Mini-Micro Systems

A CAHNERS PUBLICATION

SEPTEMBER 1981

SURVEY: SINGLE-BOARD COMPUTERS

Perpendicular recording on disks

Microcomputer rivals minis

Only one company has the complete range of disks and disk backup—Kennedy

That's right. Ask any other supplier of peripheral products for system backup, and you'll find that some can supply a disk, some can supply a cartridge recorder, others a streaming transport. But none can supply the choice which Kennedy can offer.

Kennedy is the only company that can offer an SMD compatible, 8" 40 MByte disk drive (Model 7300) and an 80 MByte 14" Winchester disk drive (Model 5380). To back them up, Kennedy has a ¼" cartridge recorder (Model 6450), and Model 6809, ½" Data Streamer Tape Transport.

Kennedy was the first to utilize the ¼" 3M cartridge for disk backup; Kennedy was the pioneer in Winchester disk technology, and was a leader in developing a low cost streaming tape drive.

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Complete systems. Morrow Designs hard disk subsystems are delivered complete with hard disk, controller, cabinet, power supply, fan, cables and CP/M* 2.2 operating system.

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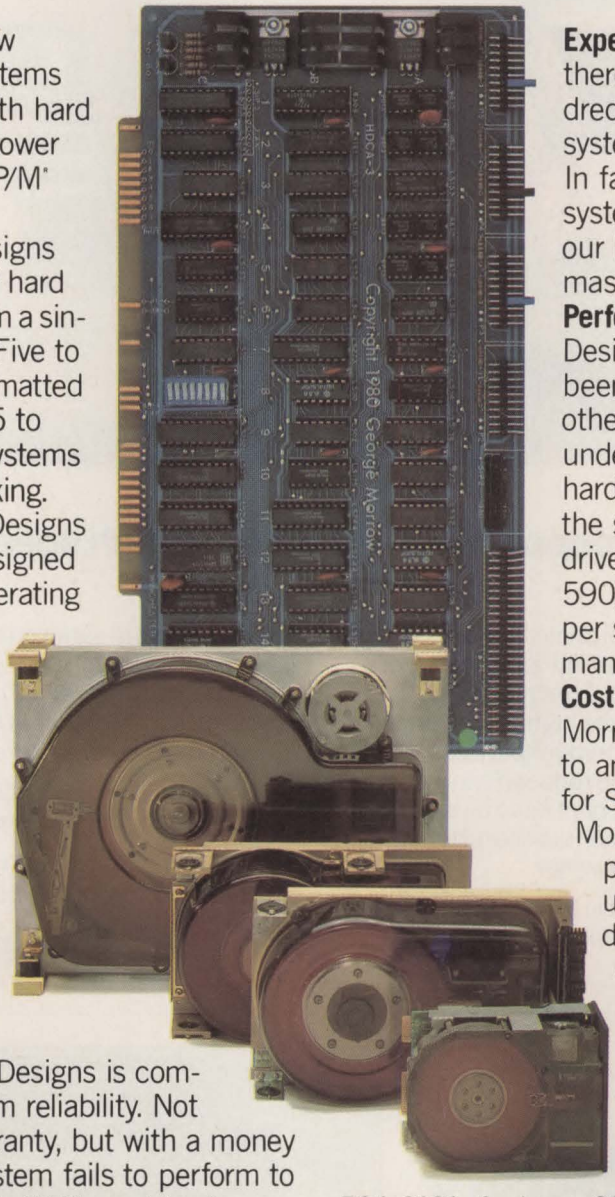
S-100 and more. Morrow Designs hard disk systems are designed for use with the CP/M operating system. Available software packages allow our systems to run on any IEEE696/S-100 Standard system with no hardware modification. Plus, Cromemco,*** North Star,** Vector Graphics, Godbout, Dynabyte, Exidy,**** IMSAI, Micromation, Processor Technology and California Computer Systems.



Reliable systems. Morrow Designs is committed to hard disk system reliability. Not simply with a 90-day warranty, but with a money back guarantee. If our system fails to perform to specification, send it back. We'll send back your money.

Experience. As of April, 1981, there were over fifteen hundred Morrow Designs hard disk systems successfully installed. In fact, over 200 independent systems integrators now use our hard disks to solve their mass storage problems.

Performance answers. Morrow Designs hard disk systems have been benchmarked against all other systems. None is faster under CP/M. Morrow Designs hard disks operate at 10 times the speed of a floppy disk drive. Transfer rates range from 590,000 bytes to 900,000 bytes per second. That kind of performance can become addictive.

Cost effective answers. Compare Morrow prices and performance to anything presently available for S-100 systems. You'll find Morrow's price/megabyte/performance ratio to be unmatched. Leadership in disk systems technology earned us leadership in price/performance. And that may have earned us a call from you. Circle the Reader Service Number for our full line data sheets. Can't wait? Call us at (415) 524-2101. And yes, OEM quantity prices are available. **LOOK TO MORROW FOR ANSWERS.**

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Print two ways...correspondence quality and high speed data processing.

The new T-1805 dual purpose serial printer uses a unique 40 x 18 matrix dot pattern for high quality correspondence printing; or, flip a switch, it uses a 7 x 9 matrix for high speed data processing printing. In the high speed mode, it generates reports at time-saving throughput rates reaching 200 lines per minute. In the reduced speed correspondence mode, its pivoting print head lays down overlapping dots to create a letter-perfect character that looks like it came from an office typewriter.

The T-1805 is the latest evolution in the popular and proven T-1000 series of serial printers. As such, the T-1805 offers the same quality construction, high reliability, ease of operation and operator conveniences. Plus, for the benefit of the office crew, the T-1805 is exceptionally quiet. Its 53 dbA noise level ranks it as the quietest impact printer on the market.

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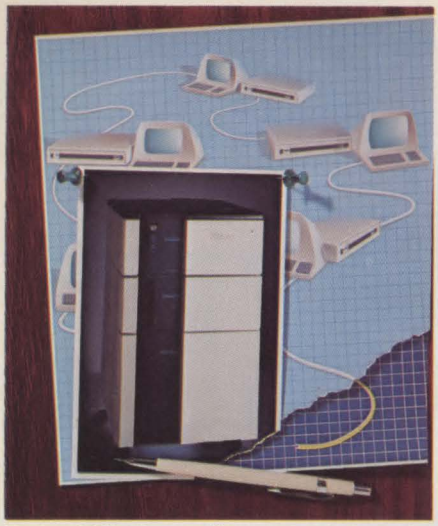
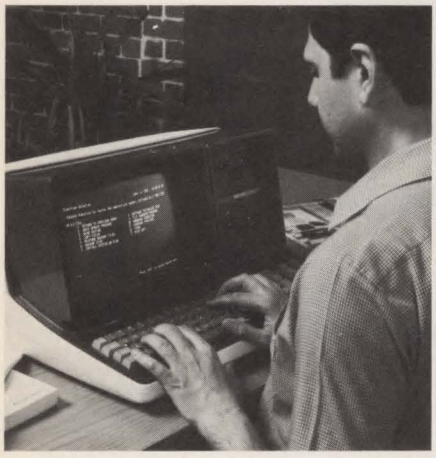
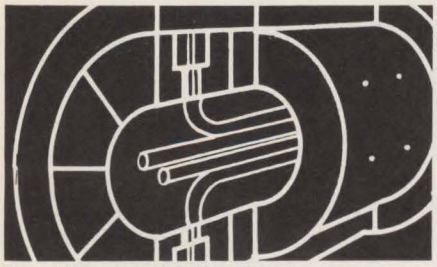
CIRCLE NO. 2 ON INQUIRY CARD



Tests of Zilog's new System 8000 show the μc matches the performance of its larger competitors in many respects and, in some operations, even exceeds them (p. 135). Cover design and art by Gail Tavares, courtesy of Zilog, Inc.



Page 80 . . . . . DG's new desk-top computer



Page 145 . . . . . Trimming aluminum costs

BPA ABP

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Mini-Micro Systems

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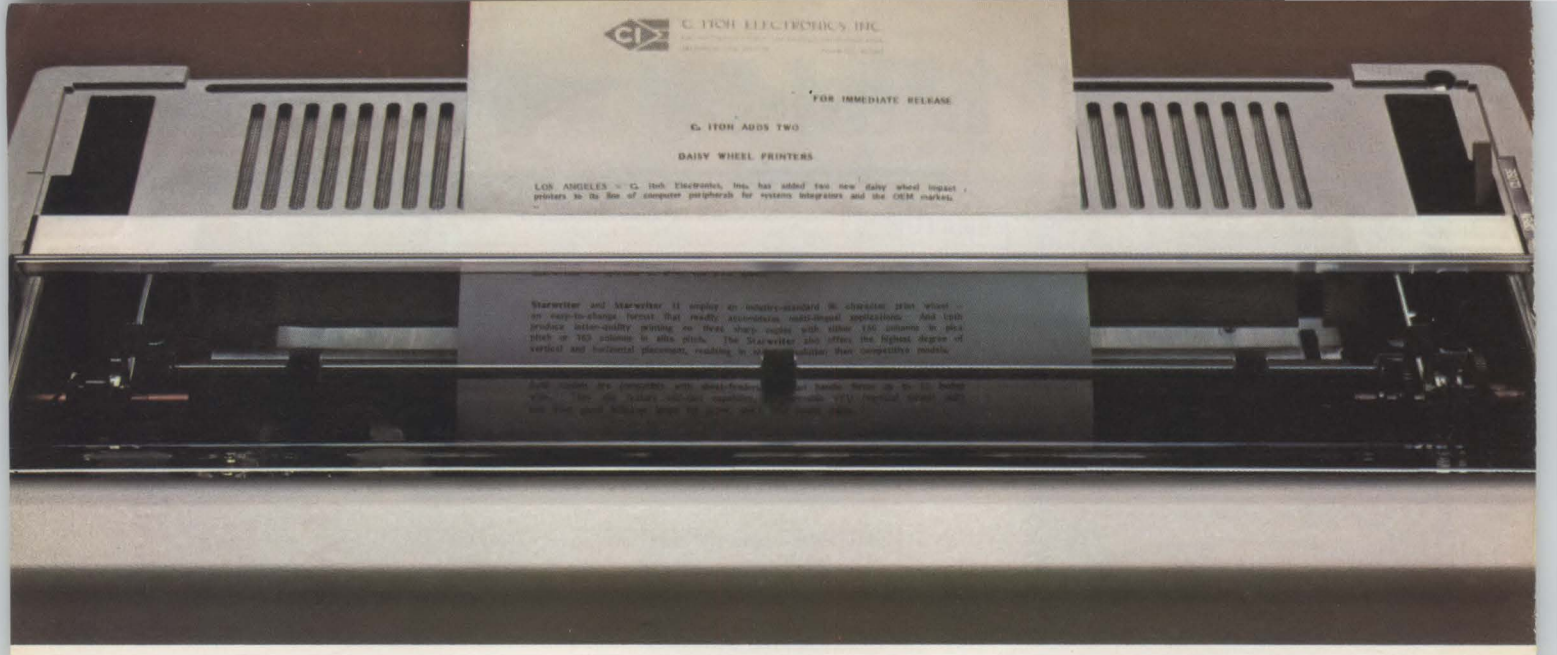
FEATURES

For feature highlights, see p. 119

MINI-MICRO WORLD

DEPARTMENTS



LETTER PERFECT.

You can actually see the superior print quality when you use C. Itoh's new daisy wheel impact printers. Besides clear and crisp print characters, you also get the throughput performance you're looking for, at prices never before available to quantity buyers of Daisy Wheel printers.

C. Itoh's Starwriter offers you a print speed of 25 cps while the Starwriter II operates at 45 cps. Both machines incorporate the latest LSI technology and utilize an easy-to-change industry standard 96-character wheel. Starwriter printers are the perfect choice for multilingual and multi-discipline applications.

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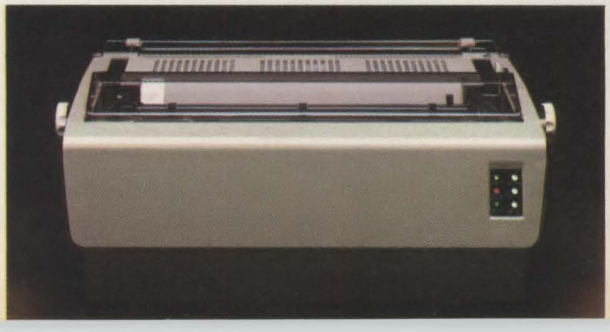
You can put our printers to work the minute they're delivered. They're plug-compatible and meet either the industry standard parallel interface specifications or serial RS 232 C with voltage or current mode capacity.



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CIRCLE NO. 3 ON INQUIRY CARD

DATAPOINT UNVEILS LOCAL NETWORK INTERFACE

The result of a three-year development effort is expected to be made public this fall when Datapoint Corp. unveils what one company source claims is "the first local network interface on a single chip." The new interface is a set of μps that will replace the $1500 Resource Interface Module (RIM). RIM is used in Datapoint's Attached Resource Computer (ARC) systems to connect processors to coaxial cable for handling data transmission, buffer management, error control and automatic subsystem reconfiguration. A RIM chip is contained on a PC board that fits in the processor's card rack and replaces the unwieldy module box. RIM boxes connect to the I/O bus of the ARC processor. The RIM is a small processor with its own hardware, software and power supply. Two 8-bit addresses are associated with each RIM. The computer uses an I/O bus address to send instructions to the RIM. The RIM bus address determines which RIM receives a given packet transmitted via the I/O bus. Company officials won't comment on RIM, but one source says the firm is considering making the chip generally available to system builders to help standardize ARC networking systems, while other networking schemes remain in the planning stages.

DEC WILL WAIT UNTIL 1982 TO EXPAND VAX FAMILY

A third member of Digital Equipment Corp.'s 32-bit VAX family is expected to appear next spring. Several DEC watchers are betting on a single-board VAX-11/730, which uses bit-slice μp technology and offers a minimum of 1M byte of memory using 64K-byte chips. The 11/730 was developed under the code-name Nebula and reportedly will be priced at about $30,000. One contrary observer, however, believes that, instead of a smaller member, DEC will introduce a high-end Venus VAX that uses gate-array technology and processes information at 3 million to 5 million instructions per sec.

DG ADDS MID-RANGE 32-BIT MINI

Data General Corp.'s MV/6000, the follow-on to its MV/8000 32-bit minicomputer, expected to be released this month, offers 70 percent of the performance of its high-end sibling at about half the price—$150,000 to $225,000. A typical configuration—including 1.5M bytes of ERCC MOS memory, a Dasher D200 system console, two intelligent asynchronous controllers, 20 Dasher displays, a 190M-byte disk drive, a magnetic-tape drive, a 300-lpm line printer, AOS/VS operating system, a 32-bit DBMS and 32-bit COBOL—is priced at $195,000. The MV/6000 has 24 bytes of main memory, one-half as much as the MV/8000, and handles one-half as many terminals—64. The system is targeted at the commercial market. The MV/6000 is rack-mounted in two bays, unlike the MV/8000, which is housed in three bays.

SHUGART BOARD WILL CONTROL WINCHESTERS, FLOPPIES, CARTRIDGES

Within a year, Shugart Associates, Sunnyvale, Calif., will deliver an LSI implementation of its SA1400, a disk-controller board that handles control functions and data transfers between host systems and mass-storage devices. The four-chip set will use Shugart Associates' Systems Interface, a standard system-level interface introduced via the SA1400 last year, and will control Winchester- and floppy-disk drives as well as ¼-in. tape-cartridge drives.

Hank Meyer, marketing manager for controller products, says the chip set will control as many as eight devices on the 8-bit-wide SASI bus. Device-level interfaces must meet the protocol for each drive, however. Meyer says the LSI devices will outperform, yet remain compatible with, the TTL version of the SA1400. The LSI components will allow the controller to be mounted within the drive housing. The chip set, controlled by a Z8 μc with 2K bytes of ROM, includes an addressing chip, which serves as the interface to the bus and handles bus contention, a serializer/de-serializer chip and two data separators.

Meyer says the first drives to use controllers built around the LSI components, available within a year, will be enhanced versions of Shugart's 5¼-, 8- and 14-in. Winchester products,

including the new high-capacity, 34M-byte, 8-in. SA1100, due this month. Controllers based on the LSI parts could sell for half as much as comparable TTL devices, says Meyer. The company considered optical storage devices in designing the chip set. First product from Shugart's developing optical-memory efforts in its Optimem unit is expected in 1983, says a company spokesman.

PLEXUS Z8000 UNIX SYSTEM HAS PDP-11/45 PERFORMANCE

Year-old Plexus Computers, Inc., Santa Clara, Calif., this month will introduce a Z8000-based multi-user UNIX system, said to be as powerful as Digital Equipment Corp.'s PDP-11/45. Co-founders of Plexus, formerly known as Cirrus Computers (MMS, December, 1980, p. 38), Bob Marsh and Kip Meyers, say the five- to 15-user systems are priced from $15,000 to $50,000, with deliveries slated to start by year-end. Marsh and Meyers founded Onyx Systems, Inc., two years ago and left in July, 1980, in a dispute with Onyx's backers over which markets should be pursued (MMS, August, 1980, p. 6).

BRITISH VENDOR CLAIMS TO SPEED BASIC GENERATION

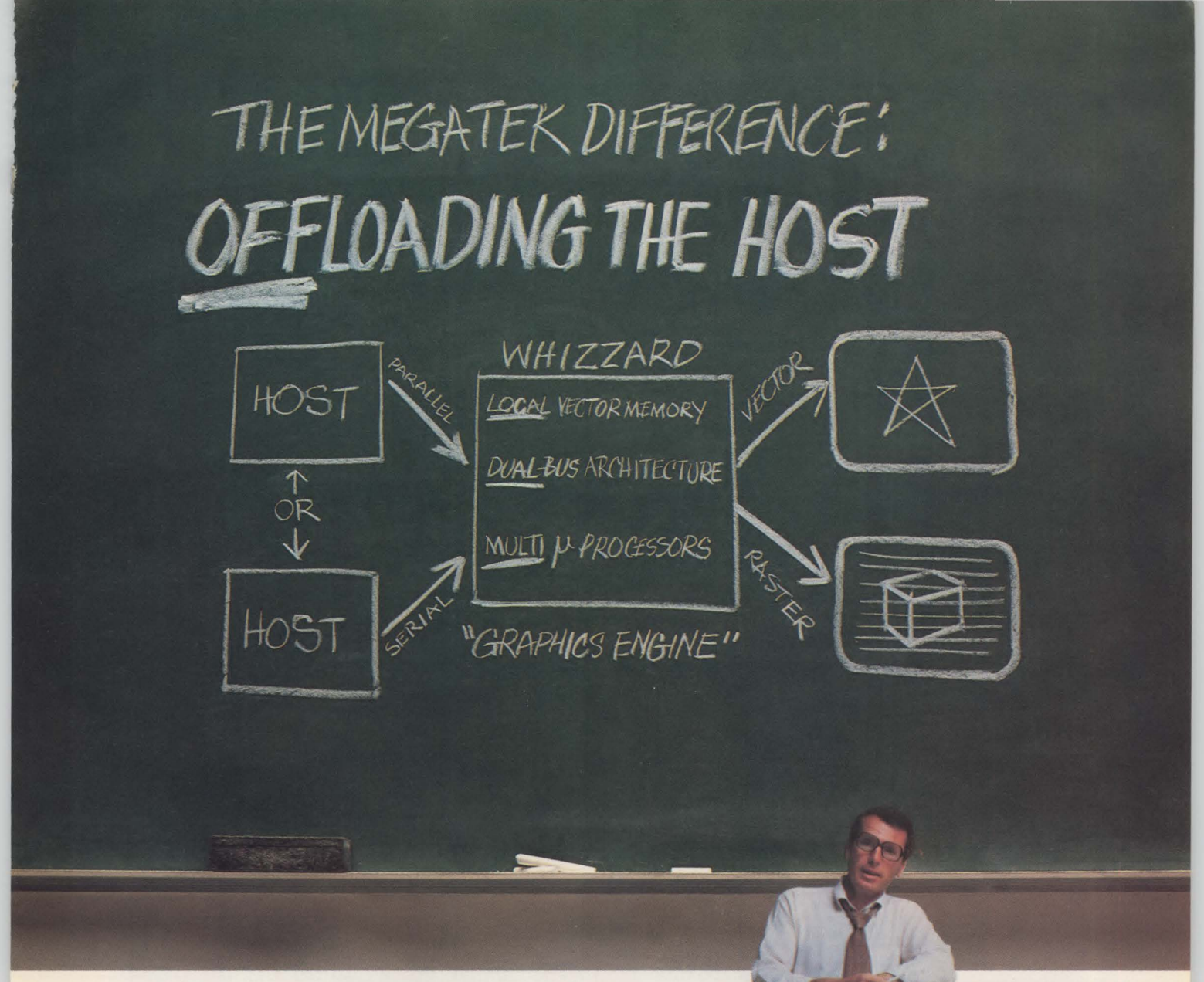
Millions of dollars worth of advance orders are said to have been placed by U.S. μc users for a BASIC program generator unveiled last month in London by its British developer, D J "Al" Systems Ltd., Ilminster, Somerset. Called The Last One, it has been heavily advertised in the U.S. computer press, and the British firm says that U.S. customers account for the lion's share of the $6 million worth of advance orders. Versions for Apple Computer Corp., Tandy Corp. and Ohio Scientific, Inc., computers are available, and there is a U.S. marketing office in Los Angeles. General Manager Larry H. Downing says he will establish a nationwide dealer network. Priced at $600 per user machine, The Last One is inexpensive enough for many customers to buy without extensive evaluation, while still providing D J "Al" Systems with a healthy profit. Its instructions, straightforward English statements, are said to speed BASIC code generation. But so far only the vendor uses The Last One, so no one can endorse this claim or vouch for the efficiency of the code generated.

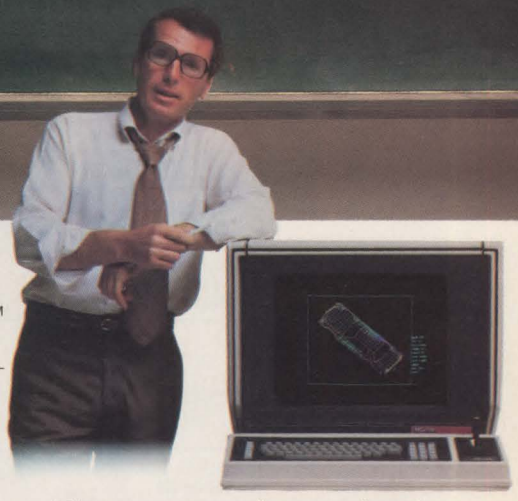
POINT 4 WILL EXPAND IRIS'S LANGUAGE OPTIONS

Point 4 Data Corp. will offer Pascal and COBOL compilers by year-end or early 1982 for use with the company's IRIS operating system. IRIS, with approximately 12,000 worldwide installations, supports only Assembler and Business BASIC. Compatible with UCSD Pascal programs, Point 4's extended version of IRIS will help the company enter such markets as data base management system (DBMS) design, says John Mather, vice president of marketing. "Our primary intent in developing the Pascal capability was to use it ourselves as a system-development language." COBOL should open the vendor's distribution doors to OEMs that deal primarily with systems incorporating this language, Mather says, including those working in IBM COBOL environments. The IRIS operating system functions on Data General Corp.'s Nova computers and on Point 4's family of Mark processors, including the high-end Mark VIII, introduced last month. With the new Mark VIII, the company also introduced its first turnkey system, the 4SITE, designed to help manage complex projects.

CONCORD DATA SYSTEMS EYES TOKEN-PASSING LAN

Over the next three or four months, Concord Data Systems, Inc., will begin its entry into the token-passing, local-area-network (LAN) market. Token passing, one of the two network-access methods proposed by IEEE 802's LAN committee, guarantees access time to all networking equipment on a rotating basis. Founded last February, the Lexington, Mass., firm has so far focused on producing modems for use in switched-telephone networks. But company president C. Kenneth Miller says his firm will introduce an RF modem for broadband LANs by late this year. The product is on hold, while Concord Data Systems waits to see if the Electronic Industries Association 40.1 committee sets standard specifications for





The more you know about graphics, the more you lean toward Megatek.

Every Megatek Whizzard™ system is a perfect "graphics guest"—allowing your host computer to concentrate on the things it does best. You get powerful, easy to use graphics without adding a burden to your expensive host CPU.

Whizzard's helping hand starts with host-computer software. Megatek's Wand, for example, enables the computer to organize display data into segments and subroutines stored in the Whizzard's own display-list memory (expandable up to 192K bytes). When a segment is extended—or its attributes altered—only the changes have to be transmitted.

Next, the interface. Either a remote-workstation data link or a parallel connection for efficient memory-to-memory transfers. Serial interfaces have their own intelligence, reducing the volume of data transfers and relieving the host from all memory-management responsibilities.

The Whizzard Graphics Engine™ takes it from there. A few simple instructions from the host, and a proprietary 32-bit processor performs translation, scaling, and display-list decoding. The display data itself is stored as 12-bit coordinates, creating a 4096^2 "virtual display space" for high-resolution stroke and real-time dynamic raster displays providing true scaling. Or you can output the data as full-resolution hardcopies directly from the Graphics Engine.

And all of this is totally "transparent" to the host. Display outputs can be either vector refresh (4096^2) or raster scan (512^2 or 1024^2, monochrome or color). Or both. High-speed hardware also generates up to eight character sizes—and allows individual segments to be moved from one point on the screen to another without changing the stored data. And in the case of Whizzard 7200 systems, optional 2D and 3D hardware clip, rotate, scale and translate modules reduce complex transformations to a single real-time operation.

See the Megatek difference. Call or write Megatek Corporation, 3931 Sorrento Valley Blvd., San Diego, CA 92121. 714/455-5590. TWX 910-337-1270.

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BACKPLANE	KD11-HA CPU 11/03	KD11-HA CPU 11/03	KDF11 CPU 11/23	KDF11 CPU 11/23
	MSV11-DD 32KW Memory	MSV11-DD 32KW Memory	MSV11-DD 32KW Memory	MSV11-DD 32KW Memory
	RL01 Controller	RX02 Controller	MSV11-DD 32KW Memory	MSV11-DD 32KW Memory
	RL01 Controller	DLV11-J Serial (4)	RL01 Controller	RX02 Controller
	DLV11-J Serial (4)	OPEN	RL01 Controller	DLV11-J Serial (4)
	OPEN	OPEN	DLV11-J Serial (4)	OPEN
	OPEN	OPEN	OPEN	OPEN
	OPEN	OPEN	OPEN	OPEN
	BDV11-AA Bootstrap	BDV11-AA Bootstrap	BDV11-AA Bootstrap	BDV11-AA Bootstrap

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CIRCLE NO. 5 ON INQUIRY CARD

such modems at this month's meeting. Miller hopes to comply with any specifications the EIA 40.1 agrees upon, although he leaves open the possibility that his company may follow a different route should the proposed standard offer poor cost/performance characteristics. "Our background in the telephone modem business gives us some advantage in this area," he notes, " and if we're disappointed with the EIA proposal, we will make a better product." This year, the company also plans to announce a network interface unit incorporating a standard RS232C interface and supporting asynchronous and synchronous communications. The unit will be available during the first quarter of next year. Like the company's other LAN products, the interface unit will be designed for token-passing-type networks. Miller believes these networks are better suited for high-load, real-time applications than networks, such as Xerox Corp.'s Ethernet, which use the Carrier Sense Multiple Access/Carrier Detect (CSMA/CD) network access method.

TI UNVEILS FIRST IN LINE OF SOFTWARE PACKAGES

A transaction-processing software package that will run on the DNOS operating system will be introduced this month by Texas Instruments Inc. The package, one of several software packages expected from the company over the next several months, will run on the company's 990 series minicomputers models 4 through 30. TI will also soon announce SNA compatibility for its upper-level computer systems.

NEW MEDIA GRAPHICS DEVELOPING VIDEO-DISK PRODUCTS

New Media Graphics Corp. is shipping its first "black box" product—an RS232C interface that connects Pioneer's VP-1000 videodisk unit to various processing units. Company founder Martin Duhms says his firm has at least two other products on the drawing board. One, a small system that incorporates the firm's DiscMaster 1000 RS232 interface, the Pioneer unit and an undetermined μp, should be available this quarter. A second product, planned for next spring, is a video mixer that combiners computer-generated graphics with pictures from videodisks. This will sell for less than $4000, Duhms predicts, and will operate with any videodisk unit and any graphics terminal having 480- to 525-line resolution. The mixed computer/videodisk graphics will probably be displayed on single-cable, composite-type videodisk monitors rather than on three-cable, non-composite graphics terminals. Noting that the three-cable graphics monitors have better definition and resolution than the TV-oriented video disk displays, Duhms says his video mixer may be able to display the combined graphic on either type of equipment.

DIGITAL RESEARCH RECEIVES VENTURE CAPITAL

Manufacturers of μc software may be the new interest of venture-capital groups as the money-fund firms begin to recognize the importance of software to the booming small-systems market. Personal Software, Inc., Sunnyvale, Calif., and Microsoft, Bellevue, Wash., recently clinched venture capital. Now, Digital Research, Inc., Pacific Grove, Calif., vendor of the popular CP/M operating system, has received an unspecified amount of venture money from four sources. Headed by T.A. Associates, Boston, the investors include Hambrecht & Quist, San Francisco, Page Mill Partners, Palo Alto, Calif., and Venrock, New York. Digital Research plans to use the money for R & D, says a spokesman, and, in return, the investors will receive a "small, minority interest." Jacqueline Morby of T.A. Associates and Larry Mohr of Hambrecht & Quist will be on Digital's board. The company had sales of $6 million this year, and expects 1982 sales to reach $10 million.

GRAPHICS BOOM UNDERSCORED BY NEW PRODUCTS AND COMPANIES

The burgeoning market for computer-graphics systems and related peripherals has spawned a host of new companies and new products. Megatek Corp., San Diego, Calif., has developed a $5000 processor option for its 7200 graphics systems designed for use in displaying solid, textured or patterned surfaces. Interactive Machines, Inc., Westlake, Calif.,

has introduced the IMI500 terminal, which features CP/M operating system compatibility. Other new products include Ramtek's RM-6211 raster-scan color-graphics terminal and a plotter from Watanabe Corp. of America, Costa Mesa, Calif., that features one or six pens priced at $1400 and $1700, respectively.

Among the new companies are Raster Technologies of Troy, N.Y., with a raster-scan graphics-display system with software-selectable point addressability and a 64K-byte RAM-based image memory; Colorgraphic Communications Corp. of Atlanta, with its MVI-7 color-graphics terminal and Omega Data Peripherals Inc., Duluth, Ga., with a 17-in. VT-100-compatible black-and-white graphics display priced at $2495.

HUGE MARKET DEVELOPING FOR OPTICAL MEMORY SYSTEMS

Optically based memory systems offering "a billion bytes of memory for a hundred bucks" will appear on the market in late 1983 and early 1984, claims a research and development vice president at a fast-growing, commercially oriented computer firm. Electronic filing cabinets will be built around the systems that use videodisk and laser technologies to create non-erasable memory. Such memories will be less expensive than an equal amount of paper. In addition to Japanese firms Fujitsu, Toshiba and Hitachi, other companies, including Xerox Corp., Control Data Corp. and RCA Corp., "are all talking about releasing products in late 1983 and early 1984," says this source, whose firm intends to incorporate video technology as soon as it is commercially available.

RANDOM DISK FILES

The 9-in Winchester will arrive next year. Two hard-disk drives from **Control Data Corp.** (CDC)—an 80M-byte, three-platter disk-cartridge drive called the Removable Storage Device (RSD) and a six-platter, 160M-byte drive called the Fixed Storage Device (FSD)—will reportedly sport disks that will introduce yet another medium dimension to the small-Winchester market—230mm., or 9.0551181 in. Both drives will support CDC's yet-to-be-announced intelligent storage interface (ISI) standard, which sources close to CDC say will be pushed as a replacement for the Storage Module Drive (SMD) standard used on many 8- and 14-in. Winchesters in the OEM market. The RSD's price is reportedly around $2000, and the FSR will sell for $2500 . . . Tests on prototype versions of a 5M-byte, 5¼-in. Winchester named the MV525 are under way at Grants Pass, Ore., start-up **Easy Design, Inc.** The two-platter drive incorporates an SA1000 interface. First offering from Longmont, Colo., start-up **MiniScribe** may appear this quarter. MiniScribe reportedly will unveil a 12.8M-byte two-platter device. Being developed at an IBM facility in the U.K. is a double-rack density (900-tpi) Piccolo drive reportedly code-named Swallow . . . Double-density 8-in. hardware may also be in the works at Milpitas, Calif.,-based **Quantum Corp.** One report says the company is considering a 700-tpi version of its four-platter 02040 Winchester—a move that could push drive capacities to 80M bytes.

Details about the 5¼-in. Winchester-disk cartridge being developed by the "club" established by **Seagate Technology, DMA Systems** and **Dysan Corp.** are beginning to emerge. The new cartridge will reportedly be called the MicroDisc and wil be based on an oxide-coated media that works with both standard 3350-technology and thin-film read/write heads. Capacities and prices have not been set.

Pacing item for the 40M-byte 5¼-in. Winchester-disk drives from **Rotating Memory Systems, Inc.,** may be medium-defect specifications, says one source close to the company. The Sunnyvale, Calif., company unveiled the as-yet-unnamed drives at May's National Computer Conference (MMS, June, p. 8). The drives are designed to operate at 700 tpi, compared to 480 tpi for a 3350-technology Winchester and 255 tpi for Seagate Technology's 6M-byte ST-506 5¼-in. Winchesters. "RMS is the only vendor of small drives that specifies the number of track defects per surface," says the source. "You don't want two times the number of defects if you're operating at two times the number of tracks." Prices for the drive have not been set.

—John Trifari

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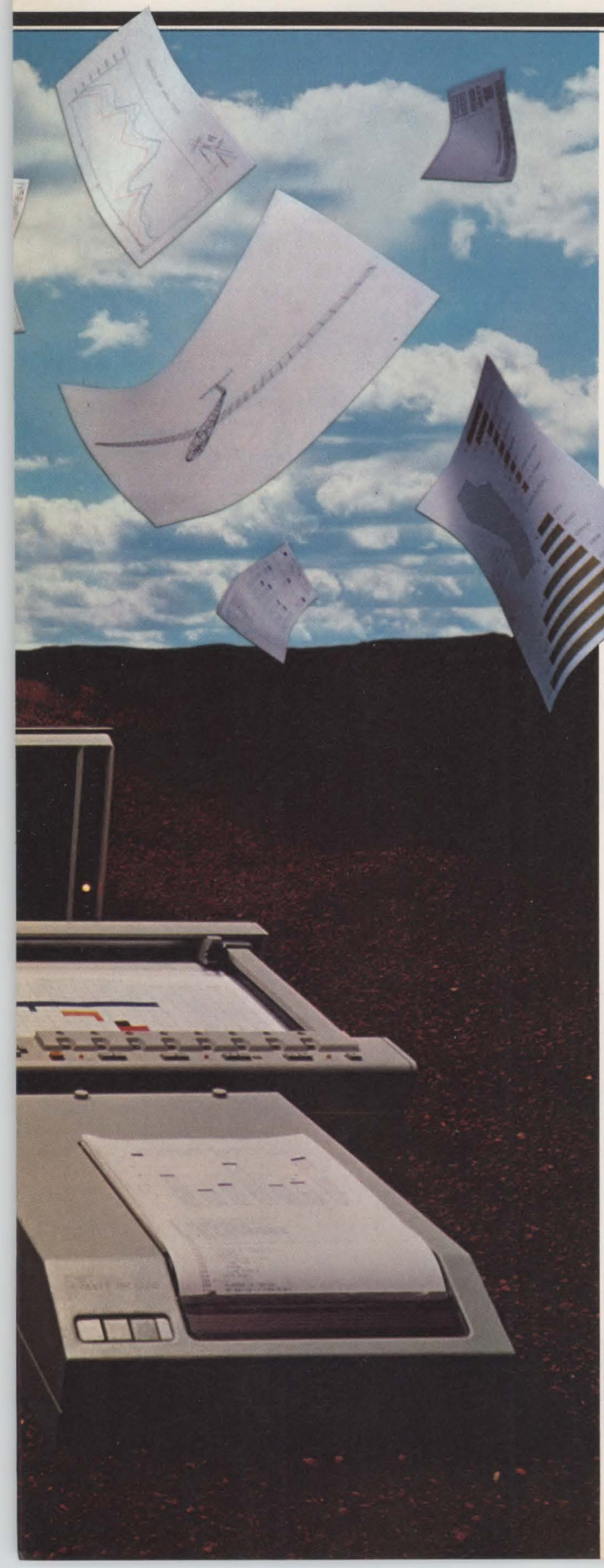

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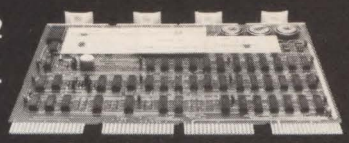

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CIRCLE NO. 10 ON INQUIRY CARD

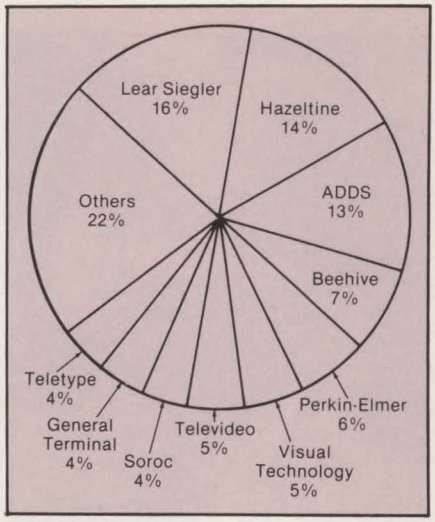
Lear Siegler takes action in terminal price war

Price cuts announced in July by Lear Siegler, Inc., for the ADM 3A and 5 were necessary if the company was to preserve its dominant share of the dumb-terminal market, company sources say. Those cuts have allowed Lear Siegler to position itself competitively in the price war that competitors initiated last spring.

Lear Siegler, which defined the low-end terminal market three years ago with its ADM 3A, has reduced the price of that terminal from $895 to $595. The company has also lowered the price of the ADM 5 from $995 to $645.

Advanced Resources Development, a Medfield, Mass. market-research firm, estimates that 179,000 low-end terminals were sold in 1980. With a 16-percent share of that market, Lear Siegler's Data Products Division, Anaheim, Calif., risked losing a portion of its sales to competitors Applied Digital Data Systems, Televideo Systems, Hazeltine Corp. and Soroc Technology Inc., each of which introduced competitive products selling for less than $700 last spring. Lear Siegler resisted cutting the prices of its low-end products, opting instead to sustain its market share by offering options, such as voice recognition, graphics capabilities and touch-sensitive screens. That strategy proved to be only a stop-gap measure, however.

"We realized that if we did not lower our prices, we could maintain a good share of our market, but we would also lose a significant share," says Bob Wolkowicz, Lear Siegler's director of national sales. Wolkowicz says that after assessing pricing through the spring and early summer, he found that the company could make cuts by lowering production costs and profit margins.



Lear Siegler, Inc., *shipped 16 percent of all CRTs sold by independent suppliers during 1980. With recent price cuts on the ADM 3A and ADM 5, the company expects to increase its market dominance in the low end. Source: Advanced Resources Development.*

As part of cutting its costs, the company reduced its employee numbers through increased automation. Wolkowicz says Lear Siegler is shipping 17 to 18 units per month per production employee, almost double last year's figure.

Like its competitors, Hazeltine and Televideo, Lear Siegler has achieved cost savings by assembling some of its terminal components overseas. PC boards are manufactured in Yugoslavia, power supplies in Mexico and monitors in Korea.

Although Wolkowicz admits that Lear Siegler will lose some of its profits over the next three to six months because of lower profit margins, he says profit gains from expected sales increases will eventually supersede initial losses. He expects sales of the company's low-end terminals to increase by as much as 30 percent during the next year.

"We've got an established customer base and a solid reputation going for us," says Wolkowicz. "Granted, some of our customers have defected over the past year because of price considerations. But with our new aggressive pricing, I think we'll have no trouble getting some of them back, as well as attracting new customers." —*Frank Catalano*

IEEE 802 advances toward balloting on LAN standards

After resolving a few sticky problems relating to its local area networking (LAN) standards this summer, the Institute of Electrical and Electronics Engineers 802 committee expects to complete its 270-page LAN document this month. Should the document be passed by a voice vote, the proposed specifications will enter the long balloting process required to become a ratified IEEE communications standard.

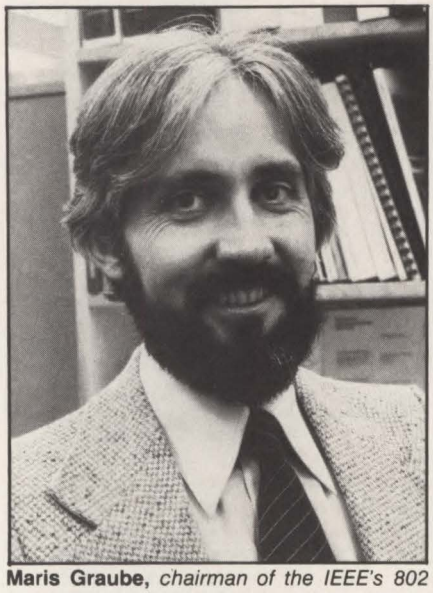
To reach this stage, several IEEE

802 committee members made a late-night push at their July meeting in Seattle to reach agreement on two remaining issues. This work was termed "a real achievement," although chairman Maris Graube estimates the LAN document "was 95 percent complete going into the Seattle meeting."

IEEE 802 consists of three subcommittees. The media (physical) subcommittee has concerned itself with specifying a media access unit (MAU) that interfaces to the network in a media-independent fashion. The data link and media access control (DLMAC) subcommittee consists of three groups: link level control, carrier sense multiple access/carrier detect (CSMA/CD) access method and token access method. The third subcommittee, high-level interfaces, attempts to ensure that the Layer 1 and 2 work of IEEE 802 is compatible with standards work at the upper layers of the OSI reference model (see table, p. 21).

Two major issues resolved at the July meeting centered on the DLMAC's link-level-control group. In one area, the watchdog high-level interface subcommittee had discovered a need to expand the scope of the data link layer's addressing capability. The link-level-control group complied by adding service-point access addressing to the physical addressing function at this layer. For example, if a computer links to both a long-haul network and an LAN, the computer can be reached through its physical address, and the desired network can be reached by using the service-point access addressing capability.

A second point of debate involved choosing a 16- or 32-bit frame-check sequence for error control. The link-level-control group ultimately chose both—16 bits for token networks and 32 bits for CSMA/CD networks. Graube stresses that this does not create two options, but recognizes that two types of network will exist, and provides an optimal frame-check sequence for each. "We already have the token and CSMA/CD split," he notes, "so going with both 16- and 32-bit has no further incompatibility ramifications."



Maris Graube, *chairman of the IEEE's 802 committee on local area network standards, says the group should complete its LAN document this month and send it out for balloting next month.*

Assuming all goes well at the IEEE 802 meeting this month, the LAN document will be sent to all eligible 802 committee members for comments and voting. To pass, 75 percent of the members must vote for the standards; Graube believes two ballots may be required to pass beyond the 802 level. Votes must then be taken by the Technical Committee on Computer Communications (TCCC), the Computer Society and the IEEE Standards Board before the LAN document can be accepted as an IEEE standard.

Graube estimates that the document won't reach the TCCC level until April or May, but he doubts that will deter equipment manufacturers. "Once the companies see a gelling of the standard, even at our committee's level, they will probably commit to production," he predicts. "They're willing to risk the small changes that may occur during the balloting process because, if their company is starting from scratch, it will take two to three years before their product is on the market." —*Dwight B. Davis*

Network users grapple with standards, set goals

Forming a users' association is never a simple matter, and when the group's focus is to be on a subject as broad and complex as communications standards, potential problems seem to grow exponentially. Nevertheless, the Network User's Association (NUA) managed its first general meeting with only a few scrapes and bruises, and seems to be on its way to becoming a stable organization that will help the user's voice be heard by the vendor-dominated standards group.

Most participants at the NUA's Seattle, Wash., meeting, in July—users and vendors alike—agreed such a group was long overdue. While users have a large vested interest in the availability of communications standards, few users can afford to meet the heavy time and travel requirements necessary to participate in the various standards-forming bodies. In theory, the NUA hopes to track the activities of the standards groups, report the implications of this activity to NUA members and arrive at a consensus that can be communicated to the appropriate

parties. In practice, the NUA leadership found this process must be slow and strictly limited to statements that will have credibility with the standards organizations.

These points were driven home during a workshop on local networking protocols. Maris Graube, chairman of the Institute of Electrical and Electronics Engineers 802 committee on local area network standards, had given a presentation about the committee's work, mentioning some then-unresolved issues (see "IEEE 802 advances...," p.19). One such issue involved the use of 16- or 32-bit frame-check sequences to catch transmission errors. Sheldon Blauman, chairman of the NUA and a senior systems analyst at Boeing Computer Services Co., attempted to gain membership support for a NUA resolution requesting that the IEEE 802 committee choose either 16- or 32-bit error checking, but not both.

Several members of IEEE 802—which had a concurrent Seattle meeting—attended the NUA workshop, and some vigorously recommended that the NUA avoid taking stands on technical issues. "This association (NUA) has nowhere near the technical expertise of IEEE 802," one 802 representative said, "and such a technical resolution would have zero weight on our committee." Many NUA members agreed that such technical issues were beyond their understanding, and the frame-check-sequence resolution was dropped. The NUA members unanimously passed a more general resolution, recommending, in part, "that the IEEE 802 standards committee develop their standards with as few as possible options."

"I was disappointed that we were unable to pass a resolution that dealt with some of the technical issues in a limited fashion," Blauman said. "We want to give inputs as knowledgeable end users where there are deadlocked standards issues, but I think we were wrong to assume the users already had a certain level of technical knowledge. At future meetings, we will have our technical committees explain the functional implication of the standards issues so the members are better prepared to arrive at a position."

Open Systems Interconnection (OSI) reference model

Number	Layer name	Layer function
7	Application	Information exchange
6	Presentation	Syntax transformation; source encryption
5	Session	Source addressing; dialog structuring
4	Transport	End-to-end transfer assurance; system encryption
3	Network	System addressing; routing
2	Data Link	Single-link data transfer; link encryption
1	Physical	Physical circuit activation; bit transfer

The OSI reference model *serves as a conceptual guideline for organizations developing communications standards. For example, the IEEE 802's work with local area network standards deals only with the Physical and Data Link layers. "Interfaces" transmit data up and down the model's seven layers; "protocols" permit information exchange between like layers of different network equipment (e.g., layer 7 to layer 7).*

While the NUA's first meeting focused heavily on the group's function in commenting on standards, its activities won't be limited to this role. "Resolutions about general needs are okay," said Gary S. Robinson, from Digital Equipment Corp.'s standards group and a member of IEEE 802, "but what 802 can use is demographic information about who the users are and what environments they work in." Blauman agreed that providing such demographic data constitutes an important function of the NUA, but he noted that it was impossible to collect such information during the first meeting. During its business meeting, the NUA decided to mail a survey to its members designed to collect environmental and application data.

Perhaps the NUA's best achievement at the Seattle meeting was to fulfill the group's goal of educating its members and serving as a vehicle for information exchange. With the local area networking workshop, the association also held workshops on broadband networks and on higher layer protocols based on the Open Systems Interconnection (OSI) reference model. The NUA members also heard from spokesmen representing several communications standards bodies. Among them were:

- Richard desJardins, chairman of the American National Standards Institute's (ANSI's) X3T5 committee on open systems architecture, who described the seven layers of the OSI reference model (see table, p. 21) and their functions. He suggested, "Don't make a transition from your current communications environment if you're satisfied; when transitioning, adopt standard solutions where possible, develop industry-wide conventions, and insist on a single-world transport-level protocol standard."
- Robert Blanc, director of the Center for Computer Systems Engineering at the National Bureau of Standards (NBS), who discussed the development path for Federal Information Processing Standards (FIPS) and said the NBS works in cooperation with national and international standards organizations. By late this year, the NBS hopes to issue standards for Transport and Session layer protocols; plans for 1982 include File Transfer/Data

Presentation protocols, a local area network interface (Layers 1 and 2) and a standard format for electronic messages. (The NUA passed a resolution strongly supporting the NBS's standards efforts.)

• Harold Katz, chairman of the Electronic Industries Association (EIA) 40.1 committee on broadband networks, who said his group is attempting to allocate specific broadband channels for data and voice traffic, and is trying to define parameters for the RF modems required to interface to these networks. Every broadband network vendor uses a different modulation technique, he noted, while claiming this variance is unnecessary.

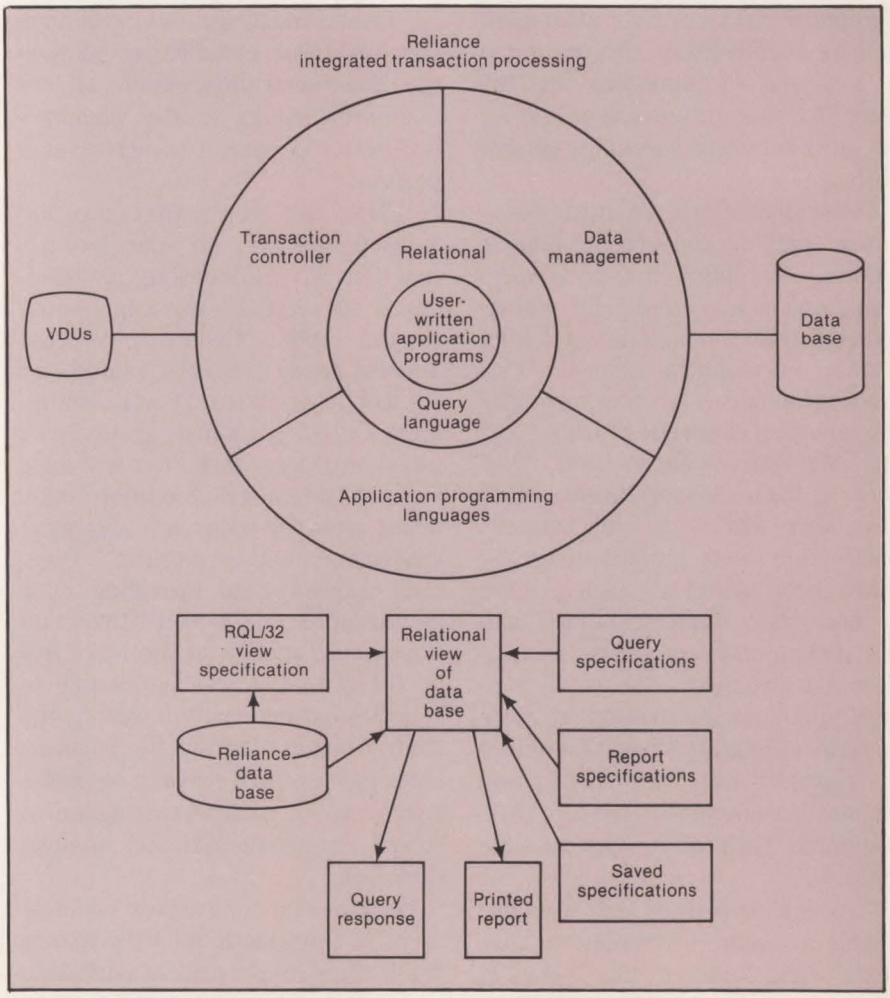
Although some of the NUA members seemed shell-shocked by the amount—and sometimes the technicality—of information presented at the meeting, the general mood was optimistic by the meeting's end. "Sure, there will be some problems at first," admitted Michael P. Rose, assistant vice president and manager of data communications at Seattle First National Bank. "We have no credibility and no legitimate power over anybody. But our credibility and our power base will grow over time, and users will begin taking an active role, for a change, in standards development. And we will probably exert a fair amount of pressure on vendors to comply with these standards when they are ratified."

—Dwight B. Davis

P-E eyes commercial market with relational query language

In what it terms the same noble experiment that other companies have gone through, Perkin-Elmer Co.'s Data Systems Group, known for its laboratory-instrumentation products, is making a late entrance into the commercial market for 32-bit minicomputers. Its entry is a relational query language and report-writing facility, called RQL/32. P-E's competitors, including Prime Computer, Inc., Digital Equipment Corp. and Data General Corp. already have software products for the potentially lucrative commercial 32-bit mini market. P-E's decision to address that market was prompted in part by competitive pressure that required the company to broaden its product line. IBM Corp. and DEC are attacking the company's stronghold —computerized laboratory instrumentation—says William G. Moore Jr., Data Systems Group computer operations vice president.

RQL/32 is not the company's only recent move in the commercial market. The company also established a $45 million Business Systems Division in Little Silver, N.J. The 100-employee division, with RQL/32 as its first product, is



RQL/32, a component of the Reliance transaction-processing system, *reduces the number of user-written application programs needed to retrieve information.*

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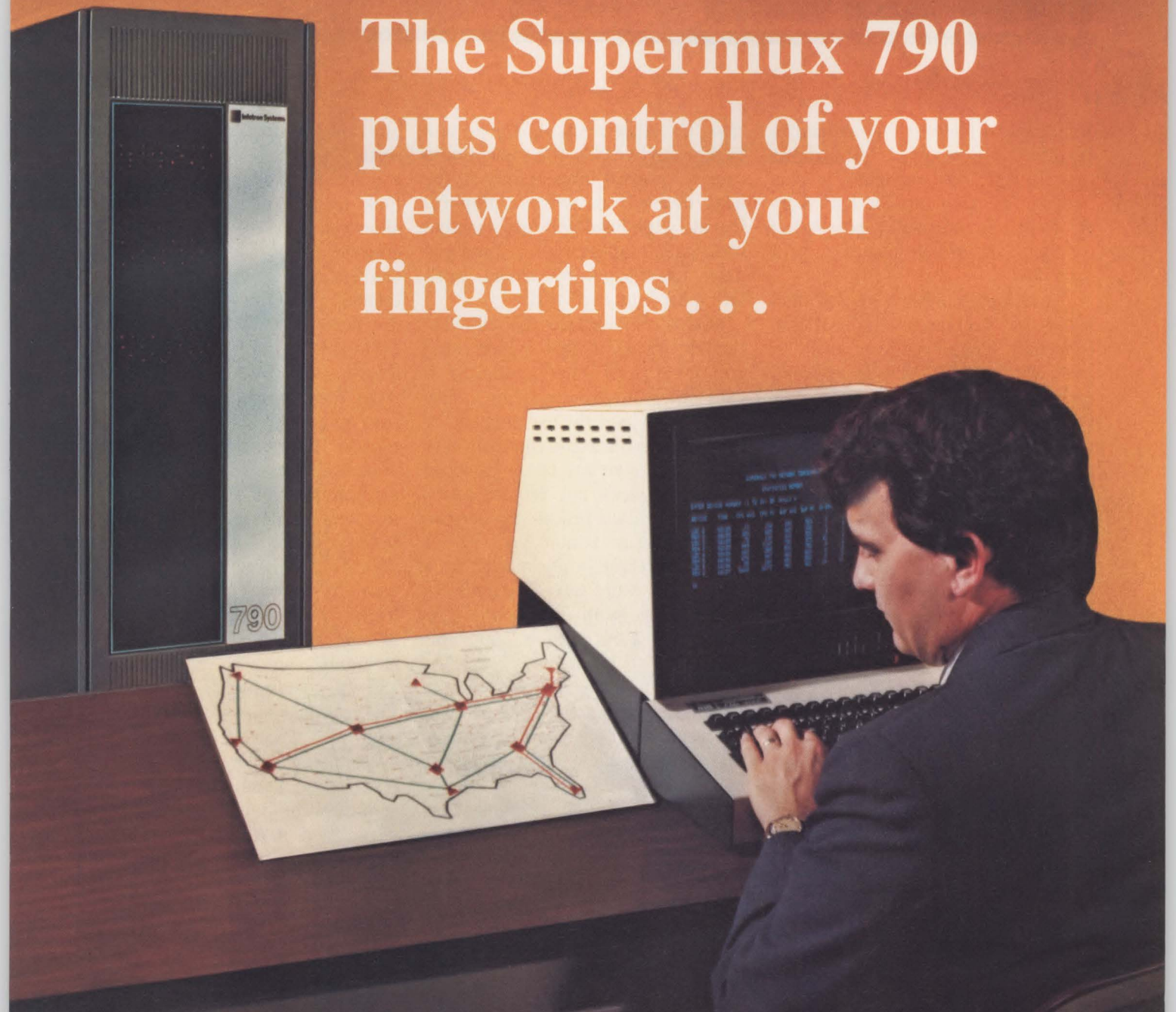

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CIRCLE NO. 11 ON INQUIRY CARD

dedicated to making the company's 32-bit minicomputer equipment easy to use. The company is also touting its two-and-one-half-year-old Reliance transaction-processing product, of which RQL/32 is a component.

The company faces a tough uphill battle in commercial applications, especially from vendors such as DEC, contends Donald H. Brown, director of small systems analysis for the Gartner Group, Inc., Greenwich, Conn. Moore acknowledges that "P-E is known for very good hardware," but that some users have found the equipment difficult to use.

The company uses two approaches to software: it qualifies externally developed software and develops tools to help cut programming time on on-line, interactive 32-bit minicomputers.

The key feature of RQL/32 is that a user does not need programming skills to extract information from a data base or to produce reports. Typical users, such as managers, clerical staff, application operators, as well as programmers, need state only what data is needed, not how the system should retrieve the information.

RQL/32 uses a relational data base, in which data are viewed in 2D tables. Operations performed on each table act on the whole table rather than on individual records in it, as with hierarchical or network data base systems. In using a hierarchical data base, a user must know the underlying data structures and be familiar with COBOL and FORTRAN to retrieve data, explains Susan E. Hoffberg, product manager for business products planning in the new division. She adds that relational data bases are thus easier to use.

RQL/32 performs many functions normally done with custom-written application programs, such as report generation, the company says. Creating a report is done as a background transaction, enabling a user to proceed immediately to the next desired transaction. Reports include page head and foot designators, page numbering and time and date. User passwords shield sensitive data from retrieval.

RQL/32 can replace the information-retrieval function, which could comprise half the needs of a data-processing department. This information can be backlogged for several years, and the company says RQL/32 can alleviate these backlogs because it does not require assistance from data-processing personnel. "It takes 1 min. to write a query (to retrieve information for a report). It could take five hours to write a program, and even then you're not done with it," explains Hoffberg.

RQL/32 is a component of the Reliance commercial transaction-processing software, which controls and monitors application programs and handles as many as 13,000 transactions per hour. Reliance files need not be altered to use RQL/32. Initial sales efforts for RQL/32 will be focused on the more than 200 worldwide Reliance installations, which include financial-service, manufacturing and distribution applications.

RQL/32 performs three basic operations: join, projection and selection. Join enables a user to combine records in several Reliance files into a new file, projection allows a subset of fields to be created in a file, and selection enables a subset of records to be created in a file. These operations are performed with a menu-driven fill-in-the-blanks feature on the CRT screen. Automatic prompting and HELP facilities aid users in composing a query. Using Reliance's DMS/32 data-management system expedites data updates and retrievals from multiple files. It also allows RQL/32 to access the same files maintained for Reliance use, so that files do not have to be extracted from a separate file system and loaded into the relational system.

License fee for RQL/32 is $5000, including complete documentation and one-year software maintenance. The product is available now. A complete transaction-processing system, including RQL/32, sells for less than $100,000. A typical configuration includes P-E's 3220C supermini with 0.5M bytes of memory, a 45-ips magnetic tape, a disk drive, four video displays, a Vanguard 1 disk, and a 180-cps printer, all totaling $74,000; a $6400 operating system; Reliance, priced at $13,700; and the $5000 RQL/32.

—L. Valigra

Vendors look to independents for CAD/CAM packages

Through marketing agreements that range from exclusive rights to a simple directory listing, hardware vendors are increasingly using independent software houses for CAD/CAM system offerings. Among those entering joint marketing agreements are Digital Equipment Corp., Harris Corp., Hewlett-Packard Co., Control Data Corp. and Prime Computer, Inc. Data General Corp. and Honeywell Inc. are expected to announce the signing of third-party agreements soon, and IBM is reportedly talking to several independent companies for additional offerings.

The hardware vendors are chas-

SUPERBRAIN QD™
VS.
SUPERBRAIN™

the two top microcomputer contenders

When you decide to buy a microcomputer system, it usually gets down to one model versus another. Will it be the SuperBrain from Intertec... or one of those other models from Intertec's competitors? Well, there's really not much of a choice in the price/performance competition. The SuperBrain wins hands down! And it's a pretty tough contender if reliability, factory support and nationwide service are important to you. So what do you do? Choose our SuperBrain just because you know it's best? Or keep waiting for someone to announce something better?

WAIT NO LONGER...

It wasn't enough that our SuperBrain had such standard features as twin double-density disk drives with nearly 350,000 bytes of disk storage. A full 64K of dynamic RAM. A CP/M* Disk Operating System which assures compatibility to literally hundreds of application packages. A crisp, 12" nonglare screen with a full 24 line by 80 column display. A full-featured ASCII keyboard with a separate keypad and individual cursor control keys. Twin RS232 serial ports for fast and easy connection to a modem or a printer. Plus, dual Z80 processors which operate at 4 megahertz to insure lightning-fast program execution. No, it wasn't enough. So we changed it. We made it even better!

ANNOUNCING SUPERBRAIN QD...

Our new QD model boasts all the features of our phenomenally popular SuperBrain with the addition of double-sided disk drives. So, for only a modest increase in price, you can order your next SuperBrain with more than twice the disk storage. But, best of all, you can field upgrade the disk capacity of either model to a whopping 10 megabytes! Now how's that for a choice?

HOW DID WE DO IT?

The secret of SuperBrain QD's incredible disk storage lies within our new double-density, double-sided disk drives. Nearly 750,000 bytes of data can be formatted on two specially designed 5¼" drives. More than enough to tackle almost any serious small business application. Plus, SuperBrain QD's 64K of dynamic RAM will handle even your most complicated programming tasks.

Of course, if you really need megabytes instead of kilobytes, just add our 10 megabyte CompuStar™ Disk Storage System. It connects in seconds and gives you the capability to expand your system into a powerful multi-user network with up to 255 CompuStar terminals. You can add users one at a time as you need them. So no matter how much your needs expand, your original investment in computer hardware is always protected.

BUT IS IT RELIABLE?

Our best salesmen are our present customers. Not only have SuperBrain and QD users been impressed with the inherent reliability of the systems, they tell us that no other microcomputers available offer such a unique modular design concept. Just about the only service tool required is a common screwdriver. But of course if you'd rather let us do the service, our total commitment to product and customer support, with service outlets in most major cities, will guarantee your satisfaction for many years to come.

The CompuStar™ Disk Storage System
... Connects in seconds to either model.

THE DECISION IS YOURS...

Whether your next microcomputer is the SuperBrain or our QD model, you'll be purchasing what is becoming one of the world's most popular microcomputer systems. And regardless of which model you choose, you'll probably never outgrow it because you can keep expanding it.

Call or write us today for more information on our full line of microcomputer systems. Ask for our "SuperBrain Buyer's Guide" and read why so many customers like yourself have made the SuperBrain and the SuperBrain QD their top two choices for performance, value and reliability.

INTERTEC DATA SYSTEMS®

2300 Broad River Rd., Columbia, S.C., 29210
(803) 798-9100 TWX: 810-666-2115

*Registered trademark of Digital Research, Inc.

CIRCLE NO. 12 ON INQUIRY CARD

Sapphire™ 160

Introducing a new standard in 160 megabyte, 14-inch Winchester disk drives.

Replaces the CDC 9730, DEC RM80 and others. Here is a new standard in 14-inch Winchester disk drives — the Sapphire 160 from Tecstor. A 160-megabyte fixed disk drive that is a direct replacement for Control Data Corp.'s 9730, DEC's RM80 and other high density Winchester drives. The Sapphire 160 has an SMD-compatible interface with execution of instructions performed by microprocessor-controlled electronics.

Available now. The Sapphire 160 is a mature product, is in production, and is available now. Utilizing up to four fixed disks, the Sapphire 160 disk drive, with 6400 bits per inch and 600 tracks per inch, can operate in non-air conditioned environments. It is ideal for expanded data storage with today's new generation of minicomputers.

In an ancient tradition. According to Greek legend, the Sapphire gem could preserve its wearer from envy, protect against captivity and serve as the key to understanding the sayings of the oracles. Tecstor's Sapphire 160 disk drive is in the same tradition. It preserves vital data records, it protects through specially designed data security features, and it can be a key element within an OEM system.

Backed by experience. Tecstor was founded by five principals who have many years of experience in manufacturing, engineering and marketing peripheral products, especially Winchester disk drives. They are committed to the OEM marketplace. Dedicated to providing the high quality products and responsive support and service that OEM's expect. And, as a new company, Tecstor has substantial capital financing through a number of blue chip venture capital firms. And, Tecstor has a 32,000 square foot manufacturing facility to handle the most demanding production requirements.

To find out how Tecstor's Sapphire 160 can be your new standard in Winchester disk drives, call or write today to arrange for an OEM evaluation unit.

TECSTOR

"We have the experience"

16161 Gothard Street, Huntington Beach, CA 92647
(714) 842-0077

CIRCLE NO. 13 ON INQUIRY CARD

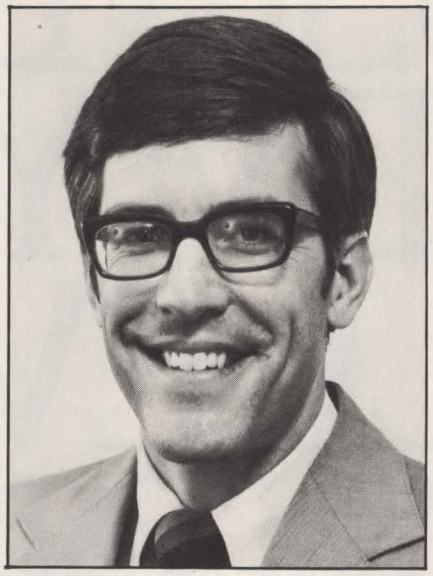
ing a piece of a market that is projected to grow at a 43 percent compound growth rate from $350 million in turnkey systems sales in 1980 to $2 billion in 1985,,according to market analysts at Creative Strategies International, San Jose, Calif. In the process, the vendors must avoid angering their OEMs, which are selling similiar packages.

Patrick J. Hanratty, president of Manufacturing and Consulting Services Inc., Santa Ana, Calif., believes the major hardware vendors are turning to third parties for CAD/CAM packages because in-house development gobbles up too much in internal resources. Hanratty's firm has agreements with several large minicomputer manufacturers to market his firm's CAD/CAM packages.

"In our own system, we are talking about several hundred man years of evolution, which includes a tremendous number of wrong paths that we have gone down and backed off from," Hanratty says. He believes the only options open to hardware vendors to avoid similar development pains are marketing agreements or acquisitions.

Hanratty's company has 160 systems installed and offers a variety of CAD/CAM packages that run primarily on high-performance wide-word minicomputers. The agreements established between Hanratty's company and the hardware vendors range from royalty contracts with Control Data and a pending similar agreement with Honeywell, to joint marketing agreements with Prime, Perkin Elmer, DEC, Harris, and H-P and a pending agreement with DG. Under the royalty agreements, the computer firms have the right to sell the system under their own names as well as gaining marketing and servicing responsibilites. Under the joint marketing provisions, the sales price and servicing responsibilities are divided between hardware and software. Hanratty finds the royalty agreements as appealing as joint marketing agreements. "Our royalty is higher than what we clear on a system," he says.

Hanratty claims to have had no problems in determining whether hardware or software is at fault when a customer's system goes down and the system was purchased under a joint marketing contract, which divides hardware and software servicing. "We don't enter into a joint marketing agreement unless we have (the joint marketing partner's) computer in-house," Hanratty says. The in-house computer is used to simulate a customer's program and pinpoint and define the system's problem.



Most computer companies *are developing relationships with third parties and systems houses for CAD/CAM marketing, says Harris vice president James Oyler.*

The Computer Systems Division of Harris Corp. recently announced a joint marketing agreement with Manufacturing and Consulting Services for a soon-to-be-released Anvil-4000 CAD package to run on Harris's 48-bit computers. Discussing CAD/CAM marketing, vice president of marketing at the Computer Systems Division James Oyler says, "I think that most computer companies are using the same route as Harris, which is developing relationships with third parties and systems houses."

The division generates 20 to 30 percent of its revenues from CAD or CAM products, and the company is forming an internal CAD/CAM marketing group.

Because CAD/CAM sales are central to the division's sales, Oyler predicts that the company will bring a CAD or CAM package in-house and handle software and hardware responsibilities.

The decision to go in-house is still at least a year away and will be made when two requirements are fulfilled, Oyler says.

"First, are you capable of supporting it (the software) properly? Second, does it make business sense to specialize in one particular package or selection?"

Third-party agreements are also on the minds of DEC's CAD marketers. Most of DEC's CAD-related marketing occurs in the Engineering Systems Group, which has 300 salesmen dedicated to its sales efforts. DEC recently signed a joint marketing agreement with the Structural Dynamics Research Corp. (SDRC), Cincinnati, Ohio, to market computer systems cooperatively for mechanical engineering applications. That agreement calls for joint marketing and sales calls, but responsibilities for servicing and the systems' price are divided between hardware and software.

"For any hardware vendor, the purpose of doing all this (entering into joint marketing agreements) is to leverage hardware sales. And that is the absolute goal. If we can leverage a system sale off of that (potential software package), we're going to make an investment in that relationship that is in proportion to the amount of hardware that it will leverage," says James Morrison, marketing manager for structural engineering of DEC's Engineering Systems Group.

THE SMALL BUSINESS SYSTEM YOU'D SELL EVEN IF YOU DIDN'T MAKE MORE MONEY SELLING IT.

CIRCLE NO. 14 ON INQUIRY CARD

DATA GENERAL'S CS FAMILY: THE FIRST SMALL COMPUTER SYSTEMS BIG IN ALL THE RIGHT PLACES.

At Data General, we derive a great deal of satisfaction from offering you the most profitable systems you can sell. But we also find it particularly satisfying when our systems happen to be the most outstanding on the market as well.

Such is the case for our Commercial Systems (CS) family.

Without getting into a long, drawn-out thesis on the proven reliability and flexibility of the integrated CS systems, or Interactive COBOL, or the wide range of programmer productivity tools, or how it's all designed to grow as your customers grow, one factor well worth detailing is our new application software.

INTRODUCING GENAP™ APPLICATION SOFTWARE. WE PUT OUR RESOURCES INTO DEVELOPMENT SO YOU DON'T HAVE TO.

Based on the notion that your time should be devoted to sales and installation (where the profits are) vs. development of software from scratch, Data General has created a financial series of application software. Software which is unmatched in the industry and, needless to say, provides you with a mammoth profit opportunity.

The applications (general ledger, accounts receivable, accounts payable and payroll) were developed by Data General's software team over a period of years and include more than a million lines of code and over 350 programs. All the programming expertise was directed by in-house accountants to help make sure the products conform to accepted accounting practices and IRS codes, and offer the features your end users will need to help them run their businesses effectively.

A national firm of certified public accountants has reviewed and tested these systems and has prepared a report containing their opinion, a copy of which is available from Data General upon written request.

SERVICE AND SUPPORT TO THE NTH DEGREE.

Data General has taken great pains to provide you with a total environment to make your end users happy: i.e., the GENAP products include not only quality application software, but also a complete series of development tools and comprehensive documentation.

Tools such as file management software supporting hierarchical data structures and a data dictionary; a flexible menu and security capability; and a series of precoded "skeleton" programs for easy coding of online transaction updating, inquiry activity and status-report programs.

And Data General provides not only GENAP technical documentation for you and your programming staff, but also comprehensive manuals to give to your end users at both executive and operational levels.

So as you customize the financial applications or write your own application software, you will spend less time and therefore considerably less money, while maintaining consistency with both the built-in standards and the user documentation.

A MYRIAD OF OTHER FACTORS.

Obviously, there are many other points we could get into, like CS's remote diagnostic feature, or the fact that Data General's percent of growth in small business systems is among the industry's highest, or Data General's unequalled delivery record, or even how our 12 successful years of dealing with OEM's have helped put us in the Fortune 500, but we won't inundate you with all that now.

For more information and then some, call your local Data General office or fill out the coupon below and we'll fill you in.

Data General

Mail to: Data General Corporation
4400 Computer Drive, MS C228, Westboro, MA 01580

Attention: Marketing Communications Department
☐ Please send me free information on GENAP application software.
☐ I'm in a rush. Please have a sales representative call on me.

Name_____

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MMS-9-81

DEC has two types of marketing agreements within the Engineering Systems Group. The first, of which the SDRC agreement is one, is the stronger relationship and can include joint sales calls, advertising and program demonstrations. DEC has 20 such agreements, Morrison says. The second type of joint effort, which is much more casual, consists mainly of DEC registering the third party's software in a referral catalog that is expanding at the rate of about 100 programs a month, Morrison says.

Because DEC does not offer its own CAD or CAM package and the Engineering System Group is an end-user-oriented organization, most hardware sales result from analyzing systems sold with or as a later addition to the CAD system.

"If you've got a CAD system that is driving high-bandwidth graphics, you've got to dedicate that system to the graphics function. If you want to do a structural analysis of that design, you have to go to another system. That is where our message comes in, which is: "What you need is another VAX," Morrison says. The VAX is DEC's 32-bit minicomputer.

While DEC has been willing to enter agreements that provide for joint sales calls, demonstrations and advertising, the company has stopped short of entering a rights agreement that would put the DEC name on a package and have a DEC company handle servicing and updating. The question of whether to seek a stronger relationship with a third party remains unresolved. Morrison hopes that DEC does seek stronger ties. However, if the company makes more binding agreements, DEC risks competing with its own OEMs. Many independent CAD/CAM systems companies, such as Applicon and Auto-trol Technology Corp., use DEC hardware.

While DEC officials refuse to comment on the size of individual product groups, one official called an estimate of $65 million for the engineering systems group,"far too conservative."

While DEC mulls the prospect of reaching stronger affiliations with third parties, Prime Computer has gained the exclusive rights to market and service a CAD package aimed at drafters and developed by Cambridge Interactive System (CIS) Ltd., Cambridge, England. The package, named Medusa, is licensed at $30,000 for a 2D version and $60,000 for a 3D model. Entry-level systems using a Prime 250 CPU are priced at $235,000.

"We are fully responsible for the product in all segments of the world other than Europe. We consider CIS our main engineering organization (for CAD/CAM products) for the short term, and they consider us their main marketing organization for the short term. How that relationship evolves has a lot to do with how our relationship works out," says Keith Mountain, Prime's business manager for market planning.

While Prime has established a close tie with CIS, the former is also considering third parties for additional CAD and, especially, CAM offerings. "We are approaching those (CAM applications) with the use of third-party software. We have arrangements with at least one package, and we are planning to expand that over the next year or so," Mountain says. Under those arrangements, the system price and servicing responsibilities are split between hardware and software.

Prime started its CAD/CAM program in earnest this year and has Medusa demonstration capabilities in most major U.S. cities. Prime expects to double its demonstration and support capabilities by year-end. The company does not have a dedicated CAD/CAM sales team but is assisting sales districts in strong CAD/CAM areas in hiring and training salesmen. The company has 10 CAD installations.

IBM, which markets some CAD/CAM software through third parties (most noticeably with Lockheed Corp.) is considering additional packages. An IBM/ spokesman says the company will continue to look internally and externally for CAD/CAM packages, but won't say how many of the company's offerings come from outside vendors.

Hanratty of Manufacturing and Consulting Services acknowledges that IBM officials have talked to him about CAD/CAM offerings, but he adds, "It would be nice to be able to say we are being wooed and pursued by IBM. We are not. We have entered into discussions with them just as many other companies have." —*Eric Lundquist*

IBM introduces new entry in small-business market

The distribution approach that seemed to work for IBM's 5120 small-business computer is being reactivated by the company for its new System/23 Datamaster, the lowest priced member of IBM's small-business systems family and the 5120's apparent replacement.

The company is selling the System/23 through IBM's systems-division sales force in 200 cities nationwide, the company's business computer centers in 50 major markets and new product centers or retail outlets in Philadelphia, San Francisco, and Baltimore, Md.

A FULL SPECTRUM OF CHOICES IN DEC-COMPATIBLE DISK STORAGE:

And now a new 32.2-Mb Winchester/Floppy System

DATA SYSTEMS DESIGN

More disk storage choices than you get from DEC.

DEC designs great CPUs. Data Systems Design gives you disk storage to match.

For CPU quality, you can't beat DEC's LSI-11 and PDP®-11. But their disk storage doesn't always measure up. At Data Systems Design, data storage is our *only* concern. That's why our DEC®-compatible disk systems are more reliable, less expensive, more compact and easier to maintain than the disk systems you get from DEC.

And you get more choices of systems, too, so you can pick the exact features your product application requires.

DSD 880 gives you more megabytes per buck for your PDP-11 and LSI-11.

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.

And the HyperDiagnostic™ panel simplifies troubleshooting for cost-effective remote diagnosis.

Fully compatible three ways.

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.

With its higher capacities, smaller size, lower cost and more, the DSD 880 gives your DEC computer-based system the disk storage it deserves.

A choice of 4 floppy systems.

Pick the features you need. Data Systems Design gives you more choices in DEC-compatible floppy disk systems, too.

Each of the four floppy systems is packaged in a low-profile 5¼-inch chassis. All offer built-in hardware bootstrap and complete DEC RX02 compatibility, plus a choice of domestic or international configurations, and complete documentation for easy system integration.

DSD 480 provides double-sided floppy storage for your LSI-11 or PDP-11.

For twice the capacity of DEC's RX02, choose the DSD 480. An optional EXCHNG™ software program lets the DSD 480 transfer files between IBM- and DEC-generated diskettes.

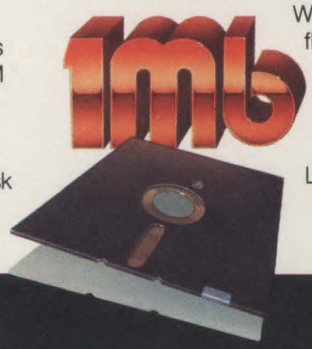
DSD 470 gives you low-cost double-sided floppy storage for your LSI-11.

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.

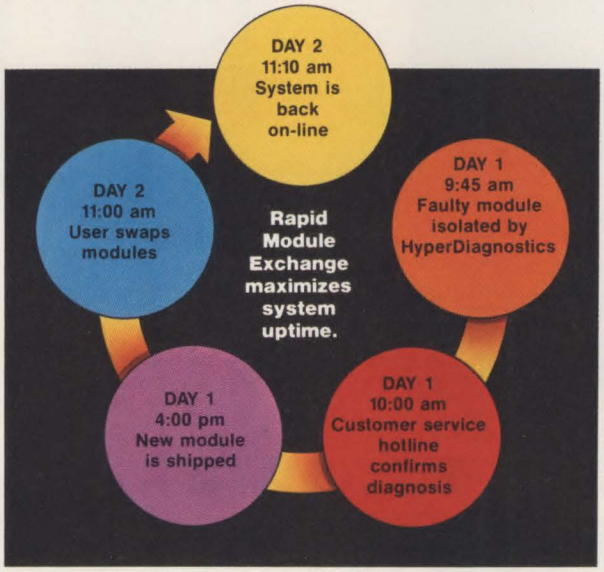
The DSD 440 is RX01 and RX02 software-compatible. It can transfer data 20% faster than DEC's RX02, and features built-in self-diagnostics for easy servicing.

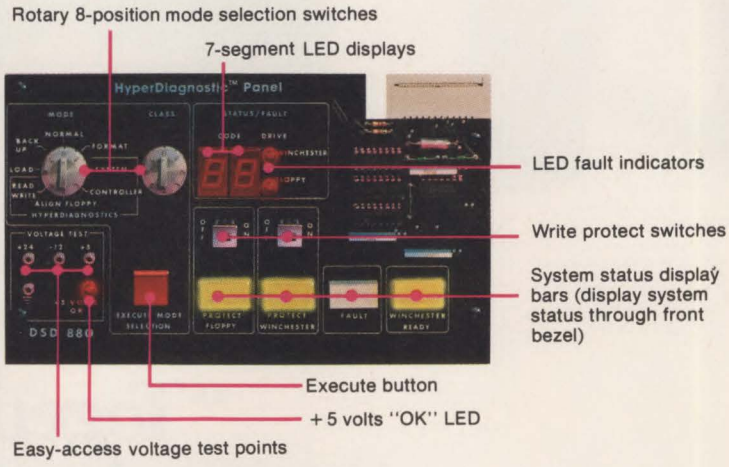
Choose DSD 430 for lowest entry cost with your LSI-11.



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

More reliable performance and easier maintenance.





DSD 880 HyperDiagnostic™ Panel

A revolutionary concept in uptime: Remote diagnosis ends costly service calls.

The true measure of a system is its ability to perform. Day after day, reading and writing data on demand. Data Systems Design units outlast any other disk system on the market. But even the most rugged system has an occasional problem. And that's when Data Systems Design really shines.

You know the usual service scenario. There's a problem, so you call the service rep. And wait for a return call. Then you wait for someone to show up. And every minute is costing money, in addition to the high cost of the service contract itself.

Data Systems Design ends all that with the service system that will soon be the industry standard: remote diagnosis.

HyperDiagnostics,™ standard on the DSD 440, 480 and 880, allow the user to test, exercise and debug without a CPU or a service call. Easy-to-use controls activate microprogrammed routines, and LED indicators designate fault status. On the 430 and 470, ODT-driven self-diagnostics and software diagnostics assist in troubleshooting.

A call to our service hotline gets instant back-up and confirmation of the diagnosis.† Our service records show that over 20% of the problems are fixed over the phone, with no service needed.

When a faulty module is isolated, **Rapid Module Exchange**™ gets the user back on-line faster than a service call. Thanks to our system's modular design, the user simply swaps modules after consultation with a hotline advisor. We usually ship out a new module the same day a failure is diagnosed in a specially-designed reusable carton for easy return of the original module.

For less than half the cost of a DEC service contract, our **HyperService**™ option extends warranty protection for one year beyond the standard 90 days and covers factory repairs and Rapid Module Exchange Service.

At Data Systems Design, we have carefully considered every step in the process to make service as easy and cost-effective as possible.

Get the disk storage you deserve for your DEC-based system.

For full technical details, write Data Systems Design, Inc., 2241 Lundy Avenue, San Jose, CA 95131, or call the sales office nearest you.

United States: Western Region (408) 727-3163; Eastern Region (617) 769-7620.

International: Australia: Melbourne 03/543-2077, Sydney 02/848-8533; Canada 416/625-1907; Denmark 01/83 34 00; Finland 90/88 50 11; France 03/956 81 42; Israel 03/298783; Italy 02/4047648; Japan 06/323-1707; Netherlands 020/45 87 55; New Zealand 4/693-008; Norway 02/78 94 60; Sweden 08/38 03 70; Switzerland 01/730 48 48; United Kingdom 01/207-1717; West Germany and Austria 089/1204-0.

*This controller/interface is also available separately as the DSD 4140.

†Although these services are available within the U.S.A. only, comparable service is available through our international distributors.

™HyperDiagnostics, HyperService, Rapid Module Exchange and EXCHNG are trademarks of Data Systems Design. ®DEC and PDP are registered trademarks of Digital Equipment Corporation.

Circle 101 for DSD 880 information.
Circle 102 for DSD 480 information.
Circle 103 for DSD 470 information.
Circle 104 for DSD 440 information.
Circle 105 for DSD 430 information.

Data Systems

"Together we're working to better serve mankind."

"On behalf of Vector computers, I'm pleased to tell our dealers and OEMs that TRW's Customer Service Division will provide a nationwide, nine-month on-site service warranty for your customers. At no charge.*

"This is the first time that any microcomputer has had this kind of comprehensive coverage. Now you can increase sales and decrease expenses by using our program — knowing that TRW will be there to service us. And eliminate the need to maintain your own expensive personnel for on-site service.

"So your customers have yet another reason to buy a Vector. We can increase their personal productivity, help them make faster decisions, improve their business, and now we offer a network that will service us at their business location. At no cost to them.

"Right now, they're already up and going in Los Angeles, New York City, Denver, Dallas, Chicago, San Francisco, Northern New Jersey, Philadelphia, Atlanta, and Boston, with more on the way.

"For more information, call us at 800-423-5857. In California, call 800-382-3367. Or write to us at 31364 Via Colinas, Westlake Village, CA 91362.

"TRW, Vector and you. Working together, we can help our customers realize their full human potential."

VECTOR

Vector Graphic Inc.

COMPUTERS FOR THE ADVANCEMENT OF SOCIETY.

CIRCLE NO. 15 ON INQUIRY CARD

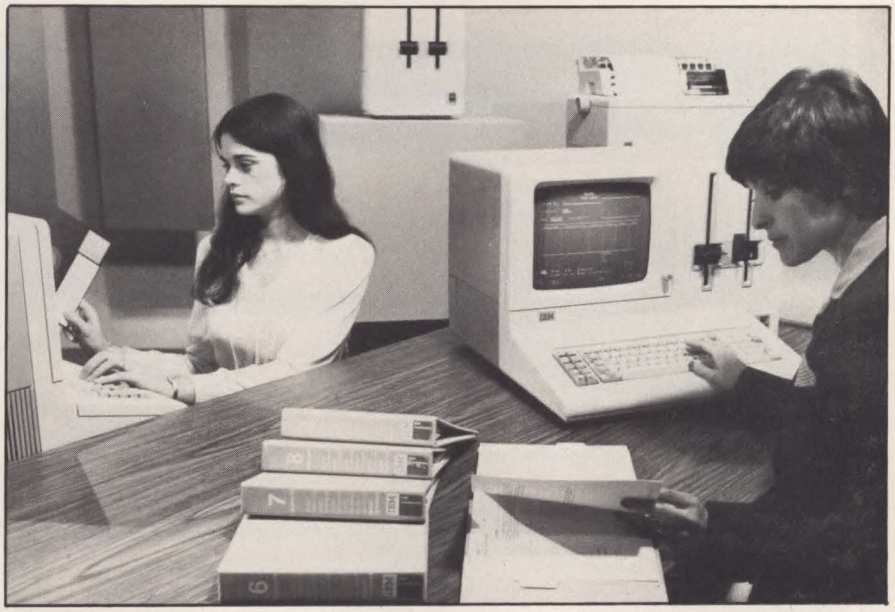
*Within 50 mile radius of a TRW service center.

Before the announcement of the System/23, the 5120 was—at $13,500—IBM's lowest priced system. Company sources say the System/23 is more cost-effective than the 5120, which has been removed from production. The unit combines data- and word-processing functions and can be expanded to include two computer work stations. It can be configured only as a single-user work station and does not include word-processing capabilities.

A full-function data-processing installation, with a single Intel 8085 μp-based work station, dual integrated floppy-disk drives and an 80-cps printer, sells for $9830. The word-processing option sells for $1100 to $2200, including software and hardware. The System/23 is available now.

IBM spokesmen say the System/23 will enable first-time users to migrate to larger IBM systems as users' businesses grow. The system uses a subset of the BASIC used in the System/34. Programs written for the System/23 can be used on the System/34 without the need for extensive reprogramming. IBM also provides a program that enables 5100 series users to convert their BASIC application programs for use on the System/23. Application programs for the new system include billing, inventory, accounting, accounts receivable, accounts payable, payroll and general ledger.

The System/23's work station contains as much as 128K bytes of main memory, expandable in 32K-byte increments. The unit's single or dual integrated 8-in. diskettes provide 0.3M to 2.2M bytes of storage and can be expanded with an optional diskette unit to store as much as 4.4M bytes. With two work stations and the additional diskette unit, memory can be increased to a total of 6.6M bytes. The word-processing option requires at least 64K bytes of main memory and 0.6M bytes of diskette storage.



IBM's System/23 Datamaster *is the lowest priced member of the company's small-business computer systems and apparently replaces the 5120.*

IBM introduced two printers with the System/23. They include the 80-cps 5241 and the 160-cps 5242, which is available with selectable speeds of 160 or 40 cps for letter-quality printing. Each System/23 work station accommodates two printers.

The unit's 12-in. CRT displays as many as 1920 characters in a 24-line × 80-character format. A typewriter-style keyboard provides function keys and a numeric keypad. Character sets are available in English, French, European, Nordic and Spanish.

The CPU contains 112K bytes of ROM and has a 975-nsec. main storage-cycle time. Storage parity checking is standard.

George Colony of the Yankee Group, a Boston market-research firm, says that the System/23 fills the gap in the low end of IBM's small-business product line. "Finally IBM has a low-end small business computer, which is upwardly compatible," he say. "The System/23 offers a bridge to the System/34 that the 5120 didn't provide." Colony says the System/23's price is competitive with Burroughs Corp.'s B-90, Texas Instrument Inc.'s 990, Wang Laboratories, Inc.'s 2200 and Data General Corp.'s CS line.

—Frank Catalano

Emulator/logic analyzer tests multiprocessor systems

Despite the attention focused on the power and versatility of 16-bit μps, designers continue to consider the potential of 8-bit devices, particularly in multiprocessing environments.

One limit to the use of 8-bit hardware in such systems, however, has been the lack of suitable development tools capable of simultaneous in-circuit emulation of one processor and logic analysis of another.

The first offering from Bellevue,

Advanced Digital Technology's model 4009 *combines a real-time in-circuit emulator and a 12-/20-MHz, 18-channel logic analyzer into one instrument.*

Wash., Advanced Digital Technology Inc., may offer designers a way around that problem, however. The firm's model 4009 combines a real-time in-circuit emulator and a 12-/20-MHz, 18-channel logic analyzer into one instrument. Aimed initially at systems based on Motorola's 6809 μp, the 4009 allows in-circuit emulation and logic analysis of systems using two μps tied to a single clock.

The company's vice president of marketing, Mark Astengo, says the 4009 is suited to I/O-port-intensive applications, such as telecommunication systems or disk-drive controllers. "The problem with emulation alone," he points out, "is that you can't really tell what's going on at the port. But in tandem with a logic analyzer, you can."

An executive at a disk-drive controller company agrees. "You may be able to look at the processor, but there are ports at the drive end and CPU end that pose problems," he says. Another controller maker adds, "Controllers must be debugged in real time."

Debugging, says Astengo, is provided by four breakpoints along with the real-time, 2K- × 56-bit-wide trace memory. Breakpoints are 40-bit-wide hardware comparators and can be built from any number of bit patterns.

Astengo claims the 4009's emulation mode is unique because it provides breakpoints on the system-under-test's DMA. This means it can look at DMA and at the whole system. Astengo says the 4009 essentially provides "a window into the DMA and lets you look at it as the processor does." The device can also trace DMA, as well as map over its own memory with outside memory.

Two RS232C ports allow the 4009 to be used with any dumb terminal for control and display of emulator and logic-analyzer functions. A cassette interface is standard, and IEEE-488 and Centronics printer ports are optional.

Astengo says the 4009 supports all Motorola 6809 NMOS 8-bit processors, including the E versions, a feature that competitive instruments lack. Plans call for supporting Motorola's 6805 CMOS processor and those available from Motorola's second sources.

Limiting the 4009 to Motorola's hardware may be a drawback to the device, however. "The combination of in-ciruit emulator and logic analyzer makes sense only if emulation will be offered for other processors," says one source. Astengo says that ADT has not excluded other processors, but that the company has no plans for them now.

Shipments of the 4009 began last month. It is priced at $4995, and additional emulator pods and boards sell for $2000 each. *—Larry Lettieri*

Software tax to be tested in California courts

California, which for nearly a decade has been a bellwether for software sales and use taxes, is about to set yet another precedent. The first software-tax case involving programming will be challenged in a state superior court, and other cases are expected to follow.

Observers note that such court cases are not common because of the cost involved. Some say the lack of challenges to earlier legislation is the reason why software taxes have passed so easily in some of the 20 states that levy such fees (see "Massachusetts bill would exempt software," p.43).

Adding fuel to the impending California lawsuits is a recent reversal of a software tax in Illinois. In April, a user's successful legal challenge to taxes on pre-written software resulted in the state ruling that software is intangible and thus nontaxable. The California company now in the spotlight is General Business Systems, which is suing the tax-levying state Board of Equalization for a refund of $50,000 that GBS paid in back taxes. Additionally, three actions intended to question the validity and implementation of the tax may be added by that state's Sales Tax Action

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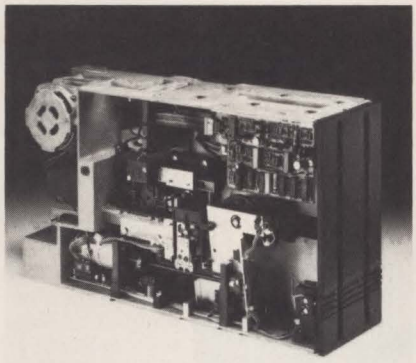

8 inch floppy. Add dual head techniques to that high reliability and you have two heads reading double density data on both sides of two diskettes in one compact package. In other words you have a PerSci Model 299B with data storage of 3.2 Mbytes—the perfect storage capacity for a wide variety of applications.

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So before you spend money and time on Winchesters and low performance floppys and cartridge drives with multiple controllers (and before you start betting on tape for backup)—consider the alternatives. PerSci drives are microprocessor based, have a patented hub and cone assembly for ultra-reliability and a unique low noise read amplifier. They have all the benefits you can expect from hard disks—with the removable, low cost, mailable, stackable floppy media that is the standard of the industry. So now that you've got a choice, choose a PerSci high density floppy—the Winchester alternative.

