester disk drives that fit this new environment—not interfere with it.

At Century, special equipment and engineering expertise combine to bring quiet drives to the office.

Anechoic is Greek for "no echo." It's also the name for our chamber specifically designed to test noise levels in Winchesters. Pyramid shapes laid over insulating materials capture and absorb sound within the room.

Drive prototypes are placed within the anechoic chamber and put through their paces, while sound measuring devices read noise levels with laboratory accuracy. Drive-quietizing studies are made at the design stage—and verified on production units—enabling advances in engineering toward the quieter drive.

While one anechoic chamber is used for testing

and reducing sound levels from rapidly spinning disks and head-positioning mechanisms, another is used to measure emissions in the radio-frequency spectrum. With this precise way to measure RF noise, we can improve our designs and reduce these emissions.

Century's anechoic chambers are just two devices among many to help us make the better Winchester. It's all part of an ongoing multi-million dollar investment in the future of disk data storage.

For the full Story of the Century...
just check the information you want, and we'll send it to you right away.

☐ Marksman: 160MB ☐ Trident: 300MB
☐ Marksman: 80MB ☐ Trident: 200MB
☐ Marksman: 40MB ☐ Trident: 80MB
☐ Marksman: 20MB ☐ Trident: 50MB

☐ I would like an evaluation unit for one of the Marksman Winchester or Trident Removable-Pack Disk Drives listed above. Someone will contact me to make arrangements as soon as possible.

Send to: Century Data Systems, 1270 N. Kraemer Blvd., Anaheim, CA 92806.

Please enclose your business card. MMS

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Anaheim, CA 92806

North American Headquarters
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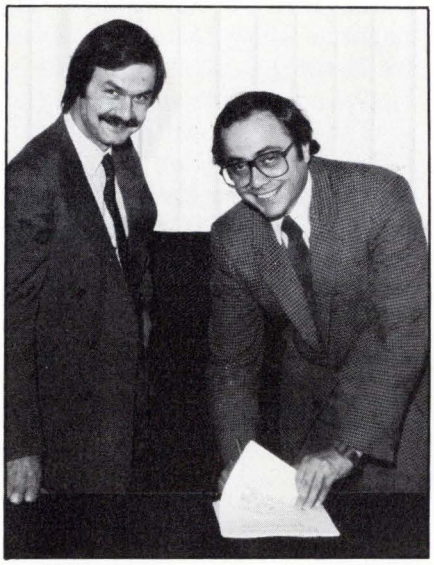
Angusglow offers COBOL compiler

A portable COBOL compiler developed by British software company Angusglow Ltd. offers the possibility of transferring COBOL applications programs for mainframes and minicomputers to the new breed of low-cost, μp-based systems.

Called Alpha COBOL, the compiler is being marketed in the U.S. by 20 dealers that sell Alpha Microsystems Corp. μcs. The two versions of Alpha COBOL were developed for AM systems. One conforms with ANSI '74 standard COBOL and has been installed by about 60 AM users in the U.S. over the last year.

The other version of Alpha COBOL, unveiled in July, is the first member of Angusglow's planned family of compilers for emulating various mainframe and minicomputer COBOLs on a variety of multi-user μcs. Called the Plug Compatible (PC) family, its first member enables Data General Corp.'s interactive CS COBOL to be compiled on an AM machine, and AM's European distributor in London has already signed a $1.5-million (£750,000) OEM order for multiple copies of the product. It hopes to capture DG-oriented systems integrators by the much lower cost of AM hardware. Also, DG-oriented software houses should be interested in augmenting their base of prospective customers with users of AM machines.



David Pheasant, *marketing director of Alpha Microsystems U.K., Ltd. (l.) and Leo Scheiner, managing director of Angusglow Ltd. sign $1.5-million agreement covering OEM marketing of Angusglow's CS COBOL-compatible version of Alpha COBOL.*

Angusglow managing director Leo Scheiner says he is talking to manufacturers of other multi-user μcs who want to support the development of versions of Alpha COBOL emulating other major manufacturers' COBOLs, including those of IBM Corp., Burroughs Corp. and Hewlett-Packard Co. Scheiner will not name his prospects but reveals that they include companies that are developing multi-user machines around the 16-bit Motorola 68000 chip.

Scheiner says a British vendor of systems based on the Digital Equipment Corp. LSI-11/23 processor has also expressed an interest in versions of Alpha COBOL to run on that machine. But DEC has expressed no interest.

Companies interested in Alpha COBOL are small but rapidly growing μc manufacturers. "Versions of Alpha COBOL for DEC machines would be very easy to develop because Alpha Microsystems machines are configured around the 16-bit MOS chip set originally developed by Western Digital Corp. for incorporation in DEC μcs."

Scheiner stresses that the U.S. is the primary thrust of Angusglow's marketing efforts with Alpha COBOL because the U.S. is seen as the biggest market. End-user prices for the two versions are $1600 for the ANSI '74 and $3000 for the DG CS COBOL version. They both run under AMOS, Alpha Microsystems' operating system.

In Europe, both versions are sold by Angusglow and by Alpha Microsystems U.K. Ltd., European

ALPHA COBOL: PORTABLE AND MULTI-USER

The portability of Alpha COBOL is a function of its "compiler-compiler" features. A specification of the COBOL source code being processed is generated in an intermediate META language. Data sets are compiled from the specification during a phase called META compilation and drive an interpreter at source-compile time.

Angusglow says it is useful to view the compiler-compiler as two data-driven interpreters with a common interface data area. On the input side, a parser interpreter is driven by data sets representing the source language syntax and semantics, and on the output side, a generator interpreter is driven by data sets representing the target language or the machine language. A master control program controls the synchronization of the two interpreters. The same pair of interpreters can be used at both META-compile and source-compile times, but Angusglow believes that better performance is achieved if functions such as data-allocation and picture-parsing are embedded in the source compiler rather than being data-driven.

Angusglow regards the compiler-compiler approach as particularly suitable for multi-user μc systems, in which compact coding is vital. The data sets produced at META-compile time are read only.

master distributor for the U.S. μc builder. The OEM agreement with Angusglow on the CS COBOL version covers a three-year period. While AMUK has revealed that it is worth $1.5 million, company marketing director David Pheasant will not disclose how many copies will be made over that period, mainly because it would indicate the size of AMUK's markup.

Pheasant says that AM hardware for a typical commercial configuration will sell for £20,000 in Britain compared with £40,000 for equivalent DG hardware. This reduces the total cost of the system from around £60,000 to £40,000. Regarding performance, Pheasant admits that AMUK has yet to benchmark test an AM machine against DG equipment, although he points out that benchmarks carried out by *Interface Age* magazine show that AM machines are faster than similar DEC PDP-11/34 systems because of the efficiency of the AMOS operating system.

Pheasant says AMUK plans to extend its Alpha COBOL marketing activities to include IBM mainframe users when an IBM COBOL version for AM machines is available. It will enable COBOL applications to be developed remotely from host mainframes, and batch communications will be facilitated by IBM 2780/3780 emulation software being developed by AMUK.

Angusglow is not the first British software house to address the substantial market for μc COBOL compilers in Europe and North America. London-based Micro Focus Ltd. has been actively marketing its ANSI '74-standard CIS COBOL in the U.S. for several years through Micro Focus, Santa Clara, Calif. —*Keith Jones*

Commodore in Europe supporting COMAL

Commodore-Machines in Europe is supporting a structural language for educational applications called COMAL. The language is described as being "55 percent line Pascal," while offering BASIC-type interactive operating features, such as immediate syntax-error indication.

COMAL is being used in the U.S. on a limited basis by owners of Commodore PET machines. But in Europe, the existing disk-based version is being used widely enough for Commodore to back the development of a COMAL ROM board for PET systems. The board might also be available later in a version for the company's new VIC μc series. The main problem with the disk version is that it occupies 26K bytes of main memory on a 32K-byte machine.

COMAL was developed in Denmark in 1974 to 1975 by professors Borge Christensen and Benedict Loefstedt. Christensen describes COMAL as a "kindergarten FORTRAN" and he believes COMAL's structure is sufficiently similar to Ada that it could also be considered a "kindergarten version" of the U.S. Defense Department's real-time language.

The existing version of the language, COMAL '80, will be enhanced with some significant extensions when it appears on a ROM board. These will include facilities for calling external procedures in different languages if required. BASIC will be available in background on PETs with the COMAL board. The disk version is free, but Commodore plans to charge for the new board. No prices have been set.

A small COMAL user group has started in the U.S. under the leadership of Len Lindsay of Madison, Wisc. A former Commodore employee, Lindsay is the founder of PET Gazette, a user publication. —*Keith Jones*

SYSTEMS '81 AIMED AT COMPUTER PROFESSIONALS

The closest thing to the National Computer Conference in Europe is the Systems Show, held once every two years in Munich, West Germany. Systems is the biggest exhibition in Europe aimed squarely at computer professionals with a direct interest in systems integration.

Systems '81 runs Oct. 19 to 21 at its normal venue, Munich's vast Trade Fair Center, called Die Messenglade. Show organizers say Systems '81 has attracted more than 600 exhibitors, an increase of 30 percent over 1979.

Around 150 of the exhibitors stand out as being North American-owned companies, including the West German subsidiaries of about 60 U.S. firms, such as Digital Equipment Corp., Data General Corp. and Hewlett-Packard Co. The importance of the show for smaller American manufacturers is underlined by the huge joint exhibit sponsored by the U.S. Department of Commerce. This year, 70 companies will be taking space, many with the aim of finding distributors to cover West Germany.

Systems is also a useful show for North American-based distributors and systems integrators interested in assessing what European computer equipment manufacturers have to offer. European hardware builders tend to follow rather than to lead their U.S. counterparts in technological innovation, but this does not necessarily stop their being competitive in terms of price and delivery.

For more information about Systems '81, telephone the organizers in Munich at 011-49-89-51071, or telex them at 5212086. For hotel information, contact the Incoming Tourist Service, Sophienstrasse 1-2, D-8000 Munchen 2, West Germany.

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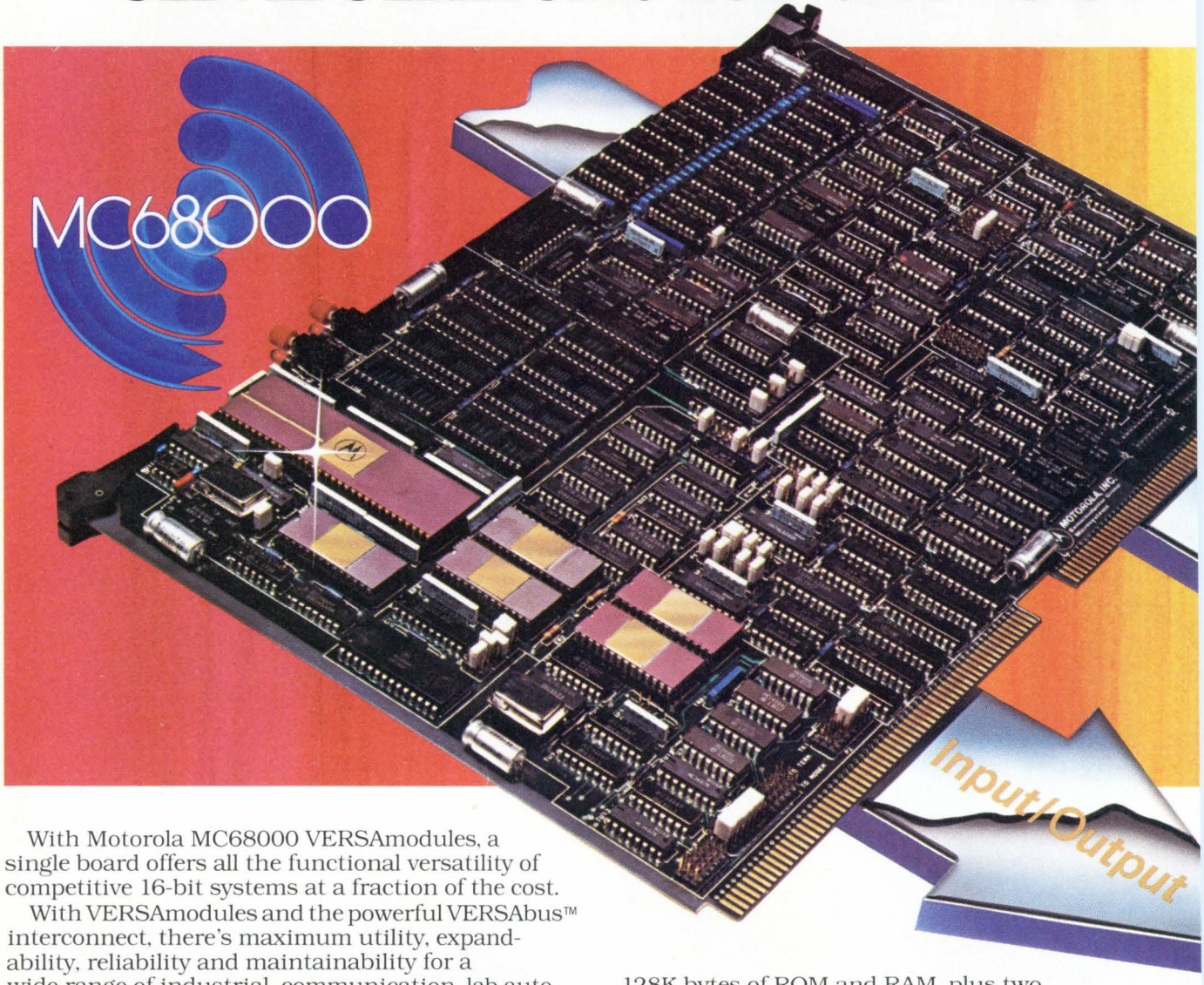

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With the complete VERSAmodule family of circuit boards, system software, packaging and accessories the microcomputer system engineer can apply the power and versatility of the MC68000 MPU at a high level of system integration.

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Most Powerful Microcomputer

The VERSAmodule Monoboard Microcomputer flagships the VERSAmodule family. Combining an MC68000 MPU, full VERSAbus interface, multiprocessor capability, substantial ROM/RAM, serial and parallel I/O and timer/counter functions, it's easily the most powerful single-board microcomputer yet offered. For designs requiring up to 128K bytes of ROM and RAM, plus two high-speed serial channels (up to 19.2K baud) and 40 lines of parallel I/O, this single board meets all system needs. Competitive approaches require two to four boards for the same capability, and, inevitably, more cost.

Total Software Environment

Many 16-bit applications, particularly in higher-performance, control-oriented areas, require a realtime, multitasking environment for efficient operation. By combining the ready-made RMS68K™ multitasking system software package with your VERSAmodule-based system, you can save the man-months of effort necessary to develop a system capable of managing resources efficiently in real time. Time and money saved can be used to apply your expertise to development of application programs.

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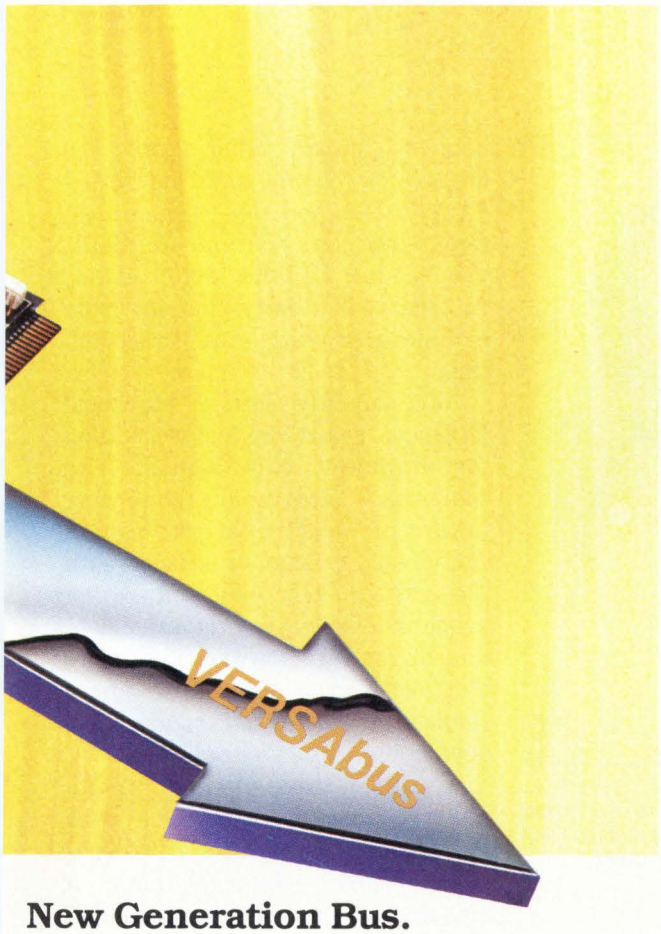

New Generation Bus.

Supporting a mixture of 8- to 32-bit MPU architectures with high-speed transfer rates, VERSAbus offers a flexible, economical system bus ideal for industrial automation, communications or general business applications. VERSAbus is incorporated in the VERSAmodule chassis/card cage backplanes and willingly accomodates multiple processors. Designed-in ease-of-use for tomorrow's upgraded systems saves money by obviating major hardware and software redesign.

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VERSAmodule products support an unmatched level of system integrity. This includes reliability of the MC68000 with its advanced architectural features such as exception-processing and interrupt handling. These allow for graceful handling of common system problems such as bus error, illegal instruction, divide-by-zero, privilege violation, spurious interrupt, etc. This "soft-failure" capability alerts operating personnel and, in many cases, allows recovery before critical failure.

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Versatile Development Support.

Unparalleled ease and efficiency in software development for VERSAmodules is yours through EXORmacs™ — a third generation 16/32-bit development system with state-of-the-art hardware architecture, advanced operating software and self-test capability. Pascal, FORTRAN and structured macro assembler allow choice of the language best suited to needs. A versatile, CRT-oriented text editor speeds up program preparation and modification. And a flexible linkage editor permits modular, top-down system development.

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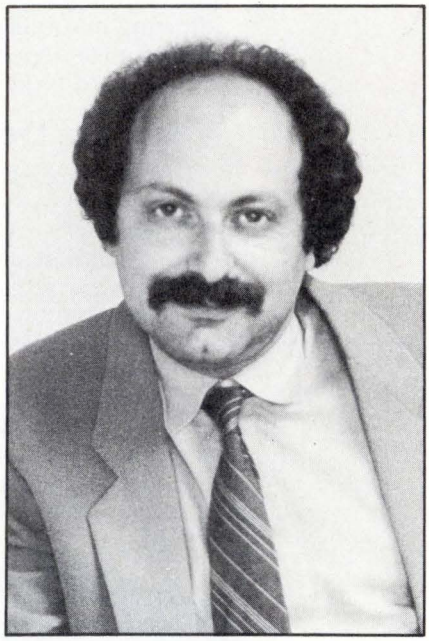
Start-up firm joins growing Ethernet activity

As Xerox Corp.'s Ethernet continues to gain recognition and credibility as a powerful local area network (LAN) design, several companies are moving to provide Ethernet-compatible equipment interfaces. One such firm, Interlan, Inc., plans to offer board-level controller products by early 1982 that will interface Intel Corp.'s Multibus and Digital Equipment Corp.'s Q-bus and Unibus processors to Ethernet networks.

While the start-up firm's founders say they won't be limited to Ethernet interfaces—other potential products include broadband network interfaces, terminal concentrators and intelligent gateways that link dissimilar networks—they say Ethernet offers the fastest growing and most attractive LAN market. Figures from the Yankee Group support this viewpoint. The Boston, Mass., market-analysis and consulting firm projects that 140,000 Ethernet nodes will exist by 1983, with 90,000 Datapoint ARC nodes representing the next largest LAN market.

Located in Chelmsford, Mass., Interlan was founded by four people with impressive credentials for entering the Ethernet controller fray. President Paul J. Severino was formerly vice president of Engineering at Data Translation, Inc., and before that position, a member of Prime Computer Inc.'s original engineering staff. Patrick Clark, vice president of marketing, comes directly from Prime, where he was manager of business and market planning. Interlan's vice president of engineering, David Potter, was formerly manager of local-network hardware development in DEC's Distributed Systems Group. And Betsy Miller, vice president of sales, also comes from Data Translation, where she served as national sales manager. Outside board members are William Poduska, founder and president of Apollo Computer, and Russell E. Planitzer, a partner of J.H. Whitney & Co., the venture capital firm that has provided Interlan with its first round of funding.



Interlan president Paul J. Severino: *"Products like ours can help make Ethernet more successful." Future products will address additional LAN technologies.*

In discussing his company's prospects, Severino disputes the theory that Interlan's success depends on the success of Ethernet. Rather, he says, "The success of Ethernet will depend upon people like us providing products that support the network." As it happens, several other people are already developing and marketing Ethernet-compatible communications controllers. With its Multibus, Q-bus and Unibus orientation, Interlan will clearly find its most notable competition at Intel and DEC.

Intel already has a Multibus/Ethernet board product scheduled for shipment this month. The company is also rapidly advancing toward its objective of producing a chip-level Ethernet interface, with the LSI product expected to be available next year. Other semiconductor manufacturers, including Mostek Corp., Advanced Micro Devices Inc. and Zilog, are also developing chip-level products.

At DEC, development of an Ethernet interface compatible with the company's products is moving more slowly. John Adams, a manager of strategic planning and marketing at the company, expects two families of interfaces to evolve: one that is early to market and that doesn't incorporate the forthcoming LSI chips, and a second family developed around the chips once they become available. With a timetable calling for introduction of its first Ethernet controller during 1983, DEC apparently plans to have its products fall within the second family.

Meanwhile, Severino believes firms such as his own and 3Com Corp., Menlo Park, Calif., will be able to get a head start on the DEC market. And Severino isn't worried about future LSI chips obsoleting Interlan's product line. "The coming availability of chips is fine with us," he says. "They will allow us to put

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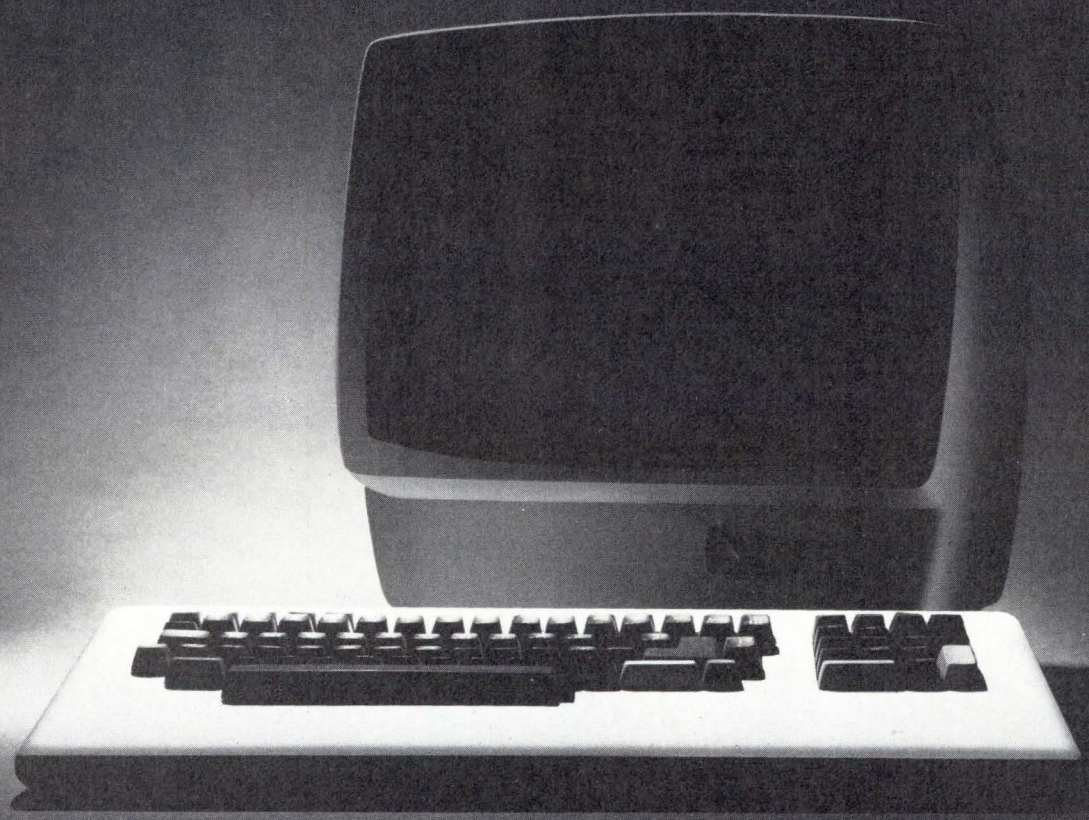

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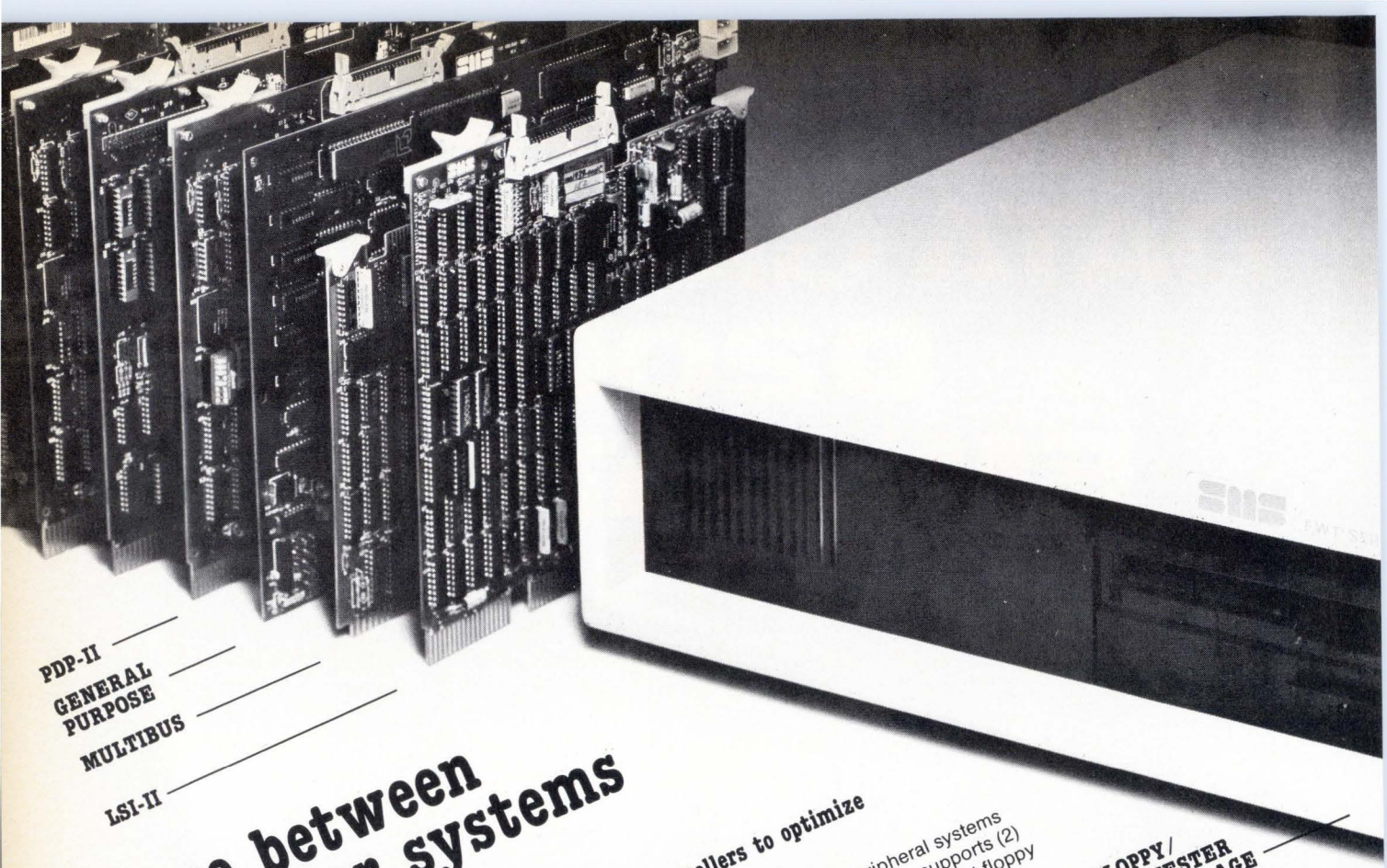

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DEC PDP-11/LSI-11

- Single LSI-11 dual height or PDP-11 quad height interface plus formatter board.
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- Emulates DEC RX02 floppy disk controller.
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- Single Multibus compatible PC board requires only 5A (max.) @ 5 volts.
- Direct connection to (2) Shugart/Quantum and (2) Shugart floppy disk drives. Eliminates external data separator board.
- Interface and command compatible with INTEL iSBC 215A and iSBX 218 controller boards.
- Supports IBM and INTEL iSBC 202 diskette formats.

GENERAL PURPOSE

- Single board controller requires only 5A (max.) @ 5 volts.
- Interface, dimension and connector compatible with Shugart 1403D.
- Direct multi-sector disk transfer of up to 543K bytes/sec.
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more functionality into our products."

Prototypes of Interlan's first board products aren't due until the fourth quarter of this year, and exact specifications are not yet available. The products will provide both hardware and software support, says marketing vice president Clark, who also indicates that OEMs and system integrators will comprise the company's primary customer base.

Despite Interlan's plan to provide extensive software support within its products, Adams at DEC suspects the young firm's controllers won't provide as high a level of diagnostic and software capability as DEC's future interfaces. "We will provide a much more sophisticated system solution for integrators," he predicts. "Interlan will be selling products to systems integrators who have a high level of expertise in controller implementation. Those integrators who don't want to invest their own resources to develop diagnostic and software support will come to us."

Pat Clark, vice president of marketing at Interlan, *expects that OEMs eventually will make up 45 percent of the firm's market targets, electronic data-processing suppliers will make up 25 percent, system houses will account for 15 percent, Fortune 500 companies for 10 percent and general end users for 5 percent.*

For companies not wanting to wait two years to come to DEC, other vendors besides Interlan will help to fill the gap. 3Com already offers a transceiver for Ethernet LANs, and the company is working on controller products "that will probably be competitive with whatever Interlan comes out with," says Robert Metcalf, 3Com's president. Ungermann-Bass, Inc., Santa Clara, Calif., is already heavily involved in the interface market, and is Xerox's sole outside supplier of Network Interface Units (MMS, March, 1980, p. 49).

The Ungermann-Bass units differ from those planned by Interlan and 3Com because the Ungermann-Bass units are vendor-independent, RS232C devices rather than interfaces designed for a specific bus, says Charlie Bass, vice president. He says such general-purpose controllers are more useful because most LANs will have to support more than one type of bus equipment.

Potter, Interlan's vice president of engineering, agrees there's a market for the Ungerman-Bass vendor-independent device, but he says that market consists primarily of end users, versus Interlan's systems-integrators target. "Also, our approach of coupling tightly with a specific bus architecture allows us to exploit Ethernet's maximum capabilities, including its transmission speed."

Whatever the differences between the various products, however, Metcalf at 3Com believes the market is so large, "that all approaches will do well." DEC's Adams concurs, drawing a parallel between the Ethernet interface market niches addressed by independent companies and the market for Unibus-oriented peripherals. "We sell a few products into the Unibus peripherals market, but it's not large enough for DEC to focus a lot of attention there," he says. "But the market is large enough to support a lot of smaller companies."

—Dwight B. Davis

Company forms and finds graphics substance

Can a systems house that originally provided specialized, high-technology, end-user graphics successfully make it as a more broadly based OEM supplier?

Three-and-a-half-year-old Form and Substance, Westlake Village, Calif., might succeed in making that transition, based on the strength of a graphics subsystem it has developed.

The company hopes to occupy "the price range between very low-end, hobbyist-type, graphic-system setups and high-end, more expensive Tektronix-, Hewlett-Packard- and Genisco-type graphics setups," says vice president Gary Gelinas.

FAS has made a cautious commitment to the OEM market. "At the moment," says Gelinas, "our primary push is toward the environmental community because we are one of the very few in the industry who are putting together μc and minicomputer systems for environmental data processing. Although there are companies that do data acquisition, we don't know of any

that do dispersion modeling on computers and provide the software package that we do."

The next step in the company's OEM integration plans are to include other applications. FAS originally designed the graphics system, called the IM-1, to meet the needs of the pollution-control industry, incorporating programmed minicomputers and μcs to simulate environmental impacts, perform scientific calculations and provide graphic displays of results. The system's "interactively executable" software package includes interactive X-Y plotting, 3D contour plotting and pie charts.

Gelinas says FAS sees the expanding OEM applications of the IM-1 as suitable to engineering, including the civil, mechanical and industrial fields. Looking at a broader spectrum, Gelinas predicts the system will fill general business applications, such as cost accounting, trend analysis, sales distribution and inventory control.

The system features interface compatibility with several minicomputers and μcs, including Alpha Micro machines, Digital Equipment Corp.'s LSI-11, Computer Automation's NM4 and other S-100 computers. FAS modifies the hardware to adapt the S-100 bus to the RS232 standard.

The IM-1 is an interactive, graphics-based computer system. Hardware is designed around an S-100 "Micro-Angelo" intelligent, high-resolution (512 × 480) graphics subsystem from Scion Corp., Vienna, Va. The subsystem comprises a Z80-based graphics board with 32K bytes of RAM and an RS232 interface. It also includes an IBM-style keyboard, a 15-in. monitor and subsystem software. A 132-cpl Anadex printer is optional.

Graphics software includes a variety of FORTRAN IV programs for environmental applications, such as air-quality simulations of complex terrain, regional photochemical smog and pollution-level forecasts.

The company's growth underlines the fact that it has substance. The name Form and Substance was chosen because company president Ralph Sklarew wanted to provide "the proper form for work of substance"—pollution control. Sklarew started the company with the idea of combining his interests in software, the environment and computing. He felt there was a need to clear up the confusion within the pollution-control industry about how to quantify pollution's impact on the environment. Some methods led to incorrect or inadequate environmental simulations, which were generally put forth in the proper form to meet government standards.

Gelinas sums up the company's future this way: "We're attempting to breach the OEM market via our graphics terminal, and if that proves successful, we could push a complete system with data acquisition for any application.

— Nancy Love

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
Burroughs	6 mos.	6/30/81	1,590,644,000	53,575,000	1.29
	6 mos.	6/30/80	1,408,793,000	108,536,000	2.63
Computer Sciences	13 wks.	7/3/81	150,196,000	6,014,000	.44
	13 wks.	6/27/80	135,406,000	6,555,000	.48
Datum	6 mos.	6/30/81	6,429,000	(82,000)	(.04)
	6 mos.	6/30/80	7,863,000	231,000	.13
Docutel	6 mos.	6/30/81	29,355,000	2,210,000	.61
	6 mos.	6/30/80	21,751,000	1,975,000	.60
E-Systems	6 mos.	6/30/81	263,779,000	11,127,000	1.56
	6 mos.	6/30/80	205,730,000	6,645,000	1.01
Honeywell	6 mos.	6/28/81	2,515,100,000	123,700,000	5.46
	6 mos.	6/29/80	2,311,900,000	100,900,000	4.53
Information Retrieval Systems	6 mos.	6/30/81	1,832,589	(504,078)	(.13)
	6 mos.	6/30/80	2,814,276	(71,818)	(.05)
Intelligent Systems	year	3/31/81	18,775,303	1,590,681	.70
	year	3/31/80	14,492,301	486,672	.24
Management Assistance	9 mos.	6/30/81	240,567,000	6,652,000	.81
	9 mos.	6/30/80	221,550,000	(2,341,000)	(.29)
Mohawk Data Sciences	year	4/30/81	287,370,000	19,118,000	1.60
	year	4/30/80	261,204,000	17,187,000	1.51
North American Philips	6 mos.	6/30/81	1,447,465,000	48,788,000	3.64
	6 mos.	6/30/80	1,094,184,000	32,250,000	2.48
Plessey	53 wks.	4/3/81	1,866,300,000	115,758,000	4.83
	53 wks.	3/28/80	1,659,700,000	77,138,000	3.25
Savin	year	4/30/81	443,651,000	(2,212,000)	(.52)
	year	4/30/80	374,308,000	28,340,000	4.35
System Industries	6 mos.	6/28/81	26,733,000	3,260,000	1.00
	6 mos.	6/29/80	17,082,000	336,000	.29
Ultimate	3 mos.	7/31/81	7,170,378	472,759	.08
	3 mos.	7/31/80	2,938,811	157,082	.03
Wavetek	28 wks.	7/4/81	32,348,000	1,360,000	.44
	28 wks.	7/5/80	28,411,000	1,862,000	.65
Wyle	6 mos.	7/31/81	125,516,000	2,447,000	.43
	6 mos.	7/31/80	133,756,000	4,281,000	.76
Zenith	6 mos.	7/4/81	572,900,000	8,000,000	.42
	6 mos.	6/30/80	530,000,000	10,700,000	.57

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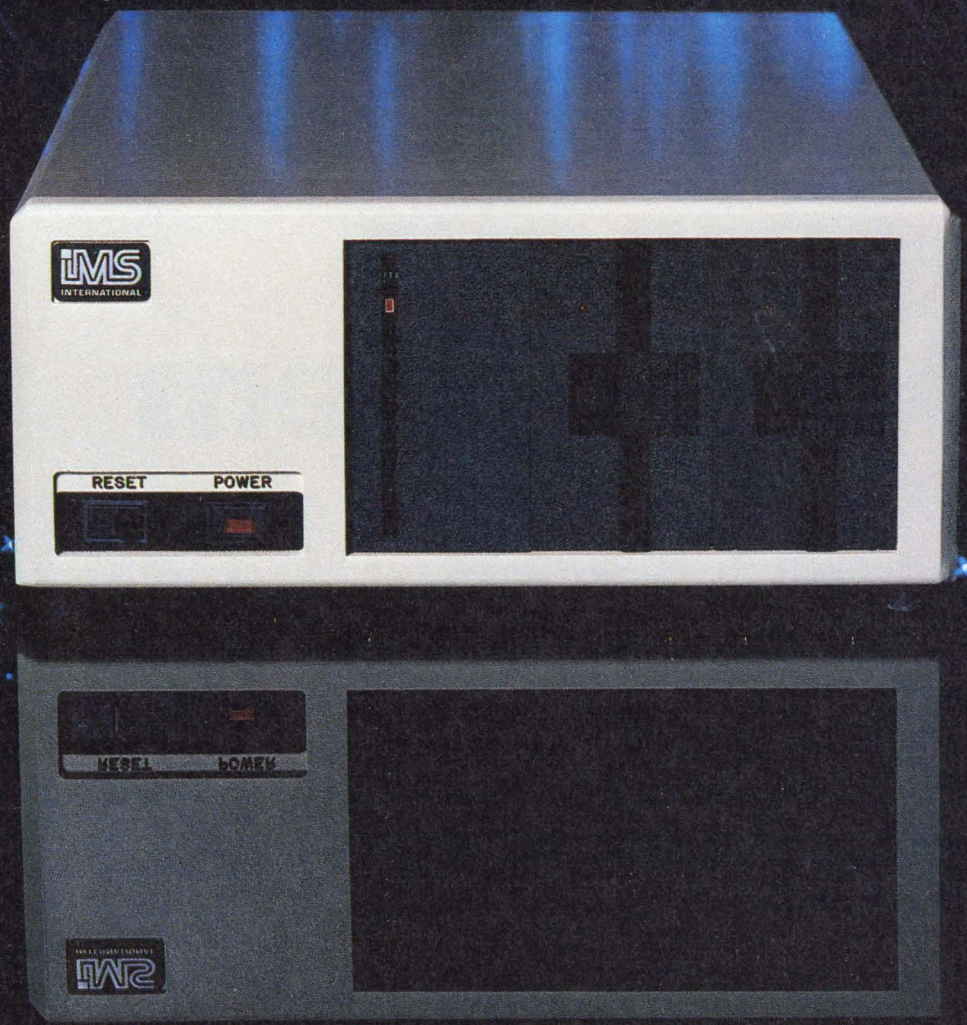

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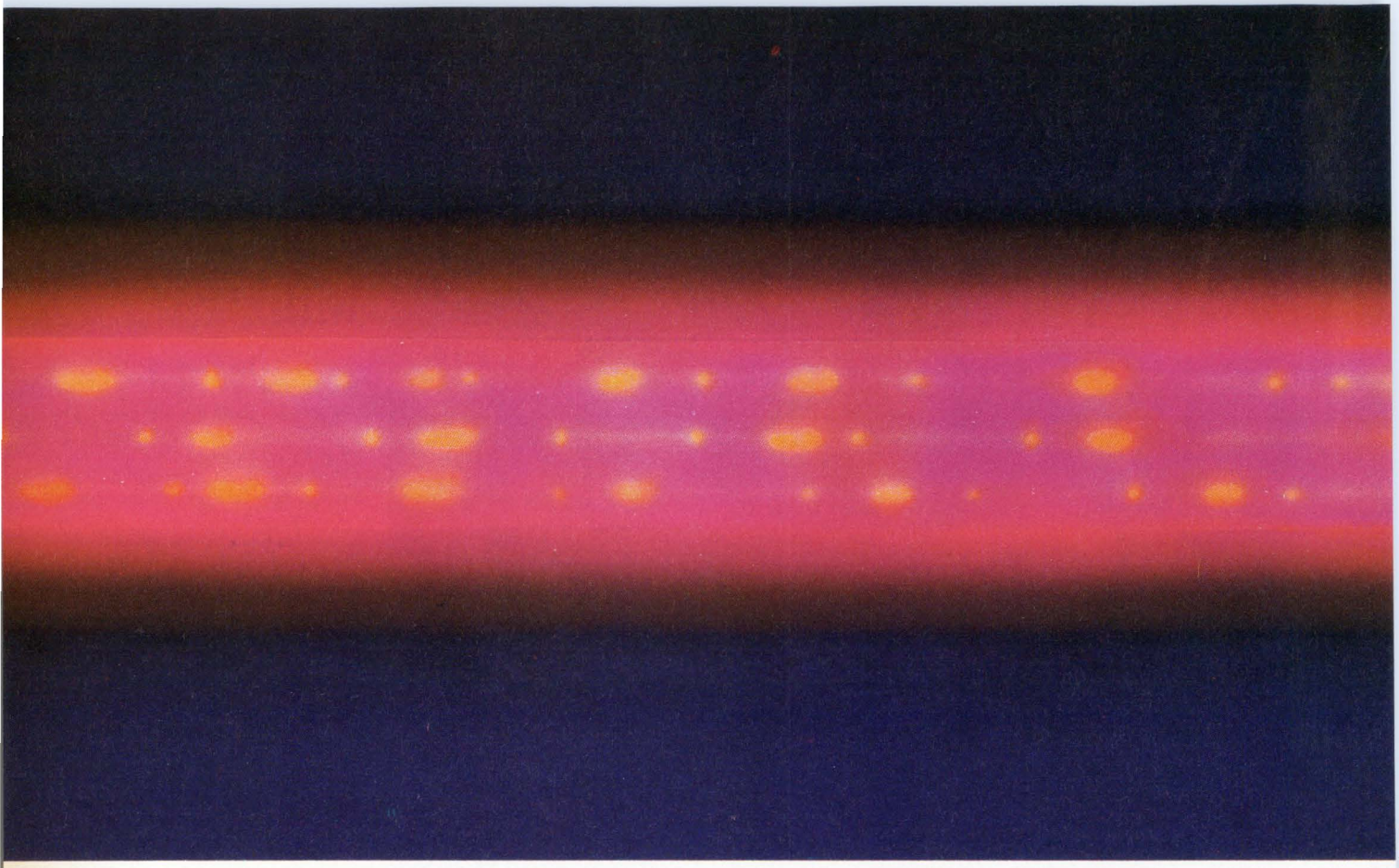

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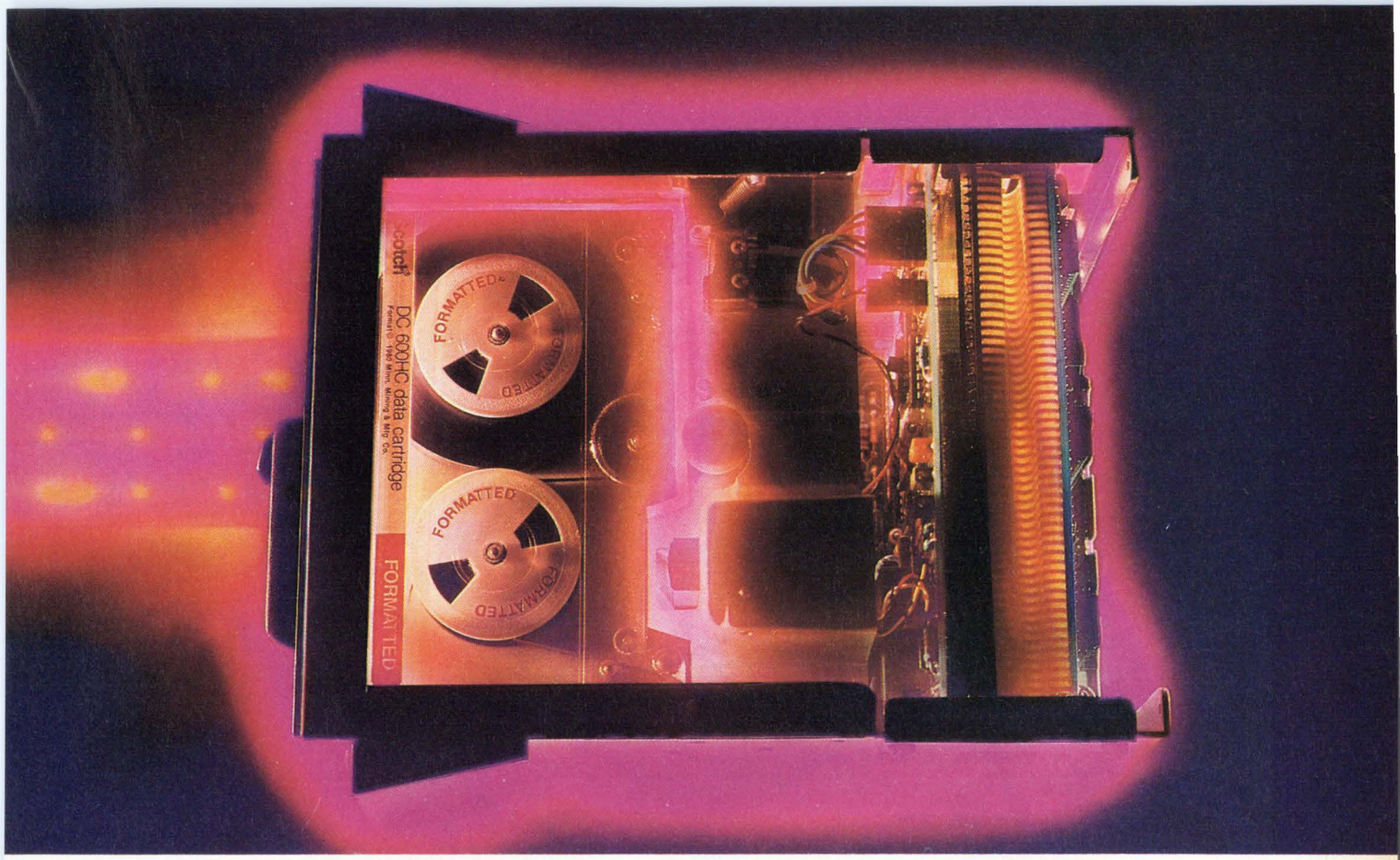

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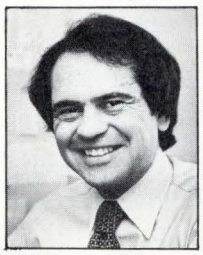
Following a westering trend


Trifari


Valigra

From the Colorado Rockies to the Pacific Coast, the computer industry is probably growing faster than it is anywhere else in the U.S. Mindful of this westering trend, *Mini-Micro Systems* is expanding in that region. John Trifari, West Coast editor since 1978, has been promoted to Western bureau manager and will shift his base operations from Los Angeles to Cahners's San Jose, Calif., office this fall. John will join Larry Lettieri, who has been covering Northern California and the Pacific Northwest out of San Jose for the past 18 months.

John's promotion and move reflect our commitment to place editors in strategic locations that allow them to provide better coverage developments on the scene. He will coordinate the activities of three other California-based field editors: associate editor Lettieri, assistant editor Nancy Love in Los Angeles and another editor to be hired and located in Southern California. John's presence in San Jose will give him easier access to the growing number of disk-drive and small-system manufacturers in that region, and will free Larry to concentrate more closely on software and μp developments in the silicon strongholds from Oregon to Arizona and Texas.

John will still travel to the growing computer and peripherals communities in the San Fernando Valley Orange and San Diego counties, and his efforts in those regions will be augmented by another editor to be named later. Having that additional editor will also enable all four western editors to follow the emergence of the computer enclaves in Colorado, Utah, Arizona and New Mexico.

But the westering trend in the computer business isn't strictly a U.S. phenomenon. Japanese hardware manufacturers are making their presence felt in global markets with quality products sold at competitive prices. The Japanese presence is especially intense in the low-priced portion of the printer business. We've had several stories on the trend toward printers for small systems selling for less than $500, including those from the Japanese companies that are in that market. But now we're taking a first-hand look by sending associate editor Lori Valigra to Japan to report on printer technology today and in the future.

Printers are an important part of Lori's beat. She has been covering these output devices since joining our editorial staff in early 1980. Most recently, Lori did the first story on a page printer from Delphax Systems in Canada (MMS, June, p. 179) that uses ion deposition to form characters.

Her special report will appear in the January, 1982, issue—our sixth annual printer-survey issue.

S. Henry Sacks

S. Henry Sacks
Vice President/Publisher

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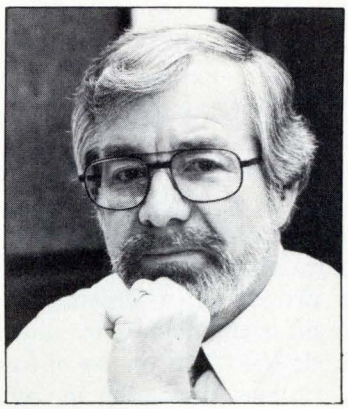
A message from Detroit



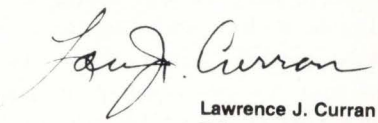
A recent conversation with Andrew Knowles, vice president and group manager at Digital Equipment Corp., both sobered and heartened me. In an interview that included questions about his major concerns as a top manager of a $3.2-billion corporation, the most critical concern he cited is U.S. industry's ability to compete in worldwide markets.

Knowles says that U.S. auto manufacturers lost sight of the fact that their products had to compete globally, causing a critical sag in the U.S. economy; a backbone industry allowed major market shares to go to non-U.S. auto builders who know how to sell and service abroad. "Detroit *is* the U.S. recession," Knowles maintains, "with 17 percent unemployment. We're in a dogfight globally, and DEC is set up to do that. The onus is on Detroit to produce competitive products," Knowles says.

In Knowles' view, Detroit's doldrums are part of a good news/bad news situation. The bad news, he says, is the worst he has ever seen it because of the apparent inability of so many U.S. manufacturers to compete overseas. The good news, especially for the computer industry, is that they're not rolling over and playing dead. "There's a lot of effort aimed at getting companies competitive again in the auto, semiconductor and appliance industries by improving productivity. Computers are important in their plans, making computers a bright light in the good news/bad news U.S. economy."

But if an industry so essential to U.S. economic vigor as automobiles can be badly mauled in international markets, what's to prevent the same thing from happening to this latter-day "bright light," the computer industry? In a word, service. Knowles points out that some 38 percent of DEC's revenues comes from outside the U.S., and that a customer-service presence overseas is critical. We agree. DEC has almost 20,000 people in more than 400 worldwide service locations. Knowles says the company trains its service personnel in 19 nations and 17 languages. Significantly, that commitment is paying off handsomely for DEC; customer service accounts for some 25 percent of revenues.

Few computer and peripheral companies can make a commitment to customer service of the same magnitude that DEC has, but those that don't consider service an essential ingredient of competition may see the bright light of their growth snuffed out under the bushel of those who do.



Lawrence J. Curran
Editor-in-chief

Letters

COMPUTER-AIDED SURGERY

To the editor:

The reader notes with some surprise the proclomation by Drs. Rogers and Fulton describing a dearth of CAD/CAM technology application and rehabilitation engineering (MMS, July p. 147). Perhaps they are unfamiliar with the fine work emanating from the Massachusetts Institute of Technology under the leadership of Dr. Robert Mann, Whitaker Professor of biomedical engineering. The MIT prosthetics laboratory provides an environment for prosthetic, microsurgery and computer-aided surgery advances, leaning heavily upon use of computer graphics simulation for efficient premanufacture testing.

Anyone interested in automation's role in the biomedical area can obtain a brochure from Dr. Mann's office, Room 3-144, Massachusetts Institute of Technology, 77 Massachusetts Ave., Cambridge, Mass. It describes several of the projects being conducted around the country, with contributions from both academia and industry. It is entitled, "An Excerpt from the Annual Report, Academic Year 1979-1980, Department of Mechanical Engineering."

Abby Gelles
Technology Consultant, Educator
New York, N.Y.

CP/M REBUTTAL

To the editor:

I was astonished by R.A. Baumann's letter (MMS, July, p. 103). Mr. Baumann is right that in automating office functions, "the personal computer can provide...many times the level of performance improvement available from NBI/Micom/Wang systems." Beyond that, he is off base.

I earn part of my living as a technical writer and part as a μc word-processing instructor. This puts me in the rather unusual position of being a WP consultant and a WP user at the same time. I have had plenty of first-hand experience with what features make a WP system productive and what features do not.

Mr. Baumann's reasons for rejecting WordStar seem to have something to do with the time it takes to display text on the screen. That is a minor factor in most situations.

On-screen formatting—the ability to display text in the format of the final printed document—is by far the most important productivity factor in most word-processing applications. It gives the user feedback as he works, making the formatting commands much easier to learn and apply.

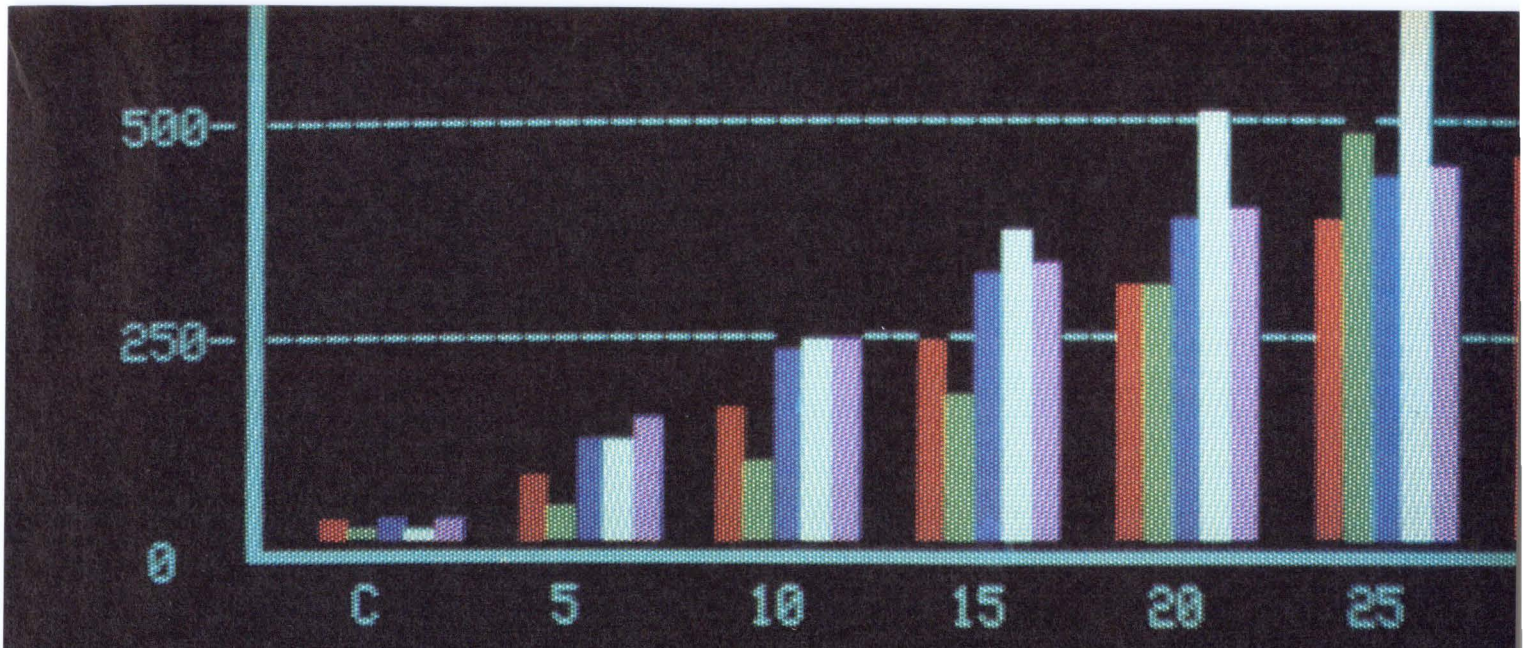
On-screen formatting is an area in which WordStar outperforms anything else available for μcs so far. Mr. Baumann ignores this point completely.

But Mr. Baumann's garbled facts concern me far more than his opinions about screen displays. He dismisses WordStar as a hobbyist's system because "CP/M systems like WordStar are heavily screen-dependent."

That statement is meaningless. CP/M is an operating system; it runs on both machines that communicate through a serial port, and machines that use direct screen I/O. Nor is WordStar inherently tied to CP/M, although it is currently implemented only under CP/M and compatible systems.

It is ironic that Mr. Baumann cites the Apple as a machine on which word processors can "develop the user's throughput to a level not possible by traditional typwriter philosophies (like WordStar)." The Apple is an excellent hobby computer. There's no other way to describe a machine that has a 24- × 40-character display, comes with an upper-case-only keyboard and boasts a disk capacity of 110K bytes.

Jonathan Sachs, Richmond, Calif.



