# Mini-Micro Systems

A CAHNERS PUBLICATION

MARCH 1983

DATA COMMUNICATIONS:

- Comm support for UNIX
- Smart modems and muxes

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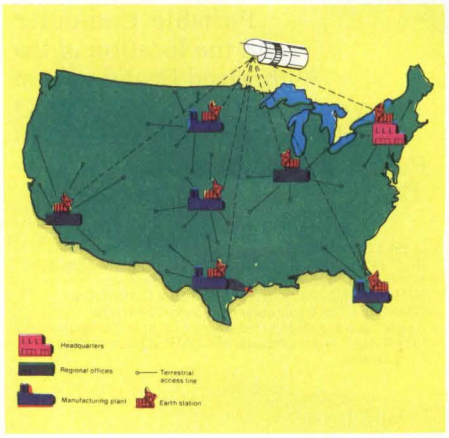
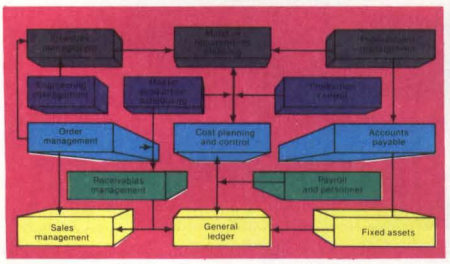
Mini-Micro Systems

*p. 17...Apollo offers distributed processing system (Art direction by Robert Fernandez, photo by Ralph King, courtesy of Apollo Computer Inc.)*




*p. 85...Communicating by satellite*




*p. 127...Business software for manufacturing*

## MINI-MICRO WORLD

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### Corporate and financial



### International



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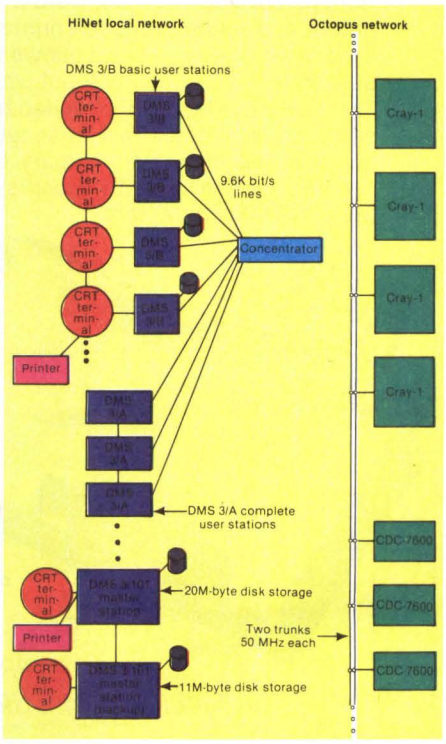
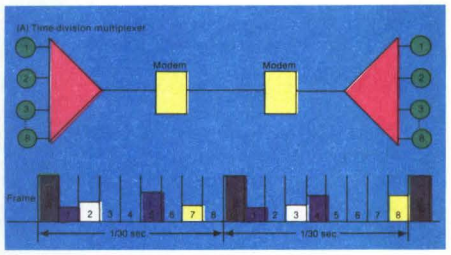
## SYSTEMS IN MANUFACTURING

## FEATURES

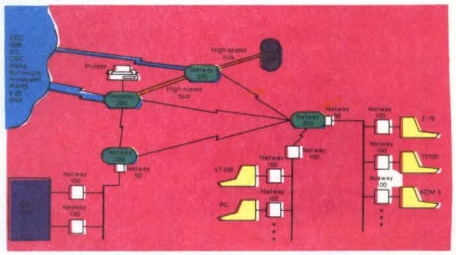





*p. 161. . . Statistical multiplexers gain status*




*p. 181. . . Local editing relieves network strain*



*p. 187. . . This family speeds communications*

## DEPARTMENTS



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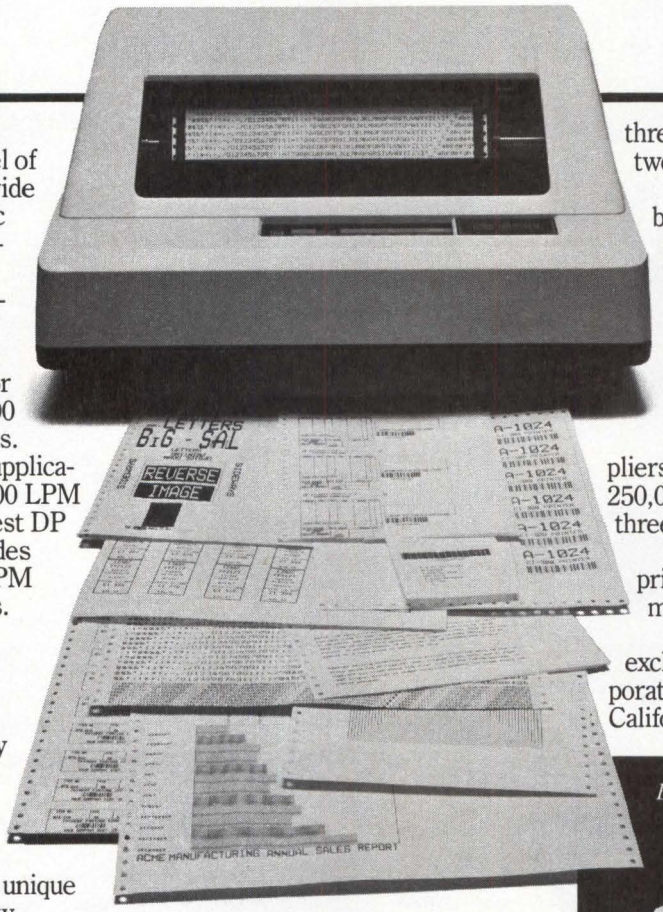
CIRCLE NO. 7 ON INQUIRY CARD

# TOP OF THE LINES.

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CIRCLE NO. 8 ON INQUIRY CARD

# Breakpoints

## HP MAY LEAD NEXT ROUND OF THIN-FILM-HEAD DRIVES

The battle for thin-film-head drives that began last year in the IBM plug-compatible market is expected to heat up as early as this summer. Hewlett Packard Co. is likely to stir the market with its first thin-film-head drive in mid summer, and Control Data Corp. and Digital Equipment Corp. are said to be not far behind. OEM suppliers will have a ready supply of heads from Cybernex Corp., a start-up that is gearing up for production by June. Meanwhile, Jack Osborne, who managed Memorex Corp.'s effort to put IBM's 3380 thin-film technology in Memorex's product, abruptly left the company last month to begin still another thin-film-head start-up. Starting a thin-film-head company is not easy, as Cybernex's William Klein can attest. It took Cybernex $33 million in investments and nearly two years to reach production stages. Osborne was accompanied by two key Memorex thin-film-head experts, Peter Bischoff and Jim Handshuh.

## HORIZON LANDS UNIX WP CONTRACTS FOR ALTOS

Horizon Software Systems Inc., one of the growing number of new ventures that has sprung up to provide application programs for UNIX OEMs, has signed a contract with Altos Computer Systems to put the Horizon word-processing system on Altos's Intel 8086-and Motorola MC68000-based systems running UNIX. Horizon, headed by former Onyx Systems president Doug Broyles, claims to have one of the few word-processing packages in the UNIX market that was developed in C and designed from the ground up to run under UNIX. Horizon previously signed with Gould S.E.L. and is reportedly close to a contract with Momentum Systems. Horizon is planning to add other UNIX-specific business applications this year, including a spread-sheet analysis package.

## MINISCRIBE MAY SUPPLY 5¼-IN. WINCHESTERS TO IBM

IBM Corp. may have found a perfect low-profile supplier for 5¼-in. Winchesters in MiniScribe Corp., Longmont, Colo. The two-year-old company has come from nowhere to rival Seagate Technology and Tandon Corp. for volume shipments. Although neither IBM nor MiniScribe is talking, MiniScribe has geared up to ship more than 6000 drives per month in a new facility that is more than large enough to accommodate the needs of IBM's peripheral division in nearby Boulder, Colo. Sources say IBM strictly enforces its nondisclosure clauses with vendors, as some of MiniScribe's rivals have painfully discovered.

## 'PORTABLE' APL IS WRITTEN IN C, RUNS ON UNIX

The APL '83 conference staged by the Association for Computing Machinery in Washington, D.C., from April 10-13 will have the first U.S. demonstration of Dyalog APL, a "portable" implementation of the interactive language that runs on UNIX-based machines. Developed by Dyadic Systems Ltd., Farnborough, England, APL Dyalog has been adopted by the British subsidiary of Zilog Inc. Zilog, Cupertino, Calif., also is evaluating the product. Dyadic managing director Ted Hare explains Dyalog APL is written in C. He says it will be shown at APL '83 on an MC68000-based machine, on at least one 32-bit minicomputer and on the Zilog System 8000. Hare believes Dyalog APL is a particularly advanced implementation of APL with features such as nested arrays, derived functions and external variables. He expects one of the first distributors to be EASI APL Systems Inc., Los Gatos, Calif.

## HEAVY-DUTY LINE PRINTER DUE FROM TELETYPE

To address a market it expects to grow 14 percent yearly over the next three to four years, Teletype Corp. scheduled a 300-line-per-min. band printer called the T300 for introduction early this month. Although prices are not yet firm, the estimated list price is about $5500. The T300 essentially is a beefed-up model 40 printer, with such changes as power-on diagnostics, stepper-motor-driven ribbon handling and electronic forms control. The T300 includes a Z80 microprocessor, operates asynchronously at speeds as high as

9600 baud and has a 2000-character line buffer. The printer has an RS232C interface, although parallel interfaces compatible with Centronics and Dataproducts printers are also available. The T300 can print an original and five copies.

### COSMETIC, NOT COSMIC CHANGES AT COSMOS

Zilog Inc. founder Manny Fernandez's start-up, Cosmos Computer Corp., is undergoing some changes that he and co-founder Wayne Sennett insist are only cosmetic. First, the company's name has been changed to Gavilan Computer Corp. after talks with Cosmos Systems Inc. Although Cosmos Systems, a supplier of UNIX-based microcomputers, incorporated two months after Cosmos Computer, Fernandez's group volunteered to give up the name because Gavilan will be easier to trademark in the 20 or more countries in which the company hopes to market its as-yet-unannounced product. The Gavilan system is being kept well under wraps, but a clue is evident in Sennett's scheduled appearance on an NCC panel devoted to portable computers. In the meantime, a second "noncosmic" change is the resignation of marketing vice president Al Davis, who joined the company from Intel Corp. only late last year. Davis, who is now consulting, says Gavilan was just not the right fit. Sennett has assumed Davis's responsibilities.

### THERE'S AN IBM IN YOUR FUTURE, FUTURE COMPUTING SAYS

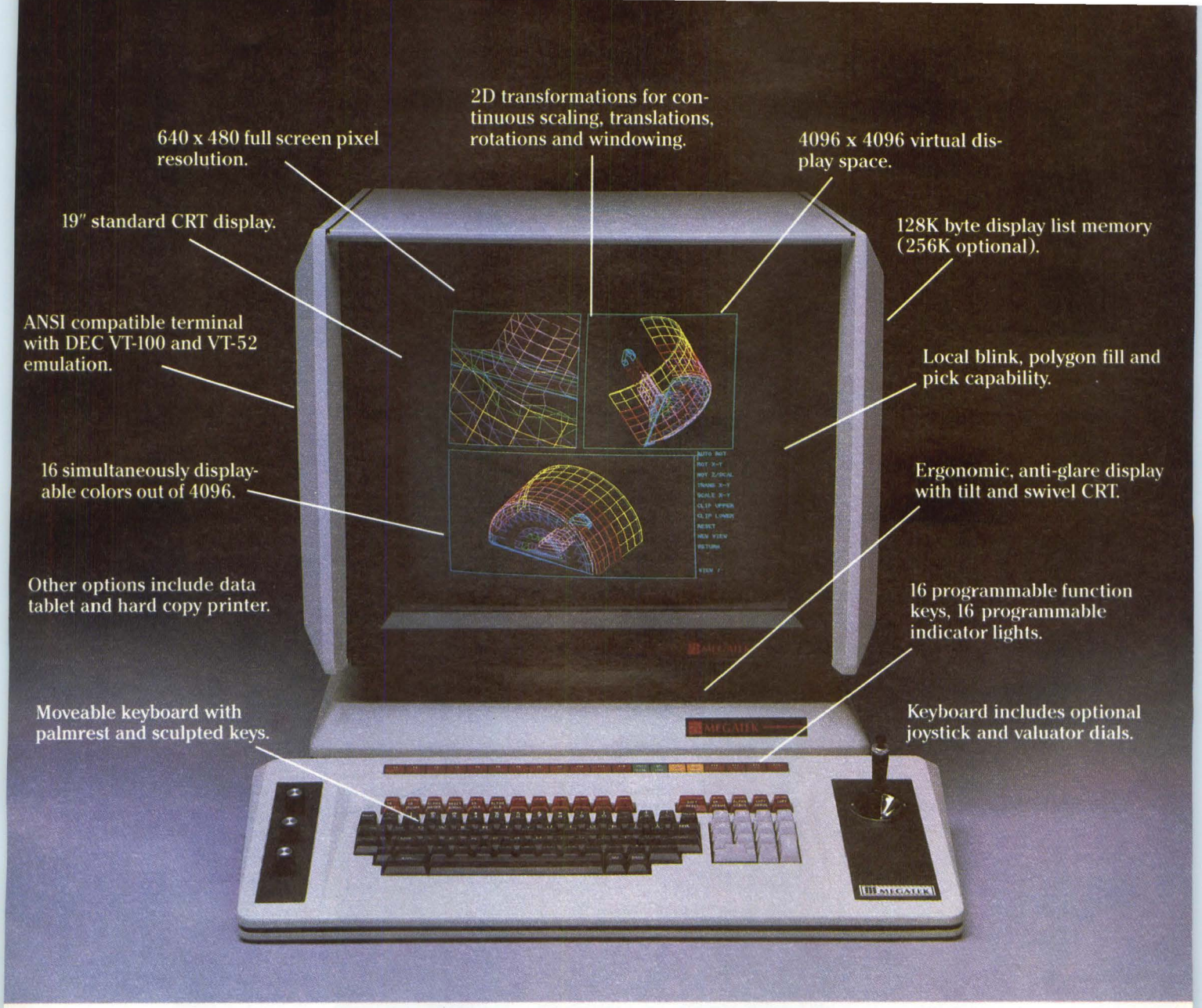
Attendees at a recent confabulation for suppliers of IBM PC-compatible hardware and software sponsored by Future Computing, Richardson, Texas, brought to light some impressive statistics. As of the fourth quarter of last year, the IBM PC has passed Apple Computer Inc. in current monthly shipments. The combination of IBM and IBM-like PCs is expected to grab a minimum of 52 percent of the market for $3000 personal computers in 1984—not counting the portables. Not surprisingly, the assembled industry mavens predicted that, by this time next year, their ranks will have swollen with 50 to 100 more IBM-compatible system vendors, many of which will be Japanese.

### EXXON OFFICE SYSTEMS ADDS PRINTER, FILE SYSTEM

Danbury Systems, an Exxon Office Systems company, has been previewing an ink-jet printer that has been under development for several years. The 965 ink-jet system is scheduled for official introduction this month and will offer letter-quality printing at speeds as high as 90 cps. It is expected to be priced well below IBM's discontinued 6640 ink-jet system and is reportedly positioned to compete with a forthcoming generation of Japanese models. At the same time, Exxon Office Systems, following an unsuccessful effort two years ago to network its Vydec word processors into a shared-resource system, is launching a new effort with its CompuCorp-designed System 500. Based on a controller with multiple Z8000 processors supplied by EOS's sister subsidiary Zilog Inc., the 8400 series will include three models with as much as 2M bytes of main memory and 306M bytes of disk storage to be accessed by as many as 16 workstations networked over multidrop, twisted-pair lines. A low-end configuration with three 500s and a 35-cps daisy-wheel printer lists for $27,500.

### TECHFILES: A QUICK LOOK AT INDUSTRY DEVELOPMENTS

**Random Disk Files:** The queasy stomachs around the Sunnyvale, Calif., headquarters of **Shugart Associates** are not all the result of the menacing flu bug. Rumors are ripe that cash-poor Xerox Corp. has put Shugart on the auction block. The rumors began when Xerox officials reportedly asked some investment counselors about the value of its low-end disk drive manufacturing subsidiary on the open market. Adding to the fuel is the rumored retirement this quarter of Shugart president Jim Campbell. George Sollmon, Shugart's vice president of marketing, dismissed both rumors, saying only, "Anything is for sale at the right price." But he knows of no Xerox plans to let go of its subsidiary. Meanwhile, however, the resumes of Shugart employees are said to be circulating at a faster clip than normal....**Rodime**, with U.S. offices in Mission Viejo, Calif., is formally

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MX-80: Parallel interface standard; optional serial interface for about $75 extra.
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**CIRCLE NO. 10 ON INQUIRY CARD**

scheduled to introduce what it claims is one of the first 3½-in. Winchester disk drives to go into production. The unit was to be announced by Scotland-based Rodime at a press conference in London on March 2 and was to be shown to selected members of the press in the U.S. soon thereafter, says a Rodime spokesman in Europe....**An industry committee formed by Maxtor Corp., and known as the Enhanced Small Disk Interface Committee, may be announcing two proposed ANSI interface standards** as a result of its inability to agree on a standard. The group was started last fall to update the ST506 commonly used by 5¼-in. Winchester drive manufacturers. The revision is needed to fulfill the requirements of high-capacity drive manufacturers that have been hampered by the interface's low transfer rate. The committee has split into a "stepper" group, named for manufacturers that still rely on stepper-motor technology and that would like to leave the interface as is except to raise the data-transfer rate to SMD levels. The second group, known as the "serial" group, wants to revise the ST506 interface completely for high-capacity drives such as those manufactured by Maxtor, Evotek, Atasi, Disctron and Control Data Corp....**Memorex Corp. reportedly has dropped its removable-disk-pack program** following a general industry trend toward more advanced Winchester technology. Memorex customers were sent a letter last month notifying them of the decision to abandon the program. The letter indicated Memorex's plans to concentrate on the more profitable IBM 3380 plug-compatible drives and on announcing the company's first 5¼-in., high-capacity Winchester....**A new vertical-recording Winchester disk drive company is in formative stages** in San Jose, Calif. Applied Information Memories Inc. has been started by a group that includes Arnold Pooley, former director of marketing of Dastek Corp. and its Applied Peripheral Systems subsidiary. Pooley will serve as vice president of marketing for the start-up. Other founders are as yet undisclosed. The company is expected to announce a 5¼-in. Winchester drive with an unprecedented 400M-byte capacity this summer.

**Micro Files: The long-anticipated movement of IBM's Personal Computer through the company's value-added remarketer channel has started quietly** in Atlanta where Computone Systems Inc. has signed to resell the popular microcomputer with its insurance-agency packages. According to Computone officials and IBM Series/1 VARs, IBM is keeping a tight rein on the PC VAR rollout. Only companies with specific vertical market packages are being signed, and these VARs will be confined to end-user sales only within those markets. Nevertheless, some of the more general-purpose Series/1 VARs still expect to get in on the act. Computer Distributors Inc., Seattle, which currently resells Series/1s with the Pick Operating System through a dealer network, expects to do likewise with the PC. CDI hopes to convince IBM that it should get a PC VAR contract by June when it is scheduled to complete a floppy disk-based implementation of the Pick Operating System for the PC....**GRiD Systems**, which last year introduced a high-end portable computer with proprietary software, has altered its strategy by adopting the MS/DOS operating system for its line. Meanwhile, David W. Hanna, who joined GRiD from IBM Corp., has been named president and chief operating officer, replacing founder George Ellenby, who remains chairman. Ellenby will formulate long-term strategies for the firm. Hanna formerly was GRiD's senior vice president of marketing....Start-up **MicroOffice Systems Technology Inc.**, Fairfield, Conn., plans to introduce its portable workstation at this year's Hanover Fair in Germany in April. The company recently announced it had received $2 million in venture capital in addition to the earlier financing by Olivetti Corp....**A laser videodisk, microprocessor-based computer graphics generator** is scheduled for unveiling this month by New Media Graphics Corp., Cambridge, Mass. The generator will be available for OEMs, and is said to generate its graphics or overlay images from videodisks, videotape or TV. Targeted applications for the GraphOver 9500 are military flight simulation and industrial training programs. The system is said to be plug-compatible with any host CPU or can operate stand-alone. The price is $9850. Quantity discounts are available....**Itek Corp.'s** OEM Systems Group, Nashua, N.H., has developed a 27-lb. desk-top converter that translates media from one word processor or personal

computer to the format of other incompatible word processors or personal computers at transfer rates as high as 9600 baud. The system accommodates both 5¼- and 8-in. diskettes and is driven by the menu of the host workstation. Translation programs are availablefor more than 20 machines including the IBM Displaywriter models 1, 2 and 2D; Wang models 5, 20, 25 and 30; and the HP 125 and Wordstar CP/M. Single-unit price is $11,500 with two translators. The OEM discount is 45 percent in quantities of more than 100.

**Printer Files: Hewlett-Packard Co.** was expected to introduce upgraded versions of its eight-pen drafting plotters late last month. The 7580B and 7585B will offer improved accuracy—0.1 percent of deflection, or 0.25 mm., whichever is greater. Both models come with two interfaces, allowing users to choose between the RS232C/CCITT V.24 communications interface port and the HP-IB (IEEE 488-1978) instrumentation interface port with a simple switch selection. The communications interface will provide "eavesdrop" capability for remote applications by which the plotter and terminal can operate in series using only one phone line and modem. The 7580B and 7585B replace the 7580A and 7585A, respectively, and deliveries are scheduled to begin in April. The eight-pen plotter models have been well-supported by CAD turnkey suppliers, and HP officials believe the upgraded accuracy of the machines will make them more useful for applications requiring tight specifications, such as design of circuits and metal templates.

**Mini Files:** In addition to X.25 networking for its 32-bit minicomputer line introduced recently, **Perkin-Elmer Corp.** plans to add two sets of low-end, 32-bit processors around the time of NCC, as well as SNA networking in June, a company spokesman says.

**Terminal Files: Qume Corp.** is believed to have a three-month delay in the start of volume shipments of its new terminals. By the time the first large shipments of production units arrive from Taiwan this month, several large competitors, including TeleVideo Systems Inc. and Lear Siegler Inc. will have low-end prototypes ready to close the price-performance gap Qume opened with its announcement of the QVT-102, 103 and 108 last November. Look for TeleVideo to announce its plan for two entries that replace its 910+ and 925 terminals at Spring Comdex in April, with volume shipments slated for June.... **C. Itoh America Inc.** has been marketing its terminal line exclusively through an independent distributor based in Irvine, Calif. But that distributor is being brought in under the corporate wing of the multibillion-dollar international trading company as part of an American subsidiary to be called CIE Terminals....**Falco Data Products** is readying its first system, but terminal industry veteran Lee Falco is reluctant to call it that. A window into his thinking: the title of a speech he is giving at a June Dataquest conference is "Will terminals obsolete the personal computer?"....Unexciting sales results for **TeleVideo's** new ANSI X3.64-compatible 970 terminal have made the company realize that even sophisticated users are unaware of or indifferent to the benefits of the ANSI standard for communications with editing terminals. The company plans an educational push on the benefits of the standard as a means of not getting locked in by a proprietary code structure to one maker's terminal. The fit between the ANSI standard and TeleVideo's commodity approach to terminal distribution is too good for the company to ignore, so the company will go ahead with plans to introduce a lower cost ANSI-compatible unit during the fourth quarter despite softness in the demand for the 970.

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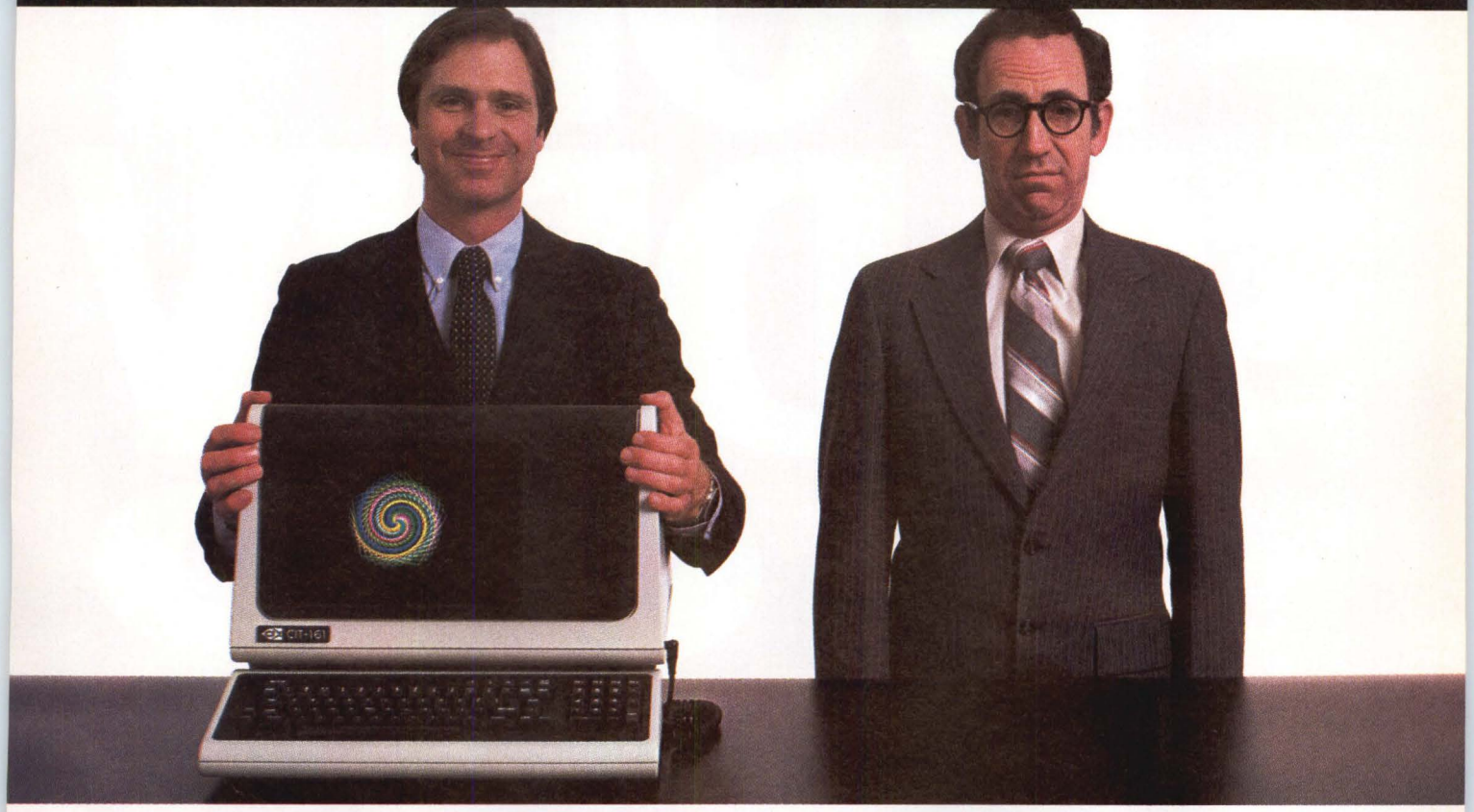


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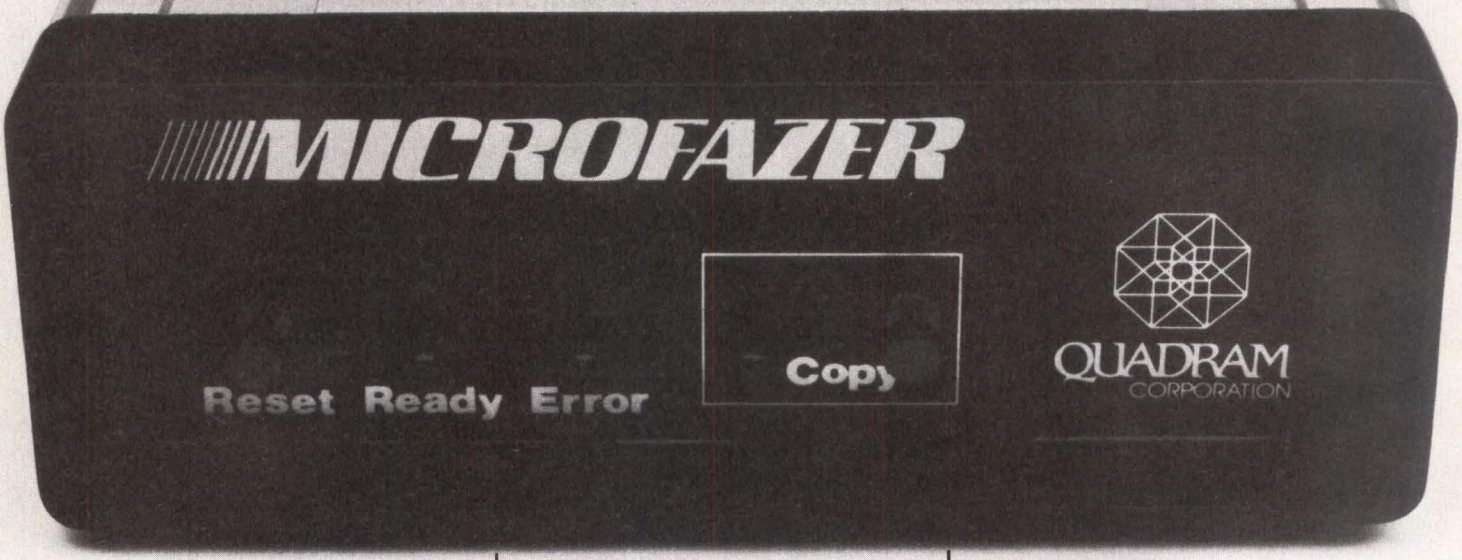


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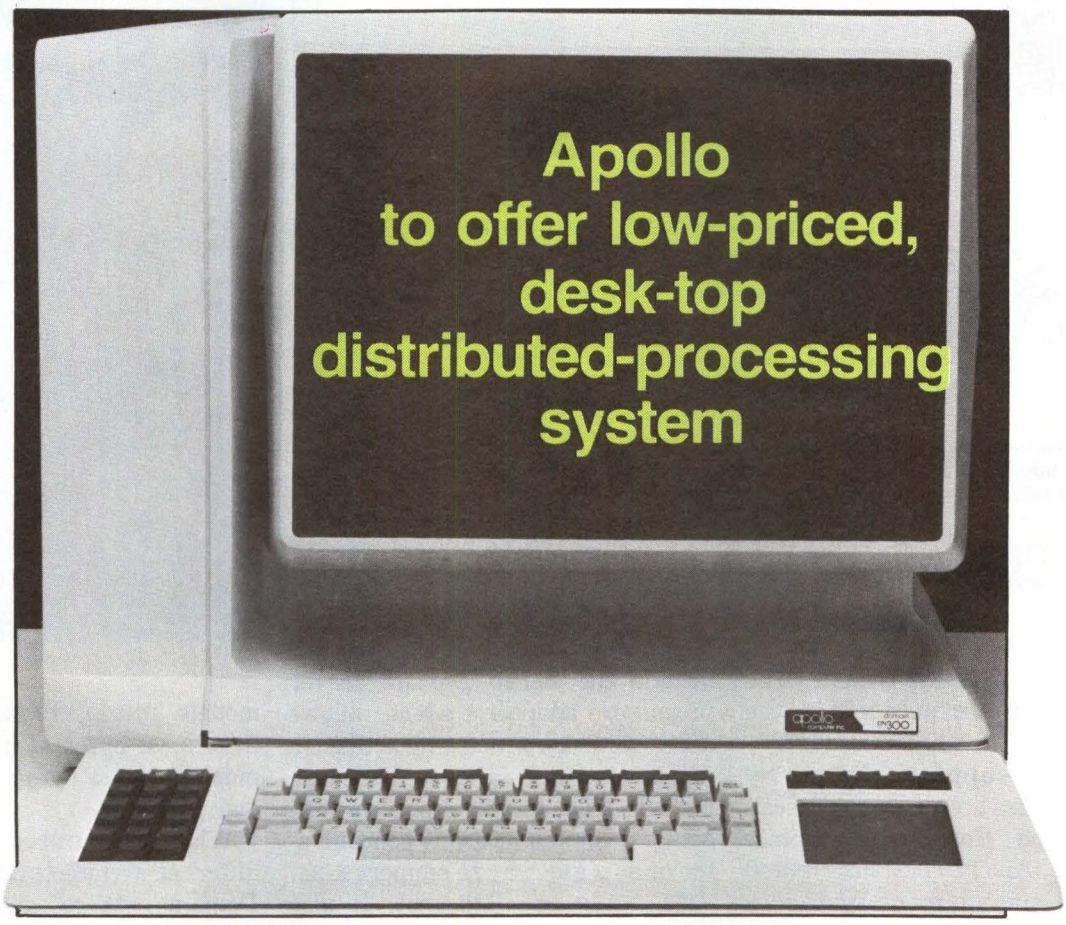
CIRCLE NO. 14 ON INQUIRY CARD

# Apollo to offer low-priced, desk-top distributed-processing system

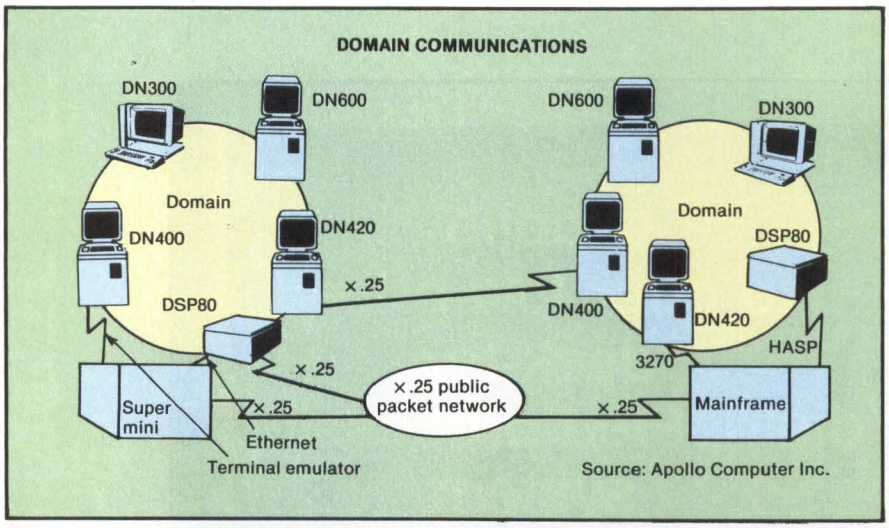



To promote its belief that time sharing is a dying art, Apollo Computer Inc., Chelmsford, Mass., brings to market the first member of a desk-top family of MC68010 distributed-processing systems at about half the price of the company's original Domain product. Apollo hopes to create new usage patterns for technical professionals by offering a more affordable system whose price is $10,000 in quantities of 50. The company's formidable competition includes Digital Equipment Corp. and Hewlett-Packard Co.

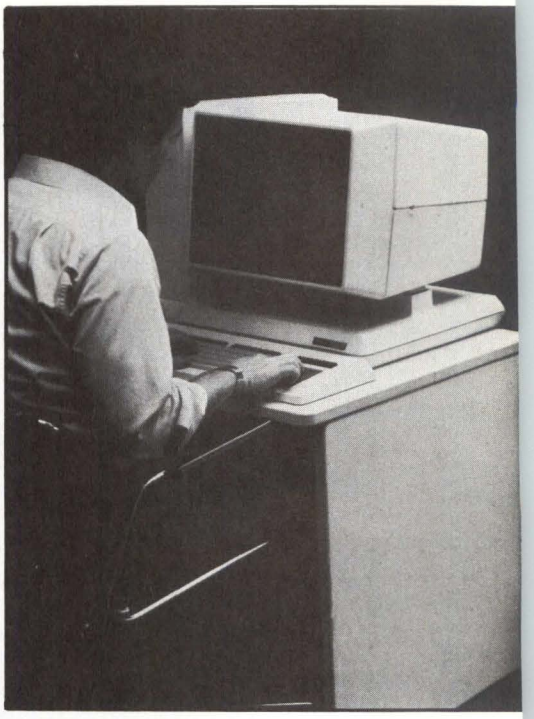
Apollo's DN300 features Motorola Inc.'s MC68010 virtual-memory processor, X.25 networking support to link multiple Domain network nodes or other networks to a Domain and the ability to share a disk and other peripherals so that each desk-top unit does not require a local mass-storage device.

Lower prices should broaden Apollo's potential customer list. Earlier Domain systems, which housed two MC68000 processors (the second was required to implement virtual memory), sold for an average of $30,000 to $35,000. The new workstations, which are pegged as mid-range models by Apollo president, chief executive officer and founder John Poduska, have an average sale price of $10,000 to $15,000. Both lower and higher end models are forthcoming, he notes. Meanwhile, Poduska expects to broaden the DN300 mid-range of the Apollo line to distributed users in engineering, scientific, computer-aided design, modeling and computer-aided software engineering applications, which the company is eyeing as promising future markets.

The basic DN300 system includes 16M bytes of virtual address space per process (as many as 15 concurrent processes per user), 0.5M bytes (expandable to 1.5M bytes) of parity memory, a 12M-bit-per-sec. token-passing baseband local-area network, the Aegis object-oriented virtual-memory operating system, a 1024 × 800 bit-mapped, black-and-white, multi-window, 17-in. display with 128K bytes of refresh buffer memory, a keyboard, two asynchronous serial I/O ports and an integral hardware




**Apollo has adopted the X.25 packet-switching protocol,** *which enables Domain nodes to be linked to each other and to independent computers.*



interface and controller. Memory resides on two cards. The 0.5M bytes of memory on the CPU card is implemented in 64K-bit RAMs. The disk drive is not included in the price.

Software support offered by Apollo includes FORTRAN 77, Pascal, C, Siggraph Core and graphics primitives, Apollo's D3M distributed database-management system, a UNIX System III environment, 3270, HASP and low-level Ethernet support such as 3Com and Interlan Inc. boards.

Other options include a keyboard with a touchpad, Priam and Micropolis 34M-byte, 8-in. Winchester disk drives or an 8-in., 34M-byte floppy disk drive. Network options include the DSP80 Domain server processor adapter, which allows users to share a 300M-byte disk, a magnetic tape and a Versatec plotter. The server processor can act as a communications concentrator or as a gateway to support X.25, 3270, HASP and Ethernet. It also allows peripherals or special devices to be connected through Multibus or one of two RS232C serial ports.

The DN300 does not have the larger memory and larger disks of its predecessors. The existing models DN400, DN420 and DN600 have 3.5M bytes of memory and as much as 158M bytes of Winchester disk storage.

While the DN300 is not very different architecturally from other Domains, there are engineering differences, says David L. Nelson, vice president of systems development. The DN300 is geared for high-volume production, which means high-volume tooling techniques, use of structural foam and

# 13 companies close in on LAN standard proposal

Reports of the demise of Ethernet may have been, like Mark Twain's first obituary, a bit premature.

With some fine tuning and bodywork, the local-area network proposed by the Digital Equipment Corp./Intel Corp./Xerox Corp. troika nearly three years ago and left for dead by some critics late in 1981, has received a new boost with the foundation of the IEEE 802.3 committee working draft. The draft received the enthusiastic endorsement of 13 key hardware and software vendors late last year.

The draft is being evaluated by the parent IEEE committee for final approval. Barring any further changes, it will resemble the original Ethernet in many ways. "The working draft is an enhancement of an already-good idea," says Don Loughry, project manager for Hewlett-Packard Co.'s Data Communications Division and chairman of the working IEEE group, referring to the original Ethernet. "We (the Ethernet and IEEE 802 committee) were like two boats in the same channel with the same sense of mission, and neither of us knew what the other was doing," Loughry says.

**The desk-top Domain DN300** *(left) is half the price of Apollo's current line (right) of distributed-processing systems. The product uses Motorola's MC68010 virtual-memory processor instead of the two MC68000 processors used on earlier Domain models.*

more standardized parts. Shipments are scheduled to begin in limited quantities this quarter. About 1000 units are expected to be installed this year, notes Edward Zander, director of marketing. Comparatively, the company shipped 500 of the earlier Domain models in a little less than two years.

For the projected high volumes of DN300s, Apollo is pushing the concept of each user's having a computer. "A computer must have a 32-bit orientation, but with mainframe capability," says Nelson. He adds that the upper limit on the IBM 360s and 370s for years has been 16M bytes of virtual memory, the same as the DN300 using the MC68010. Thus, he claims, IBM FORTRAN packages can be easily transferred to run on Apollo's product.

Competition for the DN300 includes DEC's VAXStations, two of which run on a typical VAX-11/730. Such a VAXStation 100 configuration with a Unibus interface, a keyboard, a terminal and a graphics processor is priced at $10,500 (not including the VAX-11/730). Without the Unibus interface, the VAXStation 100 sells for $9550.

Another competitor Zander claims is supporting Apollo's distributed-processing concept is minicomputer manufacturer HP. With its HP9000 32-bit desk-top minicomputer family, HP introduced its first use of Ethernet local-area networking (MMS, January, p. 21). HP's single-CPU workstation series 500 is priced at $28,250 for a model 20, which includes the workstation and CPU, 912K bytes of RAM, 270K bytes of floppy disk storage and a black-and-white display. Increasing RAM to 1M byte and adding 10M bytes of hard disk storage, a thermal printer, BASIC and HP-UX operating systems and languages boosts the price to $49,945. A rack-mounted model 30 sells for $23,105, including one CPU and 512K bytes of RAM. —*Lori Valigra*

The two missions joined forces in heavy negotiations late in 1981 after HP appeared to have given Ethernet the kiss of death by opting instead for the IEEE 802 committee standard. With HP's withdrawal, at least two independent market research firms forecast Ethernet's ultimate demise. "It should be emphasized that we never said 'no' to Ethernet," Loughry says. "We have always been in favor of the work of standards committees."

HP was, however, ill at ease with certain bugs in the original Ethernet, among them a problem of grounding hardware in Europe and HP's preference for an AC interface over the original DC to better the network's performance. In reaction to pressure from HP and others, the backers of Ethernet developed Ethernet Revision 2 in early 1982, making these and other minor revisions in the original Ethernet.

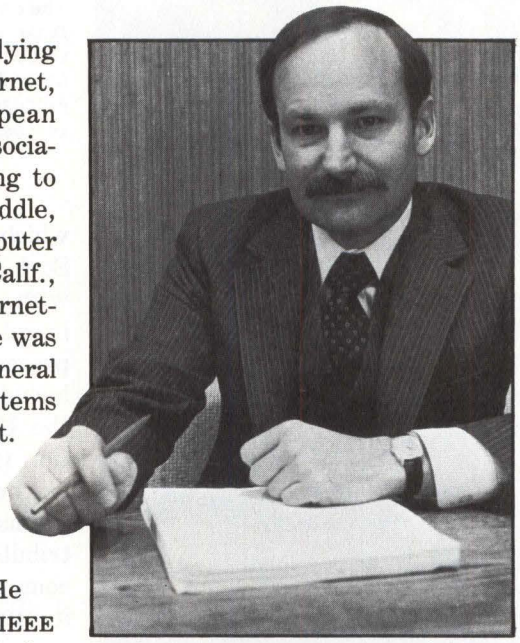
The 802.3 draft, however, further revises Ethernet Revision 2 to eliminate "jabber." That problem causes the entire network to be silenced because of one failed transmitter. In addition, the 802 specs call for the addition of an attachment unit interface that gives the network a means to control information exiting the network.

The committee standard also redesigned the "mouth," or "node," hardware that attaches to the Ethernet cable. As a result, says one Ethernet booster, hardware and software vendors supplying products for local-area networks

will no longer vary in supplying those nodes. "Be it called Ethernet, IEEE 802 or ECMA (European Computer Manufacturers' Association), everyone will be working to the same specs," says Dave Liddle, co-founder of Metaphor Computer Systems, a Santa Clara, Calif., start-up developing an Ethernet-compatible workstation. Liddle was formerly vice president and general manager of Xerox's Office Systems Division strategic business unit.

Liddle is given credit for advancing Xerox's Ethernet program, and contends that Ethernet has become an international standard. He believes products using the IEEE 802 standard could be available by the second quarter of this year because most vendors have already made product plans resulting from their involvement in the committee. The 802 committee has about 50 members representing about 35 companies.

In addition to DEC, Intel, Xerox and HP, nine other companies have endorsed the IEEE 802 draft standard. They include Ungermann-Bass, Bridge Communications Corp., Data General Corp., Fujitsu America Inc., Interlan Inc., National Semiconductor Corp., Siemens AG, Tektronix Inc. and 3Com Corp.



**Ralph Ungermann, president of Ungermann-Bass,** *says it will be relatively easy to make software changes that will bring his company's products in line with the new IEEE local-area network proposal.*

Ralph Ungermann, president of Ungermann-Bass, admits that it will be relatively easy to make the software changes that will bring his company's products to the IEEE specs, noting that one of the committee's chief aims was to facilitate the transition. In addition to the software changes, interface differences remain between the Ethernet Revision 2 products that Ungermann-Bass sells and the IEEE 802 specs.

Ungermann believes the market will not settle on the 802/ECMA standard until 1984 or 1985—after the 802 committee adopts the draft and the market is convinced that the standard is real. HP's Loughry, however, believes the market pressures, primarily from the growth in office automation, are sufficient to force vendors to accept a network standard.

Metaphor's Liddle notes that, while there is still room for a company such as IBM Corp. or AT&T to force its own standards into the market, there has not been an overwhelming push to do so. He adds that the only other published local-area network standard besides the 802 specs is the IBM-supported token-ring proposal, which Liddle says remains buried in patent bureaucracy. —*Robert A. Sehr*

# Intel to bolster 432 sales with fault-tolerant components

Intel Corp. has had little market success in pushing its two-year-old iAPX 432 32-bit micromainframe chip set by touting its architectural protection against faulty software. But the company hopes the addition of tolerance for hardware faults will make the 432 a market winner, although initial systems will be relatively expensive.

Two new Intel VLSI components, the 43204 bus interface unit and the 43205 memory control unit, incorporate the detection and recovery logic required to add a range of fault-tolerant capabilities to a 432-based system. The same chips support an interconnection architecture that allows the modular and transparent extension of the processing power and bus bandwidth of such a system.

Gordon Reid, marketing manager at Intel's Special Systems Operation, Aloha, Ore., expects this configuration flexibility and reliability, plus a fivefold performance improvement since the 432 was introduced, will overcome market resistance to the 432 before 1985, when there will be a $19-billion demand for high-availability machines, according to Dataquest, Inc., a Cupertino, Calif. market research firm.

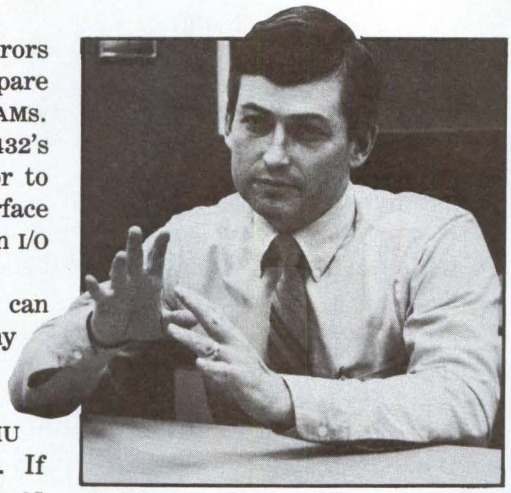
In the simplest 432 system configuration using the two new interconnect components, the MCU chip interfaces a single memory storage array, typically constructed of 64K-bit dynamic RAMs, to the memory bus. The MCU provides error-correcting circuitry correction of single-bit errors, detection

and reporting of double-bit errors and optional switching in of spare bits on only partially good RAMs. Meanwhile, a BIU connects the 432's two-chip general data processor to the bus, while the 432 interface processor communicates with an I/O subsystem.

Transparent multiprocessing can be achieved by attaching as many as 64 processors and memory arrays to the bus via BIUs. In case of bus contention, the BIU handles automatic bus retries. If more bus bandwidth is needed, as many as 8 buses can be added. No application software changes are necessary to accommodate such system expansion because processors self-dispatch to a queue of waiting tasks when idle and BIU hardware maps processor addresses to available buses and memory systems.

If more fault tolerance is necessary than the protection against transient errors provided by ECC and bus retries, a software-based, "self-healing" configuration is available. A watchdog timer on an I/O subsystem notifies the subsystem's software when a failure occurs. The software checks BIU/MCU error logging registers to determine which resource has failed. Finally, the subsystem software reconfigures the system without the failed bus, processor or memory. The system is thus back on-line quickly without human intervention.

If it is important that a system produce guaranteed results, redundant processor modules can ensure correct computation by functional redundancy checking. At system start-up, the 432 processors are configured under software control as master/checker pairs. Each 432 checker processor performs calculations with a master and puts a sample of the master's output onto the bus for comparison against its result. In the event of a discrepancy, the checker notifies all BIUs on its bus. Via redundant error reporting lines and two rebroadcasts of the error message, the interconnect architecture ensures that all nodes are notified of the error even if a single reporting line, bus or processor has failed.



**Intel Corp.'s Gordon Reid** *expects fault-tolerant components and improvements on the 432 micromainframe chip to help overcome market resistance to the product by 1985.*

This FRC configuration catches hardware faults, but does not provide the redundant resources for successful recovery. But pairing a self-checking master/slave module with another self-checking "shadow" module that operates simultaneously provides a current and complete backup for all state information in the module. Facilities in the BIU and MCU switch the system to the shadow module when the FRC reveals a failure has occurred. This fault-tolerant module is called quad modular redundant because most components are replicated four times.

Thus, the 432's new interconnect architecture provides a path to increase reliability under software control. Software can configure the system in full QMR mode for critical applications in which down-time would be ruinous, or switch the system to an FRC-only mode that provides guaranteed results and nearly double system throughput (because twice as many processors are working in parallel).

Besides the reliability of VLSI over the TTL with which the necessary detection and recovery logic are implemented in most fault-tolerant systems on the market, the 432 fault-tolerance scheme has an advantage in the inherent software reliability derived from the 432's run-time protection mechanism, says Reid.

Under the 432's run-time protection scheme, the hardware gives a procedure "permits" to perform operations on data structures. A programmer cannot change that permit list innocently or purposely. During execution, hardware also checks that the data structure type is consistent with an attempted operation. If the hardware detects an attempted protection violation, it aborts the instruction and pinpoints the line of code in which the violation occurred.

Intel's Reid says the detection of software errors is the real edge for the 432 in a fault-tolerant application. "Our hardware data protection allows detection and recovery to occur at the level of the fault," he says. Consequently, Reid claims, software faults are contained before they can corrupt a database or crash the entire system.

Ironically, the hardware's data protection is largely responsible for the 432's lack of market acceptance because of the overhead it entails. "It takes longer to make a procedure call if you do a lot of checking," says Reid. He concedes that the first 432 implementation was particularly slow. Benchmarks done by professor David Patterson of the University of California at Berkeley and published by the Association of Computing Machin-

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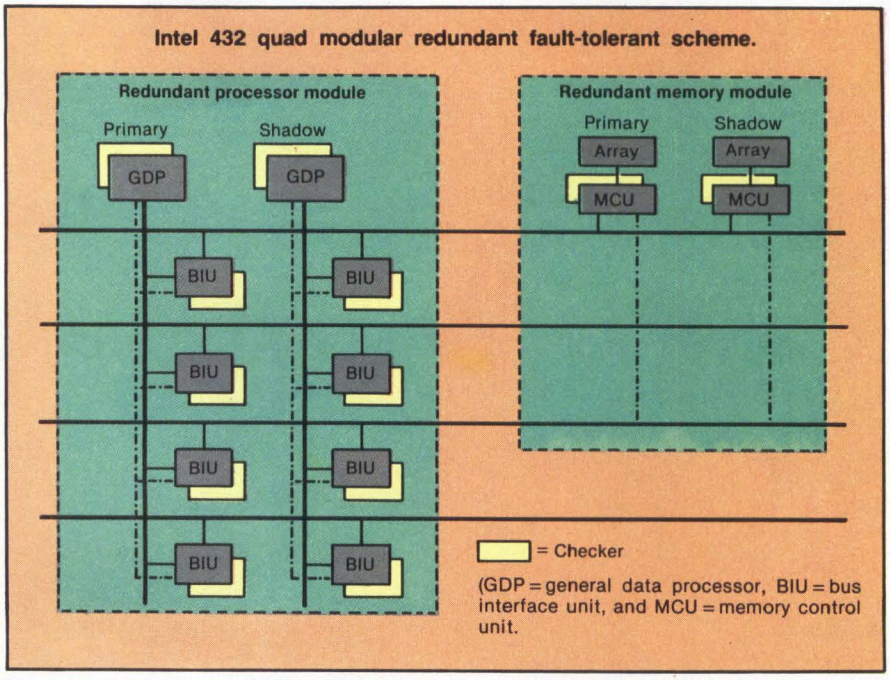
**CIRCLE NO. 15 ON INQUIRY CARD**

ery peg the initial 432's 4-MHz performance on four benchmarks at one-twentieth the performance of a VAX-11/780. But that same study indicates that two rewrites of the responsible microcode and sampling to obtain 8-MHz parts has increased 432 performance to one-fourth that of a VAX-11/780, putting it on a performance par with a 5-MHz 8086, but leaving it nearly an order of magnitude slower than the 286.




***To achieve maximum fault tolerance,** a 432-based system uses master/checker component pairs to verify the correctness of a computation and a shadow pair to take over in the event the primary pair fails.*

Meanwhile, Intel studies indicate it would take a configuration of 12 to 14 432s in parallel to make a tenfold gain in performance. Prices on the new BIU and MCU chips will be between $100 and $300 each in 1000-piece lots when production quantities are available in October, while the two-chip general data processor is $450. It is thus apparent that a full-blown fault-tolerant 432 configuration with the power of a 286-based system will not be inexpensive initially. A 12-processor system with quad redundance would sell for a minimum of $31,200 including processor and BIU chips. —*Kevin Strehlo*

# New Congress to face old and new industry issues

After the traditional Washington early-winter lull, a familiar Administration and a new Congress reported back to work facing some old problems and several new issues that will impact the minicomputer and microcomputer industries this year. Here's a cursory look at some of the significant industry issues.

- Two separate, but complementary pieces of computer software legislation that fell victim to last year's lame-duck Congress will be reintroduced. If successful, both bills will improve the degree of protection afforded computer programs under the Copyright Act.

H.R. 6983 is expected to be reintroduced by Representative Robert Kastenmeier (D.-Wisc.) after languishing in the House Judiciary Committee last year. It would have amended Title 17 of the Copyright Act to classify all forms of software as works of authorship, subject to the same copyright protection as books, plays, movies and other creative efforts, "regardless of the form used to express the programming, or the form in which the programming is embodied," the bill states. ROM codes, magnetic cards, flowcharts and any other expression of software programs would be considered protected and copyrighted under the proposed amendment.

H.R. 6420, which would have raised the criminal penalties for software piracy, probably will be resubmitted by Representative Barney Frank (D.-Mass.) with only minor modifications. H.R. 6420 would raise the maximum fine for software theft from $25,000 to $250,000 and the maximum jail sentence from one to five years. If passed, the legislation will amend Title 18 of the Copyright Act to classify the penalties for program piracy with those for theft of video and audio programs.

- National security issues are expected to dominate upcoming Capitol Hill hearings on legislation to modify and extend the Export Administration Act, scheduled to lapse in 1984. The Act governs what computer manufacturers and system integrators can market to Communist and non-Communist countries. Regional hearings on

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CIRCLE NO. 16 ON INQUIRY CARD

**Industry issues Congress may face this year**

- An amendment to the Copyright Act to further protect software authorship.
- Legislation to raise criminal penalties for software piracy.
- An act restricting the export of high-technology hardware to Communist countries, which is one of several national security issues.
- Final regulations for an act allowing U.S. manufacturers and service providers to form public export trading companies.
- Legislation allowing joint R&D among computer manufacturers.
- An "Apple Bill" allowing write-offs of computer donations made to elementary schools.
- Legislation mandating written contracts between office-equipment manufacturers and dealers.
- Trade restrictions for foreign computer vendors equal to those that U.S. vendors face.
- A rewrite of the Communications Act of 1934.

modifications were scheduled to be held during January and February.

A strong debate is developing on how the act should be modified to protect the U.S. lead in high-technology equipment and services. An argument put forth by the intelligence community and the Department of Defense recommends tight restrictions on the export of any high-tech hardware, including state-of-the-art computer systems, that could find its way into the Soviet Union. The counter-argument is that a freer export policy would not only benefit U.S. manufacturers and exporters, but would have the advantage of allowing the DOD to know better what the Soviets want. A compromise school of thought would permit the export of equipment and service, but not the underlying technology; that is, it would permit the sales of ICs outside the U.S., but impose tight restrictions on constructing IC manufacturing facilities outside the U.S.

- Final regulations for the Export Trading Act should be made available for public comment by May, according to officials at the Department of Commerce. The act, signed into law by President Ronald Reagan last year, allows U.S. computer manufacturers and service providers to form export trading companies exempt from U.S. anti-trust regulations. The law also permits banking organizations to invest for the first time in export trading companies.
- Efforts will continue during the 98th session of Congress to pass legislation that will allow joint research and development activities among computer manufacturers, according to industry observers in Washington.
- Representative Fortney "Ray" Stark (D.-Calif.) is expected to reintroduce the "Apple Bill," which will allow computer manufacturers to write off as much as 92 percent of direct costs—labor, materials and factory overhead—of minicomputers and microcomputers donated to elementary and secondary schools. The measure passed the House last year, but was blocked from reaching the Senate floor by Senator Robert Dole (R.-Kan.) and others, who branded the legislation "a blatant giveaway."

The new legislation will contain only minor modifications, according to a staff member of the House Ways and Means Committee. The period during which manufacturers can take the tax credits will be left deliberately open-ended, compared with the three-year write-off period that was specified earlier.

- Senator James Exon (D.-Neb.) is expected to introduce legislation that will mandate written contracts beween manufacturers of office equipment, including computers and peripherals, and their dealers. The measure, which was held up in the Senate Judiciary Committee last year, has polarized many trade associations based in Washington.

## SENATE PILOT PROGRAM TO TEST MINIS FOR OFFICE AUTOMATION

Office-automation techniques will be tested as part of an ambitious program to install a Senate-wide office minicomputer system beginning in 1984. As much as $228,000 has been authorized to fund a pilot program this year to operate various minicomputers and peripherals in 12 Senate staff offices. User applications will range from word processing for constituents' letters to routine office functions such as payroll and bookkeeping.

The Senate Rules Committee is coordinating the program and arranging contracts between participating Senators and hopeful vendors.

Each Senator's office will select its own vendor this month; the office systems will be installed in April. Because of the variety of computer systems likely to be chosen, says John Swearingen, technical services director of the committee, the pilot program will not include interoffice communications, although the final system will be bought from a single vendor to ensure communications compatibility. The Rules Committee expects to have the evaluation completed on the program's first phase in the third quarter of this year.


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Opposing the proposed legislation is the Computer and Communications Industry Association, which says the bill will force manufacturers to revamp their lines of distribution completely and will cost hundreds of thousands of dollars to comply with the bill's provisions. Proponents of the measure, including the National Office Machine Dealers Association, argue the bill would require manufacturer/dealer agreements that guarantee "equitable, fair and reasonable service to the dealer."

The measure, according to a legislative aide to Senator Exon, is intended to correct such abuses by manufacturers as refusing to sign written contracts with dealers and unilaterally shifting product lines from one dealer to another with little or no advance warning. Under the provisions of last year's bill, a manufacturer would be required to pay termination penalties if it changed dealers within a specified sales region. Exon, who was an office-equipment dealer before his election as Governor of Nebraska in 1970, is attempting to line up the nine Senators who cosponsored the bill last year and gain additional support for the measure before reintroducing it in the Senate.

- Proposed legislation to impose the same restrictions on foreign computer vendors operating in the U.S. as faced by American firms exporting to or operating in foreign markets is likely to surface again this year in Congress. Nontariff trade barriers, such as a recent Korean ban on the import of minicomputers, microcomputers and peripherals, are prompting the call for reciprocal measures in the U.S.

- Representative Tim Wirth (D.-Colo.) may introduce a new version of his proposed rewrite of the Communications Act of 1934. Wirth withdrew his bill from the House last year in the face of an overwhelming lobbying effort mounted by AT&T against the bill. Capitol Hill sources say the Senate is unlikely to follow suit, preferring to await the outcome of AT&T's divestiture of its operating companies and the entry of the Bell spin-off, American Bell Co., into the computer and data-processing markets.

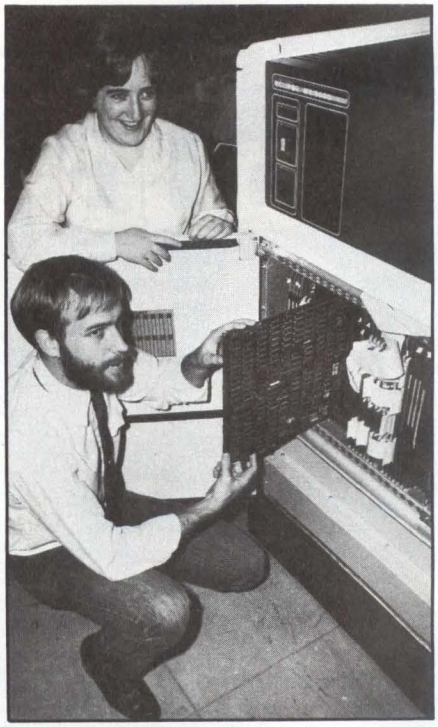
*—Stephen J. Shaw*

# Interlan adds Ethernet board for Data General systems

Interlan Inc., which last year introduced a Digital Equipment Corp.-compatible Ethernet interface board before DEC could produce its own, has jumped into the Data General Corp. market. It will introduce a DG-compatible Ethernet board just three months after the Westboro, Mass., minicomputer company announces its intentions to support the Ethernet local-area networking standard. The announcement comes nearly 18 months before DG plans to offer an Ethernet product.

The DG board is a standard 15-in. card designed to work in Nova, Eclipse and MV series systems. Like the earlier DEC board, it is built around the Advanced Micro Devices 2901 bit-slice processor. Scheduled for initial shipments in April, the Interlan NI4010A board is priced $2490 in single-unit quantities and $1743 in OEM quantities of 25. It is said to meet both the Xerox Corp./Intel Corp./DEC Ethernet standard and the IEEE P802.3 standard at the data link and physical levels (see "13 companies close in on local network standard proposal," p. 18). The DEC and DG boards differ mainly in interface requirements, say Interlan officials. The NI4040A is designed to perform all Ethernet data-link layer functions such as data encapsulation/decapsulation; CSMA/CD transmit and receive data-link management; and address recognition for physical, multicast group and broadcast frame transmissions. On the physical channel function level, it operates at 10M bits per sec. and performs Manchester data encoding/decoding and carrier deference and collision detection and provides the transceiver interface.

*Continues on page 35*



**Interlan Inc. manager of hardware development John Clayton** *installs Interlan's NI4010A Ethernet interface board into a Data General MV/8000 superminicomputer. The board is said to meet both the Xerox/Intel/DEC Ethernet standard and the IEEE P802.3 standard at the data-link and physical levels. Also pictured is Interlan engineer Kathleen Eccles.*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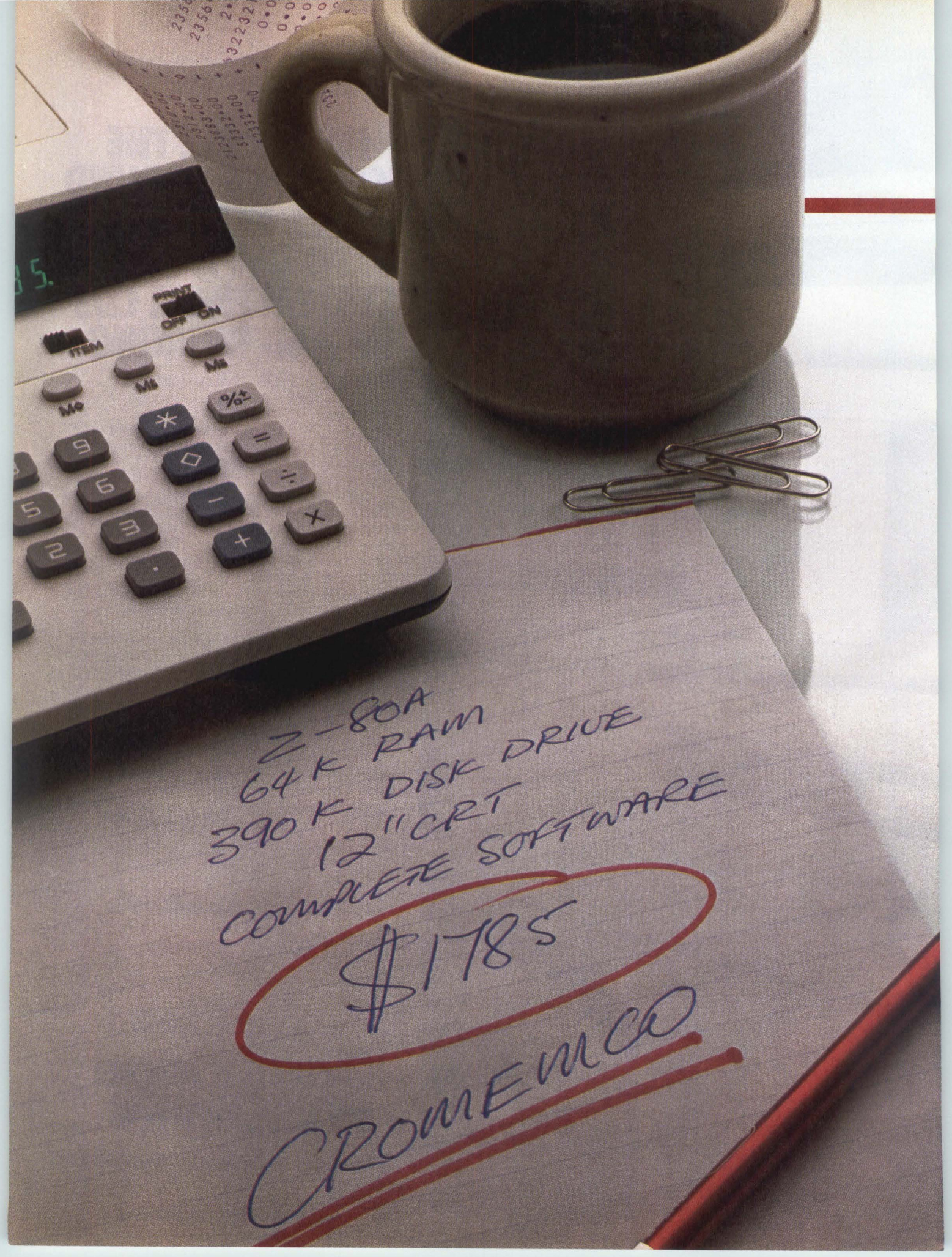
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Several VARs mention IBM hardware as a big plus. One says: "Its standing in the field helps reduce the selling hurdles." Another praises IBM's ability to, "keep customers up to date as new hardware develops." Both are referring to the success they had with the Series/1. We expect we'll soon be hearing the same praise about the Datamaster small business computer, which is now available to our VAR customers.

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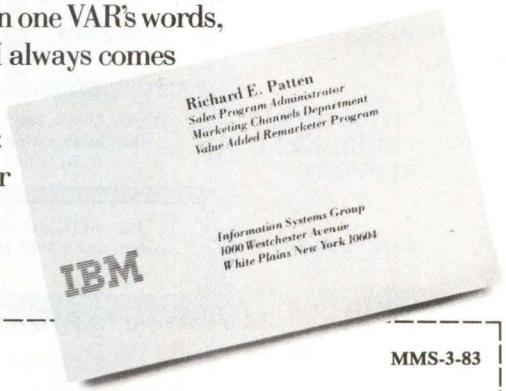


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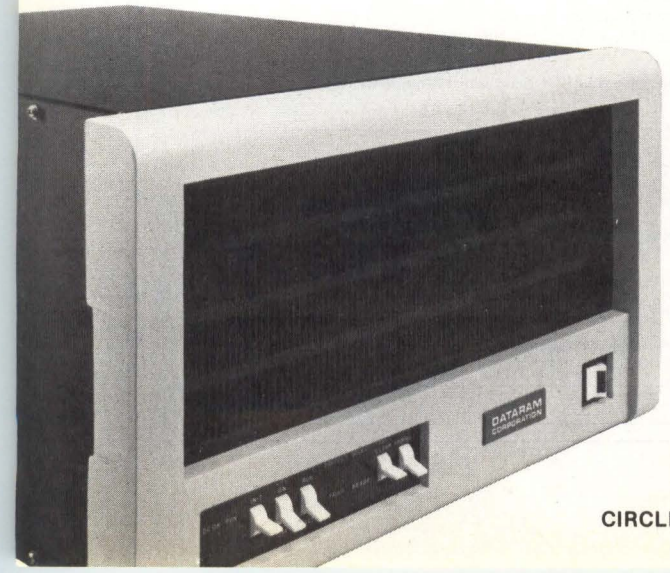


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CIRCLE NO. 22 ON INQUIRY CARD

*Continues from page 28*

The board also performs various diagnostic functions. It includes a 13.5K-byte FIFO buffer for back-to-back frame reception and a 1.5K-byte buffer for frame transmission. The NI4010A also collects network statistics such as the number of frames received with cyclic-redundancy-check errors, the number of frames received with alignment errors, the number of transmit collisions, the number of mulitcast frames filtered and the number of out-of-window collisions.

Software drivers are available from Interlan to link network operations to DG computers running under the RDOS or AOS operating systems. Price for the software packages had not been set at press time, but Interlan officials say prices will follow the pattern set by the DEC products, or $1000 for the first copy in RSX and VMS versions and $100 for subsequent copies. Interlan charges $500 for an RT-11 package and $50 for each additional copy.

Although software for the DG Ethernet board is limited to drivers, Interlan hopes to provide networking software that will operate with DG's Xodiac local networking scheme as well, says a company spokesman. Last summer, Interlan announced Etherway software, which links Ethernet to DEC's DECnet scheme through the Interlan board (MMS, August, 1982, p. 244).

DG, meanwhile, is exploring both internal solutions and OEM products to put its systems on IEEE 802 networks, says director of distributed systems development David Maloney. He adds that a primary concern is to retain the network software the company has developed for its Xodiac scheme. "We would like to put 802 under Xodiac," he says.

Interlan will market the NI4010A board through existing channels, which include direct sales to major customers and manufacturer's representatives for other OEMs. The company has landed a large OEM contract with Calma Co., a Santa Clara, Calif., CAD/CAM systems company owned by General Electric Co. Late last year, Calma said it would support the Ethernet standard on its DEC- and DG-based turnkey systems. Company officials hope to have the Interlan board integrated into Calma's systems in the third quarter, and the company will also use the DEC version of the board. —*Geoff Lewis*

# Used-mini market fading as dealers move to micros

The used-computer industry appears to be thriving. Industry analysts such as Charles C. Greco of International Data Corp., Framingham, Mass., and Adolph "Sonny" Monosson, chairman of American Used Computer Co., Boston, see the total used market rising to nearly $3 billion in 1983, with the minicomputer share of 5 percent translating into $150 million. And just recently, 49 dealers of used Digital Equipment Corp. equipment formed the Digital Dealers Association to ensure order in a chaotic market cluttered with more than 300 total dealers.

Why, then, is American Used Computer, founded in 1968 and the giant of the used-mini business, phasing itself out of that market with one final clearance sale? "Why am I having a going-out-of-used-computer-business sale?" asks Monosson. "Haven't you seen those new supermicrocomputers?"

## AMERICAN COMPUTER GROUP PUSHING SMALL MICROS

Adolph "Sonny" Monosson's American Computer Group has already begun expanding its customer base by selling and leasing several small microcomputers, including the DEC-Mate I, the Xerox 820 model 1 and the DEC VT180. Monosson says, "The DECMate has been very well-accepted."

Will the company distribute mainly vendor overstocks of somewhat inactive early models that might be purchased inexpensively? Monosson replies that "service, quality and reliability" are the only considerations. He expects to offer the DECMate II when it is available. But as to which of the newest microcomputers he will select, he says only that he and partner Bill Grinker have had "a lot of dates" with potential vendors. "We have spent a lot of time analyzing the market," he adds.

American does not offer current Apple products because Apple Computer Inc. has already saturated its possible market, Monosson claims. He expresses no interest in the Osborne personal computer, but his eyes light up when the Compaq portable computer is mentioned. Monosson also has been considering 68000-based systems.

The companies that obtain the small computers from American do so in groups of as many as 10. American's sales force is also beginning to target single professional users, such as lawyers, accountants and engineers, Monosson says.

Lease options are for one, two and three years. American claims overnight delivery. "We have the capital to carry the inventory," Monosson says. "That gives us a big advantage."

Claiming to have seen the handwriting on the wall, Monosson and Bill Grinker, his partner, are moving to the new microcomputer market, and they will begin selling about 10 small computers this year.

American's inventory, which in 1978 filled several floors of the company's warehouse, including 50,000 sq. ft. of DEC equipment, occupied only one floor at the start of the sale. The DEC portion of the stock had dwindled to 8000 sq. ft. The number of active dealers has also decreased. Monosson points out that of the 1285 companies entering the market since 1968, at least 947 have gone out of business.


**American Used Computer's "Sonny" Monosson** *has retired his famous sandwich boards and is staging one final clearance sale. His company will now focus on selling and leasing new microcomputers.*

Monosson says the rapid advances in microprocessor technology have caused the market values of used computers to decay more quickly than in the past. Many used machines that once sold for 80 percent of their original list prices now often sell for less than 50 percent of current list prices. Even a popular 128K-word DEC PDP 11/40, which in 1978 sold for $15,000, or 50 percent of list, now sells for a maximum of $5000. (The 11/40 is now out of production.)

Many dealers acknowledge a market decay. The demand for PDP 11/70s was so strong in 1976 that the Minicomputer Exchange, Sunnyvale, Calif., was able to sell available units for 10 percent above list prices (MMS, September, 1976, p. 52). Now, however, company president Walt Grueninger says he sells 11/70s for 50 percent of list price. And the Data General Corp. Nova 4X, which Grueninger says was a "hot item" a year ago at 80 to 85 percent of list price, is now down to one-half or less of list.

"The stuff we're selling now is obsolete," admits Phil Thomas, president of Thomas Business Systems, Boca Raton, Fla. He says a Nova 3 that went for 50 percent of list in 1981 now sells for only 30 percent of list.

Chuck Newman, of Newman Computer Exchange, Troy, Mich., says that, although mail-order

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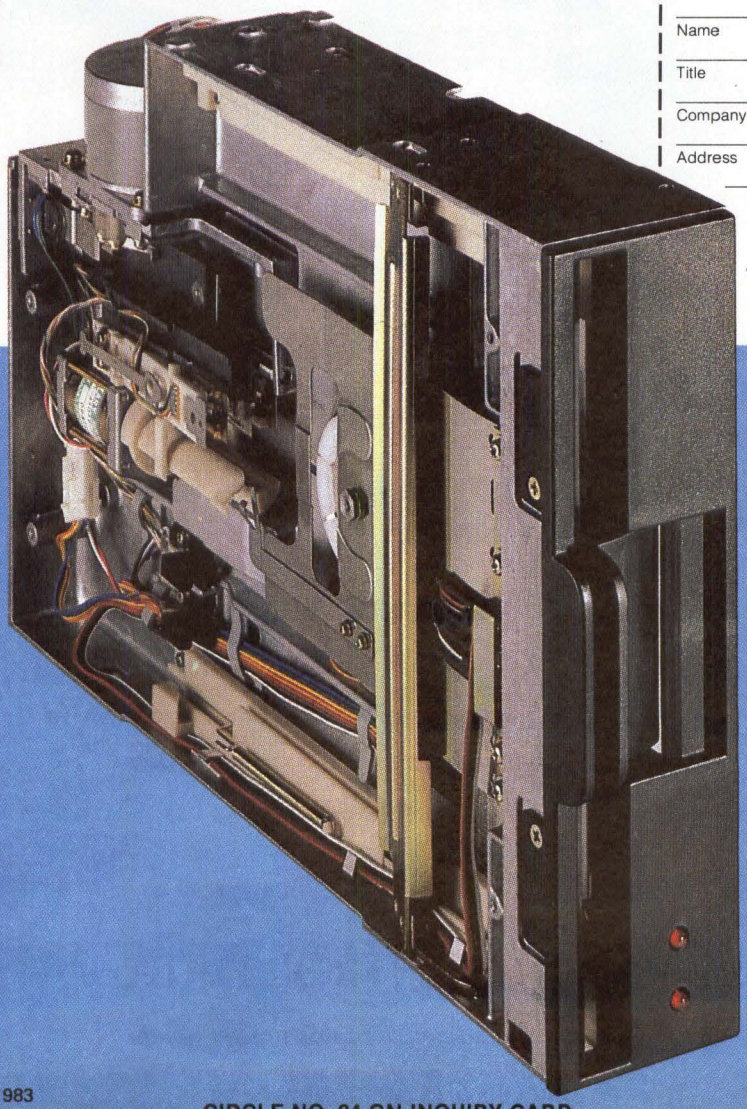

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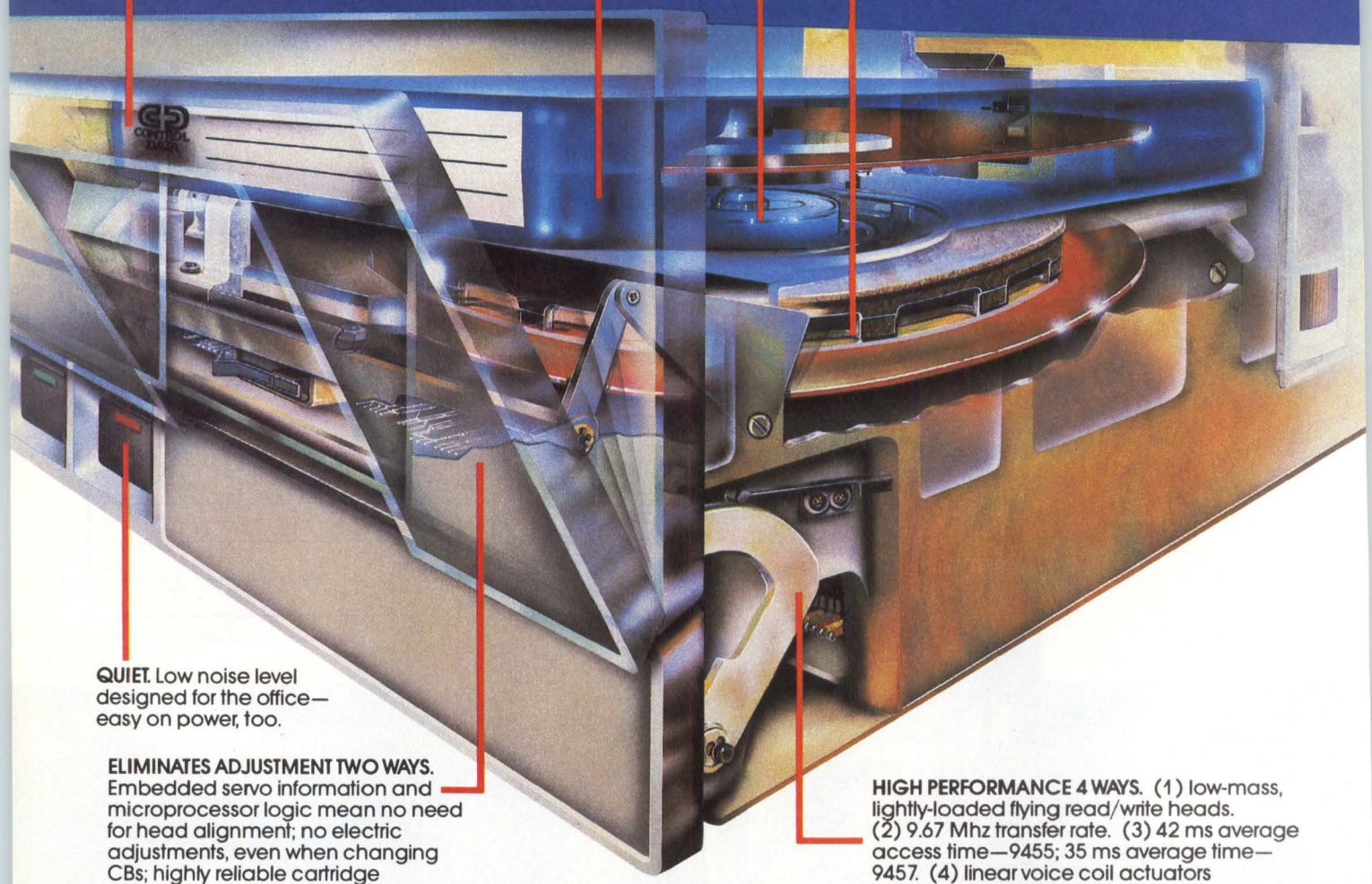

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business remains steady, "It's a little puzzling. The secondary market at the systems level is weak," he says. But, he adds, "The secondary market at the piece [peripheral] level is fine." Newman says that, possibly because of recessionary budget cutbacks in data-processing departments, many of his customers buy new disk drives or upgrade memories to keep their systems running longer instead of buying entire systems.

Also, long delivery time for new equipment—formerly a major reason for users to buy used equipment—has been shortened to 30 days in many cases. Newman recalls that the late 1979 introduction of the 11/44 caused stepped-up demand for used 11/34s because delivery times for 11/44s were as long as a year. Most dealers of used equipment offer immediate delivery. As a result, they are getting squeezed on one end by minicomputer manufacturers' competitive delivery times and on the other end by microcomputers' price/performance.

Indeed, while the old minis await their fates in basements, state-of-the-art microcomputers get previewed in upstairs offices. For example, on the second day of American Used Computer's clearance sale, a marketing team from Otrona Corp. anxiously tried to convince Grinker to add the company's portable, Z80A-based, 18-lb. Attache computer to its line of available equipment. The Attache, retailing for $3995, including several software packages, stands in sharp contrast to the 4K-word PDP 8I gathering dust on a shelf in American's cellar. When new in 1968, a PDP 8I sold for $12,800. There was still some life in them in 1976 when the Newman Computer Exchange was selling used models for $1500. But now, with a price tag of $250, the 8I will be lucky if it escapes the scrap heap.