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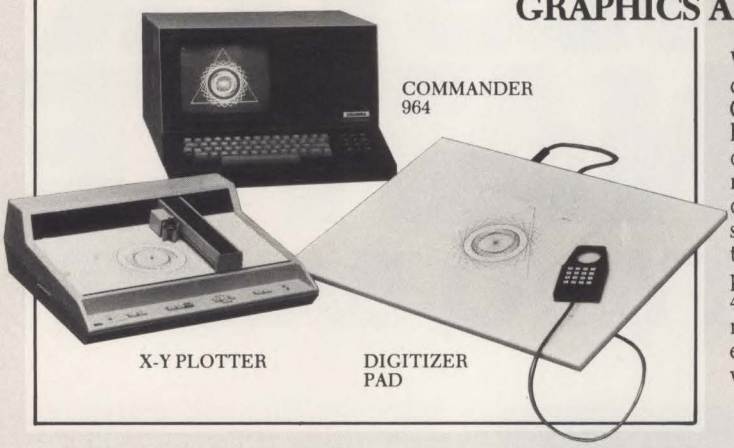

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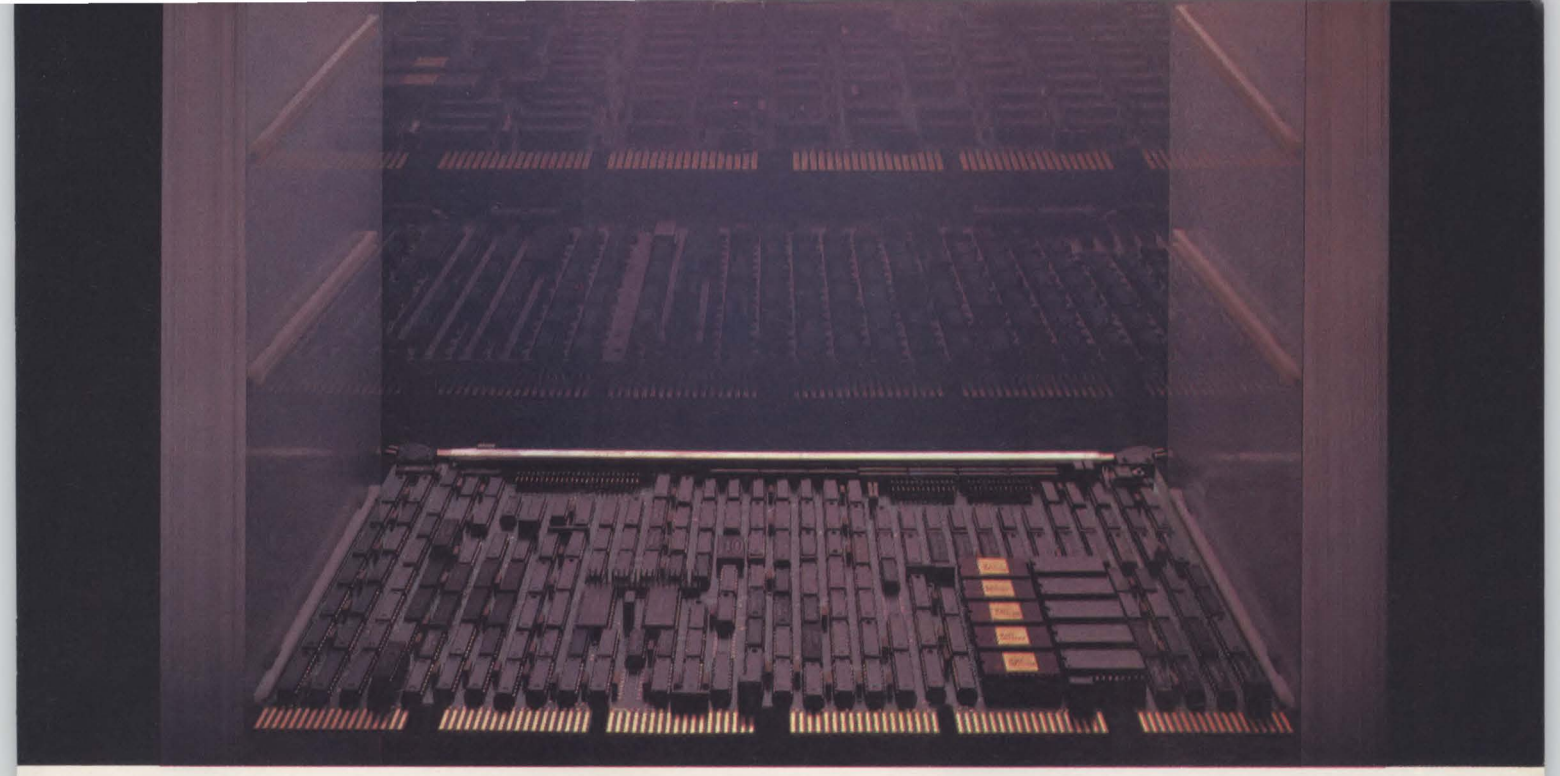

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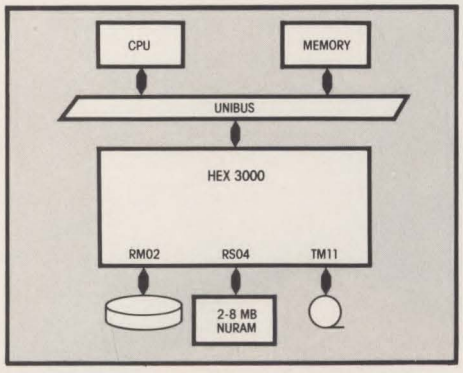

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This also means your spares inventory costs are cut way back. Not only in the factory, but in the field as well.

And at the same time, the HEX 3000 increases your system's reliability because it uses far fewer ICs to do the whole job (198 in all).

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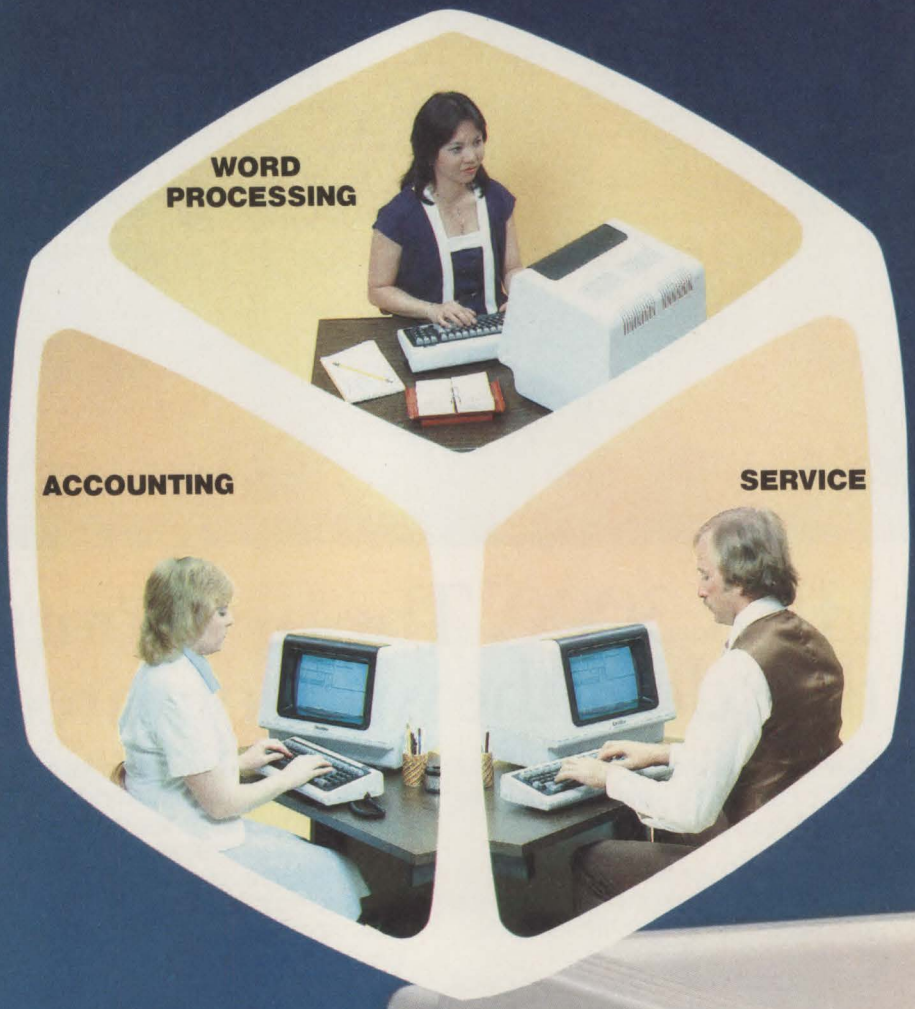

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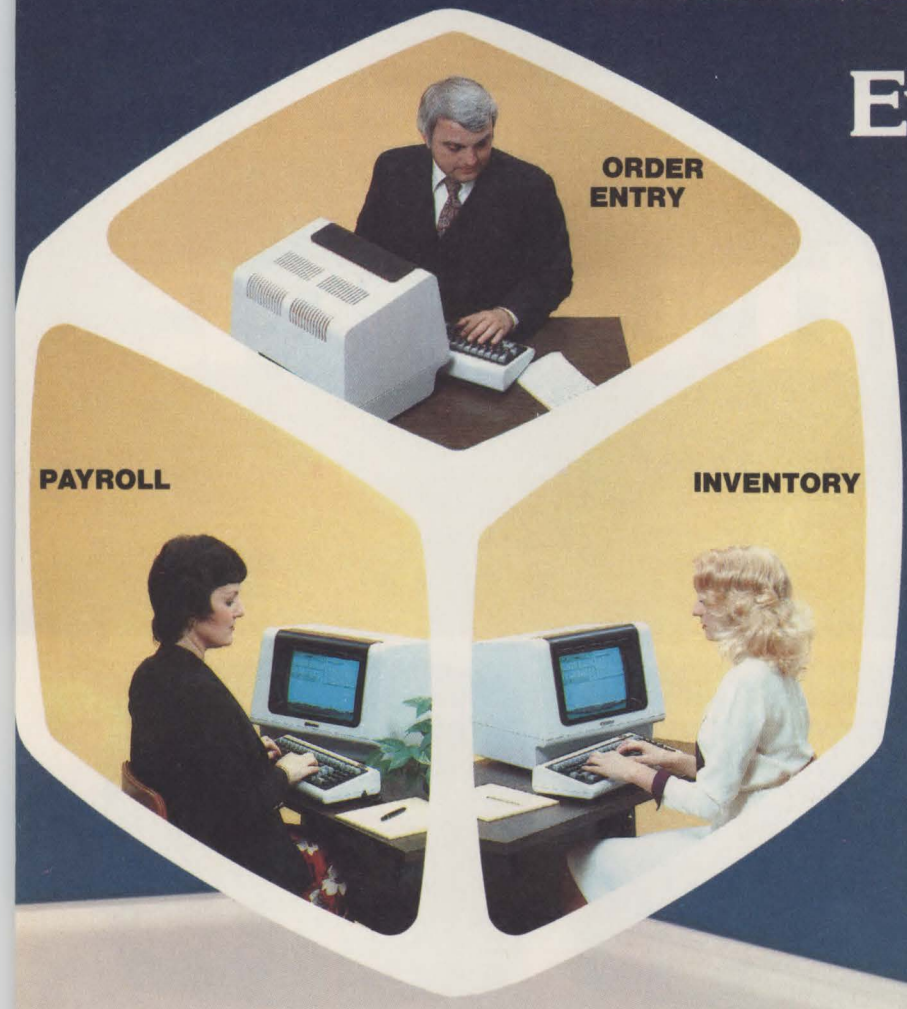

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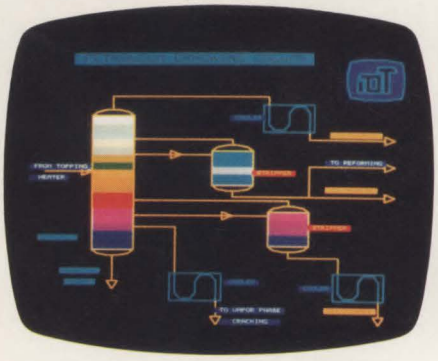

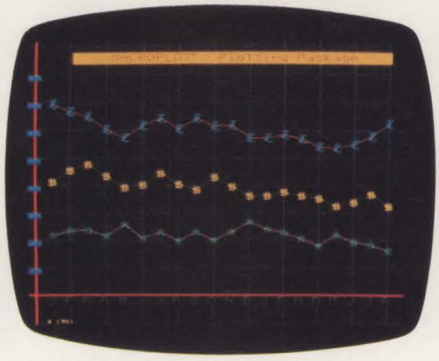

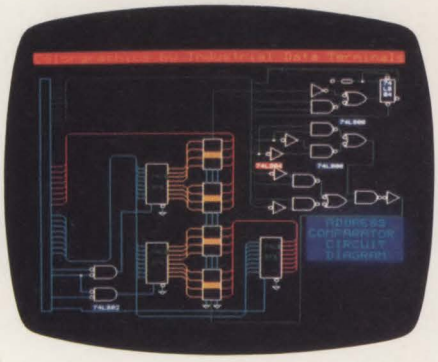

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The new IDT 2200 has all the features of the successful IDT 2000 plus speed enhancements to make our powerful proprietary features even more effective for rapid display of sharp, high-resolution color graphics. A new hardware vector generator draws vectors eight times faster. A new, ruggedized design allows front access for simplified maintenance and room for up to three full-color, prioritized, display memory planes.

System architecture employs a building block design. Multiple processors with flexible and expandable memory. The 2200 is designed and built for maximum capability and long life. Little wonder our products are rapidly gaining a reputation for outstanding cost-effective performance. In Process Control. In Business Graphics. Even in CAD/CAM, and other graphic applications. All packed into a medium-priced terminal.

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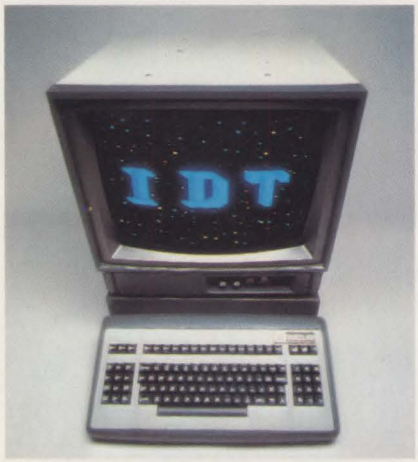

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CIRCLE NO. 19 ON INQUIRY CARD

MASSACHUSETTS BILL WOULD EXEMPT SOFTWARE

Software taxes are just beginning to be challenged in some state courts, but litigation is expensive. One Massachusetts attorney tried to stop a proposed software-tax regulation, and has taken the issue of taxing software directly to the state legislature.

Woburn attorney Robert Bigelow maintains that the legislature should decide if software should be taxed, not the state Department of Revenue, which proposed the regulation. A regulation is a clarification of existing law and, if adopted, becomes law. "The interesting thing about tax regulations is that they are presumed valid until a court finds otherwise....It is an expensive battle to have a tax regulation invalidated," he wrote in his September, 1980, *Computer Law Newsletter.*

Bigelow co-sponsored a bill and filed it with the legislature's Joint Taxation Committee last December. That bill would exempt software and services from the state's sales tax.

"The legislature should determine these matters, not a strained interpretation of the law," he emphasizes. The Department of Revenue, he says, serves the legislature by interpreting laws that have been passed.

The regulation, which was proposed—and unanimously opposed by data-processing industry representatives—at a public hearing last fall (MMS, October, 1980, p. 40), was partially adopted in March, with most software deemed taxable and time-sharing services generally considered nontaxable. Bigelow believes the tax passed partly because software taxes in other states have not been challenged because of the high cost of litigation. If his bill passes, however, it would invalidate the regulation and the tax could not be charged.

The bill was reviewed in early March by a legislative group that decides whether to recommend it for consideration by the full legislature. It was heard favorably and referred, along with more than 100 other tax-related bills, to a study "package" for further review by the House Ways and Means Committee this month. It is difficult to predict the outcome of that committee's decision.

Bigelow is not optimistic about passage of his bill because of what he sees as a pro-tax philosophy in the Massachusetts legislature. "It (the bill) doesn't have much of a chance. But if it does not pass, it is because of political reasons."

But one member of the bureau that wrote the tax regulation has a different view. "It is not unusual that we put out a regulation and the legislature changes it right away," says John White, chief of the Bureau of Rulings and Regulations, who reports to the commissioner of revenue. He says the bureau does not concern itself with bills that are not yet active. The bureau's purpose is not to raise taxes, but to clarify laws, he adds.

Group (STAG), a group of 150 data-processing companies that oppose software taxation.

Four years ago, GBS was audited by the state of California and had to pay more than $50,000 in back taxes on software, explains Larry Finch, president of Shasta General Systems, the company into which GBS was consolidated. The company paid the taxes, which Finch says is a legal requirement before a company can sue for a refund. The refund case was expected to go to trial in August in San Francisco Superior Court.

The GBS case involves whether a sales tax is applicable to programs customized for a turnkey system. While GBS taxed sales of canned software included in its turnkey systems, it did not tax any customized programs that might have been required after system installation, explains GBS counsel Al Eagle of Eagle, Williams and Courtney, San Jose, Calif. GBS considered the added application software a service, which is not taxable.

The main question, Eagle says, is, "In delivering an application program on a disk, is the programmer a fabricator or consumer of the disk?" Fabrication labor is taxable in California. "GBS says this is not a fabrication labor because the customer is buying services, and the medium is incidental to the transaction. GBS is simply a consumer of tangible media, and no fabrication of physical media is involved," says Eagle. The case involves determining what the true object of a transaction is, and that object determines whether the transaction is taxable (MMS, October, 1980, p. 41).

Eagle says the GBS complaint is not with the statute itself, but with the misapplication of the statute. "We're not seeking to throw out the statute. We're seeking to prove that the regulation's interpretation is invalid or not correct by state law.

"If we win this suit all the way—and it will be appealed regardless of who wins—it will absolutely be judicial declaration that the regulation is invalid. Then the Board of Equalization couldn't tax that type of transaction," says Eagle.

If the tax regulation is found to be invalid by a trial judge, the Board of Equalization unquestionably will appeal. That conclusion would have "tremendous impact on the state revenue situation," says Richard H. Ochsner, Board of Equalization attorney for the GBS case. Ochsner maintains that software tax revenues are "fairly substantial" in the state because of the number of companies involved, but he will not give a specific figure. The regulation, which imposes a 6½ percent tax, was adopted in 1972.

"This should be interesting," says Robert Bigelow, a Woburn, Mass., attorney and editor of the *Computer Law Newsletter.* "A lot of states rely on California (in examining software taxation). If California knocks it (the tax law) off, others will have to look at their laws carefully." —*L. Valigra*

Fixed-removable 5¼-in. Winchester due in fall

A 5¼-in. Winchester combining fixed storage and a removable disk cartridge in the same package is slated to be available to systems integrators this month.

The second such drive to be announced, the new hardware is the first effort of Santa Barbara, Calif., start-up DMA Systems Corp. and follows the fixed/removable drives unveiled at May's National Computer Conference by New World Computer Co., Inc., Costa Mesa, Calif.

Called the Micro-Magnum 5/5, the hardware addresses the issue of file backup for 5¼-in. Winchesters, which was a tender subject following the spate of 8-in. hardware announced two years ago. So far, a corresponding controversy has not surrounded the 5¼-in. devices as more of them come to market. With few exceptions, floppy-disk hardware offering one-fifth the capacity of Winchesters is being used for backup on small systems based on these smaller Winchesters. Controller development, for the most part, is proceeding under the premise that these two types of drives will be used in conjunction with each other.

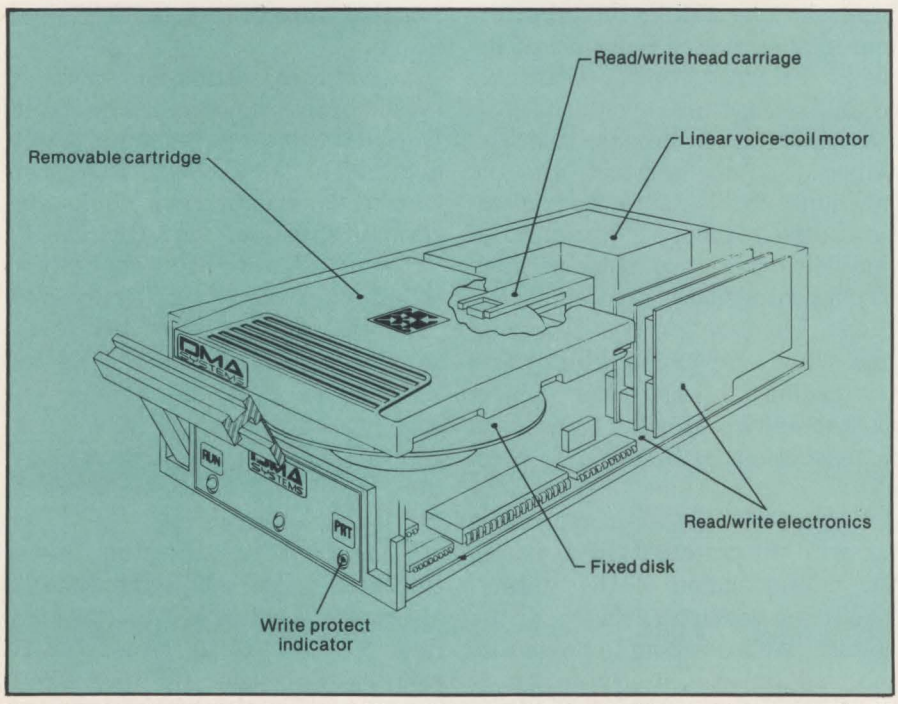
The Micro-Magnum 5/5 will be the first of its type to incorporate a high-performance voice-coil motor and to use the disk-cartridge based on the specifications set up by the informal "club" established this year by Seagate Technology (rumored to have a 5¼-in. cartridge-only drive under development), media maker Dysan Corp. and DMA.

Alternate approaches to Winchester backup are also being considered. Last year, Irwin International, Inc., announced a 5¼-in. Winchester with an integral tape-cartridge drive for file backup (MMS, November, 1980, p. 45). And, several tape-cartridge vendors are examining the possibilities of hardware designed specifically to meet the needs of system integrators planning to use the smaller devices (MMS, July, p. 16).

DMA's new offering is aimed at single-drive small-business computer systems and floppy-disk-based intelligent terminals. In dual floppy-disk-drive systems, the new DMA Winchester can be used with a second fixed-disk 5¼-in. Winchester. This creates what industry analyst Raymond Freeman Jr., Santa Barbara, calls a desk-top equivalent of Control Data Corp.'s 14-in. cartridge-module drives—fixed/removable hardware unveiled several years ago. "The 5¼-in.

Product Specifications
DMA Systems Micro-Magnum 5/5

Unformatted capacity	13.5M bytes
Formatted capacity	10M bytes (5M bytes fixed, 5M bytes removable)
Bit density	8617 bpi/8617 fcpi
Track density	454 tpi
Cylinders	306 plus 5 spares
Number of disks	1 fixed, 1 removable
Positioning times	
Track-to-track	3 msec.
Average	40 msec.
Maximum	72 msec.
Rotational speed	3443 rpm
Voltages	± 12 VDC; + 5 VDC
Dimensions	3¼ × 5¾ × 10 in.



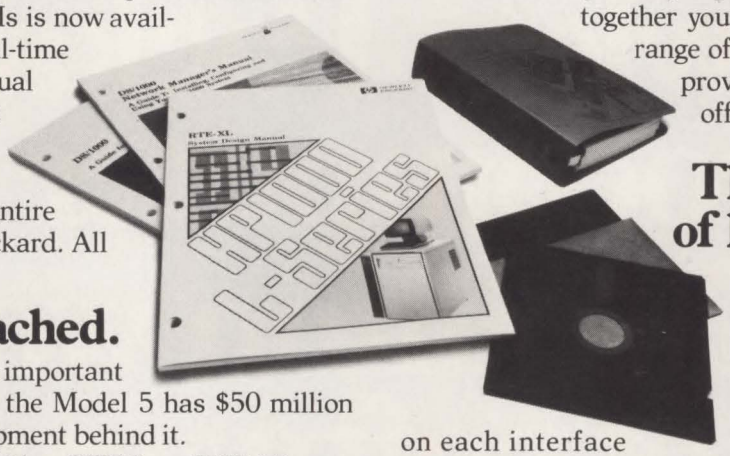
Cutaway drawing of DMA Systems' Micro-Magnum 5/5 *shows 5M-byte oxide-coated fixed Winchester disk, and 5M-byte removable cartridge. Read/write heads for both are driven by a linear voice-coil motor, a design consideration that resulted in an envelope 2 in. longer than the mechanical standard for small Winchesters, Shugart Associates' SA450 5¼-in. floppy-disk drive.*

There's more behind Hewlett-Packard's microcomputer than $50 million worth of software.

Full system support.

Announcing the new HP 1000 L-Series Model 5 microsystem.

The same two-board microcomputer that's becoming so popular with OEMs is now available as an integrated, real-time system—complete with dual minifloppies, 128K bytes of memory, your choice of interactive terminals *and* full support for the entire system from Hewlett-Packard. All for under $10,000.



All strings attached.

Software is the most important part of any system, and the Model 5 has $50 million worth of software development behind it.

You can start with either RTE-L or RTE-XL, our powerful multi-programming, multi-user operating systems. Their modular construction lets you build the real-time computing environment your applications programs demand—programs you can develop in Assembler, FORTRAN 4X and BASIC. And our HP DSN networking software makes it simple to put low-cost computing wherever you need it.

Data base management on a microcomputer? With our IMAGE DBMS, you've got a powerful tool for simple and efficient data management. And you can easily picture the possibilities offered by our GRAPHICS/1000 software. Like our other software packages, these are all upwardly compatible throughout the entire HP 1000 line, giving you an easy growth path to even higher performance.

Configure it out for yourself.

The Model 5 is completely modular, so you can virtually design a system yourself. Hard disks and other peripherals can be plugged in directly. And thanks to a 60% reduction in memory costs, you can go all the way to 1/2 megabyte of memory for an additional $2000.

Whether you buy a packaged system, or put one together yourself, you can get HP's full range of customer support services, provided from more than 170 offices worldwide.

The ins and outs of high-speed I/O.

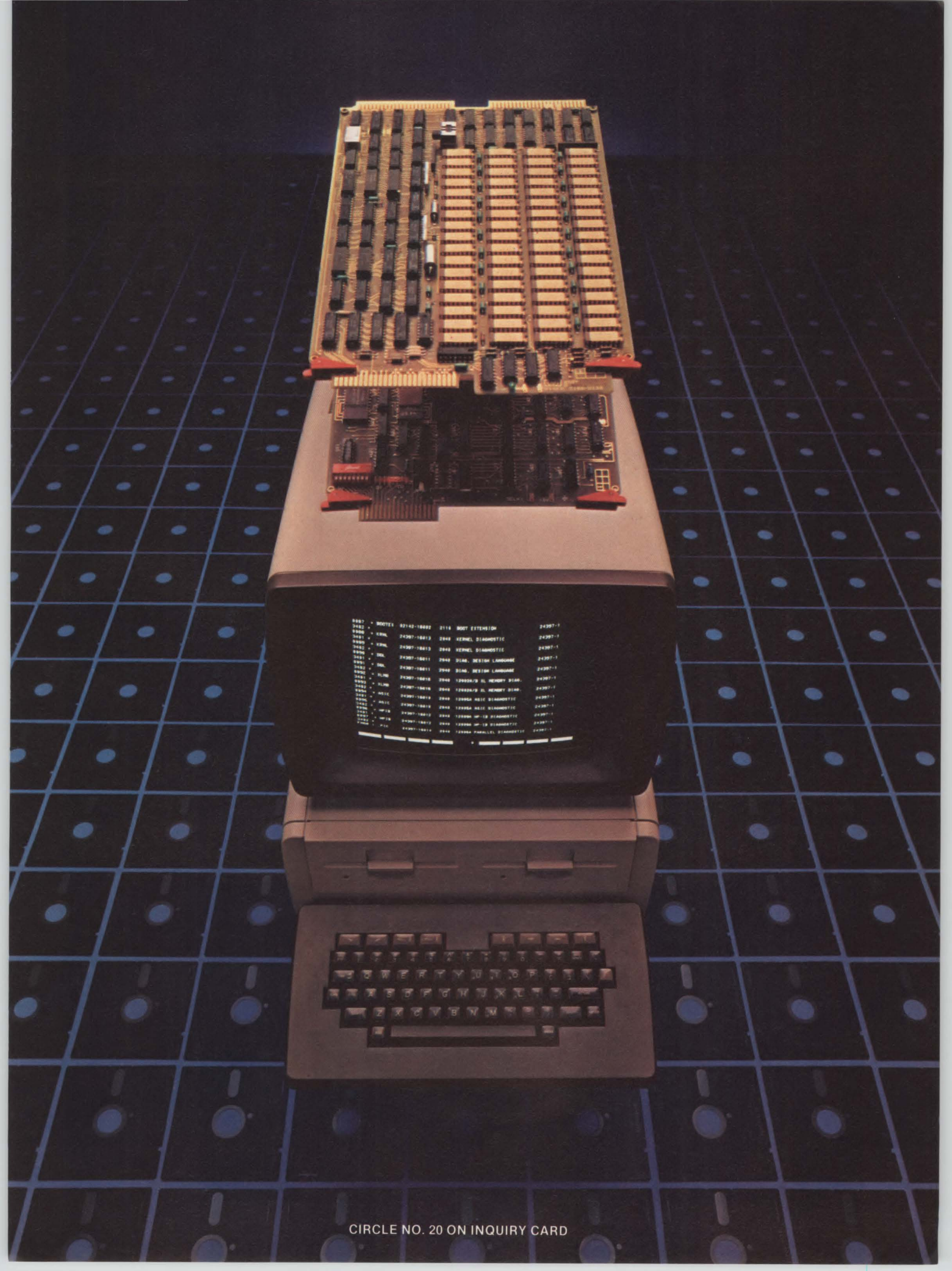
In designing the Model 5, we used an advanced distributed intelligence architecture that puts a separate LSI I/O processor board on each interface. This means each processor has its own direct channel to the entire 1/2-megabyte memory. (We used state-of-the-art 64K RAMs to put the 512K bytes of memory onto just one board.) With the CPU free to concentrate on computation, you get significantly increased throughput and exceptional performance.

If you'd like a hands-on demonstration, just contact your local HP sales office listed in the White Pages. Or for more information, and our new OEM catalog, write to Joe Schoendorf, Hewlett-Packard, Dept. 08107, 11000 Wolfe Road, Cupertino, CA 95014.

HEWLETT PACKARD

Prices U.S.A. OEM quantities of 100 units. Prices subject to change without notice.

22102
HPDS70



CIRCLE NO. 20 ON INQUIRY CARD

fixed/removable hardware will provide users with higher performance and higher capacities with no need to give up removability," he says.

Controllers designed for Seagate's 6M-byte ST-506 can be used with the Micro-Magnum 5/5, with minor modifications dictated by the drives' different configurations, says DMA's marketing vice president Don Minami. Because the 5/5 uses an embedded servo system to control the head positioner, he explains, firmware must be altered to provide for copying data to and from the cartridge, and to handle the device's hard sectoring.

The device's size is also nonstandard. Most fixed 5¼-in. Winchesters have been designed around the envelope dimensions of Shugart Associates' 500K-byte SA450 5¼-in. floppy-disk drive. The 5/5 uses the same cutout dimensions as the Shugart device, but is 2 in. longer because it uses a linear voice-coil head positioner. But Minami does not see this as an obstacle to the acceptance of the drive in systems based on SA450 dimensions. "There's plenty of room at the back end for our drive," he says.

First deliveries of the Micro Magnum 5/5 are slated for late this year, and production quantities are due during the first quarter of 1982. Prices are set at $1275, and cartridges are pegged at $45, both in 1000-unit orders. —*John Trifari*

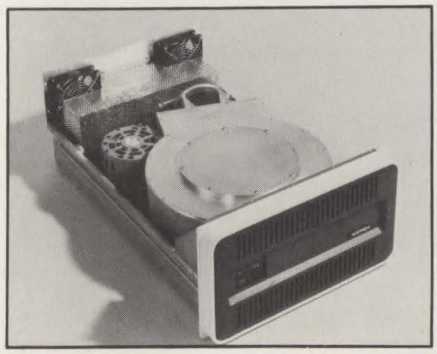
Ampex redoubles OEM disk-drive efforts

Efforts by Ampex Corp. to become a major supplier of hard-disk drives have so far been only moderately successful. But the company is readying a new assault on the OEM market for high-performance, high-capacity hardware.

The Redwood, Calif., subsidiary of The Signal Companies Inc. derives most of its drive sales from its line of 14-in. removable-pack drives, which is based on storage-module-drive (SMD) technology. The drives are designed as second sources to the hardware introduced several years ago by Control Data Corp. (CDC). Also contributing to Ampex's disk-drive revenues is a line of 14-in. disk-cartridge drives based on CDC's newer cartridge-module-drive (CMD) technology.

However, Ampex's plans for revitalizing its drive operations do not include advances in its SMD- or CMD-compatible product lines. Instead, the company is considering a new series of 14-in. Winchesters to boost its disk-drive fortunes and to provide a path for sustained, long-term growth.

The first two drives of the line, called the Capricorn series, were unveiled at May's National Computer Conference in Chicago (MMS, June, p. 10), and are scheduled to be shipped in quantity early next year. The new hardware is based on 960-tpi track density, 3350-Winchester technology, and is the first effort of Ampex's new Advanced Disk Drive Development Group, Cupertino Calif. The Capricorn series is the focal point of the company's future disk-drive efforts.



Ampex Corp.'s Capricorn series *of 165M- and 330M-byte 14-in. Winchesters is the first product from the company's Advanced Disk Drive Development Group. Head/disk assembly appears in an uncovered view, with the drive's linear voice-coil motor canted to the right.*

The focal point of Ampex's disk-drive operations *is the Advanced Disk Drive Development Group, with Tom Beams (left) as general manager, Carter O'Brien as manager of product marketing (center) and Chua Lin, manager of disk engineering.*

NEW

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The **Parallel Processing© System/48®** is the world's first **MacroComputer©**, an elegantly powerful and modular multi-user computer for business and industry. It was designed from the start to out-perform other computer systems at three or more times its price. The operating system software is so friendly, versatile and fast that it's called **MAGIC©**.

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Ampex is already looking at even higher performance, higher capacity hard-disk hardware to complement the announced 165M- and 330M-byte Capricorn drives, says Tom Beams, general manager of the new group. For example, the group is developing a thin-film read/write head, which is a double bit density, 660M-byte, five-platter device. That head most likely will be incorporated into the next iteration of Capricorn hardware. Subsequent Capricorn iterations—and other planned Ampex drives—may incorporate some other technologies now being considered by the Cupertino group. These technologies include the use of thin-film media, new spindle and actuator designs and new advanced servo and encoding/decoding techniques.

Also in the works at the Cupertino facility is an 8-in. Winchester family called the Magnum series, which could be announced this quarter. These drives will reportedly be available in 50M- and 83M-byte versions and will use linear voice-coil motors in a package that has the envelope dimensions of the industry standard, Shugart Associates' 1M-byte SA850 double-sided floppy-disk drive. The 8-in. hardware will also incorporate the SMD interface.

Ampex will aim its drives in two directions. It will target 14-in. hardware at systems integrators requiring considerable storage and the 8-in. device at those with more modest demands. "Millions of dollars have been spent for SMD controllers, and software drivers," Beams points out. "There's no need to scrap all this." For those starting from ground zero, however, Ampex's 8-in. hardware will offer optional ANSI and OEM interfaces.

Several industry observers believe that Ampex's dedication to rotating memories, plus the money being poured into the Disk Drive Development Group, could revitalize a moribund operation. "The 330M-byte Winchester is a good move," says Jim Porter, industry analyst and publisher of *Disk/Trend Report*. "The market is ready for that type of product." Another industry analyst, Raymond Freeman Jr., Santa Barbara, Calif., also gives the company high marks for the moves it has made so far. "Ampex's penetration into the OEM rigid-disk-drive market has been low, and, as a result, they have declined," he says. "They apparently recognize many of their deficiencies and have made some moves to overcome them." Feeeman warns, however, that all the results aren't in yet. "Ampex now has a road map for the future," he explains. "We must wait to see if they complete the journey."

That journey may not get completed, others caution, unless Ampex begins to emphasize marketing—of both its existing products and those being developed. Paraphrasing an old maxim about real estate—"The three things that sell property are location, location and location"—Andrew Roman, a Newark, Calif., consultant, discusses Ampex's future fortunes. "Ampex needs marketing, marketing, marketing," he says. "They are not black belts in the OEM business."

Roman, who is also publisher of *Random Access Newsletter*, says Ampex's lack of a dedicated disk-drive sales and marketing organization could hinder any technological advances the Development Group might make. He points out that the drives developed in Cupertino are handed over to the company's El Segundo, Calif., manufacturing facilities. The drives are then marketed through the Memory Product Division, also in El Segundo, where the company's other OEM products are marketed.

As a result, Ampex lacks a dedicated disk-drive sales and marketing organization, which many feel is needed for a company to become a factor in the OEM disk-drive market. But that need may be filled, says one Ampex source. The five-year plan that led to the establishment of the Cupertino think tank also provided for a separate disk-drive marketing organization once sales hit the $100 million mark—a mark many at Ampex feel could be only a couple of years away. The plan also provides for the consideration of a disk-drive division that would operate on equal status with the memory-products division. "Ampex's disk-drive operations are moving toward divisional status," says a company source. "This has not been formalized, but a disk-drive spin-off from the memo-

Unformatted capacity per drive	165M bytes, 330M bytes
Transfer rate	1.2M bytes per sec.
Positioning times	
track-to-track	10 msec.
average	30 msec.
maximum	55 msec
Rotational speed	3600 rpm
Recording density	6370 bpi
Track density	960 tpi
Number of platters	3, 5
Number of cylinders	823, 1024
Bytes per track	20, 160
Dimensions	10.4 × 17.53 × 28.03 in.
Single-unit prices	$8100, $10,355
100-unit prices	$5700, $7100

Product specifications *for Ampex's Capricorn series.*

"Quantum 8-inch Winchester drives are setting a new industry standard."

Lowest cost-per-megabyte.
Quantum Q2000 disk drives are your most affordable way to upgrade from floppy disk to Winchester reliability. Because we designed every part, every function to give you highest quality at the lowest cost-per-megabyte in the industry.

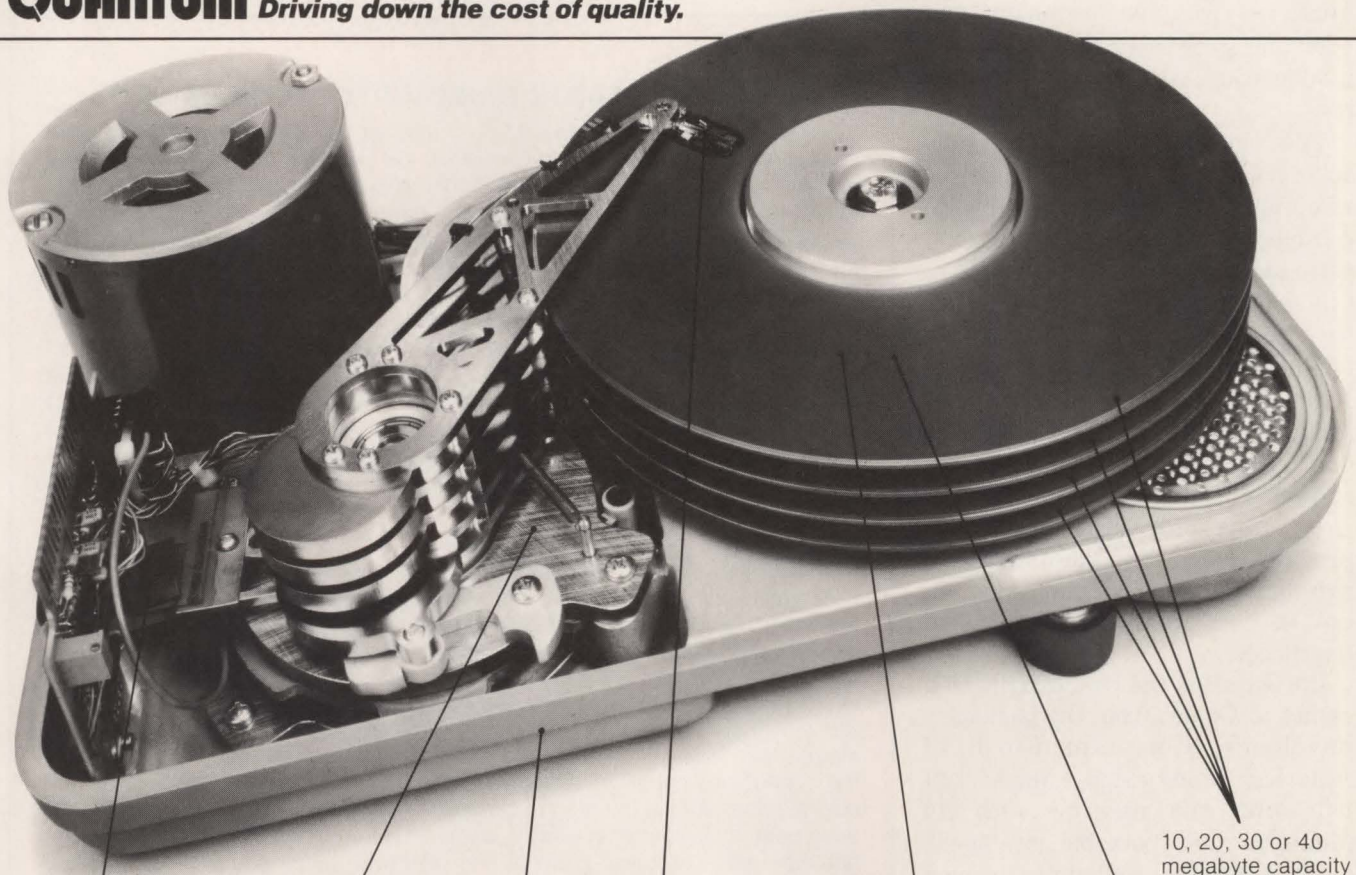
Four times the capacity.
Choose from our 10, 20, 30 and 40 megabyte versions. That's up to four times the capacity of leading 5 and 10 megabyte 8-inch Winchester drives.

Full compatibility.
Interface, power supply and mounting requirements are fully compatible with industry-standard Shugart SA1000 fixed disk drives. There's no need to alter your basic system design when you upgrade to the Q2000.

Higher performance.
Average access time is up to 28% faster than the Shugart SA1000.

To stay competitive in today's exploding market for low-cost computer systems, you need to know about Quantum 8-inch Winchester drives now. For details, call Bob Teal, Quantum Corporation, 2150 Bering Drive, San Jose, CA 95131, phone (408) 262-1100.

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



CIRCLE NO. 22 ON INQUIRY CARD

ry-products division is expected."

However, Ampex is now stressing technology, Beams says. Now that it has decided that its fortunes, lie to a great extent in disk drives, the company is launching a major effort to hire the high-horsepower talent Beams feels is needed for growth. "Ampex is pulling out all the stops when it comes to this operation," says Terry Wetterman, head of L.T. Consultants, a Sunnyvale, Calif., personnel agency concentrating on the disk-drive industry. "If they can produce and market these drives in quantity, they'll do just fine." —*John Trifari*

CDI offers electronic mail for portable terminals

An electronic-mail package introduced by Computer Devices, Inc., Burlington, Mass., could enhance the salability of the company's Miniterm portable terminals and spur the growth of the electronic-mail market, say industry observers.

The "Comet" electronic-mail software package is the first in a series of optional application software the company will offer for its portable-terminal line, say CDI spokesmen. CDI marketing director Bob Lynch says that Comet gives customers an off-the-shelf electronic-mail system from one vendor, rather than forcing them to buy a terminal from one source and the appropriate software from another. Further, he says, electronic-mail capabilities provide added applications at an incremental cost, enabling customers to cost-justify their terminal purchases.

CDI acquired the U.S. distribution rights to Comet from the package's developer, Computer Corp. of America, Cambridge, Mass. CDI will offer the package with its Miniterm 1203 portable intelligent printer terminal and with its new Miniterm 2000 series. Comet is available for $60 a month per "mailbox," or terminal on which each package is used. Lynch says that the company will try to market the product initially to its customer base of 4000 Miniterm users. That base consists primarily of field-service and sales personnel who use portable terminals while on the road to access data bases and to receive on-line diagnostics programs from a host computer. Lynch says the users are the prime target for electronic mail because they must send and receive messages while away from their offices.

The company hopes to install 1500 electronic mailboxes in the next year, but one source says CDI will be satisfied with 500 to 750 subscribers. Paris Burstyn of the Yankee

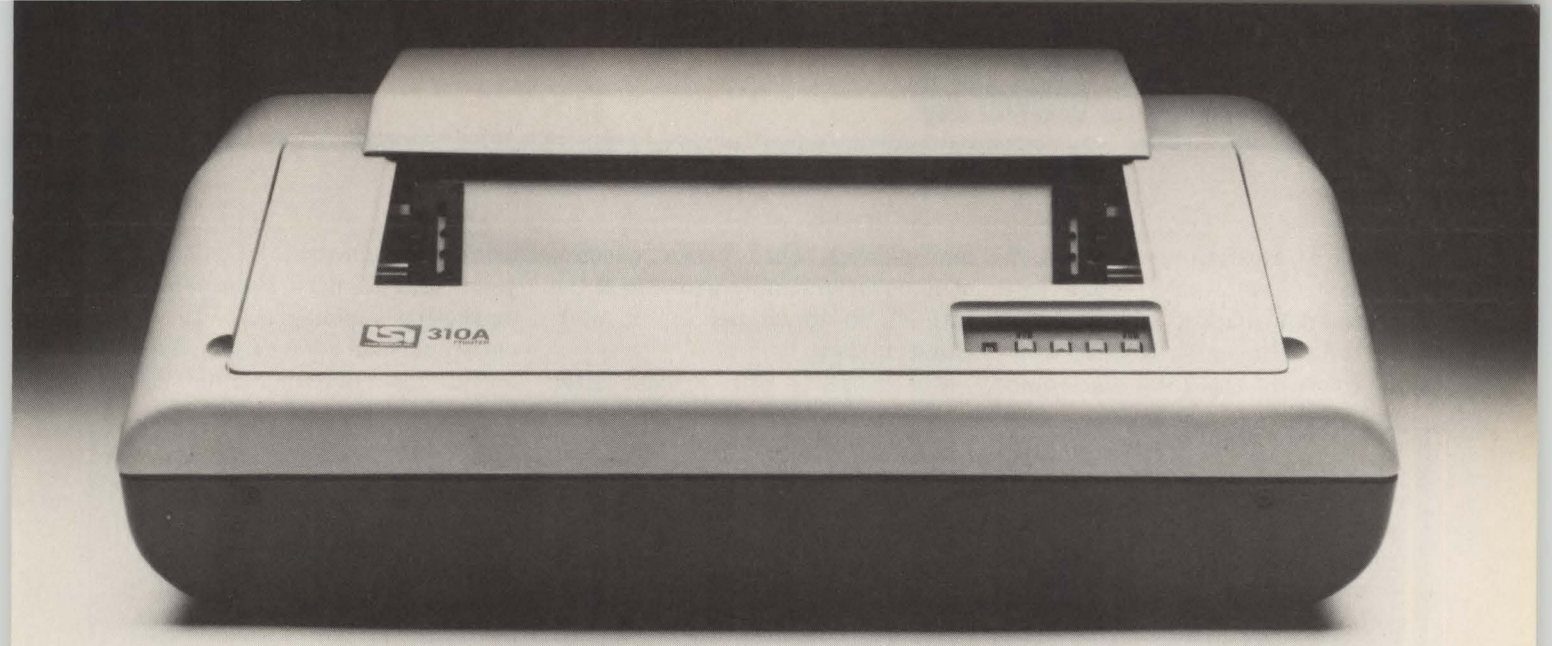
MINIBITS

RUBEN CORP. STARTS BANKRUPTCY PROCEEDINGS

Ruben Corp., a Cambridge, Mass., start-up that developed the Assistant small-business system (MMS, August, p. 32) has filed for creditor protection under Chapter 11 of the federal bankruptcy laws after finding itself with $500,000 in liabilities and insufficient cash in hand. The company publicly displayed the Assistant for the first time at last spring's Comdex show. It was then reportedly supported by more than $6 million in venture capital, but financial troubles soon developed. The firm was forced to lay off its 60 employees when some hoped-for additional financing fell through. "The situation was caused by the unexpected failure to receive some interim financing," Ruben general manager Charles Stein said in late July after a bankruptcy court judge had allowed founder Murray Ruben to put $100,000 into the company to re-open the firm on a reduced basis. Whether the $100,000 will be enough to get Ruben rolling is unknown. But the bankruptcy judge said, "Any court would have a disposition to let the thing breathe long enough to see if it survives."

TIMEPLEX OFFERS REMOTE DIAL-UP DIAGNOSTICS

Aiming to cut field-service costs and increase the uptime of its customers' networks, Timeplex, Inc., has developed the capability to remotely diagnose network problems from its field-service headquarters, Hackensack, N.J. Any customer who has a supervisory port option on the Timeplex Series II Microplexer—a statistical multiplexer/data concentrator—can opt for remote dial-up diagnostic support by simply linking the port through a 103-type modem to a telephone line. While claiming such remote support "is a first for the data-communications industry," Andy Thomas, assistant vice president of field service, admits the diagnostics provided by the supervisory port option have been available to technically oriented users for several years. But many network users, he says, prefer not to deal with the diagnostics themselves, and will welcome the chance to have Timeplex personnel troubleshoot problems remotely. Offered as part of the company's standard service contract, the remote diagnostics capability will often permit field personnel to simply travel to a site and correct a problem that has already been pinpointed at headquarters. Functions monitored by the diagnostics include loss of data, message transaction, line quality, channel status and marginal, intermittent or hard failures in the Microplexer equipment. In field tests at three locations over the past six months, Timeplex has solved about two-thirds of the network problems that occurred by phone, Thomas says.



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.

BELLS AND WHISTLES STANDARD.

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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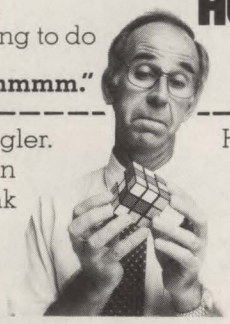
*800 numbers also includes states of: CT, DE, MA, MD, NY, RI, VA and W.V.

THE 310A HUMMM TERMINAL.

LSI LEAR SIEGLER, INC. DATA PRODUCTS DIVISION

"Hummmm."



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. 23 ON INQUIRY CARD

Group, a Boston-based market-research firm, says that the potential new market for DCI/COMET could add as much as 10 percent to the growth of the total electronic-mail market. That market consists of 40,000 users and is growing at the rate of 20 to 25 percent a year, Burstyn says.

CDI chose to offer Comet after using electronic mail internally for a year, says Richard Herzfeld, a CDI marketing spokesman. He says electronic mail allows CDI not only to spend its communication dollars

Using the 'Comet' electronic-mail package

Computer Corp. of America, which licenses Computer Devices, Inc.'s Comet electronic-mail package, considers the product appropriate for use by nontechnical users who lack data-processing experience. Such users—secretaries, salesmen, field-service technicians and managers—require an easy-to-use software package to handle their electronic-mail needs.

Because Comet is driven by fewer than 20 simple English commands, a user needs only typing skills to operate it. Prompts incorporated into the software guide the user through the operating procedure.

If, for example, a salesman in Toledo, Ohio, wants to check into his home office, he would dial into a central computer—an electronic post office—through Tymnet, Telenet or the regular phone network. He would then wait for a signal and connect his phone to an acoustic coupler built into a Miniterm terminal. The central computer would then display a series of prompts on the Miniterm's printer. The salesman would answer these prompts, such as NAME and password, to log on to Comet. (CDI is designing an automatic log-on capability into its new Miniterm 2000 series terminals. With the capability, the salesman would have only to press a function key, and the terminal would handle the handshaking procedures with the central computer.)

Once the log on is complete, the computer tells the salesman when he last logged on and how many messages he has received since. Each transmission from the computer ends with the word "COMMAND."

To get a listing of his messages, the salesman types in SCAN, and the computer chronologically lists the date the messages were sent and their subjects. If the salesman wants to read the third message he was sent, he types in READ NUMBER THREE. The computer gives the message and lists to whom the message was sent.

more effectively by cutting phone costs, but also to foster a more tightly knit organization by improving communication among field salesmen.

CDI elected Comet over other packages, particularly Ontyme and Telemail, because Comet is command-driven and, therefore, easy to learn and to use. It can also be accessed via Tymnet, Telenet or direct-distance dial networks. Telemail is accessible only on Telenet, while Ontyme can be accessed only on Tymnet.

Under terms of the licensing agreement between CDI and Computer Corp. of America, CDI/Comet subscribers can use CCS's Digital Equipment Corp. PDP-11/70 computer as their electronic post office, through which messages can be received from or sent to mailboxes in the field. As CDI builds its Comet customer base, the company can opt to transfer its accounts from a CCA computer to one at CDI headquarters. CDI will thus become its own service bureau.

Industry observers say that by offering Comet, CDI will improve its position in the printer-terminal market, which is expected to triple over the next two or three years, says Barry Gilbert of International Data Corp., Framingham, Mass. Although IDC rated CDI the number five terminal maker in terms of units sold, IDC trails in sales behind AT & T subsidiary Teletype, Digital Equipment Corp., Texas Instruments Inc. and General Electric. While CDI terminals are considered to be more portable and more suitable for on-the-road applications than those from other suppliers, they are also more expensive, says Ken Bosomworth, editor and publisher of the *Electronic Mail & Message* newsletter.

Using the "Comet" electronic-mail software package, *Computer Devices, Inc.'s Miniterm portable terminal can access Tymnet, Telenet or direct-distance dial network.*

"The real key is for CDI to sell more terminals by adding more applications," says Yankee Group's Burstyn. "Comet is a good sales tool that CDI can benefit from. It's a known quantity, it's easy to use, and it has many applications that are appropriate for CDI's customers."

—Frank Catalano

Calendar

Shows and Conferences

SEPTEMBER

21-23 Federal Computer Conference, Washington, sponsored by Federal Education Programs. Contact: Federal Education Programs, P.O. Box 368, Wayland, Mass. 01778, (617) 358-5181.

21-25 International Switching Symposium, Montreal, Canada. Contact: John M. Benet, Chairman, Publicity Program, ISS '81 CIC, P.O. Box 56, Station "Ile des Soeurs's" Verdun, Quebec, Canada H3E 1J8, (541) 761-5831.

22-24 Electrical Overstress Electrostatic Discharge Symposium, Las Vegas, sponsored by the IITRI Reliability Analysis Center. Contact: Reliability Analysis Center RADC/RBTAC, Griffiss AFB, N.Y. 13441, (315) 330-4151.

22-24 NEPCON/Central '81 (National Electronics Packaging & Production Conference), Rosemont, Ill. Contact: Cahners Exposition Group, 222 W. Adams St., Chicago, Ill. 60606, (312) 263-4866.

23-25 TREAT (TechnologyRevolution:EducationandTraining), Washington, sponsored by the Association of Media Producers and George Washington University's Department of Education and Human Resources. Contact: Mary Davis, Association of Media Producers, 1101 Connecticut Ave., Suite 700, Washington, D.C. 20036, (202) 857-1195.

24-27 Second Annual Mid-Atlantic Computer Show & Office Equipment Exposition, Washington. Contact: National Computer Shows, 824 Boylston St., Chestnut Hill, Mass. 02167, (617) 739-2000.

SEPTEMBER 29-OCTOBER 2

North American Datamanager User Group Conference, Denver, Colo. Contact: MSP Inc., 21 Worthen Rd., Lexington, Mass. 02173, (617) 861-6130.

OCTOBER

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

5-7 International Electrical, Electronics Conference & Exposition, Toronto, Canada, sponsored by the Canadian Region of the IEEE. Contact: Southex Exhibitions, 1450 Don Mills Rd., Don Mills, Ontario, Canada M3B 2X7, (416) 445-6641.

6-7 Word-Processing Systems Expo, Washington, produced by National Trade Productions, Inc. Contact: Joseph P. Rubel, Exhibits Chairman, National Trade Productions, Inc., 9301 Annapolis Rd., Suite 300, Lanham, Md. 20801, (301) 459-1815.

7-21 1981 Far East Computer/Electronics Tour, Japan, South Korea and Taiwan. Contact: Terry Butler, Commerce Tours International, 870 Market St., Suite 742, San Francisco, Calif. 94102, (415) 433-3072.

Introducing the NEC 7700.

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The new NEC 7700 Series of Spinwriter™ letter-quality character printers deliver unparalleled "cost-of-ownership" benefits right now. You save on service, sparing, inspection, testing, software, interfaces and transportation.

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NEC. Going after the perfect printer.

Calendar

12-15 Information Management Exposition & Conference: INFO 81, New York. Contact: Clapp & Poliak, Inc., 245 Park Ave., New York, N.Y. 10167, (213) 661-8410.

13-15 Word Processing & Office/Business Equipment Trade Show & Conference, San Jose, Calif. Contact: Cartlidge & Associates, Inc., 491 Macara Ave., Suite 1014, Sunnyvale, Calif. 94086, (408) 245-6870.

15-17 Business & Personal Computer Sales-Expo '81 & 1981 Houston Business Show, Houston, Texas. Contact: Produx 2000, Inc., Box 2000, Bala Cynwyd, Pa. 19004, (215) 457-2300.

15-18 Third Annual Northeast Computer Show & Office Equipment Exposition, Boston. Contact: National Computer Shows, 824 Boylston St., Chestnut Hill, Mass. 02176, (617) 739-2000.

17-18 Amacom '81, Kenner, La., sponsored by the Jefferson Amateur Radio Club. Contact: W.D. Bushnell, Amacom '81 Chairman, New Orleans Hamfest-Computerfest, P.O. Box 73665, Metairie, La. 70033, (504) 887-5022.

19-23 Systems 81-Computer Systems and Their Applications, Munich, Germany. Contact: Kallman Associations, 30 Journal Sq., Jersey City, N.J. 07306, (201) 653-3304.

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, Texas, 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.

21-24 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. 07306, (201) 653-3304.

25-28 1981 Conference on Electrical Insulation and Dielectric Phenomena, Whitehaven, Pa. Contact: Dr. Chatham M. Cooke, Program Chairman, Bldg. N-10, High-Voltage Research Laboratory, Massachusetts Institute of Technology, 155 Massachusetts Ave., Cambridge, Mass. 02139.

25-28 Issue '81, San Francisco. 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. Contact: 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.

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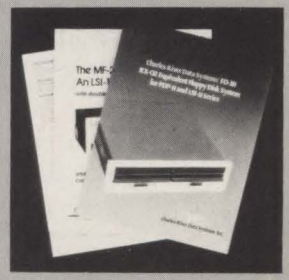

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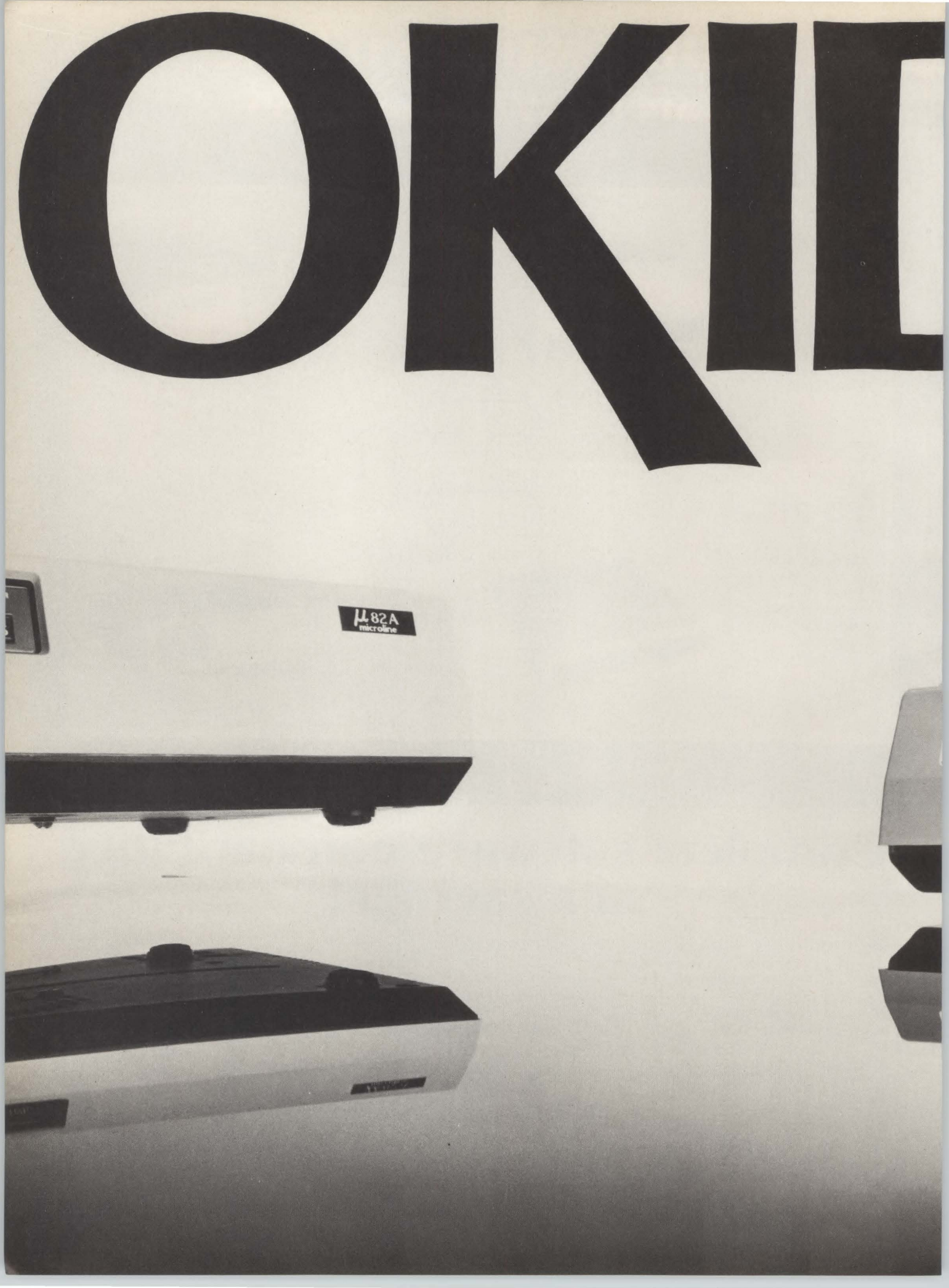

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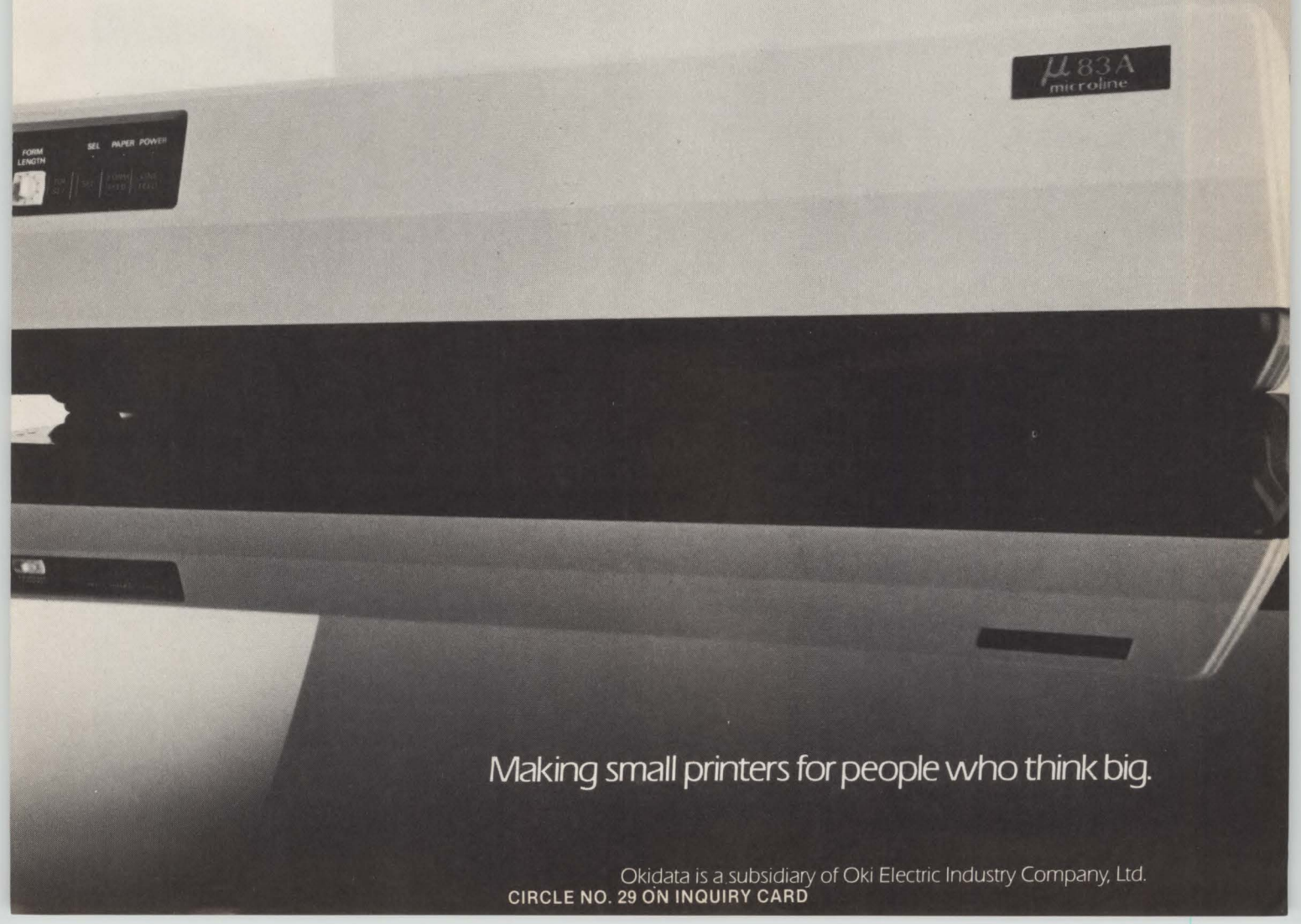

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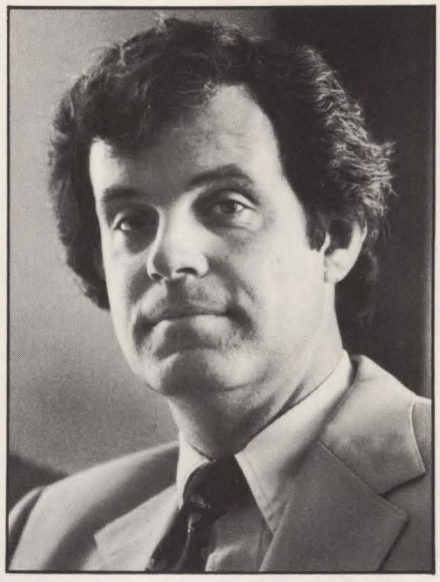
CIRCLE NO. 30 ON INQUIRY CARD

AT & T and divestiture: new fuel or just a fizzle?



With this issue, Mini-Micro Systems *welcomes Arthur M. Hill as its Washington correspondent. His contributions will appear as a regular monthly department in Mini-Micro World, and will include both short news items and commentaries. Art's topics will range from telecommunications legislation to trade and regulatory issues affecting the computer industry. Art is also Washington correspondent for other trade publications, has been a government relations/communications consultant in Washington, a legislative assistant to a U.S. senator and a reporter in the Washington bureau of Time-Life News Service.*

Reactions in Washington have been mixed to the revelation that AT & T offered to divest itself of Western Electric Co. and certain Bell System operating companies in exchange for a quick end to the Federal Government's suit against AT & T. Western Electric is AT & T's hardware-manufacturing arm, and amazement buzzed through the Capitol when word broke that, on three occasions since 1977, AT & T had quietly volunteered to do precisely what the Justice Department's antitrust suit against AT & T has as one of its aims—divestiture. AT & T has denied it offered to divest itself of Western Electric (see "The AT & T response," p. 67).

In some quarters, however, amazed looks turned to smiles for those who saw the revelation as an opportunity to tighten statutory regulations redefining the role of the corporate giant in the unregulated telecommunications market.

Reports of Bell's concessions surfaced just as the Senate Commerce Committee reported out legislation, which, if adopted will have an unprecedented impact on data communications and the computer industry. At the heart of the proposal (S. 898) are provisions that would allow Bell to create a subsidiary to compete actively against other communications and data-service providers and manufacturers in the multibillion-dollar information industry. Bell is restricted from competing in these markets by law and by the consent decree a federal court issued in 1956.

If nearly all of Bell's potential competitors in the terminal and data-services market had their way, Congress would not consider legislation intended to let Bell pitch its tent in their camp. But deregulation has swept Washington like a fever in recent years, and many feel the communications market is as appropriate for deregulation as are the trucking and airline industries.

The basic difference between the communications industry and other deregulated industries is that no other sector of the U.S. economy has anything that compares with Bell's dominance and power. With an annual budget exceeding that of most members of the United Nations, with its ownership of all long-distance lines and 80 percent of all local exchanges and with the largest manufacturer of terminal equipment as a subsidiary, no one can get from here to there without using Bell's communications "highway."

Secure in its control of the nation's communications network, Bell has not proven to be a benevolent dictator. There are numerous antitrust actions other than the Justice Department's pending one against AT & T, and several others have been decided against it. Last year, MCI Corp. won an $1.8 billion judgment against AT & T for anti-competitive actions. In an unfavorable allusion to AT & T's advertising jingle, several of the company's antagonists are fond of singing, "Reach out; reach out and crush someone..."

Yet, there is competition in the communications industry, with new technologies making the financial rewards for entering the market appear extremely attractive. Data networks are now commonplace in the business world, with some companies even offering pathways outside the Bell system to customers rich enough to afford them.

Data communications, the development of ever more sophisticated hardware and software products and the growing national dependence on telecommunications have combined to bring increasing pressure on Congress and the federal regulatory establishment to update

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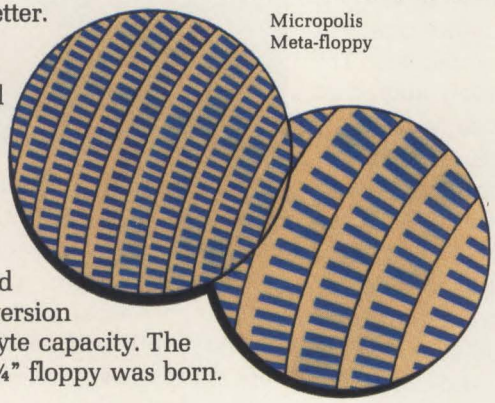

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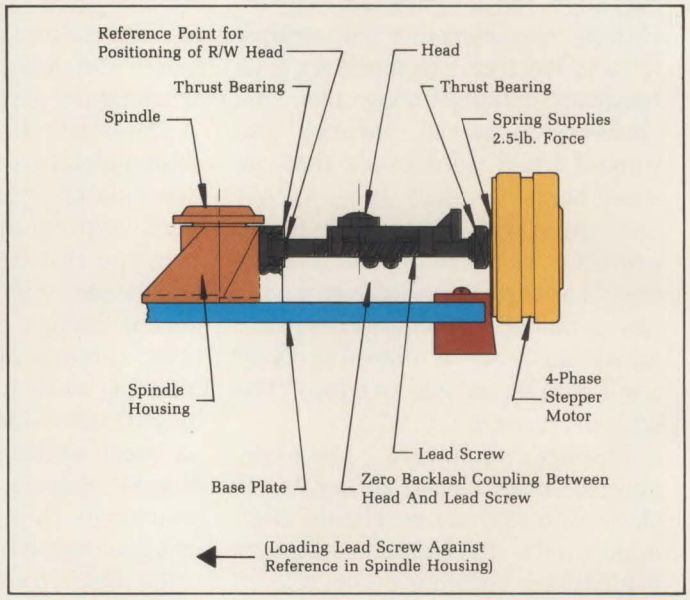
• **Head Positioning Accuracy** - A precision ground stainless steel leadscrew with metal follower provides more precise positioning than the run-out sensitive pulley and belt approach used by others. Use of a four phase stepper motor and four steps per track averages the effects of all stator and rotor poles, resulting in ± 83 μ-inches positional accuracy.

• **Temperature Compensation** - Our temperature compensation loop includes only the diskette, pre-loaded leadscrew and spindle housing. The baseplate is specifically excluded since its expansion is compensated by a proportional change in the preload of the leadscrew. This approach consistently limits temperature variations to ± 250 μ-inches.



• **Balance Between Speed & Accuracy** – We chose 10ms track-to-track positioning and 380 kbps transfer rate as an optimum balance between speed on one hand, and accuracy and interchangeability on the other.

• **Silent Operation** - In band type drives an annoying chatter results from the head's travel from track to track. Our precision stainless mechanism eliminates this noisy irritation.

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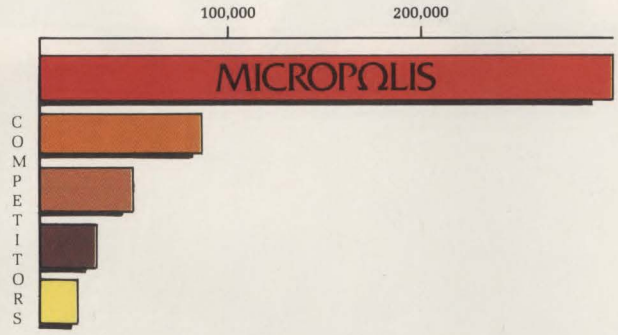
While others are still learning, our 96/100 TPI drives are operating reliably in systems all over the world. So well, in fact, that we're extending the warranty to 12 months on new OEM agreements. Design and process controls learned years ago, coupled with effective quality control, assures drives ready to work in your system.

facts about 5¼" floppies

FACT: We've delivered more 96/100 TPI drives to OEM's than all others.



To date we've delivered over 200,000 double track density drives; more than all of our competitors combined. Hundreds of manufacturers of successful small business systems have selected Micropolis drives for their cost effectiveness and proven reliability.

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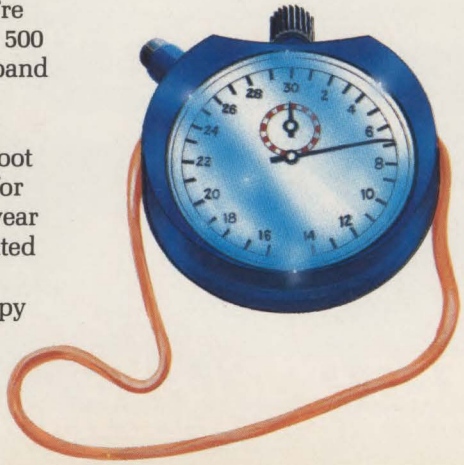

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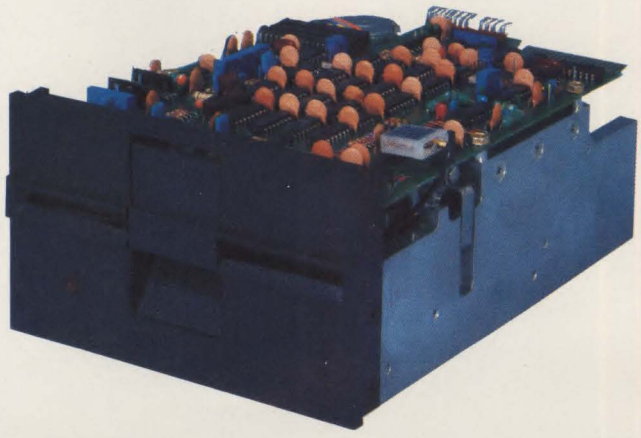

So you win both ways with Micropolis. If you need 96/100 TPI floppies now, order our field proven 1015/1016 series. If you're working on a new system, design in our 2 megabyte Model 1117, the high performance "chassis within a chassis" floppy.

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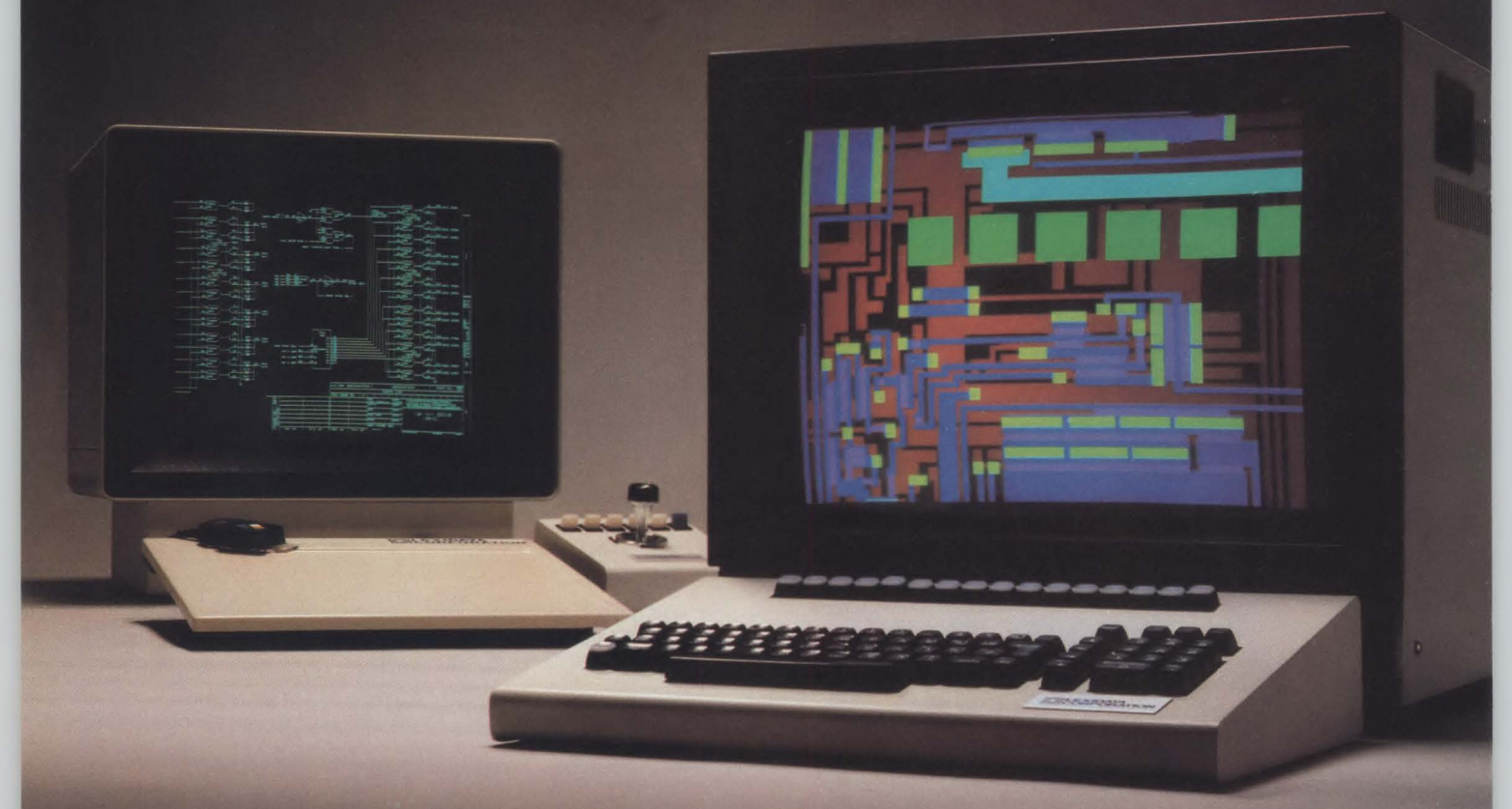


RASTER DISPLAYS...
FOR THOSE WHO DEMAND PERFORMANCE.

the anachronistic Federal Communications Act. Adopted in 1934 to regulate the telegraph and infant telephone industries, the act has not been revamped to reflect the market realities of what many call the New Information Order.

After years of effort, Congress has taken the first step toward deregulation in the Senate Commerce Committee's approval of S. 898. But the Committee ignored the issue raised by computer industry spokesmen and numerous others that the legislation, even with its requirement for a separate Bell subsidiary to compete in unregulated markets without funding from the parent, would still allow Bell to crush the competition.

Critics of the the legislation have also feared that a new telecommunications law would derail the government's antitrust suit against Bell, in which the government is seeking divestiture of several operating companies and Western Electric. But that was before the innauguration of President Ronald Reagan. Since January, the government has been searching for a face-saving way to drop the case. In its latest position, the Justice Department has stated that adoption of S. 898, with some modifications, would satisfy its claims against AT & T, allowing it to drop charges of past antitrust violations.

All this is good news for AT & T, which has spent millions of dollars on word processors, copiers and lawyers to maintain in court and before Congress that divestiture of any of its assets would cause great harm to the nation's communications network. Until now, creating a separate subsidiary to house the unregulated communications activities in which the company is engaged has been as far as Bell would publicly concede to its critics.

As a result, telecommunications leaders in Congress were as surprised as anyone when *The Washington Post* reported that in negotiations aimed at settling the suit, Bell had, on at least three occasions, offered to divest Western Electric, sell as many as three of its operating companies, as well as create the subsidiary in exchange for settling the suit. With S. 898 requiring Bell to do far less than it had previously offered in private negotiations with the Justice Department, the company's supporters on Capitol Hill appear to have been misinformed at best, badly deceived at worst.

But Congressional critics of S. 898, which include House Telecommunications Subcommittee Chairman Tim Wirth (D., Colo.) have been handed solid reinforcement, in the form of the *Washington Post* story, in their effort to fashion what they describe as a more "user-oriented" deregulatory proposal. The House proposal is also expected to reflect more clearly the action that data-processing industry groups would like to see: stronger statutory prohibitions against competitive abuses by Bell.

But critics of the so-called Bell Bill must overcome the will of the Reagan Administration, which is apparently content to side with AT & T on this issue. With the power of the Presidency clearly approaching its zenith in Washington political circles, it's clear that those who propose an alternative to the provisions of S. 898 as now written have a tough row to hoe.

—Arthur M. Hill.

House Telecommunications Subcommittee Chairman Tim Wirth *(D., Colo.) is a critic of proposal S. 898.*

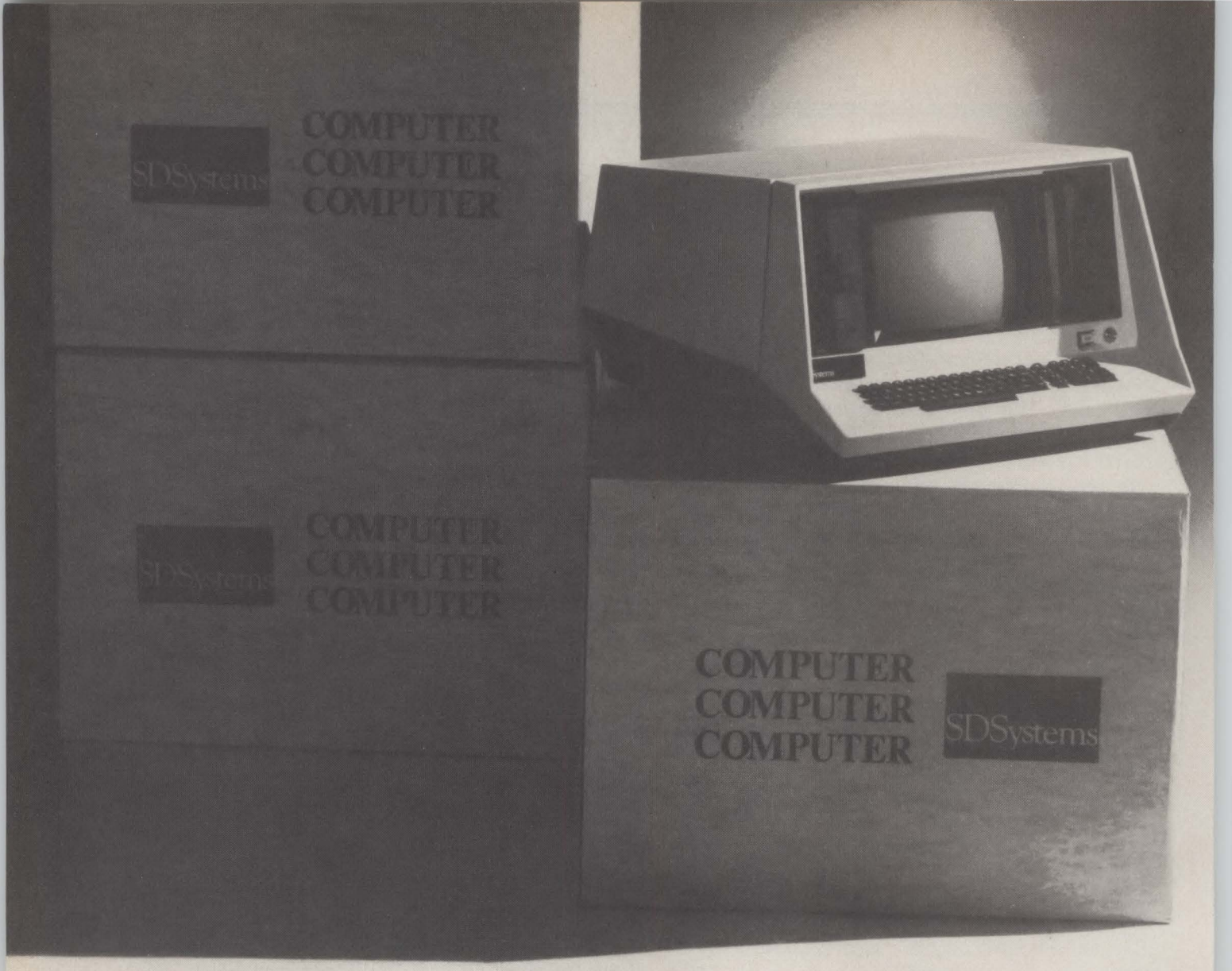
THE AT & T RESPONSE

The Reagan Administration, unsure of how it should respond to growing pressures to reform the aged federal communications laws, last May formed a task force to recommend a position. Members of the task force included the Secretaries of Commerce and Defense, as well as other agencies with a direct interest in communications policy.

While the report the task force prepared was intended only for President Reagan, a copy was leaked to *The Washington Post*. Perhaps the most significant revelation in the report was that the Justice Department, in conjunction with its antitrust suit against AT & T, had spurned three offers by the communications giant to settle the case in return for divestiture of all or part of Western Electric, together with some of its operating companies.

The disclosure by the Post was denied by AT & T in a statement attributed to its chairman, Charles Brown. "We have never offered to divest the Western Electric Co.," Brown said. "And we never intend to because the integrated nature of the Bell System has always been essential."

But a source who, during the Carter Administration, worked closely with the Justice Department on the sensitive negotiations confirms the essence of the Post story, including the offer of divestiture of Western Electric. The source adds that the third attempt to reach a settlement of the antitrust case was agreed to by the Carter Administration in the closing days of its term and then rejected by officials in the incoming Reagan Administration.



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CIRCLE NO. 32 ON INQUIRY CARD

Phase One Systems releases OASIS for 16-bit μcs

In recognition of the rapidly expanding demand for 16-bit μc systems, Phase One Systems, Inc., has developed a high-level version of its popular OASIS operating system for use on such equipment. Designated OASIS-16, the initial release of the operating system is available on 8086-based systems, with future versions slated for operation on Z8000, MC68000 and LSI-11 μcs.

Written in the C language, OASIS-16 offers complete compatibility for application programs developed for the 8-bit OASIS system and provides a high level of portability to other systems, says Howard J. Sidorsky, president of the Oakland, Calif.-based company. Sidorsky tags Western Electric's UNIX operating system as being the main competition for OASIS-16, but he claims his company's product offers features not available with UNIX.

Although both OASIS-16 and UNIX are multi-user systems, Sidorsky says, UNIX makes life difficult for dealers because its licensing price varies depending upon how many users work on the system. "OASIS-16, which supports as many as 32 users, has just one price—$1495," he says. "This price is similar to the retail price of single-user UNIX system."

Another difference between OASIS-16 and UNIX centers on each system's ability to handle various types of terminals, says Sidorsky. "With OASIS 16, any combination of terminals is automatically supported. UNIX, on the other hand, expects to see a Teletype terminal. So UNIX doesn't give the user the flexibility to configure different terminal types on the system as well as OASIS-16."

Sidorsky admits 8-bit processors and operating systems are still more than adequate for many users' needs. But he notes that, as demands increase, a bottleneck often develops at the CPU/disk interface. By moving to a 16-bit system, a user can avoid this bottleneck because of the increased processing speed and memory-addressing space available.

Maximum file size for OASIS-16 is 273M bytes, versus the 16M-byte capacity on the 8-bit OASIS. With the new version, as many as 32 volumes can reside on-line, providing a total of 8736M bytes of storage. OASIS-16 will also support cartridge- and nine-track tape drives and bubble-memory devices.

OASIS-16 also provides dynamic user partitioning, which automatically determines the location of enough memory to start a command or user task. An automatic memory-compression feature collects available memory fragments at command-load time to create space for new users whenever necessary. A dynamic file-allocation capability creates a memory space that can be expanded as much as necessary, avoiding the need to pre-allocate space for major files.

Other features include ISAM files with a Beta + tree structure, interprocess communications, a multi-level directory and a full screen editor. Designed primarily for business environments, the operating system comes with a high-level BASIC compiler and interpreter. An RM COBOL compiler and a C compiler are also available, with Pascal and FORTRAN compilers planned for release by late summer.

—Dwight B. Davis

Planning and projecting computer performance

One problem common to both computer-system vendors and users involves predicting the performance of certain equipment configurations under varying workloads and applications. The user needs to know what system modifications will best support changing demands. And vendors, whose reputations depend upon delivering systems that perform as promised, must feel confident that the products they offer will adequately meet customers' needs.

Since late 1978, BGS Systems, Inc., Waltham, Mass., has offered software solutions to such capacity-planning problems. The firm markets three products that go beyond the measurement capabilities associated with such techniques as benchmarking and system simulations. BEST/1, BGS's flagship product, uses a proprietary queuing algorithm to predict such parameters as CPU response time and the burden on peripheral devices when a system analyst inputs modeling data about a proposed configuration. The company's second product, CAPTURE/MVS, helps the analyst by

preparing this modeling data—based on an existing, base-line computer environment—for manipulation by BEST/1. CRYSTAL, introduced last December, operates throughout the design phases of any software project, evaluating likely system performance based on the designers' estimates of hardware capabilities and user requirements.

Interestingly, almost all the 200-plus BEST/1 customers are end users, says BGS president Harold Schwenk, although he believes the capacity-planning software should also be attractive to system vendors. "I don't know of any vendors who can actually go to their customer base and even offer them the ability to look at some performance projections," he says. "They'll go and say, 'Oh sure, it will fit.' They'll say, 'Ralph down the street is also doing it' or they'll say, 'Trust us. We designed it to be able to do that.' But actually to be able to go to the customer, run what are represented as being models of the performance (using BEST/1 and CRYSTAL), and gear it all to the customer's statements about his work, I think, is a new concept."

Schwenk expects this to be a growing concept, fueled by an increasing customer awareness about what to expect in terms of system performance, and by the willingness on the part of more buyers to bring matters to court when systems fail to perform as specified. Because BEST/1 and CRYSTAL are "truly vendor-independent" (CAPTURE/MVS being limited to operation in MVS-type environments), Schwenk says the products could be used by almost any vendor wanting to back up marketing claims while also insuring against dissatisfied-customer backlash.

Despite the software's machine independence and relatively low host-hardware requirements (about 500K bytes of memory space and the ability to run ANSI-standard FORTRAN), almost all BEST/1 and CRYSTAL users run the programs on mainframe computers. Schwenk notes that although the resource requirements "mean the software can run on almost any modern minicomputer," most current users have access to large systems that function almost as "computer utilities" used for any design and modeling work. He points out, however, that many of the "object" systems being modeled with CRYSTAL are minicomputer-based configurations.

In one such instance, Liberty Mutual Insurance Co. used CRYSTAL and BEST/1 to evaluate several vendors' proposals to supply a nationwide, 950-terminal network for workers-compensation claims processing. Both mainframe and minicomputer vendors submitted proposals in a format that could be manipulated by the BGS software on Liberty Mutual's IBM 3033UP processor. After projecting the likely performance of each proposed system, the insurance company awarded the contract to Hewlett-Packard Co. for its distributed minicomputer configuration.

"Before (the BGS software), we had to rely upon the vendors' estimates or on our own intuition," says Robert Taylor, manager of technical research at Liberty Mutual's data center in Portsmouth, N.H. "This is the first time we are able to use a specific methodology to evaluate such proposals." Taylor also says CRYSTAL has proven helpful in checking software in the early design stages before any code is written.

Despite the advantages BGS's software offers over benchmarking —which requires an actual system to run tests—and over simulations —which often require data that is very difficult to obtain—the planning packages do have certain weaknesses. "BEST/1 cannot be applied as easily to network modeling as we would like," Schwenk notes.

Licensing fees for BEST/1 vary from $19,000 to $24,000 depending upon the user's host computer. CRYSTAL's single-site license is $17,600; CAPTURE/MVS's is $8500. These prices apply only to customers who use the software for internal applications, Schwenk says. For users such as system vendors who make the projection results known to third parties, "we have to set up our licensing agreement in such a way that it becomes a usage-based revenue generator." *—Dwight B. Davis*

Direct moves to H-P market, looks to office systems

A year in the dicey Digital Equipment Corp. VT-100-compatible market has not discouraged video-display terminal maker Direct, Inc. Instead, the two-year-old Sunnyvale, Calif., company has turned to the Hewlett-Packard market with a line of software-compatible hardware based on Direct's original VT-100-like device, the VP800A (MMS, May, 1980, p. 38).

Shipments of the VP828, an HP2645A lookalike, began in April, while shipments of the VP825, an HP2622A-compatible device, started in July. Plans call for delivering an HP2624A-compatible unit by September.