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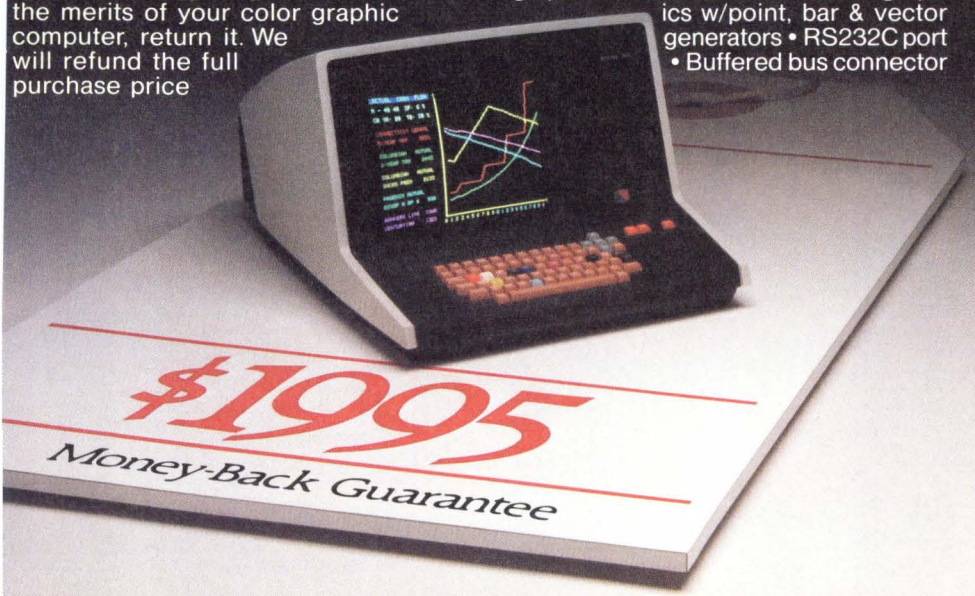

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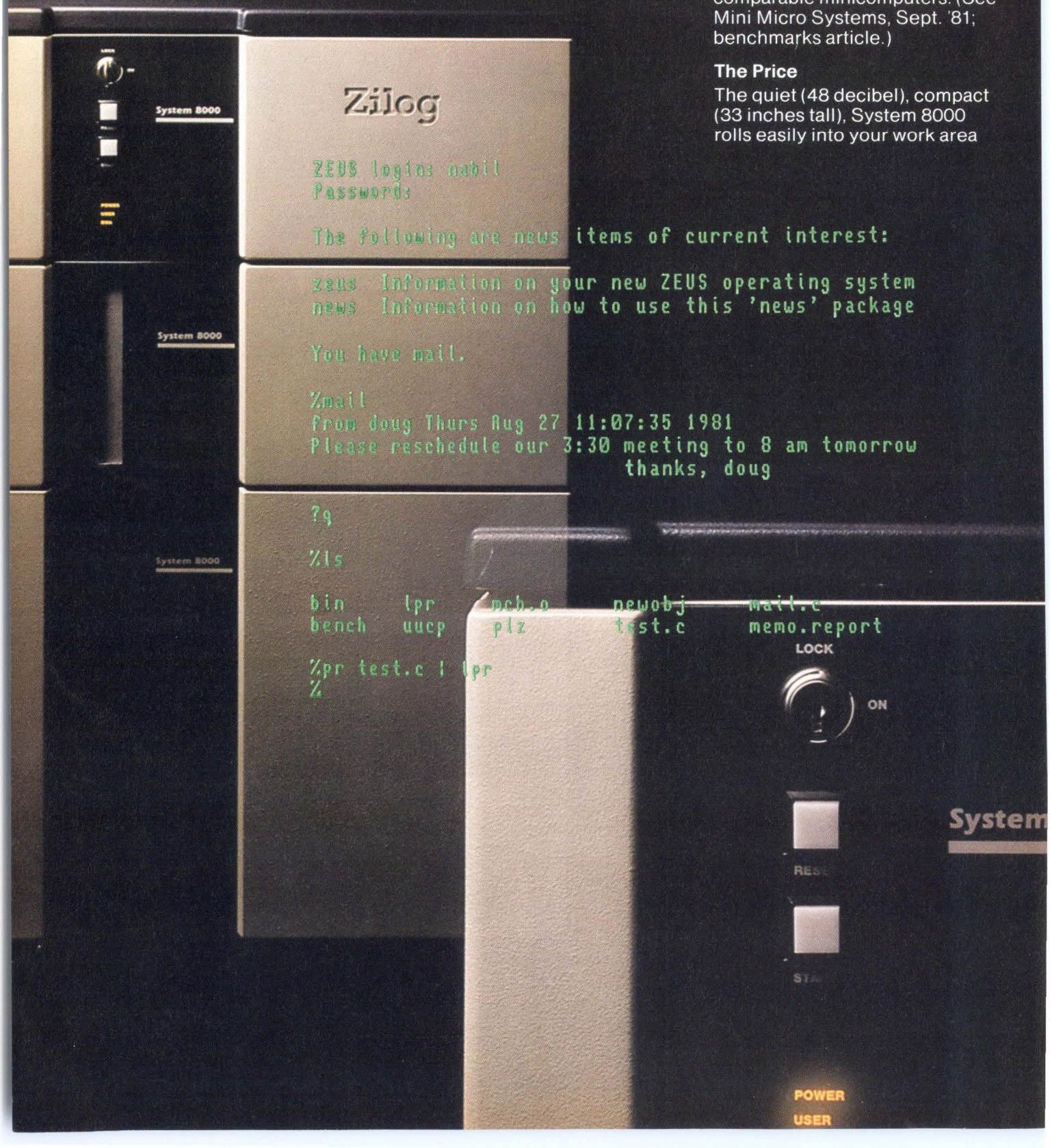
If you want to establish a low-cost UNIX*-based system, or need additional UNIX productivity on your current system, Zilog's System 8000 is the perfect choice. System 8000 is a modular, free-standing unit built for multi-user office and laboratory application. Based on Zilog's reliable, high performance Z8000™ microprocessors, System 8000 delivers supermicro power at prices far below those of comparable minicomputers. (See Mini Micro Systems, Sept. '81; benchmarks article.)

The Price

The quiet (48 decibel), compact (33 inches tall), System 8000 rolls easily into your work area



the Supermicro.

and requires no special environment. Zilog provides a complete eight user system, including system software, 256 KB of main memory, a 24 MB Winchester disk and 17 MB tape cartridge back up, along with expansion capabilities, all for only $29,950. (U.S. list.)

The Performance

The System 8000 runs the ZEUS operating system, which is a faithful enhancement of the seventh edition of UNIX, perfected through Zilog's extensive UNIX experience. Because ZEUS is a high performance implementation of UNIX, any program that runs under UNIX, written in C, COBOL, or Pascal, can be easily ported to System 8000. Programs comprising the utilities and development tools provide user access, command processing, file management status information, and communication with other devices or systems. ZEUS also includes text processing software, libraries, a symbolic debugger, programming languages (standard C, PLZ/SYS, PLZ/Assembler, plus optional COBOL and Pascal), and more than 100 other utilities.

The Future

System 8000 plans include hardware and software expansion as well as compatibility with future generations of microprocessors. Soon the System 8000 will become integrated with Zilog's Z-NET™ Local Area Network (LAN) for commercial distributed data processing. No other manufacturer offers a UNIX-based system with the price and performance of the System 8000. So, if you're seeking the right UNIX solution, System 8000 is the perfect choice.

For more information, write Zilog, Inc. General Systems Division, 10460 Bubb Road, Cupertino, CA 95014. Or call the office nearest you.

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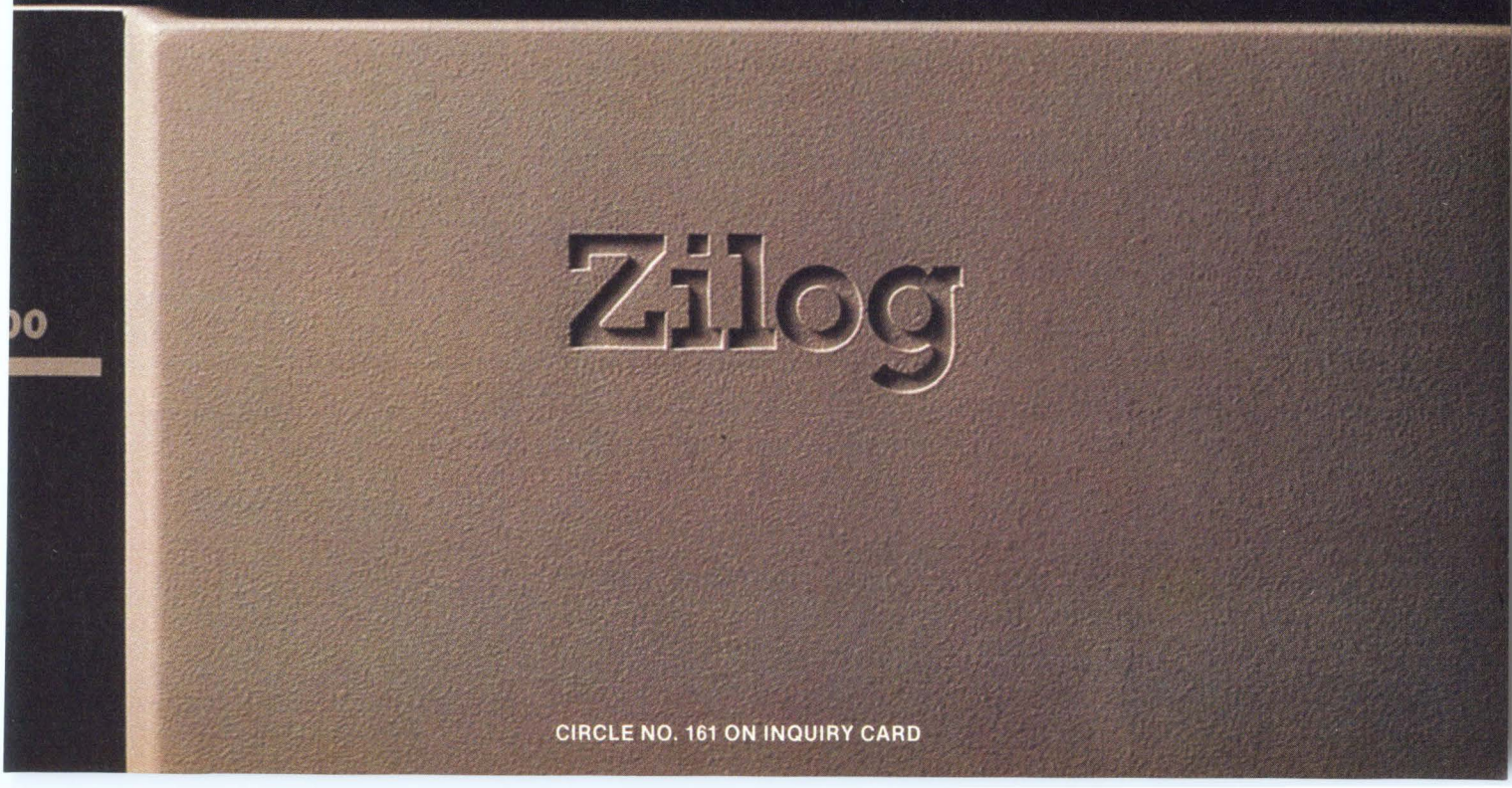

Letters

INFOSOFT'S I/OS

To the editor:

Mini-Micro Systems had a fine article on C/PM-compatible operating systems written by William Vaughn (August, p. 173). He talks about three manufacturers (Cromemco, Inc., SD Systems and Mostek Corp.) that "have molded a generally accepted μc operating systems to their own use." The article talks about Multi/OS and I/OS sold by Infosoft; CDOS sold by Cromemco; SDOS and COSMOS sold by SD Systems; and M/OS-80 sold by Mostek, all of which are CP/M-compatible.

The article does not make clear that InfoSoft's I/OS is the operating system that Cromemco, SD Systems and Mostek have molded for their use. InfoSoft is the basis for CDOS, SDOS and M/OS-80, as well as Infosoft's own Multi/OS and I/OS.

James Dart, Director of Marketing
InfoSoft Systems Inc.
Westport, Conn.

MICRO FIVE STATS

To the editor:

I found your recent survey on small business systems to be highly informative. Unfortunately, the Microstar I, Microstar II and Series 3000 were omitted in the product profile on small, multi-user business computers (MMS, June, p. 87). The following statistics represent Micro Five's business systems:

- Model number: Microstar I, Microstar II, Series 3000
- Word size: 8 bits, 64K 16 bits; 128K bytes to 1M byte
- Number of users: two to 11
- Disk storage capacity: 2.4M to 54M bytes
- Printer speeds: as fast as 600 lpm, 60 to 225 cps
- Programming languages: BASIC, COBOL
- Typical price: $8500 to $46,000.

Mark D. Lewis
Vice President of Sales
Micro Five Corp., Irvine, Calif.

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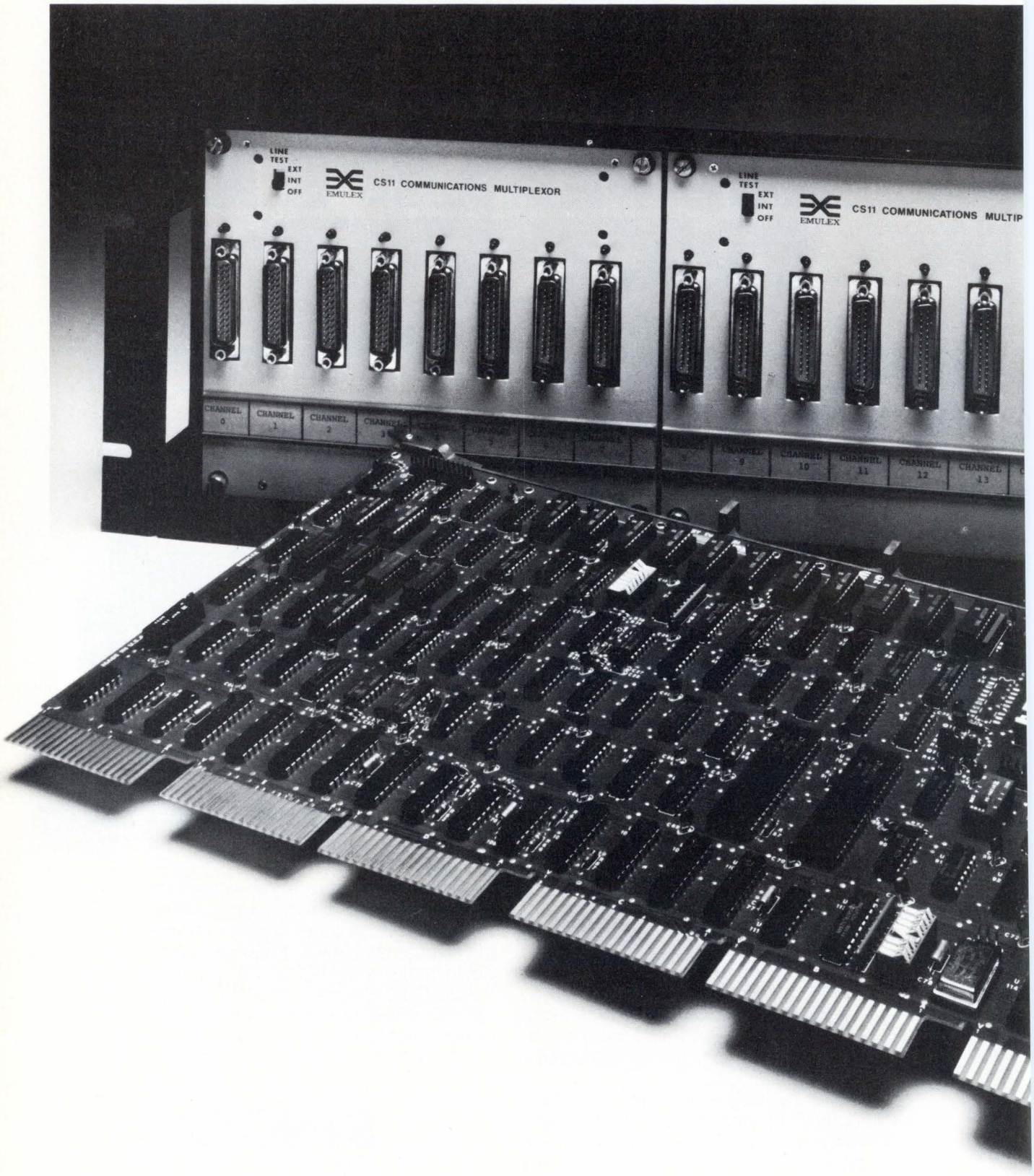

with DEC. Just concentrate.

We've earned our reputation by designing and delivering dependable, easy to live with tape and disk controllers for DEC cpus. Products that really showed the industry how to do it.

Now we've cleaned up the communications I/O morass, with a new DH-11 type multiplexer for PDP-11 and VAX systems. It duplicates all the features of DEC's DH-11. And it goes well beyond, delivering improved line handling capabilities in a far smaller package and at significantly lower cost.

You might say we're now doing for communications controllers what we've already done for tape and disk controllers — applying the latest microprocessor technology and some sexy design to give our customers the performance and reliability they deserve.

Our newest achievement proves the point. To wit: just one hex size board, occupying a single Unibus slot, provides up to 64 lines for terminals, printers or other communications I/O. That's eight times more efficient than the DEC approach.

And our unique system organization means maximum flexibility. You can daisy-chain up to four remote distribution panels, expanding in 8 or 16 line increments all the way to 64 lines. You can configure any 8 line group for an RS-232 interface, with modem control a standard feature. Or you have the option of selecting a current loop interface. And because all your interface variations are made at the distribution panels, no additional hardware or cpu restructuring is needed when you add channels.

The new Emulex CS-11/H really concentrates your communications I/O. Just one hex size board multiplexes up to 64 lines.

You get everything you got from DH-11, such as DMA on transmit operation and line format flexibility. Naturally, we're fully software transparent and run existing DEC diagnostics.

But we like to do everything we do just a little bit better than the other guy. So we boosted performance to 19.2 K baud per line. For peak traffic, we can "double fifo" to 128 characters per 16 lines. Multiple controllers can be added for increased capacity. You get full 16-bit word transfers on DMA operation — not just byte transfers. And, of course, we've taken advantage of our system's high speed bipolar microprocessor to build-in extensive controller and channel self-test and fault indicators.

We're concentrating on DEC, making the world's best cpus even better with some ingenious controllers. We've done it for tape and disk interfacing. Now for communications I/O. We'd like to send you all the details we didn't have room to include here. So write or call Emulex Corporation. Or, if you just can't wait, contact the Emulex representative, dealer or distributor nearest you.

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The 1/210X Controller writes to multiple Winchesters (5¼" or 8"), 4 floppy disk drives (5¼" or 8"), and 2 streaming tape drives (10 or 20MB). All back-up or media-to-media transfers take place in a background mode without interruption to the CPU.

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Multibus interface · Integrated controller for Winchesters, floppy disks and streaming tape drives · Fully buffered data transfers · Logical sector addressing · Implied seek capability · Multi-sector transfers with auto surface switching · Auto retry · 24 bit expanded DMA addressing.

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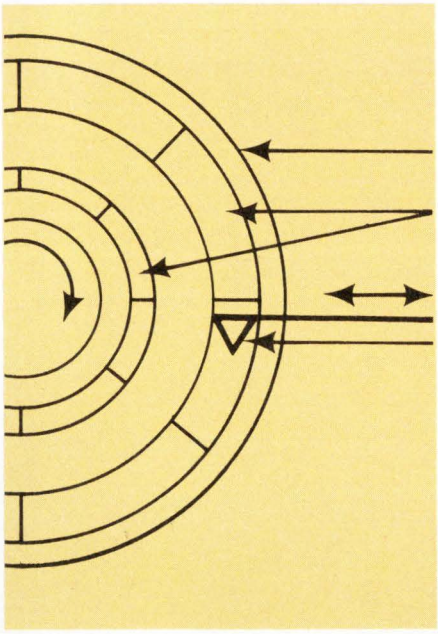
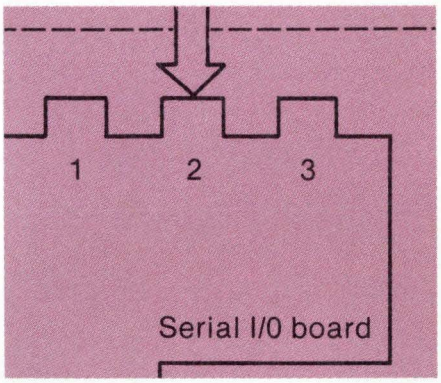
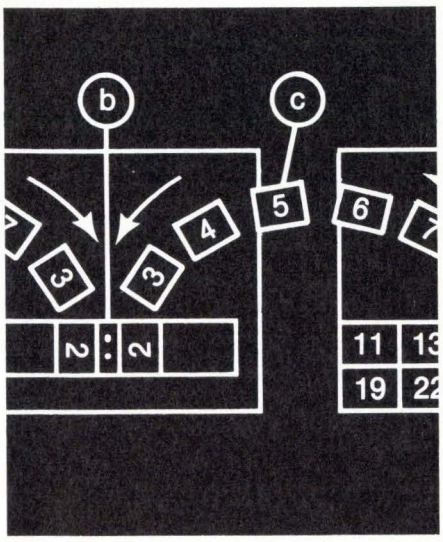
FEATURE HIGHLIGHTS



113 Like many other products, microcomputer operating systems are more expensive than they were a year ago. But this year's offerings do reflect augmented processor, peripheral, memory and file-management capabilities. And, thanks to refinements in older versions and increased versatility in new offerings, operating systems have kept pace with the improved computational power of 8- and 16-bit microcomputers. The survey article that begins on p. 113 takes a look at these and other trends, and includes a comprehensive listing of microcomputer operating systems . . . On p. 127, G. Scott Harris, president of Cybernation, Inc., takes you through "The ABCs of operating systems." He compares an operating system to a well-organized machine shop and notes that the use of the storage crib, workbenches and machines can help explain the actions of OS disk schedulers, memory managers and central-processor schedulers . . . A unique operating system is one of the key features in the Universe, a "supermicrosystem" just unveiled by Charles River Data Systems. An article on p. 145 details both the Universe and its UNOS, a UNIX-like operating system with all the attributes of that system and then some.



139 System builders who want to cut the cost and time required to develop Z80-based systems can benefit from a new single-board development system from Americomp Consulting Co. This development system often eliminates the need for wire wrapping of prototypes and the cumbersome steps of software transfers, and sells for about half the price of conventional competitors . . . Speaking of development systems, the Series 16 multiprocessor from C.M. Technologies, which is detailed beginning on p. 133, doubles as both a stand-alone development system for products to be built around the Motorola 68000 and as an 8-bit CP/M-based microcomputer offering 11M bytes of unformatted on-line storage.



149 The stunning growth of the minicomputer/microcomputer market has been fed by both old and new applications. Software for small computers has followed in the footsteps of software for medium and large systems. Many programming languages have also become available. Now, database management, a classic feature of larger systems, is entering the minicomputer/microcomputer arena. Charles W. Bachman, vice president of Cullinane Database Systems, Inc., describes database systems and shows how they soon will be available for microcomputers . . . In a related article on p. 157, consultant Harvey M. Weiss surveys available DBMS products and gives a five-step procedure to help you select the one you need . . . On p. 165, Andrew Burlingame of Prime Computer outlines the advantages of DBMS over a traditional file system, concluding that DBMSs offer control, ease of use and limited redundancy . . . Still, a database is essentially a file system, and like any other file, it can be accessed in infinite ways. On p. 171, Honeywell Information Services explains that selecting the best combination from the ways to organize is difficult, but it is important because it aids in DBMS application.

THE CLOSER YOU LOOK
at the MSC 8009 Microcomputer

For Multibus® Compatibility

The more you will be impressed by the balance of technology and standardization achieved with this Z-80A® based, Multibus compatible, single board computer. The MSC 8009's capability starts with the high speed, 4Mhz. Z80A microprocessor that offers more than 80 additional instructions over the 8080 or 8085 CPUs. Second, an on board Floppy Disc Controller for up to four disc drives is standard. Third, a unique memory management technique allows full utilization of up to 96K bytes of on-board RAM/EPROM. And, finally, all peripheral I/O interfaces normally required for most microcomputer system applications are included on the MSC 8009. For those who need complex transcendental arithmetic processing, an optional on board APU is available to add credibility to our claim that the MSC 8009 is the finest 8-bit microcomputer available today.

Superior Design

The superiority of the MSC 8009 design permits system configurations with a significantly reduced number of boards. Thus, many systems may only require a single MSC 8009 for all computer functions. The same system currently may require four or more boards to provide the same capability. In addition, a fully configured MSC 8009 requires only a single standard Multibus card slot. Full capacity configurations using many of the newest 8085 based boards, because of their "piggyback" configuration, require two board slots per microcomputer. An MSC 8009 based system will require fewer card slots and less power while providing higher reliability at an overall lower cost.

Application

The MSC 8009 Microcomputer provides the computational power, memory capacity, floppy disk controller and peripheral interfaces typically required in "high-end" microcomputer systems. It is ideally suited for floppy disk based, interactive systems running under CP/M®. Because it is CP/M compatible, users can select from a wide range of off-the-shelf systems and applications software packages when configuring a new system. The MSC 8009 configured with an appropriate software package can be the heart of a range of systems from software development stations to word processing systems, to office management systems. When used in conjunction with other MSC 8009 microcomputers, MSC 8901 memory management modules and MP/M or CP/Net, entire multi-user, multi-tasking networks are possible. These applications can be "performance optimized" by the use of multiple processors. No matter what your application is, the versatility and power of the MSC 8009 makes it a welcome addition to the Engineering Laboratory, an office environment or on the production floor.

Software Support

Software support for the MSC 8009 microcomputer is provided by the MSC 8800 family of software development systems. These are among the industry's most cost/performance optimized systems. All MSC 8800 series development stations are complete systems including a MSC 8009 computer with 64K bytes of RAM, a floppy disk controller and peripheral interfaces. Mass storage is provided by two 8" double density disk drives. A CRT terminal and line printer are standard on all systems. Higher speed systems are available with multiprocessing capability. For highest performance, a multiprocessor based system is available with a semiconductor disk emulator. CP/M 2.2 with a universal BIOS that allows formatting and transfer of data between mixed drives is standard on all MSC 8800 series systems. Both assembly language and high level languages, including Basic and Pascal are available.

Features

- ☐ Multibus (IEEE 796) Compatible
- ☐ 4 Mhz. Z80A Microprocessor
- ☐ On board Floppy Disk Controller
- ☐ 32K Bytes Dynamic Ram
  Expandable to 64K Bytes on board Ram
- ☐ Socketed for up to 32K Bytes EPROM
- ☐ User defined RAM, ROM and I/O addressing
- ☐ Two RS232C Serial I/O PORTS
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- ☐ One Non Maskable Interrupt
- ☐ Three 16 bit Programmable Counter/Timers
- ☐ Optional on board APU Provisions

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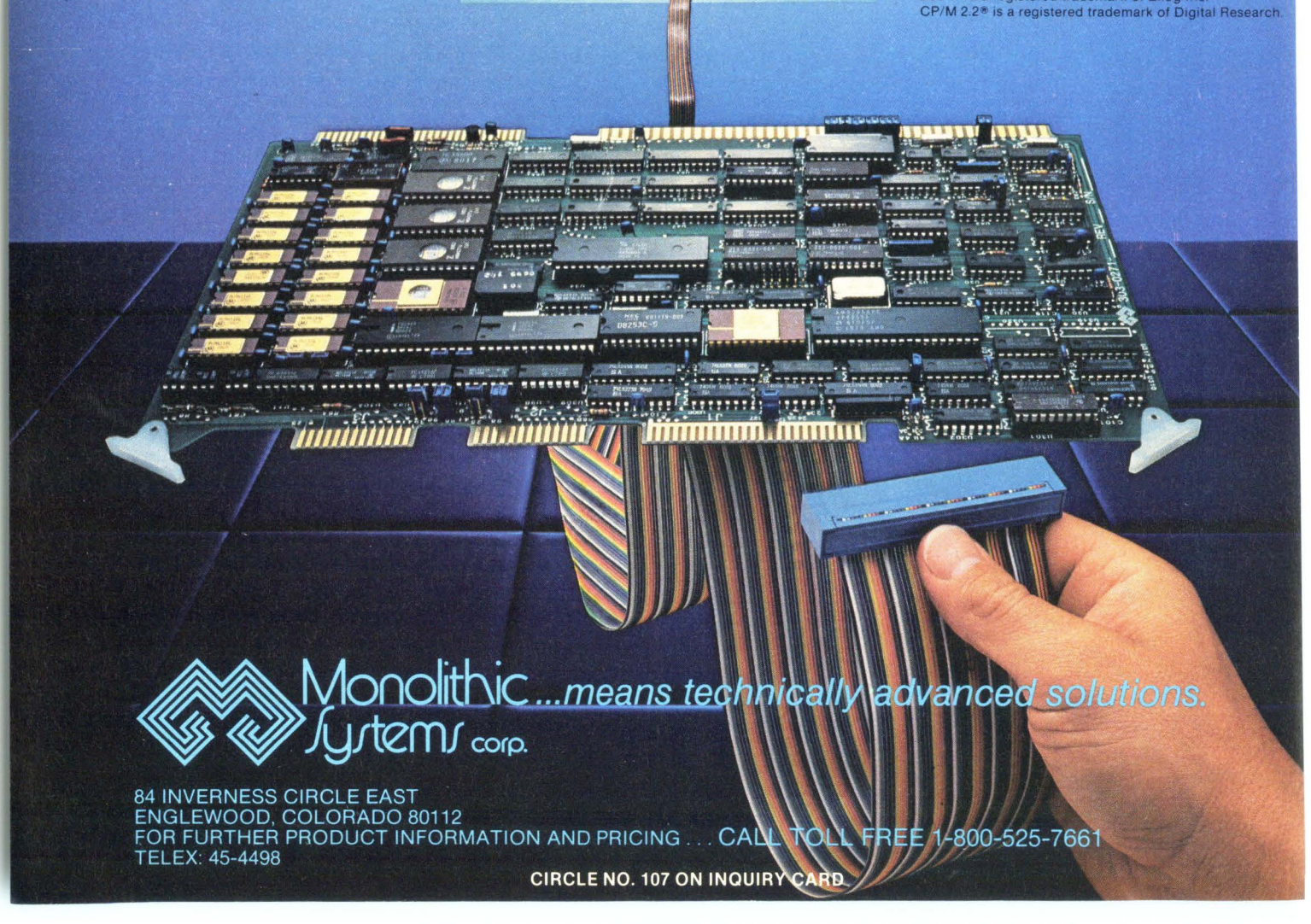

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OPERATING SYSTEMS

Operating systems cost more—but also do more

GEORGE KOTELLY, EDN Magazine

New and updated operating systems reflect suppliers' efforts to maintain performance parity with advances in 8- and 16-bit μc hardware

Like many other products, μc operating systems (OSs) are more expensive than they were a year ago. But compared with those we listed in *Mini-Micro Systems*' last survey (MMS, October, 1980, p. 97), this year's offerings reflect augmented processor, peripheral, memory and file-management capabilities. Thanks to refinements in older versions and increased versatility in new offerings, operating systems have kept pace with the improved computational power of 8- and 16-bit μcs.

This survey reflects several trends when compared with last year's products. Those trends include:

- A swing to multitasking, multi-user and multiprocessing capabilities in processor allocation/management,
- The added capability of handling hard-disk drives in peripheral management,
- Increased system-storage capacity in memory management and a focus on memory protection,
- Increased availability of data security and protection in file management,
- Increased accommodation of networking in system support,
- A preference for BASIC, FORTRAN, Pascal, COBOL and C in that order in language support with small use gains or losses for each language.

Price is increasing

Despite the importance of these trends, though, price increases account for the most noticeable change in the operating systems covered again this year. Nearly one-third of these repeats carry a higher price. For most, the suppliers' increased cost of doing business has merely taken its toll. But in several instances, offerings exhibit extra performance along with their extra cost.

OPERATING SYSTEMS COME IN THREE KEY TYPES

This survey classifies OSs in terms of user function. A development OS, for example, produces software to run on the host μc or on another target μc. The target need not incorporate the same μp type if a user develops the software by means of cross assemblers or compilers. Examples of development OSs include Intel's ISIS, Omnibyte's ODOS and Digital Research's CP/M.

A real-time or process-control OS governs industrial processes that place timing constraints on its responses: Interrupts from these external processes signal the μc system, and if the system doesn't respond in a specified time, the processes become impaired or degraded. Intel's iRMX80 and iRMX86 exemplify such operating systems.

General-purpose OSs usually deal with business or scientific applications. Digital Research's CP/M, for example, finds use in word processing, accounts-receivable generation and mailing-list maintenance.

These OS categories are arbitrary; many OSs in the tables provide capabilities in all three areas.

Another classification cuts across the three categories: an OS can be further described as either a multi-user or a single-user system.

To evaluate these OS types' suitability for an application, the OS's ability to handle its primary management activities should be considered. These activities include allocating the four main system resources—processor time, memory, peripherals and files—on the basis of user needs.

The newer OSs represent a move from single-task, single-user versions to multitasking, multi-user and—in a few cases—multiprocessor types.

Previously not available in many OSs, such features as network support, hard-disk I/O and storage, multitasking and additional support languages and target μcs have been incorporated in more than half of the earlier products that underwent price increases. For example, network support now comes standard in

REPRESENTATIVE MICROCOMPUTER OPERATING SYSTEMS

Company	OS Name	Target Systems; Languages Supported	Min. Hardware Configuration
American Microsystems, Inc.	AMIX	AMI Phoenix 1, Intel Intellec, Motorola EXORciser, TI 990/4; assembler, Pascal, FORTRAN 77	48K bytes of RAM, dual disk drives
Apple Computer, Inc.	D.O.S. 3.3.	Apple II, 6502; assembler, floating-point and integer BASIC	16K bytes of RAM, minifloppy-disk drive
	Sophisticated Operating System (SOS)	Apple III; assembler, BASIC, UCSD Pascal, FORTRAN	96K bytes of RAM
Applied Systems Corp.	O/S	8085 or Z80, ASC/80; BASIC, FORTRAN, COBOL	16K or 32K bytes of RAM
Boston Systems Office, Inc.	UMDS	more than 30 microprocessors; assembler, Pascal	64K bytes of RAM, 512K-byte disk drive
CAP-CPP Services, Inc.	MicroCobol Business Operating System (BOS)	Series/1, LSI-11, 8080, 8085, 8086, Z80, M6800 and 68000, TI 9900; MicroCOBOL	48K bytes of RAM, terminal, dual 250K-byte floppy-disk drives
Central Data Corp.	ZMOS	Z8000; assembler, BASIC, COBOL	96K bytes of RAM, one serial I/O port, one floppy- or cartridge-disk drive, one Central Data Z8000 CPU card
CGRS Microtech	CRS/DOS	6502, Microtech 6502PD, Pet, Kim, Sym, Aim	8K bytes of RAM, 1K byte of ROM, floppy-disk drive
Computer Design Labs	TPM	Z80, TRS-80; macro assembler, QSAL-structured assembly language, BASIC, APL, LIST, FORTRAN, COBOL, Pascal	32K bytes of RAM, disk drive
Convergent Technologies	CTOS	Convergent Technologies' desk-top minicomputers; 8086, BASIC, Pascal, COBOL, FORTRAN	128K bytes of RAM, dual floppy-disk drive
Creative Solutions, Inc.	Multi-FORTH	8080, 68000; assembler, FORTH	16K bytes of RAM, one floppy-disk drive
Cromemco, Inc.	CDOS	Z80; assembler, BASIC, COBOL, FORTRAN, LISP, RPGII	32K bytes of RAM
	CROMIX	Z80A; assembler, BASIC, COBOL, FORTRAN, LISP, RPGII and C	128K bytes of RAM
Data General Corp.	MP/OS	microNova, Nova 4, MP/100, MP/200, MBC/2, MBC/3; macro assembler, MP/Pascal, MP/Fortran IV	2K bytes of RAM, 4K bytes of PROM; for development, 64K bytes of RAM and disk drive
	DOS	microNova and NOVA; macro assembler, BASIC, Business BASIC, FORTRAN IV	64K bytes of RAM, disk drive, console
	ICOS	CS/10, CS/20, CS/30; COBOL	64K bytes of RAM, disk drive, terminal, printer
Digital Equipment Corp.	RSX-11M, RSX-11S	LSI-11/2, 11/23; macro assembler, BASIC, FORTRAN IV, FORTRAN IV-Plus, COBOL, BASIC-Plus II	LSI-11/23 (LSI-11/2 for unmapped RSX-11S), 48K bytes of RAM, RL01 disk drive, console port and clock
	RT-11	LSI-11/2, LSI-11/23; macro assembler, BASIC, multi-user BASIC, FOCAL, APL, FORTRAN IV	24K bytes of RAM, tape-cartridge drive, console port
Digital Research, Inc.	CP/M 2.2	8080, 8085, Z80; assembler, BASIC, APL, FORTH, LISP, FORTRAN, C, Pascal, PL/1, COBOL	20K bytes of RAM, disk drive, console
	MP/M II	8080, 8085, Z80; assembler, BASIC, APL, FORTH, LISP, C, COBOL, FORTRAN, Pascal, PL/1	32K bytes of RAM, console device, disk subsystems
	MP/M-86	8086; assembler, PL/1, BASIC, COBOL, FORTRAN, Pascal, FORTH	64K bytes of RAM, disk drive, console, real-time clock
FORTH, Inc.	polyFORTH	8080, 8086, 9900, 6800, 6809, 68000, 1802, LSI-11, PDP-11, NOVA 4, IBM Series/1, EXORciser, TI 990, COSMAC; assembler, FORTH; CP/M for 8080 and 8086	16K bytes of RAM, serial interface, terminal, disk drive

MICRO COBOL BOS, MP/M II and XENIX; hard-disk I/O in RTE-XL, HDOS and SDOS; multitasking in KOS 5.2 and UCSD P-System; and BASIC and FORTRAN support in SP/ and MSP/8086/Z8000/6800.

Additionally, some OS manufacturers provide added capability with no price increase. For example, AMIX 3.0 supports seven more μcs than it did last year, CDOS supplies processor allocation and memory management as standard, and UMDS supports Pascal as well as five additional μcs.

Not surprisingly, operating systems for 16-bit μcs constitute many of the new OS entrants. Besides

Primary Applications	Memory Management; File Management	Processor Allocation; Peripheral Management	Price
development	supports overlays and swapping; single-contiguous allocation	single-user; interrupt-driven, supports device independence	$550, plus $125 per assembler
development, general-purpose	supports overlays and chaining; random organization, linked list of sectors	single-user; supports spooling and device independence	$200
general-purpose	supports overlays and chaining; random organization, B-Tree index structure	single-user; interrupt-driven, supports device independence	$250 (free with Apple III purchase)
development, general-purpose	supports overlays; random organization	multi-user; interrupt-driven	
development	supports overlays, swapping and chaining; random organization, linked list of sectors	multi-user; interrupt-driven, supports device independence	$1200 to $3850
development, process-control, general-purpose	supports overlays, swapping and chaining; random organization, ISAM	multiprocessing, multitasking, multi-user; interrupt-driven, supports spooling and device independence	From $600
general-purpose	supports swapping; random organization, ISAM, disk-space allocation via extents	multitasking, 64 users; interrupt-driven, supports spooling and device independence	$450, including boot PROMs
development, general-purpose	supports overlays, swapping and chaining; random organization, ISAM, single-contiguous allocation	multitasking; interrupt-driven	$500; $150 customization
general-purpose	supports overlays, swapping and chaining; random organization, disk-space allocation via extents	single-user; interrupt-driven, supports spooling and device independence	$80
general-purpose	supports overlays, chaining and segmentation; sequential, contiguous and random organization, allocation via extents	multitasking, multi-user, multiprocessing; supports device independence and spooling	bundled
development, process-control, general-purpose	supports overlays, swapping and chaining; random organization, single-contiguous allocation	multitasking, multi-user; interrupt driven, supports spooling and device independence	$1500 to $5000
general-purpose	supports overlays; random organization, ISAM, allocation via linked list of sectors	single-user	$95
general-purpose	supports overlays, swapping and chaining; tree organization, ISAM, allocation via extents	multiprocessing, multitasking, seven users; interrupt-driven, supports spooling and device independence	$575
development, process-control, general-purpose	supports overlays, swapping and chaining; random organization, ISAM, indexed/element allocation structure	multitasking, multi-user; interrupt-driven, supports device independence	$1995
development, process-control, general-purpose	supports overlays, swapping and chaining; random organization, ISAM (for Business BASIC), linked/index allocation	multitasking, four users; interrupt-driven, supports device independence	$735
general-purpose	supports overlays, swapping and chaining; random organization, ISAM, single-contiguous and linked list of sectors allocation	multitasking, four users; interrupt-driven, supports spooling and device independence	$2500
development, process-control, general-purpose	supports overlays; sequential, random and ISAM access, contiguous or mapped allocation	multitasking, multi-user; supports device independence, DMA and spooling, interrupt-driven	RSL-11M, $8600; RSX-11S, $560
development, process-control, general-purpose	supports overlays and chaining; random organization, single-contiguous allocation	multitasking; interrupt-driven, supports spooling and device independence	$3620
development, process-control, general-purpose	supports overlays and chaining; random organization, allocation via extents	single-user; supports spooling and device independence	$150
development, process-control, general-purpose	supports chaining; random organization, allocation via extents	multiprocessing, multitasking, multi-user; interrupt-driven, supports spooling and device independence	$400
development, process-control, general-purpose	supports chaining; sequential and random organization, allocation via extents	multitasking, multi-user; supports device independence, interrupt-driven	$400
development, process-control, general-purpose	supports overlays and chaining; random organization, ISAM, single-continuous allocation	multitasking, multi-user; interrupt-driven, supports spooling and device independence	$5100

The wave of the future, multiprocessing OSs allow master-to-master and master-to-intelligent-slave CPUs to conduct traffic over parallel buses.

bearing higher prices than products available a year ago, the new entrants reflect a trend toward 16-bit μcs. Their increased performance entails a small price increment but satisfies users' needs to handle computation and communications simultaneously. Additionally, the newer OSs represent a move from single-task,

Company	OS Name	Target Systems; Languages Supported	Min. Hardware Configuration
Heath Co.	HDOS	8080, Z80, H-8, H-89; assembler, BASIC, C, FORTRAN	32K bytes of RAM, console, disk system
Hemenway Associates, Inc.	MSP/8086, M²SP/Z8000, M²SP/68000	8086, Z8000, 68000; macro assembler, Pascal/I, BASIC and FORTRAN	32K bytes of RAM, floppy-disk drive, real-time clock, console
	SP/8086, SP/Z8000, SP/68000	8086, Z8000, 68000; macro assembler, Pascal/I, BASIC and FORTRAN	16K bytes of RAM, floppy-disk drive, console
	SP/68	6800; macro and cross assemblers, STRUBAL+	16K bytes of RAM, floppy-disk drive, console
Hewlett-Packard Co.	RTE-XL	HP-1000L; assembler, BASIC, FORTRAN, Pascal	128K bytes of RAM
Hughes Aircraft Co.	DDOS, CP/M	1802, Z80, 8080, 8085, 1804, 8048, 6502, 6800, 6809, others; assembler	32K bytes of RAM
Industrial Programming, Inc.	MTOS-68K, -80, -86	6800, 8086, 8080, 68000; assembler, PL/M-80, -86, FORTRAN-80, -86, Pascal-86, Pascal-68K	3K to 10K bytes of ROM, 1K byte of RAM
Infosoft Systems, Inc.	I/OS	Z80, 8080, 8085; assembler, BASIC, MBASIC, FORTH, PILOT, MUMPS, FORTRAN, COBOL, Pascal, C	24K bytes of RAM, 80K-byte floppy-disk drive, terminal
	MULTI/OS	Z80, 8080, 8085; assembler, SAL/RLASM, BASIC, MBASIC, FORTH, PILOT, MUMPS, FORTRAN, COBOL, Pascal, C, RATFOR	48K bytes of RAM, 160K-byte floppy-disk drive, terminal
Intel Corp.	iRMX 80	8080, 8085; assembler, BASIC, FORTRAN, PL/M	600K bytes of RAM, iSBC 80/10, 80/20-4, 80/24 or 80/30
	iRMX 86	8086/8088; assembler, FORTRAN, Pascal, PL/M	16K bytes of RAM, MCS-86, 8253, 8259A
	iRMX 88	8086/8088; languages and drivers compatible with iRMX 86	1.2K bytes of RAM or ROM
	ISIS	8080, 8085, 8086, 8088, 8089, Intellec MDS; assembler, BASIC, Pascal, PL/M, FORTRAN	Typically 64K bytes of RAM, plus terminal or printer
Ithaco, Inc.	TMS	Z80, CompuDAS 1; DABIL	24K bytes of EPROM, 20K bytes of RAM, CompuDAS 1
Kontron Electronics, Inc.	KOS 5.2	Z80A; assemblers, BASIC, FORTRAN, Pascal, COBOL	64K bytes of RAM, 16K bytes of video-refresh memory, video controller, floppy-disk drive controller
Language Resources	RS-86	8086, upgrade for Intel MDS 800, II and III; AL/M-86 assembler, Pascal	128K bytes of memory, Intel MDS 800 or Series II, floppy-disk drive, iSBC or Microbar C86 CPU
Lifeboat Associates	CP/M	8080, 8085, Z80; assembler, BASIC, LISP, FORTRAN, COBOL, APL, ALGOL, C, Pascal	24K bytes of RAM, disk system
Micro Five Corp.	STARDOS	8086; BASIC	Series 3000, μc system and visual-display terminal
Microsoft	XENIX (enhanced version of Western Electric's UNIX)	Z8000, PDP-11 series; assembler, C, others	approx. 192K bytes of RAM
Microware Systems Corp.	OS-9	6809; assembler, BASIC-09, Pascal, COBOL	48K bytes of RAM, CPU, disk drive
Monolithic Systems Corp.	MSOS	Z80, MSC 8001, MSC 8004, MSC 8007, MSC 8009; assembler	16K bytes of RAM, floppy-disk drive controller
Mostek Corp.	FLP80DOS	Z80; macro assembler, BASIC, FORTRAN	32K bytes of RAM
	M/OS-80	Z80; CP/M compatible	32K bytes of RAM, MDXFLP controller board and serial or parallel port
Motorola Semiconductor Products, Inc.	RMS68K	68000, Versamodule 01; macro assembler, Pascal	Versamodule 01
	VERSADOS	68000, Exormacs development system, Versamodule 01; macro assembler, Pascal	Exormacs, 256K bytes of RAM, Exorterm 155, Exordisk III, printer or Versamodule 01 with 128K bytes of RAM

single-user versions (such as CP/M and ISIS) to multitasking, multi-user and—in a few cases—multiprocessor types (such as MP/M and iRMX86).

Of the approximately 20 new entrants, 80 percent feature multitasking capability, whether for 8- or 16-bit μcs. RMS68K, a 16-bit-μc OS, demonstrates the diversity of multitasking variations. RMS68K handles an unlimited number of tasks in theory, although memory capacity and overhead dictate an upper limit. Another 16-bit-μc OS, ZEUS, accommodates as many as 200 tasks. Yet another offering, REX-80, serves 8- and 16-bit μcs while providing multitasking limited only by

Primary Applications	Memory Management; File Management	Processor Allocation; Peripheral Management	Price
development, general-purpose	supports overlays, swapping and chaining; random organization, allocation via linked list of sectors	single-user; interrupt-driven, limited support of device independence	$195
development, process-control, general-purpose	supports overlays and chaining; random organization, allocation via linked list of sectors	multitasking; interrupt-driven, supports spooling and device independence	$900
development, process-control, general-purpose	supports overlays and chaining; random organization, allocation via linked list of sectors	single-user; interrupt-driven, supports device independence	$700
development, general-purpose	supports overlays and chaining; random organization, disk-space allocation via linked list of sectors	single-user; supports device independence	$150
development, process-control, general-purpose	supports overlays, swapping and chaining; random organization, allocation via extents	multiprocessing, multitasking; interrupt-driven	$2150; additional copies $1260; execute-only license $210
development, general-purpose	supports overlays, swapping and chaining; single-continuous allocation	multiprocessing, multitasking; interrupt-driven, supports spooling	
general-purpose, process-control		multitasking, multiprocessing; supports device independence	$3500 to $9500
development, process-control, general-purpose	supports overlays and chaining; random organization, ISAM, allocation via extents	multiprocessing, multitasking, multi-user; interrupts allowed, spooling and device independence supported	$225
development, general-purpose, process-control	supports overlays, chaining, multiple contiguous allocations; sequential and random allocations, allocation via clusters	multitasking, multi-user, multiprocessing; supports spooling, device independence, interrupt-driven	$900
process-control	supports overlays; random organization, allocation via extents	multitasking; interrupt-driven, supports device independence	$100
development, process-control, general-purpose	random organization, allocation via extents	multitasking; interrupt-driven, supports device independence	$6000, plus per-use royalty
process-control, test and instrumentation	dynamic memory allocation; sequential and direct access logical files	multitasking; interrupt/event or timer-driven	$2000 includes $900 training credit
development	supports overlays, swapping and chaining; random organization	multiprocessing; interrupt-driven, supports device independence	bundled
process-control		multi-user; supports device independence and DMA	
development, process-control, general-purpose	supports overlays; random organization, allocation via linked list of sectors	single-user; interrupt-driven, supports spooling and device independence	
development, general-purpose	supports overlays and segmentation; sequential and random organization, allocation via linked list of sectors	NA; supports device independence and DMA	$8950, source code; $2450, object code
general-purpose	supports chaining; allocation via extents	single-user; interrupt-driven, supports device independence	from $145
development, process-control, general-purpose		multitasking, multi-user; provides device independence and DMA, interrupt-driven	
development, general-purpose	supports swapping; allocation via linked list of sectors	multitasking, one to 12 users; interrupt-driven, supports spooling and device independence	
development, general-purpose	supports overlays, swapping, chaining, segmentation; sequential, contiguous and random organizations, allocation via mapped disk	multitasking; supports device independence, DMA and spooling, interrupt-driven	$195, Level 1; $495, Level 2
development, process-control, general-purpose	supports swapping and chaining; ISAM, allocation via linked list of sectors	single-user; interrupt-driven, supports device independence	$900
development	supports chaining; allocation via linked list of sectors	single-user; interrupt-driven, supports device independence	$595
development, general-purpose	supports overlays; allocation via extents	multitasking available; supports device independence, DMA and spooling, interrupt-driven	$250 with PROMs; $199 without PROMs
process-control	supports chaining; NA	multitasking; supports device independence, DMA and spooling, interrupt-driven	$5000
development, general-purpose, process-control	supports chaining; random organization, allocation via extents	multitasking; supports device independence, spooling	

VLSI manufacturing techniques will mature and permit the production of μc chips with extremely high denssities and many built-in processing functions.

memory constraints.

Following on the heels of multitasking as a standard OS ability comes multi-user support—a characteristic of more than half the new entrants. Again, implementation variations abound. For example, TMS, an 8-bit-μc OS, handles as many as five users, providing each at

Company	OS Name	Target Systems; Languages Supported	Min. Hardware Configuration
Motorola Semiconductor Products, Inc.	RMS09	MC6809; macro assembler, BASIC, MPL	8K bytes of RAM, Micromodule 19/19A or 68/17A
National Semiconductor Corp.	Starplex-II	8080, Z80A; macro assembler, BASIC, FORTRAN, Pascal, PL/M	64K bytes of RAM
Ohio Scientific, Inc.	OS-CP/M	Z80, C3 series; assembler, BASIC, COBOL, FORTRAN	56K bytes of RAM
	OS-65D	6502, C2-C3 series, C1P-MF, C4P-DF, C8P-DF; assembler, BASIC	24K bytes of RAM, floppy-disk drive
	OS-65U Level I	6502, C2-C3 series; BASIC	32K bytes of RAM, dual floppy-disk drives or hard-disk drive
	OS-65U Level III NETWORK	6502, C3-B, C3-C; BASIC	104K bytes of RAM, hard-disk drive, two RS232 ports, real-time clock on floppy controller
Omnibyte Corp.	ODOS	6800, OB 800, OB 850; assembler, BASIC, STRUBAL+	9⅛K bytes of RAM, 2K bytes of PROM, floppy-disk drive, console
Ontel Corp.	HDOS	8080, 8085, Ontel OP-1; assembler, BASIC, FORTRAN, OPL, Pascal	32K bytes of RAM, hard-disk drive and controller
	MDOS	8080, 8085, Ontel OP-1; assembler, BASIC, FORTRAN, OPL, Pascal	32K bytes of RAM, floppy-disk drive and controller
Perkin-Elmer Terminals Division	PETOS	6800; macro assembler, BASIC	16K bytes of RAM
Phase One Systems, Inc.	OASIS	Z80; assembler, BASIC, RM COBOL, Pascal, FORTRAN 77, C	56K bytes of RAM, dual floppy disks, Z80 CPU
	OASIS-16	8086, Z8000, 68000; macro assembler, BASIC, RM COBOL, FORTH, Pascal, FORTRAN 77, C	128K bytes of RAM, dual floppy-disk drives, 16-bit CPU
Point Four Data Corp.	IRIS	microNOVA and Point 4 Mark III; absolute and macro assemblers, BASIC, Pascal	48K bytes of RAM, 500K bytes of disk storage, terminal
RCA Solid State Division	CDOS	CDP1802, CDP18S007, CDP18S008; macro assembler, BASIC I, BASIC II, FORTH, PLM 1800, VIS	28K bytes of RAM, single-density disk drive
Ryan-McFarland, Inc.	COS990	TI990; COBOL	64K bytes of memory, disk drive
Scientific Data Systems, Inc.	SDS/DOS	6502; macro assembler, extended BASIC	32K bytes of memory, 1.25M-byte diskette
Smoke Signal Broadcasting	DOS68, DOS69	6800 (DOS68), 6809 (DOS69); macro assembler, BASIC, COBOL, FORTRAN, UCSD Pascal	8K bytes of RAM, disk drive controller
SofTech Microsystems	UCSD System Software	6502, 6800, Z80, 8080, 6809, 9900, LSI-11, PDP-11; assembler, Pascal, FORTRAN and BASIC (compiles to P-Code)	48K bytes of contiguous RAM, 175K bytes of disk storage, ASCII terminal
Software Dynamics	SDOS	6800, 6809, Motorola EXORciser, Pace 480, Wave Mate; assembler, MSI BASIC, Business BASIC	48K bytes of RAM, dual floppy-disk drives, CRT terminal, printer
Systems and Software, Inc.	REX-80	8080, 8085, 8086, Z80, single-board computers; relocatable macro assembler, C, PL/M	2K bytes of ROM, 512 bytes of RAM, real-time clock, priority-interrupt controller
Technical Systems Consultants, Inc.	UniFLEX	6809, 68000; macro, relocating and cross assemblers, BASIC, C, Pascal, FORTRAN	96K bytes of RAM, memory management, DMA-driven disk controllers, interrupt-driven I/O
Tektronix, Inc.	TEKDOS	2650/280, Tektronix 8002A; assembler, MDL/8080/8085/Z80, MDL/6800, FORTRAN-80, SCI-PLMX	32K bytes of RAM, 8002A or 8550 MDL
Telecompute Integrated Systems, Inc.	TIS-APL	Z80, Altos Super Brain, TRS-80 Model II, North Star Sorcerer; APL	64K bytes of RAM
Texas Instruments, Inc.	Component Software	9900 family; assembler, BASIC, Pascal	3K bytes of RAM, 6K bytes of ROM

least 1K byte of RAM. ZEUS, however, suits as many as 64 users and furnishes nearly 64K bytes of RAM for each. Another 16-bit-μc offering, CTOS, accommodates as many as 16 users, providing each a minimum of 128K bytes of RAM.

Although not as prevalent as multitasking and multi-user capability, multiprocessing has also made noticeable inroads in OSs. Approximately 20 percent of the latest OS introductions support more than one processor. The wave of the future, multiprocessing OSs allow master-to-master and master-to-intelligent-slave CPUs to conduct traffic over parallel buses.

Primary Applications	Memory Management; File Management	Processor Allocation; Peripheral Management	Price
process-control		multitasking; interrupt-driven, supports device independence	$2700
development, general-purpose	supports overlays and chaining; random organization, allocation via linked list of sectors	multiprocessing, multitasking; interrupt-driven, supports spooling and device independence	
development, general-purpose	supports overlays and chaining; random organization, allocation via extents	single-user; supports device independence	$695
general-purpose	random organization, single-contiguous allocation	single-user	$79
general-purpose	random organization, single-contiguous allocation	single-user	$200
general-purpose	random organization, single-contiguous allocation	maximum of eight users; interrupt-driven	$995
development, process-control	single-contiguous allocation	single-user	$200
development, general-purpose	supports overlays and chaining; random organization and ISAM (for OPL only), allocation via linked list of sectors	multitasking (for OPL only), eight users; supports spooling and device independence	
development, general-purpose	supports chaining (OPL only) and overlays; random organization and ISAM (for OPL only), allocation via linked list of sectors	multitasking (for OPL only)	
development, process-control, general-purpose	supports overlays and chaining; random organization	multitasking; interrupt-driven, supports device independence	
development, general-purpose, process-control	supports overlays, chaining, segmentation; sequential, keyed and random organizations, allocation via sectors	multi-user, multitasking; supports device independence, spooling, interrupt-driven	$850
development, process-control, general-purpose	supports chaining, segmentation, overlays; sequential, keyed and random organizations, allocation via sectors	multitasking, multi-user; supports device independence, interrupt-driven	$1495
general-purpose	supports overlays, swapping and chaining; random organization and ISAM, single-contiguous, extent and linked list of sectors allocation	multitasking, 128 users; interrupt-driven, supports spooling and device independence	$3600
development	random organization, allocation via linked list of sectors	single-user; supports device independence	$1600
general-purpose	supports overlays, swapping and segmentation; sequential and random organization, allocation via extents	multitasking, multi-user; supports device independence, DMA and spooling, interrupt-driven	$2000
development, general-purpose	supports overlays, chaining; sequential, contiguous and random organizations	NA; supports device independence, DMA and spooling, interrupt-driven	
development, general-purpose	supports overlays, swapping and chaining; random organization, ISAM, allocation via linked list of sectors	multitasking; interrupt-driven, supports spooling and device independence	$75
development, general-purpose	supports overlays; random organization, single-contiguous allocation	single-user, multitasking; supports device independence	$900
development, general-purpose	supports chaining; random organization, allocation via extents	multitasking, eight users; interrupt-driven, supports device independence	$700, including BASIC compiler
development, process-control, general-purpose		multitasking, multiprocessing; supports device independence and spooling, interrupt-driven	$1800
development, process-control, general-purpose	supports overlays, swapping and chaining; random organization	multiprocessing, multitasking, multi-user; interrupt-driven, supports spooling and device independence	$450
development	supports overlays and chaining; random organization, allocation via extents	multiprocessing, multitasking; interrupt-driven, supports device independence	bundled
general-purpose	supports overlays and chaining; random organization, single-contiguous allocation	multiprocessing, multi-user; supports device independence	$1195
process-control, general-purpose	random organization, allocation via extents	multitasking; interrupt-driven, supports device independence	

Intel's iRMX86 operating system uses object-oriented common-format interfaces to its primitives to manage jobs, tasks and messages.

For example, CTOS supports 8086- and 8087-based μcs using a hardware-synchronizing scheme. Embodying even greater capability, REX-80 works with as many as eight processors by means of test-and-set functions and interrupt synchronization. Performance advantages abound in these products because the application splits into more manageable segments for separate and more efficient CPU handling.

Many of the recent OSs support hard disks. Additionally, slightly less than half of the new OSs include network support and file protection, and a little less than one-quarter support memory protection.

A move toward 16-bit hardware nothwithstanding, most operating systems still serve the large 8-bit -μc market. Additionally, almost half the new OS entrants are 8-bit types. Operating systems serving 8-bit μcs still dominate and should continue to do so in the near future.

Less popular languages make a move

The breakdown of languages supported by this year's survey shows small losses by the popular languages and small gains by the less commonly used ones. BASIC continues to lead the pack; it is available for 66 percent of the listed OSs.

Next in popularity, FORTRAN and Pascal have also dropped slightly in use. Usage gains however, occurred in the less popular languages, such as COBOL and C. COBOL has apparently benefitted from growth in small-business-system applications. Also reflecting increased interest, C use has jumped, probably because of Pascal's standardization and portability limitations.