As a further testament to the changing market, American offers a PDP 8 with serial number 13 for $49,000. Monosson claims he has been offered $25,000 for the "antique."

Despite the poor market for used minis, 32-bit units are still being developed, and it seems certain that the market will not disappear altogether. "Instead," Monosson says, "it will become a smaller industry with greater profitability—a dealer business, not a broker or lessor business." He predicts a sharp decline to a $1-billion used-equipment market in 1986, with the minicomputer portion only 1 percent.

—*David A. Bright*

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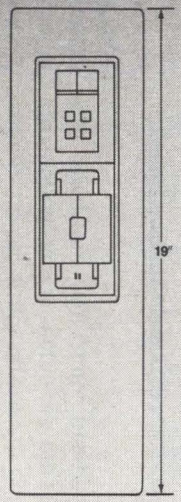


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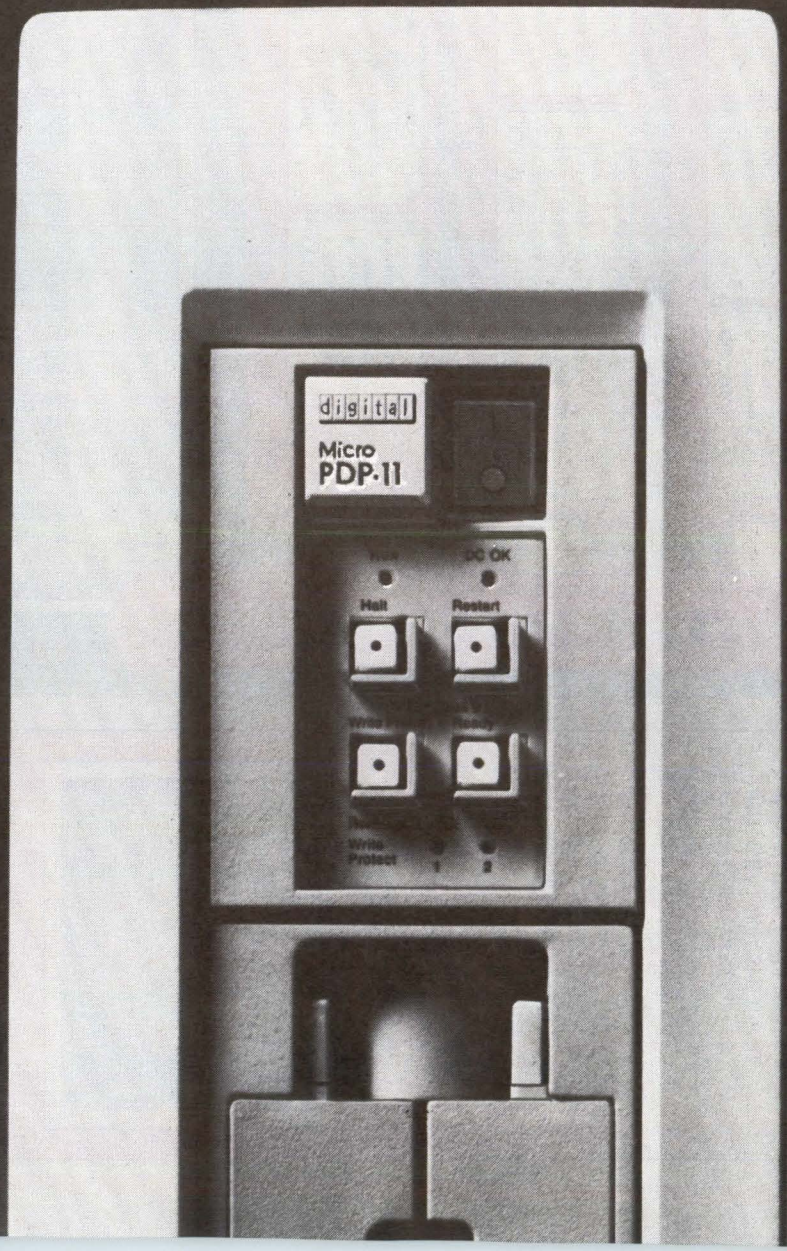

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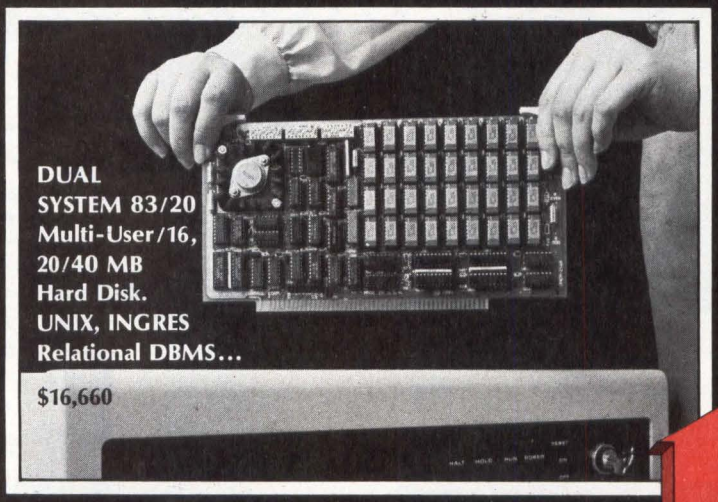

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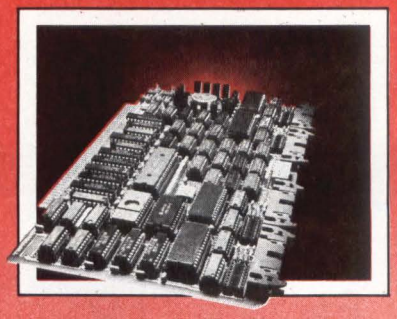

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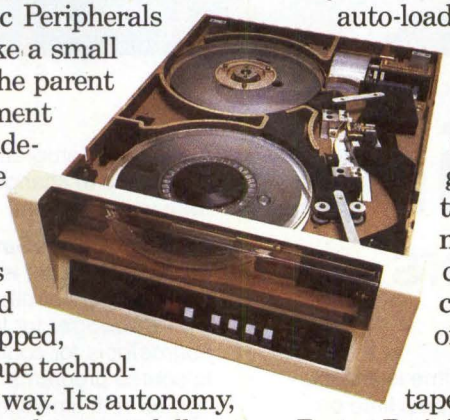

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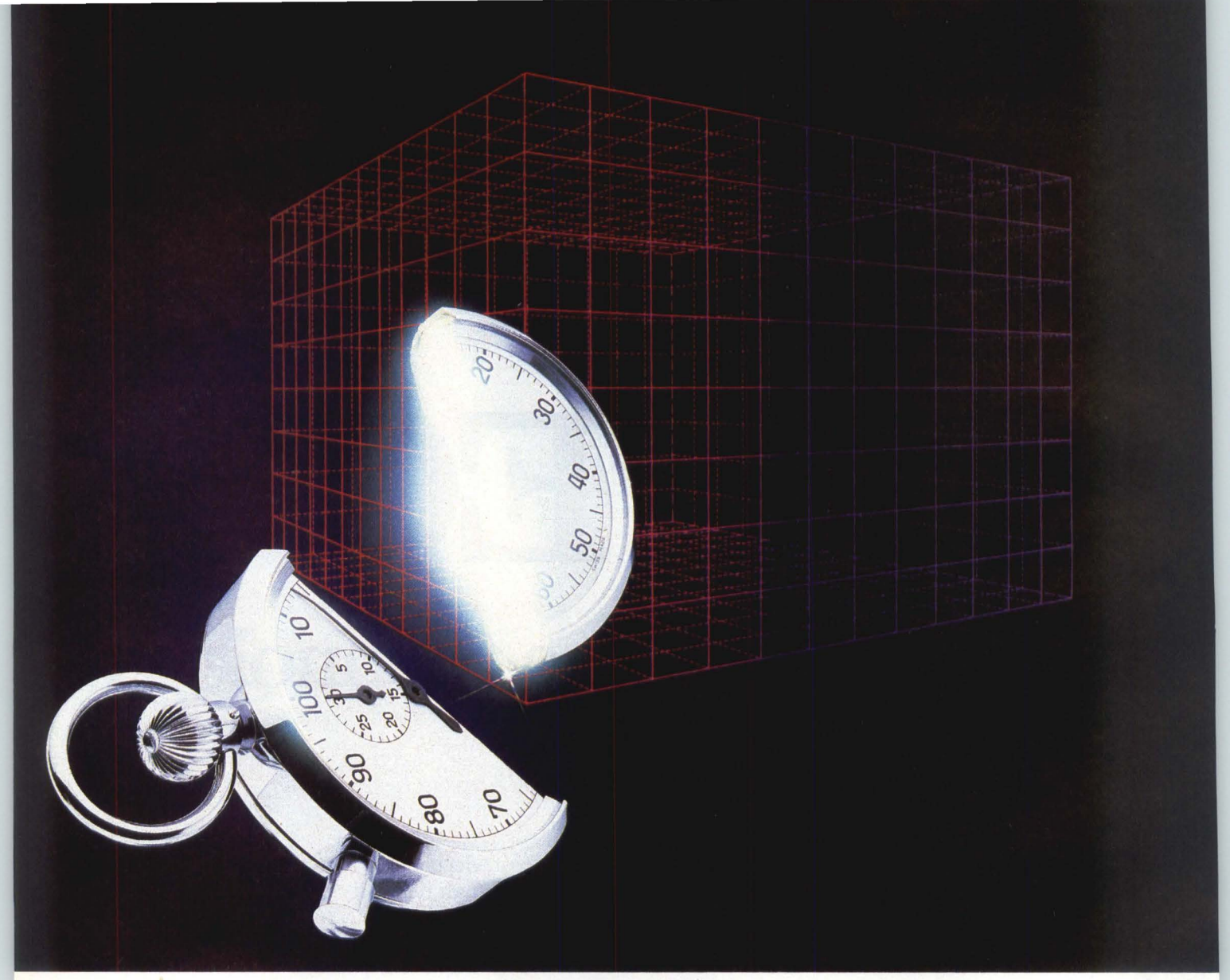

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# DG service may be testimonial to a changed company

Data General Corp. has used the lean economic period, during which its mainstay minicomputer products suffered depressed sales, to build new muscles to flex in service when the economy rebounds. Field service results may be a testimony that, after reorganizing and losing carloads of key managers, the controversial company truly may have made headway in extending its hardware-only focus to end-user sales. And, it has done so while cleaning up a spotty service record (see "Service for railway is turning point for DG," p. 50).

The change in service is a change in the way the entrepreneurial organization operates. Now, rather than 60 islands doing things 60 ways, the company provides uniform delivery of service with standards, quality and efficiency, says William W. Bentley, vice president of North American field engineering.

The company boasts an investment in the last two years of more than $16 million in field-service facilities and the addition of 600 field engineers to support service operations (see "DG's service pitch," p. 48).

The cost of supporting increased field engineer productivity is one DG finds worthwhile. "The [returns from the cost] to increase productivity of the field engineers are greater than the increase in inventory costs," says Anthony C. Nicoletti, vice president of support services in the DG Service Inc. subsidiary. "There is a corresponding decrease in the average response time for customers," he says.

Service response time is not as critical to DG's OEMs as it is to large end users whose uptime determines how successfully they run their businesses. OEMs buy large quantities of "vanilla" machines and store them in a warehouse, explains Fred Cochrane, vice president of DG's engineering services. Thus, it could be six months before a machine is pulled off the shelf and a failure is discovered. Because OEMs usually have more hardware in stock, repairs are not as time critical as those for end users, he notes.

Mandating the focus on service is DG's zeal to supply more complete systems to large end-user houses. Good service to these customers means repeat hardware business. Another expected boon to service will be new installations, especially of the company's MV series 32-bit minicomputer line. "It's crystal clear that the direction we're pushing is with 32-bit [systems]," says Frank P. Silkman, senior vice president of worldwide field engineering. He declines to reveal what percentage of the service business is planned for those high-end computers, the oldest of which has been on

**Frederick P. Cochrane, William W. Bentley, Frank P. Silkman and Anthony C. Nicoletti** *(left to right) are cooperating to present uniform service, particularly for large end-user customers that DG wants to court.*

the market about one and one-half years. For a 4M-byte, 32-bit product, typical service is priced at $1500 per month including on-site four-hour response time nine hours per day.

Silkman says the hardware service organization and the software support group will try this year to present a unified front. DG has more than 100 maintenance sites in the U.S.

While 1982 was a slow year generally for DG's revenues, field-service business grew at about 25 percent. Field-service and other revenues, which include software services through the company's system engineering group, were $188.7 million, up from $148.3 million in 1981, or about 23 percent of total revenues. Overall revenues last year were $805.9 million, up from $736.9 million in 1981. Service revenues for the first quarter of this year were $48.4 million, up from $40.8 million in the first quarter of last year.

Inventories of field engineering parts and components, which DG listed separately for the first time last year, were $102.5 million of a total $262.4 million in inventories. DG officials decline to specify what percentages of field-service revenues were allocated to maintenance gains and to increases in spare parts sales. However, one official notes that the company could not provide as satisfying or complete a service if it sold only spares. Nicoletti says the company's largest investment in inventories has already been made.

Wang Laboratories Inc., one of the few other minicomputer makers to list spares inventories separately, had $128.2 million in field-service parts and assemblies last year and $83.1 million in 1981. The $128.2 million is part of a total of $374.2 million in inventories. Wang's overall revenues topped $1.1 billion last year, with $216.9 million devoted to service revenues and rental income.

DG president Edson D. de Castro noted in the company's annual report that "It [service] is a critical factor in winning equipment sales and represents a major continuing investment, promising returns in

*Text continues on page 55*

## DG'S SERVICE PITCH

Although Data General Corp.'s service business began in 1975, the push to strengthen it has come into force during the last two years. The picture DG presents to its customers includes:

- Of a 1982 total of 2110 field engineers and 605 (software) system engineers, 600 field engineers were hired since 1980. Total company employment last year was 15,210.
- Revenue per qualified field engineer was $106,000 last year, up from $87,750 in 1981.
- Customer satisfaction survey data compiled by DG, which is based on an IBM Corp. rating of 1 to 10, shows DG service has improved from a 1977 low of 6.6 to the 1982 level of 7.6. First-quarter results were the highest so far—7.9. The industry norm is 7.5.
- Field inventory at branch offices was increased $10 million last year to $34 million.
- The availability of parts in stock requested by field engineers has improved from 45 percent of the time in 1980 to 85 percent of the time last year.
- DG has installed $1.5 million in automated test equipment since 1980.
- DG has added field engineer training centers, including a $6-million center in Woodstock, Conn., and a center in Warrington, England. Field engineers average 33 days yearly updating their skills at such facilities.
- A $10.2-million product-repair and logistics center near Milford, Mass., is DG's relatively new worldwide field engineering headquarters. The Milford facility doubled board-repair capacity to 3000 units per week. The repair center in Milford employs 275 people on two shifts. There is a 55,000-sq.-ft. test area, 15,000 sq. ft. of office space and a 50,000-sq.-ft. warehouse, all of which is contained within 275,000 sq. ft.

**DG's worldwide field engineering headquarters** *was moved to Milford, Mass., last year. The facility also serves as the product-repair center for North America. It allowed DG to double board-repair capacity to 3000 units per week.*

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## SERVICE FOR RAILWAY IS A TURNING POINT FOR DG

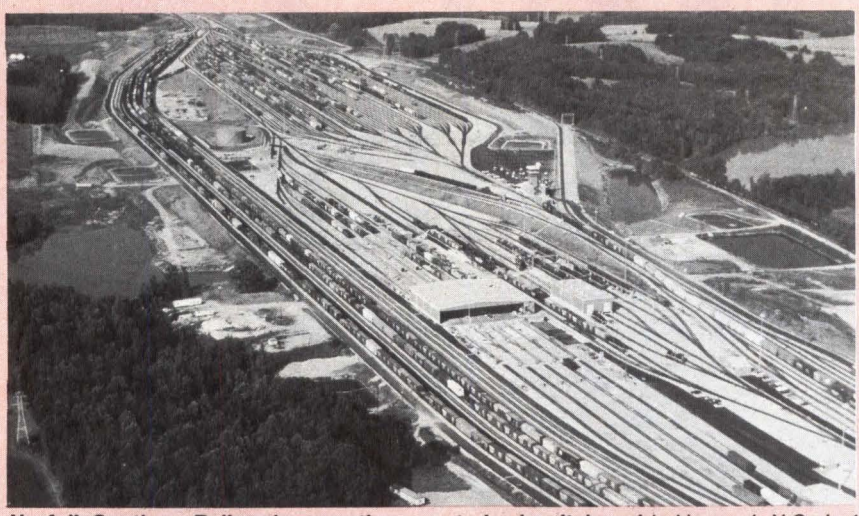
It does not take much imagination to realize what the profit potential of providing computer service for a $3.5-billion corporation would be. But the difference between realizing what those revenues are and actually realizing them is great, especially when the corporation is a railway demanding year-round service 24 hours a day. This is especially true for a service organization that is not accustomed to 24-hour-a-day response time.

In 1972, "iron" maker Data General Corp. first met Norfolk Southern Railway (then Southern Railway), and DG's change to a more responsive end-user service organization developed its roots. Southern was working with General Railway Signal Co. to automate Southern's first railway switchyard in Sheffield, Ala. The automation began with a network of five DG Nova 1200 minicomputer systems, three of which were on-line and two that served as hot backups.

"In 1972, this was an unusual decision. The term 'distributed processing' wasn't invented yet," says Jack L. Jones, executive vice president of the railway, who has headed the company's computer electronics efforts since 1963.

The Sheffield project, which also converted a flat yard into a yard with a hump to move train cars better, was to include 600 inputs as trains were moved over the hump and 300 outputs. The Nova minicomputers, which were located at the switchyard, were tied to an IBM mainframe in Atlanta. The inputs included radar measurement of car speed, sensors in the track to detect whether metal, such as that from train wheels, moved over the track, the weight of the train, the location of a car and whether all sets of wheels passed over the track. Outputs included throwing switches on the track and reducing a car's speed.

An observer in a tower also monitors all car movement on a closed-circiut television. Thus, the computer does not detect nonexistent cars or not see other cars. Jones notes that if one car in 100 gets out of step going over a hump, many cars will be pushed over the train yard without the computer's knowledge. He says that a typical car weighing 120 to 130 tons moving 2 to 3 miles per hour faster than desired is considered a runaway.



**Norfolk Southern Railway's seventh computerized switchyard** *in Linwood, N.C., is 4 miles long and handles thousands of freight cars weekly on its network of receiving, classification and forwarding tracks.*

The computers also help gather all cars going in the same direction and determine, for inventory and billing purposes, how long they are on a track.

The Sheffield project improved productivity, so Southern continued to automate its yards. The railroad has automated its 40 largest rail yards with the same system. In 18 of the yards, there are one or two hot backup machines. DG, however, did not automatically receive that upgrade business. Jones says service made the difference in the choice of products after initial automation.

"At Sheffield, we had a terrible time getting DG to fix things," Jones recalls. Although there was a DG representative 60 miles away in Huntsville, Jones says, service was so poor that Southern considered maintaining the equipment. He adds that because the CPUs were reliable, he started working with DG to develop the maintenance activities in 1977. "It took a while to build, and at first, it left a lot to be desired," Jones says, citing parts problems. "A guy would come out and say, 'Yeah, it's broke,' and would return two days later with a part."

Jones suspects that DG began to notice Southern's potential as a customer and worked to get maintenance in place. DG spent a considerable amount of money on parts and inventory, Jones adds. "In the past two years, we've had outstanding service."

Southern's standard service request is to have a repair within six hours after the service call; otherwise, penalties are assessed. "It's rare that DG is not accommodating," Jones says. "If you can satisfy a railroad's maintenance requirements, by nature of our round-the-clock business and our being spread out in hundreds of locations in 13 states in the Southeast, it's a feather in your cap."

That feather includes selling Norfolk Southern about 100 S130 minicomputers, which Norfolk has converted to C150s by a board upgrade, and 250 microNova-based CRTs. Jones is completing the conversion to the AOS operating system and DG interactive COBOL.

# If you've got logic... PacTec enclosures make sense.

In fact, PacTec enclosures are the logical choice *whatever* your computer application. Our family of systems enclosures—desktop consoles, keyboard housings, CRT terminal housings, and over 50 models of smaller enclosures ideal for modems or power supplies—has sensible features built in so you can package your product or complete system in less time and for less money than you could with vacuum-formed, custom-molded, or metal enclosures.

**Sensible Appearance.** Kits and production units, available off the shelf, offer an attractive family look, with smart styling and molded-through color for long-lasting appearance.

**Sensible Construction.** Modular units constructed of impact-resistant, flame-retardant ABS are easy to design into and easy to assemble.

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We have complete in-house capabilities from design through production, providing you with a single source for purchasing any system enclosure and/or modifying it to meet your design requirements.

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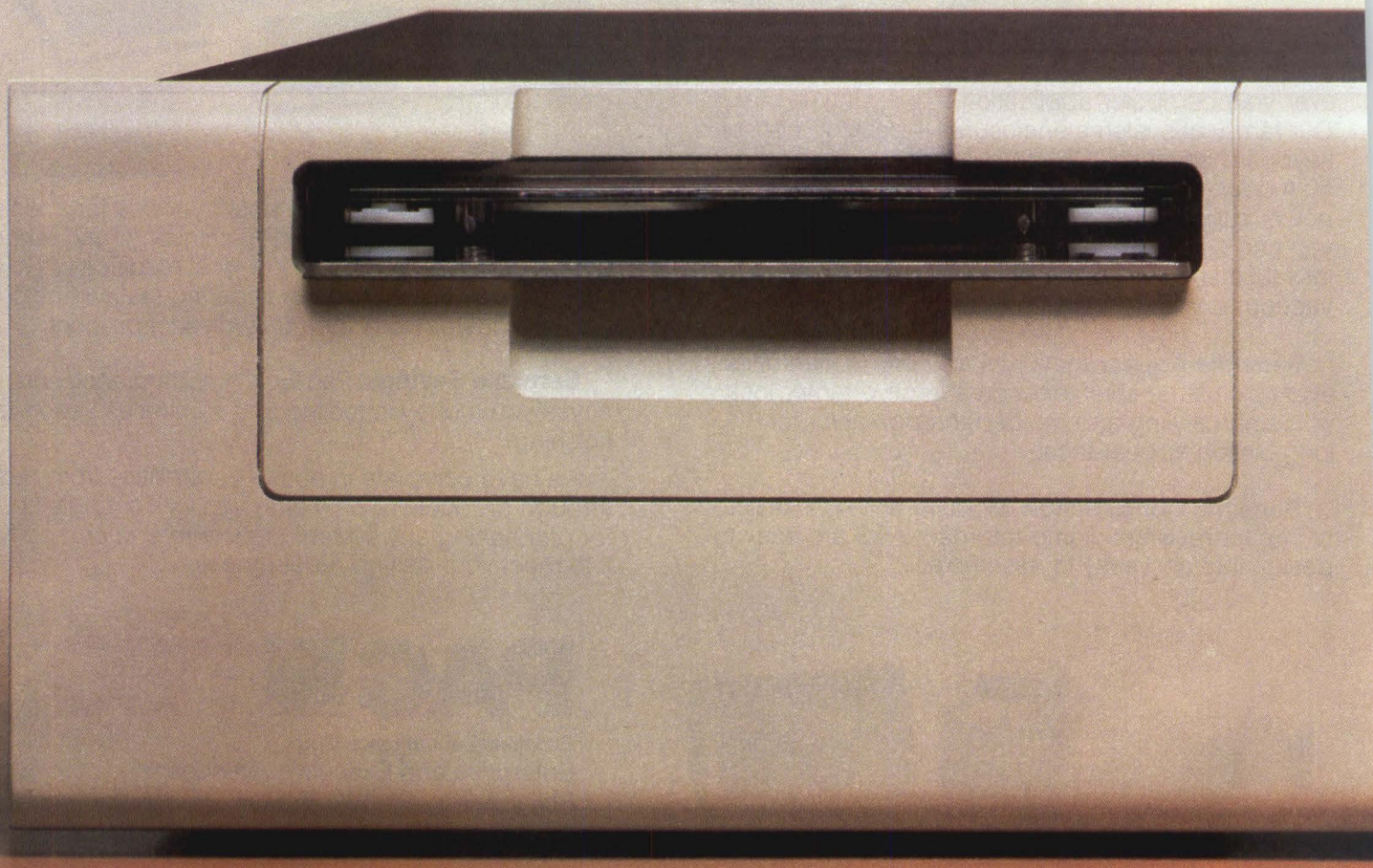
CIRCLE NO. 33 ON INQUIRY CARD

# BUILT BY POPULAR DEMAND.



## Introducing the DSD 890 DEC-Compatible Winchester/Tape.

Last year, Digital users made a big deal about our 880 Winchester/Floppy system, with its incomparable features, performance and price. And ever since then, they've been crying for more of the same, only with a tape back-up instead of a floppy.

So be it.

Witness the 890 Winchester/Tape. A 31.2 Mb Winchester and an ANSI standard ¼" cartridge tape drive for quick and inexpensive archival storage, back-up and software distribution. All in one neat package.

To get the same kind of capacity from Digital, you'd need a whole rack full of equipment.

Three RL02s and a TS-11, to be exact.

And you still wouldn't get the same kind of performance. The 890 is up to 15% faster than the RL02, thanks to our non-interleaved data transfer mode. (We can even handle simultaneous instructions to the Winchester and tape with no, we repeat, no degradation in performance.)

There's a big difference in price, too.

The 890 is about half the Digital alternative.

Yet it's just as compatible.

Our Winchester emulates the three RL02s you don't have to buy. And our tape emulates the TS-11 so that you can use all of DEC®'s handy back-up utilities. What's more, our emulation of the RL02 and TS-11 allows you to take full advantage of 22-bit addressing.

We've even designed our front bezel so it goes nicely with a PDP®-11/23.

And we've improved our HyperDiagnostics.™

Not an easy task to be sure, but on the 890, one button runs all self-diagnostics and testing. You don't even have to take off the bezel; there's a convenient little open/close front door instead.

Some things remain unchanged, though.

Like our Rapid Module Exchange,™ HyperService,™ and our nationwide sales and support network.

Because, quite frankly, we think they're already pretty good.

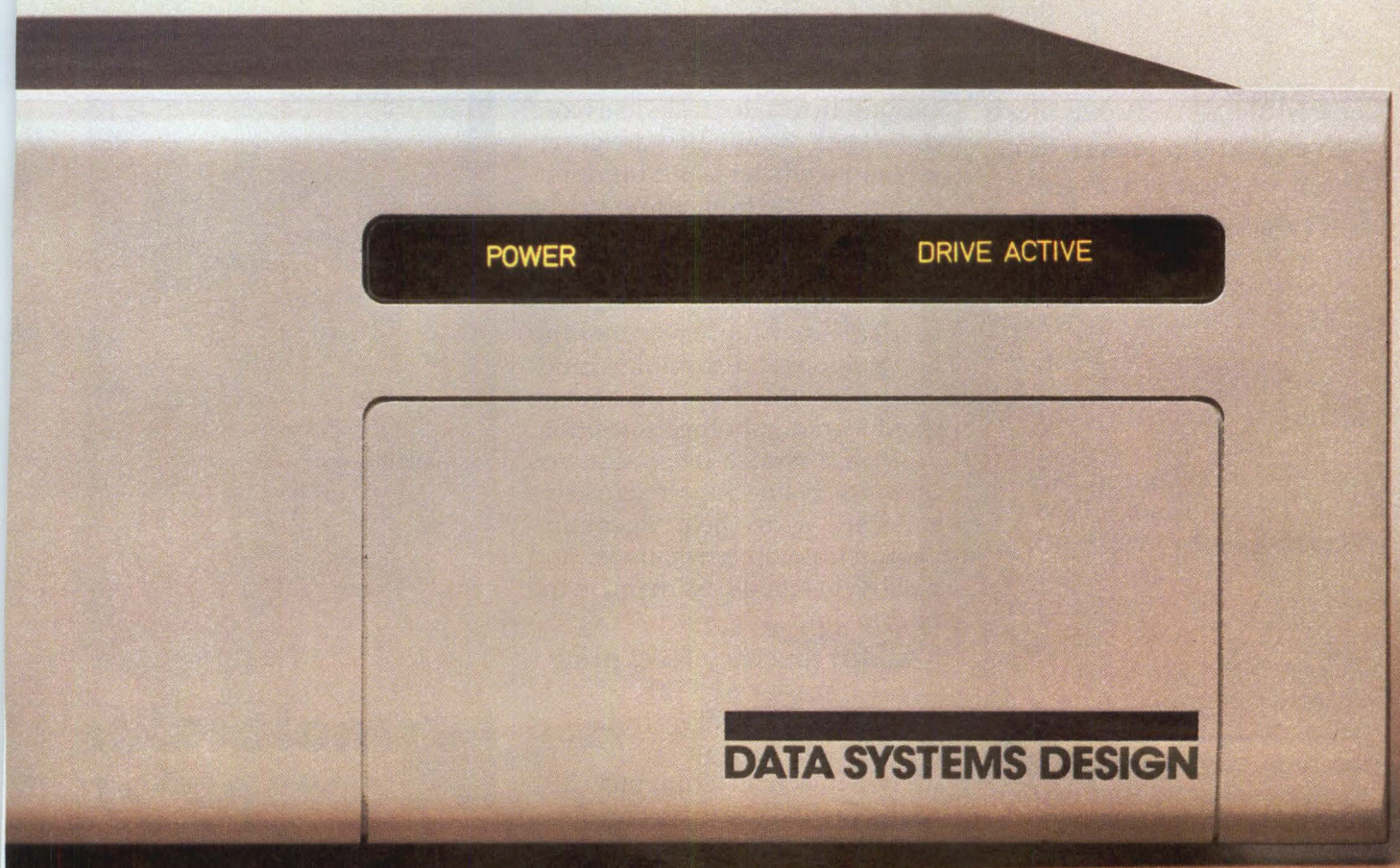
But if there's anything you think we can do to improve them, please let us know.

We don't want to say we're responsive, but when you say "jump," we leave the ground and wait for further notice.

Which explains why we're so high on the 890.

Corporate Headquarters: 2241 Lundy Avenue, San Jose, CA 95131. Eastern Region Sales and Service: Norwood, MA, (617) 769-7620. Central Region Sales and Service: Dallas, TX, (214) 980-4884. Western Region Sales: Santa Clara, CA, (408) 727-3163.

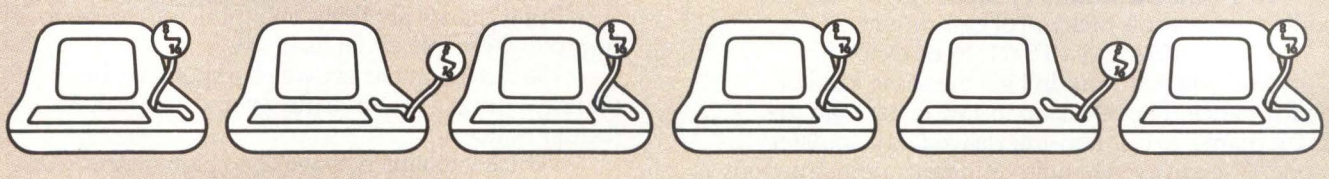
**DATA SYSTEMS DESIGN**




**INTERNATIONAL SALES:** Australia 03/544 3444; Belgium and Luxembourg 02/7209038; Canada 416/625 1907; Denmark 02/63 22 33; Finland 90/88 50 11; France 03/411 5454; Hong Kong and Peoples Republic of China 03/668252; Israel 03/298783; Italy 02/4047648; Japan, Osaka 06/323 1707, Tokyo 03/345 1411; Netherlands 020/02977-22456; New Zealand 04/693 008; Norway 02/78 94 60; Singapore, Malaysia and Indonesia 2241077; Spain 01/433 2412; Sweden 08/38 03 70; Switzerland 01/741 41 11; Taiwan, ROC 02/7719803-5; United Kingdom 7073/34774; West Germany and Austria 089/1204-0; Yugoslavia 61/263 261.

**CIRCLE NO. 34 ON INQUIRY CARD**

# Torn between 8-bit economy and 16-bit power?



# Molecular gives you both.

### The Molecular Supermicro gives you the power you want—when you want it.

Molecular's Supermicro is the world's most responsive multi-user business computer. Now the AP/86 Performance Accelerator™ makes it the most flexible, too.

The Supermicro design provides each user with a CP/M® compatible 8-bit Application Processor: a Z80A and 64KB of RAM. The optional CP/M-86™ compatible Performance Accelerator allows any user to call up a powerful 16-bit 8086 CPU with up to 1MB of RAM—with a simple keyboard command. The Supermicro's unique high speed bus connects all users to a common data base (10 to 272MB), shared peripherals, and optional Performance Accelerators.

### Applications determine the CPU.

Small business users don't need 16-bit processors for most applications. In fact, for tasks like word processing, 8-bit CPUs are generally more efficient. But for applications where 16-bit power can be used effectively, the Performance Accelerator is instantly available.

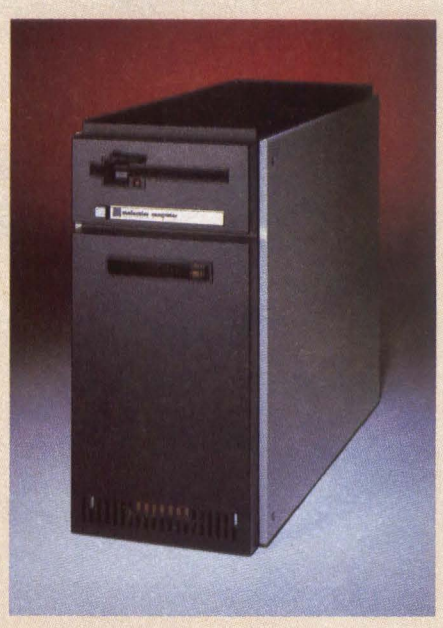
The Performance Accelerator is ideal for number-crunching applications like complex modeling, extended spread sheets, graphics, and photocomposition.

With a choice of processors, up to 64 on-line Supermicro users can stand up to their larger competitors in computing muscle. And positively embarrass them on the bottom line.

### All for an entry level price under $6,000.

To schedule a demonstration at a distributor in your area, call or write Molecular Computer, 251 River Oaks Parkway, San Jose, CA 95134. (408) 262-2122.

You don't have to choose between 8-bit economy and 16-bit power anymore. Molecular gives you both.



molecular computer™

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Text continues from page 48

future years." Superficially, those returns appear to be diminishing. Over the three years preceding 1982, service growth was about 40 percent annually. Last year, because of investments in plants, it was marginally profitable at a 25-percent growth rate, which Silkman expects to continue over the next few years. Among the factors feeding slower growth are: reduced equipment prices, better built equipment with internal diagnostics that help decrease the time of a service call and better trained personnel to decrease call time and minimize the necessity for more than one service call.

The minicomputer market's growth has slowed as well, and the number of CPUs shipped by DG has leveled off. Last year, the company shipped 13,900 CPUs, almost equal to 1979 shipments, but lower than the 17,000 listed in 1981. "Service has been growing at about double the growth rate of equipment sales over the last two to three years," says Paul Phaeneuff, manager of marketing to business planning for the field engineering division. "[We] anticipate a slowdown in [service] revenues to 20 to 25 percent over the next two to three years, which is a general industry trend, due to the reliability of equipment and remote diagnostics," says Phaeneuff. "We may be able to improve margins as we get smarter in the service organization. But the absolute dollar basis will shrink over time."

DG thus is attempting to decrease its service costs. Two-thirds to three-fourths of the field expense is labor, says Nicoletti. To drive the cost down in business is to drive the labor out of the product. This is not necessarily done by making field engineers more productive, but by building the product better.

Silkman agrees: "The way to be successful is to make machines that do not fail." He notes the MV/4000 was the first product announced with remote diagnostics, which also will be put on the MV/8000.

*—Lori Valigra*

# GUEST FORUM

*A column for guest experts to speak out*

## DP departments must guide end users

By Steven A. Epner
Independent Computer Consultants Association

As the price of computers decreases, all business operations can afford to own one. However, there is a big difference between the new users and the first pioneers in data processing.

When the original users took their first tentative steps into the world of automation, they had multi-million-dollar budgets and rooms full of technicians to support their efforts. And these fledgling in-house system integrators needed those resources. Hardware never worked as well as it did on paper, and software was a mysterious art form practiced by high priests called programmers.

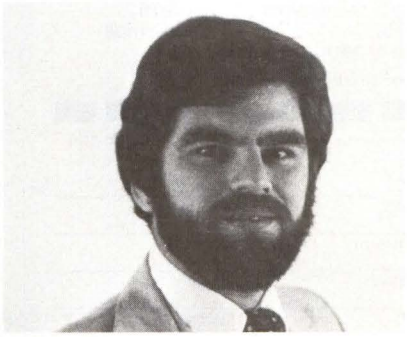
Well guess what? The world hasn't changed much. The big difference is that the new first-time user does not have the support organization within his company or department to make the computer work. It is important to point out that I am not talking just about small businesses, but also about departments and subsidiaries of the world's largest companies.

So where is the lapse in support? One answer lies with data-processing system managers. Often, they choose to retain central control of computer resources and make buying decisions for individuals outside their department. Frequently, they lose sight of the responsibility that decision implies, including educating the end user.

A large, St. Louis data-processing department recently selected a micro-based system for a subsidiary. It is obvious that the data-processing department, which is accustomed to multi-vendor equipment in large systems used by many programmers and operators, did not go out to observe the proposed computer as used in a single-user environment. The software chosen was complex and not easily understood by the end user. The company is running a risk that the purchased computer will end up on a shelf, and the data-processing department will have once again lived up to its stereotype of not understanding the users' needs.

The department did not understand or remember the amount of handholding it required when it got started. If it doesn't choose self-explanatory, easy-to-use software packages and doesn't train end users, it's dropping the ball. No one can give an unsophisticated user a magic wand with no instructions and expect results.

If the data-processing department insists on making the purchases, I recommend the managers carefully consider what the end user really needs and his ability to use the newly found tool. Involve the users in the decision-making process. If they feel part of it, you can rely on them to help make it work. And isn't that the reason we all are hired—to help implement tools to support our companies?



**Steven A. Epner** *is founder of the Independent Computer Consultants Association, a nonprofit organization representing about 1000 consulting firms nationwide. He also is president of The User Group Inc., a St. Louis consulting firm assisting large and small users in the effective use of computers.*

# Mini-Micro World

CORPORATE AND FINANCIAL

**BOX SCORE OF EARNINGS**

This monthly table lists the revenues, net earnings and earnings per share in the periods indicated for companies in the computer and computer-related industries. Parentheses denote losses. Comments are from corporate summaries unless otherwise noted.

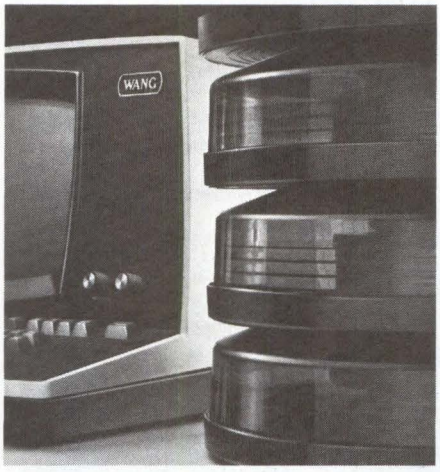
| Company | Period | | Revenues | Earnings | EpS |
|---|---|---|---|---|---|
| **Computone Systems, Inc.** | 6 mos | 11/30/82 | 10,415,000 | 827,000 | .37 |
| | 6 mos | 11/30/81 | 9,578,000 | 717,000 | .38 |
| **Data General Corp.** | 12 wks | 12/18/82 | 181,400,000 | 3,100,000 | .27 |
| | 12 wks | 12/19/81 | 183,600,000 | 14,900,000 | 1.40 |
| **Floating Point Systems, Inc.** | year | 10/31/82 | 86,591,000 | 11,546,000 | 1.32 |
| | year | 10/31/81 | 57,890,000 | 6,350,000 | .81 |
| **Gerber Scientific, Inc.** | 6 mos | 10/31/82 | 53,599,000 | 1,788,000 | .28 |
| | 6 mos | 10/31/81 | 54,279,000 | 2,140,000 | .34 |
| **Honeywell, Inc.** | 12 mos | 12/31/82 | 5,490,400,000 | 272,900,000 | 12.16 |
| | 12 mos | 12/31/81 | 5,351,200,000 | 259,300,000 | 11.35 |
| **Interdyne Co.** | year | 10/31/82 | 1,024,406 | 76,285 | .04 |
| | year | 10/31/81 | 1,002,471 | (28,335) | (.02) |
| **Magnetic Controls Co.** | year | 10/31/82 | 81,654,000 | 4,464,000 | 1.17 |
| | year | 10/31/81 | 61,500,000 | 3,542,000 | .93 |
| **Mohawk Data Sciences Corp.** | 6 mos | 10/31/82 | 177,718,000 | 5,832,000 | .40 |
| | 6 mos | 10/31/81 | 156,185,000 | 7,268,000 | .54 |
| **Penril Corp.** | 3 mos | 10/31/82 | 9,043,000 | 297,000 | .15 |
| | 3 mos | 10/31/81 | 8,629,000 | 231,000 | .12 |
| **Plantronics, Inc.** | 26 wks | 11/27/82 | 53,776,000 | 3,058,000 | .47 |
| | 26 wks | 11/28/81 | 48,706,100 | 4,171,000 | .64 |
| **Software AG Systems Group, Inc.** | 6 mos | 11/30/82 | 13,583,000 | 519,000 | .08 |
| | 6 mos | 11/30/81 | 11,082,000 | 972,000 | .16 |
| **Tandy Corp.** | 6 mos | 12/31/82 | 1,312,047,000 | 146,676,000 | 1.41 |
| | 6 mos | 12/31/81 | 1,075,979,000 | 116,706,000 | 1.13 |

**Comments:** Although **Data General Corp.'s** net earnings for the 12 weeks ended Dec. 18, 1982, declined nearly 80 percent from the previous year, company president Edson deCastro says orders so far for the new MV/4000 low-end superminicomputer have exceeded the company's expectations. DeCastro says DG hopes to stimulate demand by continuing to introduce new products. **Floating Point Systems Inc.'s** fourth-quarter sales of $23.5 million were 41 percent above the $16.7 million tallied the same quarter last year, and net earnings for the quarter were up 49 percent from $2.1 million, or 24¢ per share, to 3.1 million, or 35¢ per share, during the same periods. The company cites increased OEM deliveries of its FPS-100 array processor and increased FPS-164 deliveries to end users for the sales gain. Although **Mohawk Data Sciences Corp.'s** second-quarter sales increased 9 percent to $90.3 million from $82.7 million the previous year, net income for the quarter declined 42 percent from $3.9 million, or 29¢ per share, to $2.3 million, or 16¢ per share. The company points to a higher effective tax rate resulting from improved earnings of its international subsidiaries as a major reason for the decline.

## NATIONAL COMMUNICATIONS CENTER PLANNED

A private group hopes to begin fund-raising this spring for an $18-million National Science Center for Communications and Electronics in Fort Gordon, Ga. Charter members of the group include AT&T, Bell Laboratories, Ford Motor Co., Harris Corp., Litton Industries, Magnavox Government & Industrial Electronics, Rockwell International, Southern Bell, United Technology and Western Electric Corp. The group, which has raised $2 million, hopes to get hundreds of companies to contribute in the months ahead. To aid the money-raising effort, the U.S. Congress has recently approved and sent to President Ronald Reagan a resolution to establish the center. Congress says the center is needed to maintain U.S. scientific and technological superiority. The center will be an educational institution as well as a museum. The target date for its opening is 1987.

# Nothing adds value to great software like Wang hardware.




If you'd like to expand your business by selling your value added software with our proven office automation hardware, Wang would like to help.

Our new ISO group is now making it easy for established systems houses, software vendors, and service bureaus to work with the world's best selling data processing and office automation products.

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WANG A540

The Office Automation Computer Company





CIRCLE NO. 37 ON INQUIRY CARD

## Personalities

**Control Data Corp.** has promoted Thomas Camp to vice chairman of the corporation. Camp has been president of the company's Peripheral Products subsidiary and chairman of two independent joint-venture operations, MPI, Oklahoma City, Okla., and Computer Peripherals, Anaheim, Calif. Camp will retain his chairmanships in the latter two companies and will be succeeded at Control Data Peripheral Products by Gordon R. Brown, formerly exectutive vice president of Control Data Corp.'s international operations.

## Financings

**Rosscomp Corp.,** Cerritos, Calif., has obtained $3 million in first-round venture-capital financing from a group led by Vista Ventures, Stamford, Conn. Others in the group include Burr Eagan and Deleage, San Francisco, Brentwood Associates, Los Angeles, and Whitehead Associates, Greenwich, Conn. Rosscomp, formed in late 1981, will begin shipping its ½-in., 160M-byte backup tape drive during this quarter.

## Distribution/service deals

Compaq Computer Corp.'s IBM-compatible portable computer is being distributed by **Computerland Corp.** and **Sears Business Systems Centers.** The 28-lb. Compaq was scheduled to be available in approximately 40 percent of ComputerLand stores by this month and the remainder of qualified ComputerLands during the second quarter.


# Sky-high performance. Down-to-earth cost.

## Eagle clears the air on what it takes to buy a computer.

Forget the heavy price you thought you'd have to pay for a top-rated computer or word processor.

Nobody – but nobody – gives you more for the money than Eagle.

The era of unnecessary cost and confusion is over, once and for all.

### Eagle Power: a complete package.

A self-contained system that is fully functional with no expensive "standard options" to buy later. Just plug it in, flip the switch, and you're in business.

You get *word processing* software that speeds letters, reports, mailing lists. And stores them for easy recall.

You get *financial planning* software, an "electronic worksheet" with full "what if?" capabilities.

You get the *CBASIC® programming language* that lets you create custom software for your special business needs.

You get the *CP/M® operating system* that allows you to choose from the largest selections of software available today. And Eagle offers both flexible disk storage and integrated or add-on hard disk storage.

**New 16-bit Eagle Power: high-speed performance.**

Here's Eagle Power that's 3 to 4 times faster than the IBM PC. What's more, it is both disk-compatible and software-compatible with the IBM PC. And any board made for the IBM PC can be plugged in for the same operational capabilities. The new 16-bit Eagle is a multi-user system with networking capabilities.

**See Eagle Power in action today. For names of Eagle dealers nearest you, phone toll-free 800-538-8157, Ext. 938.**

EAGLE COMPUTER

*Above and beyond.*

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CIRCLE NO. 39 ON INQUIRY CARD

*CIES 680 Business Computer.*

# THE NEW GIANT IN MICROS

If we're calling ourselves "the new giant in micros," we had better be able to back it up.

Which we can.

And we should also have the wherewithal to back you up.

Which we do.

## *Giant performance.*

CIE Systems makes the totally modular CIES 680 series of micro business computers. And if other computer makers call their micros "state of the art," then the 680s give the term a whole new meaning.

Not only do CIES 680s exceed the performance of most minicomputers, they provide higher performance than many older mainframes.

At the heart of a 680 is the combination of the 32/16-bit 8MHz 68000 microprocessor and Intel's Multibus™ architecture.

Capacities range from one to 20 terminals, 10 to 300 Mbytes of disk, and from 256KB to one Mbyte of system memory.

And because CIES can supply OEMs with everything from boards on up, you can easily configure your system for virtually any market.

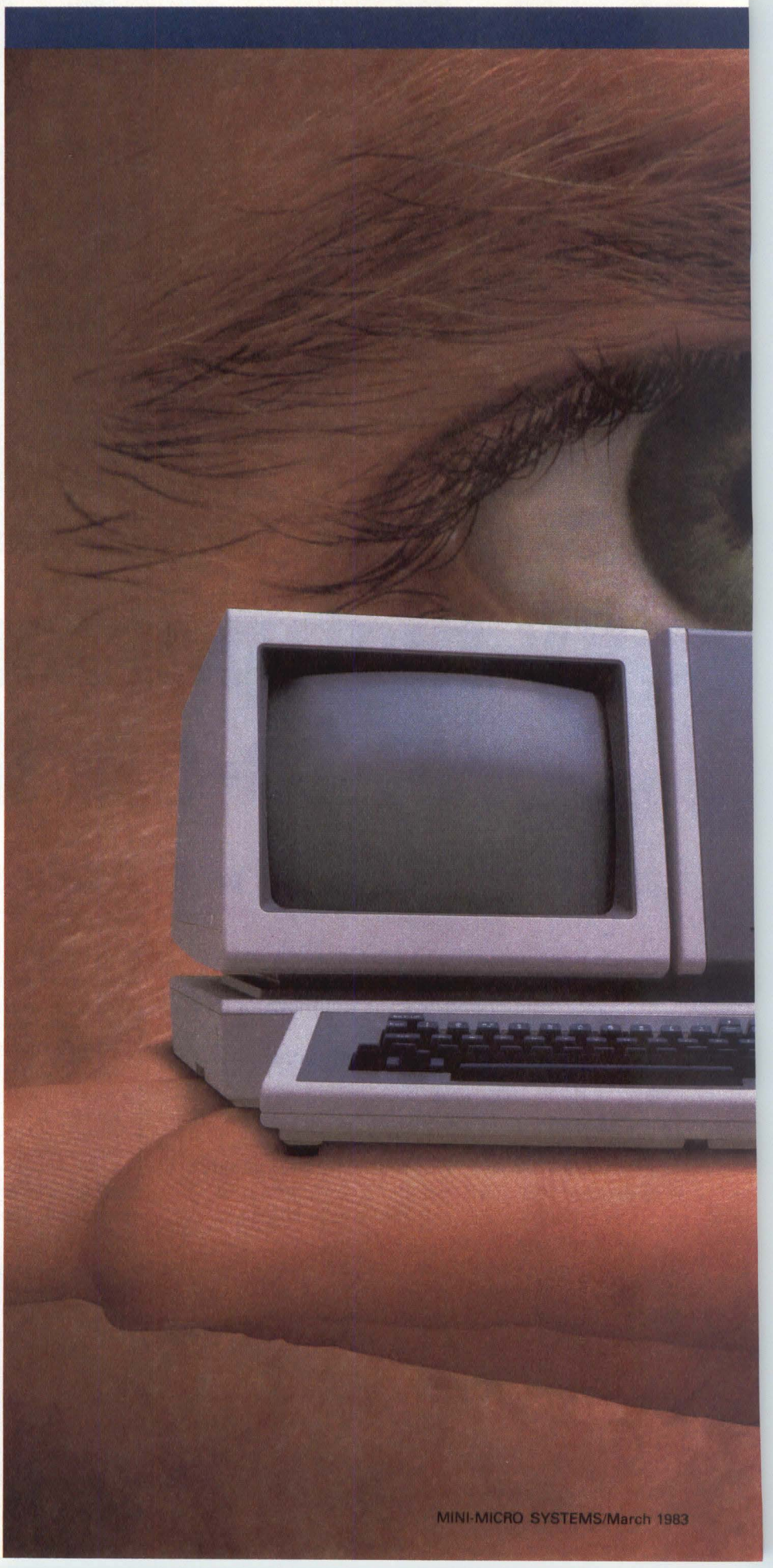
## *Giant step in software.*

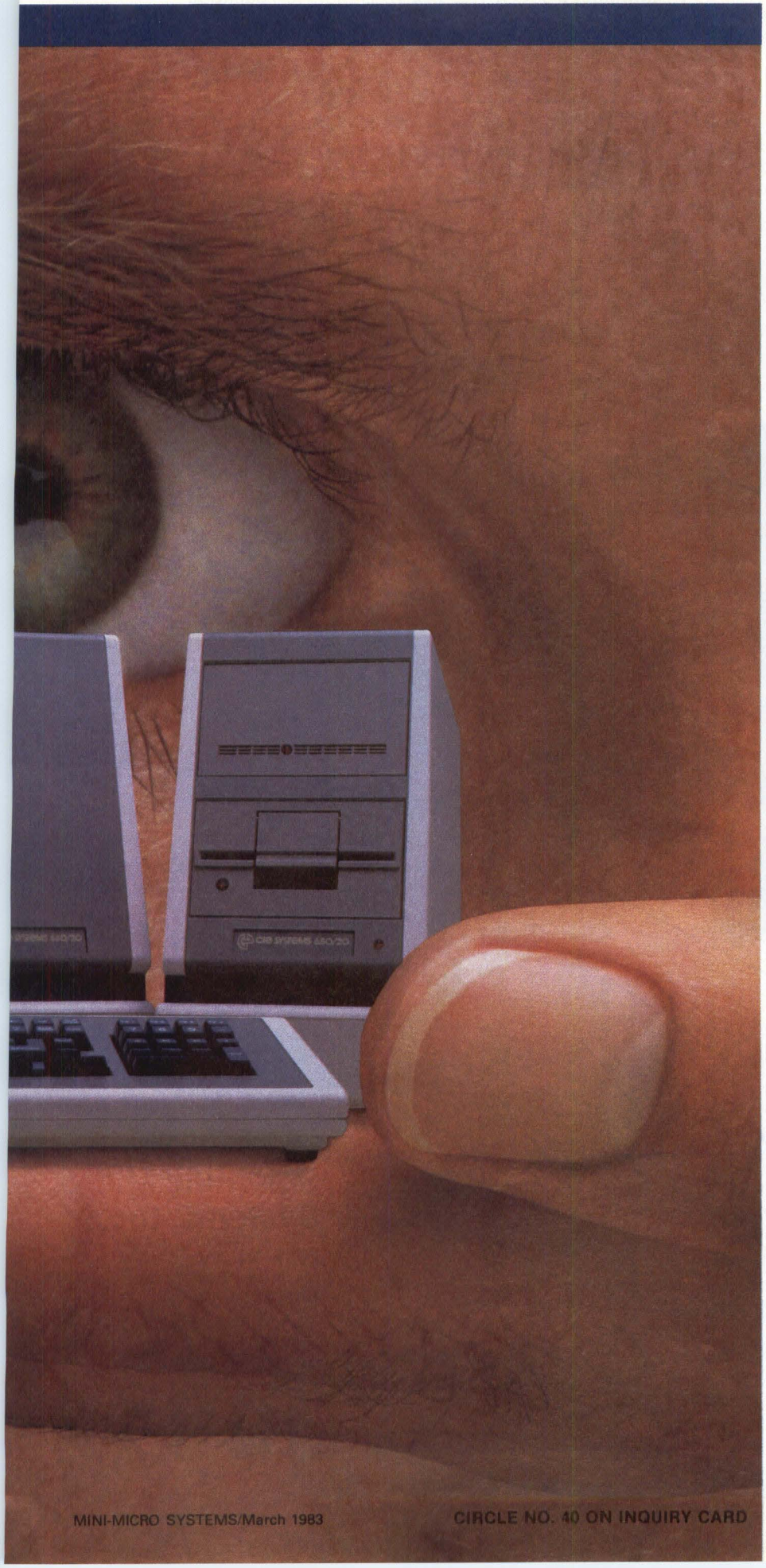
CIES provides the software to match its 680 architecture.

The operating systems offered include UNIX,™ REGULUS™ (UNIX subset) and RM/COS.™

Communication capabilities cover the full range of requirements including asynchronous, bisynchronous and bit synchronous protocols.

Language processors include BASIC, FORTRAN, COBOL and PASCAL.





Prewritten applications cover a wide variety of business operations, ranging from general accounting modules to financial modeling and word processing systems.

Even more, CIES offers PRO-IV,™ the latest in software technology. PRO-IV is an applications processor that allows you to easily and quickly develop customized applications without programming or code generation.

## *Gigantic backing.*

CIE Systems was born with all the advantages.

No computer maker has ever had greater financial or manufacturing support.

We're backed by the resources of a 125-year-old, international corporation with well over $50 billion in sales.

Our products are designed here for the U.S. market and produced abroad by one of the largest and most respected electronics manufacturers in the world.

Our future is assured. Your future can be assured with the CIES 680 Business Computer Systems and our giant commitment to continuing state-of-the-art technology and quality in any quantity.

For more information on the new giant in micros, just call or write CIE Systems, Inc., 2515 McCabe Way, Irvine, CA 92713-6579 (714) 660-1800. Call toll free, 1 800 854-5959. In California call 1 800 432-3687.

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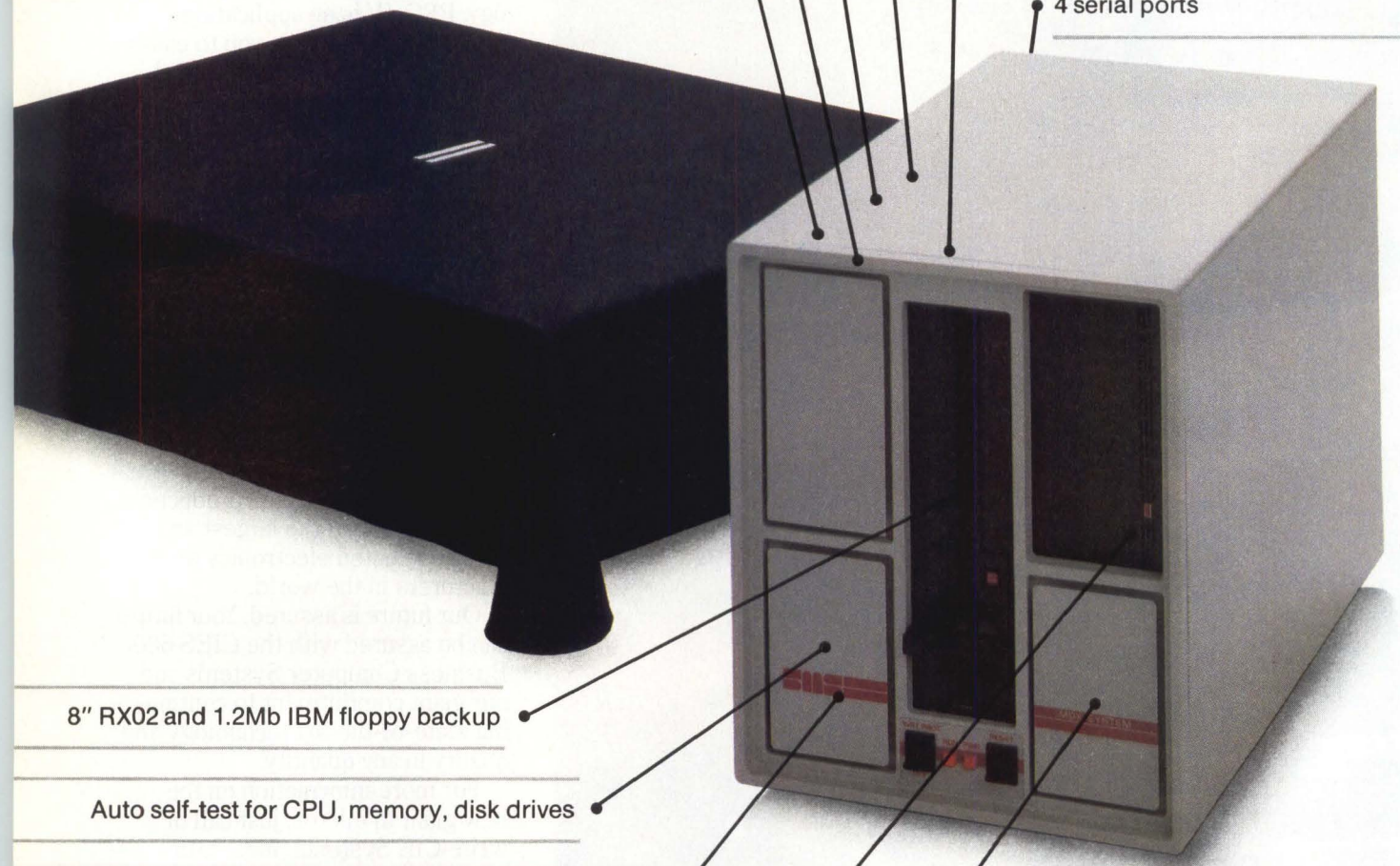
# Available now! And SMS is not afraid to show it

## A Micro Winchester System in a Micro Package



- Compact 9.5"W x 11.2"H x 17"D table top package
- 256Kb main memory (4Mb addressability)
- Expansion space for 4 dual LSI-11 boards
- PDP-11* architecture compatible with DEC* RT-11, RSX-11M and Unix** software
- LSI-11/23 processor
- 4 serial ports
- 8" RX02 and 1.2Mb IBM floppy backup
- Auto self-test for CPU, memory, disk drives
- Easy access to LED display of system faults
- 10.6Mb or 15.9Mb 5¼" Winchester package
- Advanced disk controller with ECC, flaw management, bootstrap, error retry, and direct non-interleave data transfer
- AVAILABLE WITHOUT CPU and memory for volume requirements

**Scientific Micro Systems, Inc.**

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* Trademark of Digital Equipment Corporation. ** Trademark of Western Electric.



CIRCLE NO. 41 ON INQUIRY CARD

XEROX

**Okay. Tell me how I can replace my impact printer with the Xerox 2700 and get speedy printing, too.**

Name/Title_____

Company_____

Street_____

City_____ State_____

Zip_____ Tel. (____)_____

Mail to: Keith Davidson, Xerox Printing Systems Group, 880 Apollo Street, El Segundo, CA 90245. Or call (213) 615-6329.

MMS 3/*83*

**Okay. Tell me how I can replace my line printer with the Xerox 2700 and get letter-quality printing, too.**

Name/Title_____

Company_____

Street_____

City_____ State_____

Zip_____ Tel. (____)_____

Mail to: Keith Davidson, Xerox Printing Systems Group, 880 Apollo Street, El Segundo, CA 90245. Or call (213) 615-6329.

MMS 3/*83*

# There are two ways to look at the Xerox 2700.

The first is as a letter-quality printer. The second is as a speed printer.

That's because the Xerox 2700 distributed electronic printer actually functions as both.

But in a very creative way.

You see, it doesn't limit you to typical word processor and data processor type styles.

It lets you choose from a wide variety of font sizes, designs, styles and weights. And it lets you change them, even within a single line, if you want.

It also lets you print logos and signatures, actually format a page with headings and subheadings, and create simple forms or bar charts.

So your documents end up with a customized, print-shop look.

And the people you send them to end up getting them at a handy 12 pages per minute.

But what's nicer is, the Xerox 2700 is very small. And very quiet. So you can place it exactly where it's most convenient for the people who need it.

Terrific, you may be thinking, but what does this amazingly flexible, high-quality electronic printer cost?

Not at all what you'd expect.

To find out, just mail in one of our coupons.

Either one will bring you a very pleasant surprise.

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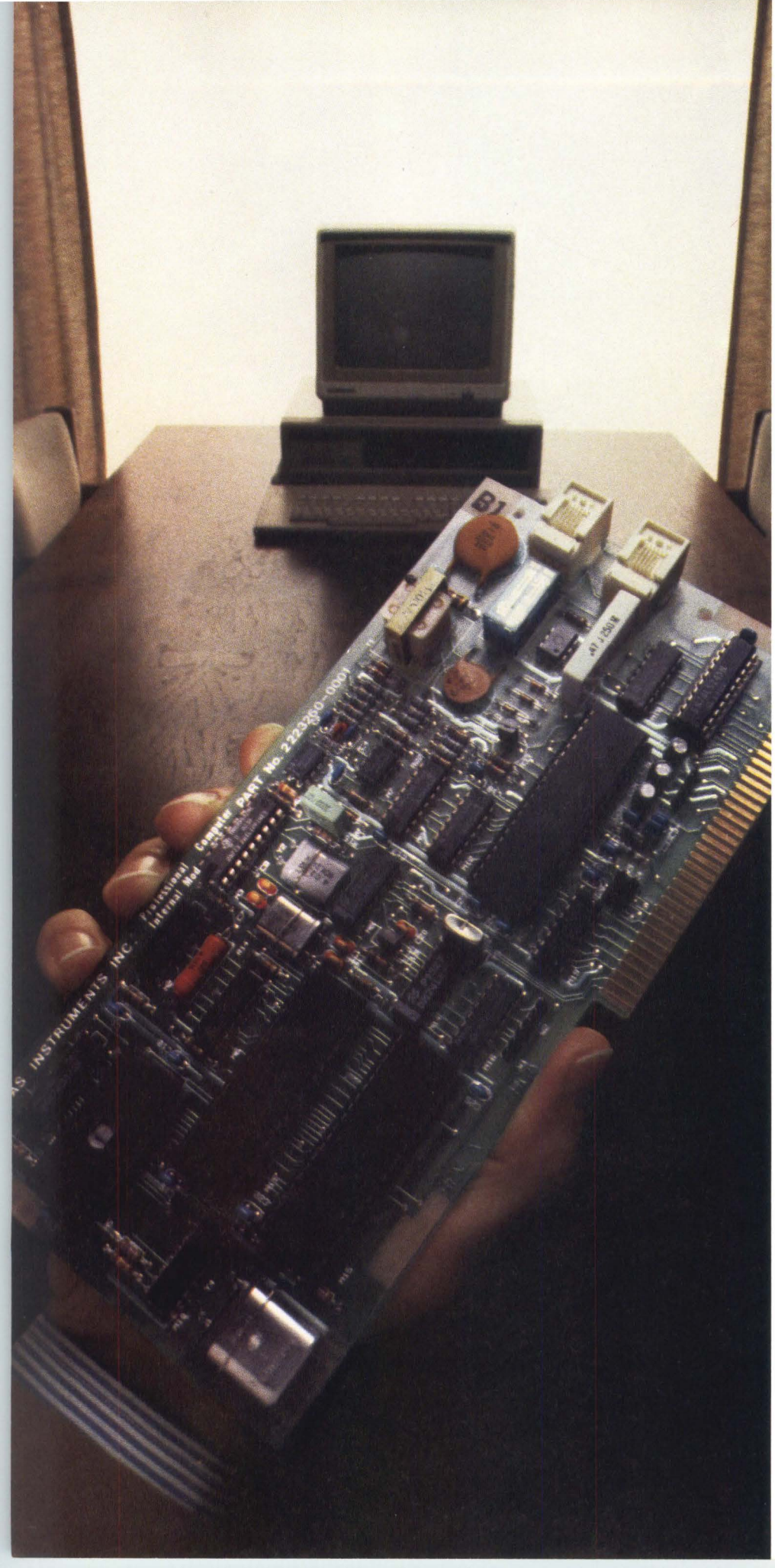
# Texas Instruments and Racal-Vadic team up to slim modems down.

- **TI's new TMS99532 modem chip** enables Racal-Vadic to slim modems down from large subsystems to small-scale components *(Page 2)*.
- **Packing more functionality on chip,** TI universal microprocessor peripherals cut system size, boost overall performance *(Page 3)*.
- **New CMOS A/D peripherals** reduce component count and power requirements in microprocessor-based systems *(Page 4)*.




# By using cuts size

That's only the beginning of what's happening to modems at Racal-Vadic, world's largest supplier of low- and medium-speed modems. Couple those space savings with 3-to-1 reductions in power requirements. And in costs.

Racal-Vadic's key to shrinking the modem is the new TMS99532 FSK modem chip from Texas Instruments.

Result: Modems no longer need be large PC boards, or expensive, space-consuming, stand-alone subsystems. They are simply becoming small-size components in such equipment as the new professional computer shown here, in interactive terminals, in point-of-sale and in credit-verification systems.

## Performance-packed package

Racal-Vadic calls TI's TMS99532 "the only complete Bell 103-compatible modem chip on the market." In a space-saving 18-pin DIP, the '99532 provides all the modulation, demodulation, and filtering functions needed for a serial, asynchronous-communications link.

Parts count in Racal-Vadic full-duplex modems has been cut by around 40 ICs and board size reduced from approximately 75 square inches to 25. But with room left for Racal-Vadic to add needed intelligence — for auto dialing, pulse and tone dialing, as well as number storage.

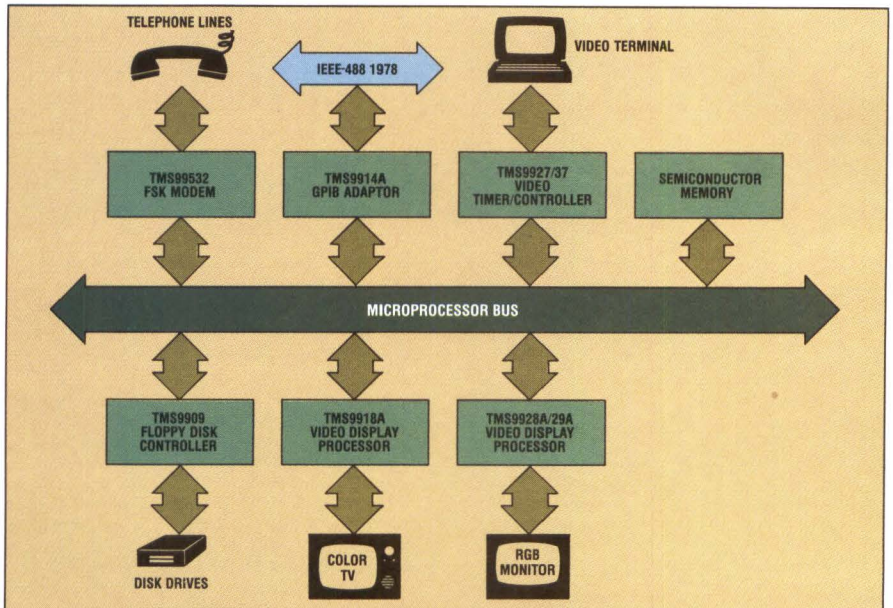
TI's '99532 modem chip has a maximum continuous power dissipation of 550 mW and a TTL-compatible digital interface. It can be direct-connected electronically through FCC registered interface circuits, or acoustically via a microphone and speaker. Interface to a handset requires only a few operational amplifiers. Racal-Vadic finds the TMS99532 extremely reliable and uses the device in other products.

**For more information** on the TMS99532, as well as the TMS99543 designed to meet European requirements, return the coupon at the end of this ad. Or call your nearest TI distributor or TI field sales office.

---

◀ **Slim size, trim cost** characterize Racal-Vadic's innovative modems. Full utilization of the functionality packed into TI's new TMS99532 modem chip results in substantially fewer components.

# TI's '99532 chip, Racal-Vadic of modems by two-thirds.




**Universally applied with any microprocessor,** TI's new highly functional, single-chip peripherals reduce component count, cut costs, and improve reliability in popular 8- and 16-bit microsystems.

## TI's advanced microprocessor peripherals: Fewer parts, lower costs, better reliability.

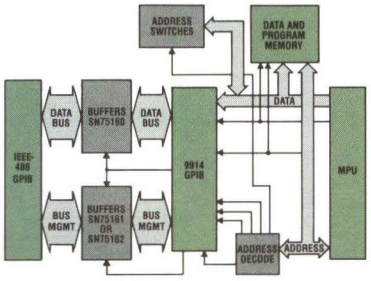
The TMS99532 modem chip that helped Racal-Vadic pare modem size is just one of TI's advanced microprocessor peripherals. Each new single-chip component performs functions that usually require multiple devices. Or entire boards.

Best of all, they are *universal* — compatible with all popular 8- and 16-bit microprocessors. So you can upgrade your design now, yet save your software investment.

### Flexible, versatile floppy disk controller

TI's TMS9909 controls the floppy disk drives used in today's word processing, business, and industrial systems, as well as personal computers.

The TMS9909 reads from or writes into partial, single, or multiple sectors of hard or soft disks. It simultaneously controls two different disks and can support any combination of up to four different single/double-sided standard 8″ or 5¼″ mini disk drives. It can be used with all data-recording formats and frequency-modulation data-encoding formats.




**Minimum System Solution** using TMS9914A GPIB Adapter

### Single-chip GPIB adaptor

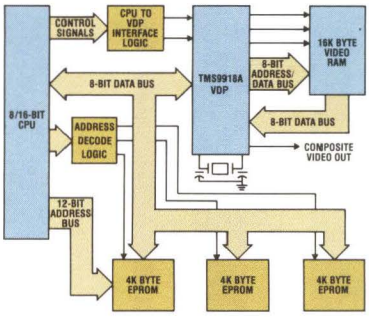
The Texas Instruments TMS9914A combines talker, listener, and controller in one General Purpose Interface Bus Adapter. And meets IEEE Standard 488-1975, 1978, and 1980 revisions.

TI's TMS9914A provides a flexible, unambiguous interrupt structure which separately latches all interrupts. No lost interrupts. No spurious interrupts.

And the '9914A is fast on the bus: Data rates as high as 500K bytes per second are possible.

### Simpler color video display processor

Video and arcade games. Home computers. Graphics terminals. Learning aids. Industrial process monitoring. Drafting and animation systems. You create an entire color system for any of these using only TI's TMS9918A display processor and picture storage dynamic random access memories (DRAMs). The composite video is generated directly on the chip, and refresh of the DRAMs is automatic and transparent.




**Minimum System Solution** using TMS9918A Video Display Processor

The '9918A produces 15 colors plus transparent, with 256 x 192 pixel on-screen resolution. The similar TMS9928A (525 lines) and TMS9929A (625 lines) offer separate luminance and chromance outputs for better resolution with R-G-B monitors.

### Industry-standard video/timer controller

Pin-compatible with industry-standard 5027s and 5037s, the TI single-chip TMS9937 generates video display timing signals for EIA Standard RS-170, as well as for non-standard CRT monitors. In non-interlaced operation, with an even or odd number of scan lines per data row. Or in interlaced operation, with an even number of scan lines per data row. And the '9937 can be programmed for interlaced operation for an odd number of scans per data row. This eliminates character distortion caused by the uneven beam current associated with odd/even field interlacing of alphanumeric displays.

**All TI universal microprocessor peripherals** are at your TI distributor. For more details, return the coupon.

# Six new TI CMOS A/D converters slash microprocessor parts count.

**TI's New 8-Bit A/D Converters**

| | | TL520 | TL522 | TL530 | TL531 | TL532 | TL533 |
|---|---|---|---|---|---|---|---|
| Analog Inputs (To Multiplex) | — | 8 | 8 | 9 to 15* | 9 to 15* | 5 to 11* | 5 to 11* |
| Digital Inputs (To Register) | — | 0 | 0 | 6 to 12* | 6 to 12* | 0 to 6* | 0 to 6* |
| Resolution | Bits | 8 | 8 | 8 | 8 | 8 | 8 |
| Unadjusted Error | LSB | ±0.75 | ±0.5 | ±0.5 | ±1.0 | ±0.5 | ±1.0 |
| Analog Access + Conversion Time | μsec | 70 | 200 | 300 | 300 | 300 | 300 |
| Supply Range | Volts | 4.5 to 6 | 3 to 6 | 4.5 to 6.5 | 4.5 to 6.5 | 4.5 to 6 | 4.5 to 6.5 |
| Operating Power (Typ) | | | | | | | |
| At 5 Volts | mW | 2.5 | 2.5 | 15.0 | 15.0 | 15.0 | 15.0 |
| At 3 Volts | mW | N/A | 0.3 | - Not Available - | | - Not Available - | |
| Operating Power (max) | mW | 5.0 | 0.6 | 88 | 88 | 88 | 88 |

* Includes 6 multipurpose (analog or digital) inputs.

**Designed as peripherals** for 8- and 16-bit microprocessor-based systems, TI's new family of CMOS A/D converters offers the designer six alternatives to cut space and power requirements.

You can now build a microprocessor-based system that can read and respond to a set of analog inputs with a low IC part count and low (CMOS) power. The new Texas Instruments family of six CMOS ICs, designed as peripherals for both 8- and 16-bit microprocessors, all make available an 8-bit digital conversion to the processor's data bus of any one of 8 to 15 analog inputs. They replace A/D converter, multiplexer, sample-and-hold, and control ICs.

The TL520 Series is a modern "switched-capacitor" 8-input A/D peripheral that replaces the "standard" ADC0808 and ADC0809 with lower power and a wider power supply range.

The new TL530 Series offers the greatest flexibility to the system designer. These ICs can handle either digital inputs and/or analog signals from up to 21 different sources — making this data available to the 8-bit or 16-bit processor on the 8-line data bus via an 8-pin I/O port. Furthermore, the TL530 Series can be controlled and its inputs selected (from the data bus) through this same I/O port.

All the new CMOS A/D peripherals are available from your TI distributor.

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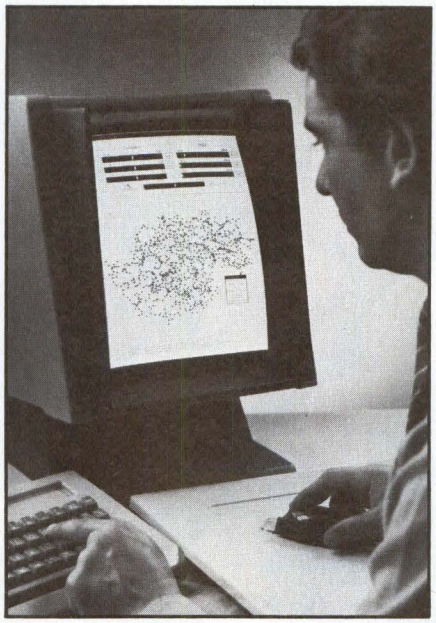
# Perq hosts tool development for FORTRAN-to-Ada conversion

Many system integrators will be faced over the next few years with the onerous task of converting FORTRAN programs to the new "standard" real-time language, Ada. Interactive graphics are being applied to the problem at the University of Bath in England, which has just embarked on a project to develop program translation and improvement tools on the Perq workstation developed by Three Rivers Computer Corp., Pittsburgh. That workstation is manufactured and marketed outside the U.S. by ICL Plc.

Called the Interactive Bath Program Improvement System (IBIS), the tools will not be confined to Perq hardware, says Dr. Rob Witty of the British government's Science and Engineering Research Council, which funds the project. "Under the SERC's Common Base Policy, all software funded by SERC for single-user applications will be portable between different machines, including multi-user computers," he says. Witty points to the portable environment under which IBIS is being developed—Pascal under UNIX Version 7. The implementation of Version 7 on the Perq is called PNX and provides microcode-based 32-bit addressing.

Witty notes that IBIS could be made commercially available by the British Technology Group, the government agency handling the commercial exploitation of an Ada compiler developed by the University of York for the Digital Equipment Corp. VAX (MMS, November, 1982, p. 138). The same team at York is also working on an Ada compiler for the Perq.

Dr. Peter Wallis, who leads the IBIS project at Bath, explains FORTRAN-to-Ada translation facilities are already implemented in part on the University's large-scale Honeywell Multics mainframe computer, but purely in batch mode. They were deliberately written in Pascal to ease transferring them to the Perq, a task that should be completed by mid-1983, Wallis says. Then, interactive features will be added to exploit the graphics capabilities of Perq, such as the generation of flowcharts from FORTRAN source code and diagrams showing how program parts relate. These facilities are intended to offer advantages over line-by-line program translation, as well as aid in improving programs. Wallis notes that the facilities should be useful for improving existing Ada programs and those being converted from FORTRAN to Ada.



**The Perq workstation manufactured by ICL Plc** *has 1M byte of storage and a high-resolution bit-mapped display. It is being used by the University of Bath in England to develop program translation and improvement tools to convert FORTRAN programs to Ada.*

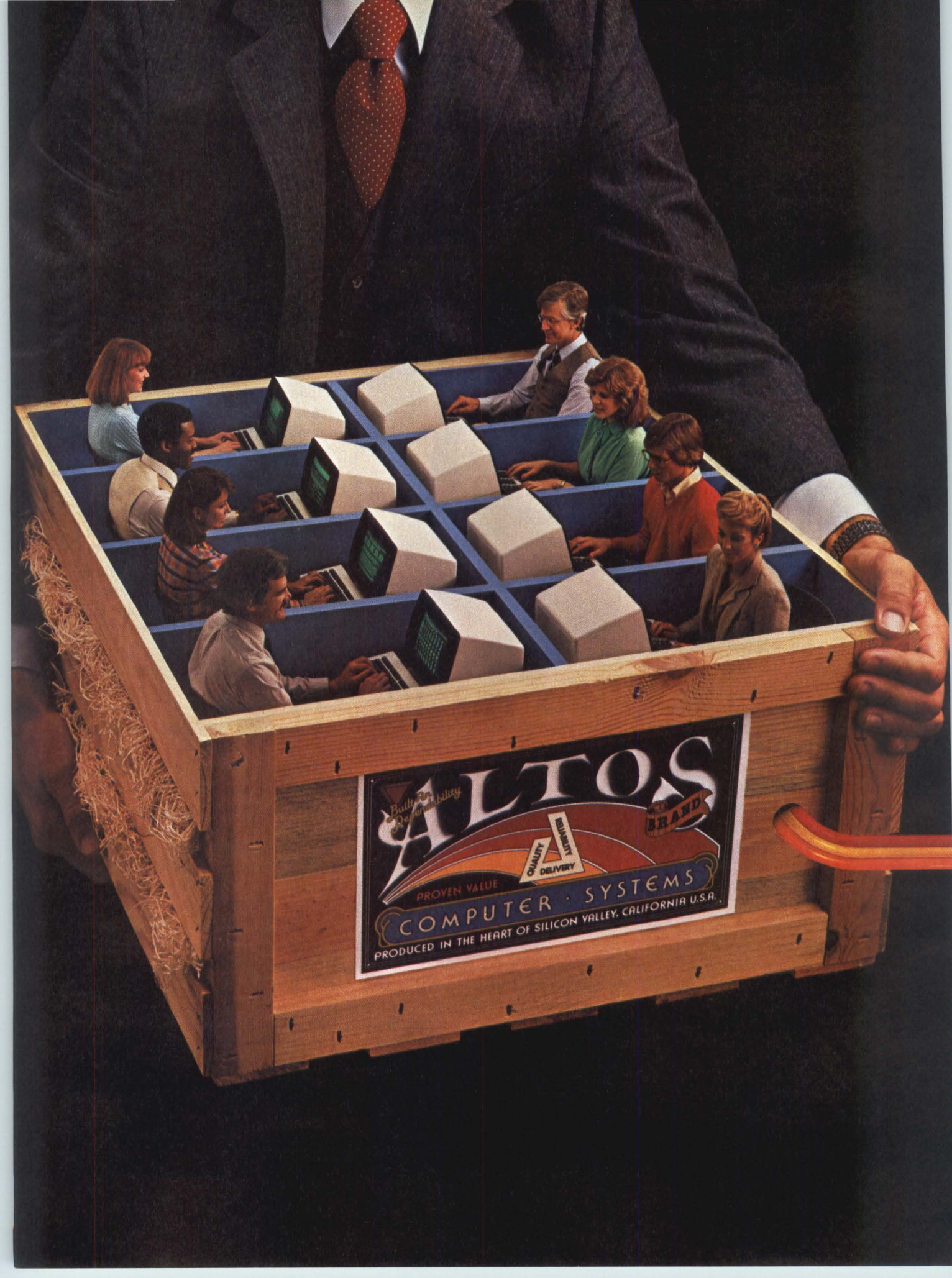
He describes the heart of IBIS as a "standard abstract data type that implements Ada parse trees." Parse trees are the paths used in compiling high-level languages to determine a program's structure. Strings of characters written by a programmer are compared with the syntactic components of the language. An IBIS user can interactively select how the parse tree will be represented in his machine, allowing for variations in syntax.

