Mini-Micro Systems

A CAHNERS PUBLICATION

SEPTEMBER 1983

Developing structural programs with MODULA-2

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Flat-panel displays gain edge

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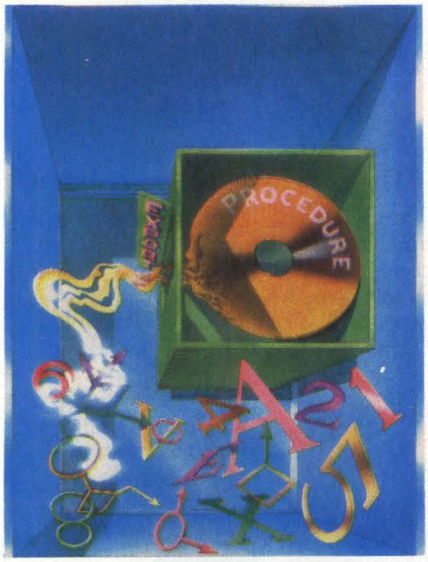
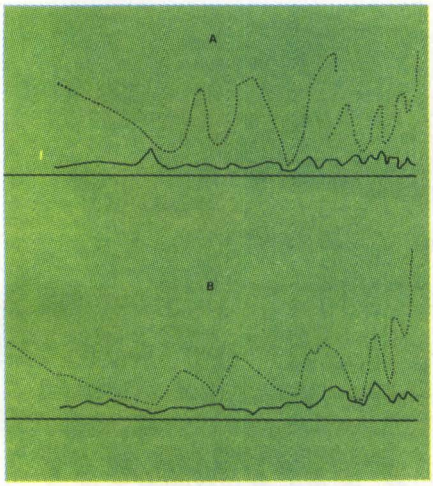


p. 183 . . . . Modula-2 combines new design concepts and Pascal's structure. Art direction by Vicki Blake, illustration by Roger Leyonmark.

p. 97 . . . . Software upgraded by Japanese



p. 127 . . . . RFI regulations soon to be final

MINI-MICRO WORLD

News

Data General desktop systems aim at PCs and supermicros (p. 21). . . Wyse 14-inch low-end terminal sets new price floor (p. 25). . . Harris-Intel CMOS alliance produces low-power 8086 (p. 28). . . Hong Kong firm gears up for IBM 4-inch floppy drive, may reap 'Peanut' harvest (p. 32). . . Heard on the Hill: Liberalizing trade with China will take time (p. 44). . . Start-up uses sputtered thin-film media for high-performance 5¼-inch drive (p. 46). . . WP package for IBM PC seen as 'leading-edge' product (p. 44). . . Start-up beats big guns to market with NAPLPS, ASCII-compatible terminal (p. 46). . . OEMs award good marks to Delphax non-impact printers (p. 48). . . Wang hopes to lower systems cost with 64K-byte DRAM (p. 56). . . Honeywell touts product compatibility for DPS micro (p. 63). . . LinkData aims IBM MC68000 system at DIBOL market (p. 70). . . A.B. Dick takes shot at VAX market with 32-bit UNIX mini (p. 70). . . Videotex, teletext applications grow despite questions about market (p. 78)

Corporate and Financial

Guest Forum: The impending death of dedicated word processors (p. 85). . . Centronics looks for revival with new line printer (p. 85). . . Corporate and financial briefs (p. 86)

International

Japanese independent software vendors push joint ventures with hardware makers (p. 97). . . Renewed trade act triggers U.S.-Europe export row (p. 102). . . Overheard Overseas: Beating the bushes in a $50 billion market (p. 107). . . Optical disks, microcomputers hold spotlight at Tokyo OA show (p. 108). . . European firms target UNIX business market (p. 110)

INTERPRETER

121 Price cuts generate activity in flat-panel display markets
127 Manufacturers work out last RFI kinks as final FCC deadline approaches

SYSTEMS IN MANUFACTURING

141 Automated material-handling systems streamline management of goods and information
155 IBM's largest educational grant is aimed at upgrading manufacturing technology
157 HP and Fluke introduce microcomputers for factory testing
162 Infosphere unveils software-development system for industrial applications

FEATURES

169 **Feature Highlights**

172 **Minicomputer spreadsheets take advantage of hardware capabilities**. . . mini packages are keeping up with the second generation of micro spreadsheets.

183 **Modula-2: Pascal's powerful heir**. . . new language merges modularity with Pascal's data and control structures.

191 **Capitalizing on the microcomputer software boom**. . . software developers can gain a foothold in this burgeoning market in a variety of ways.

197 **Extending UNIX to local-area networks**. . . ALTOS-NET II software allows user-transparent access to remote files and processors.

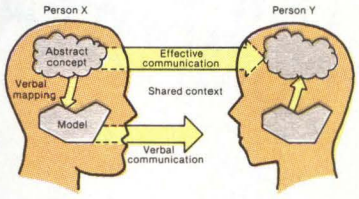
207 **Computers simulate human experts**. . . 'knowledge engineering' opens the door to an exciting new world of computer applications.

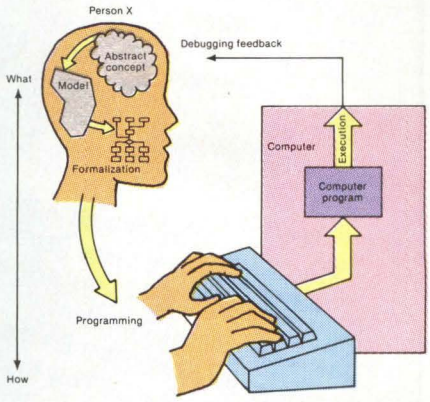
217 **Universal diskette reader resolves different formats**. . . the Trans/Media 500 bridges system boundaries.

225 **Fiber optics shine in local-area networks**. . . lasers are lighting the way for communications.

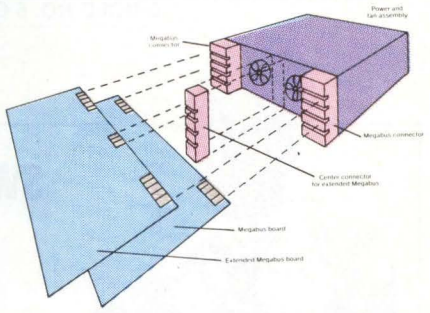
235 **Extending the Megabus**. . . enhancements boost 16-bit bus performance.

243 **OCR page reader eases word-processing bottleneck**. . . desktop unit formats text for word processors.





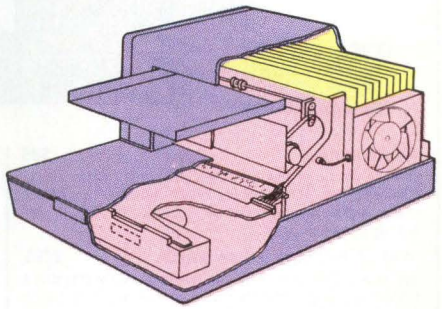
p. 207. . . . . "Expert systems" are diverse



p. 235. . . . . Growth extends Megabus

DEPARTMENTS

4 Editorial Staff
7 Editorial
9 Publisher's Letter
11 Breakpoints
91 Box Score
250 Calendar
257 New Products
283 Mini-Micro Marketplace
286 Classified Advertising
287 Career Opportunities
292 Index to Advertisers



p. 243. . . . . OCRs attract new interest

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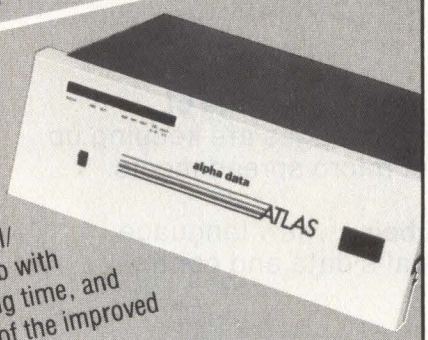

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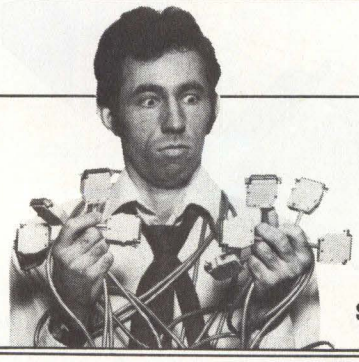

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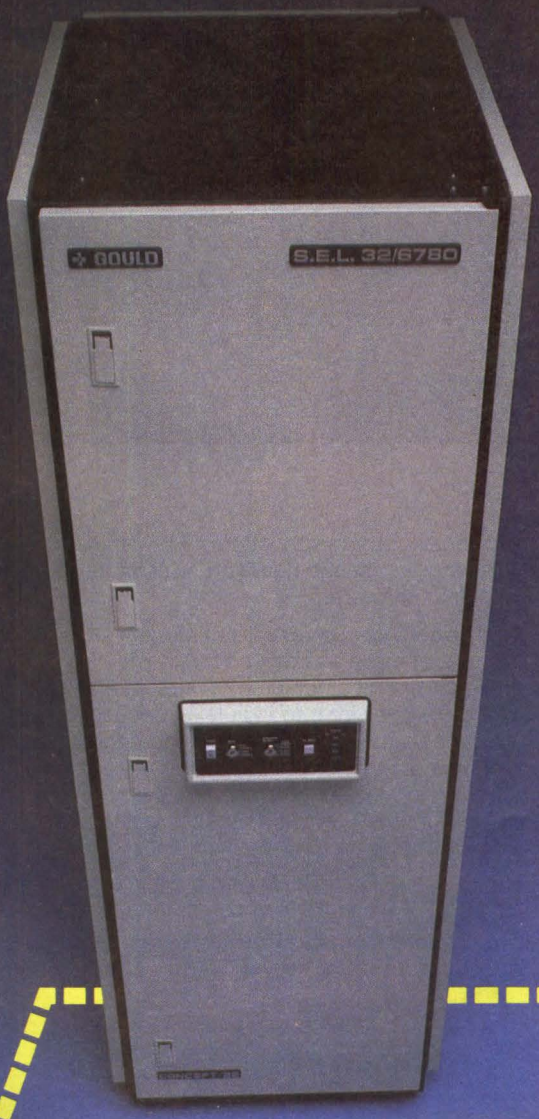

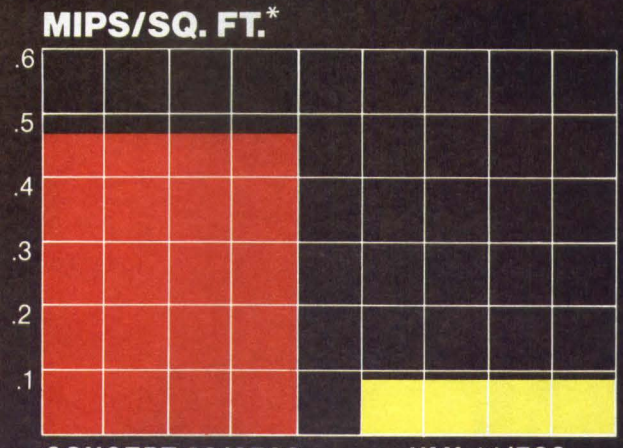

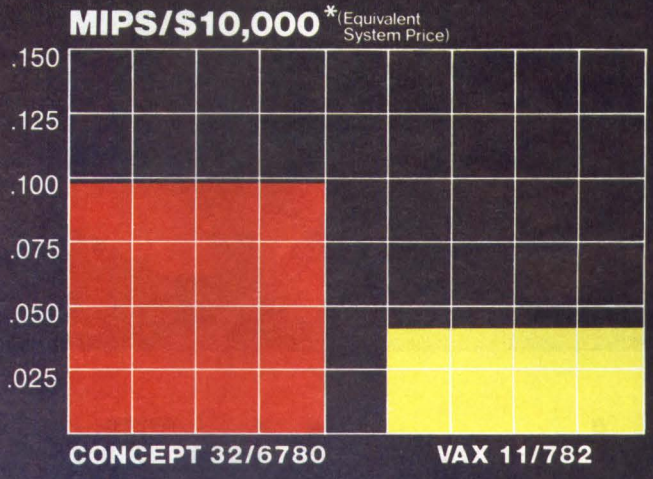

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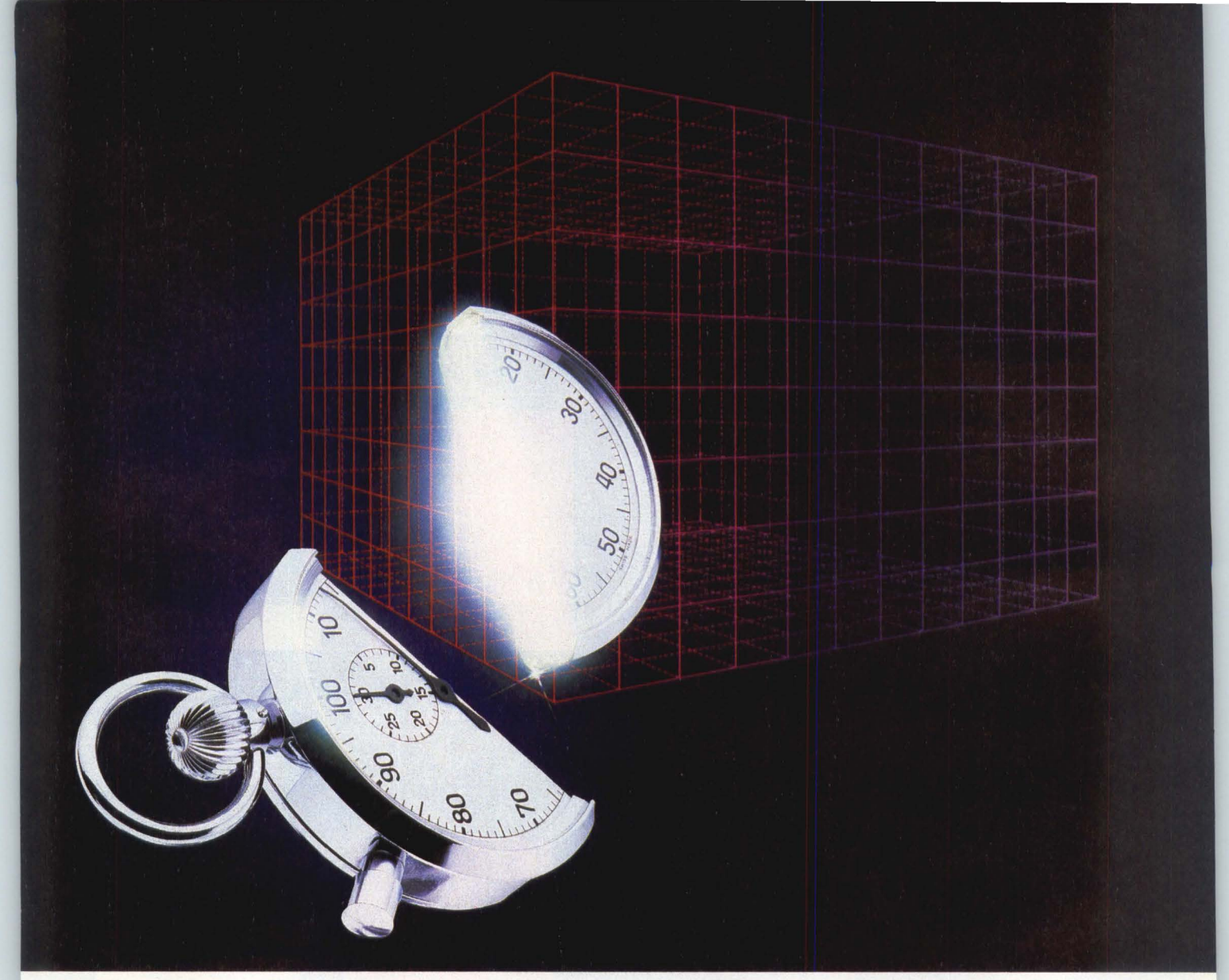

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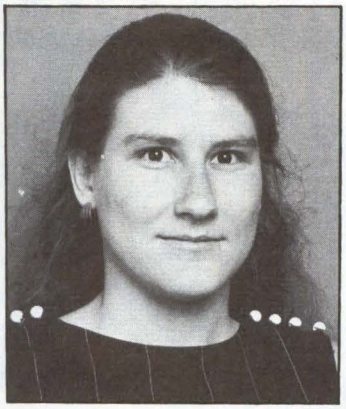
Editorial

Mending U.S./Japan fences



To date, U.S./Japan joint ventures in software marketing have been strained because of cultural and business differences. The highly competitive worldwide market for business microcomputers and application prompts a re-evaluation of why East/West cooperatives generally have been unsuccessful.

Now, business software-development efforts by Japanese independent software vendors (ISVs) lag behind the available hardware—let alone developments for export. U.S. software firms also trail in generating Japanese packages.

The immediate requirement for software firms trying to sell business applications in Japan centers on Kanji character support. To meet this need, U.S. suppliers that attempt mere modifications of their packages for Japanese businesses won't find as lucrative a market for their products. For example, packages commonly require major revisions because of the way Kanji is entered into a computer. One input method calls for an alphanumeric-type keyboard of Katakana phonetic characters. These 8-bit characters get translated into Kanji words through a database dictionary. Then the correct Kanji word is selected from the display. Consequently, typical 7-bit U.S. ASCII programs cannot support Katakana or Kanji.