GLOSSARY OF ESSENTIAL

Allocation (dynamic)—The reassignment of peripherals within a given program

Allocation(static)—The assignment of peripherals to a given job

Allocation technique—The method of providing a process with access to a shared resource

Binding—The act of assigning absolute addresses to a program

Blocked list—A catalog of the processes waiting for μp time or for completion of an I/O operation

Blocking—The process of combining more than one record into one block to make data transfers more efficient

Buffering—The process of using areas of memory to isolate I/O devices from one another and from the CPU

Chaining—The ability of an executing program to call another program that resides on disk

Common—An area of memory maintained for the purpose of passing data or parameters between programs

Constrained allocation—A resource-allocation strategy that specifies all resources a process will need, but does not prevent execution unless a deadlock might occur

Contiguous allocation—An allocation method that assigns physically adjacent sectors to a file

Deadlock—A condition that exists when a process is blocked in a state and in all future states that the system can reach

Deadly embrace—A situation in which two processes each unknowingly wait for resources held by the other

Device independence—An OS feature that frees the user from considering device-specific details. It employs mnemonics to refer to specific devices; changing these mnemonics redirects I/O to another device

Direct memory access (DMA)—A means of providing fast peripherals with access to system memory without going through the CPU **Directory**—A file containing information concerning the other files on a mass-storage device such as a diskette; also termed a catalog

Executive—An operating-system routine responsible for decision making

File-control block (FCB)—A data structure in main memory used for keeping track of files in use

Company	OS Name	Target Systems; Languages Supported	Min. Hardware Configuration
Western Digital Corp.	UCSD Pascal	Western Digital Microengine; Pascal	64K bytes of RAM, 8-in. floppy-disk drive, terminal
Wintek Corp.	UCSD Pascal	6800, Sprint 68; assembler, BASIC, Pascal, FORTRAN	56K bytes of RAM
	WIZRD	6800, Sprint 68; assembler, BASIC, C, PL/W	32K bytes of RAM, serial I/O
Xycom, Inc.	ISS	all Xycom boards and packages; Z80 and Z8000 assemblers, FORTRAN 77, Pascal	60K bytes or RAM in development system, 16K bytes in target, dual floppy-disk drives for development system, CRT terminal
Zilog, Inc.	RIO, Versions 2, 3 and 4	Z80, MCZ 1, ZDS, PDS 8000; assembler, BASIC, COBOL, FORTRAN, Pascal, PLZ/SYS	64K bytes of RAM, Z80 MDC board, Z80 MCB board, disk drives
	RIO/CP	Z80A, MCZ-2 Series, SDS 2/01; assembler, BASIC, COBOL, PLZ/SYS	64K bytes of RAM, MCZ-2 μc (or SDS 2/01)
	ZEUS	Z8001, Z-LAB 8000; assembler, C, Pascal, PLZ/SYS, COBOL	256K bytes of memory, Z-Lab 8000 CPU
	ZRTS 8000	Z8001, Z8002; Z8000 PLZ/SYS, C	

OPERATING-SYSTEM TERMS

File-management system—The part of an OS that controls the organization and allocation of disk files, which might consist of one or more sectors

Index—A number representing the relative position of a byte in either a record or file

Interrupt—A break in the normal flow of a system or routine from which flow can resume later

I/O supervisor—The portion of an OS that provides routines for I/O procedures

Job—The collection of activities needed to accomplish a specified amount of work

Linked list—A list formed by tying together (with pointers) several items such as sectors on a disk

Lock byte—An entity used to represent a resource in synchronization schemes; also termed a semaphore

Memory protection—A method of ensuring that the contents of main memory within certain variable limits are not altered or inadvertently destroyed

Noncontiguous allocation—An allocation method that assigns physically nonadjacent sectors to a file

Nucleus—The most basic level of an operating system; creates and destroys software processes used to implement abstract processes

Operating system—An organized collection of techniques and procedures used for operating a computer

Overlaying—The technique of repeatedly using the same blocks of internal storage during different stages of a program; for example, when one routine is no longer needed, another routine can replace all or part of it

Polling procedure—A routine for checking each I/O device sequentially to determine whether it requires servicing

Primitive—An operation provided by a nucleus for use in synchronization

Priority—A parameter designating a task's or process's relative urgency

Process—A computation that can occur concurrently with other computations; an OS's basic unit of computation

Process-control block (PCB)—A data structure that uniquely defines a given process

Program (code)—A set of instructions that tells a computer step by step exactly how to handle a job

Re-entrant code—A program task or routine that can be executed simultaneously by more than one process

Relocation (dynamic)—The act of assigning absolute memory addresses when a program is loaded into memory

Relocation (static)—The act of assigning absolute addresses at linking time

Resource—Any device or item used by a computer, including special areas of memory such as buffers

Rotational ordering—A method of organizing I/O requests to a disk to reduce total service time

Segmentation—A technique for managing variable-sized areas of memory, termed segments, that contain logical parts of a program

Service request—The appeal by a process or task for access to a system resource

Single contiguous allocation—A memory-allocation scheme that assigns all available memory as one block

Spin block—A loop created when a process keeps checking the state of a flag or status bit while waiting for an event to occur

Spooling— Simultaneous peripheral operations on line; used to convert a dedicated device into a shared one

Standard allocation pattern—A resource-allocation scheme designed to prevent deadlocks

Swapping—A technique similar to overlaying; involves moving processes between main memory and auxiliary storage in order to multiplex main memory

Sysgen—System generation, the process by which an operating system is configured out of individual system components to accommodate a particular hardware configuration

Task—A routine that forms the lowest self-contained unit of a job or process

Time slicing—A technique that shares μp time among several processes. The quantum of time allocated to a process is termed a time slice

Transient area—The space in memory available for user programs and system utilities

Urgency—The degree to which a task or process requires attention; determined by the task's or process's priority

Utilities—Routines used in housekeeping functions and I/O.

Primary Applications	Memory Management; File Management	Processor Allocation; Peripheral Management	Price
development, general-purpose	supports overlays; random organization, single-contiguous allocation	multitasking; interrupt-driven	$1000
development, general-purpose	single contiguous allocation, supports overlays, swapping; sequential, contiguous and random organizations, single contiguous allocation type	NA; supports device independence	$675
development, process-control, general-purpose	random organization, allocation via linked list of sectors	multitasking; interrupt-driven, supports spooling and device independence	$495
development, process-control, general-purpose	supports overlays; random organization, single-contiguous allocation	multiprocessing, multitasking; interrupt-driven, supports device independence	bundled
development, general-purpose	supports overlays and chaining; random organization (Version 3 only), ISAM (with COBOL only), allocation via linked list of sectors (Version 2) or random-access table of printers	single-user; interrupt-driven, supports spooling (Version 3 only) and device independence	$500, or free with system
general-purpose	supports overlays and chaining; sequential and random organizations	multitasking; supports device independence, DMA and spooling	$500
general-purpose	supports overlays and swapping; sequential, contiguous and random organizations, allocation via linked list of sectors	multitasking, multi-user; supports device independence, DMA and spooling	
process-control		multitasking; interrupt-driven	$300

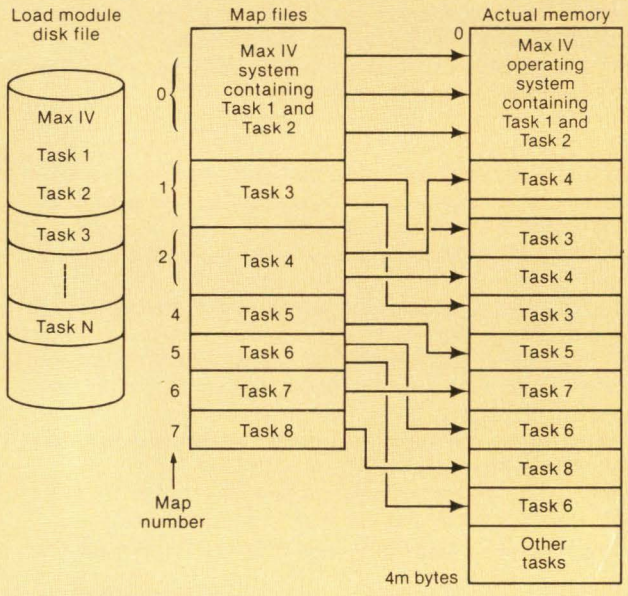
Operating systems will soon support local-area networks, such as Ethernet, and global-area networks, such as X.25.

Another less-popular language, FORTH, also reflects higher use.

A look around the corner

What do all these developments portend? During the 1980s, VLSI manufacturing techniques will mature and permit the production of μc chips with extremely high densities and many built-in processing functions. As these performance benefits slide into silicon, however, they will present users with untold operational problems. With the advent of additional μc processing parameters, functional modes and interface multiplexing, users will face virtually insurmountable problems when coupling their designs to the outside world.

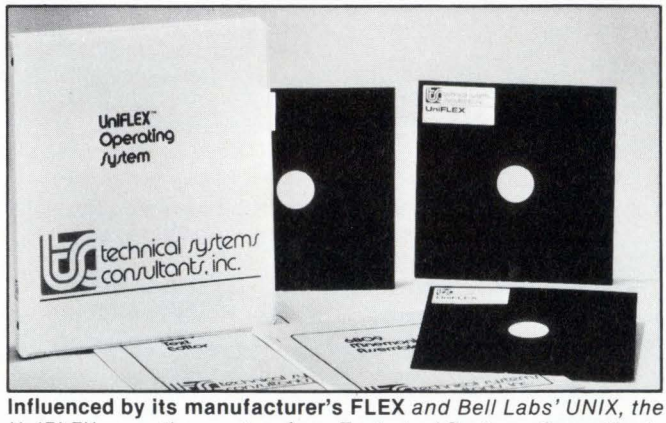
The solution? Future operating systems will be designed into VLSI devices and provide features and architectures that will insulate users from potential application pitfalls. According to Peter Palm, product marketing manager at Intel Corp., these OSs should provide modularity and configurability in the form of standard modules, layers and interfaces. For example, Intel's iRMX86 operating system uses object-oriented common-format interfaces to its primitives to manage jobs, tasks and messages. At a higher layer, this operating system offers common device-independent interfaces to device drivers that handle smart floppy- and hard-disk controllers. For an operating system with these built-in capabilities, VLSI implementation thus becomes a matter of merely improving manufacturing capability to a point at which silicon fabrication becomes practical.



Dynamic resource allocation, by which main memory is actively assigned to each active task as it is loaded, is a feature adapted from larger systems, such as Modular Computer Systems' MAX IV real-time operating system. MAX IV allocations are made on a multiple-page basis and are recorded in the task's map image. Active tasks can request additional memory at run-time, and the memory will be automatically de-allocated when the task exits.

An efficient algorithm using a double linked list of available pages is used to allocate all memory resources. The figure shows the main-memory allocation map for a typical multitask system. Tasks located in Map Zero are permanently resident and privileged, and are loaded with the MAX IV nucleus. All other tasks dynamically allocate their memory, and can construct a contiguous virtual addressing space from scattered pages of actual memory.

As many as six tasks (plus any tasks included in Map Zero) can be mapped at any given time. Context switching among these tasks does not require re-mapping. Additional tasks can exist in physical memory. In all cases, a task's map image is maintained within the MAX IV operating system data table.



Influenced by its manufacturer's FLEX *and Bell Labs' UNIX, the UniFLEX operating system from Technical Systems Consultants serves large multitasking and multiuser 6809- or 68000-μp-based systems. It supports a hierarchical file system, permitting files of 1G bytes and disk capacities exceeding 8G bytes.*

At a still higher layer, operating systems will soon provide a universal development interface (UDI) to popular languages for program develoment and a universal run-time interface (URI) to execute these developed programs. Such standard interfaces will permit common μc support languages to run on any UDI/URI-compatible operating system. The interfaces will, then, serve as a standard software bus for different languages and applications.

Operating systems will also soon support local-area networks, such as Ethernet, and global-area networks, such as X.25. They will provide high-level data-link interfaces to an Ethernet controller on the Multibus via an inter-processor protocol, for example, and support standard interfaces with standard modules. Such modules, layers and interfaces should pave the way to overcoming the potential problems of VLSI technology. ■

George Kotelly is senior editor of EDN magazine, which originally published this article in its September 16, 1981, issue.

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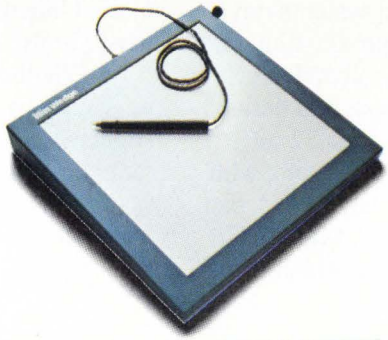

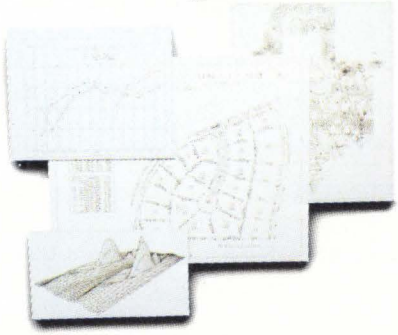

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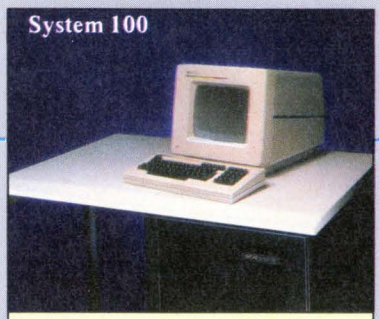

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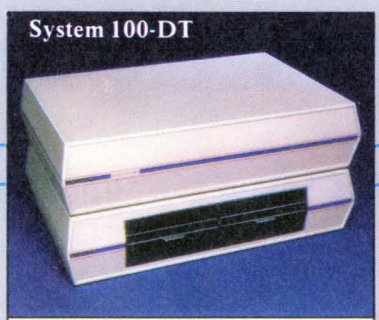

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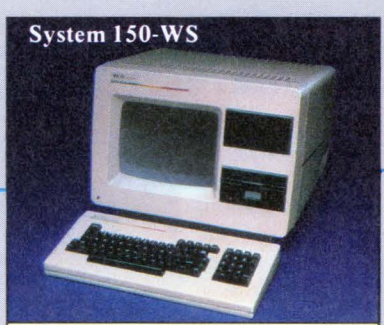

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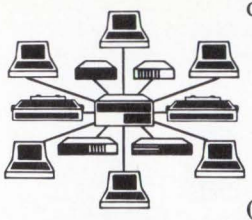

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SOFTWARE

The ABCs of operating systems

G. SCOTT HARRIS, Cybernation, Inc.

Three fundamental mechanisms inside most operating systems determine their performance

Like a well-organized machine shop, an operating system (OS) provides an efficient environment for a worker to perform his job. Equipment in the shop is similar to the mechanisms inside an OS. The use of the storage crib, workbenches and machines can help explain the actions of OS disk schedulers, memory managers and central-processor (CP) schedulers.

Extracting work from a computer is like extracting work from a saw, except that a user cuts and moves representations of information instead of wood or metal. If the saw cuts most of the time instead of being idle, production is increased. If a clumsy arrangement exists for each person to move work into and out of the saw, or if it is overloaded, production is decreased.

Computer jobs are similar to saw jobs. They may be short or long in scope, giving varying weight to the cost of changing from one job to another. The jobs may consist of many small parts to be moved into and out of a machine, or they may involve a few long, heavy cuts on large blocks of material.

With a computer, the interest lies in how many jobs can be processed, with each job often involving the execution of several programs (tasks). The number of jobs completed per hour is called throughput. The system can be adjusted for the maximum average throughput or for a minimum variation in the time for jobs from beginning to end, or turnaround time.

As the use of the saw is scheduled among available jobs, the OS has a CP scheduler that arranges available jobs for the CP and moves them into and out of it. These ready jobs wait on a queue in priority order, and the highest priority task receives the CP when it becomes available (Fig. 1a).

Once a task receives the CP and begins execution, it continues on the CP until it is preempted by a higher priority task or event, it temporarily finishes with the CP ("blocks" itself through a request service), or it finishes. Those tasks not ready for the CP reside on another queue waiting to be serviced by its mechanism, such as a clock or file I/O.

As a task executes, it alternates between bursts of CP and I/O activity (Fig. 1b). If there are two or more jobs, some jobs can do I/O, while others use the CP. Which job has the longest or shortest CP burst next cannot be easily predicted, but this information can be collected. That knowledge can then be used after the fact to determine how well the CP was used, given information that was then available. Information that is used to guess a task's behavior can come from user declarations (big, small, long, short), from job type (interactive, batch) or from a task's past history (average CP burst length). Once information is available, it can be used to determine a task's priority along with other administrative criteria.

Tasks can be arranged on the ready queue in groups and allowed to compete for priority within their group. Typical groups are interrupt-service routines, system-service routines, interactive-user jobs and batch jobs. Different scheduling policies can be enforced within and between groups.

Inter- and intra-group scheduling

Between groups, for example, a job that is ready in a higher group might receive the CP before a job in a lower group. In Fig. 1c, an interactive job receives the CP before a batch job. This is often balanced by a policy, such as parceling out the CP on a percentage basis among groups. Thus, if both batch and interactive jobs are ready, the interactive jobs might receive 80 percent of the available CP time, and the batch job might receive 20 percent.

Inside the groups, the CP scheduling policy might have a very different priority. Interrupt-service routines may be so important and time-critical that no job releases the CP until completion. System-service routines would probably reach completion, but would allow themselves to be interrupted and preempted for use of the CP. Interactive-user jobs are often arranged

Concrete objects from daily life are not far removed from the abstract mechanisms of the OS.

in a round-robin fashion, with each job receiving a small slice of time on the CP. Batch jobs can also be arranged in a round-robin fashion but with a longer time slice per job.

The effect of differing policies is that the percentage of time the CP is busy (CP use) is varied, or the amount of time the CP is busy on user, not system, jobs (net CP use) is varied. Within a group, the results of different policies are that if ready jobs are arranged in first-come-first-served (FCFS) order, any one job does not stagnate. Also, if jobs are arranged shortest-burst-next (SBN) on the CP, throughput is maximized. Finally, if the arrangement is longest-burst-next (LBN), turnaround time per job is minimized.

One mechanism can exhibit different policies. The round-robin mechanism (Fig. 1d) takes tasks off a ready queue, but gives them a maximum time limit on the CP. If a task has not finished at the end of its time slice, it relinquishes the CP and is placed at the end of the

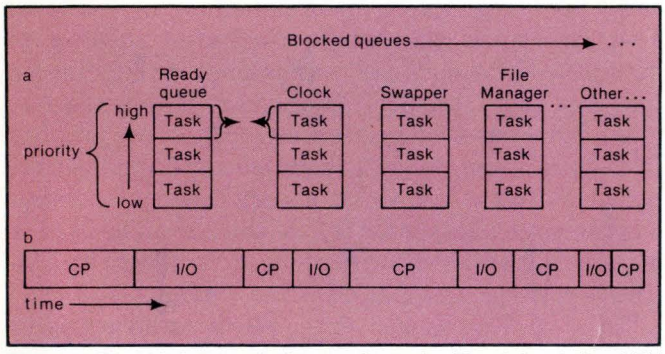

Fig. 1a. The highest priority ready task. *The job of the CPU scheduled is to place tasks into the ready queue as they are released from the blocked state in other queues.* **Fig. 1b. Alternating CP** *and I/0 bursts from a task.*

round-robin queue. If the task blocks itself by requesting some other service, it relinquishes the CP and is placed in another appropriate queue.

In the round-robin queue, time-slice size determines the policy in effect. If the slice is very long or infinite, the policy is the same as FCFS. If it is very short or approaching zero, the policy is processor-sharing, in which the processor is divided evenly among ready tasks. If the overhead to swap between tasks is small, then small slice times typically decrease response time for terminal interactions and increase throughput, while long slice times typically decrease turnaround time for whole jobs to be completed.

Central storage or "real memory" in a computer is usually arranged in a long array. Managing it is somewhat like having one long workbench in the hypothetical workshop. Space may have to be allocated as it becomes available, but each user would prefer that all his workspace be contiguous (Fig. 2a).

The amount of free space in central storage indicates how difficult it is to bring in a new job and get it ready for the machine. When there is plenty of space, it is easier to get a job ready or keep it on the workbench. If many jobs are contending for space, some may have to be moved to secondary storage to make space for others. This can overload the system, causing fewer jobs to be completed because time is wasted moving jobs back and forth between central and secondary storage.

Allocation of central storage may proceed according

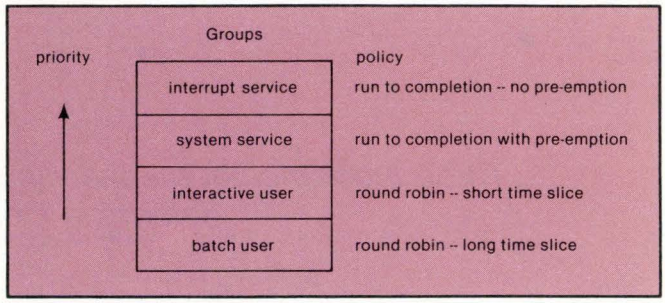

Fig. 1c. Scheduling *groups.*

to several policies or a combination. For example, segmentation can be employed, and storage can be allocated in contiguous pieces that correspond to logical (user-visible and -controlled) program divisions. This is similar to giving each worker in a shop a fixed area on the workbench. If one worker's job has logical sub-jobs, it may not be necessary for each of them to be adjacent (Fig. 2b). However, even if there is sufficient free space on the workbench to accommodate another job, it may be necessary for everyone to suspend work and combine the available space for the new job.

One way to avoid this storage-moving problem is to use another allocation policy—paging. Paging is the division of central storage into equally sized, interchangeable "pages." In workshop terms, it is similar to

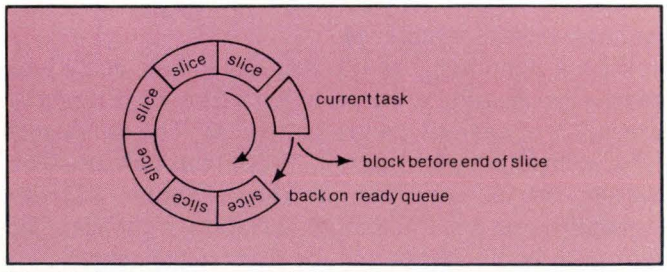

Fig. 1d. Round robin scheduling. *Time slices have fixed maximum durations, but tasks may release the CP before the slice ends or may require more than one slice.*

cutting the long workbench into shorter tables (Fig. 2c).

With paging, each job is given as many tables as it takes to hold the job. Unfortunately, two jobs cannot share a portion of a table, so if a job needs only part of the table, the rest is wasted. But if a new job comes along, free tables can be acccumulated until it has enough space without disturbing other jobs.

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Just as the use of the saw is scheduled among those jobs that are available, the OS has a CP scheduler that arranges available jobs for the CP.

is not available with physical workbenches. The workspace can appear to be grouped in terms of job segments and sub-segments for the benefit of the worker, but allocated in terms of modular pages or "tables" for the benefit of the workbench manager. This is called 2D storage management, or segmentation over paging (Fig. 2d).

Hardware with memory management must perform

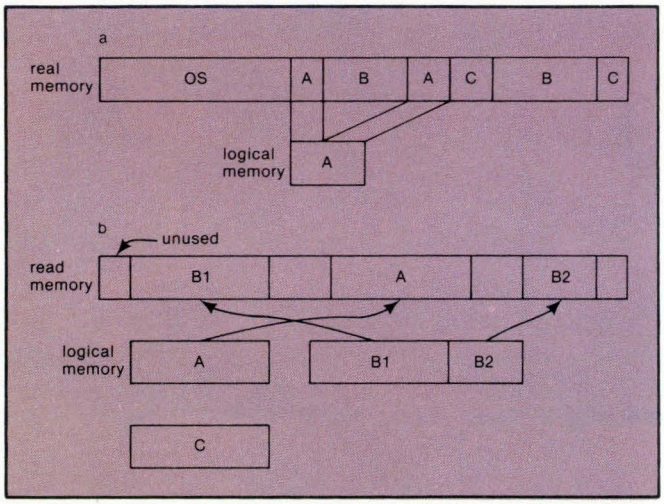

Fig. 2a. Contiguous job area. *Although jobs are stored discontinuously in real memory, they must appear continuous in logical memory (what a user sees).* **Fig. 2b. Segmentation divides** *real memory into contiguous areas by job or function. These contiguous areas are defined by the user in logical memory.*

a calculation to convert a location within a job segment or page to its location in main memory. Adding one more level of calculation helps manage job segments by pages at the cost of two address recalculations instead of one.

The worktables must be loaded with the maximum number of ready jobs or job portions to make up for the calculation cost. If the central-storage manager has been well designed and has fast access to secondary storage, it could take an inactive worktable, unload it into secondary storage and let another more active portion of a job use it. It then monitors the address calculations passing, and if one appears that requests a portion of a job that is not in central storage, it stops the requesting job until central storage can be obtained and loaded with the desired job portion. This is virtual memory or demand paging. It presumes that the increased number of jobs in the ready state makes up for the high cost of storage management and moving.

Moving material efficiently into and out of work areas from secondary storage is the job of the disk scheduler. Scheduling disks involves coordinating storage move requests with two moving objects: the disk platter and the read head (Fig. 3a). The platter has many tracks over which the head can be positioned. Each track is divided into sectors, and the system waits for the appropriate sector to appear. Head-track positioning is usually more time-consuming than rotational latency and will be the only criterion considered in this analogy.

A disk head can be compared to a forklift truck that goes back and forth before a storage crib with several aisles, each of which has a conveyor belt with storage bins on it. The forklift removes items from a bin and places them on a conveyor to the job, or vice versa. It takes time to accelerate and stop the forklift at the appropriate aisle, and then the truck waits for the correct bin to arrive.

As requests from various jobs accumulate, the forklift manager arranges them in order by aisle (and bin). There will be a constant population of requests versus location (Fig. 3b). Policy then determines which request to satisfy next. First-come-first-served (FCFS) gives minimal variation in service time and guarantees that no job will starve for material, but also gives the poorest performance if the forklift drives by aisles with outstanding requests. Shortest-seek-time-first (SSTF) gives some jobs minimum waits, but has the widest variance in service times. With SSTF, some job whose requested aisle is far from occurring requests may not get service.

Two compromises are often used in disk scheduling, both of which have a goal of minimum variance rather than minimum service time. The first of these ap-

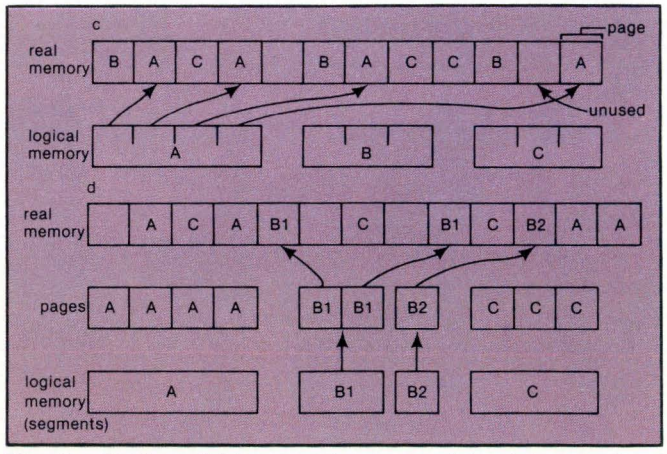

Fig. 2c. Paging divides *real memory jobs into equalized "pages."* **Fig 2d. Segmentation over paging.** *User divisions appear as continuous segments in logical memory, while each segment is supported by paging in real memory.*

proaches is usually called the LOOK, or elevator, algorithm. The head proceeds in one direction across the disk, satisfying requests until none appears in that direction. It then reverses direction. One effect of this approach is that the head "sweeps" a region clean of requests. There is then a lighter density of requests immediately behind the head (Fig. 3c). When the head reverses, the first request it services is more likely to

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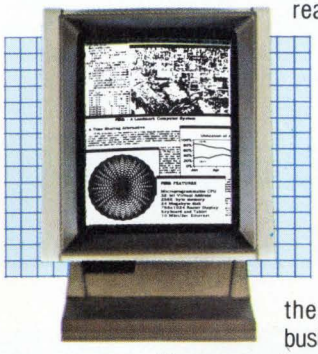

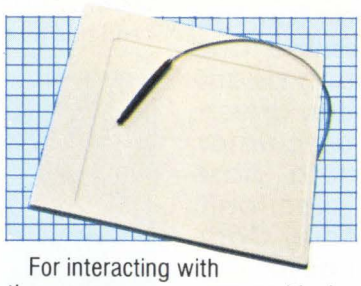

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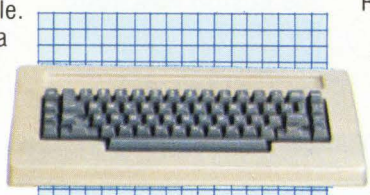

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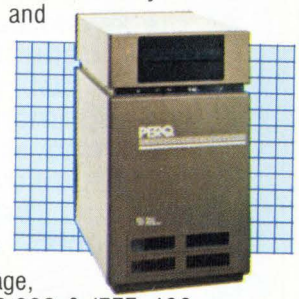

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Tasks can be arranged on the ready queue in groups and allowed to compete for priority within their group.

be recent while the last one it reaches in its new direction will be the oldest.

A solution to this problem can be found in a circular LOOK, or CLOOK, algorithm. In this approach, when the head has no more requests in the direction in which it is

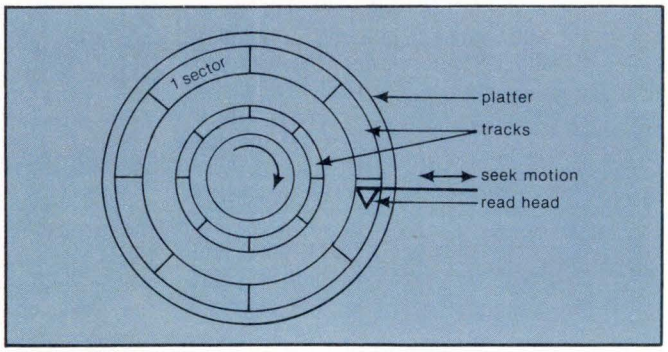


Fig. 3a. Disk *terminology.*

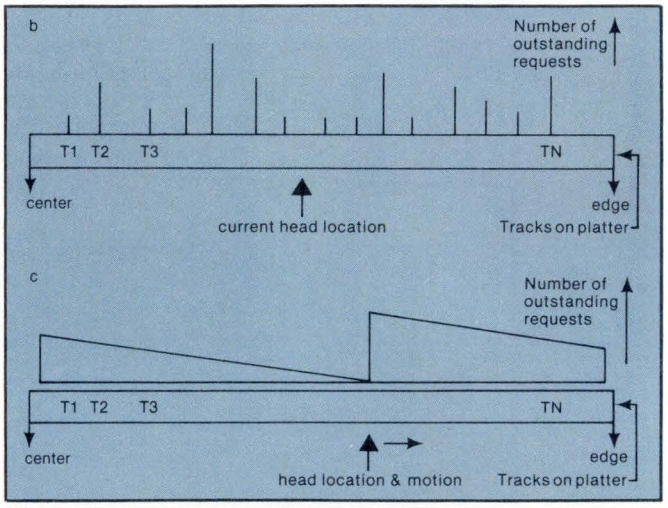


Fig. 3b. Request ordering. *Accumulated requests are viewed by location in the schedule.* **Fig. 3c. Request density during sweep.** *In evaluator algorithms, the density of outstanding disk requests is least in the region that has most recently been swept clean (behind the head) and greatest in the region that has been without service the longest (in front of the head).*

proceeding, it reverses, proceeds to the farthest request and then reverses again. It is a typewriter carriage-return effect, which always reads in the same direction. The head is now in the region of the densest and oldest requests. ■

G. Scott Harris is president of Cybernation, Inc., a systems software firm in Austin, Texas.

MULTIPROCESSORS

68000-based system features CP/M capabilities

JERRY MILLER, C.M. Technologies, Inc.

Series 16 combines 68000 and Z80 CPUs to provide efficiency, speed and large address space

The Multibus-compatible CMS Series 16 multiprocessor system from C.M. Technologies, Inc., Palo Alto, Calif., is both a stand-alone development system for the Motorola 68000 and an 8-bit CP/M-based Z80 system with 11M bytes of unformatted on-line storage. With its resident intelligent controller, the storage subsystem can be expanded to handle a mixture of four Winchester- or floppy-disk systems.

The Series 16 operates under Microsoft's XENIX multi-user operating system, which will be released in 1982. With XENIX, the Series 16 can be configured with eight remote stations and with a host Digital Equipment Corp. PDP-11 for 68000 code development.

The system is based on the 68000 and the Zilog Z80 CPUs. The 68000 provides an easy-to-use instruction set, high-speed execution and 1M-byte direct addressing. The Z80 provides storage management and a selection of professional software through the use of the industry-standard CP/M operating system.

System hardware includes Winchesters, floppies

The heart of the CMS Series 16 system is the CPU board with the 68000 and 64K bytes of on-board dynamic RAM. The CPU board operates at 4-, 6- or

WHY THE 68000?

C.M. Technologies' engineering staff determined that the power and adaptability of a 16-bit CPU were needed for the high-performance database machine they had in mind, and they examined the candidates: the Digital Equipment Corp. LSI-11, the Zilog Z8000, the Intel Corp. 8086 and the Motorola Corp. 68000.

While the LSI-11 has a large amount of software, its multi-chip implementation and relatively slow, 2-MHz clock speed ruled out its use. The Z8000 was rejected because of its relatively slow speed, and the fact that it directly addresses only 64K bytes of memory. The time overhead involved in bank-switching and other storage-management schemes is too high for the planned applications. The 8086 is—at 10 MHz—fast enough, but it also addresses only 64K bytes without storage-management overhead.

This leaves the 68000, with its 16M-byte direct-addressing ability, an 8-MHz clock and an orthogonal instruction set, an aid in writing programs for the machine because it reduces the number of special cases that have to be memorized to use the machine's resources.

Zilog's Z80 was selected because:

- It is well-known and dependable, has worldwide installations and has several sources.
- It has a large amount of machine-language and high-level language software. All software for the Intel 8080 is available because the Z80 uses a superset of the 8080's machine language. Despite the popularity of the 6502 μC used by Commodore Business Machines Corp., Apple Computer, Inc., and Atari, Inc., most commercially available μC software has been written on and for the 8080 and the Z80.
- It is compatible with CP/M, Digital Research's μC operating system that has become the de facto standard for 8-bit computer systems.

CP/M provides a convenient set of file-handling and I/O utilities that allow programs to interface with numerous peripherals with minimum programming. In addition, Digital Research has upgraded CP/M with compatible releases. In the past year, the company has released a multi-user version and high-level languages for applications programming.

Most major computer languages—BASIC, FORTRAN, COBOL, Pascal, C and even Lisp—have compilers that run under CP/M, providing flexibility in program development.

The disk system has an intelligent disk controller that provides for DMA, re-tries, error recovery and formatting and controls as many as four Shugart Associates' SA1000 Winchester- or 850/800 floppy-disk drives.

8-MHz clock speeds and provides sockets for as much as 16K bytes of EPROM. The board has a 24-bit address bus, memory-mapped I/O and seven vectored interrupt levels.

The company's proprietary monitor software allows the CPU board to serve as the bus master or as the slave. The 68000 board can be a background processor for the Z80 CPU board, or it can use the Z80 as its I/O manager.

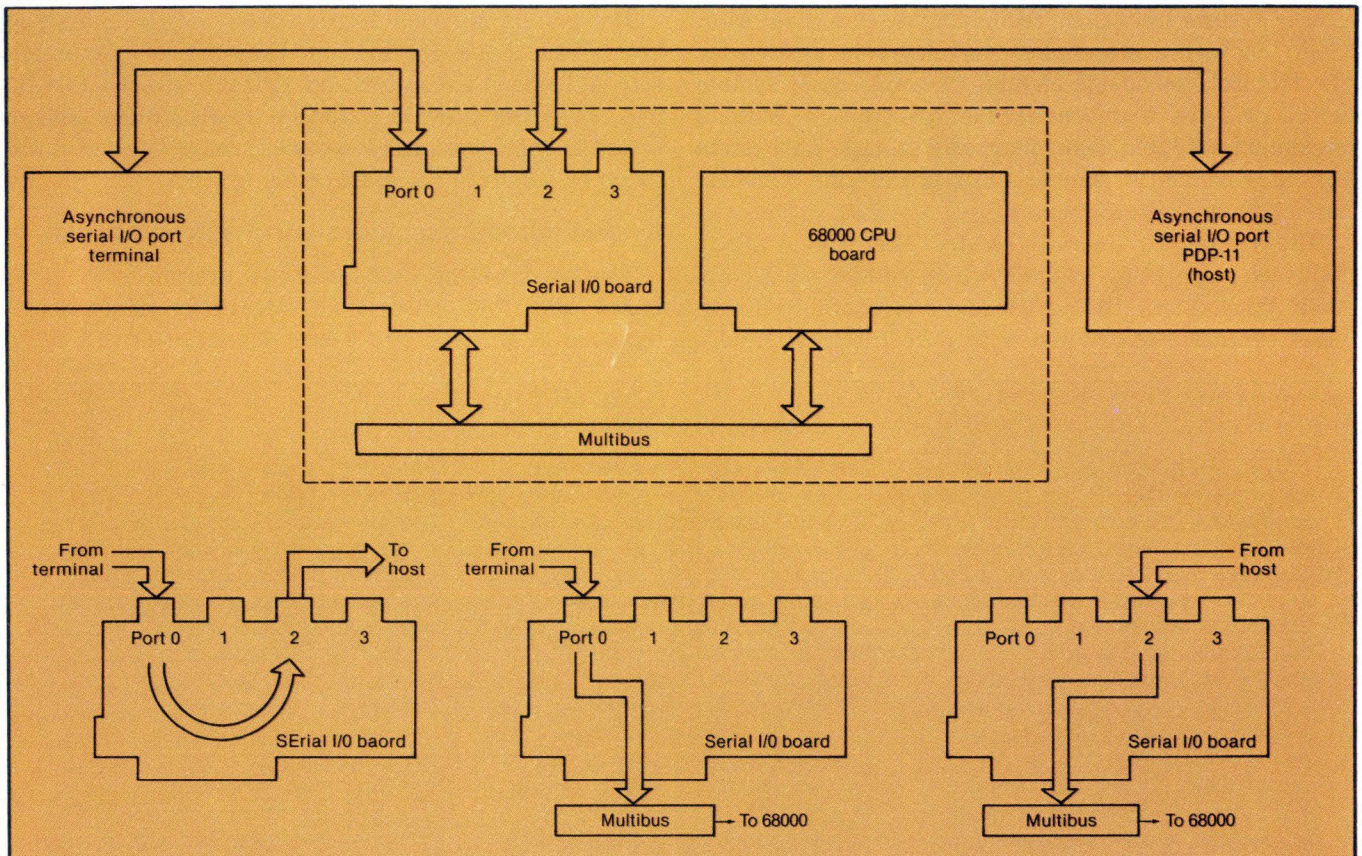
The Series 16 also includes a 11M-byte disk-storage subsystem that houses an 8-in. Winchester-disk drive and a dual-sided, double-density 8-in. floppy-disk drive On-line storage can be expanded to 40M bytes. The disk system has an intelligent disk controller that provides for DMA, re-tries, error recovery and formatting, and controls as many as four Shugart Associates' SA1000 Winchester or 850/800 floppy-disk drives in any combination. Both drives use identical drive-control signals and pin assignments, enabling designers to daisy-chain fixed and floppy drives in a system. The SA1000 has a 4.34-bps data-transfer rate.

The Series 16 also has a serial I/O board with four synchronous/asynchronous RS232 ports, a proprietary operating system for the two CPUs, a 128K-byte dynamic RAM board and a nine-slot Multibus backplane that allows users to configure the system by adding standard peripheral boards and controllers.

XENIX provides programmer aids

The XENIX operating system is based on Bell Laboratories' UNIX V7 operating system, with extensions and optimizations for the 16-bit μc environment. XENIX features a hierarchical file structure, a shell programming system, standardized communications between software modules and an extensive library of programmer aids and utilities. It provides system developers with a powerful environment to generate systems and applications.

Under XENIX, the Series 16 can be configured with as many as eight remote stations, providing multi-user, multitasking capabilities. Increases in user demands



Terminal control of the host *computer is accomplished by passing serial data from Port 0 to Port 2. The Series is transparent to the user, so the host computer can be operated without disconnecting and reconnecting the development system each time.*

Terminal control of the 68000 *is accomplished through the Multibus, whose interface receives data from Port 0. The host computer is transparent to the operator, making the Series 16 a concurrent back-end processor.*

The Series 16 accepts *down-loaded programs from the host computer. The user-initiated transfer is effected through Port 2, which passes code or data to the Multibus and on to the 68000 CPU.*

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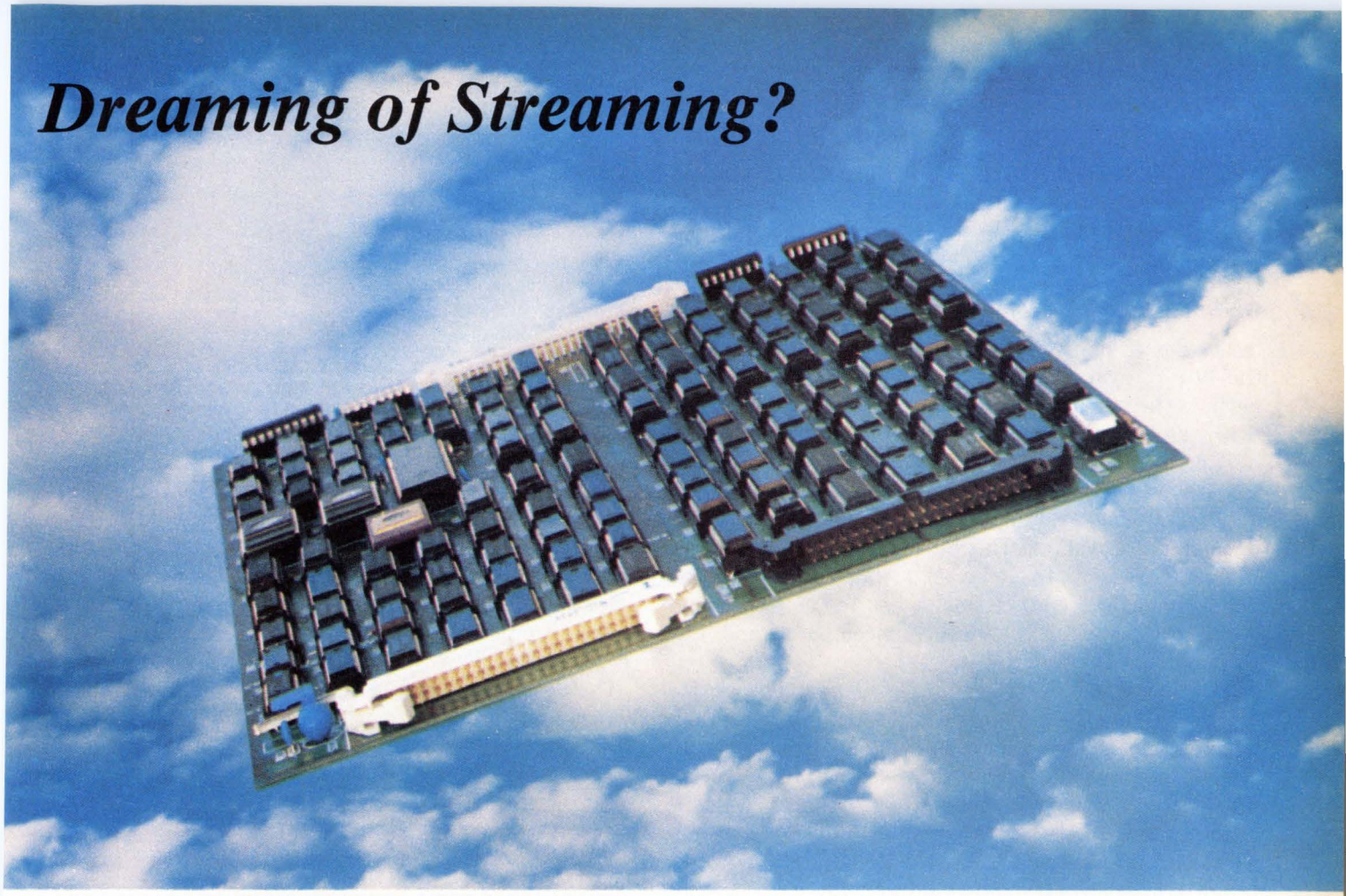

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The Series 16 uses standard RS232 ports to connect to the PDP-11 system without hardware modification.

will not require hardware changes or lengthy operator re-training.

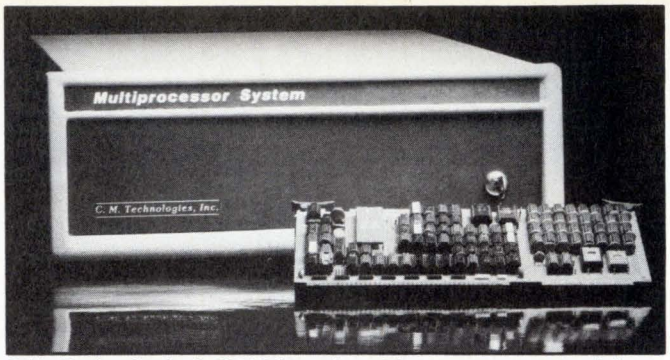
On-line processing with PDP-11

The Series 16 uses standard RS232 ports to connect to the PDP-11 system without hardware modification. It permits the PDP-11 or the 68000 to be operated from the terminal, and accepts down-loaded programs from the host computer (see Figure).

Without the Z80 peripherals controller board and additional firmware, the basic system becomes a 68000 development system. The Series 16 comes with the cabling necessary to make an RS232C interface. The development system is connected to the asynchronous serial I/O ports of the host minicomputer and the terminal.

The Series 16 is designed for engineers and programmers developing and operating 68000 software for business and industrial process-control applications. It can be used as a stand-alone development system or as a dedicated auxiliary processor.

As a stand-alone system, it helps develop code for dedicated applications using the 68000 CPU. A wide range of high-level languages and compilers is available to speed program development. The system produces ROM code and specialized applications efficiently.



C.M. Technologies' 68000-based multiprocessor *system links to Digital Equipment Corp.'s PDP-11 and is designed to run on Microsoft's Xenix multi-user operating system, expected next year.*

The 68000's efficiency, speed and large address space make it useful as an auxiliary processor for other machines. It enables the Series 16 to be used as a back-end processor for a minicomputer-database system, for example.

The Series 16 is priced at $19,450, with a 10M-byte Winchester-disk drive, a 1M-byte floppy-disk drive and serial I/O. ■

Jerry Miller is president of C.M. Technologies, Inc., Palo Alto, Calif.

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DEVELOPMENT SYSTEMS

Simplifying μp-based product development

THOMAS K. FITZGIBBON, Americomp Consulting Company

Americomp's Z80/PDP reduces the tedious and time-consuming steps of traditional methods

Thousands of μp-based products—from smart terminals to talking ovens—are introduced each year, each of which requires considerable resources to develop. Project designers who want to cut the cost and time of developing Z80-based machines can benefit from a new single-board development system that often eliminates the wire wrapping of traditional methods and many of the modifications involved in software transfers. With the new system, which sells at about half the price of others, production can be as simple as burning a PROM on the single-board computer and plugging in the appropriate chips.

Necessity breeds invention

The new system grew from the need to solve several problems that Americomp Consulting Co., New York, saw as common to the development of communication and process-control systems and other devices employing μps:

- Development systems are too expensive for low-priced products; it wouldn't make sense to spend $16,000 for a development system while building a $250 interface.
- Time constraints are severe; a few months' lead over a competitor in getting a product on the market can make a difference.
- The development system usually cannot be used later for other projects.
- An expensive custom circuit board must be designed to field test products in quantity.
- Time and resources are wasted developing hardware when standard-chip family setups can be used.

Americomp's solution to these problems is the Z80/PDP development system. The system sells for about $5700 and—with a $35 PC board expected by year-end—enables a designer to create a working prototype in about half the time of conventional methods. The Z80/PDP produces small quantities of field-testable products, and later can be used as a general-purpose computer.

Looking inside the Z80/PDP

The Z80/PDP consists of a desk-top CP/M-based computer (DPZ) with a screen, a keyboard and disk storage; and a target prototype (TPZ) single-board

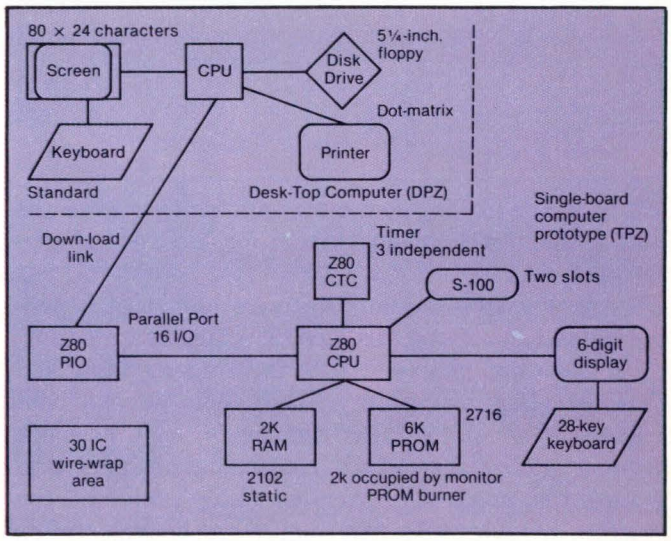

Fig. 1. Americomp's Z80/PDP system *includes a desk-top CP/M-based computer (DPZ) and a single-board-computer prototype (TPZ). Software developed in the module is down-loaded to the TPZ, where the software is further tested and used.*

Project designers who want to cut the cost and time of developing Z80-based machines can benefit from a new single-board development system that often eliminates the wire wrapping of traditional methods.

computer with a wire-wrapping area that serves as a physical prototype. Almost any CP/M-based computer can be substituted for the DPZ, thus decreasing the cost. A designer using an 8080, an 8085 or a Z80 assembler or higher level language can construct software-function modules that can be tested on the DPZ unit by software simulation; those modules then can be down-loaded and further tested on the TPZ (Fig. 1). The down-loading feature is similar to that in the Intel Corp. development system for the 8048 single-chip computer.

SIMPLIFICATION AT A GLANCE

Americomp Consulting Company's Z80/PDP development system simplifies the development procedure by transferring software directly to the prototype-compatible PC board.

Traditional Procedure	Americomp Procedure
Develop software module.	Develop software module.
Wire-wrap the prototype.	Wire-wrapping in small projects is unnecessary about half the time because of the variety of chips on the PC board (TPZ). The TPZ does provide for wrapping, if it is necessary.
Transfer software from module to prototype, a process that often involves expensive extra equipment.	Module-to-prototype transfer is built into the TPZ: down-loading is semi-automatic.
Solve the real-time problems of the project.	Solve the real-time problems of the project.
Develop the PC board.	The PC board (uni-board) is provided.
Transfer software from the wire-wrapped prototype to the PC board, which often involves modifying the software to fit the PC board.	Prototype-to-PC board transfer involves only burning PROM on the TPZ and plugging into uniboard.

The DPZ possesses many software tools that expensive development systems lack. The first is an editor, which is a word processor with full-screen editing and which provides a window to the whole development process. If an editor lacks commands, such as block move or global search and replace, a designer will require too much time just to enter and edit the program modules. He may omit vital documentation when using a cumbersome editor.

The DPZ also contains a debugger, which allows users to place program modules, such as EBCDIC-to-ASCII code conversions, in the DPZ memory and to run the program. The debugger dumps, searches, executes, inserts breakpoints, displays memory/register and modifies.

Finally, a relocating assembler and linking loader are standard software with the DPZ. These provide for creating relocatable or movable program modules, or tables, that will later be fitted together to form an entire device-maintenance program. Macros, or user-defined common subroutines, modularize the software further.

The prototype board (TPZ) stand-alone computer also has extensive debugging tools, including a six-digit hexadecimal display, a 20-key entry, single-step program execution, breakpoints, memory/register display and modify. The TPZ also has two parallel ports, three timers, 1K byte of RAM, 6K bytes of PROM and a 2716 PROM burner. The TPZ also includes a wrapping area for about 30 additional ICs and the standard S-100 connections.

Testing small quantities

Field-testing products in small quantities is impractical and expensive. Americomp solves this problem with a universal PC board (uni-board) that is hardware- and software-compatible with the original prototyping device. Limited manufacturing is done simply by plugging in the PROM containing the program, inserting the necessary functional ICs, such as a serial port, and

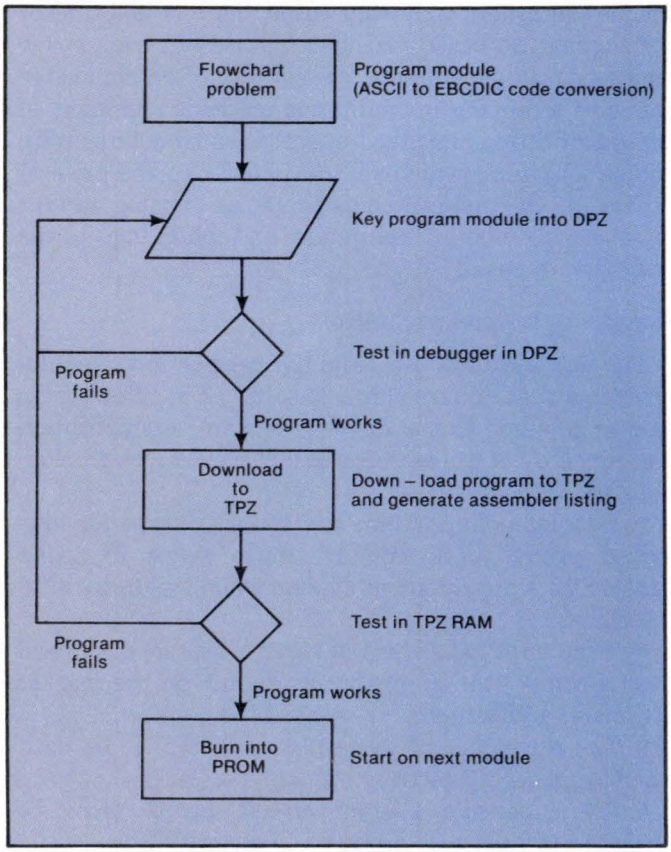

Fig. 2. A code conversion between ASCII and EBCDIC communication standards *is controlled by the DPZ debugger. Constructing a flowchart is the first step in separating the task into controllable modules for individual evaluation.*

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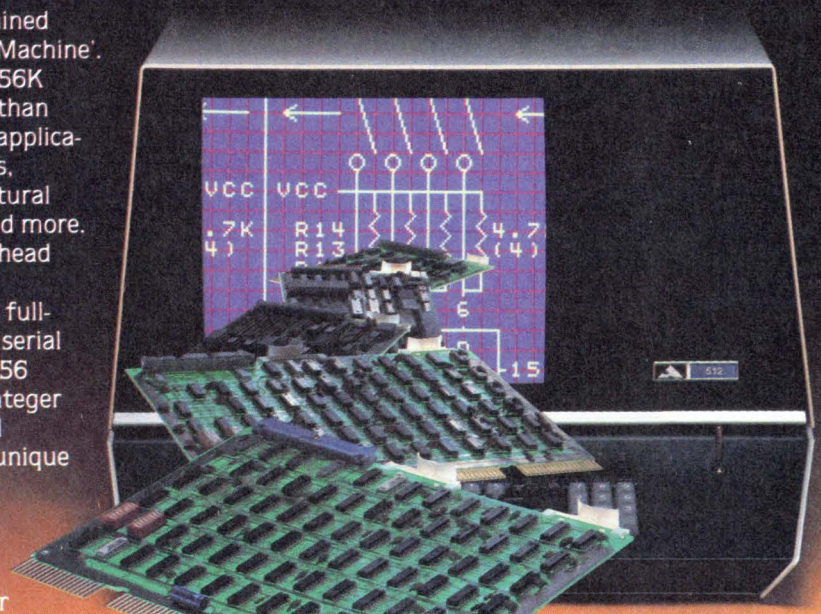

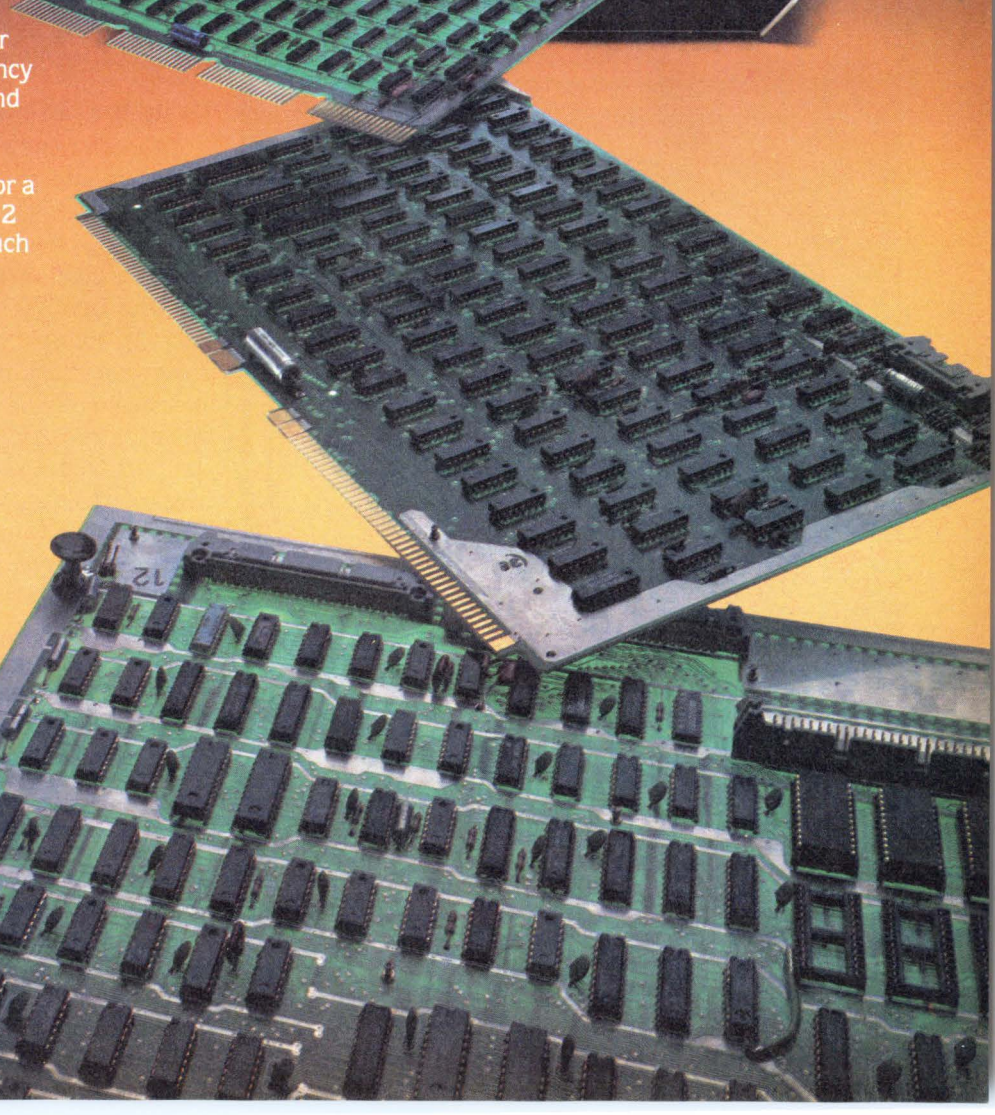

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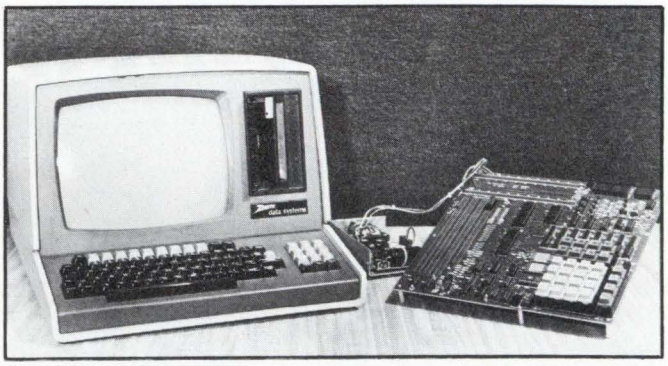
1981 THE YEAR OF AED

Field testing products in small quantities is impractical and expensive. Americomp solves this problem with a universal PC board.



Americomp's Z80/PDP development system *sells for about $5700 and—with a $35 PC board expected by year-end—enables designers to create working prototypes in about half the time of conventional methods.*

cabling the external connections. The uni-board contains space for 48K bytes of static or dynamic RAM, 8K bytes of 2716 PROM, two parallel ports, three timers, four synchronous or asynchronous serial ports and a wire-wrapping area. The ultimate manufacturer may wish to continue using the uni-board as a basis for a product or to obtain a license to use the same circuit configuration in later products.

Using the development system

As in any engineering task, a designer must divide the work into small, controllable modules that can be separately evaluated. The first step, usually omitted, is to make a flowchart of the software module. The designer then writes the program or enters it directly into the DPZ. As in ASCII-to-EBCDIC code conversions (Fig. 2), the DPZ debugger can control the process.

Any program operating under real-time constraints, such as an interface dialing another computer, must be tested in the TPZ. The program can be down-loaded to the TPZ and executed in the on-board RAM, using breakpoints, register and memory manipulation. After programming the EPROM on the TPZ with the tried-and-true instructions for the prototype, the designer can take a well-deserved vacation. ■

Thomas K. Fitzgibbon is president of Americomp Consulting Company, New York, N.Y.

NEXT MONTH IN MMS

• An article from Data General examining memory management in the MV/8000 and MV/6000 superminis.

Articles unrelated to the memory theme will cover: carry-in service centers (Sorbus), VLSI and microcomputer operating systems (Intel), and microcomputer network requirements for the business world (Nestar). We're also planning major product introductions from at least two companies.