All three terminals are fully compatible with H-P's View/3000 software package, designed to handle screen-management and da-

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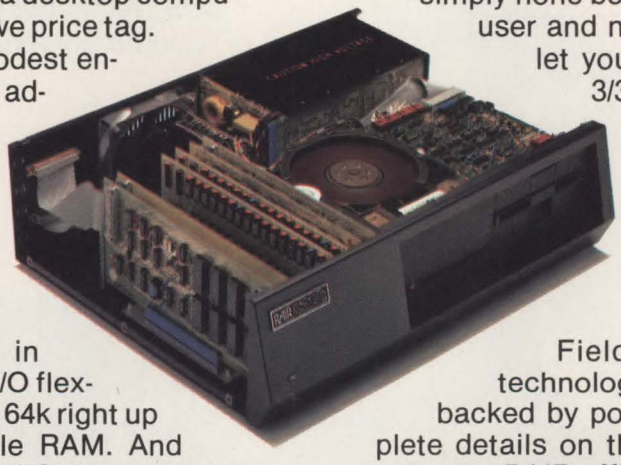

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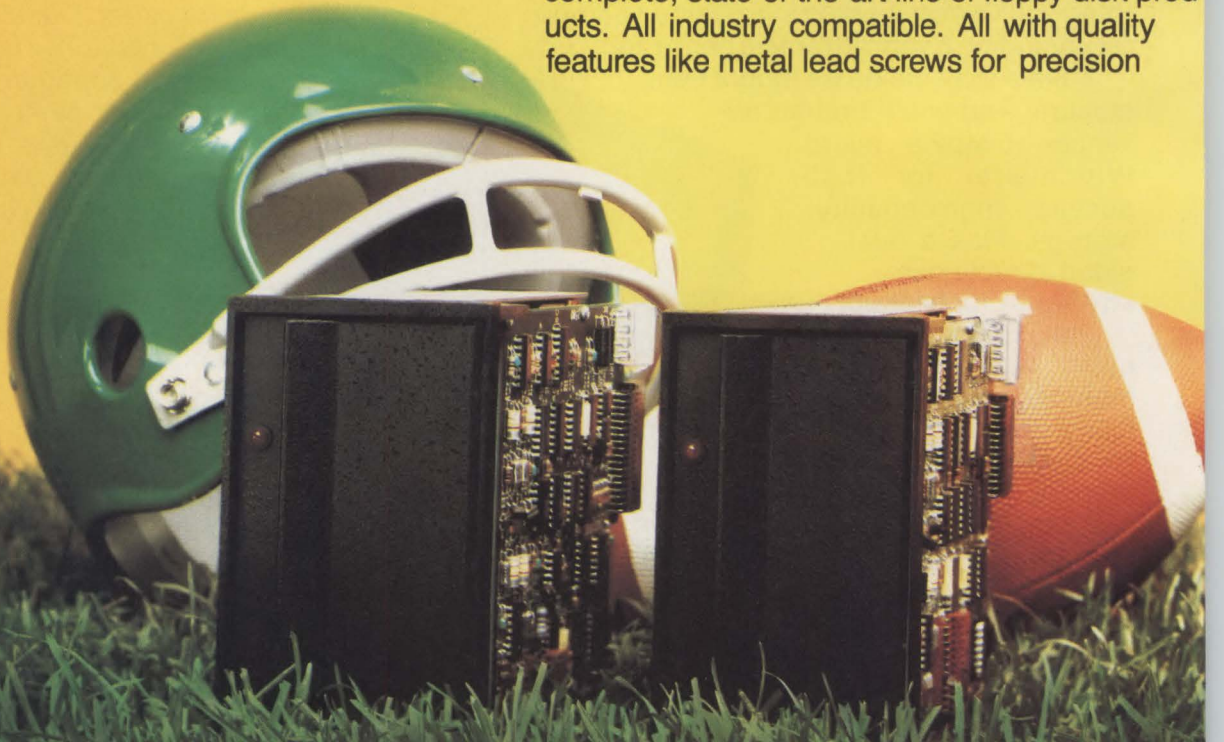

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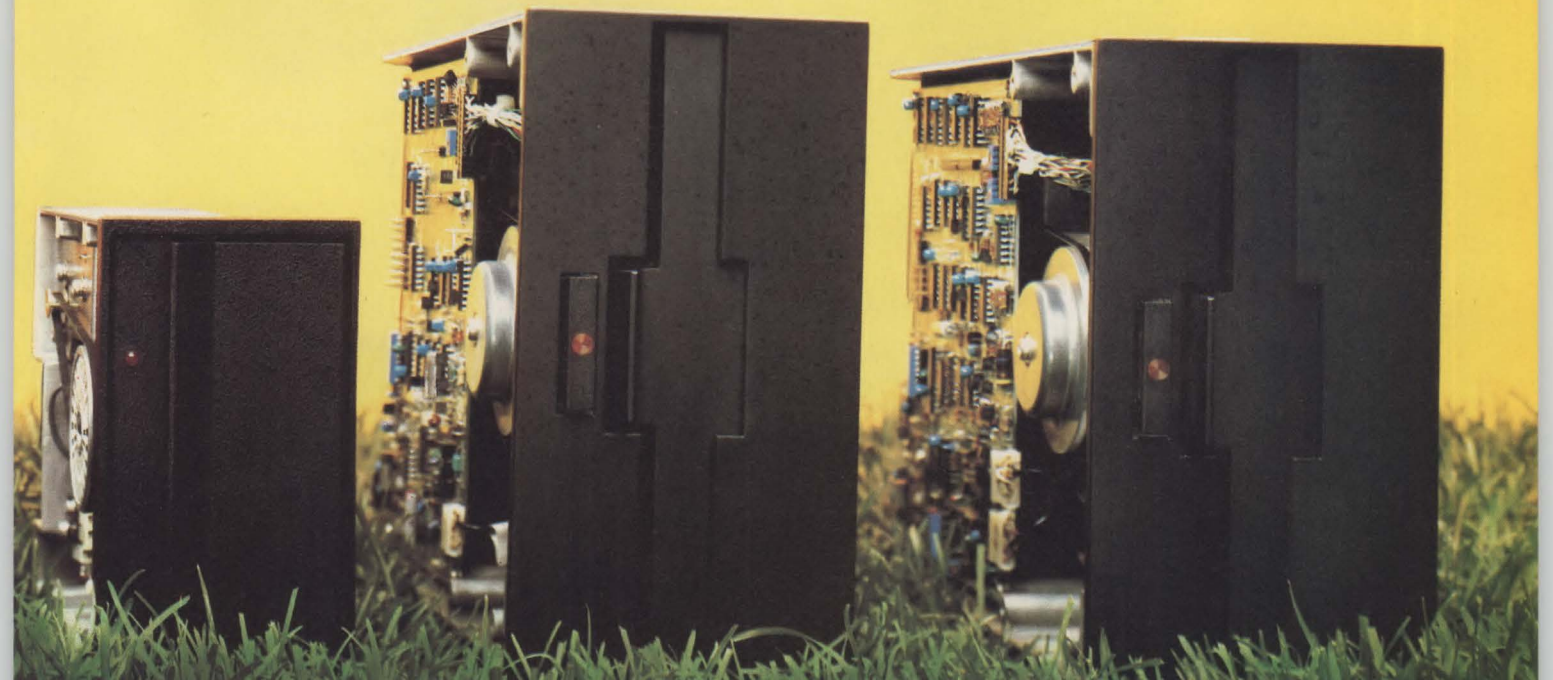

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ta-entry operations.

The Z80A-based hardware is said to be the first alternative to the 2645A for Hewlett-Packard users. Vice president of marketing Steve Auditore says, "We're selling View/3000 compatibility, not hardware compatibility. Hardware-wise, there are some things we can't do." He adds that Direct does offer some things H-P doesn't, such as a 132-column display. In addition, the VP828 is also VT-100 compatible, he says.

Both the VP828 and VP825 are priced lower than their H-P counterparts, says Auditore. In single-unit quantities, the devices sell for $2490 and $1790, respectively.

While Direct may be the only competitor in the H-P market, the size of that market is not known. Auditore's figures show that H-P's shipments of View/3000-compatible displays will account for about 50 percent of the company's total display-terminal deliveries this year. He says about 200 VP828s have been shipped since April, and the company expects to ship at least that many during the summer.

Regardless, Auditore expects to fare better in the H-P market than in the VT-100 market. He admits that Direct missed the delivery window for VT-100s and got caught in a price squeeze when a raft of competitors jumped into the business. "We couldn't follow the price as low as it was going," he explains, "and we ended up higher than we should have been."

The company plans to use the terminal business to leverage itself into the office-automation market. "We're moving away from terminals," says Auditore, "toward sophisticated office-automation products." Direct will unveil its first entry in that market this fall. Details are sketchy, but the device will be based on the firm's flagship VP800/A and will operate as a local stand-alone processor and a remote video terminal simultaneously. Further, says Auditore, the hardware will have "multiple personalities"—users will be able to switch-select among H-P, DEC or Data General compatibility, for instance.

Direct's VP825, *an HP2622A-compatible device, uses H-P's View/3000 software, which handles screen-management and data-entry functions.*

The unit will run a CP/M-like operating system and will initially include two integral floppy-disk drives. A separate matrix printer is also planned. "Our closest competitor would be the Xerox 820," he says.

Software will be available from Direct, says Auditore. The company will start an incentive program for independent software vendors to encourage them to develop application packages geared for the Direct hardware, he says. *—Larry Lettieri*

Tektronix display terminals have enhanced refresh

Tektronix, Inc., is rejuvenating its 10-year-old 4010 series of graphics display terminals by adding two new products. Officials at the Beaverton, Ore., company say the new hardware, called the 4110 series, incorporates enhanced refresh capabilities, additional local processing power and improved data communications, yet retains full 4010 software compatibility.

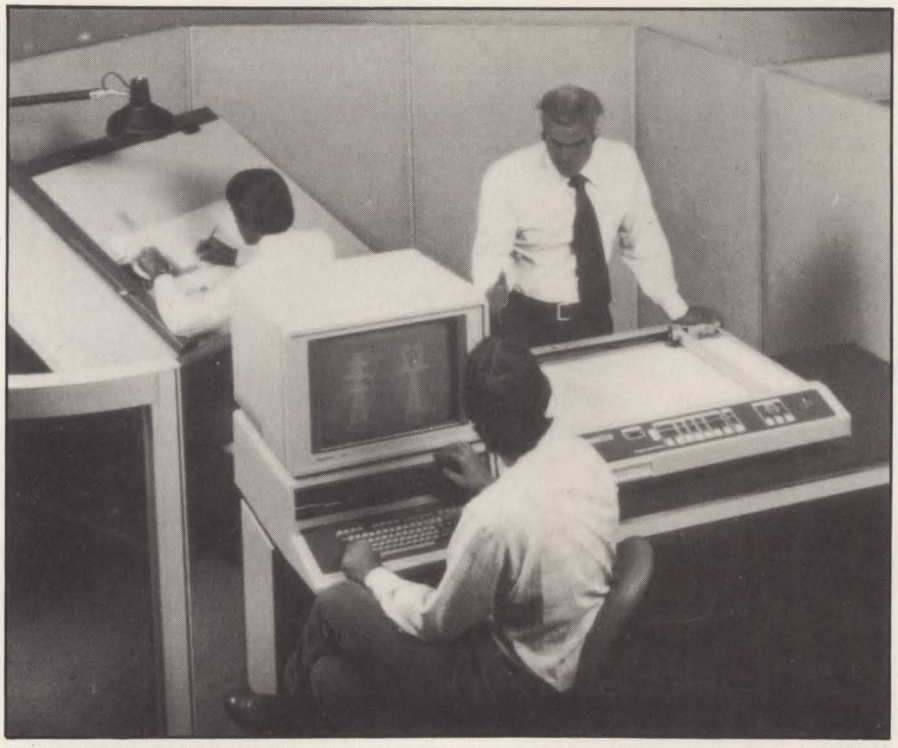
Aimed at the CAD/CAM market, the additions include the 4114—a $17,500, 19-in. direct view storage tube (DVST) display—and the 4112, a $9600, 15-in. raster-scan device.

"The 4110s are intelligent extensions of the relatively non-intelligent 4010 series DVST terminals," says Michael Kondrat, terminals marketing manager. "Our strategy is to move 4010 users to the 4110 terminals without those users having to redo their software." However, he adds, to use the advanced features of the new displays—enhanced refresh, for instance—it will be necessary to modify the software somewhat. Both displays use Intel's 8086 as the main processor and can communicate over RS232C lines at speeds as high as 19.2K bps, Kon-

drat says.

Kondrat says the key to the 4110 series' improved performance is its increased local intelligence, which enables it to reduce the number of terminal-host communications. The added intelligence also allows the displays to retain picture segments locally. Such pictures or picture elements, Kondrat explains, are those that can be defined by MOVE or DRAW commands, then stored locally, recalled and manipulated with simple commands from the host. "In other words," Kondrat says, "the host need not transmit the MOVE or DRAW commands each time a picture segment is used."

In addition to the ability to store segments, both displays can translate, rotate and scale the picture elements, enabling a user to group lines together, identify them as a segment, move them on the screen or store them locally. This feature, Kondrat says, is ideal for design graphics applications in which parts are used repeatedly.



Tektronix's new 4114 *graphics display terminal incorporates enhanced refresh capabilities, additional local processing power and improved data communications—at a $17,500 price.*

While the refresh capability to support these features is inherent in the 4112 raster display, the 4114 DVST has been augmented with the ability to handle 3000 short vectors in its refresh, Kondrat points out. The 4114's memory—expandable to 800K bytes of RAM—store the segments and make the extensive refresh possible.

Tektronix's 4112 *graphics display terminal is a monochrome raster display device that retains full 4010 software compatability. It is priced at $9600.*

"The 4114 is a breakthrough in DVST displays," Kondrat claims. Raster proponents claim that DVST is too slow without refresh, he adds. "But the 4114's segment capabilities and its ½-sec. redraw time for screen updates change those claims." The 4114 can also display 4000 lines. And, with Option 31, it can display refreshed segments in amber to highlight them.

Tektronix's new raster terminal, the 4112, has the same level of local intelligence and data communications as the 4114, says Kondrat. The 4112 is a monochromatic device with a viewable display matrix of 640 × 480 points and an addressable matrix of 4096 × 4096 points. The display space can be accessed via zoom or pan functions, Kondrat says, enabling a user to select any portion for display and enlarge it for

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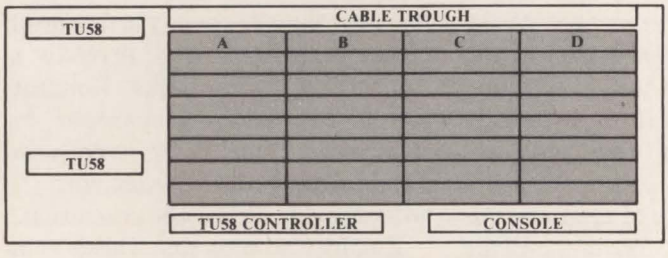

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viewing close-ups.

As many as 16 viewports can be displayed simultaneously on the 4112. Further, a user can define the size and position of separately scrollable dialogue areas anywhere on the screen. Kondrat says this allows terminal-host communications to proceed without interfering with graphics activity.

The 4112's standard single-memory plane can be expanded with two additional planes, allowing three separately addressable surfaces or overlays to be displayed. In addition, three bit planes permit separate displays to be superimposed. The three bit planes enable the 4112 to be converted to color, a feature that is also in Tektronix's plans for the display terminal. Eight levels of gray allow shading of the display.

Memory on the 4112 is expandable via RAM to 640K bytes. The 4112 and 4114 have integral floppy-disk storage for an additional 512K bytes. Kondrat says that Tektronix has no immediate plans to add hard-disk storage.

Existing 4010 applications software will run on the 4112 with minor alterations to accommodate the differences in raster and DVST display techniques. The 4112 and 4114 support Tektronix's PLOT 10 interactive graphics library (IGL) modules. PLOT 10 terminal control systems programs written for the 4010 series will run on the new hardware in a 4010 emulation mode, Kondrat says.

Shipments of the two terminals have begun, Kondrat says. Both displays are available at OEM discounts. The 4114 with Option 31 color-enhanced refresh sells for $19,500. *—Larry Lettieri*

Tektronix graphics on a low budget

For those who need graphics but who can't afford it, several companies offer the means at a very modest price, typically less than $2000. For that small sum, about half the price of a comparable Tektronix display, a standard video terminal can be made to run Tektronix's elaborate PLOT-10 graphics software.

Three California firms are selling add-in boards that turn low-cost CRT terminals into graphics displays. Two of these, Digital Engineering, Inc., and MQI Computer Products, have boards that plug into inexpensive Lear-Siegler or Televideo terminals and run PLOT-10. Digital and Selanar Corp. build boards for the higher priced Digital Equipment Corp. VT-100 general-purpose CRT terminal. Selanar, however, offers Tektronix compatibility as an option; its emphasis is general-purpose graphics.

Digital Engineering and MQI claim to match Tektronix's 4010 series displays in everything except resolution, a strong point of the 4010's storage-tube technology. But Digital Engineering says that, because its terminals are raster displays, they can do some things that Tektronix's DVST devices cannot, such as selective erase.

Keith Sutton, vice president of marketing at Sacramento, Calif.-based Digital Engineering, says his company's RG512 board and a Lear-Siegler ADM-3A terminal emulate the 4010's cursor control, vector drawing capabilities and alphanumeric mode. "We end up with all the 4010's features except the resolution," Sutton claims. The RG512 displays 640 × 480 dots. The RG512 allows point plotting, Sutton says, a feature used in Tektronix's more advanced displays.

MQI's G100 board plugs into a Televideo model 912 or 920. Avery Blake, director of marketing for the Mountain View, Calif., company, says "We end up a little more fully featured and faster" than the 4010. The G100 uses a Z80 and has a bit-mapped memory of 128 bytes for a display of 250 × 512 dots, Blake says. The board will permit point plotting, vector generation and command decoding.

Barry Southard, president of Selanar, Santa Clara, Calif., says that his company's board replaces the video board in a VT-100 or VT-103. The Tektronix option, Southard explains, calls for additional PROM and a second, smaller board that serves as a communications interface between the graphics board and the host system. Southard says that his board provides resolution of 240 vertical dots × 24 horizontal dots.

All three companies agree that their customers are Tektronix users looking for a less expensive display to serve as a "personal graphics terminal." A 4010 sells for $5500.

As far as Tektronix is concerned, if imitation is the sincerest form of flattery, then Tektronix is flattered. "Everybody says the PLOT-10 is compatible," says Mike Kondrat, terminals marketing manager for Tektronix. "But those who need high-quality graphics stick with the 4010; they buy it for the resolution."

Kondrat admits that these compatible devices are "nibbling away" at 4010 sales. But, he adds, there is nothing the company can do about it. "The software is licensed from

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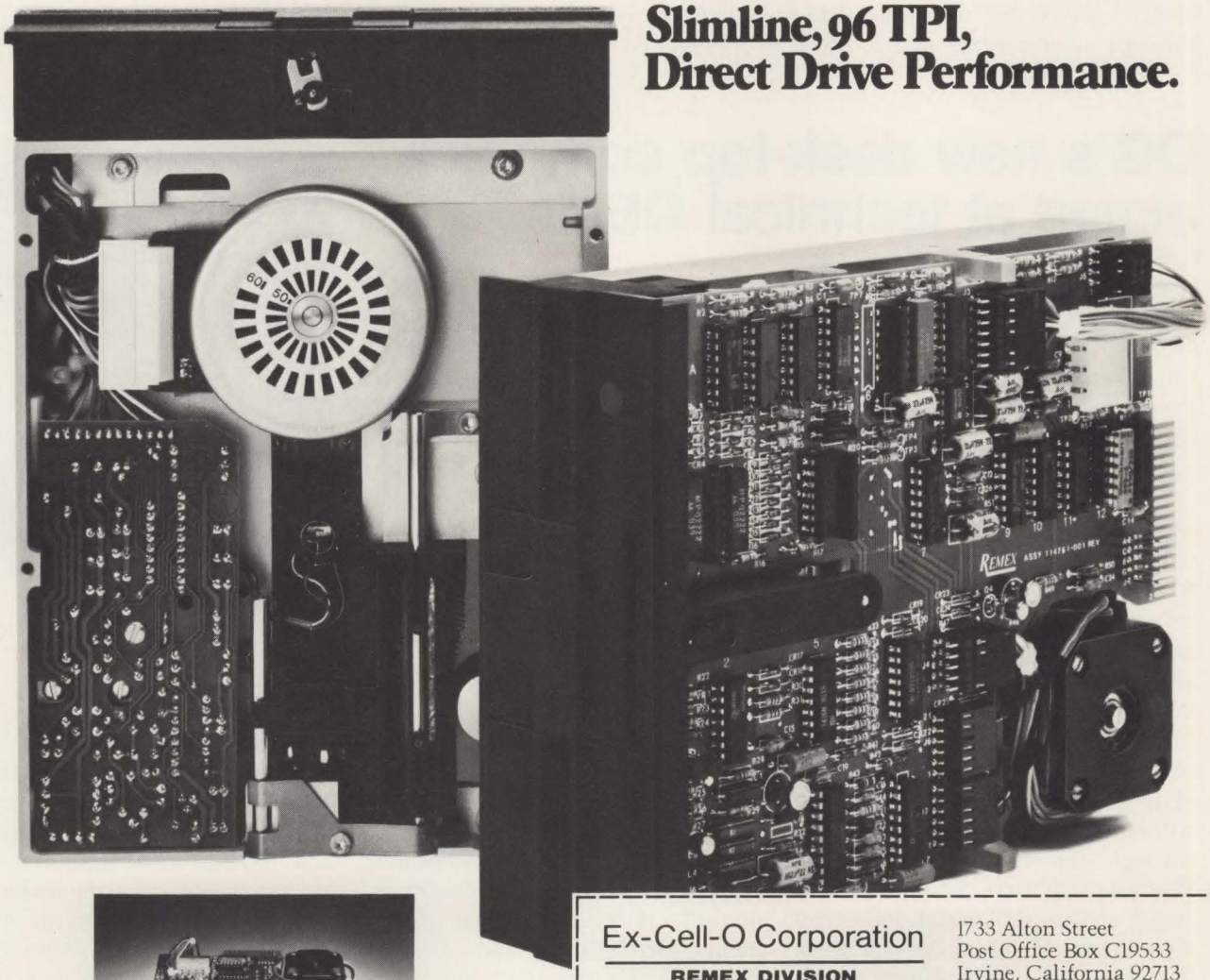

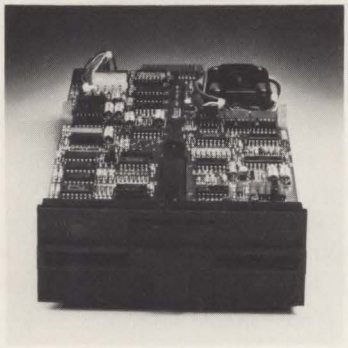

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us," he explains. "It's up to the customer to decide what to hook it up to."

Digital Engineering, which claims to have started the Tektronix-compatible, plug-in business, has about 10,000 units installed. Its RG512 Lear-Siegler board, available through Lear-Siegler distributors, sells for $1150. A converted ADM-3A sells for $2000.

MQI's G100, at $1395, is priced slightly higher. Prices for an Autograph 100 fully configured terminal start at $2395, depending on the CRT chosen. MQI also markets its boards through distributors.

Selanar's basic video board is priced at $1200. The Tektronix option is $250; a VT-100 is about $2000. The company also sells its own Tektronix-compatible software. Calcomp, three-dimensional graphics and light-pen packages are also available. Southard says his terminals also run software from ISSCO, San Diego, Calif. —*Larry Lettieri*

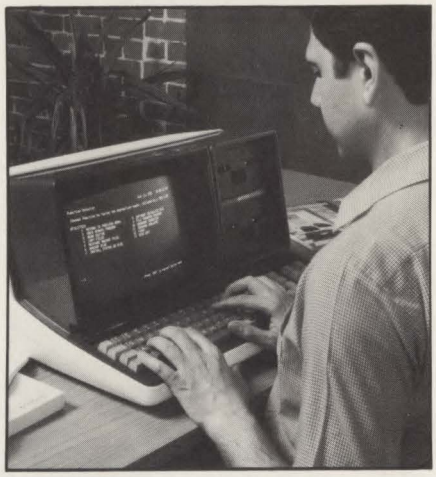
DG's new desk-top computer aimed at technical OEMs

One month after releasing the Enterprise 1000 small-business desk-top computer, Data General Corp. has announced the MPT/100, a microNova-based 16-bit desk-top machine aimed at the technical-OEM market.

The basic hardware of the two systems is functionally similar, but, unlike the Enterprise 1000, the MPT/100 does not include application software and is targeted at customers who want program development and who want to tailor the computer system into larger systems. While the Enterprise will be sold directly to end users through DG's normal distribution channels, the MPT/100 will be marketed primarily to OEMs through the company's Technical Products Division, and to professional end users through industrial distributors. Professional end users include large, technologically oriented companies that would use the MPT/100 in their laboratories, on production lines or as links to a central computer.

Rashid Nisar, product manager for the MPT family, says he expects OEMs to tailor the system with software for resale into such applications as laboratory instrumentation, medical diagnostics, data acquisition, process control and remote data entry. He notes that the major selling point of the MPT/100 is that it is software-compatible with larger DG machines because it uses the same MP/OS operating system as other microNova products, such as MP100 and MP200. The system can handle programs written in FORTRAN, BASIC, Pascal and COBOL. Nisar says compatibility should be important because it enables users to migrate to larger systems when they need added capabilities. It also allows programs written on larger machines, including the 32-bit MV/8000, to be down-loaded for execution on the MPT/100.

The MPT/100 is priced at $5350 in single-unit quantities. Nisar says its price-compatibility and program-development abilities make it competitive with other similarly equipped systems in the technical market, including Digital Equipment Corp.'s MINC and Hewlett-Packard Co.'s 83 and 85. The H-P 85 is an 8-bit system selling for approximately $3200, which includes a CRT, a printer and a cassette-storage unit. The DEC MINC LSI-11-based 16-bit machine sells for more than $10,000. It is not a desk-top system, as are the H-P 85 and the MPT/100, but it has similar applications in technical fields. "We're right in the middle, price- and performance-wise with the MPT/100," says Nisar. With 64K bytes of RAM, the MN602 μp-based MPT/100 includes two 5¼-in. floppy diskettes, providing 716K bytes of storage. Options include a 5¼-in., 25M-byte Winchester-disk drive and a 1.2M-byte floppy-disk drive.



Data General's new MPT/100 *desk-top computer has been designed for technical OEMs.*

The system provides synchronous and asynchronous communications via two RS232C programmable ports and transmission rates as high as 19.2K bps. The microNova I/O bus interfaces with microNova peripherals and with those supplied by other manufacturers. With video-refresh capabilities, the unit generates 5 × 8 dot-matrix characters on a 12-in., 25-line × 80-character green phosphor screen. The keyboard contains 83 keys, including a numeric-cursor keypad and 10 function keys.

Limited samples of the MPT/100 will be available this month, and production quantities will be ready next month. Delivery time is 90 days. —*Frank Catalano*

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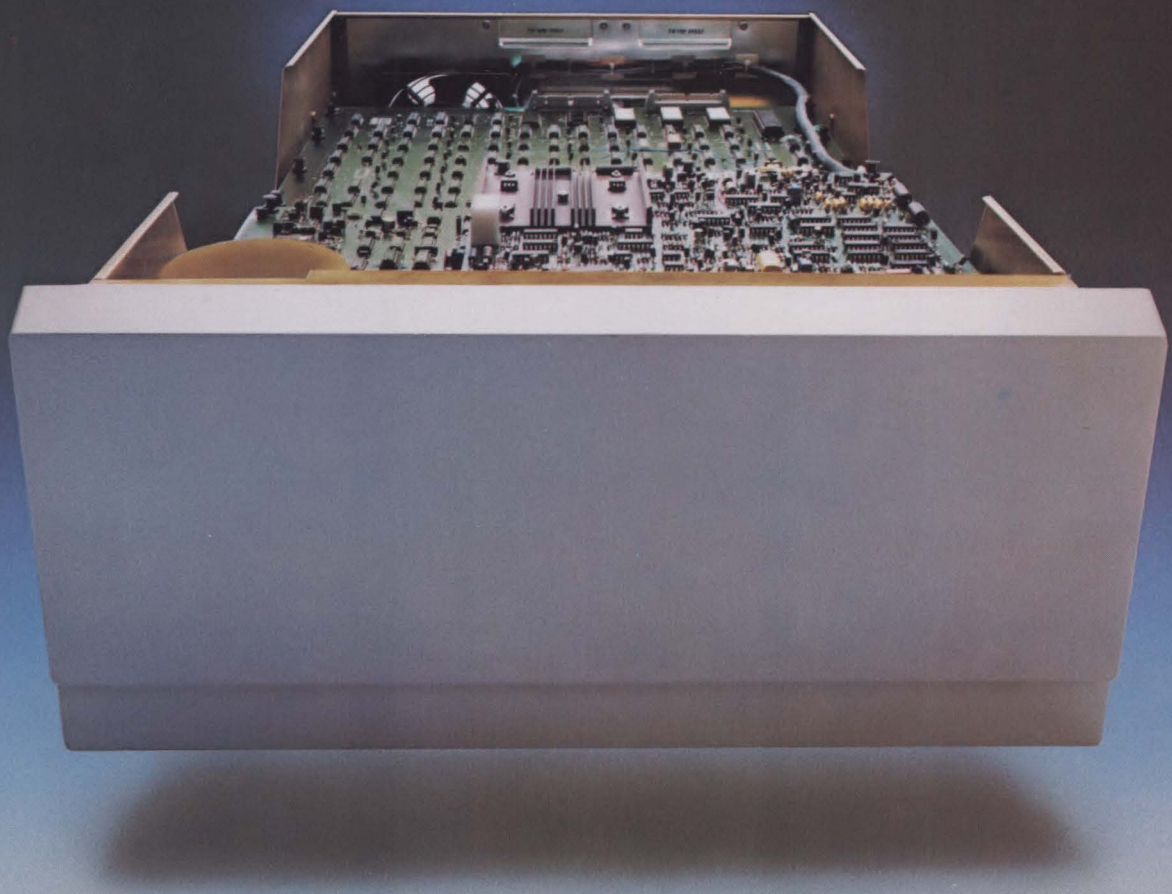

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A new torque motor and closed-loop servo system increases track density and improves data reliability. This motor boosts performance by 23 percent, yet fits in the same physical space as a stepper motor.

Remarkably easy to interface.

SMD or Marksman interfaces are standard.

It's also available with an embedded intelligent formatter

Continued on next page.

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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

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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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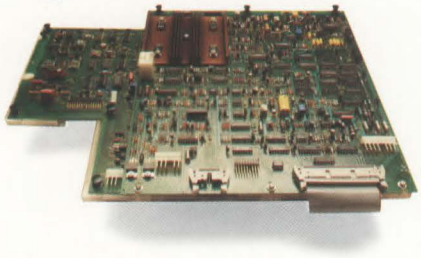

that typically enables systems integrators to interface to mini/micro bus structures in less than a week.

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.

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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.

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Nonrecoverable: <1 in 10^{13} bits
Positioning <1 in 10^{6} seeks
MTBF: >8000 hours
MTTR: <30 minutes

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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.

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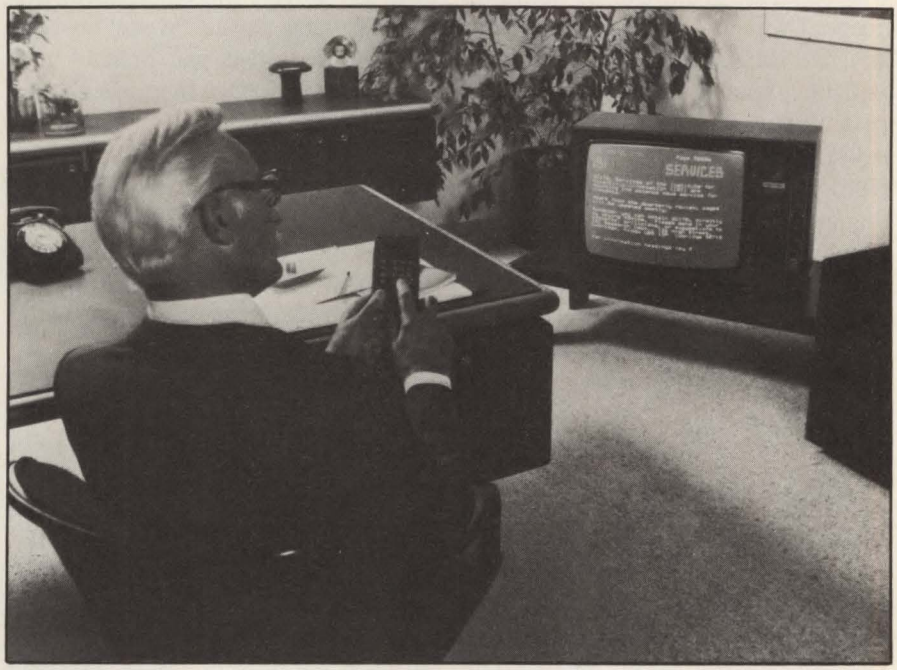
Videotex service comes to U.S.

Videotex information service for the U.S. to transmit domestic commodity prices and shipping and real-estate items as well as to provide access to a worldwide information network will begin in Boston in October. Aimed primarily at the business community, the new system will host a data base compiled from many sources, including major U.S. corporations.

Operated by facilities management specialist Avco Corp., the system consists of a proven hardware/software configuration used in the U.K. to run Prestel, the oldest and most widely used public videotex system. Prestel is owned and operated by Britain's state-owned common carrier, British Telecom.

The service will be owned and promoted by British Videotex and Telextext (BVT), which was established in Washington this year. It will be backed by the British government and run jointly by British Telecom and Logica Ltd., a leading London software house with expertise in the communications field. Its mission will be to capitalize on Britain's worldwide lead in videotex and teletext technology and to compete with French videotex initiatives in the U.S.

The service has been operating mainly from Logica's offices in New York and has already garnered a small group of Prestel users in the U.S. But its scope is limited because Prestel's overseas service is operating on a trial basis, and the hosts are located remotely—in Britain. U.S. users must phone directly to the U.K. or use the International Packet-Switched Service to gain access via Telenet or Tymnet packet-switched networks that are linked to the U.K. and other parts of Europe. IPSS was established a few years ago by several European common carriers in cooperation with U.S. international common carriers. The packet networks offer lower line costs, but their line speeds require an external modem to be used with a Prestel terminal to support 1200-bps terminal-to-host transmission. The integral modems in Prestel terminals, which are adapted television receivers, support only a 75-bps transmission speed.



Business users can access Prestel *for data provided by Ford Motor Co., DuPont Inc., ABC and other information providers.*

BVT's Washington representative, Kenneth A. Shilson, says 50 Prestel-adapted televisions to use the British service have been installed so far in the U.S. Some are specially built units from Zenith Corp. and Sony, and others are standard TV receivers with external Prestel-adapter boxes. Shilson says the difference between European and U.S. TV line standards—625 in Europe and 525 in the U.S.—has posed few problem because the interface logic in interactive videotex terminals is concerned only with data formatting. Line standards become a problem only with teletext, the non-interactive broadcast technology.

BVT's aim, Shilson adds, is to build half of its worldwide customer base in the U.S. Activities to extend Prestel outside the U.K. formerly centered on an operation called

Prestel International, which ran an 18-month trial service supporting about 400 users in 23 countries, including the U.S. customers. The international service was hosted by a system in London called Hogarth, which used the same hardware and software as the Prestel hosts but was separate from the 18 domestic hosts. Only 20 information providers fed its information data base. Shilson explains that British Telecom originally anticipated that copyright problems might arise from making Prestel's extensive domestic data base freely available to worldwide users.

But the gateway facilities pioneered by West Germany's state-owned common carrier, Deutsche Bundespost, on its Bildschirmtext videotex service have rendered pointless any attempt to separate domestic and international videotex networks. The primary future role of public videotex networks such as Prestel and Bildschirmtext is to provide access to a wide range of third-party systems and networks run by banks, retail groups and similar organizations. The networks' role as information services in their own right, although still very important, will be secondary.

Prestel International was merged with the rest of the Prestel service on July 1, opening the domestic data base—180,000 pages of information from 500 information providers—to users outside Britain. Other countries reached by Prestel include West Germany, the Netherlands, Sweden, Switzerland, Hong Kong and Australia. For now, the old international data base, which includes a great deal of shipping and commodity price information from the domestic data bases will be routed to a Prestel host in Birmingham, England.

The U.S. was selected for the first Prestel host outside Britain because of the enormous size of its potential user base. Shilson says the decision to proceed with the Boston system is attracting the attention of U.S.-based companies, and some have already signed up to provide information. They include Ford Motor Co., Dupont, Inc., and ABC.

The Boston system, called the 4080, is a 16-bit minicomputer and will use almost the same hardware and software as the Prestel hosts in Britain. The 4080 was built by GEC Computers, part of Britain's General Electric Co. (no relation to General Electric of the U.S.). Software is written in Babbage, GEC's proprietary real-time language that offers a combination of high-level instructions and the ability to write code at machine level.

A direct phone call, Telenet or Tymnet will provide access to the system from within the U.S. Shilson points out that initial marketing of the service will be restricted to the Northeast and one other part of the country, possibly Houston. The service's goal, he says, is to provide U.S. users with access to Prestel through gateway facilities. The only major restrictions will be in accessing the closed user-group data bases hosted by Prestel. These hold confidential information compiled and used by special user groups with a common interest, such as commodity brokers.

Shilson is confident that Prestel will not be rendered obsolete by the widespread adoption in the U.S. of the videotex display standard announced by AT & T this year. Prestel uses a very simple alpha-mosaic-display technique, while AT & T has opted for a technology that mixes alpha-mosaics with alpha-geometrics. The latter method requires more complex and more expensive logic circuitry in the terminal to generate much higher quality graphics than those on an alpha-mosaic terminal. But Shilson believes that a Prestel host will still be able to communicate with an AT & T standard terminal. Moreover, he expects a worldwide videotex display standard, covering existing standards, to be negotiated at the CCITT level (the international telecommunications standards body), with the Prestel standard as a subset.

But it remains to be seen if Prestel terminals can communicate with a host transmitting pages of information conforming with the AT & T standard or with any future worldwide standard. Alpha-geometrically coded graphics can not be displayed, and alpha-mosaic characters conforming with the AT & T standard would appear only in black and white because AT & T's color-defining codes differ from Prestel's. Moreover, the Prestel terminal could misinterpret a "foreign" code rather than ignore it. Shilson believes the answer to these problems is for the host computer to cater to a variety of different videotex terminals.

British and French organizations in the U.S. marketing teletext, the broadcast version of videotex, are competing for contracts from U.S. TV companies. Both sides see teletext as offering greater sales potential than interactive videotex using telephone lines (the technology referred to in Britain as Viewdata).

The British see the extension of European interactive videotex networks to the U.S. as very promising. But videotex technology sales by either side to U.S. organizations that are establishing their own public interactive networks could be hindered by the wide-ranging individual requirements of each potential operator.

In contrast, the non-interactive nature of teletext and the potentially huge volume sales of adapted TV receivers to domestic users of teletext services will demand simple, proven technology. The British believe that their CEEFAX teletext

system, with its simple page-display standard, meets this requirement. But they are worried that the Federal Communications Commission may adopt a subset of AT & T's highly complex page-display standard.

The French enjoy strong support of their teletext system—Antiope—from CBS, which filed the system as a proposed teletext standard with the FCC last year. CBS replaced its proposal in July with an extended Antiope standard more closely resembling AT & T's videotex plan. The new CBS proposal includes the picture-description-instruction (PDI) feature of AT & T's plan, in addition to Antiope's alpha-mosaic-display technique.

The Electronics Industries Association, which represents U.S. TV manufacturers, and the National Association of Broadcasters are also involved in establishing a teletext standard. The British hope the FCC will decide to deregulate teletext transmission rather than opt for a standard with which CEEFAX might be only partly compatible.

Meanwhile, the British and French are both trying to persuade as many U.S. broadcasting companies as possible to adopt the U.K. and French systems on a trial basis. That would give those systems a solid base for expansion when the FCC makes its decision. Both sides are supported by their respective governments, with the long-term aim of encouraging large-volume sales of teletext-related products in the U.S.. For example, the British have high hopes for the teletext decoder chip set fabricated by Mullard, Ltd.

The French teletext initiative in the U.S. is led by Antiope Videotex Systems Washington, which will soon move to New York and change its name to Antiope Telematics Corp. It will represent the interests of two French organizations: Sofratev, a body established by the state-owned broadcasting company, Television de France, to promote its Antiope teletext technology; and Intelmatique, an organization set up by the government to promote France's other developments in information technology. The French use the umbrella term "telematique."

U.S. use of Prestel in homes *(as above) and offices is operating on a trial basis.*

Unlike the British, with firm plans to extend their Prestel interactive videotex information service to the U.S., the French do not appear to be interested in promoting Prestel's French counterpart, Teletel, in the U.S. Teletel service has just started operating on a trial basis in France, and Teletel emphasizes providing gateway access to other networks more than providing information. In any case, much of the information on Teletel will be in French and, therefore, of limited value to U.S. users.

But the French have achieved success in the more promising market for teletext technology, having persuaded several broadcasting companies to run Antiope on a trial basis. They include Los Angeles stations KNXT and KNBC, owned by CBS and NBC, respectively, and one San Francisco station, KPIX, owned by Westinghouse Corp. Antiope software, modified to suit the U.S. 525-line standard, runs on Honeywell Level 6 minicomputers, and the terminals are RCA-built TV receivers with Antiope decoders.

British teletext initiatives in the U.S. are spearheaded by BVT. The CEEFAX system was developed by the British Broadcasting Corp., and the one U.S. customer so far is the electronic publishing division of Field Enterprises, Inc. Field's Chicago television station, WFLD, is using CEEFAX on a trial basis to broadcast 200 pages of local news and stock prices to 100 Zenith TV receivers with CEEFAX decoders located in public places throughout Chicago. The software runs on the same type of host machine as BBC's CEEFAX service, a Digital Equipment Corp. PDP-11.

—Keith Jones

Britain using satellites to link local area networks

The growing problem of linking remote local area networks without forfeiting the speed advantages they offer is being tackled in Britain by using satellite transmission. Next spring, a project called UNIVERSE—universities expanded ring and satellite experiment—will go public and should demonstrate the attractions and drawbacks of the satellite approach.

Funded in part by the British government's Department of Industry and another government-backed body, the Science and Engineering Research Council, UNIVERSE will link seven local networks at universities and research labs

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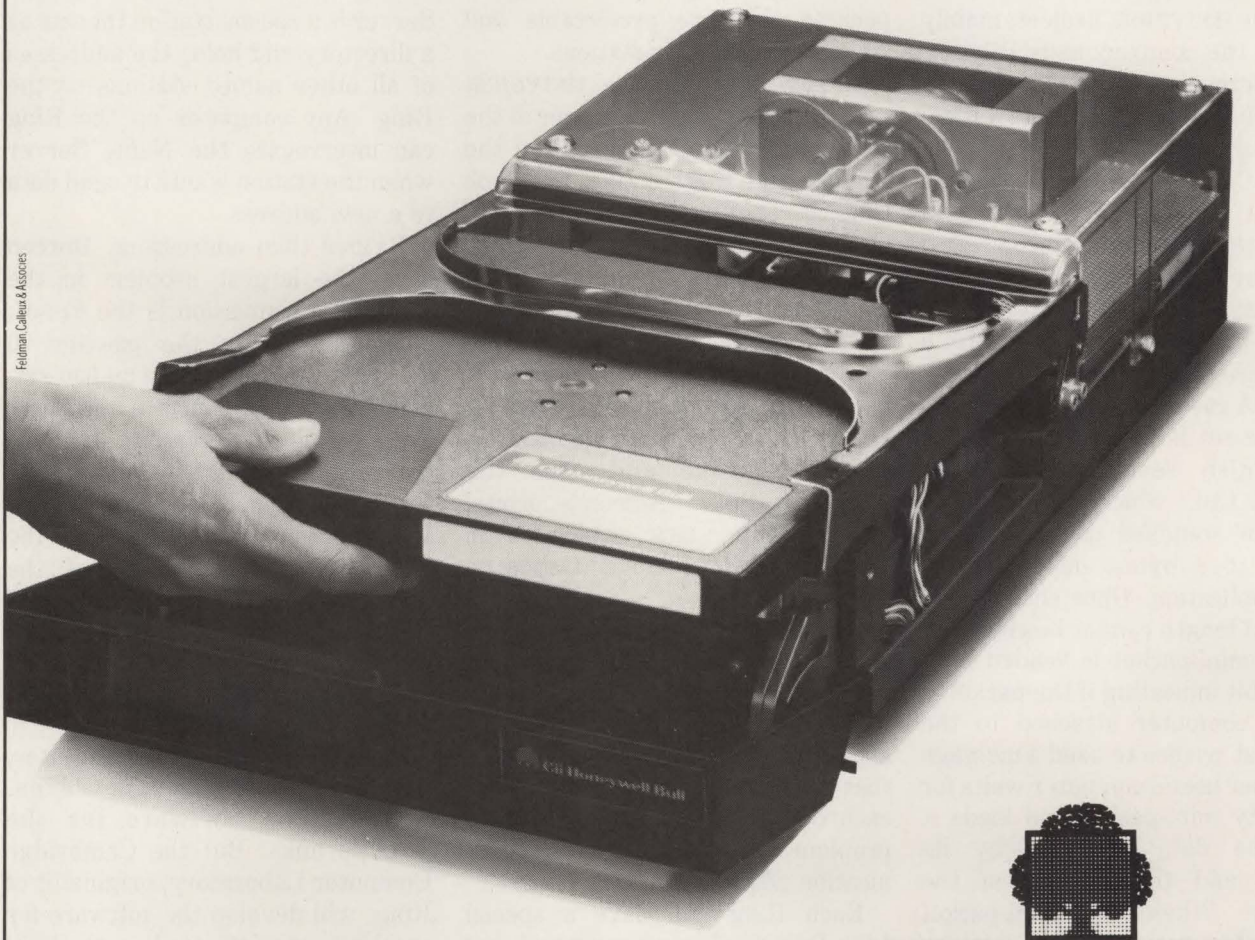

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CIRCLE NO. 40 ON INQUIRY CARD

employing the Cambridge Ring technology developed by the Computer Laboratory at Cambridge University. The participants include Cambridge University, Loughborough University of Technology, University College, London, the state-owned common carrier, British Telecom, and Marconi Research Laboratories, part of GEC-Marconi Electronics Ltd. GEC-Marconi is interested in potential factory-automation applications for the Cambridge Ring.

Logica, a London-based software and systems house, is also partaking in the UNIVERSE project, mainly because the company sells Polynet, a commercial version of the Cambridge Ring as part of its office-technology activites.

The Cambridge Ring differs radically from the Ethernet local area network, which has unconnected ends. The Ring operates at the same speed as Ethernet—10 bps, but it handles mini-packets of data with a pre-determined standard length—16 bits. A custom-designed two-chip interface set is being developed by the British semiconductor firm, Ferranti Ltd., which will provide a choice of standard packet lengths from 1 to 8 bytes, depending on their application. Once chosen, the standard length cannot be changed.

Each mini-packet is headed by a control bit indicating if the packet is full. A computer attached to the Ring that wishes to send a message to another user's computer waits for an empty mini-packet and loads it with the data preceded by its address and the address of the receiver. When the mini-packet reaches the receiver, the receiver adds acknowledged bits after removing the data. But the header bit is changed to "empty" only when the mini-packet returns to the sender. Contention for the network and scope for contention are unavailable.

The Ring must be at least 300m. long simply to accommodate the length of at least one packet, but no minimum length exists because each user station includes a repeater. This also allows the use of twisted-pair telephone wires rather than coaxial or fiber-optic cable, provided repeaters are no more than 500m. apart. In practice, the Ring is unlikely to be longer than 2 km., and the number of users should not exceed 50, although the theoretical maximum is 255. Ethernet places a restriction on the length of data packets, but advocates of the Cambridge Ring regard its mini-packets as more predictable and "digestible" by user stations.

A key figure in the UNIVERSE project is John Burren, leader of the network development group of the Science and Engineering Research Council. The SERC's laboratories at Chilton, Oxfordshire, will be another UNIVERSE site. SERC is involved in Stella, a satellite-based data-transfer project supported by the European Economic Community. It uses magnetic-tape data transfer among several research laboratories around Europe and uses the European Space Agency's orbital test satellite, OTS, which is in geostationary orbit over Gabon on the equator.

UNIVERSE will also use OTS. John Burren sees the Stella project as having provided useful experience for the satellite-communications aspect side of Universe. He feels that Rings will be able to talk to each other via satellite. The main problem will be making the communication efficient.

Each Ring will have a special Link Driving Computer acting as an interface between the Ring and the 3m.-diameter dish earth station at each site, and via the satellite with the other Rings in the network, Burren explains. The 16-bit mini is a 4000 series machine from GEC Computers. The LDC will host software that will collect and buffer mini-packets destined for other Rings in the network. Packets of mini-packets will be transmitted at 2M bps from each site during the time allocated to the site by the transponder on OTS. The packets could be destined for one or several of the other sites.

The addressing problems posed by allowing a computer on one Ring to talk to a computer on the other Rings are more complex than with a stand-alone Ring. Burren points out that this problem will be alleviated by the Name Server, a standard feature on the Cambridge Ring. The Server is a special station tht acts as a directory and holds the addresses of all other named stations on the Ring. Any computer on the Ring can interrogate the Name Server when the station wants to send data to a new address.

Rather than addressing, Burren says, the largest problem in the satellite transmission is the ¼-sec. delay caused by the passage of messages to the satellite 36,000 km. above the earth's surface and back. This delay will restrict the re-transmission of erroneous data and the use of handshaking procedures. If erronerous data were sent, the delay would near 1 sec. if the receiver had to notify the sender of the error and the data had to be re-transmitted. As a result, software strategies must be used to avoid retransmission.

Burren's team at the Atlas Center, part of the SERC complex at Chilton, will develop software for the satellite links. But the Cambridge Computer Laboratory, originator of Ring, will develop the software for another part of the project, the local linking of two Rings. This software will be demonstrated in action by a 2M-bit ground link between the two Rings in central London. They are the Rings at University College and at Logica, the latter being the one site without an earth station.

—Keith Jones

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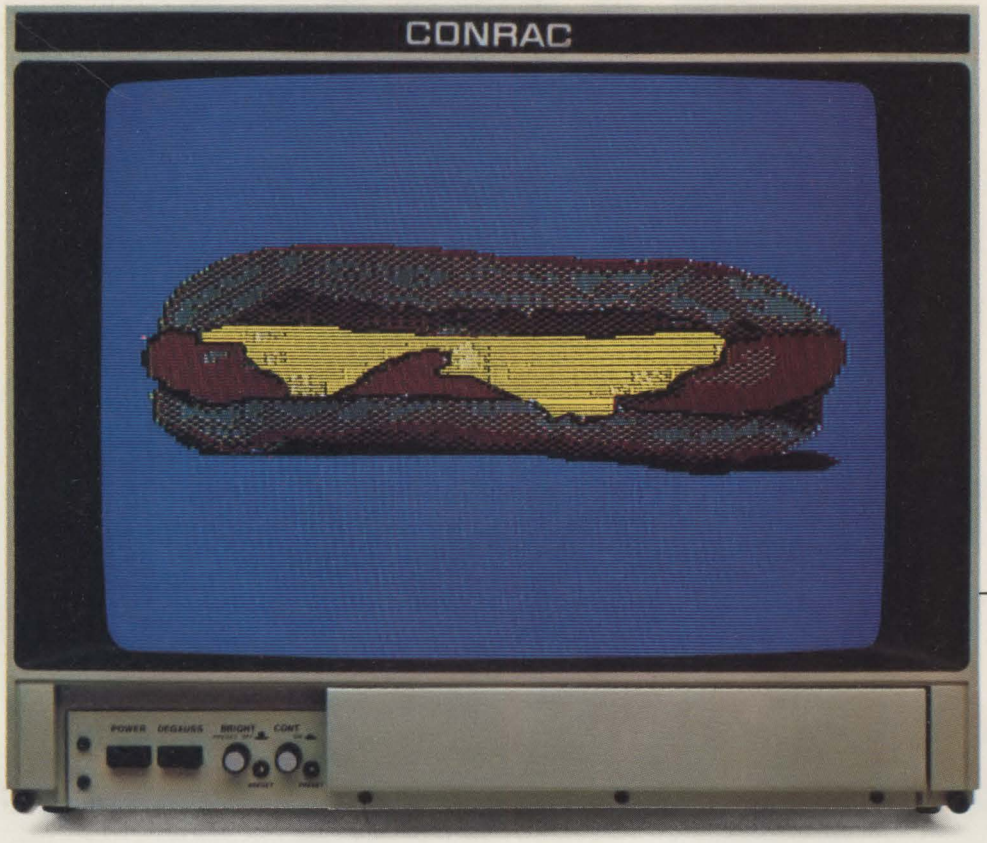

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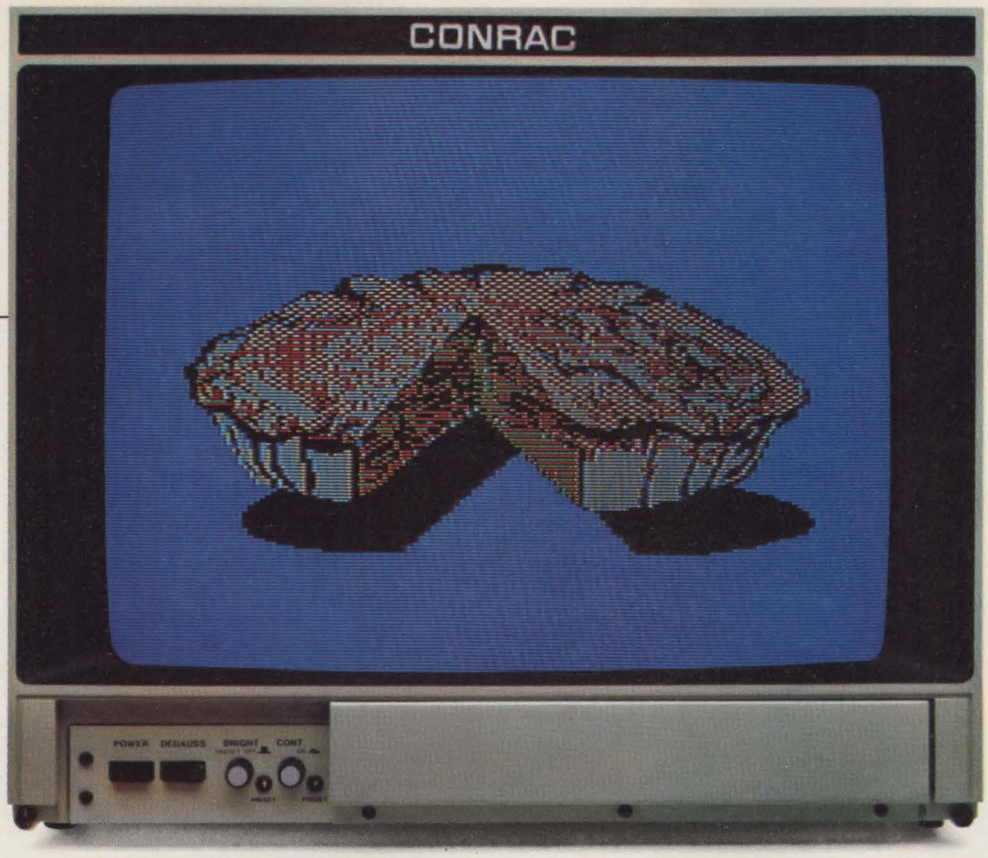

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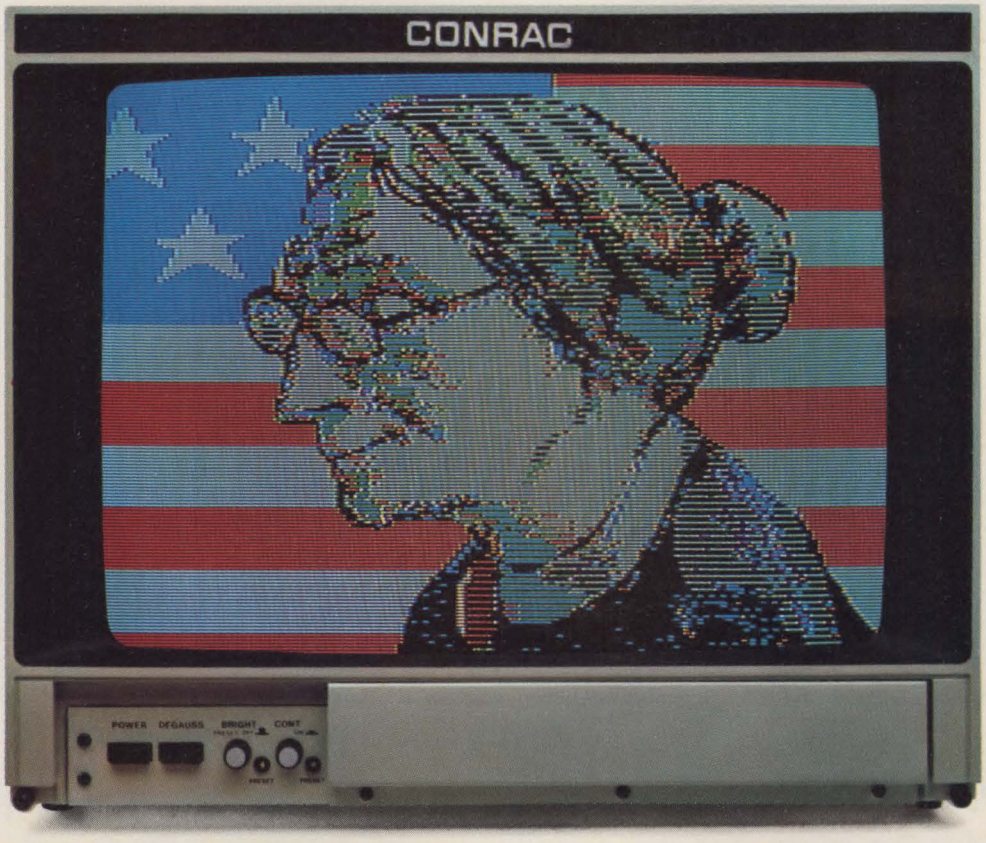

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French demonstrate experimental network

While local networking developments in the U.S. have been the subject of considerable publicity—particularly Xerox's Ethernet and the related Star office system—the French are pressing ahead with their own work in this area. The state-owned Agence de L'Informatique, which was set up to fund computer projects with clear commercial potential, is putting around $6 million into a Star-type project called Kayak, with facilities for processing, storing and transmitting data, text, messages, audio and images. It was demonstrated in prototype form at Bureautique, the first major European office-systems exhibition held in Paris, in May.

While Kayak could be regarded as the rough equivalent of Star, the French counterpart of Ethernet is called Danube. Designed to operate at one-tenth the speed of Ethernet —1 M bit per sec. instead of 10—Danube employs a coaxial cable as the transmission link and uses a similar reentry after collision technique for resolving contention between devices on the network. As many as 255 work stations can be accommodated by the maximum 1 km.-long (0.6-mile) network, but future plans include extending the distance to 10 or even 20 km.

Another major difference between Danube and Ethernet is that the French network protocol is compatible with the X.25 standard employed on the French national packet-switched network, Transpac. Recommended by the International Telecommunications Consultative Committee (CCITT), X.25 has also been chosen for the U.K. national packet-switched service PSS, the German network Datex-P, the European Commission-sponsored network Euronet and the Canadian network Datapac.

Kayak uses a hand-moved device much like the Star "mouse" for manipulating a pointer on the screen to select functions represented by graphic symbols or listed in menus. The mouse can also be used for generating graphics, either free-hand drawings or geometric figures. Graphics-processing software has been the main contribution so far of the Kayak development team, which numbers nearly 40.

Hardware components hung onto the Kayak bus include a graphics CRT terminal, the mouse interface card (which was designed by the Kayak development team), diskette and Winchester-disk storage and an Intel 8086 CPU programmed in 8086 Assembler and Pascal to handle the graphics functions. The Kayak team plans to replace the 8086 on future systems with a more powerful 16-bit CPU implemented in bit-slice technology. It will facilitate sophisticated functions, such as fully revealing panels (or "windows") of information half-hidden behind others on the same screen.

Also hung onto the Kayak bus are voice-recognition and voice-synthesis cards and an interface to Danube. *—Keith Jones*

Radofin adapter turns TV into CRT Terminals

An ordinary color TV receiver and a telephone—standard equipment in almost any hotel room—can be transformed in moments into an interactive color CRT terminal.

Radofin Electronics USA, Ltd., Avenel, N.J., is marketing a $200 portable adapter that enables a phone and NTSC standard TV to be linked up with a remote computer hosting viewdata software. The setup is functionally similar to the Prestel system operated in the U.K. as a public service by the state-owned carrier, British Telecom.

Converting a TV and phone to a viewdata terminal involves simply plugging the Radofin adapter into the TV antenna socket and the spare jack-plug socket in the phone.

The potential U.S. market for the Radofin product is among companies and organizations looking to establish private viewdata systems with the aim of providing data entry and data base-access facilities to personnel at any remote location. Traveling salesmen are one significant group of potential users.

The arrival of the Radofin adapter in the U.S. has delighted Chris Horrocks, president of Aregon Systems, Anaheim, Calif., a firm whose main product is International Viewdata Systems (IVS), a private software package that can be hosted by any one of three Digital Equipment Corp. systems. Those systems include a PDP-11/34 with two 67M-byte disk drives and 32 ports, an 11/70 with two 254M-byte drives and 200 ports or a VAX 11/780 with 550 ports and bulk-disk storage.

IVS can provide access to millions of viewdata pages of information and is being operated by Aregon on a bureau basis for 12 client

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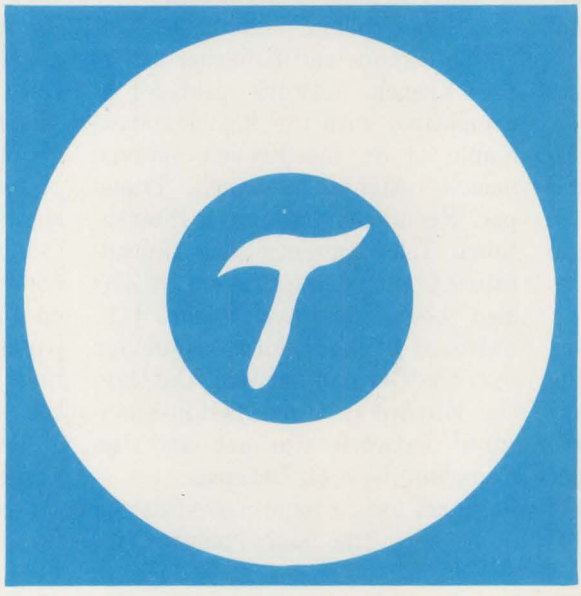

A BRAND NEW COMPANY WITH A 16 BIT INDUSTRIAL CONTROLLER FAMILY THAT'S HARD TO BELIEVE. INDUSTRIAL GRADE—100 HOUR, 55°C BURN-IN. TWO PIECE DIN 41612 CONNECTORS (MIL SPEC AVAILABLE) ONE YEAR WARRANTY. OFF THE SHELF DELIVERY. SOLID SERVICE SUPPORT.

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CIF422 16 bit optocoupled output 48 VDC at 1 A continuous
CIF423 16 bit optocoupled output 48 VDC at 2 A continuous
CIF461 16 bit AC input, optocoupled, 220 VAC rating
CIF500 16 bit optocoupled latched input
CIF491 16 bit relay output 125 VAC, 110 VDC 60 VA
CIF510 16 bit mercury-wetted relay multiplexer 100 VDC 50 VA
CIF481 8 bit optocoupled AC output 220 VAC 1 A
CIF490 8 relay output 250 VAC 50 VDC 4 A

SERIAL I/O

CIF540 Multidrop datalink, RS232, output current 120 mA both input and output are optocoupled, system-separate power supply for output, all transmission/reception parameters programmable
CIF545 4 port RS232 module, all transmission/reception parameters individually programmable, rate to 19200 baud, individual interrupts

ANALOG I/O

CIF520 10 bit A/D 16 single ended or 8 differential inputs, selectable input ranges, 40 microsecond conversion
CIF521 12 bit A/D 16 single ended or 8 differential inputs, selectable input ranges, 35 microsecond conversion
CIF522 12 bit A/D, same as CIF521 but with addition of gain programmable amplifier, gains from 1 to 1024, conversion time is function of gain
CIF530 10 bit D/A, 4 channels, each independent, either voltage or current out, voltage settling time 10 μs

SYSTEM ELEMENTS

CIF570 Watchdog monitor and timer, voltage monitoring, CPU status monitor, audible alarm, crystal clock timer, programmable clock rate
AUX760 Power fail detect monitor, selectable line dropout time response
AUX650 Programmer test console, requires no processor support, breakpoints, single step, memory contents, etc.
CIF600 I/O expansion module, allows expansion to second 19" CIF motherboard for extended I/O capability
AUX653 EPROM programmer module, 2 ZIF sockets allow programming 1 word at a time, looks like a 2K or 4K word block of memory to the system. Programs both 16K and 32K EPROMS, TMS2516, TMS2532 or equivalent
AUX659 Half width chassis 8 slots
AUX660 Full width chassis 16 slots
AUX663 Extender board, CIF board extender
AUX701 Wire wrap module for prototyping
BUS350 CIR motherboard, provides connectors for CIF bus type boards
BUS351 Memory motherboard provides connectors for 16 memory bus type boards
BUS352 Memory/CIF motherboard provides 6 memory type connectors and 10 CIF type connectors
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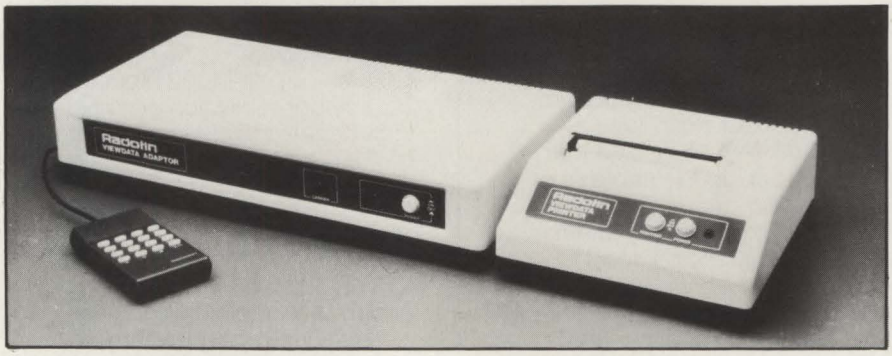
companies in California. Until now, however, users have had to be equipped with special internally adapted TVs built by Zenith and Sony, a limitation that has discouraged companies from setting up their own in-house IVS systems. An Aregon license to run IVS in-house sells for $75,000, and Chris Horrocks estimates that the total cost of setting up a system, including the DEC hardware, should work out to about $200,000.

Written in FORTRAN, IVS enables a user to access the data base on the host via a simple calculator-type keypad and makes use of its tree structure to progress through a series of index pages to the page of required information. With an alphanumeric keyboard, the user can send messages to other users by way of a "mailbox" facility. On the data-entry side, IVS enables the user to create his own viewdata pages using facilities for editing, deleting, amending, overwriting and copying. Text-handling features include character and column insert and delete.

Aregon, whose parent is the U.K.'s state-owned National Enterprise Board, also offers a package called Preview, which enables an IBM user to take an ordinary serial file and automatically generate viewdata formatted and indexed pages for his IVS host.

The Radofin adapter may improve the prospects of British Videotex (BVT) and Teletext, the Washington, D.C.-based marketing operation set up early this year jointly by British Telecom, the government's Department of Industry, and Logica Ltd., one of the U.K.'s leading software and systems houses. BVT is offering British Telecom's Prestel software to common carriers interested in establishing public viewdata services. As a host, the Prestel software needs a 4000 Series minicomputer built in the U.K. by GEC Computers, part of the General Electric Company Ltd. (no relation to the U.S. General Electric).



The Radofin Viewdata adapter *transforms a standard TV and telephone into an interactive color CRT terminal. The setup provides data entry and data-base access to persons away from their home offices.*

Radofin is also U.K.-owned and already sells adapters for European 625-line TVs to Prestel users in the U.K. It has set up a company in Hong Kong—Radofin Electronics, Far East—to build the U.S. standard adapter, and has recently opened an office at Menlo Park, Calif., to cover the West Coast market.

The adapter consists of a full ASCII keyboard and a "black box" containing logic and memory for generating viewdata characters, refreshing the viewdata page on the screen and handling the viewdata protocol. So far, samples have been supplied to about 30 potential end users. Optional hardware includes a 40-column printer priced at less than $100. The printer can generate hard copy of a viewdata page at a speed of 2 lps. *—Keith Jones*

Teleprocessing monitor offered for DEC computers

A native-mode commercial teleprocessing monitor for Digital Equipment Corp. VAX computers running under the VMS operating system is being actively marketed in the U.S. Called Systel, it was developed in the U.K. by Systime, Ltd., one of the biggest DEC-oriented systems integrators in the world.

In its fiscal year ending September, 1980, Systime had revenues of nearly $60 million, and 70 of its 300-member programming team are devoted to systems development, including enhancements to Systel.

There is a native-mode version of Systel for DEC PDP-11 machines running under RSX-11, as well as for VAX computers. The biggest attraction of the system for many users, says the company, is that they can start with Systel on a configuration as small as a PDP-11/12 with 10 terminals and move up to a VAX machine with as many as 150 terminals without having to change applications software.

Another major feature of Systel is its multi-threading facility that enables one copy of each application program to be accessed by multiple users. Apart from greatly reducing memory requirements, it allows concurrent accessing of files in the system data base.

While recognizing that several teleprocessing monitors, such as

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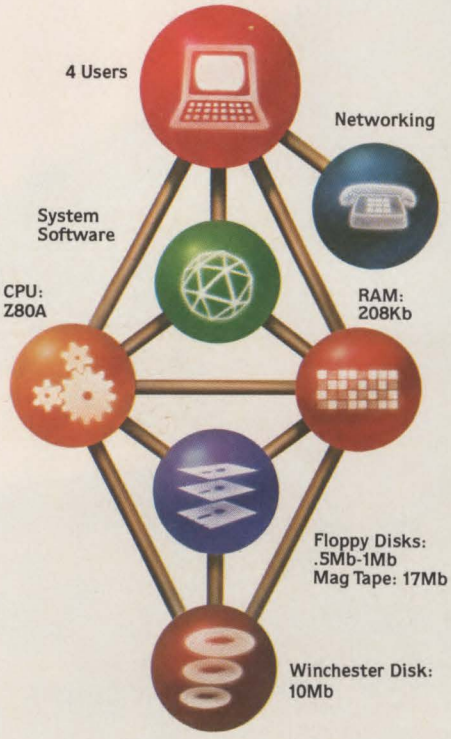

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Taps from Informatics, are already available in the U.S. for PDP-11 machines, Systime claims that Systel is the only mode teleprocessing system for VAX computers.

To take advantage of this temporary gap in the market, Systime has appointed a Systel U.S. sales manager, John N. Ward, a Briton with extensive experience in the U.S. computer market. Ward will be based in Columbia, at offices originally established by Systime for purchasing components for its U.K. manufacturing activities. Ward will appoint sales representatives in most major U.S. cities under a $5 million, five-year marketing plan for Systel. It will be funded jointly by Systime itself and by Insac, the U.K. government-controlled organization set up to promote the marketing of U.K. software overseas, particularly in the U.S. Insac funded 50 percent of the Systel development and takes a royalty on each sale.

In the U.S., Systel will be sold mainly to systems integrators and major users, and prices will start at $40,000 for one copy. Prices will drop on a sliding scale to less than $20,000 for 12 copies taken over a year. Systime has sold about 20 copies in the U.K. since marketing started there in June, 1980, but the company anticipates that the U.S. market will be far more fruitful, mainly because there are many more commercial VAX users. In the U.K., the biggest success of VAX so far has been in the technical systems market for computational applications.

Systime's plans for the U.S. market are ambitious. On a longer term basis, Systel is seen simply as the means by which the company can establish a U.S. presence. Its aim is to ship hardware to many of the U.S. organizations with which it establishes a working relationship through Systel. Systime is unusual among systems integrators in that it manufactures the hardware it sells. With PDP-11-based machines, Systime buys only the processor boards from DEC and adds the remainder of the value itself. Systime sells a family of packaged commercial systems, based on DEC processors but carrying Systime's own model names. They range from the Series 700, based on the PDP-11/04, to a VAX-based system, called the Series 7000. Most of the company's extensive catalog of applications software for PDP-11-based systems is written to run under RSTS. *—Keith Jones*

Aregon enters U.S. tele-information market

A dial-up link that operates at rates as slow as 600 bps is all that is needed to exploit the "electronic-blackboard" features of Cyclops, a multiterminal, two-way picture-and-sound system developed in the U.K. Originally for remote tutoring, Cyclops is now being sold on a worldwide basis for business and educational use by Aregon International Ltd. The U.K. government established Aregon to market viewdata and other easy-to-use British tele-information systems.

Europe is said to be ahead of the U.S. in tele-information, and Aregon, with marketing offices in New York and Anaheim, Calif., is poised to exploit the sales potential of Cyclops in the U.S.

Cyclops resembles a viewdata system in that it allows a standard TV monitor to display pages of information containing both alpha-numerics and graphics. It combines the alpha-mosaic page-display technique used by the French and British public viewdata services, Teletel and Prestel, with the alpha-geometric method used by the Canadian government's Telidon viewdata system. Cyclops technology resembles the viewdata standard issued last May by U.S. telecommunications giant, AT & T.

But Cyclops adds to viewdata the ability to draw characters and graphics on a TV screen with a light pen and to transmit that information to six or seven other terminals linked together via a "conference bridge."

All the screens on a Cyclops network display the same information at any given moment. All the participants, therefore, are confronted with the same blackboard. Because no single terminal controls the network, one user must act as a controller or tutor to avoid the possibility of several different users simultaneously drawing on the blackboard.

Two dial-up telephone links, therefore, must be established for each terminal—one for carrying picture information and the other for voice. Effective voice interaction is achieved with a loud-speaking telephone.

The Cyclops control box handles picture communications. This system component provides Cyclops with its unique combination of features. Aregon plans to ship the box directly to end users or to sell manufacturing licences. The first license has been sold to H. LeRoux, a large, Johannesburg, South Africa, consulting company specializing in educational communications.

Configured around a Motorola

6800 μp, the Cyclops box hosts ROM-based software that handles such functions as tracking the position of the light-sensitive pen as a user moves it across the screen, and compressing the digitized picture for transmission.

Prices range from around $2000 for single units to $400 for volume orders. Future enhancements could include the ability to work with a color TV monitor. But at least one major technical problem must be overcome—the light pen's insensitivity to color changes except for those from black to white. Aregon claims that getting the light pen to work with a standard black-and-white TV monitor is a considerable achievement in itself.

Cyclops was developed by the U.K.'s Open University, a government-funded organization that provides degree-level courses. Four years ago, the University began experimenting with a system that combined the low-speed transmission of viewdata-type pictures stored on cassette and information drawn with a light pen. The University's East Midlands region is now using a Cyclops network with terminals located at 15 study centers to transmit 20 courses to 200 students.

British Telecom, the U.K.'s state-owned common carrier, is considering using Cyclops in teleconferencing trials. Scheduled to begin in 1983, that plan will involve about 50 selected business customers.

—Keith Jones

British firm starts selling 5¼-in. Winchesters in U.S.

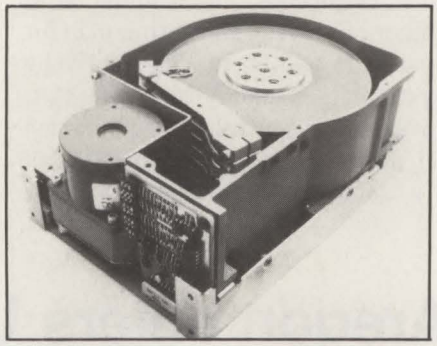
Vector Sales, Inc., Boston, is the first U.S. distributor for a British manufacturer of 5¼-in. Winchester-disk drives. Rodime, Ltd., based in Glenrothes, Scotland, is supplying evaluation quantities of its RO 100 series, which have capacity and access times that compare favorably—at least on paper—with those of its more established competitors.

Using conventional head and disk technology, the industry-compatible RO 100 offers a minimum unformatted capacity of 16M bytes, an average seek time, including settling, of 85 msec. and an average latency of 8.3 msec.

Rodime marketing director Malcolm Dudson says the 16M-byte capacity was achieved by using four disks rather than very high-density recording. Track and linear densities are 260 and 8060 bpi, respectively. Features include a rotary stepper motor to drive a rotary head positioner. Dudson says the access times are achieved by on-board programmed control of the motor. The motor and positioner are linked by a band mechanism enclosed in a sealed, filtered compartment, which is maintained at the same temperature as the head/disk enclosure.

The RO 100 series comprises four models, with unformatted capacities of 4M, 8M, 12M and 16M bytes, and their performance is the result of what the company calls reliable engineering design. In support of this claim, the company cites the credentials of its five founders, including managing director Leonard Brownlow. Before establishing Rodime last year, Brownlow, an American, was general manager of a Burroughs Corp. plant in Glenrothes that designs and builds 14-in. Winchesters and 8-in. floppy-disk drives. Before that, Brownlow was manager of advanced technology at Burroughs's magnetic-peripherals plant in Westlake, Calif.

Dudson, the only founder not from Burroughs, was formerly marketing director of Data Recording Heads, Ltd. Dudson says that Rodime deliberately avoided incorporating thin-film head technology in the RO 100 series, because the company sees no need for it now. He won't reveal much about Rodime's plans for U.S. marketing, saying only that Vector Sales is the first distributor to cover the East Coast.

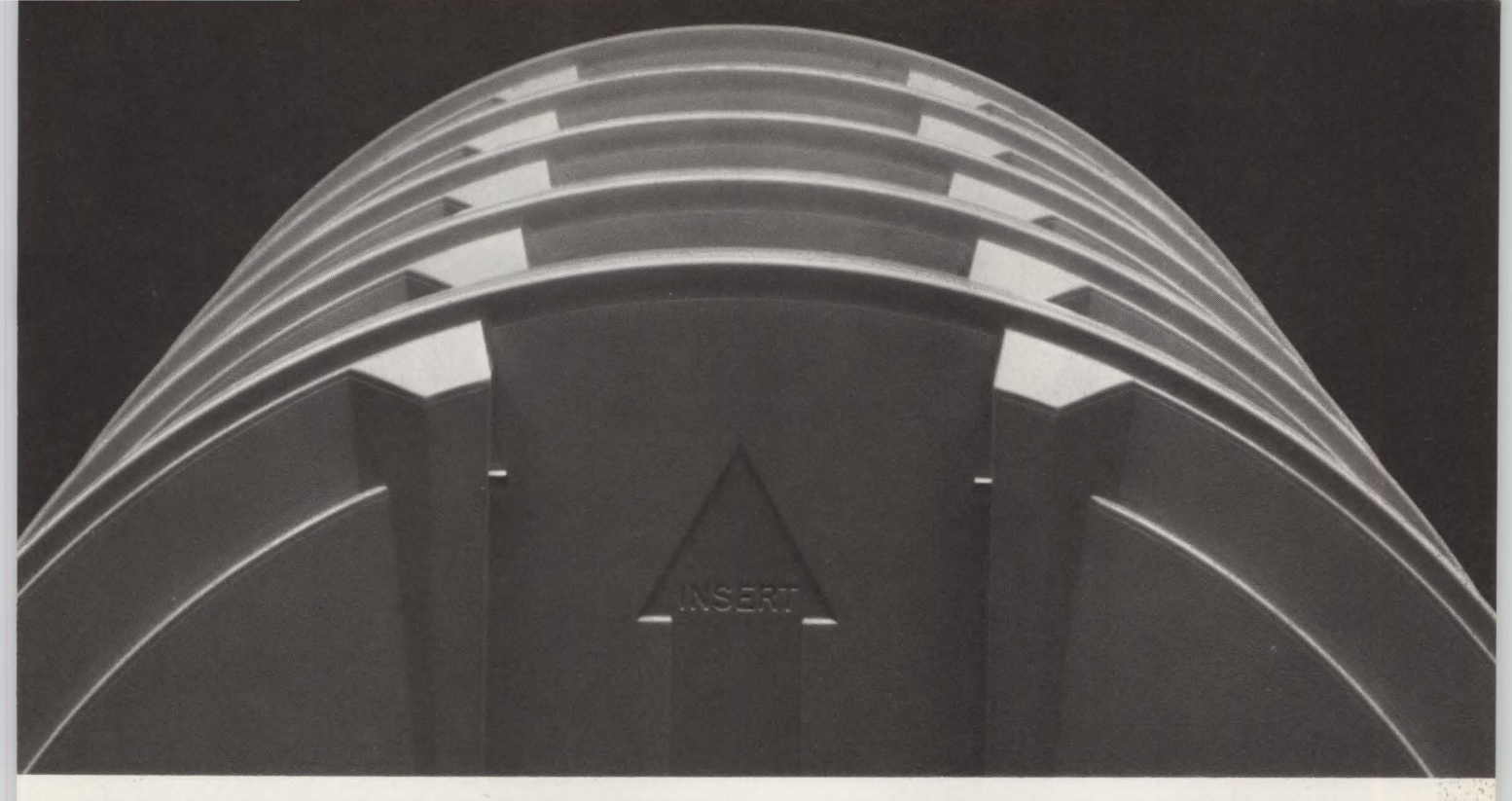


Rodime Ltd's Ro 100 series 5¼-in. Winchester *offers a maximum unformatted capacity of 16M bytes, an average seek time, including settling, of 85 msec. and average latency of 8.3 msec.*

Vector also supplies burn-in systems and services and printer interfaces.

Dudson estimates that 1000 RO 100s will be shipped from Rodime's 26,000-sq.-ft. Glenrothes plant during the second half of this year. He predicts 1982 shipments to be more than 25,000. Rodime's workforce, only 20 now, will climb to 50 by year-end and will reach 150 by the end of next year, Dudson says.

The five founders own a controlling share in Rodime. Other sources of funding include the British risk-capital organization, Technical Development Capital, which has invested $2 million. Grants have also come from the Scottish Development Agency, the body established by the British government to encourage development "north of the border". *—Keith Jones*



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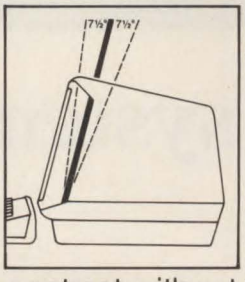
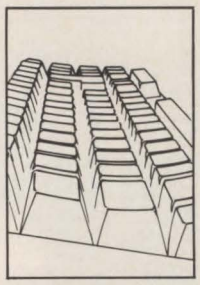
In Europe, where ergonomics is one of the most important factors in a terminal buy, this is the terminal they're buying.

As video display terminals become an accepted part of everyday business life, the issues of operator comfort and fatigue are receiving a great deal of attention. This is particularly true in Europe, where labor and management groups are working on standards to ensure that terminals are built to be responsive to operator needs. It's no wonder, then, that in many areas of Europe the Hazeltine Executive 80™ has become synonymous with the term "ergonomics."

Reduced Eye Strain. Executive 80's ergonomics excellence begins with the terminal enclosure itself, which is constructed entirely of non-glare materials that eliminate visual distraction. The large 15-inch screen enables the operator to view information accurately from a more comfortable distance than standard 12-inch screens permit. The wider screen also provides larger, and hence clearer, characters and symbols. It tilts through a 15-degree arc to eliminate reflections from ambient lighting. The P146 phosphor was selected for maximum contrast without "bloom" or flicker, and the screen's glass face is specially etched to provide a flat, glare-free surface.



Comfortable Keyboard. The keys are carefully contoured and sculptured to a comfortable angle to avoid awkward reaching or straining. The detached keyboard feature allows optimal positioning of the entire keyboard unit. And the keys themselves respond with a positive feel, tactile feedback and selectable audio click for a reassuring confirmation of data entry.



Advanced Engineering. Because of the system's powerful 8088 microprocessor, the operator can change the operating mode to suit the task being performed. As many as sixteen programmable function keys facilitate recurring operating responses by containing user defined application messages.

An Enhanced Video option goes even further to make life easier for the operator. Included are smooth scrolling, double-sized characters and 132-column format which matches line printer formats.

Answers for the Eighties. Executive 80, then, addresses all aspects of human engineering while providing the highest level of quality assurance and technical performance. The result is a terminal that satisfies operators, improves productivity and provides the highly reliable performance traditionally associated with Hazeltine quality.

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Hazeltine Executive 80

Answers for the Eighties

CIRCLE NO. 50 ON INQUIRY CARD

Introducing a two terminal system. Under twenty.

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The Model 3 features COBOL software, upward compatibility with the DS990 line, and expandability to 4 terminals so it can grow with your customers. Add to that IBM 3780 communications capability and TI's comprehensive service support, and you've got a best-seller. The DS990 Model 3. It's the right size, at the right price. For more information, contact Texas Instruments Incorporated, Box 202146, Dallas, TX 75220. Phone 800-527-3500 (Texas collect 214-995-6616). Refer to code A47-205

The New DS990 Model 3. For the medium-size businessman.

TEXAS INSTRUMENTS
INCORPORATED

DEC reorganizes, forms Technical Volume Group

At the close of a fiscal year that saw Digital Equipment Corp. report $3.2 billion in revenues, the company spawned a major marketing organization dedicated to volume sales to technical third-party purchasers and representing an estimated $400 million in revenues (MMS, August, p. 5).

While the reorganization will have no immediate effect on DEC's customers, the new group's efforts will become visible as the company develops a coherent third-party marketing policy for products from LSI-11 μcs to 32-bit VAX superminis.

The organization "takes two product groups that have very similiar market characteristics but sell at different ends of the price and performance band and groups them into one consistent market structure," explains Ward MacKenzie, the DEC vice president named to head the Technical Volume Group.

DEC created the new group by plucking the Technical OEM organization from the Technical Products Group and pulling the Micro Products organization from the Computer Products Group, placing both under MacKenzie's supervision. The company now has four large product-related organizations: Commercial Products, Technical Products, Computer Products and Technical Volume.

Although DEC officials tend to guard individual group revenue figures as closely as they do DEC president Kenneth Olsen's home phone number, MacKenzie describes as "pretty conservative" one estimate that the new Technical Volume Group represents $320 million in revenues based on fiscal 1980. "There are four hardware product groups in the company, and they tend to have about the same volumes," MacKenzie says.

Ward MacKenzie, *the DEC vice president named to head the new Technical Volume Group: The organization "takes two product groups that have very similar market characteristics but sell at different ends of the price and performance band and groups them into one consistent market structure."*

Using fiscal 1980 revenues, each of the four product groups would represent more than $400 million in revenues.

Discussing why the reorganization took place at the end of June, MacKenzie says, "We like to reorganize our operations around fiscal-year boundaries. We have been contemplating this move for quite a while."

Technical OEM is one of the largest sub-groups that form the four overall product groups and represents the traditional avenues of "moving iron" to third parties rather than selling end-user-oriented systems. The Micro Products group was a misfit in an organization primarily centered around exploring different distribution channels.

Under the Technical Volume Group, the two sub-groups remain unchanged in their basic makeup but gain the potential to offer a common ground for an outside purchaser to find a focused product line from the LSI-11 μp products through the VAX 32-bit CPUs. Associated peripherals are included in the group's efforts.

"Those businesses (Technical OEM and Micro Products) are becoming much more consistent and represent sales to the same kind of market—technically sophisticated customers who buy tools, products and pieces from us and create complete systems. The Micro Products group is selling to the same kinds of customers with the same kinds of buying patterns as we have in the Technical OEM group," MacKenzie says. Before being named head of the Technical Volume Group, MacKenzie was head of Technical OEM.

The Micro Products group was formed when the components group was split into μps and terminals several years ago. MacKenzie doesn't foresee the terminals group coming into the Technical-Volume fold. "The terminals group sells

terminals as commodities, and the intent will probably be to keep the terminals within the Computer Products group. That group handles different forms of distribution for more commodity-type products," MacKenzie says.

Large-volume buyers of DEC equipment "won't see anything different right away" in their dealings with DEC, MacKenzie says, "because we've changed the reporting structure of those two strategic businesses at the corporate level. We have one very substantial market opportunity, and my challenge is to figure out how to get the strongest market position in this business."

Regarding DEC's product lines at both ends of the company's technical-CPU spectrum, MacKenzie says, "We're selling very effectively in the Technical-OEM group with the VAX 11/780 and 11/750, the company's high-end 32-bit minicomputers. The μc group has been growing very fast and has been growing its market share over the last year substantially."

The addition of a fourth product group was only one of several changes that DEC made at fiscal year-end in June. The company's 4500-person central engineering team was also reorganized, with its focus shifted from individual components to systems and technologies. More efforts are being made to couple the engineering and manufacturing efforts of the company, and the organization is expanding geographically.

The refocusing of the engineering operations caused several internal changes, including dividing the engineering-management committee into three groups and creating a separate distributed-systems-engineering organization.

In addition, Seaforth M. Lyle was named acting head of the Computer Products Group, while Stanley C. Olsen, Kenneth Olsen's brother, is on a one-year leave of absence. A new position was created within the Computer Products Group for a manager of distribution channels. Angelo Guadagno, formerly DEC's Boston sales manager, was named to that position. *—Eric Lundquist*

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
AM International	9 mos.	4/30/81	645,362,000	(98,729,000)	(11.20)
	9 mos.	4/30/80	659,137,000	791,000	.09
Advanced Micro Devices	3 mos.	6/28/81	70,934,000	1,595,000	.10
	3 mos.	6/29/80	70,564,000	6,848,000	.44
Apple Computer	9 mos.	6/26/81	237,105,000	28,454,000	.51
	9 mos.	6/27/80	75,659,000	8,170,000	.17
Dicomed	6 mos.	6/30/81	3,436,799	203,695	.15
	6 mos.	6/30/80	2,066,162	170,858	.22
EG & G	26 wks.	6/28/81	337,596,000	14,265,000	1.01
	26 wks.	6/29/80	292,753,000	11,692,000	.85
Genisco Technology	9 mos.	6/30/81	15,911,947	696,878	.36
	9 mos.	6/30/80	12,225,986	901,226	.47
Gerber Scientific	Year	4/30/81	99,564,000	8,881,000	1.41
	Year	4/30/80	76,487,000	5,854,000	.94
Gerber Scientific Technology	Year	4/30/81	17,177,000	(1,769,000)	(.76)
	Year	4/30/80	13,517,000	(294,000)	(.13)
Hazeltine	6 mos.	6/30/81	70,905,000	1,762,000	.86
	6 mos.	6/30/80	64,797,000	2,477,000	1.21
Informatics	Year	6/30/81	131,544,000	4,774,000	2.08
	Year	6/30/80	119,973,000	4,821,000	2.18
Intel	6 mos.	6/30/81	385,820,000	11,830,000	.27
	6 mos.	6/30/80	418,851,000	48,966,000	1.13
Logicon	3 mos.	6/30/81	14,368,000	404,000	.40
	3 mos.	6/30/80	13,451,000	517,000	.54
MSI Data	3 mos.	6/27/81	14,194,926	1,110,399	.45
	3 mos.	6/28/80	12,062,960	815,907	.36
Printronix	3 mos.	6/26/81	14,375,000	1,202,000	.31
	3 mos.	6/27/80	12,066,000	1,044,000	.30
Rapidata	6 mos.	6/30/81	11,119,290	587,065	.37
	6 mos.	6/30/80	10,750,886	710,621	.44
Rogers	6 mos.	6/28/81	52,973,000	1,331,000	.47
	6 mos.	6/29/80	48,020,000	1,378,000	.48
Standard Register	26 wks.	6/28/81	152,640,000	6,369,000	2.92
	26 wks.	6/29/80	142,776,000	6,504,000	3.00
Texas Instruments	6 mos.	6/30/81	2,118,600,000	44,700,000	1.91
	6 mos.	6/30/80	1,963,700,000	105,500,000	4.60

NEXT MONTH IN MMS

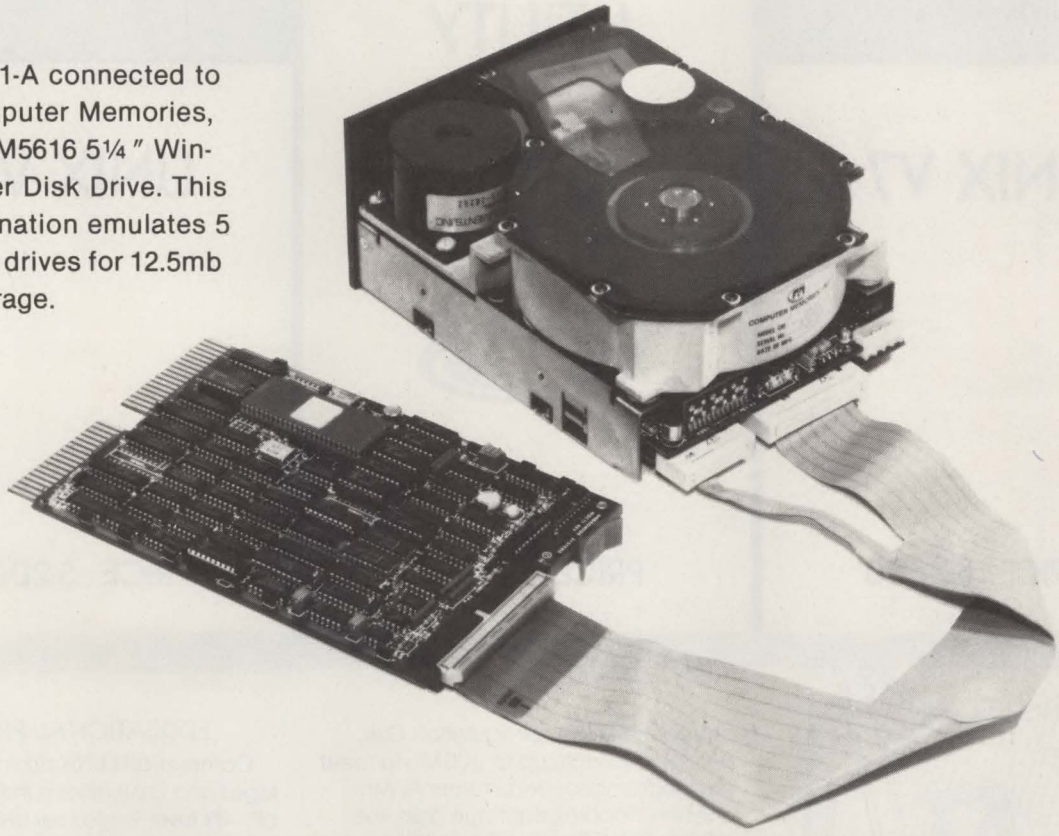
Software—data-base management and operating systems—will be the focus of the feature article section in Mini-Micro Systems next month. Key articles planned include:

- DBMS survey—a compilation of data-base systems, packages and aids for use with μcs and minicomputers. The article will be written by Harvey M. Weiss, a frequent contributor to Mini-Micro Systems.
- A tutorial on the differences between relational and network approaches to data base design. This article will be written by Cullinane Corp.'s Dr. Charles Bachman, winner of the Turing Prize for his DBMS work at General Electric.

AT LAST . . .