The keen interest in the Perq graphics workstation in Britain stems largely from the fact that the country's largest computer manufacturer, ICL Plc, holds exclusive manufacturing and marketing rights to the machine outside the U.S.

Perqs ordered or installed in Britain include nearly 100 machines at British universities.

ICL and Three Rivers are working on the development of enhancements to Perq, which will be made available in the U.S. by Three Rivers, according to company marketing vice president Aaron Colman. He notes that Three Rivers can offer a FORTRAN compiler developed at ICL's software-development center in Dalkeith, Scotland. Colman says PNX will soon be released in the U.S. He also reveals that an Ada compiler is being developed for Perq by a U.S. software house, which he declines to name. With 1982 revenues of roughly $1.2 billion, ICL is in a position to devote substantial resources to Perq enhancements.

*—Keith Jones*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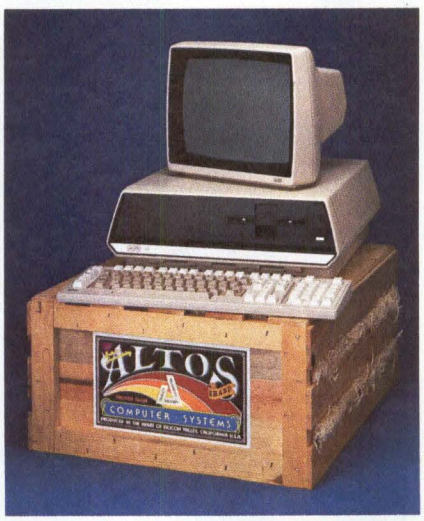


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# CMB is at center of French computer industry reorganization

Compagnie des Machines Bull, the debt-laden ultimate holding company of Cynthia Peripheral Corp., Palo Alto, Calif., and R2E America, Minneapolis, is at the center of a major reorganization of the French computer industry. The reorganization is being orchestrated by the French government, which took control of CMB and the rest of the leading French electronics manufacturers about a year ago.

A major feature of the CMB changes will be the establishment of a largely autonomous peripherals subsidiary organized around the company's operations in Belfort in Eastern France. That operation designs and builds the products sold by Cynthia in the U.S. As yet unnamed, it will be independent of parent company Cii Honeywell Bull.

Francois Peleyras, president of Cynthia, stresses that the new peripherals subsidiary will be completely autonomous from the rest of the companies within CMB and free from government interference when making decisions about new products and license deals. He concedes, however, that "the government will say what results we should achieve."

Agreements include a deal with Seagate Technology that allows Seagate 5¼-in. Winchester disk units to be built under license in France for the European market.

Peleyras says he cannot divulge the contents of a business plan Cynthia has proposed to the government. He reveals, however, that product plans for 1983 include the launch of new high-speed printers based on the non-impact magnetic technology demonstrated by Cynthia at the National Computer Conference in Houston last year (MMS, July, 1982, p. 268). He expects Cynthia to chalk up U.S. sales "at least double" the $5 million achieved in 1982, the company's first full year of operation. But he sees established products, notably the 20M-byte D160 10½-in. Winchester drive, still providing most of the revenues in 1983.

**Francois Peleyras, president of Cynthia Peripheral Corp.,** *projects worldwide OEM revenues of Cii Honeywell Bull's new peripherals subsidiary in Belfort, France, to reach about $50 million this year, double the 1982 total achieved by peripherals operations. The subsidiary will be independent of Cii HB.*

Peleyras expects total worldwide OEM revenues of the new peripherals subsidiary, including those of Cynthia, to reach about $50 million in 1983, double the 1982 total achieved by peripherals operations. He hopes that first shipments of the D520 5¼-in. fixed/removable Winchester, launched late in 1982, will start this July and predicts that 20,000 units will be shipped worldwide in 1984. As much as 50 percent of those units will go to U.S. customers.

Peleyras says there are no plans for his company to take over the optical-disk technology development group within Thomson-CSF, an operation that cooperates with Xerox Corp., Palo Alto, Calif., in this activity. "We will certainly need optical-disk technology in the future," concedes Peleyras, "although at present we are concentrating on the development of vertical magnetic recording."

R2E is also being separated from Cii HB and will form part of a new office-automation subsidiary. The only remaining link between Cii HB and the two new subsidiaries will be common holding company CMB.

In the new office-automation subsidiary, R2E will be with a diverse group of partners, including Correlative Systems International, a former Cii HB division that builds the VIPS 2000 commercial image storage-and-retrieval system. Another partner, DAP, was until now owned by Thomson-CSF (part of France's largest electronics manufacturer, Thomson Bradt SA). DAP builds a multi-workstation office system called Corail, which is configured around an Intel 8086-based processor built under license from Convergent Technologies Inc. But Andre Riviere, president of R2E in France, does not expect R2E America to start selling products

# What's unique about the GE 3000 printer family is its commonality.

"They're all the same only different." That's the simple advantage of General Electric's new GE 3000 series of printers...single design simplicity without the application limitations of a single model product line.

Our basic concept is application driven price/performance matching. Choose speeds from 40 to over 400 cps. Single or dual mode printing. Type quality from EDP to NLQ. Multi-color printing. Graphics. 80 and 136 column models. Selectable type fonts. Accessible, easily programmable set-up by either the operator or the system. Multi-model flexibility...all with high parts commonality.

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CIRCLE NO. 73 ON INQUIRY CARD

# Mini-Micro World

INTERNATIONAL

from its new sister divisions. For now, the company will continue to concentrate on its own product lines including the 16-bit 9050 series launched last year.

A fourth autonomous subsidiary under the CMB umbrella is SEMS, the largest European minicomputer manufacturer. SEMS has been transferred to CMB from Thomson-CSF.

Cii HB will now concentrate on selling computers based on its technology agreement with Honeywell Information Systems, which covers the DPS 6 minicomputer line as well as mainframe machines. The agreement was renewed last year as part of a deal between Honeywell Inc. and the French government, which reduced Honeywell's share in Cii HB from 47 to 19 percent.

Another move in the cards is the transfer of French small systems and peripherals manufacturer, Societé Nouvelle Logabax to one of the CMB subsidiaries, a development that could encourage the return of Logabax to the U.S. OEM printer market. CMB owns 35 percent of Logabax, and the remainder is held by Olivetti SpA of Italy. But the French government wants CMB to take control of Logabax, says Sylvie Benech, a consultant at the Paris office of IDC Europa.

CMB cannot comment on such a move, while Olivetti in Italy confirms that talks are continuing with the French government about a number of matters, including the possibility of Olivetti's buying back the approximately one-third share that CMB holds in Olivetti.

Logabax spokesman Jean-Pierre Nieres acknowledges that a takeover by CMB is highly likely, but says the Logabax staff does not want the company divided. They want Logabax to remain intact rather than have small systems going to the new CMB office-automation company, while OEM printers are absorbed by the CMB peripherals subsidiary.

Nieres explains that Logabax's OEM printer products generated only about $3 million in revenues

### RACAL-MILGO LAN AVAILABLE IN U.S.

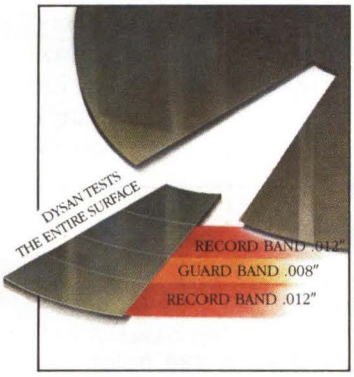
Racal-Milgo's Planet token ring series of local-area network products is now available in the U.S. First introduced in Europe last April, each Planet token ring series can accommodate as many as 500 communicating devices. The product uses baseband coaxial cable in a twin ring configuration and permits full- or half-duplex communications among devices of different vendors, regardless of protocol. The communications link is controlled by the Planet Director intelligent desk-top processor. One Director can control as many as 250 terminal access point interfaces. Each TAP has two RS232 ports that can operate synchronously, asynchronously or mixed at speeds as high as 19.2K bps per port. The system features a fail-safe mechanism that allows Planet to reconfigure itself in the event of a cable fault.

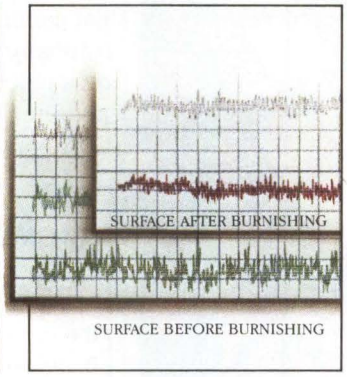
### PORTABLE COMPUTER IS OFFERED FOR $1299

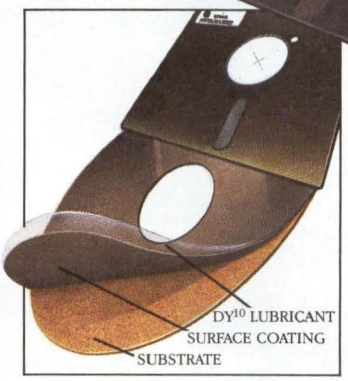
The Pied Piper Communicator I, a Z80-based portable computer weighing less than 15 lbs., is scheduled for availability this month from STM Electronics Corp., Menlo Park, Calif. The 64K-byte machine runs CP/M, has a full-sized ASCII typewriter keyboard and a 5¼-in., 256K-byte slimline floppy disk drive. A second floppy or a 5M- or 10M-byte hard disk drive can be added. Two free card slots are available. Options include a 2-line × 80-character LCD, an integral thermal printer and a modem. The $1299 price includes Wordstar, M/BASIC, MailMerge and a spread-sheet package.

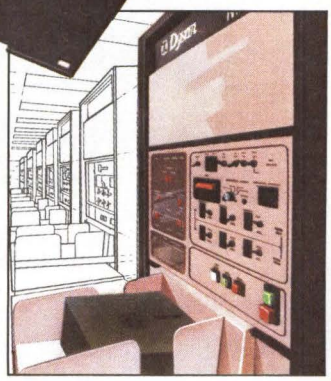
DISCOVER THE DYSAN DIFFERENCE

# Four Reasons Why The Dysan Difference is Worth Paying For

## 1. 100% Surface Tested

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CIRCLE NO. 48 ON INQUIRY CARD

last year, which was about 7 percent of Logabax's total sales. Moreover, most shipments were to customers in France. But Nieres hints that the Logabax printer family, which centers on the LX 200 line of 200-cps matrix impact units, may be exhibited at the National Computer Conference in Anaheim in May. He notes that Logabax maintained an OEM printer sales force in the U.S. before it encountered serious financial problems in the late 1970s that led to the takeover by Olivetti in 1981.

Yves Raynaud, manager of the new CMB peripherals company, will not comment on the possibility of his company's taking on the Logabax OEM printer operation and selling its products in the U.S. through Cynthia. *—Keith Jones*

## CMB SEEKS BAIL-OUT

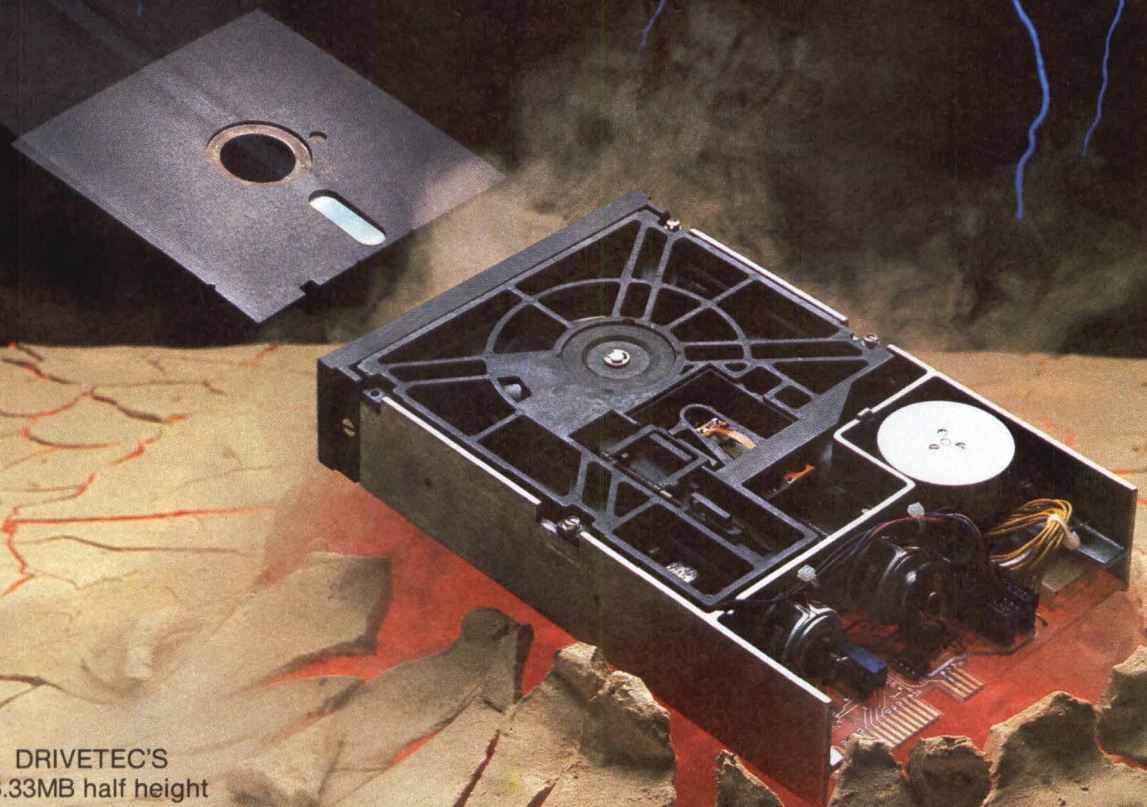
Compagnie des Machines Bull blames drastic undercapitalization for the company's mounting losses. After a net profit of about $30 million in 1980, Cii Honeywell Bull, the main operating company of CMB, lost about $70 million in 1981. A loss of more than twice that figure is expected for 1982.

A CMB spokesman notes that the company has submitted a plan to the French government asking for a capital injection of as much as 3 billion francs (about $500 million) to reduce its indebtedness, which amounts to 6 billion francs. He says CMB's debts result from its huge R&D costs. Those costs consume about 10 percent of total revenues, compared with the industry average of 7 percent. He says the costs are high because of the continuing modifications of products stemming from the merger in the late 1970s of Honeywell Bull and Cii, which were previously separate companies.

"Interest payments account for 10 percent of revenues, and we want to reduce them to 4 percent over the next three years," adds the CMB spokesman.

# RE-CREATION:

## DRIVETEC'S 3.33MB Super Minifloppy



DRIVETEC'S 3.33MB half height SuperMinifloppy is much more than a redesign. It's the ever popular minifloppy completely re-created for the systems and applications of the 80's. And beyond.

Its low cost, $333.00 in OEM quantities, makes it the perfect floppy upgrade. Add super performance specs like 3.33 MB unformatted capacity, 3 msec track-to-track access and 500 Kbit/sec transfer rate-and you've suddenly got a Winchester replacement too. And the low cost and durability of its floppy media provides the lowest offline (for archival storage or backup) storage cost of any existing disk drive.

DRIVETEC re-created this floppy drive for higher reliability too. A proprietary track following servo system ensures on-track read/write head positioning and diskette interchange. Unique Gumball Heads™ virtually eliminate head and media wear. "Absolute-Vertical" clamping provides accurate, repeatable diskette registration. These features, along with many others, are so precisely incorporated into the SuperMinifloppy™ that only one adjustment is required in the manufacturing process. That means enhanced manufactureability and serviceability.

For more information about the SuperMinifloppy, contact Ivo Adam, vice president of marketing, at (408) 942-1515. Or write DRIVETEC, 2140 Bering Drive, San Jose, CA 95131. It could make your system a super success.

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CIRCLE NO. 50 ON INQUIRY CARD

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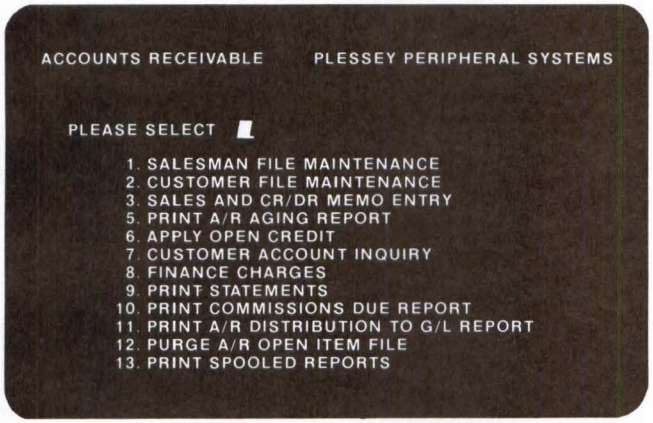
Because you could pick up a lot more of what we're all here for with the Plessey Series/6000 Small Business Computers.




## Your business is our business.

With the 16-bit Plessey Series/6000, we've made it our business to support your business.

Our computers are based on DEC's LSI-11™ micros, so you start with proven hardware that's in thousands of systems world-wide.

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Start with the low-cost System 6100, a 64 kbyte single-user workstation. Or for multi-users, choose the economical System 6200 with 256 kbytes of main memory (expandable to a full megabyte). Both use the Q-bus and come in a compact 5¼" chassis available in desktop and rackmount configurations.

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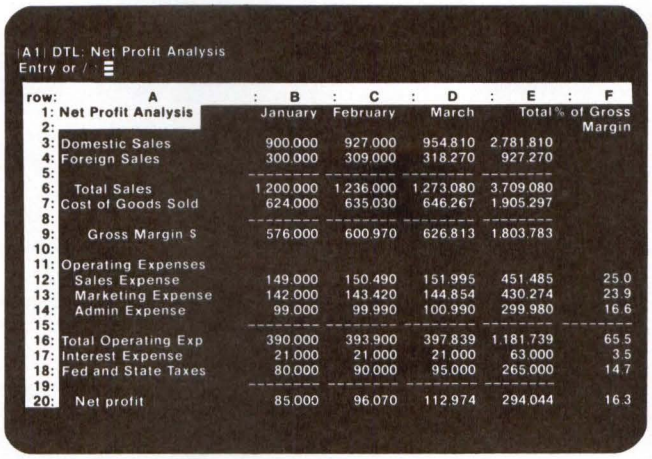
You can use BASIC, COBOL, DIBOL™, C, PL/I, FORTRAN and MACRO™ languages.

And the programs you develop on the single-user system are just as useful on the most powerful Series/6000 configuration, so your customers have an easy growth path.


A1| DTL: Net Profit Analysis
Entry or /

| row: | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| 1: | Net Profit Analysis | January | February | March | Total | % of Gross Margin |
| 2: | | | | | | |
| 3: | Domestic Sales | 900.000 | 927.000 | 954.810 | 2.781.810 | |
| 4: | Foreign Sales | 300.000 | 309.000 | 318.270 | 927.270 | |
| 5: | | | | | | |
| 6: | Total Sales | 1.200.000 | 1.236.000 | 1.273.080 | 3.709.080 | |
| 7: | Cost of Goods Sold | 624.000 | 635.030 | 646.267 | 1.905.297 | |
| 8: | | | | | | |
| 9: | Gross Margin $ | 576.000 | 600.970 | 626.813 | 1.803.783 | |
| 10: | | | | | | |
| 11: | Operating Expenses | | | | | |
| 12: | Sales Expense | 149.000 | 150.490 | 151.995 | 451.485 | 25.0 |
| 13: | Marketing Expense | 142.000 | 143.420 | 144.854 | 430.274 | 23.9 |
| 14: | Admin Expense | 99.000 | 99.990 | 100.990 | 299.980 | 16.6 |
| 15: | | | | | | |
| 16: | Total Operating Exp | 390.000 | 393.900 | 397.839 | 1.181.739 | 65.5 |
| 17: | Interest Expense | 21.000 | 21.000 | 21.000 | 63.000 | 3.5 |
| 18: | Fed and State Taxes | 80.000 | 90.000 | 95.000 | 265.000 | 14.7 |
| 19: | | | | | | |
| 20: | Net profit | 85.000 | 96.070 | 112.974 | 294.044 | 16.3 |

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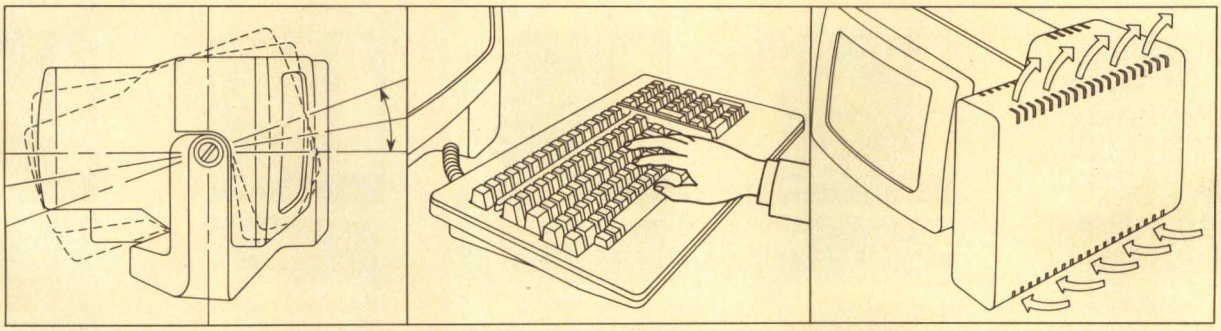

Productive office work depends on people and their equipment working efficiently together.

That's why we have engineered the exciting, new TeleVideo 970 to perform better than any other terminal.

For instance, only our "natural balance" tilting mechanism lets you easily adjust the screen at a touch, so you avoid neck-craning, straining and glare.

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Like every feature of the new 970, the screen is designed for ease of use. Our non-glare 14-inch green screen is restful on the eyes, and its 132 column display can format more information. All in highly legible double-high, double-wide characters.

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**CIRCLE NO. 52 ON INQUIRY CARD**

# These people had the

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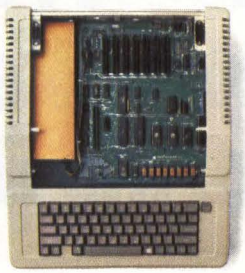
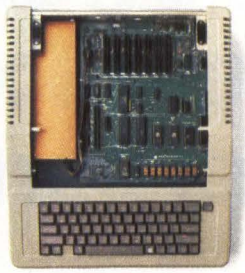
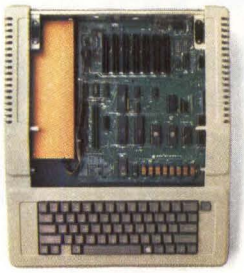
Educational courseware



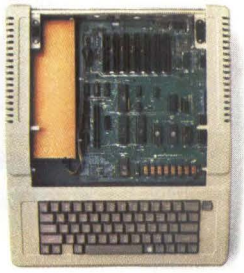
Advanced Information Systems
Computer aided drafting



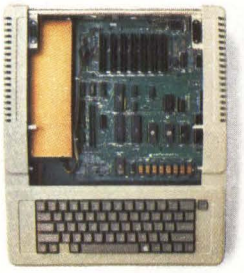
Varian Associates, Inc.
UV Spectrophotometry



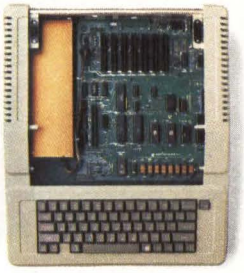
L&S Computers
Personnel profiling systems



Rockwell International
Truck fleet management

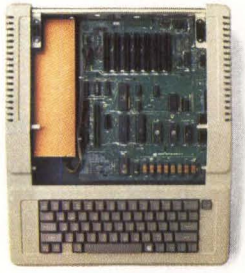


Gentech
Interactive video training

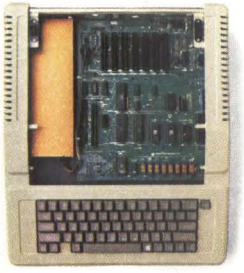


Farm Plan, Inc.
Agricultural software

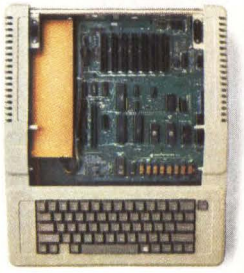
Core Technology
Burroughs terminal emulation



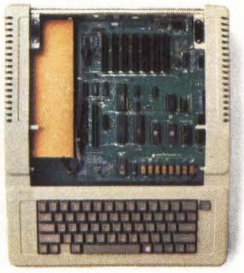
Gerber Scientific Products, Inc.
Computerized engraver



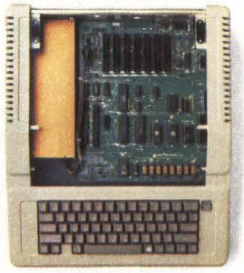
TSI Inc.
Particle sizer data analysis



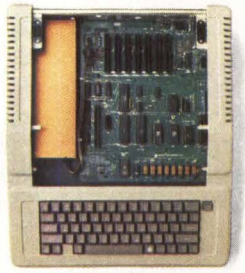
Enterprise Systems, Inc.
Hospital on-line inventory



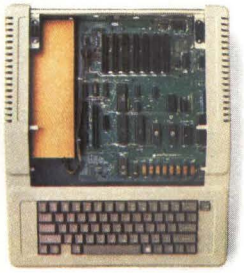
Sandu
Industrial robotics



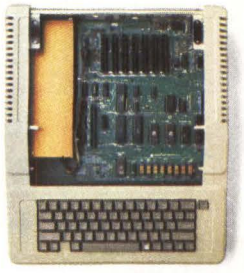
TCD, Inc.
Life insurance illustrations



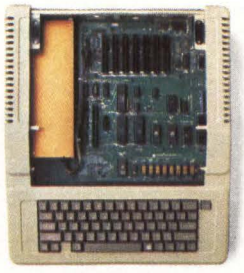
Cascade Graphics Development
Computer aided drafting



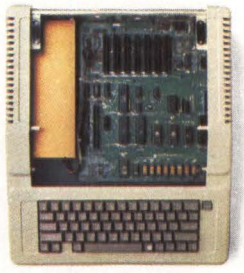
CompCoWare Inc.
Custom instructional software



Autographix, Inc.
Designs, graph slides

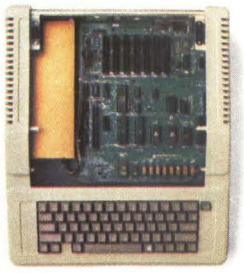


Software Resources
Financial investment packages



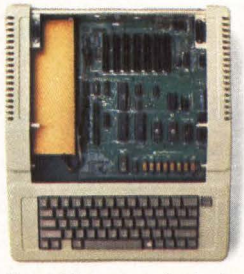
American Zettler, Inc.
Hospital nursing station

Basic Computer Literacy
Courseware



CPHA
Hospital data entry systems

Transportation Concepts
& Services
Interstate tariff rates



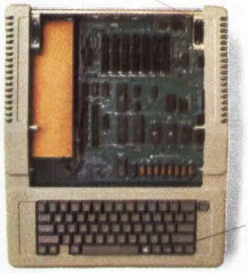
Energy Management Service, Inc.
Residential/commercial
energy analysis

Vitalograph Ltd.
Pulmonary systems,
on-line spirometer

Fisher Scientific Company
Intelligent color console
for mass spectrophotometer

First Software Corp.
Computer work station
for children

# guts to be successful.



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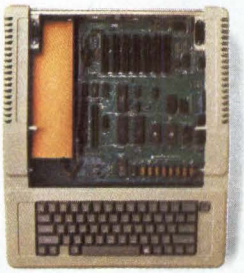
*Scientific instrumentation*



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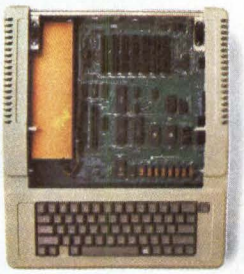

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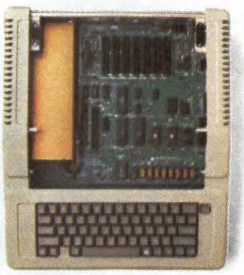

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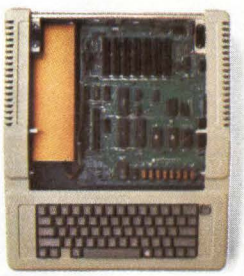
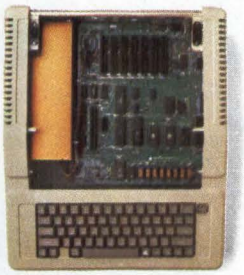


*Northwest Instrument Sys., Inc.*
*Digitizing oscilloscope*



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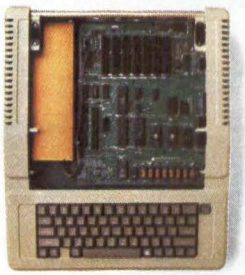

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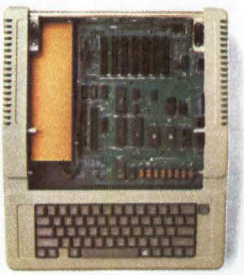
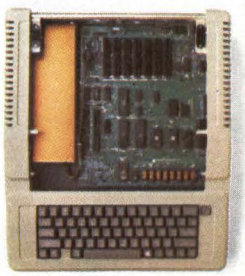


*Medical Graphics*
*Inhalation data analysis*

*Walman Optical*
*Opticians systems*



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CIRCLE NO. 53 ON INQUIRY CARD

# Communicating by satellite: options for small computers

By Sarah Glazer

Options are increasing for networks that include small computers to communicate via satellite, as more companies focus on the data segment of satellite communications. The most likely candidates to use satellite links for minicomputers are still very large corporations with high-volume, private communications networks that crisscross the U.S. But data-oriented products are appearing that can cost-justify satellite links for minicomputers even without integrating other types of communications traffic.

"Computer networks and satellites are a natural marriage," says Steven Hayashi, engineering manager at Tandem Computers Inc., a Cupertino, Calif., manufacturer of fault-tolerant computer systems. Tandem and American Satellite Co., Rockville, Md., have jointly announced a satellite-based network for distributed data processing. "How do you get ever-increasing amounts of data from one place to another cost-effectively?" asks Hayashi. "Satellites are the means to do that."

Bill Pritchard, president of Satellite Systems Engineering, a Bethesda, Md., consulting firm, voices another view, however. "It may be a while until satellites are cost-justified for small computers," he states. "Unless you also transmit other services—video, for example—transmitting data by satellite is not justified."

Walter L. Morgan, president of the Communications

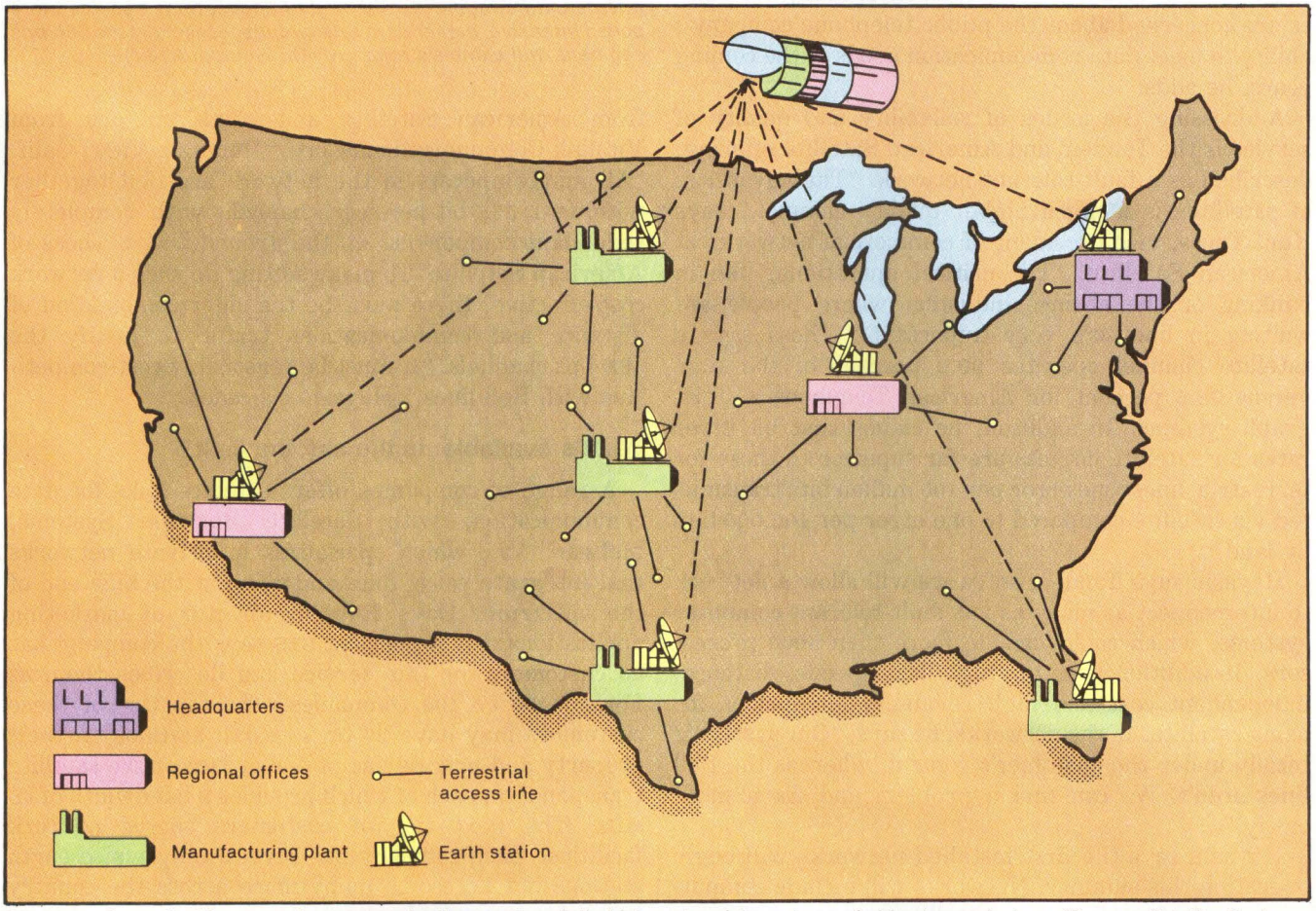



**Diagram of a typical large-scale communications network** *that integrates data, voice and video transmissions. (Source: Satellite Business Systems)*

Center of Clarksburg, a Maryland consulting firm, agrees. "It is most logical for satellite users to combine data, voice and so forth into one network," he says. If a company has far-flung branch offices and it generates large amounts of internal communications traffic, it can take advantage of satellites' greatest strengths: communication costs that don't increase with distance, wide-bandwidth channels and low error rates that allow huge transfers of information at high speeds and broadcast capability that eliminates duplicate transmission.

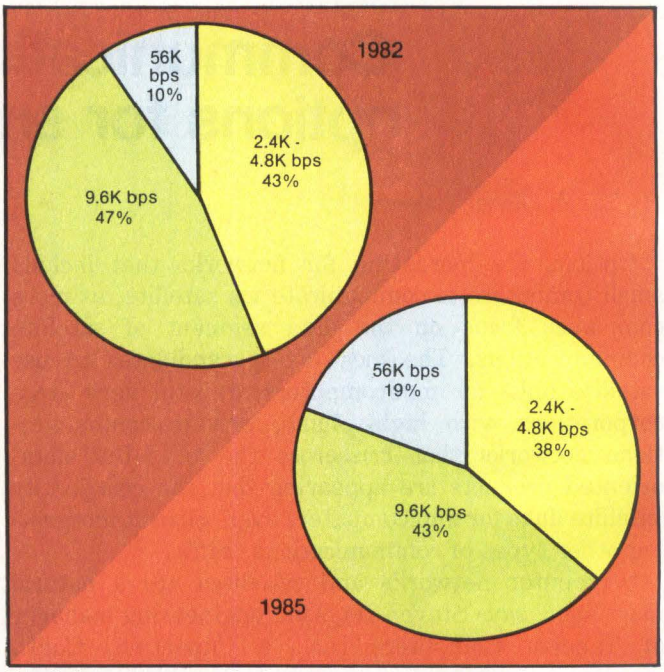
### Service quality a factor

But the decision to use satellite links is not always a question of volume of traffic alone, Morgan points out. "Sometimes, it's a quality of service determination," he says, explaining that some companies don't realize how much they depend on communications until an accident such as a fire in a manhole drives the point home. "Their computer screens go blank, their automatic teller machines stop working, and they want to have backups or alternatives," Morgan says. Many businesses are concerned about the public telephone company's ability to meet data-communication needs in the coming years, he adds.

Addressing the issues of reliability and quality of service is the Tandem and American Satellite offering, described as a fault-tolerant network. "The advantage of satellites is a much higher quality channel," says Kurt Thoss, vice president of commercial networks at American Satellite. "For critical operations, like in banking or the airlines industry, where people are waiting in line, it's very important." Thoss says a satellite channel operates 99.9 percent of the time versus 98.5 percent for American Telephone & Telegraph systems. In addition, he claims that bit error rates for satellite circuits are far superior to those for terrestrial lines: one error per 100 million bits transmitted via satellite compared to one error per 100,000 bits by land.

Hayashi says Tandem software will allow a network to interconnect as many as 255 fault-tolerant computer systems, which could include more than 4000 processors. In addition to citing high data speeds, distance-independent cost and high reliability as reasons for using satellites in the networks, he says, "Our system is totally under the customer's control, whereas the Bell lines aren't. We can find a problem and fix it more easily."

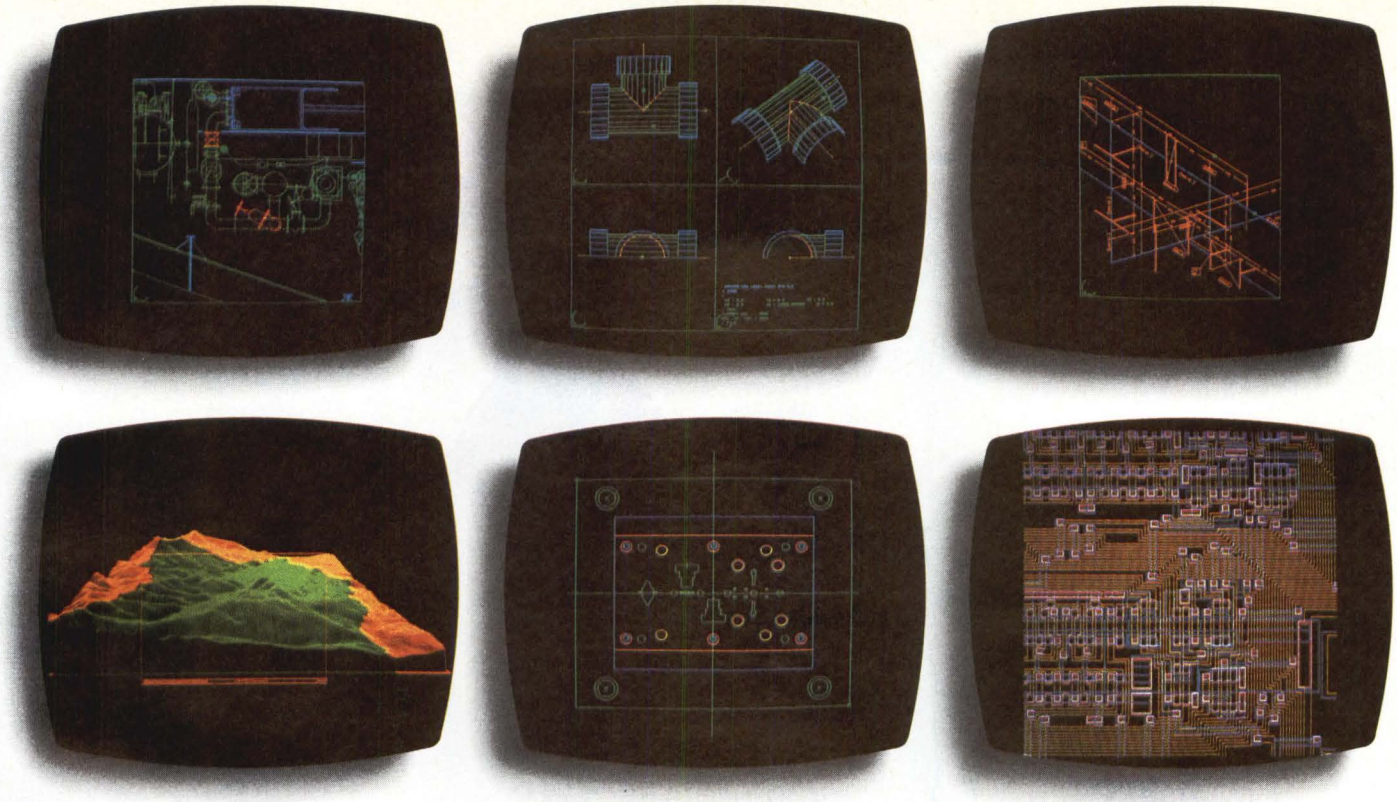
Hayashi says the first installed networks will begin operating this summer. Networks will include computer systems from Tandem, satellite transponder space from American Satellite and earth stations from Vitalink Communications Corp., Mountain View, Calif. "All minicomputers in the network are tied together with two 56K-bit-per-sec. channels with completely redundant components on the ground," says Thoss of American Satellite. To make setting up such a network cost-effective, there must be the right combination of distance and communications traffic to justify the 56K-bps channels. "It must be reasonably cost-competitive with Bell lines," Hayashi concedes.




**Breakdown by transmission speed** *of the market for dedicated, private data circuits. As distributed applications become more speed intensive, higher data rate circuits, especially the 56K bps segment, will exhibit strong growth. (Source: AT&T)*

### What's available: is the sky the limit?

A range of companies offers satellite links for data communication, with Satellite Business Systems, McLean, Va., which specializes in private networks that integrate voice, data and video, at the high end of the spectrum. Dave Russell, director of marketing applications and support at SBS says the company has 25 customers for this service and describes them as Fortune 50 or 100 companies. The top tier of these customers may have 20 or 30 earth stations on their property and private use of one or two entire satellite transponders, each of which provides a bandwidth of 48 MHz. The next tier of customers shares network facilities. Each company has several on-premise earth stations but access to many more across the country through terrestrial hookups.



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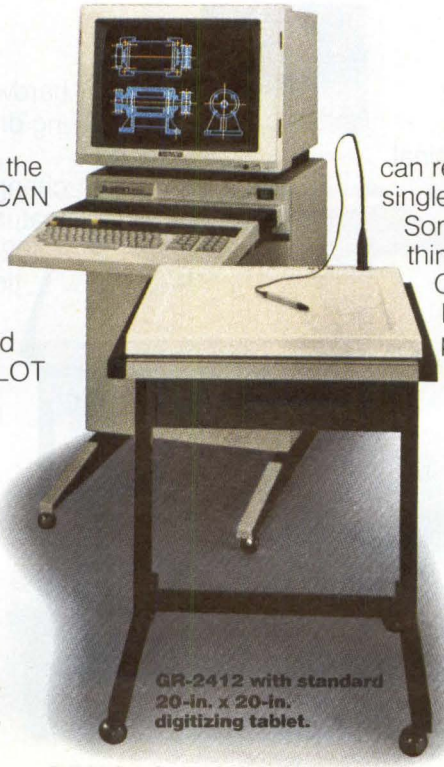

GR-2412 with standard 20-in. x 20-in. digitizing tablet.

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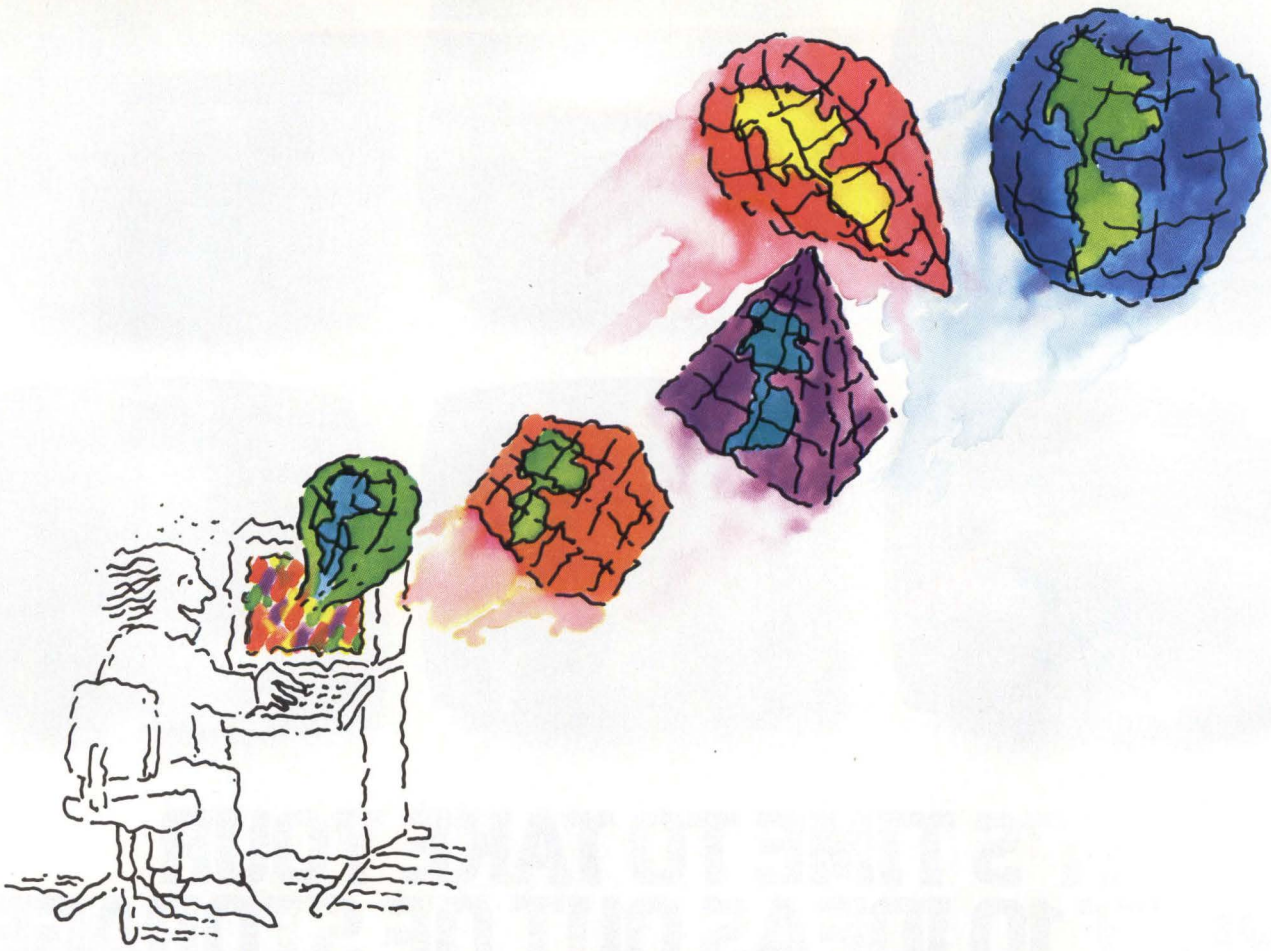
**CIRCLE NO. 54 ON INQUIRY CARD**



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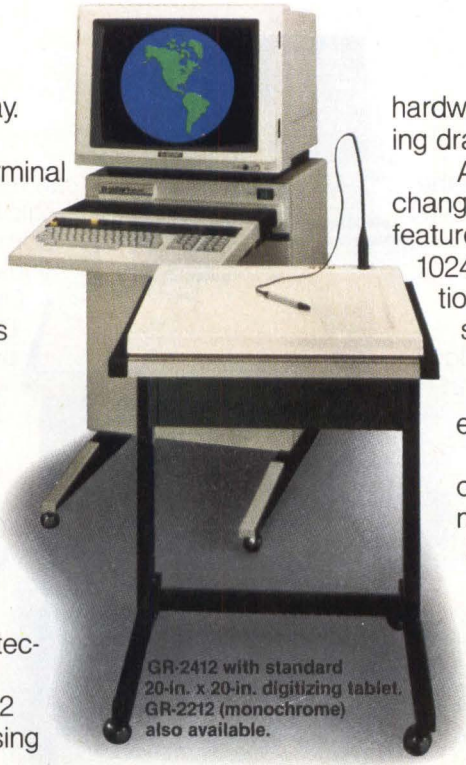

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"Voice has been the initial selling point, but the leverage, where customers make big savings, is for data," says Russell. "They can mostly justify the earth station on the voice side, so to add data ports, the incremental cost is relatively small." Since all analog traffic is converted at SBS earth stations to digital signals, voice and data can be multiplexed to make efficient use of high-speed transmission.

Rental for an SBS earth station is about $17,000 a month, with tariffs for communications capacity starting at $2400 a month for each duplex channel, says Russell. Explaining these high costs, he says, "You have to have a critical mass of voice and data ports to make an earth station cost-justified." Some critics believe high prices have kept SBS from being more successful. "Their cost is too high," says Pritchard of Satellite Systems Engineering.

American Satellite provides large-scale integrated networks in addition to its joint offering with Tandem. "Half our business is data, but it's moving toward one-third because voice is growing faster," says Thoss. "In integrated networks, data usually represent less than one-third of activity."

Thoss claims that American Satellite can compete with the cost of a 56K-bps terrestrial line at distances longer than 500 miles. "Bell's Digital Data Service costs, coast to coast for a 56K-bps channel, would be about $13,000 to $14,000 per month," Thoss says. "We're talking about $13,000 ourselves. So it's break-even." He says satellite costs become increasingly competitive with terrestrial lines as more nodes are added to a network.

Both SBS and American Satellite specialize in data channels that have 56K-bps or higher speeds. "Most minis can't handle that data speed," says Jerome Lucas of Telestrategies, a McLean, Va., consulting firm in the satellite field. "So high-speed data links don't usually come into play unless you take traffic you gather from various alternative communication media and funnel them into one earth station," he maintains. Thoss of American Satellite concedes that this is true, saying, "For minicomputers, a 56K channel would mean a number of them multiplexed into one channel."

Morgan of the Communication Center of Clarksburg points out that while such a high-capacity channel may cost more than a lower rate terrestrial line, there may be potential benefits to offset the cost. "The disadvantage of 56K is you've got more capacity than you can use," he says. "The advantage is you've got some growth potential for both data and voice."

However, by far the largest market for dedicated, private data lines is for those with rates lower than 56K

**Typical performance requirements for data system applications**

| Application | Transmission rate (bps) | Required bit-error-rate performance | Connectivity | Typical connect time | Duty cycle | Terminal interface |
|---|---|---|---|---|---|---|
| • CAD/CAM | 56K-224K | $10^{-7}$ | Point-to-point via switched channel | 1-hour session Intermittent use | 60% Business | V-35 & RS449 |
| • File transfer | 56K-1.5M | $10^{-8}$ | Point-to-point via switched channel | 2-30 min. | 10% | V-35 or block multiplex |
| • Remote job-entry station | 9.6K-56K | $10^{-8}$ | Point-to-point via switched channel | 10-30 min. | 20% | RS232 or V-35 |
| • Electronic mail & high-speed fax | 4.8K-56K | $10^{-8}$ | X.25 mesh network | 2-10 min. | 10% | RS232 or V-35 |
| • Digital voice | 19.2K-32K | $10^{-4}$ | Point-to-point via switched channel | 3-4 min. | 15% | N/A |
| • Business video | 56K-1.544M | $10^{-5}$ | Point-to-point | 30 min.-1 hour | 15% | N/A |
| • Terminal-oriented system | 300-19.2K | $10^{-6}$ | X.28 mesh network | 30 min.-1 hour Intermittent use | 20% | RS232 |
| • Computer graphics | 9.6K-56K | $10^{-8}$ | X.25 network | 30 min.-1 hour intermittent use | 20% | RS232 or V-35 |
| • Computer networking | 9.6K-56K | $10^{-8}$ | X.25 and switched channel | 5-15 min. | 15% | RS232 or V-35 |
| • Database "refresh and downline loading" | 9.6K-56K | $10^{-8}$ | X.25 mesh network | 2-10 min. | 10% | RS232 or V-35 |

Source: Vitalink

bps, says H.R. Johnson, vice president of marketing at Vitalink Communications Corp. Of the total private data line market, which he puts at $1.3 billion in 1982, only 10 percent is for lines at speeds of 56K bps or higher. Johnson says Vitalink is zeroing in on the lower speed market, leaving the high-speed links to other companies. "Our service is designed to be cost-effective at nodes that are generating only one or two 9.6K-bps channels," he says. "No one else is trying to compete for this portion of the market."

Johnson describes an entry-level network that would be cost-competitive with terrestrial lines as typically having nodes in New York, Chicago, Houston and Los Angeles. It would have four 9.6K-bps circuits—one from New York to Chicago, two from New York to Houston and one from New York to Los Angeles. Johnson says AT&T would lease such a system for $9380 per month, compared to Vitalink's charge of $8300.

Don Gooding, an analyst at The Yankee Group, a Boston research firm specializing in communications, describes Vitalink's networks as designed for distributed-computer architecture. "It's not a system designed for heavy voice use," says Gooding, and cites this as a plus for minicomputer users. But he cautions companies to look to the future, warning, "You have to consider when you're going to integrate voice and data because there is a bandwidth limitation."

Time Inc., New York, has a Vitalink-supplied network and uses it only for data. "Although you can use the Vitalink ground station for voice, digital voice is not an effective use of the network," says Sam Moss, vice president of information systems. "We're going to put on both interactive transmissions and high-speed, point-to-point batch transmission."

Another company providing circuits at less than 56K bps is RCA subsidiary Cylix Communications Network, Memphis, Tenn. Rather than renting or selling earth stations, Cylix operates them in major U.S. metropolitan areas and links them to customer premises by terrestrial lines operating at 4800 or 9600 bps or by microwave relays. Cylix vice president of marketing Ron Young says the company has 36 earth stations and plans to have 100 by the end of 1984.

The Cylix network is packet switched (MMS, May, 1982, p. 43), and all traffic from regional earth stations is beamed to a central control center in Memphis. From there, it is retransmitted to the appropriate regional earth station. "Pricing is distance insensitive and is based on volume," says Young. The charge at a customer's network host site is $900 per month for a 4800-bps channel and $1100 for 9600 bps, says Young. Charges for each remote terminal site start at $390 per month for 8 million characters. Charges include services and the installation at all sites of a very smart modem that multiplexes data, performs polling and converts protocols.

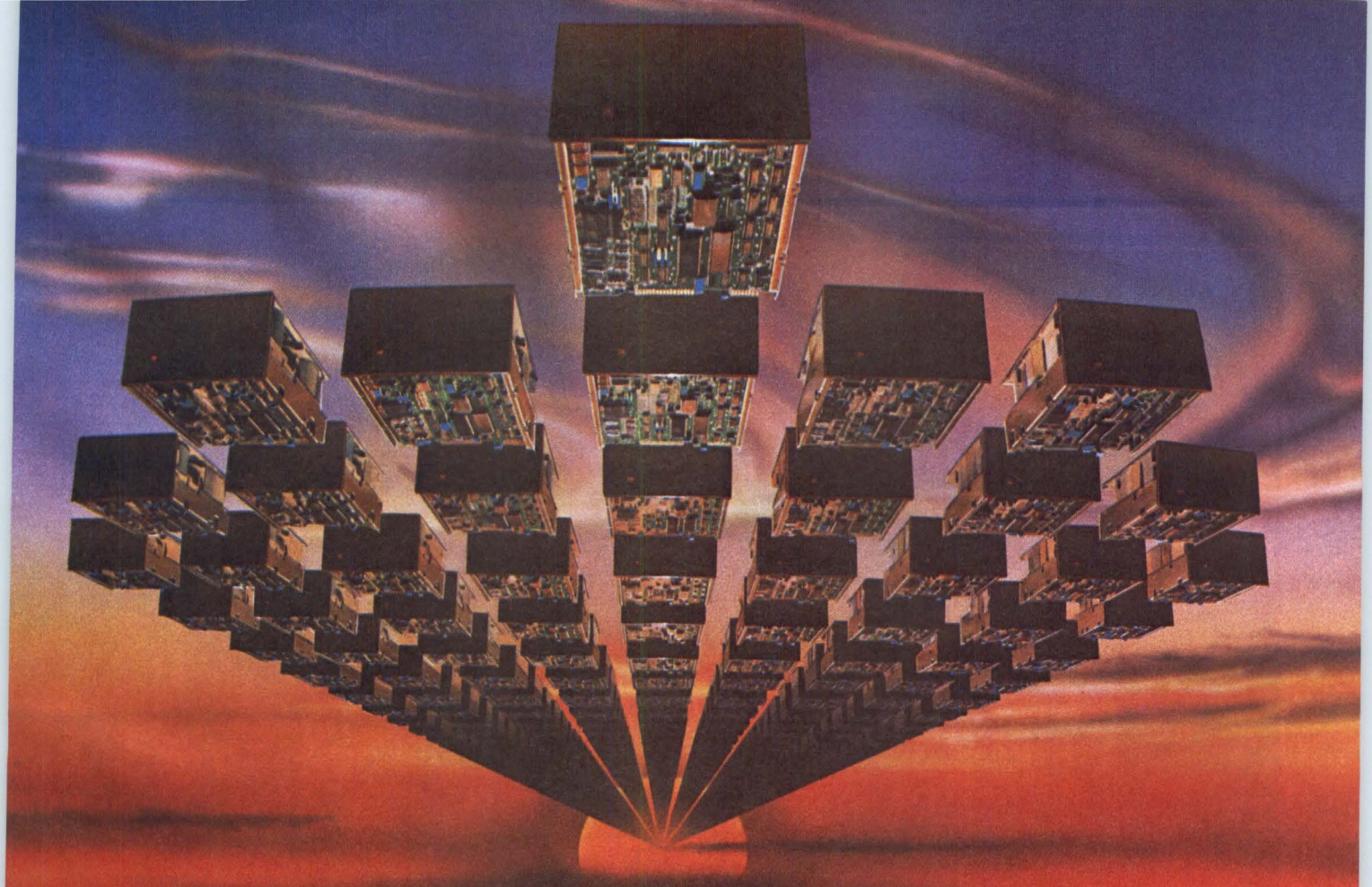
"We're not a bulk data network," says Young. "We're not all things to all people, so our market's not that big." He reports that Cylix has about 150 customers, among them many in transportation who use applications such as airline ticketing and generating freight documents for trucking.

### Distributed data processing

Particularly appropriate for satellite-based networks are those applications in which portions of a shared database are stored at different sites, says Gooding of The Yankee Group. "In the future, rather than transmitting real-time updates, there will be flags in a database indicating that somewhere in the network, that information has been updated. That flag will be broadcast," he explains, adding, "satellites are very cost-effective for broadcast communication." In some industries—insurance, for example—data will be updated at remote sites and pumped to a central location, which will broadcast the data, he continues. Each remote site would store part of the database and would select appropriate updates. "That is the direction corporate databases will take in the next two to four years," says Gooding.

"Full-mesh networks of the future" is how Vitalink's Johnson describes distributed satellite-based data networks. "Equipped with the proper software, you could address blocks of data for any station in the network and have them automatically delivered by the satellite," he says. "There are huge economies attached to that approach." Applications he cites are computer-aided design, with separate sites sharing a database, and larger scale applications such as electronic mail.

Much planning is needed to coordinate such schemes, though, says Don Kissler, telecommunications system engineer at the St. Louis headquarters of General Dynamics Corp. General Dynamics has been planning a still-unrealized integrated satellite communications network for almost five years, says Kissler. "We're going to do some database sharing, and planning for this is not easy," he says. He adds that it's a bigger job than anticipated just to consolidate corporate-wide telephone numbers. "But we were one of the first," he explains. "Once you've made the decision so you don't have any corporate delays, it should take only one and a half to two years to be up and running with a network." But he adds, "Some things will have to be developed as we go along." □



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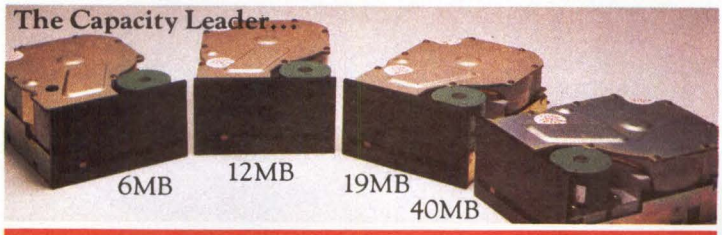


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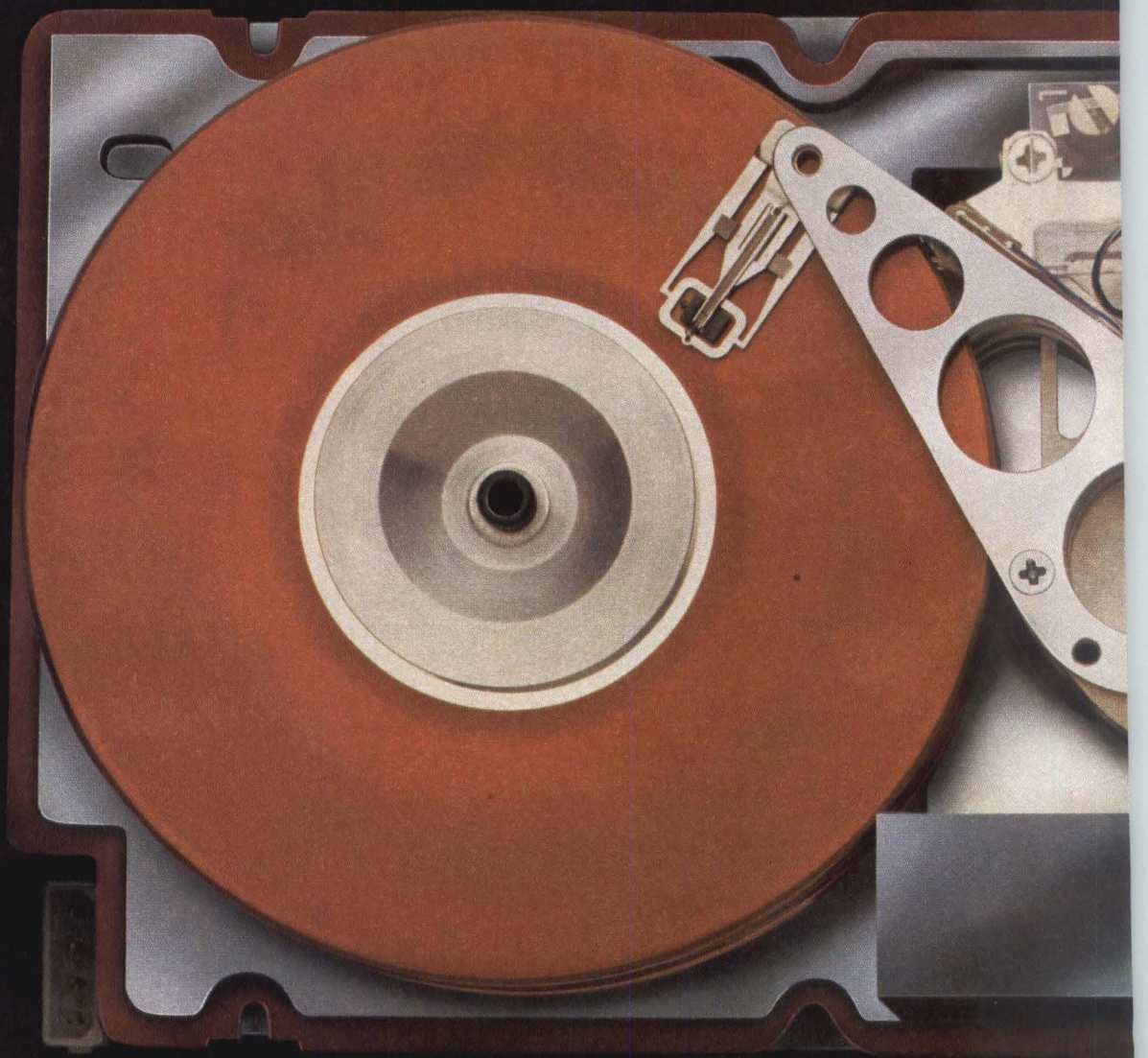

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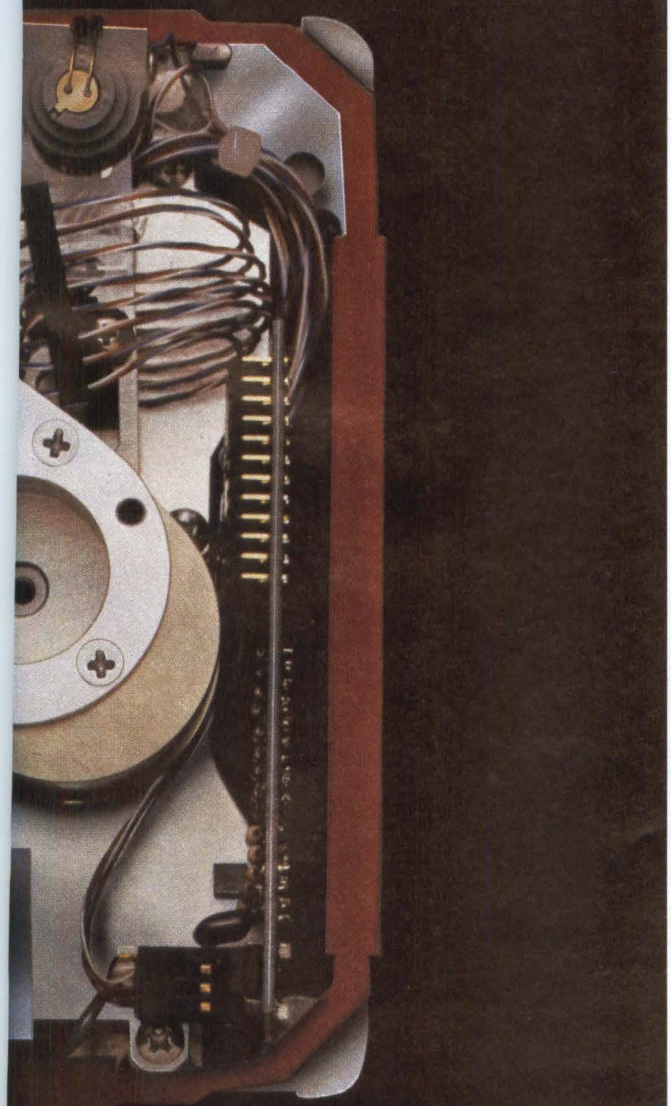

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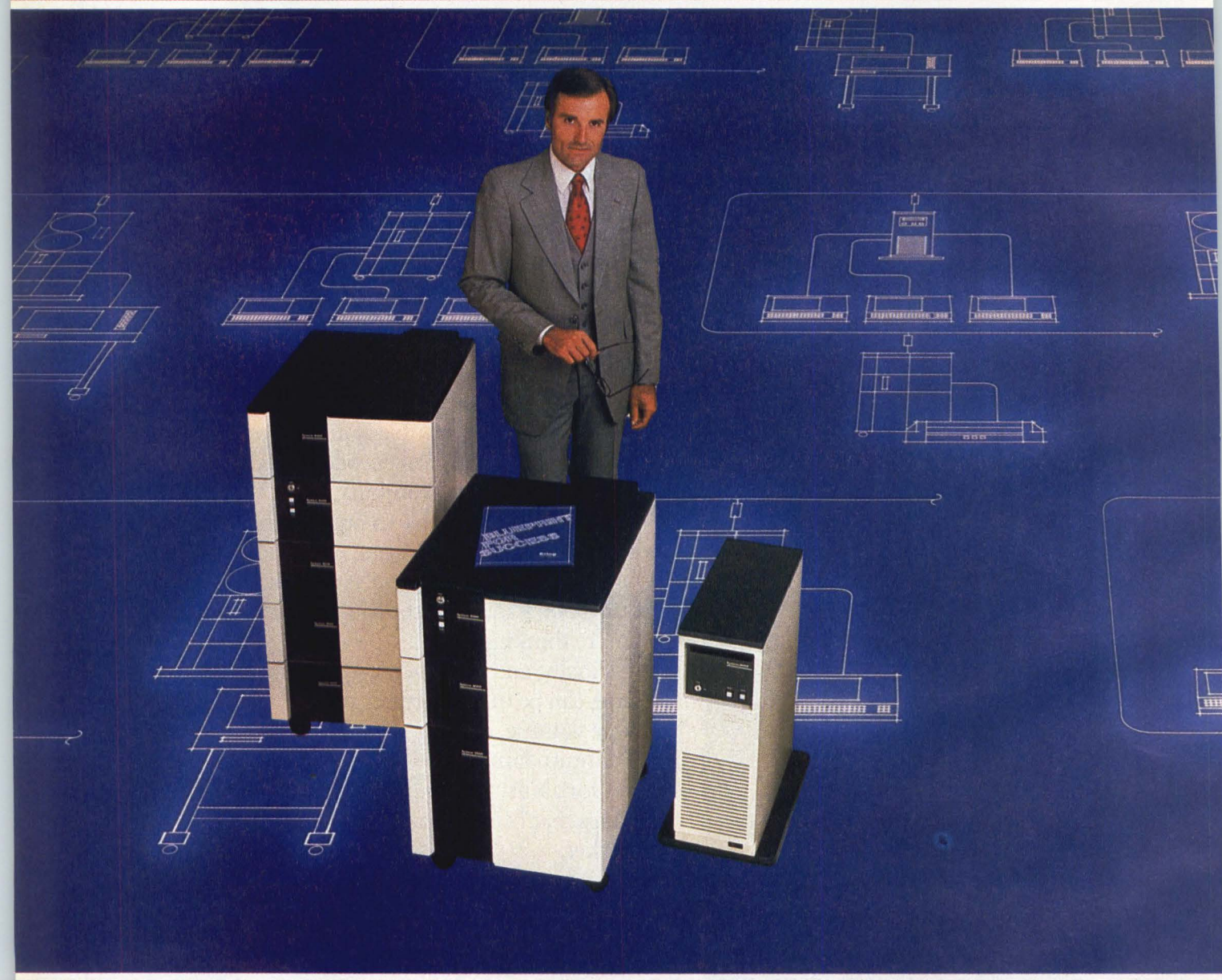
**CIRCLE NO. 58 ON INQUIRY CARD**

# Zilog's System



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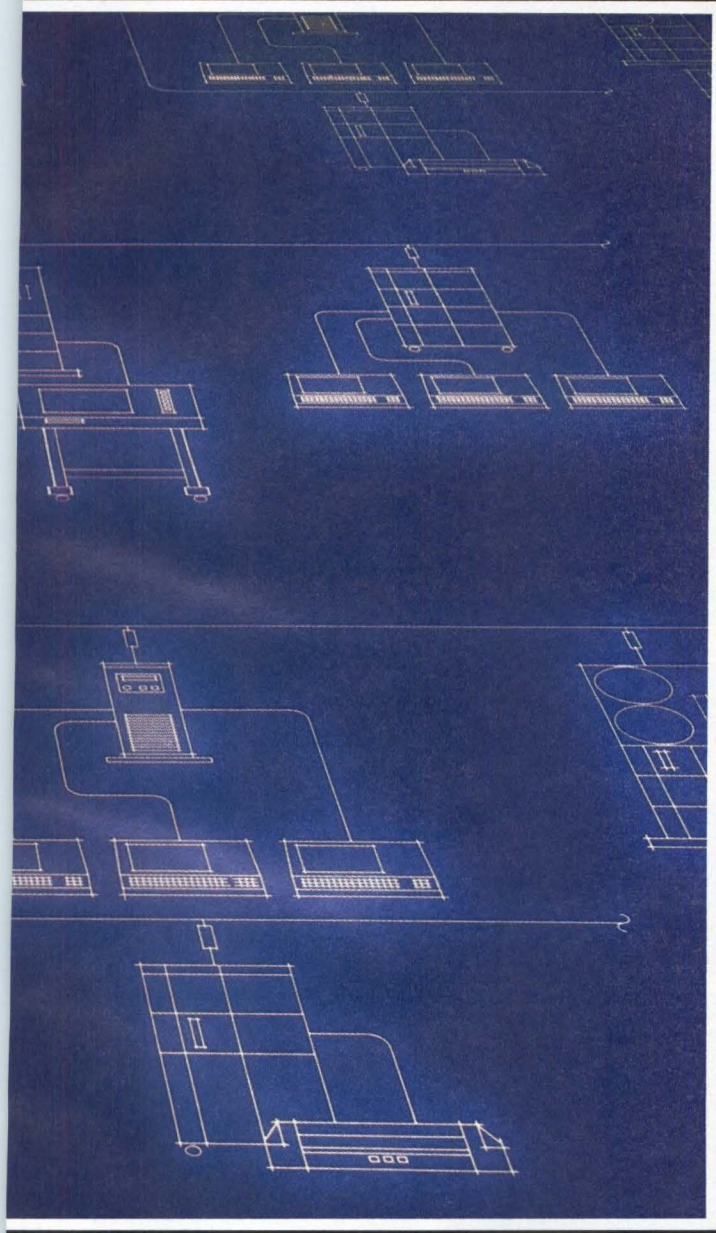

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# High-volume market developing for low-priced OCR systems

By Frank Catalano

As optical character recognition equipment suppliers shrink the size and price of their products, new opportunities are developing for OEMs and system integrators interested in adding high-speed data-entry capabilities to their systems. Once a business in which high-priced products were bought in low volumes by end users, the OCR market is rapidly becoming a business in which low-priced products are being bought in high volumes by middlemen.

But, while new low-priced wand and slot reader systems account for most OCR unit sales, higher priced systems still account for most of the industry's revenues. According to a study by International Resource Development Inc., Norwalk, Conn., the OCR market was worth $350 million in sales in 1982 and is projected to be worth $925 million by 1992. The major market for OCR systems last year included the banking industry with purchases worth $120 million, government with purchases worth $60 million, general office users with purchases worth $40 million and wholesale/retail users with purchases worth $35 million.

Peter Davison, an analyst with IRD, notes that last year, high-end systems accounted for 51 percent of sales revenues, mid-range systems for 33 percent and low-end systems for 15 percent. He adds, however, that over the next 10 years, as smaller systems start outselling bigger ones 100:1, revenues derived from mid-range and low-end system sales will overtake those from high-end sales. Davison estimates that, by 1992, sales of high-end systems will account for 30 percent of revenues, mid-range systems for 44 percent and low-end systems for 25 percent.

## OCR market segments

High-end systems, Davison says, read normal-sized pages as well as smaller documents, such as checks and credit-card receipts, at speeds as high as 4000 characters per sec. Ranging in price from $100,000 to $1 million, such floor-standing systems recognize characters printed in more than one type font and are equipped with paper-transport devices that route and sort materials as they are read. Mid-range products look much like higher speed systems but usually sit on desk tops, do not include sophisticated paper-transport capabilities and may not recognize a variety of type fonts. They sell for $10,000 to $80,000.

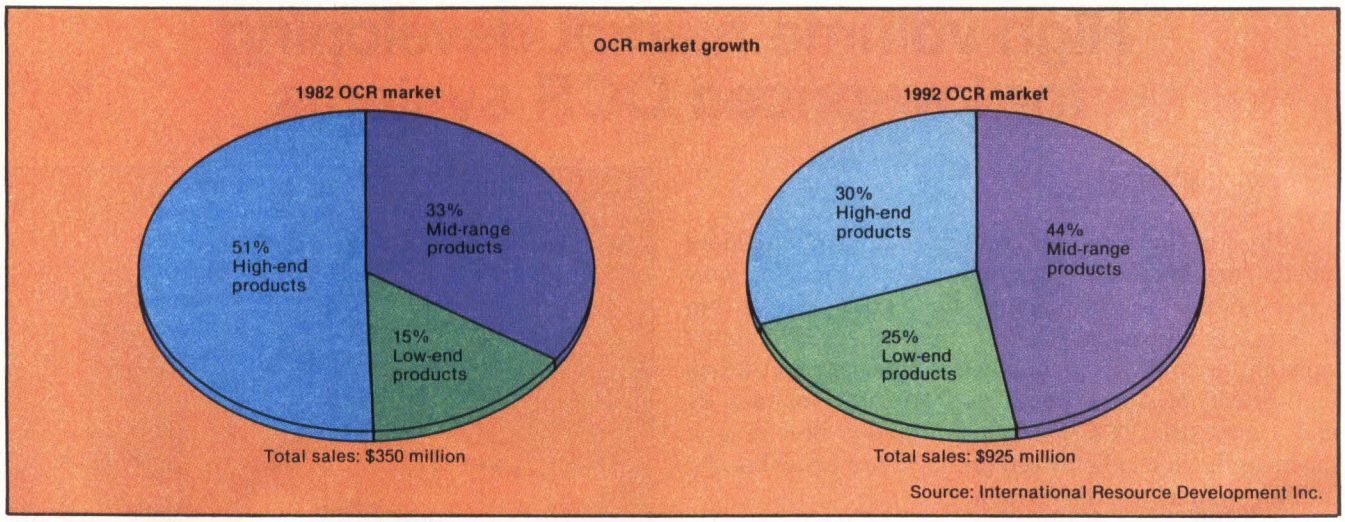

**Caere Corp. is providing OCR slot readers for a passport-reading system** *being designed by Planning Research Corp., Washington, D.C. As a means of speeding the customs system, the Treasury Department is planning to print passports in OCR-A type font.*

Unlike high-end and mid-range systems, low-end OCR products, configured as hand-held wands or as slot readers, are best suited for applications requiring only one line of characters on a document to be read. Those systems sell for prices starting at $1000 and usually can recognize only one type font.

The leading suppliers of high-end systems are Recognition Equipment Inc., Dallas, and IBM Corp., the leading supplier of mid-range systems is Burroughs Corp., and the leading suppliers of low-end systems are REI and Caere Corp., Los Gatos, Calif.

## Application history

The first OCR units, installed in the early '60s, were expensive, high-end systems. Herbert Schantz, vice president of the Recognition Technology Users Association and author of *The History of OCR*, notes that the high cost of OCR technology at that time dictated that OCR suppliers incorporate as many features as possible into their systems so that users could more easily cost-justify the equipment. Such systems were and still




are used primarily with mainframe computers for high-volume data-input applications in central processing offices of large banks, credit-card companies, insurance companies and mail-order houses.

As the technology developed and the prices of chips and memory came down, mid-range products fit into general office applications such as entering typed pages on word-processing system. Low-end systems served in stores, entering sales information into cash registers. While high-end systems performed more centralized data-entry functions, lower priced systems interfaced with minicomputers and microcomputers distributed throughout retail and wholesale stores, manufacturing facilities, government agencies, hospitals and offices.

"Applications are rapidly changing," says Edward Dato, vice president of international small systems sales for REI. "OCR is moving from a centralized position in a corporation into a distributed arrangement within departments." IRD's Davison notes that, 10 years ago, a business had to process data from at least 10,000 documents or pages before it could justify OCR. But now, OCR is practical for applications in which as few as 1000 documents or pages a day are processed, he says.

"OCR is viable in any application in which you have escalating labor costs, increasing volumes of transactions, limited space and the need for quick turnaround time," says RTUA's Schantz. "Potential users should not ask technological questions; the technology is there. They should ask economic questions."

### New distribution routes

Because of the rapid development of new OCR applications for low-priced products, suppliers are investigating distribution routes that are new to the OCR industry. A greater number of wands must be sold to generate the same revenues as those generated by high-end and mid-range OCR systems. As a result, says Dato, REI no longer sells its low-end systems directly to end users but instead through OEMs and system integrators. "I can't have a salesman standing on every street corner hawking wands," says Dato. "If I sold directly to end users I'd incur a lot of marketing costs, and that would drive up the price of the wand." He adds that, because OCR devices are usually used as integrated components of word-processing or point-of-sale

**OCR APPLICATIONS BY EQUIPMENT TYPE**

| Application | Device type: OCR wand | OCR page reader | Document reader |
|---|---|---|---|
| Retail checkout counter | ● | | ● |
| Printing/publishing | | ● | ● |
| Word processing | | ● | |
| Inventory control | ● | ● | ● |
| Remittance processing | ● | ● | ● |
| Medical records control | ● | ● | ● |
| DP data entry | ● | ● | ● |
| Test scoring | | | |
| Registration (voter, auto) | | ● | ● |
| Telecommunications message entry | | ● | |
| Order entry/sales call reporting | ● | ● | ● |
| Time/attendance reporting | | ● | |
| Grade reporting | | ● | |
| Banking administration | | | ● |

Key: ● Very useful ● Possibly useful

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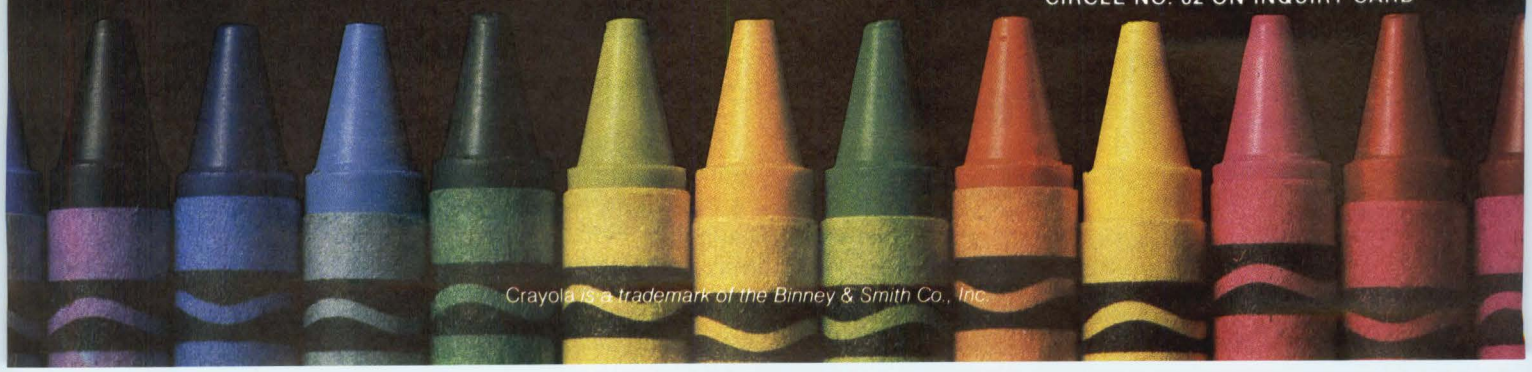

Crayola is a trademark of the Binney & Smith Co., Inc.

systems, suppliers of those systems should provide application software. "Those guys know their side of the business, and we know our side of it," says Dato. "REI is in the OCR technology business, not the system application business."