Addressing software technology differences is only part of a successful U.S./Japan joint-venture operation. General work practices differ markedly. For example, most Japanese ISVs have made little progress in working closely with Japanese manufacturers on prototype hardware, although subcontract work on existing models is gaining in popularity.

For their part, Japanese ISVs are pushing to improve the quality of business software packages. On another front, the 10 or so multiproduct IBM-sized Japanese computer firms are exploring standardized software. NEC Corp., for example, introduced its advanced personal computer in the U.S. with CP/M-86, and later with MS-DOS and the p-system.

Other Japanese firms have supported standardization efforts as well. Those firms typically have U.S. marketing or software-development facilities, which prove expensive. Moreover, U.S. firms wishing to set up an operation in Japan find it can cost as much as $1 million in the first year, mostly for rental space.

It's important to take an aggressive worldwide product stance in the face of numerous newcomers with microcomputers. Joint ventures appear to be the best answer. East/West ventures can capitalize on the software expertise of the United States, Japanese ISV's knowledge of user needs and Japanese manufacturers' expertise in producing low-cost, precision microcomputer hardware products.

To promote joint ventures and idea exchanges, *Mini-Micro Systems* magazine and the Technology Transfer Institute are sponsoring a joint study mission to Japan in December to learn about U.S./Japanese microcomputer software. For more information on participating in this study mission, contact Hideaki Hashizume, General Manager, TTI, 1 Penn Plaza, Suite 1411, 250 W. 34th St., New York, N.Y. 10119, (212) 947-2648.

Lori Valigra

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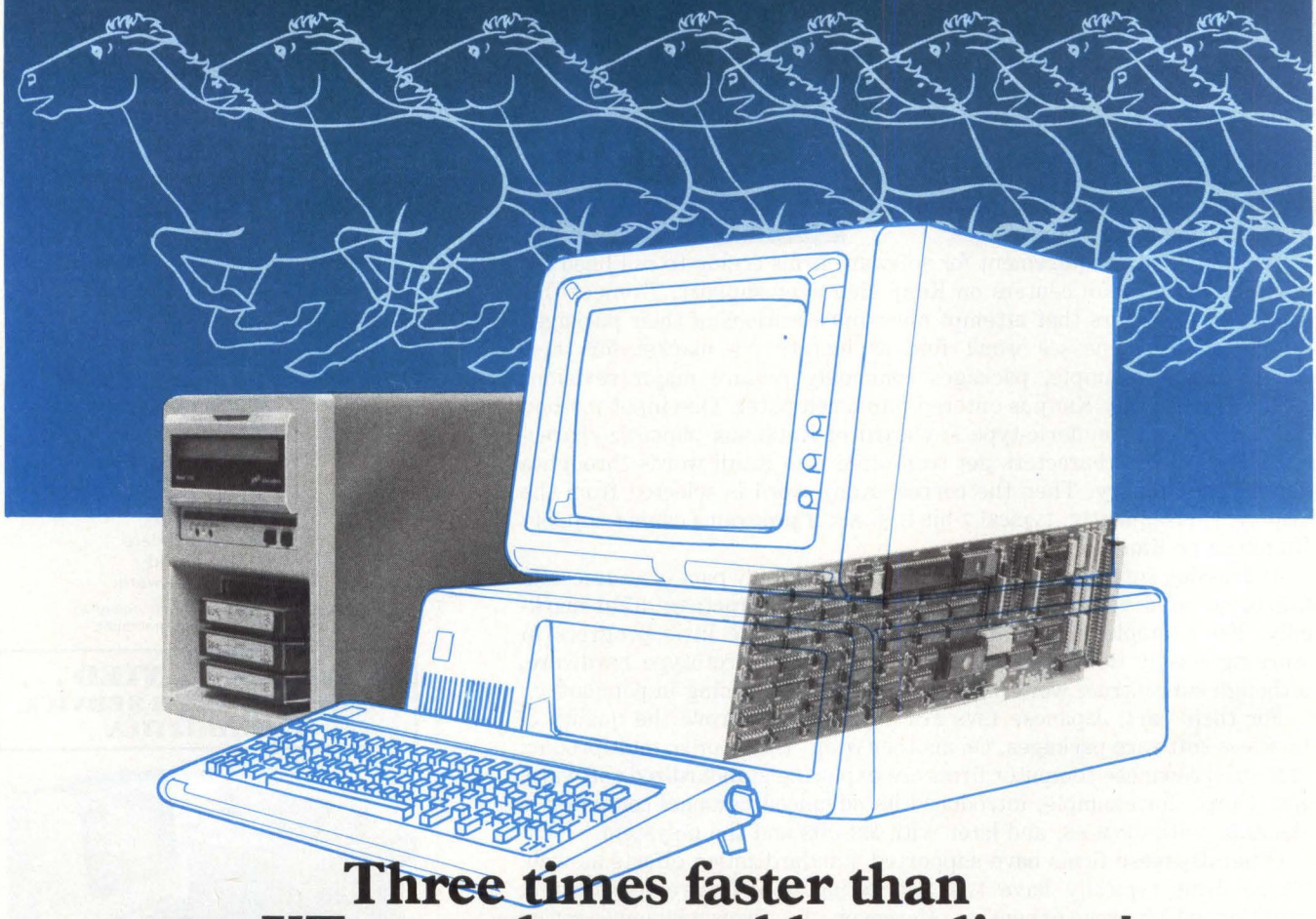

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Publisher's Letter

Expanding our staff

Last month, I introduced our new editor-in-chief and new managing editor along with two other additions to the editorial staff of *Mini-Micro Systems*. So it may be a surprise to discover that I'm right back again introducing new editorial staff additions. But *MMS* is determined to bring you the best editorial product possible. Thus, I am pleased to introduce five new additions. First, a new associate editor, David Simpson, who comes to us from GML Corp. where he was editor of the *Computer Review*, a series of hardware reference books. He also managed the firm's on-line product database service for subscribers to *Computer Review* and *Minicomputer Review*. Simpson has previously written articles for many publications including *MMS*.

Another new associate editor, Jesse Victor, has more than 10 years of technical editing experience. Before joining *MMS*, Victor was senior staff editor of *EDN* magazine, a sister Cahners publication. During his five years at *EDN*, he wrote technical news articles, wrote and edited technical features, produced a column on technology/marketing trends and edited a column dealing with significant computer/electronic legal issues, for which he was nominated for the Jesse K. Neal Award. Victor's other editorial experience includes technical editor of *Telecommunications* and writer/editor for *Computerworld*.

Also joining *MMS* recently is Roy Friedman, associate editor. Roy was a senior software engineer at Computervision Corp. where he was responsible for developing programming languages, compilers and software tools. One of Roy's major writing assignments at *MMS* is to cover developments in systems software.

Another addition to the editorial staff is Adrienne DeLeonardo, who has been with the magazine since June 1982. She has now been promoted to assistant editor/researcher with the responsibility of maintaining our editorial product database.

Last but not least, is our new copy editor, Susan Hughes, who was formerly assistant to the publisher at *EDN*. Before that, Susan was a staff assistant on *Horticulture* magazine.

We are still searching for additional editorial talent to support and maintain the largest editorial staff of any computer monthly publication.

S. Henry Sacks

S. Henry Sacks
Vice President/Publisher

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The eyes have it. Now the best-looking terminals are the best terminals to look at because they're in Ampex amber. Why amber? Because recent scientific research proves it to be 25% more relaxing on the eyes than green*. As a result, West Germany, Norway and Sweden already prefer it in the workplace. And Ampex offers it as standard on our new Emulation Plus terminals. They not only emulate twenty models of other major manufacturers, they also offer you the amber the others don't. Open your eyes to amber. Call 213-640-0150. Ampex Corporation, Memory Products Division, 200 N. Nash St., El Segundo, CA 90245.

*Data available on request.

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We've brought word processing to the big screen.

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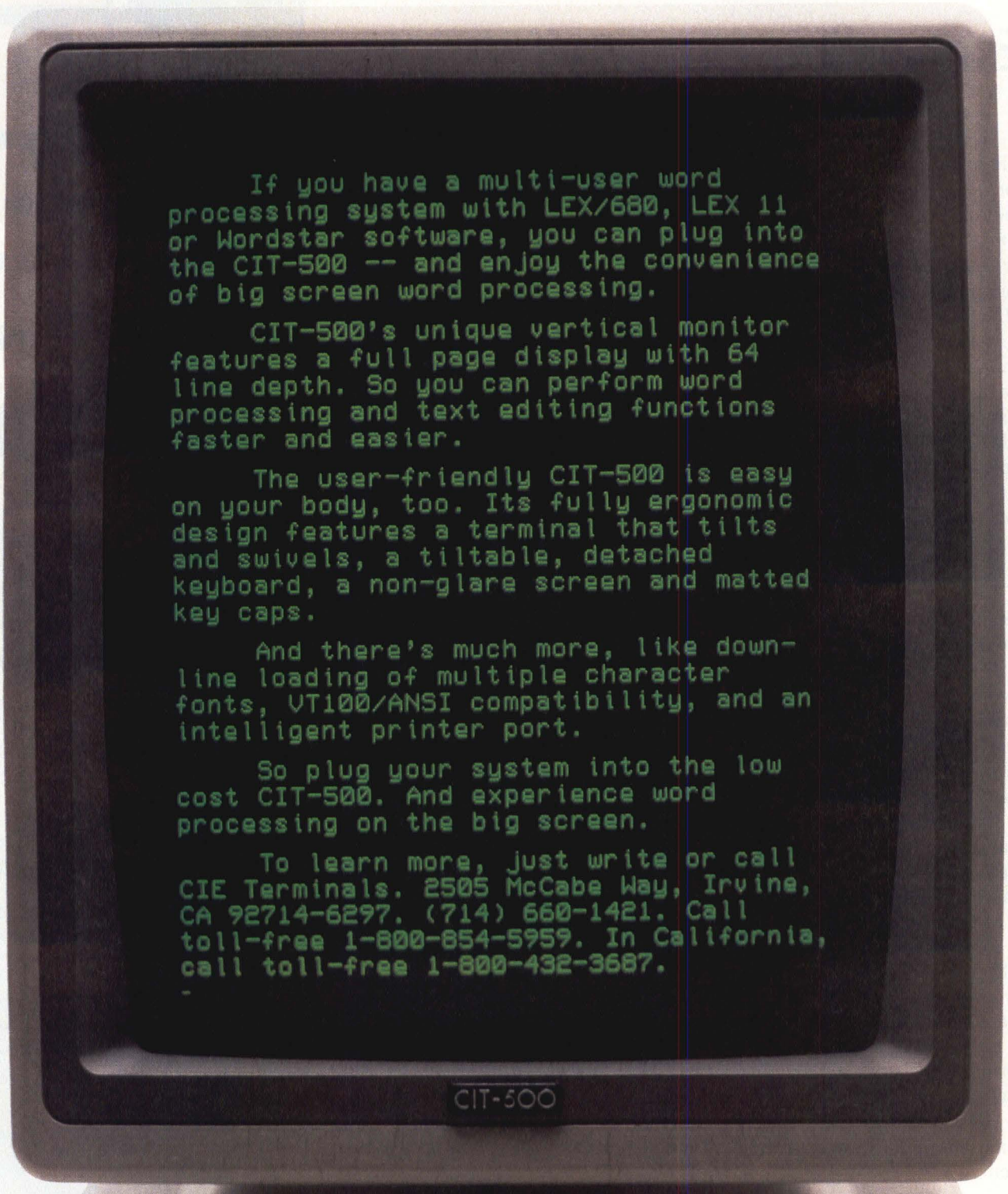

CIRCLE NO. 12 ON INQUIRY CARD

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Breakpoints

CONVERGENT LAUNCHES KNEE-TOP, DESKTOP COMPUTERS

Convergent Technologies Inc. is tossing its hat into the knee-top computer ring with WorkSlate, the first product from the Advanced Information Products division. At $895, WorkSlate is positioned as an executive portable with a proprietary operating system and several application packages for calendar, memo, client billing and telephone functions. Although priced to compete with products such as Radio Shack's model 100 and the Epson HX20, the Convergent product is aimed at a more exclusive audience: it will be featured on the cover of American Express Co.'s Christmas catalog. A follow-on product based on the same Hitachi 6303 CMOS version of the Motorola 6800 should emerge next year. That product, called WordSlate, will include a word-processing program. Meanwhile, back in the workstation market in which Convergent made its name, the so-called "N-Gen" Intel 80186-based replacement for the current 8086-based AWS/IWS series is slated for introduction next month. OEM Gould S.E.L. has already introduced the product (MMS, July, Page 20). The cost of the new product lines—and the previously introduced Megaframe series—is taking its toll on earnings, which Convergent officials say will suffer a "substantial" decrease in the fourth quarter.

MS-DOS PC IS EXPECTED FROM HEWLETT-PACKARD

Hewlett-Packard Co. has manufactured personal computers for the past two years with little impact on the market. But now the company has solidified its various operations into the Personal Computer Group, which it expects to launch along with a new product in October. The new system will run on MS-DOS, but it will not be truly compatible with IBM Corp. systems because it will implement Sony Corp. of America's 3½-inch microfloppy. Expected price is less than $3,000 for a configuration that includes two disk drives and a new touch-screen CRT.

MEMOREX DENIES INVOLVEMENT WITH TANDON, DEC ON ½-IN. TAPE STANDARD

Memorex Corp. vigorously denies association with Tandon Corp. and Digital Equipment Corp. on a ½-inch tape-cartridge standard (MMS, July, Page 7). Thomas Popek, vice president and general manager of the Memorex Computer Tape division, reports that, although the company has an interest in the low-end market for ½-inch tape drives, it is not working "in combination with DEC and Tandon." Spokesmen for both Tandon and DEC refuse comment on reports that DEC will endorse a design similar to Tandon's new non-standard, 50M-byte, ½-inch tape cartridge.

DEC MOVES AHEAD WITH UNIX PROGRAM, SIGNS HORIZON PACKAGES

DEC is preparing to fulfill its promise to adopt the UNIX operating system under a new program called Ultrix. An early step in the Ultrix program is a contract that DEC signed with Horizon Software Systems Inc. to provide word-processing and spreadsheet applications for the V7M-11 UNIX-like package that DEC supports on the PDP-11 series. Horizon is the first DEC-certified software supplier in the Ultrix program, but others are expected to follow with broad-based tools such as database-management systems. The company is still working toward a year-end deadline for getting a full UNIX package up on the VAX superminicomputer and on a UNIX package for the LSI-11-based Professional 350 personal computer. DEC has evaluated several third-party PDP-11 UNIX packages, including Venix from VentureCom Inc., for the desktop micro, but DEC sources say that a version of the DEC V7M-11 package for the system is likely to emerge this winter.

IDS, DATAPRODUCTS DOT-MATRIX PRINTER ACTIVITIES WILL MERGE

This month, Integral Data Systems Inc. (IDS), Milford, N.H., and Dataproducts Corp.'s Serial Printer division will merge to form the Dataproducts Serial Printer group, states IDS president August P. Klein. Products will be renamed to reflect a cohesive dot-matrix line. The former IDS group is expanding its 60,000-square-foot New Hampshire facility

by 100,000 square feet. It plans a 50:50 retail/OEM ratio by January. Current retail/OEM ratio is 95:5. An upcoming matrix printer with improved print quality will support this shift. The printer employs an 18-wire head in two staggered arrays of five and four pins plus a sheet feeder at the bottom of the printer.

UNISOURCE PLANS DISTRIBUTION OF UNIX PACKAGES TO LARGE IBM PC END USERS

Start-up Unisource Software Corp. has signed an exclusive agreement with VentureCom to distribute VentureCom's Venix package to IBM PC and XT users. Dick Churchill, former vice president of software at DEC systems house Cambridge Digital, has launched the new venture, which is aimed at supplying UNIX packages to major end users. Price of the VentureCom package is $800 for single-user versions or $1,000 for multiuser versions. The package was scheduled for shipment in August—reportedly six to eight weeks before Microsoft Corp.'s delayed release of XENIX for the PC. Churchill reports that Unisource intends to address the end-user UNIX market in the same way that Lifeboat Associates addressed the CP/M market—providing direct support, documentation and product certification. Unisource is concentrating on major accounts users but may branch into dealer sales.

BROTHER TO OFFER LOW-COST DAISY-WHEEL PRINTER

Brother International Corp., Irvine, Calif., plans to introduce a low-cost daisy-wheel printer. The company will most likely unveil the 23-cps HR-25 at November's Comdex Show, and volume deliveries are expected early next year. Price of the new product, which is positioned in the volatile low-end daisy-wheel market, has not been set but is expected to be less than $1,000.