A DUAL WIDTH, SINGLE CARD, WINCHESTER CONTROLLER FOR Q-BUS SYSTEMS — THE WDC11

WDC11-A connected to a Computer Memories, Inc. CM5616 5¼″ Winchester Disk Drive. This combination emulates 5 RK-O5 drives for 12.5mb of storage.



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CIRCLE NO. 52 ON INQUIRY CARD

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UNIX V7

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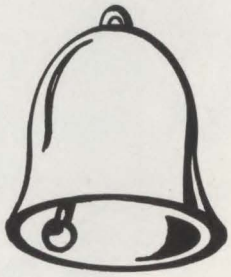
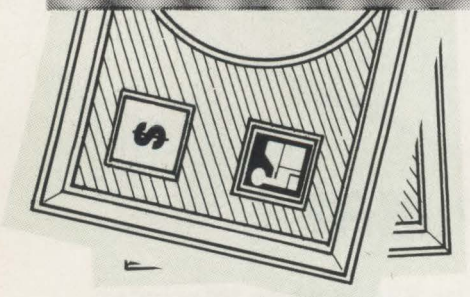


PRICE $28000

UNIX V7

PRICE $2000



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CIRCLE NO. 53 ON INQUIRY CARD

Network standards: welcoming the NUA

During the 1970s, the business world had come to grips with the concepts of data and word processing. Understanding the new technologies, their terminologies and their applications was difficult, but necessary, if one planned to stay competitive in a computerized world. Unfortunately, the educational process was mostly one-way, with vendors teaching the wonders of their products, while learning little from users about the tasks that most required automation. Partly because little two-way information exchange occurred, a situation developed in which sophisticated hardware abounded, but application software that would make the equipment useful was practically nonexistent.

Now, users are faced with another developing technology that will affect their businesses to as great a degree as the information-processing trend. But this time around, there is some indication the users won't sit by passively as this technology—data communications—takes shape. On page 20 of this issue, we report on the Network Users Association (NUA), a recently formed group that will take an active role in the development of communications standards, while also putting pressure on vendors to comply with these standards.

We commend NUA's early efforts. Users and vendors alike should welcome the organization. For users, the NUA can help educate its members about the issues and implications of data (and voice, video, facsimile, etc.) communications. Once these issues are understood, the group can provide a collective voice for expressing users' needs and concerns.

The NUA faces some obstacles before it becomes a strong force in the communications arena. For instance, the group's technical experts must sort through all the existing work evolving in the various standards bodies, and translate this technical information into functional implications that the NUA's general membership can understand. But perhaps the most pressing need for NUA is to expand its membership to ensure that all segments of industry—not just those already confronting networking dilemmas—are represented. The broader the NUA's membership base, the more weight its resolutions will carry. Users who fail to take the opportunity to participate in the NUA may find their needs go unrecognized for too long. Vendors who choose to ignore the information the NUA will provide, may discover they have products, but no market interested in buying them.

Dwight B. Davis

Dwight B. Davis
Associate Editor

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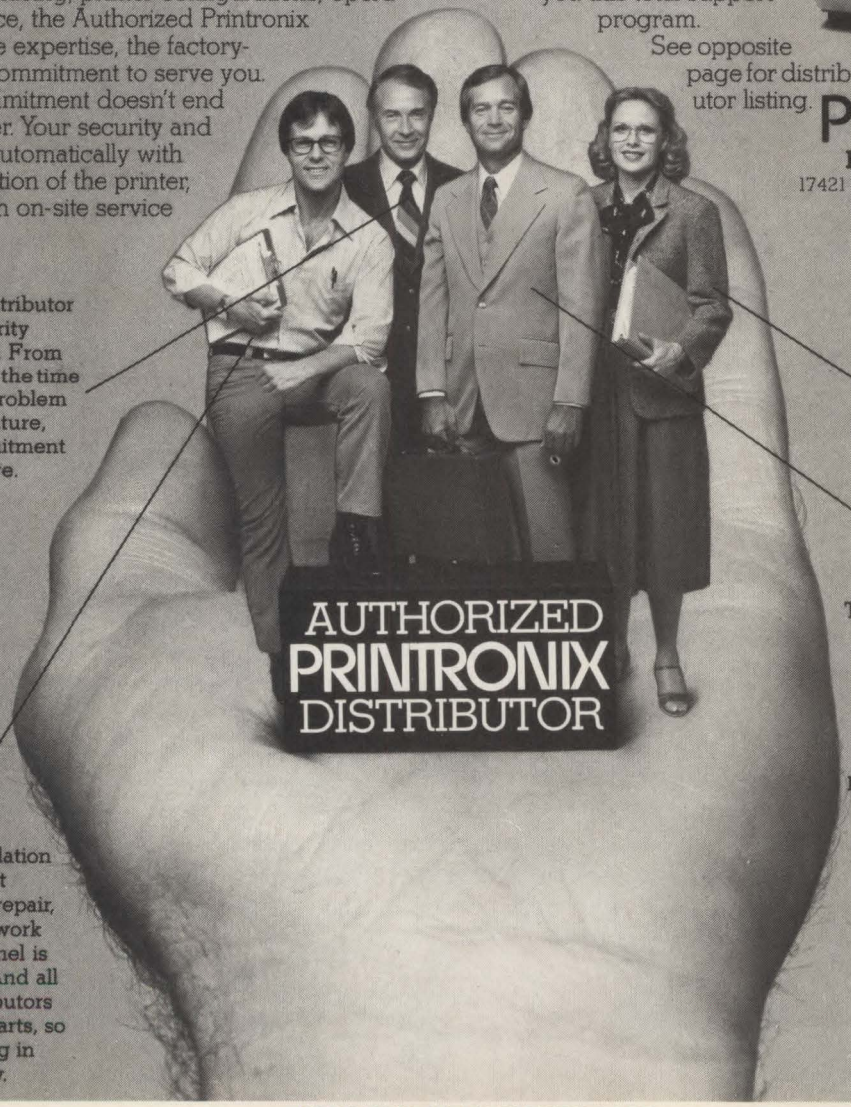

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CIRCLE NO. 54 ON INQUIRY CARD

Letters

DATA FROM MICRODATA

To the editor:

I enjoyed your recent article "Choosing a small, multi-user business computer" (MMS, June, p. 87). It was interesting and well-written. It contained, however, a few discrepancies in Microdata Corp.'s product line:

- Express III has not been a product for some time.
- Microdata does not offer a 16-bit system.
- Main memory ranges from 32K to 512K bytes.
- Number of users is eight to 48 CRTs.
- Disk storage capacity is 10M to 514M bytes.
- COBOL, FORTRAN, RPG and PL/1 are not offered.

Richard Yamaguchi
Manager, Marketing Communications
Microdata Corp.
Irvine, Calif.

NOTES ON CP/NET

To the editor:

Digital Research's CP/NET operating system has been unfairly portrayed in the comparison table of "Novell's Nexus addresses workstation market" (MMS, June, p. 99). CP/NET is a networking system that relies on the underlying physical network system and, therefore, operates at an entirely different level than depicted.

Because CP/NET can connect any system running CP/M as a slave, the cost per work station can be less than $1500, and there are machines that can run as system masters, such as MP/M for less than $5000. This means that an entire networking system, with 16 work stations, could sell for less than $30,000.

The current version of CP/NET supports as many as 16 slaves (CP/M) per master (MP/M), and as many as 256 slaves can be placed on a bus with 16 masters, as long as no more than 16 slaves are logged-on to any single master. Later network releases will allow multilayered networking and multitasking capabilities at the slave level. A 16-bit version of the network will be released in the fourth quarter of 1981, although the current 8-bit network will allow a 16-bit CP/M-86 slave.

Further, CP/NET is a networking concept that is relatively hardware-independent, that is, it will run any scheme an end user cares to devise and is definitely not manufacturer-dependent. To the best of our knowledge, any CP/M machine can serve as a network node. This means that a user's equipment is not obsolete and will not become obsolete.

Curt Geske
Marketing Representative
Digital Research
Pacific Grove, Calif.

SEL TALKS BACK

To the editor:

Mini-Micro Systems has always been a highly respected magazine in our industry, and I am sure that you intend to keep it that way. However, in your recent issue I found inaccurate reporting.

The item of concern is your article on Prime 850 (MMS, June, p. 15). In that article,Frank Madren is quoted as saying "Prime 850 is the first supermini to implement a multistream architecture." This is simply not true. Systems introduced its 32/7780 (with multistreaming capabilities) in April, 1980.

Joseph L. Barcheski
Manager, Corporate Communications
Systems Engineering Laboratories, Inc.
Fort Lauderdale, Fla.

LOOKING AHEAD IN MMS

November's issue will focus on both add-on and add-in memory systems, and also explore the system implications of semiconductor RAM technology.

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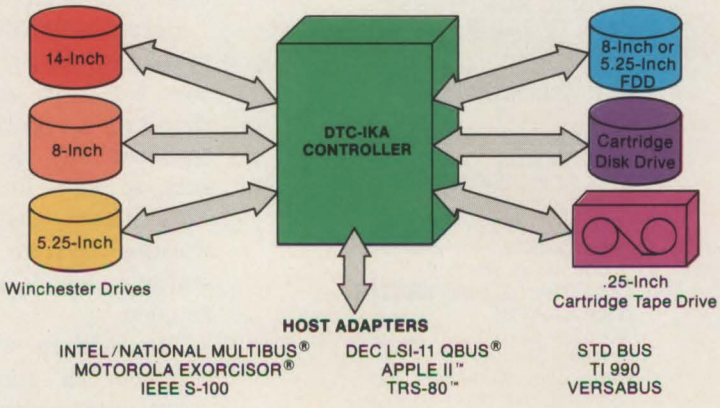
OVERVIEW



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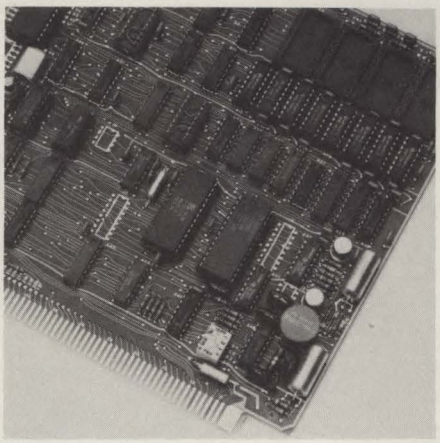
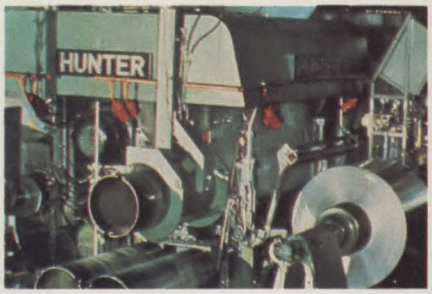
CIRCLE NO. 55 ON INQUIRY CARD

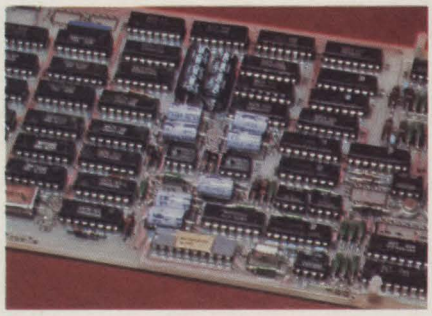
FEATURE HIGHLIGHTS



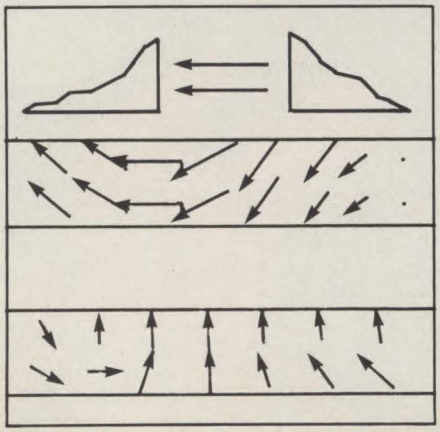
121 Change is constant in the computer business, and while the fundamental composition of single-board computers hasn't substantially altered in the past three years, SBCs now offer far more choices and power. For openers, the boards now hold more memory, microprocessors have wider data paths (16 bits) and larger address spaces, and prices have dropped considerably. Contributing Editor Mal Stiefel surveys a broad range of single-board microcomputers that are offered as standard, off-the-shelf products for integration into stand-alone systems, smart terminals, communications processors and other equipment. Extensive tables for product evaluation are included.



145 For years, computer-based process-control systems have been helping aluminum producers to wring maximum performance out of their costly rolling mills. These systems constantly monitor and adjust a mill's rolls to flatten coils of aluminum stock into sheet or foil with maximum speed and minimum waste. Unfortunately, many mills have been unable to justify the use of computer-based control systems because of their high cost. Until now. Recently, the introduction of microcomputer-based systems has brought the benefits of digital control within the reach of small mills. These systems not only lower the entry-level cost of computer control, but also offer improved maintainability through built-in diagnostic programs.



151 Analog input/output boards that are compatible with standard microcomputer and minicomputer bus systems continue to appear in greater numbers and with more special features than previously available. Increased intelligence, for example, allows the newer boards to reside close to a system's sensors, which collect the data for computer processing, rather than in the host, saving thousands of dollars in installation-wiring costs. This also permits cards to be adjusted to the rapid updating of bus structures, making the cards essentially bus-independent.



163 Perpendicular recording, a high-density data-storage technique limited so far to the research lab, may make its first commercial appearance next year in the form of 5¼- and 8-in. Winchester media from Lanx Corp. And if all goes according to plan at the five-month-old company, West Coast Editor John Trifari reports, the impact on both existing and future drive technologies could be dramatic. Lanx officials say that using media designed for perpendicular recording will permit drive vendors to boost bit densities on existing 3350-technology Winchester-disk drives 200 to 300 percent, pushing densities into the 20,000-bpi range.

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
- ☐ Eight Prioritized and Vectored Interrupts
- ☐ One Non Maskable Interrupt
- ☐ Three 16 bit Programmable Counter/Timers
- ☐ Optional on board APU Provisions

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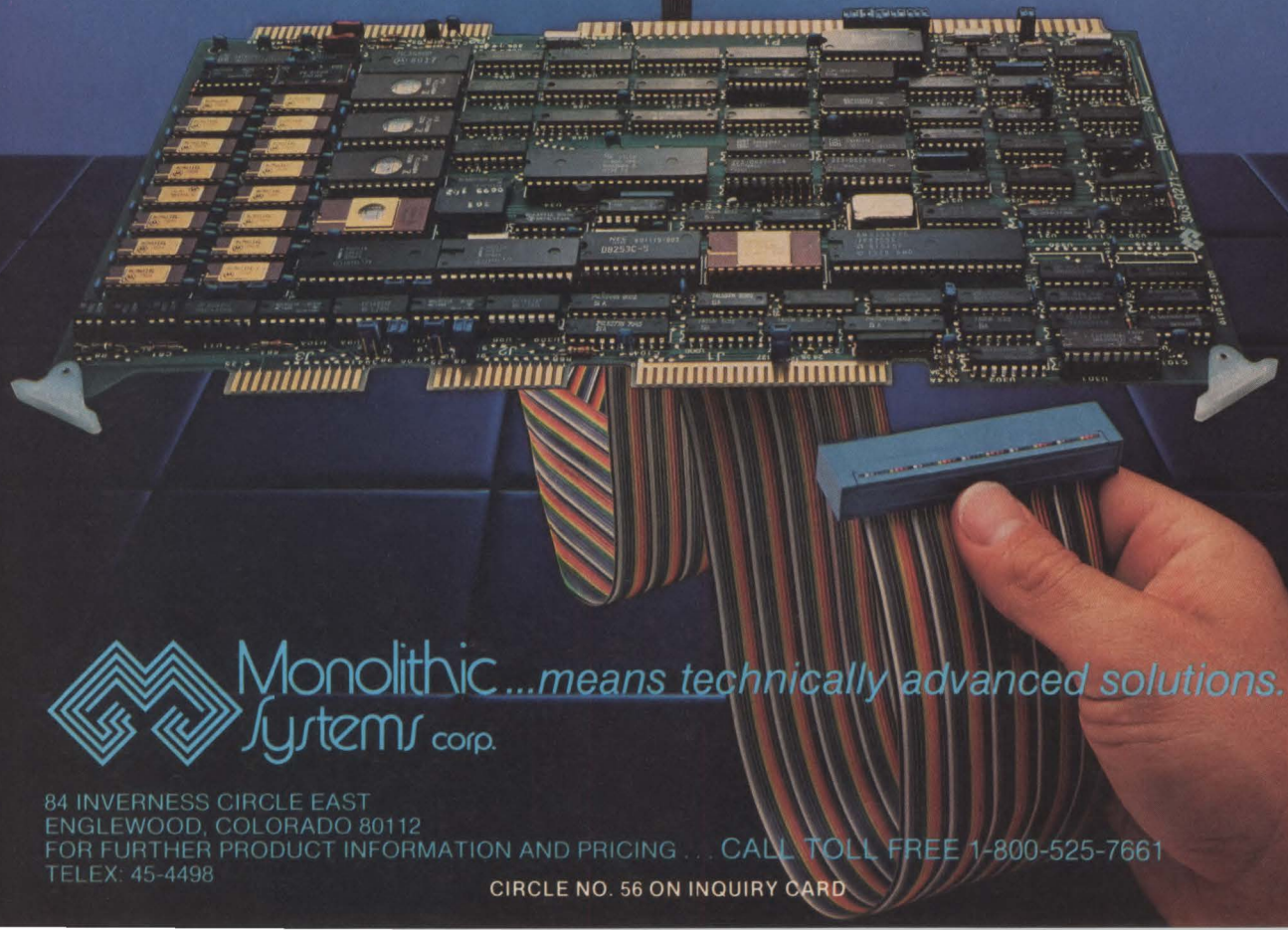

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Single-board computers offer greater choice and power

MALCOLM L. STIEFEL, Contributing Editor

The 16- and 32-bitters are here, but don't forget about the 8-bit SBCs yet

Change is constant in the computer business, and while the fundamental composition of single-board computers hasn't been substantially altered since the last product profile in these pages (MMS, September, 1978, p. 61), SBCs now offer far more choices and power than they did then.

A casual look at today's SBC would be deceiving; it still consists of the same basic components it did three years ago — a PC board that houses a μp, RAM, ROM and I/O ports. But for openers, the board now holds more memory, the μp has a wider data path (16 bits) and a larger address space, and prices have dropped considerably. A user can buy an 8-bit board in kit form with 2K bytes of RAM for $300 or less in single-unit quantities (Fig. 1). Or he can buy a dual-processor board that accepts data at 64M bps and performs fast-Fourier transforms in 7 msec. for a little less than $15,000.

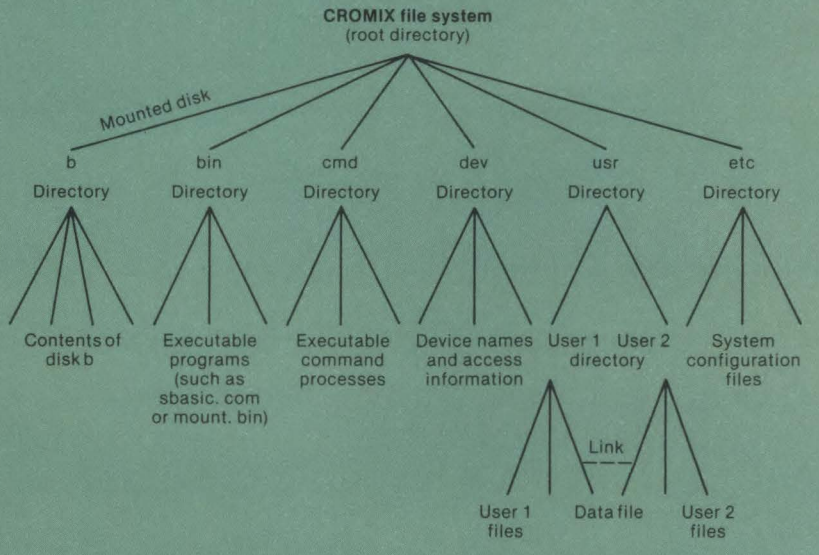
Software has matured. Most 8-bit systems come fully supported with high-level languages, monitors and utilities. The 16-bit SBCs are a bit behind, but catching

Cromemco's CROMIX operating system illustrates the level of software sophistication available from SBC vendors in support of their products. The strengths of CROMIX, a lookalike of Bell Laboratories' popular UNIX, include 8-user multitasking, hierarchical directories, compatible-file and -device I/O, extensive subsystem support with eight computer languages and a number of application packages. Memory in a CROMIX system is allocated in 64K banks, one bank per task.

As shown in the diagram, the CROMIX file system is a tree structure of three types of files: data files, directories and device files. Device and file I/O is compatible among these file types, allowing input and output to be redirected from and to any source or destination.

The tree structure allows different directories to be maintained for different users or functions. In addition, links can be established from directory to directory to allow the file to appear in multiple locations of the tree structure. Because a link to a file is merely a pointer to its location on the disk, all CROMIX links are of equal value.

The tree structure of the file system also incorporates demountable volumes. This means that each mass-storage device becomes a subset of the hierarchical directory structure of the single-file system. Thus, files on all disk devices are addressed in an identical manner. *—Alan R. Kaplan*



The 8-bit SBC remains hale and hearty, the darling of OEM and system integrator alike.

up quickly. Meanwhile, standardization efforts, some ad hoc and some formally organized, have proceeded, making life easier for system builders and helping open the market for vendors.

Taking a look ahead, the major changes to come in

REPRESENTATIVE SINGLE-BOARD COMPUTERS

Manufacturer	Model number	CPU	Memory	Input/output	Software support
Ackerman Digital Systems, Inc.	6809 SBC	MC6809, 8 bits	2K bytes of RAM, 4K to 16K bytes of ROM	One serial port at 110 to 9600 bps, three parallel ports to 1 MHz, S-100 bus	Monitor
Adams-Russell	AR-40	8085 and special architecture, 8 and 16 bits, 10 interrupt levels	9K bytes of RAM, 8K bytes of ROM	Two parallel ports, 64M bps	Cross-assembler, supervisor
Altos Computer Systems	8000 series	Z80, 8 bits	64K to 208K bytes of RAM	Six serial ports, 300 to 19.2K bps, two parallel ports	BASIC, FORTRAN, COBOL, Pascal, APL, PL/I, Assembly languages; CP/M, MP/M, OASIS operating systems
American Microsystems, Inc.	560, 590	S6802, 6809, 8 bits	As much as 2K bytes of RAM, as much as 16K bytes of ROM	One serial port at 50 to 19.2K bps, four parallel ports to 500 KHz	
Ampower Electronic Instrument Co., Inc.	AM8001	8085	0.5K bytes of RAM, 8K to 40K bytes of ROM		None
Applied Systems Corp.	ASC/80	Z80, 8085 or 8086/88, 8 or 16 bits	1K to 4K bytes of RAM, 1K to 8K bytes of ROM	One serial port, 110 to 24K bps, one parallel port to 500K bps, Multibus	Resident operating system assembler; optional cross-compiler controller software
Artec Electronics	8085	8085A2, 8 bits	2K bytes of RAM, 3K bytes of ROM	One serial port at 75 to 9600 bps, one parallel port, S-100 bus	Monitor, CP/M operating system
California Computer Systems	2810	Z80A, 8 bits	2K bytes of ROM	One serial port to 56K bps, S-100 bus	Assembly language, CP/M operating system
Central Data Corp.	B1017	Z8001, 16 bits, 8 interrupt levels	As much as 4K bytes of ROM	Multibus	BASIC, COBOL and C languages, operating systems
Codata Systems Corp.	CM68000	M68000, 16 bits	256K bytes	Two serial ports, Multibus	Merlin operating system; Assembler, Editor, Loader PASCAL, FORTRAN 77
Control Logic, Inc.	CCS-1143A, MM1-MSC	Z80, Z80A, 8 bits, 1 or 8 interrupt levels	1.25K to 8K bytes of RAM, as much as 28K bytes of ROM	One to four serial ports, to 19.2K bps, Control Logic Poly-Bus	Assembler
Creative Micro Systems, Inc.	9609, 9600A	MC6809, MC6802, 8 bits, 7 interrupt levels	7K bytes of RAM, 6K bytes of ROM	Two serial ports at 75 to 38.4K bps, four parallel ports to 400K bps, EXORbus	BASIC, Pascal and FORTH languages, operating system
Cromemco, Inc.	SCC	Z80A, 8 bits	1K bytes of RAM, as much as 8K bytes of ROM	One serial port at 110 to 76.8K bps, three parallel ports, S-100 bus	12-command monitor and 3K control BASIC available in ROM; Assembler, CROMIX multi-user, multi-tasking operating system, COBOL, FORTRAN, BASIC, LISP, C, DBM and word-processing packages
Data General Corp.	MBC/1, MBC/2, MBC/3	mN601, mN602, 16 bits, 16 interrupt levels	2K to 32K bytes of RAM, as much as 32K bytes of ROM	One or two serial ports to 19.2K bps, as many as 32 parallel ports, microNOVA bus	Pascal, BASIC, FORTRAN and Assembly languages, operating systems
Datricon Corp.	ACS 12, 14, 15, 19	6800, 6804, 6512, 6809, 8 bits	As much as 40K bytes of RAM, ROM	One serial port at 50 to 19.2K bps, two 8-bit parallel ports, two 16-bit timers, Multibus	D-FORTH operating system, cross-assembler for PDP-11
Digital Equipment Corp.	LSI-11	16 bits	8K bytes of RAM	One serial port at 110 to 9600 bps	Monitor, RT-110S, RSX-11 (multi-user), BASIC, FORTRAN, DIBOL, Assembly language; monitor, RT-11, RSX-11 operating systems
Digital Microsystems Inc.	DSC-3	Z80, 8 bits	64K bytes of RAM, 1K to 2K bytes of ROM	Four serial ports, two parallel ports	Pascal, FORTRAN, BASIC, COBOL, PLM languages; CP/M and OASIS operating systems
Distributed Computer Systems	DCS 86/16, DCS 8010A	8080, 8086, 8 or 16 bits, 1 or 8 interrupt levels	As much as 12K bytes of RAM, as much as 24K bytes of ROM	As many as three serial ports to 38.4K bps, as many as six parallel ports at 48 bits each, Multibus	FORTRAN, BASIC, PL/I, COBOL, PLMX, Pascal, C languages; CP/M or MP/M operating systems

single-board computers are readily discernible, even with a low-resolution crystal ball. The performance and functions of SBCs are intimately related to the performance and functions of their component parts. When 32-bit chip sets become widely available, they will show up in SBCs almost immediately. When 256K-bit memory chips arrive, SBCs will have them. Similarly, any advances made in languages and operating systems will be reflected in SBCs as soon as development systems can accommodate them.

Board size; power	Price	Circle No.
5 x 10 in.; +8V, ±16V	$300 to $450	391
15 x 16½ in.; ±5V, ±15V, as much as 155W	$14,950	392
	$3583 to $13,850	393
4½ x 6½ in.; +5V or +12V at 0.65A to 4A		394
11½ x 5½ in.; +5V	$495	395
4½ x 6 in.; +5V	$250	396
5½ x 10 in.; +5V, ±16V	$450	397
10 x 5 in.; +8V, ±16V	$310	398
6¾ x 12 in.; +5V, 21½ to 29½W	$1045	399
12 x 6¾ in.; +5V	$3600	400
16 x 8 in. and 10 x 7 in.; +5V and ±12V, 8 to 20W	$595 to $990	401
6 x 9¾ in.; +5V, ±12V, as much as 5½W	$495 to $595	402
5 x 10 in.; +8V, ±18V, 10W	$495 (monitor/BASIC ROM is $90)	403
7½ x 9½ in.; ±5V, ±12V, as much as 15W	$800 to $1700	404
4½ x 9$^{6}/_{10}$ in.; +5V at 700mA, ±12V at 60mA	ACS 12, $249; ACS 14, $465	405
8$^{9}/_{10}$ x 10 in.; +5V, +12V	N/A	406
	$3450	407
6¾ x 12 in.; +5V, ±12V, 15 to 25W typical	$425 to $1200	408

The long-lived 8-bit μc

One might regard the 8-bit SBC as a fading relic, rooted in the past, its turf overrun by 16 bitters. A peek at the product table, however, shows the 8-bit SBC remains hale and hearty, the darling of OEM and system integrator alike. It shows signs of becoming as long-lived as the keypunch. For example, Intel offers eight models in its 8-bit iSBC80 and iSBC88 series, but only two models in its 16-bit iSBC86 series.

The reasons for the durability of the 8-bit SBC lie in the affinity of system builders for simplicity, reliability and economy. A typical 8-bit SBC, at less than $1000 (Fig. 2), is half as expensive as an average 16-bit unit. Board-level 8-bit products, now in their second and third generations, are proven designs, permitting projects to proceed without hiccups. Development

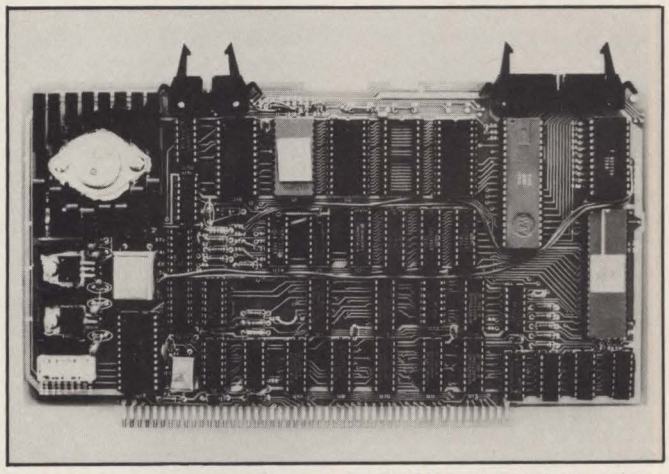


Fig. 1. Acherman Digital Systems' *6809 SBC with 2K bytes of on-board RAM sells for $299.50 in kit form.*

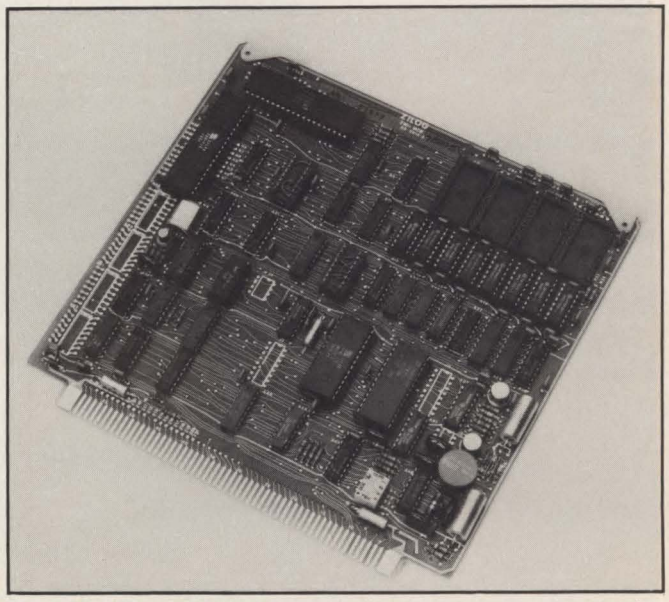


Fig. 2. The Zilog *Z80-MBC 8-bit single-board computer is priced at $795 each in single-unit quanities.*

The 8-bit SBC will thrive, even as the last bugs are removed from 16-bit software.

turnaround design jobs, in which cost and development time must be minimized. Furthermore, spare parts are readily available, as are a number of distribution outlets.

Industry observers suggest that part of the thirst for

Manufacturer	Model number	CPU	Memory	Input/output	Software support
Diversified Technology, Inc.	CBC 800/216	NSC 800, 8 bits, 20 interrupt levels	4K to 16K bytes of RAM, as much as 32K bytes of ROM	One serial port at 110 to 9600 bps, six parallel ports to 5M bps, Multibus	Assembler, FORTH, ROM-based monitor
Dual Systems Control Corp.	68K	Motorola 68000, 16 bits	16K bytes of ROM	S-100 bus	Monitor
Dynabyte, Inc.	BC2 Basic Controller	Z80, 8 bits, 6 interrupt levels	16K to 48K bytes of RAM; 4K to 32K bytes of ROM	Two serial ports at 110 to 9600 bps, one parallel port	ZIBL interpreter
ETI Micro,Inc.	8108	8085 and 8088, 8 and 16 bits, 12 interrupt levels	2K to 6K bytes of ROM	Two serial ports at 30 to 19.2K bps, one parallel port at 30 to 19.2K bps, Multibus	FORTRAN, FORTH, BASIC, C and Pascal languages; monitor
Forward Technology,Inc.	FT-86C, FT-86C/8P, FT-68M	8086, 8087, 68000, 16 bits	4K to 256K bytes of RAM, as much as 32K bytes of ROM	Two serial ports at 300 to 19.2K bps, Multibus	FORTH; monitor, CP/M-86 operating system
Heurikon Corp.	MLZ-91A	Z80A, 8 bits	As much as 64K bytes of RAM, as much as 16K bytes of ROM	Two serial ports at 50 to 19.2K bps, Multibus and IEEE 488 bus	CP/M, MP/M, CP/Net operating systems
Inner Access Corp.	8100 FMP	Z8001, 16 bits, 10 interrupt levels	As much as 16K bytes of combined RAM, ROM	One serial port at 110 to 9600 bps, one parallel port to 4.8M bps, S-100 bus	FORTH, BASIC, Assembly languages; monitor
Intel Corp.	iSBC 80, iSBC 86 and iSBC 88 Series	8080, 8085, 8086 and 8088, 8 and 16 bits, as many as 65 interrupt levels	As much as 64K bytes of RAM, as much as 64K bytes of ROM	As many as three serial ports to 38.4K bps, as many as 96 parallel lines to 1M bps, Multibus and IEEE 488 bus	Pascal, FORTRAN, PL/M, BASIC, Assembly languages; real-time executives
	SBC 80/20-4, iSBC 80/10B	8080, 8080A, 8 bits	As much as 4K bytes of RAM, as much as 16K bytes of ROM	One or two serial ports at 38.4K bps, parallel ports to 4M bps, Multibus	FORTRAN, BASIC, PLM, Assembly languages; operating system
	iSBC 80/05, iSBC 80/24, iSBC 80/30, iSBC 80/04	8085A, 8 bits	As much as 16K bytes of RAM, as much as 32K bytes of ROM	As many as three serial ports at 9600 bps, parallel ports to 4M bps, Multibus	FORTRAN, BASIC, PLM, Assembly languages; operating system
	iSBC 88/25, iSBC 88/40	8088, iAPX 8088, 8 bits	As much as 16K bytes of RAM, as much as 64K bytes of ROM	As many as three serial ports at 38.4K bps, parallel ports to 1M bps, Multibus, IEEE-488 bus	PLM, Pascal languages; operating system
	iSBC 86/05, iSBC 86/12A	8086, 8086-2, 16 bits	As much as 64K bytes of RAM, as much as 64K bytes of ROM	As many as three serial ports at 75 to 38.4K bps, as many as nine parallel ports to 10M bps, Multibus	FORTRAN, Pascal, PLM, Assembly languages; operating system
Intersil	ISB-3100, ISB-3110	Z80, 8085, 8 bits	4K bytes of RAM, 8K bytes of ROM		FORTRAN, BASIC, Pascal languages; Monitor, CP/M operating system
Lazor Systems	Lazor-5	8086, 16 bits	As much as 512K bytes of RAM, 4K bytes of ROM	Five serial ports to 19.2K bps, two parallel ports to 19.2K bps	COBOL, BASIC, Assembly languages; operating system
Miller Technology	M-80, MCPU-800	Z80, Z80A, 8 bits, 1 interrupt level	As much as 64K bytes of RAM, as much as 32K bytes of ROM	One serial port to 56K bps, as many as four parallel ports to 250K bps	BASIC, monitor
Monolithic Systems Corp.	MSC 8000 Series	Z80A, 8 bits, 9 interrupt levels	As much as 64K bytes of RAM, as much as 32K bytes of ROM	As many as three serial ports at 110 to 9600 bps, one or two parallel ports, Multibus	Pascal, BASIC languages; CP/M, MSOS operating systems
Motorola Inc.	M68MM17-1, M68MM19-1, M68MM19A-1	MC6909, 8 bits	As much as 12K bytes of RAM, as much as 96K bytes of ROM	One or two serial ports at 19.2K bps, two parallel ports	FORTRAN, BASIC, MPL, Assembly languages
Motorola Inc.	M68MM01, M68MM01A2, M6801MM01D	MC6800, 8 bits	1K to 10K bytes of RAM, 4K to 20K bytes of ROM	One serial port at 28.8K bps, as many as six parallel ports, EXORbus	FORTRAN, BASIC, Assembler languages; monitor
Motorola Inc.	M68KVM Series, M68MM Series	MC68000, MC6800, MC6802, MC6809, 8 and 16 bits	As much as 64K bytes of RAM, as much as 64K bytes of ROM	One or two serial ports at 28.8K bps, as many as six parallel ports to 6.25M bps, Versabus, EXORbus	BASIC, FORTRAN, MPL, Assembly languages; real-time multitasking operating system
	M68MM01B, M68MM01B1A	MC6802, 8 bits	128 to 384 bytes of RAM, 4K to 6K bytes of ROM	One serial port at 110 to 2400 bps, as many as three parallel ports, EXORbus	FORTRAN, MPL, Assembly
	M68KVM01A1, M68KVM01A2	MC68000, 16 bits	32K to 64K bytes of RAM, as much as 64K bytes of ROM	Two serial ports at 50 to 19.2K bps, four parallel ports at 6.25M bps, EXORbus	Operating system

systems are less expensive, and languages, utilities and operating systems—the vital support software—are mature and reliable.

These attributes are irresistible to purchasing agents and engineers, particularly those engaged in quick-

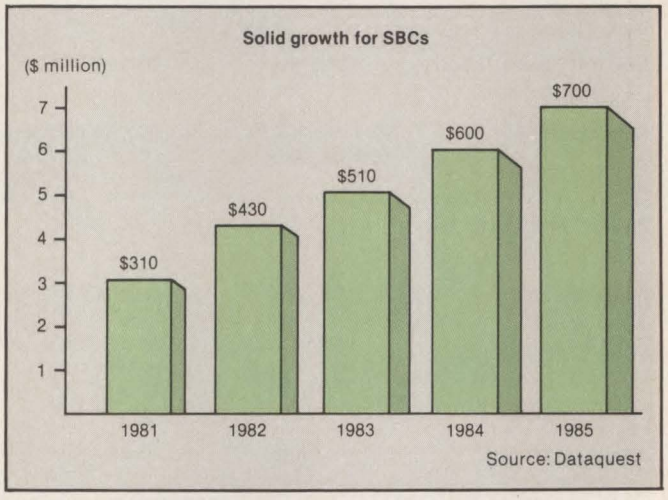
Board size; power	Price	Circle No.
6¾ x 12 in.; +5V, ±12V, 0.5 to 1W	$2295	409
10 x 5 in.; +8V	$1195	410
14¾ x 12½ in.; ±5V, ±12V, 12 to 17W	$1995	411
6¾ x 12 in.; +5V, 5W	$1275	412
6¾ x 12 in.; +5V, ±12V	$1250 to $3495	413
6¾ x 12 in.; +5V, ±12V	$2150 to $2789	414
10 x 10 in.; +8V, ±16V, 30 to 38W	$1550	415
6¾ x 12 in. (and 6¾ x 7⁸/₁₀ in.); ±5V, ±12V, as much as 34.6W	$225 to $2620	416
6¾ x 12 in.; ±5V, ±12V, 27.3W	$560 to $925	417
6¾ x 12 in. (and 6¾ x 7⁸/₁₀ in.); 26.2W	$245 to $1565	418
6¾ x 12 in.; +5V, ±12V, 23.6W	$1295 to $2000	419
6¾ x 12 in.; +5V, ±12V, 34.6W	$1790 to $2620	420
4½ x 6½ in.; +5V	$248 to $326	421
19 x 22 in.	$6700	422
4½ x 6½ in. (and 4½ x 7 in.); ±5V, ±12V, 2.5 to 5W typical	$185 to $1175	423
6¾ x 12 in.; ±5V, ±12V, 20W	$545 to $1895	424
9¾ x 6¹/₁₀ in.; +5V, ±12V, 11.9W	$495 to $795	425
9¾ x 6¹/₁₀ in.; +5V, +12V, 11.8W	$495 to $515	426
9¾ x 6¹/₁₀ in. (and 14½ x 9¼ in.); +5V, ±12V, 28.6W	$286 to $3800	427
9¾ x 6¹/₁₀ in.; +5V, ±12V	$286 to $495	428
14½ x 9¼ in.; +5V, +12V, 28.6W	$2500 to $3800	429

8-bit SBCs stems from the sponginess of 16-bit software: a complement of languages is not yet ready for some boards, and utilities and operating systems are even further behind. And even when 16-bit product lines are at full strength, 8-bit SBCs will survive because they lend themselves neatly to a broad class of straightforward engineering problems in data-acquisition, device-control and other applications in which response-time requirements are reasonable and programs can comfortably fit into a 64K-byte address space.

A comparable situation will occur in the next year or two when 32-bit boards become available. The software, cost and application gaps will then be apparent between the 16- and 32-bit products, and the 16-bit SBC will also be nominated for near immortality.

Architectures dictate the numbers

Intel Corp. introduced its first SBC, the iSBC 80/10, in 1976, so designers have had five years to acquire firm ideas about functional and performance characteristics for SBCs, and to convey these ideas to the vendors.



Worldwide market for board-level µcs *is expected to grow from $310 million in 1981 to $700 million in 1985, a five-year cumulative total of $2.5 billion that represents a 25 percent compound annual growth.*

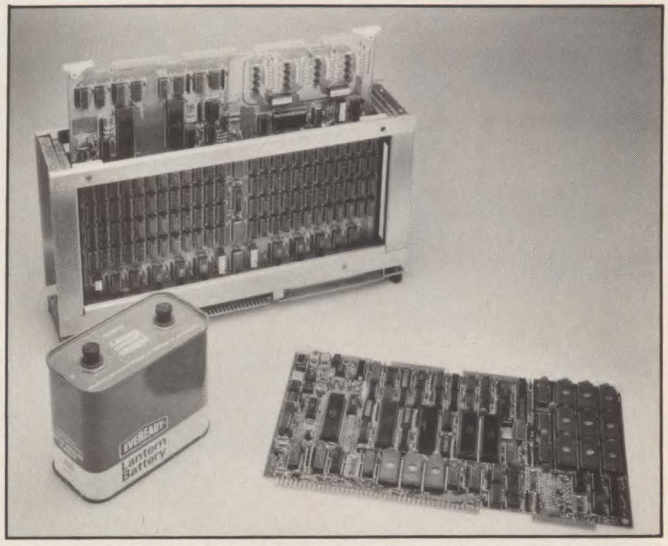


Fig. 3. Pacific Cyber/Metrix's *PPS-12 all-CMOS 12-bit single-board computer consumes only 0.5W of power.*

Most 8-bit models come with built-in ROM-based monitors that facilitate program loading and execution, register examination and interaction with terminals.

Thus, SBCs on the market have an impressive range of capabilities and features, reflecting the diversity of these requirements.

The typical SBC has an 8-bit μp, 2K to 8K bytes of RAM with off-board expansion to 64K bytes, 4K to 16K bytes of ROM, one or two serial communication ports operating at speeds as high as 38.4K bps and one to three

Manufacturer	Model number	CPU	Memory	Input/output	Software support
National Semiconductor	BLC-80 Series, BLC-86/12B	8085, 8080A, Z80A, 8086, 8 or 16 bits	0.5K to 32K bytes of RAM, as much as 32K bytes of ROM	One or two serial ports at 57.6K bps, two to six parallel ports, Multibus	FORTRAN, BASIC, PLM, Pascal languages; operating system, monitor
	80/10, 80/11, 80/11A, 80/12, 80/12A, 80/14, 80/14A, 80/204, 80/116	8080A, 8 bits	1K to 4K bytes of RAM, as much as 32K bytes of ROM	One serial port at 57.6K bps, six parallel ports, Multibus	FORTRAN, BASIC, PLM, Pascal languages; monitor, operating system
	BLC-80/05	8085, 8 bits	0.5K bytes of RAM, as much as 8K bytes of ROM	One serial port at 9600 bps, four parallel ports, Multibus	FORTRAN, BASIC, PLM, Pascal languages; monitor, operating system
	86/12B	8086, 16 bits	32K bytes of RAM, 32K bytes of ROM	One serial port at 57.6K bps, three parallel ports	FORTRAN, BASIC, PLM, Pascal, Assembly languages; monitor
NEC Electronics, U.S.A.	BP-0186	8086, 16 bits	32K bytes of RAM, as much as 32K bytes of ROM	One serial port at 19.2K bps, parallel port to 76.8 bps, Multibus	Monitor, CP/M operating system
Omnibyte Corp.	OB6000, OB8802, OB8902, OB68K1	MC6802, 6808, 6809, 68000, 8 or 16 bits, as many as 9 interrupt levels	As much as 128K bytes of RAM, as much as 64K bytes of ROM	One or two serial ports at 19.2K bps, as many as six parallel ports at 1 to 2 MHz, Multibus	BASIC, Strubal+ languages; ODOS, SDOS operating systems
Pacific Cyber/Metrix, Inc.	PPS-12	6100, 12 bits	0.5K to 8K bytes of RAM, 0.5K to 8K bytes of ROM	One serial port at 75 to 19.2K bps, one to three parallel ports to 1.2M bps	PDP-8 instruction set, monitor
Pragmatic Design	CPU-1	8085, 8 bits	0.25K bytes of RAM, as much as 4K bytes of ROM	One serial port, parallel port	None
Quay Corp.	90 Series	Z80A, 8 bits, 4 interrupt levels	16K to 64K bytes of RAM, 14K bytes of ROM	One to six serial ports at 9.6K to 38K bps, one parallel port, S-100 bus	BASIC, COBOL, FORTRAN, Pascal, PL/I, RPG, Assembly languages; CP/M, MP/M, OASIS operating systems
Relational Memory Systems, Inc.	Z80-RSBC	Z80A, 8 bits	32K bytes of RAM, 16K bytes of ROM	Two serial ports at 19.2K bps, parallel port	PLM, PLZ, Assembly languages; monitor, operating system
Rockwell International	RM 65	R6502, 8 bits	2K bytes of RAM, 16K bytes of ROM	Two parallel ports	BASIC, PL/65, Assembly languages
Synapse Corp.	CPU-85, CPU-800	8085, NSC800	As much as 1K bytes of RAM, as much as 2K bytes of ROM	Parallel port	None
Synertec Systems	MBC-01A2	6800, 8 bits	1K to 4K bytes of RAM, 1K to 32K bytes of ROM	One serial port at 9600 bps, four parallel ports	None
SSM Microcomputer Products, Inc.	CB-2	Z80A, 8 bits	4K bytes of RAM, 8K bytes of ROM	S-100 bus	Monitor
Texas Instruments	TM 990/100MA, TM 990/101MA, TM 990/1481	TMS 9900, 74S481 bit slice processor, 16 bits, 16 interrupt levels	As much as 4K bytes of RAM, as much as 2K bytes of ROM	One or two serial ports at 110 to 19.2K bps, as many as 16 parallel ports	Pascal, BASIC, Assembly languages; real-time executive, UCSD-P operating system
Western Digital Corp.	WD900 Pascal Micro Engine	WD9000, 16 bits, 4 interrupt levels	64K to 128K bytes of RAM	Two serial ports at 50 to 19.2K bps, one parallel port, 500 KHz	Pascal, BASIC languages; UCSD operating system
Wintek Corp.	MCV45, MCC00, MCL45	6800, 6801/68701, 8 bits, 4 interrupt levels	As much as 512 bytes of RAM, as much as 4K bytes of ROM	One serial port at 150 to 9600 bps, as many as four parallel ports to 100K bps	BASIC, C, PL/W, Pascal, FORTRAN, Assembly languages; WIZRD operating system
Zendex Corp.	ZX-80/05, ZX-88, ZX-85	8085A-2, 8088, 8 or 16 bits, 4 to 8 interrupt levels	As much as 64K bytes of RAM, as much as 32K bytes of ROM	As many as four serial ports at 110 to 19.2K bps, as many as three parallel ports, Multibus	BASIC, Pascal, PLMX languages; CP/M, ISIS operating systems
Zilog,Inc.	Z80-MCB	Z80, 8 bits, 3 interrupt levels	4K to 16K bytes of RAM, up to 8K bytes of ROM	One serial port at 50 to 38.4K bps, two parallel ports	BASIC, Pascal

parallel ports running at a combined rate of as much as 500K bps.

In a typical 16-bit SBC, most of the numbers are higher: 16K bytes of RAM and 32K bytes of ROM on-board, with off-board expansion to 1M byte or more; serial ports operating at speeds as high as 38.4K bps; and parallel ports, encompassing as many as 96 lines, running at aggregate rates of 5M to 10M bps.

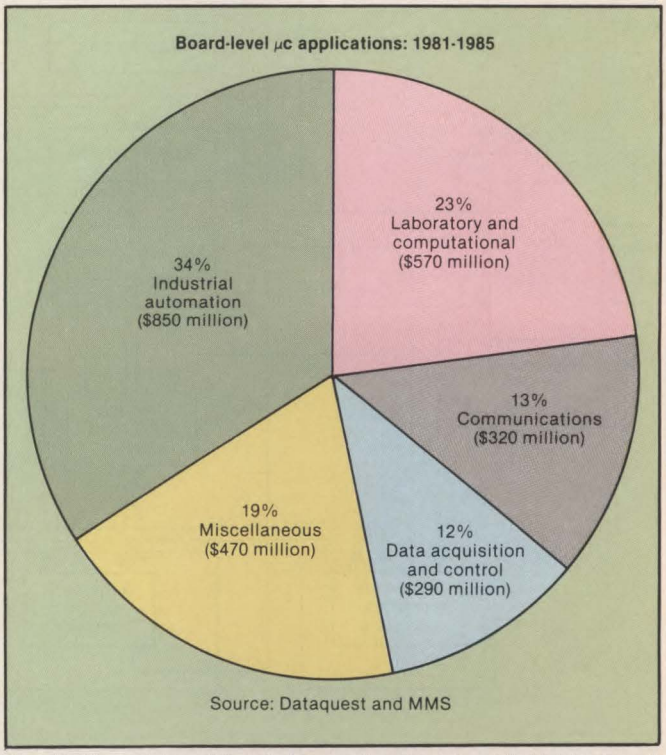
Some vendors, such as Texas Instruments Inc., also furnish on-board programmable clocks to trigger interrupts. Creative Micro Systems Inc. and Monolithic Systems Corp. provide battery-backup circuits to retain memory contents in the event of a power failure. Inner Access Corp. builds memory-management hardware into its SBCs to facilitate mapping logical addresses into physical addresses, and to enable the use of memory-protection mechanisms.

Pacific Cyber/Metrix, Inc., goes in still another direction with its PPS-12 (Fig. 3). That SBC uses a 12-bit 6100 CMOS μp that consumes only 0.5W of power instead of the 20W to 30W typically required in conventional NMOS units. Diversified Technology also uses CMOS circuits in its CBC800/216. Based on the NSC800 μp, the board dissipates no more than 1W.

ETI Micro Inc. introduces a different twist with its 8108 SBC, incorporating two μps—an 8-bit 8085 and a 16-bit 8088 (Fig. 4). The board connects to Multibus, and interleaves the two μps to divide the processing load.

Adams Russell's AR-40, another dual-processor unit, is designed for signal-processing and process-control applications. It includes an 8085 and a proprietary μp with a 144-bit word that performs complex 1024-point fast-Fourier transforms in 12.4 msec. and real FFTs in 7 msec. The parallel I/O lines can operate at a mind-boggling 64M bps. The 8085 performs interface and support functions, while the other μp crunches the numbers.

Board size; power	Price	Circle No.
6¾ x 12 in.; ±5V, ±12V	$405 to $2000	430
6¾ x 12 in.; +5V, ±12V	$448 to $1475	431
6¾ x 12 in.; +5V, ±12V	$405	432
6¾ x 12 in.; +5V, ±12V	$2000	433
6¾ x 12 in.; +5V, ±12V	$2100	434
4½ x 6½ in. (and 6¾ x 12 in); +5V, ±12V, 4.4 to 16W	$275 to $1995	435
12 x 6½ in.; +5V, 0.1 to 0.5W	$999	436
4½ x 7 in.; ±5V, +12V	$185	437
16.175 x 7.85 in.; ±5V, ±12V, 8.4W	$695 to $1940	438
+5V, ±12V	$1300	439
4¼ x 6¼ in.	$185	440
4½ x 4½ in. (and 4½ x 5 in.); +5V, +18V	$195 to $700	441
6 x 9¾ in.; +5V, ±12V	$400	442
5 x 10 in.; +8V, 6W	$260 to $344	443
7½ x 11 in.; +5V, ±12V, to 45W typical	$518 to $4790	444
8 x 16 in.; +5V, ±12V, 17.2 to 20W	$2400	445
4¼ x 6¼ in. (and 4½ x 6½ in.); +5V, ±12V, 6W	$125 to $188	446
6¾ x 12 in.; +5V, ±12V	$550 to $2750	447
$7^{7}/_{10}$ x 7½ in.; ±5V, +12V, 10W	$795	448



Distribution of board-level shipment values *(worldwide) by target application indicates that while industrial automation and laboratory/computational use can be expected to continue accounting for the brunt of shipments, miscellaneous (commercial and home appliance, automotive, games, etc.) and new applications will soak up nearly a fifth of μp boards.*

The 8-bit SBC lends itself neatly to a broad class of straightforward engineering programs in data-control and other applications.

At the opposite pole is Central Data Corp.'s B1017 board, which holds a Z8001 16-bit μp, no RAM, 4K bytes of ROM and a Multibus interface as its sole line to the outside world. It needs only a +5V power source (most SBCs use +5V, +12V and −12V. But it features memory-management circuitry, and it works with programs written in BASIC, COBOL and C. Such a bare-bones board is suitable for applications in which the system builder needs more freedom in placing memory and I/O modules.

Software: the key to success

The availability of fully tested, dependable SBC development software is the key to successful implementation. A rich variety of high-level languages can be obtained from SBC vendors and software houses for the popular 8080-, Z80-, 8086-, 6800- and 68000-based systems. Distributed Computer Systems, for example, offers FORTRAN, PL/I and COBOL subsets, C and a BASIC dialect for its DCS 86/16 16-bit and DCS 8010A 8-bit systems. Inner Access Corp., a specialist in applications of FORTH, provides FORTH and another BASIC dialect on its 8100 FMP board. Other vendors also furnish versions of these languages along with assembly languages.

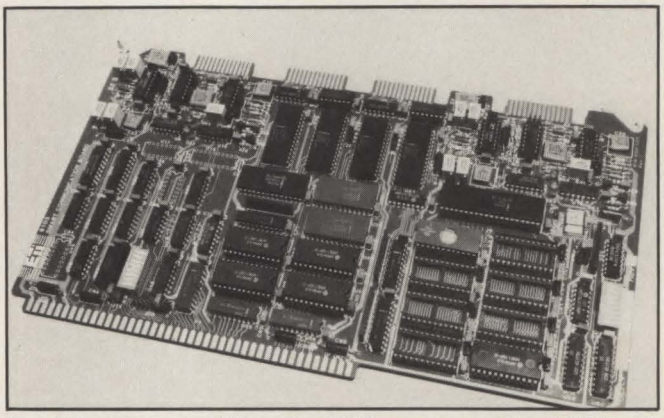
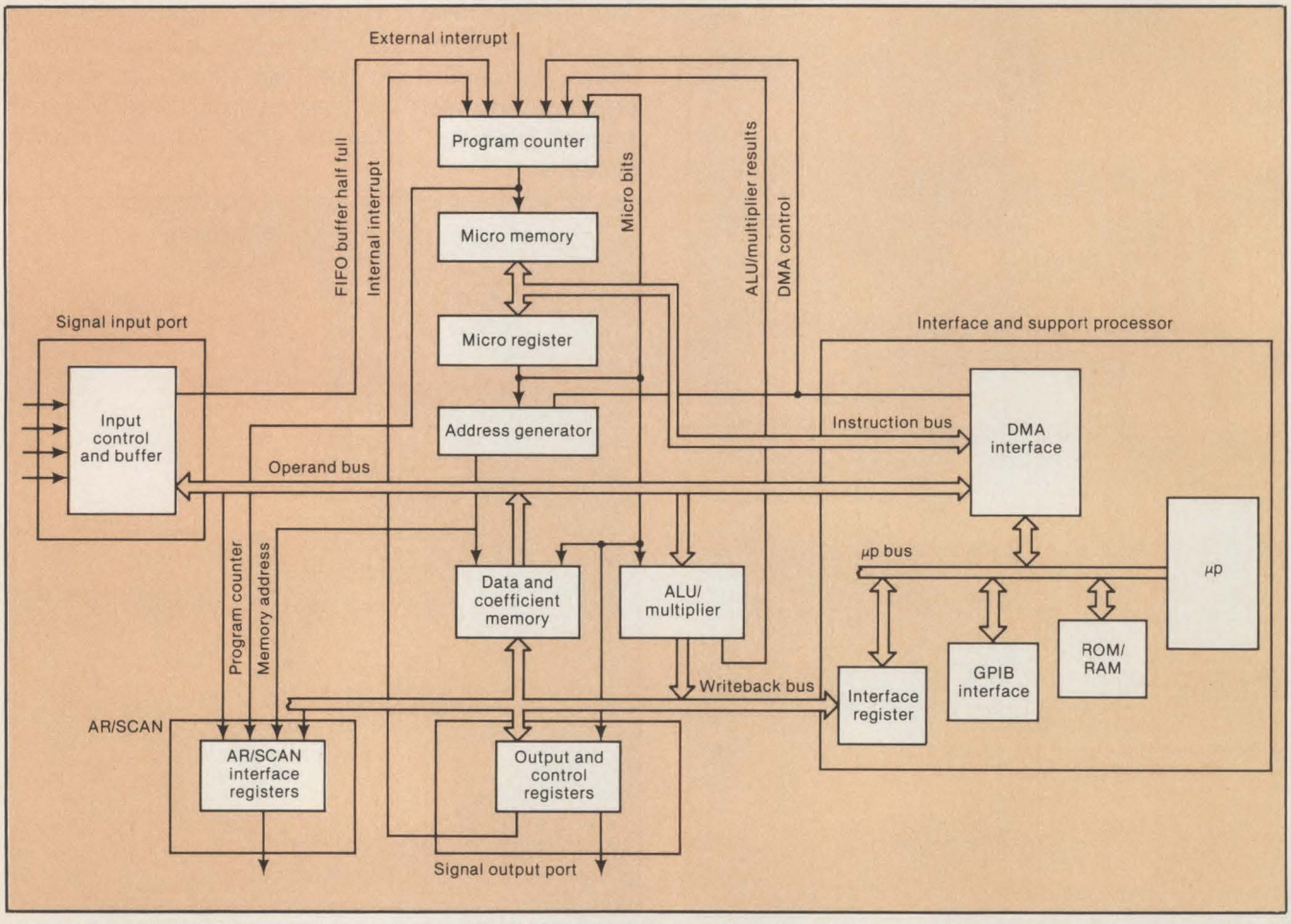


Fig. 4. Two μps—*an 8085 and an 8088—are featured in ETI Micro's model 8108, a 6¾- × 12-in. SBC.*



Adams-Russell's AR-40 *is a fixed-point, three-address "pipelined" machine with independent instructions and data memories. It operates at 4.6 million instructions per sec. with an internal cycle time of 220 nsec. This diagram illustrates the high degree of parallelism embodied in the architecture to permit this speed. All five AR-40 processing elements—high-speed processor, interface and support processor, signal input port, output port and AR/SCAN interface—operate concurrently. In addition, the processor itself performs concurrent operations within each processing cycle. The optional AR/SCAN (lower left) is a display device that plugs into the AR-40 backplane and monitors seven operational parameters.*

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Even when 16-bit product lines are at full strength, 8-bit SBCs will survive.

Most 8-bit models come with built-in ROM-based monitors that facilitate program loading and execution, register examination and interaction with user terminals. Many vendors supply their own monitors, but some, such as Monolithic Systems and Quay Corp., implement the popular CP/M operating system.

The 16-bit units use full-scale multitasking operating systems and real-time executives to take full advantage of the μp's power. Motorola has a real-time multitasking operating system for its M68KVM series of SBCs. Both TI and Western Digital Corp. produce versions of the UCSD operating system, which is a vehicle for the development and execution of Pascal programs. Close to half the vendors in the product table provide a Pascal compiler.

Along with the operating systems, monitors and language facilities, most systems come with utilities for such tasks as editing and debugging. All support software typically runs not on the SBC itself, but on a separate μp development system furnished by the SBC vendor or some other manufacturer. Intel, for example, has its Intellec Series, Motorola its Exorciser and TI its AMPL Development Lab. Many smaller vendors do not offer their own MDSs, but advise the buyer to use the development system of the μp manufacturer.

When the software is tested, it is transferred to the SBC in a variety of ways. Most common is burning a PROM on the MDS that is then plugged into a socket on the SBC. Software can alternatively be loaded from a floppy disk or tape cassette.

Some suppliers provide on-board development software, eliminating the need for a separate MDS for the production of small programs. Monolithic Systems Corp.'s MSC 8000 Series of SBCs includes an on-board assembler that can be called from a user terminal. Miller Technology takes the process a step further, providing Tiny BASIC on its M-80 SBC.

Standards spur evolution

An important factor in the evolution of SBCs has been the development of hardware and software standards. Bob Brannon, marketing manager of Intel's OEM μp systems division, points out that the intensive standardization activity in SBCs is a recent trend. "The concept of standards did not exist in 1978," he says.

The high-level languages that are becoming available are subsets of ANSI-standard languages, and all are somewhat portable. The emergence of de facto operating system standards, such as CP/M and UCSD OS, has also been a factor.

Among the most significant developments has been the advent of standard buses, notably the S-100 bus and the Multibus. Both have been embraced in proposed IEEE standards (Multibus in IEEE 796 and S-100 IN IEEE 696), giving them still more impetus. In both cases, designers of SBCs and peripherals are given vehicles for interconnection that do not require direct agreement between the vendors, thus allowing the designers to concentrate on the internal design of application software rather than on hardware interfacing. It also provides a myriad of sources for system hardware components, substantially boosting designers' chances of locating the units that will best meet project requirements at least cost.

Another area of recent standardization has been floating-point arithmetic, in which the IEEE has again taken the lead. This standard is significant because it helps make software more portable, and it allows designers to predict the results of a floating-point computation more accurately, including the effects of overflow, underflow and rounding.

These comparatively new standardization thrusts are welcome companions to the traditional communication standards, such as RS232, Binary Synchronous Communication, SDLC, and CCITT X.25.

What the future holds

The trend toward standardization and interchangeability will continue, offering users more sources and better economy, and offering vendors pre-sold, expanding markets with less need for custom parts.

The 8-bit SBC not only will survive, but will thrive, even as the last bugs are removed from 16-bit software. The 8-bit units have found their niche in simple projects with moderate memory needs, and nothing will shake them loose.

Watch for a few independent packages to pop up, however, to facilitate conversion of software from 8- to 16-bit machines. Also, look for service bureau operations to appear in the μp software-conversion business.

The market will eventually sort out the useful features from the extraneous ones. For example, users can expect to see on-board programmable clocks on more units as standard items, but battery-backup circuitry for memory won't increase in popularity because in most applications a cold restart is quite acceptable. It is not necessary, as it is in larger systems, to recover and continue operations from the point of power outage.

And, as very-large-scale integration takes hold, I/O ports will acquire additional levels of intelligence, significantly increasing SBC throughput. ■

Malcolm L. Stiefel, now a group leader at Mitre Corp., has worked as a systems analyst, systems engineer and programmer on military command-and-control, hospital administration, investment securities and municipal information systems.

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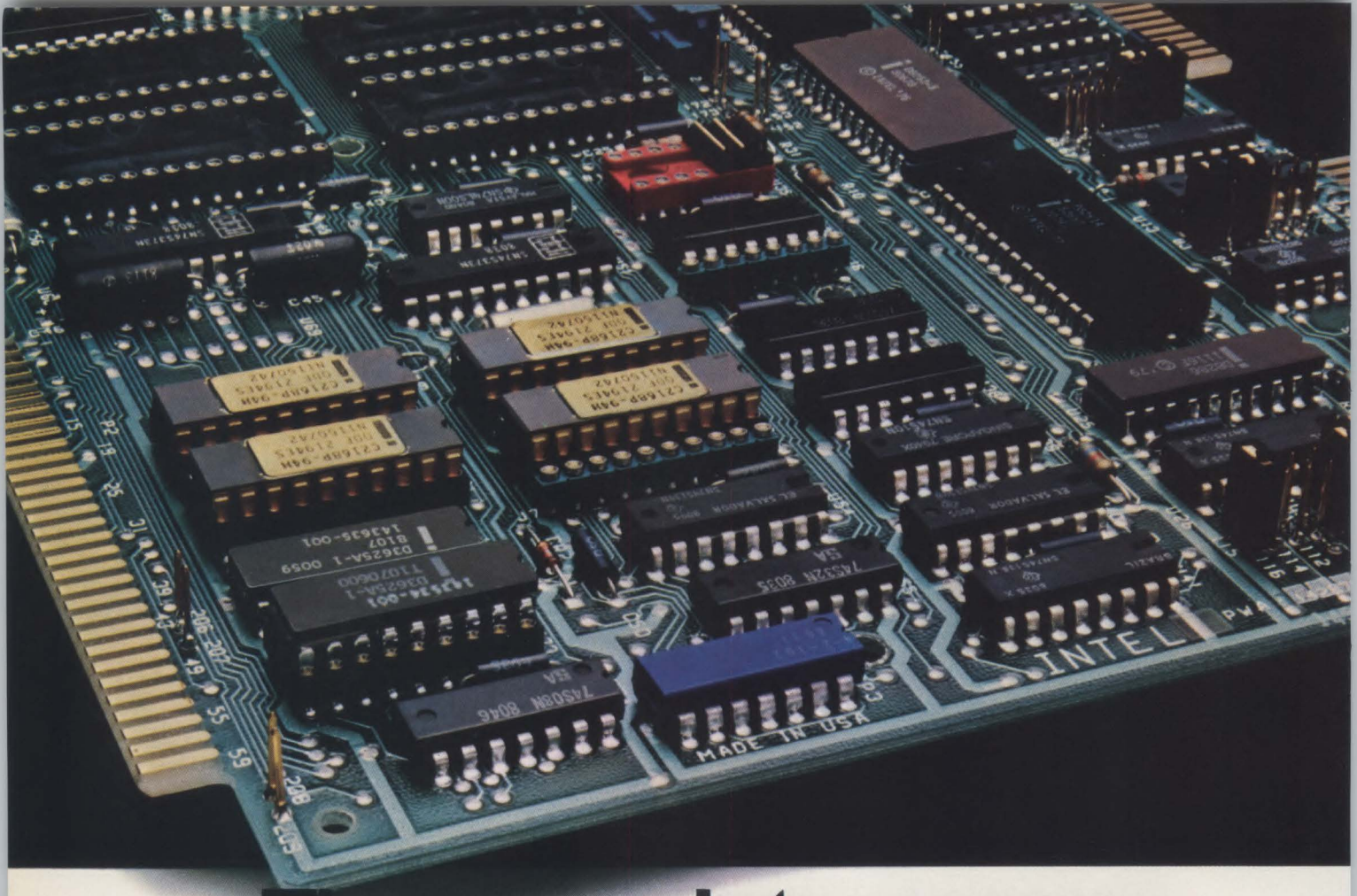

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CIRCLE NO. 60 ON INQUIRY CARD

Challenging the minis

E. J. McCAULEY, ERIC N. DOKA and NABIL A. BALADI, Zilog, Inc.

Zilog's new System 8000 outperforms the DEC PDP-11/70 in several benchmark tests

The distinction between μcs and minicomputers is becoming more obscure. Zilog has designed a new-generation μc employing advanced, very large-scale integrated (VLSI) circuits, a 16-bit μp and software originally implemented on a popular, high-performance minicomputer. Although its basic processor has only a fraction of the computational power of a large mini, tests of the new System 8000 indicate that it matches the performance of its larger competitors in many respects and, in some operations, even exceeds them (MMS, August, p. 17).

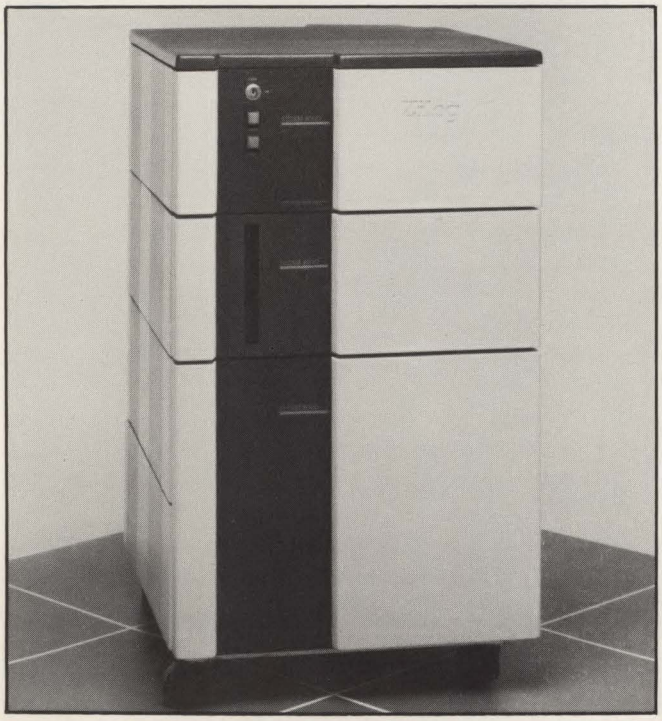
The System 8000 was designed specifically to implement the UNIX operating system developed by Bell Laboratories to run on the DEC PDP-11. The 8000 uses ZEUS, Zilog's enhanced version of the seventh edition of UNIX.

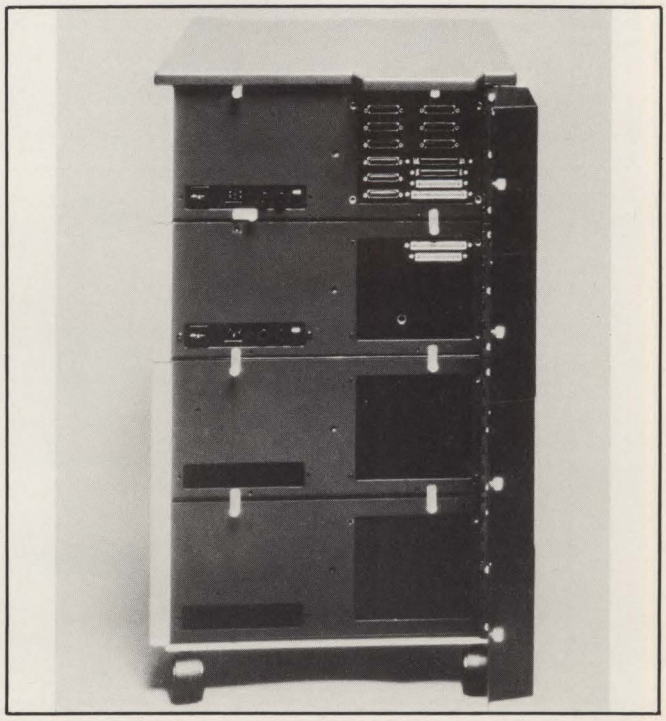
The System 8000 uses the Z-Bus backplane interconnect (ZBI), which is a true semi-synchronous 32-bit bus with address and data multiplexed on the same lines. Its 8M-byte-per-sec. bandwidth is ample for future high-speed 32-bit processors and peripheral controllers.

The System 8000 is based on the 6-MHz segmented Z8001A μp. The compilers can produce object code for either segmented- or non-segmented-mode operation. Hardware facilities for the System 8000 were designed to match those implicit in the UNIX kernel.

Because the Z8001A supports separate code and data address spaces, non-segmented user and system programs can have as much as 128K bytes of memory, of which 64K bytes are code and 64K bytes are data. Segmented programs can have as many as 128 segments of 64K bytes each. As much as 1M byte of main memory (expandable to 4M bytes) can be installed in the sytem, reducing the need for data swapping and minimizing response time during peak use.

Memory management is accomplished with three Zilog Z8010A memory-management units and proprietary supporting circuits designed to support the style





Zilog's new System 8000 high-performance μc. *The dark border on the right side of the right photo is the edge of the cable access door/channel, shown open to reveal the cable sockets.*

The System 8000 uses the Z-Bus backplane interconnect, which is a true semi-synchronous 32-bit bus.

of memory management used in UNIX. These chips support the segmented-mode addressing of the Z8001A, providing each process an address space of 8M bytes. The CPU board includes eight serial I/O ports implemented with Zilog SIO chips, a parallel I/O port implemented with a Zilog PIO (to support a line printer) and a ROM-based diagnostic monitor/bootstrap program.

The 8000's memory subsystem consists of an error-correcting memory controller and as many as four 256K-byte memory-array cards. Peripherals include a BASF 24M-byte 8-in. Winchester-disk drive and a 17M-byte cartridge-tape unit that operates as a reel-to-reel transport.

The Winchester-disk drive's controller is based on a 6-MHz Z80B with on-board buffering and other support. The controller supports as many as four disk drives. Likewise, the controller for the cartridge-tape drive uses a Z80B and incorporates several functions that were handled by the operating system in previous systems. Terminal expansion cards incorporate eight additional serial I/O ports. The backplane accommodates 10 boards.

The System 8000 enclosure measures 33 × 19 × 24 in. Special power requirements are unnecessary because the 8000 consumes only 325W. Cooling is not needed if ambient temperature stays lower than 40°C (104°F).

The System 8000 is intended for general-business applications. With the first shipment—expected next month—Zilog will offer several higher level languages, including COBOL, Pascal, C and PLZ. FORTRAN and

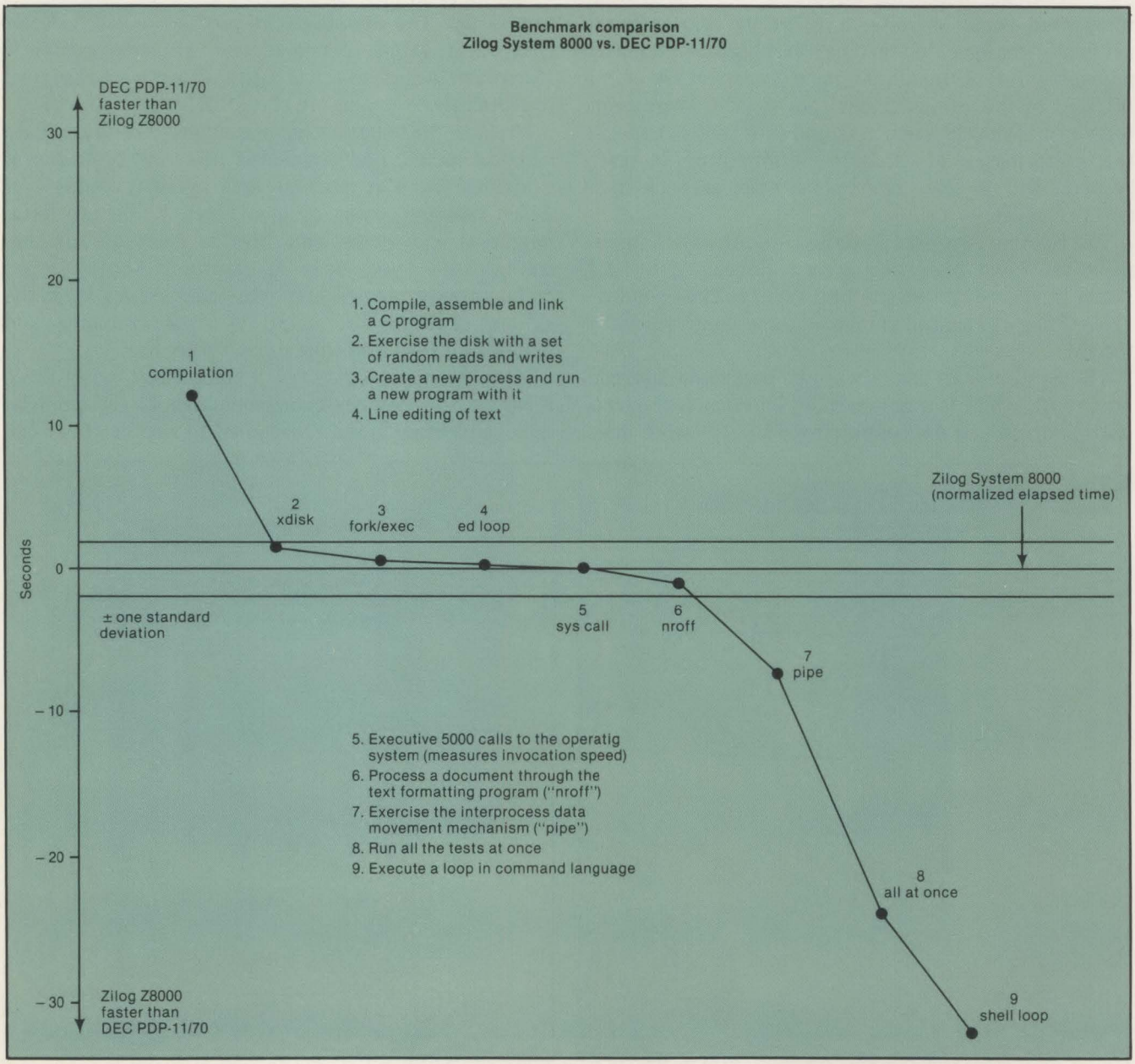


Fig. 1. Comparison of elapsed clock times *between the Zilog System 8000 and the DEC PDP-11/70 shows that the 8000 outperformed the 11/70 in four of the nine benchmarks and equaled it in one.*

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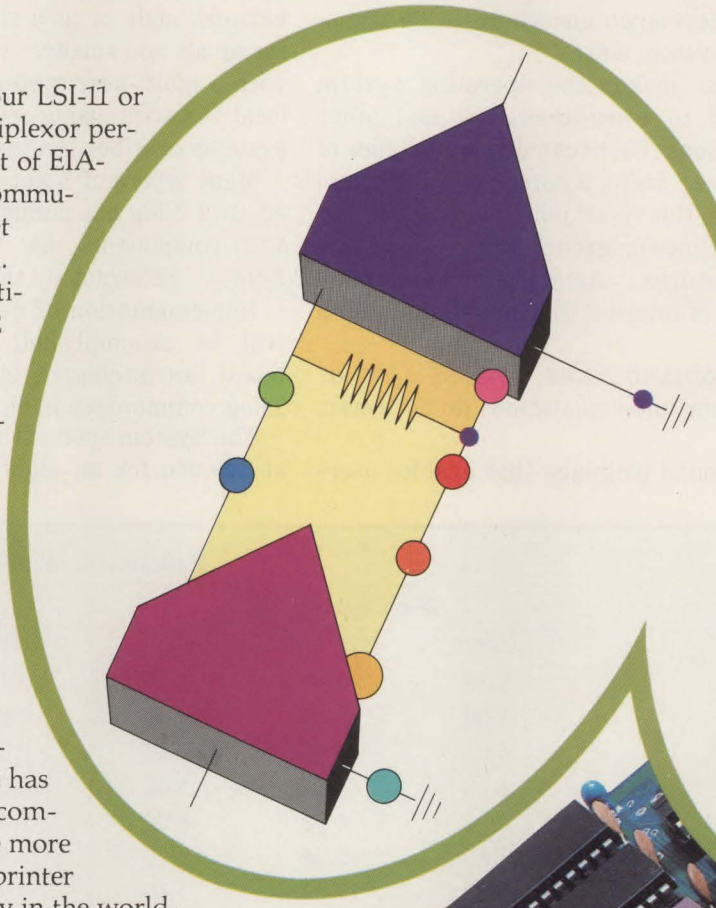

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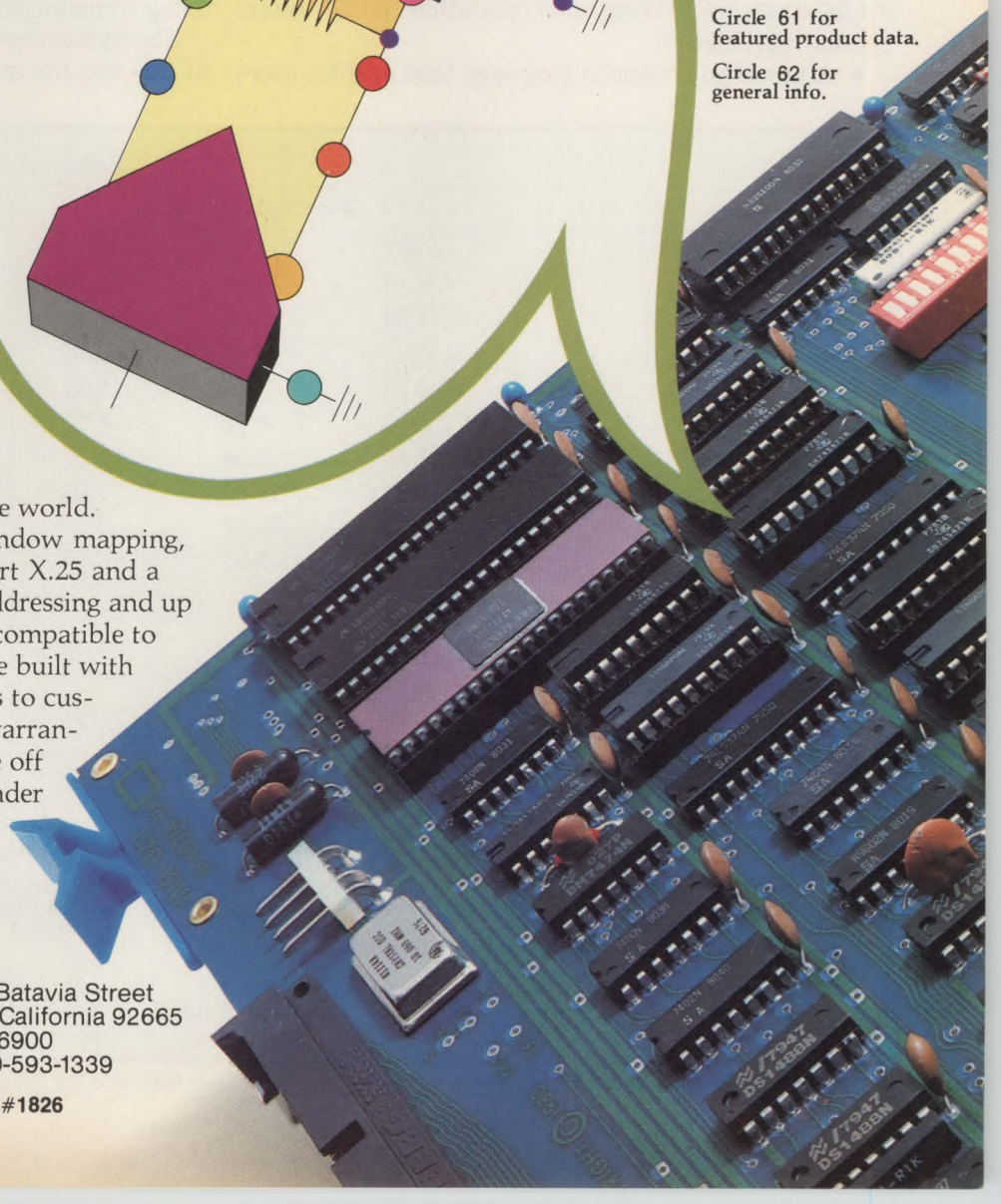
Circle 61 for featured product data.

Circle 62 for general info.



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The CPU board includes eight serial I/O ports implemented with Zilog SIO chips.

Business BASIC are expected to be available in 1982.

The Zilog COBOL for the System 8000 facilitates the transfer of COBOL application programs. The system performs word processing, general accounting, electronic mail and management information.

In the UNIX enhancements found in ZEUS, special utilities are overlaid without affecting the UNIX kernel to enable programs developed elsewhere to be transported easily to the System 8000.

ZEUS's visual editor makes the operating system especially well-suited to word-processing and other text-oriented applications. Users can display full files of text one page at a time. Using a cursor and a minimal number of keystrokes, the visual editor enables extensive editing of words, lines or groups of lines—just one of several editing features. Among other key ZEUS utilities and features of interest to commercial system users are:

- A consistent COMMAND VERB OPTIONS LIST OF FILES structure. Other implementations do not retain regular parameters.
- A powerful command language that enables users to create customized loops and control variables.
- Full ownership and access control with record locking and encryption of sensitive material.
- A customized working environment that permits bootstrapping in any program. The UNIX shell automatically starts any application program with a user's command.
- System optimization for handling random records in files as large as 1G byte.

The System 8000 and the Z-Net local area network allow the future marriage of two major computer system architectures: time sharing and distributed data processing. The 8000 can be used as a powerful network node or as a shared resource in a network of terminals and smaller systems. This lets the user begin with a multi-user system and expand through a Z-Net local network using Zilog's announced MCZ-2 series systems or other System 8000 units.

Many layers of Z-Net protocol have been implemented, and Zilog has publicized its commitment to provide VLSI components that will serve as a gateway from Z-Net to Ethernet by the mid-1980s.

Implementation of networking for the System 8000 will be accomplished through a network-interface board, an intelligent interface with its own CPU and Zilog communication chips.

The System 8000 with a 24M-byte disk drive is priced at $29,950 for an eight-user version with ZEUS soft-

	Benchmark results[1]					
	Zilog System 8000			DEC PDP-11/70		
	User[2]	System[3]	Clock[4]	User[2]	System[3]	Clock[4]
1. compile	6.78	3.76	25.60	2.13	3.43	13.60
2. xdisk	1.58	15.48	36.40	0.86	9.43	34.66
3. fork/exec	0.00	5.32	7.40	0.00	5.23	6.66
4. ed loop	4.28	4.10	15.60	3.03	4.73	15.30
5. sys call	0.26	4.82	6.00	0.13	5.96	6.00
6. nroff	17.10	5.58	26.20	13.93	7.33	27.30
7. pipe	0.08	10.70	11.80	0.10	18.66	19.66
8. all at once	64.68	32.62	200.60	80.34	22.60	224.60
9. shell loop	1.54	8.08	12.60	1.46	9.56	45.30
Terminal output 10,000 writes of one character	0.80	12.00	13.00	0.30	14.90	17.00
1000 writes of 10 characters	0.00	3.90	11.00	0.10	3.60	11.00

Notes:

1. The resolution of these measurements is 1 sec. for the elapsed time and 1/60 sec. for the execution times. The elapsed times are much larger than the sum of the two execution times due to time spent in I/O wait state or in running other programs. All numbers shown are averages of multiple runs. Fig. 1 illustrates the above information with an indication of the standard deviation about the mean.
2. Time spent executing instructions in user mode.
3. Time spent executing instructions in system mode.
4. Total elapsed clock time to accomplish the command function.

Figure. 2. Results of the benchmark test *to compare the Zilog System 8000 and the DEC PDP-11/70.*

The ultimate single user machine

The PDS-80™ with Cache BIOS™ is a professional system designed for the most rigorous single user CP/M* environments... in business, software development, scientific, educational and industrial research... where speed and program space are critical factors.

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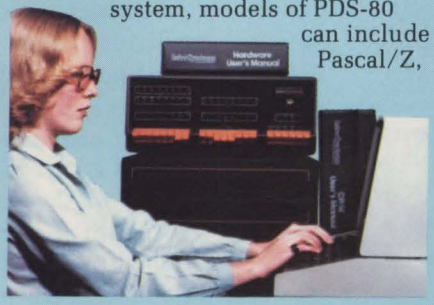
Full software support

In addition to InterSystems' Cache BIOS and the CP/M operating system, models of PDS-80 can include Pascal/Z,



our highly acclaimed Z-80® native code Pascal compiler, and InterPak 80™, a special set of utilities including a powerful screen editor and versatile spelling editor to assist in the rapid editing, proofing and documentation of your code. These powerful programming aids are also available as standalone products.

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In the UNIX enhancements found in ZEUS, special utilities are overlaid without affecting the UNIX kernel.

ware. Zilog will soon disclose plans to offer an optional 40M-byte disk drive compatible with the controller that handles the 24M-byte drive and 16- to 32-user versions of the system.

Although the basic Zilog Z8000 processor is only 70 to 80 percent as powerful as the popular DEC PDP-11/70 minicomputer, several system-level measures of the 8000 exceeded those of the PDP-11/70 in benchmark tests (Fig. 1). Fig. 2 presents the results of those tests, which compare the time required to execute identical high-level language programs in an essentially identical operating-system environment.

Because UNIX has been ported onto several computers, a set of software benchmarks can be developed that can be recompiled and executed on a wide range of these computers. The benchmarks consist of an identical set of high-level language programs and command scripts that were compiled and executed on the various machines compared. The internal timing facilities of each system were used to measure the performance of the benchmarks. The University of California at Berkeley provided the benchmark set used in these comparisons (Fig. 2) and ran the set in several UNIX-based systems.

The benchmark tests were compiled and extensively validated with multiple executions on two systems at Zilog:

- a System 8000, running with 512K bytes of primary memory and a 24M-byte disk drive
- a DEC PDP-11/70 system, running with 768K bytes of primary memory and three 80M-byte disk drives.

The benchmark results indicate that the System 8000 compares well with the PDP-11/70 when the elapsed clock time to complete the task is considered. As Fig. 1 illustrates, most of the measurements are within the range of one standard deviation.

At least part of the reason that compilation (test 1 in Fig. 2) is slower on the System 8000 results from the use of a very powerful assembler, PLZ/ASM, for assembling the compiler output. PLZ/ASM, a structured assembler with many high-level language features, is necessarily slower than the simpler assembler used by the PDP-11/70 compiler.

Particularly important is the time to complete all of the tests when they are run simultaneously. This is a measure of the effective throughput of the systems in a moderately heavy-load condition. Here the System 8000 is a clear winner, outperforming the PDP-11/70 by more than 11 percent. ■

E.J. McCauley is a system architect, **Eric N. Doka** is general systems marketing manager and **Nabil A. Baladi** is System 8000 product manager for Zilog, Inc., Cupertino, Calif.

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Intel's Series 90/iQX. The memory

Intel's new Series 90/iQX is the first standard Intelligent Memory System to offer continuous operation and high maintainability at low cost.

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With protection like this, the Series 90 system will continue operating uninterrupted until all spare memory is filled.

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For fast, simple maintenance, system diagnostics inform the user of any

machine with non-stop intelligence.

errors it has tracked—soft or hard, correctable or avoidable—and their precise location by row and column.

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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.

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APPLICATIONS: PROCESS CONTROL

Trimming aluminum rolling costs

RAY PULLMANN, Measurex Corp.

μC-based distributed-intelligence system assures maximum speed and minimum waste as it gauges sheet thickness

For years, computer-based process-control systems have been helping aluminum producers to wring maximum performance out of their costly rolling mills. These systems constantly monitor and adjust a mill's rolls to flatten coils of aluminum stock into sheet or foil with maximum speed and minimum waste. Unfortunately, many mills have been unable to justify the use of computer-based control systems because of their high cost. Until now. Recently, the introduction of μc-based systems has brought the benefits of digital control within the reach of small mills. These systems not only lower the entry-level cost of computer control, but also offer improved maintainability through built-in diagnostic programs.

The application

Aluminum-sheet and foil-rolling mills reduce the thickness of aluminum stock (fed in coiled strips) by about 50 percent in a single pass. Eight passes transform a 0.250-in.-thick strip to a foil less than 0.001 in. thick. Early passes take about 5 min. per coil; later passes take more than an hour. The economics of installing and operating a rolling mill are awesome. A rolling mill typically requires a $7 million or larger capital investment. Operating expenses are $150 an hour and more; material costs are about $1.50 a pound

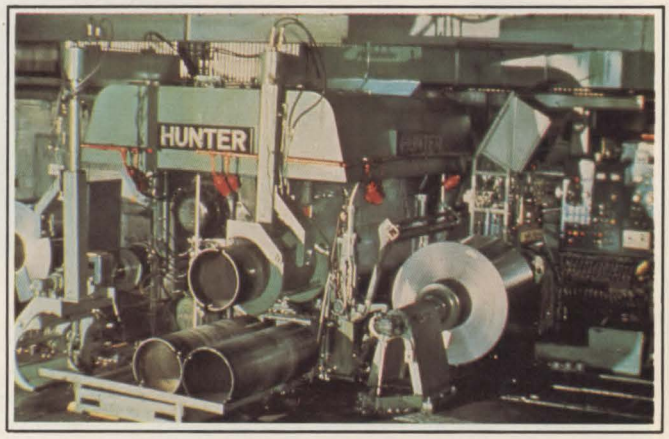
The high cost of operating a rolling mill led in the late 1960s to the introduction of computer-based process-control systems intended to optimize mill operation to produce the highest quality coils in the shortest possible time. Early systems monitored metal thickness using isotopic or X-ray sensors and increased or decreased roll pressure accordingly via actuators linked to a systems computer.

As rolling-mill controls matured during the 1970s, more and more controls were developed to wring maximum performance out of a mill. Programs such as Auto-Slowdown reduced off-spec heads and tails of rolled coils by maintaining mill speeds at highest possible levels, then decelerating at a maximum rate near the coil's end, avoiding the time-wasting stepped-slowing process typically used by operators controlling manually.

Likewise, the 1970s saw shape control introduced to the aluminum industry, using proprietary sensors to measure metal flatness on-line and to make real-time corrections to the mill. Early shape-control installations showed speed increases of 20 to 30 percent on mills that had previously been limited in speed.

Several industry trends also became apparent. Users wanted:

- "entry-level" measurement and controls for smaller mills,
- system expansion into advanced controls for larger mills,



A typical aluminum-rolling mill, *where μc-based process-control systems have helped producers wring maximum performance out of their costly manufacturing process.*

The 1970s saw shape control introduced to the aluminum industry, using proprietary sensors to measure metal flatness on-line and to make real-time corrections to the mill.

• self-maintenance capabilities for both hardware and software.