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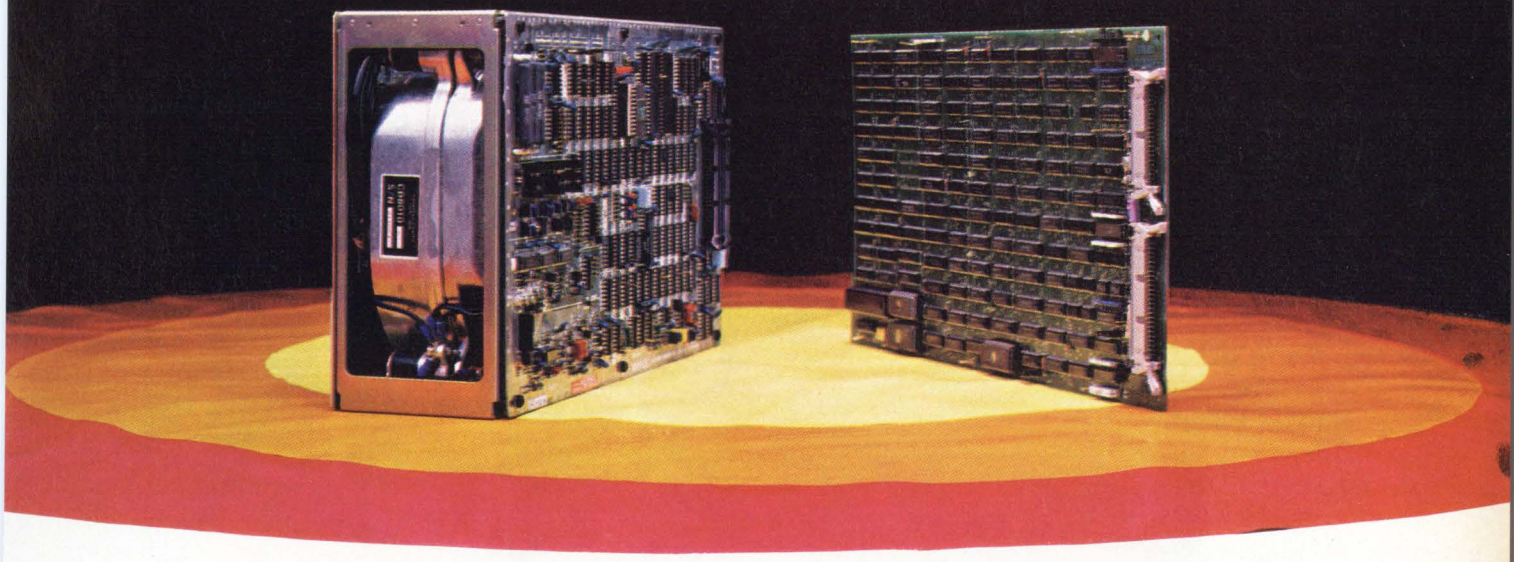

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Spare Capacity, K Bytes per Drive	✓447	98	123
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Soft Read Errors	10^{10}	10^{10}	10^{10}
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CIRCLE NO. 69 ON INQUIRY CARD

Looking at the 'Universe'

JIM ISAAK, Charles River Data Systems, Inc.

This 32-bit 'supermicro' centers on a Motorola 68000 and runs a UNIX-like operating system

OEMs have always been pioneers in bringing computers to new applications, but they have been frustrated in their efforts to move from 16-bit minis to 32-bit machines. Two factors have impeded their progress: the 64K-byte maximum address space imposed by the architecture of 16-bit minis, and the high prices of 32-bit superminis. Charles River Data Systems appears to have broken that twin barrier with the Universe "supermicrosystem" based on the Motorola 68000—a μp used frequently in 16-bit machines, but not previously in true 32-bit architecture. And the use of off-the-shelf 68000 helps keep the entry-level price of the Universe less than $20,000, roughly one-third the price of the superminis it is designed to compete with.

The Universe is designed for OEMs, systems houses and sophisticated end users who want an inexpensive 32-bit machine to drive their products. Another feature of the system that should appeal to prospective users is that the Universe runs a UNIX-like operating system with all the attributes of that system and then some.

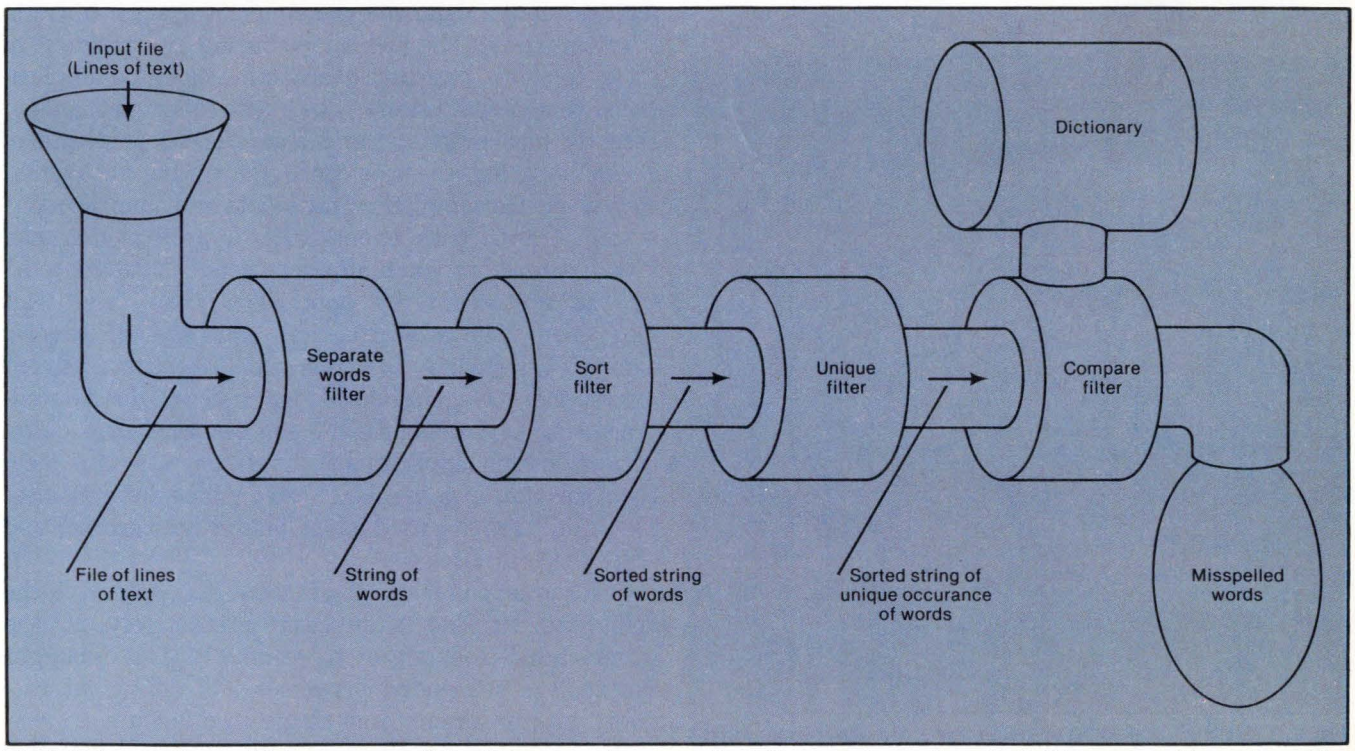

Fig. 1. "Pipes" allow multiple processes *("filters") to proceed concurrently. A filter operates on the output of the previous filter and provides input to the next filter, leaving no temporary file "residue." In the example above, pipes check for spelling errors. The text is separated into a stream of words and sorted alphabetically. The "unique" filter removes duplicate words, and the "compare" filter checks for spelling errors, separating those that do not match the dictionary spelling. These same filters can be used with any other set of small modules to form many functions with minimal programming.*

The operating system of the Universe is called UNOS—a multi-user, multitasking time-sharing system that provides easily used file systems and utilties.

The 68000 can be altered with little difficulty to implement a 32-bit architecture. All data registers and address registers have 32-bit capacity, and arithmetic operators manipulate 32-bit values. The Universe architecture exploits these capabilities. For example, the system uses the 68000's 24-bit addressing, enabling it to run programs requiring as much as 16M bytes of main memory.

Universe also includes the 32-bit Motorola Versabus. While there is still no IEEE standard for a 32-bit bus, the Versabus has been proposed as one. It includes a 32-bit address and data bus, and has a 5-MHz transfer rate (20M bytes per sec.). Charles River Data Systems also provides a Multibus interface card for connecting to 8- and 16-bit environments. This allows users to use the wide range of Multibus peripheral interfaces available.

The Universe is available in various configurations, allowing OEMs to select the level at which they want to integrate the computer into their products. Cabinet-level systems include completely integrated processor memory and disk subsystems. Desk-top configurations include 7- and 15-slot enclosures. Board sets are available for OEMs who want to build Universe capabilities into their own chassis. And, hardware and software manufacturing licenses are available to OEMs who want to integrate their product lines vertically down to the chip level.

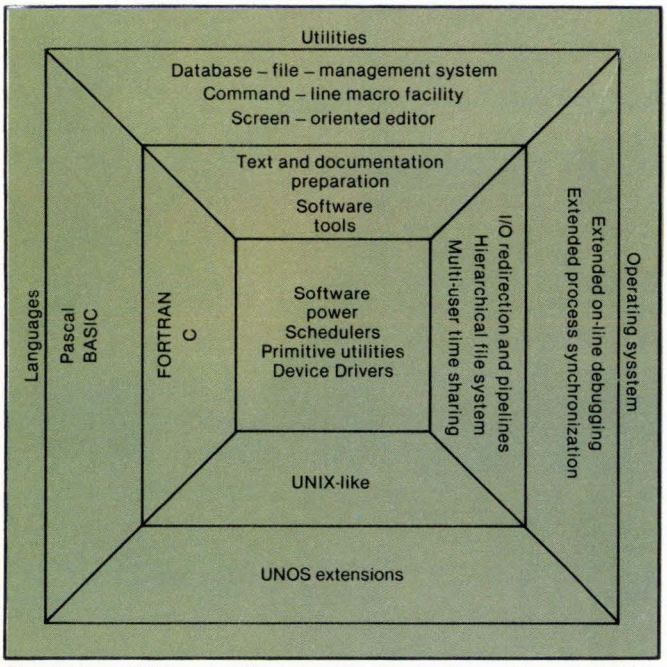

Fig. 2. The UNOS operating system *(in green) provides capabilities beyond those of Bell Laboratories' UNIX (in yellow). Both systems are extensions of conventional operating systems written in machine language, which provide the schedulers, primitive utilities and device drivers that constitute the software power core (in red) of any operating system.*

The operating system of the Universe is called UNOS—a multi-user, multitasking, time-sharing system that provides easily used file systems and utilities. It is functionally compatible with Bell Laboratories' UNIX operating system. Like UNIX, UNOS is written in C. It supports several high-level languages, including FORTRAN, BASIC, C and Pascal. The new system runs most UNIX programs with a simple recompilation.

UNOS incorporates the innovations that make UNIX effective for program development. Among these are file-management facilities, such as dynamically grown files, device independence and mountable volumes. The operating system also includes ease-of-use features that have only recently been recognized as critical. An example is the hierarchical file structure, which consists of directories of files that can contain other directories as entries, with unlimited nesting. This allows programs and data files to be grouped according to project and resolves potential file-name conflicts between users.

Another UNIX innovation incorporated in UNOS is I/O redirection. This allows prepared scripts to be used as input for a program and provides a simple method for saving program output in a file or directing it to a printer. The same facility allows the output of one process to be directed as input to a second process, forming a "pipe" (Fig. 1).

UNOS extends UNIX functions

Most important of UNOS innovations are an event-count mechanism that synchronizes concurrent processes, extended debugging and process-management features, and a database-management system (DBMS).

UNOS extends the rich time-sharing environment of UNIX to more real-time-transaction-oriented applications, using event counts. The event-count mechanism, recently pioneered at the Massachusetts Institute of Technology, unifies three concepts: waiting for events, such as device completion, time-outs and asynchronous system traps. With event calls, a programmer can invoke a function when an event count is "advanced," by the system or by another process. The wait mechanism delays a program until one of several events — including a time-out — occurs. Event counts can be generalized for use in distributed-processing environments and are essential in transaction-processing applications. Event counts also form the basis for a general set of queuing subroutines. These, in turn, are used in the line-printer spooler and other UNOS utilities.

Other extended features of UNOS (Fig. 2) include the ability to suspend a process interactively at the terminal and to debug or to resume it. The debugger can analyze suspended processes and debug interactively with breakpoint and single-step facilities.

One UNOS tool for program development is "MAKE," whose function is to decide which files to recompile when a program is changed. Completing the tool set are a screen-oriented editor, string-search-and-replace

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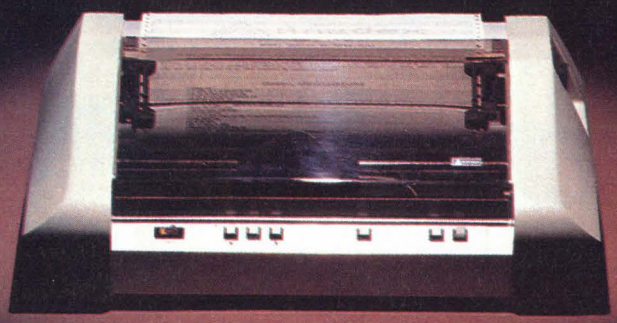

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Event counts can be generalized for use in distributed-processing environments and are essential in transaction-processing applications.

utilities and a "call tree" that analyzes all calling sequences for a specified entry and displays this tree back to the top level.

The UNOS system was bootstrapped from a DEC PDP-11/23 system using UNIX. After 15 months of development, the system was moved to a prototype 68000 system using the Charles River Data Systems Q-bus disk drives. The conversion to the 68000 (once the assembler and C code generator were complete) required two weeks. The second transition—to the Versabus system—using the Motorola map and a storage-module disk controller required four days.

This attests to the portability of high-level language code, which has been a strength of UNIX and UNIX-like systems. There are UNIX implementations and/or UNIX-like systems running on the PDP-11, VAX, Perkin-Elmer, Amdahl, 8080, Z80, Z8000 and other systems. This propagation has been a result, in part, of Western Electric's encouragement of distributors such as Microsoft Corp. and ONYX Corp., as well as the popularity of UNIX leading to independently developed systems, such as UNOS.

UNOS DBMS implements variable-length, multi-keyed, indexed (VSAM) files, which can be accessed sequentially in ascending or descending order or randomly by key value. Keys can be as many as 256 bytes of ASCII or binary information. Whole files or records can be individually locked for updating, allowing several concurrent users to access the files. Transaction-oriented logging and back out are also provided to ensure the integrity of the database.

Record schemas are described in a simple language that specifies the attributes of each field in a record, including its type and length. COBOL-like "picture specifications" describe how, by default, the fields should be read from and displayed on terminals. These schemas provide data independence, separating the program's view of the database from its physical structure and contents. Programs access fields by name, and underlying record structures can be changed without modifying existing programs.

At this nucleus level, the DBMS facility does not take on the higher level characteristics of "hierarchical," "relational" or "network," and it does not provide the related utilities, such as query or report writer. The system is for system builders and technical OEMs who need both the file-management capabilities and the efficiencies of systems-level work. ■

Jim Isaak is product marketing manager at Charles River Data Systems, Inc., Natick, Mass.

Databases for minis and μcs

CHARLES W. BACHMAN,
Cullinane Database Systems, Inc.

Database systems, already working with minis, are expected to enter the μc world soon

The stunning growth of the minicomputer/μc market has been fed by both new and old applications. Software for small computers has followed in the footsteps of software for medium and large systems. Many programming languages have also become available, as have multiprogramming operating systems with comprehensive file structures. Now, database management, a classic feature of larger systems, is entering the mini/μc arena.

Every business must access essential information, but data cannot be retrieved efficiently unless they have been organized efficiently. To do this, an understanding of data types, data modeling and mini/μc architecture, which brings out the best in a database, is needed.

Data types detailed

Databases comprise process-local, message and database data.

- **Process-local data,** such as COBOL working storage and FORTRAN common, form the short-term memory of an information system. Much of such data are held in the procedural stacks; some are discarded at the time of each sub-routine return. Process-local data are created, held and used by an individual application, which discards them after each transaction.
- **Message data,** including purchase orders, invoices, requests for airline reservations and electronics-funds transfers, transfer information between applications that cooperate to process transactions. Message data request cooperation between processes, detail the nature of these requests, exchange comments about them and report the success or failure of a request. Once the messages have been processed, they have no future use except for recovery and restart and audit.
- **Database data,** the most important type, are the long-term memory of an information system. They track orders, inventories, shipments, personnel, customers and accounts, recording what has happened and what is planned.

Improvements are needed

Today's recording media are paper forms, punched cards, magnetic tapes and magnetic disks. Effective storage of data on these media requires many technical improvements, including:

- a better way to transfer data between computer system and storage device,
- more efficient structures for sharing data (different users retrieve the data at different times),
- a means for data to be moved automatically as

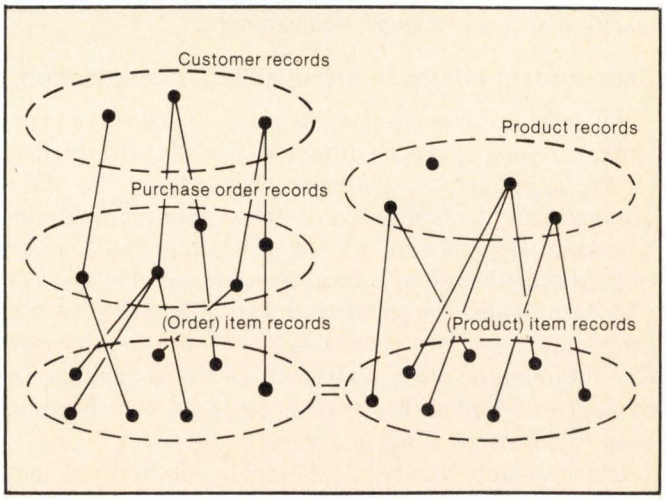

Fig 1. The hierarchical data model *uses the owner/member set relationship in a restricted manner. Each record is a member of only one set. To model a purchase or a transaction, then, the item information is stored first as the order-item record associated with the purchase-order records, and again as the product-item record, so that the same information can be associated with the product records.*

Effective storage of data requires many technical improvements, including a better way to transfer data between computer system and storage device.

necessary for "garbage collection," or performance optimization,

- better security against unauthorized use,
- mechanisms that protect a database from accidents,
- systems that are more user-friendly, and

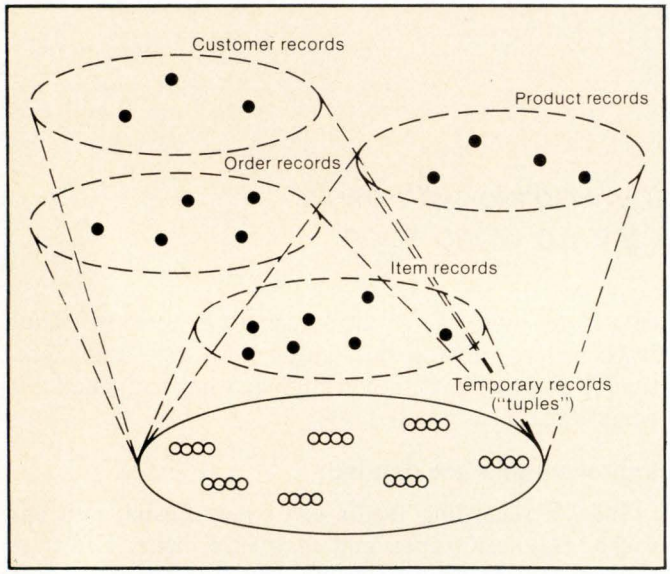

Fig. 2. The relational model *does not explicitly define owner/member set relationships as do the network and hierarchical data models. Instead, it uses its powerful data-manipulation language to create temporary records by combining information from the permanent records (in this example, from customer, product, order and item records). In relational model parlance, a record is a "tube," and an item of a record is a "value."*

- better individualized data formats independent of machine and other user requirements.

Data models influence organization, manipulation

All database-management systems tackle these problems, but each approach differs, especially with respect to the languages a database uses. Both the data-organization techniques and the data-manipulation languages depend strongly on the data model selected to guide the design of a database-management system.

A data model is a shorthand way of labeling a set of complementary data-structuring concepts and associated data-manipulation statements. It is similar in concept to a Tinker Toy or an erector set, which can be used to construct a fairly accurate model.

Data models include relational, hierarchical and network types, which differ from each other in terms of basic elements—file, record, item and owner/member set relationship. All three data models use the first three elements, but the network model uses the owner/member set fully, and the hierarchical uses it in a restricted manner. The relational model doesn't use it at all.

The hierarchical model organizes data in ranks, each subordinate to the one above it (Fig. 1). It is probably the most commonly used of the three types because it is the basis for IBM's data language 1 (DL/1). It is also probably the least-loved type because it is not simple enough for advocates of the relational type and not strong enough for the network data-model users.

In place of owner/member set relationships, the hierarchical model uses a specific data-modeling element that recognizes and maintains those correlations that have continuing significance to an application.

The hierarchical model has no dynamic ability to compensate for the absence of owner/member sets, and its static use of the owner/member set relationship is limited.

The relational data model (Fig. 2) compensates for not using the owner/member set element by using a larger number of item data elements in its records and by dynamically correlating the values of some of the items of one kind of record with those of a second kind of record. The strength of the relational model's data-manipulation language is that these correlations can be established anytime, using any item in a record without warning to the relationally oriented database-management system. Relation's weakness is that there is no means to declare and to maintain those correlations of continuing significance to an application.

The network model (Fig. 3), directly models any information network and emphasizes the owner/member set relationships between records, a technique better-suited to permanent correlations than are those

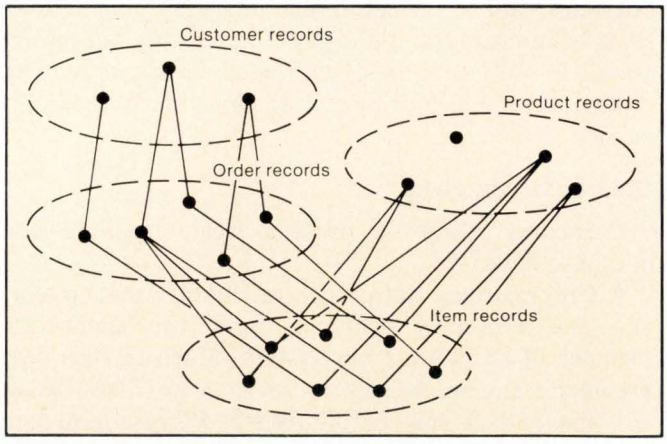

Fig. 3. The network data model emphasizes the owner/member set relationships between records. Each customer or product record owns zero, one or more order or item records. Each order record owns one or more item records that detail the substance of the order. The item records are members of two-set relationships: the order record in one set relationship, and a product record in a second set relationship.

of the other two data models.

A company should carefully review its operation when deciding on a data model to determine whether most of the firm's correlations will be permanent. Temporary correlations require less storage but cost more to maintain. Permanent correlations require more

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Both the data-organization techniques and the data-manipulation languages depend strongly on the data model selected to guide the design of a database-management system.

planning but, if sufficiently numerous, are less expensive to maintain. In addition, costs for professional time are rising, while new material technology costs decline. Will material costs decrease quickly enough to keep pace with the growth in production files and the number and complexity of transactions?

Future database systems will be multi-model

A database-management system need not be based on the abilities of one data model; the next DBMS generation will probably be multiple-model systems. Their description and manipulation languages will support not only relational, hierarchical and network data models, but also hybrid languages that support permanent and dynamic owner/member set relationships, using the advantages of each. The new hybrid languages will also support data-modeling capabilities that do not exist in the relational, hierarchical and network data models. The most likely new data-modeling element will be a "pair relationship," which will join two records that represent the same application-world entity, such as a customer record with a supplier record of the same company.

Most database-management systems have evolved in the large-computer environment, which supports and controls multiple computers, multiprogramming and concurrent access to a database by any program. These large systems need large memory capacity; a total of 100K bytes is common. However, if this functional capability is reduced to enable the DBMS to support a uni-programming environment, the basic memory requirement of a modern database-management system could be satisfied by 10K to 15K bytes—well within the memory capabilities of minicomputers and μcs.

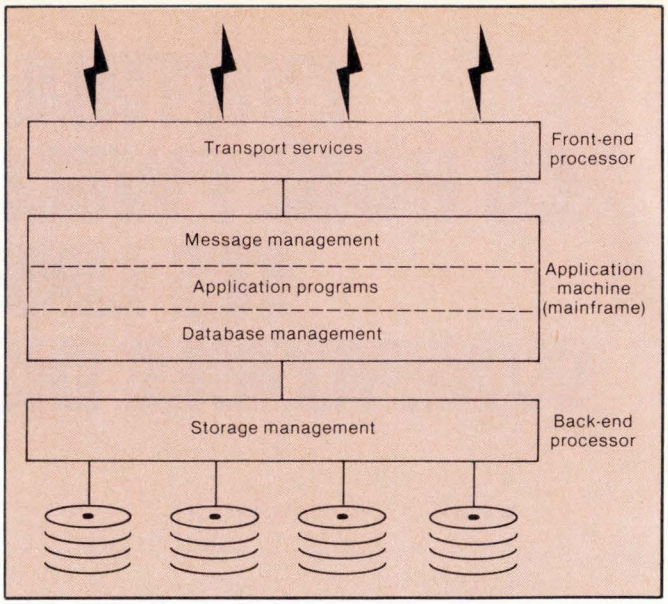

Fig. 4. Series-computer architecture. *Special front-end processors historically have handled transport services for computer-based information systems. Series-computer architecture further separates tasks by establishing a back-end processor (possibly a mini or a μc) to handle the mass-storage devices. Such back-end processors could also handle some or all of the database-management functions.*

Minicomputer/μc applications to grow

Future minicomputers and μcs will find many roles in information management as free-standing systems, as support for distributed databases or to handle the sub-functions of computer-based information systems.

Computer-based information systems have five main functions: transportation (communication-line control) services, message management, application-program execution, database management and storage management. The availability of these functions determines whether a computer plays a generalized or specialized role for computer-based systems or for database-management systems.

A dedicated or a specialized computer could serve each of these functions. Minis and μcs have several

DATABASE GLOSSARY

- **Database data:** Data placed in the permanent files during transaction processing that can be retrieved later by the same or another application process. Database data can be discarded when it has outlived its usefulness.
- **File:** A data element representing a collection of records, thus a collection of application-world entities, such as all the records representing corporations. Some files are limited to one record type.
- **Item:** A data element representing some measurable property of an application-world entity, such as an item giving the address of a specific company as "Westwood, Massachusetts," or one reporting 1981 profits.
- **Message data:** Data transferred between application processes to permit them to cooperate in completing a transaction. Message data are then unnecessary except for audit purposes.
- **Owner/member set relationship:** A data element relating one record as the owner of a set with zero, one or more records serving as members of that set, as in the relationship between a record and all the employee records of that company. Records in owner/member sets represent distinct application-world entities.
- **Process local data:** Data held by an application process so that they can track their own role in a transaction. This category includes data received in messages, data retrieved from a database and operational data generated during processing. These data are not used again.
- **Record:** A data element representing the existence of one application-world entity, such as an organization record about a database system.

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CIRCLE NO. 73 ON INQUIRY CARD

If functional capability is reduced to enable the DBMS to support a uni-programming environment, the basic memory requirement of a modern database-management system could be satisfied by 10K to 15K bytes.

years of experience as front-end processors, which specialize in supporting transport services. Back-end processors or database machines to support storage management and database management have recently been considered. This is designed to off-load the functions of the main computer executing the application programs.

Database machines: back-end disappointment

Specialized back-end processors have performed disappointingly so far because they do not off-load from the main computer sufficiently, even though they transfer a major processing load to the database machine. The reason is that the high rate of interaction between the main machine and the back-end machine creates a substantial interrupt-handling load, which is not present when the interaction between the application programs and database software can be handled internally with sub-routine calls. Dividing the functions between machines at the boundary between the application program and the database-management system may not be the best means of eliminating the interrupt-handling load. A look at data-storage and retrieval software reveals that a break between the database-management modules and the storage-management modules would be more productive. At this level, pages are the objects of exchange. Therefore, the number of interactions decrease, with more data transferred per interaction. This results in a storage machine, including an intelligent disk controller with a buffer pool, page-turning algorithms, a full file system and integrity-control modules. The storage machines support application programs located anywhere. The basic packaging may be a disk drive integrated with a mini or μc.

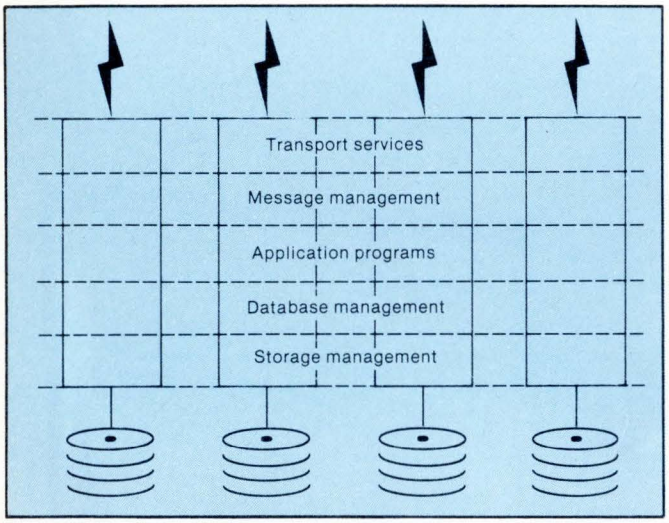

Fig. 5. Parallel-computer architecture *is based on the fact that information systems classically process a myriad of small, unrelated transactions rather than just a few large problems. A mini or a μc handles such transactions with an adequate response time, even when the small computer is also handling all of its own transportation services and storage management. In parallel architecture, individual computers and attached mass-storage devices can be grouped together or distributed.*

Architecture: serial versus parallel

A front-end processor and a back-end database or storage machine share the main computer's data-processing load. This is a series-computer architecture (Fig. 4) because processing a transaction involves a series of machines.

Another approach is parallel-computer architecture (Fig. 5), in which many computers share the transaction-processing load. Each computer is functionally complete, but has direct access to only that part of the database in which transactions are relatively simple and their impact on the database are predictable. This approach could be effective in banking- and insurance-transactions applications. The terminal system that handles the transaction entry determines from a customer's account number or address which parallel computer should process the transaction. If the computer that receives the original transaction can handle 90 percent of the other transactions, the strategy is successful. Several cooperating computers can process the remaining 10 percent of the transactions.

Small computers in parallel cannot easily handle manufacturing applications because those applications require large and highly integrated databases. Large computers in a series architecture can probably handle these applications better.

This elementary overview of database management outlines its importance, its strengths and its weaknesses. The complex subject holds exciting promise. Mainframes once had DBMS all to themselves, but now, minis and μcs are claiming a place in information management. ■

Charles W. Bachman is vice president, Cullinane Database Systems, Inc., and originator of the "network" data model.

NEXT MONTH IN MMS

The November issued will jog your memory about what's available in add-in storage for small systems in a feature section that highlights minicomputer and microcomputer memory developments. Major memory articles will include:

- A product profile, with extensive tables, on add-in memory boards for small systems from contributing editor Mal Stiefel.
- An article from Texas Instruments on error-detection/correction circuits for 64K-bit dynamic RAMS.

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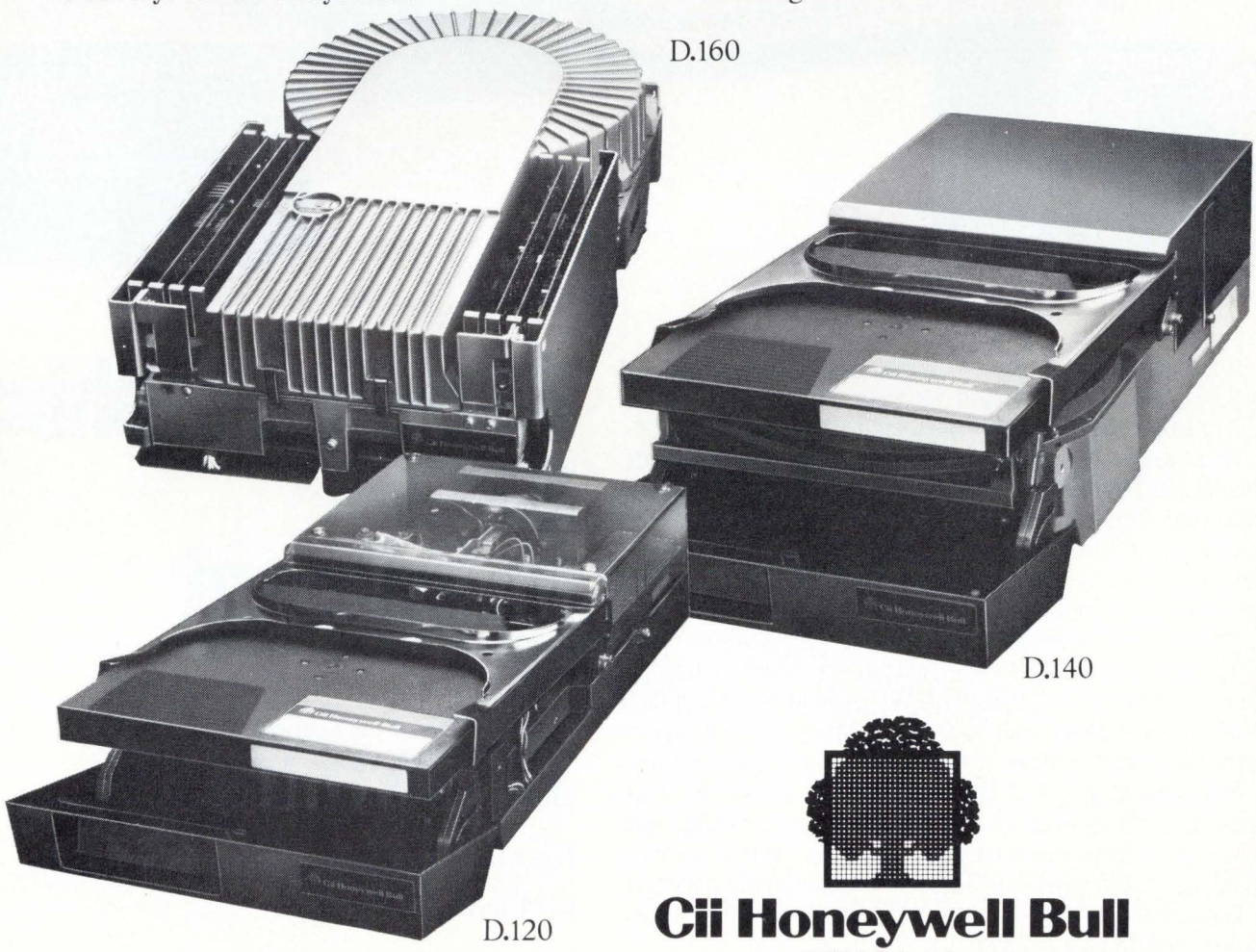

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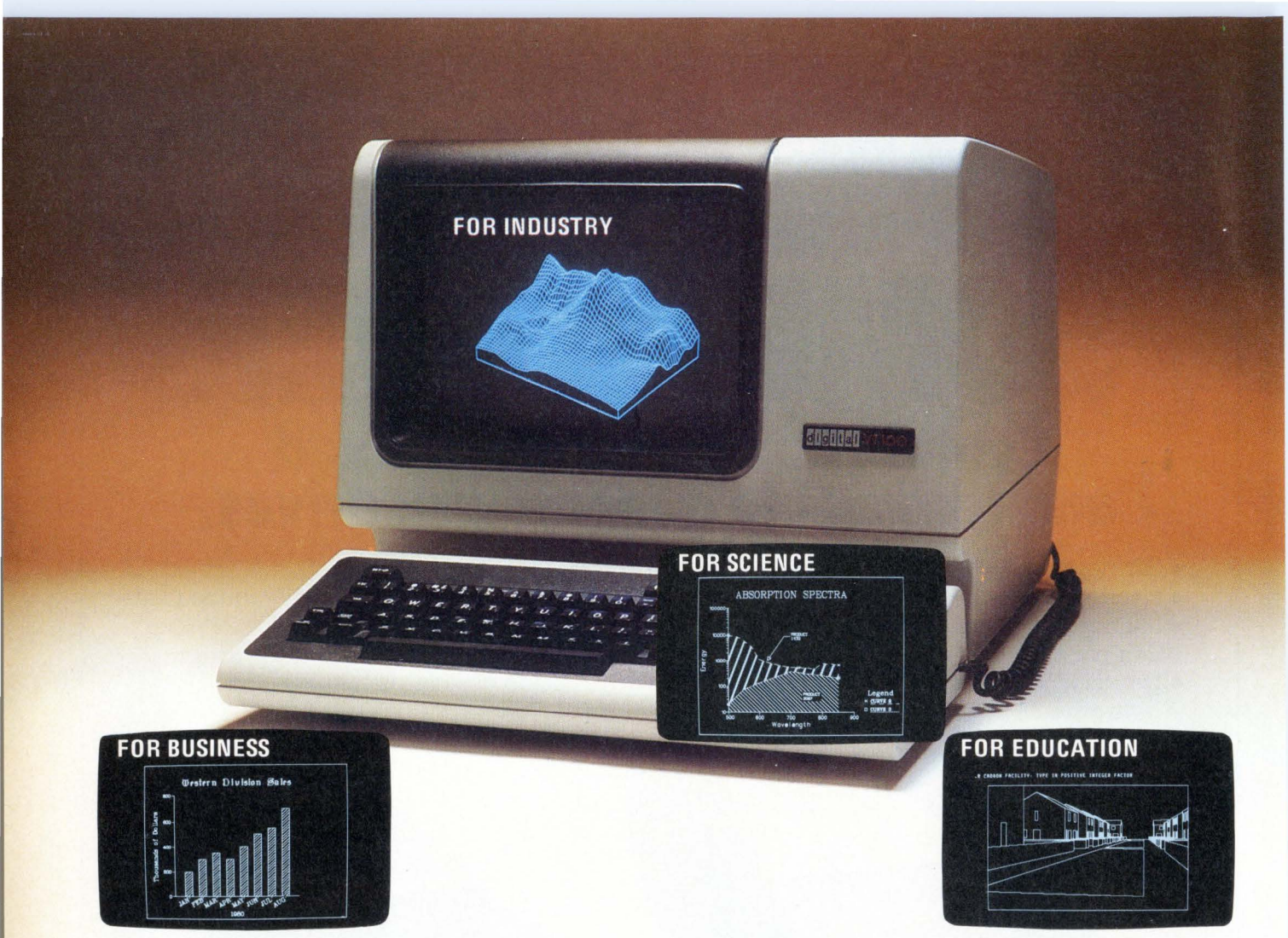

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CIRCLE NO. 75 ON INQUIRY CARD

SOFTWARE

Which DBMS is right for you?

HARVEY M. WEISS, Weiss & Associates

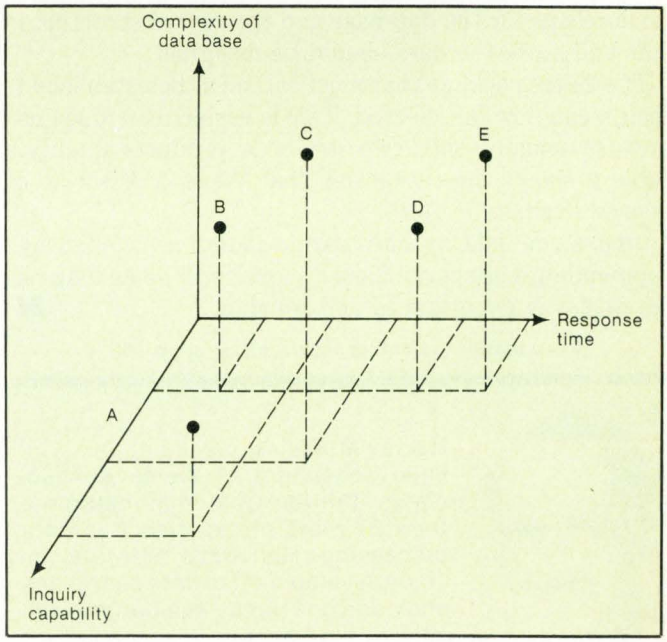
A five-step procedure will help you select the database-management system you need

The popularity contest between minicomputers, μcs and their larger counterparts is being carefully charted by information-systems developers. Mindful of the gains that minis and μcs have made in the market, the developers are tailoring an array of versatile and user-friendly products to small computer users. Leading the way are the database-management systems (DBMS) developers, as more and more users discover that a DBMS is easier to use than is file management. An increasing number of OEMs are using DBMS products as the core of their system development for that very reason.

As a result of this trend, many DBMS products have emerged, under the names file-management systems (which they are not), data-management systems, information-retrieval systems and file-manipulation systems. The DBMS and data-management system categories, grouped CODASYL (Conference on Data System Languages), non-CODASYL or data-management systems, are by far the most popular. CODASYL types meet the federal structure standards for data definition and manipulation, but non-CODASYL and

Type	Major characteristics
1. Hierarchical/Network	1. Owner/member record relationship
	2. Records linked via point scheme
	3. Access via key records
	4. Searches via chain/point connectors
	5. Records stored logically in pages
2. Inverted	1. Records of one type stored in each file
	2. Records related via key file
	3. Access via an index to the key file, then to the record
	4. Searches made easy because the value of each field in the key fields must be in the key file
	5. Records stored serially and keys refer to actual disk locations
3. Relational	1. Records stored in tables
	2. Records are created to meet specific user needs
	3. Access via an index to table
	4. Searches made easy because the key is the table identifier
	5. Records are created dynamically, attached to a table and stored via an indexing scheme

Table 1. DBMS structure: *types and characteristics.*



Database-software systems *involve some trade-off within their three principal functions, as shown in this 3D representation. Package E, for example, offers excellent response time to a complex database, but has poor inquiry capability. Source: ADL Systems, Inc.*

DBMS is easier is to use than is file management, so more OEMs are using DBMS products as the core of their system development.

data-management systems do not. These groups best illustrate how DBMSs define data structures (Table 1) and store or retrieve data regardless of their physical storage criteria.

Database-management systems allow mini or μc users to structure their data and to store or retrieve them in the necessary form. For many companies, this method is more effective than traditional file storage. But DBMS is not for everyone; a user with fewer than 1 million records might do just as well with a serial or inverted file system. For the user who can benefit from DBMS, these guidelines may help in selecting one.

Selecting systematically

First, the data needs of each **organization component,** such as manufacturing, purchasing, inventory and marketing should be studied. Special attention should be given to the nature of the data those components use, and how they use them.

Second, **business data requirements,** such as report and on-line screens, should be analyzed. The physical attributes of those requirements, including volume, and response time, should be considered.

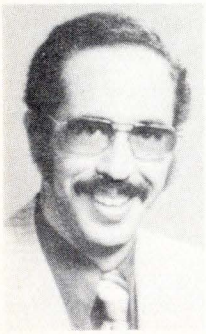
Third, **data for each requirement** should be analyzed to determine the various relationships they have with the data used for other requirements. This information provides the logical DBMS record—a grouping of those data elements that satisfy all the attributes of one or more requirements.

Fourth, a **logical design** of the storage and retrieval mechanisms for the database and the record structures that will store the data should be designed.

The DBMS package that most satisfies the established design can now be selected. This is easier than it seems because usually only two or three products qualify. Table 2 shows the categories that Weiss & Associates uses to evaluate a DBMS.

DBMSs are sold by hardware vendors as well as by independent suppliers. Either source will do as long as the dealer is experienced and reliable. ■

For a sample evaluation matrix, please see p. 160



Harvey M. Weiss, president and principal consultant of Weiss & Associates, Denver, Colo., has had more than 20 years of experience in data processing. His firm's activities include development of data base plans and designs and evaluation and selection of data base management systems for clients in industry, education and government.

Company	DBMS Name
Advanced Data Management	DRS
Amcor Computer Corp.	AMBASE
The Automated Quill, Inc.	Super English 1X
Cincom Systems, Inc.	TOTAL
Charles Mann & Associates	Business Data Base
Complete Computer Systems	CREATE
Condor Computer Corp.	Condor Series 20
CRI, Inc.	RELATE 3000
Database Systems Corp.	TAGS
Data General Corp.	DG-DBMS
Data Management Systems, Inc.	DATASCAN
Digital Equipment Corp.	DBMS-11
ELS Systems Engineering	Product 3
Exact Systems & Programming Corp.	DNA-4
Florida Computer, Inc.	Data Boss/2
	Data Boss/32
Gemini Information Systems, Inc.	DDQUERY
Harris Computer Systems	Harris-AZ7
Henco, Inc.	INFO
Hewlett-Packard Co.	IMAGE
International Computing Co.	RTFILE
International Data Base Systems, Inc.	SEED
	MICRO-SEED
Micro-Architects	IDM-M2
Micro Data Base Systems, Inc.	MDBS
Miller Microcomputer Services	DATAHANDLER
Mini-Computer Systems, Inc.	FACTMATCHER
MRP Systems	INFOTRIEVE
Prime Computer, Inc.	DBMS
Quodata Corp.	QDMS
RLG Corp.	UNIBASE
Ross Systems, Inc.	INTAC
RSI	ORACLE
Science Management Corp.	IDOL
Source Data Systems, Inc.	SDL
Software AG	ADABAS-M
The Software Store	Data 80
	INFO-80
Tandem Computers, Inc.	ENCOMPASS
Texas Instruments, Inc.	DBMS-990
Warner-Eddison Associates, Inc.	INMAGIC

Type	Hardware	Price	Features	Circle No.
Non-Codasyl/network, inverted	DEC PDP-11, VAX-11	$29,000	Report writer, dictionary, security package, transaction processor, graphics, development tool	422
Non-Codasyl/network	DEC PDP-11	$23,500	Dictionary, report writer, security package, transaction processor, development tool	423
DMS/inverted	DG Nova, Eclipse	$11,000 to $16,000	Report writer, dictionary, security package, graphics	424
Non-Codasyl/hierarchial	IBM System 3, System 4, Univac Series 70, DEC PDP-11, Harris Series 80-800, Varian V70, Perkin-Elmer 7/32, 8/32, all Prime series	$13,500 to $30,000	Report writer, dictionary, security package, transaction processor, graphics, development tool	425
DMS/inverted	TI 99/4, Radio Shack TRS-80	$89.95	Report writer	426
DMS/inverted	DG Nova, Eclipse	$18,000	Report writer, data dictionary, security package, transaction processor	427
Non-Codasyl/relational	Any Z80 μp	$695	Transaction processor, data dictionary, productivity tools	428
Non-Codasyl/relational	Hewlett-Packard HP 3000	$11,000	Security package	429
DMS/inverted	All Prime models	$35,000	Data entry, query language, forms design, transaction processor	430
Codasyl/hierarchial-network	DG Eclipse	$10,000	Query language, report generator, data dictionary, productivity tool	431
DMS/inverted	Datapoint 6000, 5500, 3800, 1800, IBM System 34, NCR 8000	$6250	Report writer, data dictionary, security package	432
Codasyl/hierarchial-network	DEC PDP-11	$16,500	Query language, security package	433
DMS/inverted	DEC PDP-11	$2800 (Custom products from $13,500)		434
Non-Codasyl/inverted	DG MicroNova, Nova, Eclipse	$4000 to $40,000	Report writer, productivity tool, security package, data dictionary	435
Non-Codasyl/relational	DEC PDP-11	$20,000	Query language	436
Non-Codasyl/relational	DEC VAX-11	$40,000	Query language, data dictionary, report writer, security package, transaction processor	437
Codasyl	Series 16, Perkin-Elmer 3200, IBM Series/1	$20,000	Report writer, query language, data dictionary, security package, transaction processor, productivity tools	438
DMS/inverted	All Harris systems	$9500	TOTAL interface, data dictionary, report writer	439
DMS/inverted	All DEC VAX series, all Prime and Harris series, Honeywell Level 6	$14,700	Report writer, transaction processor, data dictionary, security package	440
Non-Codasyl/hierarchial	HP3000, 1000, 250	Comes with hardware	Report writer, transaction processor, security package	441
Codasyl/relational	DEC LSI-11, PDP-11	$2500	Data directory, dictionary, CRT forms generation, transaction processor, command file, applications interfaces	421
Codasyl	DEC VAX-11, PDP-11, Z80 processors	$14,000 to $35,000	Query language, report writer, transaction processor	442
DMS/inverted	Radio Shack TRS-80 Level II	$199	Report writer	443
Codasyl	Any Z80, Z8000 or 8080/8086-based μp, DEC PDP-11	$1500	Report writer, query language, data dictionary, transaction processor, security package	444
DMS/inverted	Radio Shack TRS-80	$49.95		445
Non-Codasyl	MCS Micos 200	$90,000	Query language, datacom, data dictionary	446
DMS/inverted	DG Nova, all Point-4, Bytronics and Amtex series	$3000	Report writer, transaction processor, data dictionary, security package	447
Hierarchial-network	All Prime series	$20,000	Report writer, security package	448
DMS/inverted	DEC PDP-11	$8175	Report writer	449
Non-Codasyl/inverted	DEC PDP-11	$25,000	Report writer, transaction processor	450
DMS/inverted	DEC PDP-11, VAX-11	$20,000	Report writer, transaction processor, data dictionary	451
Non-Codasyl/relational	DEC PDP-11, VAX-11	$30,000	Report writer, data dictionary, transaction processor, security package	452
DMS/inverted	All Basic-Four, Rexon, Pertec and Onyx series, IBM Series/1		Report writer, transaction processor, security package, data dictionary	453
DMS/inverted	Honeywell Level 6, NCR 9020, IBM Series/1	$25,000	Report writer, transaction processor, security package	454
Non-Codasyl/inverted	DEC PDP-11	$40,000	Report writer, transaction	455
DMS/inverted	Any Z80 or 8080-based μp	$750		456
DMS/inverted	Any Z80 or 8080-based μp	$1040		457
Non-Codasyl/relational	All Tandem series	$22,500	Report writer, data dictionary, security package, transaction processor	458
Non-Codasyl/inverted	TI DS990	$2650	Query log, data dictionary, report writer, security package	459
DMS/inverted	DEC PDP-11, VAX, Hewlett-Packard HP1000	$7200	Report writer, security package	460

EXPLAINING THE EVALUATION MATRIX

The evaluation matrix is the chief tool used in evaluating a DBMS. In a competitive evaluation, the matrix would list the criteria used, the vendors being considered and the ratings each vendor receives. (Not all criteria are used each time.) The first step is to establish an importance weight factor for each criterion. This factor establishes the relative importance of a feature or capability of DBMS in meeting system requirements. A scale of 1 to 10 is used. The vendor's software is then rated, again on a scale of 1 to 10, according to its ability to meet that criterion, establishing the vendor's requirement score. Multiplying the importance weight factor by the vendor's requirement score produces an effective score.

For example, if one of the selection criterion, a database loader (software), is extremely important, it could be assigned a weight of 10. If vendor #1 does not provide such an offering, its ability to meet this criterion might be 1. The resulting effective score for this criterion for this vendor is 10 ($1 \times 10 = 10$). However, vendor #2 might provide such a product, receiving a rating of 10. That vendor's effective score would be 100.

Once all criteria used in the selection process have been weighted, and all vendors' responses have been given a rating, their effective scores can be calculated.

The criteria listed in the matrix comprise a standard list that could be used to define system requirments for a database. Details of their meaning can be found in any document describing DBMS capabilities, or are available from Weiss & Associates.

The evaluation matrix is used only to establish a rating for a certain DBMS and its ability to meet all the criteria as if all had an importance weight of 10. If a criterion receives a score greater than 7, it indicates that that DBMS could effectively meet that system requirement. A score of 4 to 6 indicates it is marginally satisfied, and a score lower than 3 is unsatisfactory.

SELECTION CRITERIA	VENDOR SCORE
1. DBMS Manipulation Process:	
1.1 Data/Record Generation	
1.2 Database Update Process	
1.3 Database Deletion Process	
1.4 Security Techniques	
1.5 Privacy Control Techniques	
1.6 Data Integrity Controls	
1.7 Data Format Translation	
1.8 Error Processing Technqiues	
1.9 Data Redundancy Controls	
1.10 Data Compaction Process	
1.11 Data/File Convertibility	
1.12 Program/Data Independence	
1.13 Data Manipulation Language	
Possible: 130	
2. DBMS Physical Structure:	
2.1 Record Structure (Logical/ Physical) Supported	
2.2 Record Creation Process	
2.3 Record Modification Process	
2.4 Physical Storage Processes	
2.5 Record Indexing Mechanisms	
2.6 Data Space Management	
2.7 DBMS Structure	
2.8 File Growth	
Possible: 80	
3. DBMS Tools:	
3.1 Data Query Facility	
3.11 Availability of Tool	
3.12 Ease of Use	
3.13 Capabilities	
3.2 Report Writer Facility	
3.21 Availability of Tool	
3.22 Ease of Use	
3.23 Capabilities	
3.3 Data Dictionary Facility	
3.31 Type	
3.32 Ease of Use	
3.33 Program/Operation Interface	
3.34 Reports Capability	
3.4 Data Communications Facility	
3.41 Protocols Supported	
3.42 Ease of Use	
3.5 System Development Tools	
3.51 System Design Tools	
3.52 Development Tools	
3.53 Database Design Tools	
3.54 Screen Design Tools	
Possible: 160	
4. System Implementation:	
4.1 Hardware Requirements	
4.2 Database Loading Facility	
4.3 Data Definition Language	
4.4 Vendor Support	
Possible: 40	
5. Secondary Features	
5.1 DBMS Utilities	
5.11 Performance Statistics	
5.12 Simulation Facility	
5.2 Vendor Response to Hardware/Software Changes	
5.3 Ease of Installation	
5.4 DBMS Maintenance Policies	
5.5 Customer Experience	
5.6 Documentation	
5.7 Training Availability	
5.8 System Performance	
Possible: 90	
Total Possible: 500	

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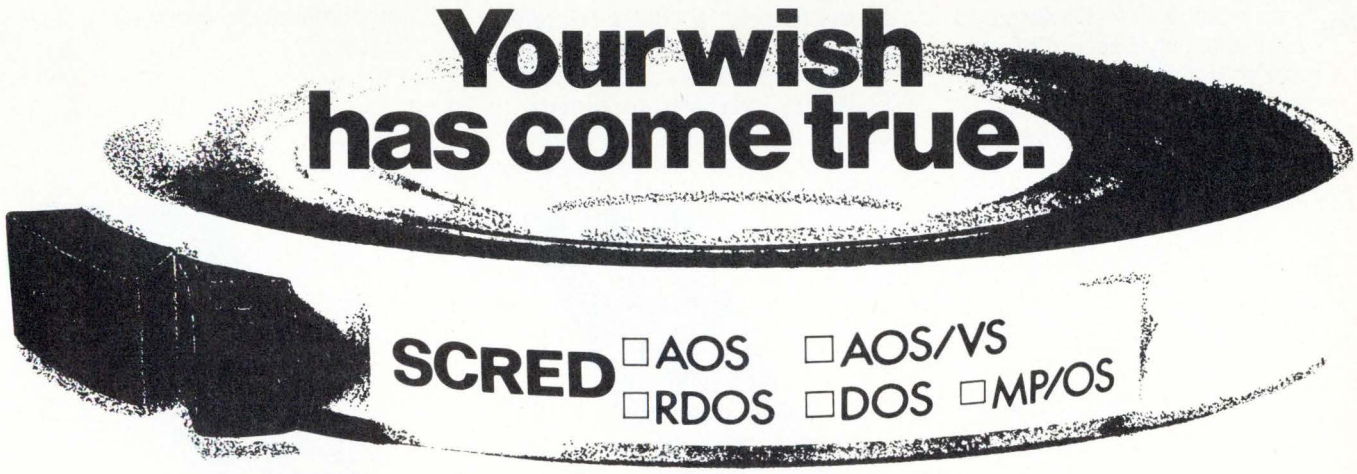

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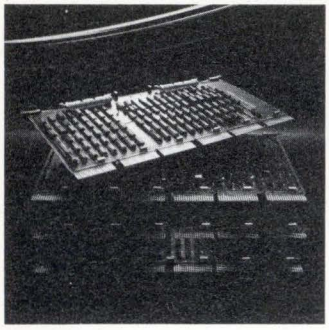

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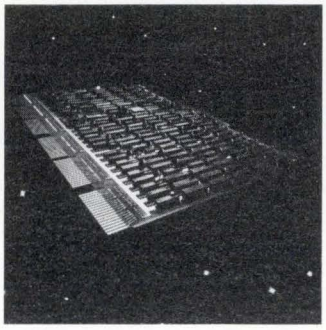

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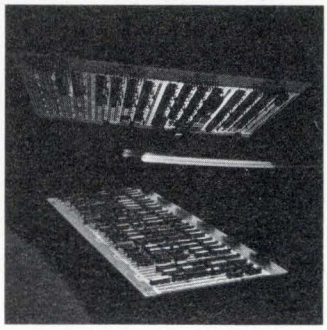

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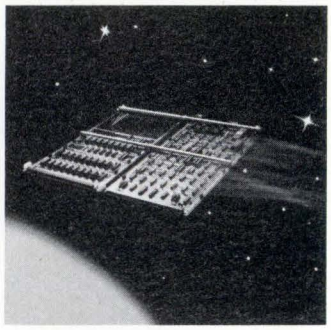
Raytheon 500 Series



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We've got the VT100™ market seeing red,

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DATABASE MANAGEMENT

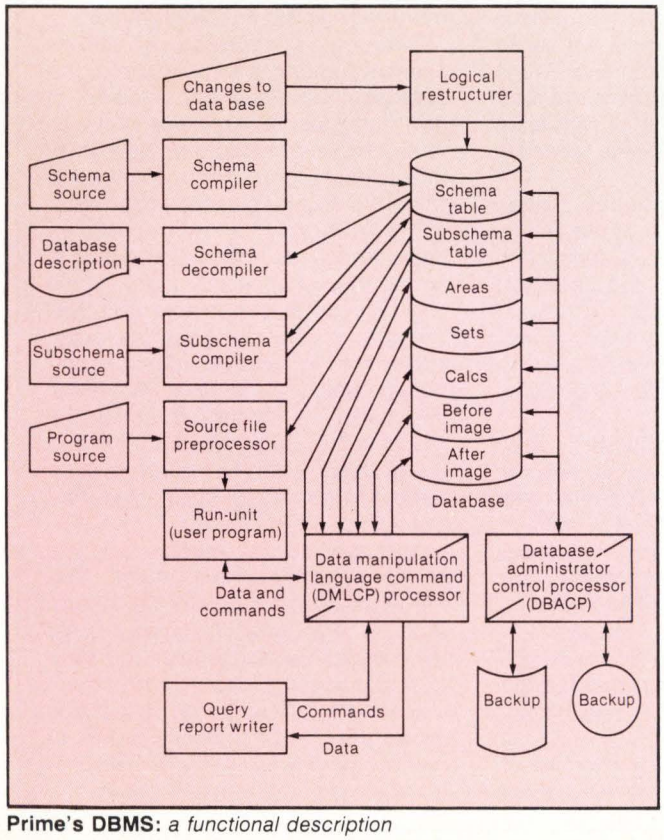
Matching a DBMS to user needs

ANDREW BURLINGAME, Prime Computer, Inc.

Today's database-management systems offer control, ease of use and limited redundancy

No one questions the "why" of a database-management system any longer. Most people now agree that any DBMS is flexible and can reduce redundancy and make changes simply.

What else should a prospective buyer look for? At a minimum, a DBMS should support more than one language and have a standardized database design, a query/report writer and programs that are easy to develop, use and change.



Prime's DBMS: *a functional description*

A general DBMS should implement the Conference on Data Systems Languages (CODASYL) advanced recommendations and specifications, and should offer concurrent user protection and backup and full automatic recovery. The net benefits of a good DBMS are its adaptability to change, data integrity, support for many structures and centralized control and standardization.

Changes are easier with data independence

The principal difference between a DBMS and a traditional file system is that a DBMS has data independence, which a file system lacks. Data independence means that data and programs can be changed independently of each other. Users have individual logical data structures and can program regardless of organization. This allows the database to be altered easily to reflect changes in an organization without affecting existing programs and systems.