MASSCOMP ENTERS CAE WORKSTATION MARKET

Masscomp, Littleton, Mass., is expected to announce the WorkStation 500 32-bit virtual-memory, computer-aided-engineering (CAE) workstation this month. The system is intended to compete with Apollo Computer Inc.'s Domain workstation. The WorkStation 500 runs UNIX and is compatible with Masscomp's MC-500 scientific computer, which was introduced last year. The system incorporates a 10-MHz 68010 virtual-memory processor linked to a 10-MHz 68000 processor via an 8M-byte-per-second memory bus. Price of a typical configuration, including a CPU, 1M-byte of error-correcting memory, an eight-slot backplane, a 51M-byte Winchester disk drive, a ¼-inch streaming tape-cartridge drive, a 19-inch color display, a floating-point/array processor and RTU UNIX with C, is $29,585 in quantities of 100. Volume shipments are set for January.

MS-DOS COMPUTER EMULATES DEC, HP TERMINALS

Direct Inc., Santa Clara, Calif., has introduced an IBM-compatible personal computer that also emulates DEC VT100 and HP 2622, 2624 and 2645 terminals. The Series 1600 incorporates a proprietary bus, runs MS-DOS and is based on an 8088 processor. Standard memory is 128K bytes, expandable to 256K bytes. Terminal display memory is 64K bytes. Two 320K-byte, 5 ¼-inch floppy disk drives are standard, and 10M- and 20M-byte integrated hard disks are optional. The 12-inch monitor has a resolution of 800 by 312 dots per inch (dpi) and a detachable keyboard. Two RS232 asynchronous ports are standard, and two asynchronous/synchronous RS232 ports, a 212A-compatible modem, PLOT 10 graphics software and CP/M-86 support are optional. List price for each model is $23,995, with volume discounts available. Delivery time is 60 days after receipt of order.

ZENTEC DELAYS PRODUCTION OF PEACOCK TERMINAL

Zentec Corp., Santa Clara, Calif., is postponing production of its first color graphics terminal, the Peacock, which the company introduced at June's National Computer Graphics Association (NCGA) show. A company spokesman says Zentec wishes to re-

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PLESSEY'S DEC-COMPATIBLE MEMORIES

		CPU									BUS		CAPACITY				PARITY		ECC	ADDRESSING		BOARD SIZE	
MODEL	TYPE	LSI-11/2	LSI-11/23	LSI-11/23+	PDP-11/24	PDP-11/34	PDP-11/44	PDP-11/70	VAX-11/730	VAX-11/750	VAX-11/780	Q-BUS	UNIBUS	EXT. UNIBUS	MEM. BUS	32K	64K	128K	256K	512K	768K	1.0M	On-Board Parity	Bits Only	Non-Parity	16-bit	18-bit	22-bit	Dual	Quad	Hex
SV32AP	MOS	●	●								●					●	●						●	●		●	●	1			
SV128A	MOS		●	●							●						●	●				●	●	●		●	●	1			
SV512	MOS		●	●							●						●	●	●	●	●	●	●	●		●	●		1		
S11L/F	MOS				●	●	●					●	●			●	●	●				●	●	●		●	●			1	
S11E/4	MOS				●	●	●					●	●			●	●	●	●			●	●	●		●	●			1	
S750	MOS							●	●	●					●			●			●			●	●					1	
✓ S780	MOS										●				●			●						●	●					1	
1116B	CORE				●							●				●								●		●	●			1*	
1132A	CORE				●							●					●							●		●	●			1*	

*Memory is contained on a single board but requires space of two slots due to stack overhang.

✓ Check this one: about ⅓ the price of the DEC equivalent!

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evaluate the product's design and price for at least 45 days. Sources outside Zentec suggest the price of the Peacock—roughly $7,000—will have to be reduced by at least $2,000 to compete with products from more established graphics terminal companies. Zentec is reportedly experiencing considerable personnel turnover in its graphics and systems division since the acquisition of Shasta General Systems, a distributor of multiuser software. Shareholders are awaiting word on second-quarter earnings, which many believe will reflect substantial losses on Zentec's Series 2000 business system.

START-UP SABER ANNOUNCES HIGH-RESOLUTION DISPLAY TERMINAL

San Jose, Calif., start-up, Saber Technology Inc., will introduce its first product—the ST31064 high-resolution color graphics terminal—this month. Price is $3,120 in quantities of 500 to 1,000. The 19-inch diagonal ST31064 has a resolution of 1,280 by 1,024 dots per inch (dpi). The terminal employs Saber's proprietary circuit technology, quasi saturated emitter (QSE) logic. According to Saber, QSE logic allows full resolution and brightness in a normal office environment. The ST31064 is expected to be followed in the first quarter of 1984 by a monochrome unit with a resolution of 1,664 by 1,248 dpi and in the second quarter with a color version having the same resolution.

TECHFILES: A quick look at industry developments

Random disk files: In what could be an unusual cooperative effort, **rivals Seagate Technology and Tandon Corp. are expected to support an ST-506/412 interface derivative for high-capacity 5¼-inch Winchester disk drives.** A Seagate spokesman confirms that the company will make an announcement about the interface this month but refuses to comment on Tandon's role. A Tandon spokesman also declines comment. The two giants in the low-end, 5¼-inch Winchester OEM market have been noticeably absent from discussions surrounding the enhanced small disk interface (ESDI) promoted by Maxtor Corp. and others. They were also missing from a forum last month seeking to bring the American National Standards Institute's standard for 8-inch drives to the 5¼-inch form factor....Another proposal at last month's forum received a warmer reception. Forum sponsors **Priam Corp. and Xebec Corp. have provided initial funding of a testing agency, dubbed Disc Labs Inc., which will act as a clearinghouse for 5¼-inch Winchester controller and drive interface adherence.** Priam president William Schroeder says the testing lab indicates a new "industry maturity" to benefit end users. Based on the idea of Underwriters Laboratory, Disc Labs will certify drivers and controllers to meet interface standards....**Tulin Inc.** San Jose, Calif., founded by the former president of Rotating Memory Systems Inc. (now Disctron), Joe Tung, **should begin shipping evaluation units of its half-height, 20M-byte, 5¼-inch drive in October.** It is expected to follow shortly thereafter with a 40M-byte drive. The 20M- and 40M-byte drives use two and three platters, respectively....**Tandberg Data,** Oslo, Norway, and **Data Electronics Inc.** (DEI), San Diego, Calif., have announced a sharing of ½-inch tape drive technology that is expected to culminate in a 100M-byte drive by the first quarter of next year. Under the agreement, DEI will have the rights to Tandberg's proprietary head technology, and Tandberg will receive DEI's expertise in cartridge design....**DEC** may have taken a large step toward a plated-media source as the result of a contract with Evotek Corp., a manufacturer of 5¼-inch, high-capacity Winchesters and media. The multimillion-dollar, two-year contract calls for deliveries of Evotek's 31M-byte Winchester and media.

Micro files: Apple Computer Inc. did not make its expected announcement of the MacIntosh personal computer last month at a meeting of security analysts. Apple's new president, John Sculley, indicated that new products using Apple's 68000 technology would not be announced until next year. The company will use its annual meeting in January to announce the MacIntosh, as it successfully did last year for Lisa. Apple also plans some adjustments—possibly bundling of accessories—in the IIe product line because of expected Christmas competition from IBM Corp.'s "Peanut" personal

computer. The Peanut announcement is expected this month. However, some Apple dealers believe they will suffer margin losses if accessories—traditionally high-profit items—are bundled into starter systems.

Mini files: The July Breakpoint (Page 12) on **Numerix Corp.,** Newton, Mass., contained some inaccuracies. Data-memory physical address space for the MARS-432 floating-point array processor is 16M words; total physical program memory space is 64K words. Data-memory read or write times are 100 nsec. each.

Notes from overseas: Convergent Technologies is reportedly about to land what may be its biggest contract ever with ITT Corp. for ITT to resell Convergent equipment. Convergent reportedly has been making successful sales forays to several ITT operations, including six U.S. and four European operations. Confronted with such a buy, ITT has sent its vice president, John Cunny, on an international fact-finding mission. There are murmurs in ITT facilities in Brussels, Belgium, and Amsterdam, the Netherlands, of ITT's plan to enter the computer business. The deal could net Convergent $150 million over two years and absorb tens of thousands of N-Gens, the company's upcoming lower priced replacement for the IWS/AWS line. Convergent's Megaframe series and manufacturing rights are also included. ITT's Standard Telephone Cables, Standard Electrik Lorenz AG and European Data Communications Center are expected to be the first to receive products....Despite the failure of its first European dealer/distributor network, built on the unsellable Enterprise line, **Data General Europe** is considering the dealer/distribution channel for its new Desktop Generation. Small Business Systems European marketing manager Gennaro Giachettia is devising a program flexible enough in its products, quotas, discount schedules and authorization requirements to work throughout Europe. European vice president Ray Fortune will make the final decision, which is expected by October. One way or the other, DG promises not to follow in DEC's footsteps—retail....**Mercator,** the Onyx and IMI European subsidiary, admits its faulty operating system, a Business BASIC emulator, bears heavy responsibility in the sudden failure last month of **Hermes Precisa Ruf Computer GmbH** (HPR). Mercator officials state that HPR is the latest in a string of distributors forced into receivership primarily because of Mercator's software. The situation leaves Mercator without a German distributor and robs Fortune Systems Corp. of its chance to sign HPR as Fortune's first German private-label partner (MMS, August, Page 14). HPR president and majority owner Gerhart Joerg must come up with a buyer soon. Otherwise, HPR with its estimated 5 to 6 percent share of the German small business systems market will be liquidated, and Joerg will be legally banned from starting another company for five years. Mercator is considering the reluctant local British **Cable & Wireless** subsidiary, **Eurotech,** to distribute to HPR's 20 dealers....Faced with a deluge of products from the United States and Japan, **European peripheral equipment builders are moving to hit back.** The Association of the European Independent Information Industry (AEIII), a body of small and medium-sized manufacturers, is asking The European Commission in Brussels, Belgium, to fund a board to determine key future peripheral technologies and how European manufacturers can exploit them. AEIII vice president Donald Willis hopes the commission will make a decision in the next few weeks. He estimates that the commission will need to contribute as little as $150,000 to the cost of the board, a trivial amount compared with its planned $750 million contribution to the ESPRIT (European Strategic Program of Research and Development in Information Technology) long-term computer research program (MMS, July, Page 8)....**Comdex/Europe may be in line for some competition.** Its debut last year in Amsterdam, the Netherlands, could hardly be called a roaring success. It failed to attract the European third parties it should have. Now, Germany's largest private fair owner, Heckmann GmbH, Wiesbaden, West Germany, is polling vendors, dealer groups, distributors and retailers about holding a Comdex-like show in Germany next year.

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The C. Itoh Starlet A-10 Daisy Wheel printer is made to order for the OEM micro market. Its footprint is so incredibly small, it goes just about anywhere – desktop, shelf, bookcase – yet it offers highest quality word processing printing at *less* than the cost of an electronic typewriter.

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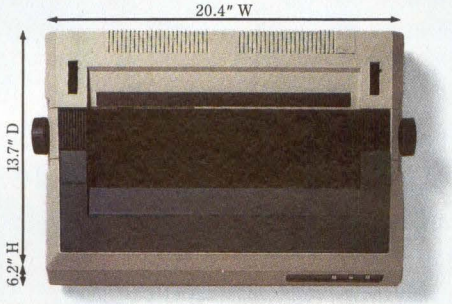
The A-10 is built around the same sound principles that have made our F-10 and Starwriter printers so successful. You get field proven, firmware-intensive technology for increased reliability. Plus a rugged, cast-aluminum baseplate, high quality metal parts, and low parts count for reduced maintenance: MTBF is 2300 hours, at 30% duty cycle (45 million character impressions). Easy access to all boards and subassemblies ensures low MTTR. And the A-10 is U.L. and FCC class-B approved as well as ESD tested.



ECONOMY OF OWNERSHIP

Low cost of ownership is one of the A-10's best features. Industry standard ribbons and a wide variety of wheels are available at popular prices. But best of all, many of the extra features that others call options come standard on the A-10. Like microprocessing for proportional printing, superscripts/subscripts, and bidirectional carriage and platen motion.

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We've not only made a dent, we're the second-largest company in the business, and we have the capacity in place to be first.

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It was impossible to sell Winchesters at such a low cost. But last year our 500 series drives were introduced at under $500, 30% under then-standard industry costs. And since then, we've led the industry to ever-lower costs on full and half-height drives.

It was impossible to produce and ship high-performance plated media drives in high volume at prices lower than most vendors are charging for oxide media drives. One of our competitors backed away from plated media because they couldn't buy enough of it to build drives in efficient quantities.

We solved that problem by building our

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UR COMPETITION, POSSIBLE.

own plated media factory dedicated to plated media production in high volume. Because we make our own, our costs are low and we are independent of outside vendors for supply.

It was impossible for a start-up company to produce and ship a broad line of products: full and half-height drives, open and closed-loop, from 6.4 to 50 MB. But we've done it. With the help of one of the industry's best-funded R&D programs. And with our steady supply of plated media, we will soon be offering 5¼" drives that push Winchester technology to the limits of its capacity. In high volume. At prices that are pure Tandon.

Impossible?

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But not for the Tandon Winchester Company.

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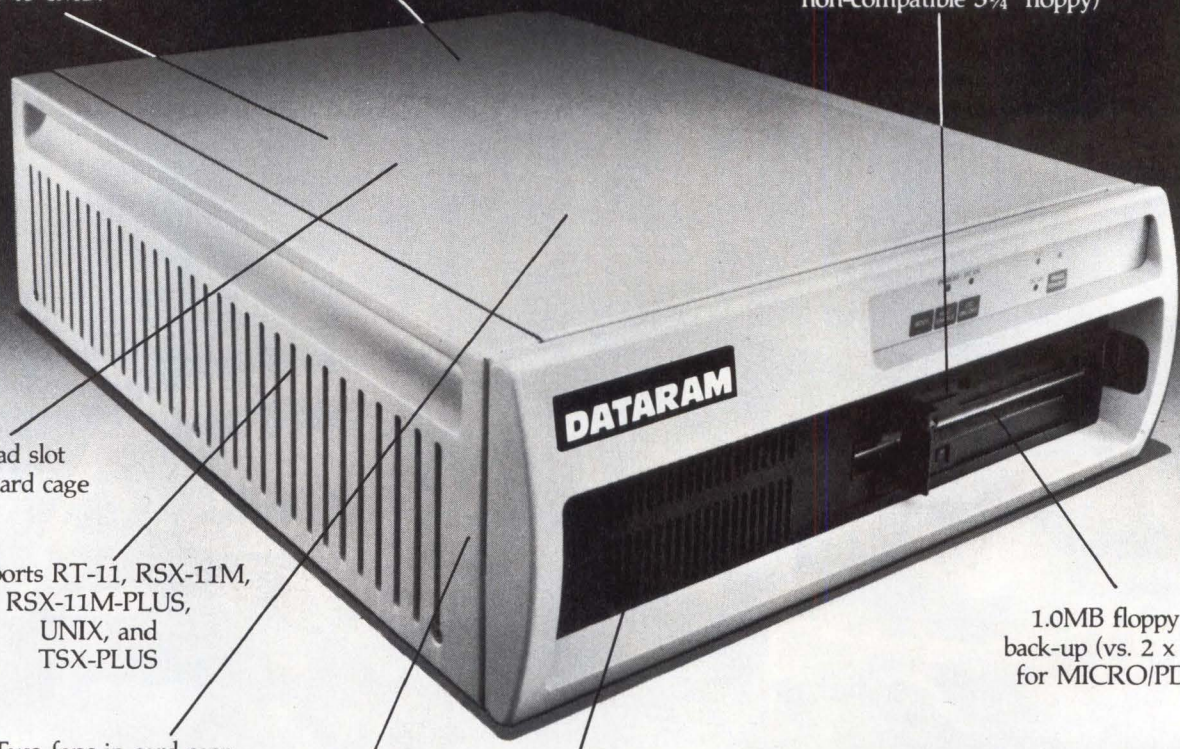

$9,800 system price*

256KB minimum... up to 4MB!

Media and software compatibility with DEC's RX02 8" floppy (vs. MICRO/PDP-11's non-compatible 5¼" floppy)

8-quad slot Q-bus card cage

Supports RT-11, RSX-11M, RSX-11M-PLUS, UNIX, and TSX-PLUS

Two fans in card cage area (vs. one in MICRO/PDP-11)

RL02-compatible 10MB 5¼" Winchester disk standard; 20MB optional

Space for future 40MB cartridge tape drive.

1.0MB floppy disk back-up (vs. 2 x 400KB for MICRO/PDP-11)

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The A22 with LSI-11/23, 256KB, 10MB Winchester, and 8" floppy is only $9,800. 30-day delivery.