Early minicomputer systems

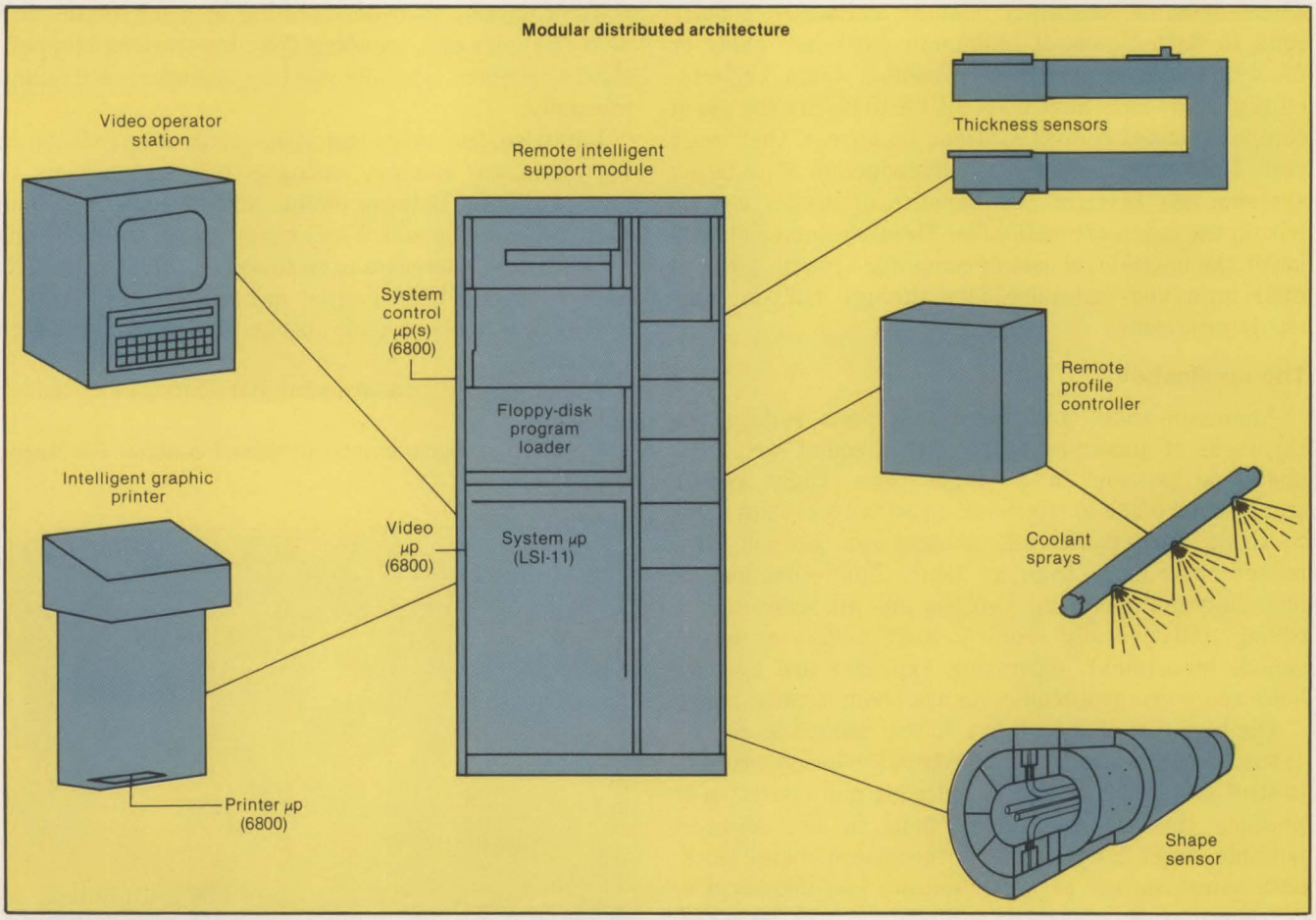
Until recently, minicomputer-based process-control systems predominated in aluminum rolling mills. For example, the Measurex 1050, introduced in 1973, used a single Hewlett-Packard 2100 minicomputer to perform four process-control functions: measurement, control, operator interface and management reporting. The minicomputer handled all thickness-sensor support functions. These included calibrating sensors for different alloys and passes and compensating on-line for varying air-temperature, oil-mist and pass-angle conditions. A control station consisting of a CRT display and three dedicated digital displays mounted in an oil-tight enclosure enabled an operator to monitor and control the mill. Process messages and management reports were printed on a Diablo Hy-Type I printer.

Early minicomputer-based systems were expensive. The Measurex 1050 system sold for about $250,000. But mill operators were willing to pay high prices because of resulting raw material savings, speed increases and scrap reduction. Many Measurex 1050 customers reported system payback periods of less than a year.

Still, minicomputer-based systems had drawbacks. For one thing, their high cost ruled them out for small mills having a low "floor" throughput level. Moreover, computational costs made system self-diagnostics quite expensive, and dictated system maintenance by highly trained service personnel.

As digital electronics became more widespread in U.S. industry during the 1970s, two developments emerged: first, computing power became much less expensive. Second, industrial customers' maintenance staffs became adept at using and troubleshooting digital electronic equipment. These industry developments suggested the possibility of designing the systems to be user-maintained, thus further improving their economic payback.

Thanks to LSI circuitry, computing costs declined enough to make an entry-level, computer-based measurement system price-competitive with conventional analog systems. And their low cost also made them



The Measurex 2002 MetalsMaster control system *is characterized by distributed intelligence. A central LSI-11 in the remote intelligent support module performs the process-control arithmetic, but as many as five other μps are employed for various subsystems. Each 2002 includes at least two M6800 μps: one each for video, printer, floppy-disk drive and control subsystem. Three additional μps can be used, depending on system complexity.*

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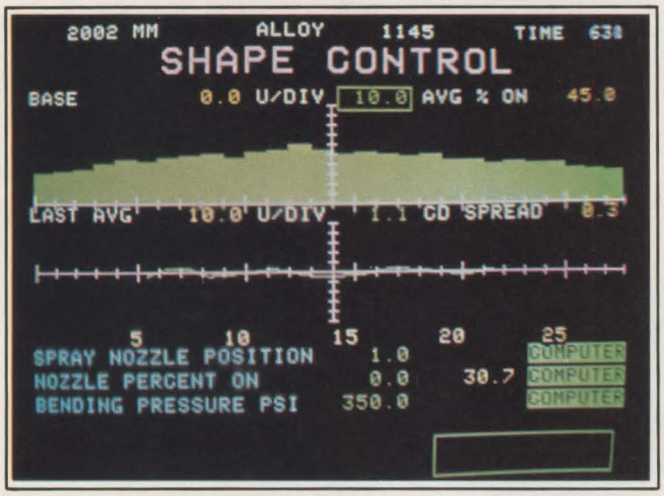
The Measurex 1050, introduced in 1973, used a single Hewlett-Packard 2100 minicomputer to perform four process-control functions: measurement, control, operator interface and management reporting.

suited for use in system diagnostics, as well as routine utility processing.

The new system

These technological developments plus the growing sophistication of the aluminum industry enabled the introduction of the Measurex MetalsMaster 2002—a multiprocessor system based on low-cost μcs. The system uses a Digital Equipment Corp. LSI-11 μc to



Video display for the shape-control process *consists of two graphs. The upper bar graph shows the duty cycle of the spray-nozzle array. The lower shape display is a cross-sectional profile of the stock.*

perform process-control arithmetic. Depending on application complexity, as many as five additional μcs support the central processor.

A Motorola M6800 μp is dedicated to controlling a color CRT used as the primary operator interface. The processor updates video displays and generates video characters. It includes ROMs for video-updating routines, and RAM for storing video-display content down-loaded from the central LSI-11. Also built into the video μp are thumbwheel-selected diagnostic routines that perform static video-alignment tests (color bars, alignment grids, etc.) and dynamic video-update tests (character and graphic generator) to allow complete CRT checkout in a matter of seconds, without special equipment and without taking the control system off-line.

Another Motorola M6800 manages the printer/plotter unit, which provides data logging, exception reporting and management-information summaries. The central LSI-11 transmits information serially to the printer/plotter through the μp. Programmed in ROM are printer/plotter logic routines to direct the printer through its various functions. The μp performs on one board functions that were previously performed on two, with benefits of reliability, maintainability and cost reduction. Of high interest to users is the built-in on-line diagnostics, which fully exercise the printer with a demanding print/plot routine in a few seconds. Evaluation of the test is visual, thus requiring no special tools or instruments to verify unit integrity.

A dedicated μp also controls coolant-spray nozzles that "thermally shape" the mill rolls to achieve a flat product. Managing the coolant-spray array duty cycles is fairly simple. The LSI-11 transmits the required duty-cycle array to the μp for the routine on/off sprays control, and is then free for more complex computations. Other dedicated μps handle inter-system communications and multiple-system software management.

There are two primary reasons for thus distributing the system's intelligence: system capability and system maintainability. By delegating some of the utility processing to dedicated μps, the central computer is free to handle more advanced controls. And by harnessing this same intelligence for self-diagnostics, most system elements can be checked on-line without special test equipment, making system troubleshooting easy and rapid. The multiprocessor architecture results in a system of greatly increased capabilities that would have been cost-prohibitive using the central minicomputer-based approach. Measurex customers can order measurement-only capabilities, complete mill-control and shape-control capability or any level in between.

Such systems are helping to reduce the cost of computer-based process control significantly. In the last eight years, the cost of equipping an aluminum rolling mill with computer-based process control has increased 25 percent in absolute terms. But the cost of process control, when normalized to aluminum costs, has declined by 60 percent in the same period. This trend will continue as more advanced control systems come on-line. ■

Ray Pullmann is industry marketing manager, rubber and metals, Measurex Corp., Cupertino, Calif.

LOOKING AHEAD IN MMS

For the last two issues of this year, Mini-Micro Systems has lined up two major survey articles that will detail available hardware and examine market and technology trends.

November's issue will focus on both add-on and add-in memory systems, and also explore the system implications of semiconductor RAM technology.

December will offer Mini-Micro Systems' third annual special report on computer graphics.

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CIRCLE NO. 68 ON INQUIRY CARD

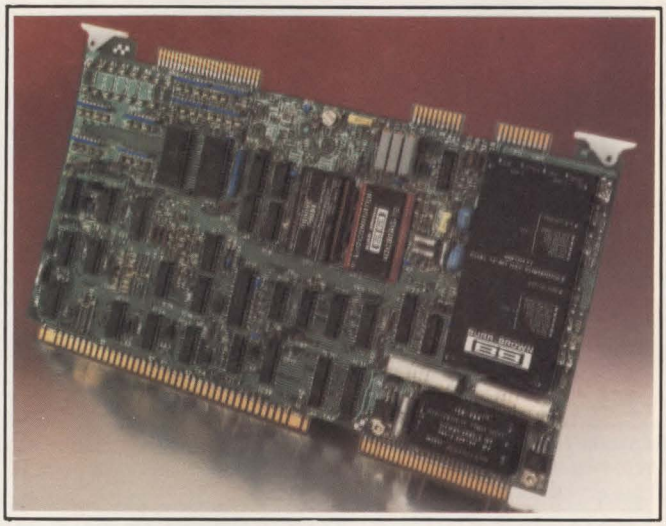
Analog I/O boards proliferate

JIM McDERMOTT, EDN Magazine

And with that growth come new designs with new features—notably increased intelligence and big savings in installation-wiring costs

Analog input/output boards that are compatible with standard μc and minicomputer bus systems continue to appear in greater numbers and with more special features than previously available. Supplied by computer manufacturers such as Intel, Mostek, Motorola, National Semiconductor and RCA, as well as independent board fabricators such as ADAC, Analog Devices, Analogic, Burr-Brown, Data Translation, Datel and Intersil (Table 1), the newest of these board-level units range from two-channel, 8-bit cards to 32-channel, 16-bit systems.

With the proliferation in card types have come new designs with new features—notably increased intelligence. This increased intelligence allows the newer boards to reside close to a system's sensors, which collect the data for computer processing, rather than in the host, saving thousands of dollars in installation-wiring costs. It also permits cards to be adjusted to the rapid updating of bus structures, making the cards essentially bus-independent. Buses are being upgraded from eight to 16 to 32 bits in as few as two to three years, rendering obsolete previous-generation cards that plug directly into a host's card cage and bus. Finally, the increased intelligence on these boards permits performance of housekeeping, overhead and other functions directly on the cards rather than in the host, putting the host's computing power to better use.



Thirty-two single-ended analog inputs *are processed by this Burr-Brown MP8418 analog I/O board with a resolution of 12 bits. It's compatible with Intel and National Multibus-oriented μcs.*

Intelligence is on the rise

Intelligent analog I/O boards communicate locally through a host computer's bus or remotely through one of its peripheral ports, using an RS232C interface, a 20-mA current loop or other standard I/O structures. Noteworthy examples of these new board types include Motorola's M68RAD1 remote intelligent conversion module, to be available in the third quarter, and National Semiconductor's BLC 8716 intelligent analog I/O board, which is available now. Analogic, a supplier to several computer manufacturers, also will soon announce an intelligent processor-independent board system designed specifically for process control.

Motorola's $850 M68RAD1, compatible with the firm's MC68000-based Versamodule system and the MC6809 Micromodule local bus extension feature, is controlled by an on-board MC68120 intelligent peripheral controller. For command and data transfers, it lets a system builder choose remote parallel or serial I/O operations to a MC68000-based Monoboard μc via a local bus extension or through an RS1422 multidropped serial communications port. Such a port supports 9600-bps operation over a maximum distance of 3000 ft.

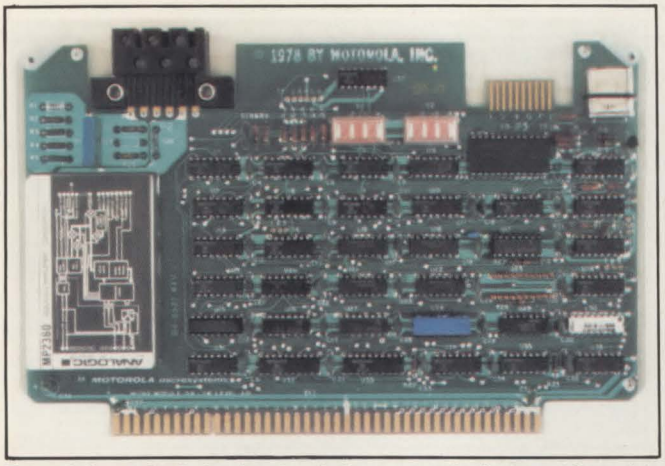
The RAD1 provides 32 single-ended or 16 differential-input A/D channels and achieves a 12-bit conversion in 25 μsec., excluding channel switching. Input signal ranges of 0V to 5V, 0V to 10V, 1V to 5V, ±5V or ±10V or current loops of 0 to 20 mA or 4 to 20 mA are possible.

National's BLC 8716 incorporates two on-board μps: a

The RAD1 provides 32 single-ended or 16 differential-input A/D channels and achieves a 12-bit conversion in 25 μsec., excluding channel switching.

Series 48 that controls the analog-input section and an 8085 that controls the digital-output section. Its older companion board is the BLC 8715, an 8085A-only unit priced at $1400. The new board's analog section is isolated from the rest of the board but communicates with the non-isolated sections through optical links.

The less-than-$2000 8716 is compatible with the Multibus, and its analog-input-to-digital-conversion and analog-output portions are isolated and floating with respect to the Multibus digital common. The analog circuitry is a single-ended, floated and guarded system that enables measurement of signal levels as low as 10



Especially suited *for low-level thermocouple inputs, Motorola's Micromodule 15B provides cold-junction compensation through a diode and resistor network.*

mV FS in the presence of several hundred volts of common-mode noise. This capability results from the use of isolated DC/DC converters and optical isolators, which transfer information between the on-board μps.

System integrators can configure a 32-channel junction field-effect transistor multiplexer input on the 8716 under program control to provide 32 channels of isolated input carrying the same common-mode voltage. They can alternatively arrange this multiplexer input for 16 input channels with 16 different common-mode voltages, or for isolated and paired measurements, under program control.

The 8716's Multibus interface includes bidirectional data buffers, address buffers, clock drivers and bus-control logic. An H8218 bus controller furnishes multimaster capability. Arranged in a serial priority chain, it accommodates as many as six masters on the bus, while a parallel-priority arrangement accommodates as many as 16 masters.

Another recently introduced intelligent analog I/O board is Intel's $2000 Multibus-compatible SPC 88/40. This board uses the firm's 8088 16-bit μp in an 8-bit mode and furnishes 32 channels of analog I/O and 24 lines of digital I/O.

A key feature for measurement and control applications is the 8/40's capacity for four of Intel's EEPROMs (expandable to eight). These EEPROMs enable users to write setpoints into PROM and to retain the information in case of power failure.

Another series of Multibus-compatible intelligent I/O boards is Data Translation's DT-3752/2754/2755, based on the 8085 μp. All three units provide a complete on-board data-acquisition system and enable users to process data with or without host-CPU intervention. They feature 12-bit resolution, are priced at $1895 and are key elements of the firm's Midax measurement-and-control system.

The 3752 and 3754 handle 16 single-ended or eight differential analog inputs: the 3755 provides four differential ports, with optional 14- and 16-bit resolutions on the 3752 and 3754.

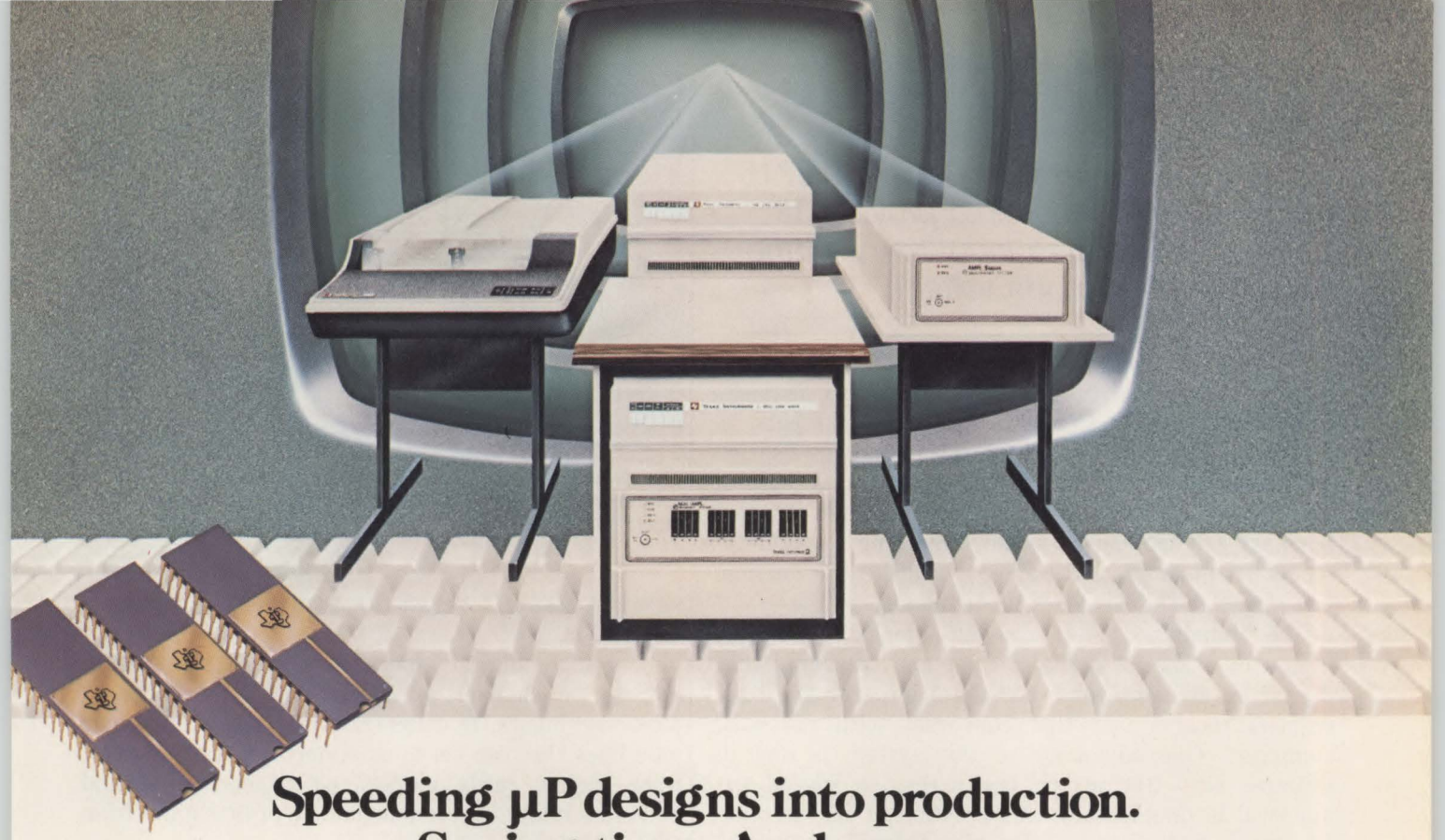
Intelligence: where the action is

Because on-board intelligence encourages the design of systems that locate analog I/O boards close to a system's sensors rather than at the host computer, the potential cost savings are significant. Assuming a representative value of $3 per ft. for running regular coaxial or other wire ($15 per ft. in a conduit), wiring 16 sensors located 1000 ft. from the host and transmitting

Buses and associated computers	Board manufacturers					
	ADAC	Analog Devices	Analogic*	Burr-Brown	Data Translation	Datel
Motorola 6800 (Exorciser, Micromodule)		X	X	X		X
Multibus (Intel, National)	X	X	X	X	X	X
Q-Bus (DEC LSI-11 PDP-11)	X	X	X	X	X	X
STD bus (Mostek, Pro-Log)		X			X	

*OEM users only

Table 1. Popular computer buses *and independent suppliers of bus-compatible analog I/O boards for them.*



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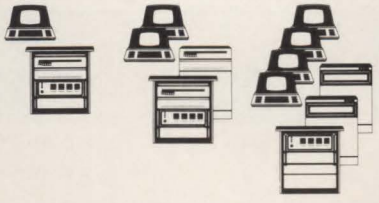

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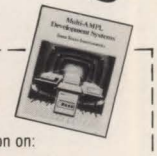

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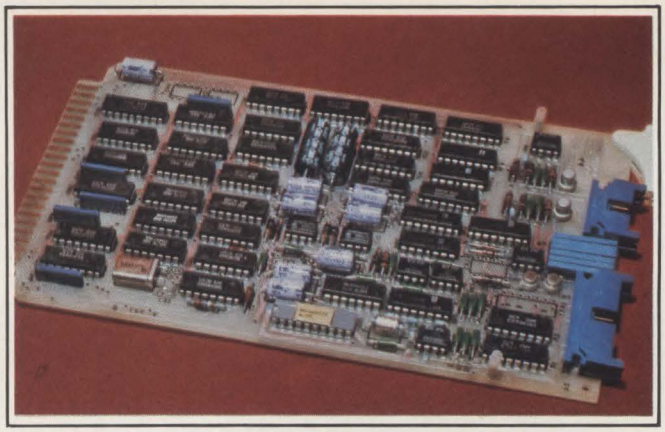
CIRCLE NO. 69 ON INQUIRY CARD

System integrators can configure a 32-channel junction field-effect transistor multiplexer input on the 8716 under program control to provide 32 channels of isolated input carrying the same common-mode voltage.



This low-power CMOS *analog A/D/A board (CPD18S644) from RCA provides 16 single-ended or eight differential A/D inputs and two D/A outputs with 8-bit resolution. Power drain is only 50 mA at 5V.*

analog data in a 4- to 20-mA loop over this distance would cost $48,000. Converting the analog inputs to digital form close to the source and transmitting a serial bit stream back over one four-wire link or one twisted pair is less expensive. With the single twisted pair, as much as $40,000 can be saved, according to Intersil, which has updated its Remdacs I with the introduction last month of the Remdacs II card family.

The Remdacs system converts analog or digital inputs to a special digital format and transmits this digital bit stream over a twisted-pair party line to a transmit/receive unit that converses with the host computer. One advantage of this system is that it requires only 24V AC on the wires, so special UL approval is unnecessary. A limitation of the system, however, is the need to linearize transducer inputs, such as those from thermocouples, in the host.

The system includes a new motherboard with one to five slots at approximately $112 per slot, into which the remote A/D sensor cards are plugged. This board comes in a standard- or industrial-grade cabinet located close to the group of sensors being monitored.

Also included in the Remdacs II family are two $550 16-channel temperature-sensing units (REM-24-T216E/U) and a $668 16-channel 4- to 20-mA card (REM-24-L216E/U) for applications in which a pre-existing installation requires this type of remote link. These also are two $550 general-purpose analog-voltage boards with preamplifiers that accept 16 (REM-24-V216E/U) or eight (REM-24-V208E/U) inputs as low as 10 mV FS.

For remote digital inputs, the $455 REM 24-D210 provides 36 channels of digital I/O. It features 16 CMOS-level inputs, 16 CMOS (2.75-mA) outputs and four CMOS lines that can serve as either inputs or outputs. Other digital cards employ electromechanical and solid-state relays to accommodate AC or DC signals from 5V to 230V.

Remdacs II cards handle 512 remote stations; Remdacs I units handle 206 stations. The twisted pair linking these stations (through the remote receiver/transmitter cards) to the receiver/transmitter at the host computer can be as long as 5000 ft. Each remote station multiplexes as many as 16 analog or digital signals, providing as many as four control outputs and a maximum of 8192 data channels or 2048 control signals with one receiver/transmitter.

Multiplexing and A/D conversion are μc controlled and occur 7.5 times per sec. Digitized data is stored in on-card memories for polling by the receiver/transmitter, which continuously looks at the transmission line to

Microboard	Version	Resolution (bits)	No. of channels	I/O voltage ranges (V)	Power (V)	Power (mA)	Price (single-unit)
CDP18S644	A/D[1]	8	8/16	±2.5 or 0 to 2.5	+5	50	$295
	D/A[2]	8	2	±2.5 or 0 to 2.5			
CDP18S647	D/A[2]	8	2	±2.5 or 0 to 2.5	+5	22	$245
CDP18S648	A/D[1]	8	8/16	±2.5 or 0 to 2.5	+5	40	$245
CDP18S654	A/D[3]	8	8/18	0 to 2.5	+5	15	$249
	D/A[4]	8	2	0 to 2.5			
CDP18S657	D/A[4]	8	2	0 to 2.5	+5	9	$99
CDP18S658	A/D[3]	8	8/16	0 to 2.5	+5	13	$199

Notes: 1. Differential or single-ended inputs
2. Differential or single-ended outputs
3. Single-ended input
4. Single-ended output

Table 2. Low-power Cosmac *D/A and A/D microboard-module system.*

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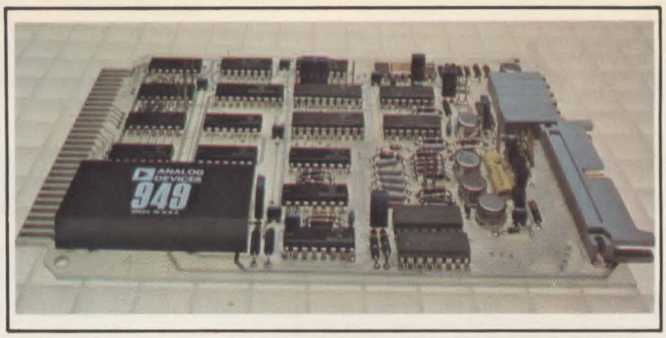
CIRCLE NO. 70 ON INQUIRY CARD

Because on-board intelligence encourages the design of systems that locate analog I/O boards close to a system's sensors rather than at a host computer, the potential cost savings are significant.



An input/output combination *board compatible with the Pro-Log and Mostek STD bus μcs, Analog Devices' RTI-1225 is fabricated on 4.5- × 6.5-in. cards to fit into in small dedicated systems.*

detect broken or shorted wires and provide error checking for extraneous noise pulses in the data field.

Protocol in the Remdacs system is supported by the receiver/transmitter card; in competing systems, the host computer performs that function. This capability arises in part from the unique bit structure of the Remdacs's remote link.

DAC uses four-wire link

Providing potential hardware savings as the Remdac system does, Burr-Brown's MCS100 modular expandable data-acquisition system uses a four-wire link rather than a twisted pair. It packages as many as nine I/O cards plus an overhead CPU card in one chassis. Base price for the card cage, CPU card and a communications card is $1800; I/O cards average $500 each. Compatible with the Multibus structure, these cards mount in industrial National Electrical Manufacturers Association and explosion-proof enclosures and in open card-and-rack chassis.

Standard analog cards have eight channels of differential inputs and 16 single-ended inputs and accommodate voltages from ±10 mV to ±5V FS. An analog input-expander board furnishes 48 CMOS differential channels. The cards communicate with the host computer using serial asynchronous ASCII at standard 19.2K-bps rates. Data transmit and receive capability is also available with RS232C or four-wire, 20-mA current loop as long as 5000 ft.

With a multidrop feature, as many as 15 MCS100s per port can provide a maximum of 16,320 I/O signals on one serial communications line. Channels are scanned at 960 per sec. maximum for analog I/O and 30,000 per sec. for digital I/O.

The MCS100 accepts Burr-Brown's standard line of Multibus-compatible A/D I/O boards. A special feature of the firm's $750 16-channel thermocouple sensor cards is measurement of the reference-junction temperature, which in this case occurs at the screw terminals where the thermocouples' wires connect. This temperature gets reported to the host computer, which accesses lookup tables to convert the thermocouple voltage to its corresponding temperature reading.

How to linearize thermocouple outputs is a venerable problem that systems handle in a variety of ways. For example, in contrast to Burr-Brown's scheme, Motoro-

For more information...

For more information on the analog I/O products discussed in this article, circle the appropriate numbers on the reader inquiry card or contact the following manufacturers directly.

ADAC Corp.
70 Tower Office Park
Woburn, Mass. 01801
(617) 935-6668
Circle No 449

Analog Devices
Box 280
Norwood, Mass. 02062
(617) 329-4700
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Analogic Corp.
Audubon Rd.
Wakefield, Mass. 01880
(617) 246-0300
Circle No 451

Burr-Brown Research Corp.
3631 E. 44th St.
Tucson, Arizona 85713
(602) 747-1111
Circle No 452

Data Translation Inc.
100 Locke Dr.
Marlboro, Mass. 01752
(617) 481-3700
Circle No 453

Datel-Intersil Corp.
11 Cabot Blvd.
Mansfield, Mass. 02408
(617) 339-9341
Circle No 454

Intel Corp.
3065 Bowers Ave.
Santa Clara, Calif. 95051
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Intersil Inc.
10900 N. Tantau Ave.
Cupertino Calif. 95014
(408) 996-5000
Circle No 456

Mostek Corp.
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Carrollton, Texas 75006
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Motorola Semiconductor Products Inc.
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(602) 962-2855
Circle No 458

National Semiconductor Corp.
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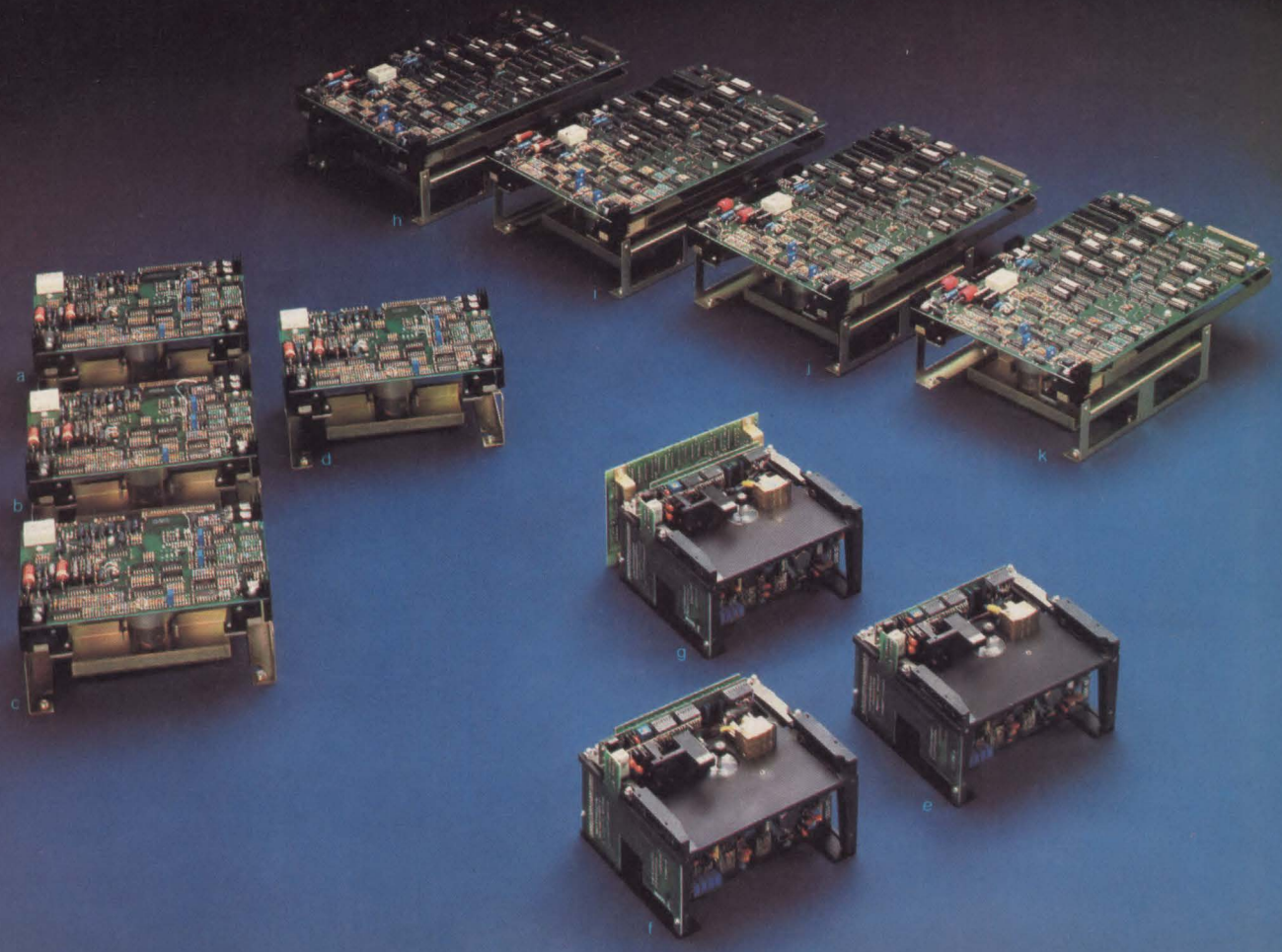
d. 20 Mbytes/90 ips	g. Codec electronics	k. 20 Mbytes/90 ips



CIRCLE NO. 71 ON INQUIRY CARD

Remote battery units or those with battery backup call for boards and μcs with substantially lower drain than the ampere level figures of many standard TTL units.

la's $595 Micromodule 15B A/D board—a 16-bit thermocouple-oriented unit with on-board cold junction and built-in linearization—employs a 16-bit dual-slope conversion technique.

Rather than using a fixed-frequency clock to count up and down, the board incorporates a nonlinear clock designed specifically for thermocouples. When the up/down counter starts to count down from the input-signal level back to the zero crossing, the rate of this nonlinear clock, which is generated by a binary rate multiplier, gets selected by on-board switches set to correspond to the particular thermocouple used. As the clock counts down (or up), its nonlinearity cancels that of the input-thermocouple signal.

Boards for battery use

One class of analog-board applications—remote battery-operated units or those with battery backup—calls for boards and μcs with substantially lower drain than the ampere-level figures of many standard TTL units. To fulfill these low-drain requirements, RCA has developed a line of six CMOS A/D, D/A and A/D/A boards compatible with the Cosmac Microboard Milliwatt Computer systems (Table 2). Requiring a 5V supply, these boards achieve 8-bit resolution for both A/D and D/A conversion.

The CDP18S644 and -S654 incorporate A/D and D/A sections as well as 16 multiplexed single-ended or eight differential inputs. The -S644 can accept and produce bipolar and unipolar inputs and outputs, while the S654 suits only unipolar inputs and outputs. Conversion time for all of these boards equals 215 μsec. for A/D inputs, plus 15-μsec. settling time for D/A outputs.

The -S644 requires 50 mA; the -S654 requires only 15 mA. The least power-hungry member of the family is the -S657, a two-channel DAC unit that draws only 9 mA. I/O voltage ranges span either ±2.5V or 0V to 2.5V.

Boards from board houses

In addition to the analog I/O boards from μc manufacturers, many similar boards are available from analog-board specialists. These boards serve both the computer firms' units and the board specialists' own bus-compatible lines.

ADAC, for example, offers an extensive line of analog I/O boards compatible with Digital Equipment Corp.'s LSI-11, PDP-11 and PDP-8/A, Data General Corp.'s Nova and Intel's Multibus. Analog Devices provides analog I/O subsystems that mate with Intel's products; the $700 to $906 RTI 1200 series is electrically and mechanically compatible with the Intel SBC series single-board computers and with the Intel MDS development system, National Semiconductor Corp.'s BLC μc boards and other Multibus-compatible systems.

Other Analog Devices cards are compatible with Texas Instruments Inc.'s TM-990/100M 16-bit μc ($436 RTI-1242, $744 RTI-1243) and Motorola's Micromodule series single-board μcs. Analog Devices also offers a combination A/D I/O board (the $439 RTI-1225) for the STD bus μcs produced by Pro-Log and Mostek.

A key element of all of these Analog Devices systems is memory mapping, which makes a card appear to the host μc as a block of contiguous memory locations.

Mostek itself offers the MDX series STD bus-compatible boards, which includes a $449 analog I/O board (MDX-A10); a $285 16-channel, 8-bit A/D board (MDX-A/D8); a $598 four-channel, 8-bit D/A board (MDX-D/A8); a $583 16-channel, high-level 12-bit A/D board (MDX-A/D12); and a $739 four-channel, 12-bit D/A board (MDX-D/A12). The analog I/O board and the 16-channel, 8-bit A/D unit are available as 2.5- or 4-MHz parts with no price differential. Mostek also offers the SDE series boards, based on the double-Eurocard format.

Data Translation supplies not only compatible A/D subsystems for DEC, Data General and Intel computers, but also a line of Datax II data-acquisition modules (12 bits, $325; 16 bits, $1195) designed to interface easily with all popular minis and μcs. These modules feature 16-channel multiplexers. If users need more than 16 channels, companion expander modules are available to increase input capability to 32 or 64 channels.

Datel-Intersil, which markets the Sinetrac series analog boards for the Multibus, DEC's Q-bus and Motorola's Exorciser μc systems, announced an industrial Multibus-compatible D/A board (ST-728) in July, with eight 4- to 20-mA outputs. This board's 8- and 16-bit data structure makes it compatible with 8- and 16-bit CPUs.

In addition to a 4- to 20-mA current loop, four other user-selectable output ranges are available: ±5V, ±10V, 0V to 5V and 0V to 10V. These values permit easy interfacing with industrial instrumentation. ■

Jim McDermott is special features editor of EDN magazine, which ran this article in its Aug. 19, 1981, issue.

NEXT MONTH IN MMS

Software—data-base management and operating systems—will be the focus of the feature article section in Mini-Micro Systems next month. Key articles planned include:

- DBMS survey—a compilation of data-base systems, packages and aids for use with μcs and minicomputers. The article will be written by Harvey M. Weiss, a frequent contributor to Mini-Micro Systems.
- A tutorial on the differences between relational and network approaches to data base design. This article will be written by Cullinane Corp.'s Dr. Charles Bachman, winner of the Turing Prize for his DBMS work at General Electric.

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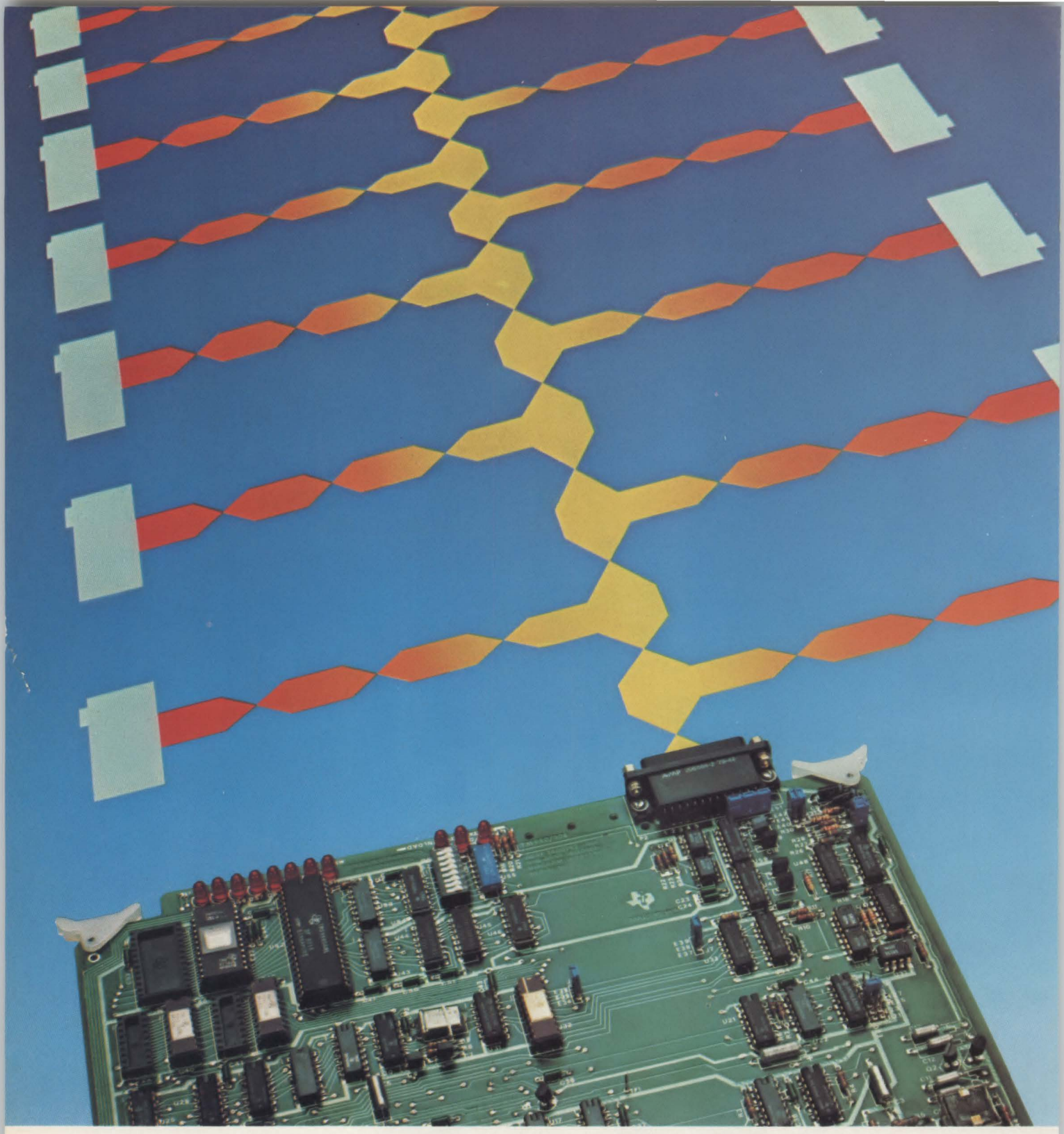

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Either way, the 308 module is an intelligent interface, with processing handled by an on-board TMS9980 microprocessor. Firmware supports address decode, down-load command decoding, self test and other primitive functions.

New Communication Expander Module

A second new TI module — the TM990/307 — allows communication with up to four devices such as terminals or modems (see diagram at right). It provides four RS 232C EIA ports using standard RS232 connectors, and one port can be RS422. A Bell 801 automatic calling unit interface is on board. Optionally, four channels of synchronous communication are possible by changing onboard devices to synchronous controllers. A loopback permits self-testing.

Demonstration Software

Demonstration software for the new communication modules enables the user to check for proper operation quickly and easily. The software listings will also facilitate application programming.

Software Support

Coming soon for the new TM990/308 module: two new software packages.

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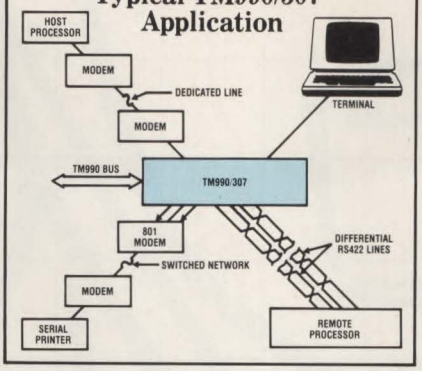
The EIA Software Communication package offers programmable features like character width, parity, start stop bits, and baud rate. Each port can be programmed independently to a particular priority level, special control character set, etc.

Typical TM990/307 Application



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Fast help: Demonstrations of the TM990 modules can be arranged at local TI distributor Systems Centers.

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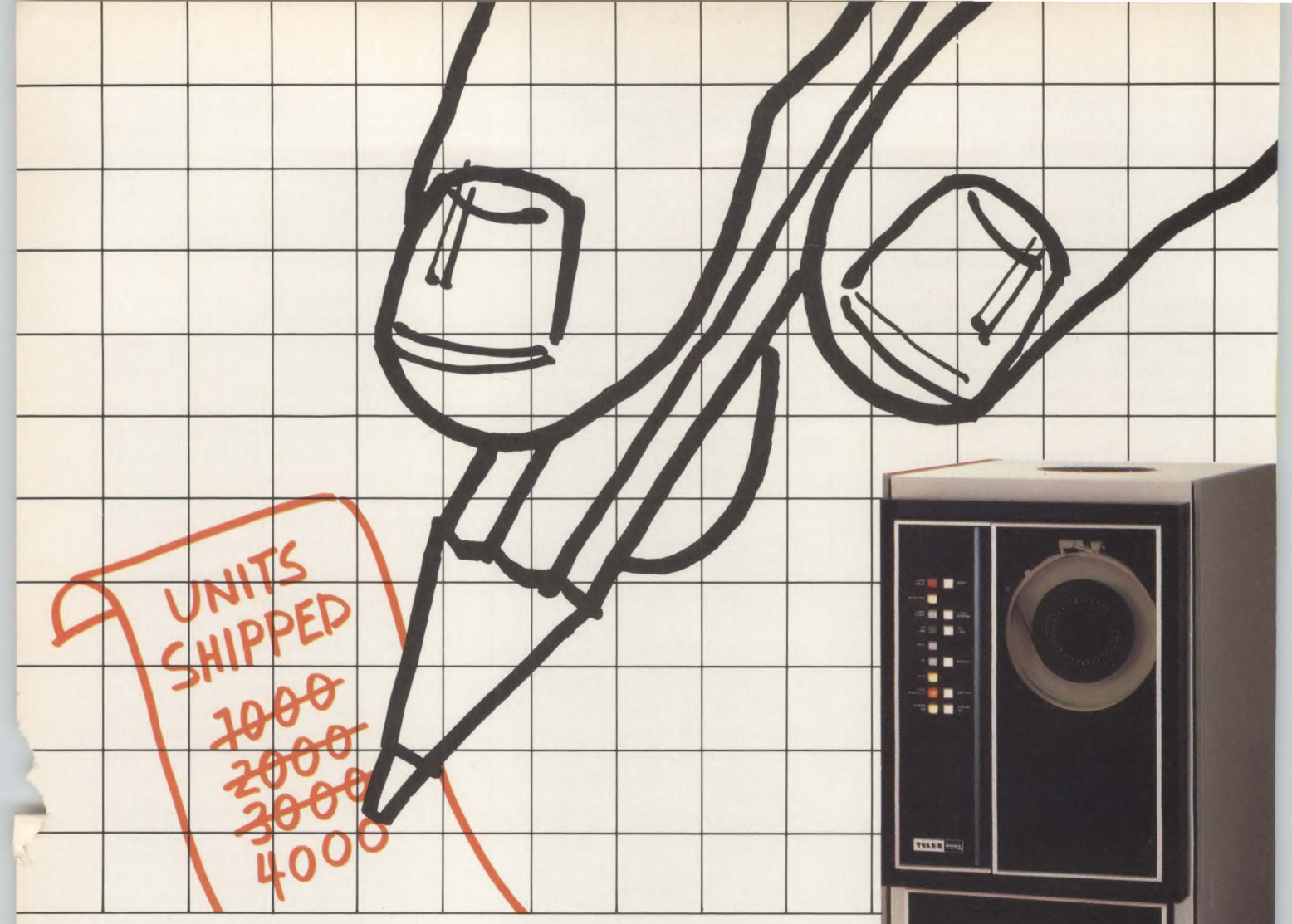

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EMERGING TECHNOLOGY

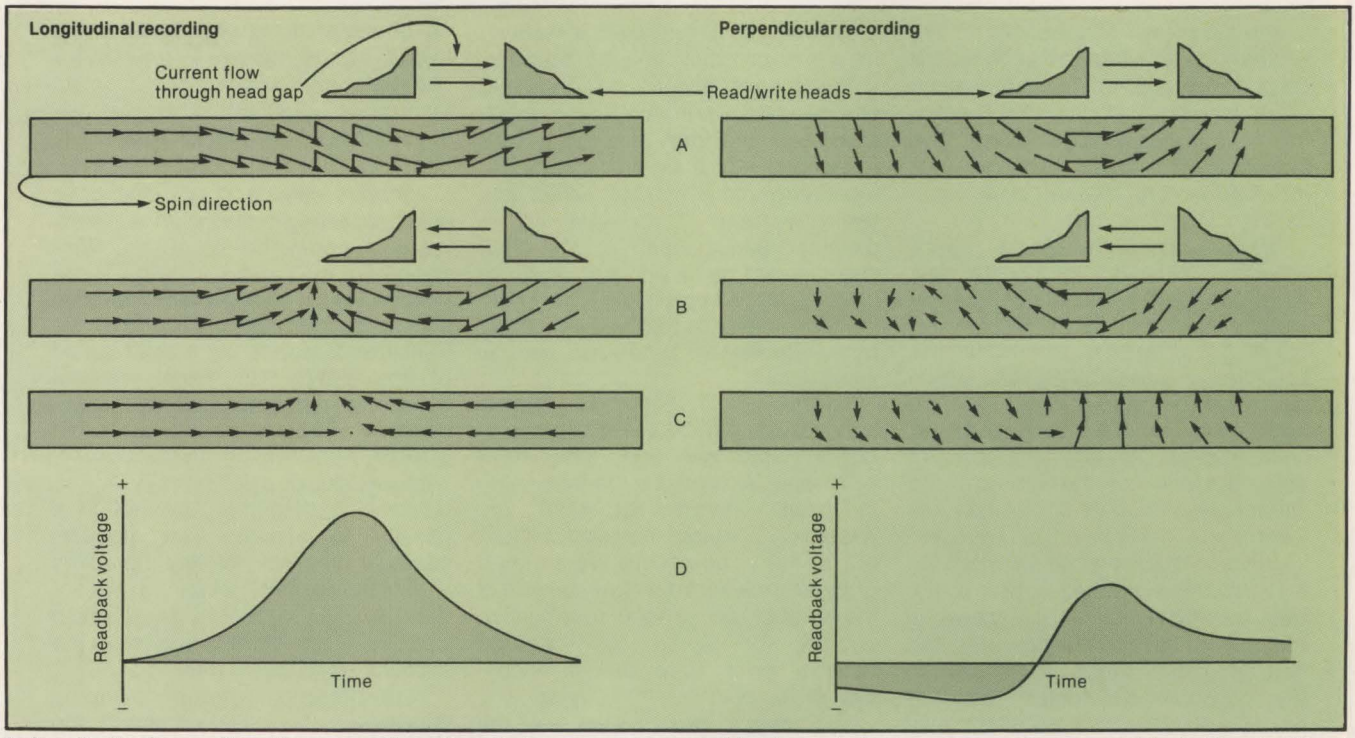
Perpendicular recording: from lab to market

JOHN TRIFARI, West Coast Editor

Vertically oriented rigid disks promise to triple data storage; first product may be ready for OEMs next year

Perpendicular recording, a high-density data-storage technique limited so far to the laboratory, may make its first commercial appearance next year in the form of 5¼- and 8-in. Winchester media from Lanx Corp., San Jose, Calif. And if all goes according to plan at the five-month-old company, the impact on both existing and future drive technologies could be dramatic. Lanx president and co-founder Bob Potter says that using media designed for perpendicular recording will permit drive vendors to boost flux reversals per in. (hence bit densities) on existing 3350-technology Winchester-disk drives by a factor of two or three, pushing bit densities from 6400 bpi into the 20,000-bpi range. If thin-film read/write heads such as those introduced last year on IBM's 3370 14-in. drives are used, Potter says, storage capacities could soar even higher, with linear bit densities in these drives reaching 30,000 to 60,000 bpi.

The key to the high bit densities claimed for perpendicular recording is found in the magnetic fields recorded onto a disk and the transitions that occur between them. In conventional (longitudinal) recording techniques used in the oxide-coated and thin-film-plated



In longitudinal recording, *the magnetic pattern before current reversal is shown in A, the pattern after reversal in B. The stabilized transition that represents either a binary ONE or binary ZERO is shown in C. Read-back signal generated by read head as it passes over transition comes next (D). This signal diminishes and broadens as bit densities increase.* **In perpendicular recording,** *the same pattern, transition and stabilized states are shown when media oriented to vertical recording is used instead. Final figure shows signal generated as read head passes over transition. Note that in longitudinal recording, each magnetic reversal produces an output pulse. In vertical recording, each reversal produces a sign change. Source: IEEE, Transactions Magazine, MAG-16, 967 (1980).*

In bit shift, overlapping voltage pulses are summed together, creating the impression that a given bit has been shifted in relation to its clocking signals.

media supplied to drive vendors today, these fields can be viewed as an array of bar magnets lying end to end.

If there is no change in the binary data being recorded onto the disk (for example, if a string of binary zeros were written), there will be no transitions between magnetic fields, and no signal will be generated in the read head as the disk rotates beneath it. In this case, data will be taken off the disk by clocking signals.

However, if the binary data does change—a binary zero followed by a binary one, for example—the poles of the magnetic fields on the disk will be reversed horizontally, creating a flux transition that will be picked up by the read head. These transitions are then translated into voltage outputs.

For data capacity and integrity, the sharper these outputs, the better. Instead of a voltage output spike, what results is an output pulse. The natural resistance of the medium and the head is one reason that transitions do not occur instantaneously. Also contributing to this is the fact that when poles of the magnetic fields are reversed and oppose each other, they push themselves apart. Another contributor to the formation of an output pulse is the impact of magnetic crosstalk from adjacent tracks.

As a result, when bit densities are increased—by cramming more magnetic fields into a given linear measurement—sequential flux transitions can lead to output voltage signals tht overlap each other, and at the drive level, causing a phenomenon known as bit shift.

In bit shift, overlapping voltage pulses are summed together, creating the impression that a given bit has been shifted in relation to its clocking signals. For the most part, however, read errors resulting from bit shifts are predictable, and, within limits, they can be minimized by control electronics in the drive by using "write precompensation," a technique in which the controller determines where the shifted bit should be in relation to its clocking signal and shifts it beforehand.

Storing the data

Whether or not write precompensation is used, however, there is a physical limit to the amount of data that can be stored efficiently, given a specified flying height and gap length for the read head, and a specified thickness of the magnetic coating applied to the disk substrate. In 3350-technology Winchesters using oxide-coated media, this limit occurs as flux reversals approach 10,000 fcpi.

A different set of rules applies in perpendicular recording, however. First, the bar magnets used to

JAPAN ALSO GOING PERPENDICULAR

Vertimag, Inc., Minneapolis, is the second U.S. firm established to exploit perpendicular recording. Its president, Clark Johnson, believes that "Japan, Inc." is preparing to use the technology to break into the OEM rotating-memory market and dominate it.

"People aren't aware of what's going on," he says. "With pitifully few exceptions, the Japanese are the only people pursuing perpendicular recording." Johnson points to the activities of Lanx Corp., IBM, which pioneered the technology 10 years ago, and to his own year-old company, as the only examples of active U.S. efforts in the technique. "In Japan, there are nine companies that I know are working on it," he says.

Johnson does not specify when the first Japanese product aimed at the OEM disk-drive market will appear in the U.S. He speculates, however, that first Japanese efforts will appear in the consumer-electronics field. "A whole new class of applications may be opening here," he says. "The high packing densities possible with perpendicular recording will make digital audio possible, for example."

Vertimag's first product is working in a pre-production environment, Johnson says, and could be ready in commercial form in about 18 months. It will take the form of a floppy disk measuring 5¼, 8 or—in response to the hardware introduced earlier this year by Sony Corp.—3½ in. in diameter (MMS, April, p. 17). Flux densities will be 50,000 fcpi or higher using a cobalt-chromium sputtering process similar to that first described by a Japanese professor several years ago.

Today's 5¼-in. floppy-disk drives, such as Shugart Associates' double-density, 500K-byte SA450, operate at 5876 bpi; Micropolis's 1M-byte, 100-tpi 1055 operates at 6380 bpi. Assuming a 10-fold increase in linear bit density by using Vertimag's proposed medium and the retention of the 40-track-per-surface specification set for the SA450, total storage capacity on a 48-tpi, 5¼-in. floppy-disk drive could reach 5M bytes.

"Vertimag's new media will be designed to accommodate such existing drives to the extent possible," Johnson says. For example, Vertimag's media prototypes are operating on off-the-shelf 100-tpi drives using hybrid heads mounted onto stock carriages and conventional contact techniques. Whether the company will manufacture the media apparently has not been decided, however.

Johnson sees a floppy-disk drive using Vertimag's media as a direct, low-cost competitor to 5¼-in. Winchesters in capacity and, more importantly, in transfer rate because the same number of bits can be transferred despite the slower speed of the floppy-disk drive. Despite Johnson's concerns, industry analyst Andrew Roman sees Japanese efforts faltering in this country. "They're doing a lot of R & D," he points out, "but they are not in a position to innovate OEM products because they lack the key ingredient —marketing. Technology is secondary. A good marketing organization can take a bad product and make it a success—and vice versa."

Nonetheless, Johnson remains concerned about the emphasis the Japanese have placed on perpendicular recording. "We're going to get wiped out," he says, "and nobody seems to give a damn."

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The first disks from Lanx will achieve the orientation required for perpendicular recording by sputtering two metallic films onto a substrate instead of one, as in conventional recording, and that the resulting magnetic coatings will be approximately as thick as those of conventional oxide-coated media.

visualize longitudinal recording techniques must be stood on end and be arranged like soldiers in ranks. When there is no transition between the pulses, data are clocked off the disk. When a transition does occur, however, it is narrower, sharper and faster than a pulse generated from a longitudinal magnetic array because, instead of a unidirectional voltage pulse, each transition causes a sign change in the output signal.

The result, Potter says, is less bit shift given a specified head-flying height and bit density. "Or viewed another way," he explains, "it means that given a certain level of bit-shift tolerance, bit densities can be cranked up." Other than the general concepts behind perpendicular recording, some of which were published by Potter during his tenure at IBM's San Jose disk-drive facility, details of Lanx's proposed product and the company's plans are being kept under wraps. Potter also prefers not to discuss the origin of the company's name. It is reported, however, that the first disks from Lanx will achieve the orientation required for perpendicular recording by sputtering two metallic films onto a substrate and that the resulting magnetic coatings will be approximately as thick as those of conventional oxide-coated media.

Potter says that this thick-film semiconductor technology will give Lanx a big edge over what some observers believe is close competition—thin-film-plated disks. "The charter of the company is to produce large quantities of media for the OEM market," he explains. "It is far more difficult to produce the 2-μin. films needed to increase bit densities using longitudinal recording techniques than it is to make the 20-μin. coatings required for perpendicular recording."

He also points to product reliability, noting that thick-film techniques promise to eliminate the corrosion problems that he says have affected some thin-film-plated disks, an allegation that causes vendors of this type of medium to bridle. "Corrosion is a problem in iron-rich films," says Marvin Garrison, development manager for disk media at Ampex Corp., Sunnyvale, Calif., "but media using cobalt and nickel alloys do not suffer from this limitation."

Pravin Patel, president of Poly-Disk Systems, Inc., Torrance, Calif., agrees, saying, "We have that corrosion problem solved. Nor do production considerations present any obstacles," he adds. "We can easily manufacture thin-film-plated disks with coatings in the 3- to 4-μin. range and produce them reliably in volume," he says, adding that bit dropouts, the standard measure for magnetic-recording reliability, do not originate in the film layer anyway. "These come from imperfections in the substrate," he explains. "We all have that problem."

Patel also feels that there is a lot of potential left in conventional longitudinal recording. "The technology for switching horizontally oriented magnetic domains is nowhere near being fully exploited," he says. "By combining thin-film-plated media and thin-film heads, we can easily go to 30,000 to 40,000 bpi."

Others examine perpendicular technology

Potter proposes to bypass this step, however. "The next logical evolution in drive technology will be to perpendicular recording," he says. "There is no need to go to conventional recording methods using thin-film-plated media." Lanx Corp. executives may not be alone in this view. Interest in perpendicular recording is being spurred by reports of intensive activity in Japan, and by plans of year-old Minneapolis-based Vertimag, Inc., to use perpendicular recording as a means of pushing storage capacities in floppy-disk drives (see "Japan also going perpendicular," p. 164). Also in the wind are rumors that IBM may introduce a 5¼-in. Winchester next year and that it will use vertically oriented media.

Despite any boost an IBM introduction may give vertical recording, however, several industry analysts warn that widespread introduction of these techniques into the OEM market may be well down the road. One problem, points out Andrew Roman, a Newark, Calif., industry analyst and publisher of the *Random Access International* newsletter, is the impact that increased bit densities will have on controllers designed to handle slower transfer rates. "Extensive controller redesign may be in the offing," he says. Roman notes that one solution to the problem of matching existing controllers to higher transfer rates—slowing the rotational speed of a drive to increase latency, a possibility also noted by Potter—could bring a whole new set of problems. "IBM has optimized the read/write heads used in these drives to operate at a certain rpm rate," he explains. "Slowing down the rotation of the disk may change the aerodynamic qualities of the heads and could open a Pandora's box filled with other problems."

Santa Barbara, Calif., industry analyst Raymond Freeman Jr. also cautions that the high bit densities promised by perpendicular recording may be a long time coming. "Comparing laboratory results today with commercial results tomorrow is a trap many fall into," he says. "I do not see bit densities hitting the 30,000-bpi range until 1985 at the earliest." Nonetheless, perpendicular recording is an indication of things to come, he says. "Until the advent of this concept I did not see anything that would keep rotating memories viable through the 1990s. Now I do." ■

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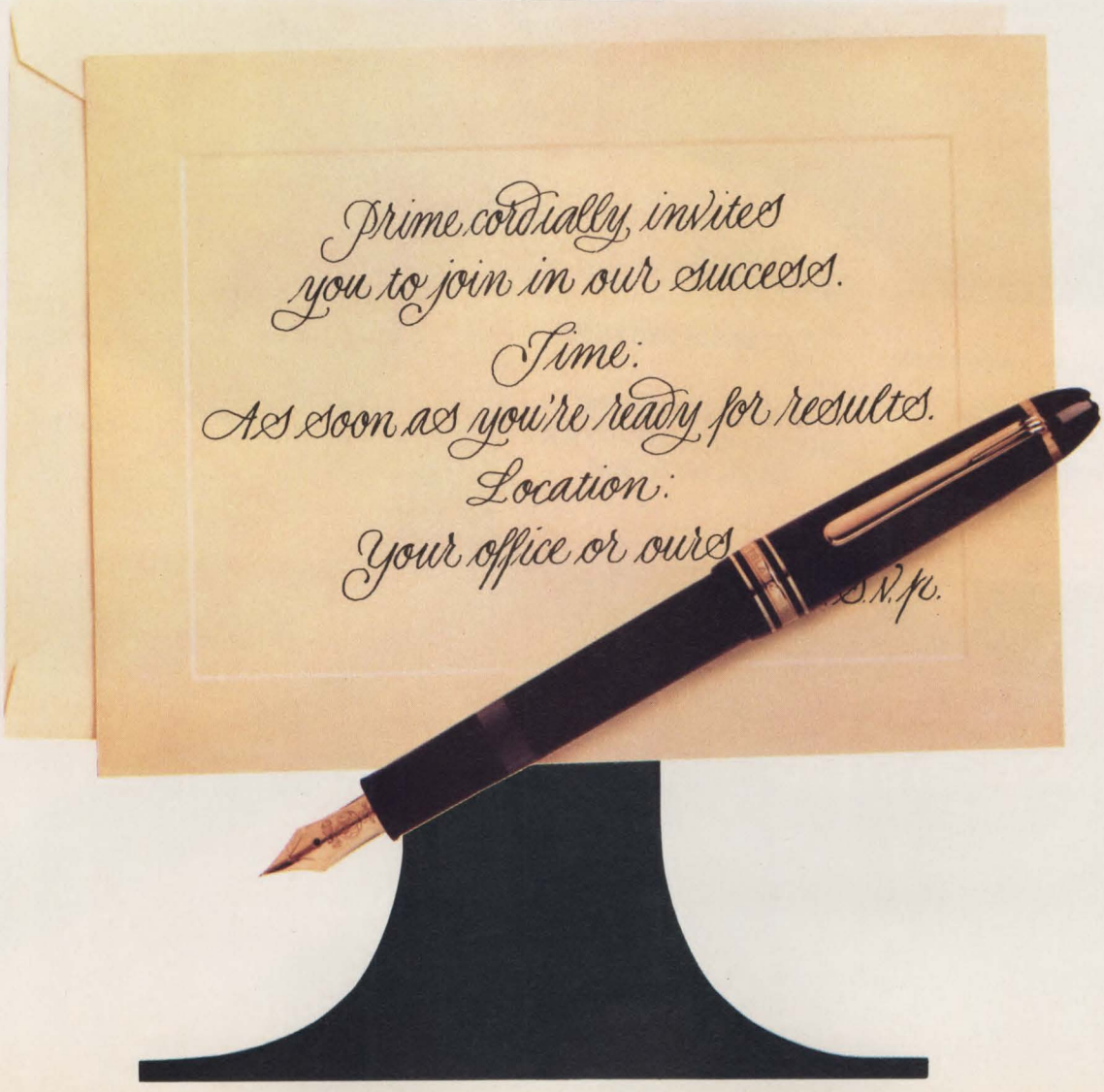

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Coordinating interpreters and compilers

CHRIS GILL, Microsoft

The strengths of both of these translators are useful, especially in developing μc software

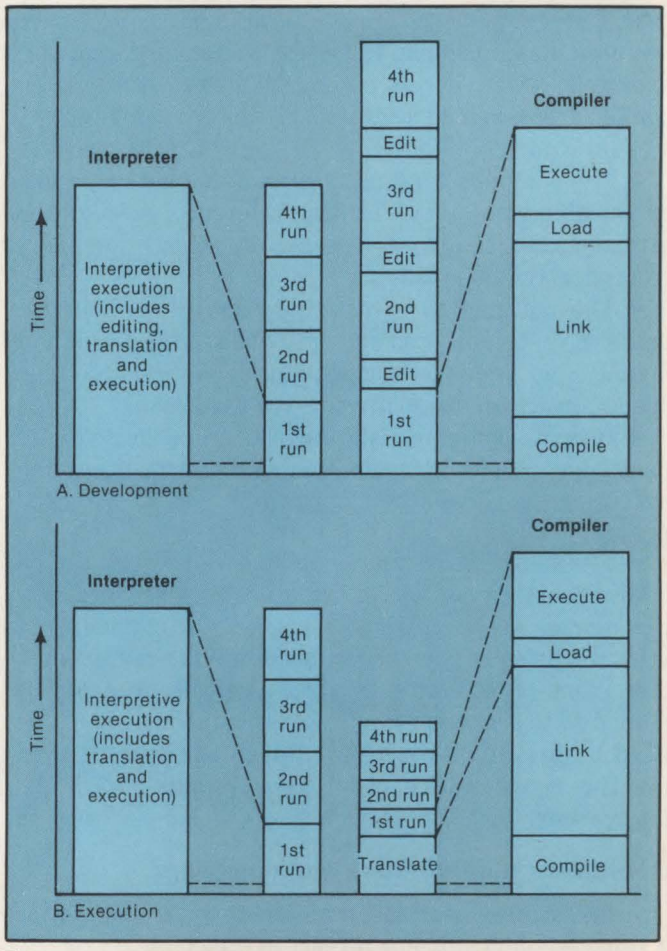
Interpreters and compilers are usually considered antagonists—competitors in a software developer's tool kit. This is not true, however, for application software development on μcs, which is a multi-phase process in which different tools are more effective for different phases. Interpreters and compilers each have their own strengths, which come to the fore at different stages in the process of software development. A significant step toward achieving cost-effectiveness in system development is the realization that these tools need not be antagonists at all—that, when compatible, interpreters and compilers coordinate most effectively. To understand why, a review of the differences between them is essential.

Interpreters and compilers are both translators, but with this important distinction: Interpreters translate and execute a program one statement at a time, each time the program is run; compilers translate an entire program only once, after which the translated program can be linked, loaded and executed any number of times without re-translation. Microsoft BASIC, one of the most popular languages for μc application development, can be translated with an interpreter or compiler. The two are almost totally language-compatible and can be used together as a complete system.

Advantages of interpreters

Interpreters combine translation and execution operations line-by-line, calling on whatever library procedure calls may be needed to implement each as a translated statement. As a result, they appeal to programmer for several reasons:

- Execution results, including all syntax and run-time errors, are reported immediately because the entire process is embodied in an interactive processor, with no additional link or load steps.
- The interpreter can have a built-in line editor, which switches it to the edit mode to change the incorrect line in the BASIC program. Correcting the problem and typing RUN allows execution and debugging to continue.
- The state of a program and its variables can easily be examined anytime the program is stopped. This facility, combined with the built-in editor and special



Time comparisons between interpreter and compiler *depend on which is being used for what—and when. During the development process (A), the interpreter's line-by-line editing capability expedites both coding and debugging. At execution (B), the compiler's whole-program object code output wins hands down.*

The compiler need not search a line number table or variable name table for each reference, with all the attendant overhead, as the interpreter must.

trace commands, is a powerful debugger for BASIC program development.

- The translation of the interpretive process is straightforward: no additional overhead for optimization or code-generation heuristics is incurred.

Advantages of compilers

Using a compiler to translate a program involves several steps. The program is first translated (compiled), the translated version is merged (linked) with the code for any utility functions or other programs it references, and then the entire executable entity is placed into the computer memory and initiated (loaded). Linking and loading are usually much less complex than compiling and are, therefore, often ignored in discussions of compilers. However, even with the additional overhead these extra steps incur, compilers can offer significant advantages:

- The compiler translates each statement only once into the machine code or library procedure calls required to implement it, so for statements that are executed repeatedly (e.g., inside a FOR/NEXT 1000), compiled programs execute much faster than interpretive programs.
- The compiler need not search a line number table or variable name table for each reference, with all the attendant overhead, as the interpreter must. Compilers reference symbolic labels.
- The machine code resulting from the translation process can be analyzed and optimized to use fewer and faster code sequences when possible—an additional speed advantage over interpretive execution.
- Because compiling is a separate step, the compiler need not reside in main memory during program execution as does the interpreter, so a compiled program can execute in less memory.
- The source code can be modularized, which can be a significant advantage in large projects because only the module to be changed must be re-compiled. The other modules in the system need only be re-linked.
- When a software product written in BASIC is delivered to a customer, only an executable load module need be provided—a security advantage over delivering the BASIC source code, as is required with the interpreter.

Coordinating interpreters and compilers

A factor often overlooked in selecting a translator for a software-development project is the changing priorities of the software-development life cycle. While the speed and source security advantages of compiled code become more important during final testing and delivery, the editing and debugging capabilities of the interpreter are more important during the coding phase. During maintenance, it can often be more efficient to enter and test proposed software fixes quickly with an interpreter. The changes in the affected software modules can then be compiled and re-linked after the initial feasibility of the fix has been demonstrated.

A powerful system can be obtained by using an interpreter during initial program development and a compiler later. Using the interpreter, a programmer can quickly enter an initial program, edit out syntax errors and selectively run, debug and correct portions of the program. The power provided with this interactive development tool is no substitute for a thorough design phase, but it enables a working system to be implemented rapidly after the preliminary design is complete. The compiler becomes more useful as the software system is integrated and tested. The greater speed and smaller space requirements associated with completed code become important only as the system is assembled. The efficiency of re-translating (re-compiling) only the corrected software modules in a large software system also becomes more important as the system nears completion.

This development scenario demands that the two translators be compatible, recognizing the same syntax and producing identical results for most language features. Switching between two subsets of the same language can be time-consuming and expensive if compatibility is lacking.

A less desirable alternative is the use of partial compilers or intermediate code (e.g., P-code) interpreters. These hybrids combine the advantages of the two translators, but also the disadvantages. They are rarely as interactive as a true interpreter and produce code that is usually not as efficient as that generated by a true compiler.

Prototyping helps avoid changes

Another benefit of coordinating compatible interpreters and compilers is that a prototype can be made rapidly with the interpreter while still permitting the use of a compiler for the delivered system. A prototype is a working system delivered to a customer early in the software-development process to permit the user to try major portions of the system well before the final delivery date. This provides early, useful feedback, allows customers to define objectives and requirements, and helps avoid extensive post-delivery modifications and revisions.

The prototype concentrates on the user-interface portions of the system (keyboard inputs, report formats). This initial system is then demonstrated to the user for evaluation, and all changes and improvements are incorporated into the final system design. The compiler will be used later, when system performance and maintainability become significant.

The following is a subset of the development process for a business inventory control program. This example

is simplistic, but conveys the flavor of some typical problems.

The inventory control program being developed is for a small business with a limited inventory. The inventory data is kept in a single file (INVEN.DAT) that uses the part number as the access key. The system must display all the information associated with a given part number. After the preliminary design of the system is completed, the following BASIC code could be developed as a portion of an initial prototype system:

```
1000 REM INVENTORY EXAMPLE
1010 REM
1020 OPEN "R", #1, "INVEN.DAT", 39
1030 FIELD #1, 1 AS FLAG$, 30 AT DES$, 2 AS QUAN$,2
     AS REORD$,4
AS PRICE$
8000 REM DISPLAY SELECTED ENTRY
8010 REM
8020 INPUT "INVENTORY NUMBER";INVEN%
8030 IF (INVEN%>1)OR(INVEN%>MAXIN%) THEN
      PRINT "INVALID NUMBER":GOTO 8020 CHECK
      INPUT VALIDITY
8040 GET #1,INVEN% FETCH SPECIFIED INVENTORY
     ENTRY
8050 IF ASC(FLAG$)=255 THEN PRINT "NO SUCH
     ITEM":RETURN
8060 PRINT:PRINT  DISPLAY ENTIRE ENTRY
8070 PRINT USING "INVENTORY NUMBER
###";INVEN%
8080 PRINT "DESCRIPTION",DES$
8090 PRINT USING "QUANTITY ON HAND #####";
     CVI(QUAN$)
8100 PRINT USING "REORDER LEVEL #####";CVI
     (REORD$)
8110 PRINT USING "UNIT PRICE ##.##";CVS(PRICE$)
8120 RETURN
```

Other portions of the program would handle functions such as data-base initialization, entry addition and modification, transaction logging and reorder-report generation. After involving the BASIC interpreter, the program containing this code segment can be entered, and debugging can begin. The SAVE command can be used to store the source code, and the RUN command can execute the program. Using the RUN command on this sample program yields:

```
SYNTAX ERROR IN 1030
OK
1030
```

This response means the interpreter has detected a BASIC syntax error in line 1030 and has entered the edit mode at that line. The interpreter edit mode commands can then be used to scan the line and correct the detected error (in this case, replaces the AT with AS). Using the RUN command after correction the error will produce:

```
INVENTORY NUMBER?
```

Assuming an initial data base has been set up for prototype testing, typing in one of the initialized inventory numbers, such as 5 yields:

```
INVALID NUMBER
INVENTORY NUMBER?
```

This is surprising, because 5 was one of the prototype data-base inventory numbers. Even more surprising is that this erroneous entry response is received regardless of what supposedly correct inventory number is specified. The Control-C character can be used to return to the interpreter and then use the PRINT command to check the current value of the inventory number read by the program:

```
INVENTORY NUMBER? 4
INVALID NUMBER
INVENTORY NUMBER? 3
```

INTERPRETERS AND COMPILERS: AN ANALOG

Suppose a user wants to build a stereo from a kit, but the instruction sheet is written in Japanese. If he uses a Japanese-English dictionary to translate each instruction and perform a specified action, and keeps repeating this procedure, he might encounter problems, especially if he failed to write the translated instructions as they were processed. Suppose halfway through the construction he translates an instruction that says "go back to instruction 14 and repeat these steps for the second speaker." One problem becomes apparent: he can't find instruction 14 without scanning the entire text from the start, searching for the Japanese characters for 14. He then faces the time-consuming task of re-translating each instruction.

Another approach to kit construction might be to translate the entire instruction sheet to English, eliminating any further need for the original Japanese text. However, other inefficiencies can arise here. Suppose instruction five says, "Tighten the four screws securely or the system may not operate," and during construction only three screws were supplied. Most of the translation effort has been wasted. Even when a new packet of screws arrives, it contains a new instruction sheet that must be completely re-translated to ensure nothing has changed.

The first method is similar to the manner in which an interpreter would implement a BASIC program, translating and executing the program one statement at a time; the second method is similar to the compilation process in which the translation portion (compilation) of the process is separate from the performance (linking and executing of the specified actions).

STRENGTHS OF:

Interpreted programs	Compiled programs
1. Allow errors to be detected and corrected immediately	1. Execute faster
2. Allow faster debugging	2. Execute in less memory
3. Involve no extra overhead for optimization or code generation	3. Recompile more easily
	4. Are less vulnerable to theft

A powerful system can be obtained by using an interpreter during initial development and a compiler later.

```
INVALID NUMBER
INVENTORY NUMBER? C
BREAK IN 8020
OK
PRINT INVEN%
3
OK
```

There is an error in this inventory number validity check. The interpreter LIST command can be used to examine the lines of code that perform this function. Line 8030 indicates that invalid inventory numbers that are less than 1, not those greater than 1, should be flagged. This can be typed as:

```
EDIT 8030
```

and the edit mode commands can be used to change > to <. Typing RUN and responding to the inventory number request produces:

```
INVENTORY NUMBER? 5
INVENTORY NUMBER 5
DESCRIPTION ATHLETIC SOCKS/10-13/PAIR
QUANTITY ON HAND 50
REORDER LEVEL 20
UNIT PRICE 0.05
OK
```

The data presented by the program shows that the values appear correct, but that price is not being expressed in dollars. Again, the LIST and EDIT commands can be used to locate and correct the statements. In this case, inserting $$ at the start of the format specification in line 8110 (i.e., changing ##.## to $$##.##) yields:

```
INVENTORY NUMBER 5
DESCRIPTION ATHLETIC SOCKS/10-13/PAIR
QUANTITY ON HAND 50
REORDER LEVEL 20
UNIT PRICE $0.05
OK
```

The ease with which this debugging is performed should be contrasted with the effort involved if a compiler has been used. Each syntax error would have required separate edit and compilation steps; each execution error would have needed separate edit, compilation, linking and loading steps. Even displaying the values associated with program variables would have required extra PRINT commands in the program and their removal after the error has been corrected.

The process of checking the system response to standard inputs, boundary conditions and invalid inputs must continue as the system is developed. However, an initial, partially functioning system is valuable for involving an end user as soon as possible. Providing a prototype system for evaluation could result in comments such as:

- "The data listed is okay, but display it in a columnar fashion."
- "The inventory number need not be repeated when the data is displayed."
- "We need 35 characters for the item description, rather than 30."

Again using the interpreter to incorporate the user-requested-changes, the following program segment results:

```
1000 REM INVENTORY EXAMPLE
1010 REM
1020 OPEN "R",#1,"INVEN.DAT",39
1030 FIELD #1,1 AS FLAG$,35 AT DES$,2 AS QUAN,2 AS
     REORD$,4
AS PRICE$
8000 REM DISPLAY SELECTED ENTRY
8010 REM
8020 INPUT "INVENTORY NUMBER";INVEN%
8030 IF (INVEN%>1)OR(INVEN%>MAXIN%) THEN
       PRINT "INVALID NUMBER":GOTO 8020  CHECK
       INPUT VALIDITY
8040 GET #1,INVEN% FETCH SPECIFIED INVENTORY
       ENTRY
8050  IF ASC(FLAG$)=255 THEN PRINT "NO SUCH
       ITEM":RETURN
8060 PRINT:PRINT  DISPLAY ENTIRE ENTRY
8080 PRINT "DESCRIPTION" TAB(20) DES$
8090 PRINT USING "QUANTITY ON HAND #####";
       CVI(QUAN$)
8100 PRINT USING "REORDER LEVEL #####;
       CVI(REORD$)
8110 PRINT USING "UNIT PRICE $$##.##"; CVS(PRICE$)
8120 RETURN
```

The interpreter has been used exclusively for performing all the steps discussed so far. The value of using the same processor for editing, running and debugging the program is immense, and the interpreter offers a significant advantage in its executable prototype system.

The other major advantage of compiled code is that only an executable load module and supporting documentation need be delivered to the user, with obvious security advantages over delivering the entire source file. For this example, then, assuming a Microsoft L80 linking loader is available, the following operating system commands could be used to compile and link the inventory control program:

```
BASCOM INVEN=INVEN
L80 INVEN,INVEN/N/E
```

These two steps would create an executable load module named INVEN.COM.

Both the program-development process and the resulting program benefit by combining the best features of both translators: the debugging power of the interpreter taking precedence during development, and the compiler strengths of faster execution, less memory and better security applied to the product. ■

Chris Gill is a systems software designer at Microsoft, Bellevue, Wash.

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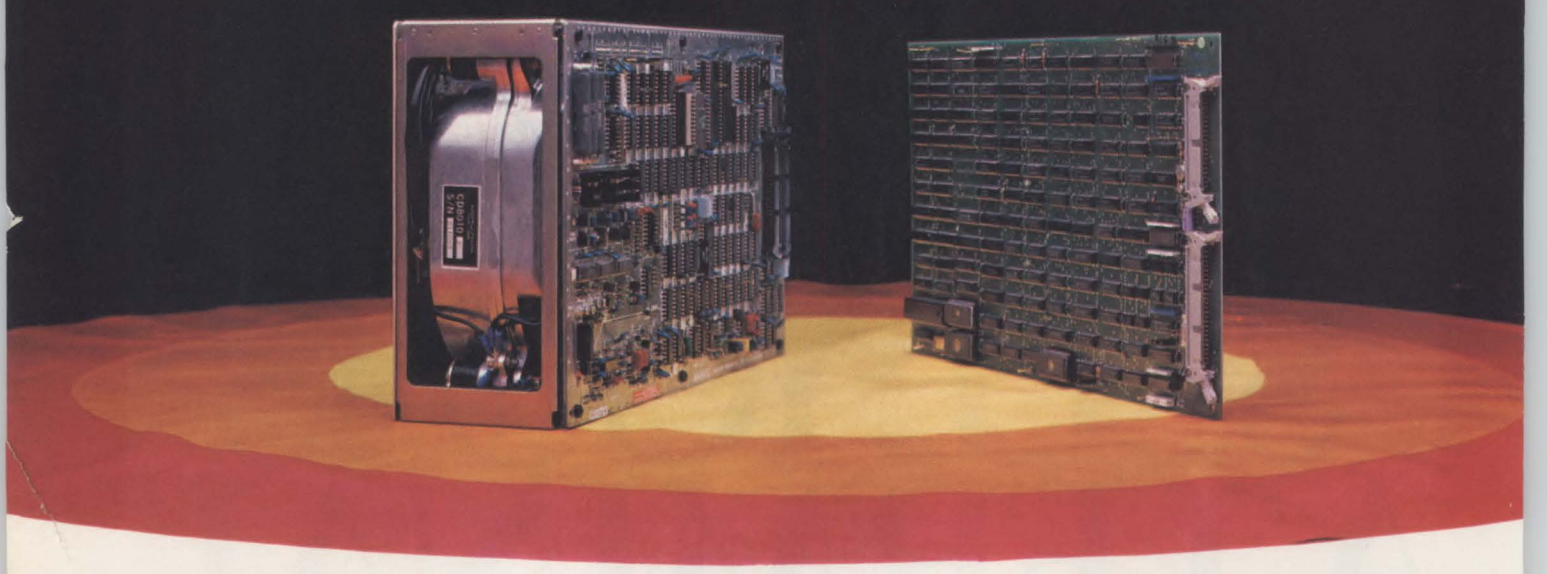

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CIRCLE NO. 79 ON INQUIRY CARD

'NoCode' makes manual coding more friendly

PETER PAPIRO, General Automation, Inc.

General Automation's system combines functions of a screen processor, DBMS and report writer to reduce programming tasks to one procedure

One recent addition to the lexicon of the minicomputer-μc industry is "user-friendly"—a term that has little meaning unless it answers the question "compared to what?". For instance, computer users who have enjoyed using software packages involving several manual coding procedures may become disenchanted with them when they learn about "NoCode," a system from General Automation, Inc., which replaces those tedious manual steps with a single procedure.

A totally self-contained software system, NoCode generates uses and expands new applications for on-line business data processing. A single specification procedure replaces conventional programming tasks in developing and updating CRT screens, data bases and other components of management-information systems.

The NoCode system combines the functions of a screen processor, data base management system (DBMS) and report writer. The software is written in a combination of GA's commercial FORTRAN and assembly languages and runs as a foreground processor under GA's real-time CONTROL operating systems. No other software is required to support or custom-tailor applications developed with NoCode; documentation is automatic.

A NoCode software system can be implemented on General Automation computers in the field. The hardware configuration, called InstaCode, includes a GA-16/2000 series or GA-16/400 series computer. The InstaCode system also includes multiples of 10M, 80M or 300M bytes of disk storage, a 300- or 600-lpm printer, a magnetic-tape drive and multiple CRTs.

The NoCode processor contains 103 pre-coded elements that were found to be constantly repeated in every business data-processsing application for which GA's computers are used. Typical elements are "open a file," "write the data," "add data" and "delete data."

Repetitive coding of these elements is very time-consuming because each element represents five to 200 lines of code in conventional software systems. Precoding these elements and linking them into a body of code inside a computer's main memory eliminates the need to write a programming code for applications such as manpower planning, expense accounting, market-share analysis or inventory control.

The NoCode system uses fill-in-the-blanks specification sheets (Fig. 1) and an algorithm that translates specification information directly into new data-driven applications. Once the specification data have been entered into the computer terminal, a user can

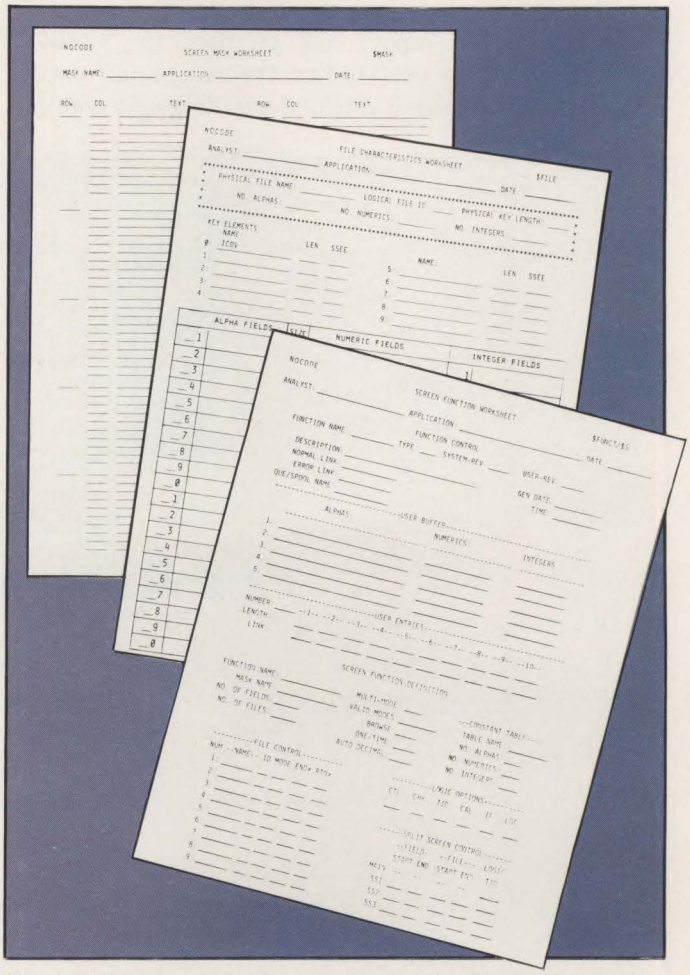


Fig. 1. NoCode worksheets organize *and simplify entering application specifications into the computer. Specifications can also be entered directly on a CRT using standard displays.*

NoCode is accessed simultaneously through several distributed terminals for development of new applications and for routine data processing.

immediately execute the resulting applications.

To change or update an application, a user simply changes the affected data on a specification worksheet and keys only that data into the computer.

NoCode is accessed simultaneously through several distributed terminals for development of new applications and for routine data processing. The NoCode processor contains the precoded application elements, which are re-entrant and always reside in the CPU main memory regardless of the number of interactive terminals on-line (Fig. 2).

NoCode's productivity gain varies with each application, but generally ranges from four to 20 times better than conventional programming. Changes to an application are usually 100 to 200 times faster than conventional methods because only the changes are entered, and no compilations are needed.

In addition, the more NoCode is used, the more powerful it becomes. Every component function of a new application—a menu, a report or a screen—can be stored as a separate pre-coded function for future applications. If a report will be used in 10 other applications, a user need design the report only once.

The ease of designing and implementing new applica-

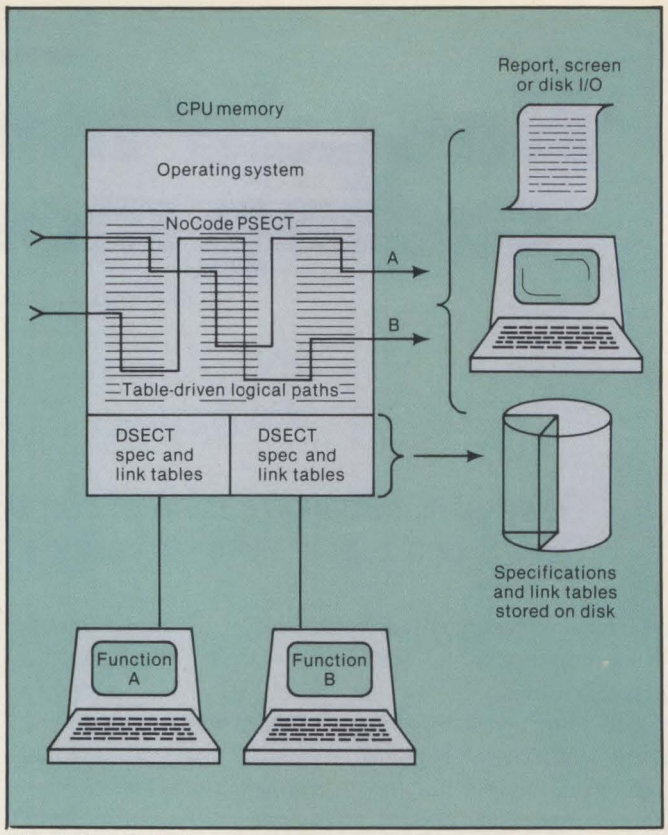


Fig. 2. The NoCode program section (PSECT) *contains pre-coded elements for virtually every business application. This processor occupies 48K bytes of CPU main memory, as does the CONTROL III operating system, leaving about 32K bytes of data section (DSECT) in the 128K-byte processor for shared processing on CRT terminals. User specifications and data become tables that form the "link" or logical path through the program section.*

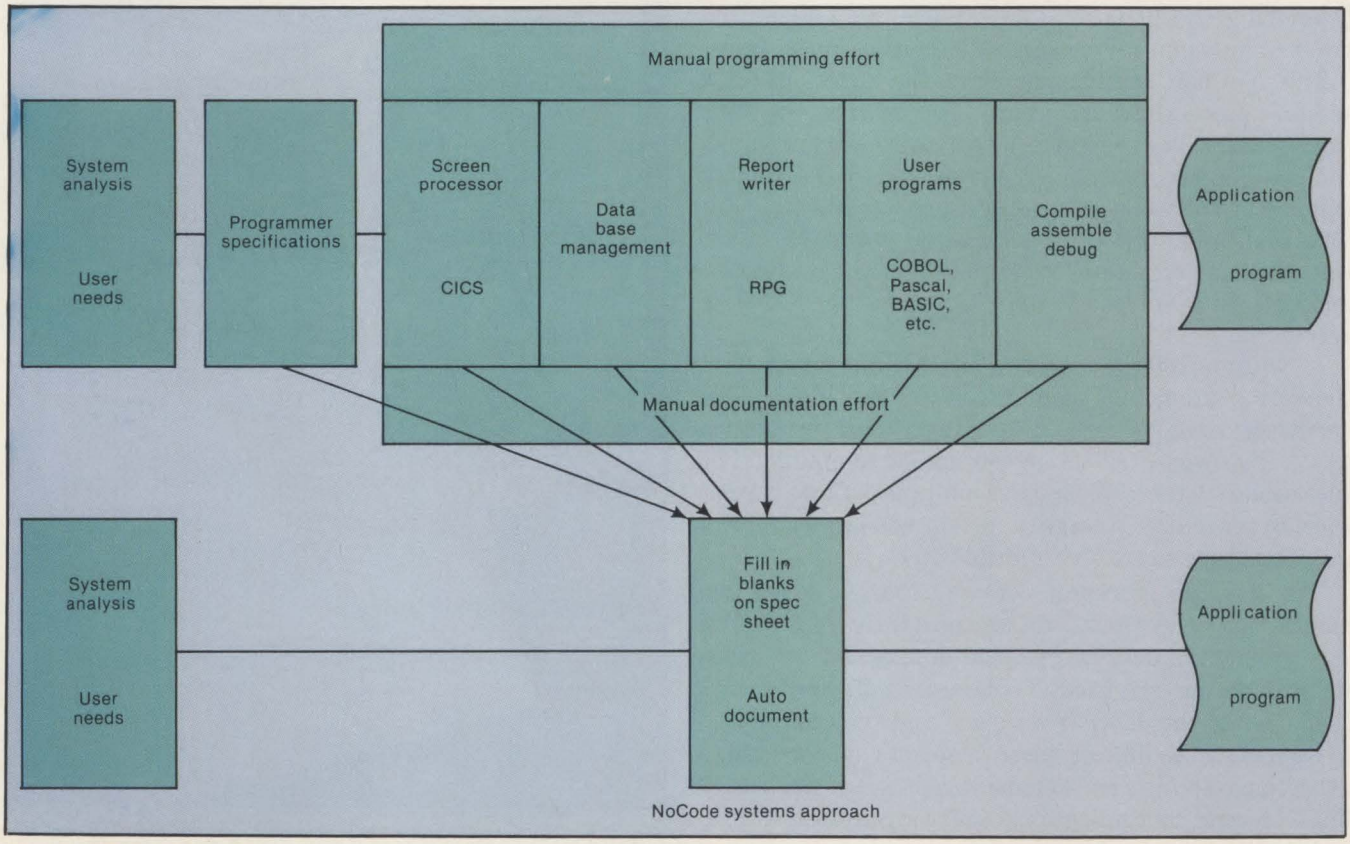
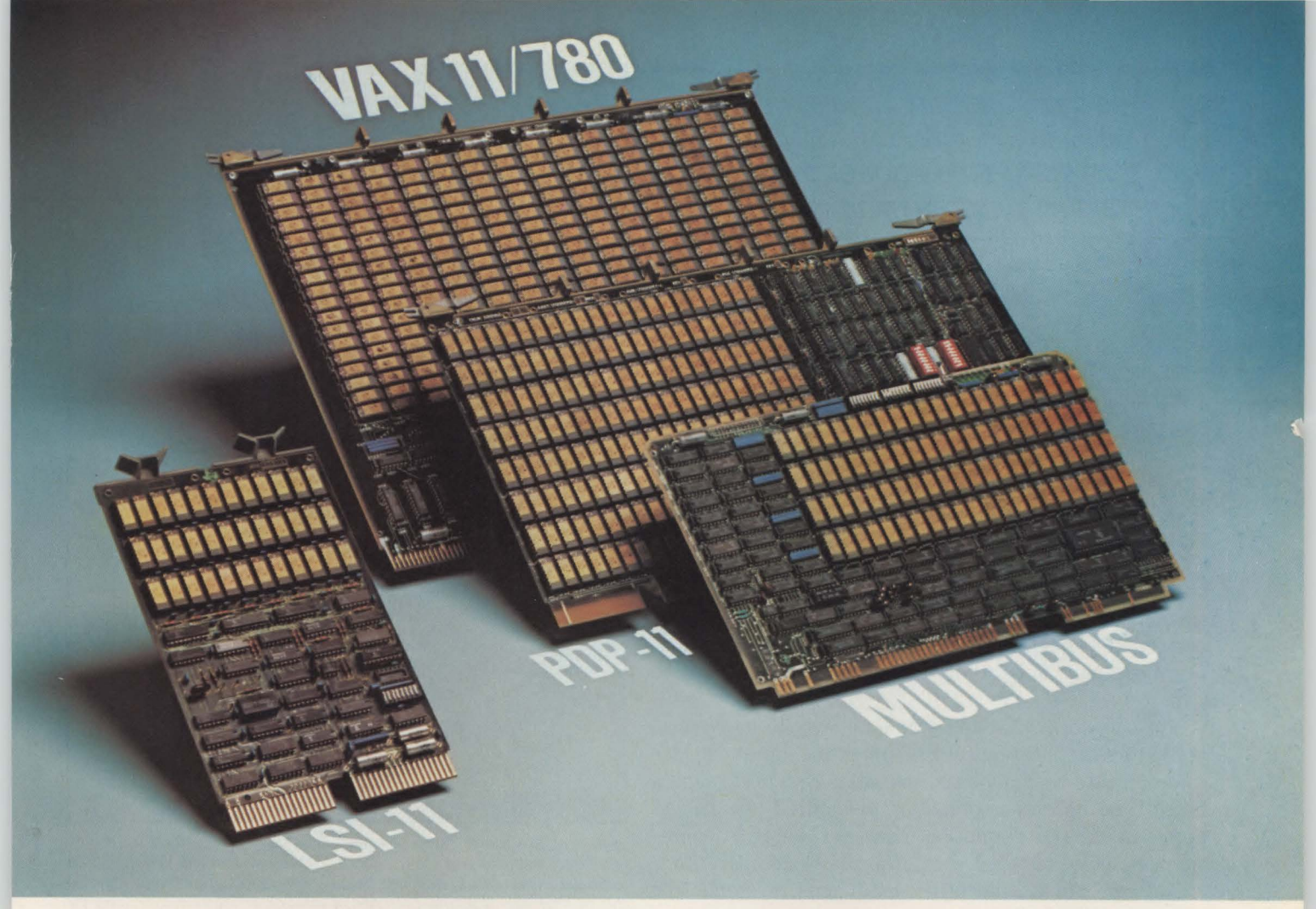


Fig. 3. NoCode's single-specification procedure *is used instead of the separate manual programming efforts that conventional systems rely on to generate data-base information, reports, CRT screens and other functional components of an application.*



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NoCode's productivity gain varies with each application, but generally ranges from four to 20 times better than conventional programming.

tions in NoCode greatly simplifies personnel training. The system can be learned in less than a week by an experienced analyst and in about two weeks by those without prior programming experience.