Much data in an organization exist more than once in a system. A good database removes much of this redundancy. Multiple data should occur only:

- When the same data items occur in many records and documents. Using appropriate software, different records can be assembled from a non-redundant database.
- When the same records and data groupings are used for multiple applications. A database system enables many applications or users to share the data groupings.
- When entire databases contain data that can serve the needs of many operations and organizations. Access to and design of databases should transcend organizational boundaries.

The ability to respond quickly to changing user demands is one of the most important features a DBMS

Because a DBMS supports a variety of data structures, it easily models the operations of virtually any business and lends itself to various access and search strategies.

offers. The ideal system uses existing data for new purposes and programs and easily accommodates changes and additions.

When DBMS data are independent of the application programs, programmers and systems analysts can concentrate on their own logical data structures and applications without regard for how the data are organized and manipulated. Existing programs still function when data organization is changed.

A major benefit of a strong DBMS is that new programs with data-description changes can be run without causing changes in existing programs that use data in original form. Without this capability, new application development requires rewriting existing programs. Programs are easier to write with a DBMS because data are automatically inserted into the program by a data-manipulation language facility.

A database in an organization is no more static than are the contents of the organization's filing cabinets. The ways data are stored and used change continuously. Programming costs have reached substantial proportions, but time spent on new applications has fallen steadily as greater effort has been placed on maintaining and modifying existing programs. As a result, users should be able to modify a DBMS to improve its performance or to meet new application requirements without affecting existing programs. Data independence and database logical-restructuring tools aid in efficient applications development and significantly reduce program maintenance caused by change.

Data integrity is preserved

A strong DBMS guarantees data integrity through before-and-after image-journaling, transaction-oriented updates, interactive facilities to perform database

PRIME'S DBMS: A FUNCTIONAL DESCRIPTION

Prime's DBMS is based on CODASYL specifications for defining a standard database language. A data-definition language (DDL) provides a way to separate the layout of files from the definition of data in the applications program, enabling the use of an independent I/O module that understands the database description.

At run time, the I/O module provides services upon commands, in the form of a CODASYL-specified data-manipulation language (DML). Because access to the data is through a central portion of the software, many features can be built into a DBMS that are lacking in a typical file system. The data description defines constraints so that contents of the database are validated by the data-manipulation-language-command processor (DMLCP), and sensitive data are protected from unauthorized use. (Prime claims that its DBMS is the only database product to use the full extent of security defined in the CODASYL specification.)

Because the data description is maintained in a data dictionary for the DMLCP's use, users see the data in consistent but different ways, a feature called data independence. Extensive changes can be made to this database system, and programs that ran correctly before they were made will continue to run correctly afterward. Prime also claims that its DBMS prevents a program from running if it will not run correctly because of database changes.

The DMLCP also allows many different users to update a database concurrently. The Prime system ensures that all users see a logically consistent database, of particular importance when the programmers coding the applications programs are inexperienced. Concurrent update has subtle implications about what data really mean at a given time. Some database systems are difficult to use because they require a series of complicated call statements. Prime has found that a programmer familiar with FORTRAN or COBOL can learn enough in a day to write effective database programs.

Five distinct functional groups comprise Prime's DBMS structure: the database-creation group (shown in red), the host-languages-support group (green), the logical restructurer (blue), the query/report writer (black) and the execute-only module (yellow).

The database creation group consists of:

- The schema compiler, which translates the CODASYL data description into a format to be kept in the data dictionary;
- The DMLCP, which provides run-time support of COBOL and FORTRAN programs and of queries;
- The database administrator control processor (DBACP), which provides an interactive means of saving, restoring, recovering and expanding the database;
- The schema decompiler, which allows legible, up-to-date descriptions to be made from a database description in the data dictionary.

The host-language-support group contains a sub-schema compiler for COBOL and FORTRAN that provides a language-specific view of the database description. A source-file preprocessor inserts the correct data description for the database, checks the DML syntax and inserts calls into the DMLCP to aid the programmer.

The logical restructurer allows extensive changes to be made to the database, including the addition of new data files, relationships between new or existing records and new fields to existing records. This can be done without changing existing programs.

The query/report writer allows users to access information easily in an ad hoc manner through simple non-procedural statements. Navigation through the database via these statements is handled internally and transparently to the user. Retrieved information is formatted using the report writer. Subsystems for various query and reporting tasks include retrieval, formatting, cataloging and HELP functions.

The execute-only module consists of the DMLCP and the DBACP. The former is used for processing COBOL and FORTRAN DMB commands against the database, which is used to define and manage the DBMS environment interactively. This group of facilities allows users with several systems to develop programs on one system and run them on others at reduced cost.

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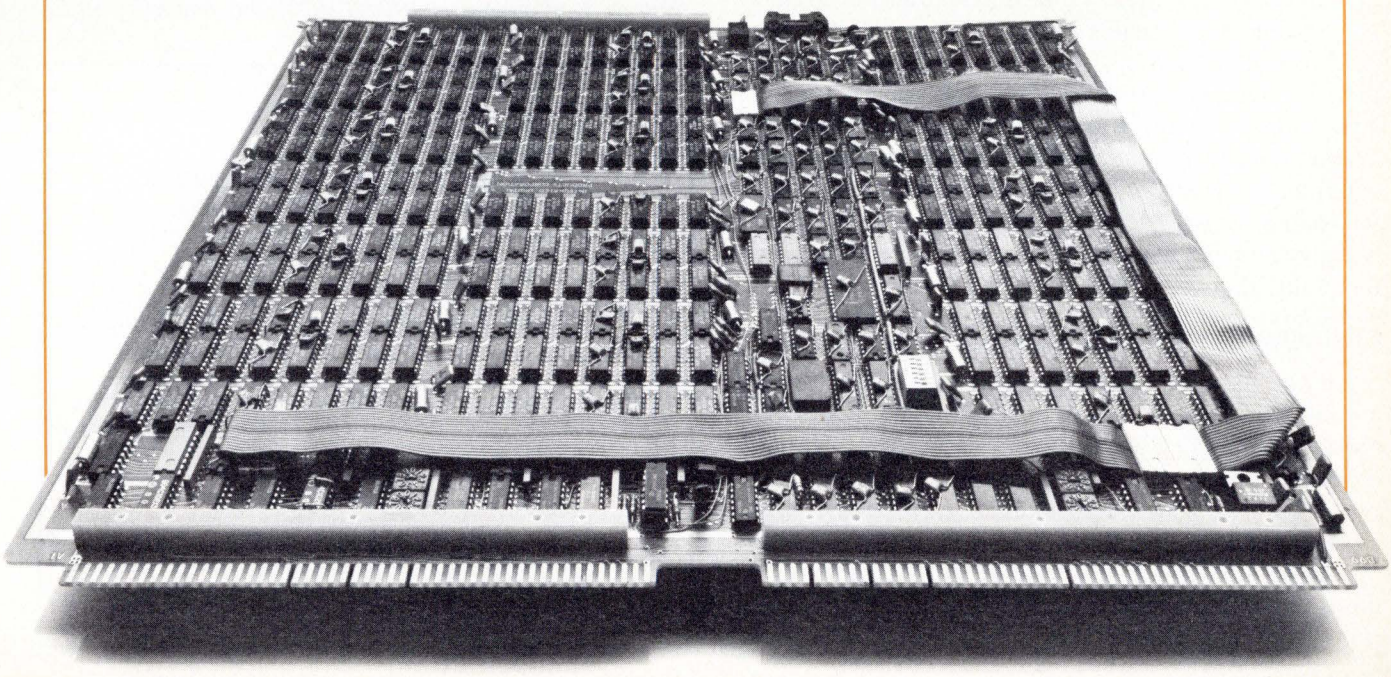

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To many executives and managers, the most outstanding benefit of a DBMS is that it provides access to the timely and updated information they need to make accurate business decisions.

"saves" and "restores," on-line recovery from incomplete transactions and protection from being aborted while a user is attempting to access a locked resource. The DBMS—not the application program—should manage all data, such as backup and recovery.

Privacy and security features should be integrated into a DBMS's operating system. DBMS security features, complemented by access-control rings and memory-protection hardware, keep unauthorized users from accessing or modifying the database.

Database-management systems are usually well-suited to transaction-oriented processing, in which each transaction is completely processed, and the relevant files are simultaneously updated. This results in a low transaction-cycle time, unlike that of batch processing, in which a transaction may wait days before it is completed.

DBMS supports many structures

With a CODASYL-compliant structure, a DBMS supports many distinct or related coexisting databases. The only limit to the number or size of databases supported by some systems is the physical restraint of disk storage.

Because a DBMS supports a variety of data structures, it easily models the operations of virtually any business and lends itself to various access and search strategies. Data can be retrieved through direct-, keyed-, calculated- or serial-access strategies. Any number of sort or search keys can be specified within the database to provide more efficient access to data.

A strong DBMS enables users to query the database quickly and easily, as well as to perform relatively complex searches and report-generating functions. A query/report writer allows access to and extraction of information from databases through non-procedural statements. Retrieved information can then be formatted using a report writer. A query/report writer usually comprises retrieval, formatting, cataloging and HELP functions.

Centralized control and standardization

All database users in an organization should operate on identical data. Duplicate or redundant information and the possibility of conflicting data values stored in different files should be minimized or eliminated. Data resources with centralized control serves many purposes and users.

A DBMS provides an overview of data, without design limitations, and facilitates modeling of user organizations and operations. This simplified view leads to better understanding and more efficient use of the data.

A good DBMS allows users to model business conditions regardless of file-system restrictions and future report and inquiry needs. The system allows easy implementation of use standards and supports the use of naming and structuring standards in database design. It should provide backup and recovery, validation of data and data relationships, data security, privacy and use statistics for all standard applications. Standardization reduces program maintenance and the need for familiarity with every application, and makes the organization's information more accurate, consistent and controllable.

Efficiency is the result

An effective DBMS streamlines multiprogramming, data-communications and MIS-related tasks. It greatly increases the scope of multiprogram scheduling by making the same data concurrently available to all authorized users. DBMS also supports the management-information system concept by eliminating many of the bottlenecks found in conventional non-DBMS systems, increasing the availability of data and making retrieval easier.

To many executives and managers, the most outstanding benefit of a database-management system is that it provides access to the timely and updated information they need to make accurate business decisions. The query/report writer of a DBMS allows users to query the database quickly and to extract information easily. The information is formatted and printed—if desired—using the report writer. Default formats can be selected, or users can create a format that specifically fits their needs. As direct user involvement increases, dependence on programmers decreases, eliminating many delays that may have been previously encountered in obtaining information. ■

Andrew Burlingame is DBMS marketing manager, Prime Computer, Inc., Natick, Mass.

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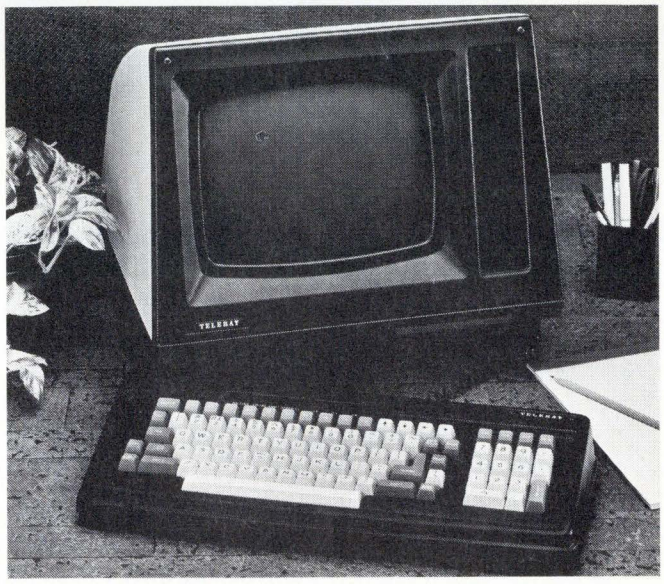

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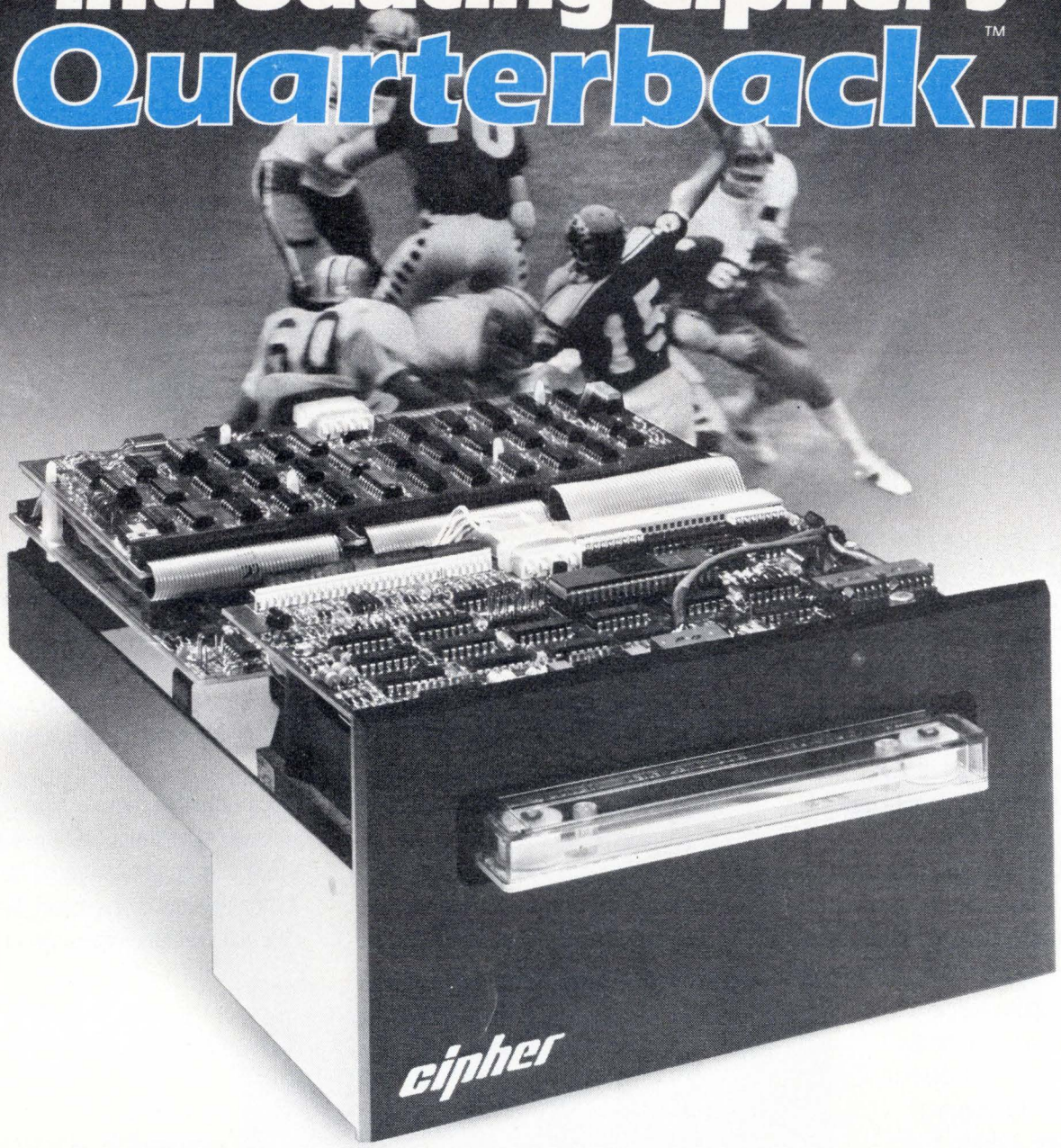

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SOFTWARE

File organizations and processing concepts

HONEYWELL INFORMATIONS SYSTEMS, INC.

Selecting the best combination from the ways to organize is difficult but aids in DBMS applications

A database is essentially a file, and like any other file, it can be organized and accessed in infinite ways. With paper documents, different accessing requirements involve combinations of duplication and indexing.

For example, before computers and electronic databases, motor vehicle registries typically maintained separate files by last name and by license-plate number. Records (documents) in the plate-number file could have been exact duplicates of those in the name file, or the plate file could have been just a listing (index) consisting of the plate number and the plate owner's name. In this case the name would be a "pointer" to the complete record in the "master" name file.

Other indexes or duplicate files might be organized by vehicle type or other criteria. Whatever the combination of organization and accessing methods, the registry had to minimize physical file space and the time required to maintain and access the file records.

The same considerations apply to files of electronic

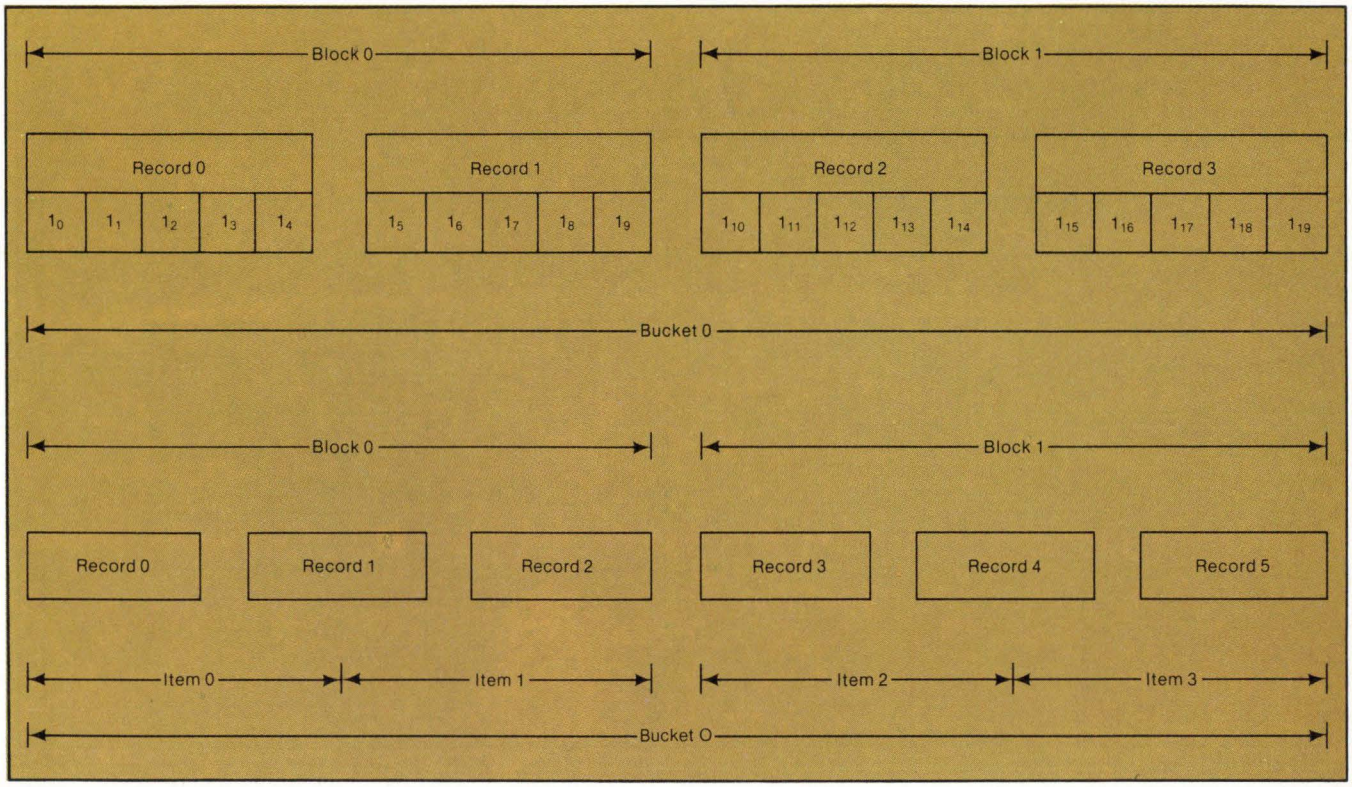

Fig. 1. Relationship between items, records, blocks and buckets, *showing example of bucket containing more items than records (above), and example of bucket containing more records than buckets (below).*

Selecting a file-organization method is crucial in achieving the overall systems objective of completing specific application processing within required time limits and at minimum costs.

data (databases) stored on computer disks.

Sequential file organization

In a sequentially organized file, items are stored in control-number (item-key) sequence. A control number is an identification field contained by all data items in a system. Item key is a term that is used interchangeably with control number. Control number is typically used when referring to the data item, and key is used when referring to the control number as it exits in an index. Items with successively higher control numbers have successively higher addresses because items are stored in control-number sequence.

A sequential file permits accessing of each item in physical sequence. Thus, items are retrieved in the same sequence that they were written. Sequential organization is intended primarily for files in which most of the items are processed each time the file is used. Each time this type of file is processed, the first item is accessed, and each succeeding item is accessed in turn.

A sequential-file format must be carefully chosen because data might be added or deleted. In a file in which items are firmly established, any re-sequencing and reordering of the file because of additions or deletions will be rare. The file can, therefore, be packed tightly and efficiently. Additions are inserted by creating a new master file. This organization is called condensed sequential.

To limit the number of re-creations of a fairly changeable master file, gaps should be inserted to allow for anticipated additions. This expanded sequential file requires more storage space than a condensed file, but it is not as critical in design or as sensitive to fluctuations in file size as is a condensed file. An expanded sequential file limits file-maintenance processing time by providing for a certain amount of growth before the entire file needs to be rewritten.

The advantages of sequential-file organization include reduced seek time for batch-processing jobs in high-activity files, quick production of reports that are in the same sequence as the file, retention of chronological order, with little read/write head movement and easy conversion from tape-oriented systems because the storage medium is changed, while the processing mode remains the same.

The disadvantages of sequential-file organization include the need to rewrite the file periodically to accommodate additions and to close gaps left by deletions and the inability to locate items quickly.

Indexed sequential-file organization

An indexed sequential file includes indexes that permit rapid access of individual records and rapid sequential processing. To use this type of file, a storage area must be reserved in memory or on the disk for an index. Each entry in the index consists of two elements—the key of the indexed item and the

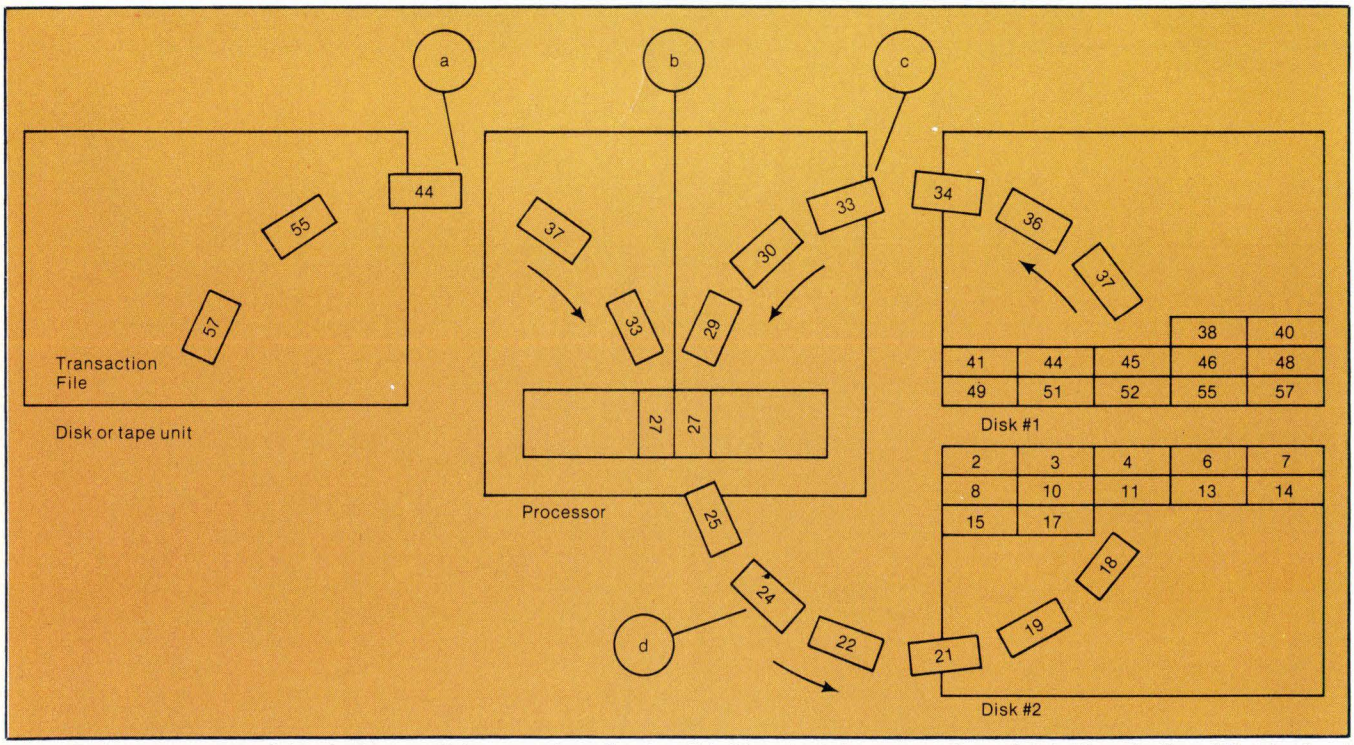

Fig. 2. Father-son sequential-order/sequential processing, *showing disk #1 as the father master file and disk #2 as the "son." Batched and sorted transactions are read into memory (a), where they are compared to the master-file items (b). The master-file items are then retrieved from storage one at a time regardless of whether they are affected (c), and a new master file is created on another disk device (d).*

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An indexed sequential file includes indexes that permit rapid access to individual records and rapid sequential processing.

corresponding address. The index permits direct-access processing of a sequential file because items can be located and processed without reading an entire file. In addition, insertions and deletions can be handled easily.

An index can be as fine and direct as space allows. Indexes ideally would be stored only in main memory so that the search to find the address of an item could be performed at the CPU's speed. But this is often impractical because of the storage limitations of main memory, and only the indexes for very small files can be stored entirely. Two methods of establishing an index network are to place an index in main memory that references a more precise index in the disk device; the fine index can be the last link in the network or can refer to a finer table within a cylinder, or to store the index in the disk device and call it into memory by segments.

Each entry in an index must contain at least an item key and the storage address of either the item or the

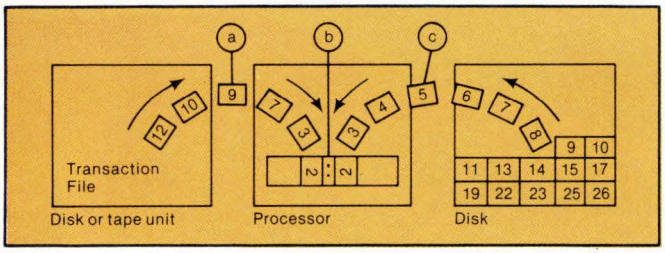

Fig. 3. One-device sequential-order/sequential processing *is typically most effective with small, static files. Batched and sorted transactions are read into memory (a), where they are compared to the master-file items (b), which are retrieved from storage one at a time, regardless of whether they are affected. After processing, the master-file items are written into their original locations.*

entry in the finer index. An index need not always contain an entry for each file item, but it can be arranged to take advantage of the hierarchical design of the disk device. For instance, as a file is being loaded sequentially, the key of the last item in each cylinder and the address of that item are entered in a rough index stored in the device. The rough index is brought into memory at the beginning of each updating run. The key of the last item on each track is entered in a finer index, located on the first track of each cylinder. To locate an item, the computer searches the rough index in memory to find the address of the cylinder in which the item is located. The proper cylinder is then selected, and the finer index (on track 00 of the cylinder) is consulted to find the item's track and record address.

The advantages of indexed sequential-file organization include the ability to locate and process items directly and sequentially, to add new items to a file easily, to delete items from a file and re-use the position, thereby avoiding gaps in the file and wasted space, and to keep file maintenance to a minimum because a file need not be re-copied to handle insertions and deletions.

The disadvantages of indexed sequential-file organization are that an index requires storage space on the disk device or in main memory, and added price is entailed for index maintenance and index-lookup time.

Direct-access (random) file organization

In a direct-access file, items are not stored in control-number sequence, but a direct relationship exists between a control number (item key) and an

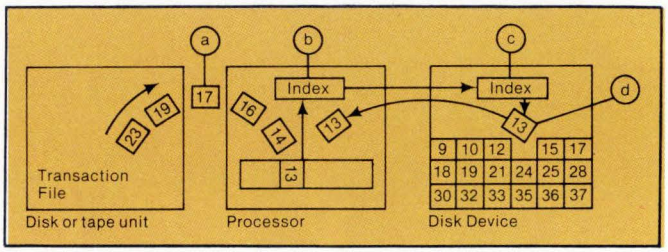

Fig. 4. Indexed sequential-order/sequential processing, *in which batched and sorted transactions are read into memory (a). Each item key is then looked up in the main-memory index (b), which references a finer index in the disk device (c), which then locates the item, to be read into memory (d). After processing, the items are written into their original locations in the same device.*

item's disk-storage address. A mathematical transformation of the control number provides a numerical disk-storage address. The control number can be completely numerical or a combination of alphabetical and numerical information.

To store data, an addressing routine is developed that will convert the control number of an item to an address in the disk device. Control-number transformation routines attempt to produce a unique storage address for each item in a file, but this is seldom possible. Instead, an optimum transformation routine is devised that minimizes the number of times the same address is assigned to more than one item. Duplicate addresses, called synonyms, are virtually inevitable. After data have been stored at a developed address, retrieval becomes simply a process of repeating the address-generating routine that originally stored the data.

A direct-access file, organized to provide fast access to items not to be retrieved sequentially, is structured principally in terms of buckets, user-defined areas that contain one or more items. When a bucket contains more than one item, no logical relationship need exist between the items, except that through some means, such as randomizing, the address of a bucket has been specified as belonging to all of the items in the bucket.

A bucket's address is the address of the first record within that bucket. A bucket can contain one or more blocks, and a block can contain one or more items. A program can find an item in a few μsec. by comparing the proper key to the keys of all items in a bucket. A subsequent access is not usually required. A large

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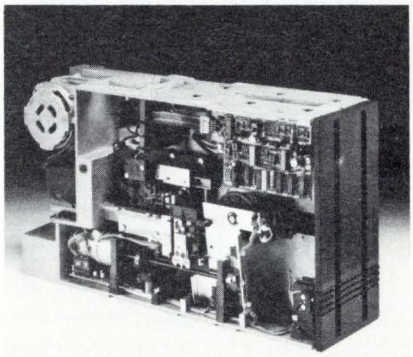

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CIRCLE NO. 85 ON INQUIRY CARD

In a direct-access file, items are not stored in control-number sequence, but a direct relationship exists between a control number and an item's disk storage address.

bucket can increase access time to an item but decrease the possibility of overflow. A smaller bucket can reduce access time to an item in the bucket because the area searched is smaller than that of a large bucket (Fig. 1).

The advantages of direct-access file organization include its ability to provide address calculating faster than does retrieving and searching an index, and it saves a user index space, maintenance time and lookup time because it does not need indexes.

The disadvantages of direct-access file organization include address-calculation schemes and control number characteristics that give imperfect results, including addresses that refer to many items (synonyms) and addresses that are not used, and deterioration of the degree of storage use after several months as a result of changes in control-number characteristics.

In sum, the sequential method of file organization may be better if the file capacity is very limited and the files must be tightly packed, and the act of locating individual items is not critical. The direct-access method may be better if there are numerous additions to and deletions from the file and if the time to locate items must be kept to a minimum. The indexed sequential method may be better if a combination of elements from sequential and direct-access organization are required. For example, the sequential file makes rapid sequential processing possible, while the indexes allow relatively quick location of records.

Processing techniques

File processing refers to the method used to gain access to items in the file and to post transactions against these items. A close relationship exists between the type of file organization and the mode of processing, the latter being designed to take maximum advantage of a file organization. For example, data items should be filed according to a plan, and the relationships between file organization and file processing should be carefully considered before a plan is chosen.

Processing can be accomplished sequentially or directly. The four most common storage/processing combinations are sequential-file organization/sequential processing, indexed sequential-file organization/sequential processing, indexed sequential-file organization/direct-access processing and direct-access file organization/direct-access processing.

- Father-son sequential order/sequential processing, a widely known method, has been used extensively in magnetic-tape systems. The transactions to be passed against the master file must first be batched and sorted into the same sequence as that of the sequentially ordered master file. The transaction file can be stored on any input device. Each master-file item is brought into memory and compared to the change item in a matching operation (Fig. 2). A master-file item is updated when a match is found. If more than one change item affects the same item, all transactions for that master-file item are posted before the next file item is examined.

A new master file (the son) is created on a separate disk device as a result of the update operation.

Summary of File Organization/Processing Methods

Methods / Characteristics	Father-son Sequential/ Sequential	One-Device Sequential/ Sequential	Indexed Sequential/ Sequential	Indexed Sequential/ direct-access	Direct-access/ direct-access
Input Transactions	Sorted	Sorted	Sorted	Random	Random
Master File Format	Sorted, serial	Sorted, serial	Sorted, serial	Sorted, serial	Random
Addressing Techniques	Direct or indirect	Direct or indirect	Direct or indirect	Direct or indirect	Key transformation
Item Retrieval from the Master File	Every item is retrieved once during a run	Every item is retrieved once during a run	Each affected item is retrieved once during a run	Each affected item is retrieved each time it becomes active	Each affected item is retrieved each time it becomes active
Rewriting the Master File	Must be rewritten entirely and on a separate disk device	Each affected master-file item is rewritten in its original location	Each affected master-file item is rewritten in its original location	Each affected master-file item is rewritten in its original location	Each affected master-file item is rewritten in its original location
Minimum required disk device(s)	2	1	1	1	1

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A direct-access file, organized to provide fast access to items not to be retrieved sequentially, is structured principally in terms of buckets, user-defined areas that contain one or more items.

Additions to the file are inserted in sequence during the run, and deletions are made simply by not writing the deleted items in the new master file. Updating is completed when the end of the transaction file is reached, but the balance (if any) of the father master file must be copied onto the son to complete processing.

The advantages of father-son sequential order/sequential processing include that the file is efficiently packed into the storage area, that is, items are packed into contiguous storage locations; the concept is simple, familiar to tape users and relatively easy to implement; a master-file item is retrieved only once during processing, regardless of the number of transactions that involve the item; the sorted master file is readily available for output reports; and an entire file need not be on-line at one time if a massive master file is being processed, thereby reducing hardware costs and requirements.

The disadvantages of father-son sequential order/sequential processing are that the entire file must be rewritten during an update, an additional disk device is required to store the updated master file, each master-file item must be read into memory and then written onto the output device, regardless of whether the item is affected, the transaction file must be sorted

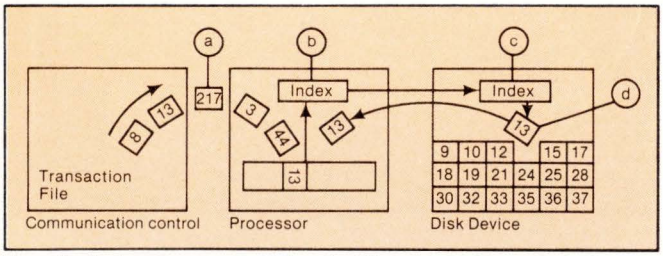

Fig. 5. Indexed sequential-order/direct-access processing, *in which randomly ordered transactions are read into memory (a). Each item key is then looked up in the main-memory index (b), which references a finer index in the disk device (c), which locates the item, which is then read into memory. After processing, the items are written into their original locations in the same device.*

before processing, and fast response to on-line inquiries is impossible because the input items must be sorted and the file items must be retrieved sequentially.

- One-device sequential order/sequential processing enables a sequentially ordered file to be processed sequentially as in father-son processing. The transaction file is sorted into the same sequence as the master file, and each master-file item is brought into memory and compared to the current change item (Fig. 3). Here, the similarity between father-son and one-device

processing ends, because only the affected master-file items are rewritten and written into their original locations in the same disk device. The time to perform an update run is thus reduced because every item need not be rewritten, and only one disk device is required.

Additions cannot be inserted into this type of file in the proper physical sequence unless gaps were originally left for this purpose, and deletions will leave gaps. Such file changes, however, must be incorporated into the master file by using a routine (daily or weekly) merge operation.

The advantages of one-device sequential order/sequential processing are that only one disk device is required to update a file; only the affected master-file

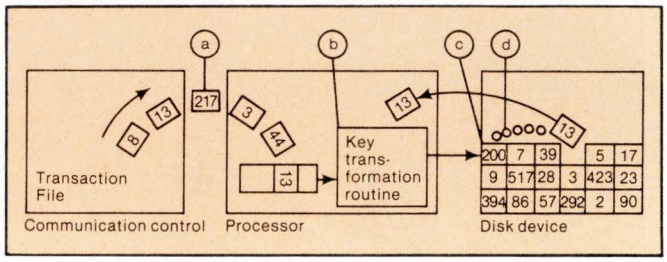

Fig. 6. Direct-access order/direct-access processing, *in which randomly ordered transactions are read into memory (a). Each item key is then transformed into an address (b), which may be the first address in a bucket (c). The bucket then identifies that item as the one to read into memory (d). After processing, the items are written into their original locations in the same device.*

items need to be rewritten; the concept is simple, similar to what is familiar to tape users and relatively easy to implement; a master-file item is retrieved only once during a run, regardless of the number of transactions that involve the item; and the sorted master file is readily available for output reports.

The disadvantages of one-device sequential/sequential processing are that file additions and deletions affect the physical sequence of the file, each master-file item must be read into memory, regardless of whether or not the item is affected; the transaction file must be sorted before processing; and fast response to on-line inquiries is impossible because the input items must be sorted and the file items retrieved sequentially.

- Indexed sequential order/sequential processing involves a sequentially organized master file and requires that the transaction file be batched and sorted as in sequential order/sequential processing. However, only the affected master-file items are brought into memory for processing. The index in the computer memory, the disk device or both controls retrieval of file items. Using the control number of the transaction item, the program locates the address of the master-file item to which the change applies by searching through an index. When the master-file item is found, it is read into memory and processed. It is then written into its original file location. Additions and deletions can be handled without rewriting the entire file.

The advantages of indexed sequential order/sequential processing are that a master-file item is retrieved

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CIRCLE NO. 87 ON INQUIRY CARD

A close relationship exists between the type of file organization and the mode of processing, the latter being designed to take maximum advantage of a file organization.

only once during processing, regardless of the number of transactions that involve the item; the sorted master file is available for output reports; only the affected master-file items are retrieved; file additions and deletions can be made without rewriting an entire file and the file can be tightly packed.

The disadvantages of indexed sequential order/sequential processing include slower reponse to on-line inquiries than is possible with direct-access processing, the need for sorted input, the need for at least two accesses for each retrieval—one for the index and one for the item—and the need to store indexes in main memory and/or the disk device.

- Indexed sequential-order/direct-access processing combines a sequentially organized master file with the fast response, direct-access capabilities of disk devices. It is useful when transactions are relatively low, for example, in inquiry processing. But sequential processing is also required, for example, for preparing output reports.

An index is used to find each master-file item in the same manner as described for indexed sequential order/sequential processing. However, the transaction file is not pre-sorted; transactions are read into memory in the random order in which they occur (Fig. 5). If a master-file item is involved in more than one transaction, each transaction requires the retrieval of the master-file item, unless a priority of input transactions is established. When the input transactions are stacked in a queue, the queue can be tested to determine if the next transaction to be posted is the only one in the queue that involves the master-file item. If more than one transaction in the queue affects the same master-file item, multiple transactions can be posted in sequence so that the master-file item need not be retrieved more than once. Once the master-file item has been processed, it is written into its original location in the same device.

The advantages of indexed sequential-order/direct-access processing include fast response to on-line inquiries, input transactions need not be sorted, the sorted master file is available for output reports, only the affected master-file items are retrieved, file additions and deletions can be made without rewriting the entire file and the file can be tightly packed.

The disadvantages include the need for at least two accesses for each retrieval—one for the index and one for the item; the need for one retrieval, unless a routine tests the queue of input transactions for the presence of more than one transaction involving the same master-file item; indexes require storage in main memory and/or the disk device; and high-activity files are not processed as efficiently as in other methods because the input is not sorted.

- Direct-access (random) order/direct-access processing eliminates the need for indexes to look up the address of an item and to make at least two accesses per master-file item. It, therefore, uses the direct-access capabilities of the disk device to a greater degree than other methods. The master file is randomly ordered by means of a key transformation technique so that an item's address is simply computing when a transaction is to be posted (Fig. 6). If the item is not the first one in the bucket, it can usually be found by searching the bucket sequentially.

The advantages of direct-access (random) order/direct-access processing include the fastest response to on-line inquiries, the most efficient processing of a low-activity file, the need for multiple accesses per item only when overflow occurs, the lack of need for sorting input transactions, the need to retrieve only the affected master-file items and the ability to make file additions and deletions without rewriting the file.

The disadvantages include the fact that the key transformation routine, unless well chosen and properly maintained, can produce gaps, which in turn, cause inefficient use of the file storage area; that no orderly sequence of the master file exists for use in output reports; that sorting is required to produce the reports; that items of a sequentially ordered file are sequenced only with regard to their primary key, necessitating sorting in different types of reports; that each transaction requires one retrieval, so that the same master-file item can be retrieved many times during processing; and that a high-activity file is not processed efficiently.

Summary of methods

The table summarizes the important characteristics and capabilities of the most commonly used file-organization/processing methods. The method selected must take into account future as well as current application requirements, and the resourceful systems analyst must also be mindful of the effect new hardware developments might have on file organization and processing. ■

Mini-Micro Systems gratefully acknowledges the use of tutorial material made available by Honeywell Information Systems, Inc.

DECEMBER AND BEYOND IN MMS

A comprehensive product profile of computer graphics terminals will lead the feature section of the December issue, and the survey will be augmented by several other graphics-related articles, including:

- A look at a new hardware/software design technique that provides extremely fast three-dimensional raster graphics processing.
- A tutorial on digitizer resolution and accuracy.

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Dedicated Line (with dedicated ground)	some, internal only	some, internal only	some, internal only	some, internal only	No	No
Ultra-Isolation Transformer	No	No	Yes	No	No	No
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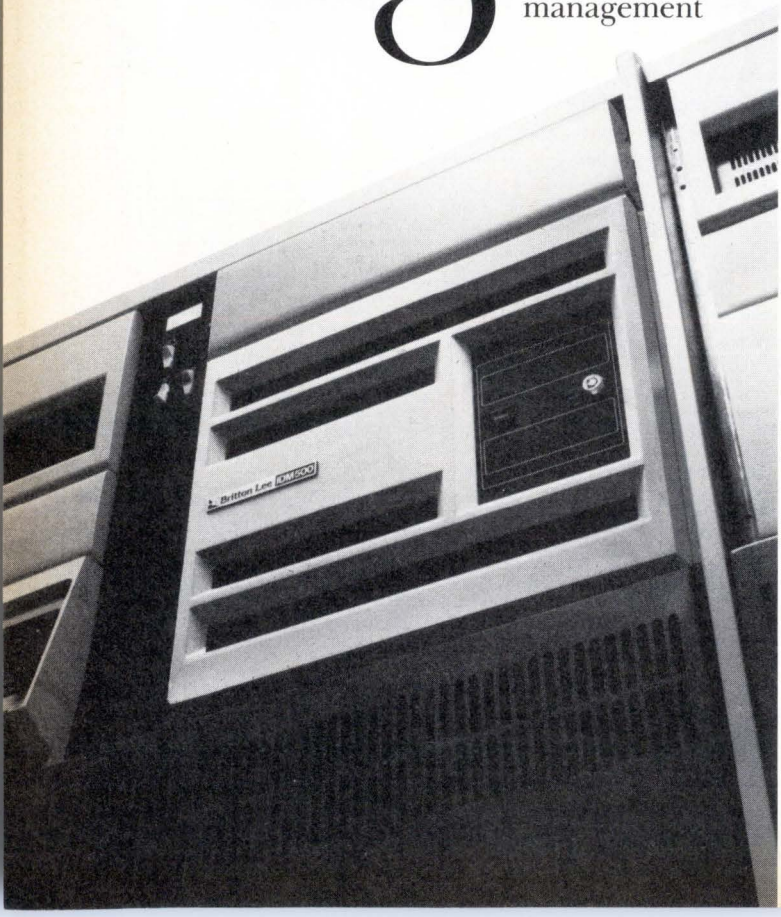

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IDM 500 Intelligent Database Machine

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SOFTWARE

Exploring integer division

K. GOPINATH, Advanced Micro Devices

Various algorithms are offered to assist users of bit-slice μps working in a microprogramming environment

Secondary systems builders or configurators—those who draw on the already built-in power of the hardware and operating systems provided by CPU vendors—are not required to understand the operational details of their system's arithmetic procedures. It is sufficient that they and their customers know only the use and limitations of those procedures. Where systems integration starts at the chip level rather than board level, however, some appreciation of microprogrammed arithmetic processes is essential.

Integer division is required in a microprogramming environment anytime a remainder (or modulus) is required in addition to a quotient, and yet division is much more difficult to realize than, say, multiplication. One difficulty can be easily understood by visualizing a 2n-bit dividend (X) and an n-bit divisor (Y). The quotient (Q) can range from 1 bit when $X < Y$, to 2ns bits when $Y=1$, discarding the attempt to divide by 0. In most divide functions, the remainder (R) is as important to find as the quotient; there is no equivalent to it in multiplication. Division becomes even more complicated when negative numbers are represented in the 2's complement notation.

Dealing with negative numbers is relatively easy in the decimal system, which uses sign-and-magnitude notation: the sign of the quotient is determined first, and a normal division is then performed. That is, the first digit of the quotient is estimated by comparing the most significant part of the dividend to the divisor. The estimate is then verified by a multiplication (no direct

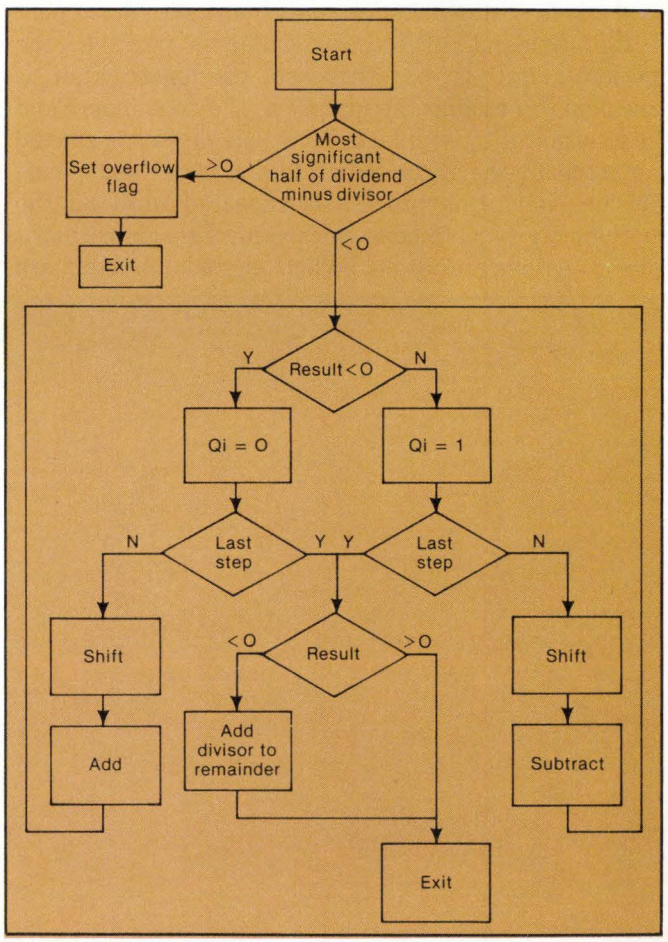

Fig. 1a. Flowchart *for nonrestoring division (unsigned numbers).*

Dealing with negative numbers is relatively easy in the decimal system, which uses sign-and-magnitude notation: The sign of the quotient is determined first, and a normal division is then performed.

division method is known), and the process continues for all of the other digits, shifting the divisor to the right one place at a time.

The most straightforward hardware integer division scheme for unsigned numbers uses subsequent subtraction. The algorithm is as follows: The divisor is subtracted from dividend and a counter initially reset to zero is incremented. This process continues as long as the remainder is positive. When the remainder becomes negative, the last step is canceled, that is, the divisor is added back and the counter is decremented. The counter will contain the quotient, and the remainder will be correct. The main drawback to this scheme is the great number of arithmetic operations required. Again, when dealing with signed numbers, the subtraction should be substituted by addition and vice versa.

Restoring and non-restoring division

Calculating the quotient digits instead of counting them enables quicker division. In this algorithm, the divisor is first subtracted from the most significant part of the dividend. If the remainder is positive, the quotient digit is 1, otherwise the subtraction is cancelled (by adding the divisor to the remainder) and the quotient digit will be 0. Now, the divisor is shifted one place to the right (much like a paper and pencil division,) and this process is repeated until all the quotient digits have been calculated. This algorithm is called restoring division. When signed numbers are involved, inversion of the operations and the quotient digits is necessary, and, in some cases, correction should be performed.

Some time is wasted in restoring division because for every 0 digit in the quotient, two arithmetic operations are needed. This can be saved in the non-restoring division. The basis of non-restoring division is the same as in restoring division. First, only unsigned (positive) numbers are considered. At the beginning, the divisor is subtracted from the most significant part of the dividend. If the result (first remainder) is positive (or 0), the first quotient digit is 1. Otherwise, the quotient digit is 0, but it should not be restored. The divisor is shifted one place to the right (or remainder to the left) and added if last quotient digit was 0; otherwise, it is subtracted. Quotient digit is determined as before, and this continues until all quotient digits have been computed. The remainder will be correct if it is non-negative; otherwise, it can be corrected by using a restoring operation on the remainder only (Fig. 1).

The number of bits to represent the value of the divisor must be carefully considered: If the divisor has n bits and the dividend has 2n bits, the above process develops n + 1 bits of the quotient. This will not be sufficient if the divisor is a small number and more digits are needed in the quotient. This condition can be easily detected because the most significant half of the dividend will be greater than the divisor. Division can then be terminated after setting the overflow flag.

Accommodating the negative

The unsigned division scheme can be applied to signed positive numbers without any change. When negative numbers are encountered, however, changes in the algorithm are necessary. The straightforward method of signed division seems to be division in the first quadrant. In this scheme, negative numbers are 2's complemented to obtain positive numbers, remem-

Initial Register Status

R

O	MSH Dividend
I	Divisor
Q	LSH Dividend

Am2901 Microcode

Program: 2's Complement Division

Final Register Status

R

O	Remainder
I	Divisor
Q	Quotient

S,F	D	Description	CL	Repeat	Pin Status (Octal) A	B	I_{876}	I_{543}	I_{210}	C_n	Q_0	Q_3	RAM_0	RAM_3	Jump to	if
(B – A)*2	B	First subtract & shift	1	—	1	0	6	1	1	1	F_3	X	0	X		
(B ± A)*2	B	Loop subtract/add & shift	0	N	1	0	6	1/0	1	1/0	F_3	X	0	X		
B + A or B + 0	B	Correct remainder	X	—	1	0	3	0	1/3	0	X	X	X	X		

N = Number of bits in the Divisor

Fig. 1b. Am2901 Microcode *for dedicated division for flowchart.*

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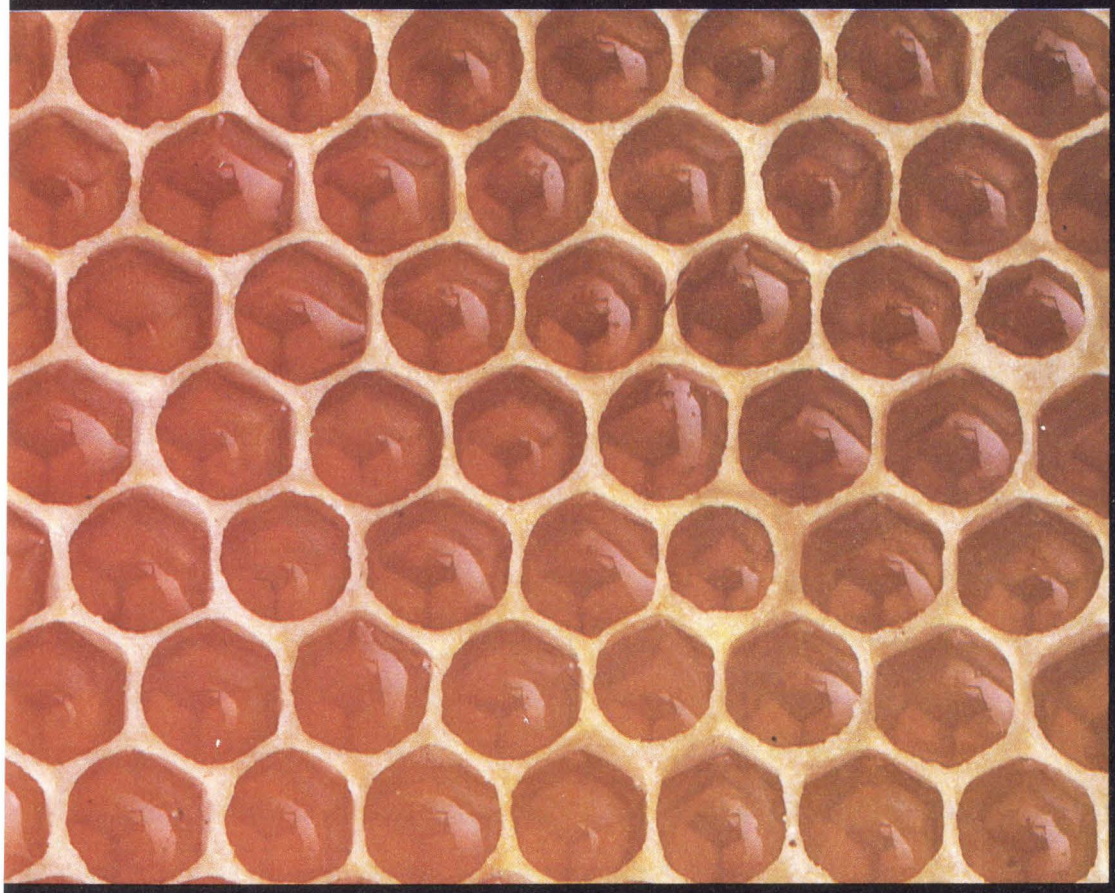

By comparison. If a 5¼ inch Winchester disk drive has been specified, the process of natural selection will lead to HD 561 from Olivetti OPE.

HD 561 offers 7.5 megabytes of storage at 120 milliseconds average access time in a mini-floppy-sized package. The sealed environment of a Winchester drive increases data reliability and eliminates preventive maintenance. While not as perfect as a honeycomb, one hard error per 10^{12} data bits read makes HD 561 come very close.

Olivetti OPE also offers other 5¼ and 8 inch disk drives, both Winchester and flexible, and a complete line of thermal, daisy wheel and dot matrix printers and printing mechanisms.

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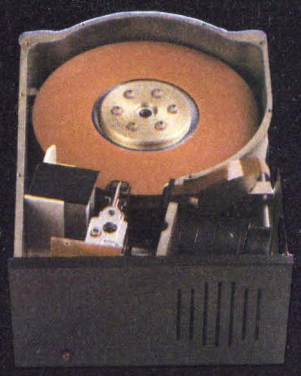

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Some time is wasted in restoring division because for every 0 digit in the quotient, two arithmetic operations are needed.

bering the changes done. If overflow occurs when the dividend is complemented (that is, dividend is -2^{2N-1}, the least negative number), the overflow flag can be set and an exit taken from the routine because (-2^{2N-1}) divided by any integer of n bits cannot be represented in n bits. If overflow occurs when the divisor is complemented, a more complex action is required. In this case, the dividend and the divisor are shifted right by one place and the shifted-out bit is stored in a flag, Z. At the same time, a flag, W, is also set to indicate that division by -2^{2N-1} is being attempted.

These actions are required because the quotient might be representable in n bits. (Here instead of dividend = divisor/quotient + remainder, we have ⌊dividend/2⌋ = ⌊divisor/2⌋ * quotient + ⌊remainder/2⌋. The remainder obtained is shifted left, and the bit Z is added to give the correct remainder.) The division is performed on positive numbers, and 2's complementing is done where necessary (Fig. 2).

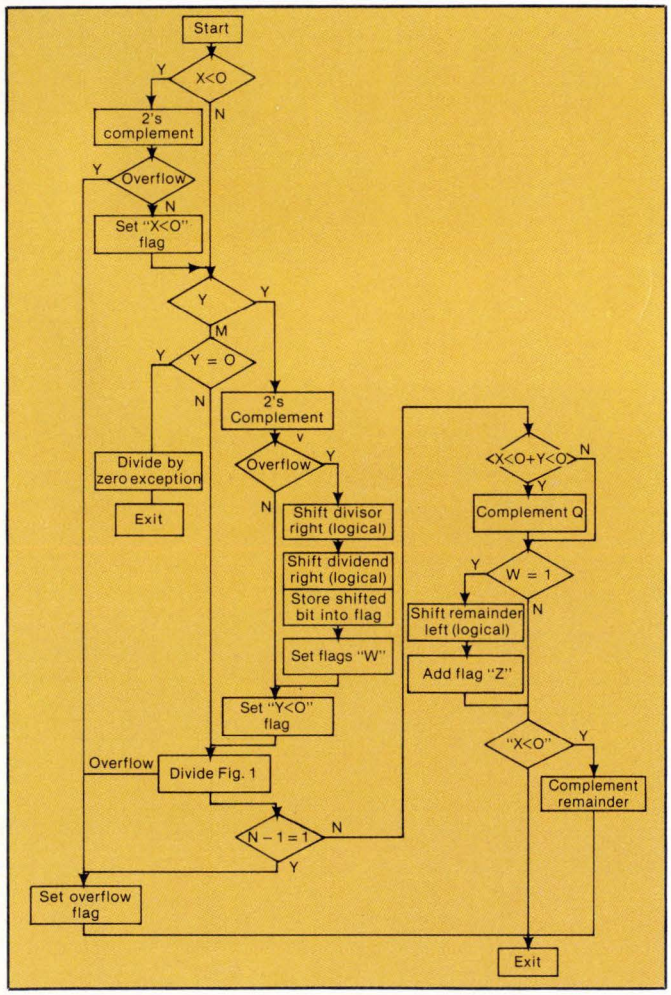

Fig. 2. Flowchart *for division with signed numbers. The quotient Q = $q_n\ q_{n-1}\ q_{n-2} \ldots q_1\ q_2$*

Division in the first quadrant is applicable to both the restoring and non-restoring methods. In non-restoring division, the inner loop of division takes n+1 steps. In restoring division, it can take n to 2n steps, depending on the number of restores done. The inner loop of non-restoring division takes one line of microcode on most micromachines and another line is needed to achieve the remainder correction. In restoring division, the inner loop requires two lines of microcode, and there is no need for remainder correction. Hence, the microcode space required is the same for both methods, except that in non-restoring division, a small amount of combinational logic is required to control the ALU operation to either addition or subtraction, depending on the sign of the previous result.

A bit-slice implementation

Fig. 3 is the interconnection diagram for a division algorithm implemented in the Am2901 bit-slice μp. It is assumed that the most significant half dividend is in register R_x (which will be lost during the division and replaced by the remainder), that the least significant half is in the Q register and that the divisor is in register R_y. The quotient will be generated in the Q register. After checking the signs of the dividend and divisor, setting the flags and negating (using 23 or 24 octal as I_5 through I_0 ALU control bits) when necessary, the overflow condition is checked. Overflow occurs if R_x is greater than R_y, and the division can be terminated by setting the overflow flag.

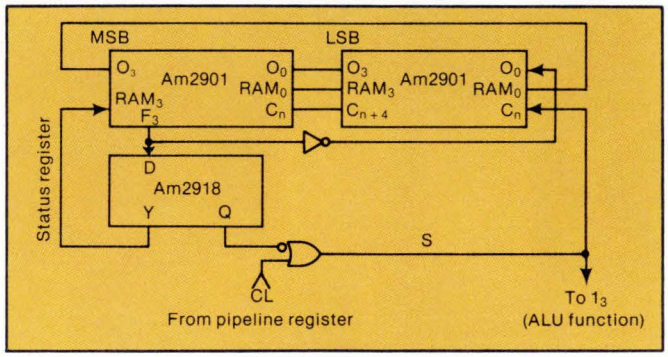

Fig. 3. Interconnection *for dedicated division for flowchart in Fig. 1.*

The first step in the division routine is to subtract, then shift the R_x and Q registers up. I_{876} equals 6 in octal, while I_{210} equals 1 in octal and $I_5 = I_4$ = LOW. Pulling the CL bit in the microcode to HIGH, both I_3 and C_n are HIGH, and the arithmetic-logic unit (ALU) performs a 2's complement subtract. The sign of the remainder is latched in the status register and the complement of it is stored in the least-significant bit (LSB) of the Q register during the shift-up operation, which also discards the sign bit of the remainder.