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CIRCLE NO. 18 ON INQUIRY CARD

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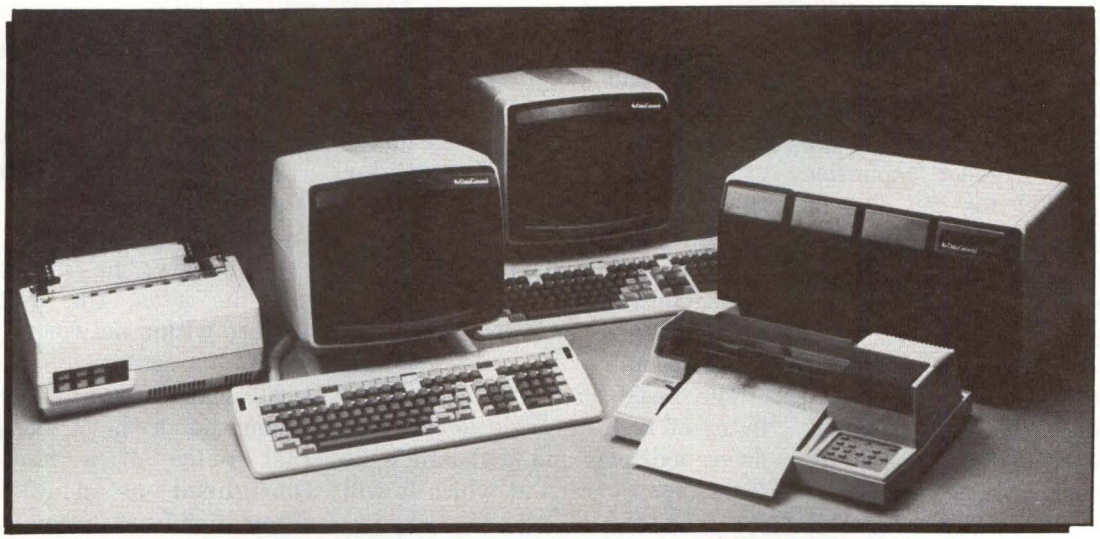


DG's microEclipse-based Desktop Generation *is available in a variety of configurations ranging from a $3,165 single-user system that includes an Intel 8086 co-processor for running MS-DOS and CP/M-86 packages. Multiuser configurations supporting as many as 12 terminals are possible. With the system, DG is introducing a new Mannesmann Tally printer (left) and a Hewlett-Packard plotter.*

Data General desktop systems aim at PCs and supermicros

Data General Corp.'s second major effort to penetrate the desktop computer market gets under way with a line of microEclipse-based systems. The new "Desktop Generation" is the result of an intensive one-year development program to replace the disastrous Enterprise/MPT/CS/5 series of microNova-based systems, which fell far short of meeting DG's expectations of gaining an early lead in the low-end market. International Data Corp. estimates that in 1982, the third year of the program, only about 400 Enterprise and CS/5 systems had been sold before the program was abandoned last November.

This time, the company has developed a series of products that could not only give it a badly needed presence in the "industry-standard" 16-bit personal-computing market, but also provide a long overdue response to the flood of supermicrocomputers that have severely eroded the low end of DG's 16-bit minicomputer line.

The four-member series consists of two dual-microprocessor microEclipse/Intel 8086 systems and two repackaged versions of the S20 and S30 microcomputers that first incorporated the microEclipse 16-bit proprietary microprocessor. They all share the same modular packaging and have been designated the "Desktop Generation," although that might be a misnomer (see "Well, near the desk...," Page 22).

The dual-microprocessor models 10 and the 10/SP incorporate a closely coupled two-board CPU with shared memory, a floppy disk controller and an on-board monochromatic graphics controller. In addition to executing all Eclipse instructions, the microEclipse regulates system I/O.

The basic 10, which is designed to run MS-DOS or CP/M-86 applications concurrently with DG RDOS, is the product with which DG General Systems division vice president John H. Crawford hopes to exploit dealer/retailer channels. The 10/SP has a firmware-based floating-point processor and, unlike the 10, can be ordered with the DG AOS operating system by OEMs and DG end users. The 10/SP is also offered to current customers including users of the CEO office-automation package that runs on 32-bit MV series systems. A version of the CEO package will run under AOS on the 10/SP as well as on the 20 and 30. A special asynchronous gateway to the Xodiac network has been added for the Desktop Generation workstations.

The basic 10 and 10/SP can be ordered with 128K to 768K bytes of main memory, but only the entry-level model 10 with a single floppy disk comes with 128K-byte memory.

The other models start at 256K bytes. All model 10s have three slots for memory expansion and standard DG 7-by-9-inch boards including digital I/O and A/D and D/A converters. Additional add-ins are possible via a five-slot expansion cage. The model 10s can also be upgraded to multiuser capability with a four-port card. The base systems come with standard serial and parallel ports.

Model 10 standard graphics provide 640-by-240-dot resolution on the new Dasher 211 terminal, which is the basic workstation of the line. An optional 13-inch color monitor can be ordered with a graphics controller card, which enables users to choose a 16-color palette from among 4,096 hues. Four 16-color palettes can be stored in the system simultaneously. With the 8086, the systems support the GSX graphical kernel package under CP/M-86 and GW BASIC under MS-DOS. The microEclipse supports the GKS graphical kernel subsystem subroutine library. Light-pen and mouse options are also offered to make the system a low-end graphics workstation.

The basic model 10, with 128K bytes of RAM, a single floppy disk drive, a display and keyboard, sells for $3,165, a price at which it will compete head-on with the IBM PC, explains Technical Product division director Don McDougall. He says, "I'm absolutely convinced we've got to match the IBM price to get major accounts business." However, he points out significant areas of divergence from the IBM target. The DG low-end systems offer multiuser capability from the start and are designed for greater expandability, he claims. Under AOS, he adds, the systems can operate within networks of 16- and 32-bit DG systems. Under RDOS, small end users can select from among hundreds of DG packages. List price of a model 10/SP configured as a CEO office-automation workstation is $9,660 in a configuration with 512K bytes of

WELL, NEAR THE DESK...

Data General Corp.'s "Desktop Generation" microcomputer may prove to be anything but desktop. The snap-together, modular packaging used in all four models of DG's new microcomputer line has been designed to accommodate everything from a standalone personal computer to a supermicrocomputer supporting as many as a dozen users. To accomplish this, Technical Product division director Don McDougall explains, the company had to forgo the low-profile system unit (with a CRT on top) commonly used by personal-computer manufacturers.

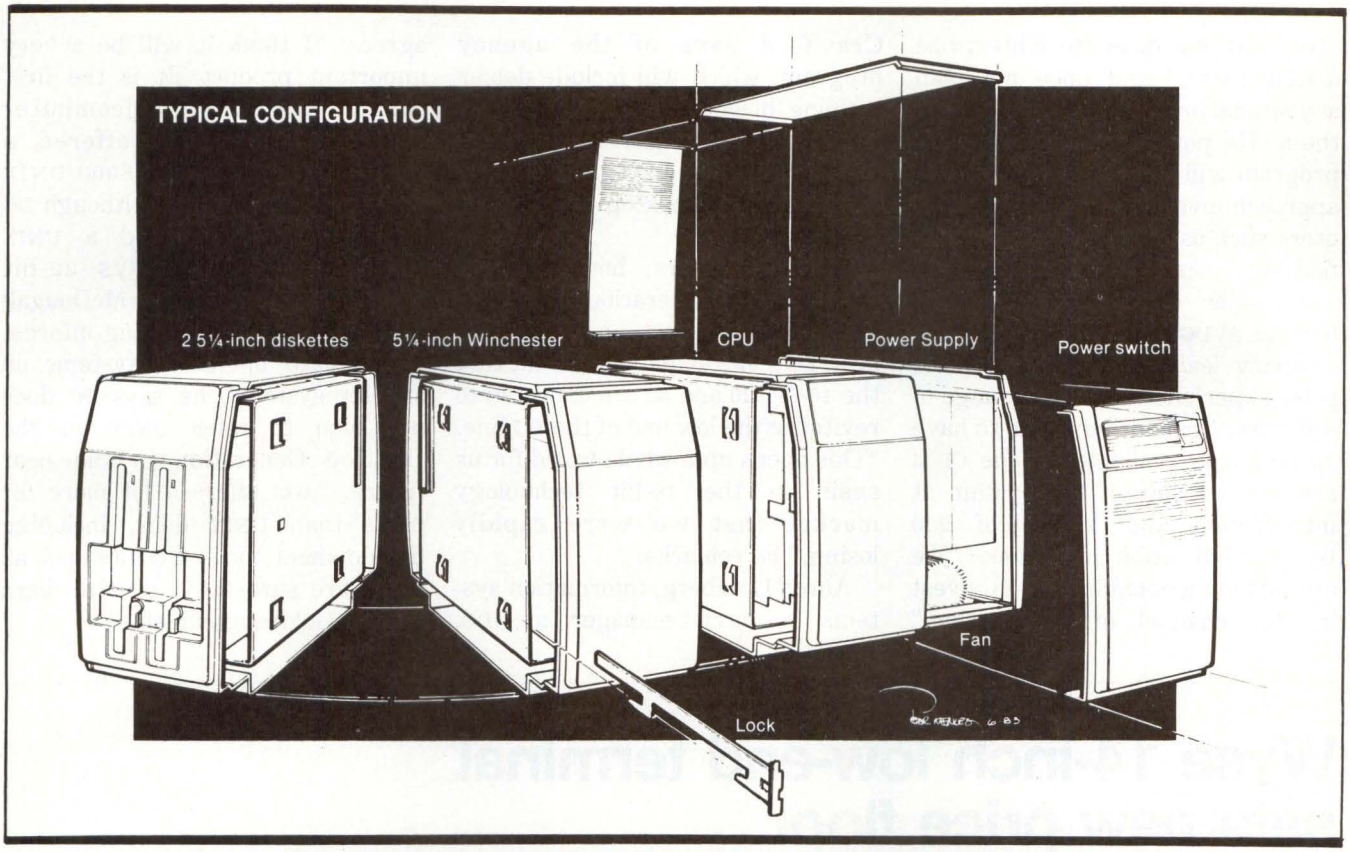
Instead, the 10, 10/SP, 20 and 30 are housed in a minimum of three modules, each measuring 9 inches high by 4½ inches wide by 12 inches deep, yielding a minimum 13-by-9-by-12-inch package. A package that size is more likely to wind up on a bookshelf or in an optional desk-height (five modules high) vertical cabinet that can be placed on the floor next to a desk, McDougall admits. But he emphasizes that this leaves only the small-footprint Dasher 210/211 CRT terminal and its detachable keyboard on the work surface. He says DG research shows that users do not object to moving the system unit off of the desk.

The snap-together design of the Desktop Generation is similar to the packaging used in Convergent Technologies Inc.'s forthcoming N-Gen series of workstations (MMS, July, Page 20). Modules snap together to form a rigid unit. In DG's systems, three to six modules can be assembled into a system using the following elements:

- The power supply and systems unit are always the first two components and, unlike the other units, require cabling. Disk storage and expansion modules are automatically linked electrically when snapped together. The five-card-slot system unit has a dual-card CPU in the 10 series. The 10s have basic memory on the CPU cards. The single-board CPU 20 and 30 have memory on a second card, and, to accommodate its hardware floating-point unit, the 30 requires a minimum of three cards.
- Expansion space beyond the available slots in the system unit (two or three, depending on the model) is provided by expansion modules. A five-card module can be added to accept additional memory, device controllers or I/O controllers in the 7-by-9-inch card format. System expansion beyond the maximum six-module package is available via a bus-extending cable to another series of modules.
- Floppy disk modules come in single- or dual-drive versions with half-height Teac floppies storing 368.6K bytes each. The 5¼-inch disks can be written in eight-, nine- or 10-sector formats to provide data compatibility with IBM PC and XT systems and with DG minifloppies.
- Winchester disk storage is provided by a $2,745, 15M-byte module. One or two IMI 5¼-inch disks can be added to a system.
- Tape storage is available on a 15.5M-byte, ¼-inch tape drive to be manufactured by DG.

In early shipments, DG plans to configure the modules, but McDougall says later customers will assemble their own. The modules will be built at DG's North Carolina facility to start, but production will later be shifted to Hong Kong.

Along with the recently introduced D 210/211 terminals, the Desktop Generation can support D 410/460 character graphics CRTs and G300 medium-resolution graphics CRTs. The series will also use two new printers, an $895 Mannesmann Tally Corp. dual-mode dot-matrix printer and a $1,515 Hewlett-Packard Co. plotter.



DG has adopted a modular packaging system for the Desktop Generation microcomputer series. *It uses 4½-inch-wide components that snap together to form a rigid unit. As many as six modules can be linked and installed horizontally on or near a desk. A floor mount-option is available.*

main memory, a 15M-byte Winchester disk drive, a floppy disk drive, a terminal, a single-line multiplexer, CEO software and the MS-DOS operating system.

Altogether, the 10 and 10/SP support five operating systems including CP/M-86 and MS-DOS for the 8086 and AOS, RDOS and MP/AOS on the microEclipse side. CP/M-86 and MS-DOS sell for $150 each. AOS and RDOS sell for $1,000 and $750, respectively, but are also available in "Pregen" versions for $750 and $250, respectively, that don't include development tools. MP/AOS/SU, at $350, is a single-user operating system that is not as reliant on high-speed disks as AOS and includes a real-time scheduler.

To re-enter retail markets, in which the Enterprise has given the DG name a lingering black eye, Crawford claims DG will launch an agency program that is unique to the microcomputer industry. Under the program, dealers and retailers will sell on consignment instead of purchasing the systems from DG and reselling them. Crawford declines to say what commission-rate structure will be used. "We will control the price, and dealers will have guaranteed commissions. We're trying to avoid situations where dealers, to develop cash flow, cut prices and destroy the market," he asserts.

Al Watts, president of Asheville, N.C., Interact Distributing Co. and a former Enterprise distributor, remarks, "They'll have to do something special (to attract dealers)." Watts, whose company recruited 30 dealers for the Enterprise program, says he and his dealers were stuck with inventory when DG shut down the Enterprise program last year. Dave Cioni, a former DG regional manager who set up Diversified Microcomputer Products in Chicago in late 1979 to handle the Enterprise, says his company lost between $300,000 and $500,000 on the program—including its unsold inventory. "Enterprise was a dismal failure," he recalls, noting that hardware was a year late and that packaged software for the proprietary MPOS operating system was never developed. "I thought if they had a new product, they would at least let us trade in our Enterprises," Cioni says, adding that he has not heard from DG on the matter.

Crawford, who denies that DG had to resort to the agency program to recruit new dealers, comments,

"We paid our dues (to Enterprise distributors)," and does not plan any special programs to compensate them. He points out that the new program will eliminate the two-tier approach involving regional distributors such as Interact and Diversified Microcomputer Products.

A major change in the retail formula at DG that indicates how the company learned from the Enterprise experience is a wider range of software. Crawford expects to have 70 packages available for the CP/M and MS-DOS side of the system at introduction and a list of 250 DG-qualified RDOS programs. "We are making a commitment to invest in this channel of distribution," Crawford says of the agency program, which will include dealer training in both sales and service. Dealers can opt to provide their own service—one of 16 available service options with Desktop Generation products.

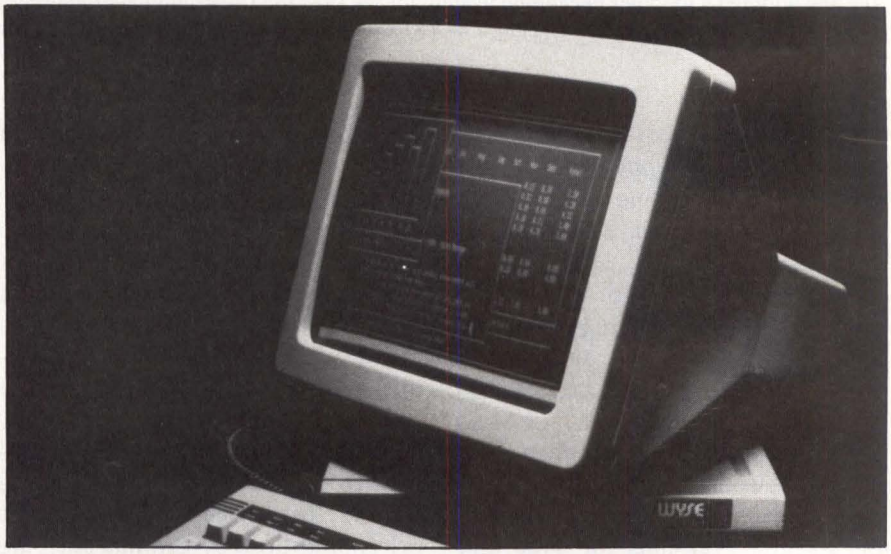
Some observers, however, feel the Desktop Generation may have its greatest impact on OEM channels. DG's McDougall points out that the 10/SP, 20 and 30 are expected to revitalize the low end of the DG line. "This opens up a whole world for us again in the 16-bit technology market that we were rapidly losing," he remarks.

Aaron Goldberg, information systems research manager at IDC, agrees: "I think it will be a very important product. It is the first time a mainline minicomputer company has really offered a challenge to the MC68000/UNIX supermicrocomputers. Although DG has recently announced a UNIX package for its AOS/VS 32-bit operating system and McDougall acknowledges the growing interest in standard operating systems on smaller systems, he says DG does not plan to offer UNIX on the Desktop Generation in the near future. "AOS offers a lot more for OEMs than UNIX does, including development tools. Besides, not all OEMs are sure they want to learn UNIX," Goldberg explains.