REI supplies wand and slot reader systems to OEMs such as IBM and Burroughs and to system integrators such as library system suplier Dataphase Inc., Kansas City, Mo.

Bill Lavale, marketing manager at Caere Corp., says that his company sells its low-end products through OEMs and system integrators, but also sells directly to large-volume end users. "There are a wide range of applications out there for these systems, and we can't be experts at all of them," says Lavale.

One of Caere's biggest customers, NCR Corp., buys OCR wand readers and incorporates those units into the company's POS terminals.

### OCR technology

Despite differences in prices and capabilities, all OCR systems use one fundamental technology and common basic components—an electro-optical sensor, an analog-to-digital converter, recognition logic and post-recognition logic. While bar-code systems recognize data represented as a series of parallel lines and spaces, OCR systems recognize human-readable letters and numbers. The electro-optical sensor throws light from a laser or a tungsten-filament lamp onto a printed page and then senses the reflective differences or contrasts between light and dark areas on the page. Contrast information is converted into binary digits using the A/D converter, and the recognition logic matches digital data about the patterns on the page with reference patterns stored in the system. A pattern can be identified as a specific character or rejected as nonidentifiable.

Post-recognition logic interfaces the OCR system to the outside world and tailors the digitized data into a form that can be transmitted to a computer. OCR systems output information either on-line to a host computer over a communications link or off-line to the host through a magnetic medium such as a tape or disk.

Although OCR systems that recognize a variety of type fonts are available, a standard font, OCR-A, has been endorsed by the American National Standards Institute, the Department of Defense and the National Retail Merchants Association. ANSI is working to standardize a second font, OCR-B, which is more stylized than OCR-A. Caere's Lavale says that, while OCR-A is more machine readable, OCR-B is more human readable.

### OCR versus bar codes

Debate continues within various industry segments over which data-entry alternative—bar code or OCR—is best suited for particular applications. While the food and automotive industries have adopted bar-code technology, some industries are endorsing both OCR and bar codes. Last summer, the DOD recommended that manufacturers supplying items to the DOD include both bar codes and OCR nomenclature on their products. The NRMA recommends that both OCR and bar codes should be printed on goods sold in grocery stores and department stores, including books, panty hose and cosmetics.

"I see the controversy over which technology to use (bar code or OCR) going on indefinitely," notes IRD's Davison, who believes use of both codes is increasing. "Eventually," he adds, "equipment suppliers will introduce products that can recognize both." Siemens Corp., REI, Caere and Sumitomo Corp., a Japanese supplier with New York offices, are working on products that can recognize both codes. □

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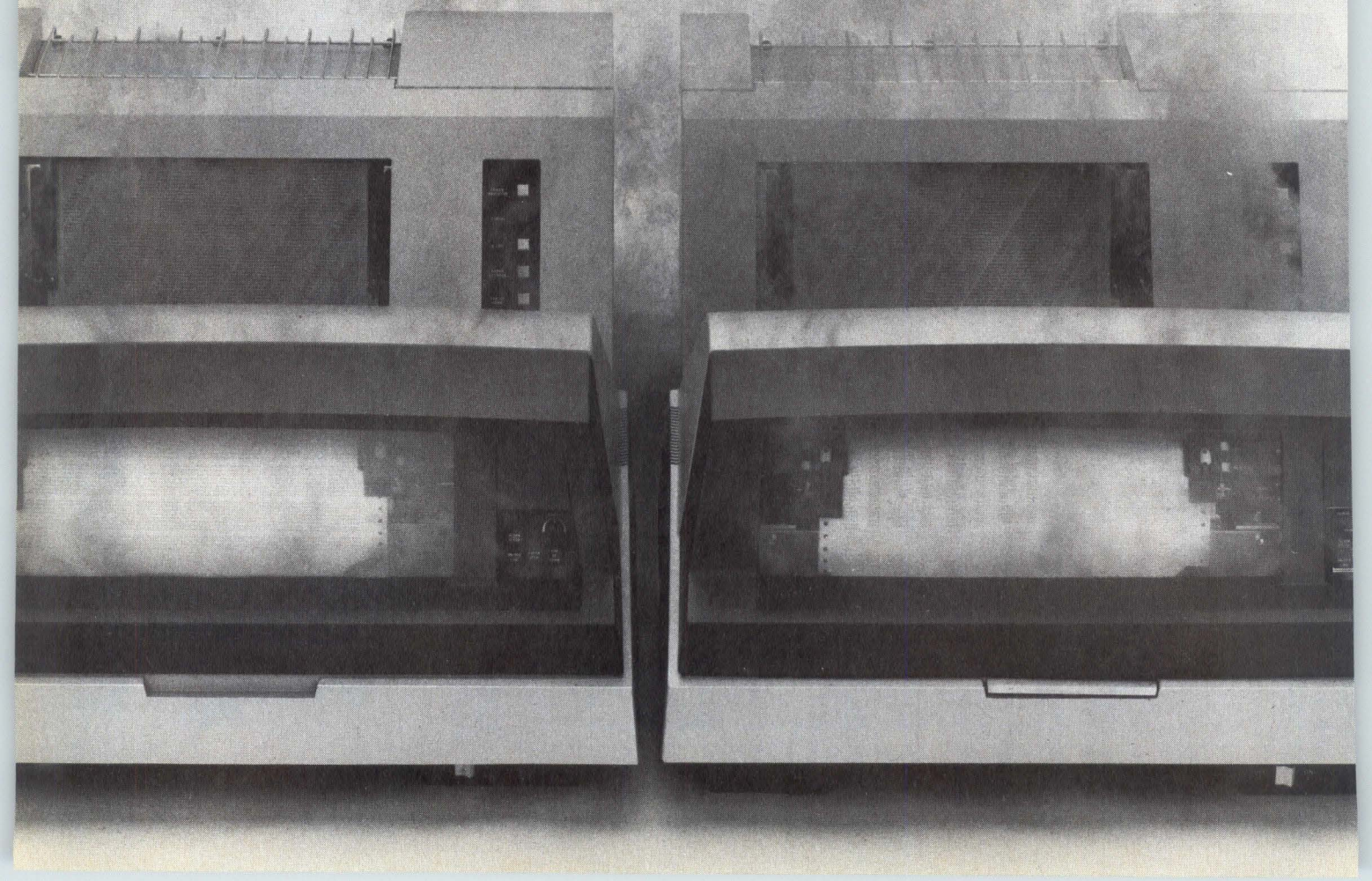

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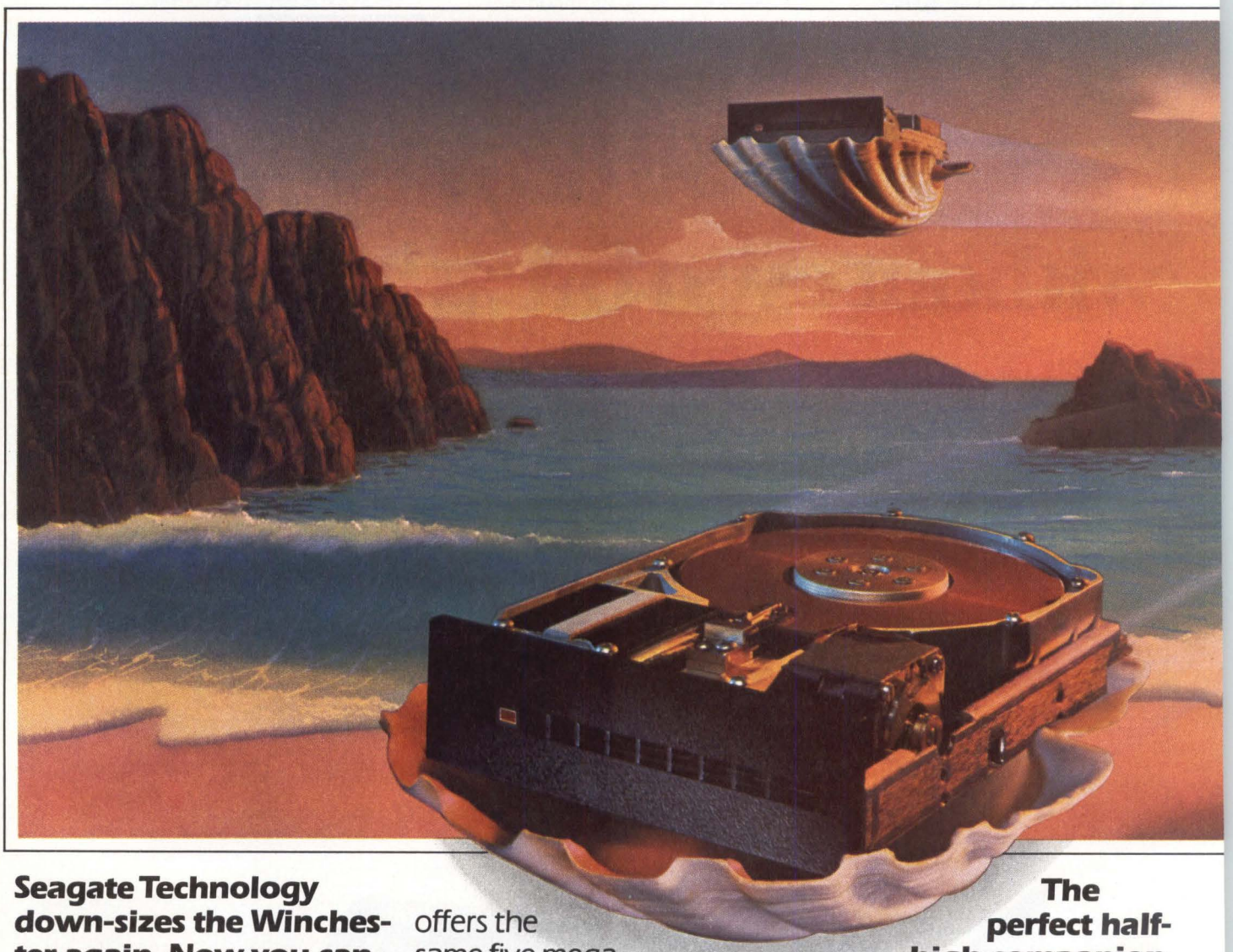

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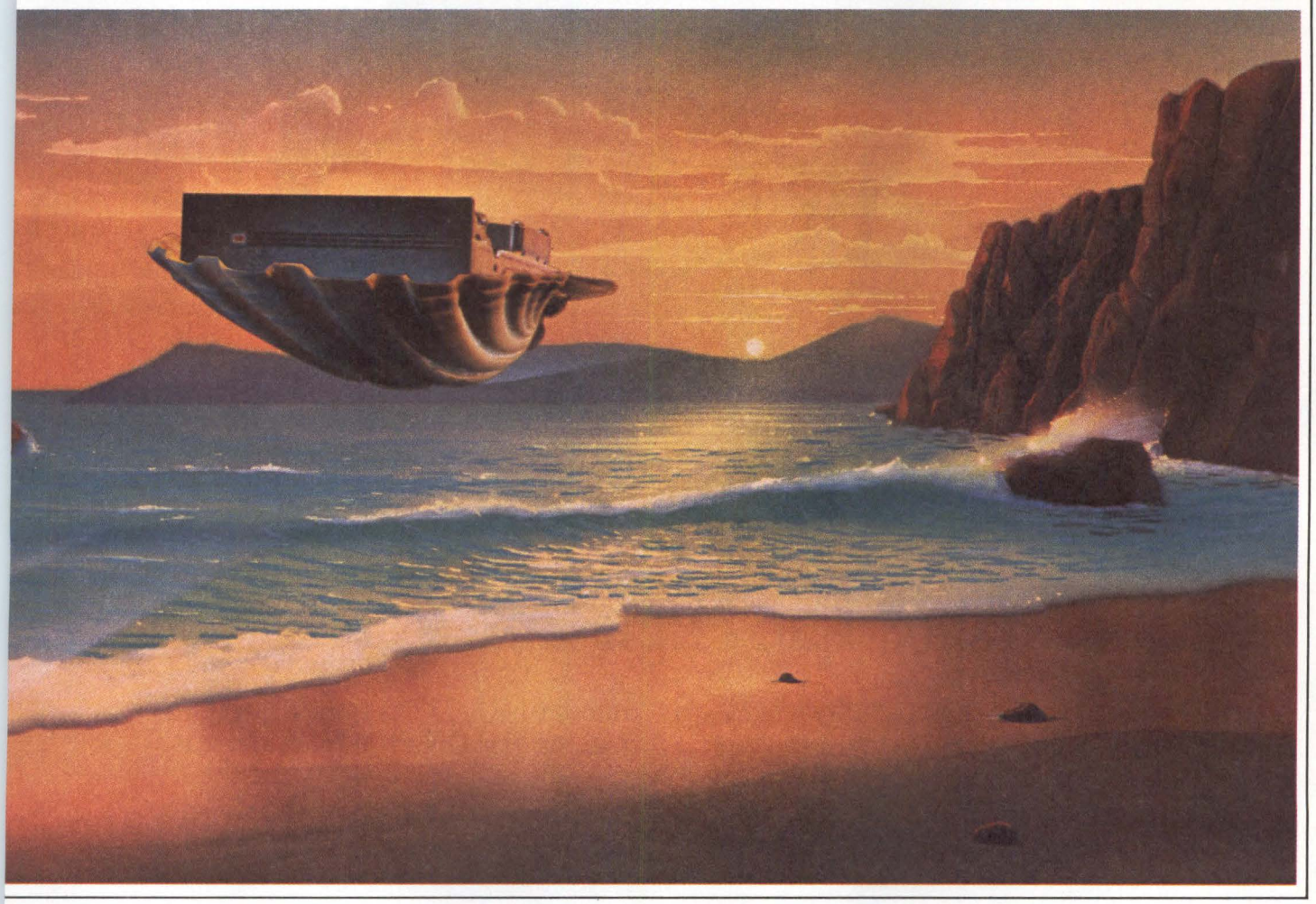

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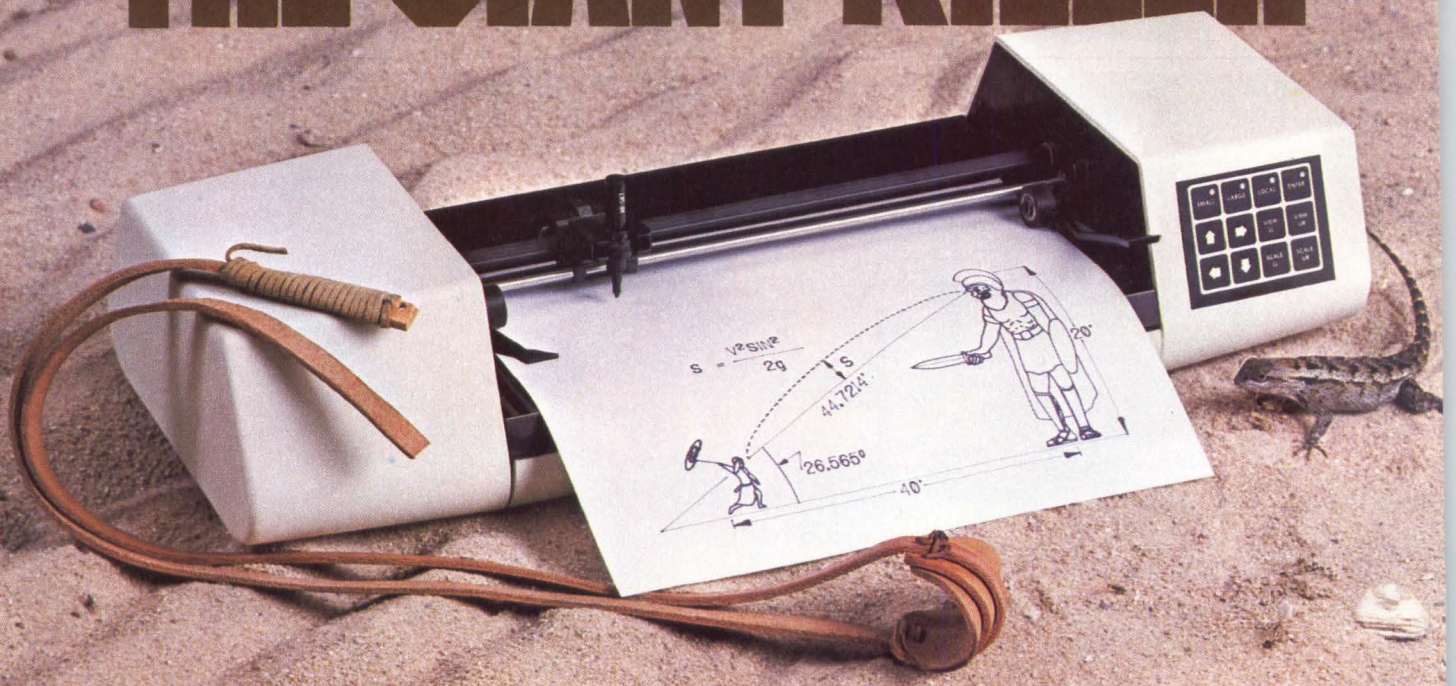


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# Diverse companies compete, cooperate to modernize America's factories

By Dwight B. Davis

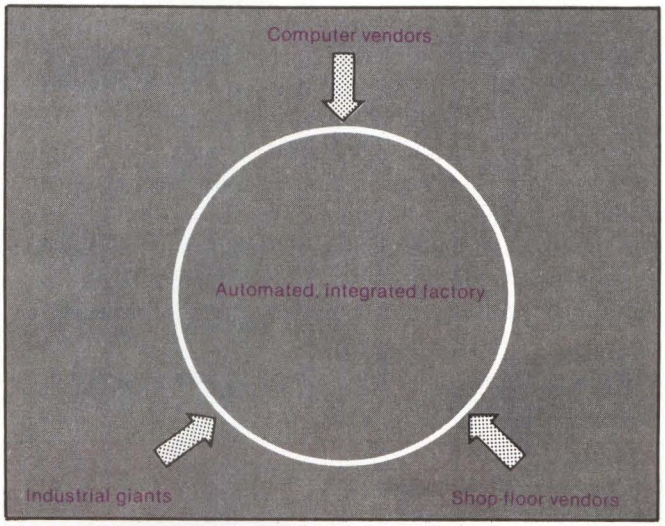
Times are tough for manufacturing companies in this country. The equipment and methods that led many U.S. industries to world dominance in past years no longer succeed when competing against foreign firms that have embraced more modern technologies and techniques. The aging of America's "smokestack" industries, coupled with the persistent recession, presents a bleak prospect for many vendors that sell products to these depressed factories. But, ironically, the dire straits in which many U.S. manufacturers are floundering may actually enhance the prospects of some vendors. These vendors are those that market the same technologies that foreign competitors have already employed with devastating success.

Reflecting the breadth and complexity of the factory market, the vendors selling to this market are far from a homogeneous group. Computer companies, machine tool vendors, programmable controller suppliers, graphics firms, automated test equipment manufacturers, robot developers and others have all descended upon somewhat bewildered factory managers and engineers. Complicating matters, many vendors have developed or acquired technologies outside the boundaries of their traditional products in an attempt to provide more comprehensive solutions to the problems facing industry.

The incentive for all these vendors is a diverse market expected to grow immensely in future years. Tony Friscia, a research analyst at The Yankee Group, Boston, predicts the yearly market for complete factory-automation systems will be around $35 billion by the early 1990s. This projection jibes with a prediction by General Electric Co.'s forecasters that places the 1991 market for factory-automation products at $29 billion to $30 billion. Thomas G. Gunn, manager of the Computer Integrated Manufacturing Group at Arthur D. Little Inc., Cambridge, Mass., says that consulting firm's research indicates an even greater potential for the computer integrated manufacturing market. An ADL study sets the 1982 U.S. CIM market at $26 billion and predicts it will reach $98 billion by 1992 (both values in 1981 dollars) for an annual growth rate of 14 percent.

William T. Ylvisaker, chairman and chief executive officer of Gould Inc., Troy, Mich., quotes encouraging growth figures for several segments of the overall market, including:

- Annual 35-percent growth in factory minicomputer, numerical-control and programmable-control equipment from $510 million in 1980 to $2.3 billion by 1985,
- A quadrupling in the U.S. annual sale of robots in four years, from 2000 units in 1981 to more than 8000 units in 1985 and
- Continued 35-percent growth in sales of computer-aided design equipment from $600 million in 1979 to $2.5 billion by 1985.




**Three primary vendor groups are addressing the factory-automation market**—*computer vendors, such as IBM Corp., Digital Equipment Corp. and Hewlett-Packard Co.; shop-floor vendors such as Cincinnati Milacron and Allen-Bradley Co.; and industrial giants such as General Electric Co. and Westinghouse Electric Corp. The still-young market will also provide many opportunities for secondary companies such as system integrators, OEMs and consulting companies. (Source: The Yankee Group)*

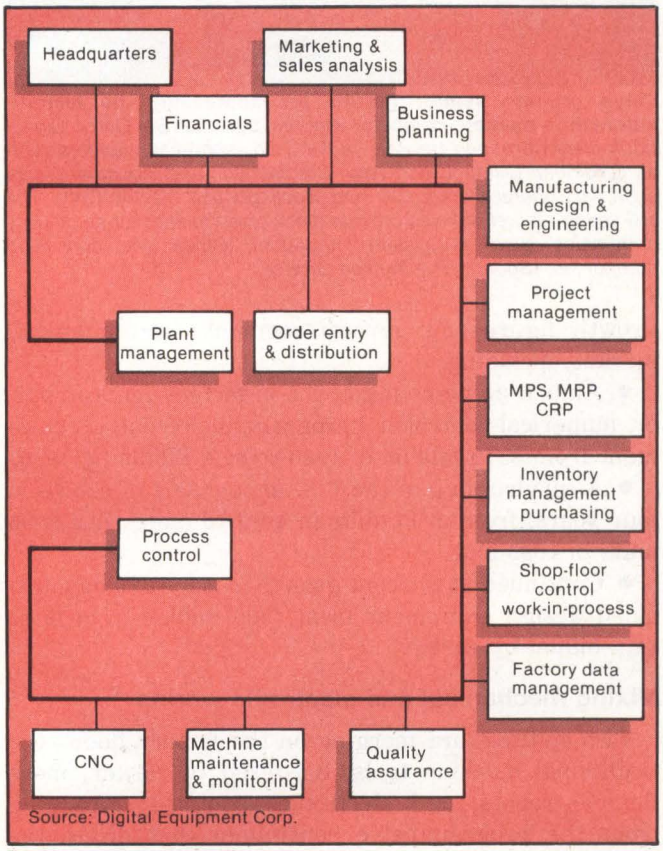
## Mixing mechanical and electronic worlds

Two cultures are merging on the factory floor—the traditional machine tools, bolstered by newer, more flexible robots, and electronics equipment, ranging from the programmable controllers that direct the machines' movements to the minicomputers and mainframes that control groups of machines and manage relevant factory data. Linked to these two basic foundations are numerous automation technologies including computer-aided design and -engineering systems, automated test equipment, data-collection devices and automated storage and retrieval equipment.

Each automation/information niche is becoming more sophisticated while vendors struggle to link these distinct and incompatible "islands of automation" via various interfaces and communications networks.

Regardless of what factory segments any vendor addresses, factory personnel are faced with two basic areas that require attention, says Bruce Rusch, vice president and general manager of Gould's Modicon Programmable Control division, Andover, Mass. "Users have to automate two things—the capital equipment in their plants and the information in their plants," he says. Al Taylor, manager of GE's Factory Automation Planning Services operation, agrees. "We are absolutely convinced that both the physical flow and the information flow must be developed in parallel," he says.

Although Taylor believes the simultaneous automation of plant information and equipment is crucial, he admits, "Many people can't cope with that." The difficulty, he points out, is that two factions in factories are pursuing automation: "the manufacturing/engineering types who are more oriented to the mechanical equipment and the business information and advanced systems people who are more oriented toward the computer." Likewise, most vendors selling into this market have backgrounds and strengths in one area or the other, with only a few larger firms claiming across-the-board experience and products.




**DEC's Unified Plant Management strategy** *consists of equipment and software that provide for the management of factory-related data and for the control and monitoring of shop-floor machines. DEC's unified approach to the factory, like those of some other broad-based vendors, is meant to ensure the existence of compatible expansion and upgrade paths as a customer's automation plan progresses. (MPS = master production scheduling; MRP = material requirements planning; CRP = capacity requirements planning; CNC = computer numerical control.)*

Computer companies such as Hewlett-Packard Co., Digital Equipment Corp., Perkin-Elmer Corp. and IBM Corp. have targeted factory applications as a key growth area, and these firms believe they have certain advantages over the shop-floor vendors that are more closely associated with the mechanical world. "The strengths of HP or any other computer company will be the integration of the various areas of the factory," says Orrin Mahoney, product marketing manager for HP's Technical Computer Group, Palo Alto, Calif. William B. Huber, marketing manager, Unified Plant Management at DEC's Manufacturing Distribution and Control Product Group, Merrimack, N.H., agrees that the tasks of linking incompatible factory-floor equipment and of developing common databases for factory information will fall within the realm of the computer companies. In fact, he hopes that DEC will set de facto standards with its UPM strategy.

"I hope the computer vendors will drive the standards of interfacing the islands of automation," Huber says, "because that's our business. Our UPM approach is really a description of what our product set will be for the next five to 10 years, with our research and development focused on solving the existing communications, database and compatibility problems."

## Removing the CAD/CAM slash

DEC, HP and other computer firms offer varying factory products, but these vendors typically build from an information-management foundation. Thus, they provide application software for material requirements planning, inventory control, market forecasting and the like, all meant to be integrated with factory-floor equipment and statistics. Typically, the computer firms also offer CAD products as integral parts of their automation solutions. These products bring them up against companies such as Computervision Corp., Applicon Inc. and Megatek Corp., which have built their reputations in the CAD market.

Most CAD companies, including market leader Computervision, are devoting increased effort to interface

| | ADM 36 | VT 100 |
|---|---|---|
| DEC Compatible | STANDARD | STANDARD |
| Graphics (Plot 10 Compatible) | OPTION | NO |
| 15 Inch Display | OPTION | NO |
| 132 X 24 or 80 X 24 Display | STANDARD | OPTION |
| Full Visual Attributes | STANDARD | OPTION |
| Printer Port | STANDARD | OPTION |
| International Character Sets | STANDARD | NO |
| English Set-Up Legends | STANDARD | NO |
| Block Mode | OPTION | VT 131 OPTION |
| User Friendly | STANDARD | ? |
| Price | $1195 | $1945 |

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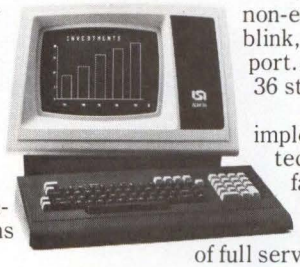

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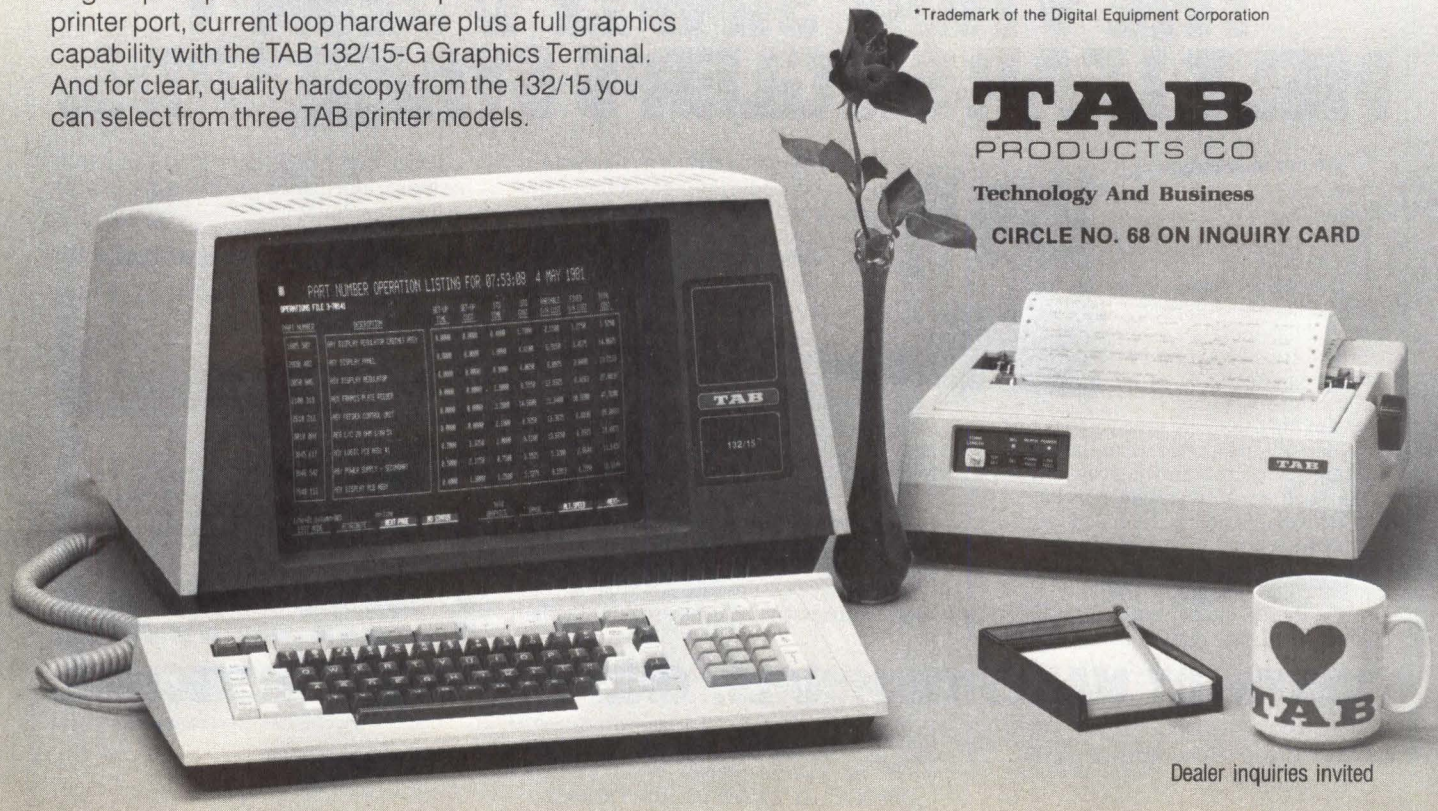



Dealer inquiries invited

**Computervision Corp.'s CAD systems** *are gaining new interfaces into the computer-aided manufacturing side of the factory. Many vendors that, like Computervision, focus on niche markets in the factory, are beginning to develop software to link their products to the most popular equipment residing in other factory sectors.*

their CAD equipment to computer-aided manufacturing equipment and processes. "We believe the better the design of the product, the less problem there will be in manufacturing,the higher the quality of the output and the lower the cost," says Gary Hodgson, director of industry marketing and productivity assurance for Computervision's CAM Systems Group. "So we're trying to remove that slash from between CAD/CAM."

Computervision is developing a library of interfaces to link its CAD equipment to all types of shop-floor equipment, such as milling machines, lathes and coordinate measurement machines. "It would be a lot easier if there was a standard machine-tool programming language and also a common robot programming language," Hodgson says, "but there's not. So we adapt to that essentially by writing everything to a neutral file and processing it to each language."

Hodgson believes the CAM market will drive the CAD market in the future. While he claims the CAD market is still growing at a healthy rate, he admits its acceleration has decreased during the recession. "Within the past two years," he says, "CAM has come into its own, and its rate of acceleration is now much greater than that for CAD." Hodgson notes that fully 50 percent of Computervision's profits come from sales to existing customers, and he points to increased integration between the CAD and the CAM segments as the logical step for CAD users to pursue.

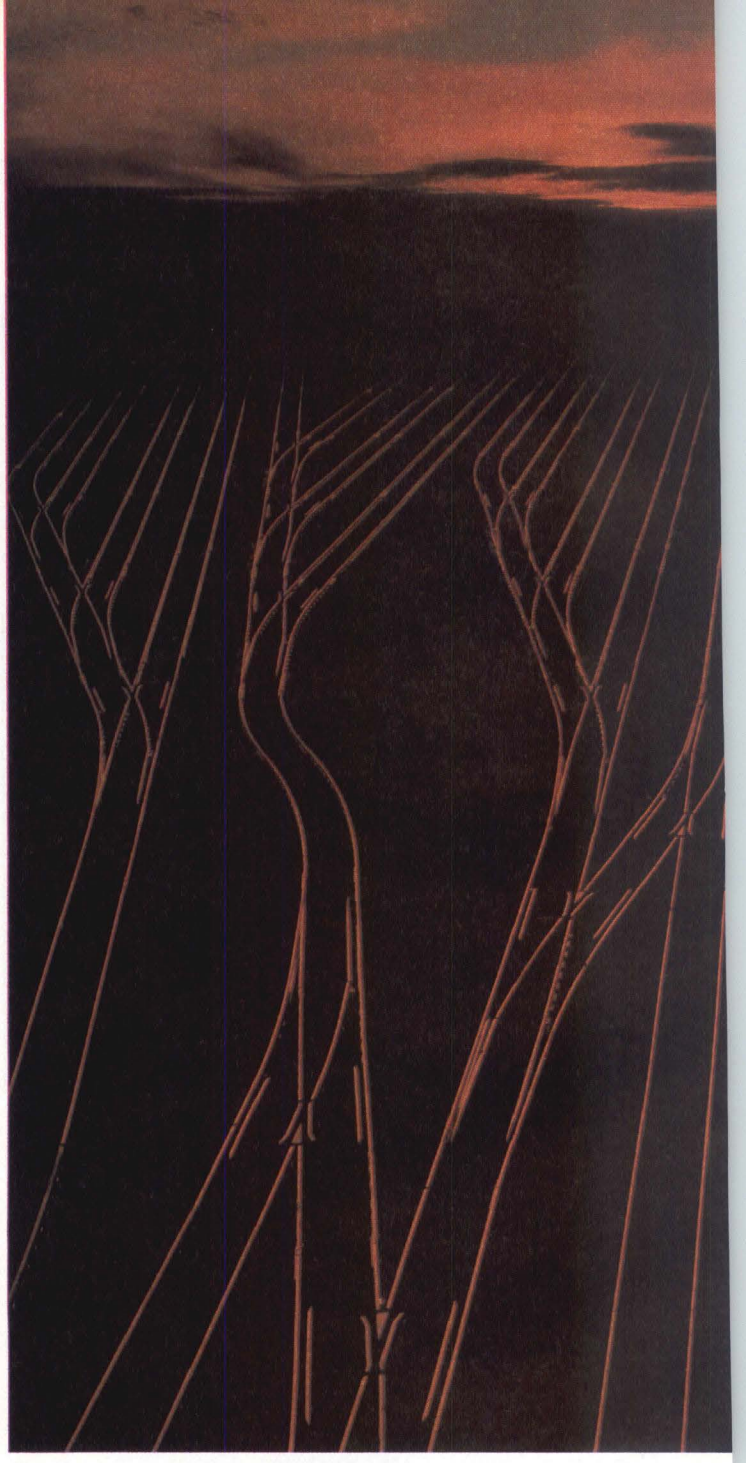
### A question of trust

In evaluating the relative strengths of the factory-market competitors, Friscia at The Yankee Group agrees with many computer vendors' belief that "Computer technology is the foundation of what this industry is becoming." However, he points out, the major shop-floor vendors have generally established their reputations with factory personnel to a greater degree than firms with electronics backgrounds. "Many shop vendors have entered the automation market because their customers have asked them to do so," Friscia says. "Customers are saying, 'We respect you people, we've worked with your equipment, we're familiar with it, and we need to integrate. Can't you help us? We'd rather not go to somebody that we don't know and don't trust.'"

Timothy Heile, marketing communications manager at Cincinnati Milacron, Lebanon, Ohio, agrees that the company's long history of supplying shop-floor equipment is beneficial as the company expands into new automation areas. The firm's major product lines are machine tools and plastics machinery, although both these segments are currently very depressed, says Heile. Robotics still constitutes just a small portion of Cincinnati Milacron's overall revenues, Heile says, but he notes that the robot sector is growing strongly even in the recessionary environment.

Cincinnati Milacron also crosses into the electronics domain because the company manufactures all of the controllers used in its machine tools, plastics equipment and robots. "We see ourselves as being very well postured in terms of our ability to bring total factory automation to the factory floor because of our long-standing machine-tool business, because of our robotics and control business and because of our financial strength," Heile says. He explains that the company is also actively researching interfaces between its traditional equipment and CAD systems, although he is uncertain if the company will ever market its own CAD equipment.

Robots, which have generated at least as much industry interest as CAD systems, have several advantages over traditional machine tools, Heile explains. "Companies are willing to invest in robots because users can increase productivity immediately with the



Your problem right now is to get your local area communications network on a track that will take you far enough, fast enough, and in the right direction. With communications technologies branching out and racing off in every direction, it's tough to know where to start, and even tougher to predict where you'll be five or ten years down the line. You need to know you're going to be in the right place, wherever that happens to be.

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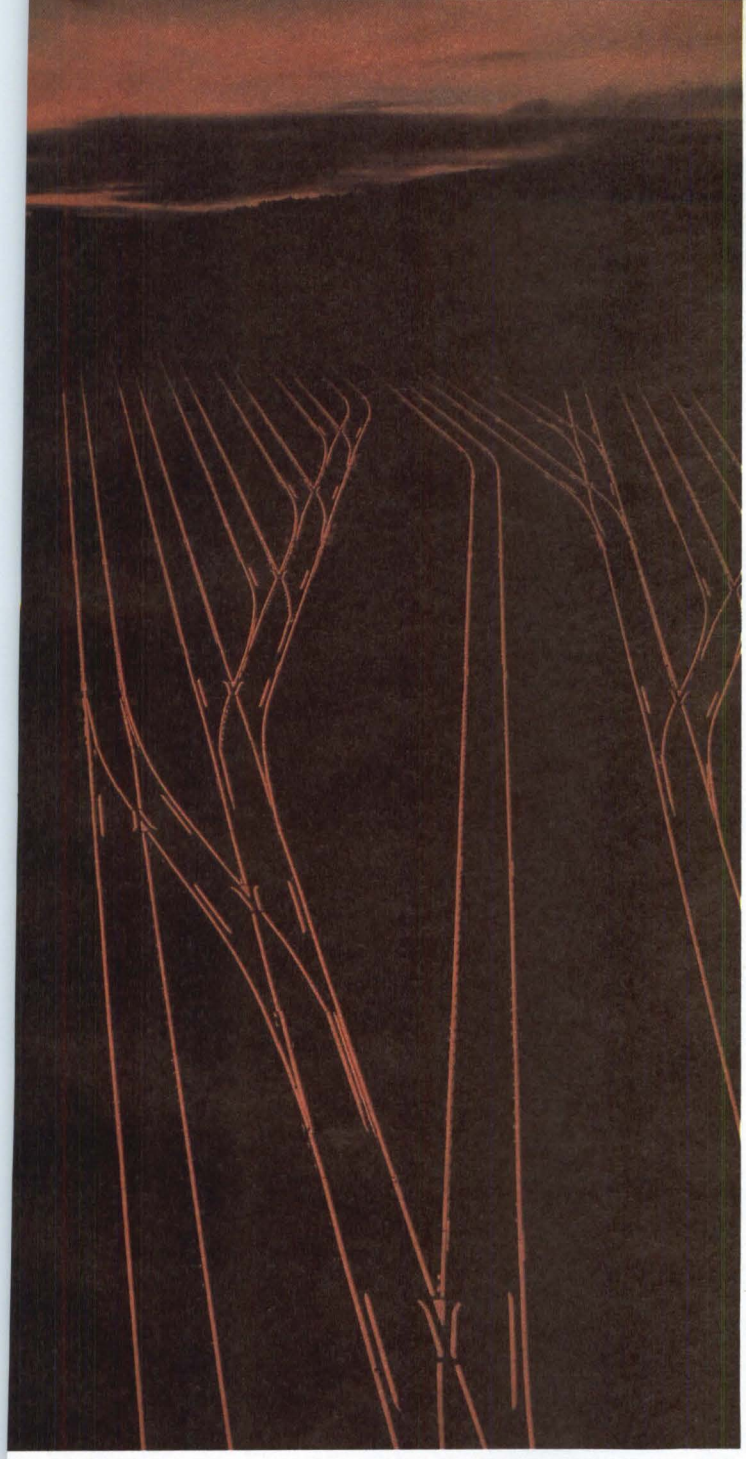

more than you have to now.

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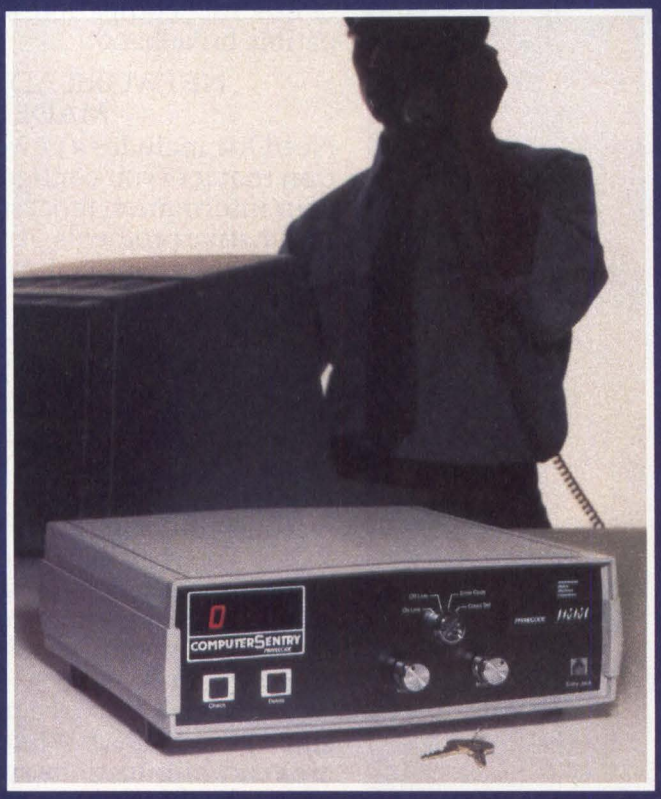


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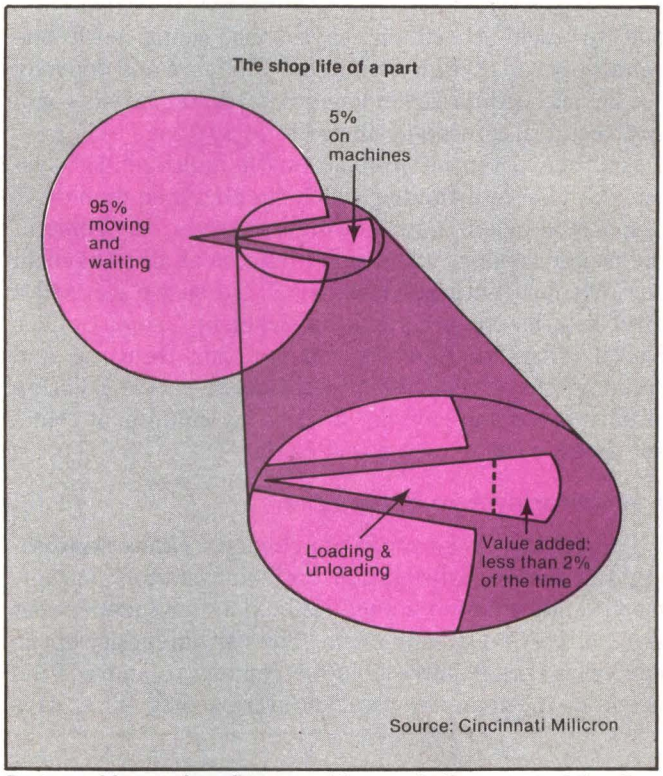
investment of $50,000 to $100,000," he says. "Six months from now, the user can pick the robot up and move it to another part of the factory to perform another application." Heile points out that machine tools tend to be much more expensive than robots—typically selling for $250,000 to $500,000—and they are dedicated to single tasks. But, he says, proven machine tools and their controllers will continue to be an integral part of the factory-automation world.

### One-stop shopping versus multi-vendors

With many vendors attempting to broaden their factory-automation product lines to cover as broad a scope as possible, the question arises about the future for single-niche suppliers. Most such vendors, while aware of the need to interface with other factory segments, believe they can prosper with their limited product lines. At Westinghouse Electric Corp., for instance, "We decided that if we were very good in the robotics business, we could survive very nicely and make a business out of robotics," says Hal Bloch, marketing manager at Westinghouse's Industry Automation division. "I don't see any reason to believe that conclusion was incorrect," he adds.

Westinghouse, which is bolstering its robot line by acquiring Unimation Inc., Danbury, Conn., initially had grander plans for attacking the factory market, Bloch says. "Originally, we thought we would take a much broader approach of providing services and hardware across the entire field of automation. But some degree of realism began to emerge, and we decided to concentrate on robotics, while continuing our efforts in the computerized numerical-control and distributed numerical-control areas." Westinghouse never intended to go head to head against robot companies such as Unimation, he says, which produce machines for high-temperature, heavy-duty tasks such as spot welding and painting. The addition of the hydraulically run Unimation robots complements Westinghouse's line of electric-drive robots, which perform arc welding, precision small-parts assembly and light to moderate material handling and machining, Bloch says.

At the other side of the vendor spectrum are companies such as GE and Gould, which pride themselves on the breadth and diversity of their factory product lines. GE doesn't manufacture computers or machine tools, but they do build just about everything in between, including CAD/CAM systems, robots, controllers and the software to drive and manage these devices. Gould, with seven factory-related divisions under its Electronic Systems Group, is particularly strong in the controller business, holding a company-estimated 40 percent of the market with more than 40,000 installed programmable controllers.




**Parts reside on shop-floor machines only 5 percent of the time they are in the shop,** *and only 2 percent of the time on machines is actually involved in modifying the parts. This information, presented by James Dunlap of Cincinnati Milacron at a recent Factory of the Future conference, illustrates how effective parts handling can dramatically impact a factory's efficiency. The conference was cosponsored by the Technology Transfer Society and the American Society for Quality Control.*

But even these companies point out that they can't supply total solutions to factory-automation requirements. "We don't have it all, and no single company does," says GE's Taylor. DEC's Huber agrees: "A lot of us would like to think we're the answer to automation, but we're not. GE is not going to become a major computer vendor again, and DEC is not a robot vendor. The big customers are going to have to shop around if they want to optimize their systems."

Nevertheless, the broad-spectrum suppliers believe the more a customer can get from a single vendor, the better off the customer will be. Charles Skinner, vice president of the Booz, Allen & Hamilton Inc. consulting firm, Cleveland, agrees that manufacturers are better off going with single vendors if possible because of the current lack of standards in this area. "Right now, everybody has his own way of linking the equipment, and the users really need these different systems to

talk to each other," he says. "So, going with one vendor—even though it may cost you more and you may not get the optimum components for certain areas—will still result in a more optimum total system."

Another potential problem with multi-vendor systems can be determining which supplier's equipment is responsible when a system failure occurs, say some of the larger vendors. "It doesn't hurt us at all to have all our divisions with products available so we can sell a total solution to a company's problem," says Gould's Rusch. "And then when you get this thing up and running, there won't be nine different people pointing at each other and saying, 'It's not my equipment that's not doing what it's supposed to do.'"

### A need for system integrators

Despite the broad range of primary vendors addressing the factory-information and -automation market, most vendors agree a need still exists for independent system integrators and OEMs. The very diversity of the market makes it impossible for vendors to address the needs of the many vertical industries that exist, says HP's Mahoney. "If you can automate an office in an insurance company, you can probably do an office in a bank or in a manufacturing company," he says. "The kinds of things people do in offices, such as accounting and word processing, are very similar from company to company.

"But, if you automate a steel mill, and then you try and do an oil refinery, and then try to do some discrete manufacturing company, their operations are quite different. So there's definitely an expertise that can be supplied by such companies as OEMs and software houses."

Rusch at Gould agrees, saying, "There's definitely a place for the system integrator. My division's expertise is industrial electronics. I can't know in great detail how to make steel, how to make tires and how to make baby food." And DEC relies heavily upon its OEMs and third-party integrators to address market niches DEC has not targeted, says Huber. "It's unbelievable how much product we move in this market through our indirect channels," he says.

Some large manufacturing companies are undertak-

ing automation themselves, says GE's Taylor, who sees in-house system integrators starting to appear within factory management. Called a "program manager," "task-force leader" or a similar title, a competent in-house system integrator can do much to ease the strain between mechanical and electronic personnel, Taylor says.

Companies without in-house expertise often use a consultant to evaluate their needs and to decide where to begin automating. Virtually no company can afford to retrofit its entire operation with new automation equipment in one fell swoop, and the first step in the process is crucial because it sets the stage for future success or failure. "Consultants can help the users decide where they can get the most bang for their bucks," says Skinner at Booz, Allen. "Should the guy be investing in CAD systems to help his R&D and engineering department, or should he be investing in equipment for the shop floor to improve productivity? You can't make that decision generically."

And to be truly successful in their modernization efforts, factories must go beyond the straightforward automation of their existing manufacturing processes, says DEC's Huber. "The Japanese study a process before they automate it," he says. "The American mind-set is not to study the process. They just go in and throw in a robot to automate something that already exists, versus sitting down and thinking about whether the process exists for a good reason. For any given application, we will end up with 10 times the number of robots the Japanese will end up with," Huber claims, "because we simply automate the existing process instead of putting our research dollars into revamping the process before we automate."

And automate the factories must, says GE's Taylor, recession or not. "People in almost all factions of society are cognizant of the fact that automation is inevitable," he says. "Only two or three years ago, the argument was about whether or not automation would happen. Now it's an argument about how to make it happen comfortably. The need to improve productivity and quality is well recognized, and people are finally beginning to get serious about how to attain these goals." □

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**Place:** Hyatt Hotel
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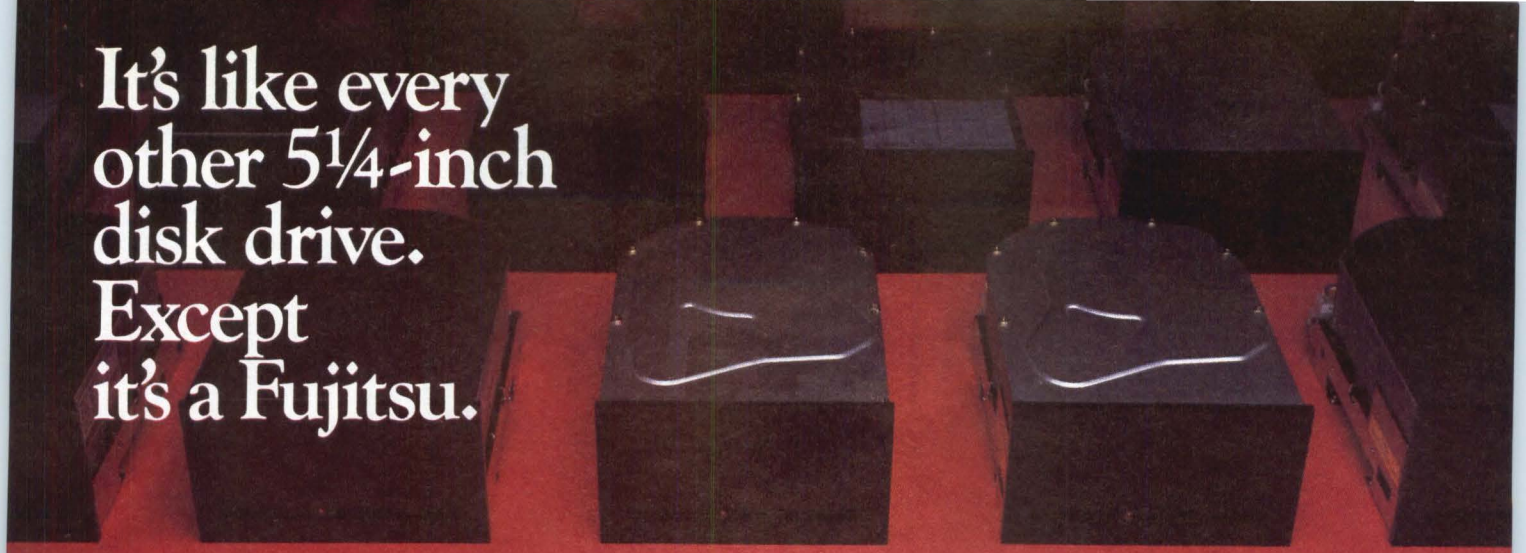

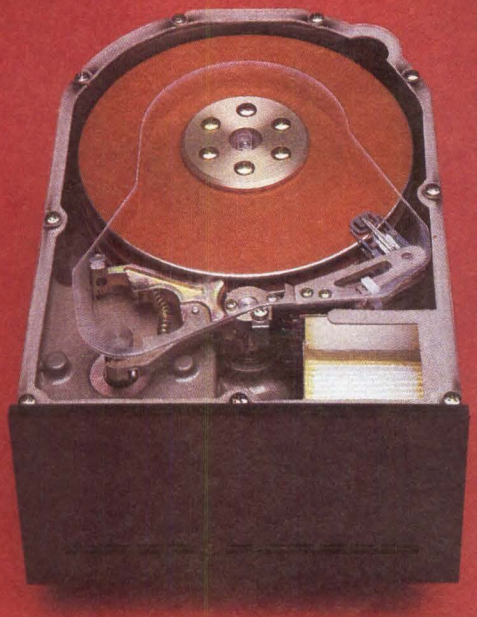

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|---|---|---|---|
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| AVG. POSITIONING TIME (ms) | 95 | 95 | 95 |
| TRANSFER RATE (KB/s) | 625 | 625 | 625 |
| INTERFACE | ST506/SA4000 | | |
| AVERAGE LATENCY (ms) | 8.3 | 8.3 | 8.3 |
| RECORDING DENSITY (BPI) | 8,020 | 10,200 | 10,200 |
| TRACK DENSITY (TPI) | 254 | 300 | 300 |
| NUMBER OF CYLINDERS | 160 | 320 | 320 |
| NUMBER OF DATA HEADS | 4 | 4 | 6 |
| POSITIONING METHOD | Buffered Stepper | | |
| DIMENSIONS (HxWxD in.) | 3.3x5.7x8.0 | | |

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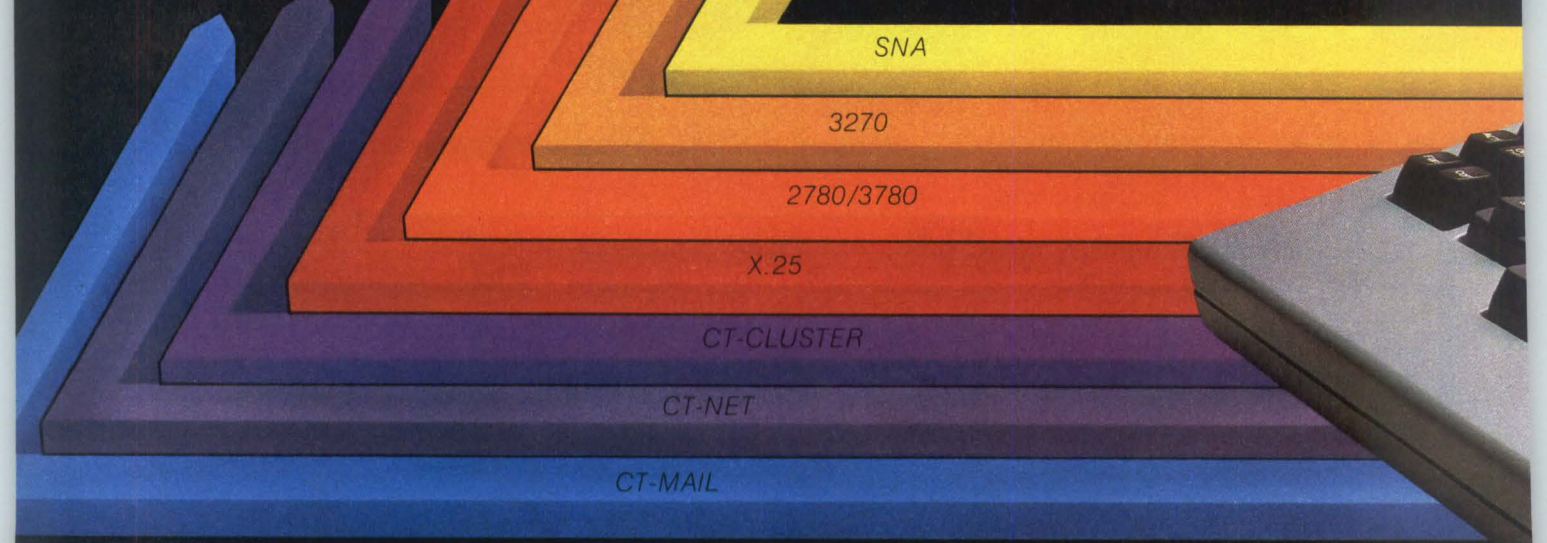
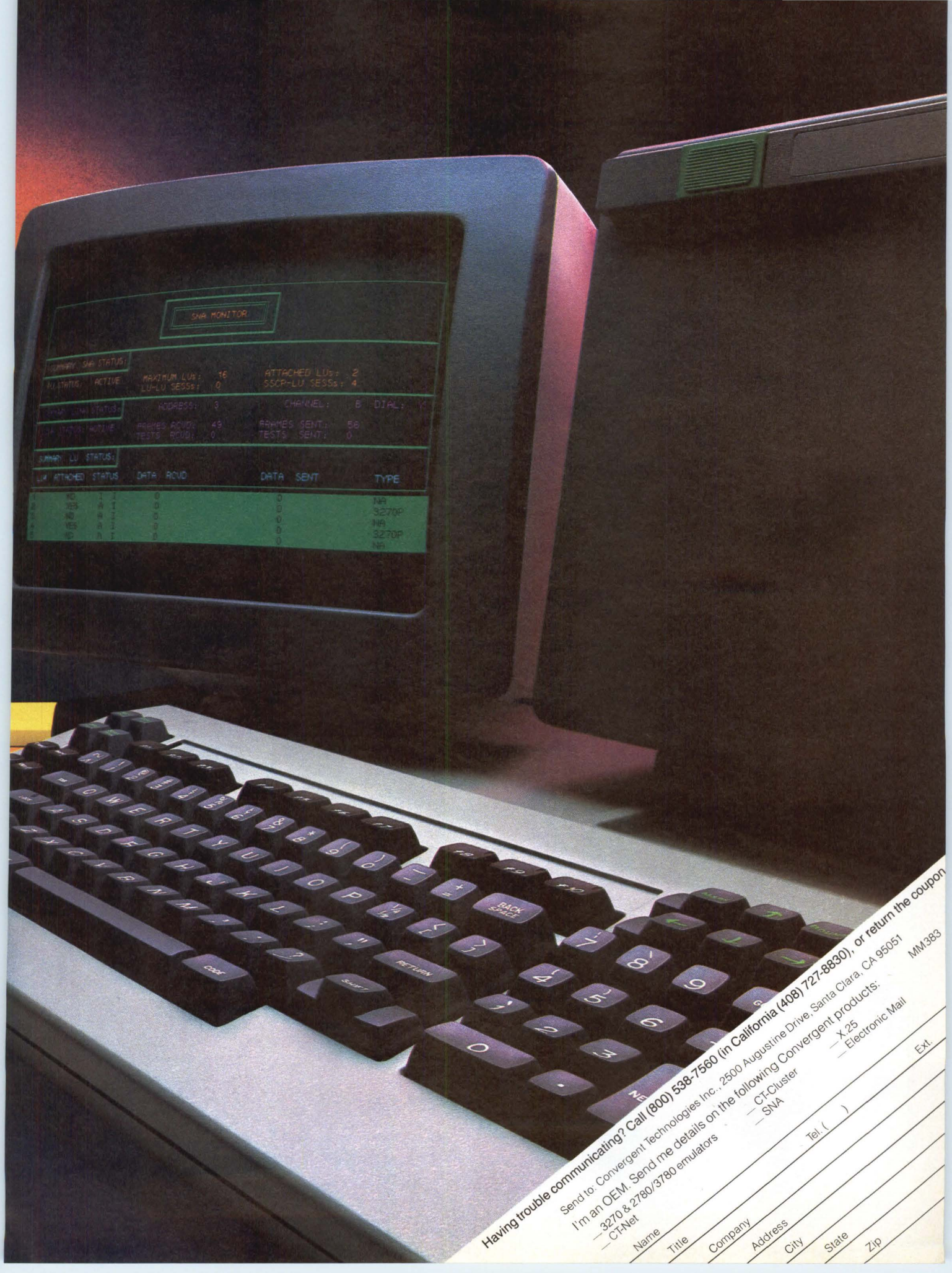
*Even if you don't need all these facilities right now, it's nice to know that they're ready to go.*

*Because you never know when you might need to make somebody talk.*

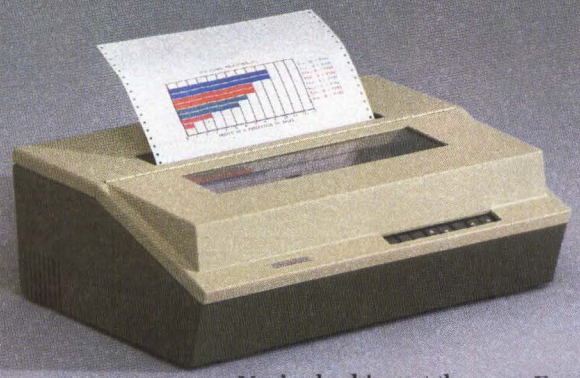



## Convergent Technologies

*Where great ideas come together.*



# We planned our family of color terminals and printers to work the way you use them.



## Together.

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Built with all the features you've been waiting for—family compatibility, upgradeability, text with graphics.

How did we do it?

We made our terminals support everything from business applications to demanding CAD/CAM. We also made them upgradeable so you could change the amount of color graphics you need.

For instance. Our model 230 terminal includes distributed graphics processing features like local storage and manipulation of graphics objects. Local 2-D transformations. True zoom and pan. 16K x 16K virtual resolution. 16 colors from a palette of 4,096. And more.

We designed our letter quality color VectorPrinter™ like a printer/plotter, using 8 colors and a fast 300 cps print speed.

Finally, we put each and every product through intensive 100% reliability testing. And if that wasn't enough, we also made them affordable*.

Best of all, you won't have to wait for Envision's color family. It's available now.

Amazing what a little planning can do.

**Envision**

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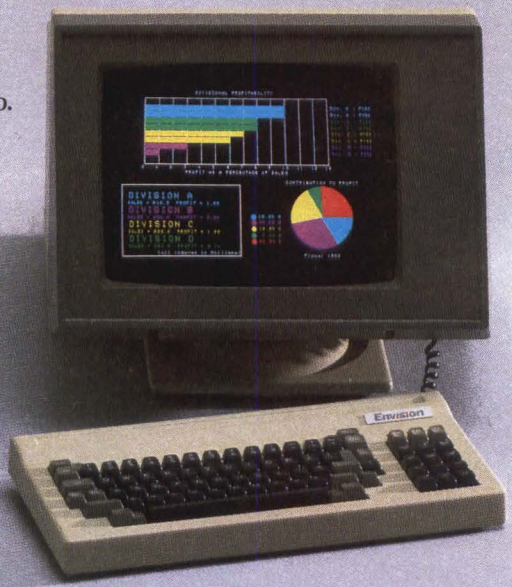


*Envision 210 Color Terminal: $2,750
Envision 220 Color Graphics Terminal: $4,950
Envision 230 Advanced Color Graphics Terminal: $6,950
Envision 420 Color Printer: $3,950
Envision 430 Color VectorPrinter: $4,950

*OEM pricing available*

VectorPrinter is a trademark of Envision Technology Inc.

CIRCLE NO. 74 ON INQUIRY CARD

# Lockheed-Georgia brings computing power to the manufacturing floor

By Eric Lundquist

In a cavernous factory originally used for building bombers in World War II, Lockheed-Georgia Co. officials are developing computer-based manufacturing technologies aimed at making airplane production less expensive while improving quality. The range of effort is as varied as the manufacturing technologies brought to bear in airfcraft production. The common ground among the projects is that the computing power once available only to the executive offices is moving down to the manufacturing floor.

The projects at Lockheed-Georgia, which are funded in part by the U.S. Air Force, include a system involving the integration of input controls on about 60 numerical-control and computer-numerical-controlled machine tools, a computer-aided setup system that keeps and updates records and a data-entry system using voice-activated inspection of incoming materials to replace written inspection reports.

Lockheed-Georgia, a division of Lockheed Corp. based in Marietta, Ga., is involved in both modifying and producing transport planes. Its efforts are sponsored by the Aeronautical System division of the U.S. Air Force. The projects fall within an overall program called Technology Modernization (Tech Mod), which offers incentives to defense contractors to make capital investments in their plant and production equipment. In the last seven years, Lockheed-Georgia has invested more than $150 million in facilities, machinery and equipment. For example, in one program for modifying the wings of C-5 Galaxy transport aircraft, the government invested $4 million, while Lockheed-Georgia and Avco Aerostructures devoted $4.4 million in fixed assets.

More than 700 ideas for new technologies and systems were originally considered for the Tech Mod program. Those 700 were whittled down to nine, with Lockheed to perform seven, and Avco to perform two. All are expected to be completed by 1984. Joseph Tulkoff, director of manufacturing technology at Lockheed-Georgia, says the program is geared toward halting stretched-out programs and toward multi-year contracts, which encourage companies to make capital investments.

Last year, Digital Equipment Corp., Maynard, Mass., received a contract to develop a computer system for integrating the input controls on the 60 numerical-controlled machines. The aim of the system is to allow the machines to be operated from control data transferred from a remote direct numerical-control supervisory computer to a computer-numerical-controlled controller.

The contract, which DEC won over other bidders including Texas Instruments Inc. and Hewlett-Packard Co., is still new. In operation, a part program would be generated by an IBM Corp. 3033 and sent to dual DEC VAX 11/750 computers. The program would then go to one of the 11 DPM-23 subsystems and be routed to a machine tool. Each subsystem will use an LSI 11/23 and will be connected to about five machine tools. The machine tools will have two attached devices, including an LSI 11/2 and an Analog Devices Inc. data-acquisition module.

The automated records system helps capture knowledge that would otherwise be lost when an experienced machinist leaves a company. The computer-aided setup program is intended to be rigid enough to allow a structured database and to extract detailed part-setup sheets, but sufficiently flexible to accommodate a machine's quirks.

The need to capture the "black book" knowledge of machinists is especially important in the aircraft industry, in which production runs consist of small batches of closely machined, high-tolerance parts. The information that is important in parts manufacture includes the proper speed at which a machine should operate, how closely a tolerance can be adhered to and whether any special shims or tools are required for a part run. Detailed knowledge of a part run is born of experience, and lack of that knowledge results in a trial-and-error approach, leading to production delays and expensive rejections.

Lockheed-Georgia made an unsuccessful attempt in the mid-'60s to use a paper system that proved difficult to maintain. The company decided that, for the system to work properly, there had to be a method for entering the data from the shop floor. The first video terminal, a DEC VT100, went to the shop floor about one and one-half years ago and has since been joined by three others connected via DECnet networking architecture to a PDP-11/70 minicomputer. Six supervisors have been trained to enter data into the system.

The data-entry system uses Interstate Electronics

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14-Jul-82                                                                PAGE  2
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**The computer-aided setup program at Lockheed-Georgia** *is an attempt to capture the "black book" information that would otherwise be lost when a machinist leaves the company.*

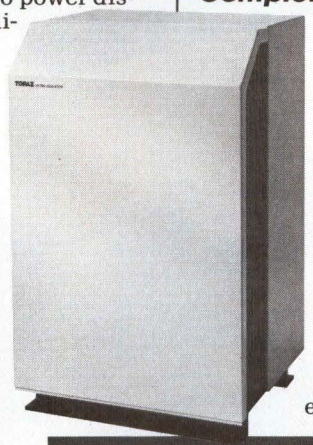
Corp. voice-recognition hardware for voice-activated inspection of incoming materials. The system's hardware includes Interstate's VRT-101 terminal, which allows voice or keyboard entry and has a vocabulary limit of 100 words. The information from the terminal is reformatted for transfer to a Sperry Univac mainframe. The system has four terminals. In operation, a user speaks the inventory number into a microphone, and numerals and letters appear on a video screen for verification. The data are then transmitted to the mainframe for inventory control. □

**Eric Lundquist,** a former associate editor of *Mini-Micro Systems,* is now managing editor of *Electronic Business.*

**Usually, Noise Protection is Enough.**

# Why Buy More Power Conditioning Than Your Computer Needs?

Electrical power disturbances cause a variety of computer problems, including program errors, memory losses and component malfunction. Although all computers are vulnerable to power disturbances, not all applications require the same degree of protection. Generally, the more critical the application the greater the need for comprehensive power conditioning. In the majority of computer applications, satisfactory performance can be guaranteed simply by providing protection against power-line noise.



### Noise is the Most Troublesome Power Problem.

Power-line noise, voltage variations and power outages all can affect computer performance. But noise is by far the most troublesome, accounting for nearly 90% of all power disturbances at typical computer sites.

| Incidence of Harmful Power Disturbances* | | |
|---|---|---|
| Type of Disturbance | Rate | Percent |
| **Power-line Noise** | **113.3/month** | **88.5%** |
| Voltage Variations | 14.4/month | 11% |
| Power Outages | 0.6/month | 0.5% |
| Total | 128.3/month | 100% |

*Reference: George Allen and Donald Segall, IBM, "Monitoring of Computer Installations for Power Line Disturbances."

Power-line noise transients originate from dozens of sources, including lightning, the switching of power grids and power-factor correction capacitors by utility companies, and the operation of countless electrical devices from elevators to electric pencil sharpeners. When noise enters a television set it creates static and snow; when it enters a computer, noise often causes errors, system malfunctions or even damage to sensitive circuitry. Power-line noise is so pervasive and so troublesome that most computer manufacturers specifically recommend that users provide noise protection in order to keep sensitive equipment operating properly.

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Noise is transmitted in two forms: as common-mode noise and as transverse-mode noise. Both types of noise cause problems for computers, but common-mode noise is the more serious because most computers use ground as a logic reference. For this reason, Topaz Ultra-Isolators are designed to provide an exceptionally high degree of common-mode noise attenuation plus excellent attenuation of transverse-mode noise. Unique triple box shielding achieves a minimum 140 dB (10 million to one) of common-mode noise attenuation, and special low-pass filters combine with peak-limiting circuits to provide up to 60 dB (1,000 to one) of transverse-mode noise attenuation. These exceptional noise-suppression characteristics enable Topaz Ultra-Isolators to eliminate costly noise-related computer problems.

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In addition to providing complete noise protection, Topaz Ultra-Isolators also offer such benefits as UL listing, attractive computer-room styling, quiet and efficient operation and guaranteed performance.

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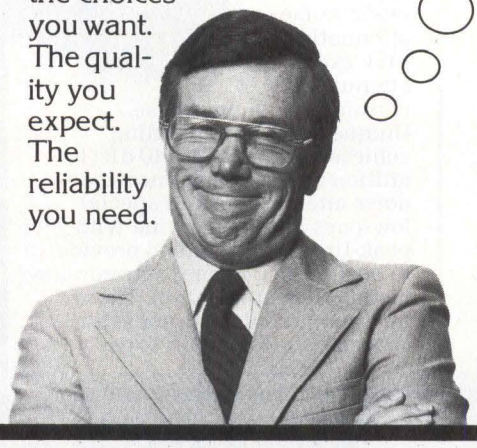

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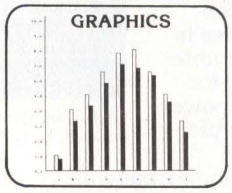


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# UNDERESTIMATED.

CIRCLE NO. 76 ON INQUIRY CARD

# GenRad integrates CAD, ATE with CADMATE

In its first step to offer products that integrate automatic test equipment with other computerized systems within electronics assembly facilities, GenRad Inc.'s new Quality Management Products group has announced CADMATE—a hardware- and software-based product that down-loads CAD-generated PC-board schematic layouts to ATE systems. Richad Faubert, manager of QMP at GenRad, Concord, Mass., says that CADMATE eliminates the need for an electronics manufacturer to generate one schematic diagram on his CAD system and another on his ATE system.

CADMATE links GenRad 1790 and 2270 PC-board testers with CAD systems supplied by Computervision Corp., Applicon Inc., Scientific Calculations and Racal-Redac. Faubert says that those four vendors supply 80 percent of all CAD systems used for PC-board design. The vendors will also offer optional file generators that reformat CAD-generated PC diagrams in a form compatible with GenRad test systems. GenRad bases its 1790 and 2270 systems on Digital Equipment Corp.'s PDP 8 and PDP 11/23, respectively. Both systems run on the RSX 11/M operating system.

Once compatible PC-layout files are generated, CADMATE transfers them to the ATE system. File transfers can be accomplished via an IBM Corp. 2780 bisynchronous communications link, a DECnet link, nine-track magnetic tape, DEC RX01 or RX02 floppy disks or paper tape. Files can be moved directly onto the test system or onto a host computer that runs a network of ATE systems. GenRad offers a 2294 host computer system—based on a DEC PDP 11/44 computer—as well as a network, GRnet, that links the 2294 to the company's ATE systems. Prices for CADMATE start at $16,900.

GenRad's QMP group was formed last October to develop products that link ATE systems with other computer-based electronics manufacturing equipment including process-control, automatic-insertion and CAD systems. *—Frank Catalano*

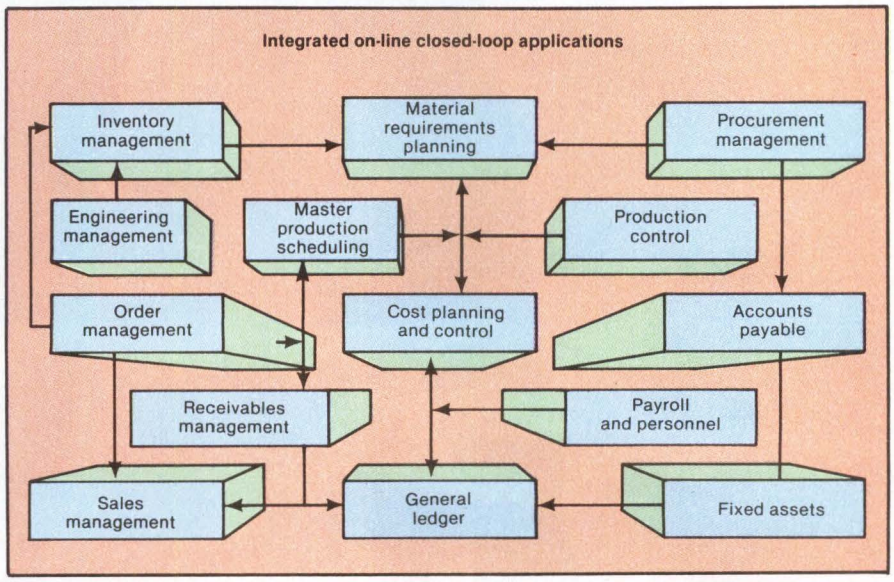
# Business software developed for manufacturers

A new software product for manufacturing firms from Xerox Computer Services, Los Angeles, ties manufacturing, financial, distribution, marketing, engineering and procurement functions into an integrated system, the company claims. The Xerox Manufacturing System runs on IBM Corp. 4300, 370 and 3000 computers and is available as a package, as application modules or as part of a time-shared network service. Similar modules will also be available for Digital Equipment Corp. VAX computers, although these are not integrated into a single software system, says Norm Raffish, marketing vice president at Xerox Computer Services.

Raffish says this product announcement represents no strategic shift from Xerox's targeted office market. "The office, which has been the predominant Xerox corporate target, is just spreading out into the factory. It's all coming together," he says. For XCS, he notes, most customers are manufacturing companies.

The Xerox Manufacturing System is aimed at companies with revenues between $15 million and $250

*Continued on page 132*




**The Xerox Manufacturing System** *integrates the business-oriented computer applications of a manufacturing company into a single software system. Designed for IBM computers, the system also includes interfaces for the Xerox 820-II personal computer.*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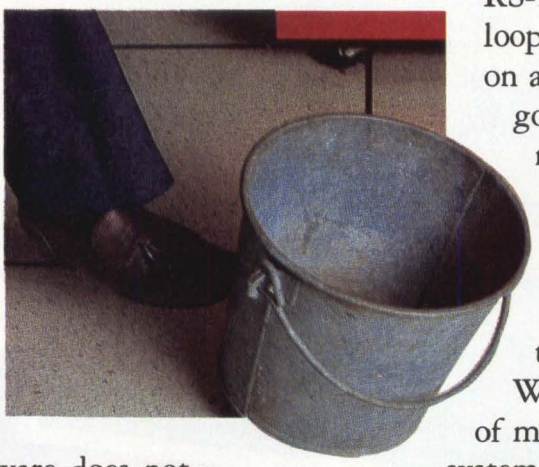

That's because MDB has developed a Buffer Ready/ Printer Busy monitor circuit to use with all printers that have a "busy/buffer full" design feature. It increases computer thruput when used with printers that do not provide Xon/Xoff protocols, or the software does not monitor these protocols. No more data delay, one more system enhancer from MDB.

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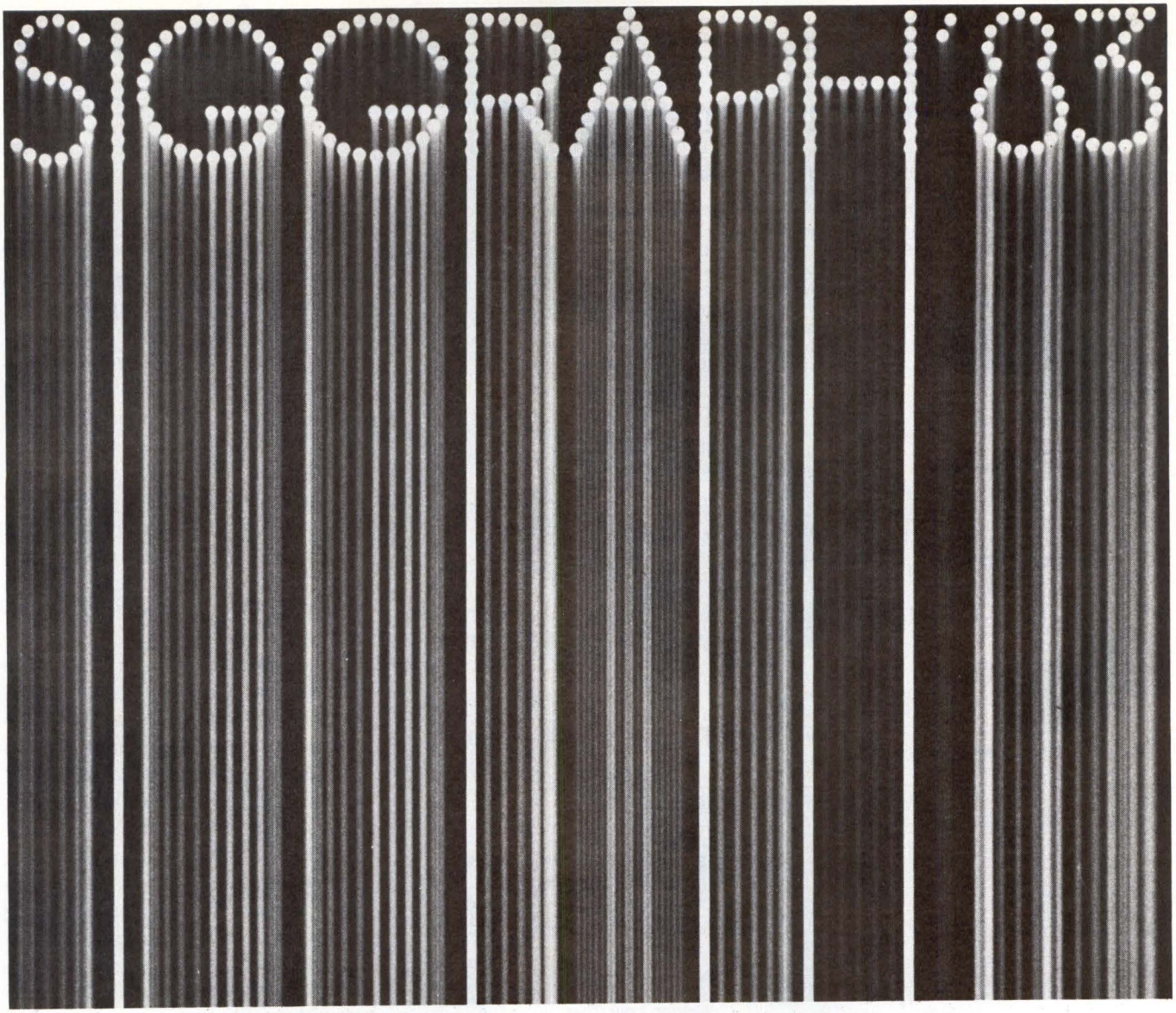


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# SiM

*Continued from page 127*

million. IBM computers comprise the largest installed base in this market, with DEC equipment second. Raffish believes the DEC VAX family is used by the low end of this market—companies with revenues of less than $100 million. "The VAX user's needs are not as stringent as the IBM user's," he says. Fewer application modules are planned for VAX computers than for IBM machines. Some VAX-based software is available now, and more is scheduled for introduction by year-end.