A user without NoCode experience can change or complete an application begun by someone else with relatively little preparation. This provides a manager flexibility in assigning personnel.

NoCode also offers a powerful multi-level security system. Access security can be applied to one or a combination of control points in the NoCode/InstaCode system. These control points, or keys, can be the CRT station, the type of data field or the type of NoCode pre-coded elements used to generate an application. Further, only an authorized user can change these keys.

NoCode works best as a stand-alone system, processing various applications at the same time, but it can also communicate with another computer system through a batch-type operation that is implemented using magnetic tape or 2780 emulation. However, batch transmission cannot be handled with other NoCode operations.

NoCode can handle other languages, systems and data bases if the files are presented to the system in a fixed-length record, fixed-length block format. The user transfers the data to tape and operates a tape function to output the data into as many as three indexed, sequential NoCode disk files. GA also provides a subroutine that enables commercial FORTRAN programs to access NoCode files.

NoCode vs. other systems

Both NoCode and conventional software systems require careful analysis of the application, including detailed design of screens, reports, logic, menus and auxiliary functions.

The conventional approach results in a formal statement, or specification, that tells a programmer what a user wants. Once the specification is complete, the programmer writes individual programs to generate CRT screens, data bases, reports, menus and auxiliary data. Each type of information-handling is often a specialty, with one programmer organizing the data base, another designing screens and so on. The individual program is then compiled with the others and debugged conventionally. With No-Code, a fill-in-the-blanks specifications procedure replaces all of these manual programming steps (Fig. 3).

NoCode also has advantages over software designed to increase productivity of conventional systems. For example, packaged software saves program development time but is usually more difficult to expand or modify than NoCode software. Users must also acquire separate packages for different applications, while NoCode is a fully integrated unit and is used for all applications.

System function Name	Use in creating screen function
$MASK	Defines screen report format. Used to generate a screen mask consisting of descriptive text data and/or prompts.
$FILE	Used to define the logical file identifier, record key length and the number of alpha, numeric and integer fields to be contained within the logical file.
$FUNCT	Establishes user function control. Used to define the number and content of alpha, numeric and integer user buffer entries to be accessed by the user function. As many as five buffer alpha entries may be assigned by each user function, typically for linking functions and storing editing masks.
$S	Defines screen functions. Used to identify the associated screen mask, number of CRT screen fields, number and name of logical files accessed by the user function. Also to define accessing of fields and files, to specify the name of size of the constant table, if any, and to identify function chaining, logic options, control and split-screen options.
$SPECS	Used to generate specification tables for the user function. A table is required for each variable data field outlined by the mask. It defines the position of the field in the mask by row and column, control data, editing, validity checking and the sequence of calculations.
$LOGIC	Used to define the structure of each file's record key, operators and operands of each calculation to be performed. Also used to define if-then-else statements and sequences of related operations.
$AUTH	Authorizes operator assignment to use the screen function

System functions are selected *for developing user screens, including establishing the screen mask, identifying the variable data and data files and specifying calculations and conditioning logic to be performed. NoCode provides a total of 19 system functions for developing user functions (analogous to conventional programs).*

Although a conventional DBMS enhances programmer productivity, it offers a limited subset of NoCode capabilities. For example, DBMS applications require additional programming in standard languages and manual documentation efforts. A DBMS benefits users with easy-to-use query/data access and file management routines, but a large program typically ties up system resources. A DBMS, therefore, with its bulk and complexity, executes much more slowly than a comparable NoCode application.

Report generators are pre-processors that typically act as interfaces to a DBMS. Some programming knowledge is usually required on the part of the user. However, the software produced by these systems still are separate programs that must be compiled and debugged conventionally. It is not unusual to find a report writer being used with both a DBMS and packaged applications software at one site with three different operating and training requirements. ■

Peter Papiro is NoCode technical director at General Automation, Inc., Anaheim, Calif.

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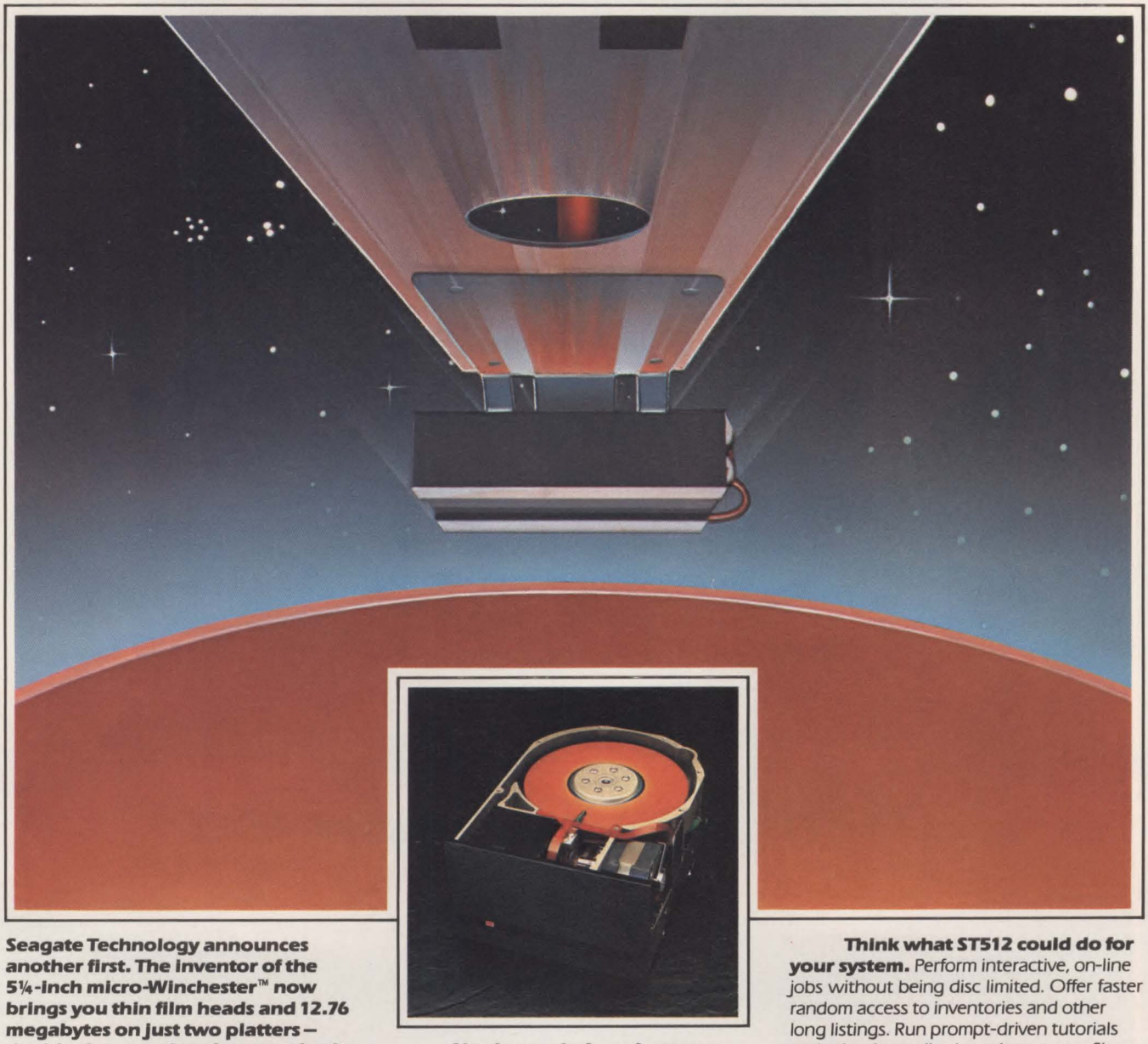

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Implementing X.25

SANDRA L. EMERSON,
The Community Memory Project

A portable, high-level system language helps keep pace with this still-evolving protocol.

In the fast-growing market for network communications and distributed data processing, the X.25 communications protocol for packet-switching networks is gaining increasing support. The protocol's lower levels have stabilized to a point at which they can be implemented in hardware, but the higher levels will continue to evolve. As a result, developers of private packet data networks and computer manufacturers planning to support X.25 should implement high-level X.25 features in software, and should adopt a software strategy for keeping pace with its changes.

Need for standardization

X.25, developed by the International Telegraph and Telephone Consultative Committee (CCITT), describes a standard interface between a computer or an intelligent terminal and a packet-switching network. Such standard communications protocols are needed to interconnect many different kinds of computers. But both rapid developments in technology and the slow but steady evolution of the protocols themselves complicate implementation.

This is particularly true with X.25. Over its history, X.25 has been refined to maintain compatibility with other protocols, to eliminate differences between packet data networks and to bring it closer to an ideal standard interface.

Refinement continues

A "standard interface" such as X.25, then, is far from being a complete recipe for implementation. X.25 must be constantly re-evaluated in the context of related protocols. X.25's internal consistency and its congruence with other protocols is constantly shifting, with some recommendations coming more sharply into focus, and others fading away. Moreover, politics as well as

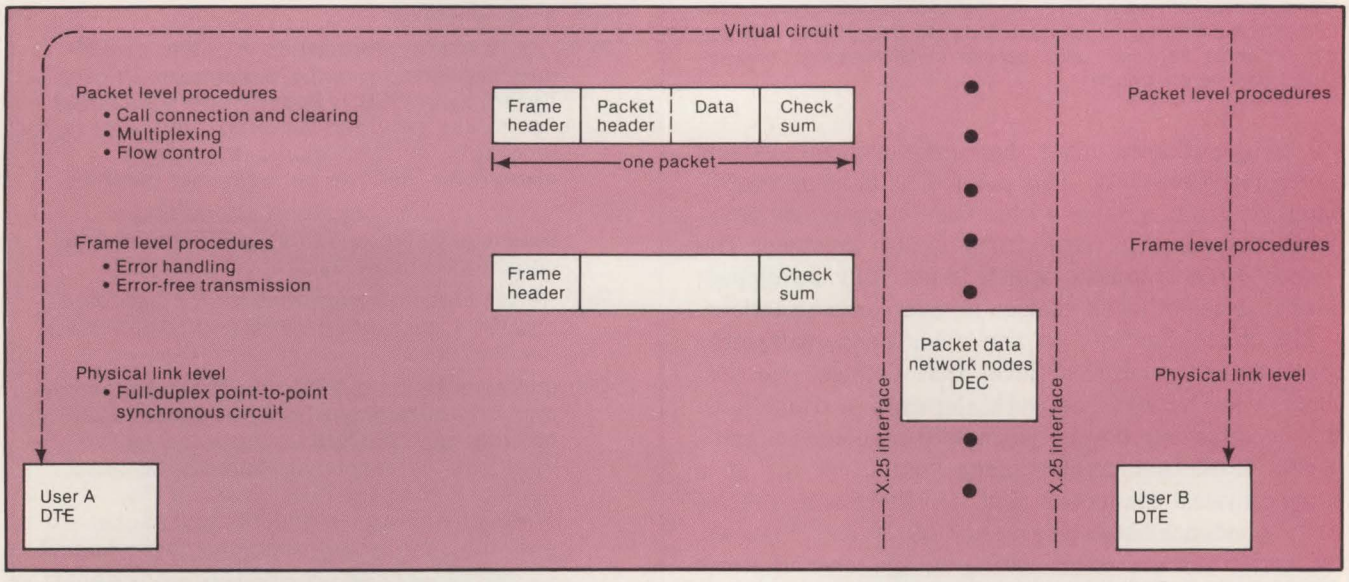

Fig. 1. X.25 structure and function. *The X.25 protocol defines the interface between user's data terminal equipment (DTE) and packet data network node data circuit-terminating equipment (DCE). Here, users A and B are linked by a virtual circuit through one or more nodes of a packet data network. At the packet level, packets acquire an identifying Logical Channel Number and addressing information in the packet header. Each packet is sent in a separate frame having a frame header and a check-sum trailer, which indicates transmission of a complete frame.*

X.25's internal consistency and its congruence with other protocols is constantly shifting, with some recommendations coming more sharply into focus, and others fading away.

pragmatics come into play in the evolution of protocols, as when a particular recommendation is promoted primarily because it is supported by a major packet-switching service supplier.

For example, efforts at defining uniform user-to-user communications protocols for many types of networks

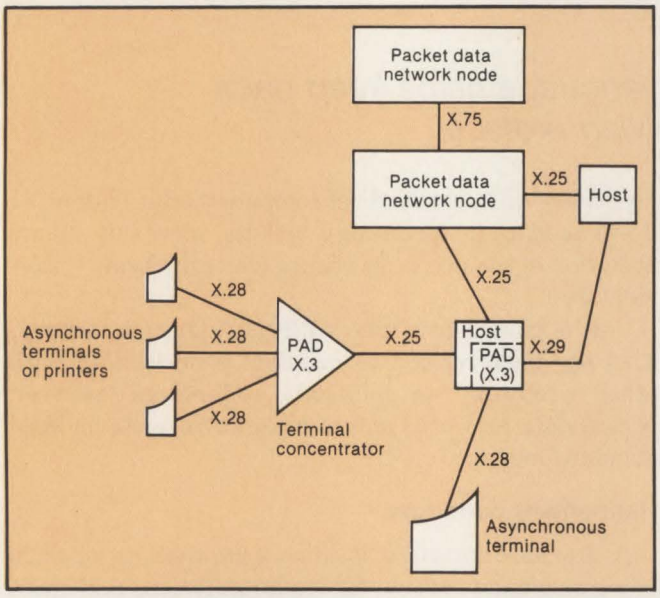

Fig. 2. X.25 with other protocols. *Asynchronous (start-stop mode) terminals or printers are linked to packet data networks and can communicate with packet DTEs using a set of three protocols: X.3, X.28 and X.29. X.3 defines the packet assembly and disassembly (PAD) functions performed in the node, in the host computer or by a terminal concentrator. Asynchronous terminals communicate with the PAD facility according to the X.28 protocol. The PAD, in turn, communicates with packet DTEs according to the X.29 protocol. The X.75 protocol defines the interface between packet data networks and, in some networks, also defines communications between packet data network nodes.*

are being gathered under the rubric of "open systems interconnection" (OSI). This movement is being coordinated by study groups within the International Standards Organization (ISO). CCITT is also involved. The proposed OSI standard, which is not fully developed, describes seven levels of user-to-user communications.

The X.25 interface, on the other hand, comprises three levels: a physical level that defines electrical connections between network elements, a frame level that controls data flow between network elements and a packet level that creates many virtual circuits on a single physical connection (Fig. 1). There is no precise correspondence between X.25 and OSI levels. However, ISO and CCITT are collaborating on the open systems descriptions, and clearer definitions should emerge. Meanwhile, the 1980 revision of the X.25 protocol suggests referring to X.25 levels by their descriptive terms—physical, frame and packet—to avoid confusion with the ISO levels. Other protocols for packet switching must also be considered in implementing X.25.

X.25 deals only with computers that generate packets. Other protocols are necessary, such as those for asynchronous terminals and printers and the interconnection of the public data networks themselves.

For asynchronous terminals and printers, CCITT developed a set of three protocols: X.3, X.28 and X.29. X.3 governs packet assembly and disassembly (PAD). These functions provide for implementing a concentrator to accept input from multiple asynchronous terminals and feed it to an X.25 network. A BPAD protocol has also been developed for the interconnection of binary sychronous terminals, such as IBM equipment.

X.28 and X.29 are the connecting protocols. X.28 governs communications between asynchronous terminals and the PAD facility. X.29 is the protocol between PAD and packet data terminal equipment (DTE).

Recommendation X.75, which allows a standard interface between packet data networks, illustrates how protocols interact and echo each other and the fruitful cooperation among standards organizations (Fig. 2). X.75 was developed from X.25, and in some networks is also used for intra-network communications between nodes. X.75 also served as the pattern for an X.25 frame-level protocol change, link access protocol balanced (LAPB). In turn, LAPB was designed to provide

X.25: EVOLUTION AND FORECAST

1964	Paul Baran proposes a fully distributed packet-switching system.
1969	First four nodes of ARPAnet installed.
1971	Spain installs CTNE, first public packet data network.
1970-1975	Growth of several public and private packet data networks.
1976	X.25, a standard interface to public packet data networks, is ratified by the 6th Plenary Assembly of CCITT. Specifications include a full duplex synchronous circuit, link access protocol (LAP), packet addressing and accounting and five optional user facilities.
1977	Interim recommendations supporting a balanced LAP procedure (LAPB) and end-to-end diagnostic fields.
1980	Revised recommendations for X.25 adopted by CCITT, supporting LAPB and 18 optional user facilities.
1982	Implementation of 1980 recommendations to minimize differences between packet data networks and provide a truly universal interface. Increased hardware implementations of X.25 as the lower levels of the protocol stabilize. Interworking of packet-switching and circuit-switching networks and increased congruence with ISO's "provisional architectural model" of user-to-user data communications.

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Computer manufacturers that plan to add X.25 capability to their machines must consider both the state of X.25 and related protocols and the state of the packet data networks to which those machines will connect.

greater compatibility with ISO's high-level data link control (HDLC) protocol. Standards for the physical link connection to the HDLC driver were based on EIA's RS232C standard. Two CCITT protocols—X.21 and X.21 interim—were added later.

X.25's continuing evolution also has historical causes. The development of X.25 began in the early 1970s after several experimental packet-switching networks had been established. A study group of the CCITT, comprised of representatives from Telenet and other packet-switching networks, began meeting in 1972, and the first version of the X.25 protocol was adopted by the plenary assembly in 1976. Although protocol development was proceeding at the same time as packet data network development, the protocol did not immediately result in a standard interface to packet data networks. Differences persisted among packet data networks, which made them incompatible with each other or with a given implementation of X.25.

Some of the incompatibilities were caused by the incomplete definition of parts of the X.25 protocol, and persisted because suppliers were reluctant to abandon their "nonstandard" investments.

Key recommendations

The 1976 to 1980 study emphasized refining the standards to reduce differences between packet data networks. The 1980 recommendations are expected to be implemented on all packet data networks by 1982. Some features of the 1980 recommendations are that:

- At the physical level, all public data networks support Recommendation X.21 interim for the operation of the duplex synchronous circuit.
- At the frame or link level, a subset of the HDLC protocol as standardized by ISO be employed through LAPB, and all new packet-switching networks support LAPB.
- At the packet level, there be minimal standard facilities, including window and packet sizes, standard error codes and a standard scheme for allocating logical channel numbers, that every public packet network must support. Certain optional facilities have been defined as "essential," including negotiated flow control and throughput parameters, closed user groups and the ability to send information without establishing a circuit (fast select). Also, a new "diagnostic" packet is available for use under certain error conditions.

The changes from 1976 to 1980 indicate that while certain elements of the protocol have stabilized, other sections continue to evolve. Computer manufacturers that plan to add X.25 capability to their machines must consider both the state of X.25 and related protocols and the state of the packet data networks to which those machines will connect. In addition to "standard" recommendations, manufacturers should implement the increasing variety of packet-level options in a modular, functionally independent way to enable users to select services that best fit their applications and the networks to which the users' machines connect.

For standard DTE, the frame level has stabilized to a point at which it can be implemented in hardware, as, for example, Western Digital's frame-level chip. However, hardware implementations have their limits. Not only are the communications protocols changing, but CPU and protocol chips are evolving even more rapidly and may require manufacturers to change hardware configurations every few years.

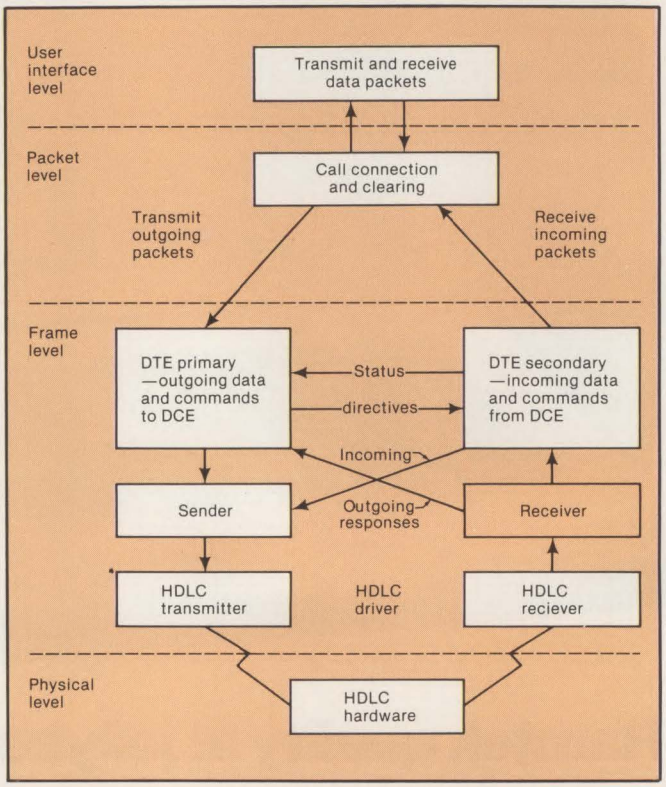

Fig. 3. Structure of the X.Dot software package. *The boxes represent independent parallel software processes in the X.Dot programs. From the user interface, the user connects to the X.Dot programs and the packet data network. Outgoing packets are assembled by the frame and packet level processes and sent out to the network nodes (DCEs). From the DCEs, incoming packets from remote users are disassembled and passed up to the user interface level through internal data paths.*

Suggestions for software

For this reason, portable software implementation in a high-level language of communications protocols can be an attractive alternative to hardware-dependent implementations. A software implementation should:

- use a high-level systems programming language, such as Pascal, PRAXIS, Ada, PL-1 or C;
- use only a portable subset of the language and

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Portable software implementation in a high-level language of communications protocols can be an attractive alternative to hardware-dependent implementations.

avoid hardware-dependent code;

- be layered like the protocol, so that new layers can be added without changing code, and a layer can be modified without affecting other layers;
- be centered on data-structure modules that implement a single data structure and all its relevant operations. An implementation should not attempt efficiency by sharing code for unrelated data structures; modules should be independent;
- keep separate logical functions in separate programs.
- use tables, such as "state machines," to drive code when possible; and
- use independent communicating processes rather than complex control structures.

One X.25 implementation that follows these guidelines is the X.Dot software package developed by The Community Memory Project, Berkeley, Calif., which is developing a highly distributed public access computer network. X.Dot is a commercially available software implementation of X.25 written in C, a high-level, portable language. In X.Dot, each level of the protocol is represented by one or more independent processes, which, as in the protocol itself, communicate with other processes by messages over separate virtual channels.

The significant data structures of X.Dot are built in a carefully layered manner. Dynamically allocated blocks of memory at its base have buffers built onto them. The buffers can be sent between parallel processes. On the buffers are the frames of the frame level, which supply the foundation for the packets, the heart of X.25. Finally, at the peak of the pyramid are messages, or calls, built out of a sequence of packets.

The implementation of X.Dot functions as independent but communicating processes facilitates the addition of higher level protocols, such as X.29 or protocols to implement the higher OSI levels (Fig. 3).

The X.25 recommendations and related communications protocols continue to evolve and expand. Developers of private packet data networks and computer manufacturers planning to support X.25 should incorporate those features of X.25 that have stabilized and are defined as essential. ■

Sandra L. Emerson is a technical consultant with The Community Memory Project, Berkeley, Calif.

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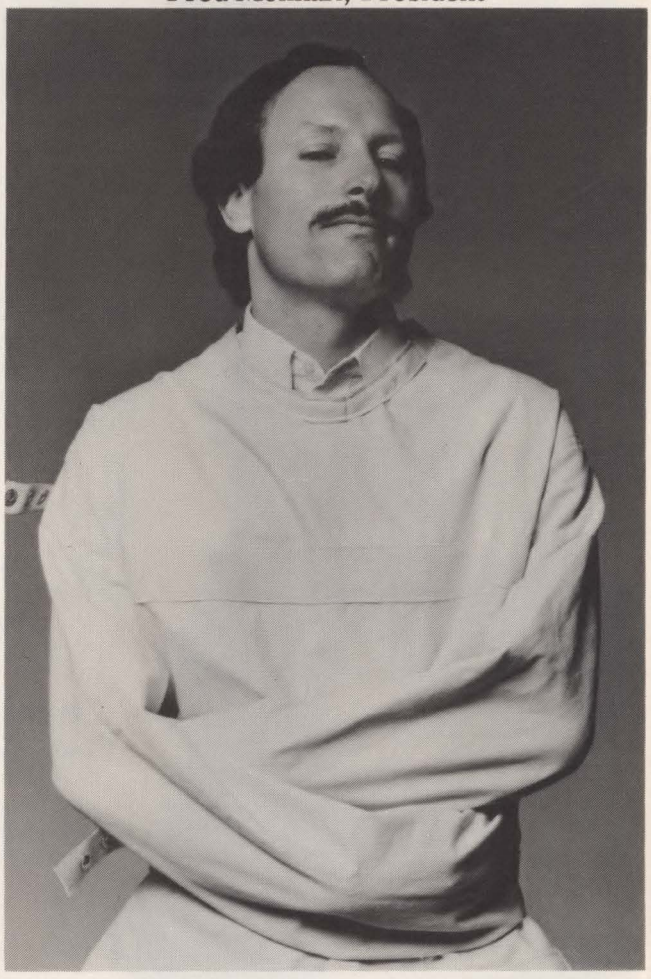

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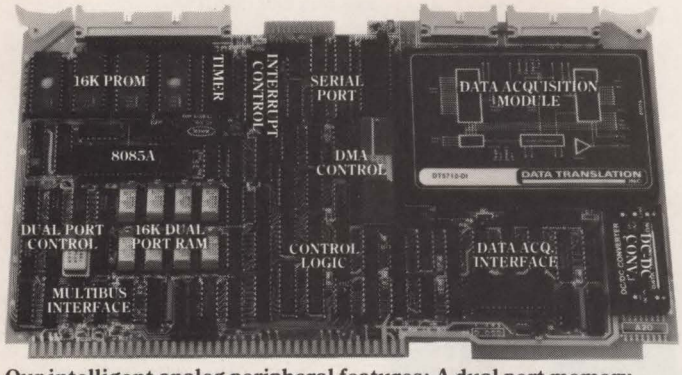

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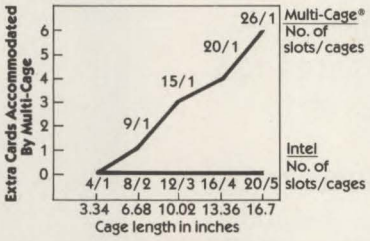

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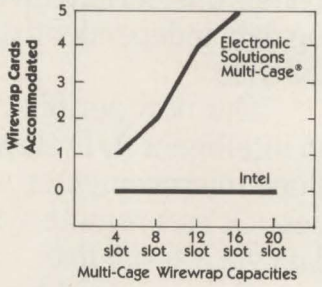

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A new route to line printing

Use of a parallel port improves system throughput and reduces costs

A new remote printer system from Digital Associates, Stamford, Conn., which operates out of a parallel port instead of a serial RS232 port, is intended to reduce operating costs while improving system throughput by about 50 percent, and host minicomputer efficiency by about 30 percent, all without modifying host hardware or software.

In addition to a printer and a controller, the remote-line system includes a transmitter, a remote receiver and a pair of 2400-, 4800- or 9600-bps synchronous modems at the host and remote sites. The modems are either Bell 201C or equivalent (for 2400 bps at printer speeds as high as 300 lpm), Bell 208B or equivalent (for 4800 bps and 600 lpm) or Bell 209A or equivalent (for 9600 bps and 1000 lpm). The line printers achieve speeds as high as 1000 lpm.

The transmitter interfaces with all the company's controllers, which operate with a variety of host minicomputers. A local printer operates through a second host-printer port or through an external switch when remote printing is not required.

Two μp-based Motorola M-6802 chips having a total of 4K bytes of memory allow the transmitter and receiver to perform data compression and automatic error detection and correction.

Compression minimizes the number of spaces (non-printable or repeated characters), and occurs after the transmitter has received a complete print line from the

COST COMPARISON: PARALLEL VS. SERIAL TRANSMISSION

Digital Associates' pilot evaluation compared two 600-lpm printers, one running in an RS232C environment and one using its Remote Line Printer System. For comparison, the use of a 4800-baud dial-up from New York to Los Angeles, and a three-hr. print job (using the RSR232C configuration), 250 days a year, were assumed.

RS232C configuration

Item	Cost
A. Two 4800-baud intelligent modems (@ $4000 each)[1]	$ 8000
B. RS232C interface box	$ 1250
C. 4800-baud line cost[2]	$22,550
Total cost for first year:	$31,800

Digital Associates' Remote Line Printer System configuration

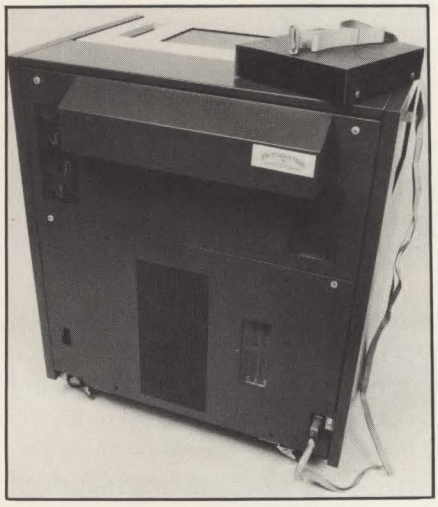
Item	Cost
A. Two 4800-baud dumb modems (@ $3000 each)	$ 6000
B. Remote Line Printer System transmitting and receiving units	$ 3500
C. 4800-baud line cost[3]	$15,050
Total cost for first year:	$24,550

The saving in the first year of operation using the Digital Associates Remote Line Printer System would be $7250 plus a 20-percent savings in the minicomputer CPU's degradation experienced in an RS232C environment

Notes

1. To make the two configurations as equal as possible, it is necessary to use intelligent modems in the RS232C configuration for error correction and detection. Since the Digital Associates Remote Line Printer System employs error detection/correction as a standard feature, less costly dumb modems are used.
2. The cost of the 4800-baud line is 70¢ for the first min. plus 46¢ for each min. following, plus 4¢ a min. for line rental. The three-hr. print job would cost $90.20 a day, or $22,550 for each business year.
3. Line-cost savings are realized by running the same print job in two hr. with a conservatively estimated 30 percent compression factor. Using the same line costs detailed above, the job would cost $60.20 a day, or $15,050 for each business year.

The use of a line printer provides greater reliability—eight or more hours a day of operation versus three to four hours a day for serial printers.



Compact size *of the Digital Associates' remote line printer receiver is evident in photo showing it atop a Data Printer 1000-lpm model 1210 Chain/Train printer. The ribbon cable connects the receiver to the printer's parallel port.*

controller. Compression works:

- by placing a print symbol immediately after the last printable character, thus supressing blanks at the end of the print line, or
- by substituting a two-character control and space-count code for any sequence of three or more spaces or repeated characters, such as zeros, between printable characters within the print line.

Error detection and correction are accomplished by sending a block of data—as well as both character and block parity bits—to the remote receiver. At the end of the block, the parity checks indicate if there is a need for retransmission. If there is, the modems are reversed to signal accordingly. The host system's operator must establish communications with the remote site. To do so, he dials the remote-site operator and receives either an answer or an automatic answer tone. He then places the modem on-line. From this point on, the system operates automatically as though the printer were local. The operator at either end terminates the call.

Digital Associates' new printer system provides several benefits.

- Improved system throughput (Fig. 1) is partly the result of the fact that the system uses a line printer at rated speed. Systems efficiency is achieved by using the printer port rather than the RS232 port. The transmitter assumes communications functions typically assigned to the host processor, thus improving host minicomputer use by 30 percent or more. Minicomputer communications protocols, on the other hand, reduce system efficiency because everything to be printed must be sensed and manipulated, a character at a time. The greater the number of characters, the more machine cycles—"stolen" from other tasks—that are required. Further, data compression accelerates transmission.
- Hardware and software do not require modification because the remote printer system is transparent to the host processor.
- Automatic error detection and correction reduce error rates. Printers using RS232 protocols lack this feature.
- The use of a line printer provides greater reliabili-

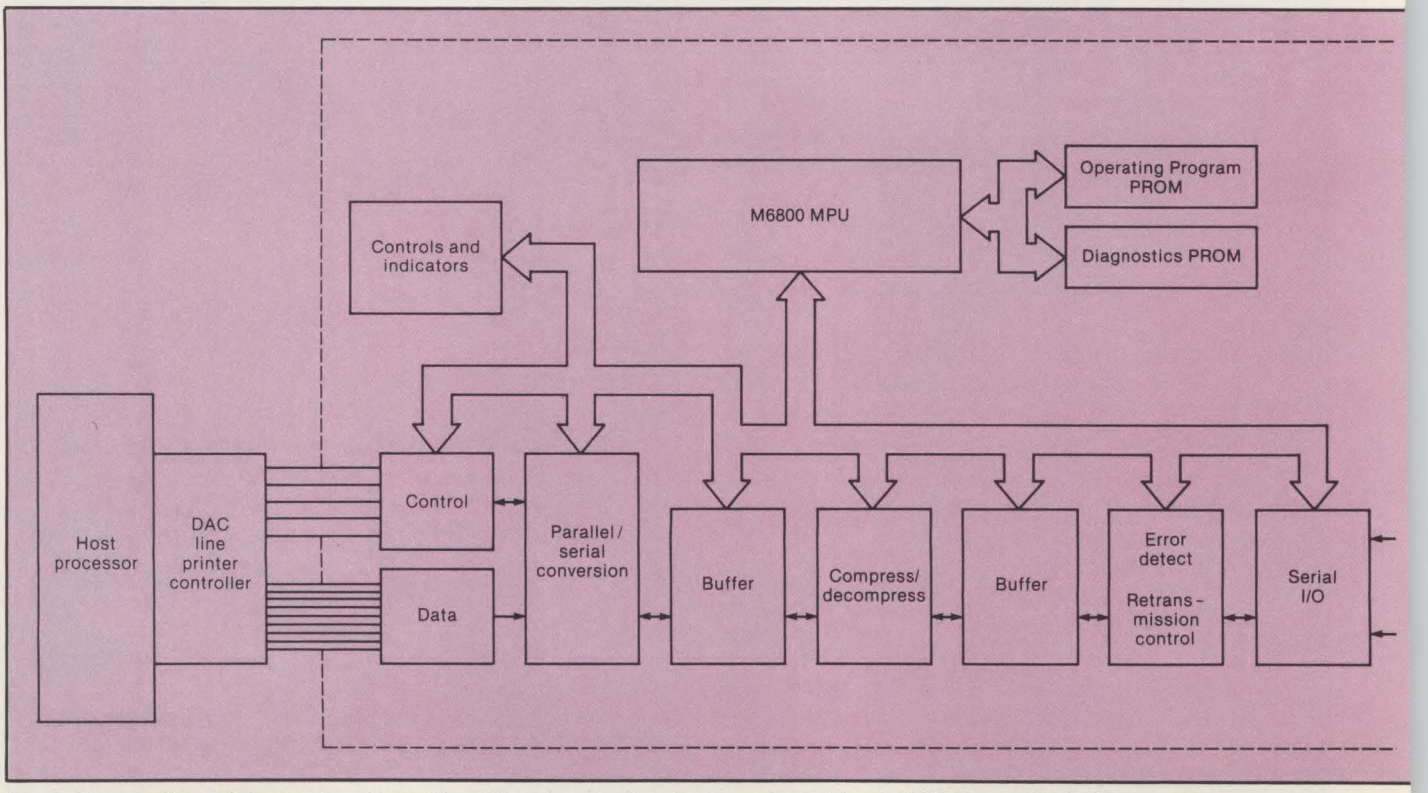


Fig. 2. Remote line printer system *(dotted box) illustrates the functions coordinated by the M6802 μp. The buffers on either side of the*

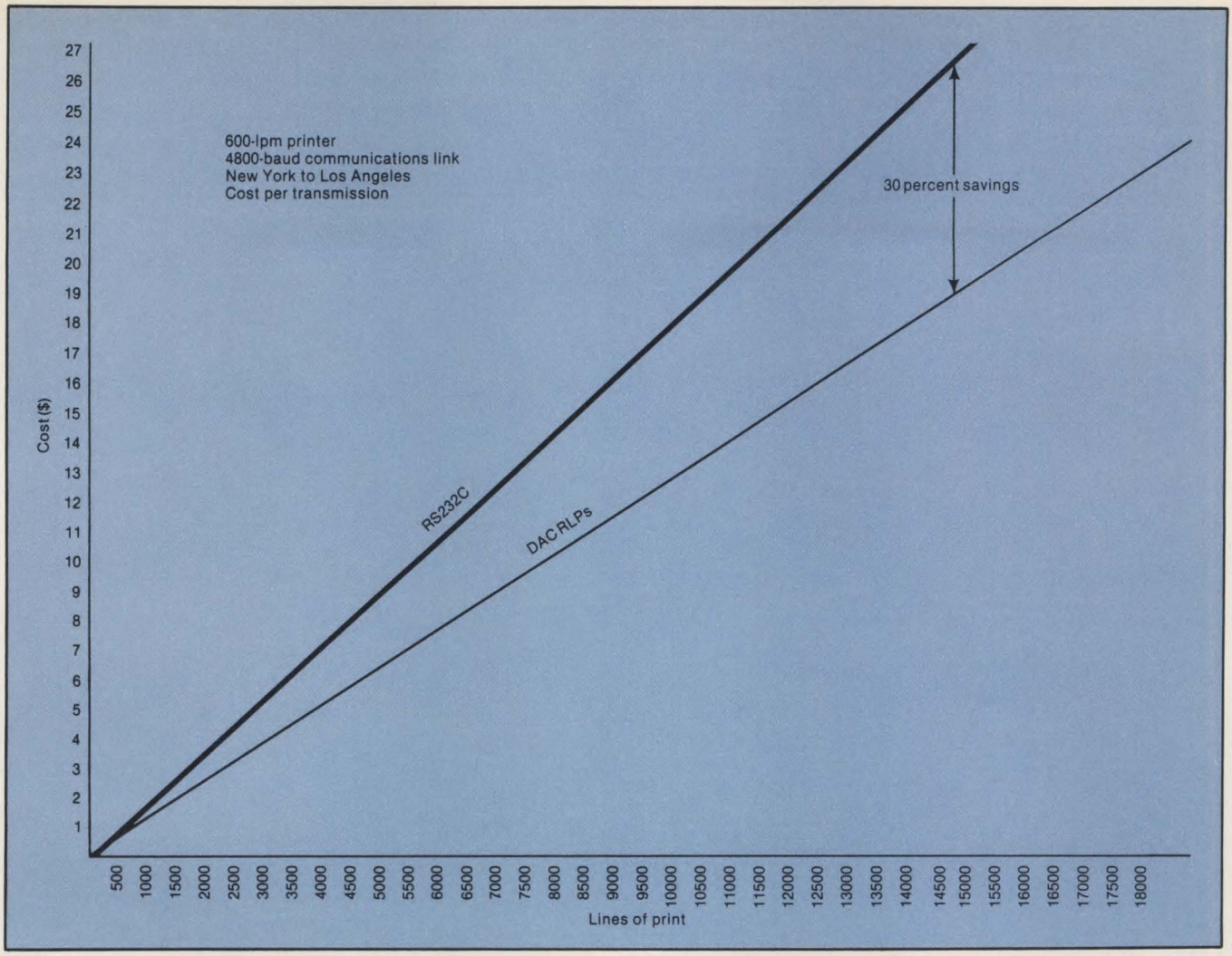
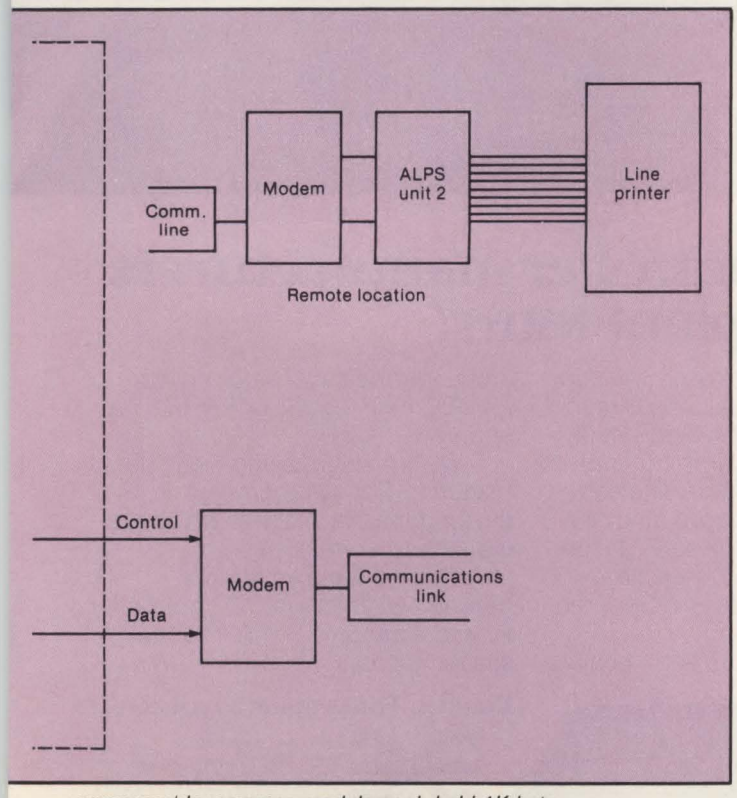


Fig. 1. Line savings realized *through use of DAC Remote Line Printer System compared to uncompressed transmission over 4800-bps phone line averages about 30 percent.*



compress/decompress module each hold 1K byte.

ty—eight or more hours a day of operation versus three to four hours a day for serial printers.

• Accelerated transmission rates, improved minicomputer use and the elimination of the need for packing and shipping bulky printouts all contribute to reduced costs.

To achieve the resulting improvement in host minicomputer performance and the benefits of DAC's system, a user must purchase an additional transmitter and a receiver. These two units raise the price of the sytem to an average of 20 percent higher than the price of the company's printers. But, the company points out, the new system sells for less than does a local printer supplied by a minicomputer manufacturer. Further, the transmitter eliminates the need for a communications operating system in the host processor.

As field experience with the new remote printer system accumulates, Digital Associates anticipates increased demand for bidirectional communications between remote sites and the host. With a video-display terminal, the remote printer can initiate communications with the host.

The company also predicts savings for digital networks. By eliminating the need for modems, an all-digital network would save $2000 to $8000. ■

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Data base management for μcs

C. W. HOLSAPPLE, University of Illinois

Seven easy steps to a data-base schema design that offers several advantages over traditional file-management approaches

A major stumbling block for persons trying to understand or manage data bases is that they continue to think in terms of files, failing to grasp the distinction between these approaches. This is especially true in the μc field. Some μc users, from their data-base experience on mainframes or minis, understand the nature and value of data-base management, but most of them do not. Complicating this situation is the confusion arising from the fact that "data base" means different things to different people. Here we define terms and

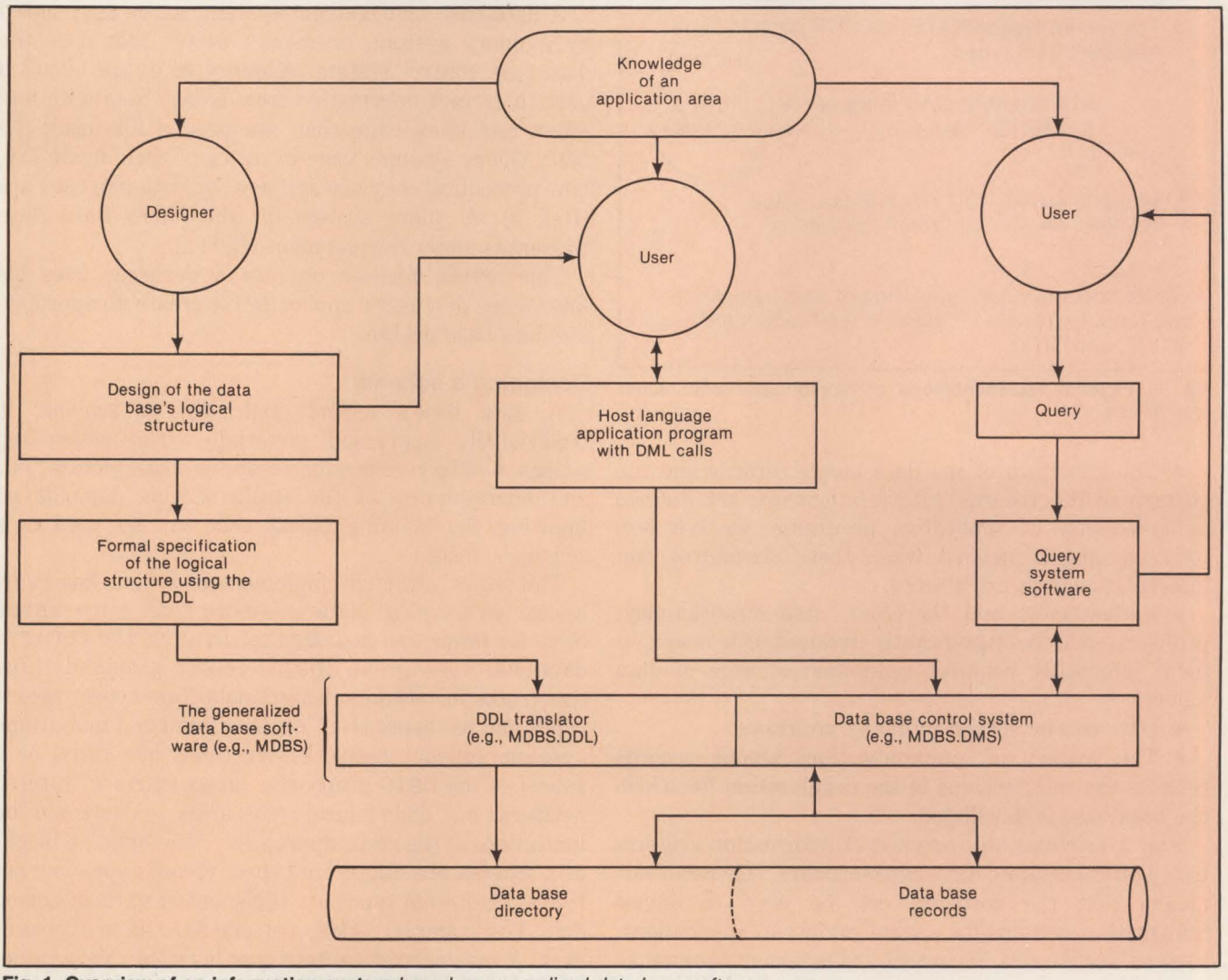

Fig. 1. Overview of an information system *based on generalized data-base software.*

The DDL specifies the logical structures of a data base: the types of fields and records and their interrelationships.

show how, once the characteristics of data base are understood, a designer can transform his knowledge of the user's needs into a data-base design likely to have greater flexibility, yet require fewer modifications and lower overhead than a user's present system.

Data-base management

The term "data base" is used in two ways. Politicians, administrators and others use it loosely to describe any collection of data, whether file-management or data-base. Those more familiar with data bases, including developers of computer-based information systems, refer to it as a repository of data records in which:

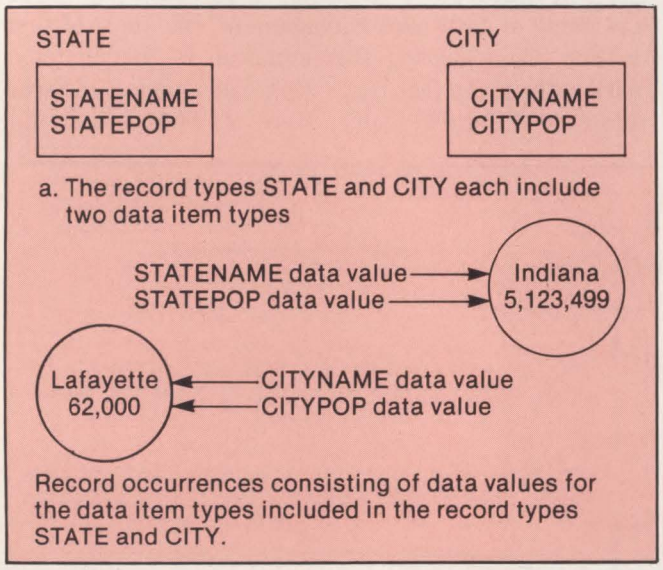

Fig. 2. Pictorial representations *of record types and record occurrences.*

- The structure of the data base's records and the pattern of the records' interrelationships are defined independently of application programs, so that less programming is needed when these structures and interrelationships are altered.
- Redundancy, and therefore, data inconsistency, problems will be significantly reduced (file management inherently requires redundant storage of data values).
- Data can be shared by many programs.
- The pattern of interconnections among records reflects the relationships in the organization for which the data base is developed.

Fig. 1 provides an overview of information systems based on generalized data-base software. "Generalized" means that the software can be used to devise information systems for a wide variety of applications, such as health care, inventory management, personnel administration and payroll. Data-base management systems furnish a data-definition language (DDL) and a data-manipulation language (DML). The DDL specifies the logical structure of a data base: the types of fields and records, and their interrelationships. The DML is used within the context of a host language, such as BASIC or FORTRAN through its call statements.

As shown in Fig. 1, software supports both DDL and DML. A DDL translator takes the DDL specification of a data base as input and generates a data-base directory as output. In the Micro Data Base System, MDBS, the most widely used data-base system for μcs, the DDL translator software is referred to as MDBS.DDL (Ref. 4).

When a host language application program calls a DML command, at least one of the modules in the data-base control system is invoked. In MDBS, the data-base control system software is referred to as MDBS.DMS (Ref. 4). These modules use the data-base directory and the data base to perform the command. The data base control system modules handle all paging between central and auxiliary memory, manage all free space in the data base, allocate space for new records, find records needed by an application program, etc. (For examples of BASIC application programs that use DML commands see Ref. 1.)

A data-base management system can be augmented by a query system, or report writer that uses the data-base control system. A query language allows a user to extract information from a data base with less effort and knowledge than are needed for using the DML. Query systems vary in terms of their flexibility, how procedural they are and how English-like they are (Ref. 3). A query system for the Micro Data Base System is under development (Ref. 5).

This article focuses on how a designer uses his knowledge of a user's application to create an appropriate data-base design.

Designing a schema

A data base's logical structure, or schema, is traditionally expressed pictorially. The seven-step design strategy generates an appropriate picture, but an understanding of the MDBS schema depends on knowing the building blocks that can be used in a schema's design.

The MDBS, although implemented on μcs, has many logical structuring features—more than some DBMSs have for minis and mainframes. In 1971, the CODASYL data-base task group (DBTG) report proposed three constructs for schema design: data-item types, record types and set types (Ref. 6). Most mini and mainframe systems support network structures like DBTG or a subset of the DBTG proposals. MDBS starts with DBTG networks and adds logical structuring to overcome the limitations of the DBTG approach. The building blocks of a schema are data-item types, record types and set types. Data-item types are the smallest units of named data. For example, NAME, AGE and SALARY are types of data. A particular data-item type is called a data value. For example, "Indiana" is a data value of the data-item

A query language allows a user to extract information from a data base with less effort and knowledge than are needed for using the DML.

type STATENAME. A data value of the data-item type STATEPOP is 5,123,499.

A record type is a named aggregate of data-item types (Fig. 2a). For instance, STATE, composed of the data-item types STATENAME AND STATEPOP, is a record type. Another record type, named CITY, might be composed of the data item types CITYNAME and CITYPOP. A particular record type is called a record occurrence. For example, the two data values "Indiana" and 5,123,499 form the record occurrence of STATE. Here, "Indiana" is the STATENAME data value, and 5,123,499 is the STATEPOP value. Data values for the record type CITY are "Lafayette" and 62,000. "Lafayette" is the CITYNAME data value and 62,000, the CITYPOP data value. A record type is pictured by a rectangle enclosing its data-item types, as shown by the STATE and CITY record types in Fig. 2a. A record occurrence is represented by an ellipse or circle enclosing its data-item values (Fig. 2b).

A set type is a named relationship between (typically) two record types, one of which is called the set type's owner and the other called the set type's member. The owner can have any number of members, but according to CODASYL DBTG convention, no member can have more than one owner. This relationship is termed "one-to-many," (1-N). MDBS is not limited to the CODASYL convention of a set type; it permits many-to-many (N:M) relationships to be directly represented. An N:M set type is a named relationship between two record types, one of which is arbitrarily called the owner, and the other of which is called the member. In both the 1-N and the N:M sets, an owner can have many members. But only in N:M is a member permitted many owners.

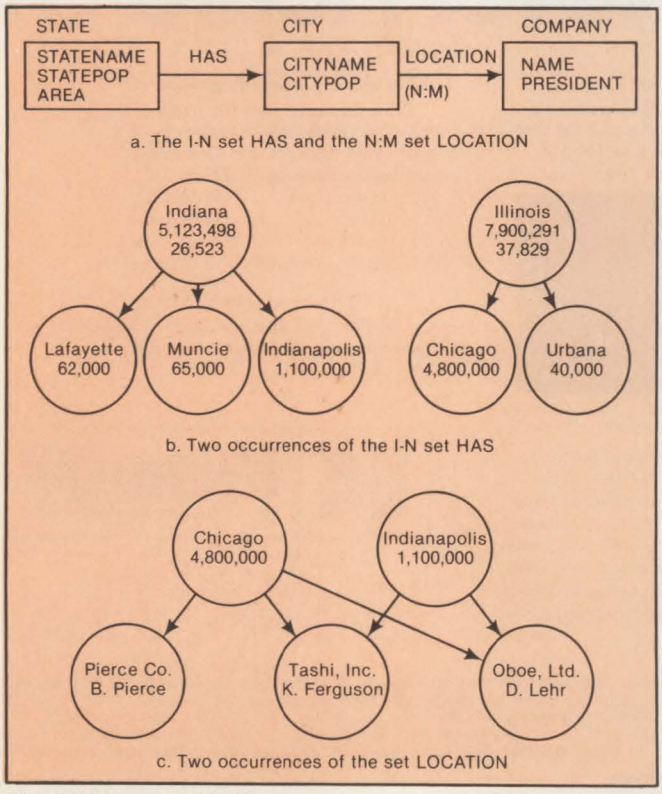

Fig. 3. I-N sets *and N:M sets.*

Set types can also include multiple-member record types, multiple-owner record types or the same record type as both owner and member. The latter two features go beyond the original DBTG proposals. As an example of a 1-N set, if we want to show that a state has cities, we define the set HAS with STATE as the owner and CITY as the member. No occurrence of the member-record type CITY is associated with more than one occurrence of STATE. However, there may be many (N) occurrences of CITY associated with a particular occurrence of STATE, showing that a state has many cities, but a city is in no more than one state.

As an example of an N:M set, if we want to illustrate that a company can be located in many cities and a city can have many companies located in it, we define the N:M set LOCATION, arbitrarily declaring CITY the owner and COMPANY the member. We can associate an occurrence of COMPANY with many (N) occurrences of CITY, and an occurrence of CITY with many (M) occurrences OF COMPANY.

An N:M set occurrence consists of an occurrence of the owner-record type and all occurrences of the member-record type owned by that owner occurrence. The occurrence of STATE for Indiana, and all CITY occurrences for cities in INDIANA, forms a set occurrence of the set HAS.

An N:M set is depicted by an arrow that points from the owner-record type to the member-record type. The 1-N set HAS and the N:M set LOCATION are drawn in Fig. 3a. An occurrence of the member-record type is associated with some occurrence of the owner-record type, as represented by an arrow pointing from the owner occurrence to the member occurrence. Fig. 3b shows two occurrences of the set HAS (assuming that information is held for only three cities in Indiana and two in Illinois). We see that for one owner occurrence, there can be many (N) member occurrences, but for one member occurrence, there is at most one owner occurrence. No two occurrences of a set have any record occurrence in common.

Two occurrences of an N:M set may have shared record occurrences. For example, the two N:M set occurrences of LOCATION shown in Fig. 3c have two record occurrences (Tashi, Inc., and Oboe, Ltd.) in common. In other words, an N:M (many-to-many) relationship between two record types means that we are associating many occurrences of the first record type with one occurrence of the second record type, and many occurrences of the second record type with one occurrence of the first. For example, if RIVER is a record type, there is an N:M relationship between

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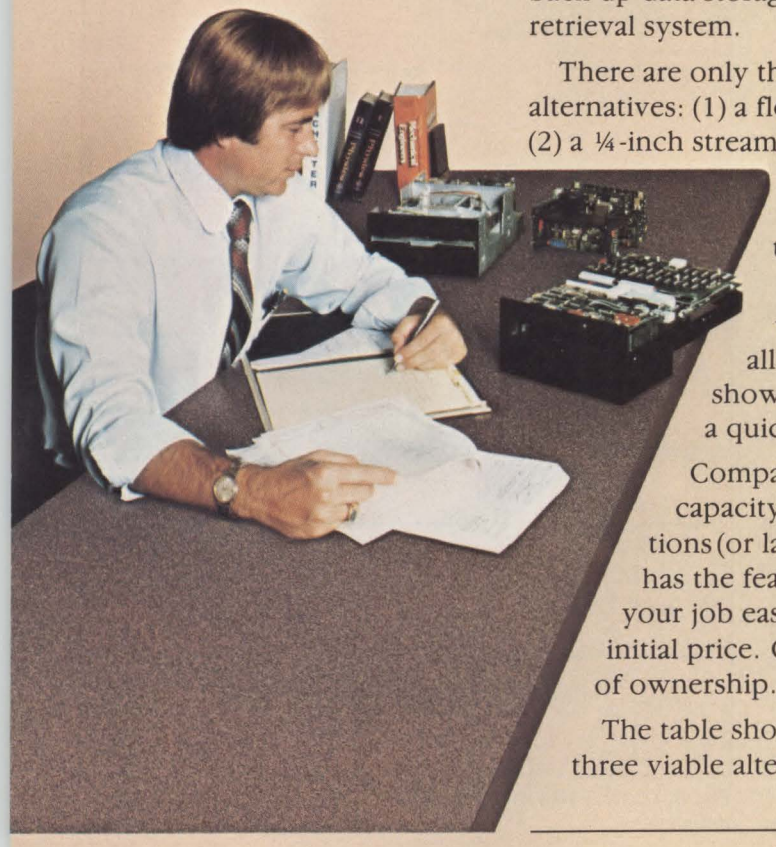
Archive ¼″ Streaming Cartridge Tape	20.0	$31	1	$30	4 (90 IPS) 12 (30 IPS)	One media insertion
¼″ Start/Stop Cartridge Tape	8.6	$140	3	$90	60 (30 IPS)	Multiple media insertions



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The MDBS, although implemented on μcs, has many logical structuring features—more than some DBMSs have for minis and mainframes.

RIVER and STATE. A river can flow through many states, and a state can contain many rivers.

We have seen that in the MDBS, an N:M relationship can be represented by an N:M set. Fig. 4a shows it can also be represented by two sets and a third record type (Z). This is the traditional DBTG method for handling N:M relationships. If the intervening Z has no data-item types, this method for handling N:M relationships is inferior to the simple use of an N:M set between STATE and RIVER. It is less efficient in terms of storage and

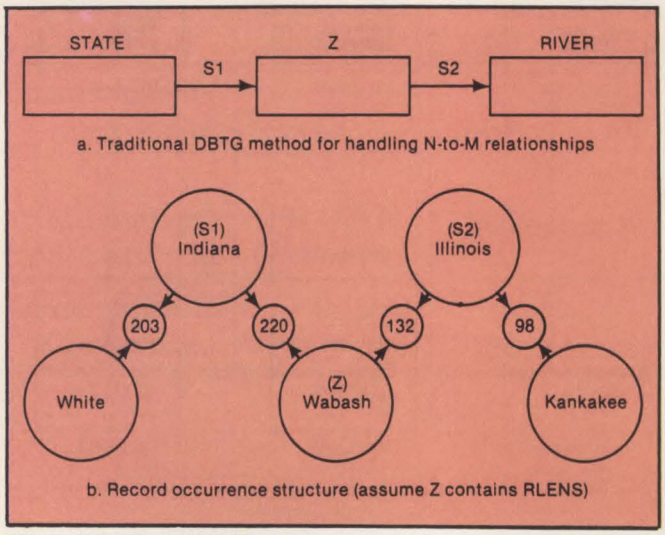

Fig. 4. N-to-M *relationship.*

processing, and it makes programming more cumbersome. However, it is sometimes desirable to have data-item types in the intervening record type. For instance, Z might contain the data-item type RLENS: River Length in State. For example, Fig. 4b shows that two sets (Indiana and Illinois) with the same member-record type (Wabash) can be used to incorporate an N:M relationship into the schema. Each occurrence of the intervening record type (Wabash) is associated with one river and one state, resulting in a river-state pair. (Wabash has a length of 220 miles in Indiana and 132 miles in Illinois.)

A diagram of data-item types, record types, 1-N sets and N:M sets is called a data-base schema. A diagram of specific data values, record occurrences, set occurrences, etc., is called an occurrence structure. By using the building blocks described above, an unlimited number of schemas can be constructed. But whatever schema is constructed, it will fall into one of the following schema categories (Ref. 7):

- Disjoint record types. This variety of schema consists of record types without any 1-N sets or N:M sets (Fig. 5a). Three files are implied by the schema:

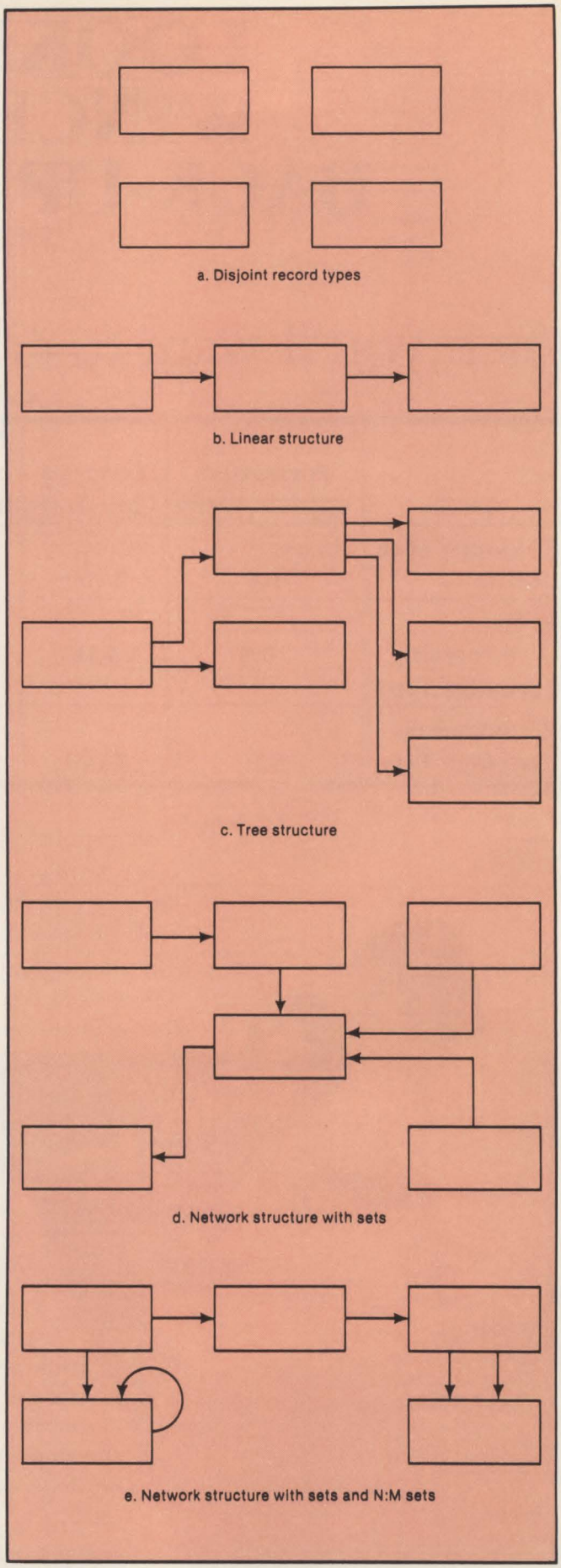

Fig. 5. Logical structure *categories. (Data-item types are not shown.)*

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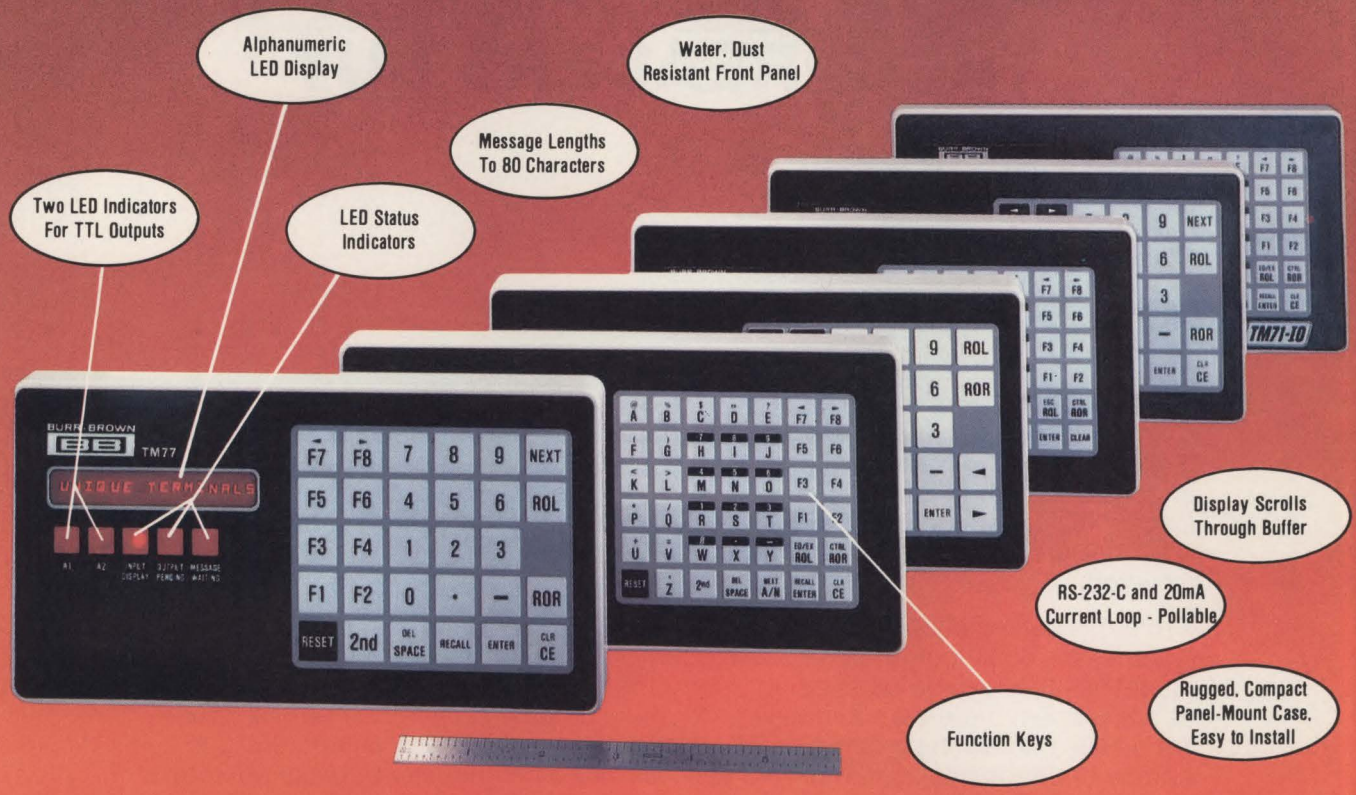

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TM71-I/O	16	110-19200	320 Characters(1)	Alpha	14	TTL I/O	+5VDC
TM77-I/O	16	110-19200	320 Characters(1)	Numeric	14	TTL I/O, larger keys	+5VDC
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MDBS is not limited to the CODASYL convention of a set type; it permits many to many (N:M) relationships to be directly represented.

one consisting of occurrences of record type X, one of Y and one of Z. A relationship between an occurrence of X and an occurrence of Y can be established only if there is at least one data-item type that appears redundantly as part of X and also as part of Y. Because this variety of schema has the same limitations as a file-management system, it should not be considered further. This kind of schema forces the use of the DBMS as if it were merely a file-management system. For example, the DBMS can be used for sorting and merging files.

- Linear structures. This schema allows any pattern of sets and record types in which no record type is the owner of more than one set or the member of more than one set. There are no N:M sets (Fig. 5b).
- Tree (hierarchical) structures. In this schema, a record type cannot be a member of more than one set, and there are no N:M sets (Fig. 5c).
- Network structures. In this schema, a record type can own or be a member of any number of sets (Fig. 5d). If a schema contains an N:M set, it is a network structure. As in Fig. 5e, an N:M set can have the same record type as both owner and member, as in 1-N sets. Two record types can have more than one 1-N set (or N:M set) defined between them. This is useful in applications such as bill-of-materials (Ref. 8). A network-based DBMS can support disjoint record types, linear structures and tree structures as special cases.

It is a long step, however, from knowing the varieties of schemas to designing one appropriate for a particular application. Typical applications yield network schemas, modeling the networks of real interrelationships. The schema-design strategy is a procedure for converting knowledge about a network of actual interrelationships into a logically correct network schema. If a data-base system is limited to hierarchical schemas, a network of interrelationships can be captured only by introducing redundancy into a tree structure.

The seven-step strategy

The first phase of setting up an information system that uses a μc data-base system is shown in Fig. 1. A seven-step procedure in designing a data-base schema for an application involving high-school students, teachers, activities, courses and course sections follows:

- Step 1: List the types of data involved and give a name to each of these data-item types.

student name	- SNAME
student address	- SADD
student social-security number	- SSN
teacher name	- TNAME
teacher office no.	- TONO
name of activity	- ANAME
description of activity	- ADES
course title	- CTLE
course number	- CNO
section number	- SNO
course subject	- SUBJECT

- Step 2: Determine whether SNAME and SADD have a nearly 1-to-1 relationship, that is, whether a student name has only one address and whether a student address has only one student name. If so, SNAME and SADD can be aggregated into the same record type and referred to as STUDENT (Fig. 7a). Determine whether SSN and SNAME is nearly 1-to-1, that is, whether a social-security number has only one student name and whether a student name has only one social-security number. If so, SSN can be aggregated into the same record type as SNAME (Fig. 7b).

Determine whether TNAME and SNAME are nearly 1-to-1. This will not typically happen because a teacher can have many students, so TNAME is not incorporated into STUDENT. Continued checking for 1-to-1 relationships gives the record types shown in Fig. 7c.

- Step 3: Determine whether there are any data-item types not yet in a record type. If so, create a record type for each, giving the two additional record types shown in Fig. 7d.
- Step 4: Draw in all sets (1-to-N relationships) between the record types. If STUDENT and TEACHER have a 1:N relationship, which they do in at least one sense (a teacher can advise many (N) students, but a student has only one advisor), construct the ADVISES set as shown in Fig 7e. Teachers are also related to students in that they teach students. But this is not a 1-to-N relationship because a teacher can teach many (M) students, and a student can have many (N) teachers.

Drawing sets for the remaining 1-to-N relationships gives the structure of Fig. 7f. ACTIVITY remains unattached because it has no relationship to SUBJECT, COURSE, SECTION or TEACHER, and does not have a 1-to-N relationship with STUDENT.

- Step 5: Remove the set between SUBJECT and SECTION because it represents a transitive 1-to-N relationship between subjects and sections. The sets WITH and HAS already account for the relationship between subjects and sections (Fig. 7g).
- Step 6: Determine if there are any unattached record types, which, in this case, is ACTIVITY. The other record type that seems most closely related to ACTIVITY in a conceptual sense is STUDENT. The notion of an activity is more closely related to the concept of student than it is to subject, course, section or teacher. Thus, incorporate ACTIVITY into the network schema by means of an N:M set PARTICIP (participation), giving the logical structure of Fig. 7h. STUDENT is arbitrarily the owner of PARTICIP. So each STUDENT occurrence can own many ACTIVITY occurrences via the PARTICIP set. Conversely, each ACTIVITY occurrence can be owned by many STUDENT occurrences via PARTICIP.
- Step 7: Determine whether there are any important N-to-M relationships not yet incorporated into the schema. There is one: the schema does not allow

The structure of the data base's records and the pattern of the records' interrelationships are defined independently of programs.

determining which student is enrolled in which sections, or which section contains which students. This can be remedied by creating the N:M set ENROLL, giving the schema in Fig. 7i. SECTION is arbitrarily the owner of ENROLL.

By first representing the N-to-M relationship between SECTION, which was not previously the owner of any set, and STUDENT, the N-to-M relationships between TEACHER & STUDENT, COURSE & STUDENT and SUBJECT & STUDENT, have been automatically provided. For example, ENROLL provides all sections for a student, and for each of those sections, TEACHES allows us to find the teacher that teaches each section. That is, each member of TEACHES has only one owner. Similarly, the HAS set provides the course for each section, and WITH provides the subject of each course.

The SYSTEM-record type

The MDBS automatically creates a special record type called SYSTEM, which has only one occurrence—also created and maintained by MDBS—and contains no data. The occurrence of SYSTEM serves as the entry point into a data base; all processing of occurrences begins at the SYSTEM occurrence.

The seven-step schema produces a procedure that must be amended by making SYSTEM the owning-record type for at least one set. Additional sets, with SYSTEM as owner, can also be declared. As a rule of thumb, if a record type is not a member of a set, it should be declared the member of a set owned by SYSTEM, and if a record type is the owner or member of an N:M set, it should be declared the member of a set owned by SYSTEM. Thus, the example shown in Fig. 7j is amended by adding the SYSTEM-owned sets: S1, S2, S3, S4 and S5.

Using the DDL

The DDL is used to describe formally the data-item types, record types, 1-N sets and N:M sets that appear in a schema diagram. The DDL description is input to the DDL Translator (MDBS.DDL analyzer/editor), which checks the consistency of the DDL description and uses it to generate the data-base directory. The data-base directory, sometimes called schema tables, contains all information about the logical structure of a data-base in an internal form for use by the data base control system.

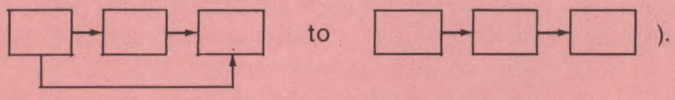
The 7-step procedure for schema design

Step 1: List all data item types.

Step 2: If there is a 1-to-1 relationship (or nearly so) between two data item types, aggregate them into the same record type.

Step 3: For each data item type that has not been put into a record type, declare a new record type to contain it alone.

Step 4: If a 1-to-N relationship exists between two record types draw in the appropraite set.

Step 5: Remove the sets of any transitive 1-to-N relationship (i.e., change 

).

Step 6: For each unattached record type (i.e., not yet participating in a set) find the attached record type that, conceptually, seems to be the most closely related to it. Create an N:M set between these record types, arbitrarily calling one the owner and the other the member.

Step 7: Determine if the concept represented by each record type has an N:M relationship to any other record type, a relationship you want to have incorporated into the schema. If it does and if that relationship is not already represented in the schema, add an N:M set to represent this relationship. Begin by considering those record types that are not owners of sets; then recursively consider those record types that own already-considered record types.

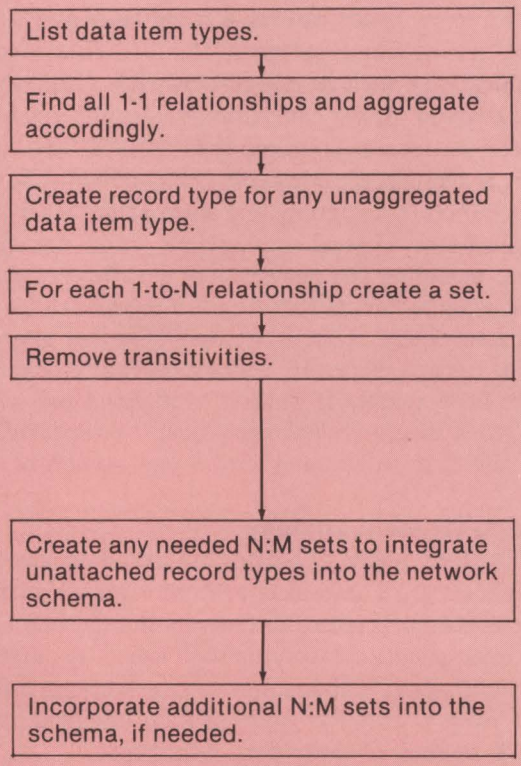
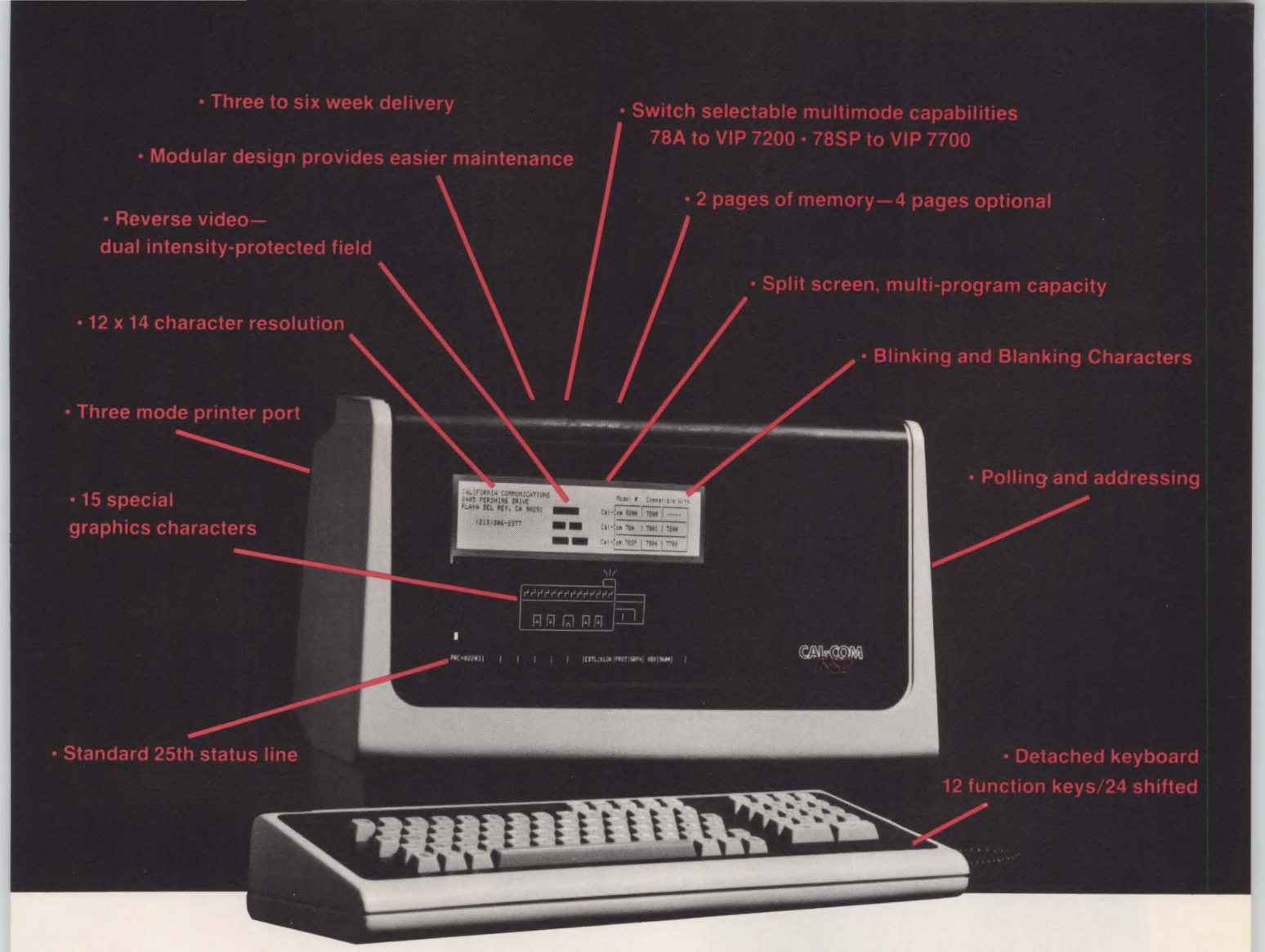


Fig. 6. A schema-design *strategy.*



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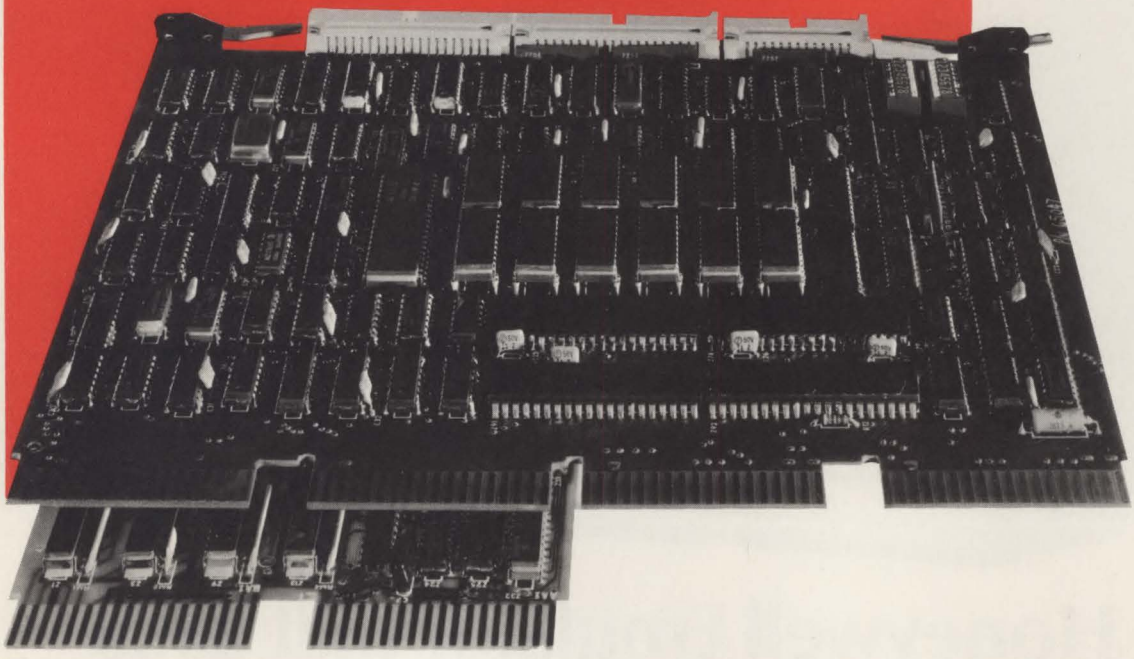

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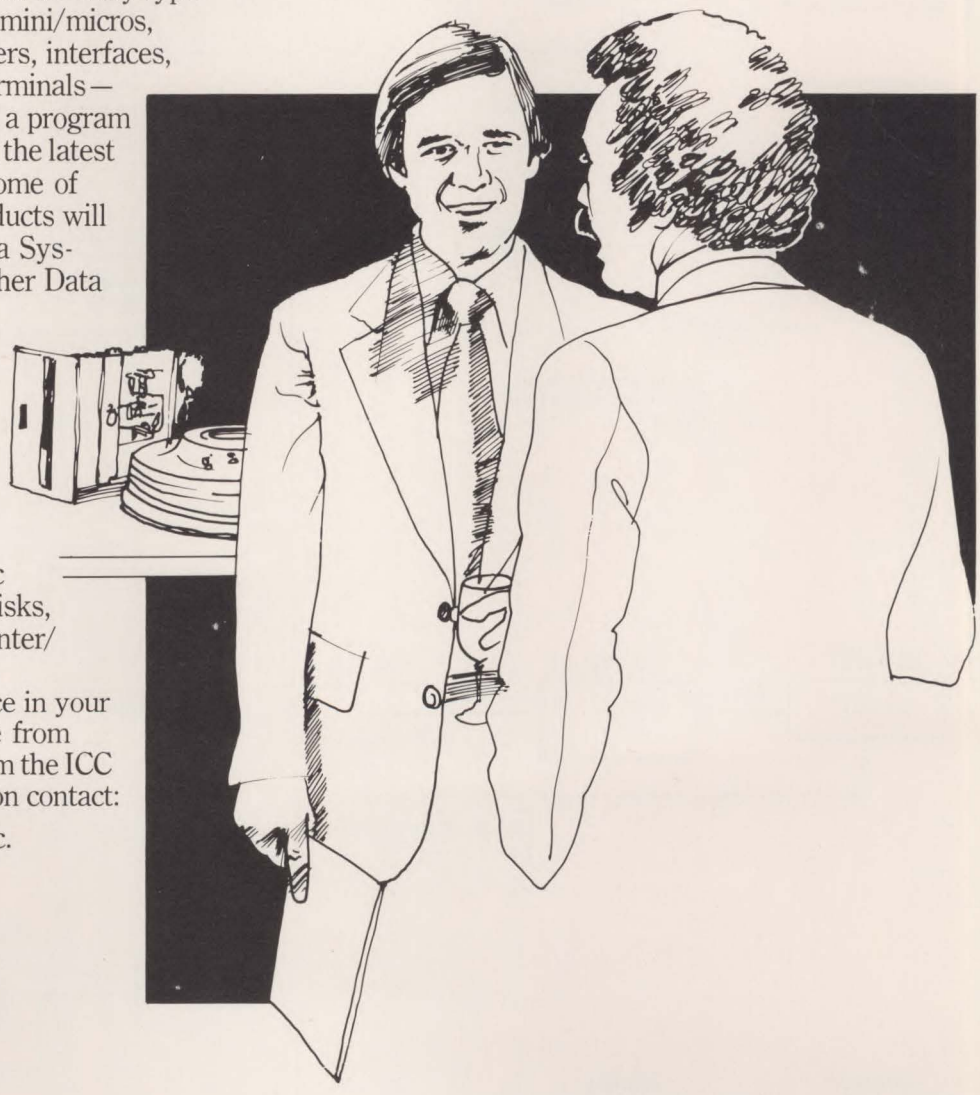

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Member records for some owner to be maintained in k orders can be provided by declaring sets between the two record types.

The DDL syntax for the Micro Data Base System is more streamlined than the DDL syntax proposed in the DBTG Report. When defining a set with the DDL, a designer can specify how the member record occurrences in any occurrence of that set are to be organized. Using the ADVISES set to obtain a sorted list of names of all students advised by a teacher, the ADVISES set should be declared sorted on the basis of SNAME:

```
SET       ADVISES    AUTO 1:N
OWNER     TEACHER                SORTED  SNAME
MEMBER    STUDENT
```

The data item type used as the sort key of a set occurrence must be from the set's member-record type. Here, AUTO means that, as each occurrence of STUDENT is created, it is automatically added to a set occurrence of ADVISES. The 1:N indicates that ADVISES is a conventional CODASYL set. Other orderings, can be employed such as LIFO, FIFO, NEXT or PRIOR, or no ordering (IMMATerial) can be selected.

To obtain a list of all students advised by teacher, but sorted on the basis of social-security number, another

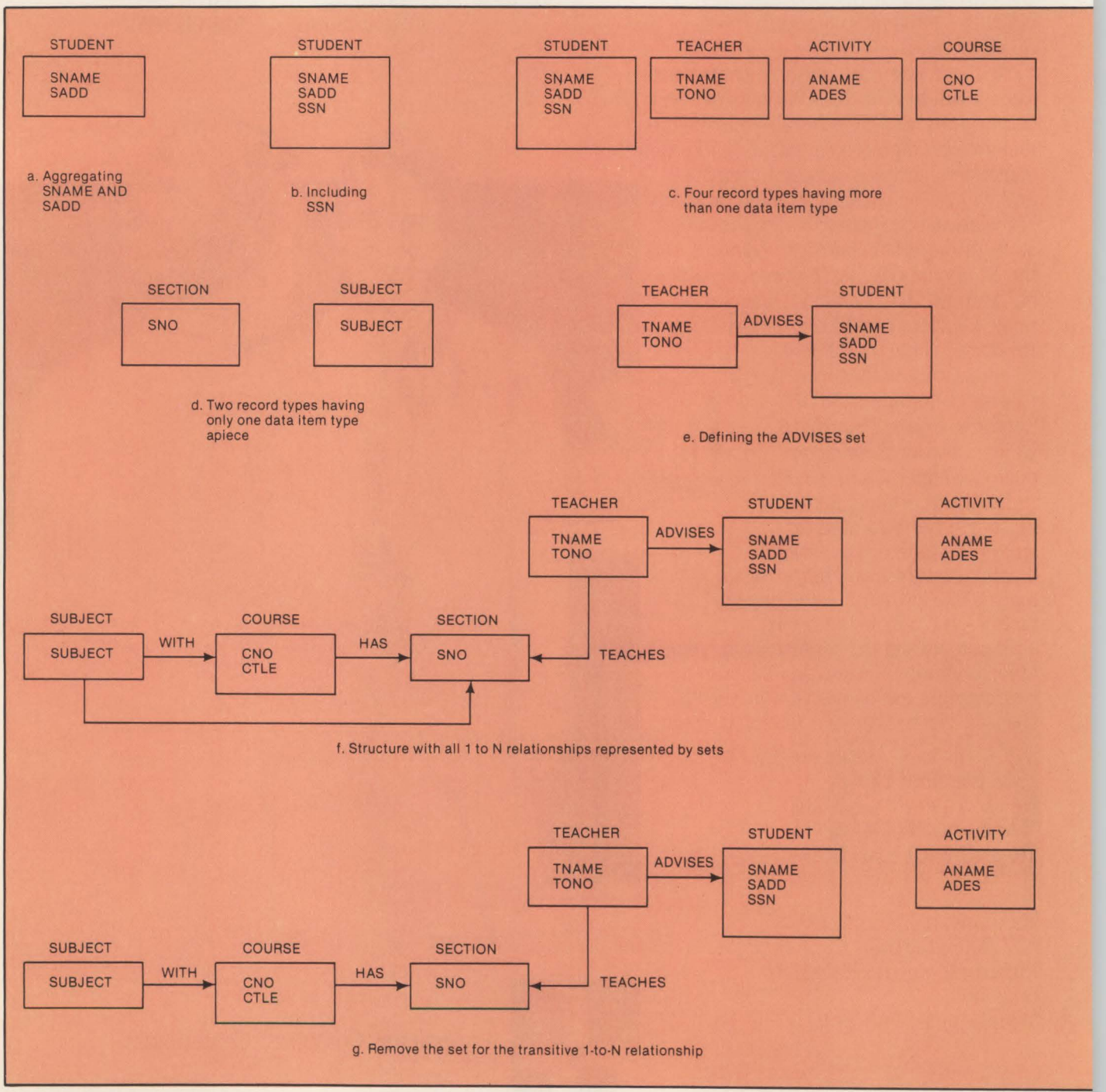


Fig. 7. Schema design *steps 1 through 7.*

set, called ADVISES2, BETWEEN TEACHER and STUDENT can be declared. The MDBS DDL description for this set is:

```
SET       ADVISES2    MAN    1:N
OWNER     TEACHER                SORTED   SSN
MEMBER    STUDENT
```

Here MAN (manual) means that as each occurrence of STUDENT is created, it is not automatically added to a set occurrence of the ADVISES2. It can be added manually by giving a DML command to the MDBS.DMS.