Repeating the operation for all other bits of the remainder with the CL bit in the microcode LOW leaves the control of I_3 to the (complemented) previous sign bit. If it was 0 ($R < 0$), I_3 and C_n will be HIGH, and the ALU will subtract; if it was 1 ($R > 0$), I_3 and C_n will be

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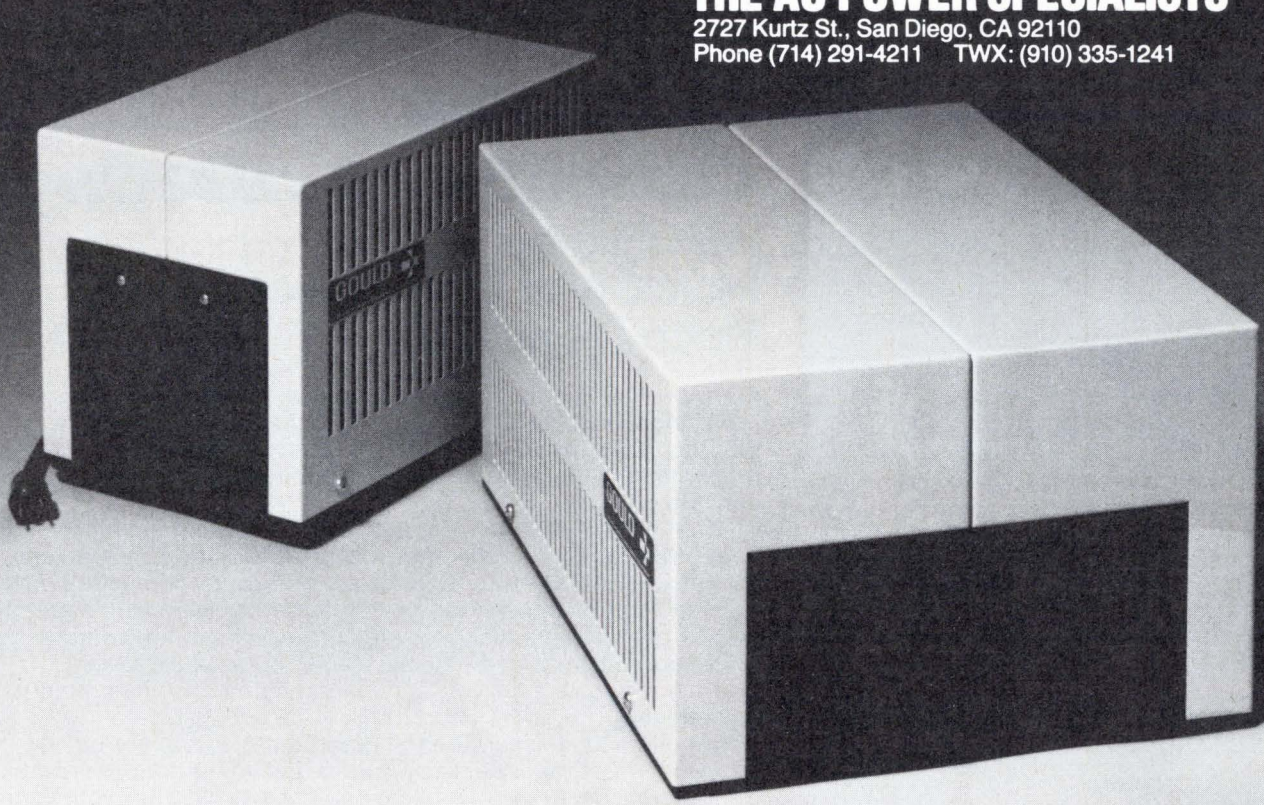

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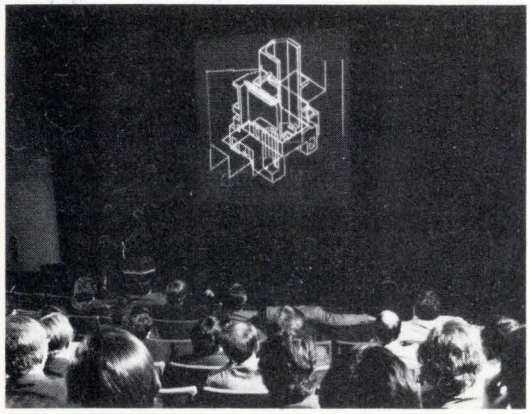
The unsigned division scheme can be applied to signed positive numbers without any change.

LOW and the ALU will ADD, as required. In each up-shift, the complement of the present sign bit will be placed at the right of the quotient, as required.

At the end of the division, if the sign bit of the remainder is HIGH, the divisor is added to it. This can be easily implemented by performing an unconditional ADD (with C_n LOW), letting I_2 LOW, I_0 HIGH and controlling I_1 by the complement of the sign of the remainder, thus adding to the R_x either R_y (if $R_s = 1$) or 0 (if $R_s = 0$). If the dividend and the divisor were shifted right because the divisor was equal to -2^{n-1}, the true remainder is obtained by shifting the remainder left and adding the flag Z. This method generates n+1 bits of the quotient $(q_n...q_0)$ of which $q_n = 0$, because the most significant half of the dividend is less than the divisor. The overflow flag should be set if $q_{n-1} = 1$ because $q_{n-1}...q_0$ is an unsigned positive number.

The number of clock cycles needed in the method described and in those methods using pre-normalization differs. Pre-normalization, a technique used in floating-point arithmetic to increase dynamic accuracy, entails shifting the dividend and divisor until the MSB of the divisor is one. This pre-normalization must finally be followed by a post-normalization of the remainder. The number of clock cycles in this method is lesser than in methods that use pre-normalization by two times the number of shifts introduced in the pre-normalization. Hence, use of the above method is suggested when integer division is to be performed. ■

K. Gopinath is a product-planning and applications engineer at Advanced Micro Devices Inc., Sunnyvale, Calif.



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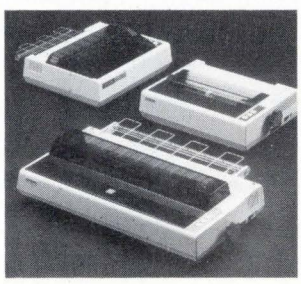

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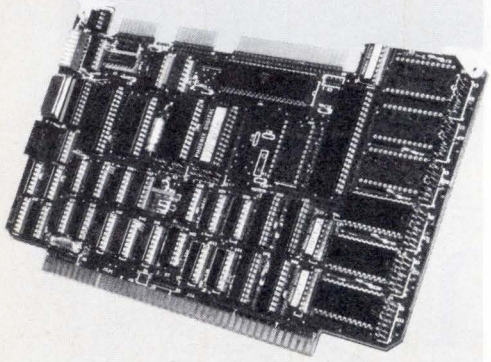

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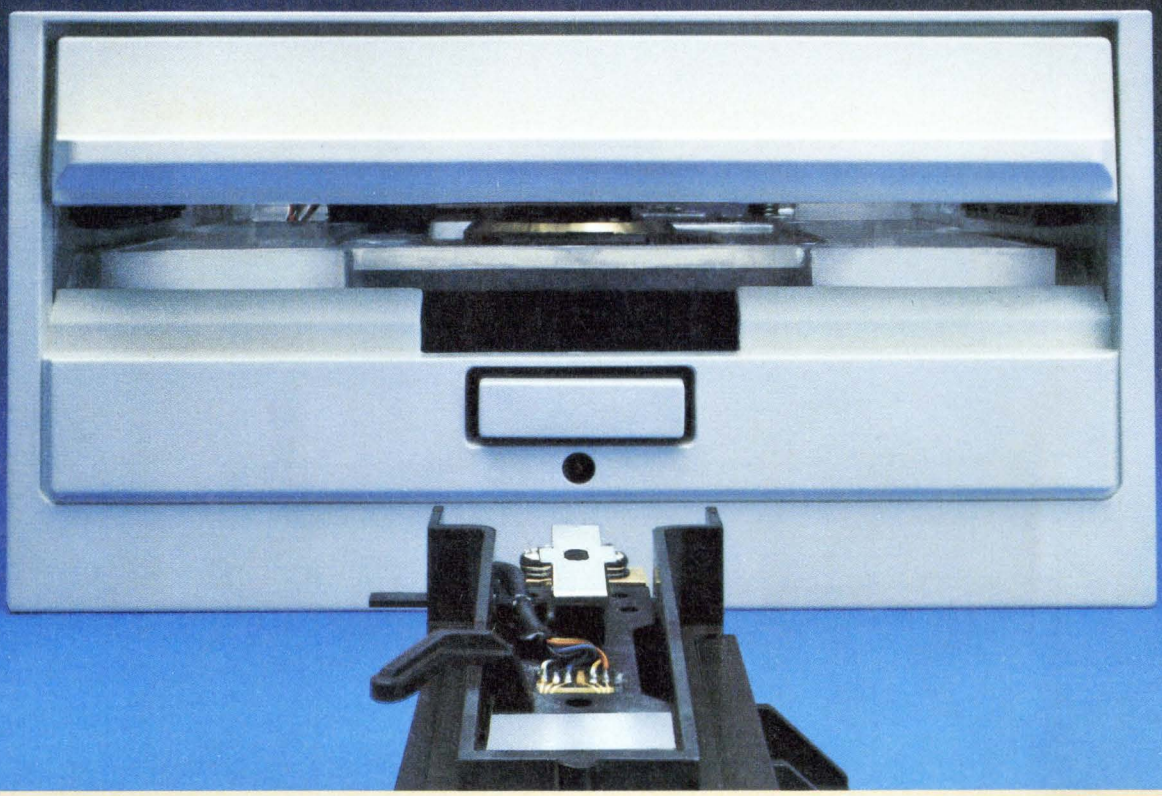

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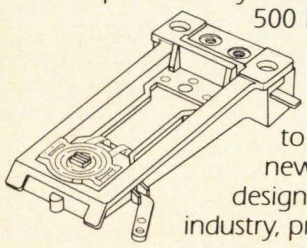

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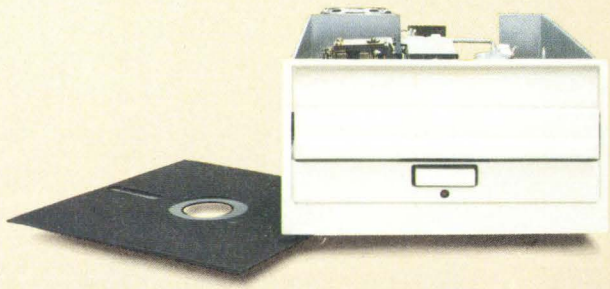

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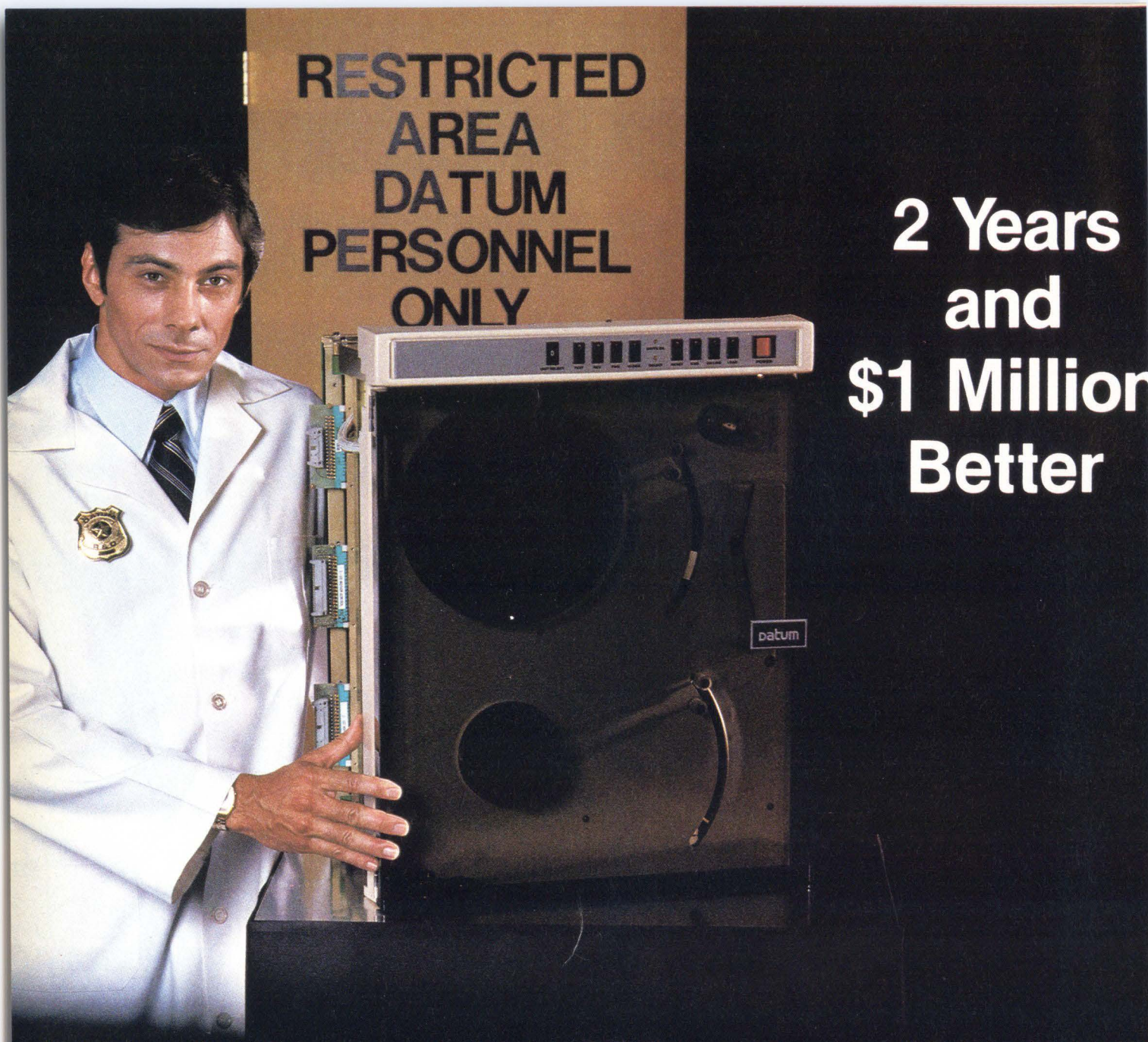

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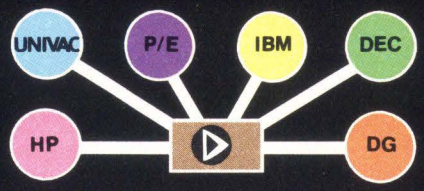

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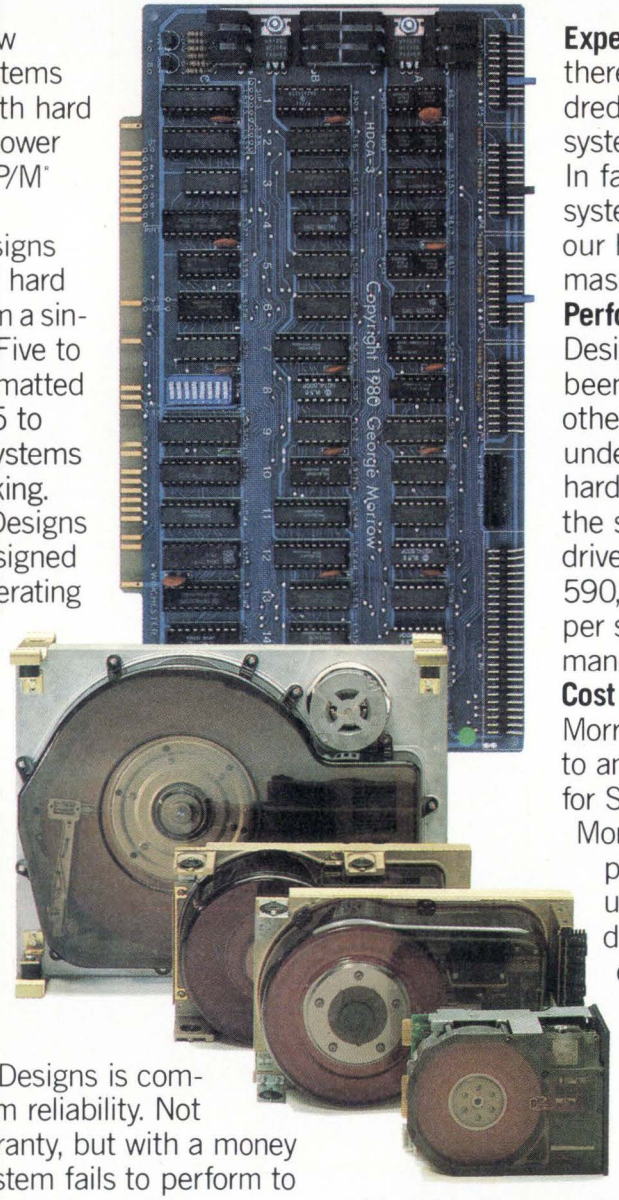

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Advances in data base management

This book offers a look at what you should know if you use or plan to use DBMS

ADVANCES IN DATA BASE MANAGEMENT, edited by Thomas A. Rullo, Hayden & Son. Inc., Philadelphia.

Reviewed by
James F. Hemenway

As might be expected when a book has more than 10 authors—each contributing his own chapter—*Advances in Data Base Management* suffers from a lack of continuity and direction and tends toward repetitiveness. For instance, the well-known virtues of minimal data redundancy, integrated systems, data independence and integrity and the importance of a data dictionary are repeated in many chapters. Still, the book is worth reading. The topics are both practical and theoretical. For example, there is an excellent chapter by Larry E. Towner on "The Hazards of DBMS," and another entitled "The Semantic Data Model" by Michael Hammer and Dennis McLeod.

I found the chapter on DBMS hazards to be by itself worth the price of the book. Its author discusses:

- Politics—some practical solutions to the explosive issue of update authorization: "Who loads the database?"
- Law—legal problems associated with integrated databases.
- Personnel—minimum DBMS staff needs and the function of the database administrator and staff.
- Supporting software—the elements needed for the effective use of DBMS.
- Applications software—the three approaches: modify existing programs; redesign existing programs; re-design entire application (with some notes on the usefulness of DBMS report writers).

A chapter called "Data Base Planning" includes a review of five methodologies:

- bottom-up approach
- IBM's information-systems planning
- information-flow analysis
- conceptual data model
- information systems architecture

The author of the chapter, Ronald F. Voell, then presents a case study using a database planning method that combines some of these approaches.

"Creating the Proper Environment for DBMS" by Chester C. Lin examines the needs for, and functions of, a database administrator and a data dictionary. The author also explains how to evaluate various DBMSs and determines whether to attempt application-program conversion.

"Data Base Design" by Thomas R. Finneran stresses the importance of business analysis and examines the logical database design: initiating it, converting it to the physical design and considering design trade-offs. With some straightforward pros and cons, the author also describes hierarchical, network and relational database structures; automated design assistance; access methods for a database; and blocking and data compression.

The chapter "Evaluating the Benefits of DBMS" by Gabrielle and John J. Wiorkowski relates the views and experiences of more than 24 users. Here, we learn of one innovator who incorporates some data redundancy into his system to give it better on-line response.

Jack F. Thorne's "Auditing DBMS" outlines some problems for auditors. Those include trying to overcome the complexity of the systems and the variety of available packages. In two appendixes, Thorne presents some electronic

Despite repetitiveness and a lack of continuity, this book is worth reading. The topics are both practical and theoretical.

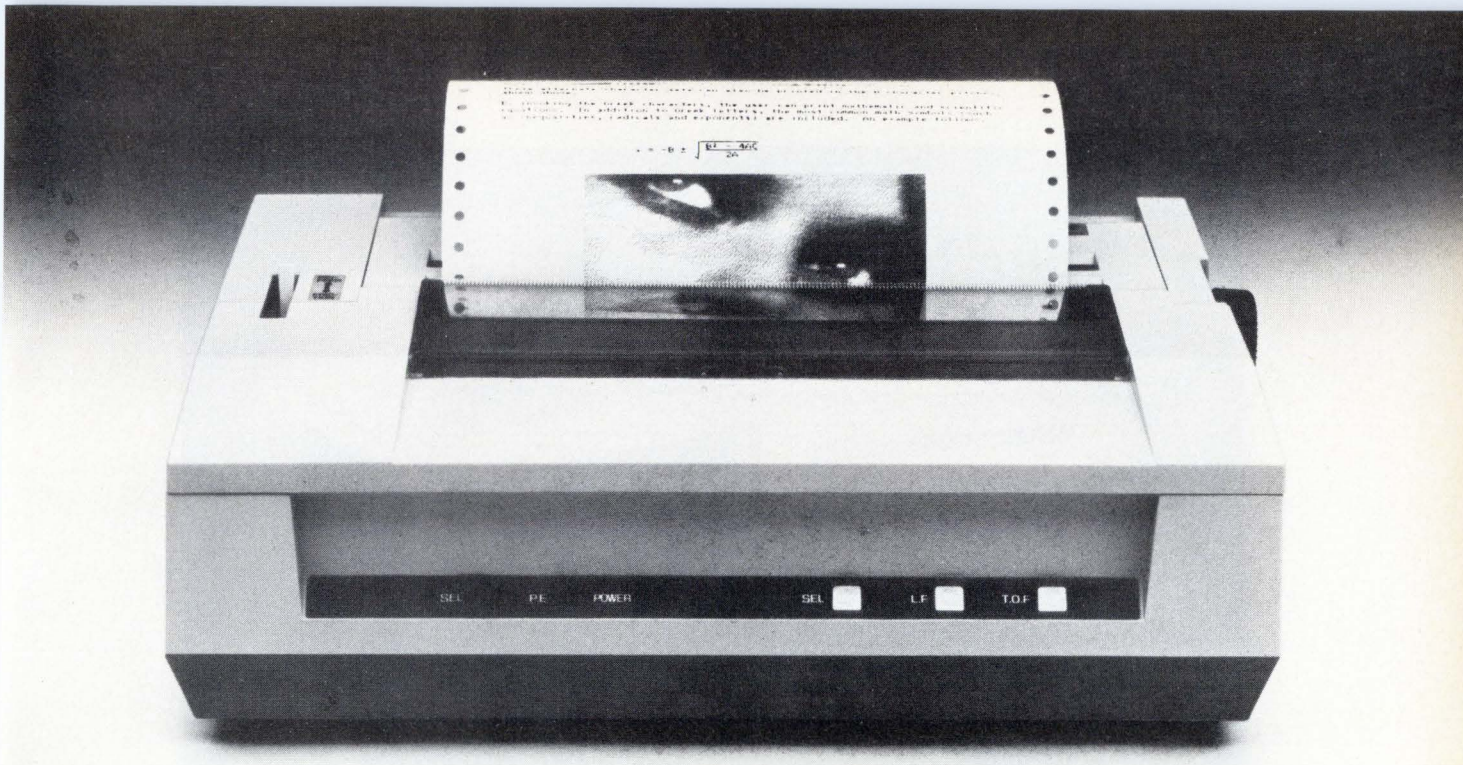
data-processing accounting controls and some computer-auditing techniques.

"Data Dictionaries—a Pragmatic View" describes a typical dictionary and how it enhances DMBS use. The author, Myles E. Walsh, examines considerations that are needed for selecting a data dictionary and some of its inputs and outputs. He distinguishes between a data administrator (political) and a database administrator (technical), details IBM's data dictionary and concludes with an overview of some of the entries into the field: Lexicon by Arthur Anderson and Co.; Uccten by University Computing Co.; Data Catalog by Synergetics Corp.; Data Manager by MSP, Inc.; Integrated Data Dictionary by Cullinane Corp.; Contol 2000 by MRI Systems Corp.; and TOTAL by Cincom Systems, Inc.

The last chapter, "Distributed Data Bases" by Dan Zutyko, examines decision-support systems that help decision makers process local databases through user-oriented query and reporting languages. There is also a case study in which a database was distributed over several minicomputer modules, each having a database function, and interconnected to a network designed to handle more than 3000 terminals.

"Advances in Data Base Management" is a compendium of dos, don'ts and case studies: a source of practical information for almost any prospective and current users of a database management system. ■

James F. Hemenway is marketing director for Hemenway Associates, Inc., a Boston-based system software house specializing in operating systems and languages for μps.



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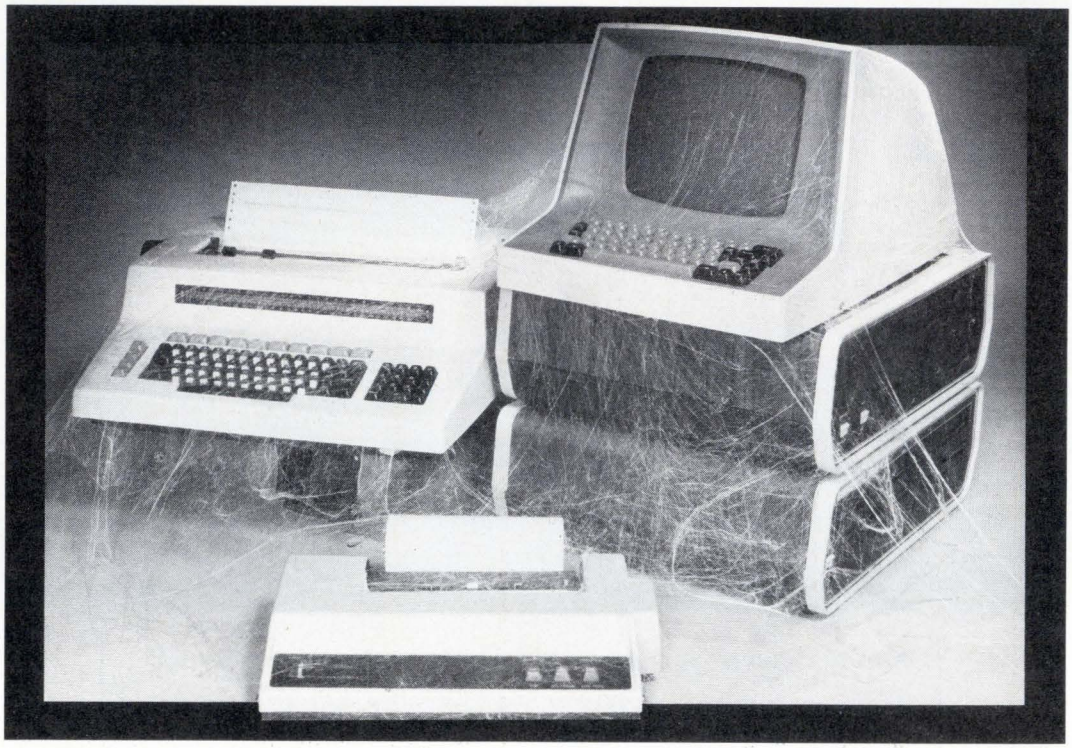

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Data Support Corporation

CIRCLE NO. 35 ON INQUIRY CARD

DG unveils color alphanumeric display terminal

Data General Corp., Westboro, Mass., has introduced a color version of its Dasher CRT terminal and is targeting the new system, the D280C, for sales in the engineering, scientific, business and industrial markets.

The eight-color D280C will be used primarily for highlighting and providing special emphasis to alphanumeric copy, according to Neil Hackler, senior marketing specialist for DG. Hackler says that applications include providing color copy within detail drawings, alerting users to special status and alarm conditions, process-control applications and reducing operator error and fatigue. While the terminal does not have graphics capabilities, it can construct line and bar charts.

DG is not offering a color printer with the D280C, but Hackler says that any RS232C-compatible device capable of providing color hard-copy output can be used with the unit.

No new software packages have been introduced with the D280C, but support is provided by DG's Eclipse, Nova and microNova computers using standard software. The terminal is compatible with the Dasher D100 and D200 displays in single-color mode.

The D280C includes 128 upper- and lower-case ASCII characters as well as two sets of user-definable characters providing 128 symbols. Seven alphanumeric language sets reside within the terminal, and available languages include American, British, Danish/Norwegian, French, German, Spanish and Swedish/Finnish.

The video display measures 13 in. diagonally and has a screen format of 80 columns × 24 rows. A 5- × 9-dot character matrix is used in a 7- × 10-dot cell. A detachable keyboard contains a typewriter-style keyboard, a 14-key numeric keypad, a 12-key screen-management keypad, 15 program-function keys and five operator-function keys.

The D280C color alphanumeric display *terminal is targeted for engineering, scientific, business and industrial markets.*

With a 20-mA current loop, the terminal can be connected to a host computer as far as 1500 ft. away. The standard RS232C interface can be used for remote applications via modems. Users can select seven transmit and receive speeds.

The Dasher D280C lists for $3750 ($3500 for the video display and $250 for the keyboard). Deliveries are 120 days after receipt of order.

—Frank Catalano

Data General Corp., Rte. 9, Westboro, Mass. 01581.

Circle No 200

Point 4 adds high-end processor, turnkey system

Incorporating almost 2000 macroinstructions in firmware, Point 4 Data Corp.'s new, top-of-the-line Mark VIII processor offers a performance improvement of as much as 2:1 over the firm's Mark V. The Mark VIII was introduced with the company's first turnkey product, 4SITE, designed as a control system for use by managers.

Like the Mark V, the Mark VIII packages its CPU, 128K bytes of memory and all options on a PC board that resides in a seven-slot chassis. The chassis also accomodates various peripheral controllers. Each Mark VIII supports 40 to 60 ASCII terminals, says John Mather, vice president.

The new firmware instructions

were formerly implemented in Point 4's IRIS operating system. "By implementing functions in firmware, the time required to fetch an instruction is effectively reduced from 400 to just 100 nsec.," explains Renny Bosch, vice president of new product research. Also, he says, because the Mark VIII macroinstructions include a subset of two-word instructions, the CPU can perform many functions as 32-bit instructions, even through the memory address bus is just 16 bits wide.

Software-compatible with the Mark III and Mark V computers, the Mark VIII will be sold primarily through Point 4's network of about 250 system integrators. While the company's products are generally small-business-oriented, Mather believes the more powerful Mark VIII will expand Point 4's penetration into scientific markets. Available next month, the Mark VIII lists for $10,700, with OEM discounts available.

Representing "a major change for our company," the 4SITE turnkey system is targeted at Fortune 500 companies and government agencies, says Mather. Point 4 will make every attempt to avoid competing with its systems integrator for end-user sales, and Mather notes that the target market for 4SITE should minimize such competition. "Systems houses haven't been that successful in selling to the Fortune 500," he claims. "Those big companies tend to go directly to the vendors to do business."

Incorporating a Mark III or a Mark V processor, the 4SITE systems run Point 4's READINET project-control system software. The low-end 300 model supports three concurrent users and includes 64K bytes of memory, a four-port multiplexer, a 200-lpm printer and at least 16M bytes of on-line storage. The 4SITE 500 supports 16 users and includes 128K bytes of memory, an eight-port multiplexer, a 300-lpm printer and 32M bytes of on-line storage.

Existing READINET installations —sold through Point 4 systems houses—are primarily in the construction field, Mather says. He expects managers using PERT/CPM (performance / evaluation - review technique/critical-path method) approaches in the oil and aerospace industries to be major 4SITE customers.

Point 4 has opened a full-service office in New York to sell, service and support its turnkey systems, and the firm's initial marketing push will be along the Eastern seaboard. Available immediately, the minimum 4SITE 300 configuration sells for $28,500; the minimum 4SITE 500 system sells for $65,500, with quantity discounts available.

—Dwight B. Davis

Point 4 Data Corp., 2569 McCabe Way, Irvine, Calif. 92714.

Circle No 201

AM International offers low-priced printer for OEMs

Last month, AM International, Inc.'s printer-systems operation, Livingston, N.J., introduced a low-priced, non-impact printer for letter-quality printing. The PXL-6 OEM printer operates at 6 pages per min. and will be priced at about $5000 in 1000-unit quantities. This

The PXL-6 *magnetographic printer fills a price and performance niche above daisy printers and below page printers.*

means a $12,000 to $13,000 price for end users.

Three to 11 work stations can share the printer, making it ideal for shared word-processing systems or for small-business computer applications requiring quality output.

The PXL-6 was developed by the company, and is based on magnetographic principles rather than on a Xerographic copier. The announcement follows reports that General Electric Co. has refocused development for its much-heralded Termi-Net 8000 electromagnetic printer, which was introduced in prototype form at the 1980 National Computer Conference. GE has the product on hold while trying to improve the product's resolution to 240 dpi and to recoup some of its initial investment.

A company source explains the PXL-6's operation: Through electronic pulses, a write head writes magnetic pulses onto a magnetic tape. Single-component toner is applied to the tape, transferred onto paper and fused by electrostatic forces and pressure. The paper has a negative charge, the toner, a positive one. The printer includes a "background cleaner" to remove the gray residual matter common to magnetic-based printers.

The printer contains an 8-bit 8085 μp and a bit-slice μp for character handling. It contains as much as 33K bytes of buffer memory and stores four fonts on-line simultaneously. Each of the four are produced in regular, bold, slanted, double-height or double-width word modes, for a combination of 24 styles. OEMs can select from more than 40 fonts. Typestyles are mixed within a word, line or page. Fonts are stored in plug-in cartridges containing 128 characters each in ROM. Four cartridges are available for the printer. Print resolution is 240 × 480 dpi. Equipped with a 12-bit parallel interface compatible with major daisy-wheel printers on the market, the printer also can be configured with paper-handling devices for use in offices.

The machine's price and performance place it in a market above daisy-wheel printers, but below data-processing-oriented printers, such as Delphax Systems' ion-deposition unit (MMS, June, p. 179). The fully configured Delphax model, also an OEM product, sells for about $35,000 and prints 15 to 60 pages per min. —*L. Valigra*

Circle No 202

Modular system combines logic analysis, pattern generation

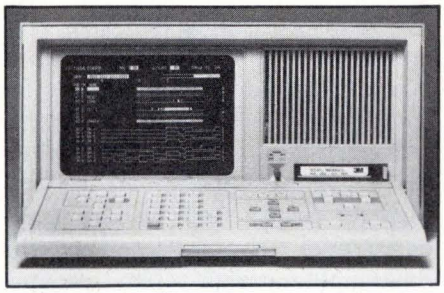
By integrating logic-analysis functions, pattern generation, mass storage and communication interfaces into a single, modular package, Tektronix, Inc., claims to have a product that reduces design time and cuts the amount of throwaway code produced during the design process.

Available from Tektronix's Design Automation Division, the new DAS 9100 digital-analysis system monitors hardware and software operations simultaneously, says Steven R. Palmquist, logic analyzer engineering manager. "With this combined monitoring capability, we can identify functional problems regardless of where they occur," he notes.

Configured as a six-slot mainframe unit with an integral 9-in. raster-scan CRT, the DAS 9100 can be modified to suit designers' needs. Users can choose any combination of data-acquisition, pattern-generation, communication and power-supply modules to create many permutations of the system.

Three data-acquisition modules, both asynchronous and synchronous, are available. A 32-channel module provides 40-nsec. resolution (25 MHz) with 512 bits per channel memory and two clock qualifiers. An eight-channel module provides 10-nsec. resolution (100 MHz), 512 bits per channel memory, separate acquisition and glitch memories and a clock qualifier. A four-channel module offers 3-nsec. resolution (330 MHz), 2048 bits per channel memory and a high-resolution mode that provides 1.5-nsec. resolution (660 MHz) on two channels. As many as 104 data-acquisition channels can be supported at one time.

The DAS 9100 also includes a trigger-arming mode that allows a high-speed data-acquisition module-monitoring hardware activity to be triggered from lower speed modules tracking software flow. Acquired data is time-aligned in both timing



Using the DAS 9100's *color-coded keyboard, designers can access instrument set-up menus that highlight any variable parameters.*

and state-table displays.

Designers can use the unit's pattern-generator modules for such applications as simulation of memory, I/O ports and other hardware or simulation of microcode and hardware. Combined with the DAS 9100's data-acquisition capabilities, a pattern-generation feature aids simultaneous hardware and software development, says Dave L. Parmley, marketing manager for logic analyzer products. He notes that such development is typically inefficiently staggered, with software development following hardware design.

A DAS 9100 module provides 16 channels of pattern generation at 25 MHz, with two independent programmable strobes. This can be extended to 48 or 80 channels with as many as 10 programmable strobes by adding one or two 32-channel expander modules.

"It's important to recognize the difference between word generation and pattern generation," Palmquist points out. "With word generation, you must enter every single state you want out of the system. Pattern generation allows you to enter one line and get 256 states out."

State-table data can be formatted in hex, octal, binary or user-defined mnemonics. "Designers can define their own tables with the mnemonics," Palmquist says, "rather than waiting for each vendor to produce a probe. "Timing magnification to 10,000x, a memory window, word search and glitch highlight are also provided.

An optional communications package consists of an RS232C port, a GPIB interface and a standard video out. An optional DC-100 magnetic-tape drive is also available.

The μp-controlled DAS 9100 mainframe with keyboard and CRT sells for $4950. Modules begin at $3500. Designers not wanting a customized system can choose from four available models priced at $11,700 to $26,900. *—Dwight B. Davis*

Tektronix, Inc., P.O. Box 500, Beaverton, Ore. 97077.

Circle No 203

Peripherals add versatility to V77 minicomputer line

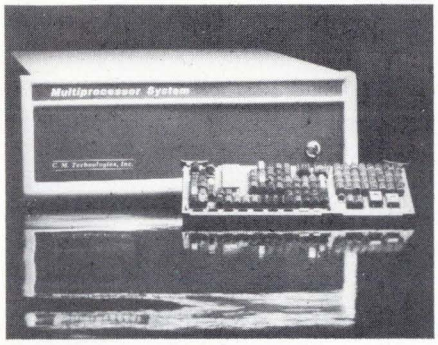
Sperry Univac has recently announced mass storage, CRT, printer and software enhancements to its V77 line of minicomputers, thus adding versatility to the family. With the model 3770 14-in. fixed Winchester-disk drive, users of the V77-500, -700 and -800 minicomputers can add 70M or 104M bytes of storage using two drives and a single controller, at a data-transfer rate of 1.2M bytes per sec. The model F3064 dual-drive, double-density floppy-disk subsystem expands the storage capacity of the V77 to 2M bytes, with a four-drive, 4M-byte option available. Price for the F3770 is $13,000, and price of the 3064 is $6500.

CRT peripheral enhancements include the model UTS-20 μp-based communications terminal, which incorporates Uniscope 100 and 200 and UTS-400 functions into the V77 systems. The model UTS-40 intelligent terminal offers UTS-400 compatibility, including user-programmability, and supports 64K bytes of self-contained memory and a variety of peripherals. The UTS-20 is priced at $3200, and the UTS-40 is $4160.

Printer enhancements include the model 0797 tabletop, hard-copy matrix-impact printer. The μp-controlled peripheral device features an 80-column line with optional switch-selectable 6 or 8 lpi. The bidirectional model 0798 200-cps μp-controlled serial output printer is also available. It sells for $6000, and the 0797 sells for $1900.

Sperry also offers two COBOL-based software products, the Commercial Transaction System I for entry-level V77-500 users, and the System II for high-volume production requirements. The System I comprises the Vortex II operating system and approximate resourcing communication handlers. The System II includes all the components of System I, but COBOL 74-800 is substituted for COBOL. It does not include indexed sequential access method (ISAM). A System I software license is priced at $12,000, and System II software is licensed at $14,000. **Sperry Univac,** 10880 Wilshire Blvd., Suite 2110, Los Angeles, Calif. 90024.

Circle No 204



Development system has 68000 CPU

The Multibus-compatible CMS-16 engineering-development system, based on the Motorola 68000 CPU, includes a single-board CPU with 64K bytes of dynamic RAM, two sockets for 16K-bytes EPROMs, seven vectored interrupt levels and circuitry to configure a Multibus system with multiple masters. The CPU operates at 4, 6 or 8 MHz. Other features include a synchronous or asynchronous serial interface board with four ports and a nine-slot Multibus card cage and power supply with protective enclosure. The CMS-16, including monitor firmware in EPROM, is priced at $4995. **CM Technologies, Inc.,** 525 University Ave., Palo Alto, Calif. 94301. **Circle No 205**

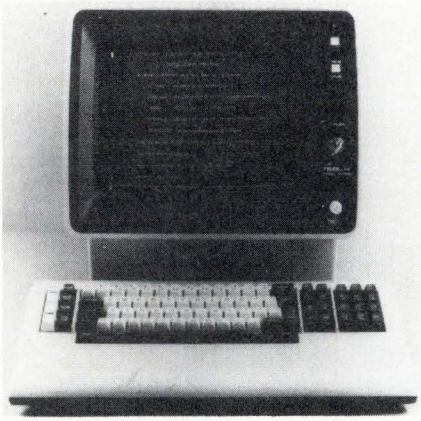
Qantel systems include 64K-byte memory

The System 22 and System 23 stand-alone network systems have memory expandable to 256K bytes and support as many as eight video terminals and three printers. System 22 includes 64K bytes of memory, a 10M-byte Winchester-disk drive, a 650K-byte floppy-disk drive, a 90-cps printer and a video terminal. System 23 includes 64K bytes of memory, a 650K-byte floppy drive, a video terminal, a 20M-byte Winchester-disk drive and a 150-cps printer. System 22 and 23 sell for $19,950 and $23,950, respectively. **MDS Qantel, Inc.,** Hayward, Calif. **Circle No 206**

MBS announces business system

The MBS 3000 business computer system includes a 16-bit μp on-board memory, including 64K bytes of RAM, 10M- or 20M-byte, 8-in. Winchester disks and an optional SDLC port. Software packages include general ledger, accounts payable, accounts receivable, inventory, job costing, payroll and order processing. The MBS 3000 is priced at $19,900 for a single-user system and $27,100 for a fully configured system. **Mercator Business Systems,** 1294 Lawrence Station Rd., Sunnyvale, Calif. 94086. **Circle No 207**

New Systems



Telex unveils library system

The 476L display terminal for library cataloging, circulation control and record functions accommodates the ALA/MARC character set, Cyrillic and Hebrew alphabets, diacritics, superscripts, subscripts and graphics. The system operates from an IBM S/360, S/370, S/303X or S/4300 and can be used stand alone, in branch library environments or in multi-station clusters of as many as 16 displays within 5000 ft. The 476L is priced at $2850, with quantity discounts available. **Telex,** 6422 E. 41st St., Tulsa, Okla. 74135.

Circle No 208

Energy-control system monitors 512 inputs

The μp-based AC 256 energy-control system for control and analysis of electric, oil, gas, steam or solar systems monitors 32 to 512 inputs and controls 16 to 256 outputs. As many as 16 AC 256s can be connected within a building or remote buildings to provide a network of 8192 inputs and 4096 outputs. Other features include temperature, pressure, digital and counter inputs; digital and pulse-analog outputs; program battery backup; comprehensive data logging; dial-telephone access; manual override; and rugged design. The user-programmable system's software features English-word commands and prompting messages, edit and simulation capability, a math package and three levels of password security. The system sells for $7805, and I/O expansion modules, designated as AC 256 slaves, sell for $4050, with dealer discounts available. **Andover Controls Corp.,** York and Haverhill Sts., Bldg., 5, Fl. 5, Andover, Mass. 01810.

Circle No 209

Nixdorf introduces stand-alone word processor

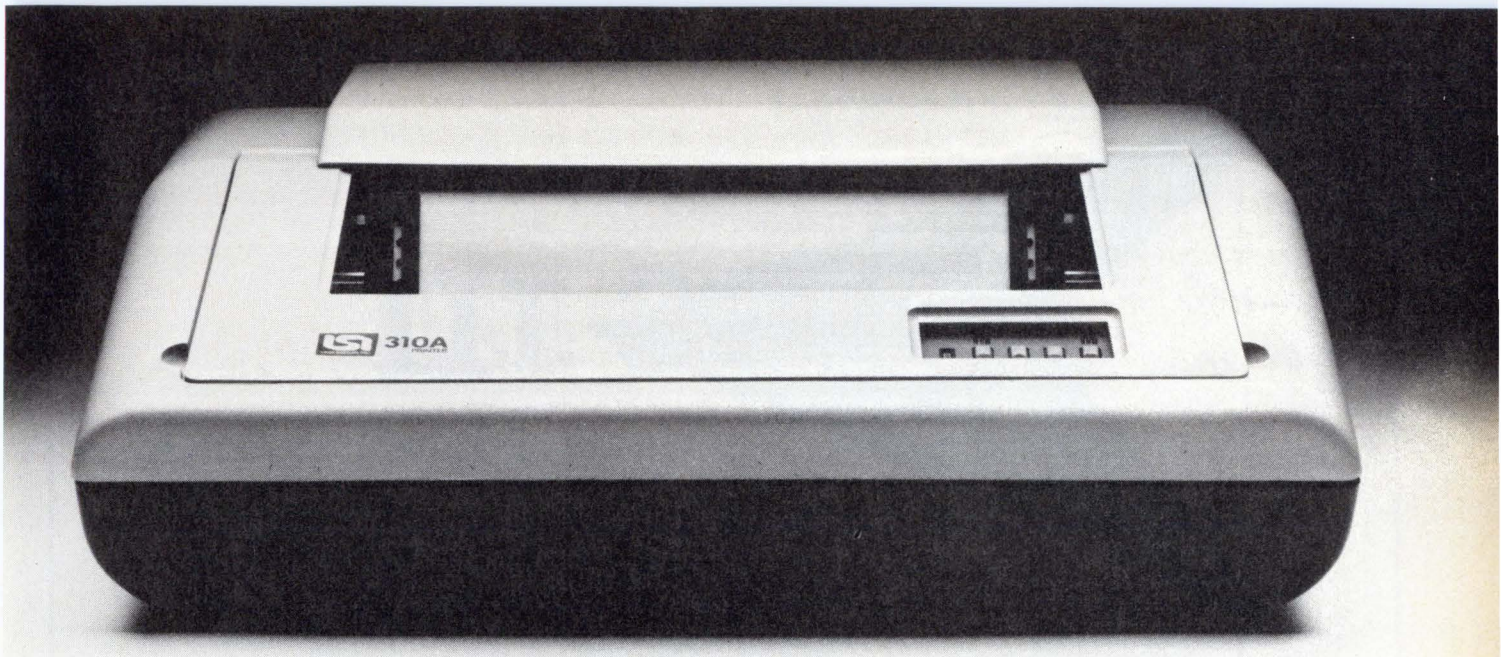
The 8830/3 word-processing system with Text Communications (TECOM) software can be used as a stand-alone work station or can communicate with the vendor's 8870 general-business system. TECOM provides 30-level selection, including a logical and/or function, combined selection of two files, a security-utility program, text archiving on the 8870, including attributes and codes and password security. The 8840/3 stand-alone system includes a control unit housing two diskette drives with 65 to 80 pages of storage each, 48K bytes of MOS memory, a 12-in. large-character screen, a detachable keyboard and a 540-wpm daisy-wheel printer. The 8840/3 sells for $12,500. **Nixdorf Computer Corp.,** 168 Middlesex Tpk., Burlington, Mass. 01803.

Circle No 210

Quota announces medium-sized systems

This line of medium-sized-business systems includes configurations offering 8- and 16-bit CPUs and floppy-, fixed- or removable Winchester disks. The 16-bit system features 192K bytes of main memory expandable to 1M byte. An integrated chassis incorporates as much as 30M bytes and external-expansion storage can be added. A 10M-byte removable Winchester can be used for on-line storage or backup. The unit supports as many as eight users. **Quota,** 6680 Sierra Ln., Dublin, Calif. 94566.

Circle No 211



LSI quietly presents the Hummm Terminal.

From those wonderful folks who brought you the Dumb Terminal® video display, now there's the Hummm Terminal™ Printer.

Featuring quiet operation that's almost unheard of, outstanding reliability and print quality, impressive throughput and a long list of sensible features.

All at a hard-to-believe low price. So low, in fact, that you'll immediately know why we call it Hummm Economics.

A LOT OF IMPACT PRINTER WITHOUT A LOT OF NOISE.

Quite simply, the 310A Hummm Terminal is one of the quietest impact printers in its class. In fact, with its Acoustic Quieter it checks in at a soothing 56dBA. That's quieter than most typewriters. And than most copy machines.

Fine engineering is the quiet secret. The Hummm Terminal hums along bidirectionally at 180 cps.

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You won't find many options on the Hummm Terminal. Because we made most of them standard.

Its logic seeking capability finds the shortest path to the next character on a new line—thanks to space and blank character compression. And with an optionally expanded buffer of 2048 characters, a full terminal screen can be dumped instantly.

You get superior printing capability, including true lower case descenders and underlining—good for an original and five crisp copies on multipart forms. A 9x7 character field. Complete horizontal and vertical forms control. 14 switch selectable form lengths, and 14 perforation skip-over formats. And a 100% duty cycle.

HUMMMAN ENGINEERED.

The Hummm Terminal brings to computer printers the same high standards that made our Dumb Terminal video display the standard for an entire product category. It's rugged, durable, and stylish so it fits right into any office decor.

So call your nearest LSI Authorized Distributor and ask him for some Hummm Terminal information. And when you do, fill out the coupon completely and send it to us. We'll send you a free Hum^3 with over 3 billion combinations—and only one right one.

It'll give you something to do during those quiet moments when the Hummm Terminal is humming along.

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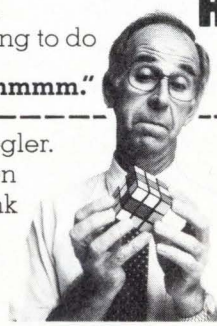
THE 310A HUMMM TERMINAL.

LSI LEAR SIEGLER, INC. DATA PRODUCTS DIVISION



Hummm, Lear Siegler. You've certainly given me something to think about. I asked my distributor about the Hummm Terminal.

Here's his name along with my business card. (I realize that I can't get a Hum^3 if I don't include my card.)

Name_____

Distributor _____

Distributor Sales Rep_____

Distributor Location_____

Distributor Telephone_____

Lear Siegler, Inc., Data Products Division, 714 North Brookhurst Street, Anaheim, CA 92803. Attn: Adv. C

CIRCLE NO. 39 ON INQUIRY CARD

MDBS, Incorporated

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MDBS III

a new generation in data base management technology

not limited to relational, tabular, flat-file structures

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The structures above are mere subsets of the capabilities of MDBS III.
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For serious application development, MDBS III offers major advantages in these seven key areas:

Extraordinary data structuring
Unmatched flexibility for relating records to each other with ease.

Automatic data *compression* where desired.

Up to 255 record types per schema.

High-level query language
Automatically generates desired report or data file with a *single statement.*

Language is *English-like, non-procedural,* and has report writing capabilities.

Extensive performance control
Gives application designer extensive control over record placement...includes automatic *clustering* and *CALC* features.

For highest performance, a streamlined DML...over 20 *host language* interfaces available.

All processing is *data-dictionary driven.*

Data security and integrity
User *passwords* and optional data *encryption.*

Comprehensive *access code facility* for automatic security enforcement.

Automatic *range checking.*

Available for Minis and Micros
Availability for numerous *8* and *16-bit micros,* as well as for *minis,* provides standardized approach to data handling.

Allows extensive portability of application systems...from the *Z-80* to the *PDP-11.*

True multi-user capabilities
Supports multiple *concurrent* users of the same data base.

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Automatic transaction logging
Automatically logs all transactions after last back-up.

Selective restoration of data base in event of a crash.

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☐ Yes, please send me a copy of the MDBS III brochure.
☐ Please send me the complete MDBS III manual set including manuals for MDBS III, RTL, QRS, and DMU plus tutorial materials. Check for $75.00 enclosed. (Indiana residents please add $3.00 for Indiana tax.)

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Company _____

Address _____

City _____ (State) (Zip)

Phone _____

MAIL TO: Micro Data Base Systems, Inc.
Box 248-M
Lafayette, IN 47902

CIRCLE NO. 40 ON INQUIRY CARD

Attention, Multibus™ users...

Only the CD100M now supports CP/M and CP/M86 in the perfect desktop package.

Hear this, LSI-11 users...

Only the CD100L emulates a VT103, an RL02 and an RX02 in a single desktop package.

And both now include a 10 megabyte Winchester!

CD100M — THE TOTAL OEM SOLUTION

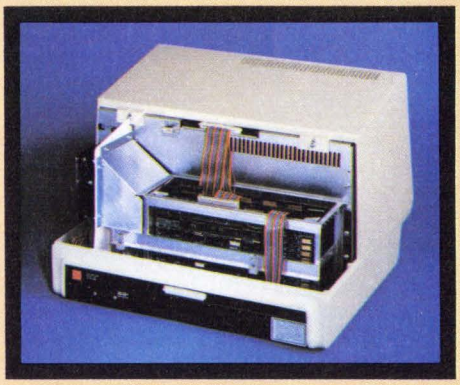
To give your Multibus microcomputer system increased file storage, the Callan™ CD100M Integrated Work Station now includes a high performance 10 Mbyte 5¼-inch micro Winchester disk drive complete with full DMA and fully automatic and transparent burst error correction. A one Mbyte unformatted floppy provides file entry and back-up. With its integral 6 slot Multibus compatible card cage, intelligent video terminal, and Winchester/Floppy disk system, the CD100M is the *only* single desktop package available to OEM and volume end-users who wish to configure a modular microcomputer system using any Multibus compatible card set. It's the perfect solution, significantly reducing product costs and development time.

CP/M AND CP/M86 CONFIGURATIONS

If you prefer the popular CP/M operating system, Callan can provide the CD100M with either 8-bit or 16-bit micros. A Z80 with 64K RAM and CP/M, or an 8086 with 128K RAM with error correction and CP/M86 are both available as the complete solution for CP/M compatible software. And both systems include 10 Mbyte Winchester performance.

If you're using Multibus cards in your system you must see the Callan™ CD100M Integrated Work Station.

CP/M and CP/M86 are trademarks of Digital Research. Multibus and 8086 are trademarks of Intel Corp. Z80 is trademark of Zilog.



Built-in card cage holds 6 Multibus or 7 quad/14 dual height LSI-11 cards.

Callan™

DATA SYSTEMS

2637 Townsgate Road
Westlake Village, CA 91361
Telephone: (805) 497-6837

CIRCLE NO. 41 ON INQUIRY CARD

CD100L — COMPLETE DEC COMPATIBILITY

For the OEM or end-user configuring an LSI-11 system, only the Callan™ CD100L Integrated Work Station can emulate a 10 Mbyte RL02 Winchester disk, a 0.5 Mbyte RX02 floppy, and a VT103 Terminal in a *single* desktop unit. Software presently running on RT-11, RSX-11 or other LSI-11 operating systems can now run on the CD100L, reducing hardware costs by as much as 30%. For users who prefer a more complete solution, the CD100L can also be ordered complete with LSI-11/2 or LSI-11/23 and RT-11.

MORE FOR LESS

No other solution compares for performance, features and price. The VT100/VT52 compatible terminal offers 6 video attributes, true split screen with separate scrolling regions standard. The LSI-11 Q-bus compatible card cage provides 7 quad or 14 dual height slots to house even the largest configurations. A Winchester controller is available to directly emulate the 10 Mbyte RL02. RX02 emulation is available either in a 1 Mbyte dual floppy configuration or as 0.5 Mbyte back-up for the Winchester.

If you're tired of multiple package or multiple vendor solutions, you must see the CD100L.

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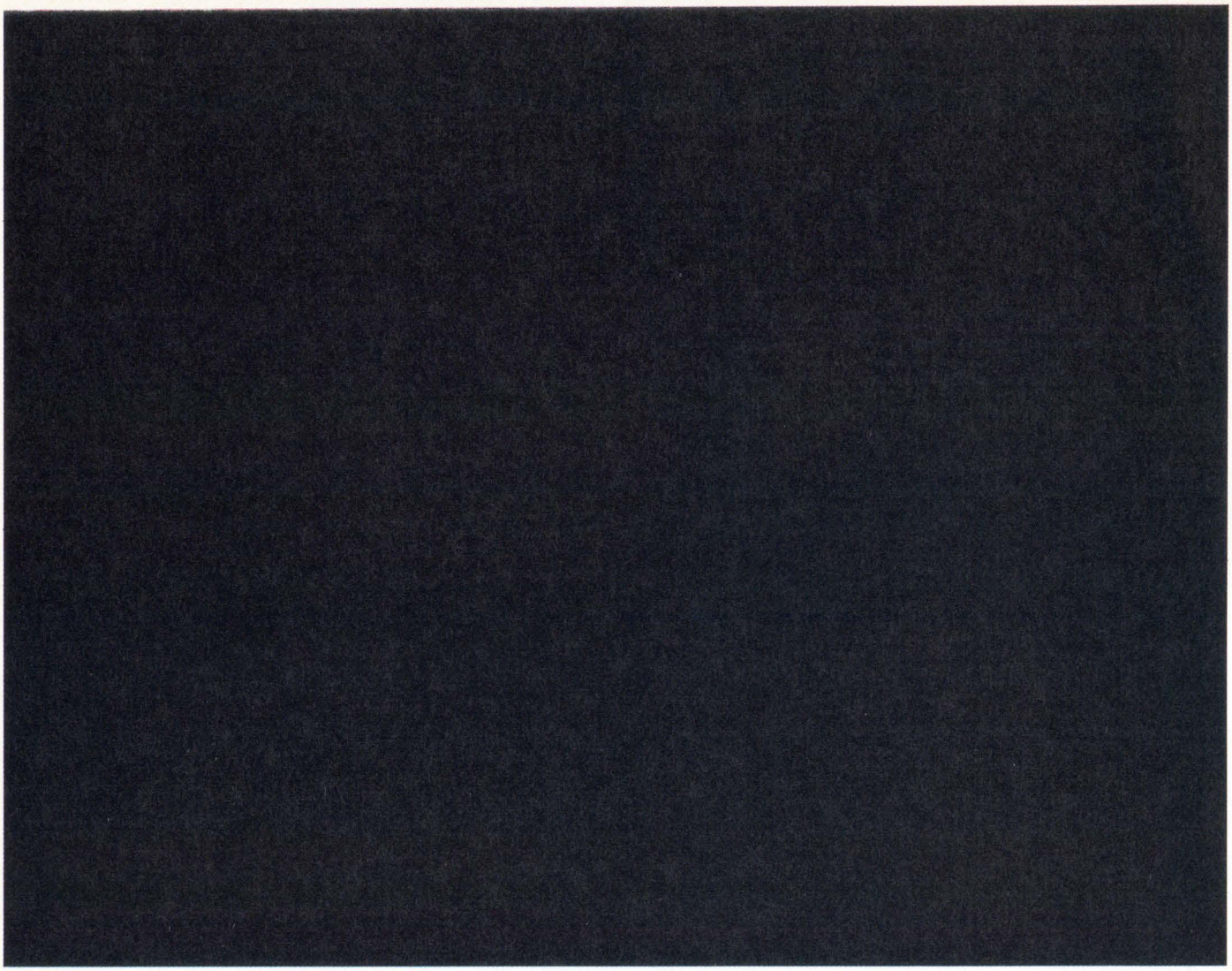

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Any independent supplier can save you a bundle on add-in/on memories for your DEC minicomputer.

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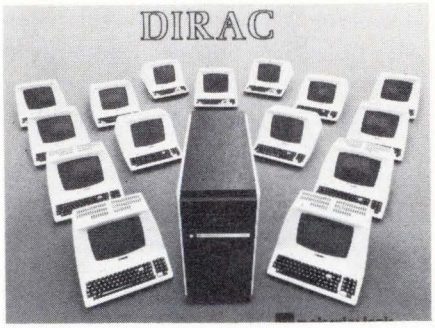
New Systems



System supports 255 users

The DIRAC computer system supports as many as 255 users by providing each with a 64K-byte module that can access a database via the vendor's MOLE bus. The sytem features two types of μp module, one for disk-storage management and the other dedicated to each user. The system also includes 30M bytes of disk storage and an 8-in. floppy-disk drive for software interchange and data backup. The system is based on the Z80A μp and features the CP/M operating system. A basic system sells for $9000; additional processor modules are priced at $1250. **Molecular Logic Corp.,** 10311 S. DeAnza Blvd., Suite 4A, Cupertino, Calif. 95014.