The IBM-based system is portable across SSX, DOS/VSE, OS/VSI and MVS operating systems. It also includes personal computing software for use with the Xerox 820-II microcomputer and software that allows the 820-II to access IBM mainframes. Application modules sell for between $15,000 and $35,000 each, under a perpetual licensing agreement. All applications are business oriented. These include such functions as master production scheduling, material requirements planning, inventory and procurement management, production control, factory data collection, cost planning and control, engineering management, general ledger, accounts payable, sales management, payroll and personnel.

XCS plans to announce another integrated software system near the end of this year, says Raffish. The system will be aimed at what he calls "repetitive manufacturers"—those with long-term, high-volume production schedules. "They have business problems that are distinct from the problems of the small, work-order-type manufacturer," he says, and categorizes this market as comprising manufacturers with revenues of $50 million or more.

*—Sarah Glazer*

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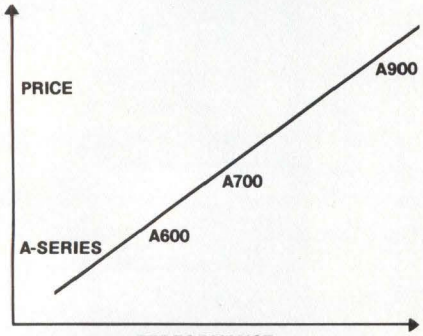
We made our computer exceptionally fast and rugged, as well as simple to use, expand and maintain. With state-of-the-art LSI technology, we were able to integrate the CPU and floating point hardware chips. We also included HP's Scientific Instruction Set and Vector Instruction Set firmware. Combined with a 4-kilobyte cache memory, two-level pipelined implementation and 3.7 megabytes per second I/O bandwidth, this made it comparatively simple to reach a CPU speed of 3 MIPS. As well as 560,000 floating point operations per second. All for an astonishingly low $14,818.




*If price/performance is important in your business, you can't do better than this.*

Since we used only a quarter the number of components that are in our previous top-of-the-line computer, the A900 is even more reliable and simple to maintain. MTBF is a healthy 8000 hours; average repair time a scant 90 minutes.

You'll have an easy time expanding your system, too. You can start with our standard 3/4-megabyte board, and move all the way up to 6 megabytes of 64K RAM error-correcting main memory. Without straining your budget. Because you can get this additional memory for just $3340 per megabyte.

## The Automators: a well-matched family.

In our HP 1000 A-Series family, you'll find two other members with the same level of price/performance as the new A900. For example, the A600 microcomputer gives you 1 MIPS minicomputer capabilities for only $5K. The A700 minicomputer adds an easily customized microprogrammable processor. So, for just $10K, you can tailor its power to handle data acquisition, process control and supervision of several dedicated processors.

All three computers come in a range of configurations, from $2K micros to $50K super-minicomputer systems. They all support identical peripherals, making it simple to expand or add power any time you want. And we simplify planning your own system with a choice of nine graphics I/O devices, six CRT terminals, and a wide range of printers, disc drives and HP-IB compatible instruments.

## A simple software story.

We made the software not just compatible but identical for the entire A-Series family. So you can interchange programs without any modifications at all. What could be simpler than that?

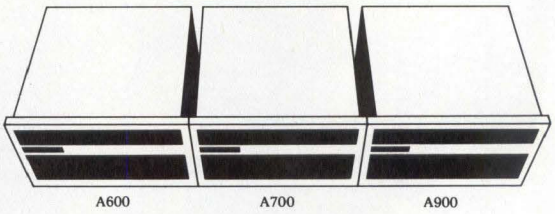
The family supports all major HP 1000 software packages, too. Including Graphics/1000 and IMAGE/1000 data base management. You can also use DS/1000-IV to network with the other HP 1000 or HP 3000 systems, as well as X.25 packet-switching datacomm software.

All the Automators utilize the new RTE-A.1 real-time operating system. This supports programming in FORTRAN 77, Pascal, BASIC and Macro Assembly languages.

## A new program for OEMs.

This is going to make things much simpler for you. It's a package of new discounts and credits that will help you sell more and keep more for yourself.

For instance, we'll give you a 10% credit for HP add-ons a customer orders for your system. And a 6% credit on the net price of a system for which you supply the software. To help your cash flow, we're offering 40% discounts on demonstration and development systems, too.




*The HP 1000 A-Series Automators provide a range of capabilities for real-time applications.*

That's just for starters. Our new OEM program also involves competitive discounts, extended warranties, free training and much more.

So if you're looking for the best-performing real-time computers for the money—and a better-looking bottom line in the bargain—simply contact your nearest HP sales office. Ask a Technical Computer representative for complete details about the A-Series family and our new OEM plan. Or write to Joe Schoendorf, Hewlett-Packard, Dept. 08161, 11000 Wolfe Road, Cupertino, CA 95014.

Prices USA list, OEM quantities of 100

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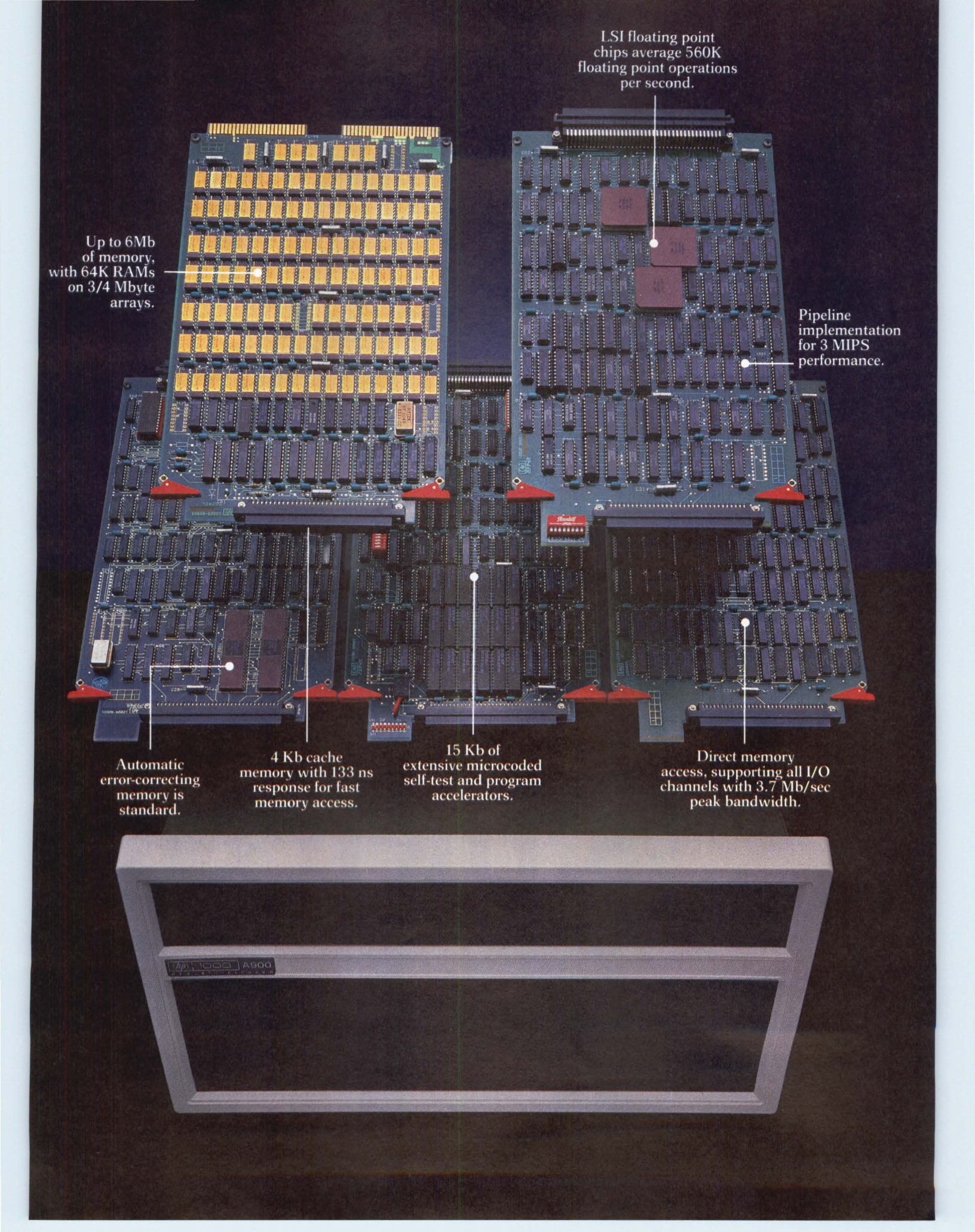
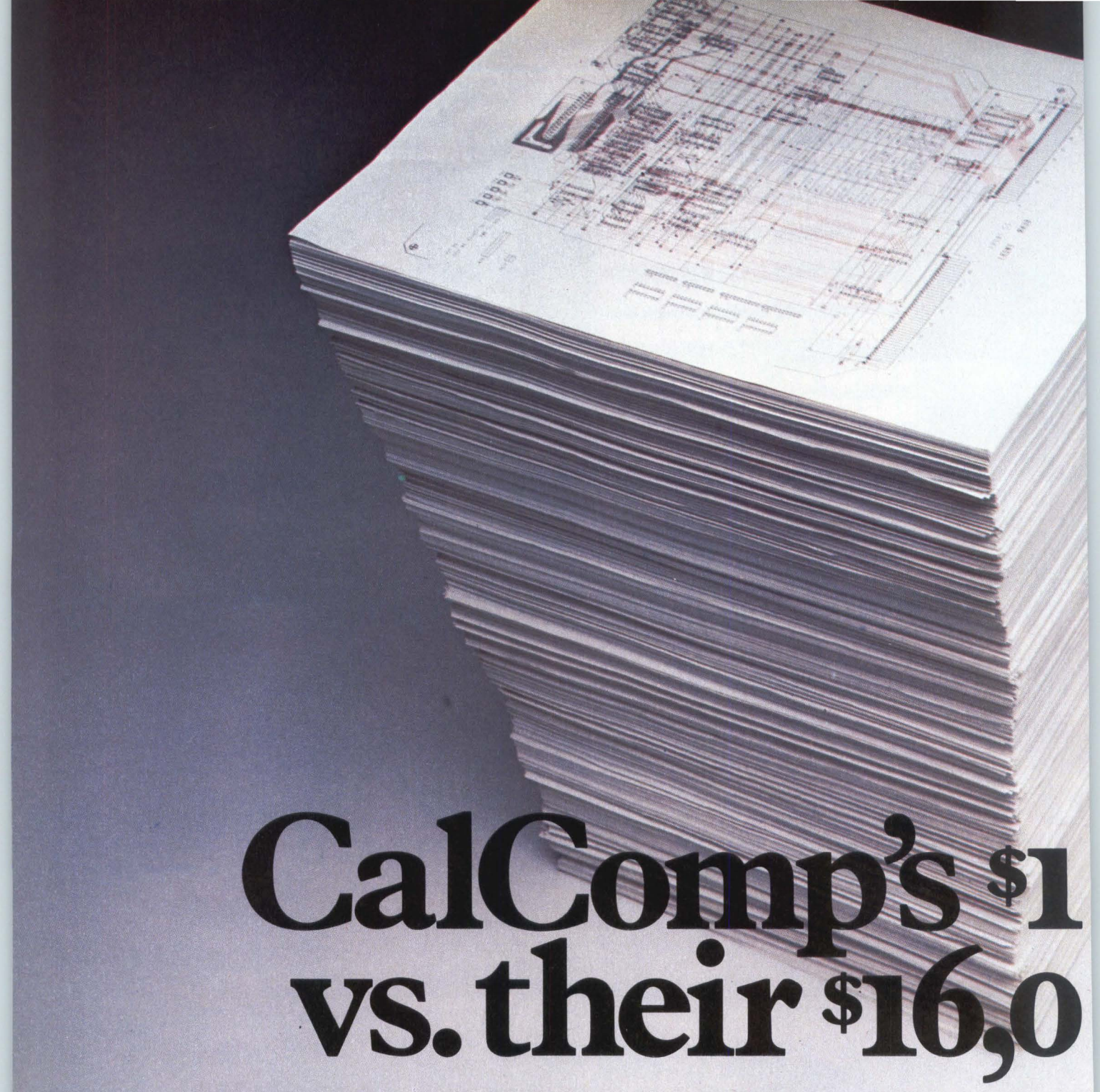

LSI floating point chips average 560K floating point operations per second.
Up to 6Mb of memory, with 64K RAMs on 3/4 Mbyte arrays.
Pipeline implementation for 3 MIPS performance.
Automatic error-correcting memory is standard.
4 Kb cache memory with 133 ns response for fast memory access.
15 Kb of extensive microcoded self-test and program accelerators.
Direct memory access, supporting all I/O channels with 3.7 Mb/sec peak bandwidth.
A900



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

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

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

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

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

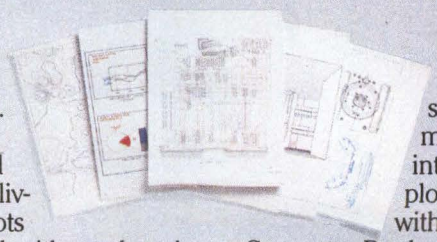
CalComp's Model 945 and Model 965 plotters, by comparison, allow you to map up to 16 logical pens to four physical pens continuously poised over the plot surface—ready to be activated

# 6,000 plotter 00 plodder.

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

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

The same interactive firmware gives the operator complete control over plot parameters. Training time is all but eliminated.



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

So write or phone today for your illustrated copy of "The Plotter and the Plodder." Compare the performance specifications. Then make your own move into the fast track of plotter technology—with CalComp. California Computer Products, Inc., 2411 West La Palma Avenue, Anaheim, CA 92801. 714-821-2011 TWX: 910-951-1154

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# FIVE OF A KIND

## LOW POWER ★ LOW PRICED ★ LINE POWERED MODEMS

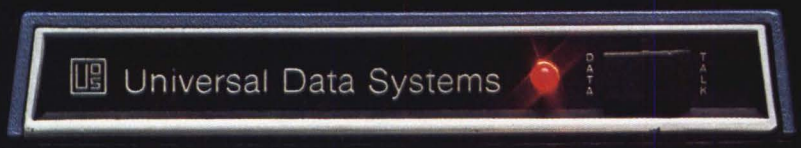
**212 LP**
originate/answer
1200 bps


**$445**
(quantity one)

**202S LP**
auto-answer
1200 bps

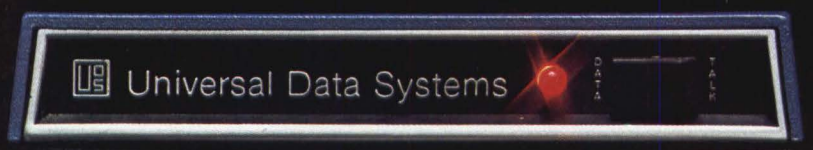

**$245**
(quantity one)

**202 LP**
1200 bps



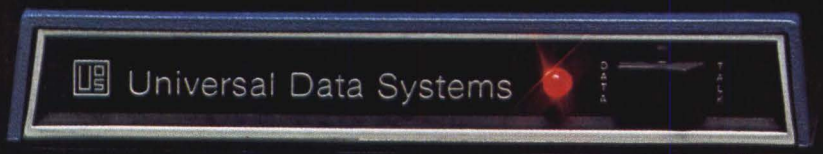

**$195**
(quantity one)

**103J LP**
originate/answer
auto-answer
300 bps




**$195**
(quantity one)

**103 LP**
originate/answer
300 bps




**$145**
(quantity one)

All UDS LP modems are FCC-certified for direct connection to the telephone network and require no AC power connection. For details, contact Universal Data Systems, 5000 Bradford Drive, Huntsville, AL 35805. Phone: 205/837-8100.

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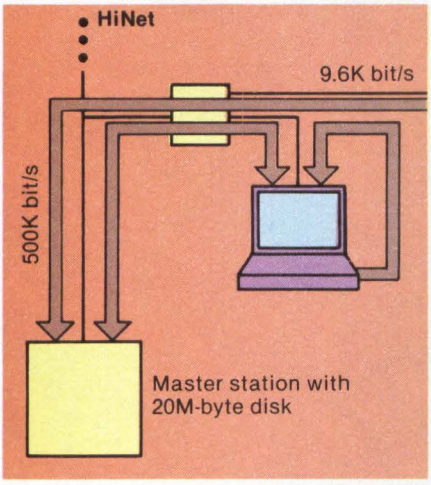
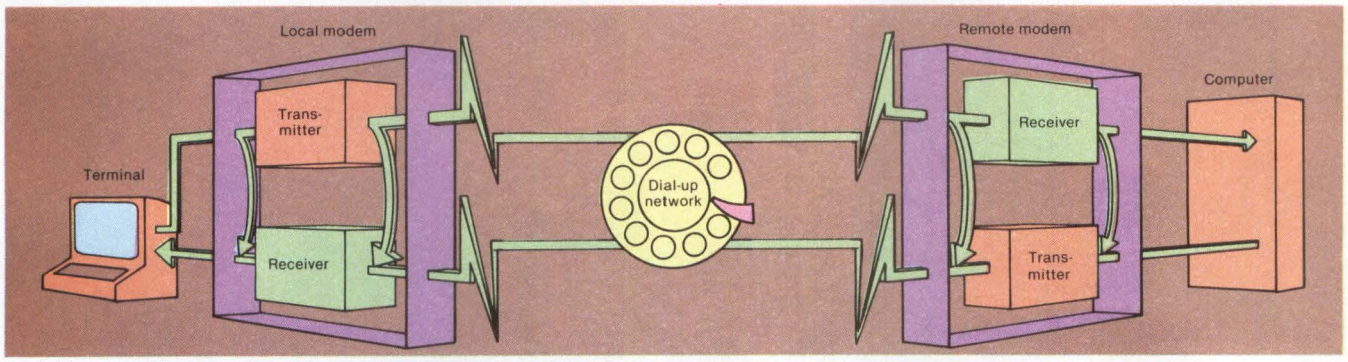
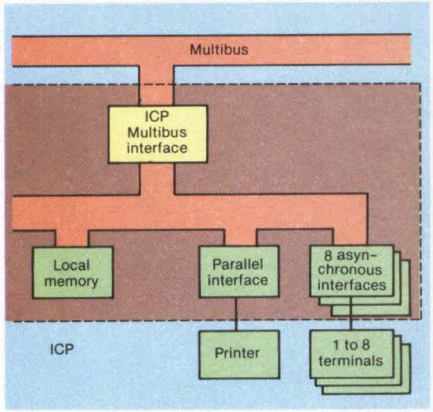
Created by Dayner/Hall, Inc., Winter Park, Florida

# FEATURE HIGHLIGHTS



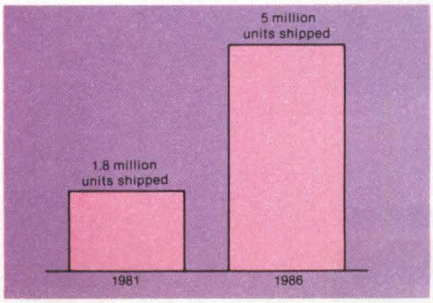

**DATA COMM:** The original **statistical multiplexer** simply provided users with a means of shaving line costs while maximizing data traffic by dynamically combining input from multiple active asynchronous terminals into a composite bit stream. Today's products are loaded with enhancements and sophisticated networking features, such as integral modems and extensive diagnostics capabilities. For a look at what's available, consult the article on p. 161. . . Many program-development installations that rely on time-sharing systems are distributing some of the programming tasks to microcomputer networks. The Lawrence Livermore National Laboratory, for example, has installed several microcomputer **local networks** as front-ends to its massive Octopus network, composed of Cray-1 and Control Data Corp 7500 mainframes. See p. 181 for an in-depth look. . . Tri-Data has introduced the Netway **communications processor family** which combines a communications-oriented operating system with distributed microprocessor-based intelligence. The multifunctional subsystems connect dissimilar workstations and multiple hosts and provide extensive network-management functions. The offering is profiled on p. 187.



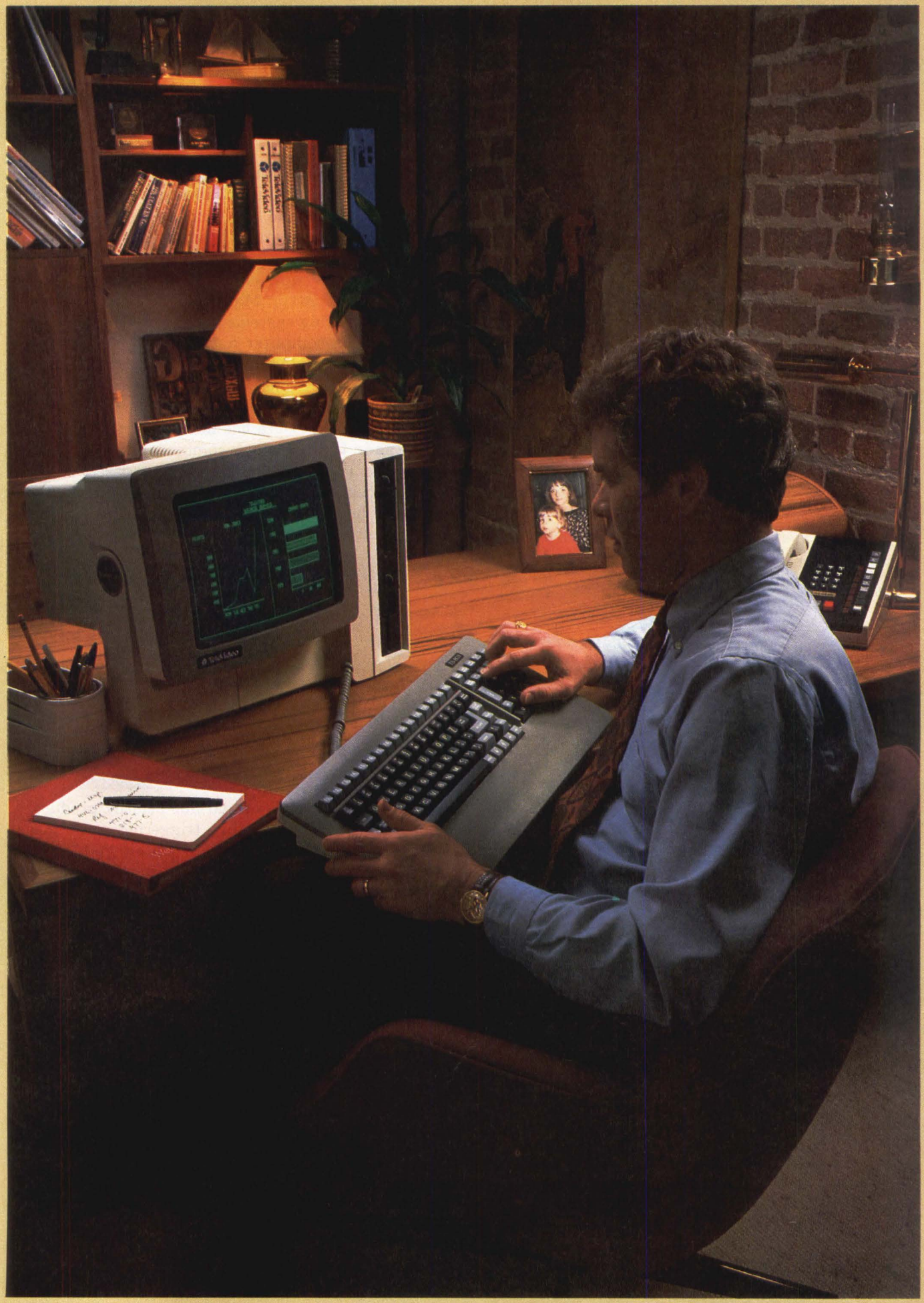




**MODEMS:** The **voice grade modem** is an old but healthy product. Available models are smaller and more flexible, triggering an annual market growth at 14 percent through 1990. Approximately 40 modem manufacturers offer a surprisingly similar number of features which have been tabulated and appear beginning on p. 145.

**MINICOMPUTERS:** Handling the many interrupts and disk accesses involved in a multi-user, multitasking environment presents a problem for UNIX-based systems. Plexus Computers Inc. has taken a multiprocessor approach, distributing tasks such as controlling high-and low-speed peripherals to outboard processors. By giving these processors their own memory and a direct-memory-access channel, they handle most interrupts. The key component is an intelligent **communications processor.** A look at the Plexus P/40 starts on p. 153.




**PRINTERS:** New head designs, multiple microprocessors and hard-wired logic are making **matrix line printers** more versatile. Trilog Inc.'s new 300-lpm printer uses dual print-head assemblies to increase reliability and provide multiple levels of print quality, and a dual-processor architecture that allows I/O and print parameters to be changed independently. The TIP-300 can thus provide near-letter-quality printing, bar-code printing, labeling and graphics. For more information, see p. 197.



# The TeleVideo Personal Computer. Not the first. Just the best.

When we set out to build the new TeleVideo Personal Computer, we decided to do it better than anyone else serving the OEM community. It wasn't easy. All we had to do was design a special casing that keeps heat away from sensitive electronics, with no fan for no noise and greater reliability, put in a big clear 14" screen that tilts for operator comfort, include a detachable keyboard so advanced it relieves typing fatigue, throw in extra storage (for an unformatted total of 1 MB), and put it all in a very smooth and easy-to-use integrated package. We call it the TS 803.

We also made it CP/M® compatible, allowing users to choose from the largest selection of applications software in the world. And we made it possible to link up to sixteen TS 803s in one system, so more people can work smarter together. Then we did one final thing. We included a powerful graphics package and priced the TS 803 at $2,495. That's about $1,000 less than a comparably equipped Apple.*

Naturally volume discounts are available for even greater savings. And since the TS 803 is such a complete package, we think you'll agree that it's the ideal OEM computer.

For more information, write TeleVideo Systems, Inc., 1170 Morse Ave., Sunnyvale, CA 94086, call toll-free 800-538-1780 (in California call (408) 745-7760), call one of our authorized distributors or dealers, or contact one of our regional sales offices, listed below.

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TeleVideo Systems, Inc.

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CIRCLE NO. 84 ON INQUIRY CARD

# PCI's 1076. Get ASCII to SNA/SDLC 3270 emulation with money to spare.

## HAVE YOU HUGGED YOUR MONEY TODAY?

The 1076 Protocol Converter from PCI lets you give your money a great big hug, because you're going to have a lot more money left over to love.

Now you can use ASCII terminals on your SNA/SDLC network communications lines. The wide variety of non-IBM equipment, with its price and versatility advantages, is available to you with SNA/SDLC. The 1076 makes ASCII CRT's appear as 3278's to SNA/SDLC hosts. Even your personal computers can function as 3278's; attached printers look like 3287's. And your personal computer's diskettes can store data from, and send information to your host.

One of the country's largest retailers recently used the 1076 to hug their money tight. The 1076 allowed them to pay only an eighth of their original estimated equipment costs. Others are doing the same, with equally large savings.

Besides direct connection, the 1076 makes ASCII compatible with SNA remotely from anywhere in the world. Dial-up from home, warehouse, customer site—wherever you are.

PCI saves you cable money, too. Our CoaxFACE™ is a connector that interfaces between RS-232 and coaxial cable. Use your existing cable, or add new cable at minimal costs.

The 1076 comes with some very special optional features, too. A graphics terminal interface lets you use ASCII graphics terminals (Tektronics, Ramtek) on your SNA/SDLC network as 3278's. And with the exclusive PaperCRT™ option, your ASCII hard copy keyboard terminals have all the flexibility and versatility of 3278 CRT's. Now you can full-screen edit on paper, and do it with a portable hard copy terminal from any location in the world. It's as simple as picking up the phone.

There's lots more to this small, huggable wonder. Like its powerful hardware and logic which diagnoses line and terminal device problems from a line monitor on every port. Call now for a free demonstration of the PCI 1076.

We'd like you to keep hugging your money.

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# Modems for microcomputers

PATRICK KENEALY, Senior Editor

## *Greater integration and intelligence distinguish the new modems*

The voice-grade modem is an old but healthy product. Greater integration has made it smaller, more flexible and less expensive than ever, and the growth of microcomputer sales, distributed processing and on-line information utilities has boosted demand to unprecedented levels. Creative Strategies Inc., a San Jose, Calif., market research firm, pegged 1982 modem shipments at $1.2 billion and annual modem market growth at 14 percent through 1990. Approximately 40 major modem manufacturers offer more than five times that number of voice-grade modems. Despite the large number of vendors and products, there is a surprising similarity among modem features and consensus among vendors on modem market and product trends.

### Tried, true and tiny

Basic half- and full-duplex, 300- and 1200-baud modems have gained features over the past few years but have changed most drastically in prices and form factors. Price pressure from microcomputer owners has pushed end-user, 300-baud, manual dial modem prices to less than $100 each and 300-baud, auto-answer/originate prices to less than $250. End-user prices for "standard" auto-answer/originate, 1200-baud units vary from $500 to $800 and differ greatly among vendors.

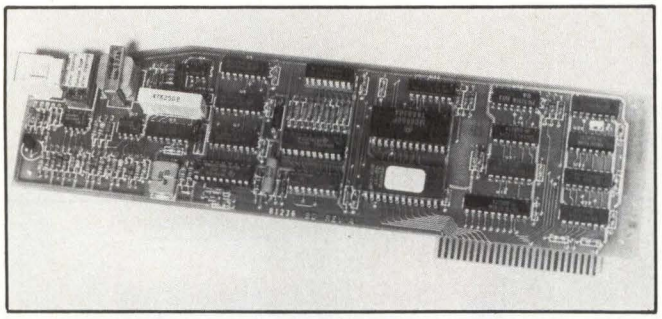
Microcomputer modems are available in stand-alone enclosures and board-level and chip-level form factors. Stand-alone enclosures (Fig. 3) sit on or near a terminal or under a telephone and almost always connect to the phone via an RJ-11 jack rather than an acoustic coupler. Stand-alone modems are usually controlled from the keyboard rather than by modem-mounted switches, but most feature LED status lights to monitor modem operation. A growing number of stand-alones feature LCDs for clock and calendar functions. Stand-alone


**Fig. 1. Novation Inc.'s J-CAT miniature stand-alone modem** *is approximately one-fifth the size of conventional units. The 300-baud auto-answer/originate modem measures 5 × 1.9 × 1.3 in. and sells for $149. It features LED status indicators, a disconnect/test key, a connect/break key and a beeper that tells a user when a busy signal, carrier or dial tone is detected.*

modems measure from about the size of a notebook to about the size of a package of cigarettes (Fig. 1).

Board-level modems (Fig. 2) are available for microcomputers and terminals or for popular microcomputer buses. They sell for roughly 40 percent less than stand-alone modems and are easily installed by OEMs and end users. Integral modems are popular microcomputer and terminal options. They cost system integrators roughly $100 and can support end-user prices of $300 or more. Integral modems help sell terminals and microcomputers by saving buyers from the job of choosing and integrating a separate modem.

Modem chip sets are available from Rockwell International, Cermetek Microelectronics, Texas Instruments Inc., and others and sell for less than $50 in OEM quantities. Chip sets consist of a modulator/demodulator chip, a data-access arrangement chip and an auto-dialer chip. Chip sets are available for 300-baud applications, with 1200-baud chips expected to be



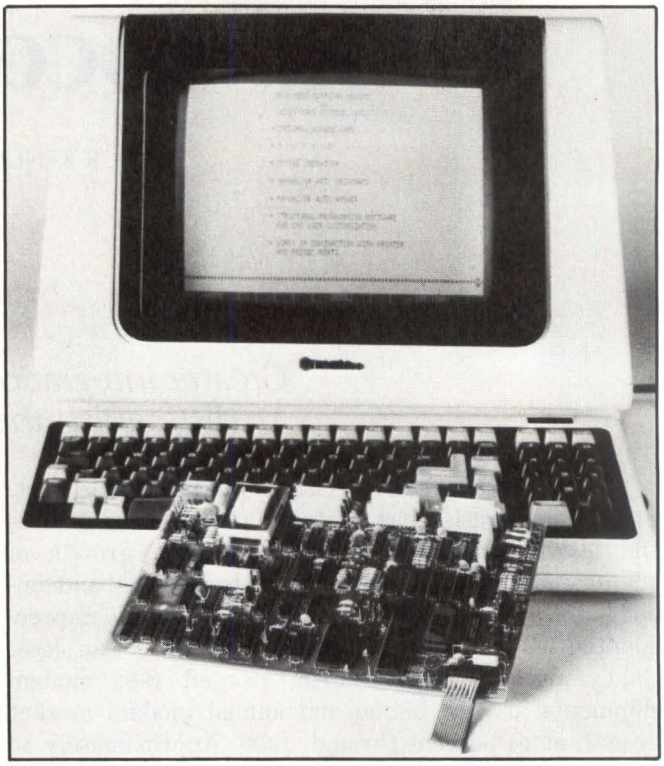


**Fig. 2. Board-level modems** *are available for OEMs and end users. The SSM Microcomputer Products Inc. Apple ModemCard (left) is a 110/300-baud, auto-answer/originate unit that plugs into any Apple II slot and sells for $299. The MicroBaud Systems Inc. MB80505 (right) is a 1200-baud intelligent modem that mounts directly inside Televideo Systems Inc.'s 910, 920, 925 and 950 terminals. The 80505 retails for less than $700.*

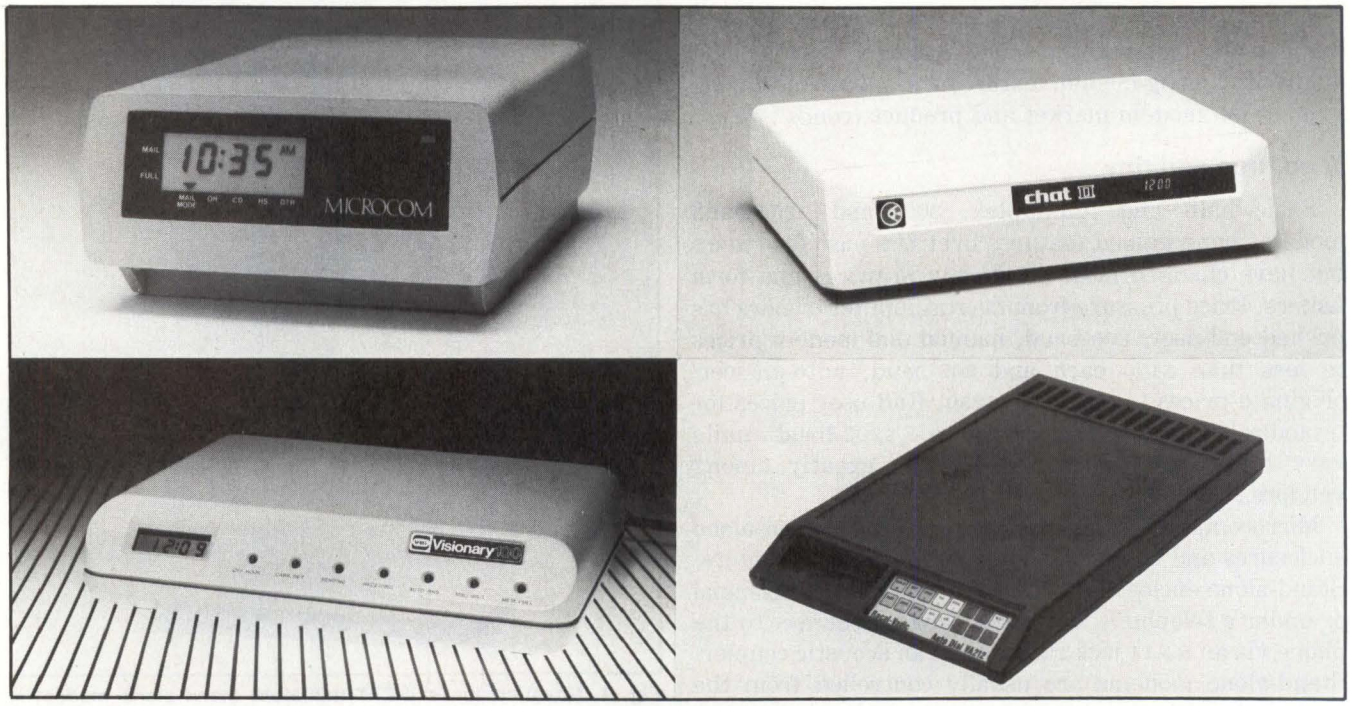



**Fig. 3. Four stand-alone intelligent modems.** *Clockwise from top left, these units are the Microcom Inc. Professional communication system, the Chat Communications Corp. Chat II, the Racal-Vadic VA212 and the Visionary Electronics Visionary 100. All are 1200-baud, auto-answer/originate units that can be programmed from a microcomputer or a terminal keyboard. The units store multiple telephone numbers, automatically send and receive messages under clock or program control, provide password security and perform extensive local and remote diagnostics. Prices range from $760 to $1645, depending on options.*

# "Racal-Vadic's Invisible Modem Gives Grid's Ultra-Portable Computer Access to a Whole World of Data!"

*Dave Hanna — V.P. Marketing and Sales, Grid Systems, Inc., Palo Alto, California*


One of the hottest personal computers on the market is the new Grid Compass. It weighs about 10 pounds and takes up less than half of a standard briefcase.

*Business Week* calls Compass "a Porsche for top executives."

A custom Racal-Vadic modem is behind the smashing success of Compass. This VS212A/103 modem — complete with auto dial and auto answer — is built on a 6" by 6" PC board. "Without this built-in modem we couldn't have made the product," says Glenn Edens, V.P. of Development for Grid Systems, Inc., Palo Alto, California.

Racal-Vadic's incredibly small modem is vital because it gives Compass a unique communication capability, setting it apart from other portable computers. For example, Compass can "talk" to another Compass... or to Compass Central, a user-owned, 240 Mbyte desk-top computer, which is designed to support a number of Compass computers in the field. It can also access Grid Central, a Grid-owned mainframe which distributes new software and provides data storage for its users. And there's more! The ultra-portable Compass can access corporate mainframes and public data bases.

Imagine... a Fortune 500 executive in a hotel room with the whole wide world of data at his or her fingertips — using the dial-up telephone.

Why Racal-Vadic? Because we invented 1200 bps full-duplex technology. Because we ship more modems than anyone. Because we utilize the most advanced automated production equipment and superb quality control. And because our custom modem department is dedicated to creating integral modems for OEMs.

WE DID IT FOR GRID. WE CAN DO IT FOR YOU!

**"See us at Interface Booth 633"**

**Racal-Vadic** Member IDCMA

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available by next year. Many vendors now use custom modem chips in their board-level and stand-alone modem products, and, as modem chips become more standard, microcomputer and terminal manufacturers will build modems into even more of their products.

### Intelligent modem features

A half-dozen modem manufacturers now advertise "intelligent" modems (Fig. 3), and the term is quickly being diluted to describe an emerging class of full-function modems. Modem intelligence, like terminal intelligence, is in the eyes of the beholder, but the new modems have many common features.

Intelligence in the form of extra memory and on-board microprocessors has improved modem performance and flexibility. On-board microprocessors have boosted modem performance by allowing faster dynamic signal equalization. The micros automatically adjust amplifiers, filters and attenuators to compensate for line problems, enhancing reliability and increasing data rates. Integrated, programmable components can replace many dedicated, discrete components, reducing parts counts, prices and down-time. Microprocessors allow local and remote analog and digital diagnostics without operator intervention (Fig. 4). The Racal Vadic VA212, for example, offers seven user-selectable diagnostic routines.

Flexibility and convenience are the two most apparent benefits of modem intelligence. Using software running on a host microcomputer or their own firmware, intelligent modems give users complete communications control from their keyboards. Keyboard dialing without a telephone has been standard on better modems for the past few years, but intelligent modems offer a host of new dialing features.

Intelligent modems automatically choose between rotary-pulse and touch-tone dialing and can store multiple telephone numbers and log-in sequences, complete with pauses, account numbers and passwords. The Multi-Tech Systems Inc. MT2/2A stores five 25-digit numbers, the Rixon Inc. R212A stores 10 60-digit numbers, and the Universal Data Systems UDS 212A/D stores five 30-digit numbers. Hayes Microcomputer Products Inc. provides log-on sequences for The Source, Compuserve and Dow Jones News Retrieval Service information utilities; Chat Communications offers routines for Telex, TWX and direct distance dialing communications. Intelligent modems redial busy telephone numbers a specified number of times and can sequentially dial a list of telephone numbers for message distribution. Cermetek Microelectronics even offers a retrofit auto-dial unit for non-auto-dial modems (Fig. 5).

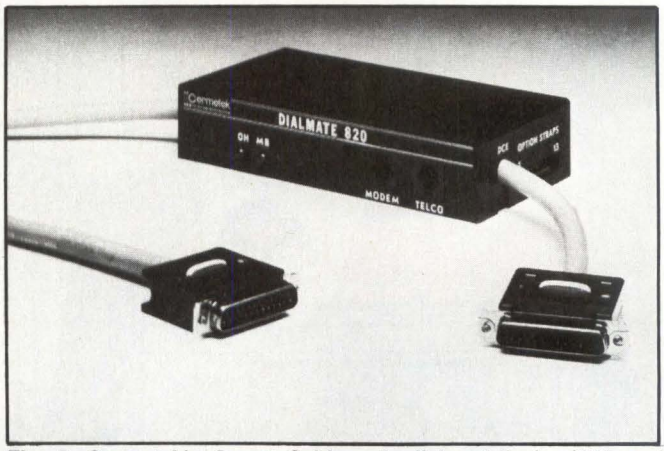


**Fig. 5. Cermetek's Smart Cable auto-dialer** *sells for $249 and retrofits to modems that cannot auto-dial. The Smart Cable replaces the RS232C cable that normally connects the modem to the data terminal, and receives serial dialing commands from the terminal keyboard. The unit automatically selects a touch-tone or rotary-pulse dialing mode, stores seven frequently called numbers and supports 10 dialing commands.*

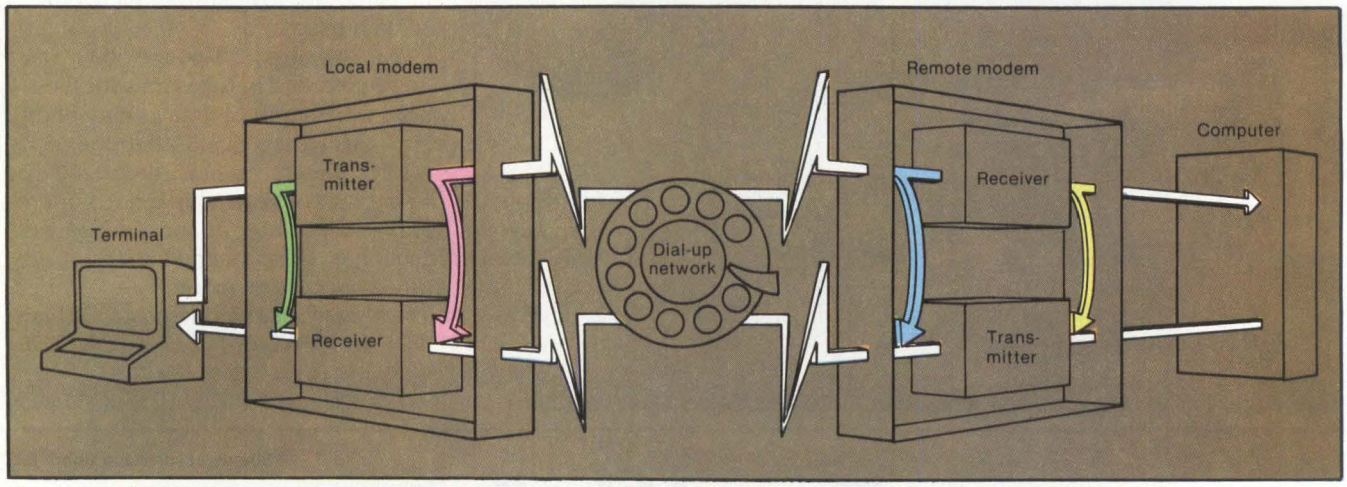


**Fig. 4. Local and remote loopback diagnostics** *are a major feature of modern microprocessor-based modems. Local digital loopback (green) tests the digital interface connections of the local terminal and modem. Local analog loopback (red) tests add local A/D and D/A and transmit and receive functions to the test circuit. Remote analog loopback (blue) adds two transmission lines to the test circuit. Finally, remote digital loopback (yellow) adds all remote-modem functions to the test circuit. Signals for loopback testing can come from the terminal, the computer or, most recently, a self-test pattern generator in the modem.*

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For complete information on STR®-Stream, write to Electronic Processors, Inc., P.O. Box 569, Englewood, CO 80110. Phone (303) 761-8540.

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CIRCLE NO. 87 ON INQUIRY CARD

Large memories such as the 24K-byte buffer on the Visionary Electronics Inc. Visionary 100 or the 64K-byte buffer on the Microcom Inc. Professional communication system permit background-mode and unattended data transmission and reception, often under calendar/clock control. The buffers allow selective direct printing of messages, comprehensive error checking, password security programmable answer-

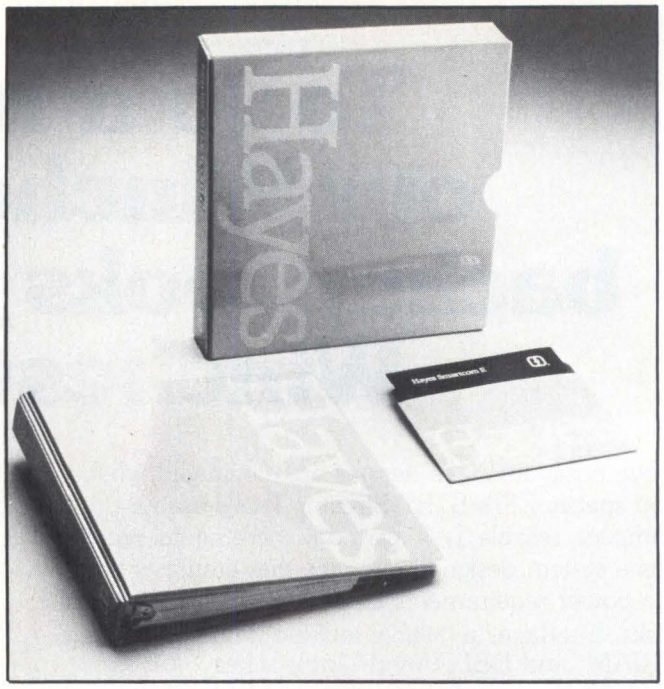


**Fig. 6. Modem software for personal computers** *is available from modem and personal computer manufacturers, and from third-party software houses. The Hayes Microcomputer Products Inc. Smartcom II package runs on the IBM Personal Computer and typifies current offerings. It is menu-driven with a "help" feature and can store and execute dial-up and log-on sequences for as many as 25 remote systems. Routines for The Source, Compuserve and Dow Jones are included in the $119 purchase price. The package supports remote and unattended operation; character, buffered and verifed file transfers; and selective storing and printing.*

## MICROCOMPUTER MODEM MANUFACTURERS

Anderson Jacobson Inc.
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Circle No 822

Astrocom Corp.
120 W. Plato Blvd.
St. Paul, Minn. 55107
Circle No 823

Avanti Communications Corp.
Aquidneck Industrial Park
Newport, R.I. 02840
Circle No 824

Backus Data Systems Inc.
1440 Koll Circle
San Jose, Calif. 95112
Circle No 825

Bizcomp Corp.
P.O. Box 7498
Menlo Park, Calif. 94025
Circle No 826

Cactus Technology
3024 N. 33rd Dr.
Phoenix, Ariz. 85017
Circle No 827

Cermetek Microelectronics
1308 Borregas Ave.
Sunnyvale, Calif. 94086
Circle No 828

Chat Communications
2438 Wyandotte St.
Mountain View, Calif. 94043
Circle No 829

Codex Corp.
20 Cabot Blvd.
Mansfield, Mass. 02048
Circle No 830

Concord Data Systems
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Lexington, Mass. 02173
Circle No 831

Datapoint Corp.
9725 Datapoint Dr.
San Antonio, Texas 78284
Circle No 832

Digilog Inc.
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Montgomeryville, Pa. 18936
Circle No 833

Digital Equipment Corp.
129 Parker St.
Maynard, Mass. 01754
Circle No 834

Facit Inc.
66 Field Point Rd.
Greenwich, Conn. 06830
Circle No 835

Gandalf Data Inc.
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Wheeling, Ill. 60090
Circle No 836

General Datacomm Industries
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Danbury, Conn. 06810
Circle No 837

Hayes Microcomputer Products Inc.
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Norcross, Ga. 30092
Circle No 838

IBM Corp.
Data Processing Division
1133 Westchester Ave.
White Plains, N.Y. 10604
Circle No 839

Infotron Systems Corp.
Cherry Hill Industrial Center
Cherry Hill, N.J. 08003
Circle No 840

Intertel Inc.
6 Shattuck Rd.
Andover, Mass. 01810
Circle No 841

Kinex Corp.
6793 Cross Bayou Dr.
Largo, Fla. 33543
Circle No 842

Lexicon Inc.
8355 Executive Center Dr.
Miami, Fla. 33166
Circle No 843

Micom Systems Inc.
9551 Irondale Ave.
Chatsworth, Calif. 91311
Circle No 844

MicroBaud Systems Inc.
3393 De La Cruz Blvd.
Santa Clara, Calif. 95050
Circle No 845

backs and a host of electronic-mail capabilities. Modems with large memories feature short- or long-term battery backup but are roughly $500 more expensive than their unbuffered equivalents.

### Future developments

The new intelligent modems will redefine modem flexibility and reliability, while LSI chip technology redefines modem prices. AT&T will still define transmission standards. Sales of 300-baud modems are suffering as 1200-baud units become more affordable. Full-duplex, 1200 baud should be the standard voice-grade transmission speed within a few years. (International Data Corp. predicts 1200-baud modem dollar sales will grow at 25 percent annually over the next five years.) Modem sales will be pushed by low prices and by demand for access to electronic mail, on-line banking, teleshopping, information utility and database network systems. Late last year, for example, The Source, a subsidiary of Readers Digest Inc., had 25,000 subscribers, and Dow Jones had 54,000 subscribers. Both claim to be adding 2000 subscribers per month. That's a lot of modems, and the fact that 85 percent of the two services' subscribers are personal-computer owners says a lot about which direction the low-end board- and stand-alone modem market will take.

TI and Rockwell International have put most modem functions on a single chip, and the availability of single- or even multi-chip modems will revolutionize the low-end modem market as microcomputer and terminal manufacturers decide to make rather than buy modems. Modems will be added to add-in microcomputer memory boards as calendar/clocks and serial ports are today, and will be available from plug-compatible manufacturers and independents.

A last development affecting modems is the spread of communication software packages that control modem parameters (Fig. 6). Programs such as Cross-Talk, Transcend, Smartcom II, MicroCom, PC-Talk and E-Mail give microcomputer users menu-driven keyboard control of modem parameters and data-communications protocols. □

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1400A Providence Highway
Norwood, Mass. 02062
Circle No 846

Multi-Tech Systems Inc.
82 Second Ave., S.E.
New Brighton, Minn. 55112
Circle No 847

Novation Inc.
18664 Oxnard St.
Tarzana, Calif. 91356
Circle No 848

Omnitec Data
2405 S. 20th St.
Phoenix, Ariz. 83034
Circle No 849

Paradyne Corp.
8550 Ulmerton Rd.
Largo, Fla. 33540
Circle No 850

Penril Corp.
Data Communication Division
5520 Randolph Rd.
Rockville, Md. 20852
Circle No 851

Prentice Corp.
266 Caspian Dr.
Sunnyvale, Calif. 94086
Circle No 852

Qytel
285 Madison Ave.
New York, N.Y. 10017
Circle No 853

Racal-Milgo Inc.
8600 N.W. 41st St.
Miami, Fla. 33166
Circle No 854

Racal-Vadic Inc.
222 Caspian Dr.
Sunnyvale, Calif. 94086
Circle No 855

RFL Industries Inc.
Powerville Rd.
Boonton, N.J. 07005
Circle No 856

Rixon Inc.
2120 Industrial Parkway
Silver Spring, Md. 20904
Circle No 857

Rockwell International
P.O. Box 3669, RC48
Anaheim, Calif. 92803
Circle No 858

Telenokia OY
P.O. Box 33
Espoo 60
02601 Finland
Circle No 859

Universal Data Systems Inc.
5000 Bradford Dr.
Huntsville, Ala. 35805
Circle No 860

Ven-Tel Inc.
1390 Walsh Ave.
Santa Clara, Calif. 95051
Circle No 861

Visionary Electronics Inc.
141 Parker Ave.
San Francisco, Calif. 94118
Circle No 862

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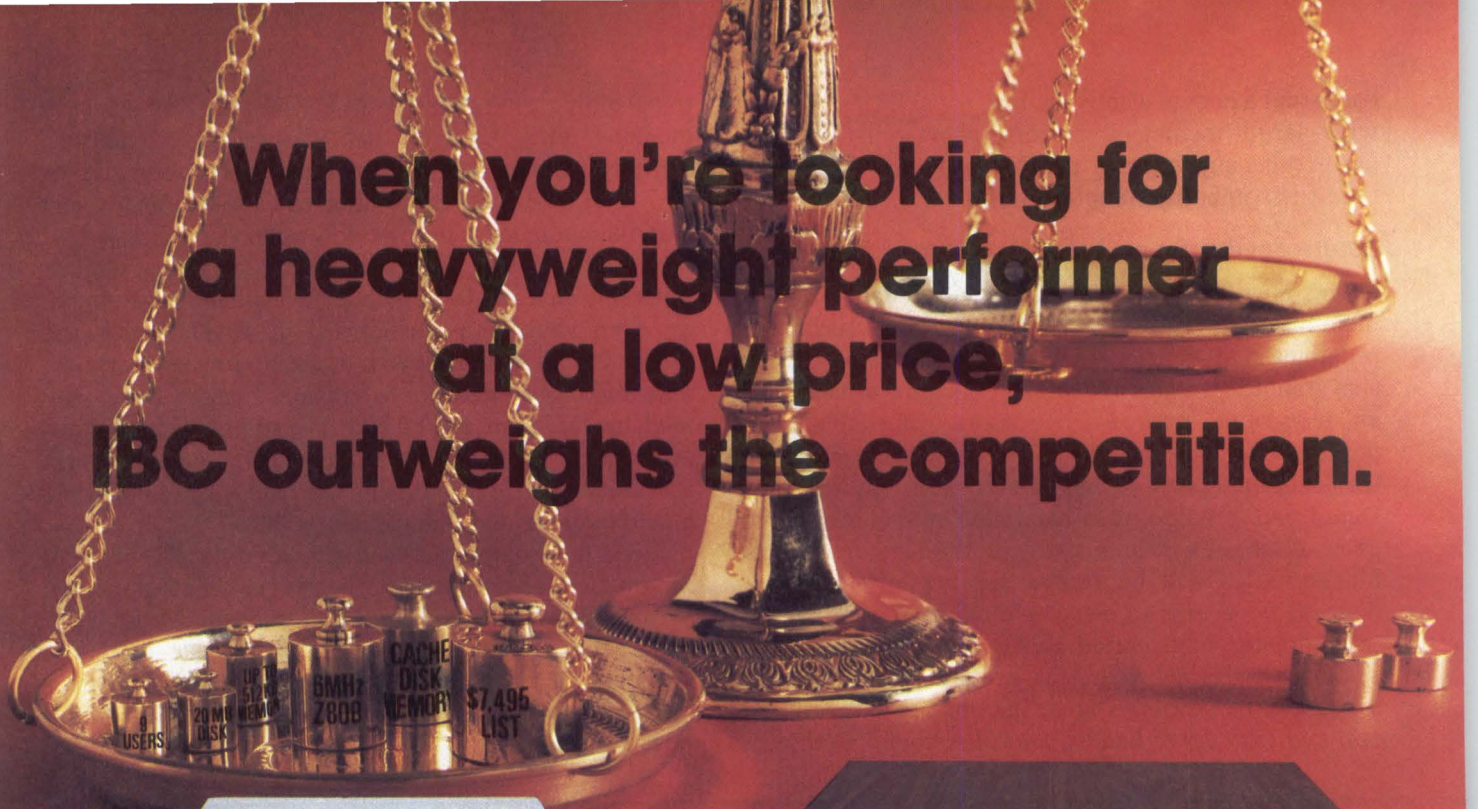



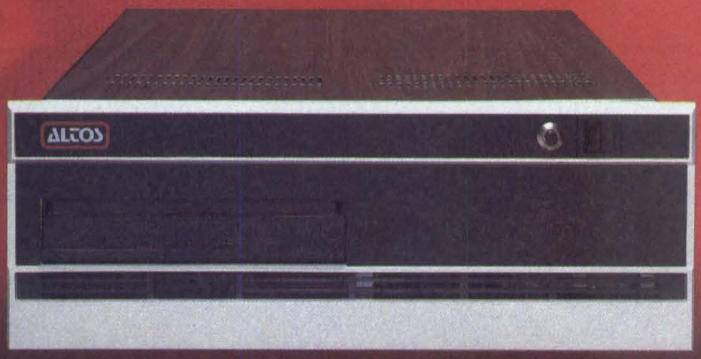


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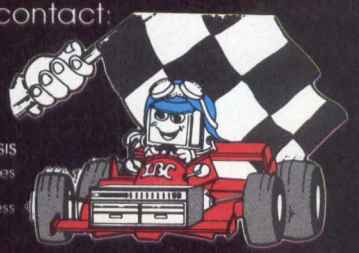


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DEALERS CIRCLE NO. 88 ON INQUIRY CARD

# Communications processor speeds UNIX-based multi-user system

MONTE PICKARD, Plexus Computers, Inc.

*Multiprocessor design frees CPU from interrupt and memory-handling chores*

Handling the many interrupts and disk accesses involved in a multi-user, multitasking environment presents a problem for UNIX-based systems. The Plexus Computers, Inc.'s P/40 takes a multiprocessor approach, distributing tasks such as controlling high- and low-speed peripherals to outboard processors. By giving these processors their own memory and a direct-memory-access channel, they can handle most interrupts. The key component to this approach is the intelligent communications processor, which, along with intelligent peripheral controllers and a memory-control unit, frees the main processor to manage heavy, computing loads.

**Plexus P/40 16-bit minicomputer** *supports as many as 24 users with UNIX, using an intelligent communications processor to increase throughput. A typical eight-user system with 512K bytes of memory, 72M bytes of disk storage and a nine-track magnetic-tape unit sells for $41,500.*

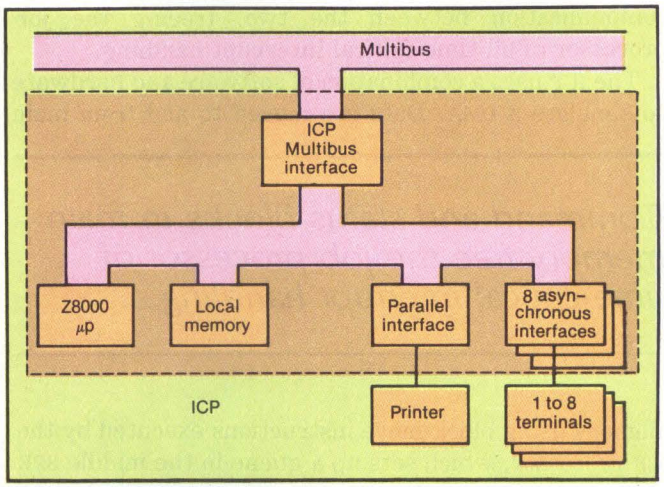


**Fig. 1. Intelligent communications processor (ICP) architecture** *includes a 16-bit Z8000 microprocessor with 16K bytes of PROM and 32K bytes of RAM, eight serial ports, one parallel port, a Multibus interface and DMA channels. The P/40 supports as many as three ICPs, with DMA channels in each ICP handling all terminal and printer interrupts.*

## The intelligent communications processor

The ICP comprises a processor, memory, eight serial ports, one parallel port, a Multibus interface and DMA channels (Fig. 1). The P/40 supports as many as three

ICPs, allowing the system to run 24 active terminals (Fig. 2).

The ICP uses a 16-bit Z8000 microprocessor with 16K bytes of PROM for diagnostics and bootstrapping the ICP for down-line loading, and 32K bytes of RAM composed of two 16K × 9 banks (including parity). The ICP operating system, essentially a stripped-down UNIX kernel and TTY device-handling module, typically occupies 24K bytes, leaving the remainder for local applications.

The ICP processor directly addresses 64K bytes of memory, with the lower 48K resident on the ICP, and the upper 16K mapped into main memory via the Multibus and the memory-control unit. The MCU is controlled by the main processing unit, called the job processor, with system input/output instructions. The MCU contains address-mapping circuitry, error-correction logic and a dynamic RAM controller.

Command and status blocks placed in main memory by the job processor or the ICP maintain efficient communication between the two, freeing the job processor of all time-critical interrupt handling.

The ICP uses a combination of software and hardware to simulate a DMA. Data are moved to and from main memory using block-move instructions executed by the ICP processor, which sets up a queue in the middle 32K of memory. To get the data to main memory, the ICP processor executes a block move from the middle 32K of memory to the upper 16K. It then programs a CTC channel to provide a repeated pulse, typically every 1 to 2 msec., depending on the application. This pulse goes to an arbiter and requests the bus. When control is obtained, the arbiter sends an interrupt to the ICP processor, which initiates a block move of approximately 32 words, also depending on the application. The 20-bit Multibus addresses are formed by concatenating a 6-bit port with the least significant 14 processor address lines.

*Command and status blocks in main memory free the job processor of time-critical interrupt handling.*

After the move is complete, the processor signals the arbiter to release the bus. The ICP processor disables the CTC channel when no blocks remain in the DMA queue so that no more interrupts are generated.

This technique moves 64K characters per sec. into main memory, and uses less than 10 percent of the Multibus bandwidth. A DMA task can thus run in the background without monopolizing the Multibus or the local ICP bus, leaving most of the ICP processing capabilities for tasks such as executing segments of UNIX, table conversions for data-communications protocols, terminal-handling programs and other local processing tasks. Because both the timer circuit and the length of the block are tunable, system programmers can maximize throughput and response times for particular applications.

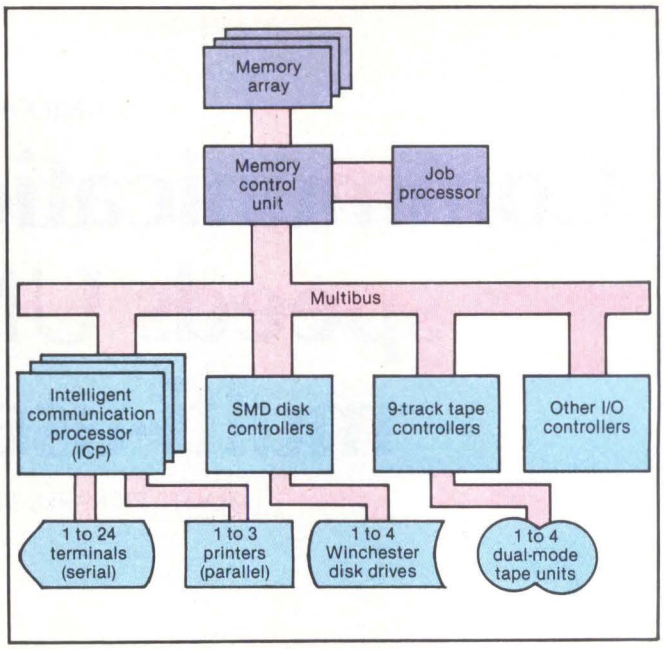


**Fig. 2. P/40 architecture** *includes separate job and communications processors, each with its own local memory.*

## ICP communications

The eight RS232 ports are implemented with USARTs. Asynchronous baud rates from 50 to 38.4K are programmed for each channel through a CTC counter/timer. Character length, parity and the number of stop bits are also programmable. Each serial port can support asynchronous, bisynchronous and bit-oriented protocols running as applications based on software within the ICP.

The P/40 also uses DMA channels for serial and parallel port handling within each ICP. Three 8-bit AMD 9517 DMA chips transfer 1 byte at a time from local memory, releasing the bus to the processor between transfers. This ensures that the ICP processor gets at least every other local memory cycle, without hindering DMA throughput. Control logic associated with the parallel port generates all control and handshake signals necessary for the DMA channel to transfer data to a line printer without processor intervention. The port sends a vectored interrupt to the processor if the printer asserts the FAULT line. Printers such as 300-line-per-min. band printers can be operated with minimum CPU overhead.

The ICP handles all terminal and printer character interrupts internally. The job processor is interrupted only at the completion of a task or message, reducing

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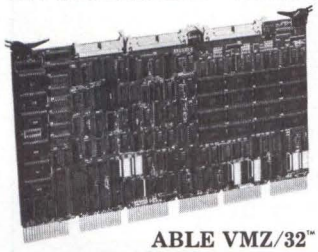

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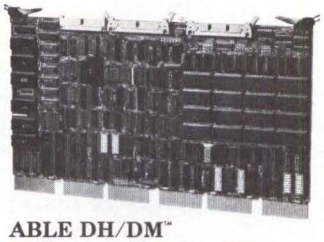
Here's an asynchronous microcontroller with programmable DMA, fully transparent to VAX/VMS as two 8-line DMF 32's and contained on a single board. Priced below the DZ11-E, it outperforms DZ or DH devices under VMS v.3, has interrupt-driven modem control on every line, and includes an output throttle which lets peripheral devices optimize their own data rate.

**#1 UNIBUS DMA.**



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Then there's our DH/DM, the original multiplexer which puts 16 lines with modem control on a single board. This popular device meets UNIX VAX system needs for DMA communications requirements, serves UNIBUS systems equally well, and beats them all for MTBF, throughput and price. Other features include on-board diagnostics, modem control on all lines, superior on-board silo depth and variable prom-set.

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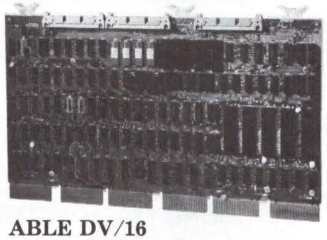

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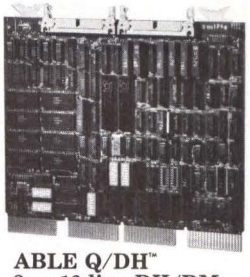
A controller for the PDP-11 user, the DV/16 contributes microprocessor-derived flexibility, which permits mixing of sync and async lines in combinations of 4 or 8 lines with modem control and full system software compatibility. It takes less than half the space of a DV11 and uses word transfer instead of byte DMA to gain a 2 to 1 speed advantage or permit operation in half the bandwidth required for data transfers.

**Q-BUS DMA.**



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

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

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the number of interrupts handled by the job processor by as much as two orders of magnitude.

The ICP RAM is expandable, allowing the ICP to handle local program-development tools such as full editors and compilers, local applications and graphics pre-processing routines. Further developments in a generalized transport mechanism between main memory and the ICPs will allow end users to load and return modules.

In throughput tests on the ICP, the aggregate total of bits per second continued to rise as terminals were added, to the maximum of eight terminals that an ICP can support (Fig. 3). The ICP is faster than most terminals; those tested could not sustain a character stream at 19.2K baud. ICP tests were therefore run at 9600 baud so that the terminals could keep up.

The same tests were run against a 16-bit processor with no ICP for comparison. As terminals are added to this system, aggregate throughput becomes level. To a terminal user, this would appear as slowed terminal response.

### Disk and tape controllers

The Plexus P/40 provides fast and efficient disk accesses through high-performance disks and intelligent disk controllers that, like the ICP, are supported by DMA channels.

The intelligent disk controller supports as many as four SMD disk drives, which have a 1.2M-byte-per-sec. data transfer rate. These drives are available in capacities ranging from 20M bytes to 1G byte from many vendors, allowing system integrators to match disk capacity precisely with applications.

The controller is based on an Intel 8089 16-bit I/O processor with 10K bytes of memory, and incorporates DMA channels with a 500K-byte bandwidth. The job processor issues the starting addresses and number of blocks needed, and the disk controller assumes command. The controller performs multiple sector opera-

## P/40 HARDWARE SPECIFICATIONS

| | |
|---|---|
| **Job Processor** | |
| Processor | Z8000 |
| Floating-point | Conforms to proposed IEEE standard |
| Clock/calendar | Battery-powered; battery is charged when system is on and lasts as long as 60 days between charges |
| Diagnostics | Diagnostic routines are implemented using 16K of on-board PROM and 2K of on-board RAM |
| **Memory** | |
| Size | As much as 4M bytes |
| Available memory slots | Four (maximum) |
| Word size | 22 bits (2 bytes plus 6-bit error code) |
| Addressing modes | Byte, word |
| Cycle time | 600 nsec. (including error detection and correction) |
| Error handling | Single-bit error detection and correction, double-bit error detection |
| **Intelligent Communications Processor** | |
| Serial ports | Eight<br>RS232C interface<br>Full duplex<br>19.2K baud rate (maximum)<br>Modem support on all ports<br>Hardware support for HDLC, asynchronous, and bisynchronous protocols |
| **Parallel ports/Configurability** | Centronics-type interface; A P/40 can be configured with as many as three ICPs for a maximum of 24 serial ports and three parallel ports |
| **Disk Subsystem** | |
| Formatted capacity | As much as 580M bytes using 72M- or 145M-byte disk drive |
| Number of drives | As many as four |
| Technology | 14-in. fixed Winchester, 35-msec. average access time, 1.01M-byte-per-sec. data transfer rate |
| Disk MTBF | 10,000 hours |
| Controller interface | Storage module disk |
| **Tape Subsystem** | |
| Tape drive | Automatic threading, ANSI/IBM compatible, 1600 bpi, ½ in., nine track |
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tions that span tracks. It uses a 32-bit error-checking code to detect 32-bit burst errors and correct 11-bit errors. All these operations are transparent to the job processor.

Like the ICP, the controller receives commands from the job processor by reading its control block in main memory. Unlike the ICP, which controls the Multibus for transfers of about 32 words, the disk controller can be interrupted after each word by Multibus interrupts with a higher priority, preventing data transfers from tying up the Multibus. The ability to transfer large amounts of data from the disks to main memory with minimal job-processor involvement ensures high system throughput.

A controller for nine-track, 1600-bpi magnetic-tape drives is similar in concept to a disk controller. Because it maintains record buffers in its memory, there is no limitation on tape block length.

### Memory management

The multiple processors and the DMA channels complicate memory management, requiring extensive mapping.

The MCU receives requests for main memory from both the job and peripheral processors. The MCU takes 21 address lines from the job processor or 20 lines from the Multibus and maps them into 8M bytes of 23-bit physical address space. When the job processor accesses memory, the five-segment address lines and the 16 address lines form the address to the MCU. Segment-line 0 is ORed with the instruction/data line. The job processor can access as data all memory in segments 0 to 31, but instruction references can be made only to odd-numbered segments (I/D bit = 1). This gives the operating system access to all memory segments, while user programs have access to one code and one data space.

The highest five MCU address lines select one of 32 maps. A typical process or program requires two maps, one for instructions and one for data. A map contains from one to 32 2K-byte pages of memory, so that the minimum memory for a single program is 4K bytes, and the maximum is 128K bytes. This mapping scheme allows processes to reside in memory without a map slot; an "unassigned" process is called for execution by assigning it a map slot. Depending on overall memory usage, this map swapping can be far more efficient than the process swapping associated with UNIX.

The MCU also has a Multibus map RAM that allows processors on the Multibus to access memory through the MCU. This RAM typically stores eight map sets. Again, swapping maps rather than processes can greatly reduce execution times.

The Multibus memory port maps the upper half of the

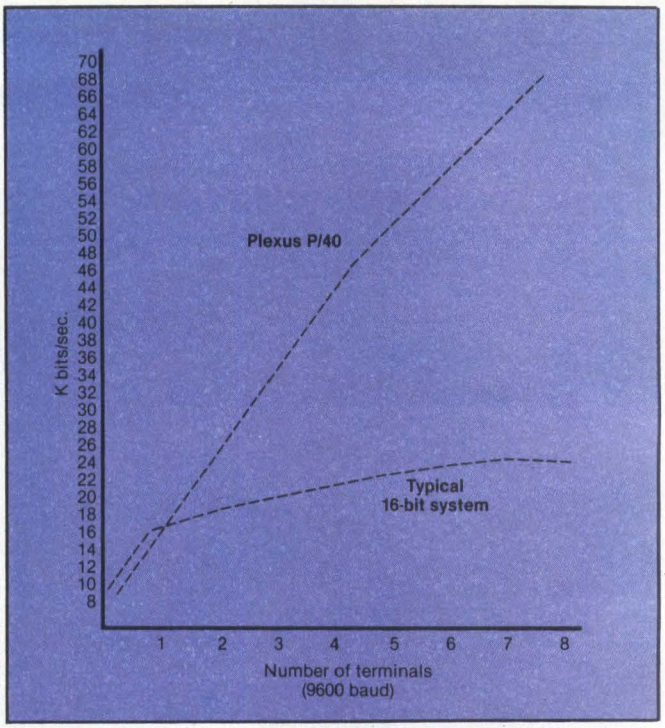


**Fig. 3. Effect of additional terminals on throughput** *is minimized in P/40 by intelligent communications processor. Most 16-bit systems suffer a significant drop in throughput per terminal as terminals are added.*

1M-byte Multibus memory address space through the MCU, allowing Multibus controllers to access main memory without additional interfaces. When the port detects a Multibus memory request with the high address bit active, the port requests control of the MCU, initiates the memory cycle and generates the acknowledge signals when the cycle is complete. The peripheral processors use an acknowledge signal generated before the cycle completes to increase throughput.

The MCU is also responsible for error handling. It checks each reference to memory for consistency with the attribute bits assigned to each page. Each page can be assigned a read-only or invalid status. When a violation occurs, the MCU determines whether an illegal reference was generated by the job processor or a peripheral processor and takes appropriate action. A modified Hamming code is used for data integrity.

The Plexus multiprocessor approach also makes networking simple by adding an additional processor at each node. An ICP can be programmed to handle X.25 or other network protocols.

A 16-bit processor similar to an ICP and supporting DMA in both directions can handle many network-management functions independently of the job processor. The primary function of this processor is to make networking transparent to a user by distinguishing between local and remote resources and processes. □

**Monte Pickard** is senior software engineer at Plexus Computers, Inc., Santa Clara, Calif.

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# Statistical multiplexers gain sophistication and status

LINDA L. BACHMANN, Associate Editor

*Statistical multiplexers are being packed with enhancements that give them a greater role in networks*

Since their emergence less than 10 years ago, microprocessor-based statistical time-division multiplexers have been steadily climbing the service scale. The original statistical multiplexers simply provided users with a means of shaving line costs while maximizing data traffic by dynamically combining input from multiple active asynchronous terminals into a composite bit stream. Through buffering, they handled peak loads of interactive "bursty" traffic and provided error correction and data compression. Today, statistical multiplexer manufacturers are loading their products with enhancements and sophisticated networking features such as synchronous channels; extensive diagnostics and monitoring capabilities; easy programmability; integral modems; switching; port contention; and interfaces to packet switching, satellite and wideband networks.

The cost consciousness of sophisticated end users and the proliferation of minicomputer and small-business computer installations ensures dramatic growth in the high- and low-end statistical multiplexer market (see "Statistical multiplexer market booms," p. 162). A survey of statistical multiplexer manufacturers drew

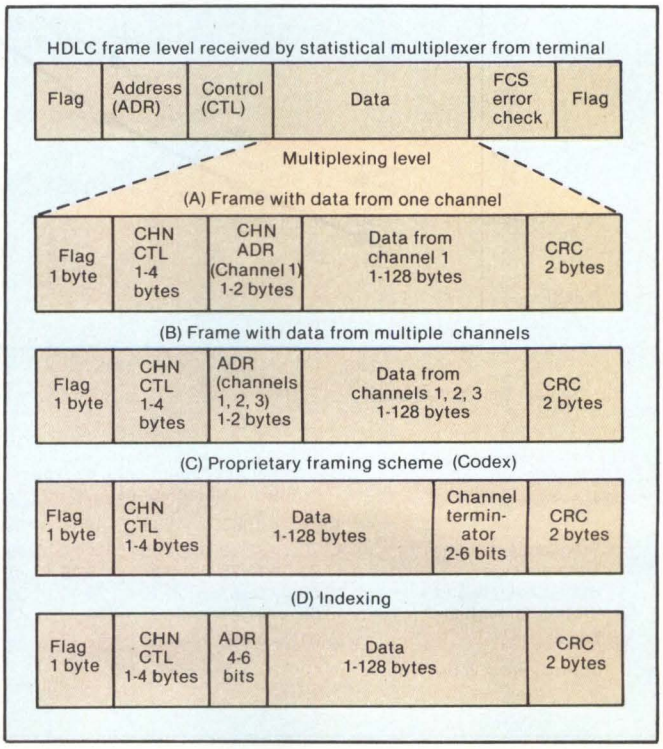



**Fig. 1. Common multiplexer framing techniques.** *Statistical time-division multiplexers strip off the original framing bits from incoming data and reframe the data from one or more channels by adding control and address data. There are several methods of framing, each associated with a performance level and a type of traffic. The following are representative. (A) Some statistical multiplexers frame data from only one channel by adding a flag and channel control, channel address and cyclic-redundancy-check (error-checking) bytes. This is inefficient if the amount of data characters transmitted from the channels is small because overhead is high in relation to data. However, an advantage is that no overhead must be sent for inactive terminals. (B) A more efficient scheme combines data from several channels in a single frame. (C) Codex's proprietary framing scheme uses a 2- to 6-bit channel teminator that eliminates the 1 to 2 bytes of address used in methods A and B. Because the channel terminator must be sent for both active and inactive channels, this method is most efficient when all channels regularly transmit data. (D) Indexing, although probably the most efficient scheme, is the most costly to implement. Incremental addresses specify the relative position of a channel. For example, a 4-bit channel address would permit 16 possible bit combinations. If channel 1 is active, and then channel 5 becomes active, the address characters show the incremental difference between channels 1 and 5.*

responses from 32 vendors with products ranging from two-channel asynchronous-only units that sell for about $1000 to 248-channel units that sell for $20,000 (see table, p. 172). The table includes only microprocessor-based products that concentrate data from multiple terminals by dynamically sharing bandwidth. Minicomputer-based concentrators, the forefathers of microprocessor-based statistical multiplexers are essentially obsolete and have been excluded from the table, as are computerized private branch exchanges. Also omitted are frequency-division multiplexers, which divide bandwidth into channels dedicated to individual connected devices, and nonstatistical time-division multiplexers, which allocate time slots to all attached devices, regardless of whether they are active.

Major development areas of modern statistical multiplexers are performance, flexibility, ease of use, network monitoring and diagnostics, all of which reflect the realities of expanding network and computer installations. Improvements in these areas facilitate network growth and protect the original equipment investment.

## STATISTICAL MULTIPLEXER MARKET BOOMS

Although the numbers differ, depending on the market research firm that reports, the trend is clear. The overall multiplexer market is growing at an annual compound rate of about 30 percent, and statistical time-division multiplexers are claiming the lion's share of this market.

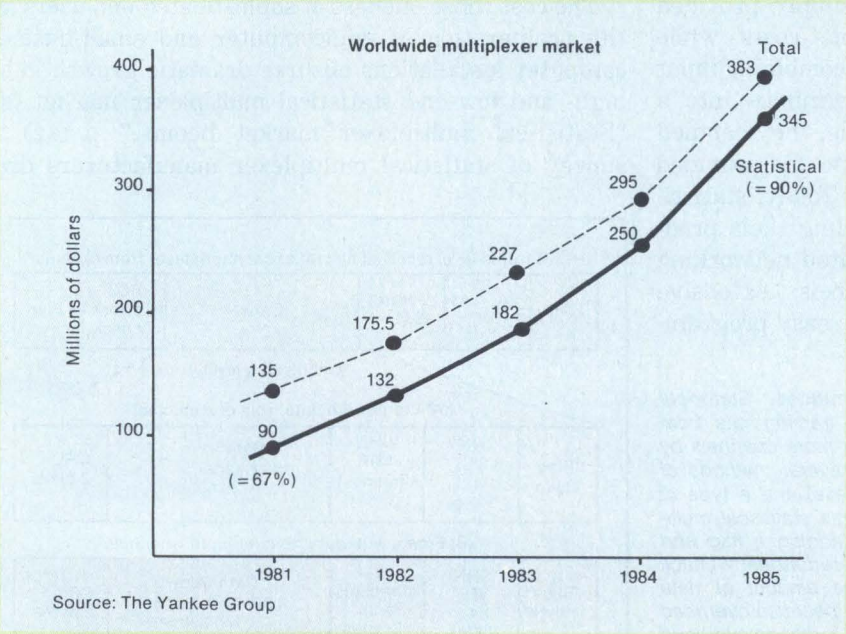
Kenneth G. Bosomworth, president of International Resource Development Inc., says most multiplexers are manufactured in the U.S., and 40 percent of these are shipped overseas. D. Wade Frembd, international product manager of Gandalf Data Inc., a multiplexer manufacturer, estimates that, by 1985, Europe and Asia will consume 50 to 60 percent of U.S.-manufactured multiplexers.

Almost all exported multiplexers use statistical time division, according to a report by Frost & Sullivan. The high level of statistical-multiplexer exports results from "inferior line quality that makes error detection/correction capability even more important than in the U.S.," the report notes.

High-end statistical multiplexers, which offer many sophisticated networking features, fit into the non-Systems Network Architecture networks of Fortune 1000 companies. Because these companies are extremely sensitive to service interruptions, they demand statistical-multiplexer designs that incorporate comprehensive network management philosophies.

Low-end products find their place in the minicomputer and small-business computer markets, as well as at remote sites of large time-sharing services.

Most market consultants agree that the statistical multiplexers that survive in the market will provide diagnostics, automatic speed and protocol conversion and efficient handling of synchronous channels. An important price/performance consideration is the breadth of service a vendor provides.