Wyse 14-inch low-end terminal sets new price floor

Wyse Technology hopes to make the terminal industry even more a price-driven commodity market with this month's introduction of the $695 WY-50, which offers several features of terminals in the $900 to $1,200 range. Quantity discounts could bring the price to less than $400.

A 14-inch diagonal green phosphor CRT screen, selectable 80-/132-column displays and basic ergonomic features such as a low-profile, detached keyboard, tilt-and-swivel adjustment and enhanced character display make a package that "can't to our knowledge be found on the marketplace for under $1,000," claims Wyse marketing manager Jim Munro.



The WY-50 from Wyse Technology *is the company's lowest priced offering featuring a 14-inch diagonal screen and 80 or 132 columns.*

Robert Sanekoff, manager of Dataquest Inc.,'s Display Terminal Industry Service, sees the WY-50 as representing a trend toward "free features." He believes that manufacturers will continue to place previously expensive features on low-end terminals such as the WY-50. "The 14-inch screen is very attractive at that price, and you need 132 columns in a number of areas these days," says Sanekoff.

Dataquest sees the WY-50 aimed at a high-growth, active-competition market segment, which will represent more than $1 billion by 1987.

Wyse's Munro believes his compa-

McDougall says, "What this product does is integrate us back into the desktop market with graphics where the 68000/UNIX products are." He also points out, "This time, we are not excluding people from the market," referring to the Enterprise, MPT and CS/5 programs, which shared the same hardware but were launched at three different times and aimed at three customer groups. With the 10s, 20s and 30s, DG is providing a single, coherent line of products for end users and OEMs, he notes.

The 10/SP, 20 and 30 are expected to appeal to a large number of OEMs—McDougall claims the company has first-day orders in the thousands of units—that need a desktop package to run their applications. In addition, the new systems will serve as a bridge for new customers into the DG line. By using the less expensive 5¼-inch peripherals and sharing the manufacturing costs of a single package among three marketing organizations, DG is hoping to offer a price-competitive product to keep OEMs within the DG camp, retrieve some who have gone to other suppliers and attract new customers who can't wait for a body of application software to evolve in the UNIX market. "Even if it isn't compatible with the rest of the world, AOS is a better operating system (than UNIX) and has hundreds of proven programs," McDougall asserts. A model 20 configured as a small-business system sells for $10,640 with 256K bytes of main memory, a 15M-byte Winchester disk, a floppy disk drive, a four-line multiplexer, a D 210 terminal, a correspondence-quality printer, the RDOS operating system and Business BASIC. A model 30 with 1M byte of main memory, a floating-point accelerator, a 15M-byte disk, a floppy disk drive, a four-line mulitplexer, a D460 terminal, a multifunction printer, the AOS operating system and FORTRAN 77 carries a $17,030 price.

—Geoff Lewis

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ny's introduction of the WY-50 for that market is an act of "throwing down the gauntlet. Our competitors are going to have to respond," he says. He considers the terminal's most important feature to be its ability to switch to 132 columns. "I don't think there's any question the industry is going that way," he says. "With the spreadsheets becoming more and more popular, you need 132 columns. You can't really do it on a 12-inch screen."

Munro is also proud of the WY-50's design, which is a more compact version of the WY-100, the company's previous low-end offering. Height of the WY-50 at 11¾ inches is ¼ inch less than that of the WY-100, although the WY-100 has a bigger screen, he points out. The footprint of the unit has also been reduced, with a base measuring 12¼ inches by 10¼ inches. The tilt-and-swivel mechanism can be adjusted easily with one hand, yet it stays in position until moved.

The 100-key detached keyboard has a low-profile Deutsches Institut fur Normung (DIN) standard design with sculptured keys and tactile feedback. A total of 16 programmable function keys offers 32 possible codes. Communication is through an ASCII RS232C interface in character or block mode with a maximum transmission speed of 19,200 baud. Character display has been improved by a 10 by 13 dot matrix. The WY-50 also features a soft setup mode allowing menu selection of the terminal's various functions. The display has a 25th status line and a 26th soft function-key legend line.

Munro feels that one of the reasons Wyse has been able to set a new price level is the company's introduction of ergonomic features such as detached keyboards and tilt-and-swivel CRTs, which are rapidly becoming mandatory. Munro sees ergonomics as important, particularly in the OEM market. "Many of our OEM customers feel that our terminal is what the end user sees when looking at a computer system," he says.

Munro believes that Wyse's wholly owned manufacturing facility in Taiwan gives the company an advantage over manufacturers that subcontract to independent firms there. "We can design a product from the ground up," he says. The company manufactures its own monitors, power supplies and other components. "We can be very careful about not having to spend any more than necessary," he says.

Wyse plans to build a new series of terminals around the WY-50 model. While the company does not see it as competing directly with the WY-100, company officials are trying to time its introduction to minimize damage to WY-100 sales.

Wyse's vice president of marketing, Larry Lummis, says the company will not announce the WY-50 until it is produced in volume. Wyse had hoped to produce the new machine last month, but difficulty with a key-cap supplier required a month's delay.

Lummis says Wyse is gearing up for production of as many as 200,000 WY-50 terminals over the next two years. "Even that might not be enough," he says. Wyse is looking at the growing ANSI-standard market and is considering a version of the WY-50 for VT-100 emulation.

—Edward S. Foster

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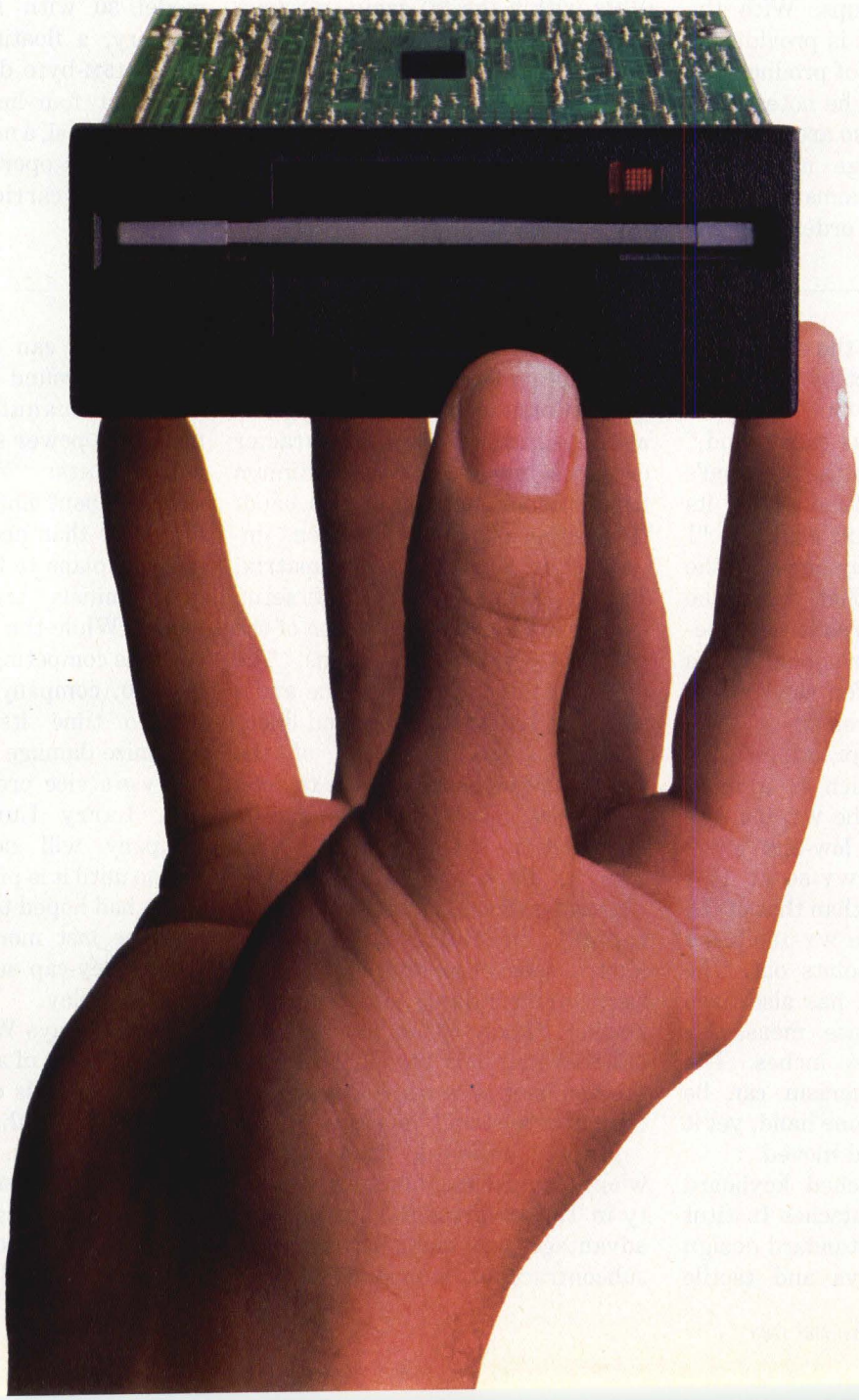

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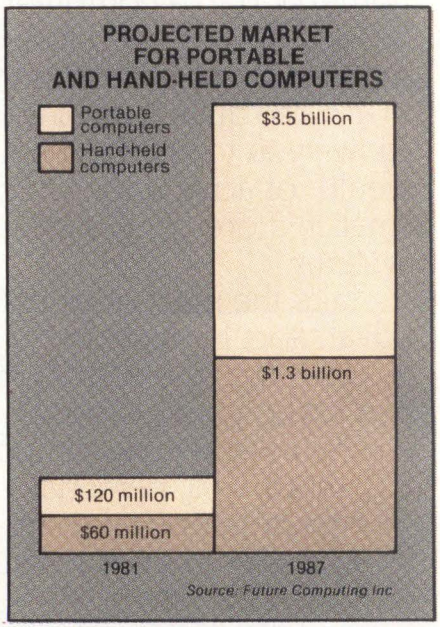
Harris-Intel CMOS alliance produces low-power 8086

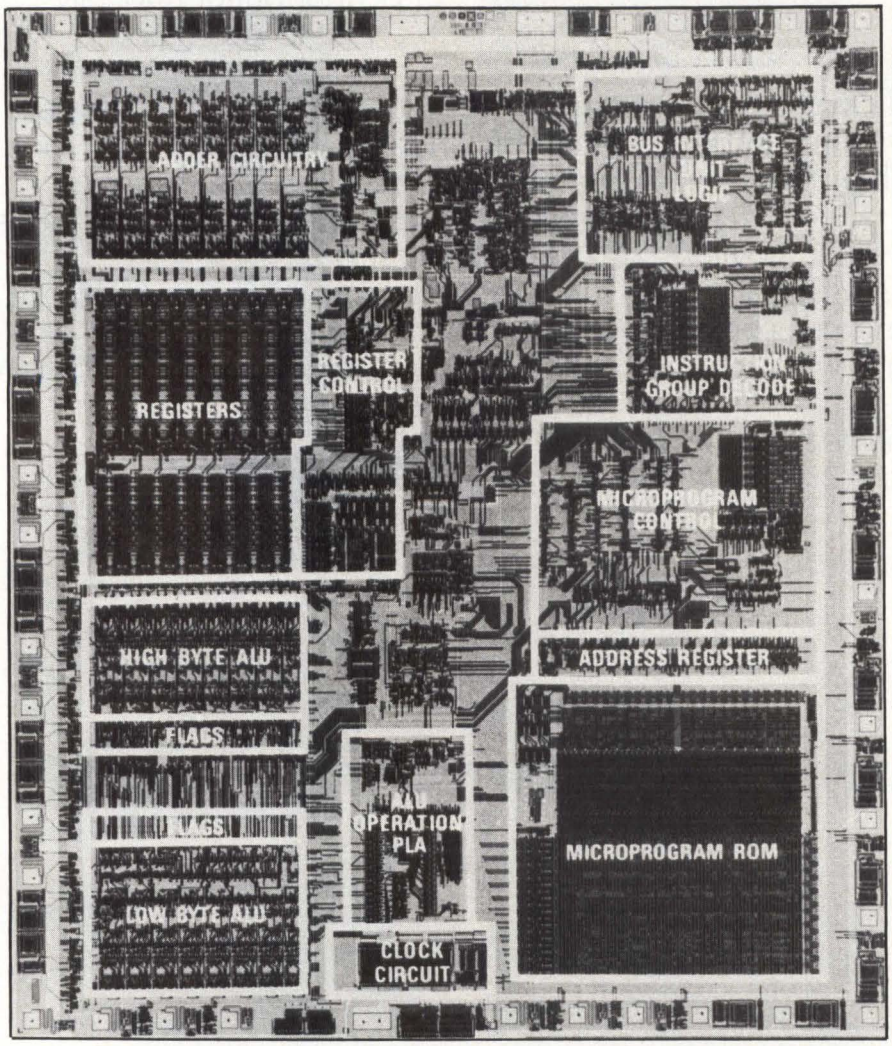
Harris Corp.'s Semiconductor Products Division and Intel Corp. have banded together to grab a share of what could be a $1 billion market for CMOS-based microprocessors and peripherals by 1988. The first product to emerge from their two-year-old CMOS (complementary-metal-oxide-semiconductor) technology-exchange program is Harris's 80C86 CMOS version of Intel's 16-bit 8086, scheduled for production this month. Intel's version of the CMOS 80C86 will follow in mid-1984. By the end of next year, Harris expects to offer a 14-member family of 8086 parts and peripherals including the 8-/16-bit 8088.

The two firms—and competitors such as Texas Instruments Inc. and National Semiconductor Corp.—are counting on the increasing dominance of CMOS technology throughout the rest of the decade (see "Why CMOS?" Page 30). CMOS techniques have been known for nearly 20 years, but applications have been largely restricted to ruggedized industrial or military systems in which the relatively high cost and low density of CMOS are not major obstacles. Now, Harris and Intel maintain, the price of CMOS is dropping to the range of the dominant NMOS (N-channel MOS) silicon technology, and advances in CMOS fabrication methods have progressed to the point at which NMOS densities are forseeable (MMS, July 1983, Page 115). The two companies cite predictions by market research firm Dataquest that CMOS will grow from 10 percent of today's $1 billion microprocessor/peripheral market to 20 percent of 1988's $5 billion market.

More importantly, Harris and Intel claim their 80C86 design is the first "drop-in" CMOS replacement for

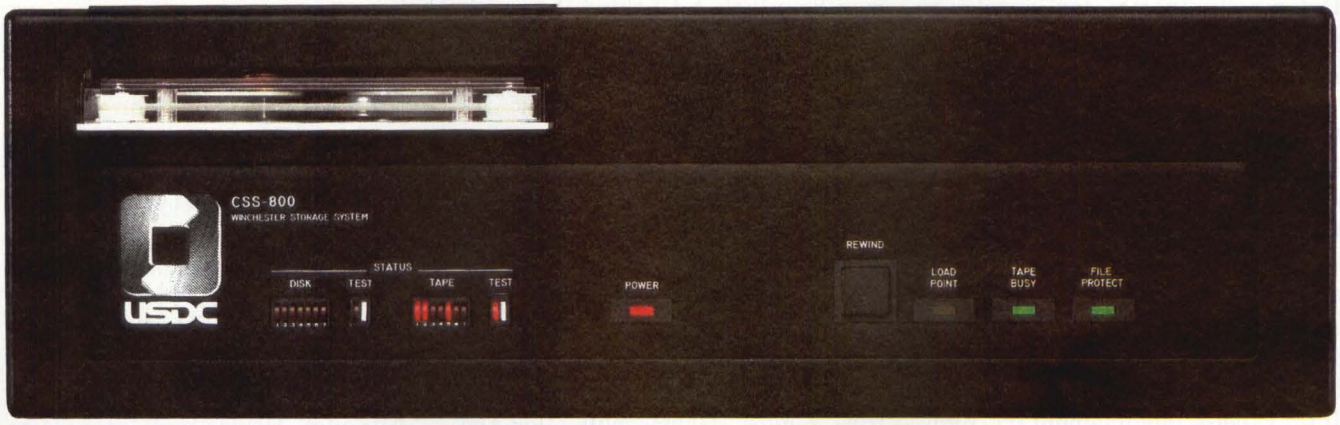


One of the most dynamic markets for CMOS microprocessors *will be in portable and hand-held computers, although Harris and Intel expect wide usage in office systems as well.*



Harris Corp.'s version of the 80C86 CMOS replacement for the Intel 8086 *uses 2.5-micrometer geometries to pack 38,000 transistors onto a ¼-square-inch die. A 5-MHz part will initially be offered, but it will be followed by an 8-MHz version and a family of peripherals as well as a CMOS version of the 8088.*

The Long Wait Is Over



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a standard 16-bit microprocessor and will therefore give the team a head start vs. competitors such as National Semiconductor and Motorola Inc., which plan their own or second-sourced CMOS products for 1984.