Circle No 212

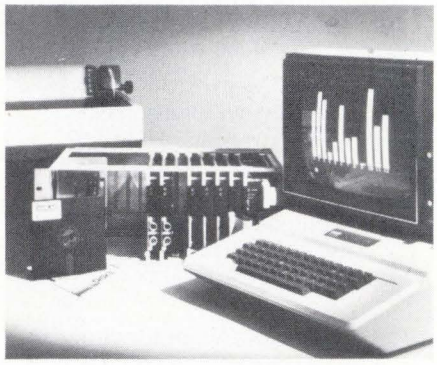
Minicomputer system aids PC-board design

This minicomputer system for automated interactive PC-board design incorporates an eight-color raster-scan graphics system with a 13- or 19-in. display monitor. The 32-bit virtual memory system features a disk drive, a tape drive and a system console and enables designers to select as many as eight different colors from a 4096-color palette. Color selections can be implemented for each phase of the design process, including placement, interconnection and editing. Other features include hardware-assisted zoom and dynamic panning. **Scientific Calculations, Inc.,** 7635 Main St., Fishers, N.Y. 14453.

Circle No 213

Sanlab announces analog-measurement system

The Analogger I temperature/low-level-analog data-acquisition system combines an analog-measurement system with an Apple II Plus Computer. Data logging can be done with a printer, a tape cassette, a disk or any combination. A 48K-byte RAM enables development of averaging, alarms, temperature gradients and other process-control functions. The system includes Level 1 software on disk for configuring, calibrating and running most data-logging and alarm functions. A memory-mapped analog-scanner interface is written in



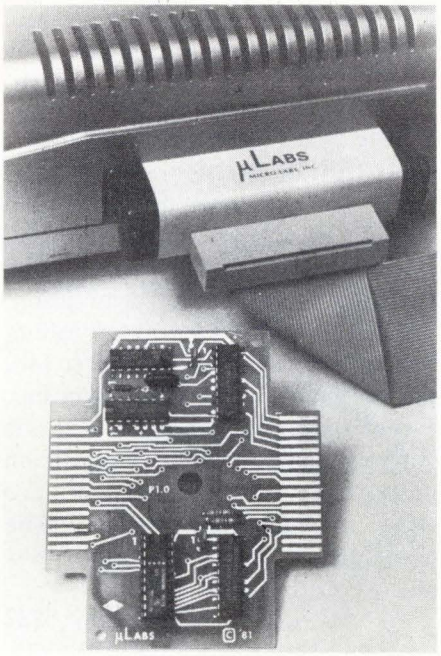
machine language. The system, including the computer, a CRT display, a floppy-disk drive, a clock/calendar, a parallel interface, a card cage for I/O modules and software, sells for $5995. **The San Diego Instrument Laboratory, Inc.,** 7969 Engineer Rd., San Diego, Calif. 92111.

Circle No 214

WDC offers μc Pascal-development series

The model ME1600 modular MicroEngine series of μc systems enables system integrators and OEM designers to develop customized programs in Pascal for professional, business and industrial applications. The system is available in four versions: the ME1660 subsystem, the ME1665 system and the ME1670 and ME1675 packaged systems. The ME1660 subsystem includes a Pascal processor, a 128K-byte dynamic RAM module, a floppy-disk controller, a serial-parallel I/O controller, a boot-terminator module and a 10-slot chassis with 170W power supply. The ME1665 system incorporates the 128K-byte ME1660 and a double-density, double-sided floppy-disk drive. The ME1670 packaged system includes the ME1660 and two double-density, double-sided floppy-disk drives and a desk-top enclosure. The ME1675 contains the ME1670, a 150-cps line printer and an 80-character × 24-line CRT terminal. **Western Digital Corp.,** 3128 Redd Hill Ave., P.O. Box 2180, Newport Beach, Calif. 92663. **Circle No 215**

printers



Micro-Labs unveils color-printer interface

The CPRINT color printer interface module provides TRS-80 color computers with a plug-compatible Centronics-type parallel printer port for use with all parallel Radio Shack, Centronics and Epson printers. The unit includes software in permanent on-board memory, providing transparent operation. Features include the ability to automatically reroute LLIST and PRINT ×-2 output; a screen-print function that can be initiated at any time; and the ability to set line width, to access graphics in the LPVII, to set page length and to insert blank lines between pages. In a plastic case, the module sells for $49.95. **Micro-Labs, Inc.,** 902 Pinecrest Dr., Richardson, Texas 75080.

Circle No 216

Wang adds printers for VS series

These printers for the vendor's VS computer family include the 5575 band printer, which prints as many as 136 columns on single- and multi-part continuous-forms paper. It operates at print rates of 850 or 1100 lpm, depending on the print band used. Price is $29,500. The 2281WR daisy-wheel printer and the 2281WCR wide-carriage version operate with the VS 2246R remote work station. The 2281WR prints at an average 30-cps rate. The bidirectional, impact unit provides printing at remote locations. The 2281WR and 2281WCR accommodate a variety of removable print wheels. They sell for $4500 and $6000, respectively. **Wang Laboratories, Inc.,** One Industrial Ave., Lowell, Mass. 01851. **Circle No 217**

Line printer prints 1800 lpm

The Reliband 1800 line printer for OEMs features field-upgradeable speeds of 1200, 1500 and 1800 lpm, depending on character-set length. The unit includes operator-changeable print bands, a servo paper drive, four paper tractors with shift system, a paper stacker, a choice of vertical-format units, internal diagnostics and ribbon compatibility with IBM 1403. **Storage Technology Peripherals Corp.,** Wickham Rd., Melbourne, Fla. 32901.

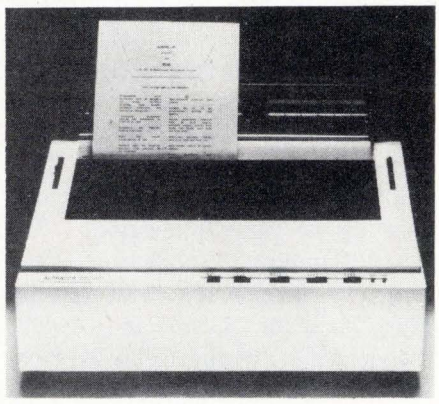
Circle No 218

Printer offers nine-needle print head

The bidirectional 132-cpl model M-132 matrix serial printer prints bar code and ASCII OCR-A or OCR-B characters. It features a dual-line, nine-needle print head that prints an overlapping dot pattern to achieve a formed-character appearance. Paper can be bottom- or rear-loaded, and optional split-platen forms handling enables a user to print labels and a summary sheet simultaneously. The 140-cpi unit also includes an RS232 interface, a 600-character buffer and switch-selectable forms length. Prices start at $2795, with OEM discounts available. **Mannesmann Tally,** 8301 S. 180th, Kent, Wash. 98031. **Circle No 219**

New Products

printers



Alphacom announces daisy-wheel printer

The model DP 2000 20-cps daisy-wheel printer includes a 100-character print wheel; more than 30 proportionally spaced, 10, 12- and 15-pitch typefaces; normal, automatic-underlining, boldface and boldface-underlined print modes; horizontal tabulation; and incremental horizontal spacing to 1/120 in. The printer includes a Centronics-type 8-bit parallel interface, and IEEE 488 parallel and RS232C interfaces are optional. The bidirectional unit handles forms as wide as 17 in. and having as many as five parts. Prices are $1695 with a parallel interface and $1795 with an IEEE 488 or an RS232C. **Alphacom, Inc.,** 2323 S. Bascom Ave. Campbell, Calif. 95008. **Circle No 220**

Versatec offers 1000-lpm printer/plotter

The 1000-lpm V-80 electrostatic printer/plotter prints 132 cpl and plots an 8½- × 11-in. page with 200-dpi resolution in 7 sec. With an optional controller, the unit produces hard copy from a CRT or a video source in 20 sec. Options include an RS232C interface; long-line drivers and receivers; underlining; a 96-character ASCII set in Gothic, Roman or Courier; a 124-character set for scientific/engineering applications; and plug-in PROM configurations for nine languages. Price is $8500 in single-unit quantities, with OEM discounts available. **Versatec,** 2805 Bowers Ave., Santa Clara, Calif. 95051. **Circle No 221**

Standard Register unveils dot-matrix printer

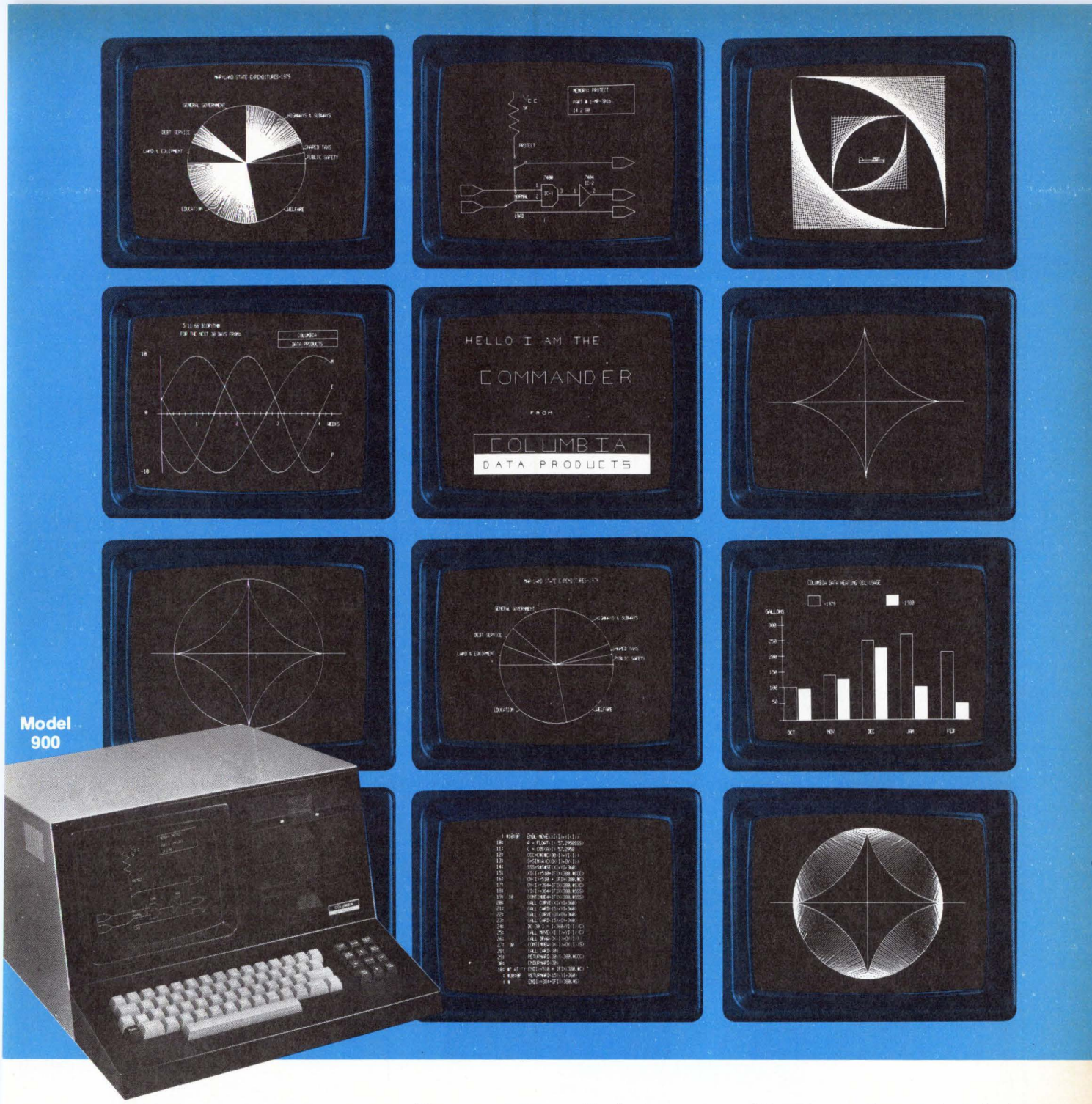
The 300-lpm dot-matrix "Flexible Image Printer" prints variable-sized bar codes, graphics and OCR-a characters in normal orientation, upside down or sideways, reading from top to bottom or bottom to top, in normal or reverse printing. Power requirements are 110, 60 Hz single phase. Prices range from $9550 to $12,700; lease charges are $320 to $450 per month. **The Standard Register Co.,** P.O. Box 1167, Dayton, Ohio 45401. **Circle No 222**

Dot-matrix printer is Apple II-compatible

The Apple II-compatible model 170 dot-matrix unit prints 18 or 21 cpl and 6 lpi on 2¼-in. adding-machine tape. Features include a parallel interface with a Centronics-type handshaking and a DB-25 interface connector, an internal three-line buffer, switch-selectable, ASCII or Baudot input code, upper- and lower-case characters and an internal clock and calendar. Price is $299, with quantity discounts available. **Addmaster Corp.,** 416 Junipero Serra Dr., San Gabriel, Calif. 91776. **Circle No 223**

Siemens announces ink-jet facsimile unit

The HF 2040 ink-jet facsimile printer transmits via telephone lines in a 2- or 3-min. format and is compatible with CCITT Group II printers. The unit's ink supply lasts for about 2000 pages. The unit provides push-button indication of transmission or receiving modes. Price is approximately $3200. **Siemens Corp.,** Box 1000, Iselin, N.J. 08830. **Circle No 224**



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When you need a graphic display capability with your microcomputer...don't buy a separate terminal...select our Model 900 Commander with the self-contained vector and point plotting features of a sophisticated graphics terminal and 512x256 point resolution.

You can display bar charts, pie charts, histograms and complex point to point plots. You can even output displays originally intended for a Tektronix® 4010 with our Tektronix terminal emulator. And with Commander's double processor architecture, graphic display processing is independent of the primary Z80A CP/M™ based computer system. This means larger program capacity and faster execution time for user software.

So buy a Commander 900 microcomputer and get a graphics display terminal free.

Other standard features include dual Z80A processors, 96K RAM, 4 RS-232 ports, 4 parallel ports, RS-170 composite video, 4 channels of programmable counter/timer, 400 Kbytes disk storage and CP/M operating system. Optional features include APU, DMA, IEEE bus controller and expanded disk capability.

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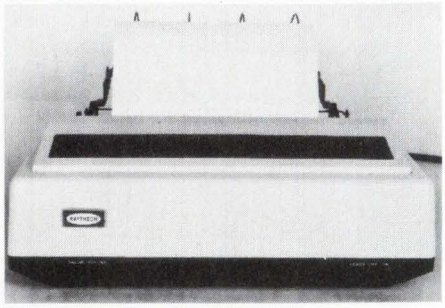


Raytheon offers printer for PTS-2000

The model R2185 desk-top, dot-matrix screen printer for the vendor's PTS-2000 intelligent terminal system prints 100 cps, 80 cpl and 6 lpi. The 12-lb. 5- × 15- × 17-in. printer is modularly packaged and features a pin-feed platen, a 96-character ASCII set, a Mobius loop-cartridge ribbon system and the ability to accept cut sheet one- to three-part fanfold or roll paper. An optional print buffer allows use of the display during printing, and optional host access enables printing of messages from the host. The unit sells for $1910, including a display adapter. One- two- and three-year lease rates are $97, $80 and $71 per month, respectively, including maintenance. The print buffer is $120, and the host access is $235. **Raytheon Data Systems Co.,** 1415 Boston-Providence Tpk., Norwood, Mass. 02062.

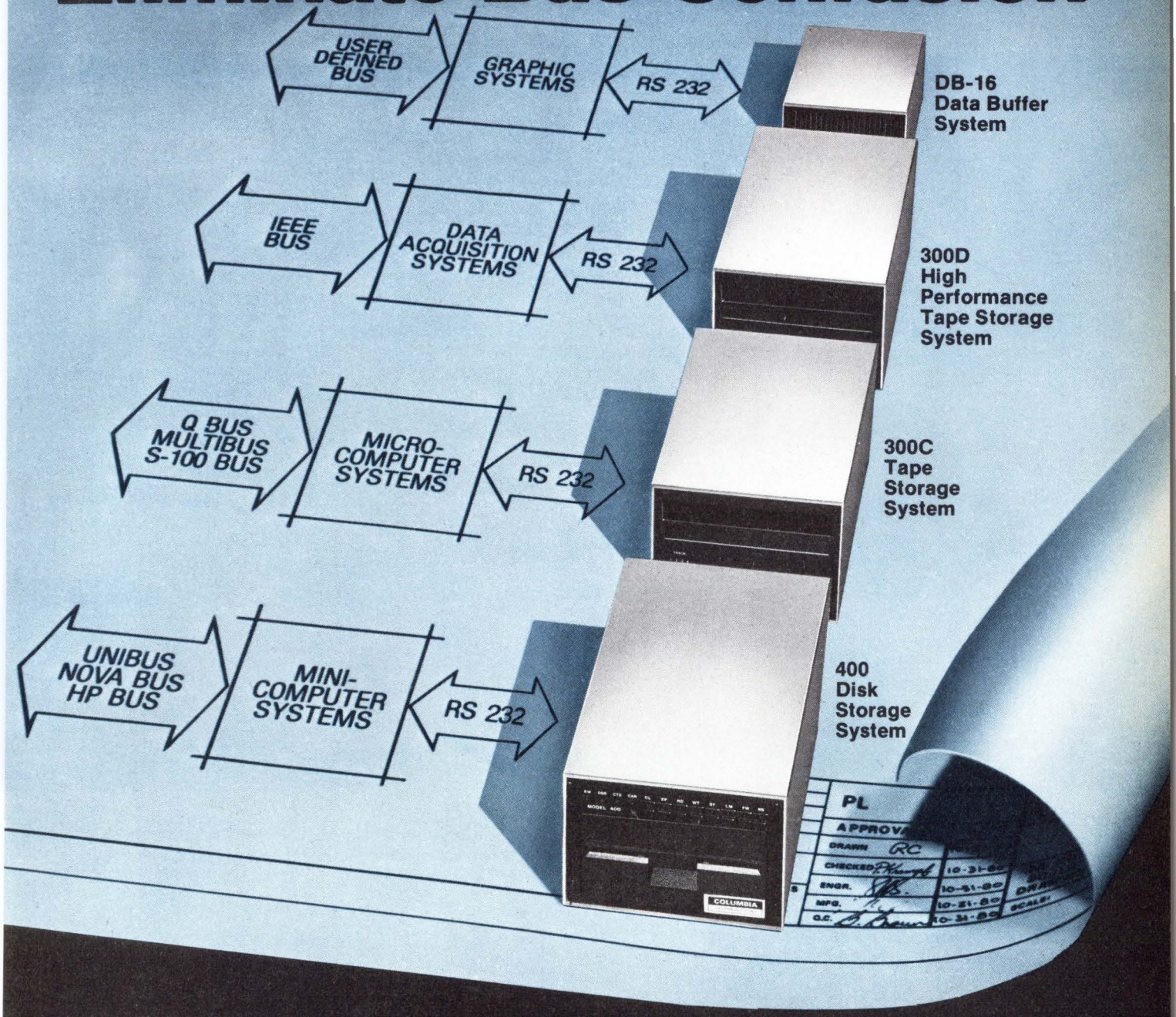
Circle No 225

Laser unit prints 2600 lpm

The 2600-lpm "Electronic Page Printer" uses the vendor's 780-nm. semiconductor laser and the Holoscan scanning system. Features include 6-ips print speed, 300-dpi imaging, μp-controlled plain-paper printing, dry toner dual-input paper cassettes and a μp-driven phase-locked-loop printing engine. Price is $4000 in OEM quantities. **General Optronics Corp.,** 3005 Hadley Rd., South Plainfield, N.J. 07080.

Circle No 226

Our RS-232 Peripherals Eliminate Bus Confusion



Forget about compatibility with the Multibus, Q bus, S-100 bus, Unibus or the host of others. Most systems have an RS-232 data port. So select an RS-232 compatible peripheral from Columbia Data Products and leave the bus confusion to others.

System compatibility isn't all you get with CDP peripherals. You also get microprocessor intelligence in our floppy disk, cartridge tape or RAM based storage systems.

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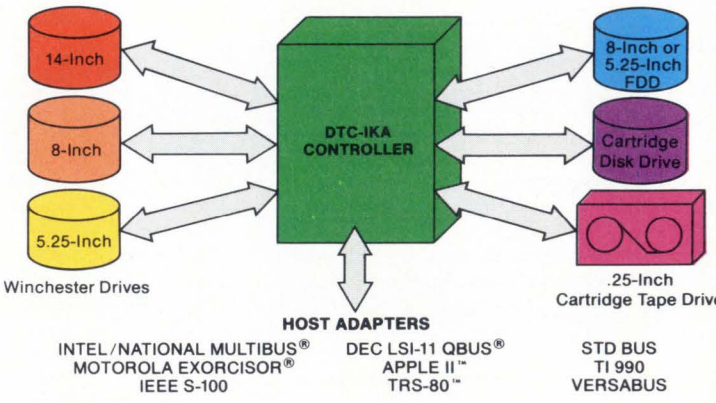

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CIRCLE NO. 49 ON INQUIRY CARD

datacomm

Racal-Vadic introduces 2400-bps modem

The VA2450/55 series 2400-bps direct-connect modem for remote-terminal users replaces the Bell 201B/C. The unit is FCC-registered for direct connection to the switched network through voice or programmable data jacks. A two- or four-wire-leased line version is available for point-to-point and multipoint systems. The VA2455 features a switch-selectable 75- or 150-bps auxiliary channel that can be used in forward or reverse mode. It incorporates an interface display, local (analog) loopback, "Force Request to Send" (RTS) and self test. Price is $725, with OEM discounts available. **Racal-Vadic,** 222 Caspian Dr., Sunnyvale, Calif. 94086. **Circle No 227**

Anderson Jacobson offers 'triple' modem

The model AJ 1259 "triple" modem is designed for users in mixed communication environments of low and medium speeds, multiple Bell and Vadic protocols or those who send data at one speed and receive answers at another. The originate/auto-answer modem communicates at speeds as high as 300 bps with Bell 103/113 and at 1200 bps with Bell 212 or VA 3400 protocols. The μp-controlled unit automatically selects the correct protocol when answering a call, and performs continuous self-testing. It connects directly to RJ11C telephone jacks, is FCC-approved and meets UL and CSA standards. **Anderson Jacobson, Inc.,** 521 Charcot Ave., San Jose, Calif. **Circle No 228**

Front-end concentrator connects units to IBM host

The FEC/1 front-end concentrator runs on the IBM Series/1 and enables the 370/158 host to communicate with a 500-terminal network, including Bunker-Ramo 2001 teller terminals, Hazeltine general-purpose CRTs, ISC teller terminals and Docutel ATMs. The unit assumes network-polling duties and handles local transactions during host down time. The system can also include a negative file of unauthorized bank cards, balances and credit limits. **Argos Computer Systems,** 200 Madison Ave., New York, N.Y. 10016 **Circle No 229**

interfaces and controllers

Single-board controller is SMD I/O-compatible

The model 202A SMD I/O-compatible disk controller features a mix-or-match interface of one or two 8- or 14-in. Winchester, SMD pack or CMD cartridge hard-disk drives to LSI-11, 11/2 AND 11/23 computers. The controller, which stores 8M to 300M bytes, uses a universal firmware set that does not retain drive parameters in on-board components, permitting mixing or matching drives without controller or component changes. The μp-based unit is compatible with DEC RP02/RP03 software drivers in RT-11 and RSX-11 operating systems. Price is $2775. **Distributed Logic Corp.,** 12800 Garden Grove Blvd., Garden Grove, Calif. 92643. **Circle No 350**

Intel offers GPIB Multimodule

The iSBX 488 GPIB Multimodule board provides a standard interface from any Intel iSBC Multibus board equipped with an iSBX connector to instruments and computer peripherals that use the IEEE 488 standard. The module can be configured as a talker, listener, talker/listener or bus controller. The board enables Intel single-board computer users to program and control as many as 15 instruments over a parallel bus. Other features include a 50K-byte-per-sec. data rate, DMA data transfers, interface-clear sending, bus-control-transfer and response-to-service-requests functions. Price is $650 in single-unit quantities and $598 in quantities of 10. **Intel Corp.,** 5200 N.E. Elam Young Pkwy., Hillsboro, Ore. 97123.

Circle No 351

Device links mainframes to PDP-11s

The μp-based IF-11/U200 enables Sperry Univac 1100 mainframes to link remotely to a DEC PDP-11 minicomputer that clusters as many as 31 terminals. The unit emulates a Univac/Terminal multiplexer with Uniscope 200 terminals and supports modem links to two 1100 mainframes. A basic configuration supports eight terminals and sells for $11,400. As many as three add-on X/U200 units can be added, each selling for $5000. **Associated Computer Consultants,** 228 Cota St., Santa Barbara, Calif. 93101.

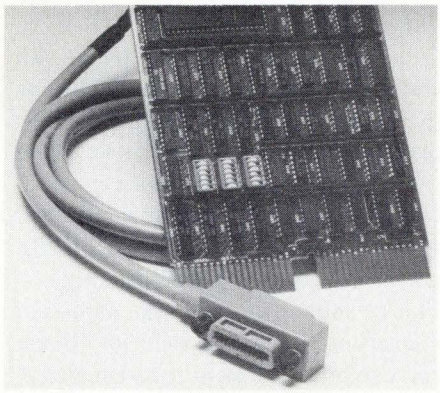
Circle No 352

PerSci announces diskette-drive controller

The model 1180 single-density, FM-encoding or double-density,

MFM controller operates with IBM diskette 1 or 2D formats in single- or double-sided drives. The controller uses a command set that allows data storage and retrieval from sector write/read to file management. It also provides diskette initialization and diagnostic commands. The unit controls one or two model 299B dual-head drives or two model 277 single-head drives. Price is $950 in single-unit quantities. **PerSci, Inc.,** 12210 Nebraska Ave., W. Los Angeles, Calif. 90025.

Circle No 353



Interface links LSI-11 and GPIB

The model GPIB11V-2 DMA interface links the IEEE-488 bus and the DEC LSI-11 Q-bus. The unit provides data transfer speeds as high as 250K bytes per sec. and allows 16-, 18- or 22-bit addressing on the LSI-11 bus. The system provides all GPIB functions, including extended talker, extended listener and controller. The interface allows the LSI-11 to be connected with as many as 14 GPIB-compatible devices, such as multimeters, frequency counters, spectrum analyzers and computers. Support software includes drivers, utilities and interactive control program. A standard package, including the interface card, software, a 4m. cable with GPIB connector on the outboard end and documentation, sells for $1495. **National Instruments,** 8900 Shoal Creek Blvd., Austin, Texas 78758.

Circle No 354

interfaces and controllers

Universal I/O board uses Intel 8741A

The model DM-4100 universal I/O board incorporates an Intel 8741A universal peripheral interface 8-bit μc, which acts as a slave to the STD bus CPU. It is compatible with 8088, 8085 and Z80 CPUs. More than one-half the unit's PC board is available for mounting ICs, connectors and discrete components. The Intel 8741A has an integral 1K × 8 UVEEPROM for program memory, 64 × 8 RAM for data storage, an 8-bit timer/event counter and a 6-MHz crystal-controlled clock. Prices are $195 in single-unit quantities and $136.50 in 100-unit-quantities. **Desert Microsystems, Inc.,** S/R 1, Box 1174-D, Pasco, Wash. 99301.

Circle No 355

National offers RAM interfaces

The DP8408 dynamic RAM controller/driver and the DP8409 multimode dynamic RAM controller/driver are 48-pin devices that can drive 4K-, 16K- and 64K-byte dynamic RAMs, and provide all control and address signals for as many as 88 dynamic RAMs with propagation delays of 20 nsec. The DP8408 offers five modes of operation, including externally controlled refresh and access, all-RAS write and fast and slow automatic access. The DP8409 includes eight modes of operation, including refresh, burst refresh and all-RAS automatic write, with nine multiplexed address outputs and control signals able to drive 256K-byte dynamic RAMs. In quantities of 100, the DP8408 is $35, and the DP8409 is $40. **National Semiconductor,** 2900 Semiconductor Dr., Santa Clara, Calif. 95051.

Circle No 356

Backus announces intelligent switch

The "Digilink" μp-based device can be used as an intelligent switch or as a print buffer. It can be configured to connect two dissimilar terminals to share one modem or connect two remote CPUs with a monitor terminal on a third part. Each RS232 port can be set through keyboard commands to accommodate devices with different baud rates, parity, X-on/X-off, fill characters, buffer length and auto line feed. When used as a print buffer, the unit accepts data from host computers at high speeds and

transfers it to slower speed off-line printers or other peripherals through parallel or RS232 ports. Other features include as much as 16K bytes of RAM, text-editing capabilities, code conversion and serial/parallel conversion. Prices for a 4K-byte model start at $775. **Backus Data Systems, Inc.,** 1440 Koll Circle, Suite 110, San Jose, Calif. 95112. **Circle No 357**

Disk cache stores 256 data sectors

The Turbo-21 single-board add-on disk cache works with the EDC21 disk controller on DEC PDP-11 and VAX processors. The unit uses 128K bytes of dynamic on-board RAM with transparent refresh, which allows the board to store 256 sectors of data. The system includes a μc that uses a proprietary caching algorithm and a 32-bit ECC. Other features include the ability to lock as many as 254 sectors into the cache memory, enabling a user to designate high-use sectors, and the ability to unlock, which enables locked sectors to be deleted. Price is $6750 in single-unit quantities. **Minicomputer Technology,** 2470 Embarcadero Way, Palo Alto, Calif. 94303. **Circle No 358**

Controller links printers to H-P computers

The DataLynx printer controller enables Hewlett-Packard computers to drive Printronix 300- and 600-lpm printers. The model is plug-compatible with the HPIB interface bus for the HP250, 300 and 3000 series. The unit converts the HPIB output to asynchronous serial format, which can be conducted more than 15 m. by an RS232C cable. The controller increases the baud rate of the printers to 19.2K bps. Price is $2395. **Local Data,** 2701 Toledo St., Torrance, Calif. 90503. **Circle No 359**

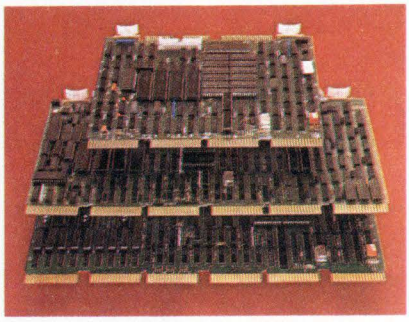
Family pride.

Now there's an advanced technology family of single board controllers for DEC* computers from Western Peripherals—the number one name in controllers.

The TC-131 (for PDP-11s*) is the first TM-11 emulating controller to combine PE and NRZ on one standard hex board. It lets you mix 9-track, PE, NRZ or dual density tape units in any combination up to 125 ips. A 64 byte data buffer allows installation at any point on the unibus without consideration of NPR priority.

The TC-151 single board NRZI tape controller interfaces any industry-standard drive to the LSI-11.* Add a dual width Phase Encode Board for the same performance as the TC-131.

The DC-231 accommodates up to four SMD disc drives of 40 to 600 mb each with RMO2 emulation. Its four sector (2048 bytes) data buffer makes "data-late" errors a thing of the past. The advanced technology "micro-engine" allows a complete track to be written on a single drive revolution. A measurable performance advantage for your PDP-11.



All three controllers are software compatible. All have self test. All are backed by one of the best factory service organizations in the business. And all can be delivered in 30 days.

For more information, call or write today: Western Peripherals Division, Wespercorp, 14321 Myford Road, Tustin, CA 92680, U.S.A. (714) 730-6250. TWX: 910 595-1775. CABLE: WESPER. 1st floor The Parade, Frimley Camberley. Surrey GU16 5HJ England, Telephone 0276 20934, TWX: 858306.

Number 1 in controllers for DEC and Data General computers.

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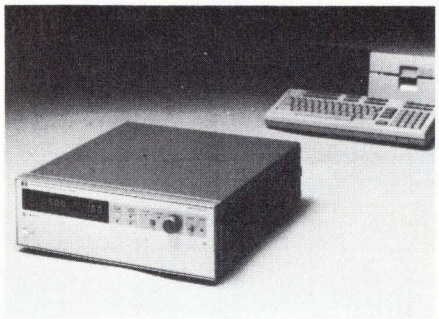
CIRCLE NO. 56 ON INQUIRY CARD

*Trade name of Digital Equipment Corporation.

New Products

power supplies

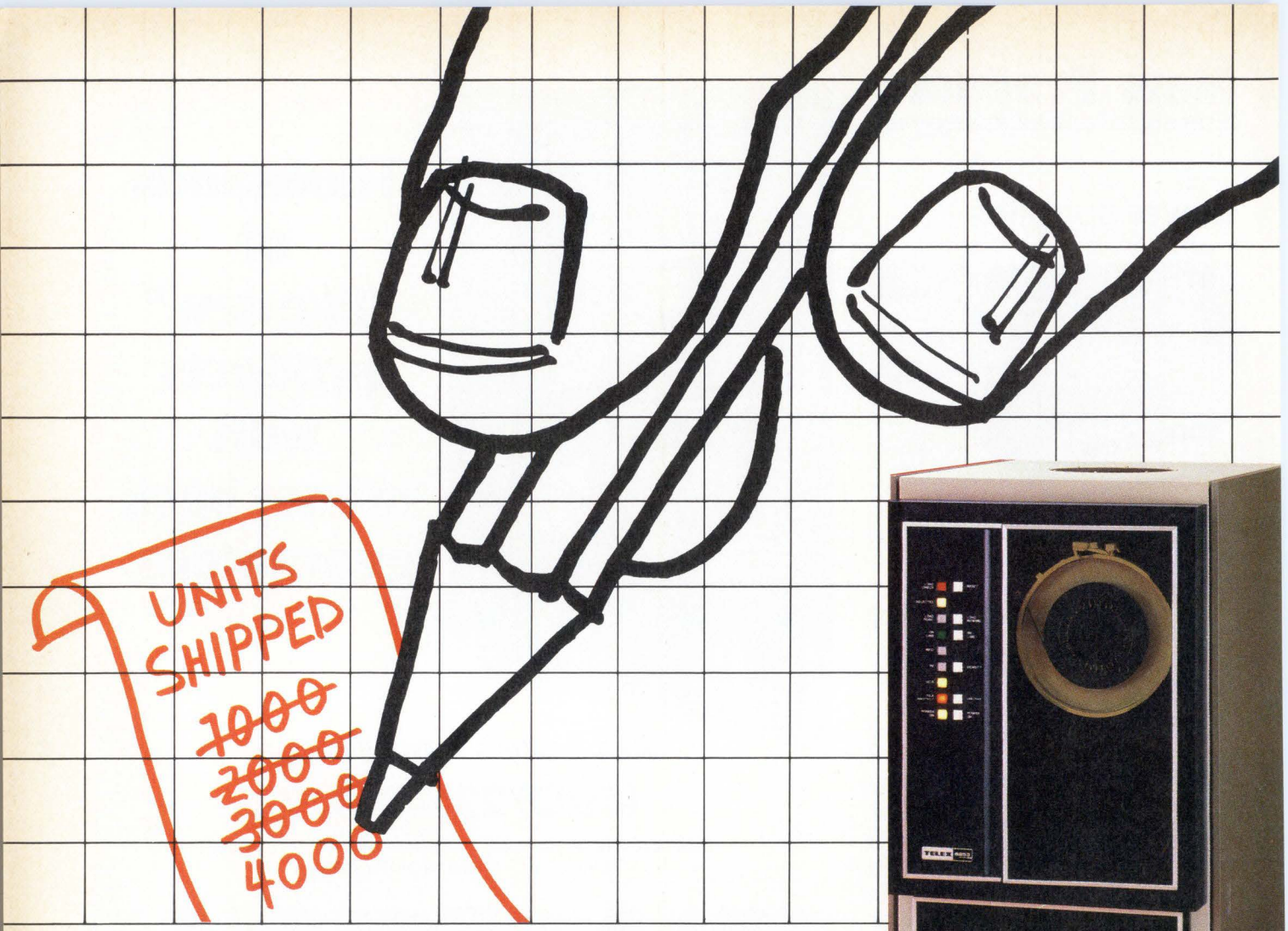


H-P announces HP-IB power supply

The HP 6034A HP-IB DC power supply with a bidirectional interface and autoranging combines an integral μp-based programmer with FET switching. The unit's firmware allows the output voltage and current to be programmed directly in volts and amperes with 12-bit resolution. Other features include a built-in diagnostics program and a removable front panel for access to the calibration board. Price is $2700. **Hewlett-Packard Co.,** 1507 Page Mill Rd., Palo Alto, Calif. 94304. **Circle No 360**

Gould announces open-frame switchers

The Simflex family of open-frame switching power supplies include SX, SXD and SXT versions, which are single-, dual- and triple-output units, respectively, rated 50W, 60W and 75W. The units also provide overvoltage protection on the main output, pre-set at 120 percent to 130 percent of nominal output voltage. All outputs feature constant current limiting, and auxiliary outputs have thermal overload protection. All outputs are fully regulated; ripple and noise are rated at 1 percent rms (.012 percent on auxiliaries) and 4 percent peak-to-peak (2 percent on auxiliaries). **Gould Inc., Electronic Power Supply Operation,** P.O. Box 80878, San Diego, Calif. 92137. **Circle No 361**



Join the leading computer houses . . . specify Telex GCR.

The word is out. Telex GCR Tape Subsystems are the most proven, high performance rack-mountable GCR units available. Field proven in demanding seismic operations. Compatibility proven by five CPU manufacturers. Versatility proven in system house interfaces to sixteen different CPU's.

That's why the leading computer houses are specifying Telex GCR. The Telex 6200 family is available in the model 6253 (6250/1600/800 bpi), 6250 (6250/1600 bpi) and 6240 (1600/800 bpi) tape drives and 6850 tri-density formatters. Tape speeds of 50, 75 and 125-IPS are available. In addition, Telex engineers will provide experienced assistance in making Telex subsystems enhance your high performance computer systems.

With more than 4,000 units shipped (most for high speed 125-IPS operation with tri-density capability), customers are discovering that Telex provides a design, manufacturing and quality maturity that is unmatched in the marketplace today. They get field proven maturity and a lower total cost of ownership. With your name on the line, Telex should be in the system.

For more information, contact the nearest Telex OEM Sales Office listed or phone our OEM Marketing Department in Tulsa.

(918) 627-1111.

Model 6253
Tape Subsystem

Telex Computer Products, Inc.
Terminals/Peripherals/Systems/OEM Products
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(918) 627-1111

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- Houston, TX (713) 497-6770

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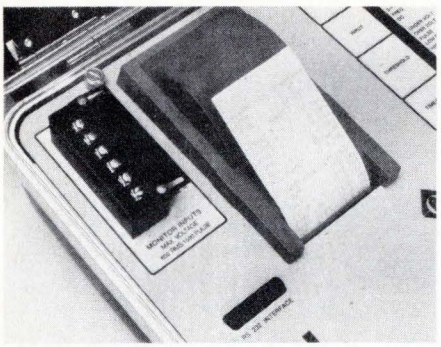
CIRCLE NO. 59 ON INQUIRY CARD

power supplies



Franklin Electric announces disturbance monitors

The model 3600L power-line disturbance monitor provides three captive, strain-relieved 8-ft. leads, and the model 3600T features a conventional terminal strip. The briefcase-sized instruments simultaneously monitor four channels of power (normally three AC and one DC) for disturbances. Prices start at $4990. **Franklin Electric, Programmed Power Division,** 995 Benicia Ave., Sunnyvale, Calif. 94086. **Circle No 362**

Power General offers four-output supply

The Series 4100 line switchers provide as many as four output voltages on a PC board. Full rated output is provided over an ambient temperature range of 0°C to 40°C with a 2 percent °/C derating to 71°C. Four models are available, including 4100-1 (+5V at 10A, +12V at 1.5A, −12V at 1.5A, −5V at 1A), 4100-2 (+5V at 10A, +15V at 1.5A, −15V at 1.5A, −5V at 1A), 4100-3 (+5V at 10A, +12V at 2A, −12V at 2A, −5V at 1A) and 4100-4 (+5V at 10A, +15V at 2A, −15V at 2A, −5V at 1A). Price is $159. **Power General,** 152 Will Dr., P.O. Box 189, Canton, Mass. 02021. **Circle No 363**

Marconi announces 1024-MHz signal generator

The μp-controlled model 2017 10-KHz to 1024-MHz low-noise signal generator can be used by direct keyboard entry or rotary controls. The unit is programmable via the GPIB, enabling it to perform automatic testing. The unit's cavity-tuned oscillator provides a wide-band noise figure of better than −136 dBc per Hz at 20 KHz offset from 256 to 512 MHz. The 2017 uses a series of digital dividers and filters to obtain output frequencies lower than 256 MHz. A +19-dBm output level across the full frequency range permits overload tests on receivers and on passive devices. **Marconi Instruments, Division of Marconi Electronics Inc.,** 100 Stonehurst Ct., Northvale, N.J. 07647.

Circle No 364

AN AUTHORIZED PRINTRONIX DISTRIBUTOR CAN REALLY COME IN HANDY.

When you buy a Printronix printer from an Authorized Printronix Distributor, you're handed the right choice—the right printer, the right interface, the right features and options—precisely matched to your specific needs. And much more....

The total support commitment of the nationwide distribution network—19 Authorized Printronix Distributors with 42 locations, including Canada and Puerto Rico. The authorized distributors know the Printronix printer inside and out, and they've had years of industry experience in providing solutions for applications and systems needs.

Buying from an authorized distributor means you can count on continued support from the entire distributor network. Whether you need parts or advice on systems compatibility, interfacing, printer configurations, operation or maintenance, the Authorized Printronix Distributor has the expertise, the factory-trained staff, the commitment to serve you.

And that commitment doesn't end with the sale, either. Your security and protection starts automatically with distributor installation of the printer, and continues with on-site service and subsequent support through the warranty period. What's more, you get ongoing post-sale followup via new product information, option/enhancement announcements and dependable support throughout the United States, Canada, and Puerto Rico.

At Printronix, we're proud of our reputation for quality and reliability. Satisfied customers are the reason for our success. That's why our distributor makes sure your printer meets your requirements and that you understand how to operate and care for it.

Get the most from your Printronix printer. Buy from an Authorized Printronix Distributor—hands down, the only one who hands you this total support program.

See opposite page for distributor listing.

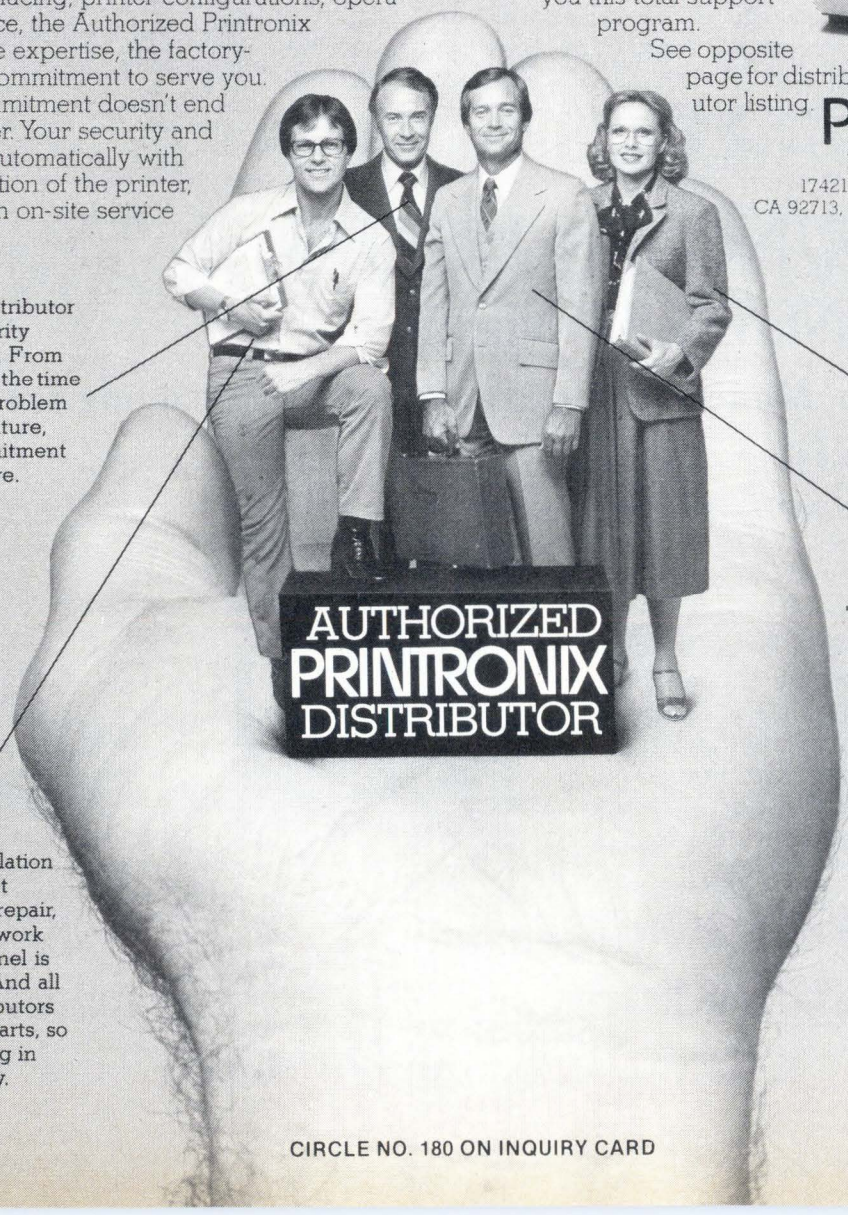
PRINTRONIX

It's simple, to be reliable.

17421 Derian Ave., P.O. Box 19559, Irvine, CA 92713, (714) 549-7700, TWX: 910-595-2535

An Authorized Distributor provides security you can count on. From operator training at the time of installation to problem solving in the future, the support commitment is always there.

Interfaces, printer configurations, systems compatibility, the Authorized Distributor has factory-trained personnel always available to solve your technical problems.



The Authorized Distributor sales force has years of experience matching printer configurations to applications. And their commitment to customer satisfaction is ongoing, providing consultation and new product or application information.

Whether it's installation or subsequent maintenance and repair, a nationwide network of service personnel is always available. And all Authorized Distributors carry a full line of parts, so there's no waiting in an emergency.

CIRCLE NO. 180 ON INQUIRY CARD

interactive terminals

Character generator tests raster-scan VDTs

The model 801A μp-controlled video-character generator for testing raster-scan VDT displays features an internal frequency synthesizer that provides pixel rates as high as 65.520 MHz. The unit enables a user to program video and synchronization timing and to hold frame, line or dot rates constant. Formats can be saved in nonvolatile memory. A matrix entry key enables users to enter custom character matrixes from the front panel. Price is $2995. **Quantum Data Inc.,** 455 E. Kehoe, Suite 104, Carol Stream, Ill. 60187.

Circle No 365

Hewlett-Packard introduces desk-top terminal

The HP2382A desk-top display terminal is software-compatible with the HP2622A and HP2604B terminals. It operates in block, line or character modes with full-duplex, asynchronous data communication via an RS232C interface. The terminal incorporates a 9-in. screen with an 80-column × 24-line display, eight screen-labeled soft keys, a detached keyboard and four display enhancements. A 64-character line-drawing set and six language keyboards are optional. Price is $1700. Optional keyboards and character sets sell for $80 each. **Hewlett-Packard Co.,** 1501 Page Mill Rd., Palo Alto, Calif. 94304.

Circle No 366

Micro Five announces video-display terminal

The V-2000 video-display terminal features a 12-in. non-glare screen, a detached keyboard, 12 control keys, a numeric keypad, a printer interface and two pages of memory. It also offers 20 programmable functions, including reverse video, flashing, underline and half-intensity. Price is $1500, with dealer discounts available. **Micro Five,** 17791 Sky Pk. Circle, Irvine, Calif. 92714.

Circle No 367

Zentec announces intelligent terminal

The model ZMS-35 intelligent terminal includes an Intel 8085 μp, 16K bytes of user RAM, a keyboard and a 12-in. non-glare CRT with a 128-character set. Interfaces include an RS232C for operation at speeds as high as 9600 bps and a 20-mA current loop at speeds as high as 19.2K bps. A printer interface, a down-line loader and a software debugger are optional. **Zentec Corp.,** 2400 Walsh Ave., Santa Clara, Calif. 95050.

Circle No 368

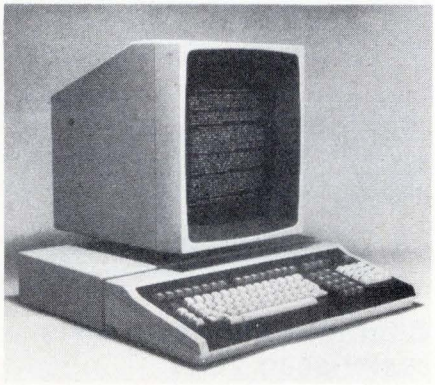
Micro-Term offers ergonomic terminal

The Ergo 3000 terminal includes a low-profile keyboard with an integrated palm rest, seven LEDs and a green, non-glare, tiltable screen. The unit is code-compatible with the DEC VT-100 and offers a 132-column display; scrolling regions; double-high, double-wide characters; current loop; user-definable function keys; a 10-key-style-accounting pad; and a VT52 printer port. Price is $2195; an optional VT-100 printer port is $225. **Micro-Term, Inc.,** 1314 Hanley Industrial Ct., St. Louis, Mo. 63144.

Circle No 369

New Products

interactive terminals



Terminal uses 8086 μp

The model PM 2010 video terminal combines ANSI-standard control functions with an 8086 μp and 32K bytes of RAM, with 256K bytes optional. The unit incorporates two RS232C ports, a parallel printer port, a video display using a 7 × 9 dot matrix in a 9 × 15 field, a 207-key detachable keyboard with eight function keys, a numeric keypad and dedicated keys. The terminal also features 10 switch- or software-selectable 75K- to 19.2K-bps transmission rates. Prices start at $2500 in 500-unit quantities. **Piiceon, Inc.** 2350 Bering Dr., San Jose, Calif. 95131.

Circle No 370

Direct offers terminal for H-P View/3000

The VP825 ASCII video-display terminal for Hewlett-Packard's View/3000 forms-design and data-entry programs offers 8K bytes of display memory, expandable to 32K bytes, a line-drawing graphics set, an 80- or a 132-column display, a 7- × 12-character matrix and block-mode communications. Other features include a set-up menu, a status line and keyboard control of tabs, margins, key clicks, margin bell, auto repeat, screen background, screen intensity, scroll rate and cursor style. Price is $1990 in single-unit quantities. **Direct Inc.,** 1279 Lawrence Station Rd., Sunnyvale, Calif. 94086.

Circle No 371

Ramtek offers raster-scan terminal

The RM-6211 desk-top raster-scan, color-graphics terminal offers 640- × 480-pixel resolution operating at 30 Hz, with an option for 640 × 512 pixels operating at 60 Hz. Features include a 13-in. monitor with a 64-dpi image, four refresh memory planes controlled by a user-programmable video look-up table, the vendor's Colographic Programming Language, and a Centronics-compatible parallel printer interface. The unit is compatible with Tektronix Plot 10 software and the DEC VT-100 alphanumeric terminal. Price is $5995. **Ramtek Corp.,** 2211 Lawson Ln., Santa Clara, Calif. 95050.

Circle No 372

Portable terminal has touch-tone feature

The model 729 Port-A-Tone portable, battery-operated terminal features 12 keys in standard touch-tone format. It can be acoustically coupled to any telephone hand set. The unit accesses long-distance dialing networks, such as SPC, ITT and MCI. It also performs remote telephone switching using Action WATSBOX and Datapoint Infoswitch for accessing or controlling dictation/word-processing systems and for remote data entry to computer systems. The terminal can use voice/tone response systems, including the vendor's Touch-talk order-entry systems. Price is $49 in single-unit quantities. **Interface Technology Inc.,** 10500 Kahlmeyer Dr., St. Louis, Mo. 63132.

Circle No 373

Synchronous Communications Interfaces with X.25 capability.

MDB makes the difference!

The industry's only DUP-11* compatible interfaces for Q-bus* (as well as Unibus*) computers are now available with support for X.25, the international data communications protocol. This means that the popular MDB DUPV-11 (Q-bus) and MDB DUP-11 (Unibus) synchronous communications interfaces are ideally suited for use in public common carrier packet-switched networks and multi-computer or terminal communications.

In addition to X.25 capability, the interfaces offer a number of significant performance advantages above and beyond their functional equivalency and software compatibility with DEC. The small size quad boards will accommodate BI-Sync and DDCMP in byte control and SDLC, ADCCP and HDLC bit-oriented protocols with programmable character lengths and complete hardware error control. For Q-bus users, this is big system protocol handling never available before.

But that's not all the difference MDB interfaces can make to your system. MDB offers line printer controllers for over 100 computer/printer combinations and some of them test themselves. MDB makes the only DZ11 compatible multiplexors for DEC's LSI*-11 series — and RS-422 is available. We offer PROM modules with window mapping, asynchronous serial interfaces, LSI-11/23 box systems with 22 bit addressing, and a wide range of products for Data General, Perkin-Elmer and IBM Series/1 computers. Our boards are warranteed for a full year, many are available off-the-shelf and they can be purchased under GSA contract #GS-00C-02851.

Let MDB make a difference in your system.

*Trademark Digital Equipment Corporation

Circle 132 for featured product data.
Circle 133 for general information.

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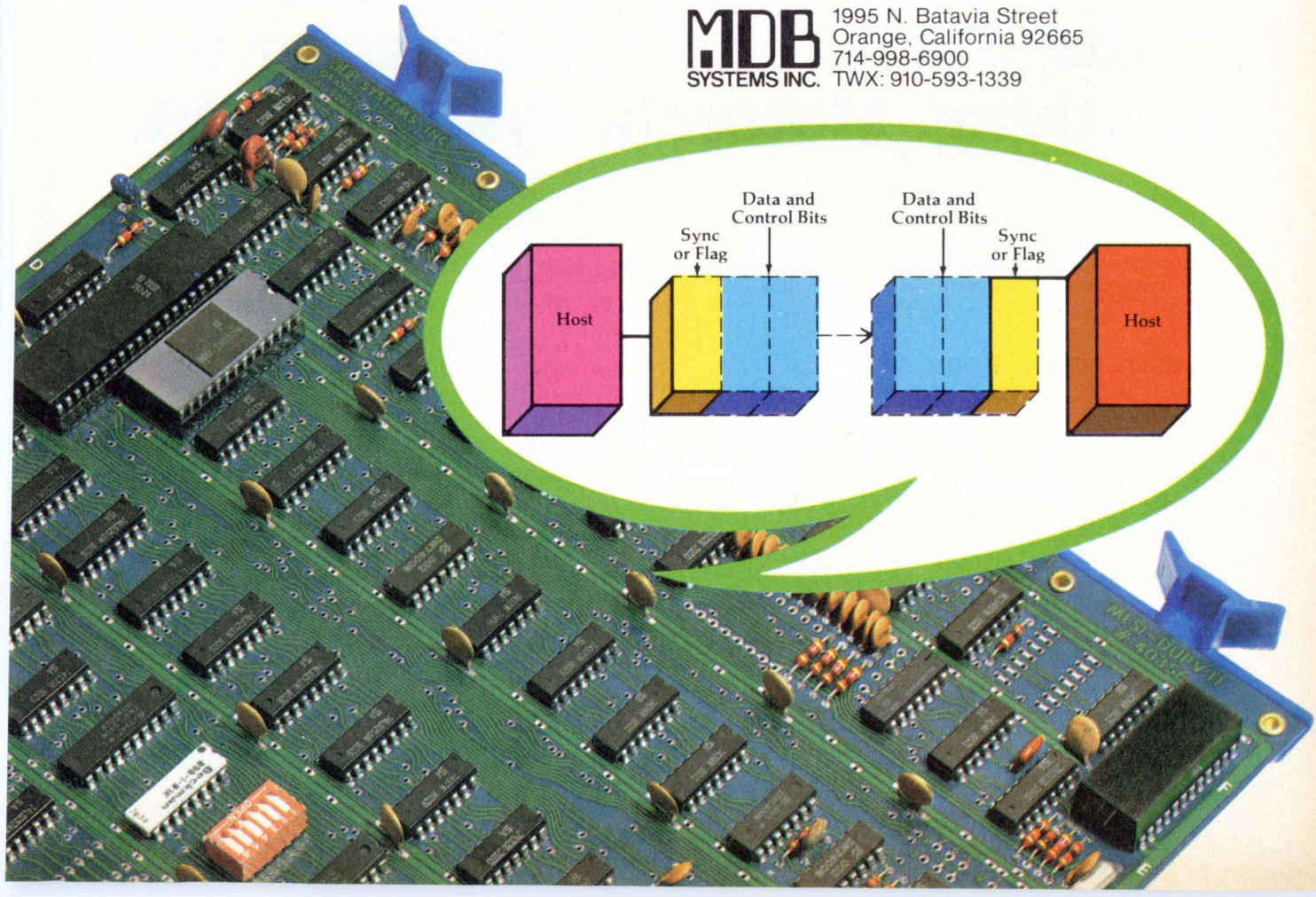
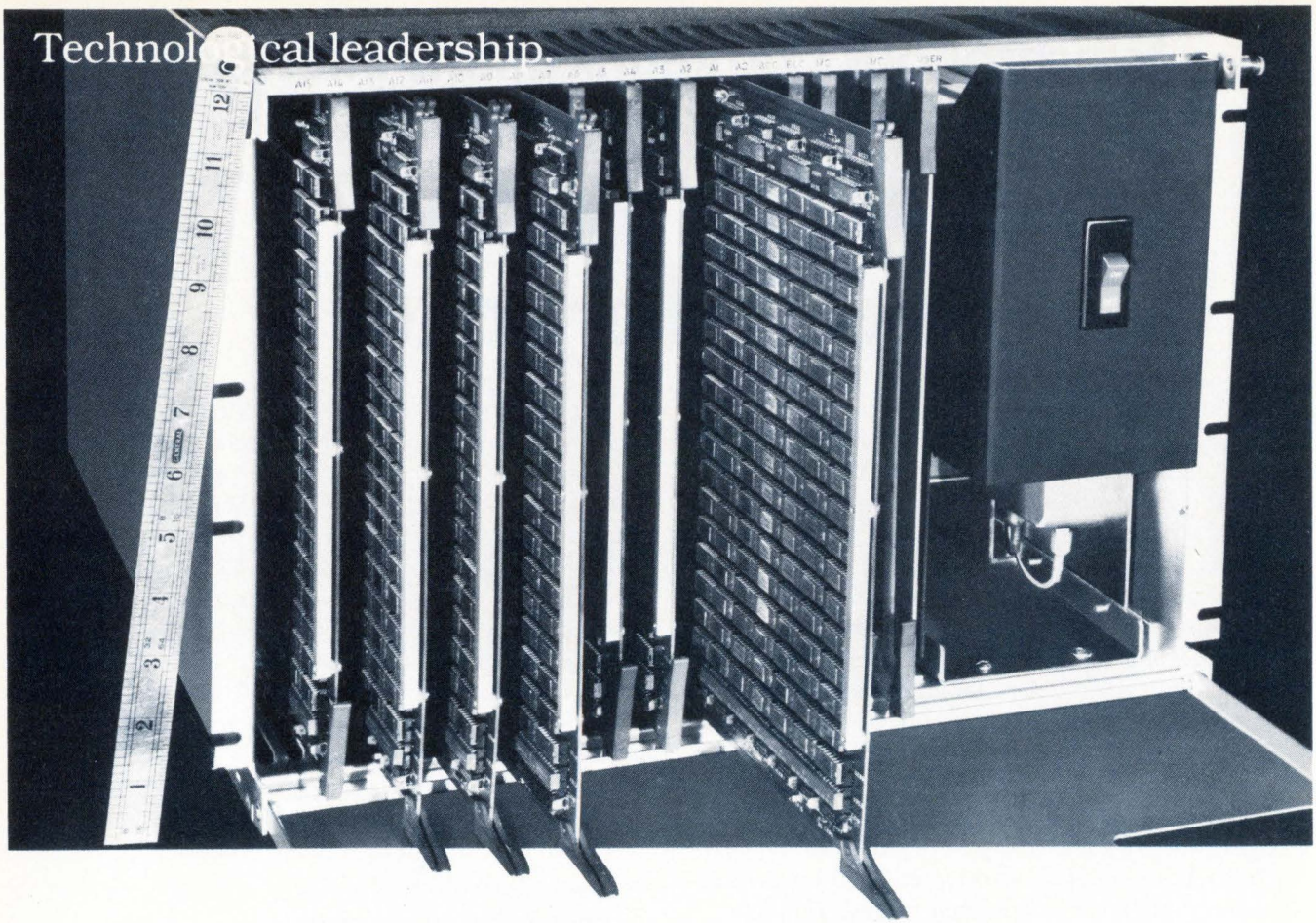




It's small, square and transfers 32 megabytes of memory faster than anything. Motorola System 3000.