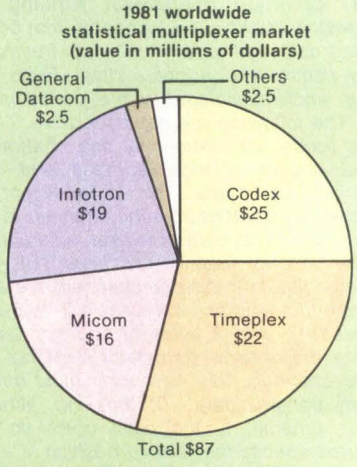



Source: The Yankee Group

**European market shipments, by type**
(Value in millions of dollars)

| | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1982-6 |
|---|---|---|---|---|---|---|---|
| Frequency division | $2.70 | $2.10 | $1.65 | $1.20 | $0.75 | $0.45 | $6.15 |
| Time division | 11.93 | 10.75 | 9.84 | 8.78 | 7.03 | 5.25 | 41.65 |
| Statistical low-end | 6.50 | 10.63 | 16.10 | 26.40 | 38.33 | 52. | 143.46 |
| Statistical high-end | 13.88 | 17.44 | 24. | 33. | 43.35 | 54.69 | 172.48 |
| Totals | 35.01 | 40.92 | 51.59 | 69.38 | 89.46 | 112.39 | 363.74 |

Source: Frost & Sullivan

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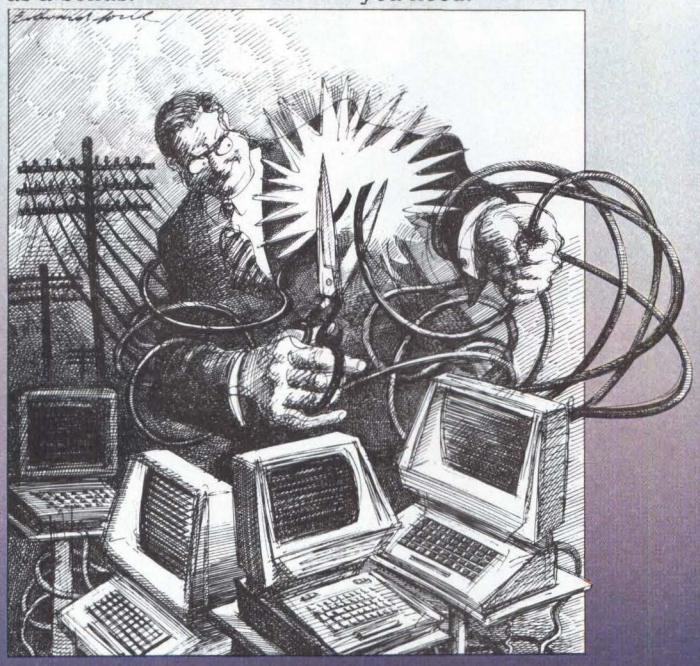

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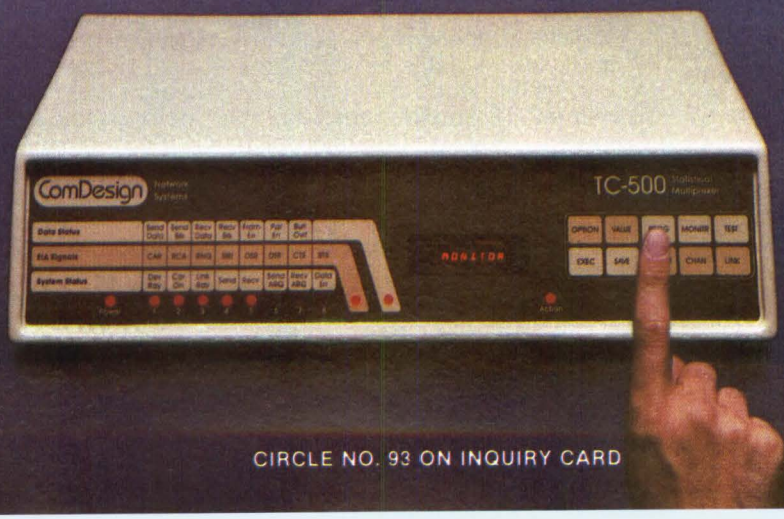


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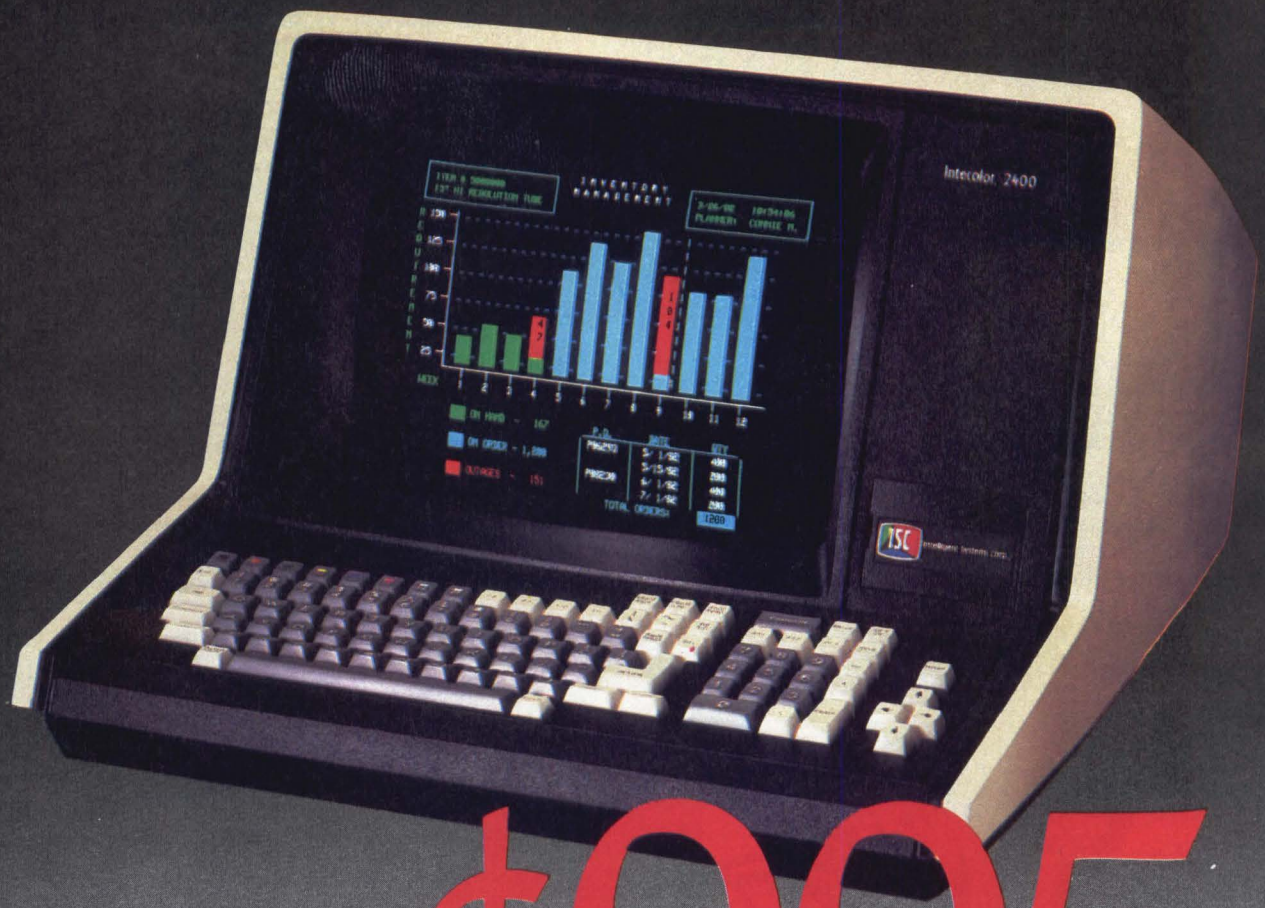


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## Performance

Probably the most difficult factor to determine, performance indicates how efficiently a statistical multiplexer can collect data from incoming terminals, strip off synchronization characters and add addressing and control bits (overhead) and pass the multiplexed data stream down the composite link. But performance-measurement figures can be misleading. An example of this apparent efficiency—the ratio of total possible input data to the instantaneous composite link speed (see "Multiplexer efficiency," p. 166). Although most vendors surveyed report an apparent efficiency of 400 percent, this figure does not account for the multiplexing overhead, such as address and error-control characters, or the loading effects of traffic.

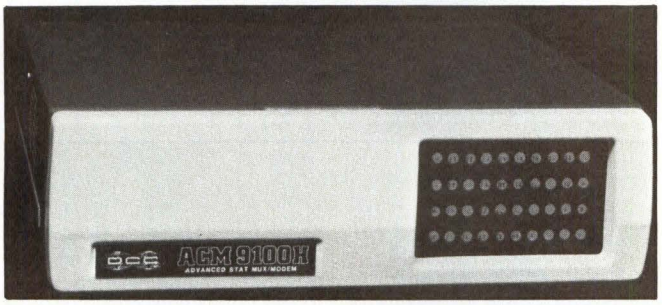
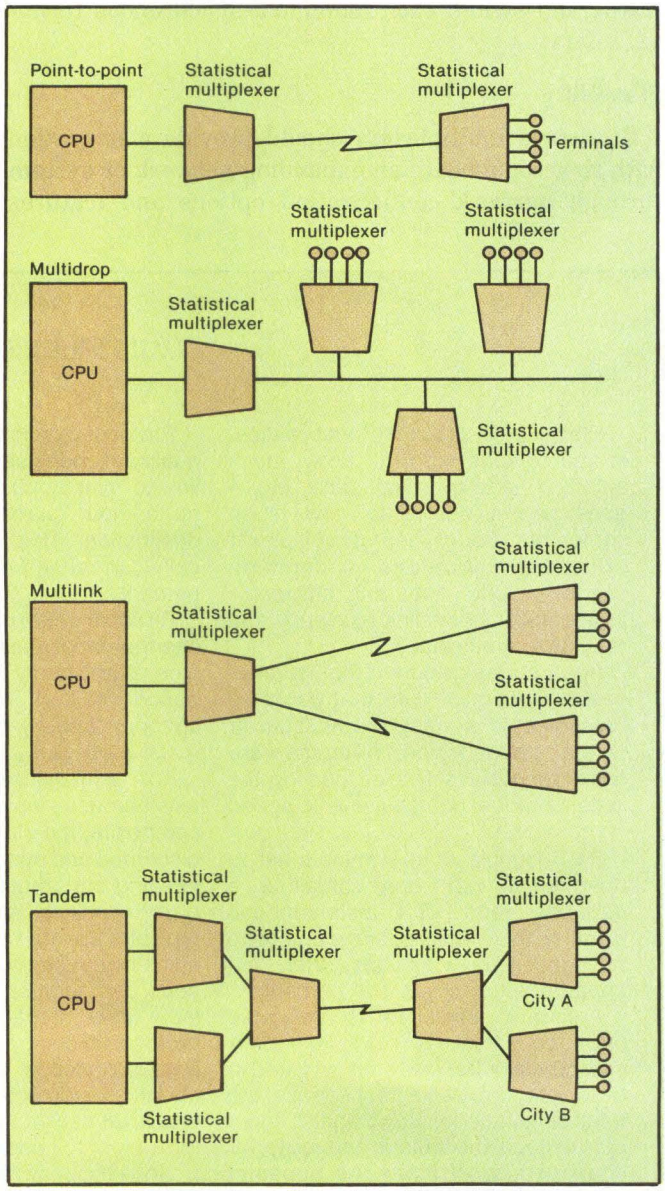



**Fig. 2. M/A-Com DCC Inc.'s ACM9100** *with integral modem concentrates as many as 32 asynchronous or BSC input channels on one or two 19.2K-bps links.*

Two factors critical to performance are the internal multiplexing method and the handling of synchronous data channels. Fig. 1 illustrates the major multiplexing techniques. Some statistical multiplexers, for example, can put only one channel's data within a frame that carries a 1-byte overhead. Others use 1 byte of overhead for every 2 bytes of data. Because these address bytes must be sent even when the terminal is not active or when there are very few characters per channel, these schemes are less efficient than, say, a scheme that uses a 2- to 6-bit-long channel terminator as the channel address. This significantly reduces the ratio of overhead to data.

There are three common ways that vendors handle synchronous data. One is the band-split, or time-division, approach, which reserves a piece of the bandwidth for synchronous channels, thereby limiting the amount of bandwidth left for multiplexing asynchronous data. For example, two 2.4K-bit-per-sec. channels use as much as 4.8K bps of a 9.6K-bps link, leaving only 4.8K bps for asynchronous transmissions. Another approach is to tie synchronous transmissions into the clear-to-send/ready-to-send control signals of the RS232C communications interface; the channel is reserved for synchronous data only when CTS is high.

**Fig. 3. Timeplex's SM24 switching multiplexer** *supports networks with as many as three nodes and 144 ports. The smallest SM series family member, which handles four to eight asynchronous channels and eight synchronous channels at rates from 50 to 9.6K bps, sits atop the master unit.*




**Multiplexers in network configurations.** *The most common network configurations are point-to-point and multipoint. Some statistical multiplexers have dual-output links to support two remote multiplexers or to provide redundancy. The tandem topology can be useful in saving line costs between nearby remote sites and the central processing site.*

The advantage to this method is that bandwidth is not reserved for the synchronous channels. The third method of handling synchronous data is to interpret the synchronous protocol coming in and to throw away the filler characters, bits or bytes. Comdesign and Codex Corp. use this third method, which is the most efficient to date; however, even this scheme is not true statistical multiplexing because it cannot address each connected device, but instead passes the synchronous terminal controller stream intact. This summer, Codex plans to release a synchronous capability in a high-end product that will mix synchronous and asynchronous traffic and switch each individual synchronous terminal's data.

### Flexibility

Statistical multiplexers should provide a migration path to accommodate an expanding network or system through network configuration options and features

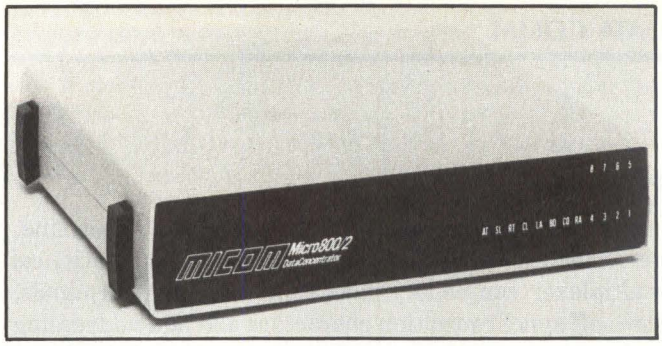



**Fig. 4. Micom Systems Inc.'s Micro 800/2,** *one of the best selling low-end statistical multiplexers on the market, supports from two to 16 asynchronous channels and four synchronous channels and two 19.2K-bps output links.*

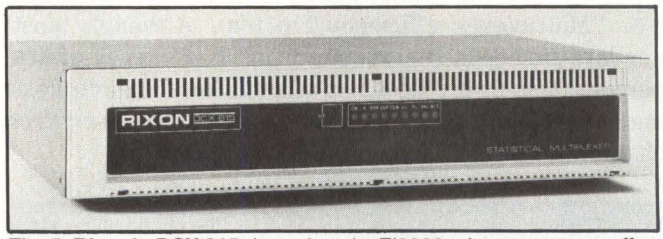



**Fig. 5. Rixon's DCX 815,** *based on the TI9900 microprocessor, offers basic multiplexing capabilities at a price of $1600.*

## MULTIPLEXER EFFICIENCY

Efficiency is a concept that relates, in percentage terms, how much anything—energy, heat, data, etc.—goes into a device to how much comes out. Four types of multiplexer efficiency definitions in common usage include apparent efficiency, protocol efficiency, link efficiency and real, or true efficiency.

Apparent-efficiency = the instantaneous amount of data that could be presented to a statistical multiplexer on the user input side if all inputs were simultaneously active divided by the instantaneous composite link speed ×100 percent.

For example, four terminals set to operate at 1.2K bps constitute a 4.8K-bps (1200 [×] 4) instantaneous input. If this multiplexer's composite link speed is 1.2K bps, then the apparent efficiency is 400 percent.

Apparent efficiency is definable only for statistical multiplexers. A substantial buffer is always required in a statistical multiplexer because the total simultaneous (aggregate) input can exceed the output capability for short periods of time. The apparent efficiency achieved depends on the interactivity of the environment. Rates from 200 to 1000 percent have been touted.

Protocol efficiency measures the quality of code used on the composite link to synchronize, error check and route input channels to the correct destination. This efficiency theoretically can range from about 25 to 125 percent.

Protocol efficiency = total single channel input data (all bits including stop, start, parity and data) per time period divided by the composite channel capacity bits per time period ×100 percent.

For a statistical multiplexer with asynchronous input and a synchronus composite, the start and stop bits are discarded and synchronization housekeeping bits, routing information and error checking are added, yielding typically 95- to 110-percent protocol efficiency. A statistical multiplexer that adds one address character for each input data character would have a protocol efficiency of 50 to 60 percent. Packet protocols yield efficiencies of about 25 percent for a low, single-character packet to about 120 percent for a high, full packet.

Link efficiency measures how much of the capacity of the composite data-communications channel is being used.

Link efficiency = the data being presented to the composite communication channel by the multiplexer composite output in bits per time period divided by the composite channel capacity bits per time period ×100 percent.

For example, if the multiplexer composite output rate equals 10K bps, and a composite communication link clocks data at 19.2K bps, link efficiency is 52 percent. In this case, the multiplexer transmits live data in only one-half the clock periods and is idle in the other half.

Real, or true, efficiency comes closest to the classical definition of efficiency.

Real efficiency = total bits (including stop, start) that are input from the user on all channels and presented to the composite for transmission in a period of time divided by the total bits output on the composite in the same time period ×100 percent.

This efficiency must always be less than 100 percent (it is impossible to get out more than is put in) and is the most stringent. For statistical multiplexers, 90 to 99 percent is typical.

*—Henry Morgan*
*Product Line Manager*
*Gandalf Data Inc.*

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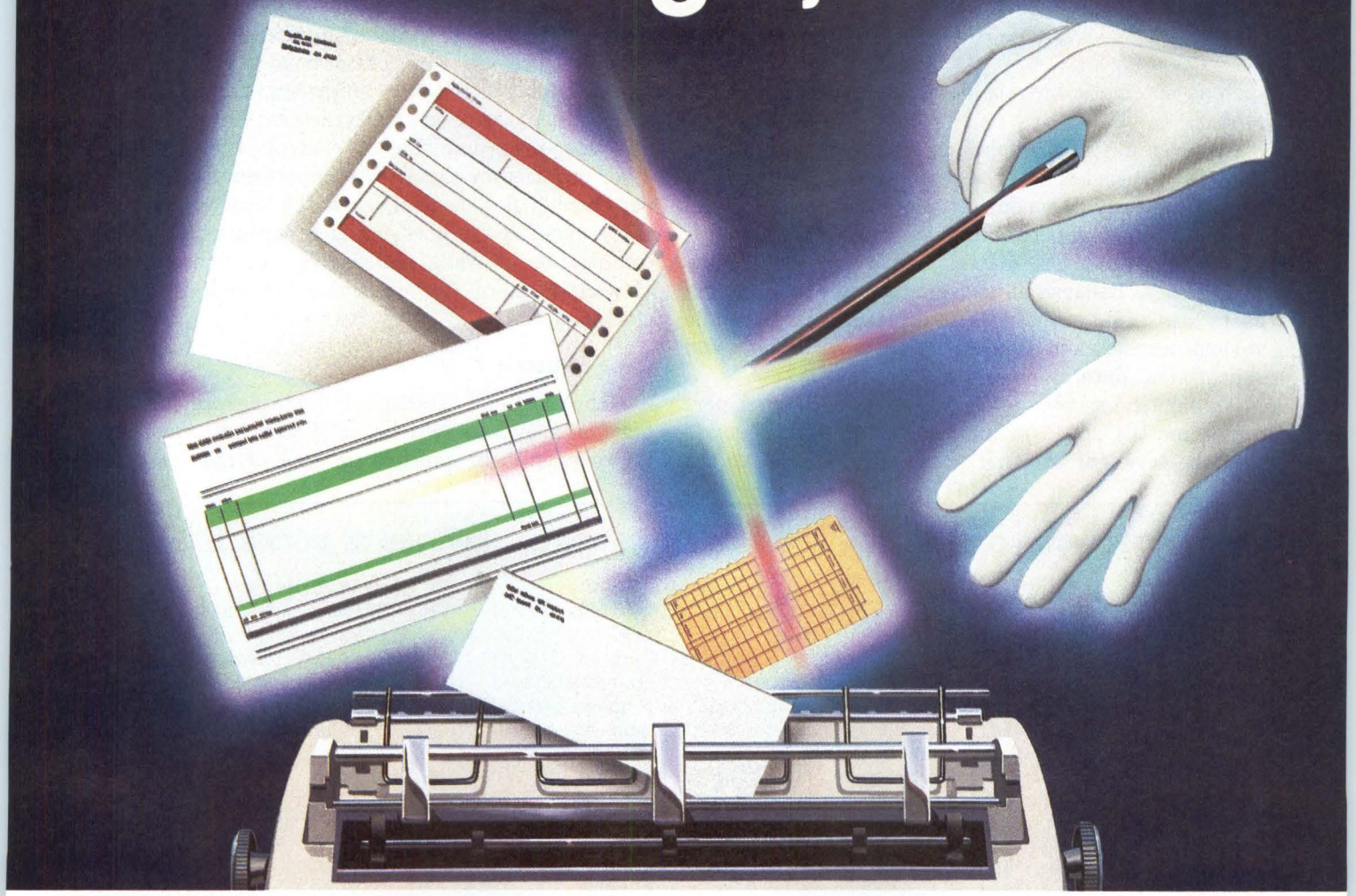

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such as automatic bit-rate detection and flexible flow control.

An example of flexible network configuration is Codex's INP series. The basic 6001 INP handles from four or eight asynchronous terminals and can be used in a point-to-point application or as a slave nodal multiplexer to the 6040 INP master, which handles as many as 16 nodes. Because all INP products are compatible, users can mix statistical multiplexers that handle various numbers and combinations of asynchronous and synchronous data.

Automatic bit-rate detection lets the channel port determine the speed of incoming data. This requires that the terminal transmit a sample character to the multiplexer, which checks its speed against an internal clock.

Flow-control signals prevent buffer overflow of both the multiplexer and attached equipment. Most manufacturers provide both out-of-band signals CTS/DTS, DSR/DTR (pins of the RS232 interface) and in-band flow control, such as X-on/off characters. Several vendors offer user-programmable EIA controls, HP ENQ/ACK and other proprietary signals. An important user feature is per-channel flow control, so that users can program, say X-on/off at the host end and, at the remote site, a combination of Wang Laboratories Inc. on channel 3, Hewlett-Packard Co. on channel 4 and CTS/DSR on channel 6.

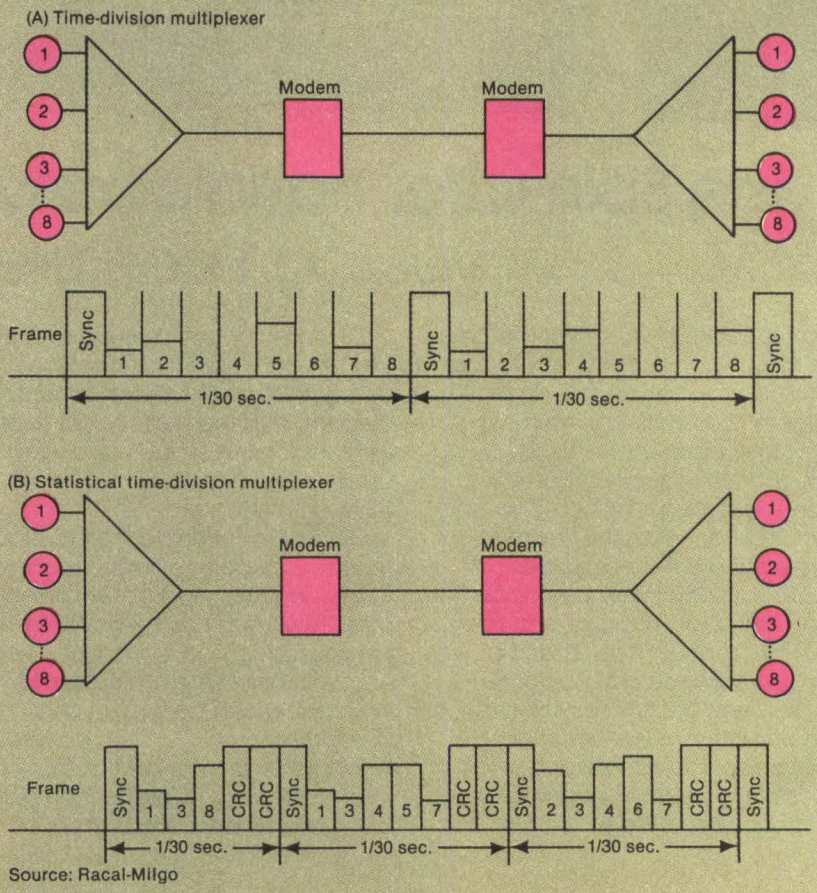
### Ease of use

Many low-end statistical multiplexers are programmed by DIP switches and jumpers. One of the improvements in multiplexer ease of use is allowing

## COMPARISON OF TIME-DIVISION AND STATISTICAL TIME-DIVISION MULTIPLEXING

A time-division multiplexer (A) divides a unit of time into *n* equal time slots, where *n* is the number of terminals attached. One time slot accommodates a bit, a byte or a block, depending on the model, from one channel. If a terminal does not have data to send, a sync or place-holder character fills the time slot. The data collected from each terminal during a unit of time (here referred to as one unit frame time) comprise a frame. Because the amount of data per time slot may vary, depending on the speeds and status of the terminals, and the number of time slots per frame and time per frame are constant, the frames may contain varying amounts of data. When only a few terminals are active, the data transmitted per unit frame time may be considerably less than the amount of data capable of being transmitted over the composite link (output channel).

A statistical time-division multiplexer (B) allocates time slots only to active terminals, according to the priority assigned those terminals by a user. During one unit frame time, a succession of active terminals is invited to submit a maximum number of bytes each, the total collected not to exceed a preestablished frame size. The frames are therefore unequal in length because the number and assignment of time slots in a frame varies. As the frame lengths vary, the statistical multiplexer makes sure that the amount of data collected approaches the capacity of the composite link by adjusting the number of frames that are transmitted during a period of time. For example, assume a maximum frame length of 30 bytes and a unit frame time of 1/30 sec. If all terminals were transmitting at full speed, all the frames would be full, and the number of frames needed to fill a 96.K-bit-per-sec. (1200-byte-per-sec.) composite link would be 40 per sec. (1200 ÷ 30). If only two terminals were transmitting at 300 bps, the frame length would be 20, and the number of frames needed to fill the composite link would be 60 per sec.




Source: Racal-Milgo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Hall-Mark Electronics Corp.—Dallas, Texas

**CIRCLE NO. 95 ON INQUIRY CARD**

configuration programming through a front-panel keypad, a dedicated supervisory port CRT or an attached user terminal. Unlike DIP switches or jumpers, which require removing the front of the multiplexer or a console that occupies a data channel, front-panel keyboards or dedicated ports do not interfere with the other channels. For example, Comdesign's unit allows changes to be made through a front-panel with an English-language display, through a supervisory CRT or through a user's terminal. Parameters can be programmed at either end and down- or up-line loaded to the other end.

### Network monitoring

Many network-monitoring functions traditionally found in front-end computers now reside in statistical multiplexers, especially in the high-end products that assume other network responsibilities such as data modulation/demodulation, switching and port contention. Most vendors' products have line and channel-by-channel use statistics, so a user knows how much more he can load the system, and LED indicators showing EIA control signals, such as receive and transmit and link ready.

*The cost consciousness of sophisticated end users and the proliferation of minicomputer and small-business computers ensure dramatic growth in the high- and low-end statistical multiplexer market.*

Fewer units provide counts and percentages of framing errors, parity errors, buffer overflows, receive and transmit errors and the times the phone line has been out. These kinds of statistics are useful in balancing data traffic loads and in determining equipment needs for expansion. Also important are the ways this monitoring information is displayed: LED indicators are not as convenient as English-language displays and printouts.

### Diagnostics

Good diagnostics allow a user to track errors and to identify a problem from the unit or from a supervisory port or user terminal without interfering with active channels. Important tests are remote and local loopbacks that can last from 1 min. to a week and that show transmit and receive errors per channel and self-tests on power-up that indicate bad UARTs or RAM or ROM microprocessors. □

# How do you create a microcomputer to match the power of the UNIX™ operating system?

Imagine. You are perfecting a revolutionary operating system. In about two years, it will be the system of choice for 16-bit microcomputers.

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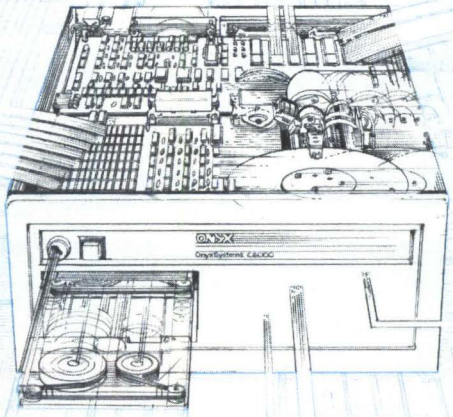
But these advantages will require intensive disk access, and superior memory management. In simple language, disk access must be as fast as possible, and the disk must have an unusual capacity to maintain complex file systems on-line at all times.

Floppy disks with their low capacities and high access times won't do.

Winchester disk drives that utilize slow-moving stepper motor head positioning devices won't do.



ONYX's IMI Winchester disk storage system, with its servo-driven voice coil head positioning, is more than twice as fast!

So, obviously the ONYX C8002 *will* do.

And, as developed, the ONYX C8002 features expandable memory up to 1 Mbyte, and disk storage up to 160 Mbytes on-line. Its cartridge tape backup offers cyclical redundancy checking on every backup. Both the Winchester disk storage system and the cartridge tape backup are *internal.*

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

Now it's 1982. The UNIX system's preeminence among 16-bit operating systems is established. And ONYX is the only company that has significant production experience with UNIX systems.

ONYX has installed over 1500 UNIX systems.

Today there are a lot of systems being developed to operate UNIX (and *"look-alike"*) operating systems. But there are many reasons why you should consider ONYX and the UNIX operating system as inseparable.

**System III available now for immediate delivery.**

Phone this special number: (408) 946-6330 Ext. 251. Ask about these System III enhancements, including:

- Multi-key index sequential files under RM COBOL;
- "Term Cap" capability that supports a wide variety of terminal interfaces;
- Enhanced printer handling capability;
- SCCS to maintain edit histories in text management applications.

**UNIX is a trademark of Bell Laboratories.*

CIRCLE NO. 97 ON INQUIRY CARD

**Make the Connection**

ONYX UNIX

OPERATING SYSTEM

Onyx Systems Inc., 25 East Trimble Road, San Jose, CA 95131

## STATISTICAL MULTIPLEXER MANUFACTURERS

| Company | Amdahl Corp. | | |
|---|---|---|---|
| Model | 4440 | 4450 | 4460 |
| Microprocessor used for central control | 8086 and multiple Z80s | 8086 and multiple Z80s | 8086 and multiple Z80s |
| Input Maximum no. and speeds of async channels | 39 @ 75 to 19.2K bps | None | 39 @ 75 to 19.2K bps |
| Maximum no. and speeds of sync channels | None | 15 multidrop 3270 bisync @ 2.4K to 19.2K bps | 15 multidrop 3270 BSC @ 2.4K to 19.2K bps |
| Buffer size (bytes) | 40K to 50K | 40K to 50K | 40K to 50K |
| Automatic bit-rate detection | Yes (110 to 2.4K bps) | No | Yes |
| Output Maximum no. and speeds of composite links | 8 @ 38.4K bps | 8 @ 19.2K bps | 8 @ as high as 19.2K bps |
| Composite link protocols | X.25 level, 1980 LAPB | X.25 level, 1980 LAPB | X.25 level, 1980 LAPB |
| Programmable by channel | Yes | Yes | Yes |
| Additional features | Full output link switching, port contention | Full output link switching, poll list | Full output link switching, port contention |
| Price | $6650 to $14,000 | $10,700 to $14,700 | $12,000 to $22,000 |

| Company | Codex Corp. (cont'd) | Comdesign | |
|---|---|---|---|
| Model | 6040 INP | TC-500 | TC-3 |
| Microprocessor used for central control | 6800 | Multiple 8088s | TI 9900 |
| Input Maximum no. and speeds of async channels | 248 @ 50 to 9.6K bps | 32 @ 9.6K bps, split speeds, speed conversion | 8 @ 9.6K bps |
| Maximum no. and speeds of sync channels | 248 @ 50 to 9.6K bps | 28 @ as high as 9.6K bps | None |
| Buffer size (bytes) | 32K | 16K to 320K | 4K to 32K |
| Automatic bit-rate detection | Yes | Yes | No |
| Output Maximum no. and speeds of composite links | 5 @ 19.2K bps | 2 @ 19.2K bps | 2 @ 9.6K bps |
| Composite link protocols | Codex sync | HDLC, SDLC, synchronous, async | JDLC, SDLC, sync, async |
| Programmable by channel | Yes | Yes, per end | Yes |
| Additional features | Report logging, data compression, SDLC, BSC, DDCMP, Burrough's poll/select, Univac, Honeywell, protocol support, CDC and other sync. | Busy out, channel priority, echoplex, dial-up handshake, flow-control translation, view of EIA signals, view of channel data | Combines DEC DZ11 with stat. mux., provides 8 remote DZ11 ports over 1 phone line. |
| Price | $20,000 typical | Basic $1700 | $2100 base |

| Company | Datagram Corp. | | Datatel Inc. |
|---|---|---|---|
| Model | DM900 | DM4800 | DCP5000, DCP5020 |
| Microprocessor used for central control | Z80A | Z80A | 6502 |
| Input Maximum no. and speeds of async channels | 9 @ 110 to 9.6K bps | 52 @ 100 to 9.6K bps | 4 @ 9.6K, 2 @ 9.6K bps |
| Maximum no. and speeds of sync channels | 1 @ 1.2K to 9.6K bps | 2 @ 1.2 to 9.6K bps | N/A |
| Buffer size (bytes) | 16K, 64K optional | 16K, 64K optional | 16K |
| Automatic bit-rate detection | Yes | 1 @ 19.2K bps | Yes |
| Output Maximum no. and speeds of composite links | 1 @ 19.2K bps | X.25 level 2 | 1 @ 19.2K bps |
| Composite link protocols | X.25 (HDLC) level 2 | RS232C, V.24/28, 20-mA | |
| Programmable by channel | Yes | Yes | Yes |
| Additional features | Field expandable in 2-channel increments, compatible with DM1600 and DM4800 | Field expandable in 4-channel increments, compatible with low-end units | |
| Price | 3 channels $1550, 9 channels $2750 | 4 channels $3650, 52 channels $13,250 | $1300 in single units, quantity discount available |

| Codex Corp. | | | |
|---|---|---|---|
| 670 | 6050 DCP | 6001 INP | 6030 INP |
| Z80 | M6800, M6809 | 6809 | 6800 |
| 16 @ 110 to 4.8K bps | 120 @ 50 to 19.2K bps | 8 @ 50 to 9.6K bps | 124 @ 50 to 9.6K bps |
| None | 120 @ 50 to 19.2K bps | None | 124 @ 50 to 9.6K bps |
| 14K | 48K per port | 16K | 32K |
| No | Yes | Yes | Yes |
| 1 @ 9.6K bps | 8 @ 64K bps | 1 @ 14.4K bps | 1 @ 19.2K bps |
| Async or HDLC | HDLC | HDLC | Codex sync |
| No | Yes | No | Yes |
| | Switching, X.25 support, 2780/3780 protocol intervention, data compression, automatic alternate routing | Integral modem, 9-bit data code support for graphics and word-processing terminals | Report logging, SDLC, BSC, DDCMP, Univac 1004, NTR and other Honeywell, CDC, ICL sync protocol support |
| 2 channels $1350, 16 channels $5300 | $35,000 base | 4 channels $1850, 8 channels $2850 | $10,000 typical |
| Compre Comm Inc. | | | |
| Data Xchange series | Economux series | BiLink series | Data Express XL series |
| 8085A, 1 per 4-port board | 8085A | 8085A | 8085A |
| 4 to 32 @ 110 to 9.6K bps | 2, 4 or 8 @ 300, 1.2K, 2.4K, 4.8K bps | 2 @ 300 to 9.6K bps | 4 or 8 @ 110 to 9.6K bps |
| None | None | None | None |
| 12K per 4-port board | 2K or 4K | 6K | 20K |
| Yes, to 2.4K bps | No | No | 1 sync @ 9.6K bps, no |
| 1 sync or async @ 19.2K bps | 1 sync @ 9.6K bps | 1 sync @ 9.6K bps or 1 async @ 2.4K bps | ACB 1 sync @ 9.6K bps |
| Addresses character block | Addresses character block | Dynamic block management protocol | RS232, V.24, ACB |
| Yes | No | No | Yes |
| Integral modem | | Integral modem | |
| 4 channels $2550, 16 channels $5400, 4-channel card $1150 | 2 channels $895, 8 channels $1695 | $675 | 4 channels $1850, 8 channels $2650 |
| | Digital Communications Associates | | ENA Telesystems |
| System 110, 120 | System 125 | System 355 | Minimux, Micromux |
| Z80A | Z80A | Multiple Z80As | 6502 |
| As many as 32 @ as high as 9.6K bps | As many as 32 @ as high as 9.6K bps | As many as 126 @ as high as 9.6K bps (expandable by cascading) | Mini: 8 or 16 @ 50 to 9.6K bps, Micro: 2 or 4 @ 50 to 9.6K bps |
| None | | None | None |
| 20K to 25K | 20K to 25K | 880K | 12.5K |
| Yes | Yes | Yes | Yes |
| 1 @ 19.2K bps | 1 @ 19.2K bps | 44 @ 19.2K bps | 1 @ 9.6K bps |
| Synchronous DDCMP | Synchronous DDCMP | Synchronous DDCMP | HDLC, X.25 level 3 |
| Yes | Yes | Yes | Yes |
| DIP switches, synchronous channel option | Synchronous channel option | Switching, port contention, synchronous channels, X.25 level 3 gateway | Supports X.3, X.28, X.29 |
| $1495 base | $3250 base | $9995 base | Mini: 8 channels $3950, 16 channels $6100, Micro: 2 channels $2175, 4 channels $2950 |

## STATISTICAL MULTIPLEXER MANUFACTURERS

| Company | Gandalf | | |
|---|---|---|---|
| Model | PIN 9103 | PIN 9101 | PIN 9106 |
| Microprocessor used for central control | Z80 | Z80 | Z80 |
| Input<br>Maximum no. and speeds of async channels | 32 @ 2.4K bps<br>8 @ 9.6K bps | 16 @ 2.4K bps or<br>4 @ 9.6K bps | 2 or 4 @ 9.6K bps |
| Maximum no. and speeds of sync channels | None | None | None |
| Buffer size (bytes) | 12K | 11K | 16K |
| Automatic bit-rate detection | Yes | No | Yes |
| Output<br>Maximum no. and speeds of composite links | 1 @ 19.2K bps | 1 @ 19.2K bps | 1 @ 9.6K bps |
| Composite link protocols | HDLC level 2 | HDLC level 2 and 3 | SDLC framing with ARQ |
| Programmable by channel | Yes | Yes | Yes |
| Additional features | HP flow-control option | Switching, port contention, HP flow control option | |
| Price | 4 channels $1650, 32 channels $7150 | 4 channels $2650, 16 channels $5250 | 2 channels $825 |

| Company | GTE Telenet | | Halcyon |
|---|---|---|---|
| Model | TP3005 | TP3040 | 4220 |
| Microprocessor used for central control | Z80A | Z80A | 6809 |
| Input<br>Maximum no. and speeds of async channels | 4 @ 150 to 9.6K bps | 27 @ 150 to 9.6K bps | 60 @ 50 to 9.6K bps |
| Maximum no. and speeds of sync channels | None | 8 @ 1.2K to 9.6K bps | 12 @ 1.2K or 4 @ 9.6K bps |
| Buffer size (bytes) | Variable | Variable | 28K |
| Automatic bit-rate detection | Yes | Yes | Yes |
| Output<br>Maximum no. and speeds of composite links | 1 @ 19.2K bps | 1 @ 19.2K bps, full-duplex | 2 @ 19.2K bps |
| Composite link protocols | X.25 | X.25 | X.25 level 2 |
| Programmable by channel | Yes | Yes | Yes |
| Additional features | Switching, port contention<br>Down-line-loadable software | Switching, port contention, down-line-loadable software | |
| Price | $2350 | $7500 | 8 channels $6650 |

| Company | Infotron Systems Corp. (cont'd) | | Intersil Systems |
|---|---|---|---|
| Model | Supermux 616, 632 | Supermux 780 | ISM 5300 |
| Microprocessor used for central control | 6502B | 6502B | Z80 |
| Input<br>Maximum no. and speeds of async channels | 16, 32 @ 50 to 9.6K bps | 128 @ 9.6K bps | 16 @ 50 to 9.6K bps |
| Maximum no. and speeds of sync channels | 16, 32 @ 1.2K to 9.6K bps | 128 @ 9.6K bps | None |
| Buffer size (bytes) | 80K, 144K | 16K | 32K |
| Automatic bit-rate detection | Yes | Yes | Yes |
| Output<br>Maximum no. and speeds of composite links | 2 @ 19.2K bps | 1 @ 19.2K bps | 1 @ 9.6K bps |
| Composite link protocols | HDLC | HDLC | HDLC |
| Programmable by channel | Yes | N/A | Yes |
| Additional features | Switching, port contention, integral modem, 750 quad I/O channel | Optional dual I/O channel | Down-line loading of parameters |
| Price | 616: $2750 base, 632: $3250 base | $1700 base | 4 channels $1270, 16 channels $2164 |

| Data Inc. | | General DataComm Industries | |
|---|---|---|---|
| MX4, MX8 | PIN 3270 E5, E7, E8 | STDM 1262/08, STDM 1262/24 | Pollkat |
| | Z80 | Yes | Yes |
| 4 or 8 @ 9.6K bps | 4 or 15 @ 9.6K bps | 8 @ 59 to 19.2K bps,<br>24 @ 50 to 19.2K bps | 16 @ 110 to 96K bps |
| None | None | 8 @ 9.6K bps, 24 @ 9.6K bps | None |
| 2K | 4K (E5), 30K (E7, E8) | 32K, 72K | 4K |
| No | Yes | Yes | No |
| 1 @ 9.6K bps | 1 or 2 @ 9.6K bps | 4 @ 168K bps | 1 to 16 drops @ 9.6K bps |
| | 3270 BSC (E5, E7), 3270 SDLC (E8) | X.25 (HDLC) | Pollkat special |
| No | N/A | Yes | No |
| | Switching (E7, E8), redundancy (E7) | | |
| 4 channels $1500, 8 channels $2400 | E5: $6240, E7: 8 channels $9950,<br>16 channels $15,950 | 8 channels $4100, 24 channels $8200 | 10-drop system $13,000 |

| Communications, Inc. | Hewlett-Packard Co. | Infotron Systems Corp. | |
|---|---|---|---|
| 4001 | HP2333A | Supermux 380, 480 | Supermux 680 |
| 8088 | Z80 | 6502B | 6502B |
| 32 @ 50 to 9.6K bps | 19.2K bps | 4 or 8 @ 50 to 9.6K bps | 32 @ 50 to 9.6K bps |
| None | 9.6K bps | 1 @ 2.4K to 9.6K bps,<br>2 @ 600 to 9.6K bps | 16 @ 2K to 9.6K bps |
| 8K to 56K | 1K | 16K | 32K |
| Yes | Yes | Yes | Yes |
| 1 @ 153.6K bps per 16 channels | 16 @ 154.6K bps | 1 @ 19.2K bps,<br>1 @ 9.6K bps | 3 @ 9.6K bps |
| X.25 level 2 | BSC | HDLC | HDLC |
| Yes | Yes | Yes, 480 only | Yes |
| Satellite delay | Dual host port configuration, switching, port contention | Integral modem | Integral modem<br>Dual async, sync modules |
| 4 channels $1695 | | 380: 4 channels $1357,<br>8 channels $2150<br>480: 4 channels $1900,<br>8 channels $2900 | $3000 base |

| Intertel Inc. | M/A-Com DCC, Inc. | | Memotec |
|---|---|---|---|
| NES9100 | SM9200, ASM9200 | CM9100, ACM9100 | MPAC 2000, MPAC 3X, Statpac, APAC |
| 6502A | 6502A | 6502A | Z80 |
| 32 @ 75 to 9.6K bps | As many as 64 @ 50 to 9.6K bps | 4 to 32 @ 50 to 9.6K bps | 64 @ 75 to 9.6K bps |
| 32 @ as high as 9.6K bps | Bisync as high as 9.6K bps<br>(optional on SM9200) | Bisync as high as 9.6K bps<br>(optional on CM9100) | None |
| 32K | 16K, 32K | 16K, 32K | 16K to 64K |
| Yes | Optional, yes | Optional, yes | Yes |
| 1 @ 16K bps | 2 @ 16K bps (SM9200),<br>19.2K bps (ASM9200) | 2 @ 16K bps (CM9100),<br>19.2K bps (ACM9100) | 4 @ 9.6K bps |
| HDLC/SDLC, X.25 level 2 | SDLC/HDLC, bit sync, X.25 | SDLC/HDLC, bit sync, X.25 | HDLC, BSC |
| Yes | Yes | Yes | Yes |
| Satellite link support, quad channel boards | ASM9200-satellite interface, HP flow control, 230V, backup data link, async data link, autobaud, SM9200-supervisory port, bisync inputs, enhanced flow control, 16K SM9200 RAM expansion | CM9100-satellite interface, HP flow control, 230V, backup data link, async data link, autobaud, ACM9100-bisync inputs, 16K RAM expansion, enhanced flow control | Port contention |
| $2950, $120 per mo. 2-yr. lease | SM9200-$2200, ASM9200-$3050 | CM9100-$1800, ACM9100-$2450 | $3900 to $27,900 |

## STATISTICAL MULTIPLEXER MANUFACTURERS

| Company | Memotec | | Micom |
|---|---|---|---|
| Model | MPAC 6000 | MPAC 4000 | Micro800/2, Micro8000 |
| Microprocessor used for central control | Z80 | Z80 | Z80 |
| Input<br>Maximum no. and speeds of async channels | 48 @ 75 to 9.6K bps | None | 2 to 16 @ 50 to 9.6K bps |
| Maximum no. and speeds of sync channels | 12 @ 9.6K bps | 12 @ 1.2K to 9.6K bps | 4 @ 9.6K bps |
| Buffer size (bytes) | 64K | 16K to 32K | 16K |
| Automatic bit-rate detection | Yes | No | Yes |
| Output<br>Maximum no. and speeds of composite links | 4 @ 9.6K bps | 4 @ 9.6K bps | 800/2: 2 @ 19.2K bps,<br>8000: 1 @ 9.6K bps |
| Composite link protocols | HDLC | HDLC | ADLC (Micom proprietary add-on data link control) |
| Programmable by channel | Yes | No | Yes |
| Supervisory port | Yes, remote | Yes, remote | Yes, dedicated |
| Additional features | Switching | Port contention | 8000: integral modem |
| Price | $16,000 to $25,000 | $5200 to $15,000 | 800/2: 2 channels $1050, 8000: 2 channels $1650 with 2.4K-bps modem |

| Company | Nolton Communications | | Paradyne |
|---|---|---|---|
| Model | 1904 | DCX 815 | DCX 825 |
| Microprocessor used for central control | Intel | TI9900 | TI9900 (multiple) |
| Input<br>Maximum no. and speeds of async channels | 4 @ 110 to 9.6K bps | 4 or 8 @ 50 to 9.6K bps | 4 to 32 @ 50 to 9.6K bps |
| Maximum no. and speeds of sync channels | None | 1 to 4 @ 1.2K to 9.6K bps | 3 to 9 @ 1.2K to 9.6K bps |
| Buffer size (bytes) | 1K | 4K | 16K |
| Automatic bit-rate detection | No | Yes | Yes |
| Output<br>Maximum no. and speeds of composite links | 1 @ 9.6K bps | 1 @ 19.2K bps | 1 @ 19.2K bps |
| Composite link protocols | | HDLC/X.25 level 2 | HDLC 1, X.25 level 2 |
| Programmable by channel | No | Yes | Yes |
| Monitoring<br>Traffic statistics | None | Line, channel, buffer | Line, channel, buffer |
| Supervisory port | No | Yes, dedicated | Yes, dedicated |
| Additional features | | Channel and link validate, character test- N/C, switching, port contention | Channel and link validate, character test, - N/C, switching, port contention |
| Price | £550 | 4 channels $1900, 8 channels $2700 | $5000 to $11,000, depending on configuration |

| Company | Racal-Milgo Inc. | | Rixon |
|---|---|---|---|
| Model | Omnimux 30, 40 | DCX815, 825, 836 | Commux |
| Microprocessor used for central control | 8085A | 9900 | 9900 |
| Input<br>Maximum no. and speeds of async channels | 8 @ 50 to 9.6K bps | 8, 32 or 60 @ 50 to 9.6K bps | 8 @ 50 to 9.6K bps |
| Maximum no. and speeds of sync channels | None | 2, 8 or 30 @ 1.2K to 9.6K bps | 2 @ 1.2K to 9.6K bps |
| Buffer size (bytes) | 4K to 7K | 5.5K per 8 channels (DCX815, 825), 16K to 64K (DCX836) | 5.5K |
| Automatic bit-rate detection | Yes | Yes | Yes |
| Output<br>Maximum no. and speeds of composite links | 1 @ 9.6K bps | 1 @ 19.2K bps | 1 @ 9.6K bps |
| Composite link protocols | HDLC (modified) | HDLC | HDLC |
| Programmable by channel | Yes | No (DCX815), in 8-channel increments (DCX825), in 4-channel increments (DCX836) | No |
| Supervisory port | No | No | No |
| Additional features | Integral modem | Integral modem and onward linking of 8-channel composite (DCX825) | |
| Price | 4 channels $1825, 8 channels $2825 | DCX815: 4 channels $1600, 8 channels $2300, DCX825: 10 channels $5000, 32 channels $7400 | 4 channels $3990, 8 channels $4690 |

| Systems Inc. | | Network Products Inc. | |
|---|---|---|---|
| Micro900, Micro8000 (point-to-point) | Micro800/X.25, Micro8000/X.25 | Babymux | Babynet |
| Z80 | Z80 | 8088 | 8088 |
| 1 to 16 @ 50 to 9.6K bps | 4 to 16 @ 50 to 9.6K bps | 8 @ 50 to 19.2K bps | Master: as many as 22 channels, node: 8 channels per node, as many as 8 nodes @ 50 to 9.6K bps |
| None | None | N/A | N/A |
| 14K | 32K | 16K | 16K |
| Yes | Yes | No | Yes |
| 1 @ 9.6K bps | 800: 1 @ 19.2K bps, 8000: 1 @ 9.6K bps | 1 @ 19.2K bps | 1 @ 19.2K bps |
| ADLC | X.25 level 3, LAPB/HDLC | SDLC, X.25 level 2 | SDLC, X.25 level 2 |
| No | Yes | Yes | Yes |
| Yes, dedicated | Yes, dedicated | No | Yes, not dedicated |
| 8000: integral modem | Local switching, port contention, 8000/X.25: integral modem, asymmetric data rates (1.2K/75 bps) for videotex-type applications | | |
| 900: 1-channel node $900, 16-channel master $4200, 8000: 1-channel node with 2.4K-bps modem $1650, 16-channel master with 4.8K-bps modem $5950 | 800/X.25: 4 channels $2050, 8000/X.25: 4 channels and 2.4K-bps modem $2600 | Base unit $1350, expander $475 | Base unit $1250, expander $475 |
| Corp. | | Prentice Corp. | Racal-Milgo Inc. |
| DCX 861, 871 | DCX 840, 850 | SNP 110, 1200 | Omnimux 80, 160, 320 |
| TI9900 (multiple) | TI9900 (multiple) | Point-to-point, multipoint 8085 | 8085A |
| 4 or 8 @ 50 to 9.6K bps | 4 to 240 @ 50 to 9.6K bps | 4 or 8 @ 110 to 9.6K bps | 32 @ 50 to 9.6K bps |
| 871 only: 3 to 9 @ 1.2K to 9.6K bps | 2 to 129 BSC and 3 to 45 SDLC @ 50 to 9.6K bps | SNP 1200 option: 1 @ 9.6K bps | 8 @ 9.6K bps |
| 4K | 16K to 64K | 1K per channel, dynamic | As much as 32K |
| Yes | Yes | Yes, SNP 1200 only | Yes, optional |
| 1 @ 9.6K bps (19.2K bps with external modem) | DCX840: 14 @ 56K bps (63 network nodes) DCX850: 15 @ 56K bps | 1 @ 9.6K bps | 1 @ 19.2K bps |
| HDLC X.25 level 2 | HDLC/X.25 level 2 | HDLC | HDLC (modified) |
| Yes | Yes | No | Yes |
| Line, channel, buffer | Line, channel, buffer | None | Line, channel |
| Yes, dedicated | Yes, dedicated | No | Yes, not dedicated |
| Character and link validate character test, switching, port contention | Switching, port contention, dial-in supervisory port, line and channel validate character test | Autospeed firmware (SNP 1200) | Flow control, supervisory control and monitor, satellite, integral modem |
| $3900 | DCX840: $6000 to $100,000, DCX850: $7000 to $150,000 | 4 channels $1195, 8 channels $1995, sync channel $495 | 8 channels $3850, 32 channels $8500 |
| Inc. | Scitech Corp. | | Technical Analysis Corp. |
| DCX840, 850 | MMux-25, NPX-25, CPX-25 | Mux-25 | SM/2A, SM/4A |
| 9900 | 8085 | 8085 | 8085 |
| 240 @ 50 to 9.6K bps | 28 or 32 @ 50 to 9.6K bps | 4 @ 50 to 9.6K bps | 2 @ 9.6K bps, 4 @ 9.6K bps |
| 120 @ 1.2K to 9.6K bps | 8 @ 9.6K bps | 1 @ 9.6K bps | None |
| 16K to 250K | 8K per 4 channels | 8K | 16K |
| Yes | Yes | Yes | No |
| 14 or 15 @ 19.2K bps | 4 @ 560K bps | 1 @ 19.2K bps | 1 @ 9.6K bps |
| HDLC | X.25 level 2 | X.25 level 2 | Async, sync |
| In 4-channel increments | Yes | Yes | Yes |
| Yes, not dedicated | Yes, not dedicated | Yes, not dedicated | No |
| Integral modem, switching and port contention (DCX850) | Integral modem, satellite, user-defined in-band flow control, BSC option, 56K bps V.35 (CDX-25) | Satellite option, user-defined in-band flow control, BSC | |
| | MMUX-25: 4 channels $4500, NPX-25: 4 channels $5330, CPX-25: 4 channels $1850 | $1200 | $895, $1795 |

## STATISTICAL MULTIPLEXER MANUFACTURERS

| Company | Tellabs Inc. | | Teltone Corp. |
|---|---|---|---|
| Model | 330 Dataplexer | 331 Xplexer | M-860 |
| Microprocessor used for central control | Z8000 | Z8000 | |
| Input<br>Maximum no. and speeds of async channels | 32 @ 50 to 9.6K bps | 32 @ 50 to 9.6K bps | 16 @ 9.6K bps<br>32 @ 4.8K bps |
| Maximum no. and speeds of sync channels | 8 @ 1.2K to 9.6K bps | 8 @ 1.2K to 9.6K bps | None |
| Buffer size (bytes) | 25K | 25K | 25K |
| Automatic bit-rate detection | Yes | Yes | Yes |
| Output<br>Maximum no. and speeds of composite links | 2 @ 76.8K bps | 8 @ 76.8K bps | 2 @ 76.8K bps |
| Composite link protocols | Subset of X.25 level 2 | Subset of X.25 level 2 | SDLC/HDLC |
| Programmable by channel | Yes | | Yes |
| Supervisory port | Yes, not dedicated | Yes, not dedicated | Yes, dedicated |
| Additional features | Integral modem, dual RS232 links, local digital line driver/receiver, V.35 modem interface, sync channel interface, multidrop configuration for dual link, dual integral modem line interface | Switching, port contention, integral modem, extended network support firmware, quad data link interface with digital line driver/receiver, dual integral modem line interface unit | V.29 integral modem, V.35 DDS 56K-bps composite, channel interface, dual RS232/V.35 composite interfaces, switching and port contention planned |
| Price | $2400 base | $3200 base | |

| Company | Timeplex Inc. | | |
|---|---|---|---|
| Model | E/series | Microplexer series | Switching Microplexer series |
| Microprocessor used for central control | | | |
| Input<br>Maximum no. and speeds of async channels | 4 to 16 @ 50 to 9.6K bps | 4 to 48 @ 50 to 9.6K bps | 4 to 48 @ 50 to 9.6K bps |
| Maximum no. and speeds of sync channels | 1 @ 50 to 9.6K bps | 8 to 24 @ 50 to 9.6K bps | 8 to 48 @ 50 to 9.6K bps |
| Buffer size (bytes) | 16K | 16K to 208K (16K per 4-channel module) | 48K to 208K, 16K per 4-channel module |
| Automatic bit-rate detection | | | |
| Output<br>Maximum no. and speeds of composite links | 1 @ 9.6K bps | 1 or 2 @ 19.2K bps (single), 9.6K bps (dual) | 1 or 2 @ 19.2K bps (single), 9.6K bps (dual) |
| Composite link protocols | X.25 level 2 | X.25 level 2 | X.25 level 2 |
| Programmable by channel | Yes | 100% | Yes |
| Supervisory port | No | Yes, dedicated, any ASCII device | Yes, dedicated, any ASCII device |
| Additional features | Integral modem | Down-line loading of parameters, priority, traffic flow control, four full-duplex modem control functions per channel, data compression, optional async channel expander, sync protocols, extended diagnostics, alarm driver, adaptive speed, TSO/TCAM, routing tables | Switching, port contention, closed user group option for ports and supervisory port |
| Price | $1650 base | $1625 to $5150 | $1800 to $5150 |

| Company | Timeplex Inc. (cont'd) | Western DataCom Co. |
|---|---|---|
| Model | Wideband Microplexer WML/8 | PRISM 3/A |
| Microprocessor used for central control | | 6502 |
| Input<br>Maximum no. and speeds of async channels | 4 to 48 @ 50 to 9.6K bps | 3 @ 75 to 19.2K bps, split speeds |
| Maximum no. and speeds of sync channels | 50 to 9.6K bps | None |
| Buffer size (bytes) | 224K | 2.5K |
| Automatic bit-rate detection | | No |
| Output<br>Maximum no. and speeds of composite links | 1 @ 72K bps | 1 @ 19.2 K bps |
| Composite link protocols | X.25 level 2 | Async |
| Programmable by channel | Yes | Yes |
| Supervisory port | Yes, dedicated, any ASCII terminal | No |
| Additional features | Integral modem, electronic patching, extended ARQ buffer and selective repeat, password protection to supervisory port | Autodial modem, dual-baud rate modem support, modem pass-through mode, dynamic priority assignment for keyboard devices, card-compatible with Vadic modem. |
| Price | | card only $875 |

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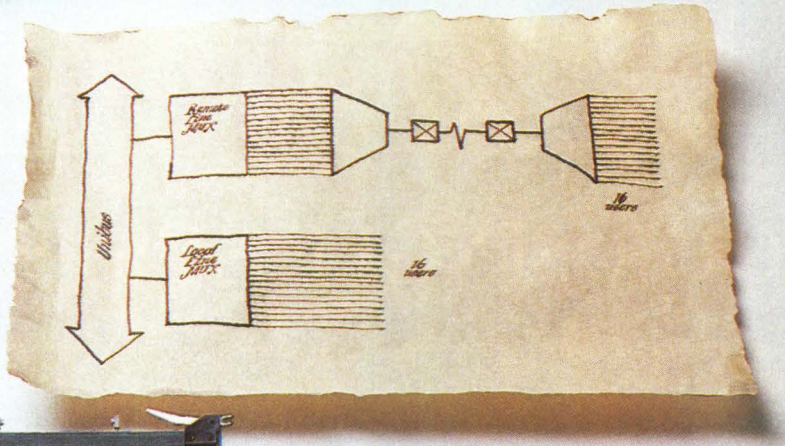

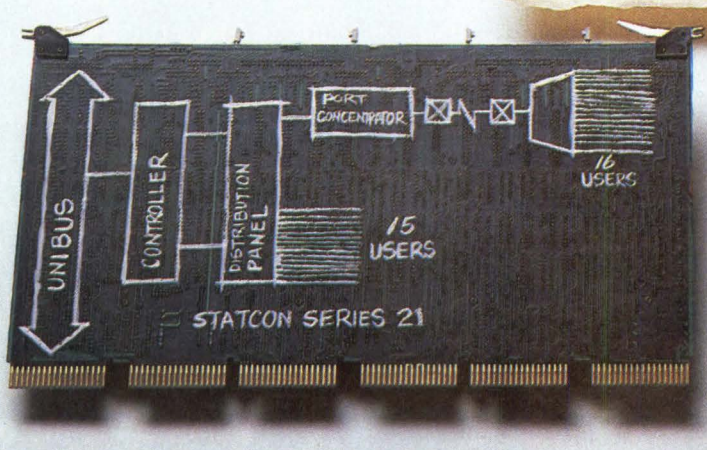


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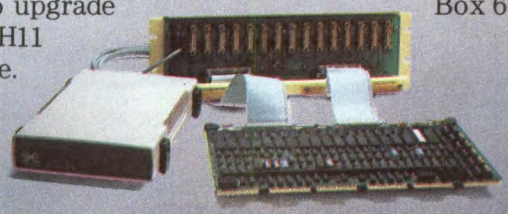

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CIRCLE NO. 98 ON INQUIRY CARD

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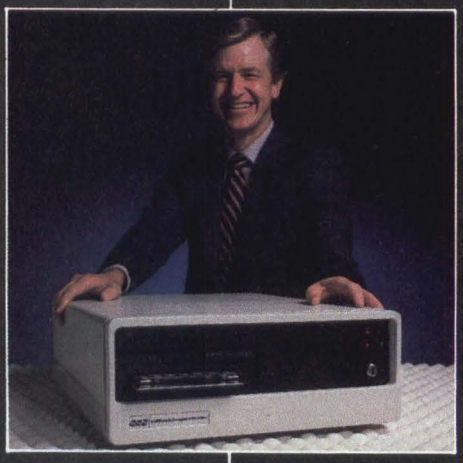

Available as a single-user system utilizing the popular CP/M* operating system, the **Slimline** is upgradeable to a multi-user system and will run either MP/M* or OASIS*. You can choose from any of thousands of single and multi-user applications software packages currently available.

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CIRCLE NO. 100 ON INQUIRY CARD

# Micro network unburdens Lawrence Livermore's supercomputers

ALEX CECIL, Lawrence Livermore National Laboratory

*By bringing each user local editing, this master/slave local network relieves the strain of interactive programming on the host network*

Many program-development installations that rely on time-sharing systems are distributing some of the programming tasks to microcomputer networks. The Lawrence Livermore National Laboratory, for example, has installed several microcomputer local networks as front-ends to its massive Octopus network, composed of Cray-1 and Control Data Corp. 7600 mainframes. One local network, which incorporated terminals from different vendors, is used by the programming group for nuclear weapons simulation. It allows programmers to perform local text editing, which reduces the time necessary to retrieve, modify and verify code, and frees the central host for compilation and execution. It also facilitates job resubmission and user scheduling.

## Local text editing

Before the local network was implemented, programmers used a line-by-line, interactive, nonscrolling, command-based text editor tied directly to the time-sharing system. Not only were the editing features cumbersome, but the editor itself was at times unpredictably slow, depending on what jobs were running simultaneously.

These problems were corrected by allocating some program development and maintenance functions to Digital Microsystems, Inc.'s HiNet, a CP/M-based, packet-switching local network providing 500K-bit-per-sec. serial data transmission with SDLC protocol (Fig. 1). The network was implemented by simply connecting the installed base of Digital Microsystems' Z80-based microcomputers that were used with different vendors' terminals and adding a master station with a 20M-byte disk. HiNet interfaces with the mainframes via 9.6K-bit-per-sec. lines funneled through a teletypewriter concentrator. It supports as many as 32 users, using a master/slave polling scheme with RS422 specifications.

By providing each user with a dedicated CPU at every workstation, HiNet permitted programmers to adopt Lifeboat Associates' PMATE full screen-oriented editor for program development and maintenance. Editing now takes place in an environment isolated from the Crays, and response time is consistent, even when all terminals are operating (Fig. 2).

To provide the text-handling facility, programmers developed "transferring" software that serves as an interface between HiNet and the mainframes. The utility down-loads an isolated chunk of code from the Octopus source files to the 1M-byte disk partition at the master station assigned to each individual. After the PMATE editor is used to make changes and additions, the completed file is transferred back to the mainframes.

Data entering HiNet are transmitted at approximately 7.2K bits per sec. in full-duplex mode. HiNet transmits back in packets at a lower rate—2.4K bits per sec.—because the time-sharing system cannot buffer. Therefore, programmers generally find it faster to call

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in no more than 1500 to 2000 lines of code at a time. Small changes, or changes spread over large source files, are still best done on the mainframe. The transferring software also provides soft keys for editing, scrolling and file transfer onto a Winchester hard disk. Because these features are at the software level, inexpensive dumb terminals can be added easily to the network.

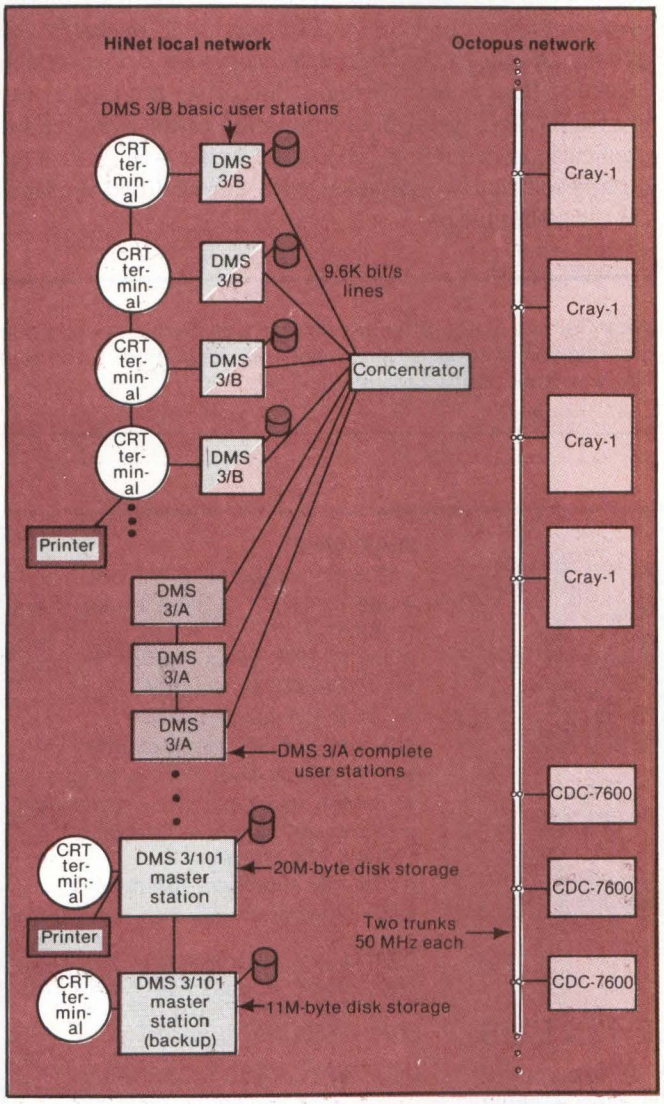


**Fig. 1. The HiNet arm of Octopus.** *Running HiNet networking software, a DMS-3/101 master station with 64K of RAM and 20M bytes of Winchester hard disk storage polls three DMS-3/A CRT stations and nine DMS-3/B basic user stations, which connect to different manufacturers' terminals and provide RS232C interfacing. A second DMS-3/101 with 11M bytes serves as backup master station. Hard-copy output is delivered through a daisy-wheel printer and two serial printers attached to the master station and five low-speed printers at the user stations. Octopus input/output ports are hard-wired into each office, in which they meet a conversion box (not shown) that translates RS422 signals generated by the hosts into RS232C signals understood by the microcomputers. Lines supporting 9.6K bits per sec. are funneled through a teletypewriter concentrator to the host network.*

## Off-hour jobs

HiNet also facilitates automatic job resubmission. Formerly, programmers could initiate low-priority jobs from their terminals to run on a standby basis during nights and weekends. However, when the mainframes were shut down and restarted during a scheduled maintenance or unscheduled interruptions, these jobs would simply be lost because an operator was not there to take corrective action. Job mortality was 30 to 50 percent.

This problem was solved by using a special program residing on the HiNet master station that continuously logs in for each of the mainframe's users. The program checks each user station for jobs to be reinitiated because of a dead start. For backup, this program also runs on a stand-alone floppy disk microcomputer; the CP/M submit facility automatically boots the program if power is interrupted. The result is a near 100-percent job-completion rate.

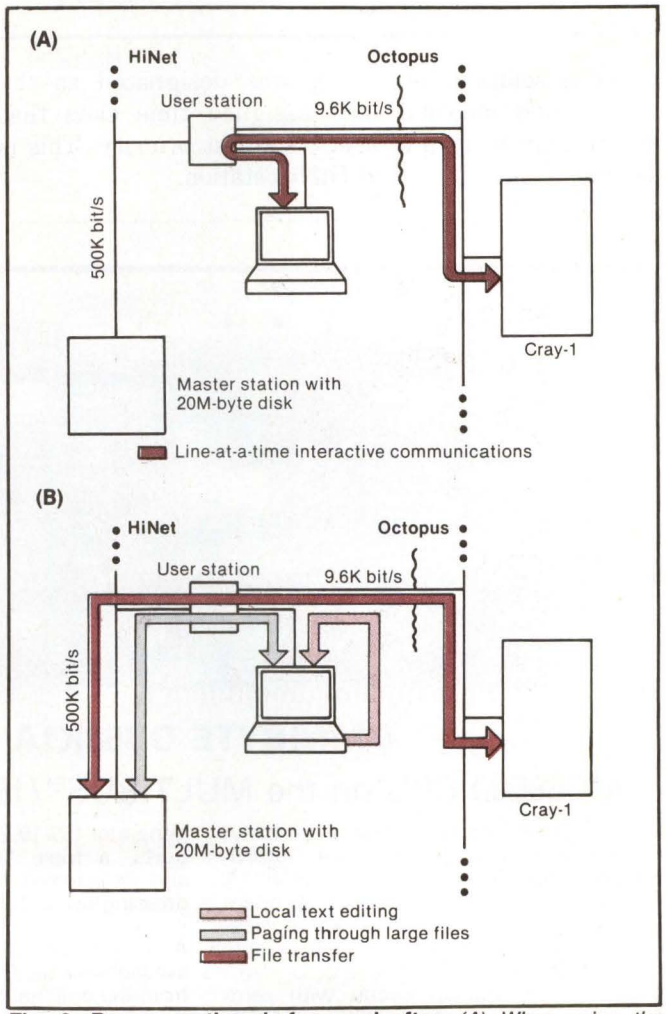


**Fig. 2. Response time before and after.** *(A) When using the line-by-line interactive editor tied to the time-sharing system, programmers experience a response time ranging from 1 to 6 sec. per line, or approximately 14 to 80 characters per sec. (B) On HiNet, editing can be done locally at 9.6K bits per sec., or approximately 1200 characters per sec. File transfer occurs at 750 cps from host to HiNet and 300 cps from HiNet to host. Programmers can page through larger files at 4000 cps.*

### Regulating access

A problem with the time-sharing system is that code is not paged, but entered into contiguous disk space. In scheduling a large job, the operating system must therefore clear 70 to 80 percent of the systems's 16M-byte memory, which takes its toll on other simultaneous tasks.

*Before the local network was implemented, programmers used a line-by-line, interactive, nonscrolling, command-based text editor tied directly to the time-sharing system.*

As a solution, one Cray was designated as the "production machine" and assigned time slots that dictate which team of users has first priority. This is now done on a dedicated HiNet station.

A second microcomputer on HiNet enforces the total time allotment for the other three Crays. At the beginning of each day, all user teams start with the highest priority for running jobs. When a team exhausts its time quota, its priority is lowered. The group's time allotment is renewed each weekday morning and evening and once at the outset of the weekend. A log file, accessible from any terminal on HiNet, gives the status of these administrative functions.

### Future expansion

HiNet provides an easy expansion path. At this time, about a third of the group's 30 potential users are on the local network, and more stations will probably be added, among these Digital Microsystems' Fox, which provides floppy disk storage. The programming group is evaluating Digital MicroSystems' 16-bit systems for applications requiring large RAM and its System 5000 high-resolution workstation with vertical and horizontal CRT orientation. □

**Alex Cecil** is a programmer with the code development group for nuclear weapons simulation at Lawrence Livermore National Laboratory, Livermore, Calif.

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| | | | 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 |
| 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 |

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# Communications processor connects dissimilar hosts and workstations

TOM WILLIAMS, Tri-Data

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The Netway communications processor family from Tri-Data combines a communications-oriented operating system with distributed microprocessor-based intelligence that connects dissimilar workstations and multiple hosts and provides extensive network-management functions. This is done by a combination of Z80-based communications nodes and a layered operating system that manages protocol translations and network resources.

The Netway family consists of several interconnecting devices that can serve a wide array of functions. As a multiplexer or data concentrator, the Netway can combine several workstations and host ports onto a single high-speed line. As a protocol converter, it can provide communications between dissimilar workstations and hosts. As a cluster controller, it can combine workstations into a cluster and manage communications with multiple dissimilar hosts. As an X.25 packet processor, it allows ASCII start/stop terminals to communicate with their host while taking advantage of the X.25 network facilities. As a nodal processor, it combines many different hosts and terminals into a network. As a simple networking device, it can connect many different workstations such as display terminals, word processors, teleprinters and printers.

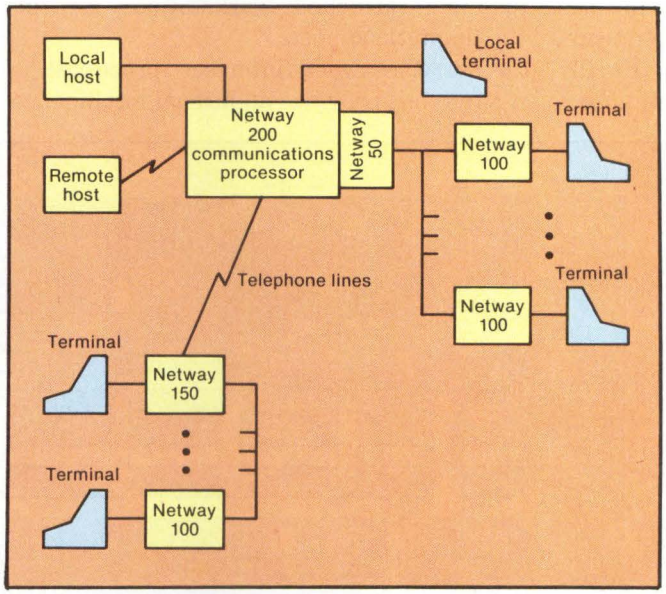



**Fig. 1. The Netway family** *is built around the Z80-based N200 communications processor and runs the NCOS operating system. The N200 connects to terminals and host computers via RS232C links. The N100 device interface processor connects to terminals or host ports and the Netway RS422-based local network. The N50 interface device translates RS232C levels to RS422 and connects N200s to N100s. The N150 permits terminal interconnection to N200 via telephone lines.*

## The hardware—modular, Z80 based

The Netway family consists of three processors and a line translator (Fig. 1). The heart of the system is the N200 communications processor consisting of a 4-MHz Z80A processor, 256K bytes of RAM, 32K bytes of ROM, four multiplexed DMA port controllers, six serial RS232C ports, an integral 5¼-in. minifloppy disk drive with 800K bytes of storage and a Shugart Associates System Interface bus for optional Winchester disk drives (Fig. 2). The N200 runs the NCOS Netway communications operating system that provides host and workstation

transparency. It translates from one protocol to another without placing demands on the computer or the terminal. It is multitasking and supports user-defined tasks. The N200 also handles network routing, usage and error statistics, permits symbolic addressing of connected devices and dynamic reconfiguration of a network. It also provides protocol programming facilities for developing and interfacing communications protocols. The NCOS handles memory management, definition of device capabilities, message queuing and task management.

The N100 device interface processor, also Z80 based, supports workstation or host port emulation and can be down-loaded by an N200. The N100 is not needed when its functions are workstation or host resident. An N50 local network interface connects as many as 32 N100s to a Netway 200 processor I/O port at speeds of 19.2K bits per sec. It translates the N200 RS232C levels to RS422 electrical levels and can connect to four-wire twisted pairs (such as those used to connect telephones in an office) to lengths exceeding 2 miles. Using the N50, multiple N100s and attached workstations can be connected to a single N200 port.

Finally, the N150 network interface processor is similiar to an N100, but provides additional intelligence that can respond to commands sent from a modem port. This allows connection of a cluster of local terminals to a remote Netway 200 via telephone lines.

With its protocol-translation facility, the Netway family permits a user to configure a network that includes, for example, IBM Corp., Burroughs Corp. and Digital Equipment Corp. host compters at local or remote sites. Workstations can include ASCII CRT terminals, word processors, teleprinters, personal computers and host-computer-protocol-dependent terminals. Any workstation can send data to and receive data from any host on the network, and workstations can pass data between themselves. The Netway family makes the native protocol of the host or workstation transparent to the application by translating the originating protocol into the protocol required by the application. More concurrent users can be added, and local networks can be configured with additional N200 and N100 processors. As many as 254 Netway processors can be connected to form networks with as many as 32 workstations on each Netway 200 processor. Data rates of 56K bits per sec. on each N200 serial I/O port are possible with a maximum aggregate data throughput of 115K bps. The local network connection available on the RS422 links supports a 19.2K-bps rate, and the SASI bus offers a 100K-byte-per-sec. transfer. The SASI is an intelligent processor/disk bus that allows for multiple processors and multiple disk systems. Thus, two N200 processors can communicate via the SASI high-speed parallel bus.

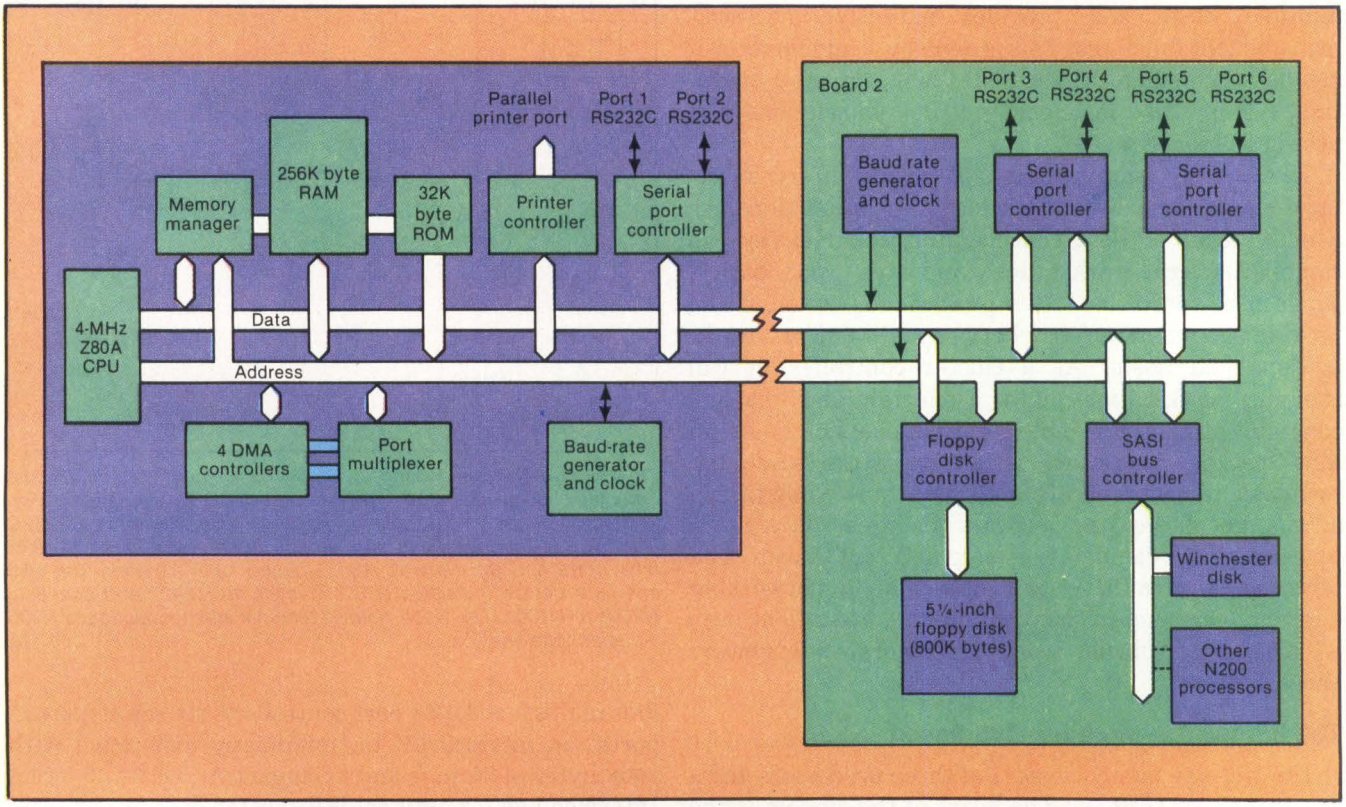
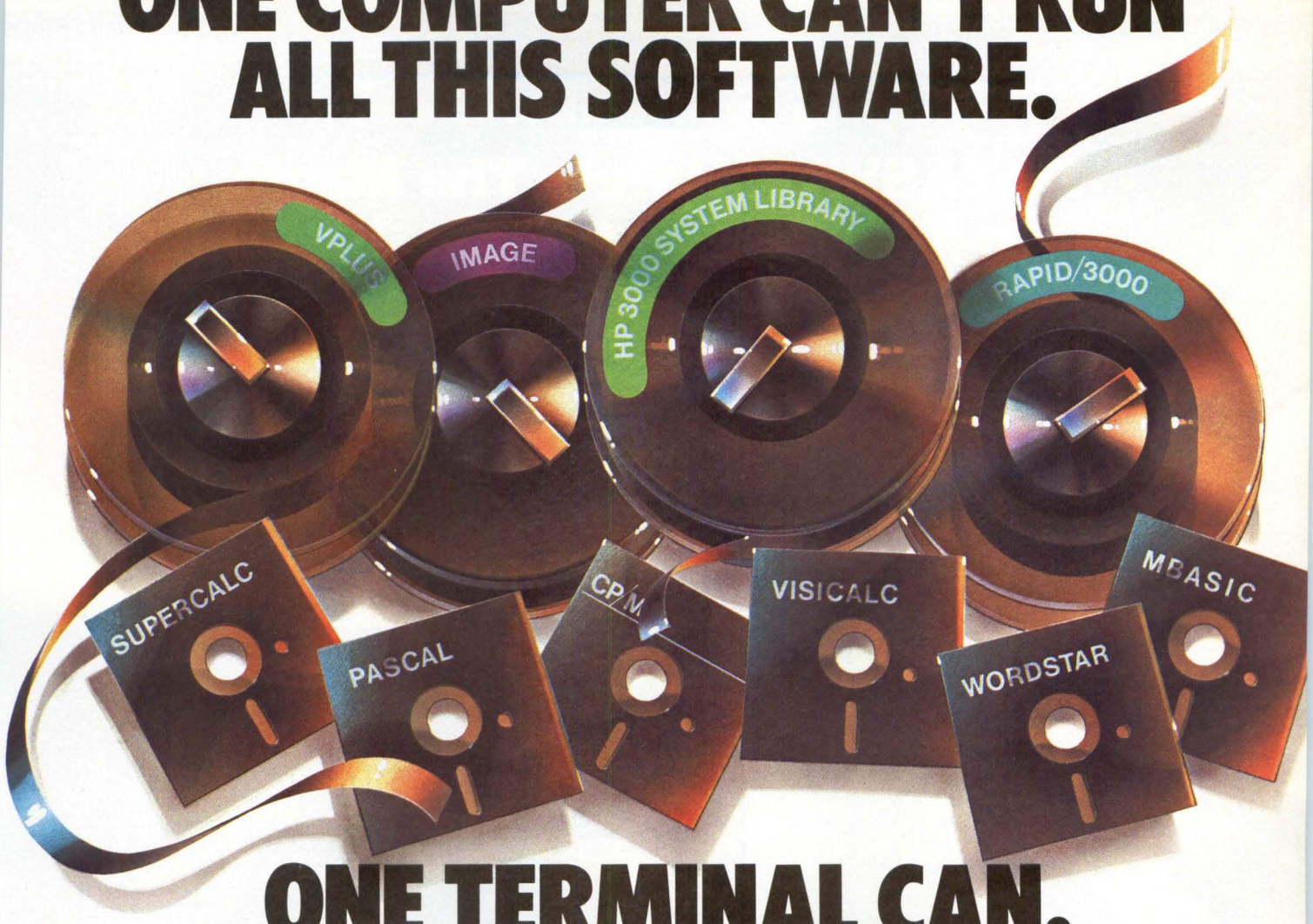



**Fig. 2. The Z80A-based N200** *has eight 32K-byte memory banks containing 256K bytes of RAM and 32K bytes of ROM. The processor board contains two serial I/O ports and the communications board. Four DMA channels are multiplexed between the six serial ports in an on-demand fashion. The SASI intelligent bus operates at 100K byte-per-sec. speeds and supports a processor-to-processor interface and processor-to-Winchester disk data transfers.*

# ONE COMPUTER CAN'T RUN ALL THIS SOFTWARE.

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CIRCLE NO. 105 ON INQUIRY CARD

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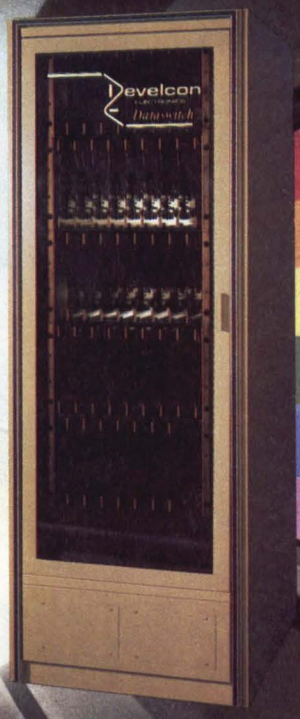


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CIRCLE NO. 106 ON INQUIRY CARD

### NCOS—message oriented, multitasking

The NCOS operating system handles I/O operations, protocol translations, port assignments, file management and user task assignments (Fig. 3).