Harris has been producing CMOS —largely for U.S. Department of Defense contracts—for nearly 10 years and is now using a fourth-generation version of its self-aligned junction CMOS method, which enables the company to build the 80C86 with 38,000 transistors on a 284-by-284-mil die using 2.5-micrometer circuit geometries.

Ken Fine, Intel's general manager of microprocessor operations, says Intel will not simply adopt Harris' CMOS fabrication techniques but will continue to develop the Intel CHMOS (complementary high-performance MOS) method, which is adapted from its HMOS (high-performance MOS) process. Intel has produced dynamic RAMs as well as 8048, 8049 and 8051 controllers in CHMOS. Nevertheless, Will Strauss, vice president of Integrated Circuit Engineering Corp., a Scottsdale, Ariz., market research firm, predicts Intel will learn much about CMOS fabrication from Harris. Dane Elliot, microcomputer product marketing manager at Seeq Technology Inc. and a nine-year Intel veteran, observes, "In CMOS, they (Intel) may be a little bit behind, but with the machine (organization) Intel's got, they won't be for long." Seeq, which has used CMOS for its Ethernet-Manchester encoding part, plans to use CMOS in future products including its EEROMs, Elliot notes.

Pricing for Harris' 80C86 is $50 for a single part packaged in a plastic carrier that is pin compatible with the 8086 and is designed to operate within commercial temperature ranges. Harris will offer the part for sampling at the 100-unit price of $31.25 for its first 90 days of availability, company officials state. An Intel spokeswoman, who explains that Intel does not currently offer the low-priced plastic package, says the basic list price for an 8086 in a ceramic DIP is $25 in quantities of 100. Harris' ceramic DIP 80C86 is $42.19 in those quantities.

At National Semiconductor, Tony Moroyan, marketing manager for the CMOS-based NSC 800 points out how quickly the company's 8-bit part has decreased in price. "I believe it was $100 or more when we introduced it in 1981, and now the part can be had for under $5 in the entry-level 1-MHz version in high quantities," he explains. The NSC 800, which has a Z80 instruction set and enhanced 8085-type I/O, has been adopted for a number of portable computers including Epson America's HX-20, Micro Office Systems Technology's Portawriter and Sunrise Systems' version of the Xerox 820.

Although Harris and Intel claim the advantage of pin compatibility between the 80C86 and the 8086, Moroyan insists pin compatibility is not a major consideration. "Drop-in sounds good, but if you're building a CMOS product anyhow, you'll do a

WHY CMOS?

The major benefit of CMOS (complementary-metal-oxide-semiconductor) technology is its low power consumption. Harris Corp. says its CMOS 80C86 (initially available in 5-MHz versions and later to be released in an 8-MHz format) requires only 50 milliamps compared to the 340 mA used by a standard 8086 operating at the same speed. Low power consumption will appeal to manufacturers of battery-powered portable computers. However, semiconductor manufacturers and industry analysts also expect all types of system manufacturers to use the technology.

Will Strauss, vice president of Integrated Circuit Engineering Corp., predicts that CMOS will be used to cut costs in a variety of systems because its low power consumption is accompanied by low heat dissipation, which means manufacturers can eliminate heat sinks, fans and convection-cooling designs. The low power requirements also allow the use of less expensive power supplies. Harris Semiconductor Products Group vice president Jon Cornell contends the combination of smaller power supplies, elimination of fans and use of more compact packages could produce a CMOS system at a 19 percent cost savings compared to an all-NMOS (N-channel MOS) product. The estimates assume a 50-percent reduction in power-supply expense and a 29-percent cut in enclosure/cooling components. The electronics would rise from 26 percent to 33 percent of overall system costs. An additional benefit of CMOS is its relative imperviousness to noise and its low-level radio-frequency and electromagnetic radiation. The low emission levels can cut the cost of meeting Federal Communications Commission-mandated RFI and EMI standards, Cornell points out.

All these factors will have increasing allure for system builders, says ICE's Strauss. "First, you'll see it in premium-priced portables—derivatives of products like the Compaq (portable computer)—but in a couple of years, office equipment and terminals will follow. Anywhere you want to eliminate a fan or save space, CMOS will be used," he believes. ICE estimates CMOS will grow from 11 percent of U.S. manufacturers' current IC production to 15 percent in 1985 and 32 percent in 1990.

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CIRCLE NO. 21 ON INQUIRY CARD

whole CMOS design from the ground up," he argues. Harris and Intel counter that pin compatibility enables 8086 customers to use their installed in-circuit emulators and other development tools, thereby speeding products to market. National Semiconductor acknowledges that it plans a drop-in CMOS replacement for its 16032 microprocessor for introduction next year.

Harris marketing vice president Michael H. Graff reports 15 beta site companies sampled the 80C86 over the summer, and all are designing it into products that will begin appearing late this year. He declines to say which companies are the beta sites.

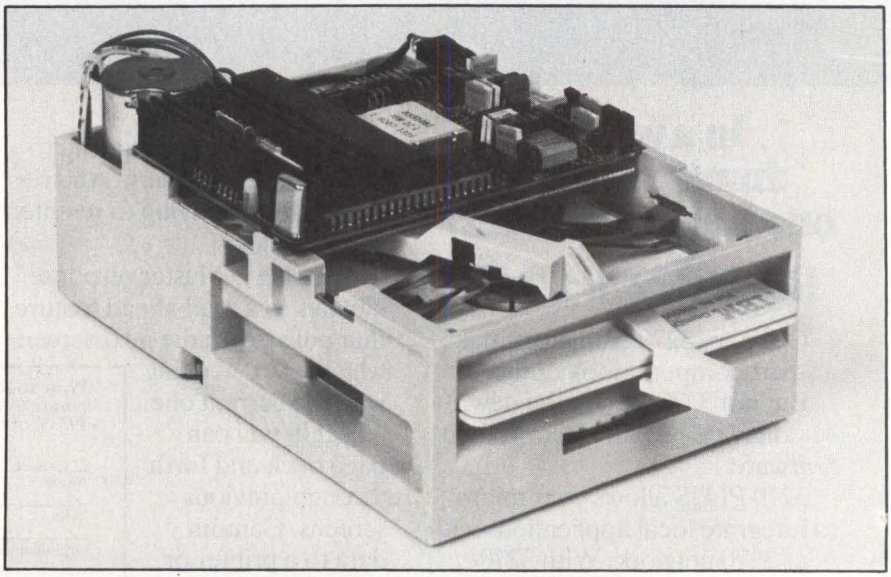
One likely candidate for the 80C86 or the follow-on 80C88 (due out in the first quarter of next year) is Gavilan Computer Corp., the Campbell, Calif., manufacturer of a "knee-top" system using the HMOS 8088. Product marketing manager George Moore says the firm plans to incorporate a CMOS microprocessor part within the next 15 months. He estimates that its addition to the current system (which uses CMOS RAM and an LCD display) could add as much as 20 percent to the system's 10-hour battery life. He claims the company has been discussing CMOS 8088s with Intel and expects to have a part by the end of next year. "They indicated that we are near the head of the line for the part, but I suspect Big Blue would go straight to the head of the class," he says, alluding to IBM's widely rumored "Peanut" portable computer, which reportedly will use the CMOS 8086 or 8088 and would consume much of Intel's initial capacity.

IBM's competitors offering transportable versions of PC-compatible computers are not rushing to adopt CMOS. Columbia Data Products, whose portable was slated for July shipments, "won't use CMOS at least through the end of '84," says vice president of planning and development Dick Mathews. "The chips are still too expensive and you really need a flat panel display to build a 10-pound portable," he adds. But he predicts that Columbia will be able to use CMOS, custom LSI (large-scale integration) and a full-page flat-panel display to produce a $3,000 to $4,000, 10-pound portable by 1985.

—Geoff Lewis

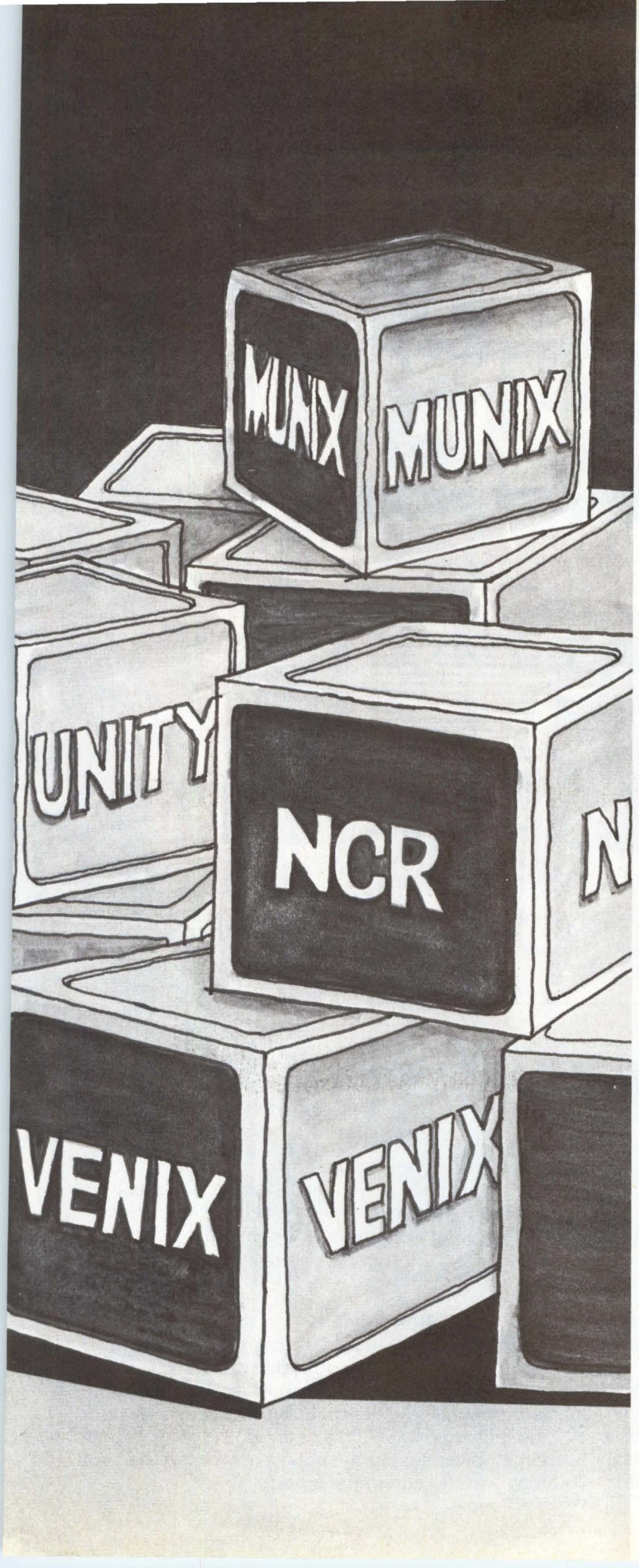
Hong Kong firm gears up for IBM 4-inch floppy drive, may reap 'Peanut' harvest

Far East manufacturing, traditionally reputed to be a shortcut to quantity at the price of quality, is about to win the Big Blue seal of approval. In an unprecedented move, IBM Corp. will submit to the lure of off-shore volume manufacturing for its controversial 4-inch floppy drive—its lowest priced disk drive product. The drive will be manufactured by Atlas Ltd., a Hong Kong producer of tape drive heads and plastic moldings for consumer electronic products. It is also likely that a forthcoming IBM "Peanut" portable microcomputer incorporating the drive will be manufactured in the Far East.



IBM's controversial non-standard 4-inch microfloppy disk drive *will be produced by Atlas Ltd., a Hong Kong manufacturer.*

Since its introduction last spring, (MMS, April, Page 24), the IBM 4-inch drive has been regarded as an orphan—almost an embarrassment to the company. It caused industry observers to wonder why IBM would introduce yet another product in the baffling sub-5¼-inch floppy drive market. Many observers, believing IBM had made a rare error in marketing judgment by not incorporating the product in a captive



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CIRCLE NO. 23 ON INQUIRY CARD

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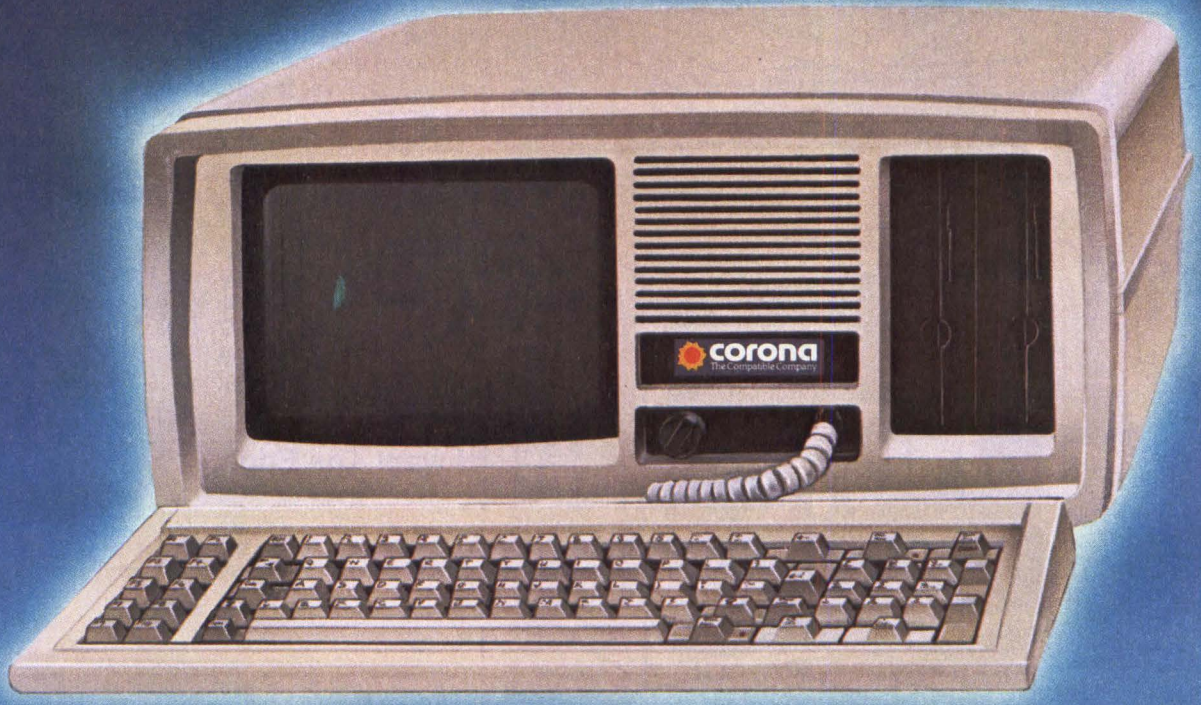

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CIRCLE NO. 24 ON INQUIRY CARD

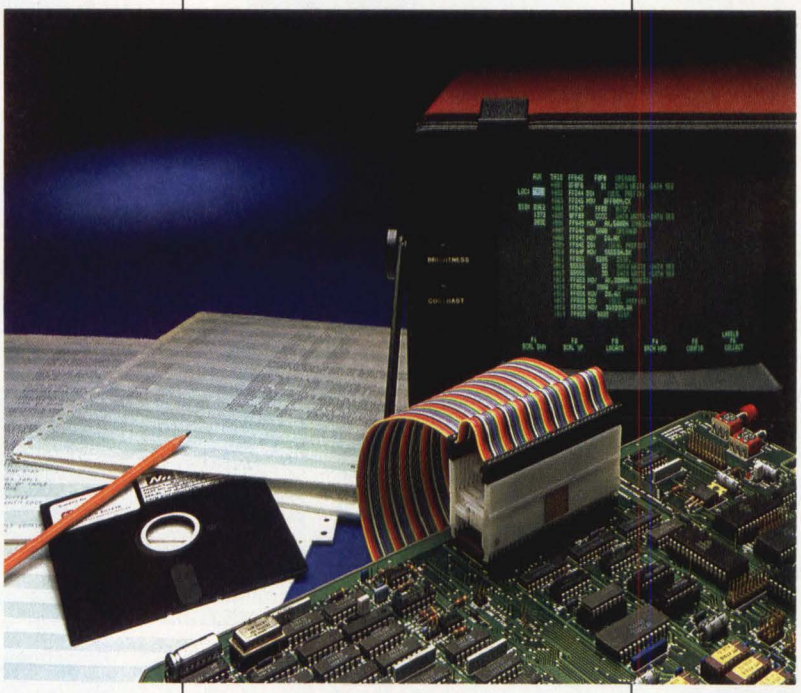
Designer Note #1

Does A Logic Analyzer Really Analyze?

Until recently the term logic analyzer has been a misnomer—it was the user who actually did the analysis. However, when a large test and measurement company (with a lot of advertising clout) called their first entry into the marketplace a logic analyzer, all other manufacturers followed suit.

Nearly a decade has passed since these early logic instruments were introduced and substantial progress has been made in giving meaning to the term "analyzer." In the NPC-700 series instruments for example, the *HOLD ≠* test mode allows you to detect and isolate intermittent failures when they're most likely to occur—overnight or while you're on your coffee break. In this mode, known good results in the state auxiliary memory are repetitively compared with incoming data from the system-under-test. When a difference is detected, the NPC-700 automatically stops data collection and highlights the intermittent problem.