To obtain an alphabetical list of all students in the data base, regardless of advisors, the following DDL description for S4 can be used:

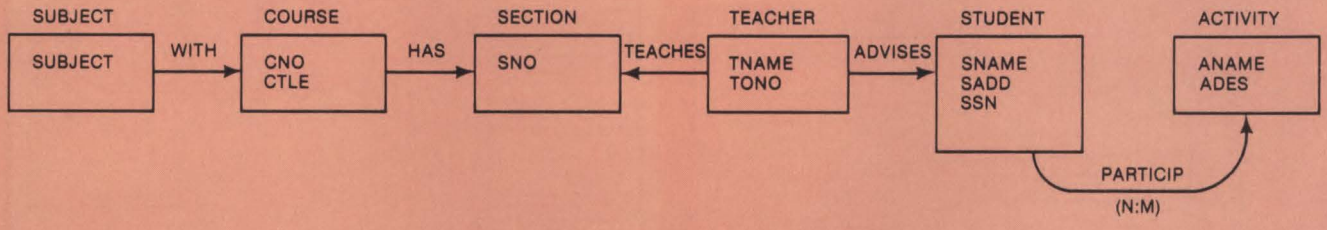
```
SET       S4          AUTO   1:N
OWNER     SYSTEM                 SORTED   SNAME
MEMBER    STUDENT
```

S4 has only one set occurrence, and its members are sorted on the basis of SNAME.

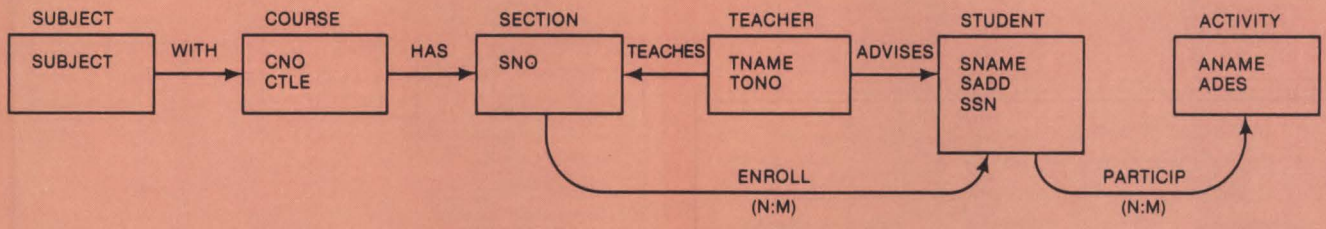
Member records for some owner to be maintained in k, perhaps three, orders can be provided by declaring sets between the two record types. Each set is sorted on the basis of a different data-item type. Set orders other than SORTED can be declared, including IMMAT, LIFE and FIFO. All data-item types of a record can be used simultaneously as a sort key for a set, and although a record can logically belong to many sets, record occurrences exist only once in the data base.

When defining an N:M set with the DDL, an order for member occurrences and an order for the owner occurrences associated with each member occurrence can be specified. To use SORTED order for owner occurrences, a data-item type from the owner-record type must be declared as the owner-sort key. Thus, an N:M set can have an owner-sort key as well as a member-sort key. To obtain a sorted list of all students participating in an activity and a sorted list of all activities in which a student participates, the MDBS DDL description should be used:

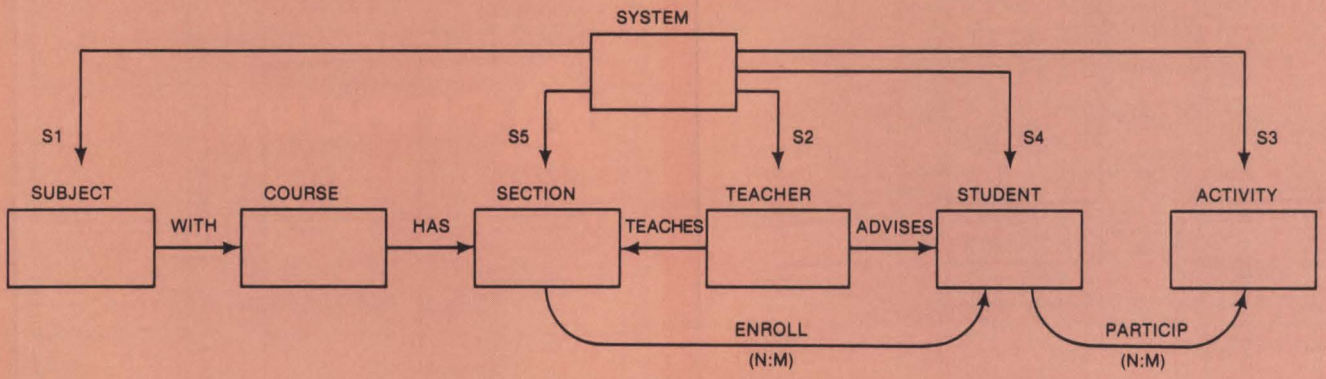
```
SET       PARTICIP    MAN    N:M
          SORTED      SNAME         SORTED   ANAME
OWNER     STUDENT
MEMBER    ACTIVITY
```



h. Connecting ACTIVITY to STUDENT via PARTICIP



i. Schema constructed by the seven-step design strategy



j. Inclusion of the SYSTEM record type

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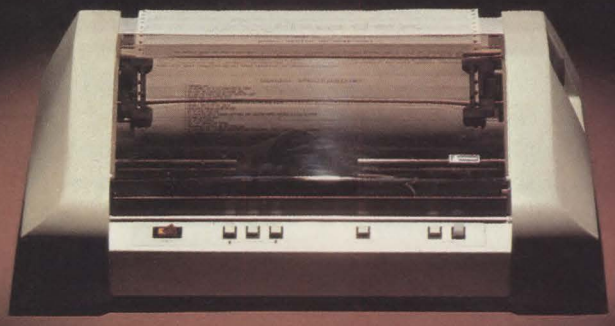

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The MDBS automatically creates a special record type called SYSTEM, which has only one occurrence and contains no data.

The first sort key (SNAME) is the owner-sort key; the second (ANAME) is the member-sort key.

As each data-item type is declared in the MDBS DDL, a designer can specify the read-access level or the write-access level for that data-item type (Ref. 4). There are 225 levels for each data-item type. Similarly, read- and write-access levels are declared for each record type, 1-N and N:M set. These access levels are used by the MDBS.DMS with the PASSWORDS section of the DDL, for data security.

In addition to specifying a schema, a DDL description includes a PASSWORDS section, which lists authorized users of a data base and the users' passwords and access levels. Each user who is given a read-access level and a write-access level can read occurrences of the data-item type, record type, 1-N or N:M set if those sets' read-access levels are less than or equal to his own. A user can also write data items, records, 1-N or N:M sets if those sets' write-access levels are less than or equal to his.

Refinements

Following the seven-step design strategy yields a good, workable, logically correct schema, and provides the designer a framework for organizing his thoughts about an application. The resulting schema can be refined in several ways, including "collapsing," or combining two record types, which can improve storage and processing efficiency. This is especially helpful in cases in which the owning-record type has one data-item type. This is known as measuring the member-record type. If, in the school-schema design example, it were important to keep track of each student's age (SAGE), the design strategy would yield an AGE-record type owning the STUDENT-record type (Fig. 8a). There may be many students of a given age, but no student has more than one age. Age can be regarded as measuring a student.

An alternative logical structure to that of Fig. 8a is obtained by collapsing SAGE into STUDENT (Fig. 8b), which forces a given SAGE value to be stored redundantly (once for each student of that age). With the

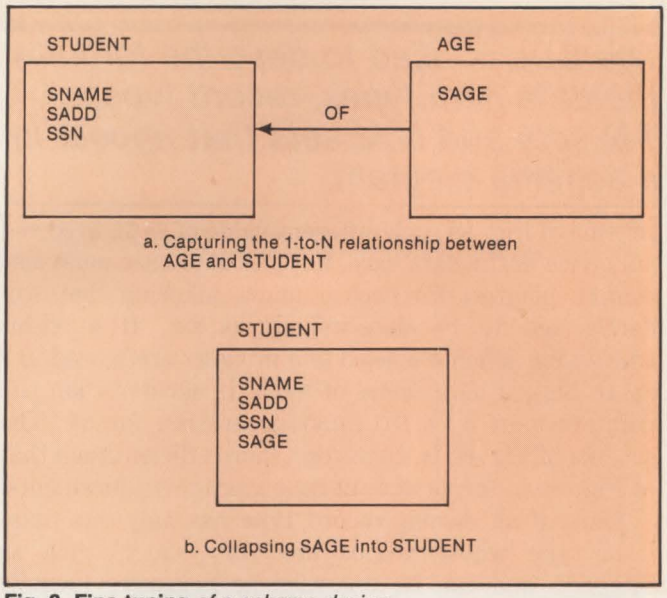

Fig. 8. Fine tuning *of a schema design.*

GLOSSARY

1-N: the one-to-many set-type relationship proposed originally by CODASYL, in which an owner can have several members, but no member can have more than one owner.

Data-Base Schema: A diagram consisting of data-item types, record types and set types.

DBTG (The CODASYL data-base task group): A group that proposed a structure comprising three building blocks: data-item types, record types and set types.

DDL (data-definition language): A language used to specify the logical structure of a data base, the types of fields and records and their relationships.

Data-Item Types: The smallest units of named data; for example,

Disjoint-Record Type: A schema consisting of record types without 1-N or N:M sets.

DML (data-manipulation language): A language used for data-base information changes.

Data Value: An occurrence of a data-item type, such as Indiana or 5,123,499.

Linear Structure: A schema allowing any pattern of sets and record types in which no record type is the owner of more than one set or the member of more than one set. There are no N:M sets.

MDBS (Micro Data Base System): The μc data-base network comprised of DBTG plus logical structuring features.

N:M: A many-to-many set-type relationship, in which any number of owners and members can exist.

Network Structure: A schema in which a record type can own or be a member of any number of sets.

Occurrence Structure: A diagram of specific data values of data-item types, record types, 1-N sets and N:M

Record Type: A named aggregate of data-item types, such as STATE, composed of STATENAME and STATEPOP.

Seven-Step Strategy: A method by which a designer can translate knowledge of the user's application into a data-base design.

Schema: A logical data-base structure, usually expressed as a diagram.

Set Type: A named owner-member relationship between two record types.

Sub-Schema: A non-disjoint part of a schema remaining after eliminating some record types and their sets, and after eliminating some data-item types from the remaining record types.

System: An MDBS record having only one occurrence and containing no data.

Tree Structure: A schema in which a record type may not be the member of more than one set, and in which there are no N:M sets.

The DDL is used to describe formally the data-item types, record types, 1-N sets and N:M sets that appear in a schema diagram.

schema of Fig. 8a each different value of SAGE is stored only once in the data base, but this data base must also contain pointers for each student, allowing that student's age to be determined via OF. If a 32-bit addressing scheme is used and integers are stored in 8 or 16 bits, a data value of SAGE is shorter than the pointers used by a STUDENT occurrence for OF. The schema of Fig. 8b is, therefore, more efficient than that of Fig. 8a in terms of data-base storage requirements.

Thus, if an owning-record type has only one data-item type whose values are very short, such as integers, and can be regarded as measures (usually quantitative) of associated member occurrences, collapsing is usually appropriate. Other examples of data-item types that can be regarded as measures are those involving weights, volumes, distances, years and—in some situations—dates. As experience in data design accumulates, more refining may be needed.

The seven-step design strategy does not necessarily yield optimal schemas. The schema must be augmented by SYSTEM-owned sets, must have its sort keys specified (perhaps with the need for addition sets) and can be examined for possible refining. Even after this has been done, a designer should be wary of claiming that a resulting schema is optimal. A schema's usefulness is determined by what criteria the designer uses—report-generation time, programming effort, update time, storage costs or a mix of these. These criteria often conflict. Moreover, the designer must specify the data volumes of each record type, the mix of reports needed, how often and how soon each report is needed, what mixture of updating is needed and how often and how quickly each kind of update must be made. If all the constraints are formalized correctly, they will change, often in unanticipated ways.

The DBTG idea of sub-schemas involves non-disjoint parts of schemas that are left after eliminating 0 or more record types and the sets in which they participate from the schema and after eliminating 0 or more data-item types from the remaining record types.

With data-base systems that adhere to the DBTG-sub-schema proposals, a designer must use a sub-schema-data-definition language (SSDDL) to define a number of sub-schemas and use the DDL to specify the schema. Each application program that uses a data base must have a sub-schema defined for it via the SSDDL, and more than one program can use the same sub-schema. Several data-base systems, including MDBS, do not explicitly use the DBTG-sub-schema proposals, so they are not burdened by the additional overhead required for sub-schema use. This overhead includes the design and specification of sub-schemas, the need for an SSDDL, software and processing time to translate the SSDDL specification of each sub-schema into a sub-schema directory and additional storage to hold the directory.

Whether this overhead is justified can be determined by examining the most commonly proclaimed advantages of a sub-schema facility: data independence, data security and simplicity. Sub-schemas are often claimed to provide greater data independence. MDBS provides virtually the same level of data independence, without the sub-schema overhead.

Access to sub-schemas in a data-base-management system can be restricted with a privacy lock, such as a password.

It is often claimed that if a programmer is allowed to work only with a pertinent sub-schema, his task is less confusing than if he sees the entire schema, which includes record types, data-item types and sets not pertinent to the program. The same degree of simplicity can be achieved without incurring sub-schema overhead by giving the programmer a schema in which all nonpertinent data types and sets have been masked out.

If a schema needs to be altered, the design strategy can be used to incorporate the changes. Instead of discarding all data, rerunning the DDL translator with the revised schema and then reloading the discarded data into a data base with the new logical structure, the schema can be restructured dynamically with μc software, called DRS (dynamic restructuring system) (Ref. 8). ■

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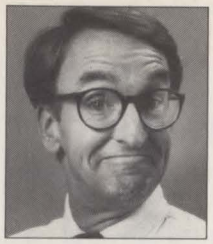
C.W. Holsapple is associate professor of business administration, University of Illinois at Urbana-Champaign. He is a researcher, author, teacher and consultant in data-base management, information systems and decision-support systems.

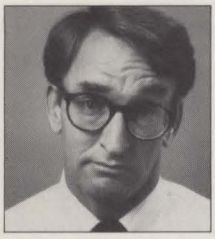


Barney Stevenson just spent two years programming and de-bugging a process control system in assembly code.

Now Barney thinks he deserves some congratulations for his efforts.

Sorry Barney,

NO CIGAR.



Barney Stevenson thought he deserved a pat on the back. As project manager at Smart Widgets, Inc., he had taken on the biggest real-time process control headache of his life. And after 24 months he'd finally succeeded in programming and de-bugging Smart's newest product.

We think Barney missed the boat.

Barney figured the choice was simple. High level languages like Pascal and Fortran could program quickly, but would run too slowly and take up too much memory. Assembly code would take longer to program and de-bug, but was the only answer for real-time applications.

Wrong.

Real wrong.

Barney didn't know about FORTH: a language that runs nearly as fast as assembly, is just as compact (if not more so), yet can cut development time by a factor of 10 over assembly language.

He also didn't know about FORTH, Inc.

They're the people who invented this remarkable tool, evolved it, and for 10 years have seen it used in thousands of applications . . . from running an observatory to sorting baggage, from video games to industrial robotics. Virtually every real-time application imaginable.

The latest evolution of FORTH is called polyFORTH.™ An incredible programming environment available for just about any mini or micro processor.

For Barney? Still no cigar. But for *you*, FORTH offers a software tool that in speed, compactness and extensibility, simply has no match.

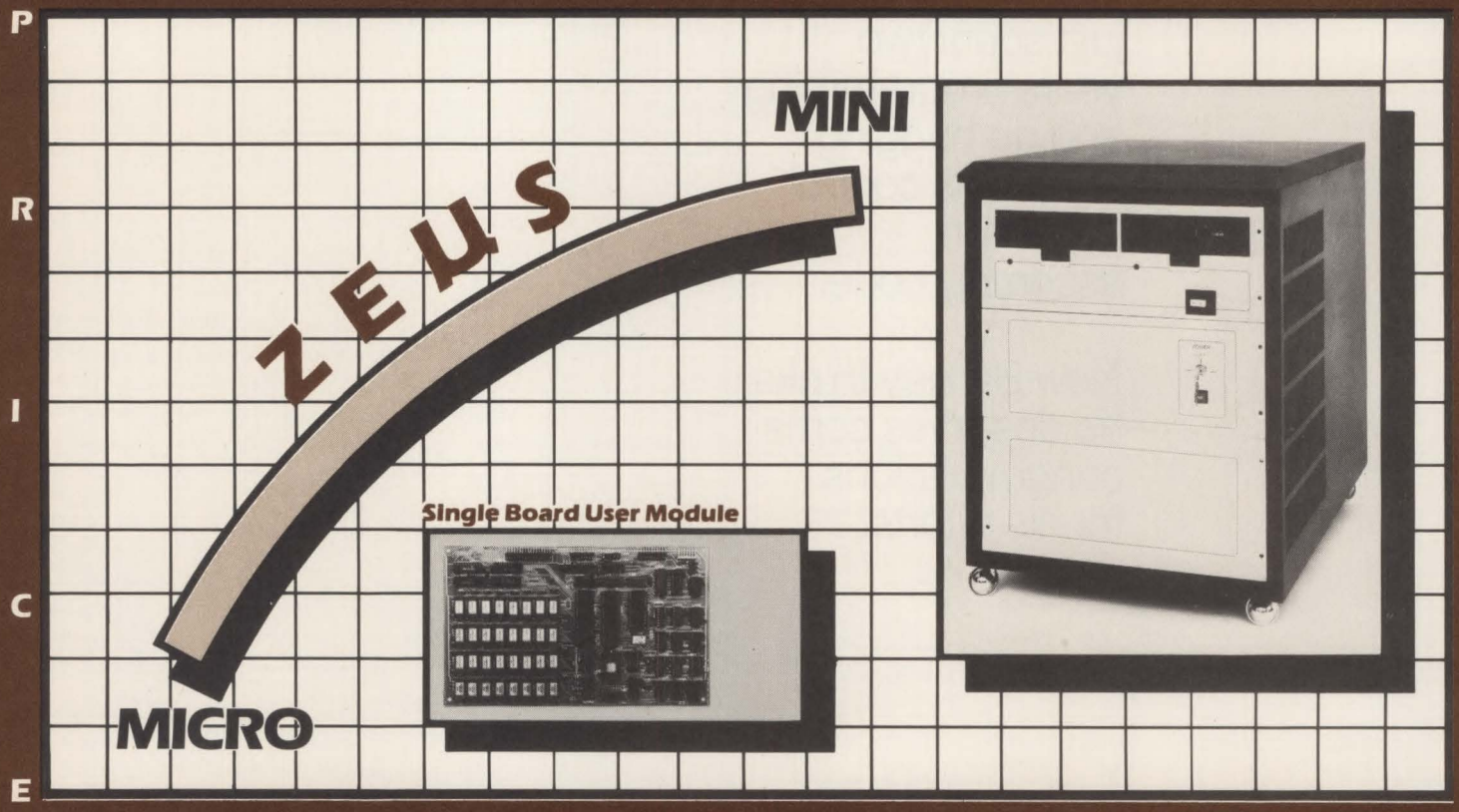
So call us at (213) 372-8493. Or write FORTH, Inc., 2309 Pacific Coast Highway, Hermosa Beach, California 90254. We'll rush you the latest on polyFORTH,™ and tell you where you can see it in action.

FORTH, Inc.

...the real-time saver.

CIRCLE NO. 98 ON INQUIRY CARD

ZEμS SPANS THE MICRO-MINI GAP.



Multiprocessor Technology

In multi-user applications, single processor computer systems have limited expandability and suffer severe performance degradation as users are added. ZEμS' modular multiprocessor architecture eliminates the CPU bottleneck and offers performance levels normally associated with more costly mini and mainframe computers.

Single Board User Module

ZEμS is expandable from 1 to 64 users simply by adding the OSM-1080 single board user module for each user. Each module consists of a Z80A, 64K RAM, two serial and parallel I/O. A master processor module supervises all user requests for common storage and/or shared peripherals. Each user module communicates with the master module via a high speed, parallel, synchronous, interprocessor data channel. Response time remains fast even as more users are added. And each user remains autonomous from each other. A unique reset feature through the console break key eliminates the need for operator attendance at the main computer. Should a user "crash," he simply resets himself and loads in a fresh copy of the operating system. Consider the advantages for remote and timeshare applications.

CP/M® Compatible Operating System

OSM's proprietary MUSE® (Multi-User System Executive) operating system was specially designed for ZEμS. Many times faster than other leading operating systems, MUSE provides a true multi-user environment. And MUSE is totally CP/M compatible allowing execution of readily available languages and application programs. MUSE also allows for almost unlimited expandability. Each user can choose from up to 3 system printers with full print spooling as well as a dedicated local printer. Plus, over 600MB of hard disk storage can be accessed through MUSE's proprietary directory management system. Other multi-user operating features provided by MUSE include both user and common file areas, password protection, and record locking for shared file update.

OSM

Computer Corporation

2364 Walsh Avenue
Santa Clara, CA 95051
(408) 496-6910 TWX 910 338 2099

Broad Application Spectrum

ZEμS systems satisfy a broad spectrum of applications—from a wholesale environment where many users access and update a large shared data base to a true multitasking environment, such as professional offices, where various tasks are performed simultaneously.

Best Price/Performance Ratio

ZEμS single user systems are competitively priced with single processor microcomputer systems, and ZEμS' multi-user systems are priced thousands of dollars less than comparably performing larger systems. For example, the ZEμS 5+ system is a five user configuration including 6-Z80A processors, 384K RAM, 12 serial and 11 parallel I/O, 34MB of hard disk storage, .6MB of floppy storage, and 20MB of tape backup. Also included with every system is the MUSE operating system—all for just $19,900.

We're shipping ZEμS multiprocessor computer systems now! For more information call our marketing department today!

ZEμS Delivers MAINFRAME POWER —AT A MICRO PRICE

Northern Telecom offers stand-alone business systems

Northern Telecom has joined the ranks of companies offering models of stand-alone small-business systems with the introduction of its model 503, an Intel 8085-based system with 64K bytes of RAM. The system is base-priced at $6490 or $232 a month lease and $72 a month maintenance.

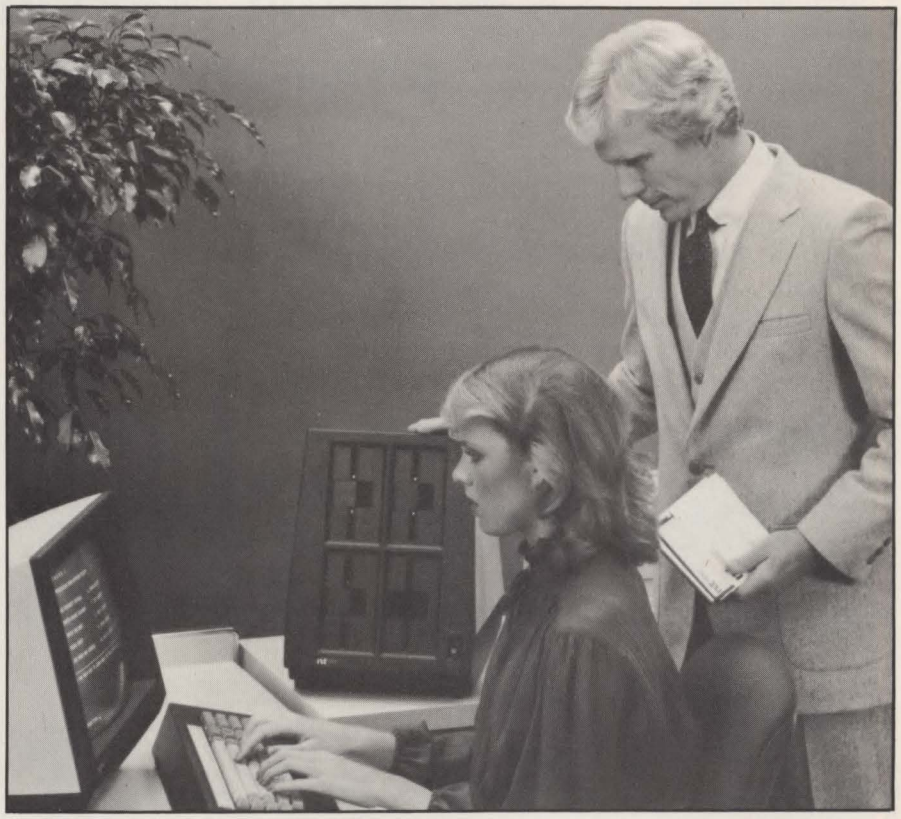
The model 503 includes a 15-in., 2000-character video-display terminal that contains the μp and memory, a detachable keyboard and a cable-connected diskette cabinet. The cabinet houses two or four 5¼-in. diskettes that each store more than 800,000 characters of formatted data. Company officials say hard-disk storage will probably be added later.

For data processing, the 503 supports COBOL, BASIC and TAL 2000, a proprietary language designed for data entry. Word-processing capabilities can be added to the system with a $750 Omniword word-processing package and a $4290 Diablo printer. Data and word processing cannot run concurrently. As a communications device, the 503 supports asynchronous, bisynchronous and synchronous data-link control transmission modes.

The 503 also supports an IBM 3270 emulator that allows interactive communications with a mainframe computer. Company officials say the system will eventually offer the CP/M operating system and associated software programs, and the system's memory will be increased to enable concurrent word and data processing.

Northern Telecom, Inc., Airport Rd., Concord, N.H. 03301.

Circle No 201



Northern Telecom's model 503 *is a stand-alone small-business system with 64K bytes of RAM. It is base-priced at $6490.*

Third iRMX release triples performance of original

The third release of the iRMX 86 real-time, multitasking operating system for iAPX 86- and iAPX 88-based single-board μcs triples the performance of the original iRMX 86 release, introduced in April, 1980. The system enables users to remove unnecessary features and to add customized extensions. The system's object-oriented structure is suitable for event-driven systems. Some critical functions, such as queuing a message from one task to another, now run eight times faster on this release than do those on the earlier release.

Two system layers have been added. The extended I/O system (EIOS) layer automatically synchronizes read and write functions and improves I/O performance by filling input buffers, keeping ahead of read requests, optimizing output buffers and enabling users to interface directly with the basic I/O system, boot loader and application loader.

The new human interface layer adds utilities for application programmers, end users and custom programs using a system console. A command-line interpreter invokes both application packages and iRMX 86 utilities to create, delete, copy and re-name data, directory files and format devices and to submit commands for batch execution.

While many applications store the system in PROM, others use the bootstrap loader or the application loader to load part or all of an iRMX 86 application into system memory from supported iSBC device controllers or custom devices. Loaders and file-access mechanisms support Multibus device controllers for 8- and 5¼-in. floppy disks, Winchester- and SMD-disk drives and bubble-memory systems.

The iRMX 86 operating system is available on single- or double-density diskettes for use on the vendor's MDS development systems under various licensing options.

A $7500 OEM license (plus royalties) includes one year of update service, credit for an iRMX 86 customer-training course and the iSBC 957A system monitor. Other options include source listings on microfiche, a $2250 single-use license for system houses and a royalty buy-out license to enable pre-payment of future royalties. **Intel Corp.,** 5200 N.E. Elam Pkwy., Hillsboro, Ore. 97123.

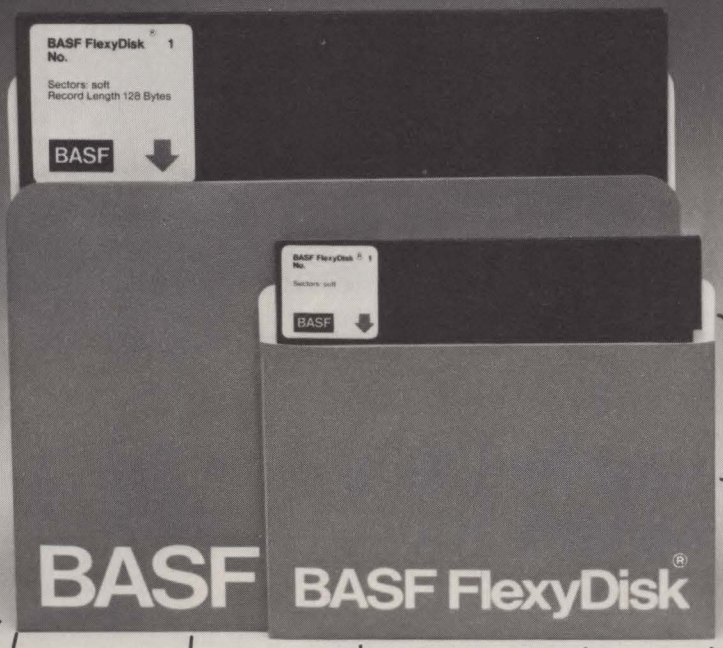
Circle No 202

Omron announces miniature programmable controller

The SYSMAC-MO miniature programmable controller from Omron Electronics, Inc., Schaumburg, Ill., combines an integral keyboard programmer, display and PROM loader in a 3- × 6- × 4-in. package. The miniature PC is designed for an industrial machine and small-system equipment-control applications.

The unit enables a user to enter logic or ladder-diagram programming instructions on a 23-button keyboard. The user's program can be stored in RAM or UVPROM and recalled to perform a variety of production, process-control, ma-

Ten reasons why your floppy disk should be a BASF FlexyDisk®.



More than four decades of experience in magnetic media – BASF invented magnetic recording tape, the forerunner of today's wide range of magnetic media, back in 1934, and was the first independent manufacturer of IBM-compatible floppy disks.

Tough Tyvek sleeve – no paper dust, no static electricity.

Special self-cleaning jacket and liner help eliminate data errors and media wear and tear.

Center hole diameter punched to more accurate standards than industry specifications, for top performance.

Packaging to suit your requirements – standard flip-top box, Kassette 10® storage case, or bulk pack.

100% certification – every single disk is tested at thresholds 2-3 times higher than system requirements, to be 100% error-free.

Bi-axially oriented polyester substrate – for uniform and reliable performance year after year.

Cross-linked oxide coating – for low head wear and long trouble-free media life.

Total capability – one of two manufacturers in the world that makes both 8″ and 5.25″ models, has tape and disk experience, and manufactures floppy disk drives.

Double lubrication – lubricants both in the formula and on the disk surface, to minimize media wear due to head friction.

For the name of your nearest supplier, write BASF Systems, Crosby Drive, Bedford, MA 01730, or call 617-271-4030.

BASF

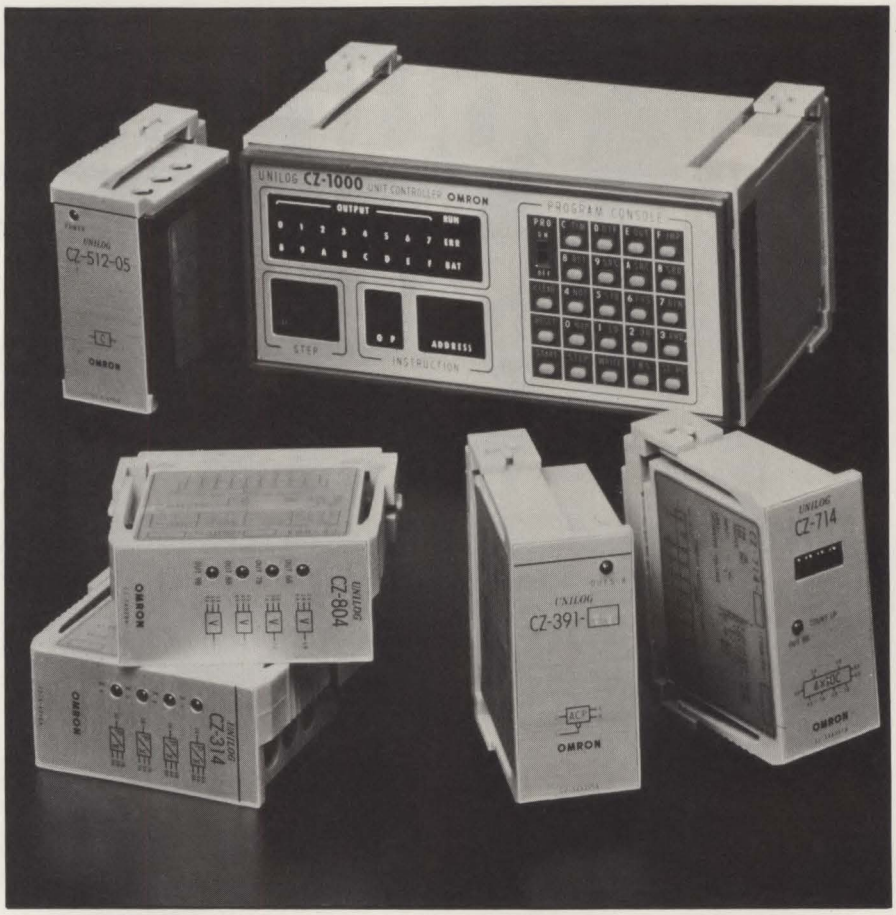
Floppy Disks Mag Cards Cassettes Computer Tapes Disk Packs Computer Peripherals

CIRCLE NO. 159 ON INQUIRY CARD

chining, inspecting, assembling and material-handling operations. The controller offers on-line monitoring/debugging of the step, plus instruction and output displays, shift registers, 48 counters, 16 timers and 48 temporary storage points. Using modular building-block approach, peripheral functional modules can be added, extending the unit's cost-effectiveness and operating flexibility with six additional counters, 13 more timers, two more shift registers, two seven-segment displays, 11 logic-gate modules, and a comparator module.

The SYSMAC-MO offers a choice of three different controllers, a 256-word RAM, a 1024-word UVPROM with programmer and down-loader or one using RAM memory only with program keyboard. Another UVPROM controller without programmer for OEM use is available. Prices range from $350 to $1200, depending on controller types and the number of modules used. **Omron Electronics, Inc.,** 650 Woodfield, Schaumburg, Ill. 60195.

Circle No 203



The SYSMAC-MO miniature programmable controller *from Omron Electronics combines an integral keyboard programmer, display and PROM loader in a 3- × 6- × 4-in. package.*

WICAT offering M-68000 μp-based System 100

Orem, Utah-based WICAT, a company that formerly specialized in developing video-disk courseware, has entered the hardware business with a 16-bit μp-based μc, the System 100.

Company sources say the unit is powerful enough to compete with the DEC 11/70 in the high-end μc market but is priced low enough to compete with Altos systems on the low end.

Configured as a basic data desk and targeted for sales to OEMs, the System 100 is pegged for instructional and small-business applications. It is available with either 10M- to 200M-byte Winchester-disk storage and cartridge-tape backup or two double-sided, double-density floppy-disk drives providing 1.2M bytes of storage each. The unit contains three real-time clocks, four RS232C serial interfaces and a high-speed serial network interface.

Company sources say the System 100 can stand alone or be configured in a storage/work-station network. The storage station supports as many as 100 work stations, each supporting as many as four users.

With a real-time, multi-user, multitasking operating system, the system handles Pascal, BASIC, COBOL and Assembler. Data-management facilities and communications are also supported. Built around the Motorola 68000 16-bit μp, the System 100's existing software can accommodate future 32-bits μps, according to WICAT sources.

While WICAT does not offer a terminal or a printer with the system, sources say the company is planning to introduce a fully featured Z8000-based graphics terminal in September. Prices for the System 100 start at $12,000 with floppy-based storage and software, and $23,000 with a Winchester and software. **WICAT Systems,** 1875 S. State St., Orem, Utah 84057.

Circle No 204

The new VISUAL 200 terminal has the features of competitive terminals and will code-for-code emulate them as well. A flick of a switch on the rear panel programs the VISUAL 200 for compatibility with a Hazeltine 1500, ADDS 520, Lear Siegler ADM-3A or DEC VT-52. This allows you to standardize on the new, reliable VISUAL 200 for virtually all of your TTY compatible video terminal applications, with no change in the software you've written for the older, less powerful terminals. And you're not limited to mere emulation; you can outperform them at the same time by taking advantage of the additional features and human engineering of the VISUAL 200, such as:

- Detachable Solid State Keyboard
- Smooth Scroll
- Tilt Screen (10° to 15°)
- Large 7 x 9 Dot Matrix Characters
- Others in the Feature Comparison Chart

For a pleasant surprise on prices, call or write us today.

FEATURE COMPARISON CHART

FEATURE	Visual 200	Hazeltine 1500	Hazeltine 1420	Lear Siegler ADM-3A	Digital VT-52	ADDS 520	ADDS Regent 20	ADDS Regent 40
24 x 80 Screen Format	STD	STD	STD	STD	STD	STD	STD	STD
7 x 9 Dot Matrix	STD	STD	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Background/Foreground	STD	STD	STD	**NO**	**NO**	**NO**	**NO**	STD
Insert/Delete Line	STD	STD	**NO**	**NO**	**NO**	**NO**	**NO**	STD
Insert/Delete Character	STD	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Clear End Line/Field/Page	STD	STD	**NO**	**NO**	STD	**NO**	**NO**	**NO**
Blink	STD	**NO**	STD	**NO**	**NO**	**NO**	**NO**	STD
Security Mode	STD	**NO**	STD	**NO**	**NO**	**NO**	**NO**	STD
Columnar and Field Tab	STD	**NO**	STD	**NO**	**NO**	**NO**	**NO**	STD
Line Drawing	STD	**NO**	**NO**	**NO**	STD	**NO**	**NO**	STD
Upper/Lower Case	STD	STD	STD	**OPT**	STD	**NO**	STD	STD
Numeric Pad	STD	STD	STD	**OPT**	STD	**NO**	**NO**	STD
Composite Video	STD	**NO**	**NO**	**NO**	**NO**	STD	**NO**	**NO**
Current Loop	STD	STD	**NO**	**OPT**	**OPT**	STD	STD	STD
Serial Copy Port	STD	STD	**OPT**	STD	**OPT**	**NO**	STD	STD
Hold Screen	STD	**NO**	**NO**	**NO**	STD	**NO**	**NO**	**NO**
Detachable Keyboard	STD	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Solid State Keyboard	STD	**NO**	**NO**	**NO**	**NO**	**NO**	STD	STD
Typamatic Keys	STD	STD	STD	**NO**	**NO**	**NO**	STD	STD
Cursor Addressing	STD	STD	STD	STD	STD	STD	STD	STD
Read Cursor Address	STD	STD	STD	**NO**	**NO**	**NO**	**NO**	STD
Cursor Control Keys	STD	**NO**	STD	**NO**	STD	**NO**	**NO**	STD
Secondary Channel	STD	**NO**	**NO**	STD	**NO**	STD	**NO**	**NO**
Self Test	STD	**NO**	STD	**NO**	**NO**	**NO**	**NO**	STD
Baud Rate to 19,200	STD	STD	**NO**	STD	**NO**	**NO**	**NO**	**NO**
Smooth Scroll	STD	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Microprocessor	STD	STD	STD	**NO**	STD	**NO**	STD	STD
Tilt Screen	STD	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Switchable Emulations	STD	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

The new VISUAL 200 obsoletes competitive terminals without obsoleting the software.

VISUAL See for yourself

Visual Technology Incorporated
540 Main Street, Tewksbury, MA 01876
Telephone (617) 851-5000, Telex 951-539

CIRCLE NO. 160 ON INQUIRY CARD

New Systems

Honeywell unveils Infowriter systems

The single-station, table-top Infowriter office-automation system includes a visual display terminal, a processor with diskettes and a keyboard. The system includes OAS/1 (office automation system/1) software, and can support document processing, preparation, printing, sorting and archiving. A single-station system, including memory, diskettes and keyboard, is priced at $6595, plus an annual maintenance fee of $830. With a 35-cps letter-quality printer, the unit sells for $8395, plus $1000 annual maintenance; with a 55-cps printer, price is $10,495, plus a $1000 maintenance charge. Annual license fee of the OAS/1 application software is $160, including support. **Honeywell Inc.,** 200 Smith St., Waltham, Mass. 02154. **Circle No 205**

PMC-81 includes 14K ROM

The PMC-81 TRS-80 model I emulator includes 16K bytes of memory, 14K bytes of ROM, a Z80 μc, a keyboard, a cassette interface and a video monitor interface. It uses the EXP-100 expander to add interfaces for 5¼-in. floppy disks, printers and RS232C and S-100 buses. Other features include a 15-key numeric pad, four function keys, lower-case letters and true descenders. The PMC-81 sells for $740. **Personal Micro Computers, Inc.,** 475 Ellis St., Mountain View, Calif. 94043. **Circle No 206**

Dynatem unveils μc system

The AME 1000 super-intelligent μp industrial control system enables as many as 10 modules to be added to a Rockwell AIM 65 μp in one enclosure. The system drives floppies and minifloppies, cassettes, D/A and A/D modules, solid-state relays, CRTs and printers. It also includes a disk operating system, software and application engineering. The system comprises an enclosure, a motherboard and a power supply. The AME 1000, including the AME 400 enclosure, DMB 200 motherboard and DPS 512 power supply (5V, 6A to ±12 V, 1A), sells for $625. **Dynatem Inc.,** 20881 Paseo Olma, El Toro, Calif. 92630. **Circle No 207**

DILOG NUMBER 1 FOR DEC 11*

With LSI 11/PDP 11 Software Compatible Disc/Tape Controllers Offering Single Board Low Power μP Based Design and Low Cost... Plus Many Other Good Reasons!

The reasons start with DILOG'S (Distributed Logic Corp's.) full time engineering and design staff. *Not outside suppliers.* That means when you contact DILOG for product selection or after sale service, you'll get "first hand" assistance... along with years of experience manufacturing μP based controllers that interface with DEC 11 CPUs.

The intelligent products you'll discuss all utilize common proprietary architecture and DILOG automated design techniques—products with exceptional reliability and cost efficiency... mostly available from stock. And when you plug a DILOG controller into your DEC CPU it's ready-to-run because it's *fully operating system software compatible.*

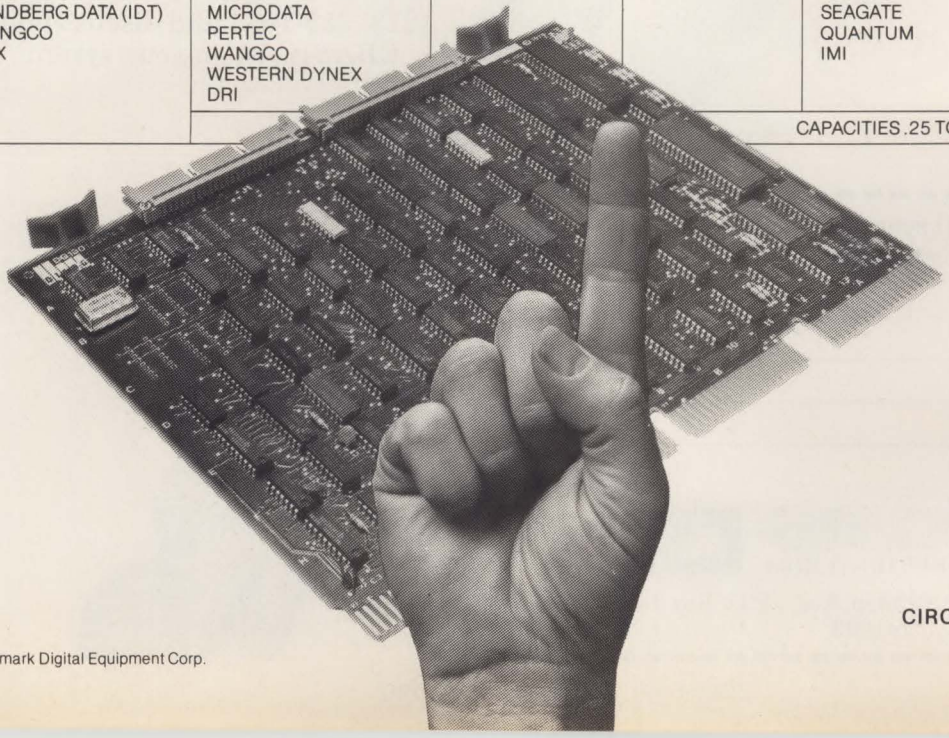
These high performance data storage interface products also feature • minimum bus/space requirements • up to 60% less power • 10 to 50% lower cost • automatic self-test... and numerous other features for easy system integration.

Consult the DILOG/disc-tape compatibility table for your needs. Then ask for detailed data on existing, or future products from DILOG... #1 in single board DEC 11 compatible disc/tape controllers.

Distributed Logic Corp., 12800-G Garden Grove Blvd., Garden Grove, CA 92643, Phone: (714) 534-8950 • TELEX: 681 399 DILOG GGVE

DISC/TAPE DRIVE MANUFACTURER COMPATIBILITY CHART

MAGNETIC TAPE	DISC					
½" REEL-TO-REEL STD. & STREAMER	2315/5440/RK05 CARTRIDGE CLASS	CMD CARTRIDGE MODULE	SMD STORAGE MODULE	WINCHESTER 5¼", 8" OR 14"	¼" TAPE CARTRIDGE	FLOPPY DISC DRIVE
AMPEX CIPHER CONTROL DATA DIGI-DATA KENNEDY MICRODATA PERTEC TANDBERG DATA (IDT) WANGCO TDX	AMPEX CAELUS CENTURY DATA CONTROL DATA DEC DIABLO IOMEC MICRODATA PERTEC WANGCO WESTERN DYNEX DRI	AMPEX CONTROL DATA	AMPEX CENTURY DATA CONTROL DATA BALL COMPUTER MITSUBISHI	BASF CONTROL DATA FUJITSU KENNEDY MEMOREX PRIAM SHUGART SEAGATE QUANTUM IMI	DEI KENNEDY PEREX QUANTEX	BASF DECITEK MICROPOLIS PERTEC REMEX SHUGART
	CAPACITIES .25 TO 300 MB					



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"In 1977 Compiler Systems, Inc. introduced CBASIC™ as a CP/M® programming language. It quickly became the most widely used BASIC dialect. Since then CBASIC has been adapted for use on systems supporting MP/M™ and TRSDOS."

"At Compiler Systems we learned the lessons of the past well. So well, that in the relatively short time we've been in the software business, we managed to make history ourselves. In fact, CBASIC is the standard for CP/M-based business systems."

— Gordon Eubanks, CSI president

Today CSI offers CBASIC/86 designed for 16-bit microcomputer-based systems running under CP/M-86. CBASIC/86, now available worldwide, is based on concepts first used by CBASIC including such business-oriented features as: BCD arithmetic with fourteen-digit precision; full format control of printed reports; random and sequential records of any length (not limited to 256 bytes); aids to structured design, i.e. multiple line functions and control structures as well as excellent file-handling and stringing capabilities.

But perhaps the best of CBASIC/86 becomes clear when you're using it. To learn more about CSI's commitment to support CBASIC/86 and CP/M-86 call (213) 355-1063 and discuss putting CBASIC/86 on your system.

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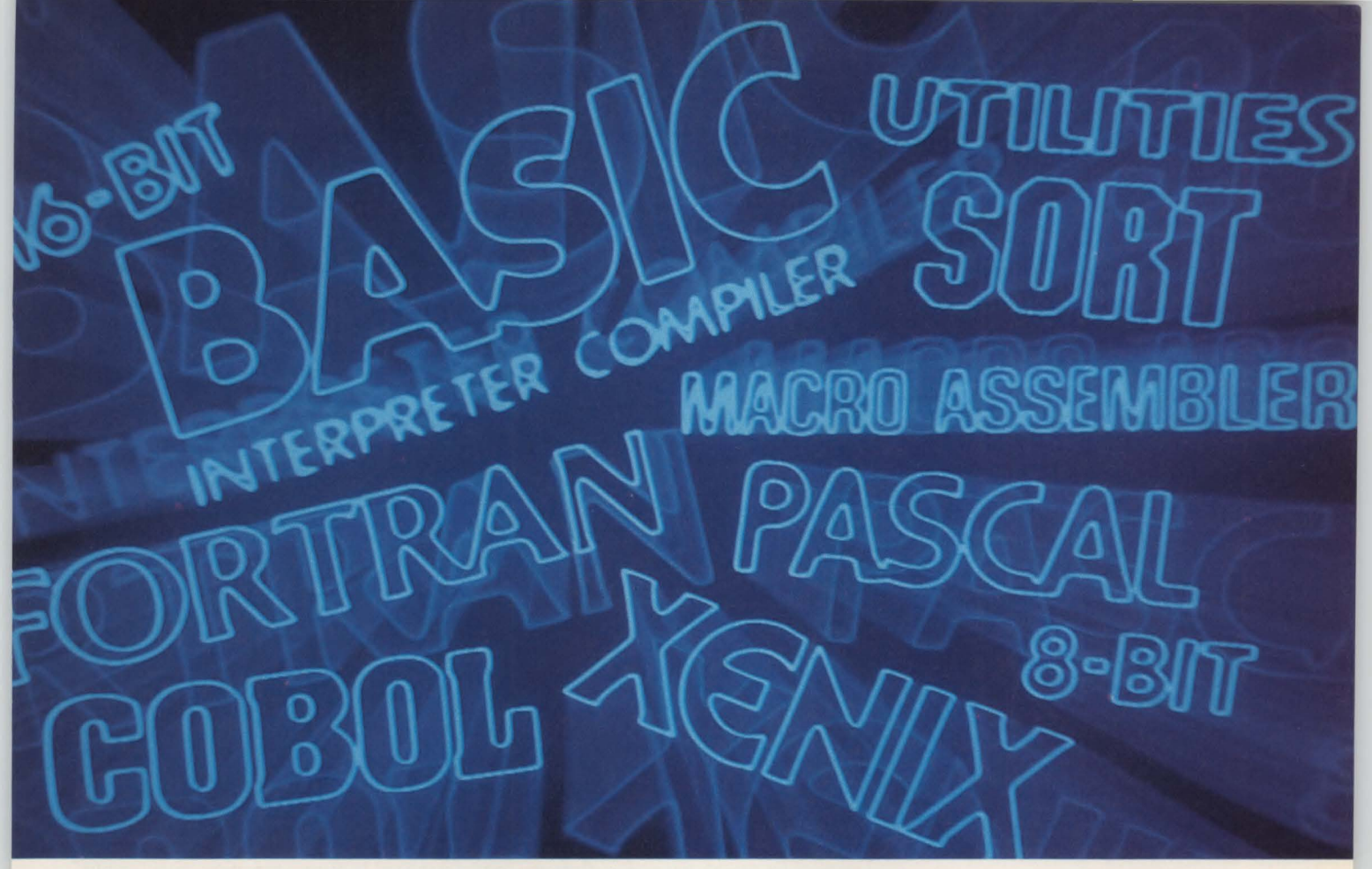

We don't claim leadership in microcomputer software. We earn it.

Every day. We think that supporting software is as important as developing it. Six years ago, we put BASIC on the first microprocessor based computer. Today, Microsoft BASIC is running on over 700,000 systems. Worldwide. Because we never stopped improving it. It's an everyday job at Microsoft.

Languages. BASIC for 8-bit microcomputers was our first language. Today we offer a full range of languages: BASIC, COBOL, FORTRAN and Pascal for both 8-bit and 16-bit microcomputers. Fully supported languages that meet industry standards. Plus enhancements we add to increase their utility. Languages that provide transportable applications software between microprocessors. Synergistic languages that provide feature-for-feature compatibility between 8-bit and 16-bit machines.

More than languages. In addition to languages, Microsoft has utility programs and end-user system software. Microsoft developed XENIX,™ our implementation of UNIX® for 16-bit microcomputers. It isn't "UNIX-like." It's fully supported UNIX for the 16-bit world.

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Easy to OEM. Our royalty plan for licensing software allows you to add Microsoft software to your system with a very low initial investment, paying royalties on a when-sold basis. And if you're on a sensitive schedule, remember most of our products are available off the shelf. No waiting.

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CIRCLE NO. 163 ON INQUIRY CARD

New Systems

Development system includes Z80 CPU

The microsystem4 STD-Z80 development system includes a 4-MHz Z80 CPU, 60K bytes of program memory, 1M byte of double-density floppy-disk storage, a keyboard, RS232C and programmable parallel I/O and CP/M 2.2 or Forth disk operating systems. The unit features an 80 × 24 video format, an 800-line resolution CRT with programmable attributes for each character, including reverse/normal video, underscore, blink and half/full intensity; two EPROM-resident 7 × 12 character sets; and a 16-position rack-mountable card cage. Price is $4980 in single-unit quantities, with quantity and OEM discounts available. **Applied Micro Technology, Inc.,** P.O. Box 3042, Tucson, Ariz. 85702.

Circle No 208

Able announces DEC-compatible systems

The models 34 and 44 Magnum computer systems emulate Digital Equipment Corp.'s PDP-11/34 and -11/44. The units include CPUs with floating-point and memory-management units, a serial console interface, 4M-byte memory addressing, dual TU58 tape units, a programmable-line clock, an 8K-byte cache memory, microcoded ODT and maintenance console. The 34 Magnum comes with 256K bytes of memory, and the 44 Magnum comes with 512K bytes. Both systems use DEC-authorized RSTS/E, RSX-11M and RT11 software and are mounted in a 24¼- × 17- × 10½-in. chassis. Prices are $21,000 for the 34 and $27,000 for the 44. **Able Computer,** 1751 Langley Ave., Irvine, Calif. 92664.

Circle No 209

Sharp introduces business computer

The XY-3200 desk-top business computer features a 32K-byte ROM and a 64K-byte RAM, expandable to 72K bytes of ROM and 128K bytes of RAM. The system uses dual-sided, double-density 5¼-in. floppy-disk drives that can store as much as 285K bytes per diskette. A 12-in. CRT display offers an 80-column × 24-line screen. A bidirectional, dot-matrix 80-cps printer prints 80 or 132 columns. Software includes general ledger, accounts receivable, accounts payable, word processing and order entry. Price is less than $6000. **Sharp Electronics, Inc.,** 10 Keyshore Pl., Paramus, N.J. 07652.

Circle No 210

Quadex unveils composition systems

The Q500 series of composition systems includes a file-management package, enhanced foreground and background processing and an optional interactive composing-editor. The multiterminal, front-end Q500 replaces the vendor's Q200 in commercial and in-plant applications. The system's software includes four styles of hanging punctuation, simultaneous vertical justification during composition and the ability to express paragraph leading as a percentage value. A multi-language hyphenation capability enables users to mix as many as four languages, each with its own large dictionary and hypenation logic, in one job. **Quadex Corp.,** a subsidiary of Compugraphic Corp., 200 Ballardville St., Wilmington, Mass. 01887.

Circle No 211

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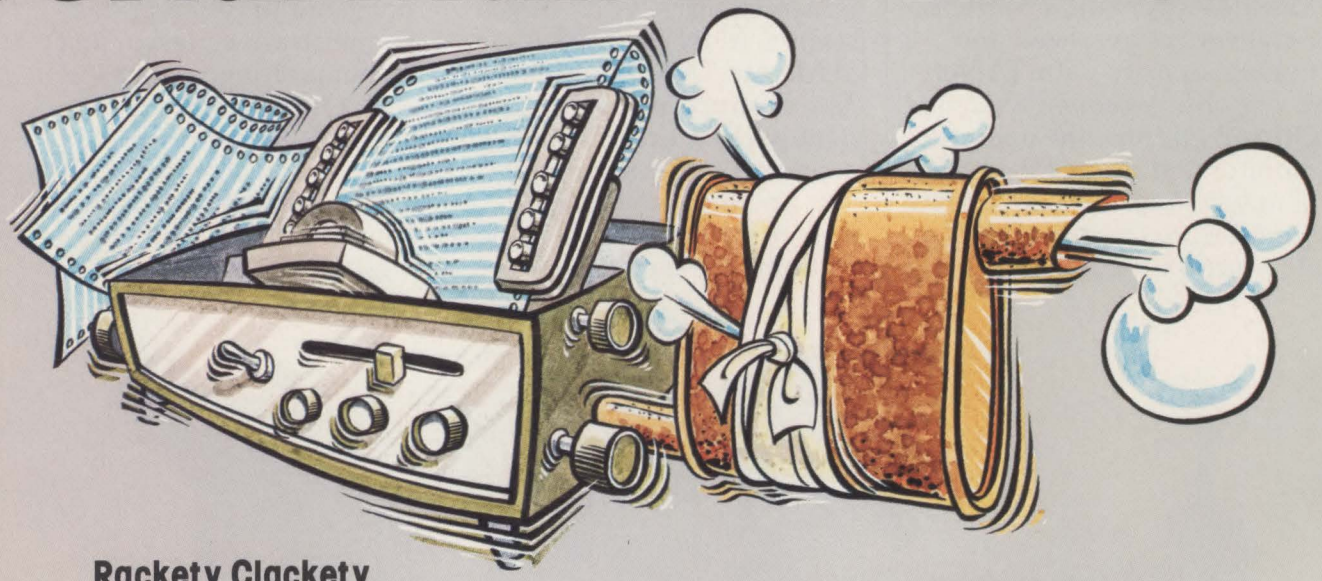
CIRCLE NO. 106 ON INQUIRY CARD

Do You Need to Midasize™ Your Serial Matrix Printer?



Rackety Clackety

If you want the work a matrix printer outputs, you have to live with the noise it puts out. That's the nature of the beast.

Until now.

INFOSCRIBE 1000 is a serial matrix impact printer, but its sound level is **only 53.9 dBA.** By independent sound laboratory test.* No other matrix printer we know of can make this claim.

If you ran **INFOSCRIBE 1000** in the public library, Marian the Librarian wouldn't even look up. It's that quiet.

Our Family Tree

INFOSCRIBE 1000 is not only no nuisance, it's no nonsense. The whole Infoscribe printer family shares technology and parts, cutting down on operator training, maintenance time, parts stocking, and specialized software. And this reflects where it counts: in lower bottom-line cost of ownership.

Cornucopia of Features

We poured features into the **INFOSCRIBE 1000**; it will pour them out for you. Sophisticated features like versatile graphics, under full software control; data processing quality characters at 10, 12, or 16.5 cpi, with correspondence quality characters at 10 cpi; subscripts and superscripts in any selected pitch; double-wide printing, true underlining; three 96-character sets in any alphabets, selectable on a character-by-character basis; rugged tractor feed; and an input buffer expandable to 3532 characters, to name a few.

As for throughput, you'll be delighted. A basic print speed of 180 cpi coupled with vertical and horizontal tabbing, plus bidirectional printing with logic seeking in both directions, pushes work out of the machine at an impressive rate. 100% duty cycle operation, naturally.

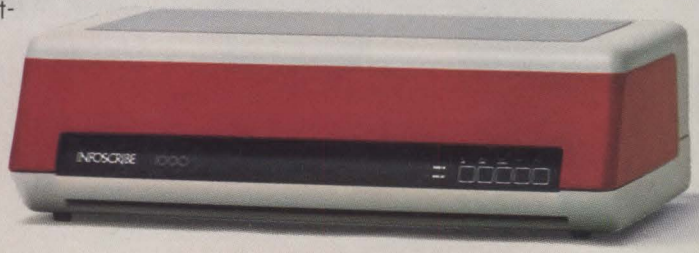
Beauty and the Beasts

INFOSCRIBE 1000 sits on a pedestal in your office, but it could as easily sit on a pedestal in the Louvre. It's a wonder of sleek, gracious design that makes competitive instruments, with their protruding ganglia and tumorous knobs, look like props for a horror movie.

And **INFOSCRIBE 1000's** esthetics are pure practicality. They reduce noise, exclude dirt, simplify operation, and put maintenance where it belongs: inside the case. Why not upgrade your computer with a printer that's a work of art: **INFOSCRIBE 1000.**

And Why Not Now

This is the time to place your order for one or a thousand **INFOSCRIBE 1000's.** At $1,825 for single units (considerably less in OEM quantities), Infoscribe's prices are outright philanthropy. Get full details immediately from your local Infoscribe distributor/representative or computer dealer.



Contact Infoscribe for an abstract of the independent testing laboratory report.

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CIRCLE NO. 107 ON INQUIRY CARD

New Systems

TRW-Fujitsu announces desk-top computer

The Affinity 16 multitasking desk-top μc operates stand-alone, on-line to a central computer or in a network environment and performs batch, on-line or distributed-processing applications. The CPU includes a 16-bit μp and 128K bytes of memory and two 5¼-in. floppy disks that can record 320K bytes each. An 8-in. floppy-disk drive unit provides as much as 2.5M bytes of auxiliary disk storage. Other features include an overlay function that increases main storage capacity by bringing program subroutines into a main storage area from floppy disks, and deleting them after use. Prices range from $6000 to $10,000, depending on configurations and quantities. **TRW-Fujitsu Co.,** 9841 Airport Blvd., Suite 620, Los Angeles, Calif. 90045.

Circle No 212

Lexitron introduces text processors

The Information-Station line of text processors incorporates a 5-MHz μp, 393K bytes of RAM and optional dual-density, double-sided diskettes that can store as much as 640K bytes. Two models are available: the single-drive Informa 2202 and the dual-drive 2303. Software provides advanced formatting, background processing, multiple search and replace, horizontal scrolling and printing of as many as 316 cpl, multiple variable line spacing within a page, user programming and an optional 88,000-word spelling dictionary. The 2303 is priced at $13,895, including a printer, and the 2202 sells for $13,345. **Lexitron Corp.,** 1840 DeHavilland Dr., Thousand Oaks, Calif. 91359. **Circle No 213**

MCE announces IC development system

The UniDES IC development and evaluation system consists of a set of PC boards upon which layout worksheets of the vendor's proprietary Uniray semi-custom chip geometries are mounted. IC kit parts are mounted under the board and electrically routed to the appropriate emitter, collector, base and resistor contact points on the layout worksheet through a PC. Miniature patch cords plugged into pin jacks at each of the layout contact points provides IC breadboarding. Three sets of 1 percent plug-in resistor kit parts simulate the circuit performance with component variation. **Micro-Circuit Engineering Inc.,** 1111 Fairfield Dr., W. Palm Beach, Fla. 33407.

Circle No 214

Integrated control unit stores 132M characters

The OASys System 64 integrated control unit uses the vendor's System 3000's System 8 workstation clusters with OASys model II intelligent work stations, printers and communications capabilities. The system provides document storage of as many as 132 million characters to combinations of as many as 32 work stations, printers or other System 8 and 64 ICUs. Prices start at $27,900 for a system serving as many as 16 devices. Asynchronous and bisynchronous communications are priced at $2500 to $4000. An expanded system, supporting 32 devices, is priced at $41,400. **NBI Inc.,** 1695 38th St., Boulder, Colo. 80301.

Circle No 215

New Products

datacomm

Anderson Jacobson unveils electronic-mail work station

The AJ 412 electronic-mail work station broadcasts messages selectively to remote locations through polled or point-to-point networks, and refiles messages between dissimilar networks and terminals in central message rooms. Individual passwords secure remote terminal access. When equipped with a triple modem, the unit automatically identifies and adapts to the protocol of the calling modem to select the correct transmission rate and mode. In networks with a message switch, the AJ 412 provides store-and-forward messaging capability unattended, functioning as an intelligent buffer between asynchronous ASCII terminals and the communications line. Prices range from $2000 to $3000; 24-month leases are $76 to $87 per month, depending on quantity. **Anderson Jacobson, Inc.,** 521 Charcot Ave., San Jose, Calif. 95131. **Circle No 216**

Multiplexer cuts wideband use

The Lineplexer II inverse multiplexer provides full-duplex communications at 19,200 bps over two independent analog or digital channels, eliminating the need for using wideband facilities. Features include automatic/manual rate adjustment, automatic compensation, day/night reconfiguration, an interface adapter and a built-in 9600-bps modem. Price is $5200. **Timeplex, Inc.,** One Communications Plaza, Rochelle Park, N.J. 07662. **Circle No 217**

GDC introduces synch/asynch buffer

The SAB-1 synchronous/asynchronous buffer enables the tranmission of asynchronous data through synchronous modems or synchronous digital facilities operating in point-to-point or multipoint network applications at data rates as high as 9600 bps. The SAB-1 accommodates 10-bit ASCII data at seven user-selectable data rates. The unit tolerates input speed distortion of as much as ±2 percent and input bias distortion of as much as 43 percent with less than 3 percent asynchronous ouutput distortion. The unit provides full-duplex, half-duplex or simplex operation over dial access or private lines. Price is $295 in quantities of one to nine. **General DataComm Industries,** One Kennedy Ave., Danbury, Conn. 06810. **Circle No 218**

MDB announces DZ11-compatible multiplexers

The MLSI-DZ11 series for Z-bus processors includes multiplexers that provide the features of the DEC Unibus DZ11-A and DZ11-B 8-line multiplexers and the DZ11-E 16-line unit. The multiplexers include four-level interrupt, programmable character formats and data rates from 50 to 19.2K bps. PC-mounted DIP switches provide device addressing and vector-interrupt selection. The unit contains a 64-character buffer with a 16-bit SILO counter. Prices range from $1350 to $2800. **MDB Systems, Inc.,** 1995 N. Batavia St., Orange, Calif. 92665. **Circle No 219**

THE RELIABLE ALTERNATIVE TO DISK...

If you've been looking for the storage capacity of head-per-track disk with the speed and reliability of main memory — you've just found it... MINIMEG™, the *reliable* alternative to disk.

Independent studies have shown that most CPUs sit idle, waiting for the disk. MINIMEG stores the disk data (software compatible with most head-per-track controllers) and transfers it immediately, eliminating disk delays. No disk delays means no idle CPU, which results in increased system speed.

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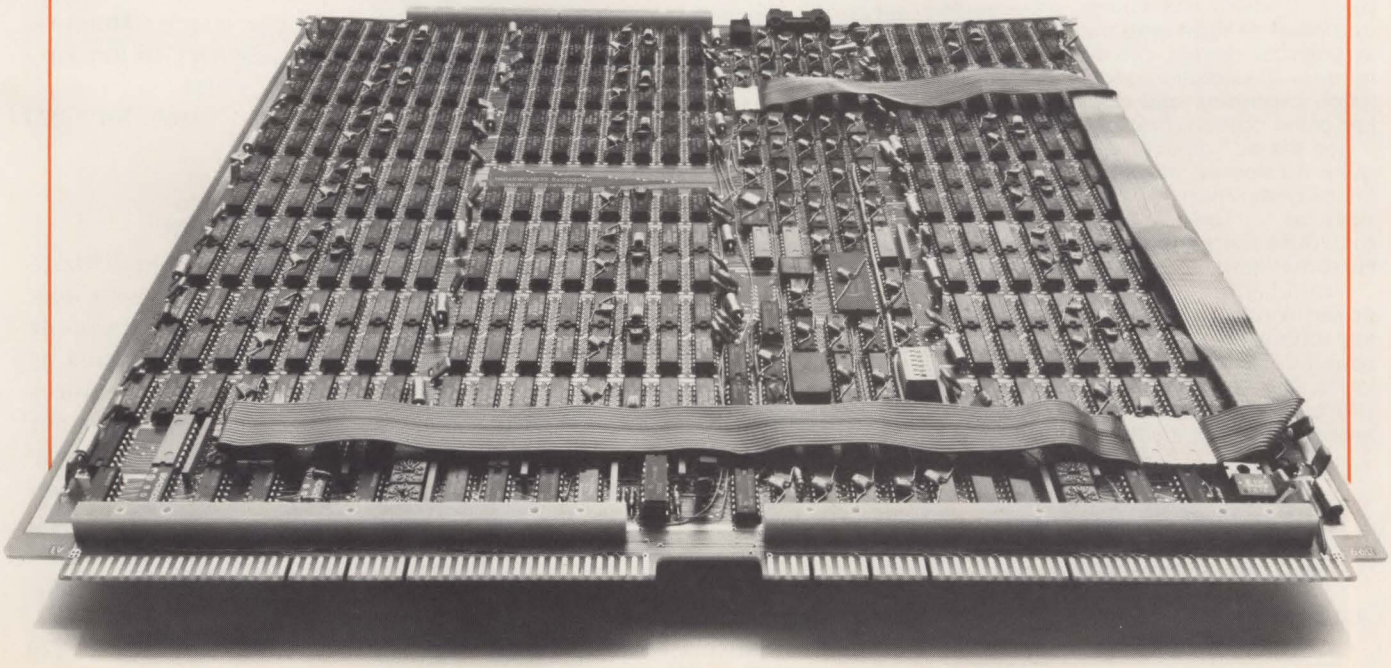

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CIRCLE NO. 109 ON INQUIRY CARD

New Products

datacomm

Racal-Vadic announces multi-line calling unit

The μp-controlled VA811 single- and multi-line calling unit enables an RS366 computer port to address as many as 60 single-board modems or 28 double-board modems. With the addition of the vendor's VA831 adapter, an RS232C port can be used. The VA811 can handle the VA3400 modem and Bell 103, 201, 202 and 212 units. Other features include automatic selection of pulse or tone dialing; positive dial tone; answer-tone and busy-signal detection on the DDD and TWX networks; 2025-, 2100- and 2225-Hz answer-tone detection; 15- to 56-sec. abandon call and retry times, and forced-exchange clearing between calls. Price is $600 in single-unit quantities, with OEM discounts available. **Racal-Vadic,** 222 Caspian Dr., Sunnyvale, Calif. 94086.

Circle No 220

Tri-Data announces integral dual modem

The model 802 dual-channel, full-duplex modem enables a terminal to communicate with DDD, TWX or Telex networks. The terminal storage unit includes a Z80 μp, 16K bytes of RAM and ROM edit firmware and text-editing capability. Other features include auto-dial, retry, auto-answer and directory. Price is $1350. **Tri-Data,** 505 E. Middlefield Rd., Mountain View, Calif. 94043.

Circle No 221

Sperry announces communications processor

The model DCP/20 distributed communication processor operates as a front-end processor for the vendor's 1100 and series 90 host processors or as a remote network processor. DCP/20 simultaneously supports transaction-processing, time-sharing and remote job-entry applications. The unit includes a processor, local storage and communication line modules. The unit's IC error-correcting memory can be expanded from 256K 8-bit bytes in 128K-byte increments to 512K bytes. The DCP/20 handles as many as 45 communication lines and accommodates asynchronous, synchronous and wideband transmissions at speeds as high as 64K bps. Price is $45,800; a five-year lease is $960 per month, and maintenance is $215. **Sperry Univac,** P.O. Box 500, Blue Bell, Pa. **Circle No 222**

MDS announces desk-top system

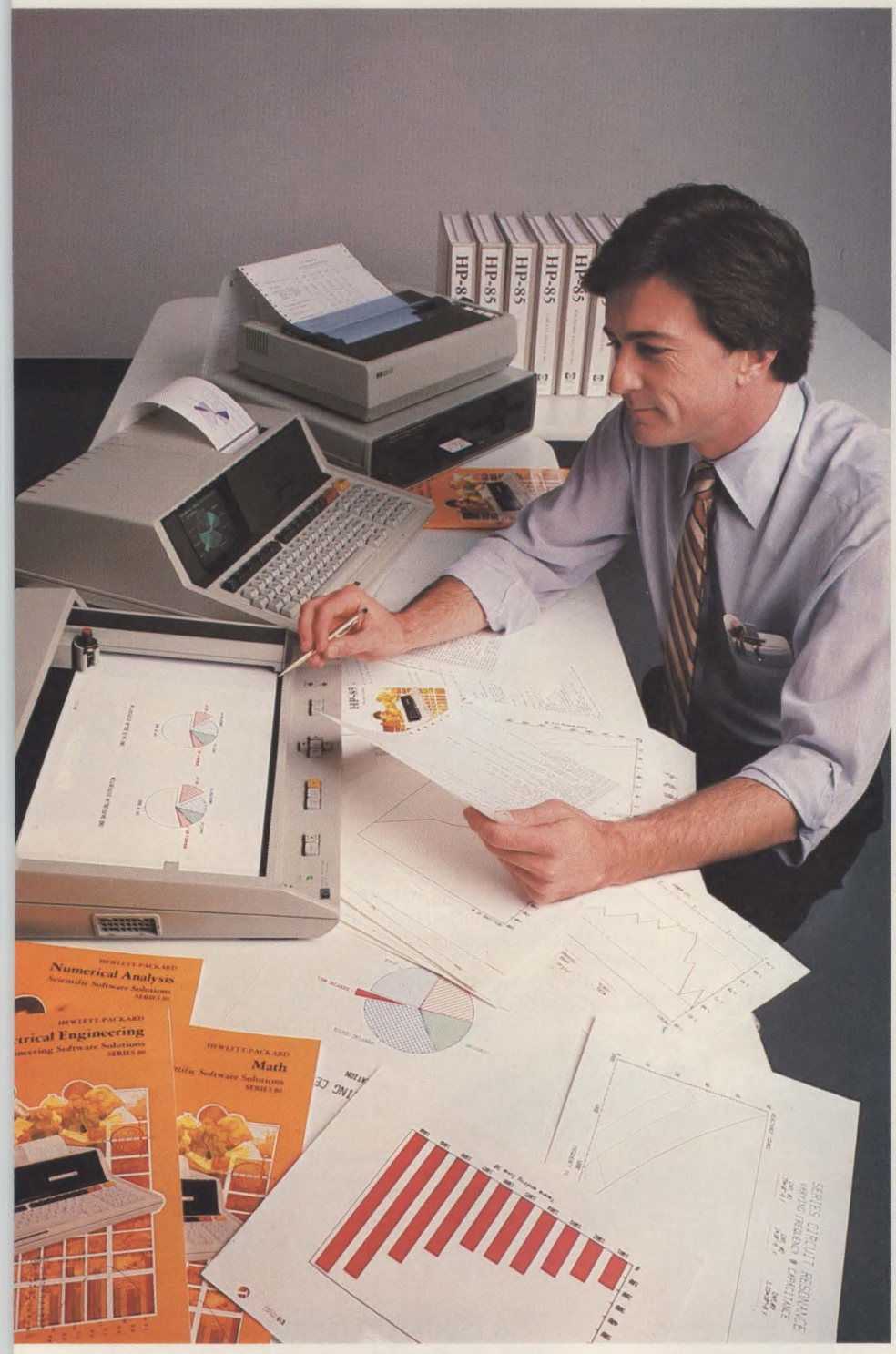
The model 21/10 distributed data-processing system features a controller console/CRT terminal with a 96K-byte memory, a communications controller, a diskette drive, a display screen and a keyboard. The system supports turnkey programs, including word processing, data entry and utility. The system also supports asynchronous and bisynchronous communications with 3270 dialogue at speeds as high as 4800 bps. Price is $7035 in single-unit quantities; rental on a five-year lease is $175 per month. **Mohawk Data Sciences,** Seven Century Dr., Parsippany, N.J. 07054.

Circle No 223

IDS offers high-speed modem

The model 6210 limited-distance modem provides asynchronous operation over Telco or private two- or four-wire non-loaded conductors at speeds as high as 9600 bps. Features include high and low transmit levels, normal and high receiver impedance and a pulse-modulation scheme. A 20-mA TTY current-loop interface is available. Price is $330. **International Data Sciences, Inc.,** 7 Wellington Rd., Lincoln, R.I. 02865. **Circle No 224**

Meet HP Series 80: Hewlett-Packard's new one-on-one computing systems for professionals.



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611/04

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*Suggested retail price excluding applicable state and local taxes—Continental U.S.A., Alaska & Hawaii.

HEWLETT PACKARD

CIRCLE NO. 111 ON INQUIRY CARD

Never Before Has A Back-up System Been As Intelligent As The System It's Backing Up.

This is the 3M Brand HCD-75 High Capacity Data Cartridge Drive. And the reason it's as intelligent as a computer is because it thinks like one.

You see, unlike other back-up systems, the HCD-75 is interfaced directly with the primary system by means of sophisticated, microprocessor electronics. When the host computer has data to feed, the HCD-75 starts automatically. When the host computer stops, it does too. And since the HCD-75 also positions to any location, it not only saves tape cost but retrieval time as well.

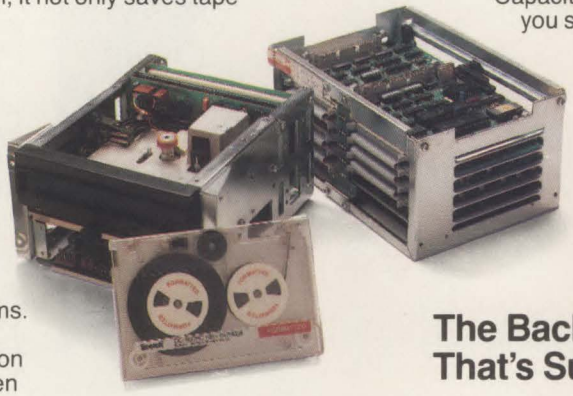
Of course the use of microprocessors allows the HCD-75 to perform a number of other time-saving functions, too. Like block replacement, so you can easily correct errors or change files which pertain to updating. And fast random access which makes it useful both as an I-O device or as a storage unit for low-usage files. All of which relieves the host computer from difficult timing and formatting problems.

What's more, the HCD-75 features state-of-the-art error detection and correction capabilities. Even when the system is off-line, self-test diagnostic routines monitor its performance. And, combined with each of its high-capacity cartridges, the HCD-75 provides a full 67 megabytes of formatted user information (144 mbytes unformatted). So costly operator interventions are sharply reduced.

If you're looking for a reliable, cost-effective solution to the problem of disk back-up, the 3M Brand HCD-75 High Capacity Data Cartridge Drive is the system you should be thinking about.

Not only has a lot of thinking gone into it. But a lot of thinking comes out of it, too.

For more information, check the listing on the next page for the representative nearest you. Or write: Data Recording Products Division/3M, Bldg. 223-5N 3M Center, St. Paul, MN 55144.



The Back-up System That's Suddenly Way Out Front.

CIRCLE NO. 112 ON INQUIRY CARD

New Products

datacomm

DEC introduces dual-speed modem

The DF03 free-standing, full-duplex modem, which enables terminals and processors to communicate over unconditioned dial-up lines, operates asynchronously at data rates as fast as 300 or 1200 bps and synchronously at 1200 bps. The modem is available in two versions: the AA and the AC, each featuring manual-originate, manual-answer and automatic-answer modes. The DF03-AC provides an automatic-originate mode and serial autocall. Both are compatible with the vendor's synchronous and asynchronous data-communications controllers, which support the RS232C interface and offer public switched-telephone-network modem control. The DF03 is also compatible with the Bell System 212A modem. The DF03-AA is priced at $950, and the DF03-AC sells for $1350. **Digital Equipment Corp.,** 146 Main St., Maynard, Mass. 01754.

Circle No 341

Tymnet announces communications processor

The Mini-Engine general-purpose communications processor for packet network applications is available in three configurations. Versions 1 and 2 provide asynchronous terminal interfacing at selected speeds from 110 to 1200 or 300 to 4800 bps. Both support synchronous network lines at speeds as high as 9600 bps. Model 1 supports as many as 32 terminals and two network lines; model 2 supports as many as 64 terminals and 16 network lines. Mini-Engine 3, designed to run under internally switched interface system software, can be configured for 3270, X.25 and 2780/3780/HASP applications. It supports 16 synchronous lines at speeds as high as 9600 bps. **Tymnet, Inc.,** 20665 Valley Green Dr., Cupertino, Calif. 95014.

Circle No 342

16-channel multiplexer replaces DG's ALM-16

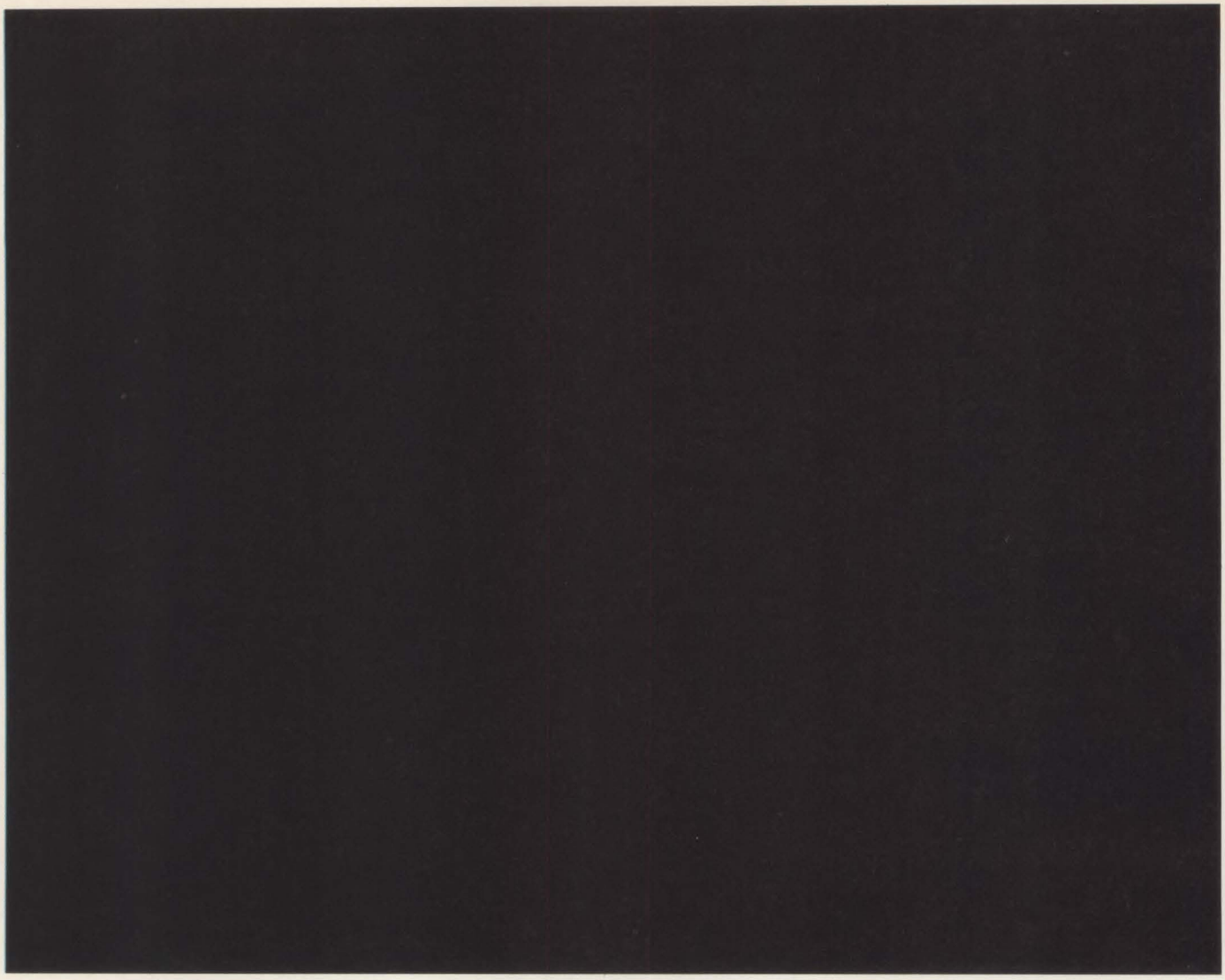
The model 420 programmable terminal interface is a direct replacement for Data General Corp.'s ALM-16 and ATI-16 multiplexers. The unit supports clear-to-send, can be switched by line to operate RS232 or 20-mA terminals and can be mounted in the CPU chassis of all Nova 3, Nova 4 or Eclipse computers. The unit also features a pre-wired 16-port distribution panel for retma mounting at the rear of the computer cabinet. Price, including full documentation and distribution panel, is $2200. **Custom Systems, Inc.,** 6850 Shady Oak Rd., Eden Prairie, Minn. 55344.

Circle No 343

Systems integrate communication functions

The models 141, 241, 341 and 441 multifunctional communications systems have one, two, three and four communications ports, respectively. The units handle Telex, TXW, DDD, leased line, private Telex and 2780 bisynchronous messages. The systems include character-code-to-facsimile-code translators, which allow incoming messages to be converted automatically to facsimile format and then forwarded to facsimile machines. The systems provide stand-alone word processing that enables an operator to prepare mailings from sorted mailing lists, to handle contracts for fill-in-the-blank processing and to edit many types of text. Price, including a printer, a floppy-disk drive and a communications port, is $8500. **Compression Labs, Inc.,** 2305 Bering Dr., San Jose, Calif. 95131.

Circle No 344



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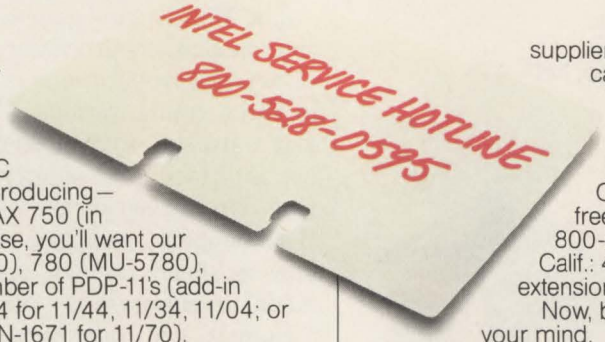

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New Products

printers

Printer series features UPS

The Spinwriter 3500 series of character printers/terminals operates at 37 cps and features a UPS and word-processing assist capabilities. The unit automatically selects characters and shadow, bold and underline printing. The series is Qume-, Diablo-, Centronics- and RS232-interface-compatible. Prices in 100-unit quantities for OEM mechanisms start at $1080 and $1735 for terminal models. **NEC Information Systems, Inc.,** 5 Militia Dr., Lexington, Mass. 02173. **Circle No 225**

Matrix print head is bidirectional

The model 4000 dual-row 18-wire bidirectional matrix print head is available in two versions. Version A, arranged in a staggered configuration, prints data-processing output at 400 cps, and B, arranged with dots in line, prints 800 cps. Version A provides 144-dpi vertical resolution and 100-cps letter-quality output. Prices range from $130 for OEM quantities to $295 for 50-unit quantities. **DH Associates,** 754 N. Pastoria Ave., Sunnyvale, Calif. 94086.

Circle No 226

Harris announces 300-lpm printer

The model 9289, 300-lpm band printer is compatible with IBM's 3274 controller and 3278 displays. The unit includes a 64-character set and a 240-lpm speed with a 96-character set. The printer allows an operator to adjust horizontal and vertical formats, including horizontal and vertical margins, case selection, lines per in. and space density. The unit, including a 64- or 96-character band, sells for $10,403; a two-year lease, including maintenance, is $330 per month. **Harris Corp.,** 16001 Dallas Pkwy., Dallas, Texas 75240. **Circle No 227**

MDS unveils 132-cps printer

The model 2144 matrix printer provides 120-cps printing to users of the vendor's MDS Series 21 distributed-processing systems. As many as four model 2144 printers can be attached to the system. The unit prints 132 columns and includes a forms tractor and a multi-part-forms capability. Price is $2650; rental fee is $60 per month on a five-year lease. **Mohawk Data Sciences,** Seven Century Dr., Parsippany, N.J. 07054.

Circle No 228

Graphics printer operates at 100 cps

The model 739 small-business computer printer produces text and data processing and graphics. The unit features 74-dpi horizontal resolution, 72-dpi vertical resolution and 100-cps monospaced print speed. It prints 7 × 8 dot-matrix characters with true underline at 10 and 16½ cpi for data processing, and N × 9 proportional characters for text editing. Price is less than $1000. **Centronics Corp.,** One Wall St., Hudson, N.H. 03051.

Circle No 229

printers

Gulton announces thermal printer

The Microplot 80 fixed-head thermal-graphic printer, designed for use with μp-based systems, is available in desk-top and panel-mount versions. The unit features 80-column printing and accepts analytical and computational data in digital form. It plots data, prints the grid and scale, annotates the date with alphanumerics and prints alphanumeric text with both X- and Y-axis orientation. Other features include individual dot addressing, enhanced vector plotting, double density, 512-dot resolution, fixed-head linear array technology, manual and programmable mode selection and backspacing capability. Price is less than $2000 in single-unit quantities. **Gulton Industries Inc.,** Gulton Industrial Park, E. Greenwich, R.I. 02818.

Circle No 230

Printer features 4K message buffer

The series 6010 dot-matrix impact printer includes a 2K-byte message buffer, expandable to 4K bytes. The standard buffer enables printing of a full 1920-character CRT screen without restraint pauses. The printer can accept 80 more characters after the generation of a restraint signal. The μp-controlled unit operates at 150 cps with a 9 × 9 dot matrix. It includes a Centronics-compatible parallel or an RS232 interface operating at rates as high as 19.2K bps. A rear-panel switch permits choice of active or passive 20-mA current loop. Other features include full operator controls, built-in test, true descenders and underlining and logic seeking. Price is $1550 with parallel interface and $1580 with serial interface, with distributor and OEM discounts available. **Qantex Division, North Atlantic Industries, Inc.,** 60 Plant Ave., Hauppauge, N.Y. 11787.

Circle No 231

There's a new look in intelligent terminals and terminal systems.

At Delta Data, we've always looked at intelligent terminal products with a different eye. An eye towards problem-solving, where sophisticated hardware and software serve as part of a solution. And people who understand your needs provide the rest.

We know your applications problems are special. That's why our intelligent terminals and systems reach out beyond the ordinary. With so many special features that each of our products is virtually customized for you alone. For over a decade, we've built our success on this premise. And we'd like to build your success on it too.

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DELTA DATA

DELTA DATA SYSTEMS CORPORATION
Metropolitan Industrial Park
Trevose, PA 19047
Telephone (215) 322-5400

CIRCLE NO. 115 ON INQUIRY CARD

New Products

printers

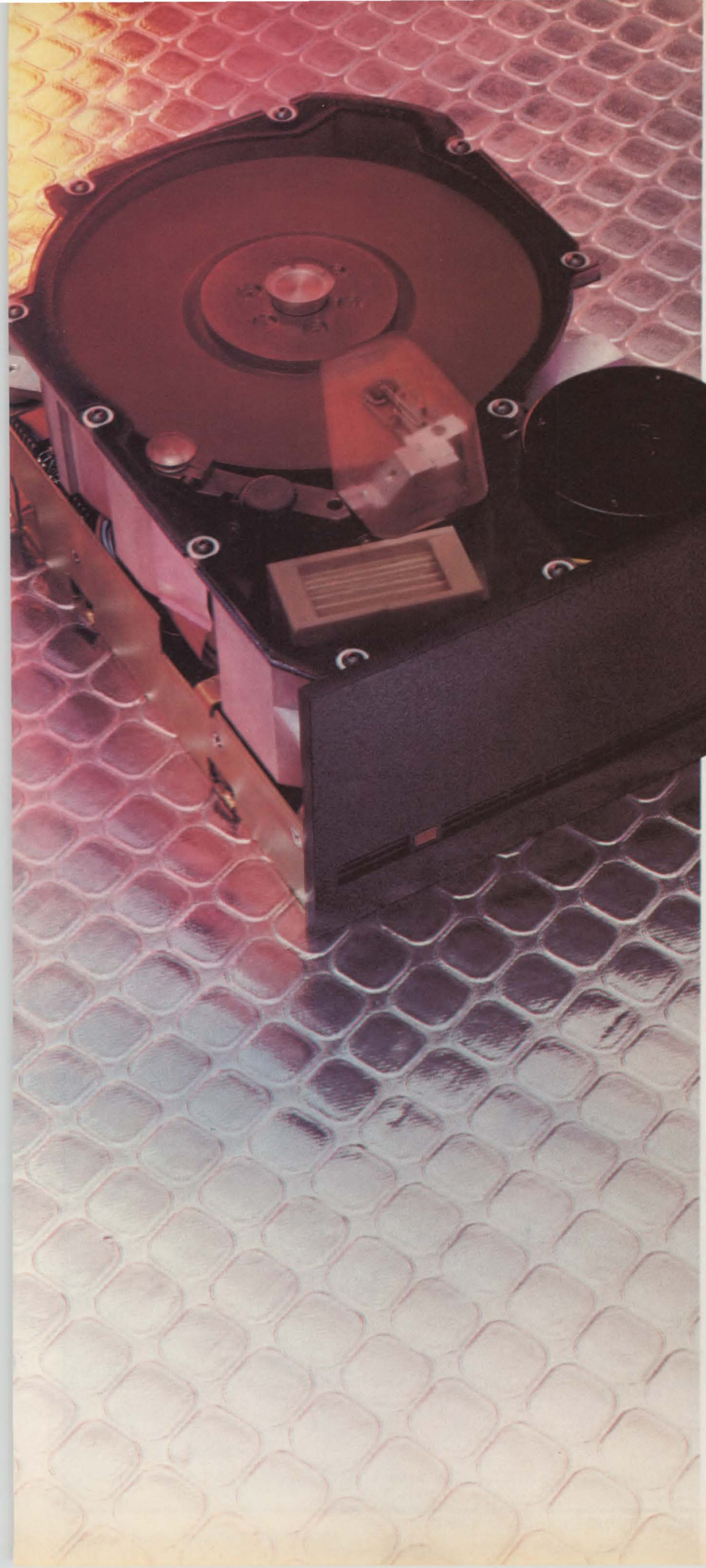
H-P announces thermal-printer family

The HP 2671A thermal printer offers a 128-character ASCII set, a line-drawing character set for creating forms and a Roman-Extension set for national characters. Two print modes are available: 80 columns per 8-in. line and compressed mode of 132 cpl. Price is $1095. The model 2671G graphics thermal printer features 90-dpi resolution. It is priced at $1295. The model 2673A features the capabilities of the 2671A and 2671G plus raster-graphics functions, including auto-centering, windowing and offsets. Price is $1895. **Hewlett-Packard Co.,** 1507 Page Mill Rd., Palo Alto, Calif. 94304.