Motorola introduces the fastest, densest mass memory storage system yet devised — System 3000.

Measuring only about 12" high and 17" wide, the cage contains everything you need to custom-design memory-intensive products without the time- and cost-consuming headache and hassle of starting from scratch.

The heart of 32 megabytes.

Each of the 16 available array cards contains 288 Motorola 64K dynamic RAMs. All timing and control logic is condensed onto a single address/control card (ACC) allowing maximum room for memory on each card and increasing reliability due to decrease in control logic duplication.

By simplifying the array card, the system's easier to test and debug which provides distinct cost advantages. And you don't pay for additional control circuitry when cards are added.

Speed all at once.

The array bus handles timing signals and data line communication for the cards allowing the ACC to parallel-read all 16 cards at once making available 16 72-bit words in a single, 500 ns cycle. Sequential accessing produces a 64-bit data word every 125 ns onto the bus.

Single-bit error correction and double-bit detection on one card with pipeline registers allows 100 ns transfer rate.

More than bits in a box.

By adding an MC68000 MPU card into one of the three user I/O slots, an intelligent memory system is created to handle those data formatting tasks that hinder the host system. By adding an emulator card, any slow mechanical disk can be replaced with fast semiconductor buffer memory. Any system requiring 1-32 megabyte memory at high data rates is a candidate.

We'll be announcing intelligent memory, disk replacement and DISCACHE™ system enhancements soon. Watch for them.

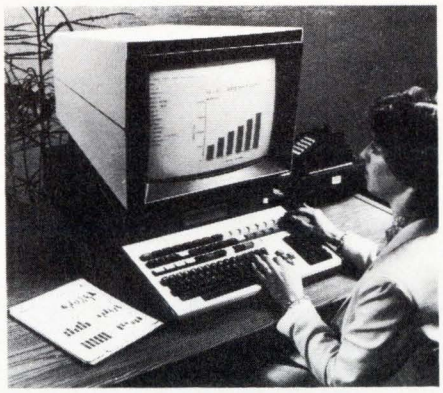
Now, contact Motorola Semiconductor Products, Inc., P.O. Box 20912, Phoenix, AZ 85036 or call (800) 531-5118, toll-free, for state-of-the-art System 3000 data and your mass memory

Innovative systems through silicon.

MOTOROLA INC.

CIRCLE NO. 134 ON INQUIRY CARD

graphics



Color-graphics system uses pictorial cues

The Execuchart family of computer-based color-graphics systems uses pictorial cues and a mouse pointer device with three buttons to initiate actions. The cues, including a paintbrush for creating colors, enable users to operate via a rapid-response mechanism. The system also includes a menu, enabling a user to select charting steps. Other features include the ability to create progressive-disclosure slides, to save 5000 charts or graphs, to correct slides and to code a user's time on the system. Available peripherals include a color printer for paper-chart prints on plain paper, a color camera for 35-mm. slides and a plotter for color transparencies. Menu-driven and custom software are available. A desk-top version sells for $14,000 or can be leased for $525 per month, plus maintenance. A self-contained console unit sells for $45,000 or can be leased on a variable-length agreement starting at $900 a month, plus maintenance. **Comshare, Inc.,** 3001 S. State St., Ann Arbor, Mich. 48106.

Circle No 374

Lexicon introduces graphics display system

The Lexiscope 4000 μp-based video-display system, an add-in for Nova and Eclipse computers, provides monochrome graphic display using raster-scan technology with 560 × 500 fixed resolution. The system's firmware provides vector generation, selectable plotting modes and line styles, elastic line-plotting aids and graphics text with multiple sizes, styles and orientation. Other features include a 12-in. P39 green-phosphor unit, a keyboard and emulation of Hewlett-Packard's 2648A graphics terminal. Price, including monitor and keyboard, in single-unit quantities, is $3400, with OEM and quantity discounts available. **Lexicon, Inc.,** 60 Turner St., Waltham, Mass. 02154.

Circle No 375

AXIOM'S NEW EX-1650 VIDEO PRINTER PRODUCES FULL-SIZE HARD COPY OF VIRTUALLY ANY VIDEO DISPLAY.

The New Video UN-Interface

Now you can get full-size 8-1/2 x 11 inch hard copy of anything displayed on the screen of your graphics terminal, video monitor, computer terminal... even your TV set! And with absolutely no hardware or software modification to your equipment.

The new EX-1650 gives you high resolution hard copy of anything displayed, and we do mean anything — complex graphics or charts, alphanumerics in any size or font, foreign symbols, even hieroglyphics! Whatever is on the screen is faithfully reproduced with superb 3000 dot horizontal resolution.

This amazingly simple printer, like its smaller brother the famous EX-850, operates from the composite video input of the CRT display. Just connect the video input cable to your video source and start printing.

IBM, DEC, Tektronix... You Name It

Nowhere will you find another printer that does what the new EX-1650 can do. For example, it provides hard copy for many Tektronix graphics terminals at a much lower cost and higher speed than competitive printers. The EX-1650 also connects directly to the standard video jack on IBM's 3270, DEC's VT-100 and many other terminals. Then, you can print whatever is displayed, whenever you want, with no warm up time required.

Call It The 'Electronic Notepad'

The compact EX-1650 is the ideal companion for CRT terminals in banks and insurance companies and in medical and scientific laboratories... anywhere hard copy is desired from video data. It is equally at home on an executive's desk or on the production line floor.

Low On Maintenance, High On Reliability

Not a stripped-down model, the EX-1650 is a complete stand-alone printer, including an attractive case, all electronics, a roll paper holder, and a low paper detector. The simple and reliable mechanism needs virtually no maintenance. The sharp, high contrast printout is a result of our patented high-resolution self-adjusting print-head and the readily available, low cost electrosensitive paper which eliminates chemicals, messy inks and ribbons. Finally, every AXIOM printer is backed by our nationwide distribution and service centers in the USA and in 21 other countries around the world. So call or write for more information, today.

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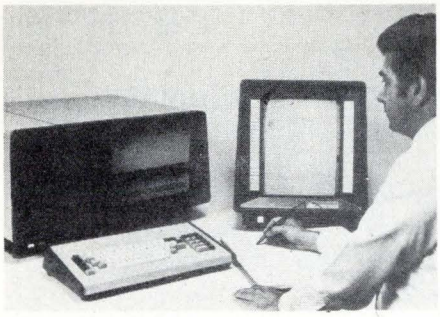
CIRCLE NO. 136 ON INQUIRY CARD

graphics

Intergraph announces entry-level graphics system

This PDP-11/23-based entry-level graphics system is intended as a stand-alone system or as a node in a distributed network. As a stand-alone system, it creates, manipulates, displays and plots any form of graphics information and manages data associated with the graphics. A typical two-work-station configuration includes the CPU with 1M byte of memory expandable to 3M bytes, a file processor and communications concentrator, a 160M-byte disk drive, a nine-track tape drive, an alphanumeric control console and two monochromatic, dual 19-in. raster-screen work stations. The system includes the RSX-11M operating system, all graphics and database-management software and training. Price is approximately $180,000. **Intergraph Corp.,** One Madison Industrial Pk., Huntsville, Ala. 35807. **Circle No 376**



Avera offers graphics systems

These four graphics work stations for OEMs are based on Intel's 16-bit 8086 μp and an operating system incorporating more than 200,000 lines of Pascal code. The basic model GS1100 configuration includes two diskette drives, 192K bytes of parity memory, dual processors, two RS232 ports, a keyboard, a black-and-white display, a data tablet, a 64K-byte bit map, power supplies and enclosures. Other versions include combinations of one diskette drive and a 10M-byte Winchester-disk drive, and a 13-in. color display instead of a black-and-white monitor. Available software includes an IC designer package; a general-purpose package, including vector to raster, clip and scale, communications, multiprocessor-link and MTOS features; and a multitasking operating system with a dual-processor interface. **Avera Corp.,** 340 El Pueblo Dr., Scotts Valley, Calif., 95066. **Circle No 377**

disk/tape

Floppy-disk features ferrite head

The M2894-63 double-sided, double-density 8-in. floppy-disk drive features two ferrite MnZn heads in a gimbal-mounted assembly. The Shugart- and IBM-compatible unit requires +5 VDC of power. Front-panel controls include a door lock and a programmable LED indicator. Price is $450 in OEM quantities. **Mitsubishi Electronics America, Inc.,** 220 W. Artesia Blvd., Compton, Calif. 90220. **Circle No 378**

Disk subsystem offers 40M-byte capacity

The CHD-11 Winchester-disk-drive subsystem offers as much as 40M bytes of formatted storage. The system uses a controller with automatic bootstrap. It is hardware- and software-compatible with the DEC RL01/RL02. Other features include DMA transfer capability, an eight-sector buffer for DMA throttle control and 3600-rpm disk rotation. Price is $6495. **Cyberchron Corp.,** P.O. Box 164, Manitou Rd., Garrison, N.Y. 10524. **Circle No 379**

CRI announces Phoenix-compatible cartridge

The Opus 6016 high-density single-disk cartridge is compatible with Control Data's 9448 cartridge module and equivalent Honeywell, Prime, NCR and Wang disk drives. The unit features a proprietary oxide disk surface, an OEM-approved plastic enclosure and hub assembly and a cartridge-to-spindle mounting system. Prices start at $250. **Computer Resources, Inc.,** 4650 W. 160th St., Cleveland, Ohio 44135. **Circle No 380**

Storage unit supports 64 disk drives

The model 3676 μp-based storage-control unit for the vendor's 3652 disk-storage subsystem incorporates two independent storage directors. It controls as many as four strings per storage director of the 3652 635M-byte disk drives and supports as many as 64 disk drives. Other features include enhanced error recovery (EER), which recovers error in home address, count and key fields and uses the system's error recovery system (EREP) to aid recovery from previously unrecoverable data. Price is $72,160, and a three-year lease is $1875 per month. **Memorex Corp.,** M/S 12-16, San Tomas at Central Expressway, Santa Clara, Calif. 95052. **Circle No 381**

Announcing new standards for image processing.

COMTAL's new low cost, standard systems

COMTAL leads the way again. Now, COMTAL offers standard versions of its Vision One/10 and Vision One/20. For as little as $33,250, you can have a full-scale, real-time digital image processing system — with delivery in less than sixty days!

Price and delivery breakthroughs

COMTAL's new standard systems, the Vision One/10-M6 and the Vision One/20-M8, represent major breakthroughs in price and delivery for digital image processors. Because of COMTAL's continuing technical leadership in the industry, vigorous expansion in the market, and the economies of scale through expanded manufacturing facilities, only COMTAL can make this kind of offer.

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COMTAL's new standard systems perform maturely. Each can operate as a real-time, stand-alone or host-interfaceable system. Each provides real-time roam and zoom, pseudocolor processing, and contrast stretching. Even the operating systems are standard! The Vision One/10-M6 is a compact, table-top system. The Vision One/20-M8 is a more powerful system with a larger memory capacity, a second user channel capability, and a broader range of options.

From the leader

With these new, economical standard systems, COMTAL advances its tradition of innovative leadership in image processing. Only COMTAL can offer this combination of performance, price and predictable delivery. Check it out.

With the cost of digital image processing lower than ever before, isn't it time to explore how digital image processing can help you? Call or write today and learn how you can have a new standard for your image processing and analysis needs.

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CIRCLE NO. 139 ON INQUIRY CARD

Language Resources unveils Pascal compilers

The PAS-86 series Pascal compilers includes versions for 8- and 16-bit applications, plus an optional 8-bit interpreter package to support 8080 and 8085 μp applications. PAS-86 runs on DEC, VAX-11 and PDP-11 computers and on IBM System 370 computers supporting development, maintenance and upgrading of programs for Intel's 8086/8087/8088 μp family. The PAS-80 package for the 8080/8085 family runs on VAX computers. Each package includes the Pascal compiler, a macro assembler for AL/M assembly language, a run-time support library, a resolver subsystem that generates a variety of code outputs and a human interface. A single-copy object use license sells for $4800. **Language Resources, Inc.,** 4885 Riverbend Rd., Boulder, Colo. 80301. **Circle No 382**

CIS COBOL runs under UNIX

CIS COBOL, said to conform to ANSI standards, permits programs to be compiled and executed on DEC PDP-11- and LSI-11/12-based UNIX systems. The software can also be made available on any other processor equipped with a UNIX operating system and C compiler. The package includes interactive extensions and is designed to be compatible with other UNIX languages, utilities and files. Data files can be sorted, edited and processed by other UNIX subsystems. In addition, UNIX software-development tools can be used. **Micro Focus Inc.,** 1601 Civic Center Dr., Santa Clara, Calif. 95051.

Circle No 383

Program monitors energy system

The Machine Monitor (M^2) functions simultaneously with an energy-management program on the IBM Series/1FCPM computer system. The M^2 counts operational hours on monitored devices in a building. Features include monitoring as many as 158 devices, 10 service codes for each device, three service time levels for each code, menu-oriented personalization and remote monitoring. Price is approximately $7500, including Series/1 hardware modifications. **General Energy Systems Co.,** 201 N. Federal Hwy., Deerfield Beach, Fla. 33441.

Circle No 384

COMPARE FLEXIBILITY.

Model 950

- *Advanced editing with wraparound*
- *Smooth scrolling*
- *15 baud rates (50B to 19.2kB)*
- *Protected fields*
- *Underlining*
- *Split screen with line lock*
- *Non-glare screen*
- *Programmable function keys*
- *15 special graphics characters*
- *Versatile screen attributes*
- *Self test*
- *25th status line*
- *Buffered auxiliary port*
- *14 X 10 character resolution*
- *Integral modem option*
- *Tiltable screen*

Tailor this smart CRT terminal to your particular needs and make it your own. It has the flexibility and brains to provide all the performance you need but is priced to make sense whether you need 10 or 1,000.

The TeleVideo model 950 detachable keyboard CRT Terminal has 11 special function keys—22 functions with the shift key—that can readily be programmed to your requirements using 256 bytes of on-board RAM.

You needn't stop there. You can change keys, key functions, even keyboard locations. And the 950's microprocessor based design means you can customize the firmware for your system.

Of course the 950 has premium TeleVideo performance—advanced editing with wraparound, split screen with line lock, and smooth scrolling. It also features a 25th status line, speeds to a true 19.2 kilobaud, and 15 special characters for powerful line graphics.

Contact TeleVideo for a detailed brochure, or call today to discuss how you can use these capabilities to make this terminal uniquely yours. TeleVideo, Incorporated, 1170 Morse Avenue, Sunnyvale, CA 94086. (408) 745-7760.

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CIRCLE NO. 141 ON INQUIRY CARD

GET THE FACTS

About the $24 billion* minicomputer and microcomputer markets

The tenth annual *1981 Mini-Micro Computer Market Report* gives you the facts. It is the industry's most comprehensive survey covering purchases for the past year plus projected purchases during the next 12 months in 22 separate categories including minicomputers, microcomputers, tape and disk drives, CRT terminals, printers, modems, software and related equipment. For OEMs and end-users.

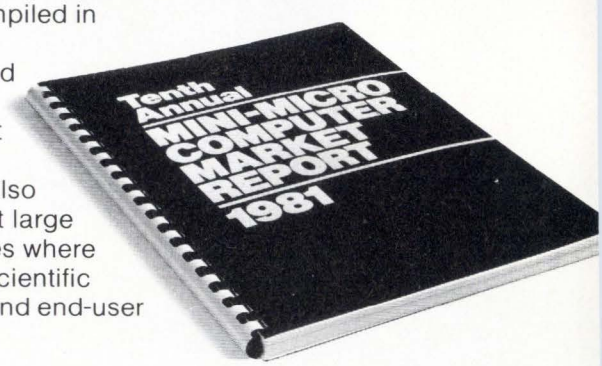
State-of-the-industry

If you are marketing to the minicomputer and microcomputer markets, the *1981 Mini-Micro Computer Market Report* is *must* reading. It gives you the key market trends in each and every product category. With it, you can:

- determine competitive positions
- evaluate current market shares
- determine projected changes in market shares
- identify emerging industry growth areas
- identify the major criteria used by purchasers to evaluate suppliers
- identify application trends
- analyze industry or product growth trends to better plan marketing directions

Most comprehensive industry survey

The *1981 Mini-Micro Computer Market Report*, compiled in conjunction with the computer industry's leading independent research firm, Dataquest, Inc., is based on responses received from more than 12,000 *Mini-Micro Systems* readers. Covered by the report are Third-Party OEMs such as systems integrators, specialized system OEMs, and, software houses. Also covered are the sophisticated end-users located at large corporations with volume requirements, at EDP sites where minicomputers interface with mainframes, and in scientific and engineering areas. The report gives you OEM and end-user buying plans separately.



Market Segment Data Base

In addition, you can get the specific buying plans of individual respondents for any of the 22 product categories covered by the *1981 Mini-Micro Computer Market Report* through our *Market Segment Data Base* (price upon request). For the facts about the $24 billion mini-micro computer markets, call your *Mini-Micro Systems* sales representative. Today.

*Projections based on statistics compiled for the *1981 Mini-Micro Computer Market Report*

Mini-Micro Systems

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221 Columbus Avenue, Boston, MA 02116
(617) 536-7780

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I want the facts about the $24 billion minicomputer and microcomputer markets.

☐ Send me a copy of the *1981 Mini-Micro Computer Market Report*
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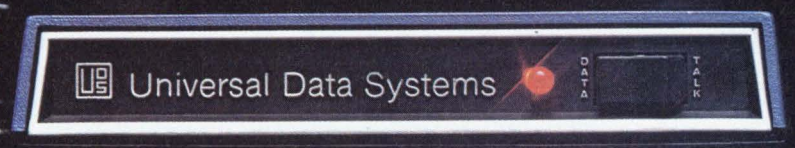
FIVE OF A KIND

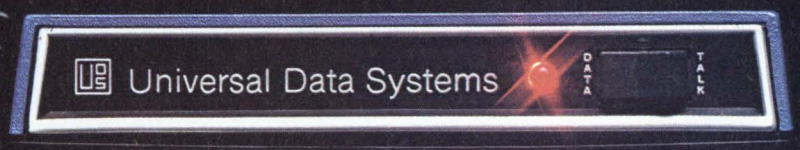
LOW POWER ★ LOW PRICED ★ LINE POWERED MODEMS

202S LP
auto-answer
1200 bps



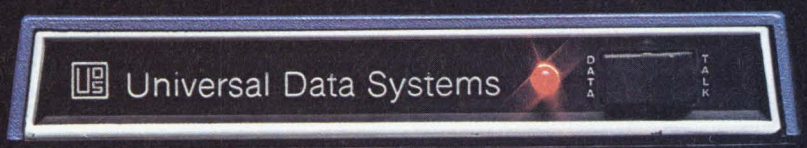
$295
(quantity one)

202 LP
1200 bps



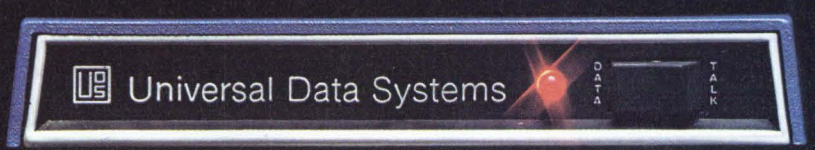
$245
(quantity one)

103J LP
originate/answer
auto-answer
300 bps



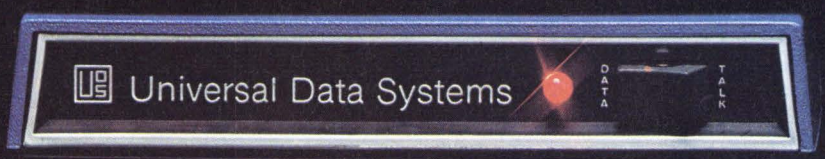
$245
(quantity one)

103 LP
originate/answer
300 bps



$195
(quantity one)

103 LP
originate only
300 bps



$185
(quantity one)

All UDS LP modems are FCC-certified for direct connection to the telephone network and require no AC power connection. For details, contact Universal Data Systems, 5000 Bradford Drive, Huntsville, AL 35805. Phone: 205/837-8100.

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CIRCLE NO. 144 ON INQUIRY CARD

Layered software for applications programming... helps the pieces fit.

Meeting each minicomputer user's software requirements is a difficult and time-consuming task for the systems integrator. Now, with a unique layered approach to software, SYSTEMS makes applications programming more efficient and less costly. Each layer addresses a related set of user programming problems. Within each layer, there is a choice of software aids that focus on specific user requirements.

In addition to most modern high-order languages and the advanced MPX-32 interactive, real-time operating system, SYSTEMS offers extensive software libraries. They contain prefabricated code to eliminate repetitive programming. SYSTEMS software tools and libraries allow the programmer to more efficiently generate, test, optimize and document applications programs and reduce development and maintenance costs. These tools also provide management with greater visibility and control.

SYSTEMS has the most comprehensive selection of software development tools and methodologies available today. We also offer the SOFTOOL 80™ package as a licensed part of our standard product line. Memory requirements and CPU overhead are never a problem as all the tools and libraries are removed after program development is completed.

SYSTEMS layered approach provides all the pieces for your applications programming needs ...and they fit. Call or write the company with a lifetime of real-time experience and watch the pieces fall in place for you.

Systems Engineering Laboratories, Inc.,
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CIRCLE NO. 145 ON INQUIRY CARD

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Proven COMPUTER Performance
SYSTEMS
A Subsidiary of GOULD INC.

Software International offers financial-MIS system

Fiscal DSS enables users to integrate accounting functions into a shared data base. An audit trail of each transaction is provided from release of purchase order through general ledger. Written in COBOL, it runs on IBM mainframes and H-P 3000 computers and enables individual and blanket purchase orders to be tracked and controlled. The system schedules payment dates according to user standards, and enables transactions to be edited, errors to be corrected and account updates to be performed. Other functions include allocation management, budget management, reporting and security-audit control. Prices range from $75,000 to $125,000. **Software International,** Elm Sq., Andover, Mass. 01810.

Circle No 385

Medical accounting system maintains diagnostic codes

The medical accounting system (MAS) allows an operator to process charges and payments through a "ticket-entry" program by patient or guarantor. Diagnostic and procedure codes are also maintained. A method is provided for logging adjustments prior to posting the daily or monthly journals. The MAS statement generator prints standard Medicare insurance forms. Reports include activity summaries by treating and referring doctors, outside services and payment types. Aging, revenue and recall reports are also standard. MAS is priced at less than $1000. **Cimarron Corp.,** 666 Baker St., Costa Mesa, Calif. 92626.

Circle No 386

Utility aids filing under RT-11

The "Sub-Device" system consists of a handler and a utility program and enables a user to create, use and maintain special files, each containing a directory, volume label and subsidiary files. Each special file (sub-device) can be used as though it were an RT-11 directory-structured block-replaceable unit, and it can reside on any random-access directory-structured device. A sub-device can be an image of a physical device, such as a floppy disk, allowing rapid access to a working space holding the contents of a slower peripheral. No special coding is needed to interface sub-devices to RT-11 programs. **Omnex Corp.,** 801 E. Charleston Rd., Palo Alto, Calif. 94303.

Circle No 387

New Literature

Boschert brochure outlines power supplies

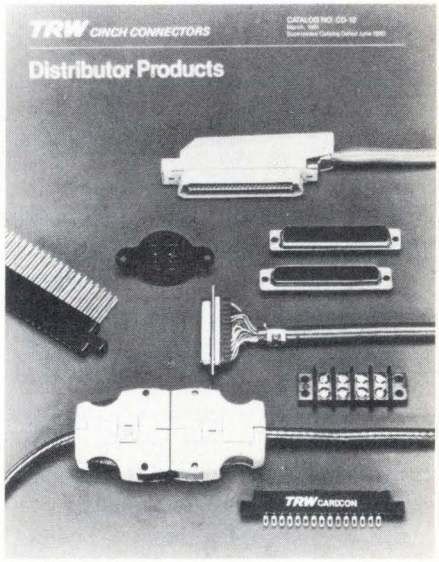
A line of switching power supplies is described in a catalog. The 12-page publication outlines open-frame, multiple-output switchers, single-output supplies, modular switching regulators, encapsulated switchers and a 1500W enclosed supply. The catalog also provides photos, dimensions, options, a selection guide and a voltage-/current-rating chart. **Boschert Inc.,** 384 Santa Trinita Ave., Sunnyvale, Calif. 94086.

Circle No 388

Catalog describes 6800/6809 software

The SDOS disk operating system and software package for 6800/6809 μps are described in a catalog. The pamphlet outlines single-user, multi-user and network operating systems; BASIC compilers; assemblers; editors; and word-processing and accounting software. The catalog also provides an order form with a nondisclosure agreement, recommended software combinations and ordering information. **Software Dynamics,** 2111 W. Crescent, Suite G, Anaheim, Calif. 92801.

Circle No 389



Booklet details cinch connectors

A line of cinch connectors is detailed in a catalog. The 60-page booklet details Cardcon PC edge connectors, Super D-sub-miniature connectors, Duracon double-D connectors, PC edge connectors, Jones Plugs, sockets, barrier blocks and accessories. The catalog also provides mechanical, electrical and environmental specifications, dimensional drawings, illustrations and distributor part numbers. **TRW Cinch Connectors Marketing Services,** 1501 Morse Ave., Elk Grove Village, Ill. 60007. **Circle No 390**

Prime. One line of compatible systems. A whole spectrum of powerful solutions.

Just a few years ago, advanced technology and system compatibility were mutually exclusive. But when Prime began making computers, technology and compatibility became one.

Big. Better. Best. The Prime 50 Series includes the Prime 250-II, 550-II, 750, and the new Prime 850. The Series is so flexible, it can handle virtually any application you have. And so powerful, it can meet your most demanding needs.

If you're in a start-up mode, the perfect way to begin building your system is with the Prime 250-II. If you need more power, you'll find the solution in the Prime 550-II or the Prime 750. And if you're looking for maximum performance, the Prime 850 is the most powerful mini available today.

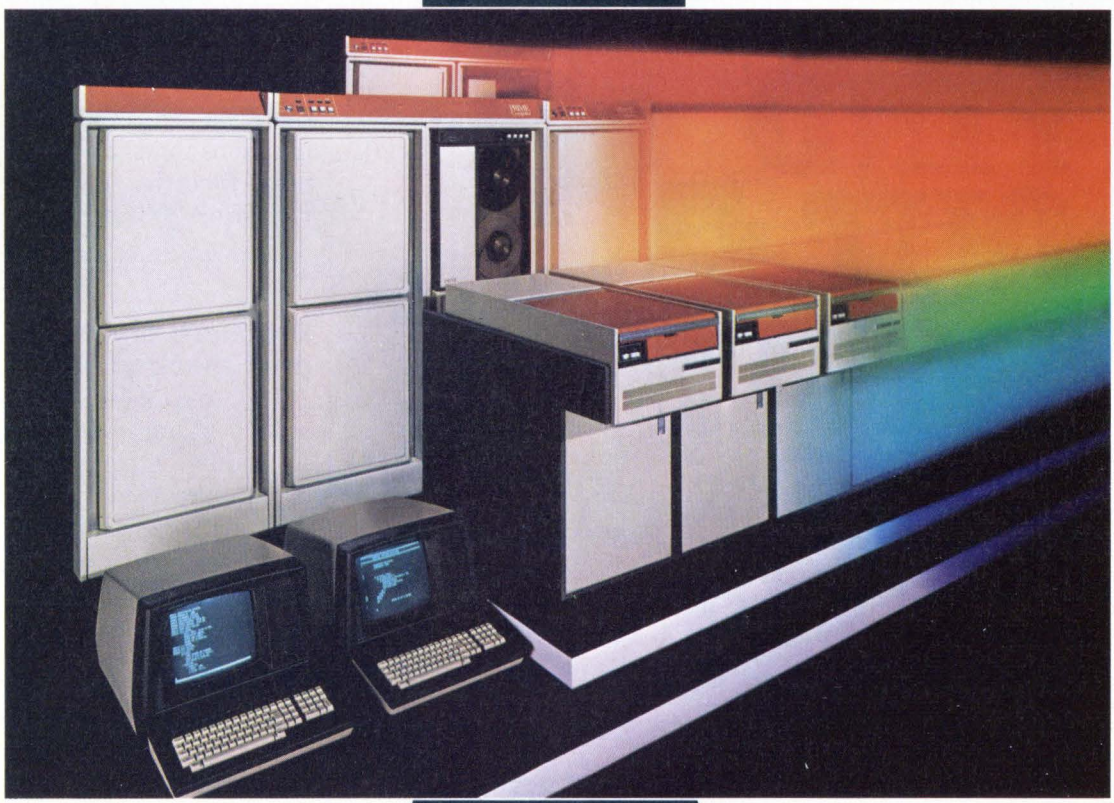
You should know too that any 50 Series system can be networked with any other. They can also communicate directly with mainframes. And all Prime systems support a broad band of industry-standard languages.

The economy of compatibility. The Prime 50 Series is designed around a single operating system, which makes all systems compatible with each other. So you can easily and economically move up to a larger system, or expand to any number of small, remote systems. And you'll have nothing new to learn because the same software goes with you.

A spectrum of solutions. The 50 Series was designed to provide a broad spectrum of solutions for just about any application you might have, including manufacturing, financial, education, utilities, engineering, energy, automated office, you name it.

Consider Prime first. Today, more than ever before, you need the compatibility and the spectrum of solutions that only Prime can offer. For more information, write to us at Prime Park, MS 15-60, Natick, Massachusetts 01760. In Europe, write Prime Europe, 6 Lampton Rd., Hounslow, Middlesex, TW3 1JL, England. Telephone: 01-570-8555.

PRIME
Computer



New Literature

Application note details bar-graph array uses

Uses for HDSP-48X0 series of 10-element bar-graph arrays is described in an application note. The eight-page publication details the system's package design, electrical configuration, design considerations and mechanical information. The booklet also lists analog and digital input interface techniques, ICs and recommended filters. **Hewlett-Packard Co.,** 1507 Page Mill Rd., Palo Alto, Calif. 94304. **Circle No 391**

Brochure describes 325-kVA UPS

A line of uninterruptible power systems is described in a brochure. The 24-page, illustrated publication highlights three types of UPS, ranging from ferro-resonant 1.5- to 15-kVA models to 325-kVA pulse-width-controlled units. The brochure also includes electrical, mechanical and environmental specifications, UPS case-history applications and a selection guide. **Sola Electric,** 1717 Busse Road, Elk Grove Village, Ill. 60007. **Circle No 392**

Brochure offers print mechanisms

The M-4 series of dot-matrix impact print mechanisms is described in a brochure. The six-page bulletin provides engineering drawings and illustrations for split-paper-feed printers, document printers and single-roll printers. The brochure covers print speeds, characters per line, print area, print-head sweep, pulse width and current requirements, duty cycles, input voltages and operating temperatures. The catalog also lists the vendor's worldwide sales offices. **Eaton Corp., Count Control/ Systems Division,** 901 S. 12th St., Watertown, Wis. 53094. **Circle No 393**

CIRCLE NO. 78 ON INQUIRY CARD

THE END OF THE LINE.

Micro Five has what you've been waiting for; A small business computer that puts an end to the terminal wait. It's the Micro Five Series 3000, and unlike most computers that handle only 3 or 4 users at a time, our system can handle up to 10.

Not only does it support 10 users, but with up to one megabyte of main memory the 3000 allows many sophisticated applications to run concurrently while still offering high-speed response.

FOR SMALL BUSINESSES THAT THINK BIG.

When we designed the Series 3000 we made sure it represented the latest advancements in computer technology, and that those advancements met the specific needs of small businesses. That's why the 16-bit Series 3000 offers three popular storage media—an 8-inch Winchester, 8-inch diskette, and a ¼-inch tape—for added flexibility in data storage management.

The Series 3000 also expands as your needs grow. The system begins with 10 megabytes of internal hard disk and 1.2 megabyte of diskette storage. As your business grows, the 3000 can be upgraded to 34 megabytes of internal hard disk, tape cartridge backup, and another 20 megabytes of external hard disk.

Another way the Series 3000 handles the specific needs of your business is by offering a complete library of application programs. Along with general business applications, the Series 3000 also has field-proven software in a variety of industry-specialized applications.

SIMPLIFYING THE COMPLEX COMPUTER.

In order to make the Series 3000 easier to use, Micro Five has designed a unique operating system: STARDOS, a true multi-user system which supports programming in Business BASIC. In addition there is a complete word processing system that also handles mailing lists, and a data base system that's so sophisticated, it gives instant data access to non-programmers.

We also made the Series 3000 as easy to maintain as it is to operate. The computer is on a single board, compared to most computers with 6 or 8 boards, to virtually eliminate downtime and to minimize service.

So if you're tired of waitng, it's time you looked into the affordable Micro Five Series 3000. For more information contact: Micro Five Corporation, 17791 Sky Park Circle, Irvine, CA 92714; (714) 957-1517.

Micro Five

CIRCLE NO. 150 ON INQUIRY CARD

New Literature

Inmac booklet outlines μc supplies

More than 1000 accessories, supplies, peripherals and cables for μcs are listed in a catalog. The 32-page publication covers software packages, CRTs, floppy disks, printer ribbons, furniture, print wheels, cassettes and acoustic couplers and articles on computer equipment. The catalog offers the Centronics 739 printer, Sanyo data-display monitors and VisiCalc and DB master software packages for Apple II computers. The booklet also provides photos and prices. **Inmac Corp.**, 2465 Augustine Dr., P.O. Box 4780, Santa Clara, Calif. 95051.

Circle No 394

Atlantic Research offers datacomm catalog

A line of data-communications products is detailed in a catalog. The publication covers test equipment, patching and switching products and network-management and tech-control systems. The catalog details portable data test sets, message generators, data-quality analyzers, digital, analog and coaxial patching units; fallback, crossover, spare-modem and matrix switches; data-interface cables; and interface adapters. **Atlantic Research Corp.**, 5390 Cherokee Ave., Alexandria, Va. 22314.

Circle No 395

Catalog lists modems and accessories

A line of 300-, 1200- and 2400-bps modems and automatic dialers is detailed in a catalog. The six-page brochure describes the VA3480 originate/answer triple modem, the VA3413 full-duplex acoustic coupler and the Modemphone. The catalog also covers Bell-compatible modems, CCITT-compliant modems and the Multiline Automatic Calling System (MACS). **Racal-Vadic,** 222 Caspian Dr., Sunnyvale, Calif. 94086.

Circle No 396

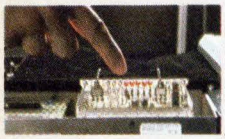
Brochure outlines systems multimeters

The series 9574 6½-digit systems multimeters, for measuring DC volts, AC volts, resistance, DC current and ratio, are described in a brochure. The eight-page publication details the units' IEEE-488 interface and lists applications, accessories, options and ordering information. **Guildline Instruments, Inc.,** 2 Westchester Plaza, Elmsford, N.Y. 10523.

Circle No 397

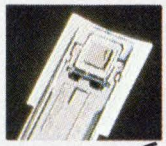
Removable storage and larger capacity

Attach your Series/1 to Control Data Storage Module Drives

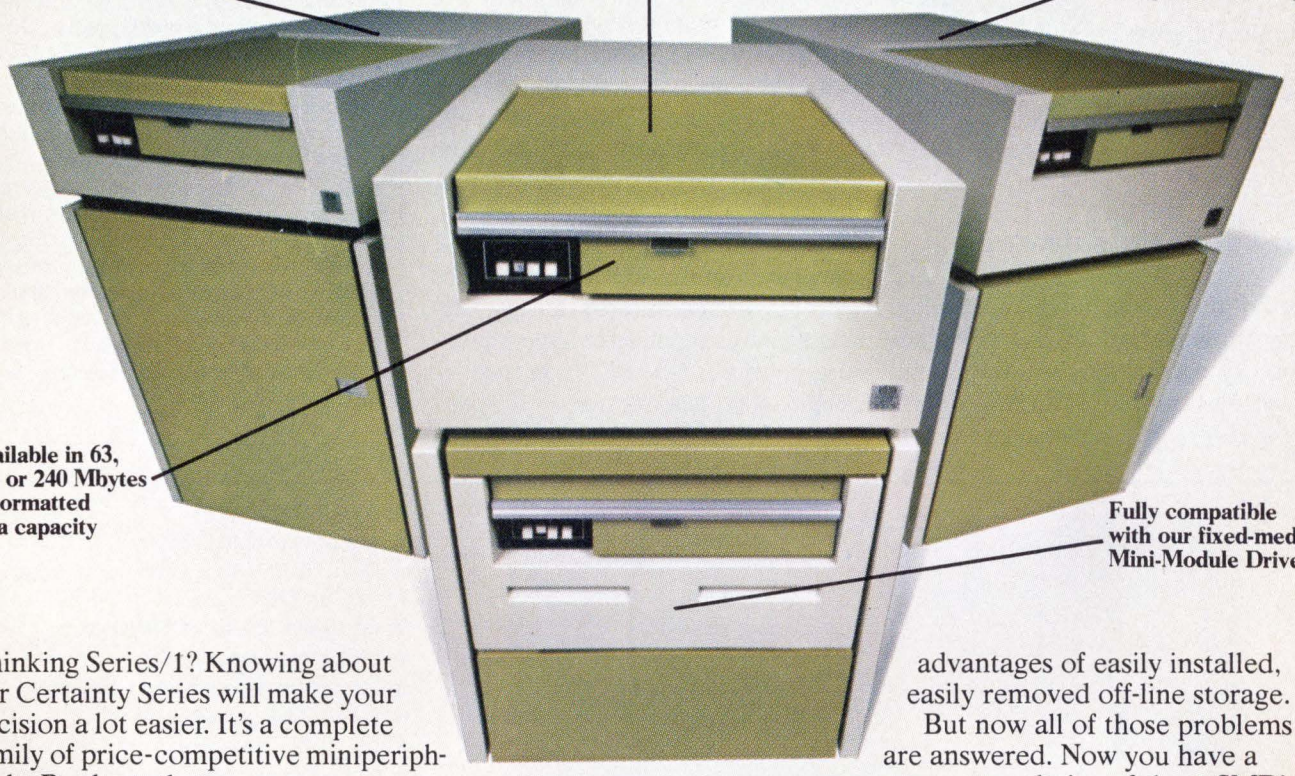


Microdiagnostics and modularity
Lessens your downtime for maintenance and speeds repairs.

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.

Our Certainty 270 Storage Module Drives are good examples. Because until we made them available, you couldn't buy compatible disk storage units with capacities greater than 64 Mbytes. And you didn't have removable back-up capability, either. (Unless you wanted to back-up 64 Mbytes of fixed storage into 100 or so floppy disks!) Until the Certainty Series, you just didn't have all the advantages of easily installed, easily removed off-line storage.

But now all of those problems are answered. Now you have a choice of three SMD's. Three models with formatted data capacities of 63, 126 or 240 Mbytes of removable media. All are ready for direct connection to the I/O bus of your Series/1 processor. All are ready to give you more performance for your money.

You won't have to worry about service, either. More than 4800 Customer Engineers in our worldwide maintenance organization support our products. And Control Data also provides the required software support of all major releases of IBM operating software.

Available Now
Our Certainty 270 Series is ready to help you get optimum performance from your Series/1. For data sheets and more information, call today, toll free. 800/328-3390.

CONTROL DATA CORPORATION

Addressing society's major unmet needs as profitable business opportunities

CIRCLE NO. 152 ON INQUIRY CARD

New Literature

Pamphlet outlines Multibus products

The MSC 8000 series of Multibus-compatible μc products is described in a catalog. The 20-page pamphlet details single-board computers, software, software-development support, system-level software packages, system peripherals, add-in memory, digital and analog I/O, controllers, chassis, power supplies, hardware and accessories. **Monolithic Systems Corp.,** 84 Inverness Circle, E, Englewood, Colo. 80112. **Circle No 398**

Catalog details μp hardware/software

A line of μp hardware and software is detailed in a catalog. The 40-page booklet describes the 6801 μp control system, the Sprint 68 development system/control computer, the 6800-based single-board computers and utility modules. The catalog also covers educational services, cross-software products and specifications. **Wintek Corp.,** 1801 South St., Lafayette, Ind. 47904. **Circle No 399**

Brochure describes interconnection components

A line of electronic-interconnection components and packaging assemblies is described in a catalog. The publication details packaging components, backplanes and boards, IC sockets, single-lead stamped contact sockets, adapter headers, LED-display sockets, adapter plugs and lead-socket carrier assemblies. The catalog also covers vertical-integration packaging services, connectors and mounting racks. **Garry,** Box 94, N. Brunswick, N.J. 08902. **Circle No 400**

LITERATURE THAT COSTS

Datapro report compares alphanumeric terminals

Guidelines on buying general-purpose, non-user-programmable alphanumeric-display terminals are provided in a 67-page report. *All About Alphanumeric Display Terminals* includes market perspectives of terminal characteristics and summarizes users' experience with more than 11,300 installed units. The book provides ratings of terminals' overall performance, ease of operation, hardware reliability, maintenance, service and technical-software support. The $15 book also provides comparison charts of 262 terminals available from 68 vendors. The charts outline the terminals' availability, display, keyboard and transmission parameters; ancillary devices and pricing. **Datapro Research Corp.,** 1805 Underwood Blvd., Delran, N.J. 08075.

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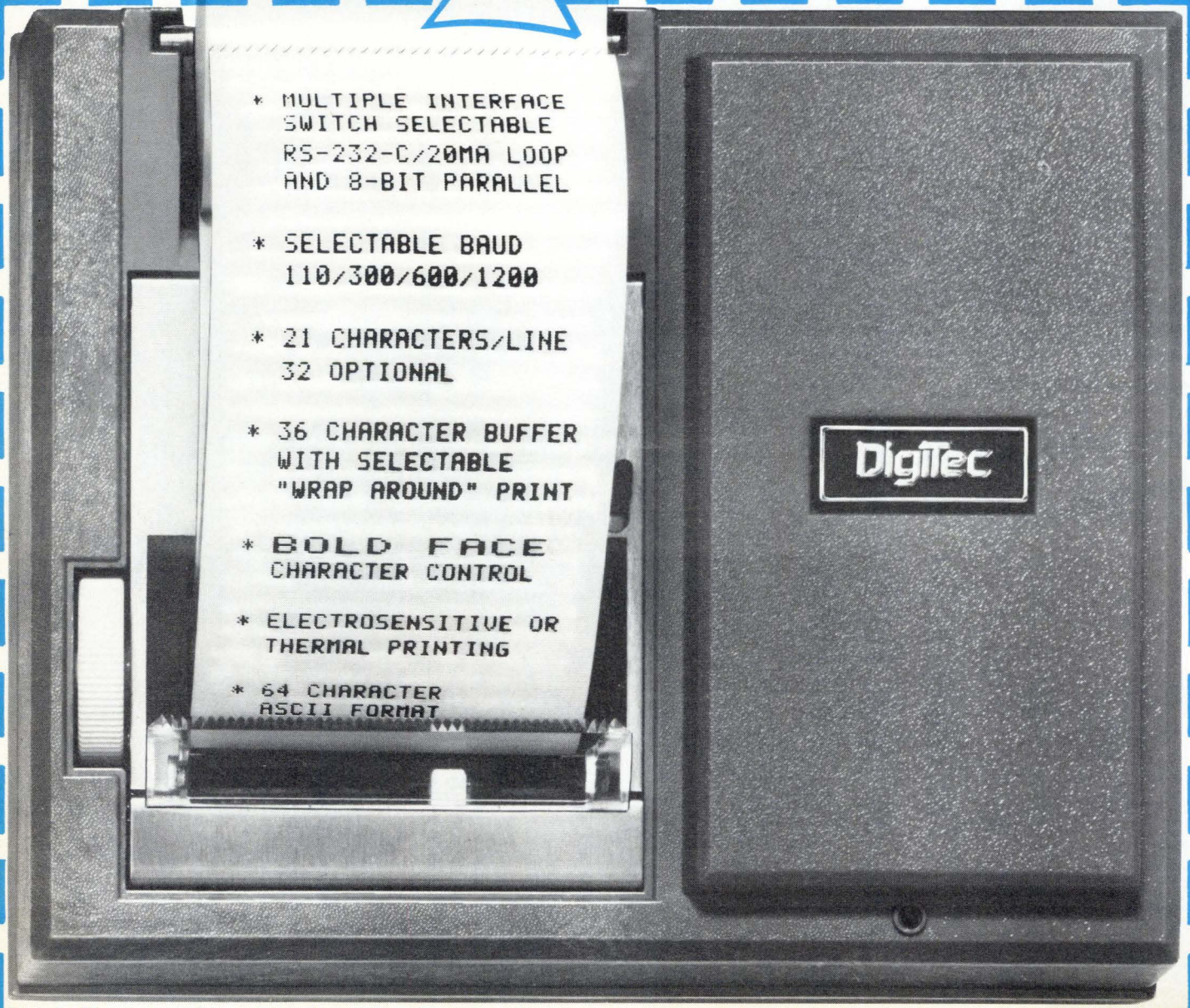

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Oct. 27, 1981	**Valley Forge, PA**
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Jan. 14, 1982	**Orange County, CA**
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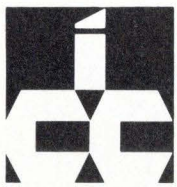

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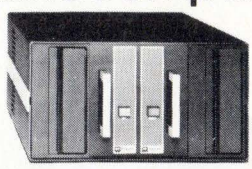

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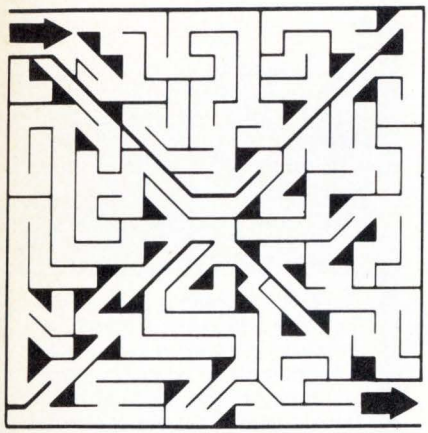

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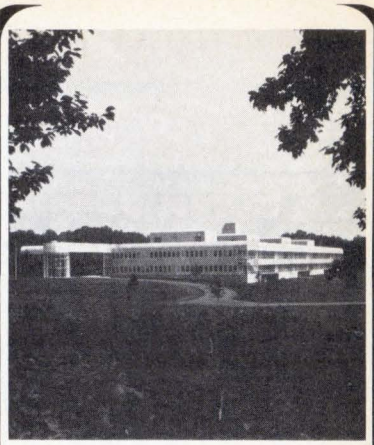

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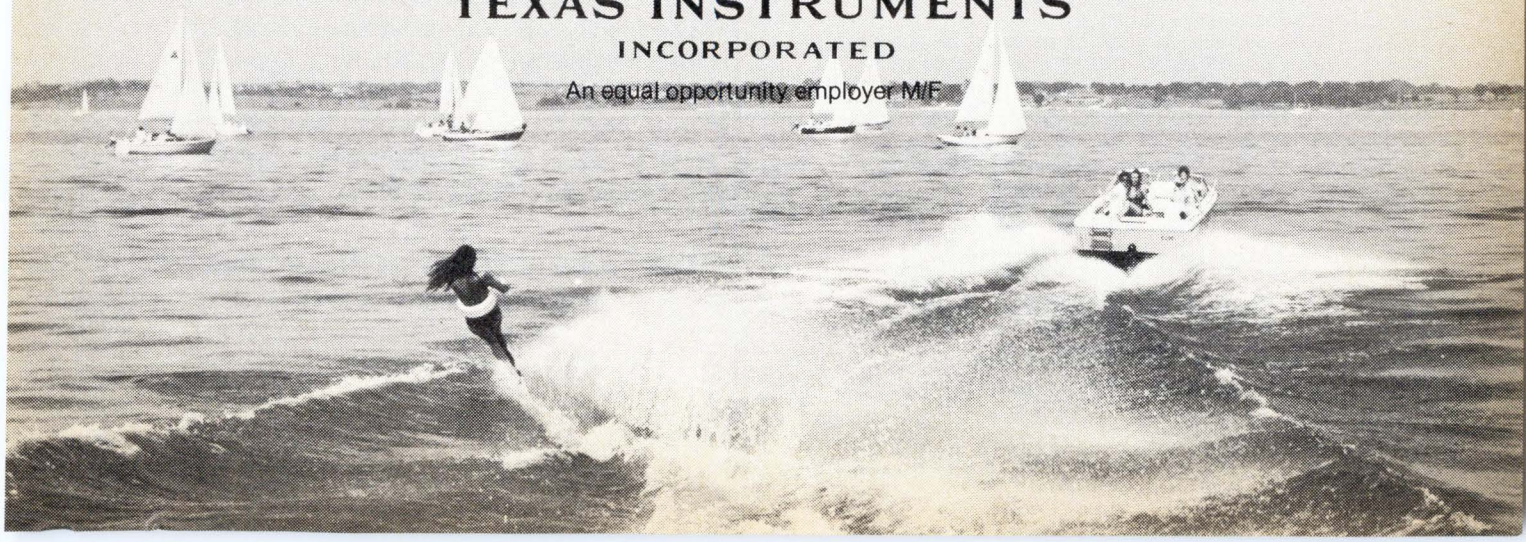

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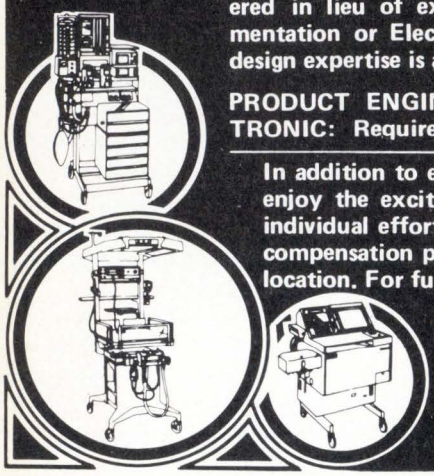

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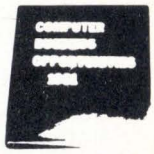

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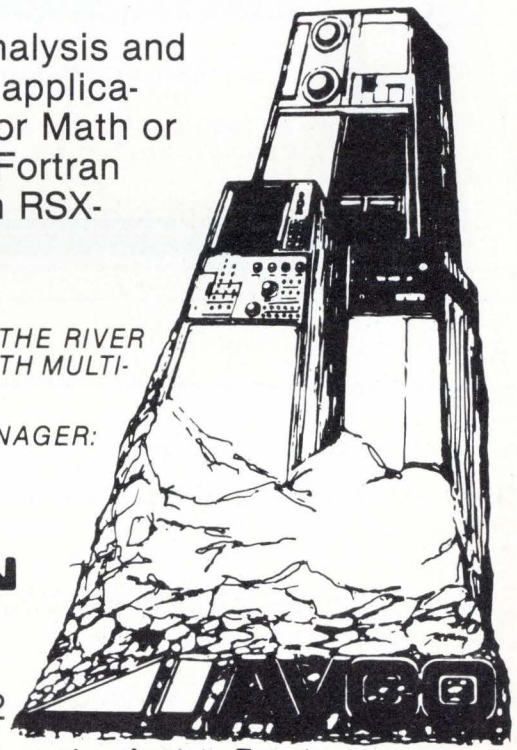

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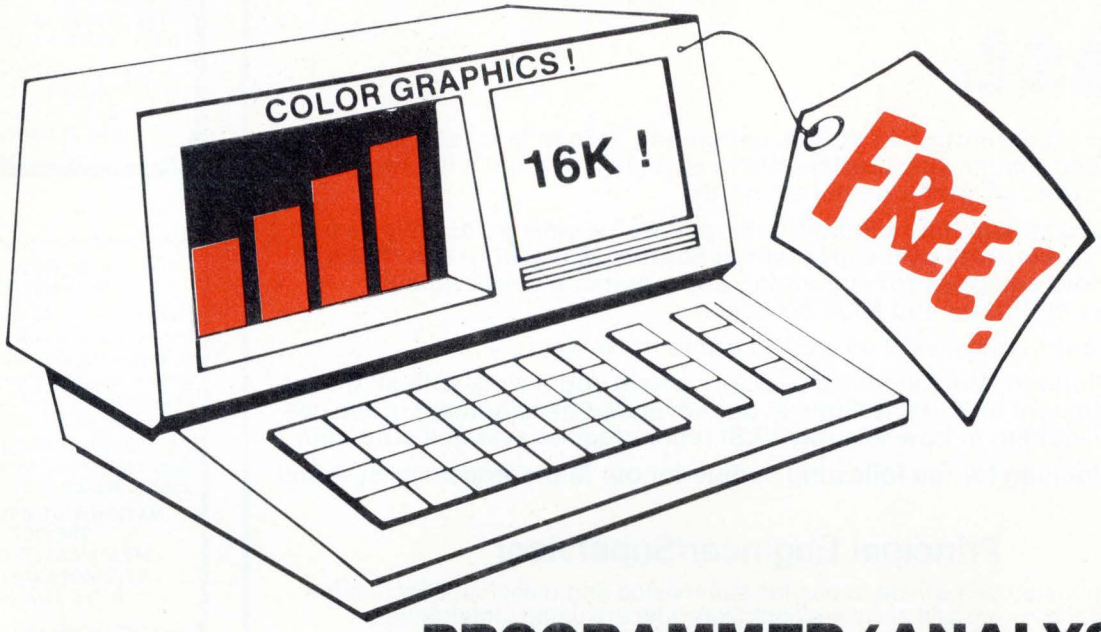

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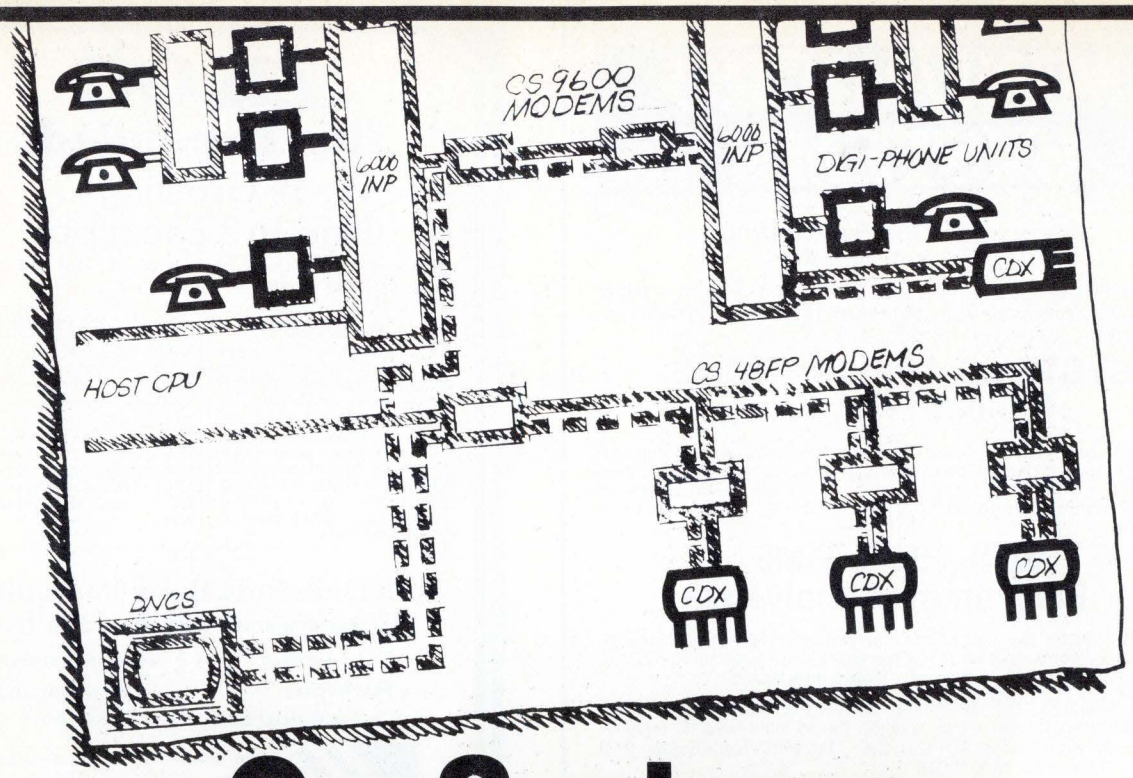

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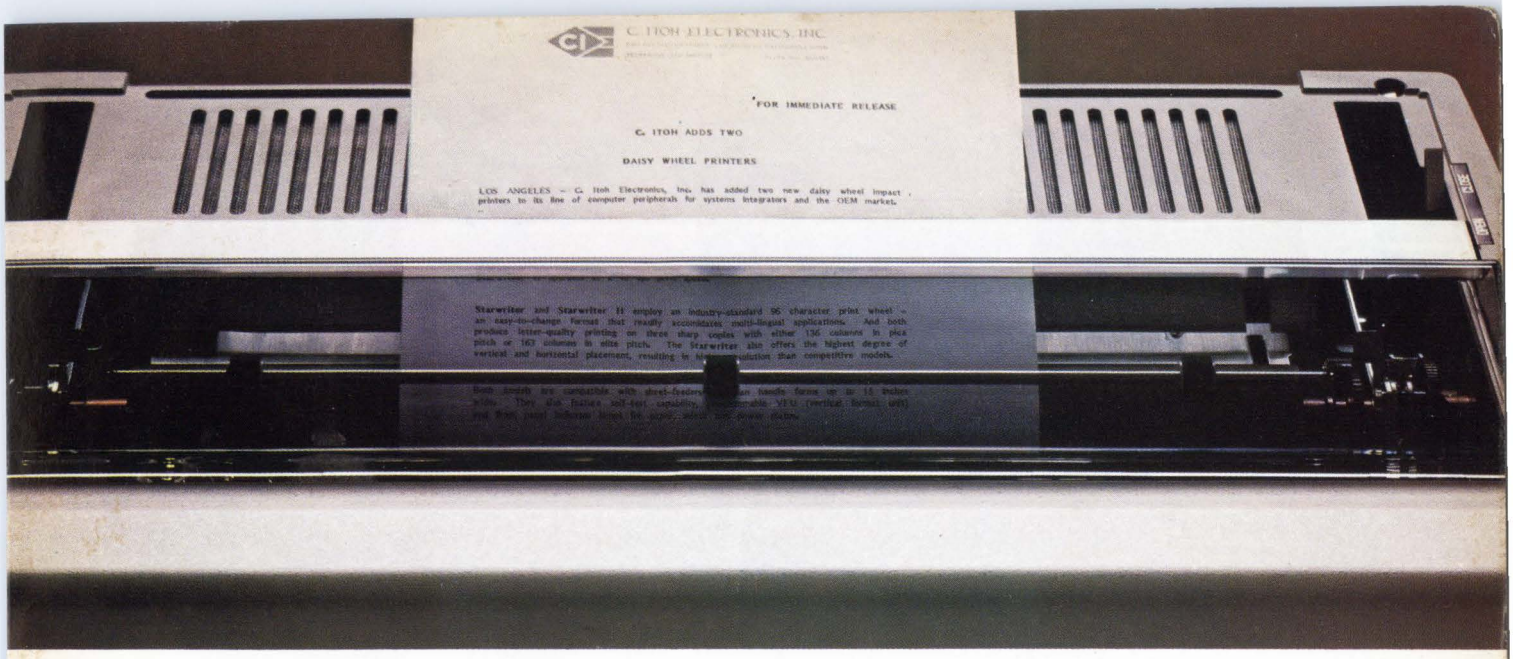

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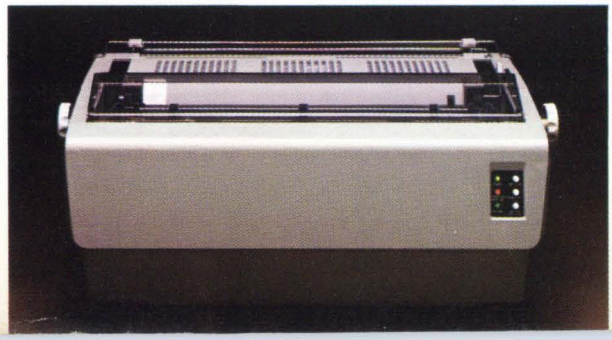

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