Another advanced mode of operation, pioneered by NPC, is called nonoccurrence triggering. This mode is available at each of the NPC-700's 16 trigger levels and is used to identify precisely what occurred in place of an expected event. This capability is essential for analyzers with multi-level triggering because of the difficulty in getting a faulty system-under-test to satisfy several triggering levels.

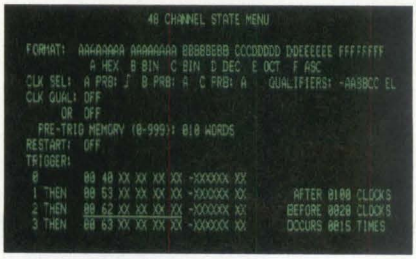


For example, let's assume that your system has satisfied three of the four triggering levels in the figure.

After initiating a data collection, the NPC-700 will display a status message indicating that your system did not satisfy the triggering conditions associated with the last level. In order to find out what occurred, you simply go back to the state menu and select nonoccurrence triggering at that level. This time, when you initiate the data collection, the analyzer will complete the triggering sequence and display the erroneous event. This feature can save you a substantial amount of time during system debug.

Other advanced analysis features such as *SEARCH WORD, DIFFERENCE,* and *RESTART,* can further reduce system debug time—especially when you're trying to unravel subtle hardware and software interactions.

These and other advanced features of the NPC-700 add a measure of intelligence not available in earlier logic analyzers and provide real meaning to the term "analyzer."



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CIRCLE 26

system, predicted a quick death for the 4-inch drive in the OEM market.

Big Blue, however, disagrees: "It's true that in the past we have introduced our primary product (the captive system) before the secondary product (the 4-inch drive)," states William Wachs, senior OEM marketing representative at IBM's Information Products Division in Boulder, Colo., "but there is no reason for us to delay the introduction of a secondary product just because the primary product is not ready."

In typical IBM style, Wachs does not comment on the primary product. He hints, however, that it will be a smaller version of the successful PC that IBM introduced in 1981. "If you go to the trouble of developing a new system" he remarks, "why not take advantage of new technology?"

Most observers believe that IBM will introduce the less-than-$1,000 Peanut by this Christmas.

The activities at Atlas lend credence to this speculation. The five-year-old-company, which had $5 million in sales in 1982, is undergoing an unprecedented $55 million expansion in its Far East manufacturing facilities, including a 400,000-square-foot manufacturing plant in Malaysia. At the heart of this expansion is the contract with IBM to start producing the 4-inch drive this fall. "We expect to produce a million drives in our first year of production," claims Ken Hardesty, president of Atlas.

That figure is far more ambitious than IBM's plans—to produce 400 drives per day at the Boulder facility, which now makes 8-inch disk drives. Like similar companies making commodity items, such as Atari, Qume Corp. and Tandon Corp., the bottom line in production for IBM is cost. "I can beat IBM's cost for manufacturing in Boulder by three times," boasts Hardesty. "There is no one who can manufacture at lower cost to IBM's specs."

Atlas apparently proved its claims to IBM's satisfaction. IBM held a competition among three finalists—reportedly Tandon, Qume and Atlas—once it decided on offshore production for the less-than-$200 drive. "Some companies just like to go over there and take advantage of the cheap labor without making an investment in state-of-the-art equipment and training," Hardesty asserts. "Our manufacturing lines in Hong Kong and Malaysia are the equal of any in the U.S."

IBM will not take any chances on its first high-volume offshore manufacturing being less reliable than products manufactured in the United States. IBM engineers have manufactured portable test units that measure each drive against IBM benchmarks. The drive has been simplified with fewer than 30 parts and only three factory adjustments. "It's basically a disposable drive. If it ever breaks down, it will be cheaper to simply replace the drive in the field than to have a serviceman repair it," contends IBM's Wachs.

Wachs also says it would be impossible even for mighty IBM to use traditional assembly labor in the United States and make a profit on the drive. IBM is, however, prepared to produce additional volumes of the drive by using robotics if the demand warrants it. However, Atlas' Hardesty doubts that IBM will need to supplement his firm's production because current expansion plans will allow Atlas to produce drives in the millions.

Atlas has established a reputation as a drive head manufacturer for its U.S. subsidiary, Data Magnetics Corp. Data Magnetics manufactures heads for other IBM products and for Digital Equipment Corp., Hewlett-Packard Co. and other manufacturers. "We are not going to be another Tandon," Hardesty insists, referring to Tandon's entry into the drive market in 1978. Most of its customers were angered by the move, which put them into competition with their former supplier. "Atlas is and will always be a manufacturing company—not a development company," emphasizes Hardesty.

Atlas has options to manufacture three other 4- and 5¼-inch IBM drives. In addition to producing the drives, the company is the success-

ATLAS: TROUBLED HISTORY TURNS BRIGHT

Atlas has come a long way for a company that was once a high-revenue, low-profit manufacturer of low-end consumer electronics. The company was acquired in 1980 by A-Alphatronics, a Hong Kong entrepreneurial operation owned by California financier A.J. Miller. Miller had previously acquired Data Magnetics, which began operations in 1965, primarily as a supplier of heads for tape products. The company had the advantage of vertical integration—including its own ferrite manufacturing facility—but suffered from inadequate management. Miller acquired Data Magnetics when it was on the brink of bankruptcy in 1978. He infused it with cash and management that enabled it to become debt free and profitable after its first year.

A-Alphatronics then looked for another troubled company ripe for acquisition. It found its target in Atlas. Atlas thus became the holding company governing the various A-Alphatronics electronics subsidiaries in both Hong Kong and the United States. Consequently, Atlas became profitable in 1981 for the first time in its history.

ful bidder for the rights to manufacture Peanut itself. "It's a natural step," Hardesty says.

Although some manufacturers see Far East production as a cure-all for companies undergoing "labor pains" in the United States, Hardesty believes that those counting on continuing to pay low wages in the Far East will be in for a disappointment. "Wages are likely to increase threefold from the $13 per day average paid today," he concludes. "Productivity will be the key." As a result, Hardesty says, Atlas will continue to invest in equipment designed to get the most out of todays' workers while preparing for the reduced work force of the future.

—Robert A. Sehr

HEARD ON THE HILL

By Stephen J. Shaw
Washington Contributing Editor

Liberalizing trade with China will take time

In late June, the U.S. Department of Commerce announced that guidelines for exporting high-technology items to the People's Republic of China would be loosened to allow shipments of "dual-purpose" equipment for both commercial and military applications.

The announcement came as President Reagan apparently overrode objections by the U.S. Department of Defense, conservatives within his own administration and other federal agencies to liberalizing export-license regulations for U.S. computer manufacturers and system integrators. The president's decision was a victory for Commerce Department secretary Malcolm Baldrige, a staunch advocate of freer trade between the U.S. and mainland China.

But potential exporters of advanced computer technology, eyeing what has been called the "last great economic frontier of the 20th century," should not rush to break out the champagne or apply for export licenses. A closer look at the president's decision and the political realities faced by those hoping to exploit the Chinese market indicate that it will be some time before any real impact of the decision is felt, except in isolated cases.

Development of the new export guidelines within the Commerce Department will likely take at least a year, despite Baldrige's promise to the Chinese during his June visit of results within six weeks. In mid-1980, China was formally moved from export category "Y"—subject to the same controls as the Soviet Union and its Eastern bloc allies—to category "P," created to apply only to China. Those guidelines required six months to develop. Once they were issued, glaring deficiencies quickly surfaced. For example, the new regulations did not address embedded-microprocessor technology, nor were they consistently applied. Technical guidelines that detailed I/O bus rates, internal memory capacity, data-transfer speeds and other specifications were only loosely interpreted. Equipment that exceeded the maximum specifications was sometimes approved, while systems that fell far below specifications were sometimes denied licenses.

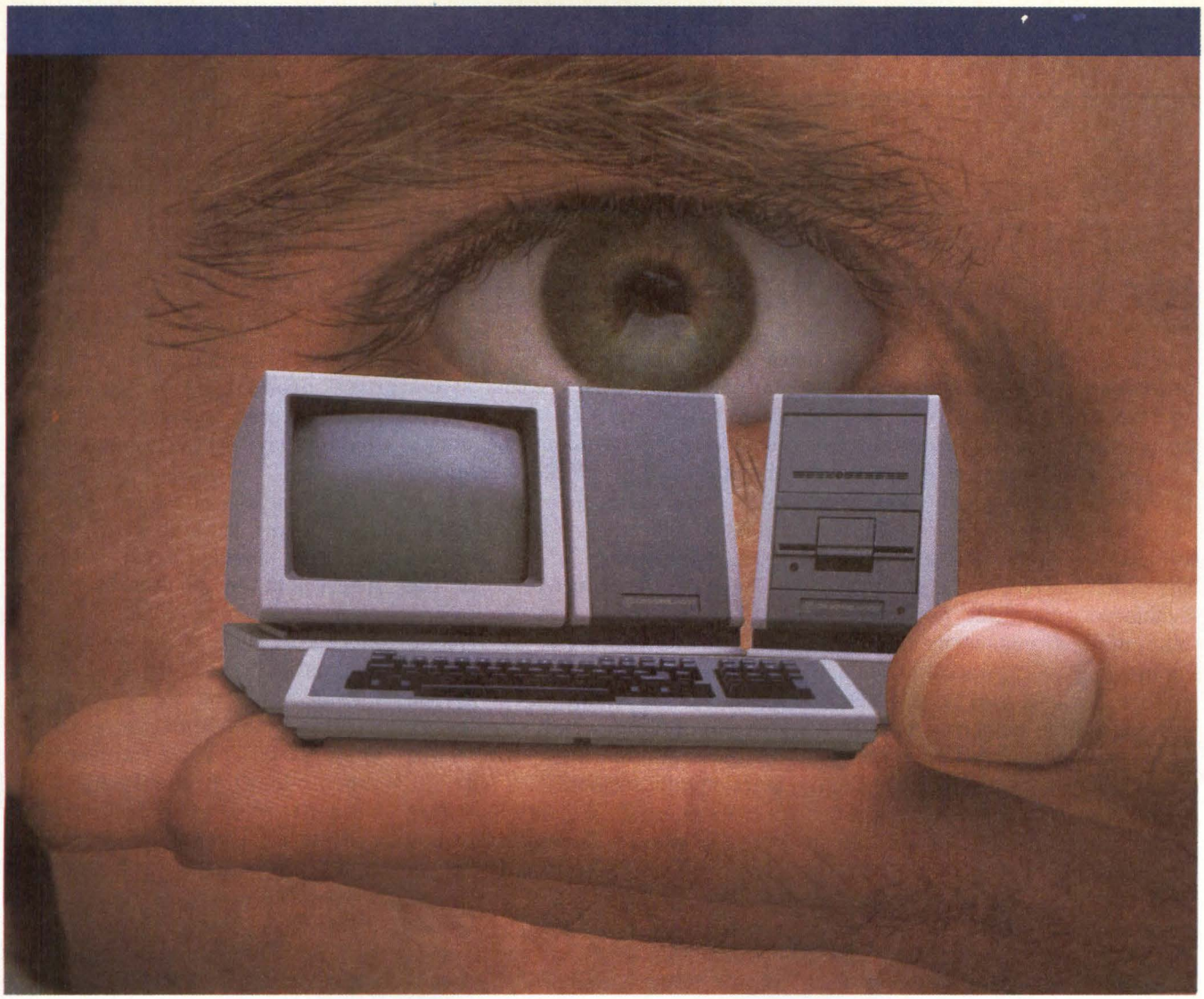
In the near term, it's likely that initial high-priority showcase projects will be approved on an ad hoc basis, if only to show good faith on the part of the administration. But routine approval of licenses for dual-purpose computer technology is still a long way off.

Although China is now officially grouped in category "V," which includes both allied and non-allied nations from Great Britain to Yugoslavia, national-security considerations and review procedures will still be in effect. Development and implementation of the new export guidelines, announced the Commerce Department, will occur only after "intense technical review" of proposed changes and consultation with U.S. allies. Such consultation will presumably focus heavily on the problem of re-export of U.S. technology to China through a third country and the willingness of U.S. allies to sell equipment and technological capabilities that are restricted under U.S. guidelines to the Chinese. Such equipment includes 16-bit microprocessors.

Finally, while there is widespread agreement about the potentially lucrative Chinese market for advanced U.S. computers and computer technology, it is difficult, if not impossible, to estimate that market's size.

Given the centralized, planned nature of the Chinese economy, projections of demand are useless. The driving factor behind the Chinese desire to import U.S. technology is based more on hard currency allocations than on needs.

The best piece of advice to U.S. computer manufacturers and system integrators is simply to wait and watch closely for future export guidelines from the Commerce Department. That will be the crucible of whether the "liberalization" of high-technology trade with China is more real than the announcement that it is.



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CIRCLE NO. 27 ON INQUIRY CARD

Start-up uses sputtered thin-film media for high-performance 5¼-inch drive

A well funded, year-old start-up in Milpitas, Calif., has combined sputtered thin-film media and a proprietary linear actuator in a 5¼-inch form factor drive that threatens to upset performance standards for small drives. Applied Information Memories (AIM) claims the "Dart" drive, to be shipped in evaluation quantities beginning in November, possesses an 18-millisecond average access time and a storage capacity of 140M bytes.

Access time compares favorably with the 3380, the most recent 14-inch thin-film-head drive from IBM Corp., which has an average access time of 16 milliseconds. Most other high-performance 5¼-inch thin-film-head drives operate in excess of 25 milliseconds. Exceptions are Atasi Corp.'s 3020, which specifies a 19.8-millisecond access time but has a storage capacity of only 36M bytes, and Maxtor Corp., which has a 140M-byte, 5¼-inch drive with an access time of 30 milliseconds. "We expect it to be faster than 18 milliseconds," asserts Arnold Cooley, AIM's vice president of sales and marketing, "but we will specify 18 milliseconds."

The AIM drive uses four platters in a conventional head-disk assembly. Both the actuator and the 15,000-flux-changes-per-inch sputtered media are proprietary designs. Maxtor's drive uses a proprietary spindle arrangement and eight platters. Cooley says AIM's design is "fearfully simple." He notes the company has remained underground until now to reduce the chances of a competitor's copying the actuator before production. "Also, it wasn't proper to hype anything until we were absolutely sure the product worked to specifications," Cooley remarks.

Jim Porter, disk drive analyst and author of *Disk Trend Report*, remains cautious about the drive. "It has a lot of ifs—a lot of unconventional technology—and it remains to be seen if it can be put together in volume."

However, he concedes that AIM has assembled a first-rate team. Cooley was previously vice president of marketing at Applied Peripherals Systems Inc., a Dyson Corp. subsidiary manufacturing drives and thin-film heads. AIM founder and president Jack Torranto is a founder of Ibis Inc. and most recently headed Burroughs Corp.'s disk drive development facility in Westlake Village, Calif. AIM's vice president of engineering, William Glover, was a senior engineer at Digital Equipment Corp.'s Colorado Springs, Colo., disk drive manufacturing plant. The company's vice president of operations, William Deering, comes from a similar role at Storage Technology Corp., Louisville, Colo.

A measure of the financial community's faith in AIM's future is the fact that the company has fulfilled its goal of acquiring $30 million in venture-capital financing far ahead of schedule. The company is backed by Hillman Co., a Pittsburgh, venture-capital firm, and General Electric Co.'s venture-capital arm.

AIM officials see the Dart primarily as a revenue producer, while another product using perpendicular magnetic recording is reportedly in development. The ambitious development project is expected to expand the Dart's capacity to 500M bytes. Cooley, however, believes the market does not yet require that capacity. "We decided to make our first product only 140M bytes because our potential customers told us that's all they needed now," he states.

Because the company plans to manufacture both disk drives and thin-film media, it has a huge investment in equipment, unlike many of its competitors. Furthermore, AIM plans an automated plant in Austin, Texas. That plant will manufacture the media using robotics and semiconductor sputtering equipment. The Austin plant will also produce the drives, but only 67 percent of that manufacturing process will be automated. "Anyone can do this in a vacuum chamber," Cooley admits. "The key will be doing it in volume." The company expects to manufacture 50,000 of its 140M-byte Dart models in 1985, the first full year of production. The first units are slated to come off the assembly line in April 1984, and the company expects about 5,200 drives to be built during the remainder of 1984. The Dart is expected to sell for about $15 per megabyte.

AIM also plans to incorporate the drive into a rack-mount cabinet housing four head-disk assemblies of 220M bytes each. This will give system integrators 880M bytes of storage in a 10-inch-high box that weighs less than 100 pounds, far lighter than most bulky, 8- and 14-inch rack-mount boxes available. Called "Lance," the package will reduce the cost per megabyte to $12.