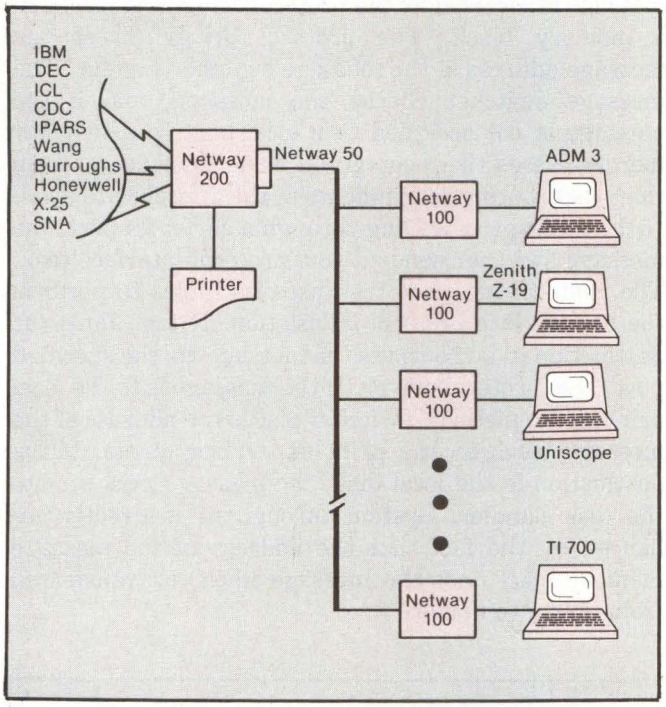


**Fig. 3. Basic configuration** *shows an N200 attached to a local network consisting of several N100s connecting standard ASCII terminals. The N200 controls the local printer resource and interfaces the terminals to a number of attached host computers.*

The kernel contains the executive-level functions and utilities, configuration tables, the NCOS message switcher and task scheduler. This portion of the operating system assigns task priorities and schedules system activities. The system task manager also handles file management, local printer control and the SASI. Files are CP/M Plus (CP/M 3.0) compatible. The NNET network manager provides message routing, maintains statistics on usage and permits dynamic allocation of network connections.

*Two N200 processors can communicate via the SASI high-speed parallel bus.*

At the bottom layer are the protocol drivers. These are interrupt driven and can respond to any system serial I/O port. The drivers are responsible for receiving the raw data from the selected port, and they use information contained in the port tables. These contain configuration information and a work-space area. The protocol interface task is paired to a protocol driver and accepts the raw data from the protocol driver, strips off the originating protocol (if necessary) and assembles the data into the NCOS message format. The internal message format is SDLC with header information followed by data.

*The N200 runs the NCOS Netway communications operating system that provides host and workstation transparency.*

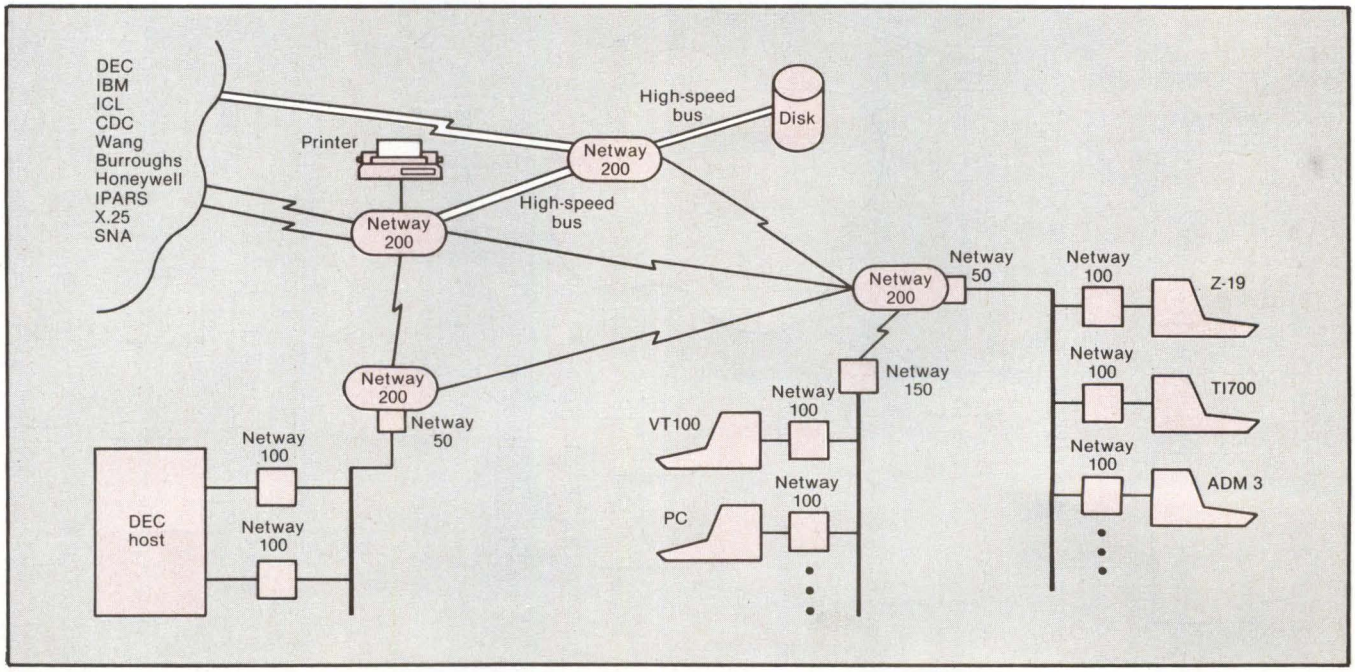


**Fig. 4. A private network** *can be established using multiple N200s, some of which control local networks. The N200s connect to each other and remote computer hosts via modems and telephone lines.*

The key to achieving high data rates throughout the system is the fact that no data interpretation or movement is done. The protocol driver routines are optimized for speed, and the data are simply accepted, encoded into NCOS messages and transmitted to the destination. While in the Netway processor, the message remains in its memory buffer.

The message switcher, the protocol interface task and any other system task (the print supervisor, the NCOS command task, the NNET task and user-written tasks) are queue driven. Messages are simply a series of blocks in memory. The beginning of each block has a pointer associated with it, and if a block exceeds 128 bytes in length, multiple blocks and associated pointers are assigned. Message pointers are placed in the desired queue and acted upon in order.

Each message block has header information starting with the next block pointer (if any) and the last block pointer. In the last block of the message, the next block pointer is 0. The message has a source ID, a destination ID, a pointer to the start and end of the data, various function codes identifying the type of message and status and scratch bytes. The status and scratch bytes are useful for special inquire messages between devices. Should more space be needed for scratch bytes, the data area can be used because the data block pointer indicates the start of the true data.

### Tracing a message through the Netway system

An incoming message in any protocol arrives at a port on an N200. It is reformatted by the N200 software into an SDLC bit-oriented message. The original message with SDLC framing information is routed by NNET to the appropriate destination. Internally to the N200, the message sequence begins when an incoming message is received by the protocol driver and placed in a memory block. The protocol driver places the message address in the message switcher's queue. The message switcher checks the message, and if the message is not assigned to a local port, the switcher merely passes the message on using information from the NNET routing assignments to the appropriate node. If the message is leaving through a serial I/O port, the message switcher sends it to a protocol interface task. The protocol interface task uses its tables to perform the appropriate protocol translation. It then finds the destination ID and outputs the message via the specified port table/protocol driver. If the message is to the local printer, the message switcher places the address of the message block on the print supervisor queue. If the destination is the local disk, the message gets sent to the disk handler. System throughput is greatly enhanced by the fact that the address of the message memory block, not the message itself, is transferred from queue to queue.

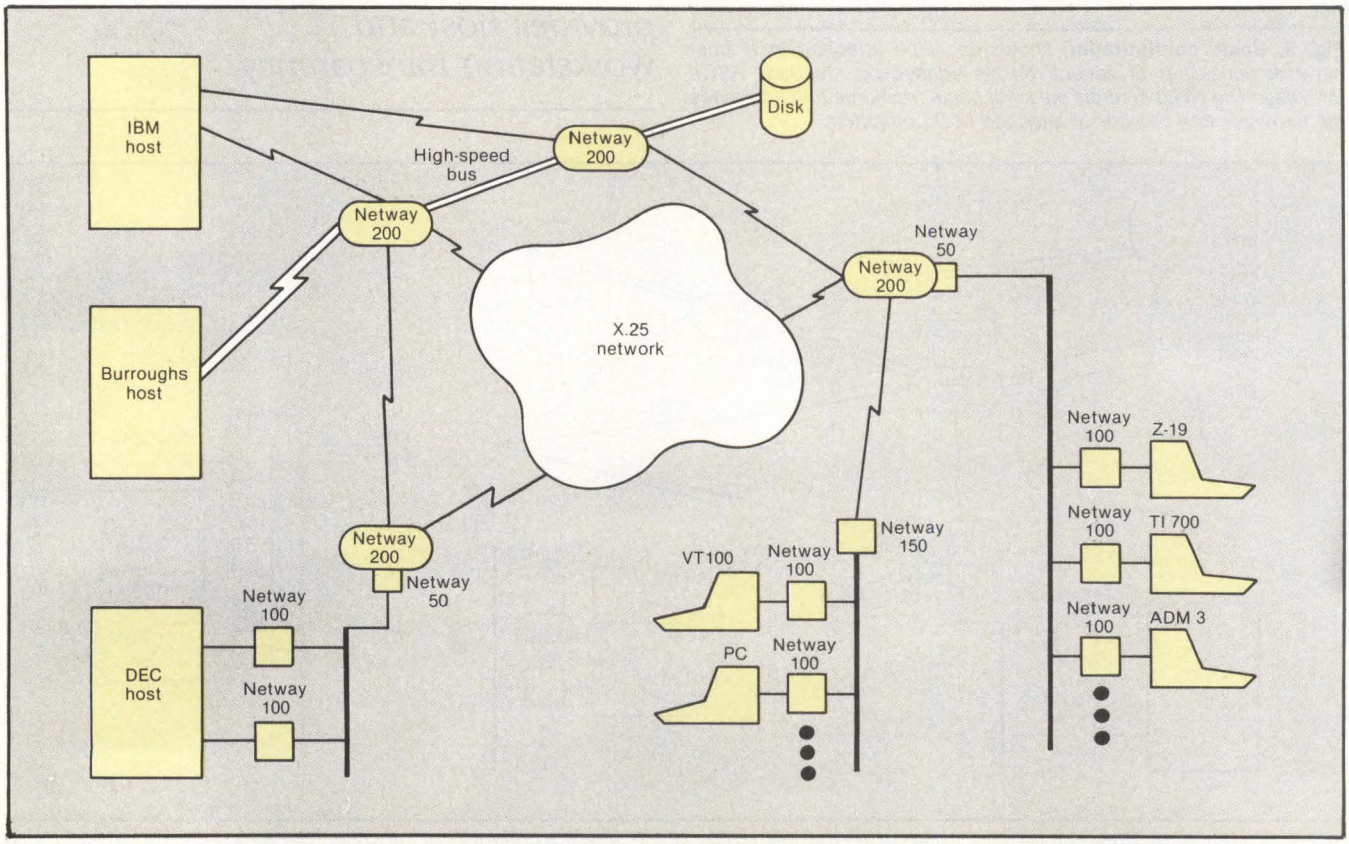


**Fig. 5. A very large network** *can be configured with the same capabilities as the above networks plus X.25 public data network facilities.*

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CIRCLE NO. 107 ON INQUIRY CARD

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***Take one Fujitsu Eagle, add one CDC Keystone streamer for backup, mix well with an Emulex disk controller and an Emulex tape coupler, and pour into a 42-inch DEC-compatible cabinet. The result: The PXD51 Series, a complete line of high-speed, high-reliability mass-storage subsystems that provide combined disk and tape capability.***

***Storage capacities: 349 to 414 MBytes. Prices from $26,150. Compare that to the competition, byte for byte.***

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### FROM THE EMULEX FILE...

***Emulex's figures for the first half of FY '83 are in: Revenues up 98 percent; earnings up 120 percent; earnings per share up 93 percent (that reflects our second public offering, completed in October). Emulex has reduced prices on selected Q-bus and Unibus products—SC02, SC04, TC01, SC21/V, and TC11. Special invitation: Next time you're in Southern California, give us a call to schedule a visit to our new 70,000 square-foot home in Costa Mesa, and we'll talk DEC there.***


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Each port has an associated port table that contains port information such as port ID number, configuration, priority level and other NCOS-assigned status. Protocol drivers and protocol interface tasks are reentrant code, and there can be as many as four. The NCOS command task is also queue driven and can be expanded to include OEM-defined functions.

NNET provides the network-management functions for the Netway family. It provides password protection, symbolic addressing of network ports and keeps a record of network activity that can be used to optimize the network configuration. It also has diagnostic routines. NNET selects the routing of messages when there are multiple N200s and N100s attached to a network and provides the facilities to add or subtract users or nodes dynamically without interrupting network activity. When an N200 processor is added to a network, it automatically notifies the other processors of its facilities and receives similar information about them. When two or more alternate routes are available for a message, the NNET selects the more efficient one. And should one route be disconnected, NNET automatically switches to alternate ones.

NCOS provides a facility for development of protocol emulation. It consists of a set of macros that provide access to the primitive routines concerning I/O communications, message storage and message queuing. These macros handle memory management, device drivers, multitasking and queuing, thus simplifying the programming task required to add more protocols or proprietary protocols to the Netway system. Tri-Data supplies several standard protocols (Table 1).

**Protocols supported**

The Netway 200 communications processor supports a variety of communications protocols including the following:

- IBM 3270 Bisync
  - 3271—models 1, 2
    - —3277-2
    - —3287 printer
  - 3276—models
    - —3278-2
    - —3287 printer
- IBM 3270 SDLC
  - 3271—models 11, 12
    - —3277-2
    - —3287 printer
- IBM 3270 SNA/SDLC
  - 3274—model xC
    - —3278-2
    - —3287 printer
- Start/stop ASCII
- Burroughs poll/select
- ICL C01, C03 (full XBM)
- X.25 (Geneva 1980) with X.3, X.28, X.29
- 2780/3780
- IBM 1006 IPARS (Sabre)—airline reservation system

The Netway processor can communicate with a variety of host computers. Some of the hosts are:

- IBM
- Honeywell
- Burroughs
- DEC
- ICL
- Univac
- CDC

## Application examples

In its basic version, the Netway family can be arranged in a typical multipoint configuration (Fig. 3). Shown are standard, off-the-shelf ASCII conversational terminals connected via RS232C ports to an N100 device interface processor. Each N100 is tied via an RS422 four-wire twisted pair to an N50 that translates the RS422 to RS232C into the N200 communications processor. The N200 can be connected to as many as six remote host computers. The N200 would down-load the terminal-specific emulation information to each N100 and handle all network traffic.

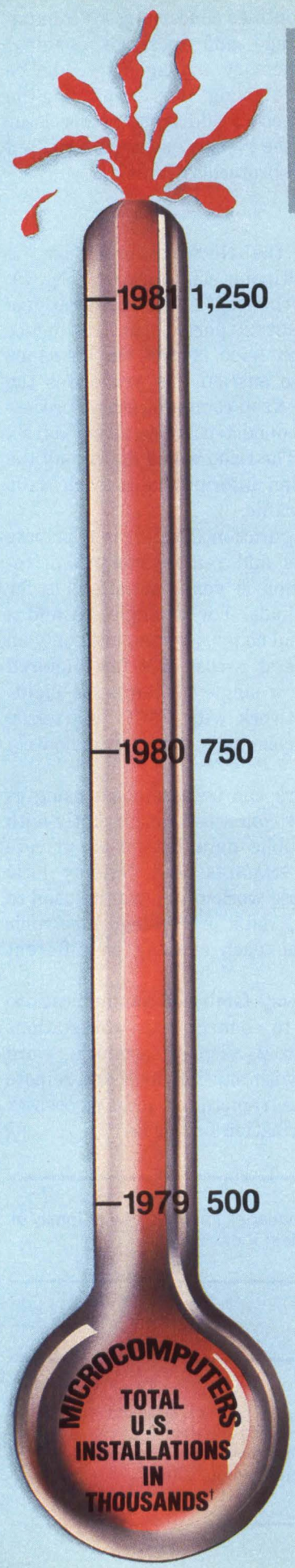
A more complex configuration (Fig. 4) is a private network connecting local and remote computing resources. This configuration is very cost-effective for connecting remote terminals. For example, to add a remote VT100 and personal computers requires only an N150 and multiple N100s at a cost of a few hundred dollars per station (plus a single modem). An eight-station Netway local network with ASCII start-stop and bisync 3270 protocols sells for approximately $11,000.

An even larger network can be assembled using as many as 254 Netway 200s connected concurrently with X.25 packet-switched public data networks, private networks such as IBM SNA/SDLC and Netway local networks (Fig. 5). A single workstation can be used to access word processing, data processing, electronic mail and other functions, each running on different hosts.

In summary, the Netway family of communications processors can be used to connect user workstations such as personal computers, display terminals, word processors and printers with multiple local and remote hosts, regardless of the remote or local processor employed, to create information networks. □

**Tom Williams** is product manager for the Netway family of products for Tri-Data, Mountain View, Calif.

Ferranti Computer Systems Ltd. of England was listed incorrectly as a manufacturer of tape drives in the October, 1982, issue of *Mini-Micro Systems*. Tape drives are not part of Ferranti Computer Systems' product line.




# MICRO FEVER

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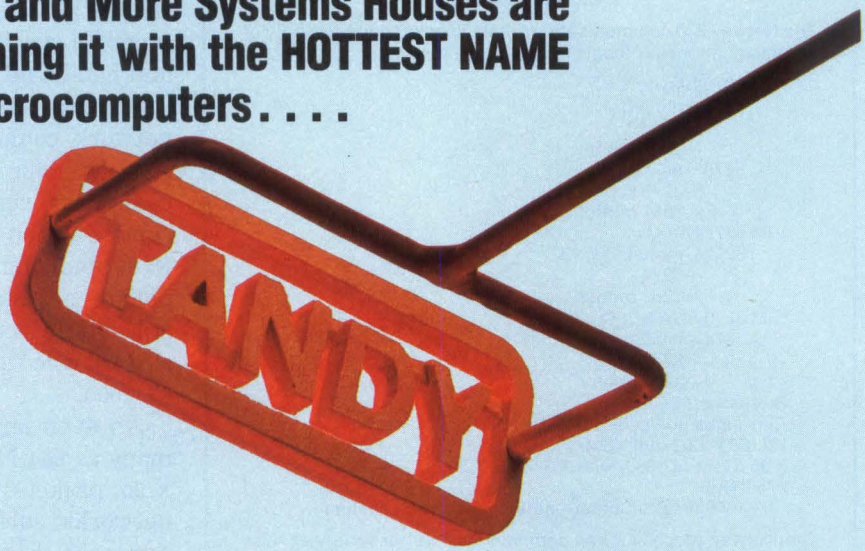


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*Focus Research, West Hartford, Connecticut as commissioned by Time Magazine.

†Source: Mini/Micro Systems Magazine Estimates

CIRCLE NO. 109 ON INQUIRY CARD

# Dual-head line printer uses two Z80s

LORNE GRUMMETT, Trilog Inc.

*Dual-print head assemblies and dual-microprocessor architecture broaden the range of applications for this dot-matrix printer*

New head designs, multiple microprocessors and hard-wired logic are making matrix line printers more versatile. An example of this trend is Trilog Inc.'s new 300-lpm matrix line printer. It uses dual print-head assemblies to increase reliability and provide multiple levels of print quality, and a dual-processor architecture that allows I/O and print parameters to be changed independently. Near-letter-quality printing, bar-code printing, labeling and graphics are becoming valid line-printer applications, thanks to these mechanical and electronic innovations.

## Mechanics

Using two print heads, one above the other, the Trilog TIP-300 achieves higher print quality and speed than most impact line printers, while minimizing printer noise and vibration. In normal operation, the top print-head assembly prints line one, while the bottom print-head assembly simultaneously prints line four (Fig. 1). Then the paper is advanced one line, and the top print head prints line two, while the bottom head prints line five and so on. After every third

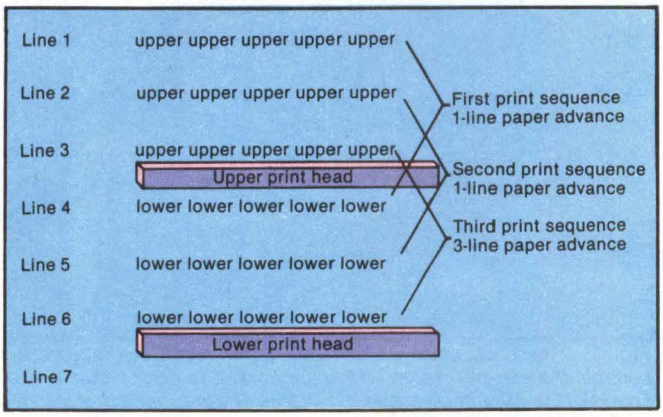


**Fig. 1. Dual-head printing.** *The print-head assemblies are located three lines from each other. Each simultaneously prints three consecutive lines; six lines are printed every three print sequences. After every third print sequence, the paper advances three lines so that the top head does not print over lines just printed by the bottom print head. If there are insufficient data to require both print heads, or if one print head becomes disabled, the microprocessor instructs one print head to print all lines at 150 lpm.*

**The Trilog TIP-300 line printer** *prints 300 lpm with two print-head assemblies, features dual-microprocessor architecture and an optional enclosed pedestal and lists for approximately $4900. Single-print-head TIP-150 sells for $3900 and can be upgraded to the TIP-300 for about $1500.*

single-line-feed print sequence, the paper is automatically advanced three lines so that lines just printed by the top and bottom print heads do not overlap. If the host generates data too slowly to use both print heads effectively, the system automatically prints the available data with one print head.

A single stepper motor drives the two head assemblies, which are linked by flexure pivots. This provides variable shuttle speed at one-quarter to one-third the cost possible with voice-coil or linear motor-driven positioners. Because each print-head assembly acts as a counter weight for the other, there is low vibration during operation and relatively low noise (Fig. 2).

The printer operates in five print modes: standard data-processing quality, two versions of compressed printing, graphics and near letter quality (Fig. 3). Each print head has 44 hammers arranged in a row. The print heads oscillate horizontally, each counterbalancing the other. In the 10-character-per-in., data-processing mode, each hammer addresses three characters. In the compressed modes, each hammer addresses four characters at 13.3 cpi and five characters at 16.6 cpi. Any quality can be achieved at the expense of speed by overlapping the dots closely and precisely. For example, a row of dots overlapped 50 percent provides a line that approaches the quality of a formed character, but print speed is reduced to 90 lines per min.

The standard (default) character pattern for uppercase characters is a 9- × 7-dot matrix in a 12- × 12-matrix region. For characters with descenders, it is a 9 × 9 matrix; for letter-quality printing, it is 16 × 16 dots. Because of hammer-response speed limitations, when the printer is operating at a density of 10 cpi, firmware control prohibits impacts at consecutive horizontal matrix positions. Therefore, the 9- × 7-dot matrix becomes, effectively, a 5 of 9 × 7 matrix. The dot-matrix density that results is 60 dots per in. horizontally × 72 dpi vertically. These microprocessor-controlled parameters can be reprogrammed for special graphics applications to achieve a square aspect ratio.

Two pairs of tractors are used to control paper movement (Fig. 4). Because the print-head assemblies on dot-matrix impact line printers shuttle back and forth, the paper tends to be dragged horizontally. One method for eliminating drag is to use a single tractor and a "paper ironer," a spring-loaded flap that bears against the paper and adds tension. TIP printers use a second, lower tractor, which not only stabilizes the

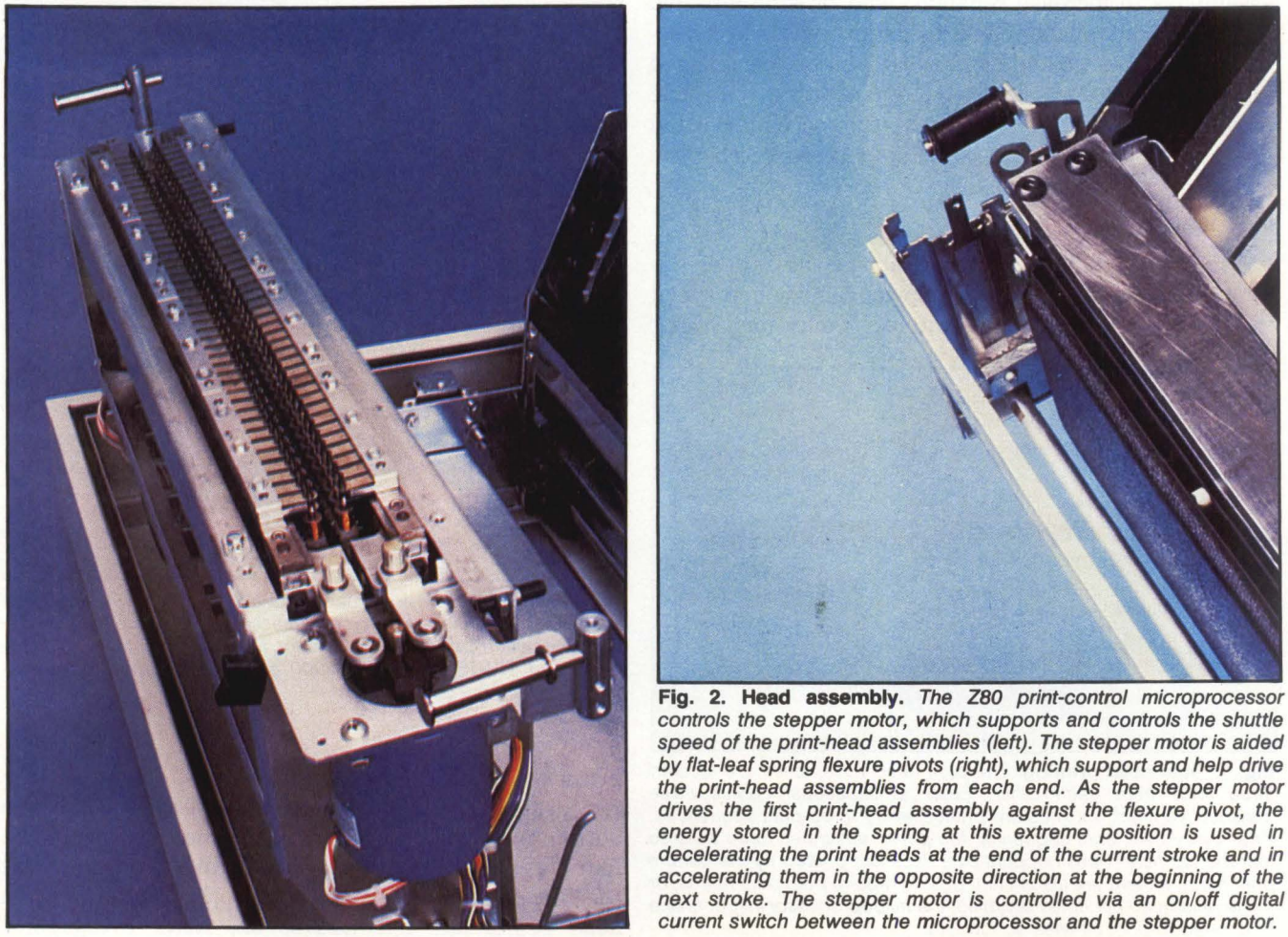

**Fig. 2. Head assembly.** *The Z80 print-control microprocessor controls the stepper motor, which supports and controls the shuttle speed of the print-head assemblies (left). The stepper motor is aided by flat-leaf spring flexure pivots (right), which support and help drive the print-head assemblies from each end. As the stepper motor drives the first print-head assembly against the flexure pivot, the energy stored in the spring at this extreme position is used in decelerating the print heads at the end of the current stroke and in accelerating them in the opposite direction at the beginning of the next stroke. The stepper motor is controlled via an on/off digital current switch between the microprocessor and the stepper motor.*

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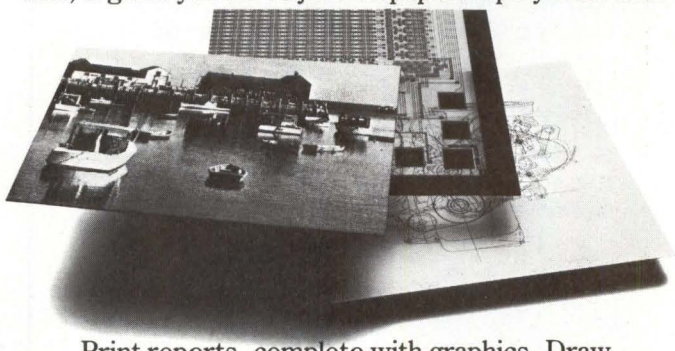

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paper but also assists in driving it, minimizing additional friction to the paper path. The tractors can drive the paper both forward and backward.

### Electronics

Each prints head's 44 hammers and associated drivers are consolidated with all hammer interface electronic circuits in a single-print-head assembly. Instead of sending 44 hammers' worth of information to the print head, all electronics move with it. This eliminates the great number of flexing interconnections necessary when stationary electronics are located away from a moving print head.

All high-current circuits are contained on the print-head assembly board itself, with only low-level control signals entering the head assembly through edge connectors. The hammers and circuits are cooled by air blown between the two head assemblies. A power test sends feedback signals from both print heads to the microprocessor to indicate "power OK," and a power-measuring network flags any errors. Another feedback signal ensures dot integrity: in a continuous process, the serial stream of dot information that has been sent to the print head is retrieved by the print controller and examined to ensure that its integrity has been maintained through transmission and execution. A malfunction of the print-head assemblies or other system components will be detected by one of the two microprocessors and signaled on a diagnostic display.

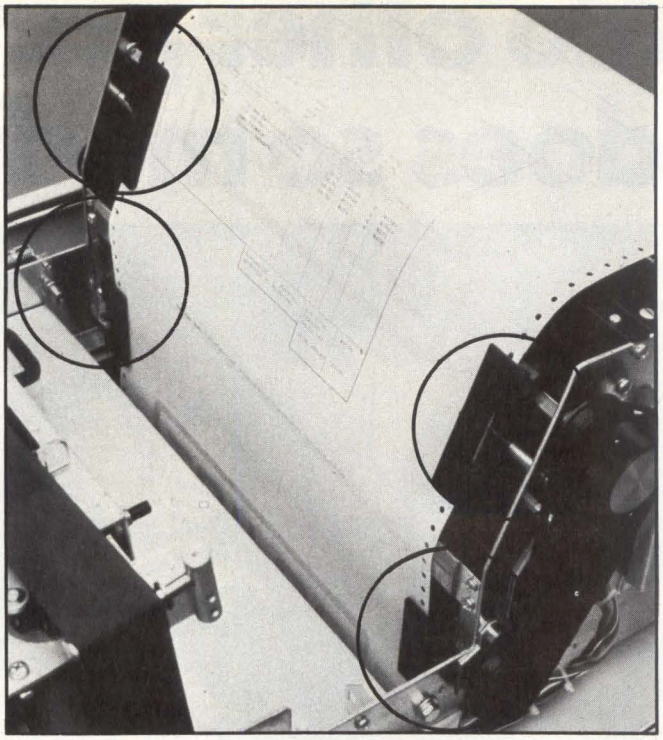

**Fig. 4. Tractors operate bidirectionally.** *Upper and lower tractors (circled) in the TIP printer limit horizontal paper motion and drive the paper either forward or backward. A control panel (not shown) in the enclosure cover displays the status of all printer activities.*

The TIP-300 uses separate Z80 microprocessors for I/O and printing control (Fig. 5). The I/O processor

To ensure that your printing needs don't outdistance the capabilities of the printer, the TIP-150 can be upgraded to a TIP-300 by installing a field upgrade kit. With the addition of this kit, the printer incorporates all the capabilities of the TIP-300.

For ease of interfacing, TIP printers are delivered with both RS-232C serial and Centronics plug compatable parallel inputs.

The above text was printed in the data processing mode. This paragraph is an example of the Trilog Letter Quality (TLQ) print capability. While each character matrix still employs the same size character, the number of dots within that matrix has been increased from 9 x 9 to 16 x 16. As you can see, this results in a character which appears to be fully formed, allowing you to utilize this printer for official correspondence.

Each TIP printer is capable of producing character spacings of three different pitches: 10 Characters Per Inch (CPI) as the default set, 13-1/3 and 16-2/3 CPI as compressed sets. This paragraph is being printed in 13-1/3 CPI compressed print where 132 characters can be printed on a 10" line and up to 176 characters can be printed on a 13.2" line.

Reports can be reduced to notebook size by selecting the 16-2/3 CPI compressed print mode. A total of 132 characters can be printed on an

**Fig. 3. Several print modes** *of the TIP-300 line matrix printer are shown in the letter above: data processing in the first two paragraphs, near letter quality in the third paragraph, 13.3-cpi compressed in the fourth paragraph and 16.6 compressed in the fifth paragraph.*

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| **Detached keyboard** | **No** | No | No | **Yes** | Yes | **Yes** | Yes | Yes |
| **Buffered mode** | **Yes** | No | No | **Yes** | No | **Yes** | Yes | Yes |
| **Tilt screen** | **No** | No | No | **Yes** | No | **Yes** | Yes | Yes |
| **Function keys** | **14** | No | 10 | **14** | 3 | **22** | 22 | 22 |
| **Line graphics** | **No** | No | No | **No** | No | **Yes** | No | Yes |
| **Page/line transmit** | **Yes** | No | No | **Yes** | No | **Yes** | Yes | Yes |
| **Character/line editing** | **Partial** | No | No | **Yes** | No | **Yes** | Yes | Yes |
| **Split screen** | **No** | No | No | **No** | Yes | **Yes** | Yes | Yes |
| **Smooth scrolling** | **No** | No | No | **No** | No | **Yes** | No | Yes |
| **Price** (in quantity of one) | **$595** | $595 | $699 | **$645** | $645 | **$895** | $995 | $1,195 |

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accommodates standard and custom protocols and formats and sends all commands to a common RAM buffer. It is also responsible for user and front-panel interfaces. A Centronics parallel interface is standard, and Dataproducts and RS232C interfaces are optional. The print-control processor is responsible for real-time functions that involve shuttle control, hammer-fire timing, paper feed, ribbon drive and dot-pattern generation from ASCII codes.

In standard operation, the I/O processor uses 2K bytes of RAM and as much as 16K bytes of PROM to receive and format commands in all standard protocols. Input can be via either the RS232C or the parallel interface. The resulting plot or character code data is loaded into a 2K-byte common RAM buffer, where it is accessed by the printer-control microprocessor. Timing sequences for shuttle motion, paper drive and ribbon servo are generated by a counter/timer circuit.

The I/O microprocessor also monitors a self-test mode. As part of the test pattern, configuration information and data, including type of interface, interface parameters and whether both print-head assemblies are functioning, are printed.

The print-control microprocessor alone is not fast enough to handle all the real-time manipulation of data from ASCII characters into dot data for printing. It sets up parameters for the type of print required and then loads this information into a block of standard TTL hard-wired logic, called a "mapper."

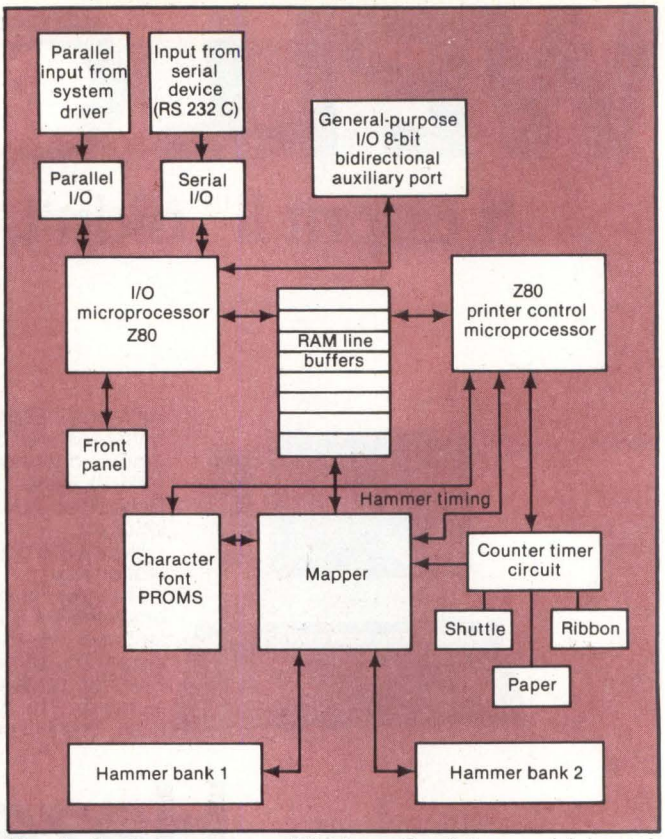


**Fig. 5. Dual-processor architecture.** *Parallel or serial input is processed by an I/O Z80 microprocessor and sent to an eight-line, 2K-byte common RAM buffer. Real-time manipulation of data from ASCII characters into dot data for printing is then handled by a hard-wired mapper. These data are then transmitted to the print-control Z80 microprocessor and onto the print-head assembly.*

The mapper returns dot data to the print-control microprocessor in 8-bit sections corresponding to 8 dots

## LINE PRINTERS ANSWER CALL FOR BAR-CODE PRINTING

A number of companies, including serial and dot-matrix line-printer manufacturers and turnkey marking system suppliers, are selling systems that can provide bar-code-reading capabilities. This number should grow in view of a decision by the U.S. Department of Defense that will increase demand.

In July, 1982, the DOD launched an automated inventory-control program that requires military contractors to label their product containers for identification by automatic bar-code readers like those used in grocery stores, banks and libraries. These readers bounce a light beam against a printed bar-code pattern, digitize the returned analog signal, determine the identity of the bar-code character, convert it into ASCII characters and transmit the information to a video display terminal or host computer.

The DOD chose a bar-code-based inventory system after a five-year survey of marking systems that could replace their human-readable system and speed distribution of military materiel to the field. The study was conducted by the Defense Logistics Agency, which published its findings in a 76-page report called "Logistics Applications of Automated Marking and Reading Symbols," in January, 1982.

Included in the report is a section detailing changes to MIL-SPEC 1198 and MIL-SPEC 129 regarding the marking of product containers shipped to the DLA. Any bid requests issued by the DOD require that the supplier label unit containers, intermediate containers and external containers with the national stock number and contract number in Code 3 of 9 bar code.

Code 3 of 9 is based on Code 39, an alphanumeric code invented in 1974 by Dr. David Allais, president of Intermec Corp., Seattle, Wash. It allows all 128 ASCII characters to be encoded in combinations of three spaces and six bars.

The DOD has reportedly allocated $66 million over the next three years for developing systems that will process the incoming bar-coded equipment and material. Printing costs incurred by the nation's 26,000 military contractors to comply with the new requirements will typically be included in the contract bid. Many military suppliers do not have the volume of government contract activity to justify purchase of bar-code printing equipment. These companies are contracting label printing from specialized services or from packaging houses that have purchased bar-coding equipment and are offering printing services to help offset those costs.

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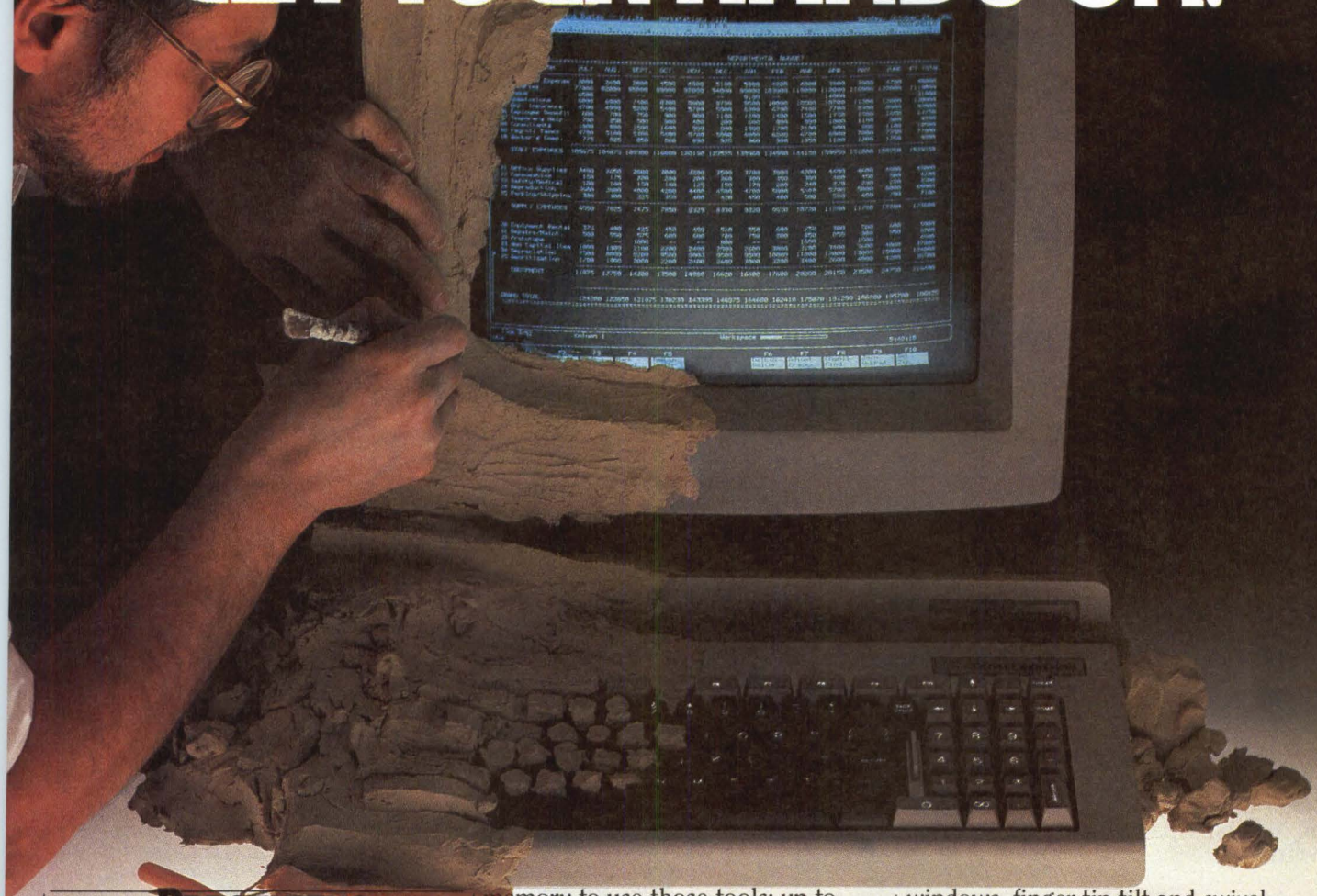

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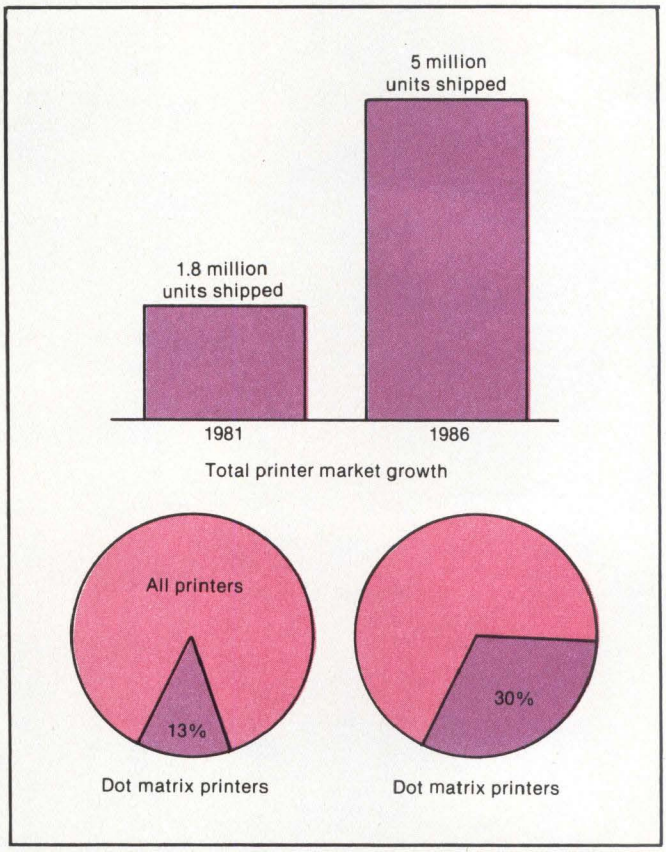
horizontally across the page. The data are then transmitted by the microprocessor to the print-head assembly in blocks of data equivalent to a complete horizontal line of 1320 dots.




**The dot-matrix line-printer market** *is expected to swell from 13 percent of the total printer market in 1980 to approximately 30 percent in 1986, with revenues of $30 million. Contributing to this growth is the emergence of specialty applications that can be accommodated by matrix line pinters, such as forms generation, graphics and bar coding and near-letter-quality printing.*

The print-control microprocessor also monitors the status of all activities within the printer. It signals two types of faults on a diagnostic display: operator-correctable faults and faults requiring service calls. The display is an eight-segment LED consisting of a dot plus a seven-segment alphanumeric character that allows more than 70 faults to be identified. If two faults occur simultaneously, the display indicates the most significant fault and displays the second as soon as the first is corrected. □

**Lorne Grummett** is vice president of advanced development and a member of the board at Trilog Inc., Irvine, Calif. He is responsible for company-wide R&D.

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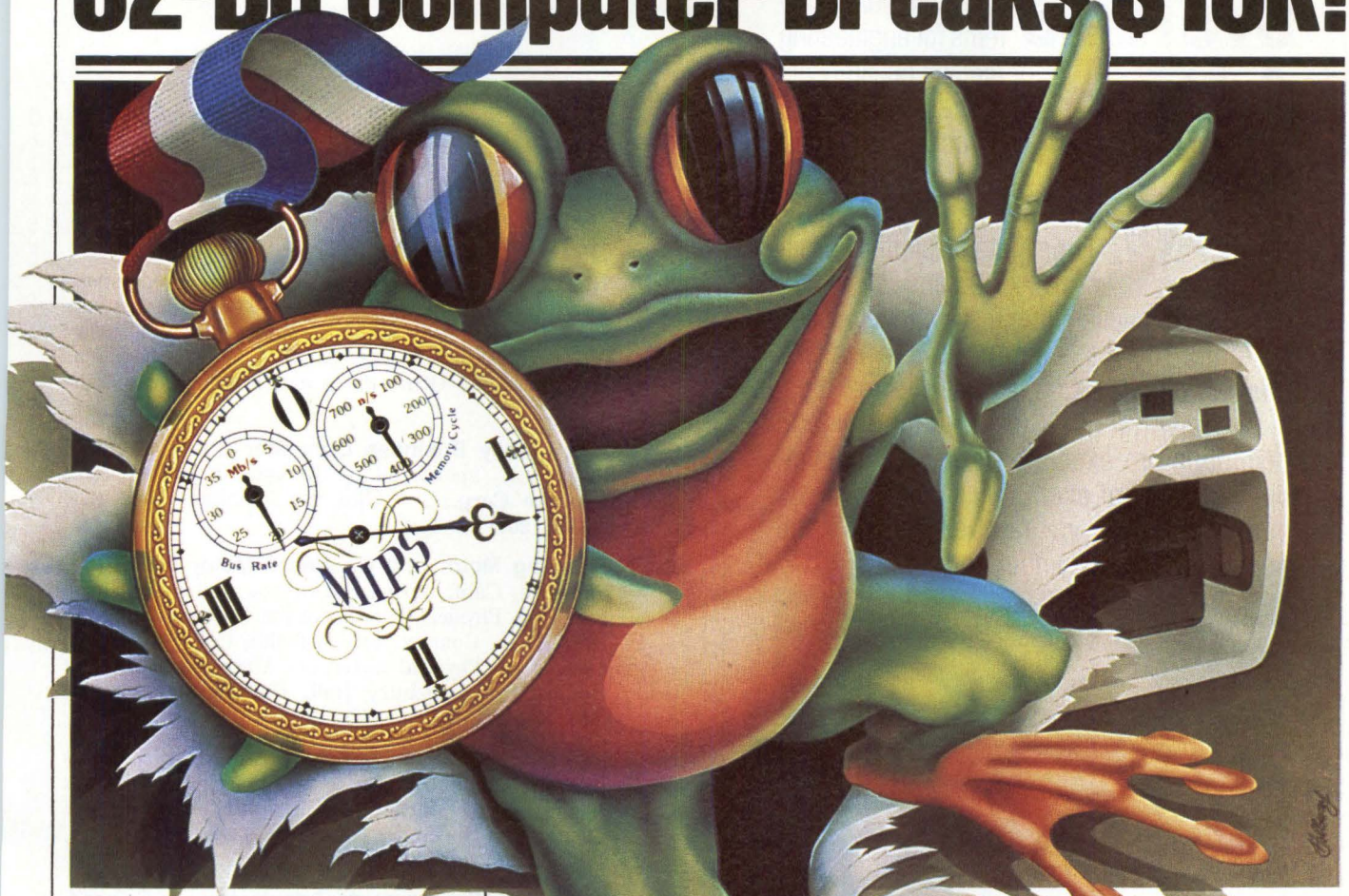
# 32-Bit Computer Breaks $10K!




## Universe 68/05 First to Smash Price Barrier

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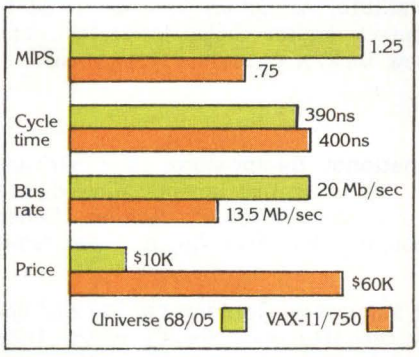
Its *price* is even more impressive when you look at Universe 68/05 *performance* versus that of 32-bit "superminis" several times more expensive, like the VAX-11/750.

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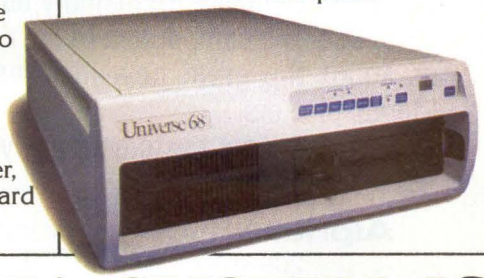


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# Calendar

**MARCH**

**14-16** **Seventh Annual Federal Office Systems Expo,** Washington, sponsored by National Trade Productions Inc. Contact: Mary Beth Gouled, National Trade Productions Inc., 9418 Annapolis Rd., Lanham, Md. 20706, (301) 459-8383.

**15-18** **"Computer Graphics" Course,** Washington, sponsored by Integrated Computer Systems. Contact: Ruth Dordick, Integrated Computer Systems, 3304 Pico Blvd., P.O. Box 5339, Santa Monica, Calif. 90405, (213) 450-2060. Other dates and locations are available.

**17-19** **New Jersey Business Computer Show,** Franklin Park, N.J., sponsored by Kengore Corp. Contact: Kengore Corp., P.O. Box 13, Franklin Park, N.J. 08823, (201) 297-2526.

**21-23** **Stepping Motor and Brushless Motor Workshop,** San Jose, Calif., sponsored by the College of Engineering & Physical Sciences of the University of New Hampshire. Contact: Lee Wilhelm, College of Engineering & Physical Sciences, University of New Hampshire, Kingsbury Hall, Durham, N.H. 03824, (603) 862-3750.

**21-24** **Interface '83,** Miami Beach, sponsored by *Business Week* and *Data Communications* magazines. Contact: Irwin Stern, Marketing Director, The Interface Group, 160 Speen St., P.O. Box 927, Framingham, Mass. 01701, (617) 879-4502 or (800) 225-4620.

**21-24** **"Personal Microcomputer Interfacing and Scientific Instrumentation Automation" Seminar,** Blacksburg, Va., sponsored by the Virginia Polytechnic Institute and State University. Contact: Dr. Linda Leffel, C.E.C., Virginia Tech, Blacksburg, Va. 24061, (703) 961-4848.

**24-25** **Western Educational Computing Workshops,** Hayward, Calif., sponsored by the California Educational Computing Consortium. Contact: Jerry Rose, Computer Center, California State University, Hayward, 25800 Hillary St., Hayward, Calif. 94542.

**29** **1983 Public Conference of the American National Standards Institute,** Arlington, Va., sponsored by ANSI Inc. Contact: Walter Gelles, ANSI Inc., 1430 Broadway, New York, N.Y. 10018, (212) 354-3315.

**APRIL**

**5-8** **TI-MIX International Symposium,** New Orleans, sponsored by the Texas Instruments Minicomputer Information Exchange. Contact: Dorene Cohen, TI-MIX M/S 2200, P.O. Box 2909, Austin, Texas 78769, (512) 250-7151.

**5-8** **International Magnetics Conference,** Philadelphia, sponsored by the Magnetics Society of the IEEE. Contact: Intermag '83, Suite #700, 1629K St., N.W., Washington, D.C. 20006.

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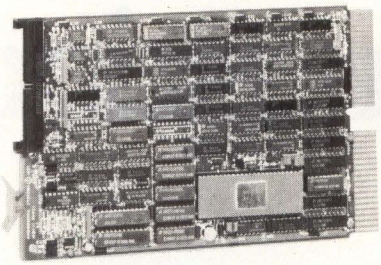

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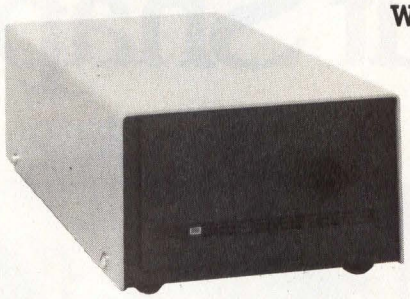

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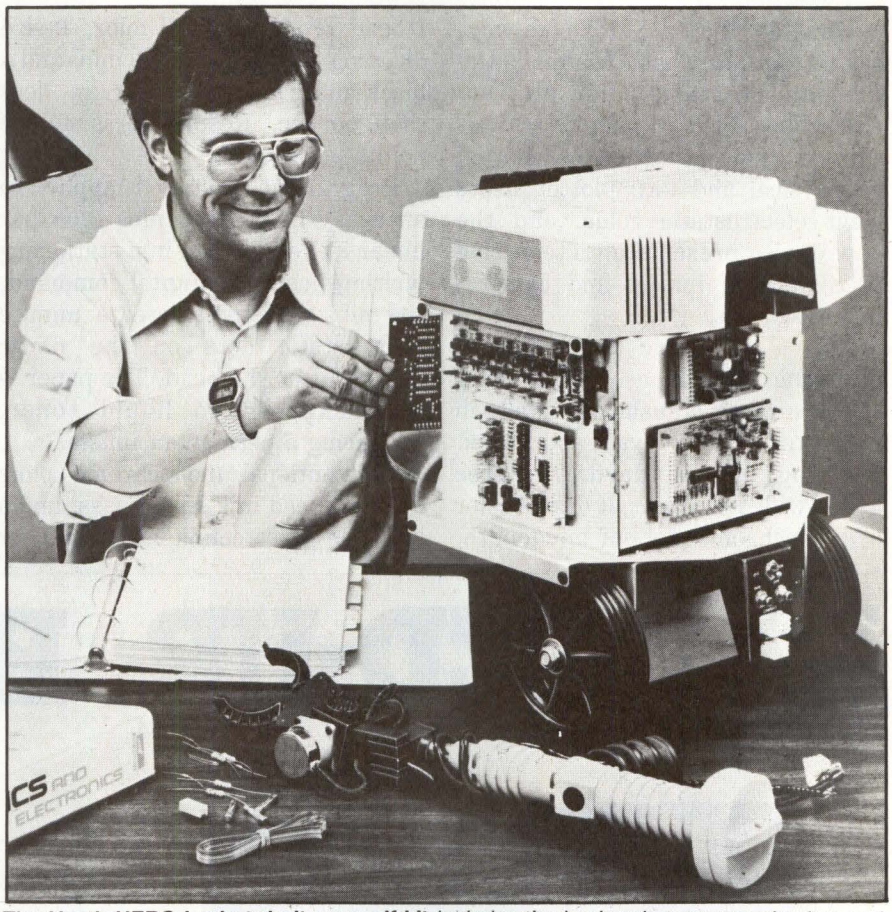
# Robotics training system includes intelligent robot, robotics education course

Anticipating rapid growth in the number of installed and operating industrial robots in U.S. plants from fewer than 7000 now to more than 100,000 by 1991, Heathkit/Zenith Education Systems has introduced a computerized, multifunction robot and companion robotics education course claimed to be the most complete robotics training system ever marketed in the U.S. It is designed to fill what the company sees as a pressing need for people with the training and skills to design, install, operate and maintain the machines.

The self-contained, mobile, electromechanical robot, called HERO I, is available in kit or assembled form, stands 20 in. high and weighs 39 lbs. Featuring an on-board, programmable 6808 microprocessor and sensors that detect light, sound, motion and obstructions in its path, HERO I can interact with its environment. The robot's computer can be programmed through the hexadecimal keyboard mounted on the robot's head or with a hand-held, remote-control unit. Programs can also be stored on any standard audio cassette tape recorder and loaded through the robot's cassette serial port. An experimental circuit board enables a user to interface circuits of his own design with the robot's computer.

With its head-mounted arm and gripper mechanism, the robot can pick up small objects weighing 16 oz. or less. The arm rotates 350 degrees in a horizontal plane with the robot's head, rises and lowers 150 degrees in the vertical plane and extends and retracts as much as 5 in. The gripper pivots 90 degrees above and below the axis of the arm and rotates through 350 degrees.



**The Heath HERO I robot do-it-yourself kit** *includes the basic robot, arm mechanism and speech synthesizer. Builders should have experience in kit building and electronics, including circuit-board building, soldering and wiring harness assembly.*

The robot also features a phoneme-based speech synthesizer that can generate 64 phonemes that can be linked in any combination to simulate human speech or various sound effects. A three-wheeled base with drive and steering on one wheel propels the robot in any direction. Four rechargeable batteries, protected against total discharge by an automatic low-voltage sensor, power the robot.

The companion robotics education course is available as a two-volume, 1200-page program. The course is divided into 11 teaching units covering topics such as robot fundamentals, direct-current power and positioning, data acquisition, voice synthesis and interfacing. The HERO I robot is priced at approximately $1500 in kit form or $2495 assembled. The robotics education course sells for $99.95. **Heath Co.,** Department 150-155, Benton Harbor, Mich. 49022.

**Circle No 300**

# Electrostatic plotter provides color for graphics users

Versatec Inc., a Xerox company, has introduced what it claims is the first electrostatic color plotter. According to the company's market surveys, more than 85 percent of geophysical and CAD plotter users want electrostatic color, and the new device presents an alternative to color pen, ink-jet and camera-based plotters.

The electrostatic color plotter electronically produces the full-color spectrum with translucent toners in magenta, yellow, cyan and black. Plotting on standard Versatec 42-in.-wide roll paper, it draws color or monochrome plots of any length. It can produce a full-color, E-size drawing (34 × 44 in.) in 8 min. and a black-and-white drawing in less than 90 sec. Resolution is 40,000 points per sq. in.

Programmed voltage is applied to an array of writing nibs (200 per linear in.) embedded in a stationary writing head. On digital command, the nibs selectively create minute electrostatic dots on the paper passing over the head. The paper is then exposed to liquid toner, producing a permanent image.

Conventional monochrome plots are produced in a single pass, and a multiple-pass technique is used for plotting multiple colors. In the first pass, paper is marked with an

**The Versatec electrostatic color plotter** *produces complex color plots in a few minutes, requires no operator intervention and offers a broad spectrum of colors and plot sizes. It uses an all-electronic writing technique based on existing electrostatic technology.*

"end-of-plot" mark to assure proper registration. Paper is then automatically rewound at 10 ips to plot-starting position. Four passes, each writing one color from one of four toning stations, overlay the four colors. Automatic dual-axis tracking maintains registration.

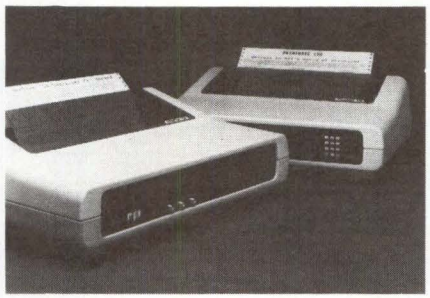
The Versatec color plotter uses standard Versatec interfaces, and monochrome plotting requires no changes in interfacing hardware or software. Plotting in color requires modifications to existing electrostatic plotting software.

In single-unit quantities, the plotter sells for $98,000, with OEM and quantity discounts available. **Versatec Inc.**, 2710 Walsh Ave., Santa Clara, Calif. 95051.

**Circle No 301**

## Printers feature front-panel keypad

The PrintMate 150 models A1, A2, B1 and B2 impact dot-matrix printers print 150 cps and feature dot-addressable graphics with a resolution of 72 dpi vertically and

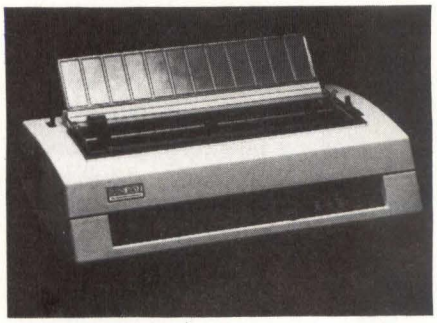


50, 60, 75, 80 or 85 dpi horizontally. They feature a 96-character ASCII set with descenders and three selectable foreign-character sets. A Centronics-compatible parallel interface is standard, and an RS232 interface is optional. PrintMate 150 models A2 and B2 have standard 16K-byte memory buffers, and models A1 and B1 have 4K- and 2K-byte buffers, respectively. Models A1 and A2 also include the SoftSwitch front-panel keypad for direct control of forms length, print density, horizontal and vertical tabs, baud rate and character set. Software application packages called AP-PAKS support the PrintMate 150 printer with graphics extension packages for different computer systems. Prices start at $995, $1095, $1295 and $1395 for the models B1, B2, A1 and A2, respectively. **Micro Peripherals, Inc.**, 4426 S. Century Dr., Salt Lake City, Utah 84107

**Circle No 302**

## Daisy-wheel printer features 48K character buffer

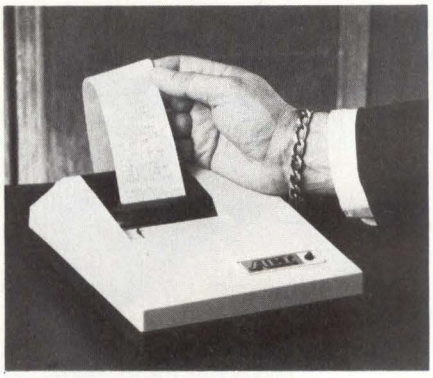
The DTC 380Z daisy-wheel printer features a 48K character buffer and a print speed of 32 cps. It offers bidirectional printing, automatic proportional spacing, serial and parallel interfaces, software compatibility with the Diablo 1640/1650/630 and communications speeds from the 50 to 19.2K baud. The 96-character printwheel cassette is available in 12 print styles and 15 languages. Options include a forms



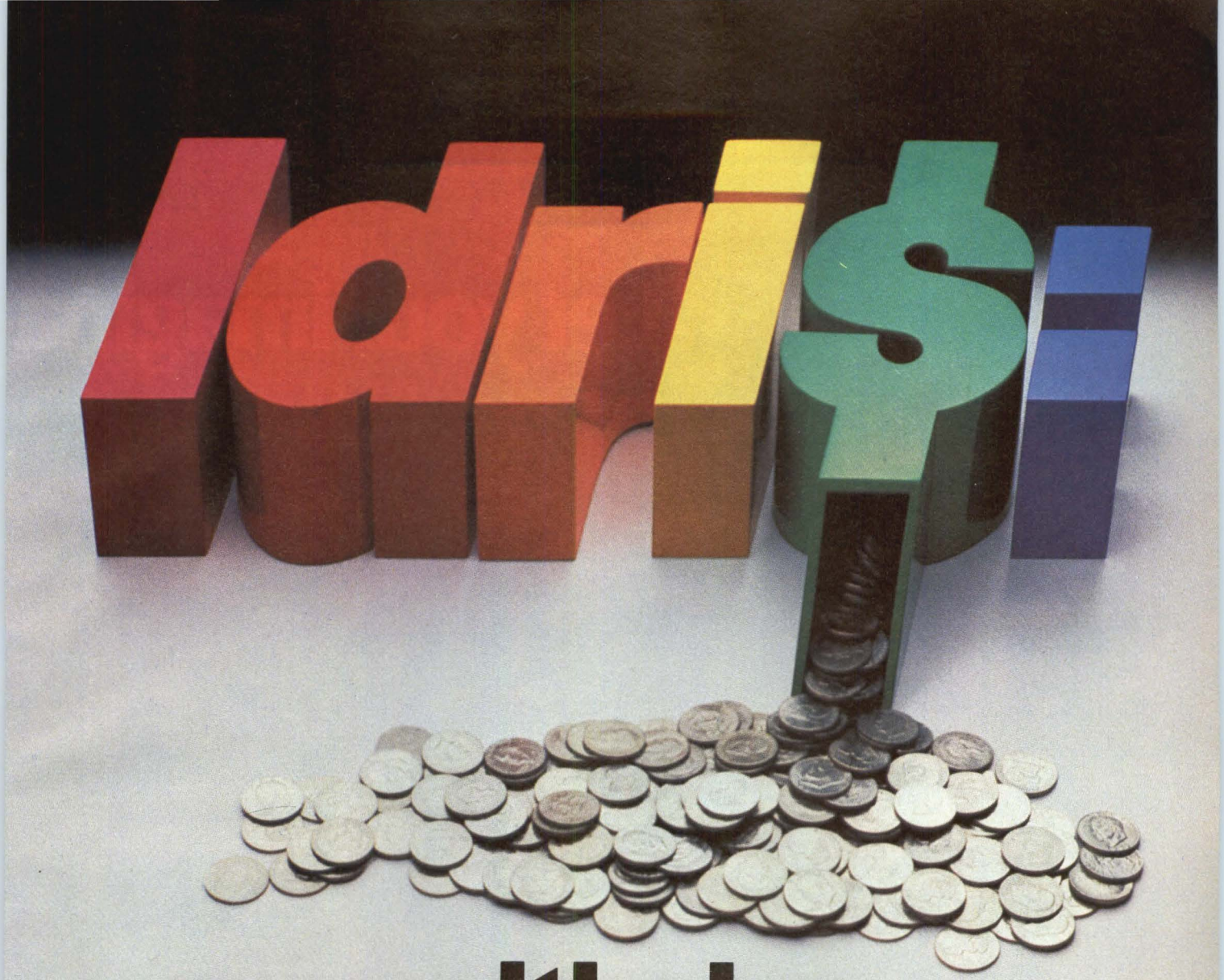
tractor and interconnecting cables for Osborne, IBM, Apple or TRS-80 personal computers. Price is $1199. **Data Terminals and Communications,** 590 Division St., Campbell, Calif. 95008. **Circle No** 303

## Teleprinter has integral modem

The model MP-2000 intelligent microprocessor-based teleprinter features an integral Bell 103 standard ASCII 300-baud FSK modem for communications over any dial-up phone line. The 20-column, thermal printer prints 5 × 7



dot-matrix characters at 30 cps. The FCC-registered printer plugs into any standard RJ11 telephone jack and does not require special installation. It also features unattended automatic answering on the first or fourth ring. Price is $295 in single-unit quantities, with quantity discounts available. **Advanced Communications, Inc.,** 462 Oakmead Parkway, Sunnyvale, Calif. 94086. **Circle No** 304




# UNIX, with change.

Idris is a trademark of Whitesmiths, Ltd. / UNIX is a trademark of Bell Laboratories.

Put off by the UNIX price tag and licensing restrictions? If you are, take a closer look at Idris.

Idris gives you all the power of UNIX at a fraction of the cost—and they're highly compatible—even pin-for-pin in some cases. Upfront expenses are much lower, you only pay for the parts you ship, and the end-user licenses can be transferable.

What's more, we wrote Idris ourselves—from the ground up—so you'll have fewer licensing hassles. We wrote it almost entirely in C, for maximum portability across a wide range of processors. And we kept it small.

Idris can run comfortably where UNIX can't even fit: On an MC68000 with no memory management hardware, for example. On a bank-switched 8080 or Z80. Or on any LSI-11 or PDP-11 with memory management. A very big Idris plus.

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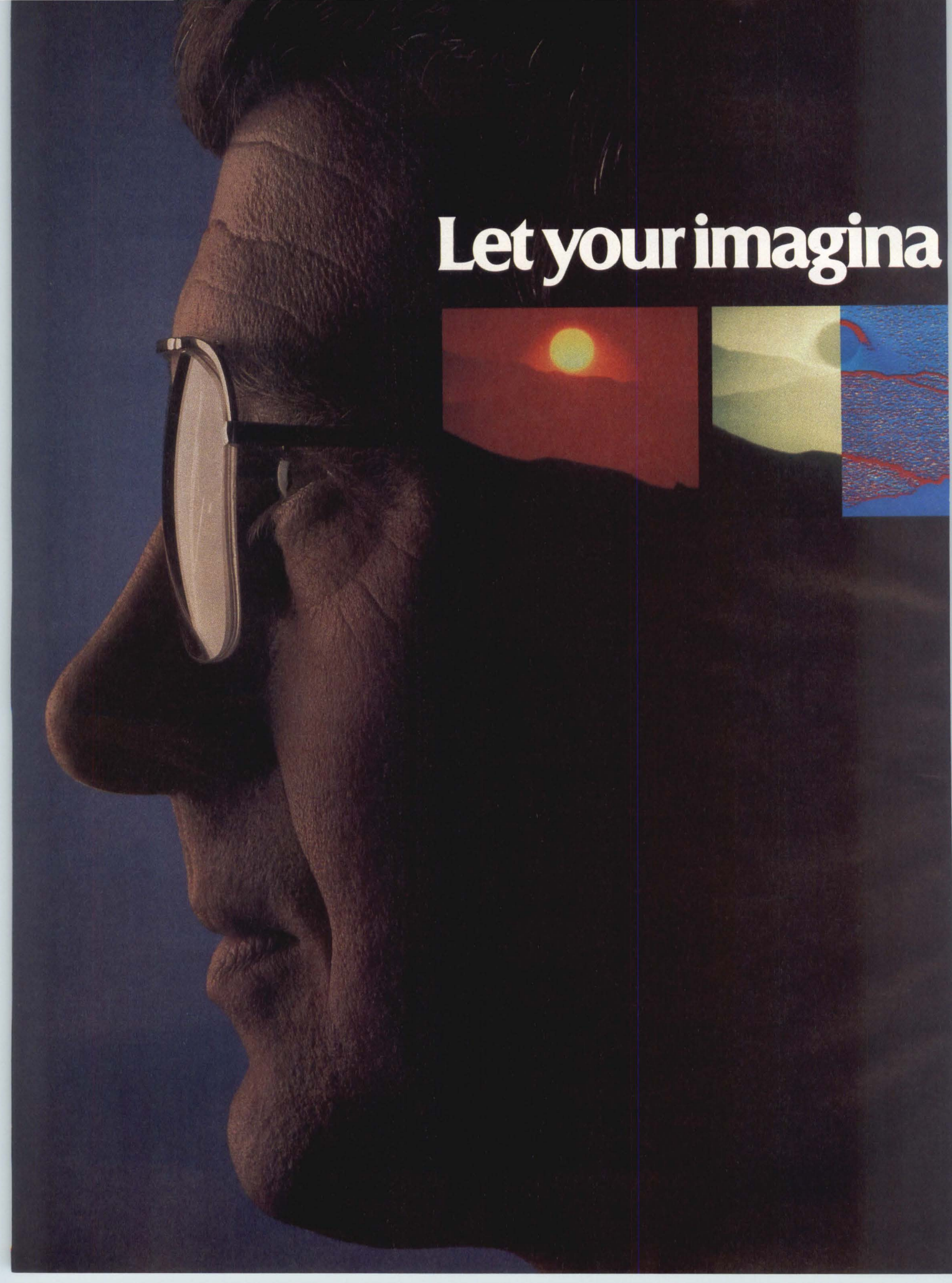
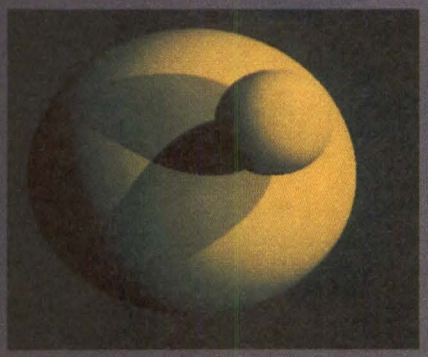
**United Kingdom,** Real Time Systems, Newcastle upon Tyne 0632 733131

CIRCLE NO. 120 ON INQUIRY CARD


Let your imagina

# tion run wild, not your budget.

## Introducing the Grinnell 2800 Image Processing/Graphic Display System.

Whatever your mind can imagine, the new Grinnell 2800 System can visualize. And it does it at an astonishingly cost effective price.

**Power and flexibility in a compact system.**

For 512x512, 512x640, 480x640, 1024x1024 and 1024x1280 graphics, image enhancement and image processing, the 2800's exceptionally fast, easily programmed distributed computing architecture (built around a high-speed bit slice processor) puts an incredible repertoire of graphics instructions and image processing capability at your disposal for a wide range of monochrome, 3-color and multi-spectral applications.

**Exactly what you need, when you need it.**

Because of its unique, modular design, the 2800 System can be sized to your specific needs without sacrificing performance, allowing for multiple, modular processors and controllers for parallel, multi-spectral processing. And each processor is individually programmable, letting you manipulate input, graphics and imaging for simplified operation and maximized throughput.

For added cost-effectiveness, each video controller is associated with an ultra-fast pipeline processor. And should you need it: an optional microprocessor (Motorola MC68000, 512K RAM, 32K PROM) for Command Control Processing.

**Programmable for your applications.**

With the 2800 System, its microprogrammable System Controller gives you the choice of using standard or special instruction sets, with the option of downloading from the host computer or through the Command Control Processor. The CCP can also be programmed to interface with your choice of interactive control devices and off-load frequently used routines from the host computer. In addition, the system's Intelligent Host Interface offers you several data transfer modes to further enhance throughput.

**Now imagine how it can work for you.**

Compare its performance to anything on the market. Then, when you compare prices, you'll buy Grinnell. For details, write or call (408) 629-9191. Whether you're an OEM, end user, or involved in educational or industrial research, you'll agree: the Grinnell 2800 lets your imagination run wild, but not your budget.

**GRINNELL SYSTEMS**

6410 Via Del Oro Drive
San Jose, CA 95119 (408) 629-9191

CIRCLE NO. 122 ON INQUIRY CARD

# Signetics introduces CRT-terminal chip set

Signetics Corp.'s four-chip LSI CRT-terminal set enables a system builder to assemble a CRT terminal with as few as 15 IC packages. Each of the four chips in the set performs specific functions partitioned for maximum efficiency and programmability.

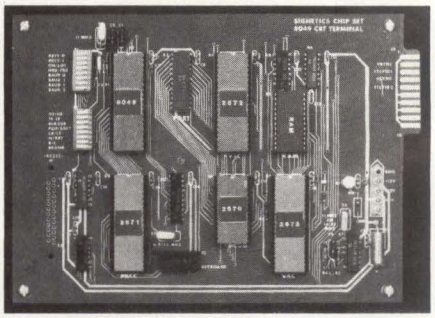
The SC2670 display-character and graphics-generator chip converts character and line address information into dot patterns for raster scan displays. It stores patterns for 128 characters and provides as many as 256 graphic characters (15 are line-drawing segments).

The SC2671 programmable keyboard- and communications-controller chip provides keyboard encoding and an asynchronous receiver/transmitter with baud-rate generator in a 40-pin package.

The SC2672 programmable video-timing controller generates synchronous and blanking signals and displays RAM addresses. It provides timing signals for cursor, light-pen, underlining, blinking and other auxiliary functions.

The SC2673 video-attributes controller chip provides high-speed timing functions, generates the character clock, serializes dot data and controls video attributes (low intensity, blink, underline, reverse video, nondisplay and graphics) on a character or field basis.

A single-board controller can be built by combining these four chips with a microcomputer chip (such as the SC8049), memory chips and TTL logic. With the addition of a nonencoded electromechanical or



**Using the Signetics four-chip LSI CRT set,** *a full-featured CRT terminal is implemented in 15 IC packages.*

# WINCHESTER BACKUP/ DATA BASE MANAGEMENT!

## Model 451 — serpentine write
## Model 450 — standard write

Back-up your Winchester with the new Model 450 or 451 cartridge tape drive. With the capability of a full tape peripheral, the new Qantex drive can be used to perform file search, update records, and edit/reformat data.

Designed for disk backup as well as archival storage or data logging applications, the 450/451 packs, 17.2 megabytes on a single data cartridge, with a packing density of 6400 bpi and 192,000 bits per second transfer rate.

Both models incorporate a rugged transport mechanism with a precision servo motor. Model 450 offers a standard, and Model 451 a serpentine recording head. Read-after-write dual gap and selective erase are standard features of both models.

The serpentine tape drive features a special read-after-write recording head that provides bi-directional tape operation avoiding time-consuming rewind time.

The new Model 450/451 is available now! Contact us today for complete details!