Circle No 232

H-P introduces dot-matrix printer

The HP-82905 dot-matrix printer, designed to run with Series 80 personal computers, features a graphics mode that prints a dot-by-dot version of CRT graphics onto hard copy. It features 80-cps bidirectional printing, 40 to 132 columns per 8½-in. page and an HP-IB interface. The unit sells for $945. **Hewlett-Packard Co.,** 1507 Page Mill Rd., Palo Alto, Calif. 94304. **Circle No 233**



Superior!

The Superior 5¼ inch Winchester Disk Drive

We're starting out ahead of the industry. Our new CM 5000 5¼ inch Winchester disk drive is already superior to any drive available. It delivers more capacity at the lowest cost per megabyte. An incredible 16 megabytes in a minifloppy-sized unit that fits into most floppy systems without requiring system structural changes. It's a result of our no-compromise design philosophy that improves upon proven Winchester technology.

No Equal

Our CM 5000 has no equal. We've designed features into a 5¼ inch Winchester disk drive that no one else has. For example, there are our high resolution, high output heads. There's a unique no hysteresis positioning feature. Added to that are such exceptional features as 345 TPI recording, an internal microprocessor and a high torque stepper motor. With capacities of 5.3, 10.7, and 16 megabytes in one, two or three platter versions. All built around proven Winchester technology.

The Leading Edge

We're not stopping here. Our concept, philosophy and commitment is to keep ahead. To stay at the leading edge of Winchester technology. You'll see us lead the rest in innovations and features that translate into an even lower cost per megabyte.

To find out how you can have the superior Winchester drive in your system, call us at (213) 709-6445 today for complete specifications, prices and for immediate delivery of an evaluation unit.

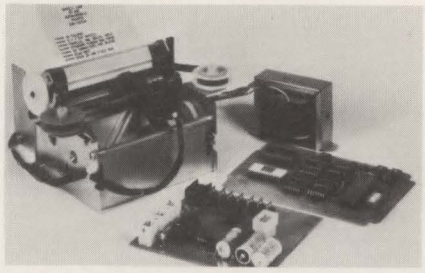
Computer Memories, Incorporated
9233 Eton Ave. Chatsworth, California 91311
(213) 709-6445 TWX 910 494-4834

New Products

printers

Versatec announces electrostatic plotters

These plotters, which draw on electrographic film, a transparent, stable 4-mil polyester-base medium, are available in three models. The 8222-F plots on 22-in.-wide media at 1 ips to draw 8.8 sq. ft. per min. The 8236-F plots on 36-in.-wide media at ¾ ips to draw 11 sq. ft. per min. The 8242-F plots on 42-in.-wide media at ½ ips to draw 8.5 sq. ft. per min. All offer 200-ppi resolution on opaque or translucent film or paper. Optional thermal dryers speed imaging drying. Prices are $30,000, $47,400 and $61,200, respectively. Electrographics film in 200-ft. rolls sells for approximately $1 per sq. ft. in large quantities. **Versatec,** 2805 Bowers Ave., Santa Clara, Calif. 95051. **Circle No 234**



Syntest announces 40-column dot-matrix unit

The SP-300, 40-column, dot-matrix impact printer features a 5 × 7 dot matrix, a 64-character ASCII subset, parallel and serial ASCII inputs, optional RS232C or current-loop interfaces, 50-cps print speed, parallel input data rates as high as 1K bps and serial input as high as 12.5K bps. Price, including printer mechanism, electronics and a 115-VAC power supply is $289 in 100-unit quantities. **Syntest Corp.,** 169 Millham St., Marlboro, Mass. 01752. **Circle No 235**

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Our competitive edge has always been our technology. Our ability to originate and apply innovative scientific and engineering ideas has made us a leader in the peripherals industry.

It's easy to grow with Control Data.

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But we don't stop there. We believe that service is just as important to the customer as the quality of our hardware.

Quality in our OEM service and support, too.

Our customers can rely on our maintenance organization of several thousand qualified customer engineers. And our spare parts depots are strategically located all over the world.

Let us share the secrets of our success with you. We've learned a lot in building a billion dollar peripheral products business.

Call us today. (612) 853-7600. Or write OEM, Control Data Corporation, HQN11I, P.O. Box 0, Minneapolis, MN 55440.

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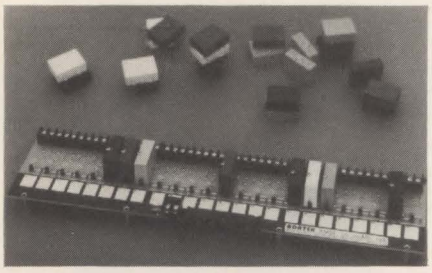
CIRCLE NO. 121 ON INQUIRY CARD

design aids



Adatek announces I/O module racks

The AM series of I/O module racks can be connected to any μc parallel port cable as long as 50 lines. Using a latching pin header connector, the racks accept any connector that fits a .1-in. hole pattern. Channel positions are labeled starting with 1, and each field-wire terminal is labeled with the channel number and the polarity. The units also accept industry-standard plug-in relay and sense modules. The racks are available in eight-, 16- and 24-channel versions and sell for $42, $66 and $90, respectively, in single-unit quantities. **Adatek Inc.,** P.O. Box 1339, Sandpoint, Idaho 83864. **Circle No 236**

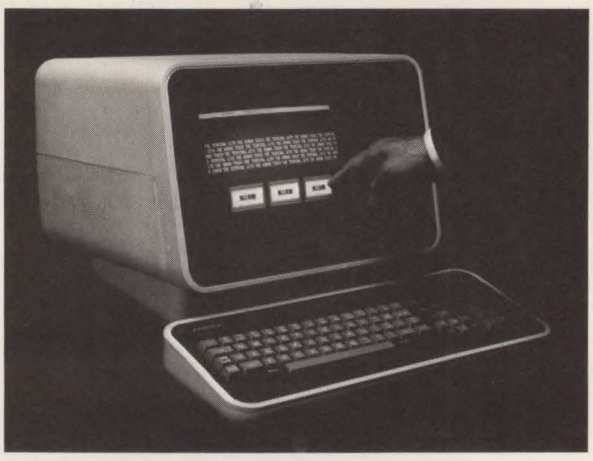
MDB announces single-slot DMA module

The DR11-BLL DMA module provides bidirectional exchange of 16-bit data between a PDP-11 or VAX computer. The BLL11 module provides RS422 long-line differential levels, which allow the peripheral to be placed as far as 3000 ft. from the computer. The units are compatible with DEC DR11-B operating and diagnostic software and occupy a single hex slot in the computer. The DR11-BLL includes interrupt request, bus master control logic, address selection and device interface logic. The dual-size BLL11 can upgrade any DR11-B module into the DR11-BLL. Price for the DR11-BLL is $1995, and the BLL11 sells for $795. **MDB Systems, Inc.,** 1995 N. Batavia St., Orange, Calif. 92665. **Circle No 237**

PC press-fit back panels offer gold-plated contacts

This family of four- or nine-slot PC press-fit back panels offers two-sided or multilayer designs for reduced wiring. The LSI-11- and PDP-11-compatible back panels use interference fit contacts that can be arranged in 0.125- × 0.125-in. or 0.125- × 0.250-in. centers with wrap-type or flush tails. The units provide removal of insulators and replacement of damaged pins, without changing entire connector assemblies. The contacts are copper, selectively plated with 20 μin. of gold over 50 μin. nickel on contact crown only. **Dynatech Corp.,** 1225 E. Wakeham Ave., Santa Ana, Calif. 92702. **Circle No 238**

DON'T TYPE IT. TOUCH IT.



Our new TouchTerm™ 80 terminal makes operating a terminal as easy as touching the screen with your finger . . . it's that simple!

One touch puts you in touch with your computer, in virtually any application from data base inquiry to factory data entry. Operators with no training can use your computer with the confidence of an expert.

To make it simple for you to use TouchTerm, we've designed it with "SOFT" escape codes for easy compatibility with your operating system; and you'll be amazed how easily TouchTerm can be implemented in your application programs.

The Ampex TouchTerm™ 80 terminal: It's the new and perfect way for OEM's to differentiate their product from the competition and increase sales. For the information that'll give your business that extra touch, touch bases with Harvey Hirsch, Ampex, Memory Product Division, 200 N. Nash Street, El Segundo, California 90245. (213) 640-0150.

CIRCLE NO. 123 ON INQUIRY CARD

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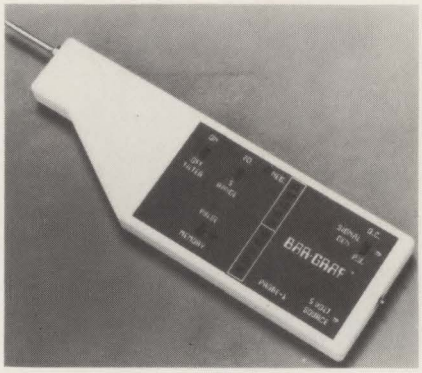
design aids

Amcorp announces logic-test probe

The Bar-Graf logic probe detects pulses as short as 20 nsec., reads to 0V and reads voltages containing high-level noise, with a selectable input filter. The probe features an instant 10-segment display with no settling time. AC and DC voltages are displayed with 5 percent accuracy. Other features include reverse and overvoltage protection, tip jack outputs for all standard test leads, a 20-KHz square-wave signal source and a 50-mA, 5V source for



use as a nondestructive test signal. **Amcorp, Inc.,** 10531 Parkway Loop, Tustin, Calif. 92680.

Circle No 239

Programmable tester uses 8085 μp

The model TS230 SCR and diode tester provides measured V_{gt}, I_{gt}, V_{DRM} and V_{RRM}, with a peak V_{DRM} capability of 2 KV. A high current to measure V_{TM} at current levels as high as 4000A is optional. The TS230 uses an 8035 μp with 2K bytes of program memory. Programmable upper and lower limits and test conditions are stored in nonvolatile memory. Price is $4695. **Markenrich Corp.,** 14946-F Shoemaker Ave., Santa Fe Springs, Calif. 90670

Circle No 240

Nylon resin provides EMI/RFI shielding

The Plasticon EC-636 electrically conductive nylon 6/6 molding resin combines engineering properties with EMI/RFI shielding. It provides 20 to 30 dB of shielding effectiveness to 1000 MHz, which represents attenuation of 95 percent of incident radiation. EC-636 eliminates static electricity in electronic, photographic, coating, printing, plastic-extrusion and molding applications. It is approved by Underwriters Laboratories, Inc., and the Canadian Standards Association. **Plastic Systems, Inc.,** 88A Ellsworth St., Worcester, Mass., 01608.

Circle No 241

SYSTEM 2800

another A MAJOR BREAKTHROUGH!

20 MByte Winchester Hard Disk with Tape Backup

The SYSTEM 2800, designed for business, industrial and educational applications, is now available with a 20 MByte Winchester Hard Disk and a 20 MByte Tape Drive for disk backup. Created to be innovative and competitive, the SYSTEM 2800 utilizes our existing line of field-proven and dependable "2nd Generation" S-100 Memory, Z80 Processors, Disk Controllers and Serial I/O boards.

As a family of expandable microcomputers intended for single and multi-user applications based on CP/M*, MP/M* and OASIS**, the SYSTEM 2800 contains many big system features. Outstanding characteristics such as FAST operation make it a clear market leader. In fact, the SYSTEM 2800 is one of the fastest Z80-based systems recently benchmarked by Interface Age magazine.

*CP/M and MP/M are Registered Trademarks of Digital Research

**OASIS is a Trademark of Phase One System, Inc.

Other featues include the capability to BOOT from any drive including the hard disk, and extensive error recovery. The error recovery prompts the user with detailed error messages and prevents system lock up, all too common to many other systems.

Designed for easy service, the SYSTEM 2800 comes with two 8-inch drives: a choice of single or double sided, double density floppies with up to 2.52 MBytes of formatted storage; 10 or 20 MByte Winchester hard disk; and 20 MByte tape drive for disk backup.

These enhanced features result in a highly reliable, quality built, state-of-the-art microcomputer that gives you the cost/performance edge you need to be a leader in your field.

Dealers, OEM's and System Integrators share many common needs. Not the least of these is dependable products. That's why we back our SYSTEM 2800 with our established reputation for high quality, superior support, prompt and courteous service, an inclusive one-year warranty and comprehensive dealer support program.

Take the next logical step. See your nearest computer dealer, or contact us for the complete story on our S-100 family of board products and enhanced systems.

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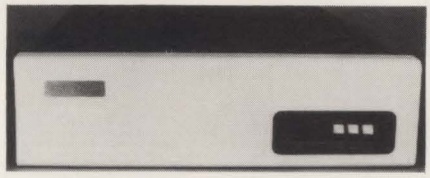
CIRCLE NO. 125 ON INQUIRY CARD

New Products

design aids



System enclosure features 9 × 6 backplane

The C11/03/23 enclosure for LSI-11/2 and LSI-11/23 systems features a 9 × 6 backplane and 18 pre-wired Q-bus slots that allow as many as nine dual and nine quad modules to be used simultaneously. The unit has an integral line time clock with front-panel switch control and a switching power supply of +5V at 25A and +12V at 6A. The unit also features a console switch panel with power and run indicators, halt/enable and DC on/off switches and optional locking-key switch control. **Cyberchron Corp.,** P.O. Box 164, Garrison, N.Y., 10524.

Circle No 242

NEC offers component packaging

The Miniflat family of miniature ICs is available in three eight-pin operational-amplifier versions and two 14-pin versions—an operational amplifier and a low-power quad comparator. Both have a lead pitch of 1.25 mm. and are 1.5-mm. thick. The eight-pin version is 5-mm. wide, and the 14-pin IC is 10-mm. wide. The A-Series capacitors for coupling, bypassing and timing include 4V to 50V voltage ratings, 0.1- to 68-μF capacitances and five case sizes. Mini-Mold packaging for bi-polar transistors, diodes and FETs measure 1.1 mm. × 1.5 mm. × 2.9 mm. Prices for Miniflats range from 62¢ to 99¢ in 1000-unit quantities; prices for the A-Series range from 17¢ to 48¢; and the Mini-Mold packages sell for 10¢ to 20¢ in 25,000-unit quantities. **NEC Electron, Inc.,** 252 Humboldt Ct., Sunnyvale, Calif., 94086.

Circle No 243

Want reliable power for electronic instruments and controls without costly special wiring?

Just plug in a Sola.

With CAD/CAM systems, numerical or digital process controls, lab instruments, energy-management or security electronics, you often get instructions to put in a "dedicated" power line. But, instead of breaking through walls, cutting trenches in floors, laying special conduit, pulling lots of wire and adding more breakers and switchgear to get reliable power, why not simply plug a portable Sola Power Protector into the outlet that's already there?

Dedicated lines can add anywhere from $1200 to $8000 or more per machine, even in new construction. For a fraction of that cost, a Sola Micro-Minicomputer Regulator not only replaces the dedicated line but does what dedicated lines can't do. It raises and lowers voltage to compensate for line fluctuations and brownouts. It blocks out electrical noise, and destructive power dips or surges. Our new Mini-UPS goes one step further. Its built-in battery maintains power when your electric utility fails. This keeps your electronics running smoothly until your generator comes on line. Both units are available in 60 Hz or 50 Hz.

Dedicated lines, at best, minimize power disturbances that are caused by other equipment in your building. Sola Power Protectors guard you against all kinds of power line disturbances regardless of where they originate. Check this chart to compare effectiveness.

	spikes and faults	dips and surges	line noise		Brownout	Blackout
			common-mode	transverse mode		
	momentary sharp voltage peaks or split-second power outages	short-term high or low voltages due to load start-up or shut-down	Unwanted voltages or frequencies due to bad grounding, switching, or radio-type interference		Planned voltage reductions in response to high demand	Total loss of line power
			line-to-ground interference	line-to-line interference		
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
Sola Micro-Minicomputer Regulator	Yes	Yes	Yes	Yes	Yes	No
Sola Mini-UPS	Yes	Yes	Yes	Yes	Yes	Yes

Don't go through another day risking electronic malfunction due to unreliable power. Talk to your local Sola Electric representative or distributor. Or contact Sola Electric, 1717 Busse Road, Elk Grove Village, IL 60007. (312) 439-2800. We're the people who invented power protection 50 years ago.

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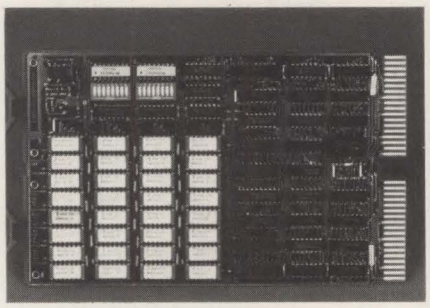
SOLA

CIRCLE NO. 127 ON INQUIRY CARD

New Products

memories



LSI-11 add-in stores 256K bytes

The CDM-77/03R 256K-byte LSI-11 add-in memory includes addressing to 22 bits, which provides the use of as much as 4M bytes of main memory with an LSI-11/23 CPU. Other features include on-board transparent refresh, delay-line timing, switch-selectable starting and ending addresses and extended boundary for an additional 4K bytes in the I/O page. Access time is 200 nsec., and cycle time is 375 nsec. Price is $1895 in single-unit quantities. **Cyberchron Corp.,** P.O. Box 164, Garrison, N.Y. 10524.

Circle No 281

Mostek announces 64K-byte EPROM

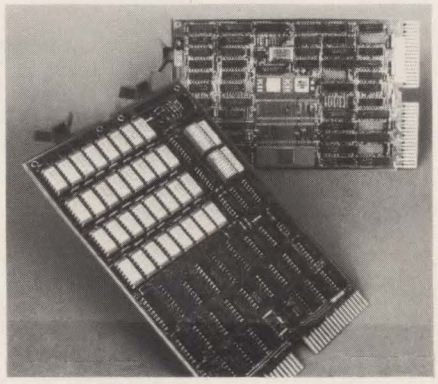
The MK2764 64K-byte EPROM, organized as 8K × 8, is pin-compatible with the vendor's "Bytewyde" memory components. Three versions are available. The 500-nsec. MK2764 T-9 is priced at $52.70; the 550-nsec. MK2764 T-10 is $44.80; the 650-nsec. MK2764 T-12 is $32.50 in 100-unit quantities. **Mostek Corp.,** 1215 W. Crosby Rd., Carrollton, Texas 75006.

Circle No 282

TI announces vocabulary ROMs

This line of vocabulary ROMs—synthesized-speech components—stores vocabularies of commonly used words. The first four VROMs in the series contain numerical- and industrial - type vocabularies. Speech includes words that have been recorded, analyzed and encoded using linear-predictive-coding technology, which provides synthesized speech at data rates of 1200 to 1600 bps. Two of the VROMs in the series are used with the TMS5100 voice-synthesis processor. The VM71001 contains 49 industrial-oriented words, and the VM71002 has 34 words, including numeric- and time-related vocabulary. The VM61002 and VM71003 contain data for the TMS5220 voice-synthesis processor. The VM61002 128K-bit VROM offers a 206-word industrial vocabulary. Prices range from $6.25 to $11.65 in single-unit quantities and $3.25 to $6 in 10,000-unit quantities. **Texas Instruments Inc.,** P.O. Box 202129, Dallas, Texas 75220.

Circle No 283



Memory offers 128K or 256K bytes

The CDF-11-HF/K CPU and memory includes the DEC LSI-11/23 CPU and high-density CDM-77/03R memory, which offers 128K or 256K bytes of memory on a dual-height card. The CDF-11 is an upgrade for the CD11-HC/D LSI-11/2 CPU and memory. The CDF-11-HC/D offers extended 22-bit addressing, enabling a user to configure a system with as many as 4M bytes of main memory. Memory access time is 200 nsec. **Cyberchron Corp.,** P.O. Box 164, Garrison, N.Y. 10524.

Circle No 284

A blueprint for office automation.

There are a lot of questions these days about office automation. Namely... what it is, what it will do, how to build the right system. Artelonics has analyzed these questions and more, and now has the answer. We call it our "blueprint for office automation." And the cornerstone is a powerful 8086 microprocessor-based desktop office computer—the Series 1000.

Designed for systems architects.

From its inception, the Series 1000 has been specifically designed as a tool for use in an integrated office computing system.

Combining word processing, data processing and communications with high resolution graphics, the Series 1000 offers extraordinary versatility at a surprisingly low cost. Prices start at only $7,900.

A building block for office automation.

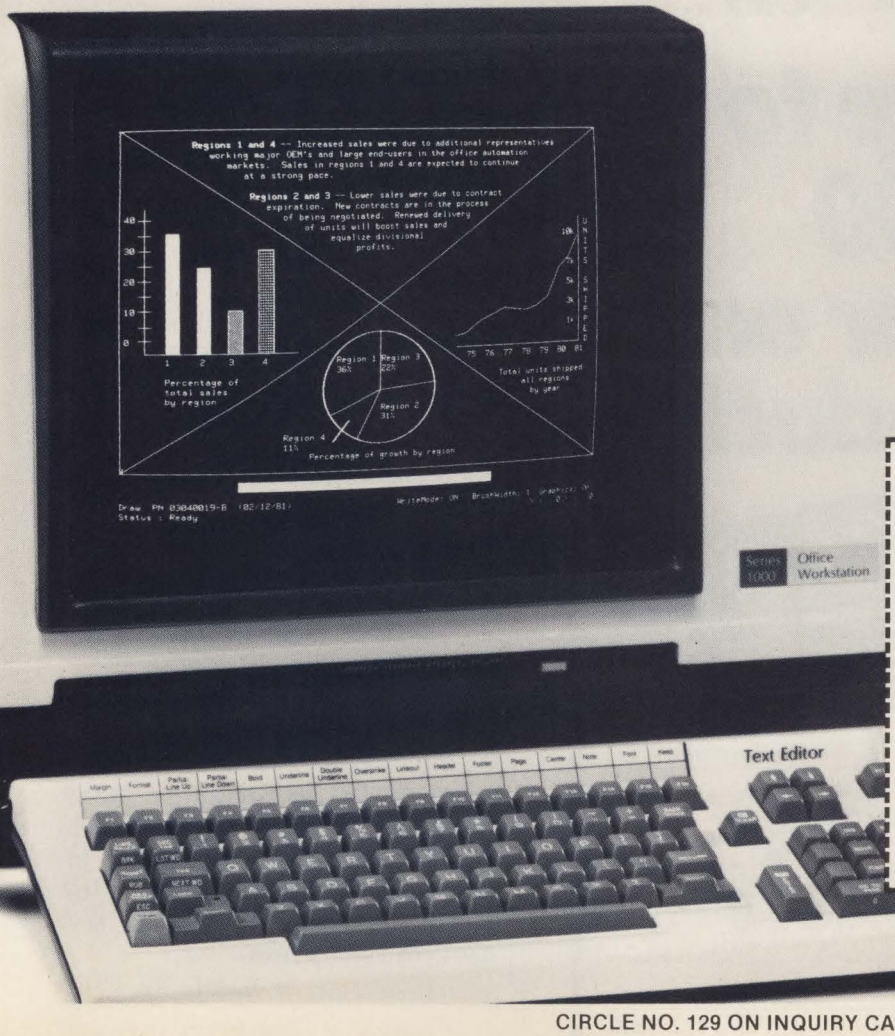
The Series 1000 is readily expandable. You can begin with a single stand-alone terminal, add to it in small increments, or build it into a large and complex system using your own customized hardware and applications software.

A cornerstone for future expansion.

Multibus™-compatible, the Series 1000 lets you plug-in a variety of custom interfaces, and currently supports RS232 and asynchronous communications. Bisynchronous communications protocols including 3270, 2780 and 3780 will be available soon.

A blueprint + the right tool = office automation.

A blueprint is only as useful as what it enables you to build. With the Series 1000's exceptional combination of features plus remarkable flexibility, you can begin creating the future of office automation . . . today.



CP/M-86™ is available now. MP/M-86™ is coming soon.

For more information, clip the coupon or write: Artelonics Corporation, 2952 Bunker Hill Lane, Santa Clara, CA 95050. Better yet, call us at (408) 727-3071.

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Tell me more about your "blueprint for office automation." My immediate need is:

☐ Word processing ☐ Communications
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2952 Bunker Hill Lane,
Santa Clara, CA 95050. MMS/9/81

CIRCLE NO. 129 ON INQUIRY CARD

memories

AMD offers bipolar PROMs

These 10 2048 × 8-bit PROMs are available in a 600-mil, 24-pin DIP or in a 300-mil, 24-pin DIP. Maximum access times are 50 nsec. Two units have open-collector outputs, and two offer three-state outputs. Two devices recover to full operating capabilities in less than 10 nsec., with a maximum address-access time of 50 nsec. In the power-down mode, current drain is 90 mA. The devices use platinum-silicide fuses. Prices start at $38.15 for the 600-mil version and $51.65 for the 300-mil version in 100-unit quantities. **Advanced Micro Devices Inc.,** 901 Thompson Pl., Sunnyvale, Calif. 94086. **Circle No 285**

Monolothic announces 256K-byte memory system

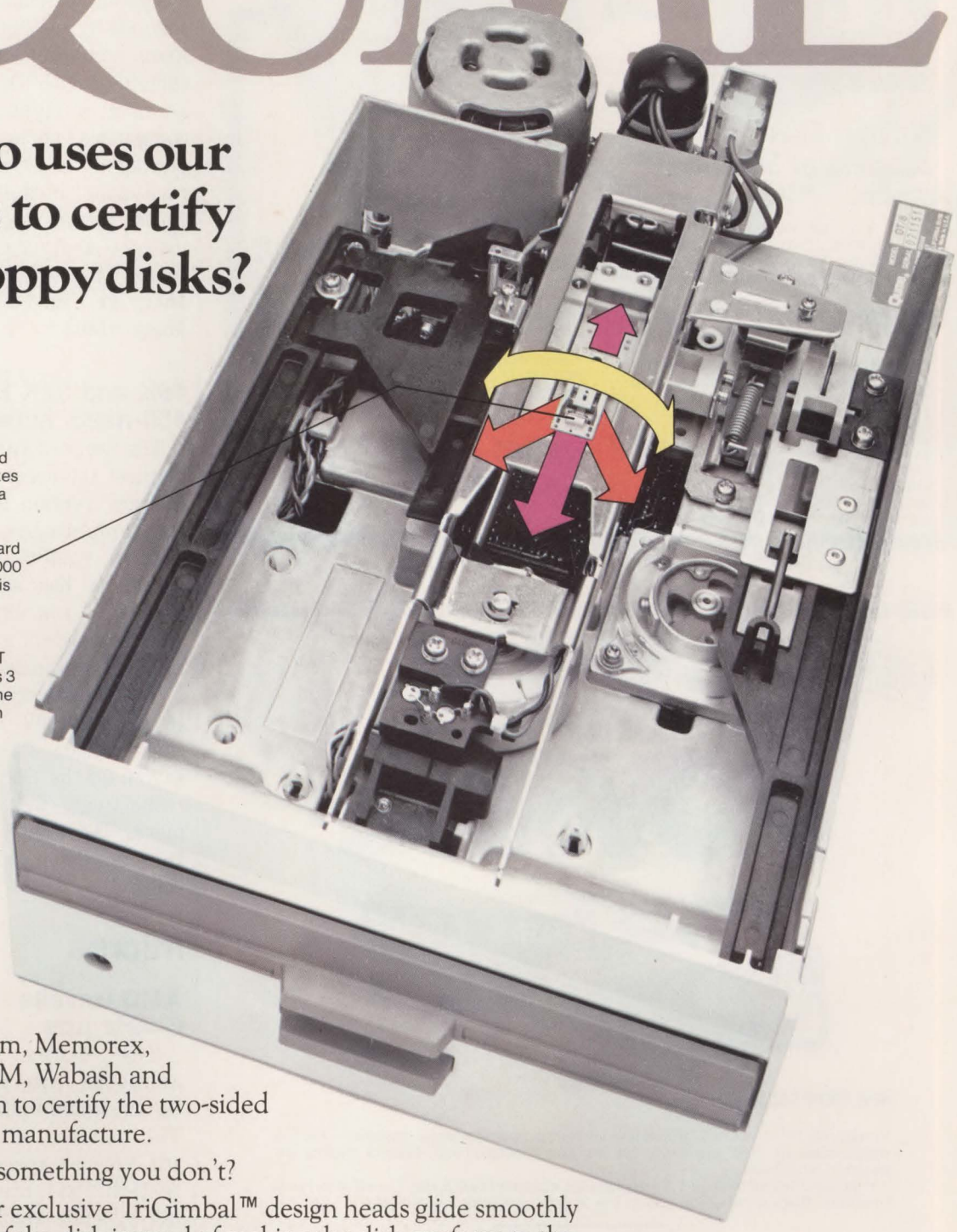
The 256K-byte MSC 4804 memory system for the LSI-11/23 uses 64K-byte RAM technology and occupies one Q-bus slot. Available in 18- and 22-bit address versions, the unit can be addressed on any 16K-byte boundary in capacities of 128K or 256K bytes and uses jumper pins. Other features include on-board parity generation, checking and storage. Price is $2200 in single-unit quantities, with OEM, educational and GSA discounts available. **Monolithic Systems Corp.,** 84 Inverness Circle E., Englewood, Colo. 80112. **Circle No 286**

TI announces RAM modules

The TMM10010 series and the TMM40010 series of RAM modules provide memory expansion for LSI-11 and Multibus computer systems, respectively. The TMM10010 series, which offers 128K-, 192K- and 256K-byte modules operates at maximum Q-bus speed. It also provides a typical read-access speed of 175 nsec., a typical write-access speed of 75 nsec. and a typical read or write cycle of 360 nsec. Other features include jumper-selectable address space, enabling users to address 256K to 4M bytes of memory and the ability to select starting addresses on 4K-byte boundaries. Prices for the TMM10010 series range from $1315 to $3290, and the TMM40010 series ranges from $1845 to $8000 in single-unit quantities. **Texas Instruments Inc.,** P.O. Box 1443, M/S 6404, Houston, Texas 77031. **Circle No 287**

QUME

Who uses our drives to certify their floppy disks?



ROLL, PITCH, and YAW: Exclusive TriGimbal™ head design rotates on three axes for a floating ride on media surface.

TAP TEST: Industry standard is a modest 25,000 to 30,000 impacts. QUME standard is an awesome 100,000 to 150,000 impacts.

CONTINUOUS CONTACT TEST: Industry standard is 3 to 3.6 million passes. Qume standard is 10 to 12 million passes.

ACCURACY: QUME drives have fewer seek/read errors due to improved head compliance to media surface.

Dysan, Verbatim, Memorex, BASF, Nashua, 3M, Wabash and CDC all use them to certify the two-sided floppy disks they manufacture.

Do they know something you don't?

They know our exclusive TriGimbal™ design heads glide smoothly over the surface of the disk instead of making the disk conform to the heads. We're proud of that, and it's a good example why Qume has installed more 8" double-sided floppy drives than any other manufacturer. For more information about the gentlest, most reliable drives on the market, call or write Qume Product Marketing (415) 942-4000, 2350 Qume Drive, San Jose, CA 95131.

Qume®
A Subsidiary of ITT

CIRCLE NO. 131 ON INQUIRY CARD

New Products

memories

Xylogics announces LSI-11/23 expansion module

The XL2300 single-module memory system includes the LSI-11/23 μp, a 20.8M-byte Winchester disk with RL02 emulation, a 17M-byte tape cartridge with TU10 emulation and as many as eight pre-wired RS232-compatible ports. The system is packaged in either a desk-top or rack-mount module. It also features 22-bit addressing, which enables users to configure systems with 96K to 4M bytes of memory. **Xylogics, Inc.,** 42 Third Ave., Burlington, Mass. 01803. **Circle No 288**

16K and 32K EPROM have 450-nsec. access times

The Am2716/Am9716 16K EPROMs feature 450-nsec. access times. A military version features an ambient-temperature specification of −55 to +125°C. The Am2732 32K UVEPROM has a 450-nsec. access time. The 16K EPROM is organized as 2048 words × 8 bits, and the 32K EPROM is organized as 4096 words × 8 bits. Both require a +5V power supply and are housed in 24-pin DIPs. Prices start at $14.70 and $17.60 for the 16K and 32K versions, respectively, in quantities of 100 or more. **Advanced Micro Devices Inc.,** 901 Thompson Pl., Sunnyvale, Calif. **Circle No 289**

micros

AMD unveils 6-MHz μps

The 6-MHz AmZ8001A and AmZ8002A μps perform a 16- × 16-bit signed multiply in 11.7 μsec. The units are screened to MIL-STD-883 specifications and are tested to meet or exceed INT-STD-123 requirements. Prices start at $99 for the AmZ8002A and $107 for the AmZ8001A in quantities of 100 or more. **Advanced Micro Devices Inc.,** 901 Thompson Pl., Sunnyvale, Calif. 94086.

Circle No 290

DDP MADE EASY WITH SPERRY UNIVAC MINICOMPUTERS.

When it comes to distributed data processing, Sperry Univac Minicomputers provide an ease of use and flexibility you can't find anywhere else.

Our V77 minicomputer family takes the worry out of DDP – because we offer a unique variety of configurations fitting virtually any DDP environment you may have. Letting you retain central control. And putting problem-solving tools where the problems are.

Take it a step at a time for gradual controlled growth. And you don't have to be planning a large system. When your mainframe needs upgrading, the lower cost of our V77s can reduce the load on the main system, or handle separate functions. And V77s as communication processors can significantly reduce your remote terminal communications costs.

Our V77 minicomputers are designed to integrate with most mainframe systems installed today. Including IBM, Sperry Univac, and others.

We provide interconnection schemes compatible with virtually all network architectures, including the SPERRY UNIVAC Distributed Communication Architecture (DCA). What's more, we even provide you with an interconnection scheme to public data networks (X.25).

We're not new to DDP. The fact is, our V77 systems are based on technology which was providing DDP solutions long before the term was even used. So you're not taking chances.

Would you expect anything less from a division of the $4 billion Sperry Corporation? After all, as the first ones in the computer business, we've a reputation to uphold. That's why we have over 10,000 field engineers worldwide, servicing equipment whenever and wherever it needs attention.

So if you're considering DDP, call us at Sperry Univac Mini-Computer Operations. We'll listen. And then we'll tell you all about how safe a buy our DDP solution is. After all, we don't want you taking any unnecessary risks.

For more information, write to us at Sperry Univac Mini-Computer Operations, 17900 Von Karman Avenue, Irvine, CA 92714.

In Europe, write to Mini-Computer Operations, International Division Headquarters, London NW10 8LS, England.

Or call toll-free **800/854-7517** *(8:00 a.m. to 4:30 p.m. PST). In California, call 714/557-9398 collect.*

SPERRY UNIVAC

The Computer People Who Listen.

CIRCLE NO. 134 ON INQUIRY CARD

New Products

micros

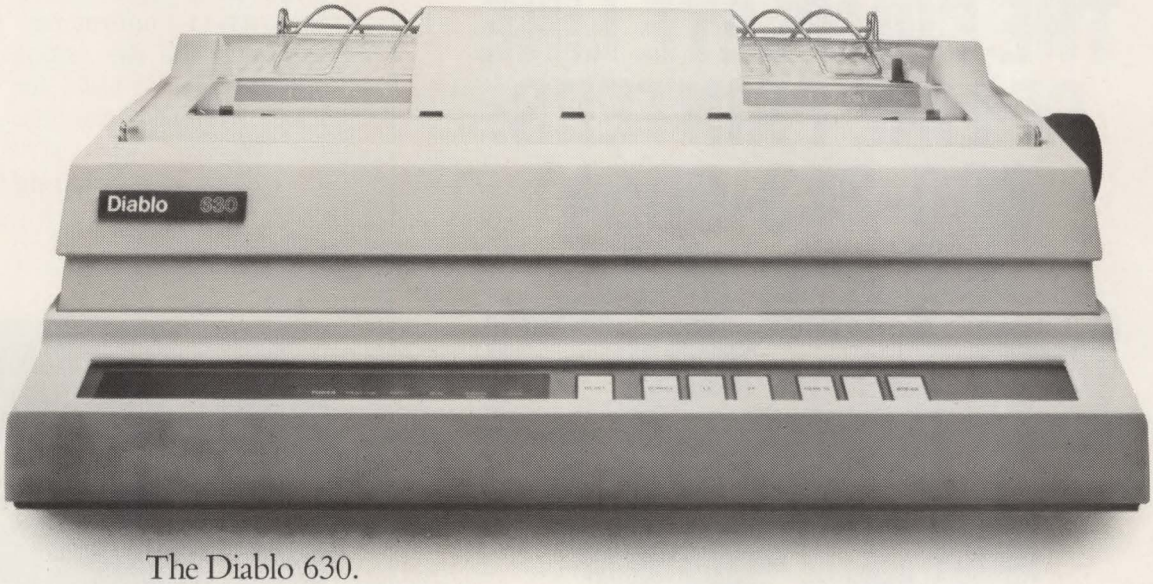
TRW announces 16-bit μc

The Affinity 16 μc operates stand-alone, on-line to a central computer or in a network environment and performs batch, on-line or distributed-processing applications. The CPU includes a 16-bit μp and 128K bytes of memory. Two minifloppy disks can record 320K on two dual-sided, double-density disks. As much as 2.5M bytes of auxiliary disk storage is available with an 8-in. floppy-disk drive. In batch or on-line network environment, the unit communicates with a host computer as a transaction pre-processor or performs data entry, transmission and report-printing functions. For distributed-processing, foreground and background user partitions can run as many as 256 tasks. An overlay function increases main storage capacity by bringing program subroutines into a main storage area from floppy disks, and deleting them after use. Prices are $6000 to $10,000, depending on configurations and quantities ordered. **The TRW-Fujitsu Co.,** 9841 Airport Blvd., Suite 620, Los Angeles, Calif. 90045. **Circle No 291**

Quay unveils 8-bit μc

The 90MPS Z80 8-bit single-board μc includes as much as 65K bytes of dynamic RAM, as much as 14K bytes

If you want a choice in print wheels, here's the first choice in printers.



The Diablo 630.

It's the first one that lets your customers use either metal or plastic print wheels. Which means they can choose the print wheel that's just right for the job.

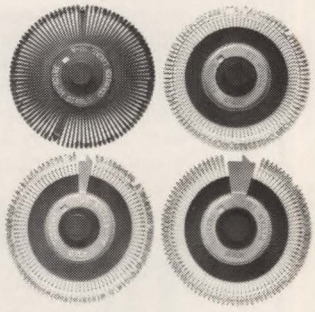
The 630 works as well with a 96-character plastic daisy print wheel as it does with an 88-, 92-, or 96-character metal daisy print wheel. In over 100 different type styles.

Every 630 has a fully strappable power supply. It's as easy to use in Paris, Kentucky as it is in Paris, France. So you only need to stock one printer for international and domestic markets.

It has fewer moving parts than competitive printers, which makes it more reliable. And it offers unsurpassed print quality. Compatibility with Diablo supplies. And bi-directional printing capability.

Once your customers hear they can change their print wheels, they're going to be changing their printers.

To Diablo 630 printers.



Diablo Systems

XEROX

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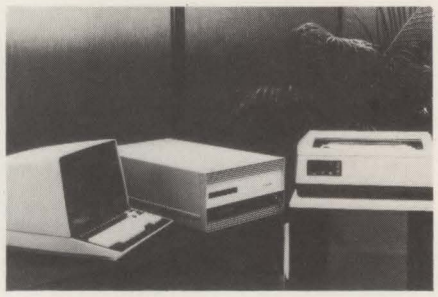
CIRCLE NO. 136 ON INQUIRY CARD

micros

of UVEPROM with programmer, 1K byte of static RAM, as many as eight 8-bit programmable I/O ports, four counter/timer channels, as many as three serial ports, 2.5-MHz or 4-MHz operation and a PROM-resident system monitor. The unit also includes a floppy-disk controller with DMA-based disk-access data scanning, multi-track transfers and optional CP/M disk operating system. **Quay Corp.,** P.O. Box 783, 527 Industrial Way W., Eatontown, N.J. 07724. **Circle No 292**

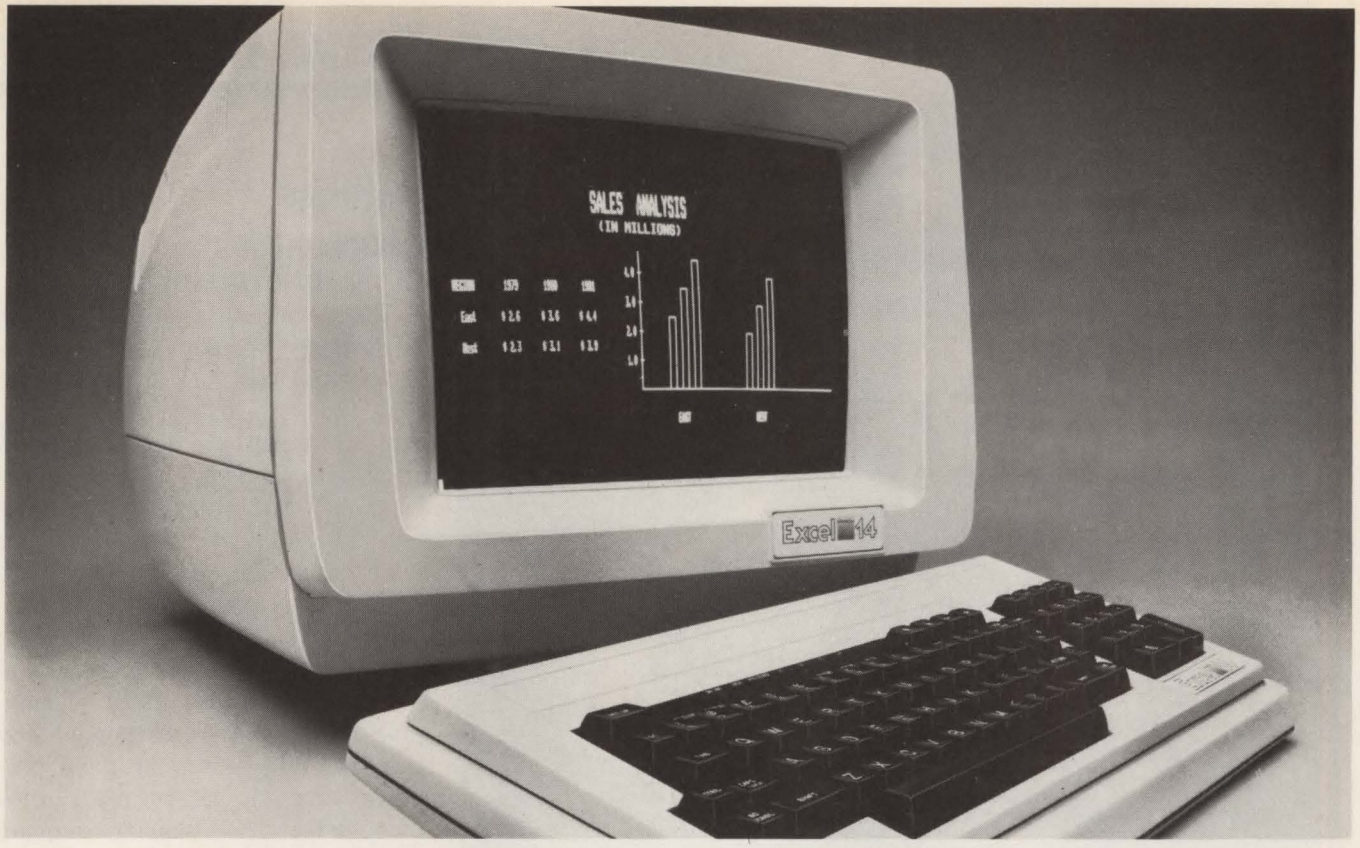
EEC offers PDP-11/23-based μc

The PDP-11/23-based Micropower-W provides multi-user word processing and data processing. The word-processing package includes custom menus, calculator and data base-management facilities. The unit supports as many as five users with 256K bytes of memory, 8M bytes of disk space using a Winchester-floppy-disk combination, a VT-100 terminal, a letter-quality printer, the RT-11 operating system, TXS-PLUS and the LEX-11 processing package. It sells for $27,600. **EEC Systems,** 286 Boston Post Rd., Wayland, Mass. 01778. **Circle No 293**



Mercator unveils business system

The MBS3000 16-bit μp processor system, which is compatible with Basic Four systems, includes 64K bytes of RAM expandable to 500K bytes. Memory storage is provided by 10M- or 20M-byte, 8-in. Winchester disks, with tape-cartridge backup. An optional SDLC port enables communication with remote host computers or compatible devices. Software packages include general ledger, accounts payable and receivable, inventory, job-costing, payroll and order processing. Prices are $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 294**



NOW PICK JUST THE 132-COLUMN PERFORMANCE YOU NEED.

Choose from our popularly priced Excel 32 to our big screen Excel 14.

All eight Excel models feature superior ergonomics like tiltable displays, non-glare screens, and detachable keyboards with familiar typewriter response.

Standard performance features include bi-directional smooth or jump scrolling, split screen/regional scroll, double-high/wide and double-high characters, keyboard selected set-up parameters and CRT Saver. Plus you get a 128 character set that includes special graphic symbols displayed across either 80 or 132 columns. Various Excel models also emulate many popular terminals and all are designed for high-speed interactive communications.

The new Excel terminals from Datamedia are proven products in advanced ergonomic packages. And they've got what the 132-column market has needed for a long time — Selection. Find out how the smarter terminal maker will make you a smarter terminal buyer. Call (609) 665-5400. Use the handy coupon or write: Datamedia Corporation, 7401 Central Highway, Pennsauken, NJ 08109.

DATAMEDIA

Eight Excel terminals to choose from.

☐ **EXCEL 12**
- VT100™, VT52™ Compatible
- Advanced Video Option
- Enhanced Printer Port
- 12" Screen

☐ **EXCEL 14**
- VT100, VT52 Compatible
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- 14" Screen

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- "Software Saver" — emulates Datamedia 1521, ADM™3A, Regent™25, and Hazeltine™1420.
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☐ **EXCEL 34**
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- 14" Screen

☐ Please call to arrange a demo.

☐ Please send product information.

Return to: Datamedia Corporation, 7401 Central Highway, Pennsauken, NJ 08109 (609) 665-5400.

Name _____

Company _____ Title _____

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Phone _____

From the smarter terminal maker.

*VT100, VT52 are registered trademarks of Digital Equipment Corporation; ADM3A is a registered trademark of Lear Siegler, Inc. Regent 25 is a registered trademark of Applied Digital Data Systems. Hazeltine 1420 is a registered trademark of Hazeltine Corporation.

CIRCLE NO. 138 ON INQUIRY CARD

New Products

micros

CSSN unveils three μc systems

These three μps use the vendor's proprietary version of a CP/M-compatible hard-disk operating system, the Z80 μp, a 64K-byte RAM, 10M- to 169M-byte disk drives, a 134M-byte cartridge-tape drive and controller that interfaces as many as four drives and an IEEE S-100 bus with slots for expansion. The System 1010 μc system includes a 10M-byte disk drive, the Stretch 1000 includes as much as 1M byte of RAM and hardware memory mapping for data base management, and the multiprocessor MP-1000 provides as many as 16 users with independent μps, sharing common disk storage. System 1010 sells for $10,900, Stretch 1000 and the MP-1000 sell for less than $15,000 each, with OEM discounts available. **CSSN, Inc.,** 120 Boylston St., Boston, Mass. 02116.

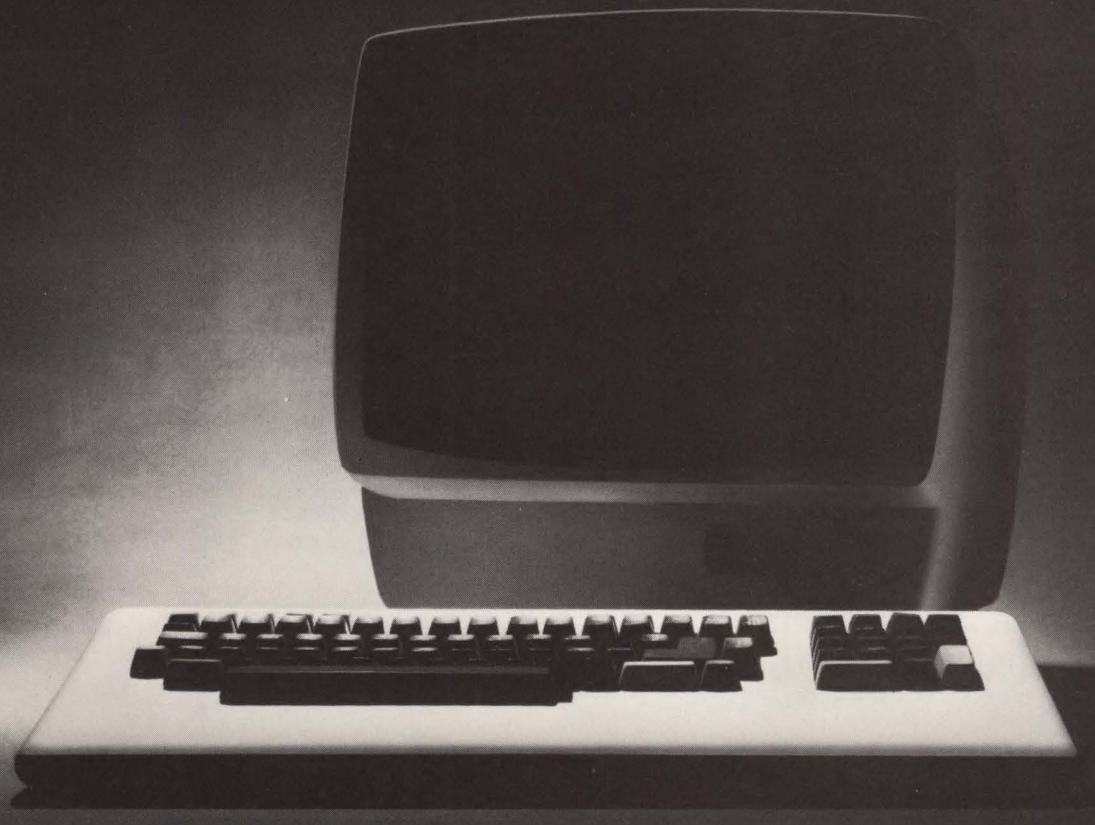
Circle No 295

Datapoint announces OEM μp

The model 2150 Z80-based dispersed data processor for OEMs supports the vendor's DATABUS business programming language, FORTRAN, BASICplus, word-processing and electronic-message services. The unit provides 32K, 64K or 96K bytes of memory on 8-in. floppy-disk drives or hard-disk drives. Dual-diskette modules are available in single-sided, single-density or double-sided, double-density versions, providing a .5M- or 2M-byte system. Price for a 32K-byte system with a .5M-byte disk system is $7075, and $9075 for a 2M-byte version. Prices for 64K-byte system with a hard-disk drive range from $18,250 to $18,750, with OEM discounts available. **Datapoint Corp.,** 9725 Datapoint Dr., San Antonio, Texas 78284.

Circle No 296

THE PERFECT DATA GENERAL D200 EMULATOR



The **Log 200** is Emulog's best user oriented terminal yet.

The **Log 200** is completely compatible with the D200 and the DG6053. It comes standard with features like Reverse Video, Detached Keyboard, Sculptured Keycaps and Adjustable Monitor Tilt.

Best of all the **Log 200** is priced **35% less** than the D200. Even better pricing is available in large quantities.

Call us today at **415-490-1290** for more information on the **Log 200**.

"The Great American Copy Cat."

EMULOG

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FREMONT, CA. 94538
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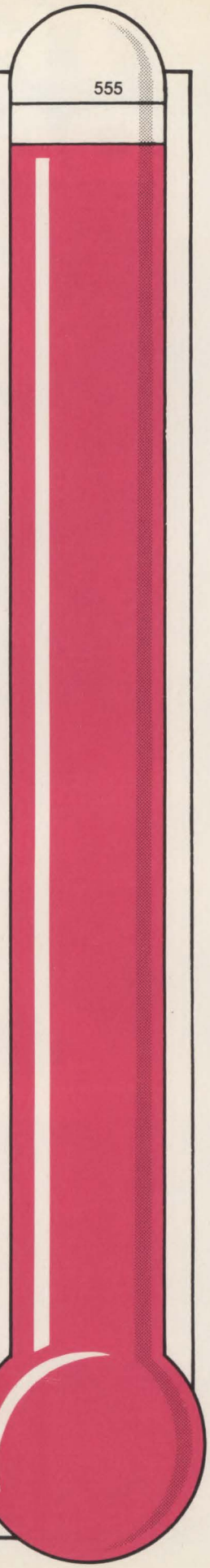
Leasing and service nationwide through General Electronic Instrumentation and Communication Equipment Service Departments.

CIRCLE NO. 140 ON INQUIRY CARD



COMDEX roster now at ~~529!~~ 540!

Will COMDEX break NCC's record? NCC '81 had 555 exhibitors.

You remember NCC '81 at McCormick Place in Chicago. Those huge, multiple exhibit floors presented hands-on displays from 555 computer-related companies. That was an all-time record for computer industry trade shows.

Now COMDEX, in only its third year, is threatening to eclipse that NCC record. More than 520 computer-related companies have already signed to exhibit in over 1,600 booths at Las Vegas Convention Center, November 19-22. And there's still a few weeks left for additional companies to get on board!

Size Without Sightseers

But if COMDEX and NCC are now roughly comparable in the number of exhibitors each can boast, **there remains one very significant difference:** COMDEX will not have tens of thousands of attendees who are students, or businessmen on their lunch hours, or computer hobbyists. **The COMDEX audience is limited to qualified ISOs (Independent Sales Organizations)!**

COMDEX '81 -- A very big show indeed, possibly even a record breaker for the computer industry. But the atmosphere WON'T be "zooey." Rather, it will be conducive to the serious negotiations so necessary to move an avalanche of computer related products.

There's still time to be an exhibitor. And there's plenty of time to pre-register as an attendee. Call us today!

COMDEX'81™

November 19-22, 1981
Las Vegas Convention Center

For further information, write to COMDEX '81,
160 Speen Street, Framingham, MA 01701.
Or call us toll-free: 800-225-4620 (in Mass., 617-879-4502).

Another Conference and Exposition from THE INTERFACE GROUP
Producers of: INTERFACE, FEDERAL DP EXPO, COMDEX, COMDEX/SPRING,
THE COMPUTER SHOWCASE EXPOSITIONS

Give your Q-BUS the UNIBUS award.

There's a definite place for the Q-BUS. Some applications are right on target, but if yours has even a slight chance of expanding upward, we want you back on the UNIBUS. That's where the action is, and that's where you belong. We can get you there, too. Quick and easy, with two highly effective add-ins.

QNIVERTER™, our exclusive Q-BUS to UNIBUS or UNIBUS to Q-BUS converter, opens the wonders of the UNIBUS world to PDP-11/23 and LSI-11 users. Completely contained on a single quad-width board, QNIVERTER™ plugs into the LSI-11, LSI-11/23, PDP-11/03 or PDP-11/23 and allows UNIBUS compatible controllers to be used with LSI computer systems or LSI based peripherals to be used with PDP-11 systems.

Our companion add-in, the ABLE BUSLINK, installs in any LSI-11 or PDP-11 and provides UNIBUS to UNIBUS, UNIBUS to Q-BUS or Q-BUS to Q-BUS link. ABLE BUSLINKS deliver in pairs of hex-width, hex/quad-width or quad-width boards. They provide full DA11-B compatibility, operate at DA11-B transfer rates up to fifty feet and are software compatible with the existing and proven DA11 driver.

QNIVERTER™ and the ABLE BUSLINK are designed exclusively for use in LSI-11 and PDP-11 computers. Just like the rest of our line, they cost less but do more than the products they are intended to replace. To find out more about them, call or write for details. We'll include information on our complete line of UNIBUS compatible general-purpose, special-memory and data-communications products as well as the MAGNUM™ Series of computer systems.

ABLE

the computer experts

ABLE COMPUTER, 1732 Reynolds Avenue, Irvine, California 92714. (714) 979-7030. TWX 910-595-1729 ACT IRIN.

ABLE COMPUTER-EUROPE, 74/76 Northbrook Street, Newbury, Berkshire, England RG13 1AE. (0635) 32125. TELEX 848507 HJULPHG.

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CIRCLE NO. 156 ON INQUIRY CARD

See Able products, COMPAT '81, San Francisco

New Software

STSC announces language processor for VAX

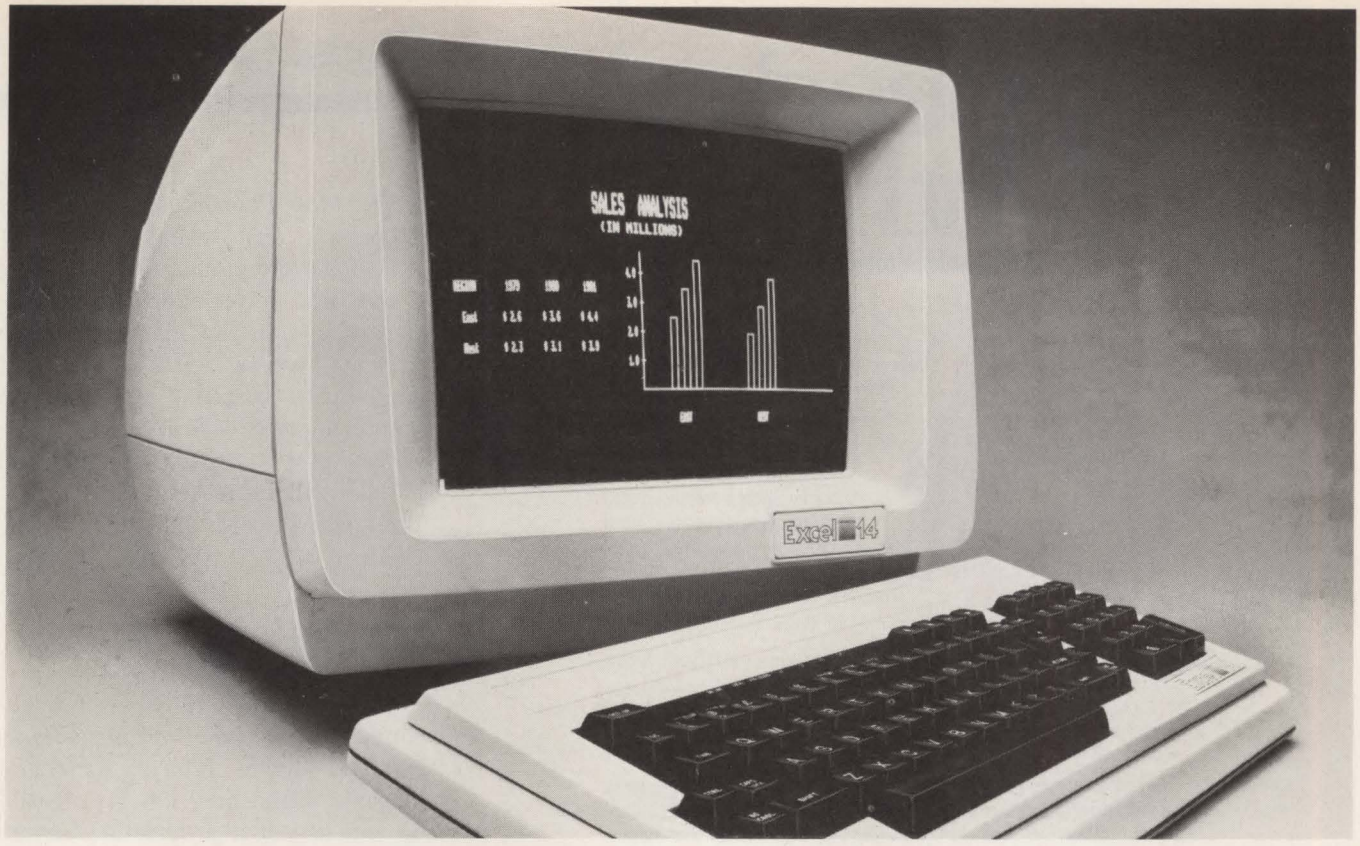
APL*PLUS/2000 runs on the DEC VAX-11/780 and VAX-11/750 computers. Features include a formatting function that combines FORTRAN notation and COBOL picture editing; a range of system functions and variables that control the application environment and allow efficient use of virtual workspaces; an exception-handling facility that automates and expands an APL program's ability to react to errors and exceptions that can occur during program execution; a file system that allows users to store, retrieve, share and update data; utilities that aid in the readability and maintainability of source code; and a full-screen editor. **STSC Inc.,** 7316 Wisconsin Ave., Bethesda, Md. 20014. **Circle No .304**

Package enables users to maintain mailing list

Post-Haste, running on UCSD Pascal and Pascal MT+ systems, allows users to make and maintain a mailing list and to produce lists and labels of selected records. Features include sort capability using as many as six fields and menu-driven input. Each record contains three address lines, city, state and zip and a 50-character miscellaneous field. Records are fetched by a whole name or part of it. The package on 8-in. single-density or 5¼-in. Apple II floppy disks sells for $149. **C.J. Wigglesworth Software,** P.O. Box 755 Cardiff, Calif. 92007.
Circle No 305

Elliam announces CP/M-status program

When recovering an ERAsed CP/M disk file that has been overwritten, more than one file could occupy a given disk area; by UNERAsing one file another file may be ruined. The Conflict program goes through the



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DATAMEDIA

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- Enhanced Printer Port
- 12" Screen

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☐ Please call to arrange a demo.
☐ Please send product information.

Return to: Datamedia Corporation, 7401 Central Highway, Pennsauken, NJ 08109 (609) 665-5400.

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Company _____ Title _____

Address _____

City _____ State ____ Zip _____

Phone _____

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CIRCLE NO. 143 ON INQUIRY CARD

New Software

directory and reports to the console or printer any conflicts that may exist for a given disk space, among erased and active files, and identifies the conflicting files. The package works with multi- and single-disk systems that use a standard CP/M disk directory. Price is $35, plus $1.50 for shipping and handling. **Elliam Associates,** 24000 Bessemer Street, Woodland Hills, Calif. 91367. **Circle No 306**

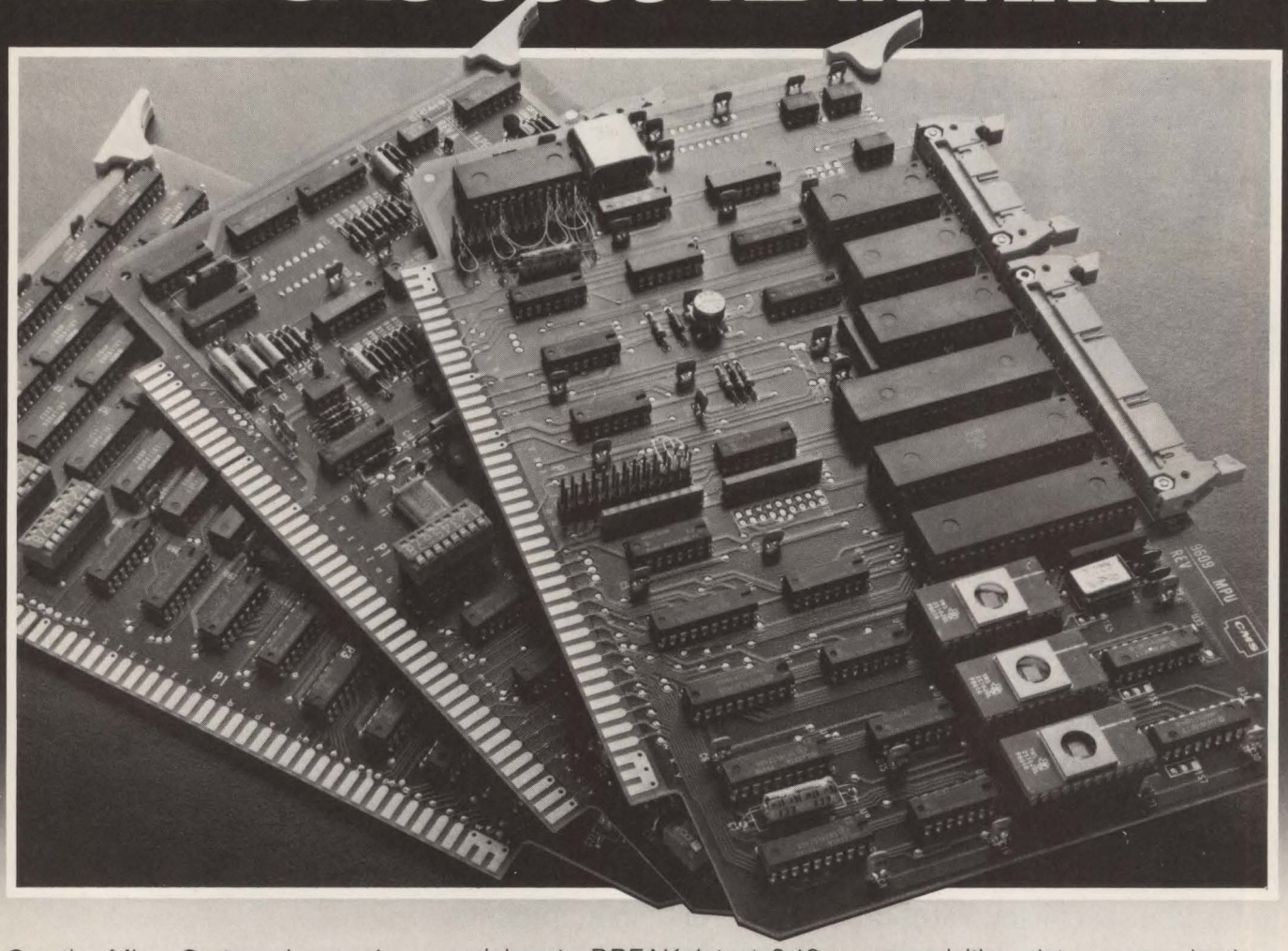
Telesystems unveils conversion service

This assembly-language software-conversion service for minicomputers and μcs is offered for many languages and dialects. It is based on the use of a proprietary macro processor. A range of services is provided from clean assembly/compilation to full optimization. Conversion libraries have been developed for the DG Nova, Intel 8080, Z80, Z8000, HP 1000 and DEC PDP-11 family. The package is intended to reduce the time and cost required to re-host proven software, despite language incompatibilities. **Telesystems, Inc.,** 4607 Briar Patch Ct., Fairfax, Va. 22032.
Circle No 307

Pegasus announces BASIC compiler for OSI

FBASIC, running in 48K bytes of memory under the OS-65D3 operating system, is an integer subset of OSI/Microsoft BASIC. The package produces stand-alone, 6502 machine-code modules. Features include user-definable array locations, WHILE loops, GOTOs and GOSUBs to absolute addresses and direct access to registers. Compiled modules can be linked to the OSI interpreter. The disk-based compiler can produce programs larger than available memory. The package is available on 8-in. floppy disks for $155. **Pegasus Software,** P.O. Box 10014, Honolulu, Hawaii 96816.
Circle No 308

COMPARE
THE CMS 6809 ADVANTAGE



Creative Micro Systems is proud of its line of general purpose microprocessor support modules. These M6800/M6809 based modules are pin and outline compatible with the industry standard EXORciser* and Micromodule* bus.

COMPARE THE CHOICE

That's why we want you to compare our products with the competition before you design your next microprocessor based system.

Each module in our product line is designed to respond to the needs of a major computer system function. Our 9609 module, featured above, is a complete microcomputer on a single board. It features the MC6809 processor, 6K of EPROM, 1K of RAM, 40 parallel I/O lines, 2 RS-232C serial ports, BREAK detect, 3 16-bit programmable timers, priority interrupt vector generator and a power failure protect/restart circuit.

*Trademark of Motorola

For more extensive system requirements, the 9609 is supported by a variety of Memory, I/O, and Data Acquisition modules, and a broad line of card cages, power supplies, mother boards, prototype boards and accessories.

THE OEM ADVANTAGE

Try to find another set of microprocessor modules in the same price and quality range with all the positive features Creative Micro Systems has to offer.

Original Equipment Manufacturers who compared our products have specified Creative Micro Systems for applications in data acquisition, data communication and encryption, materials testing, automatic test equipment, process control, energy management systems, agricultural instrumentation and small business data processing systems.

WANT MORE TO COMPARE

Once you compare you'll agree Creative Micro Systems has more to offer your application. Write or call for our new product catalog. We'll also be happy to tell you about our exciting new products in development now.

CMS

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Find us in the 1981 IC Master Catalog on pages 1160-1161.

CIRCLE NO. 146 ON INQUIRY CARD

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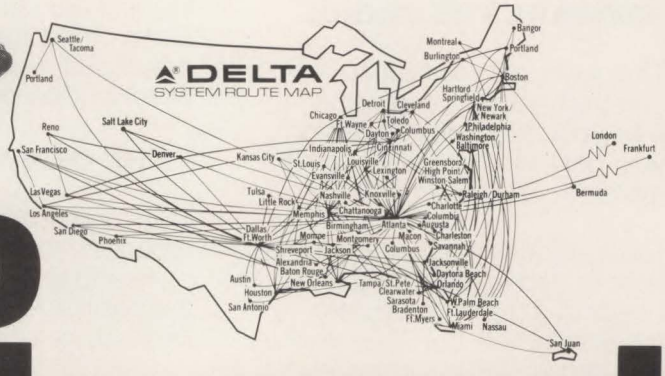

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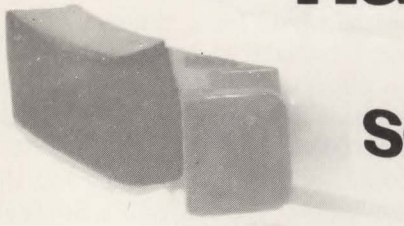

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Rational Data Systems 205 East 42 Street New York City 10017 212/697-5855 TWX 710-581-6016

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Lease-accounting system maintains files

LEASING, intended for companies that deal in equipment leases, maintains files concerning lessees, leases, assignees and vendors. It generates bills for payments due, processes payments received from lessees and prepares vouchers for authorizing payments to vendors and assignees. It also provides the capability for assessing late charges. The system, written in COBOL, runs on DG commercial systems, Vector Graphic or Z80-based computers with CP/M and CIS COBOL, Microsoft COBOL-80 or Ryan McFarland COBOL. Price is $3500. **COM Business Computer Systems, Inc.,** 551 E. Genesee St., Fayetteville, N.Y. 13066. **Circle No 309**

Mini-Micro Systems *receives dozens of news releases each week about new software products that may not warrant the detail included in the foregoing New Software section. Nevertheless, we don't want to deny readers the opportunity to get more information about the latest software developments. Toward that end, we offer the following brief entries, compiled and edited by Malcolm L. Stiefel, contributing editor.*

OPERATING SYSTEMS. Lexidata Corp., Billerica, Mass., announces a graphics operating system for the System 3400. **Circle 384...Optimized Systems Software,** Cupertino, Calif., offers an operating system and command processor along with a BASIC interpreter for Atari computers. **Circle 385...Silverman Associates,** Oakland, Calif., unveils the Northshare multi-user OS (update) for the North Star Horizon. **Circle 386.**

SOFTWARE DEVELOPMENT TOOLS. Allen Ashley, Pasadena, Calif., has a new assembly-language development system for the Radio Shack TRS-80 model III. **Circle 387...Leeco, Inc.,** Winston-Salem, N.C., introduces a business BASIC development system for the DG Nova or Eclipse under RDOS. **Circle 388...SDA,** New York, provides a COBOL program generator for the H-P 3000. **Circle 389...Softech Microsystems, Inc.,** San Diego, announces a UCSD μc development system for the TI 99/4 home computer. **Circle 390...Softool Corp.,** Goleta, Calif., offers a software-management, development and maintenance package for SEL, DEC, DG and IBM systems. **Circle 383**

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  - Byte manipulation (high, low, swap)
  - Imbedded assembly language
  - Easy linkage to external assembly language
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  - Fast floating point, both software and AMD 9511
  - Accurate 18 digit BCD (fixed point, 14,4)
  - Include files
  - Hex literal numbers
  - And more...

Linker

- Combines relocatable modules into executable files
- Can generate Hex format for use with PROM programming

Interactive Symbolic Debugger

- Variable display
- High-level breakpoints by procedure/function name
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- Procedure/function entry and exit trace available

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Guide describes μc software

A line of μc software is listed in a buyer's guide. The 35-page catalog covers more than 50 media formats, CP/M-compatible disk operating systems, hard-disk integration modules, system tools, telecommunications, languages, language and application tools, word-processing systems and aids. The guide also details data-management systems, general-purpose applications, mail-list systems, financial-accounting packages, numerical problem-solving tools, professional and office aids, books, periodicals and accessories. **Lifeboat Associates,** 1651 Third Ave., New York, N.Y. 10028.

Circle No 310

Booklet covers dynamic IC tester

The Thalamus 1 dynamic in-circuit digital IC tester is described in a pamphlet. The brochure details the system's alphanumeric display, signal monitor, audio, RS232C port and keyboard. The publication also details modes of operation, applications, specifications and system components. **Thalamus Electronics Inc.,** 1885 Sismet Rd., Unit 1, Mississauga, Ontario, Canada.

Circle No 311

Bulletin features breadboarding products

A line of μc prototyping boards, breadboarding supplies and packaging equipment is detailed in a brochure. The 28-page catalog describes perforated boards, enclosures, card cages, wire-wrapping tools, terminals, sockets, receptacles and etched-circuit kits. The illustrated brochure also includes ordering information. **Vector Electronic Co., Inc.,** 12460 Gladstone Ave., Sylmar, Calif. 91342.

Circle No 312

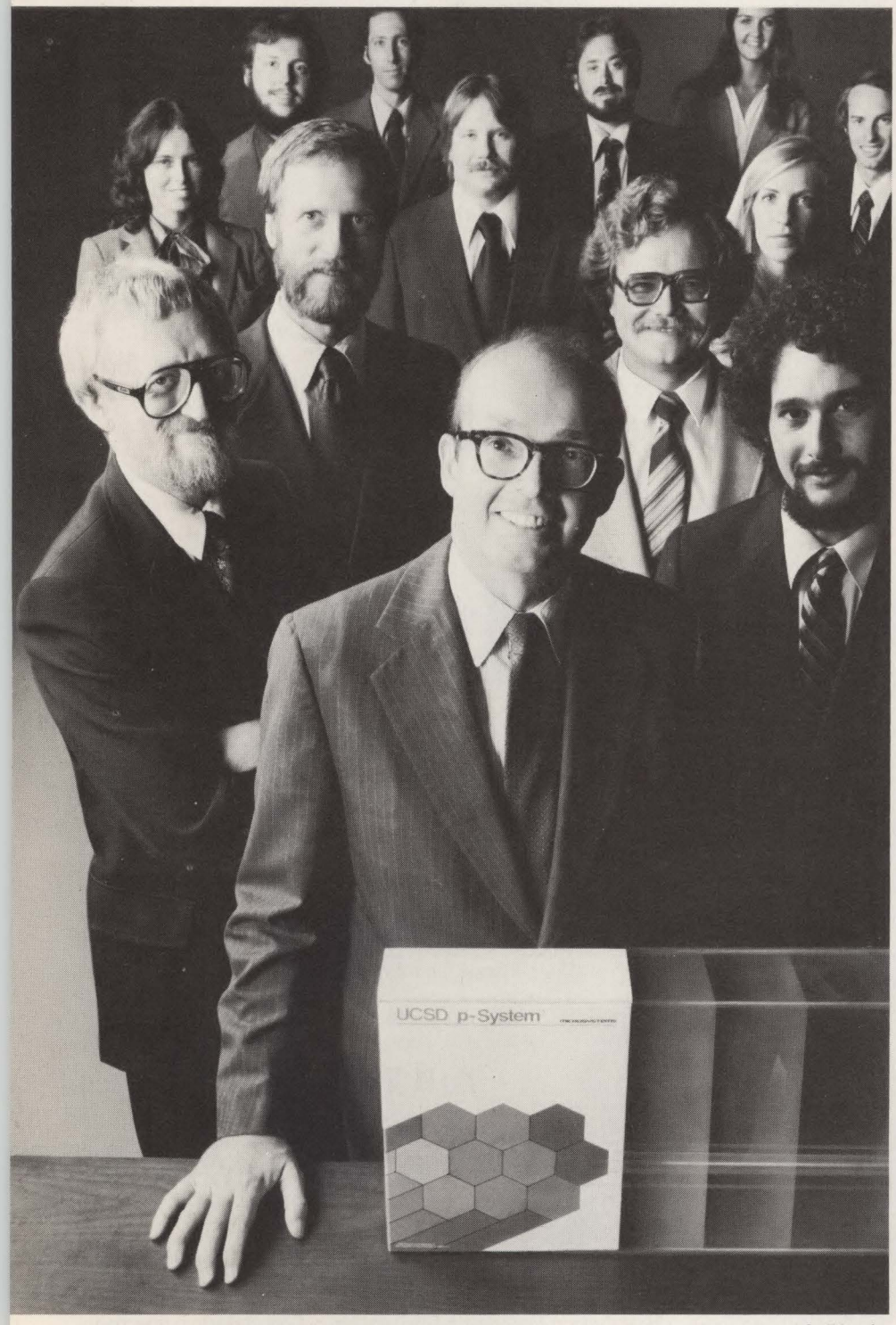
Directory features software products

A line of applications software and language compilers is detailed in a software directory. The 90-page publication includes CAD/CAM and graphics packages; RAPPORT relational data base management system; FORESIGHT, a financial-planning and -reporting package; and NISA, a computer-aided design program for structural analysis. **Harris Corp.,** 2101 West Cypress Creek Rd., Fort Lauderdale, Fla. 33309.

Circle No 313

"OUR NEWEST DEVELOPMENT IN THE CONTINUING EXPANSION OF THE UCSD p-SYSTEM™ SOFTWARE. VERSION IV."

JOHN BRACKETT, President, SofTech Microsystems



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CIRCLE NO. 151 ON INQUIRY CARD

New Literature

Booklet examines Multibus products

A line of Multibus-compatible products is detailed in a catalog. The 56-page booklet includes OEM-oriented μc board-level products, mass-memory subsystems, a Multibus display, tracer and analyzer, EPROM programmer and prototyping cards. The catalog lists applications, prices, ordering information, photos and diagrams. **Zendex Corp.,** 6680 Sierra Lane, Dublin, Calif. 94566. **Circle No 314**

Publications present banking modems

The TABS total automatic-banking-system modems are detailed in a series of data sheets. The bulletins describe the DB 1200 and DB 2400 private-line/dial modems and the DI 1200 internal modem. The publications also detail installation, controls and indicators, test capabilities and enclosures. **Diebold Inc.,** Canton, Ohio. 44711.

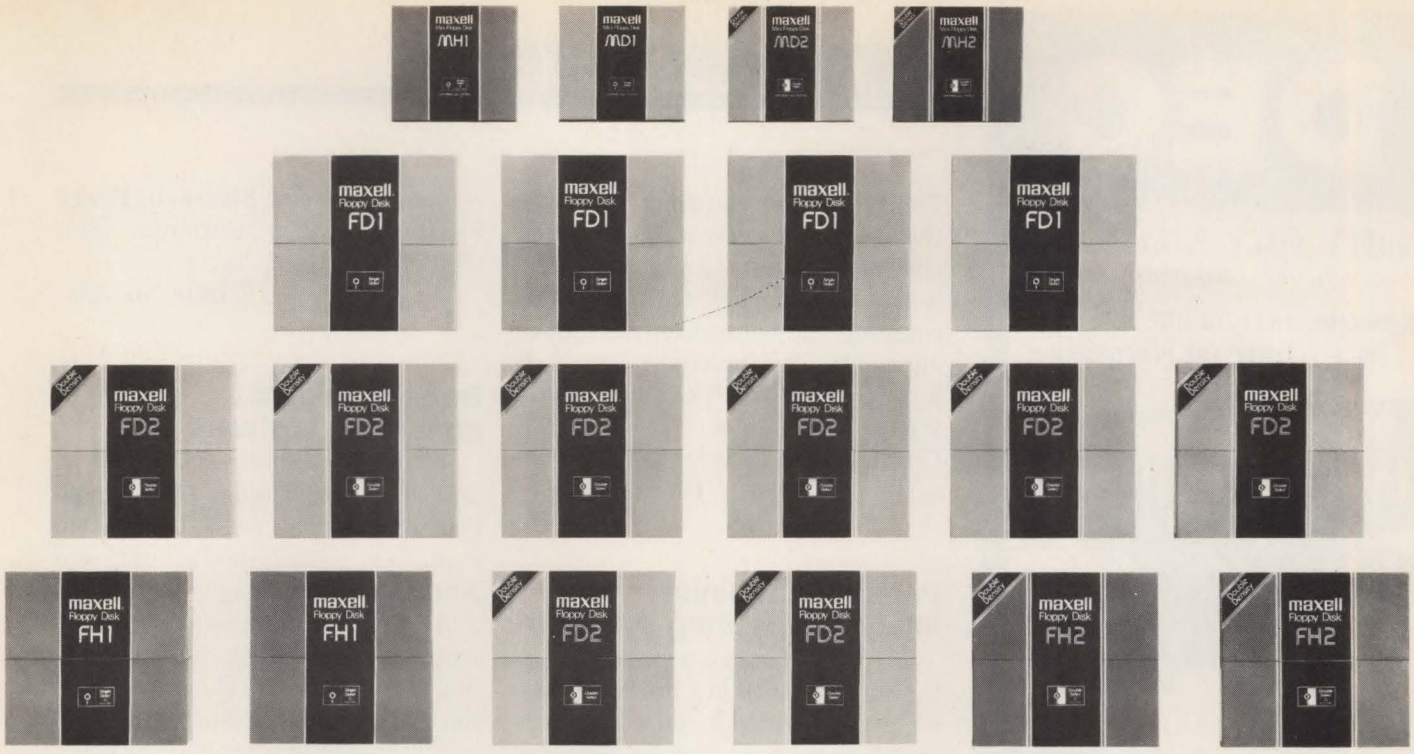
Circle No 315

Pamphlet discusses VLSI components

A line of digital signal-processing VLSI components is detailed in a catalog. The four-page publication details multipliers and multiplier-accumulators, high-speed A/D and D/A converters, digital correlators and shift registers. The catalog also lists word sizes and power and conversion rates. **TRW LSI Products,** P.O. Box 2472, La Jolla, Calif. 92038. **Circle No 316**

Pamphlet features MIS terminal

The IM3 management-information system is detailed in a brochure.



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CIRCLE NO. 154 ON INQUIRY CARD

New Literature

The illustrated pamphlet describes the system's process monitoring, automatic quality control, production management, down-time accounting and centralized data management. The brochure also lists applications. **Hunkar Laboratories, Inc.,** 7007 Valley Ave., Cincinnati, Ohio 45244.

Circle No 317

Pamphlet outlines image-processing systems

The IP6400 image-processing systems are detailed in a brochure. The six-page pamphlet describes the systems' memory management and data control, master timing unit, memory control unit and refresh memory. The brochure also provides diagrams and information on options, software, applications and specifications. **DeAnza Systems, Inc.,** 118 Charcot Ave., San Jose, Calif. 95131. **Circle No 318**

Catalog presents relay products

A line of relay products is detailed in a catalog. The 125-page booklet describes sealed, power, mercury-wetted and programmable-time-delay relays and cycle timers. The catalog also lists relay applications and contact selections. **Midland-Ross Corp.,** 1650 Tower Blvd., N. Mankato, Minn. 56001.

Circle No 319

Booklet examines EMI emission rules

FCC regulations governing EMI emission rules for computer device manufacturers are detailed in a booklet. The eight-page publication covers the devices affected, restrictions, filing and effective ruling dates, rule enforcement and penalties, EMI emission levels and cost trade-offs on EMI suppression. The booklet also provides tables and reference sources. **Sierracin/Power Systems,** 20500 Plummer St., Chatsworth, Calif. 91311.

Circle No 320

Booklet details consumer software

A line of software packages is described in a catalog. The 36-page booklet details BASIC-80, BASIC compiler, COBOL-80 M/Sort and FORTRAN-80 languages; SoftCard and RAMcard hardware; utility software; and TRS-80 muMatch and muLisp/muStar-80. The catalog also lists applications, specifications, requirements and product formats. **Microsoft Consumer Products,** 400 108th Ave. N.E., Suite 200 Bellevue, Wash. 98004.

Circle No 321

Publication lists data-comm products

A line of data-communication products is detailed in a catalog. The 35-page publication covers the Hawk 4000 series data traps; data test sets; EIA, telephone-line patch, monitor and switching modules; data-interface cables; error-detection devices; interface monitors; and breakout panels. The catalog also describes the model 65/60 bit-error-rate tester and EIA breakout panel. **International Data Sciences, Inc.,** 7 Wellington Rd., Lincoln, R.I. 02865. **Circle No 322**

Publication features μc modules

A line of CMOS μc systems is detailed in a booklet. The 16-page publication describes memories, digital I/O expansion modules, video-audio-keyboard interface modules and A/D and D/A converters. The booklet also covers high-level languages, chassis and accessories. **RCA Solid State Division,** Box 3200, Somerville, N.J. 08876. **Circle No 323**

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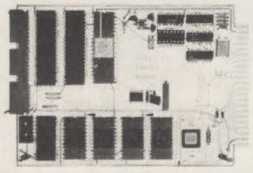

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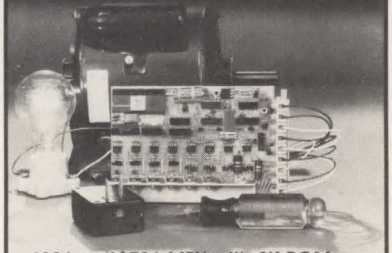

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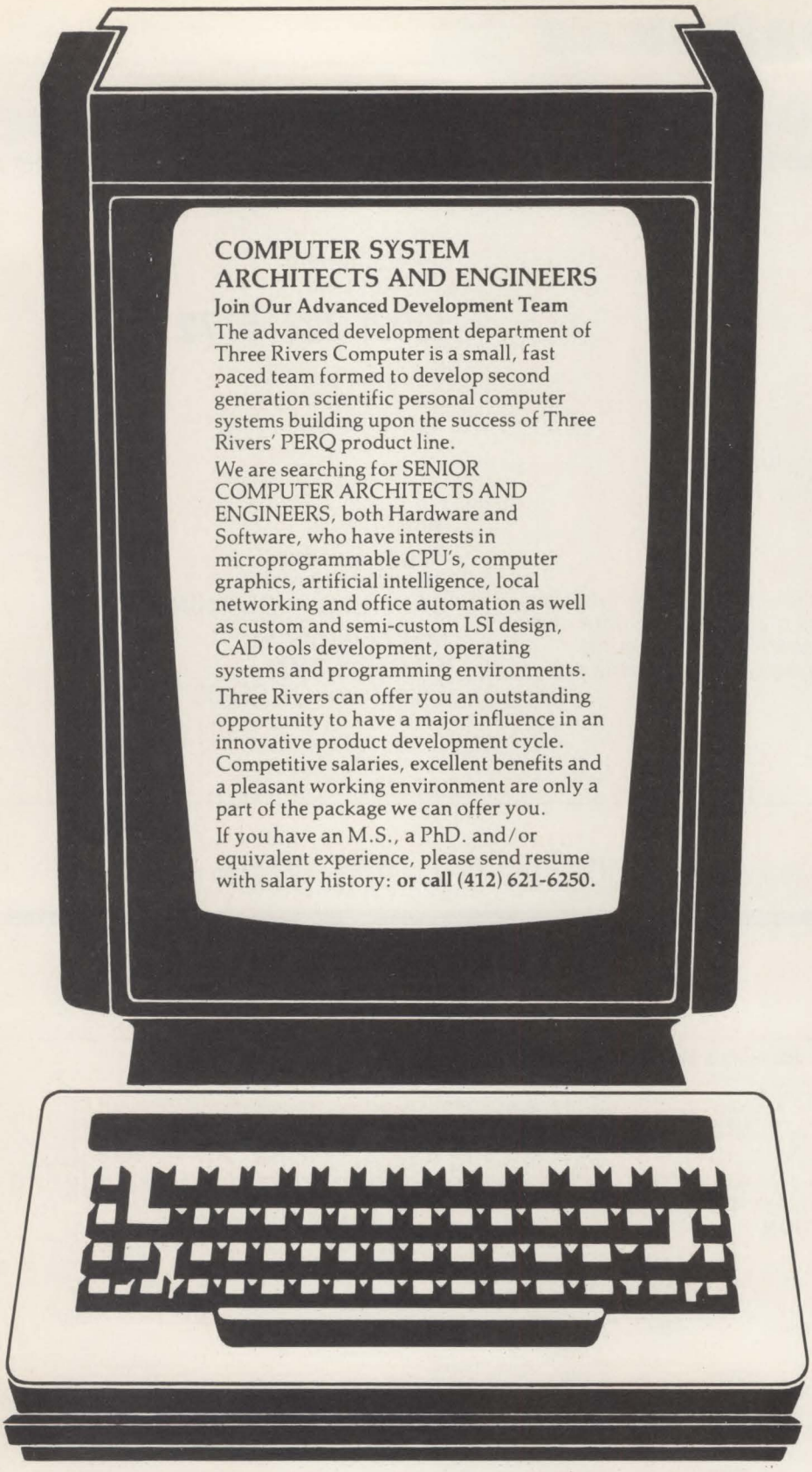

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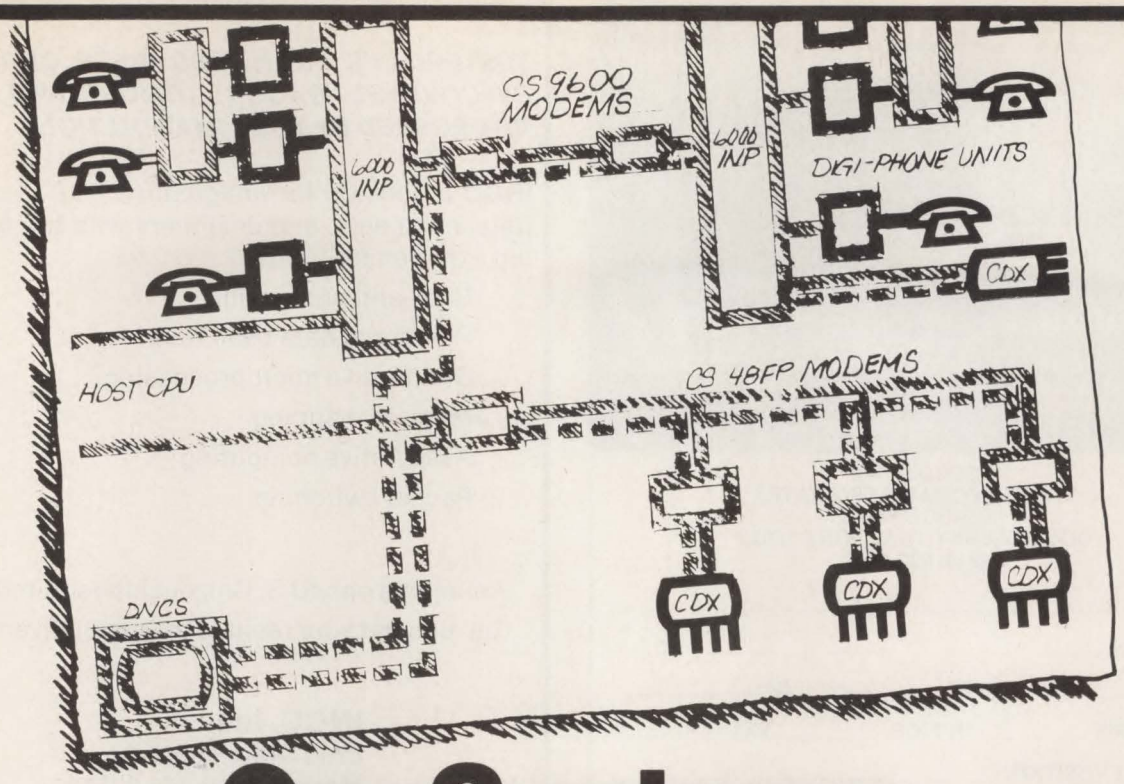

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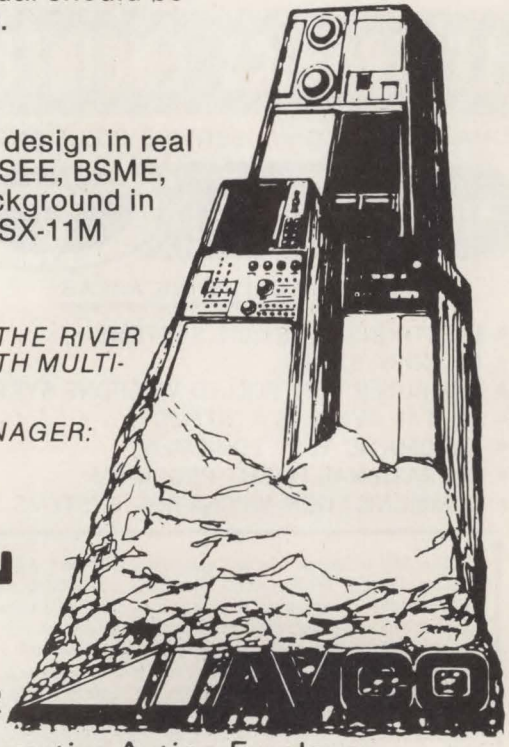

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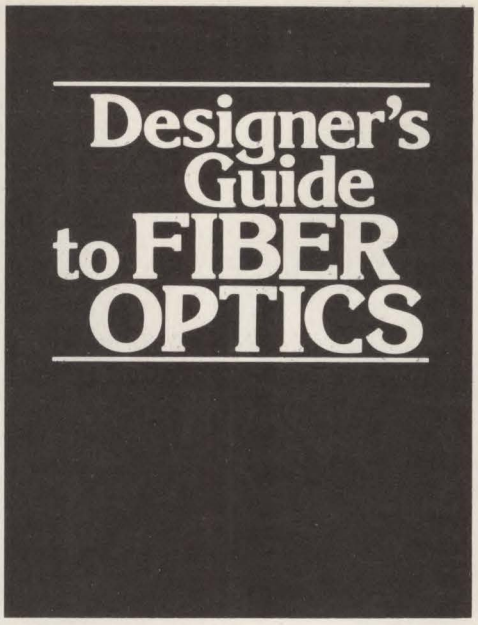

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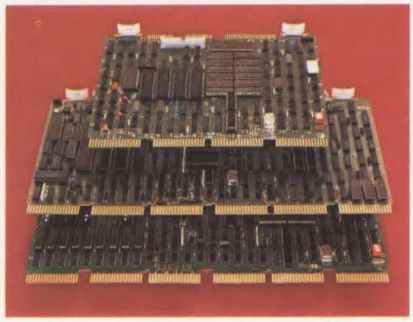

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