Qantex*

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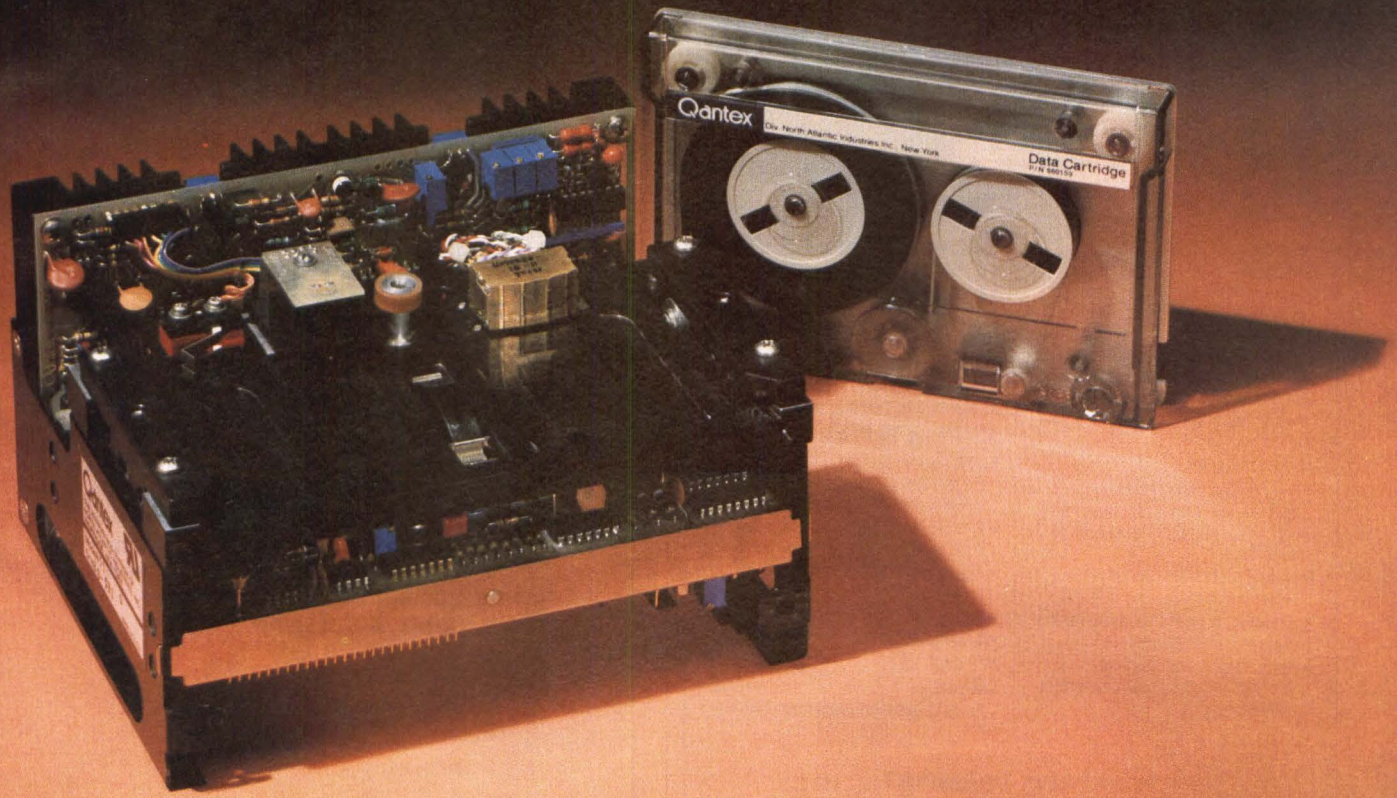



CIRCLE NO. 124 ON INQUIRY CARD

capacitive keyboard and raster-scan monitor, a low-cost monochrome terminal can be constructed with features such as smooth scroll, thin-line and block graphics, interlaced or noninterlaced operation, variable cursor type, composite or separate synchronization, reverse video, highlight, underline, autorepeat keyboard, four rollover modes and an audio alarm. The chip set also implements split-screen capability in hardware.

The Signetics chip set is appropriate for terminal applications demanding additional features such as double-height character rows, partial screen scrolling, multiple page buffers and color displays.

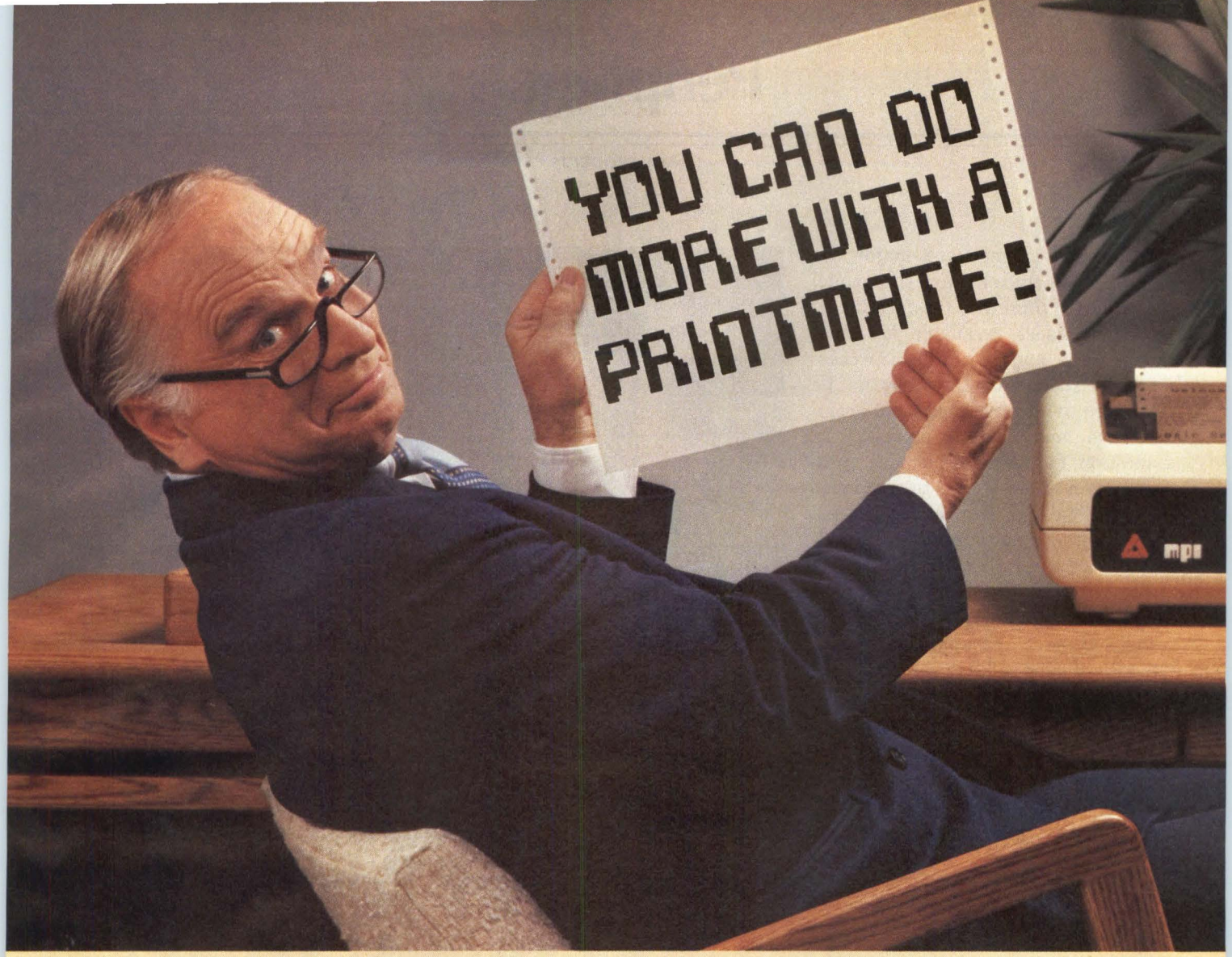
Prices of the chips in plastic DIP pin form are $7.30, $13.65, $16 and $24.40 for the SC2670, SC2671, SC2672 and SC2673, respectively, in quantities of 100 or more. The ceramic form of the chips each sell for $3 more. **Signetics Corp.,** 811 E. Arques Ave., P.O. Box 409, Sunnyvale, Calif. 94086. **Circle No** 305

# Hewlett-Packard introduces stand-alone logic analyzer

Hewlett-Packard Co. has introduced the 1630 stand-alone logic analyzer, which it claims is the first logic analyzer to incorporate timing, state, interactive timing/state and software performance measurements in one low-cost package.

Two models are available. The model 1630D, priced at $10,000 in single-unit quantities, allows choices of 43 channels of state or 16 channels of timing in state-only or timing-only modes. In interactive modes, it offers 35 channels of state plus eight channels of timing or 27 channels of state plus 16 channels of timing. The model 1630A, priced at $8500, allows choices of 35 channels of state or eight channels of timing in state-only or timing-only modes. In the interactive mode, it provides 27 channels of state plus eight channels of timing.

Measurement capability and op-




## Print in special fonts, SPECIAL FONTS! SPECIAL FONTS, *SPECIAL FONTS*, or create your own special fonts!

PrintMates™ with AP-PAKs™ go all out to help you get your message across. With an ordinary printer you're limited to ordinary printing. Not so with PrintMates. They let you do more with your computer—choose from 60 different type styles, print characters up to ⅝ of an inch high and even create your own logo and special fonts.

Applications Packages called AP-PAKs support PrintMates and most popular microcomputers with software and hardware for exciting and usable graphics printing. You can intermix text with graphics on the same line and even print the screen with AP-PAKs.

PrintMates print great on any computer system, and with an AP-PAK you can do more. Special AP-PAKs are provided for OEM's who want to differentiate and enhance their systems with a PrintMate printer.

You can do more in style when you mate your system with a PrintMate and AP-PAK—and for less than just another printer.

Call us toll-free at 1-800-821-8848 for more information and your sample of PrintMate's styles.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The Printer People

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**Micro Peripherals, Inc.**

4426 South Century Drive
Salt Lake City, Utah 84107
1-800-821-8848

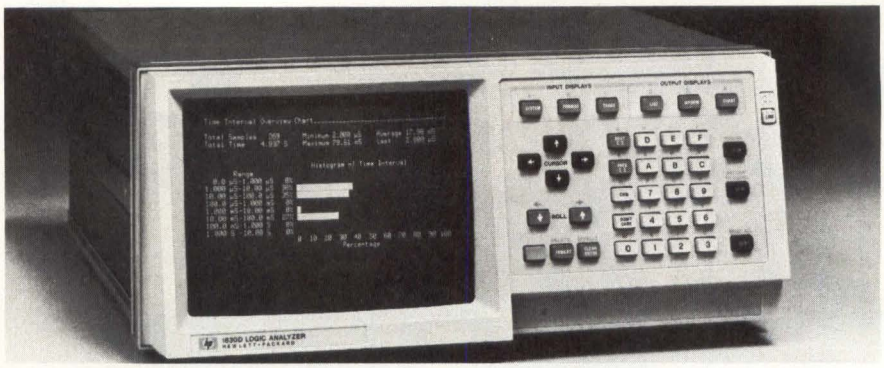
**CIRCLE NO. 126 ON INQUIRY CARD**

Made in U.S.A

erator convenience are major design considerations for the model 1630. It includes a family of pre-processors, available for most popular 8- and 16-bit microprocessors, that allows the 1630 to be tailored to a microprocessor's architecture and instruction set. In addition, a general-purpose preprocessor allows a user to customize an interface for proprietary processors or those not supported by HP.

Advances in the 1630's user interface, such as label assignment and mnemonic display, reduce measurement and analysis time. A series of user-callable panels simplifies initial setups and measurement specifications.

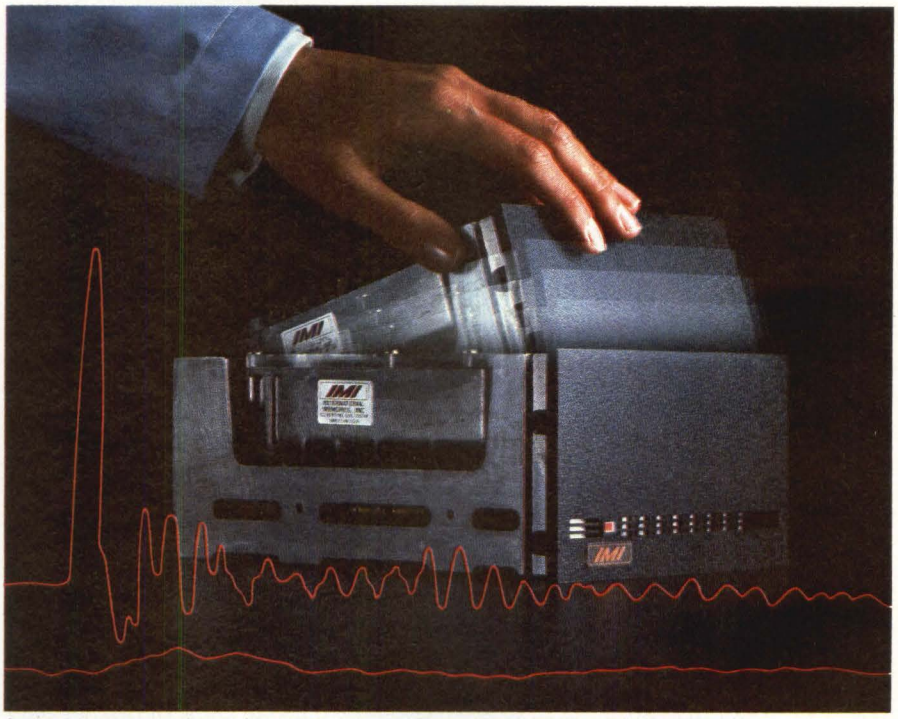
By providing a nonintrusive method of measuring software performance, the 1630 extends logic analysis into the area of software optimization. For example, users can determine the minimum, maximum and average execution times of a module of code and pinpoint bottlenecks and areas of software inefficiency.



**Hewlett-Packard's 1630A/D logic analyzer** *spans the development cycle from dynamic checkout of controlled functions to system performance analysis.*

The model 1630 also features built-in HP Interface Bus and HP Interface Loop capabilities that allow it to be used with a variety of peripheral devices including minicassettes and printer/plotters. **Hewlett-Packard Co.,** 1820 Embarcardero Rd., Palo Alto, Calif. 94303. **Circle No 306**

# This won't hurt a bit.



Accelerometer waveforms. Upper trace: frame. Lower trace: HDA.

## AND HERE'S THE PROOF.

**To prove that our new 5000H Series 5¼" Winchesters can stand up to the knocks that desk-top systems often go through, even in the office, we put them through some brutal drop-tests.**

We really let them have it. 1500 Gs on the outside frame.*

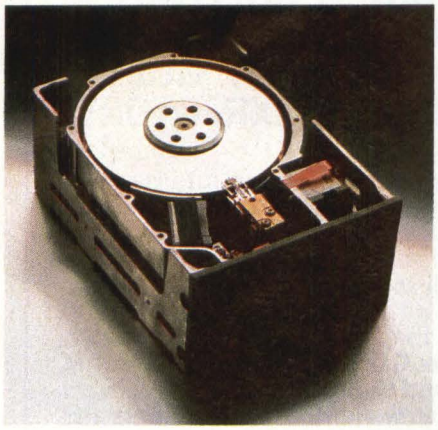
And what happened?

Nothing.

No head crashes. No media damage. No component misalignment. No loss of data or processing performance.

That's because 5000H Series drives have an exclusive 2-piece shock isolation system. The head/disk assembly is recessed within a rugged outer frame, where integral shocks at the center of gravity reduce impulses to the HDA by over 90%.

*Accelerometer reading for 3" drop-test.



They also have thin-film plated media, which is over 1000 times harder than ferric-oxide coatings, and which combines with the shock isolation design to make the drive even less vulnerable to head crashes and subsequent data loss.

During installation and use, even in the most demanding applications, 5000H Series drives ensure data integrity and reliable operation.

A new thermally stable design enhances data reliability over a wider temperature range.

And to reduce EMI/RFI noise susceptibility, the read/write preamps are located right on the head stack – where they combine with the higher performance of plated media to deliver the best signal-to-noise ratio in the industry.

## INDUSTRY'S ONLY 2-YEAR WARRANTY.

The design of the IMI 5000H Series drive makes it the most reliable 5¼"Winchester ever built.

But the proof is in the warranty. For if the drive couldn't withstand extreme shock and vibration, the last thing we'd do is give it an unprecedented 2-year warranty.

For spec sheets and further information, including the higher capacities and faster access times we have planned for the future, call or write:
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10381 Bandley Drive
Cupertino, California 95014
(408) 446-9779. TWX: 910-338-7347.

## 68 MSEC AVERAGE ACCESS FOR ENTIRE 5000H SERIES LINE.

That includes head settling time.

At this speed, your system can excel in critical comparative benchmark tests.

And depending upon the drive model and interface selected, it can meet a wide range of capacity requirements.

| IMI 5000H Series | 5006H | 5012H | 5018H |
|---|---|---|---|
| Unformatted Capacity (Mbytes) | 6.38/7** | 12.76/14 | 19.14/21 |
| Formatted Capacity (Mbytes) | 5/6.3 | 10/12.5 | 15/18.8 |
| Access Time (msec) | 68 | 68 | 68 |
| Number of Disks | 1 | 2 | 3 |
| RPM | 3600 | 3600 | 3600 |

** Industry standard interface and format/Industry standard interface with expanded format.

IMI

**We're at it again.**

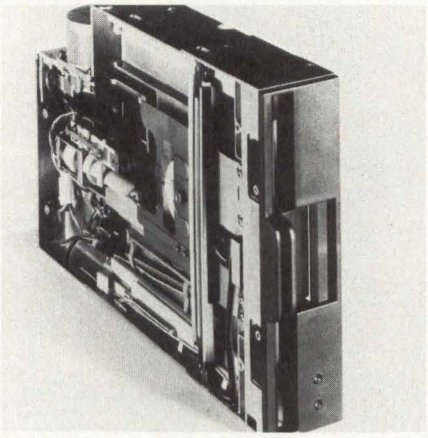


CIRCLE NO. 128 ON INQUIRY CARD

## Removable disk stores 287M bytes

Designed to operate with the Status32 Continuous Processing System, the 287M-byte (formatted) capacity model D105 removable disk drive uses 3330-type disk technology. The drive features a free-standing cabinet, a 1.2M-byte-per-sec. data-transfer rate, an average access time of 30 msec. and has a removable disk pack. The companion model D104 controller suports one to four D105 disks and has logic that allows the controller board to check itself continuously. Price of the D105 disk drive and one disk pack is $33,000. The D104 controller is priced at $9000. **Stratus Computer, Inc.,** 17 Strathmore Rd., Natick, Mass. 01760.

**Circle No** 307



## Flexible drive features four interface options

The 8-in., half-height, single-sided, single-density model FD1164 flexible disk drive has an unformatted capacity of 400K bytes and can transfer data at 250K bytes per sec. The disk drive is offered with several interfaces, including a built-in NEC interface with a 3M-type converter, a standard Shugart-type interface with on edge-card connector, an NEC interface with a variable frequency oscillator option that refines interface signals and a Shugart-type interface with the VFO option. The disk drive features a microprocessor head-loading mechanism that extends media life to more than 7 million passes. MTBF is 24,000 hours. In 100-unit quantities, the drives are priced at $475. **NEC Information Systems, Inc.,** 5 Militia Dr., Lexington, Mass. 02173.

**Circle No** 308

## Cartridge-tape drives feature expandable storage capacity

The models TDC 3204 and TDC


# MAKE THE ADAPTEC CONNECTION

**The Adaptec Connection:** Controllers that actually enhance your system's I/O capability. Superior quality and reliability. Detailed attention to customer support. Leader-of-the-pack performance at low cost. Sound like the connection you need for your Winchester? Read on.

**The High Performance Connection**: Adaptec intelligent ANSI SCSI (SASI) bus controller devices. Fully-featured Adaptec LSI 5000 Series Chip Sets and Controller Boards complete your high performance, multi-tasking system perfectly. Popular ST-506, SA-1000 and Q-2000 drive interface compatibilities assure a tight fit no matter what drives you select. And a range of features allowing complete device independence, logical block addressing, disconnect/reconnect, and a 10Mbit/second transfer rate mean that these low cost controllers won't be a performance bottleneck.

**The Very Low Cost Connection**: The Winchester Controller Chip™. This device lets you design your own controller board with as few as eleven "glue" chips. You still get powerful features like automatic error correction and software selectable sector sizes. You still get Adaptec reliability and support. But you also get costs (and margins) that let you compete in the personal computer marketplace. Finally, a Winchester controller that costs a fraction of the drive.

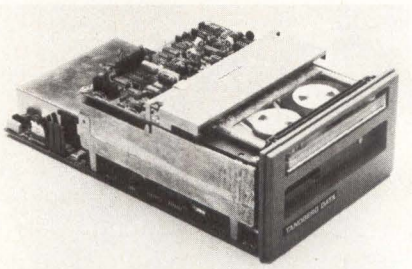
Adaptec people are experts in systems, drive and LSI technology. We even provide complete PCB design and manufacturing information for volume chip customers. And since you can build or buy, and choose the right performance level for your needs, you don't waste money. So don't waste time. Call Don Rector, vice president of marketing, at (408) 946-8600. Or write Adaptec, 1625 McCarthy Boulevard, Milpitas, CA 95035.

adaptec, inc.

**The best controller connection you can make . . . or buy.**

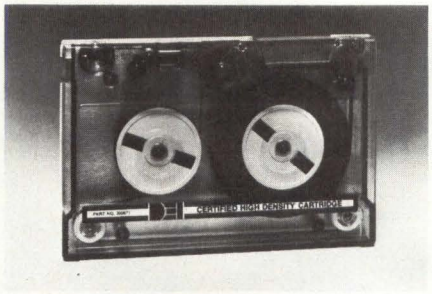
CIRCLE NO. 131 ON INQUIRY CARD

3214 ¼-in. streaming cartridge-tape drives store 20M bytes on four tracks and 40M bytes on eight tracks, respectively. The drives operate at 90 ips and feature an 8128-bpi recording density and an 88K-bit-per-sec. data-transfer rate. The drives' design allows a user to expand storage capacity from 20M to 40M bytes by changing heads. No mechanical adjustments are necessary. Other features include a three-point cartridge-locking mechanism and a floating-head design.



Requiring only two circuit boards, the drives have a 4K- to 16K-byte circular buffer and internal self-test diagnostics. Single-unit prices are $1600 for the model TDC 3204 and $1950 for the model TDC 3214. Quantity discounts are available. **Tandberg Data-Data Storage Division,** 571 N. Poplar, Suite H, Orange, Calif. 92668.

**Circle No** 309



## Data cartridge is certified for 6400 bpi

The model 300671 ¼-in. magnetic-tape data cartridge is certified for 6400 bpi recording and has a capacity of more than 17M bytes of data. With 450 ft. of tape and the ability to operate in start/stop or streaming modes at tape speeds as high as 90 ips, the ANSI cartridge features data reliability of one error or fewer in a 64-block write then read, erase then read and write then read test. Expected life of the cartridge is 5000 passes. Measuring 4 × 6 × 0.665 in., the cartridge weighs 8 oz. Single-unit price is $39, with distributor and OEM discounts available. **Data Electronics Inc.,** Media Division, 10150 Sorrento Valley Rd., San Diego, Calif. 92121.

**Circle No** 310

# Check The Chart Before You Choose Your New 16-Bit Computer System.

## Columbia Data Products' New Multi-Personal® Computer, Featuring IBM-PC® Compatibility, Excels In Professional, Business And Industrial Applications. Check it out.

Columbia Data Products' MULTI-PERSONAL® COMPUTER can use software and hardware originally intended for the IBM® Personal Computer . . . while enjoying the flexibility and expandability of all Columbia Data's computer systems.

Available operating system software includes single-user MS-DOS® or CP/M 86® or multi-user, multi-tasking MP/M 86® or OASIS-16®, with XENIX® available soon, providing users with a host of compatible software packages for personal and professional business and industrial applications. A large selection of higher level languages are also available, including BASIC, FORTRAN, COBOL, PASCAL and MACRO Assembler.

Our standard 16-Bit 8088 hardware configuration provides 128K RAM with parity, two RS-232 serial ports, Centronics parallel printer port, interrupt and DMA controllers, dual floppy disks with 640K storage, Winchester disk and keyboard interfaces, and eight IBM-PC compatible expansion slots . . . and lists for only $2995. Winchester hard disk configurations, featuring cache buffer controllers for enhanced disk access performance are also available, starting at $4995.

So, when you need to grow, why gamble and hassle with independent third party hardware and operating system vendors which may or may not be compatible . . . not to mention the hidden expense and frustration of implementing peripheral drivers in the different operating systems and upgrades? Who needs the finger-pointing when things don't work out?

After you review our chart, you will agree . . . for overall 16-Bit microprocessor superiority, expandability, flexibility, compatibility and real economy, Columbia Data is your *total source.*

Our Multi-Personal Computer . . . the 16-Bit system born to grow!

Get yours now.

**CIRCLE NO. 133 ON INQUIRY CARD**

| MAIN FEATURES | CDP-MPC | IBM-PC* | OTHERS |
|---|---|---|---|
| Microprocessor | 16-Bit 8088<br>8-Bit Z-80 (Opt) | 16-Bit 8088 | ? |
| USER Memory | 128K-1 Mbytes | 16K-256 Kbytes | ? |
| IBM-PC Compatible Expansions Slots Beyond Professional Configuration[1] | 8 Slots | 0 | ? |
| Resident Floppy Disk Storage | Dual 320K (std) | Dual 160K (Opt)<br>Dual 320K (Opt) | ? |
| Resident Cache Buffer Hard Disk Storage | 5M/10M | — | ? |
| **OPTIONAL OPERATING SYSTEMS (Supported by Company)[2]** | | | |
| MS-DOS (PC-DOS) | Yes | Yes | ? |
| CP/M 86 | Yes | Yes | ? |
| MP/M 86 | Yes | — | ? |
| OASIS-16 | Yes | — | ? |
| XENIX | Soon | — | ? |
| **OPTIONAL HARDWARE EXPANSION BOARD (Supported by Company)** | | | |
| RS-232 Communications | Yes | Yes | ? |
| B/W and Color Display Controller | Yes | Yes | ? |
| Expansion Memory | Yes | Yes | ? |
| Z-80 CP/M-80 Board | Yes | — | ? |
| Cache Buffer Hard Disk | Yes | — | ? |
| Time/Calendar Board | Yes | — | ? |
| IEEE Bus Controller | Yes | — | ? |
| 8" Floppy Disk System | Yes | — | ? |
| 8" Hard Disk System | Up to 40 Mbytes | — | ? |
| Tape Cartridge System | Yes | — | ? |

[1]For comparison purposes, typical professional configurations consist of 16-Bit 8088 Processor, 128K RAM with Parity, Dual 320K 5-inch Floppies, DMA and Interrupt Controller, Dual RS-232 Serial Ports, Centronics Parallel Port and Dumb Computer Terminal or Equivalent.

[2]Columbia Data Products also supports CP/M 80* with an optionally available Z-80 CP/M Expansion Board.

*As advertised in BYTE Magazine, August 1982.

**COLUMBIA**
**DATA PRODUCTS, INC.**

**Home Office:**
8990 Route 108
Columbia, MD 21045
Telephone 301-992-3400
TWX 710-862-1891

**West Coast:**
3901 MacArthur Blvd.
Suite 211
Newport Beach, CA 92663
Telephone 714-752-5245
Telex 277778

**Europe:**
P.O. Box 1118
450 Moenchengladbach 1
West Germany
Telephone 02161-33159
Telex 852452

## DBMS offers on-line user assistance

The System 1032 relational-like VAX database-management system features inverted file structures for fast data retrievals, a built-in, block-structured programming language for application development, asynchronous I/O and a host language interface for COBOL, FORTRAN, BASIC, Macro and PL/1 application programmers. It runs on any model of Digital Equipment Corp.'s VAX computer family using the VMS operating system. Built-in user aids include choice, help and recognize keys, automatic command recall and editing and on-line documentation. In addition to text, logical, integer, real, double- precision integer, double-precision real and packed decimal data types, System 1032 supports date/time and time-span data types. A typical System 1032 license for the VAX 11/780 sells for $40,000. **Software House,** 1105 Massachusetts Ave., Cambridge, Mass. 02138

**Circle No** 311

## Screen handler/report works with BASIC, dBASE II

Zip, a screen handler and report generator for CP/M-based microcomputers, works with code written in MBASIC, CBASIC or the DBASE II database-management system language. To create a screen or report format as long as 88 lines, a user enters text and variable names where they are to appear in the form, and Zip writes the code needed to generate the output. Commands for opening disk files or for displaying or printing items can be included in the form's blank areas. The user inserts a single statement in the application to invoke the code. Price is $160. **Nexus,** 5455 Wilshire Blvd., Suite 802, Los Angeles, Calif. 90036.

**Circle No** 312

## Text processor works on IBM Series/1

Intended for use in standard word-processing and more demanding applications such as creating technical reports with complicated equations, Textstream/1 runs on IBM Series/1 minicomputers in interactive mode under the EDX operating system. Features include word-string substitutions, multiple fonts, subscripting and superscripting. Users can create com-


# TEAM PLAYERS.

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At Advanced Digital, we believe in co-operation between computers and their operators. That's why our new team of S-100 master and slave processors are designed with your team in mind and feature superlative reliability and ease of operation.

Our team captain is SUPER QUAD, a unique multi-function master processor combining 64K of bank selectable RAM, single- and double-density floppy disk controller, system monitor EPROM, Z80A CPU, two serial and two parallel communication ports on a single board.

The players consist of one or more SUPER-SLAVES, the latest addition to Advanced Digital's line of superior multi-function S-100 boards.

Each SUPER-SLAVE is a powerful single-board slave processor designed for use with the SUPER QUAD in either network or stand-alone configurations. The outstanding features of the SUPER-SLAVE include:

- A DEDICATED Z80A CPU FOR EACH USER
- IEEE-696 standard conformity
- 4 serial, 2 parallel interface ports
- 2/4K EPROM (monitor)
- 64/128K bank switchable RAM
- One year warranty
- Turbo-DOS™, the state-of-the-art operating system with an advanced failure detection and recovery facility that makes the master-slave network virtually crash-proof.
- Also, for the first time CP/NOS® operating system from Digital Research. Plug as many SUPER-SLAVES into the BUS as you need users.

Your team needs the strong support of the SUPER QUAD/SUPER SLAVE team from Advanced Digital Corporation. The Super System includes SUPER QUAD and CP/M operating system. The shugart SA-1000 or quantum Q2000 hard disks are also supported.

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CIRCLE NO. 135 ON INQUIRY CARD

mands for specific applications. A graphics feature enables users to construct charts and diagrams with boxes. Text is formatted for laser, line and letter-quality printers. Price is $2950. **Computerized Office Services, Inc.,** 309 N. First St., Ann Arbor, Mich. 48103.

**Circle No** 313

## Database-management runs on IBM PC

MDBS III, a database-management system for the IBM Personal Computer, permits developers to use named many-to-many and recursive relationships in application design. The package allows users to assign record types to areas on disk, segregate records and indexes and use variable-length records. Data-manipulation commands perform logical intersections and logical differences on entire groups of records at a time. An interface to the host BASIC language is furnished. The data-description language, intended to generate data dictionaries, permits data compression and encryption and supports nine data types. Price is $3120. **ISE-USA,** 350 W. Sagamore Parkway, West Lafayette, Ind. 47906.

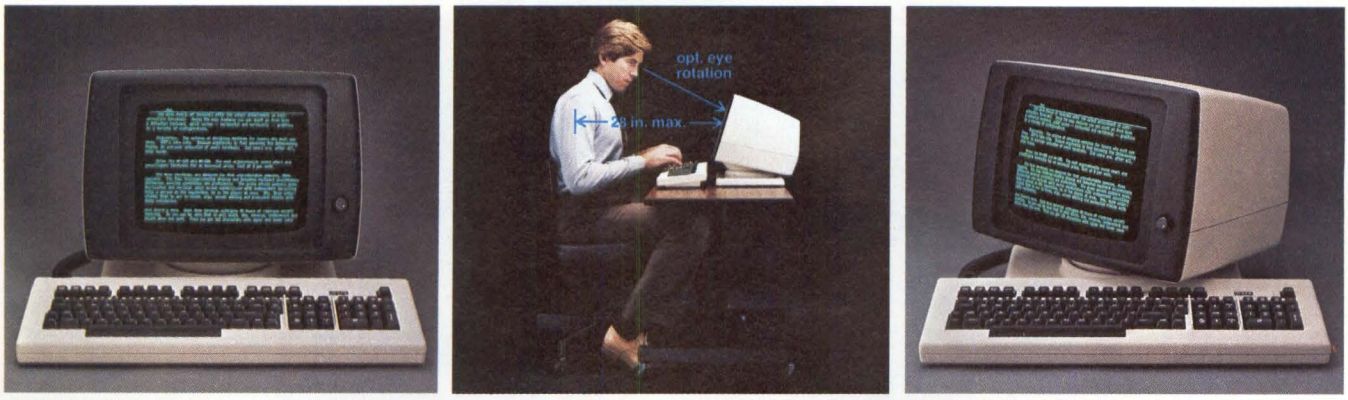
**Circle No** 314

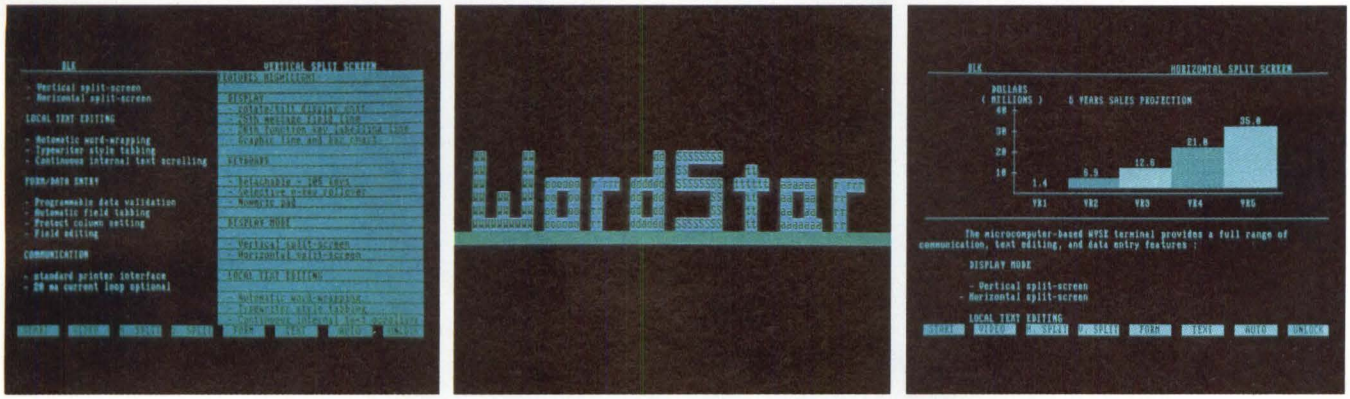
## DMS features English-like query language

DDQUERY, an on-line database-management and -query system for the IBM Personal Computer, IBM Series/1 computer and 32-bit Perkin-Elmer computers, offers an English-like query language that allows nontechnical users to retrieve, modify and report data interactively. The package also offers protection of the database against unauthorized data access at the data-set and data-item levels and provides database security through utilities that allow backup and restoring of the database. Other features include automatic date stamping of records, formatted screen entry and the ability to access data sequentially, directly by relative record number or randomly by an alphanumeric key value. Single-unit price for the IBM PC version starts at $7500 including the query language and report writer, with substantial quantity discounts available. **Gemini Information Systems, 5500 S. Syracuse Circle, Englewood, Colo.** 80111.

**Circle No** 315

# A WORD TO THE WISE.




## No one gives you more in an ergonomically engineered smart terminal than Wyse.

These days there's little room for waste of the corporate dollar. And these days the WY-100 smart terminal looks even better when you compare it to the other guys.

You definitely get more from Wyse — the leader in low-cost, high-performance, ergonomically engineered smart terminals.

To begin with, you get a great looking terminal that features die cast aluminum packaging and takes up a minimum of desktop space.

You also get a terminal with an uncanny way of pleasing people. It comes with an easy-on-the-eyes green phosphor screen. And a fully tilting/rotating display and detached keyboard. (After all, one person's just-right-tilt is another's not-quite-right-tilt).

When the workload seems impossible, horizontal and vertical split screen capabilities with independent scrolling allow you to be in two places at once.

There's more. You get programmable function keys and transparent print. Plus 128 characters with upper and lower case, line drawing and graphics, and a keyboard with 105 keys — including cursor pad, special mode and function keys.

Of course, all of this wouldn't mean much if you couldn't count on Wyse quality. That's why each WY-100 is put through an extensive on/off testing program.

On top of that, WordStar® and other emulations are now available from your distributor. Which means you can automatically get 32 of WordStar's most commonly used multi-key commands fully-implemented on our function keys for faster, easier use.

We think you'll be quite impressed when you compare the WY-100 to other terminals in its class. But don't take our word for it. Call or write us today. We'll send you detailed information on why the WY-100 smart terminal gives you more. A lot more.

WYSE TECHNOLOGY

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In the East, call (516) 293-5563
**Outside California, 800-538-8157 ext. 932**
**Inside California, 800-672-3470 ext. 932**

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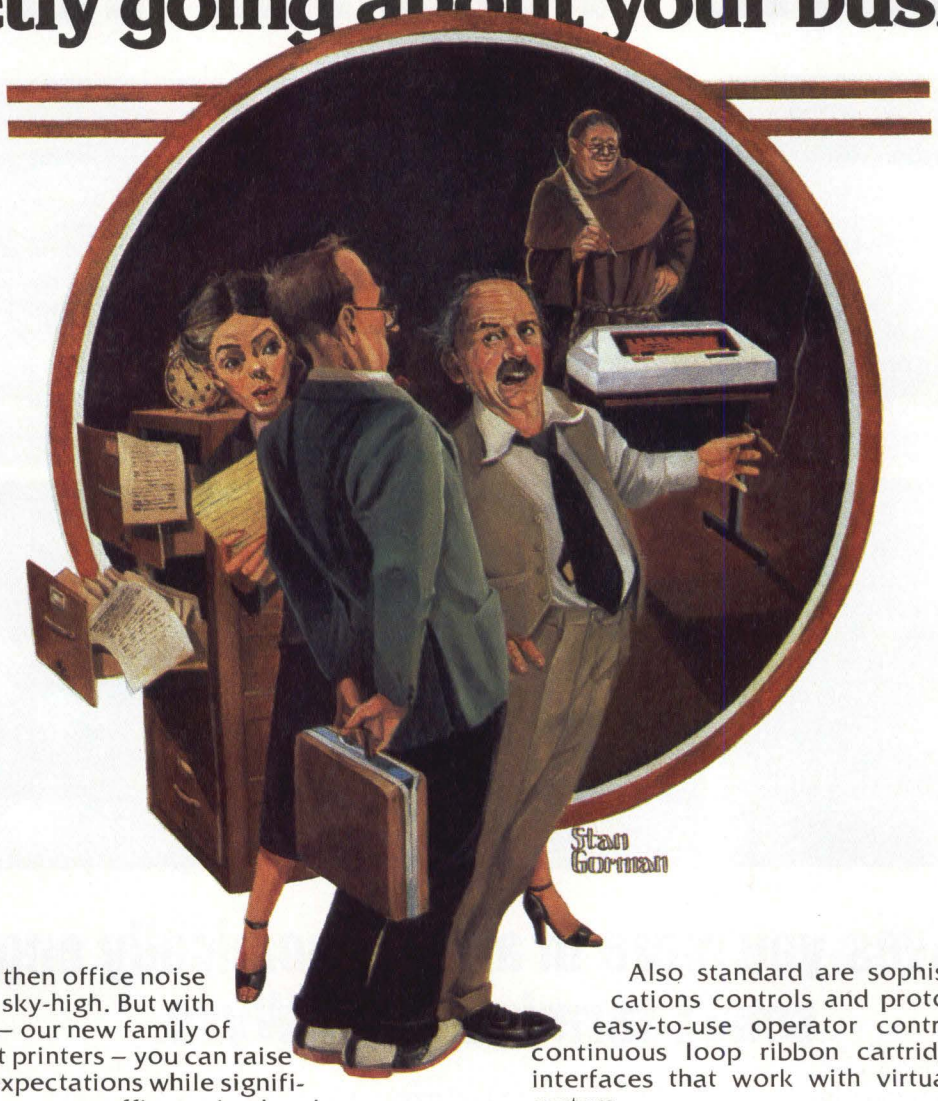
CIRCLE NO. 136 ON INQUIRY CARD

# Anadex SILENT SCRIBE™ printers. Quietly going about your business.




Now and then office noise levels can go sky-high. But with Silent/Scribe – our new family of matrix impact printers – you can raise your printer expectations while significantly lowering your office noise level.

How quiet is "silent"? Silent/Scribe operates at less than 55 dBA, which means that in the average office you may have to look at it to determine whether it's printing.

**SILENT/SCRIBE MODELS**

| Standard Features | Char. per Inch | DP-9000A | DP-9500A | DP-9001A | DP-9501A | DP-9620A |
|---|---|---|---|---|---|---|
| **Printing Speed** (Char. per Sec.) | 10 | 150 | 150 | 120 | 120 | 200 |
| | 12 | 180 | 180 | — | — | 120 |
| | 12.5 | — | — | 150 | 150 | — |
| | 13.3 | 200 | 200 | — | — | — |
| | 15 | — | — | 180 | 180 | 150 |
| | 16.4 | — | — | 200 | 200 | 164 |
| Enhanced | 10 | — | — | — | — | 100 |
| **Expanded Print** (Double Width) | | Yes | Yes | Yes | Yes | Yes |
| **Dot Addressable Graphics** (Dot/In., H/V) | | 60/72 | 60/72 | 75/72 | 75/72 | 72/72 |
| **Max. Line Width** (In.) | | 8.0 | 13.2 | 8.0 | 13.2 | 13.2 |
| **Audible Alarm** | | Opt. | Opt. | Opt. | Opt. | Yes |
| **Out-of-Paper Sense** | | Yes | Yes | Yes | Yes | Yes |
| **Ribbon, Continuous Loop Cartridge** (Yds) | | 30 | 30 | 30 | 30 | 30 |
| **Interfacing:** | | | | | | |
| **Parallel Cent. Comp.** | | Yes | Yes | Yes | Yes | Yes |
| **RS-232-C Serial** | | Yes | Yes | Yes | Yes | Yes |

And Silent/Scribe is as easy to buy as it is to live with. You can select a variety of printing speeds, fonts and line widths. Some models provide both draft and enhanced quality copy. All models have superb dot-addressable graphics at no extra cost.

Also standard are sophisticated communications controls and protocols, flexible and easy-to-use operator controls, quick-change continuous loop ribbon cartridge, and universal interfaces that work with virtually any computer system.

For full details on how Silent/Scribe can fit your application – quietly – contact Anadex today. You'll find the units attractively packaged, quality engineered, modestly priced, and available now.

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# Literature

NEW PRODUCTS

## Planning guide aids system designers

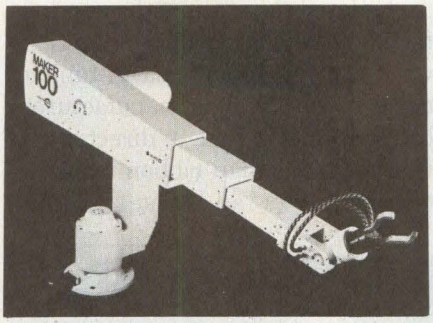
The 16-page Microcomputer System Planner, intended to facilitate system designers' selection of modules, provides an overview of the ModulasOne microcomputer family, application hints, typical system interconnections and a module-selection guide. The brochure describes MPUs, APUs, memory modules, digital and analog I/O modules, development-system sets and other hardware and the software available to support the hardware. **Adaptive Science Corp.,** 4700 San Pablo Ave., Emeryville, Calif. 94608. **Circle No** 316

## Folder describes videotaped Pascal course

A three-part, color, videotaped course covering the concepts of computer programming using Pascal is described in a folder. The course is a structured, disciplined approach to programming that impacts program development, readability, flexibility and maintainability. **Colorado State University, Engineering Renewal and Growth Program,** Christman Field, Bldg. 1000, Fort Collins, Colo. 80523. **Circle No** 317

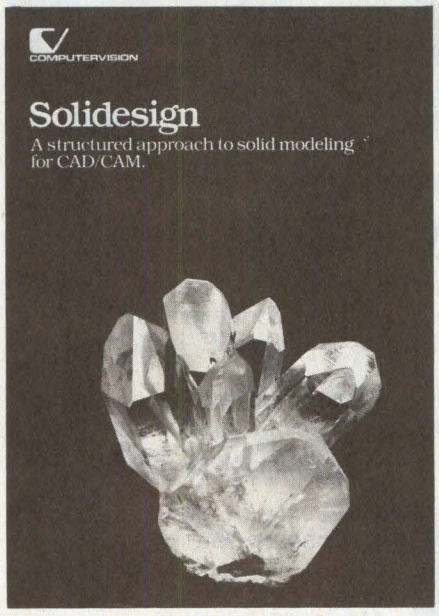
## Catalog describes Multibus controllers

A line of Multibus-compatible products including ANSI and Priam disk controllers, ½-in. tape and ¼-in. cartridge adapters and boards that provide Winchester disk control with magnetic-tape backup are described in a pocket-sized catalog. The booklet details the vendor's Pico-Mate ¼-in. cartridge-tape adapters, the Tapemaster ½-in. magnetic-tape adapters and the Rimfire disk/tape controllers. **Computer Products Corp.,** 2405 Annapolis Lane, Suite 250, Plymouth, Minn. 55441. **Circle No** 318




## Brochure describes robot system

The Maker 100, a five-axis, electric servo-driven robot able to handle a 5-lb. payload, is described in a brochure. The brochure describes the robot manipulator, a controller and a teach pendant (the primary communications link between an operator and the Maker 100 robot system). The booklet also lists typical applications including assembly, material handling and others. **United States Robots,** 1000 Conshohocken Rd., Conshohocken, Pa. 19428. **Circle No** 319




## Solids-modeling system outlined in brochure

Use of the Solidesign solids-modeling system is described in a brochure. The booklet describes Solidesign's geometric-modeling and shaded-picture generation and explains how Solidesign can be integrated into engineering-design and manufacturing tasks. The booklet notes the benefits of Solidesign over wire-frame models in the design and analysis of complex parts and tools. **Computer-Vision Corp., Marketing Communications Department,** 3 Oak Park, Bedford, Mass. 01730. **Circle No** 320

## Remote terminal interface described in brochure

A four-page color brochure describes the vendor's Series 11 BusDriver remote-cluster and local-terminal interface for Digital Equipment Corp.'s PDP-11 and VAX-11 computers. Illustrated with photographs and line drawings, the publication explains how the DEC-compatible BusDriver can replace standard DEC communications multiplexers and provide additional capabilities such as controlling statistically multiplexed remote clusters of terminals connected to Micro800/2 data concentractors. **Micom Systems, Inc.,** 20151 Nordhoff St., Chatsworth, Calif. 91311. **Circle No** 321

## Brochure examines network development

An eight-page integrated communications brochure details the principles of multiplexing, switching and automated network control. Its application-oriented approach explains the vendor's product capabilities and how they impact network design such as reconfiguration flexibility and protocol compatibility. The brochure is one of four in a series covering modems, networking products and network switching and management products. **Codex Corp.,** 20 Cabot Blvd., Mansfield, Mass. 02048. **Circle No** 322

# Literature

NEW PRODUCTS

## Booklet provides ribbon, toner information

The 64-page *Third Annual Guide to Ribbons and Toner* provides references on companies, products and technology for ribbons and printers. Articles written by experts detail the state of the art, inks for impact printing and multistrike word-processing ribbons. A table of more than 60 ribbon manufacturers lists products, and a directory of U.S. and Canadian ribbon manufacturers gives addresses, phone numbers and histories of companies. The booklet also includes articles on electronic imaging with toners and on the variables in electrophotographic systems that influence toner development. Another directory lists more than 20 toner manufacturers. **Datek of New England,** P.O. Box 68, Newtonville, Mass. 02160. **Circle No** 323



## LITERATURE THAT COSTS

### Guide lists products for CAD/CAM field

The *1982 Computer Graphics, CAD & CAD/CAM Product Guide and Suppliers' Directory* is available in two 400-page volumes that cover hardware and systems and software products for business graphics, CAD/CAM and engineering analysis. Volumes one and two list 810 systems and hardware products and 680 software products, respectively, available from more than 700 manufacturers and suppliers throughout Europe, North America and Japan. The first volume's entries are divided into 15 sections by product type including systems, processors, input devices, CRT monitors, terminals, plotters, printers and controllers. The second volume's entries are divided into 15 applications including business graphics, drafting systems, architecture and mapping, engineering, numerical-control programming and peripheral driving. Each entry lists the manufacturer's name, address and telephone number and the names and addresses of as many as three suppliers from countries other than the source. It also describes the product and provides prices. A manufacturers and suppliers index lists all the companies identified in the directory, their country of origin and the sections in which their products appear. The software acronym index alphabetically lists all the software products with their originators and the section in which they appear. The two-volume set is priced at $220. **Frost and Sullivan, Inc.,** 106 Fulton St., New York, N.Y. 10038.

**Circle No** 324

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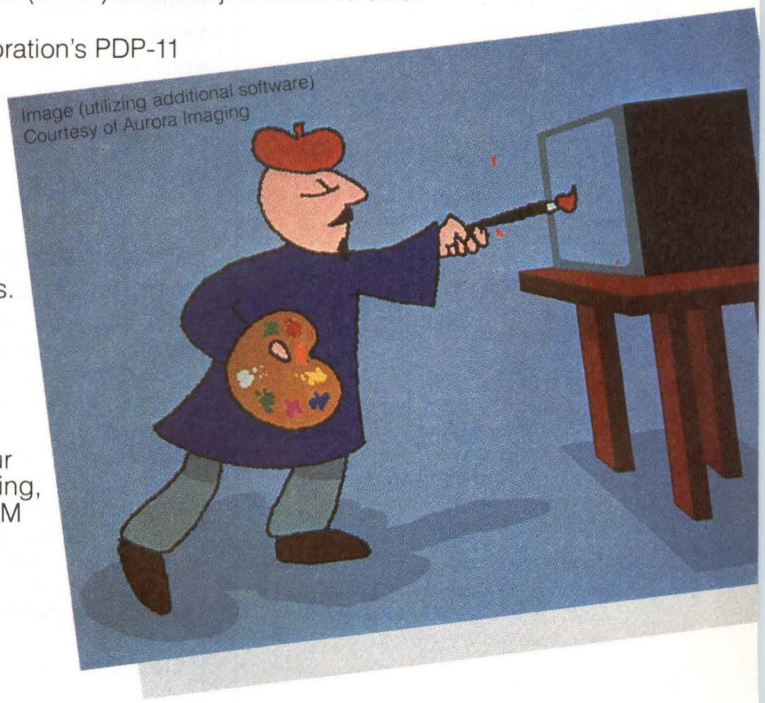
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**CIRCLE NO. 140 ON INQUIRY CARD**

# Literature

NEW PRODUCTS

## Catalog lists 37 seminars

The 56-page Datapro Catalog of Seminars and Information Services lists 37 seminars in data communications, systems and software, electronic data-processing management and office automation and four general-interest seminars given from January to May, 1983. Each listing includes course information, instructor profiles, location and dates and fee information. Complete schedule information in table format and registration information follow the listings. **Datapro Research Corp.,** 1805 Underwood Blvd., Delran, N.J. 08075. **Circle No** 325

## LITERATURE THAT COSTS

### Databook describes microcomputer products

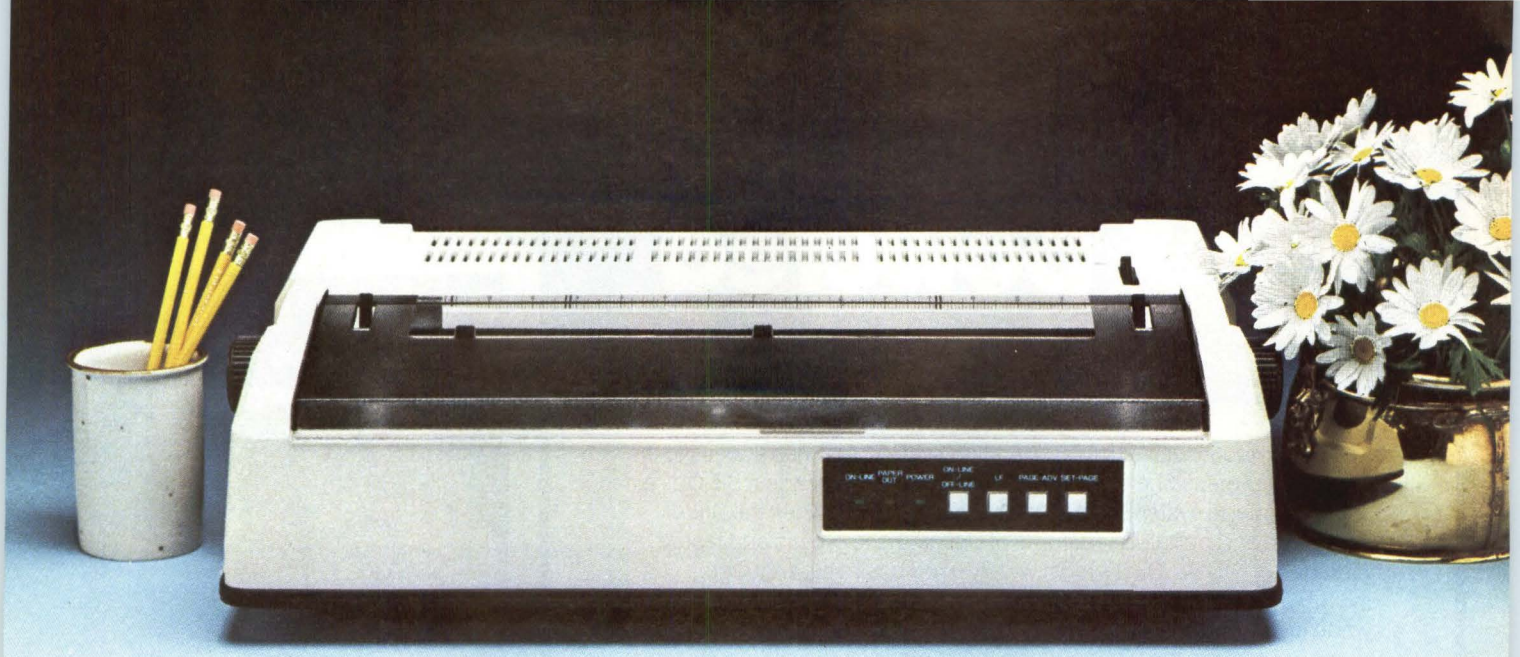
A 643-page catalog describes the vendor's microcomputer components, development systems and board-level computers, as well as the company's program of technical training courses. A functional description, architecture and programming information and electrical specifications are given for the Z80 8-bit microprocessor and associated peripheral circuits; the Z8000 16-bit microprocessor and associated peripheral circuits; the Z8 family of single-chip microcomputers; the Z8500 series of universal peripherals; and Z80 microcomputer board products. The 1982/1983 *Zilog Databook* is priced at $5. **Zilog, Inc.,** 1315 Dell Ave., Campbell, Calif. 95008. **Circle No** 326

### Directory focuses on mechanical CAD/CAM

*Turnkey CAD/CAM Computer Graphics: A Survey and Buyer's Guide for Manufacturers* is a soft-cover, three-volume set describing CAD/CAM and its vendors. Part 1, Contemporary CAD/CAM Technology, serves as a tutorial on contemporary computer-graphics technology to automate engineering design and manufacturing. With the aid of photographs and drawings, it explains hardware and software components and systems and includes sections on workstations, displays, plotters, computers, databases, networks and software. Part 2, Evaluating Today's Turnkey Systems, aids prospective users of CAD/CAM in choosing, justifying, acquiring and installing CAD/CAM equipment. It explains how to compare systems and vendors, the ramifications of turnkey pruchasing, the impact of CAD/CAM on user organizations, how to determine CAD/CAM needs and how to prepare a financial justification. Part 3 is a directory of 44 vendors. Information for each company includes a financial profile, a sales and installation profile, product descriptions with photos, a list of key executives, R&D resources and other data. For quick reference, the volumes include a topical index and an index of systems and vendors. Parts 1, 2 and 3 are priced at $107, $89 and $150, respectively. **Daratech, Inc.,** P.O. Box 410, Cambridge, Mass., 02238. **Circle No** 327

### Study charts disk drive industry

The 1982 *Disk/Trend Report* is a detailed annual business review of the worldwide disk drive industry. In addition to individual revenue and unit shipment projections for rigid disk drives in nine product groups, the report provides statistics and analysis of installed drive populations, average OEM drive selling prices, competitive market shares of manufacturers and a review of competing data-storage technologies. The report also contains basic specifications on 590 rigid disk drives and profiles on 65 drive manufacturers worldwide. A similar report on flexible disk drives is also available. The report, including rigid and flexible disk drive sections, is priced at $1260. The individual sections are priced at $840 for the report on rigid disk drives and $585 for the flexible disk drive report. **Disk/Trend, Inc.,** 1224 Arbor Court, Mountain View, Calif. 94040. **Circle No** 328



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

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

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

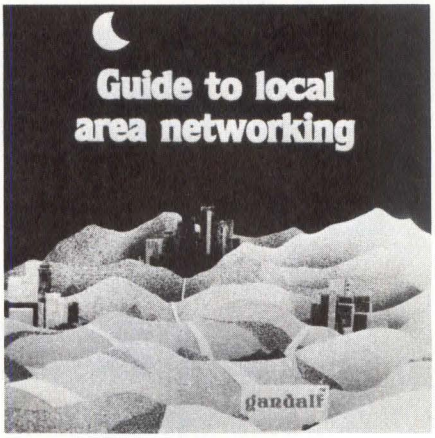
The F-10 is fully backed by C. Itoh's warranty and complete support organization. Contact C. Itoh Electronics, Inc. 5301 Beethoven St., Los Angeles, CA 90066 (213) 306-6700.

**C. ITOH ELECTRONICS, INC.**
One World of Quality

# HOW DO I LOVE YOU? LET ME COUNT THE WAYS.

# Literature

NEW PRODUCTS




## Brochure presents data comm products

A 12-page, color brochure, entitled "Guide to Local Area Networking," highlights the vendor's expanded data-communications product line. The short-form catalog presents an overview of PACX data-switching systems, modems, multiplexers and other local-area networking products. The brochure includes applications, diagrams and charts. **Gandalf Data Inc.,** 1019 S. Noel, Wheeling, Ill. 60090.

**Circle No** 329

## Software-development tool described in brochure

The TAPS transaction-processing application-development system that can be moved across a variety of mainframes, minicomputers and microcomputers is described in a 36-page brochure. The brochure reviews product features and includes a step-by-step example of how to develop an application. It explains how 80 percent of programming tasks usually required when building on-line systems can be eliminated by using TAPS. The brochure also describes a screen-painting capability and explains application of TAPS to distributed data processing and communications network management. **Informatics General Corp., TAPS Division,** 401 Park Ave., New York, N.Y. 10016. **Circle No** 330

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4650 W. 160th Street, Cleveland,
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CIRCLE NO. 147 ON INQUIRY CARD

# Literature

NEW PRODUCTS

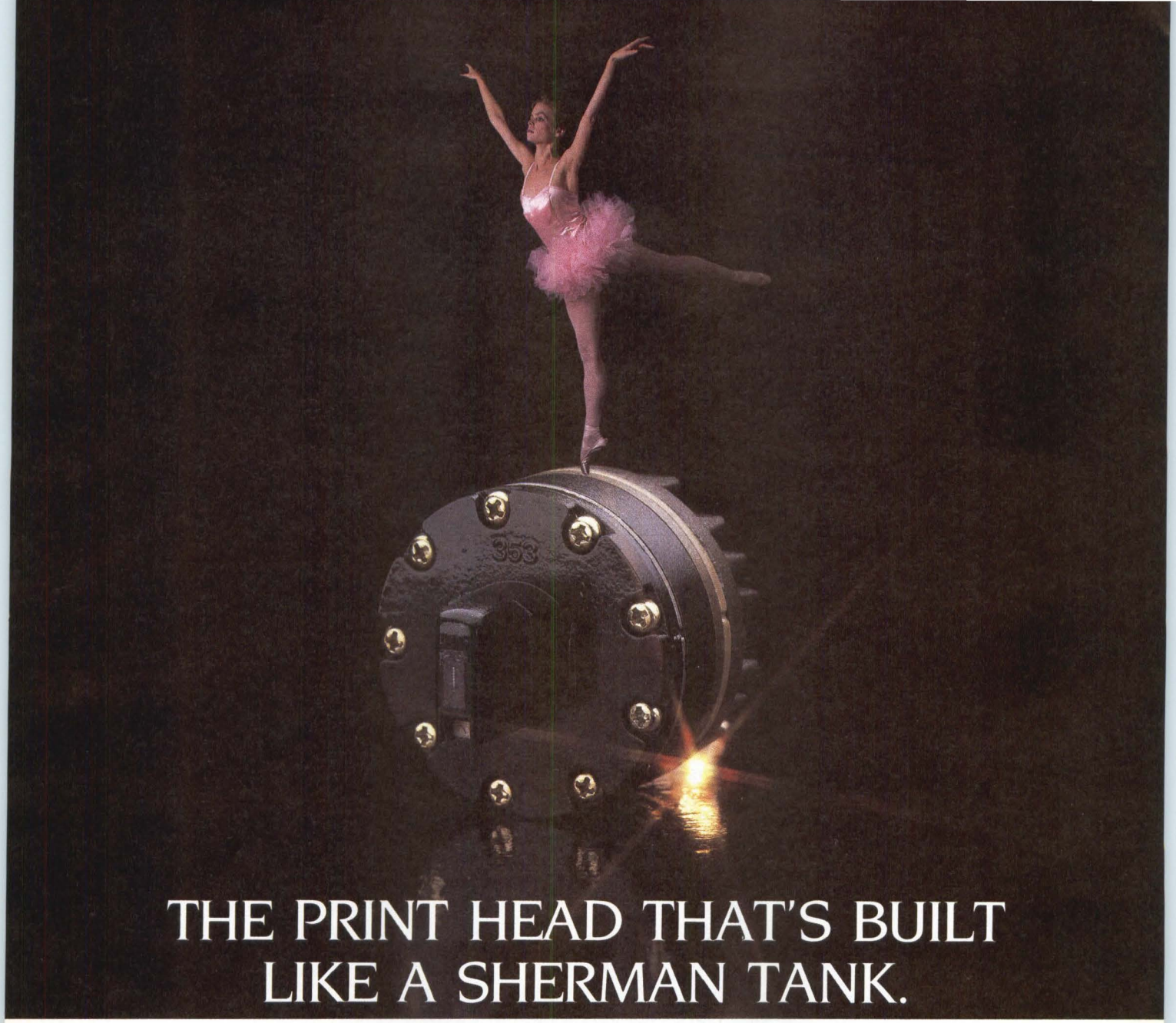
## LITERATURE THAT COSTS

### Catalog lists CP/M application software

The *CP/M Compatible Software Catalog,* published annually by Digital Research, Inc., the orginator of the CP/M operating system, provides information on many CP/M-compatible application software products produced by independent vendors. The 104-page catalog is divided into three parts. Section one alphabetically lists and describes first domestic companies and their products, then international companies and their products and ends with an index. Section two lists and describes products in detail according to Digital Research language compatibility. Separate language indexes are also provided. Section three lists companies by the specific application programs they produce. Price is $10. **Digital Research, Inc.,** P.O. Box 579, Pacific Grove, Calif. 93950. **Circle No** 331

### Books explore STD bus interfacing

Three new books in the Blacksburg Continuing Education Series are available. *Real-Time Control with the TRS-80,* a 116-page book priced at $14.95, guides a reader step-by-step through the elements needed to plan and develop a real-time data logging or control system. *STD Bus Interfacing,* a 286-page book priced at $13.95, describes this well-defined bus and shows readers how to interface it to various peripherals. The authors explain how to address various I/O devices, interface to input and output ports and nonstandard peripherals, decode and assign addresses and transfer data and control signal timing. *FORTH Programming,* a 246-page book priced at $13.95, examines the FORTH programming language. The FORTH-79 and fig-FORTH dialects are described, and their programming differences are identified. The book contains more than 50 programs that execute with little or no modification on any FORTH system. **Group Technology Ltd.,** P.O. Box 87, Check, Va. 24072. **Circle No** 332

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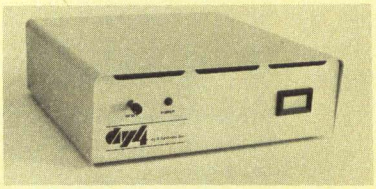

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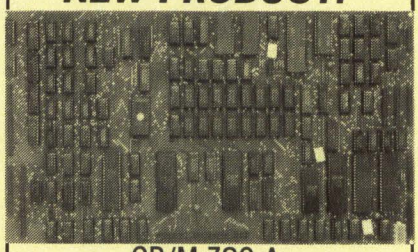

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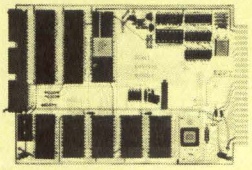

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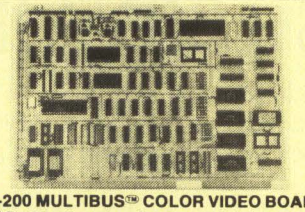

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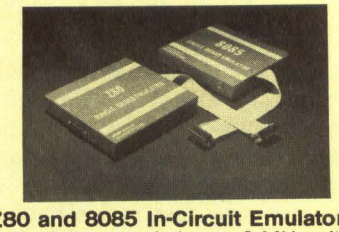

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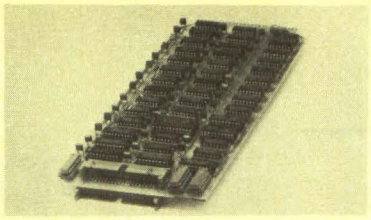

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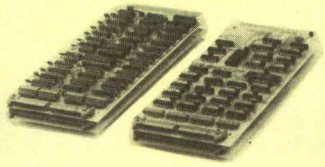

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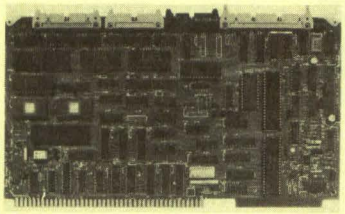

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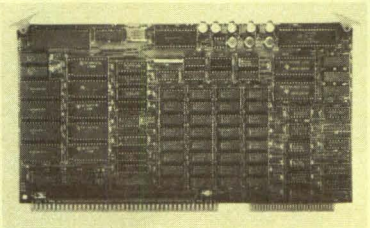

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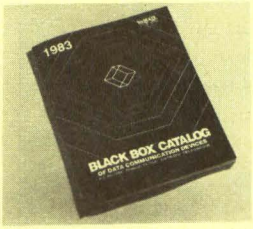


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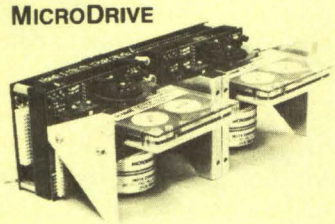

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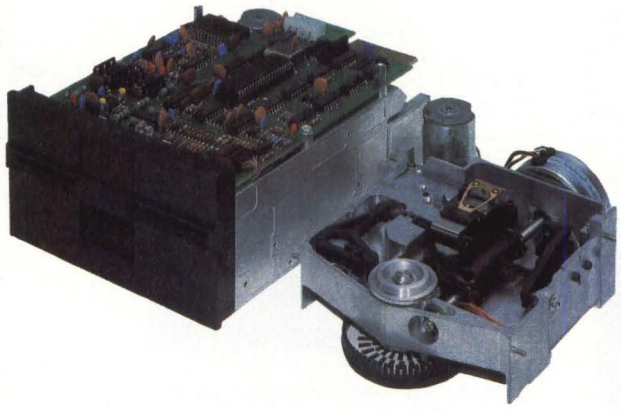

Left: Model 1115 with industry standard mounting holes and bezel. Right: Inner chassis, model 1105, available separately for integration into OEM systems.

Another plus—our drive is microprocessor controlled, so there are no electrical adjustments, time drifts or pot settings, and field replacement of the PC board is a snap.

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# Literature



## LITERATURE THAT COSTS

### Guide lists products for Timex/Sinclair computers

The 96-page *Timex/Sinclair Sourcebook* lists more than 600 application software packages, add-on hardware, books, catalogs and magazines available by mail order from more than 160 worldwide sources for the Timex/Sinclair family of microcomputers. Each listing includes the name of the product, a brief product description, media the product is supplied on, minimum equipment configuration required, price and ordering information. The listings are divided into nine categories including business, books/newsletters, education, games, hardware accessories and home/personal use. An alphabetical index of products concludes the guide. Price is $6.95. **Micro Design Concepts,** P.O. Box 280, Carrolton, Texas 75006.

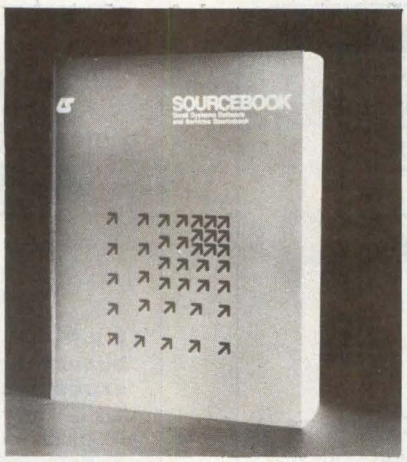
**Circle No** 333

### Reference source covers image-processing system

The 203-page *Digital Image Processing: a Systems Approach* examines all essential techniques of designing, implementing and maintaining computer-based digital image-processing systems. Numerous diagrams and almost 100 illustrations of techniques and hardware components are included. The illustrations and block diagrams demonstrate various current and future computer peripheral devices. Also included are before and after image-processing examples from earth resource evaluation, medical, astronomical and weather- and climate-analysis applications. Price is $34.50. **Van Nostrand Reinhold,** 135 W. 50th St., New York, N.Y. 10020. **Circle No** 334

### Library provides how-to guide for DP

The Auerbach Data Processing Management Library contains eight how-to books for data-processing professionals and managers. Each 150-page book contains tested, practical solutions to data-processing management problems in data communications, system development, distributed processing, database management, electronic data-processing auditing, computer programming, data-center operations and general data-processing environments. The library covers the latest trends and technologies. It is priced at $79.95, and single copies are priced at $11.95 each. **Auerbach Publishers, Inc.,** 6560 N. Park Dr., Pennsauken, N.J. 08109. **Circle No** 335




### Directory compares software alternatives

The 500-page *Small Systems Software and Services Sourcebook* helps buyers determine which programs to use for their applications and equipment. The directory details the applications and limitations of approximately 1300 programs for small-business computers. The report covers business applications, legal, accounting, report generators, program development aids, file managers and word-processing programs. It gives information on hardware, operating-system and language compatibility; price; training availability; and the names, addresses and telephone numbers of each vendor. Data on related services, such as consultants and time sharing, are also included The directory is available at a one-year subscription rate of $125. **Information Services, Inc.,** 1807 Glenview Rd., Glenview, Ill. 60025. **Circle No** 336

### Primer covers 8086/8088 micro

The revised edition of the *8086/8088 Primer* introduces Intel's 8086 and 8088 microprocessors. The 288-page book covers 8086 architecture, system design and programming. The book offers a technical and historical perspective of microcomputers with emphasis on the 8086; microprocessor architecture; and 8086/8088 machine organization, register and memory structure and addressing modes. It also explains the 8086/8088 instruction set and shows how to put the 8086 and the 8088 together with other components to form a complete system. Assembly-language programming and high-level-languages programming for PL/M-86 and Pascal are also discussed. Single-copy price is $10.95. **Hayden Book Co. Inc.,** 50 Essex St., Rochelle Park, N.J. 07662.

**Circle No** 337

### Booklets introduce personal computers

Two 50-page, color guidebooks introduce personal computers for homes and businesses to inexperienced users. *The Personal Guide to Personal Computers* explains in easy-to-understand terms how personal computers are used in the home, how they work and how to choose one. A glossary of frequently used computer terms from "acoustic coupler" to "word processing" is included. Price is $1.95. *Personal Computers in Business* introduces managers, professionals and small-business owners to personal computers as business tools. Helped by color photographs and illustrations, the booklet explains how personal computers are used in offices, how they work, how to plan for them, where to shop for products and services and how to estimate costs. A special section explains tax benefits to business users of personal computers. Each booklet sells for $2.95. **Apple Computer, Inc.,** 20525 Mariani Ave., Cupertino, Calif. 95014.

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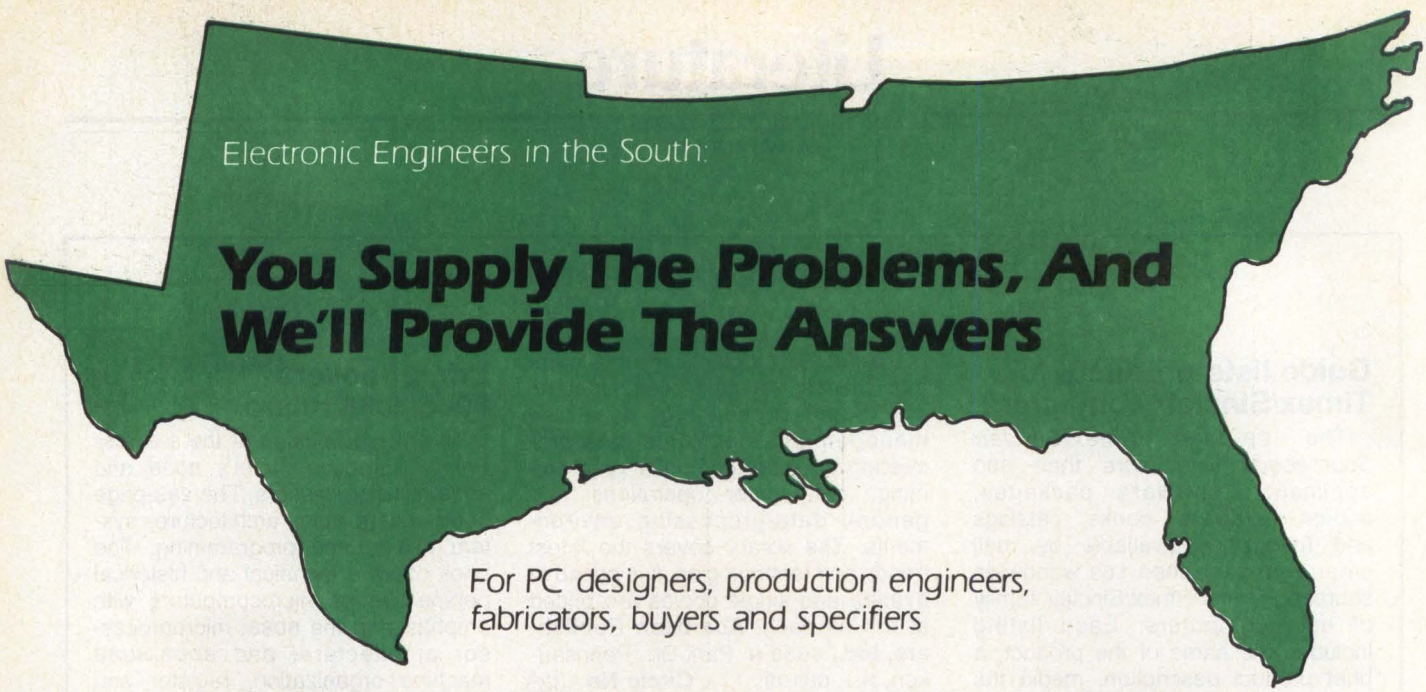

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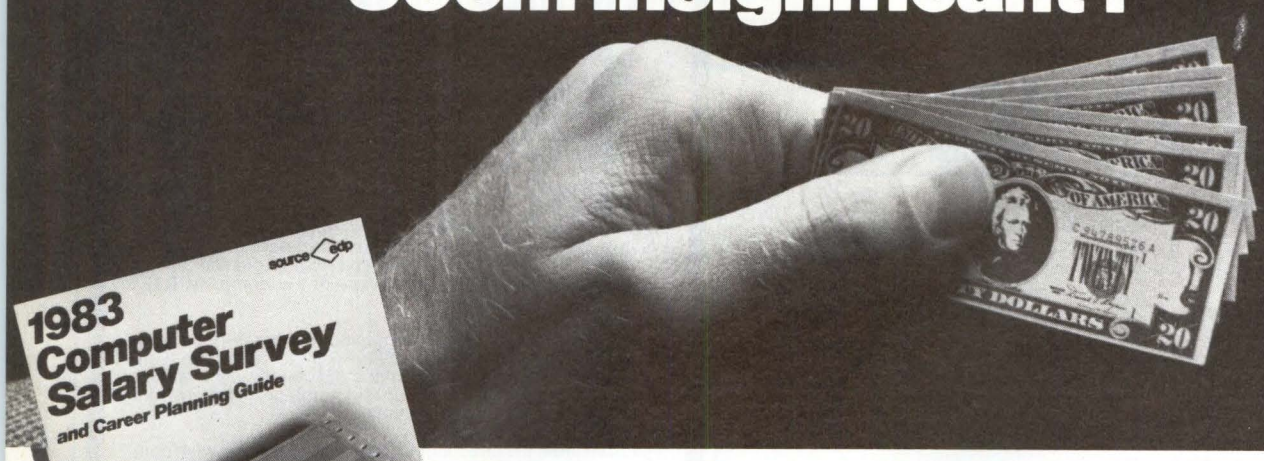

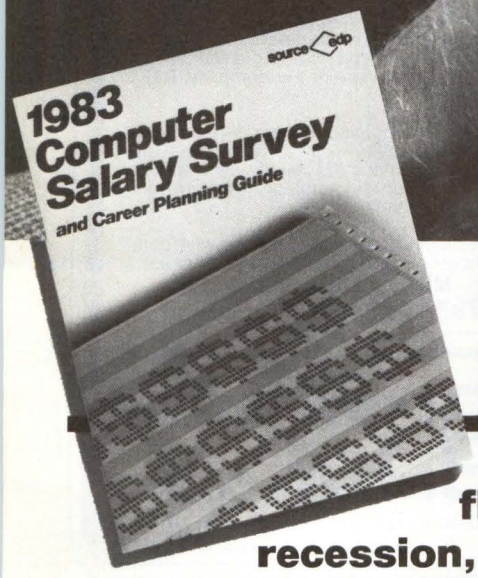


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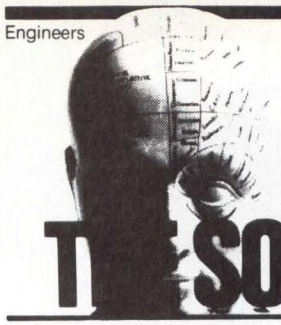


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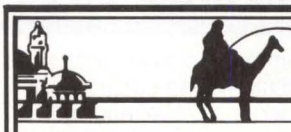


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# Advertisers Index




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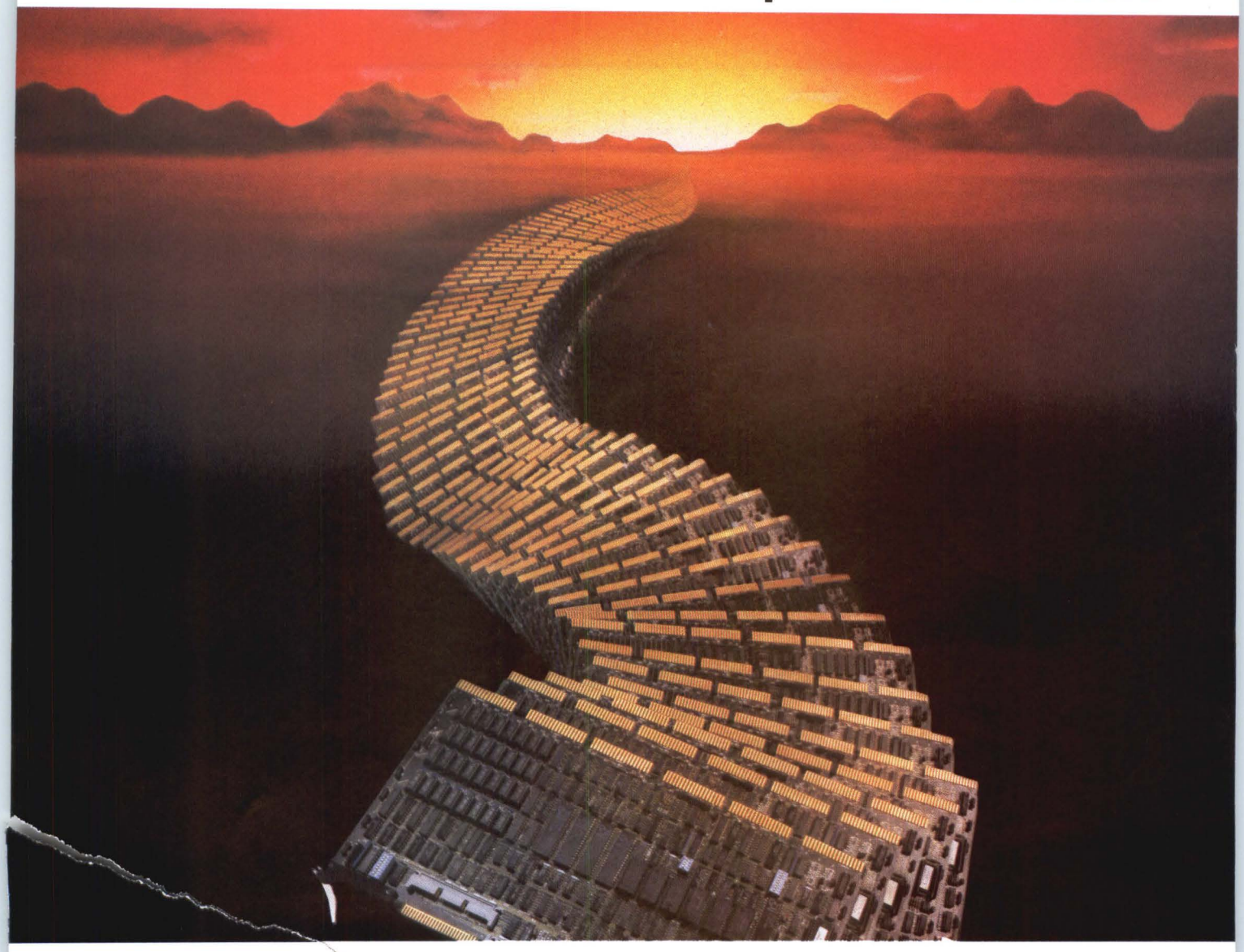

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