On the media side, the company expects to produce as many as 750,000 5¼-inch disks per year on three production machines being manufactured by a West German company for AIM. The high produc-

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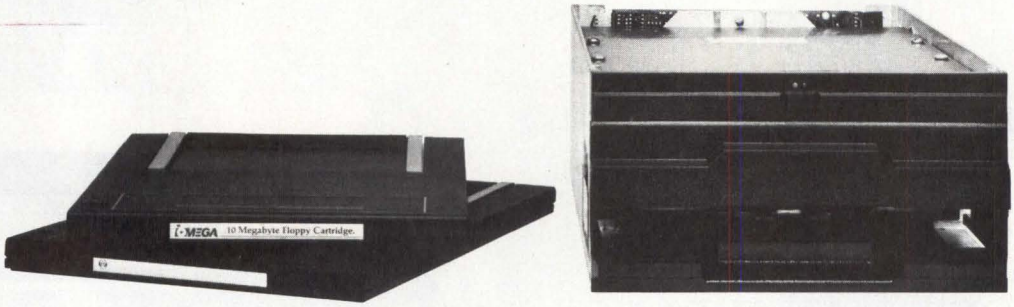

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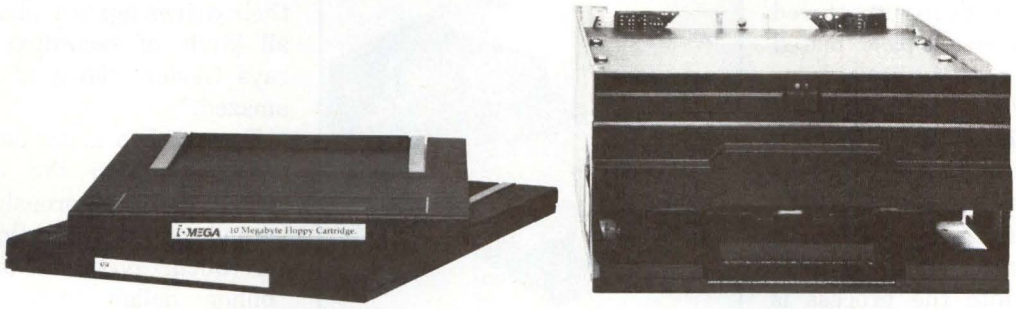

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Sure, the camera angle on each view is the same. But "front" and "back" refer, in this case, not to a photographic perspective, but rather to an *applications* perspective. They refer to the fact that this revolutionary cartridge drive is the most versatile and economical storage device you can buy for a full range of applications—from back-up and archival storage to up-front primary storage.

Front View: High Reliability Primary Mass Storage.

There are several powerful reasons to seriously consider the Alpha 10 as a primary mass storage device. First of all, each cartridge stores 10 Mbytes of data—easily matching capacity with today's Winchesters.

But just as important, the Alpha 10 matches the Winchesters in reliability, thanks to several IOMEGA innovations in flexible disk and removable cartridge technology. As for versatility, the unique cartridge format of the Alpha 10 speaks for itself—a straightforward approach to library management and data interchange.

Back View: High Versatility Back-Up And Archival Storage.

The Alpha 10's advantages for back-up and archival storage are just as impressive. For instance, a 10 Mbyte Winchester file can be dumped onto a single Alpha 10 cartridge in literally minutes, not the usual hours. You can look forward to a new standard of reliability that is integral to our design. And, because our cartridges are the most inexpensive on the market today, archival storage doesn't cost you an arm and a leg.

Overview: The Careful Evolution, And Immediate Availability, Of A Drive Design Revolution.

Any way you look at it, the Alpha 10 is a breakthrough in data storage device design. Actually, it's a series of breakthroughs, including non-contact head-to-disk interface, high linear bit densities, a run-length limited code that compresses the data stream from the host, and closed servo control of the head positioning, all to achieve the economy and versatility of flexible disks with the capacity and reliability of hard disks.

But the best part of the technology is that it's here, now, packaged and available in OEM quantities. Get the whole story, today, on the Alpha 10 from IOMEGA.

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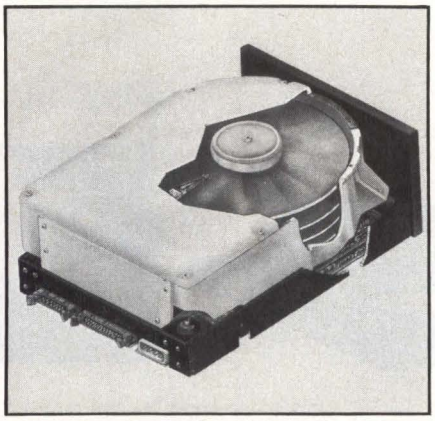
CIRCLE NO. 29 ON INQUIRY CARD

tion capacity is expected to help reduce the shortage of thin-film media. Cooley believes sputtered media is likely to surpass plated media in popularity because sputtered media's alloy content provides increased durability and corrosion resistance.

Other manufacturers, including IBM, are investing in sputtering technology. Among those believed to be looking into the process is Dysan Corp., which for years has resisted customers' pleas to manufacture plated media because of Dysan chairman Norm Dion's reservations about the reliability of plated media. "We have had lots of drive manufacturers come in here and test our sputtered media in their drives against plated disks at all kinds of recording densities," says Glover. "Most of them leave amazed."



Applied Information Memories' four-platter "Dart" drive *has 1,000-tpi track density and 19,220-bpi bit density and uses standard MFM recording code. Capacity is 140M bytes.*

To establish a standard for both the media and the drives, the company is vigorously pursuing second, and possibly third, sources for both. Negotiations with a "billion dollar drive and media manufacturer" second source are near completion, Cooley says.

The agreement is expected to be in place before media production begins this fall. *—Robert A. Sehr*

WP package for IBM PC seen as 'leading-edge' product

The new word-processing package from Leading Edge Products Inc. for the IBM PC is a harbinger of even better things to come, says Thomas Billadeau, president of the Office Systems Consulting Group, Cambridge, Mass. Advances in the personal-computer word-processing field are happening so rapidly that by year-end, "No one will want to buy a Wordstar-like package," Billadeau claims. With packages such as Samna Word (see "The impending death of dedicated word processors," Page 85), Micro Tool Word from Microsoft and the Leading Edge Word Processor, users are "finally getting dedicated word-processing functionality in the personal-computer environment," he observes.

The Leading Edge package is a departure from the company's

MAINFRAME FINANCIAL-PLANNING SOFTWARE RUNS ON IBM PC

Execucom Systems Corp.'s interactive financial-planning system (IFPS) for mainframe computers has been ported to the Computer Devices Inc. IBM PC-compatible DOT portable computer as well as to the IBM PC. The package is priced at $3,000 in single-quantity licenses or $500 or less for licenses of 200 or more packages. It is aimed at Fortune 1000 users whose installed mainframes run mainframe IFPS's more complete version of the package. Most of those users will have had some experience using the software.

IFPS Personal is an integrated product that performs financial modeling, graphics, communications to corporate databases and libraries and report writing/editing. The product runs in 256K bytes of memory, so the IBM XT hard disk model is not a prerequisite. The heart of the product is a model interrogator, which allows both the accuracy of assumptions and solutions to be reviewed. The IFPS software is used in courses at 150 business schools, company officials explain.

The product now runs with asynchronous protocols, but Execucom plans to add SDLC/SNA and bisynchronous protocol support this month. Company officials claim not much synchronous communication is performed between installed mainframes and microcomputers.

The company plans to convert the software to run on other MS-DOS machines this year, and says it is pushing to get a joint marketing agreement with Apple Computer Inc. for its Lisa 16-bit microcomputer.

The IFPS software for the PC can run on 20 mainframe operating systems, including those from Digital Equipment Corp., IBM Corp. Honeywell Inc. and Burroughs Corp. and minicomputer operating systems from Prime Computer Inc.,Hewlett-Packard Co., DEC and Data General Corp. Simultaneous remote updating and interrogating requires use of mainframe IFPS software.

Execucom has so far dealt only with timesharing companies as resellers. IFPS for the PC will expand that to include value-added resellers.

—Lori Valigra

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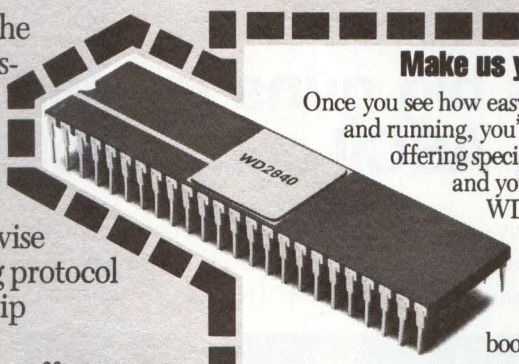

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normal position as marketer and distributor of products developed elsewhere, such as C. Itoh printers. The Leading Edge Word Processor was developed in house by two engineers imported from Wang Laboratories Inc.'s WangWriter word-processing team. Philip Florence, Leading Edge executive vice president of research and development, managed WangWriter development at Wang, and Leading Edge vice president of word processing J.B. Royal managed the WangWriter word-processing editor project.

Features of the Leading Edge package include:

- Forward and backward cursor movement by character, word, line, sentence, screen or page, and a "go-to-page" command;
- An "oops" key to replace text erroneously erased;
- A maximum margin setting of 200 characters;
- Menu override;
- Cut and paste;
- Windows;
- Footnote capability;
- On-line help.

Billadeau claims the package's most impressive feature is its speed, which is a result of the system's requiring at least 128K bytes and its being written in PL/M-86 rather than C as are most other word-processing packages.

Most of the package's functions require one or two keystrokes. Plastic overlays are provided. The company says it commissioned a novelist to write the manual in an easy-to-read style. (The manual, however, was not ready by press time.)

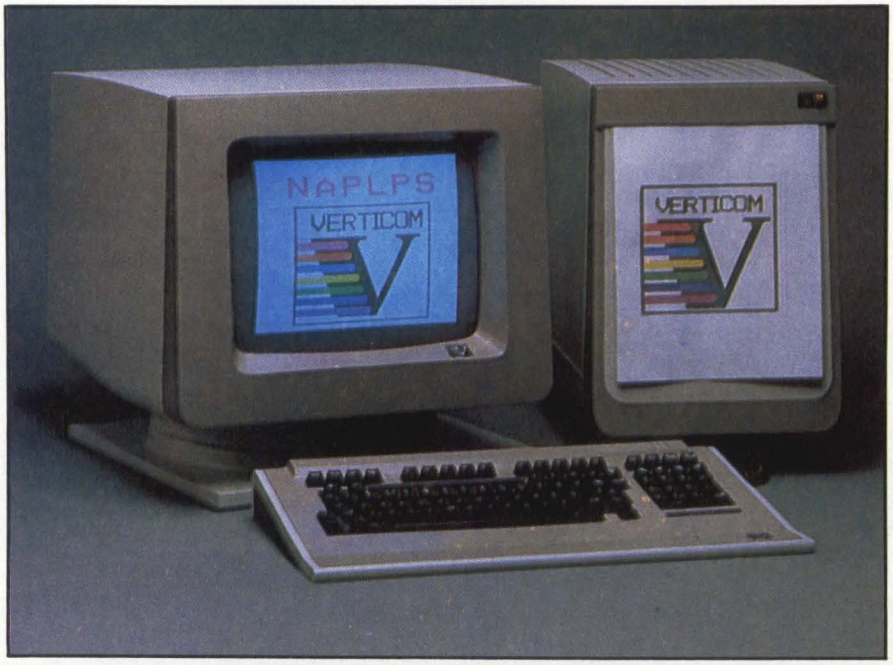
Price of the package is $295, with shipping scheduled for this month. The company may integrate spreadsheet and graphics capabilities and a spelling corrector into the package by December, Florence hints.

Billadeau sees such word-processing packages, instead of spreadsheets, as the heart of future integrated systems. He expects competing packages to appear at the fall Comdex in Las Vegas.

—David A. Bright

Start-up beats big guns to market with NAPLPS, ASCII-compatible terminal

Verticom Inc., a year-old Sunnyvale, Calif., start-up, has developed one of the first graphics terminals conforming to the proposed North American Presentation Level Protocol Syntax (NAPLPS) standard.



Verticom Inc.'s terminals *are both ASCII and NAPLPS compatible and emulate the DEC VT100 and Tektronix 4010. Resolution is 640-by-480 at 30 Hz interlaced. The low-profile keyboard has 105 keys and a palm rest.*

The endorsement of NAPLPS by giants such as AT&T, Digital Equipment Corp., Intel Corp. and Honeywell Inc. is likely to assure that the Verticom terminal will be only the first in a long line of graphics devices adhering to the standard.

The PLP100, which is compatible with DEC VT100 and Tektronix 4010 terminals, sells for $5,650 in single-unit quantities. Another version, the PLP200, allows interactive generation of NAPLPS databases. List price of the PLP200 is $6,450. Those are not commodity prices, but Verticom president William Chu advises, "Those prices are subject to adjustment later when there are more competitors in the NAPLPS market."

Although NAPLPS is stuck in the American National Standards Institute's (ANSI) hearing process, it is unlikely that other manufacturers will wait for a puff of white smoke from ANSI before adopting the

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NAPLPS standard. Many expect NAPLPS eventually to replace ASCII codes for graphics terminals. Chu, however, believes ASCII and NAPLPS can coexist, because NAPLPS was designed as an upward extension of ASCII, allowing fast communication of graphics and text between the terminals and a central database. Under NAPLPS, only about one-half as many characters need be generated and communicated. Thus, they can be transferred twice as fast as with an ASCII terminal.

A key market for the terminals is expected to be videotex, for which NAPLPS was created. Color graphics will play a key role in the success of videotex, which will allow more cost-effective business communications and enable consumers to tie into electronic banking, electronic mail and news networks. As that market matures and volumes increase, terminal prices are expected to drop, and some experts expect videotex terminals to become as much of a commodity item as video cassette recorders are today.

Both Verticom terminals provide 640-by-480-dot resolution at 30 Hz interlaced, on 13-inch tilt-and-swivel color monitors. Each terminal employs dual Z80 processors and features a 320K-byte dual-port graphics display memory, allowing users to work on one page while another is being printed. Standard on the terminals is 2K bytes of CMOS RAM with battery backup. Verticom claims the terminals are device independent. Each has one serial port with current loop and one parallel printer port. Each terminal has three free Multibus slots and can display 16 colors out of a palette of 4,096.

The optional software package, which is compatible with ISSCO's, DISSPLA and TELL-A-GRAF, is written in C and allows the development of NAPLPS-compatible frames on the terminal with an optional mouse. Price of the software had not been set by press time.

Deliveries of the terminals are expected to start in October. Verticom plans to sell the terminals to OEMs and end users.

—Robert A. Sehr

OEMs award good marks to Delphax non-impact printers

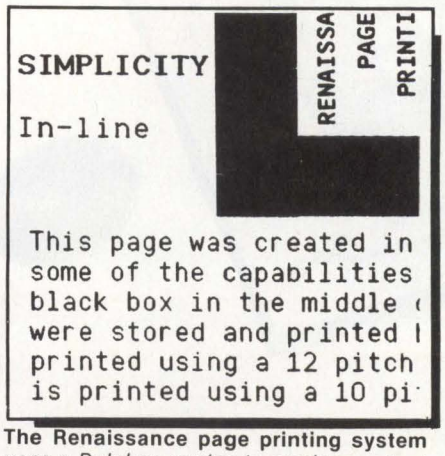
A tangible alternative to laser xerographic printers has finally emerged from the host of non-impact technologies that until now have resulted in no commercial products. The alternative takes the shape of Delphax Systems' ion-deposition printing system. Beta-test-site data on the new technology's reliability indicates volume shipments should begin next year.

Six companies introduced printing systems incorporating the Delphax ion-deposition engine in the first half of this year. Delphax, Mississauga, Ontario, is a joint venture formed two years ago by Dennison Manufacturing Co. and Canada Development Corp. (MMS, June 1981, Page 179). Some of the systems developed by Delphax's OEM customers are in end-user sites with beta testing complete or nearing completion.

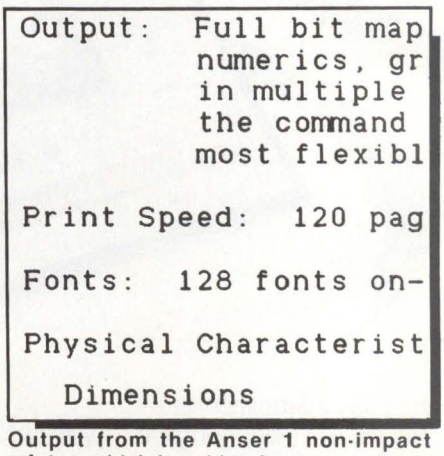
The basic Delphax A2460 image output module, upon which the new printers are based, prints at a maximum speed of 60 pages per minute with a density of 240-by-240 dots per inch. Delphax's customers are placing the ion-deposition engine in a variety of markets with processors designed for vertical applications or for replacement of line printers using compatible controller software with a target host.

Southern Systems Inc., Fort Lauderdale, Fla., began shipping its Mercurion 1 printer based on Delphax's system in April. The product is targeted at data-processing environments using high-speed band or chain/train line printers that have Dataproducts-compatible interfaces. Southern Systems president Joseph Horn sees the Mercurion 1, priced at $60,000, as a cost-effective, high-

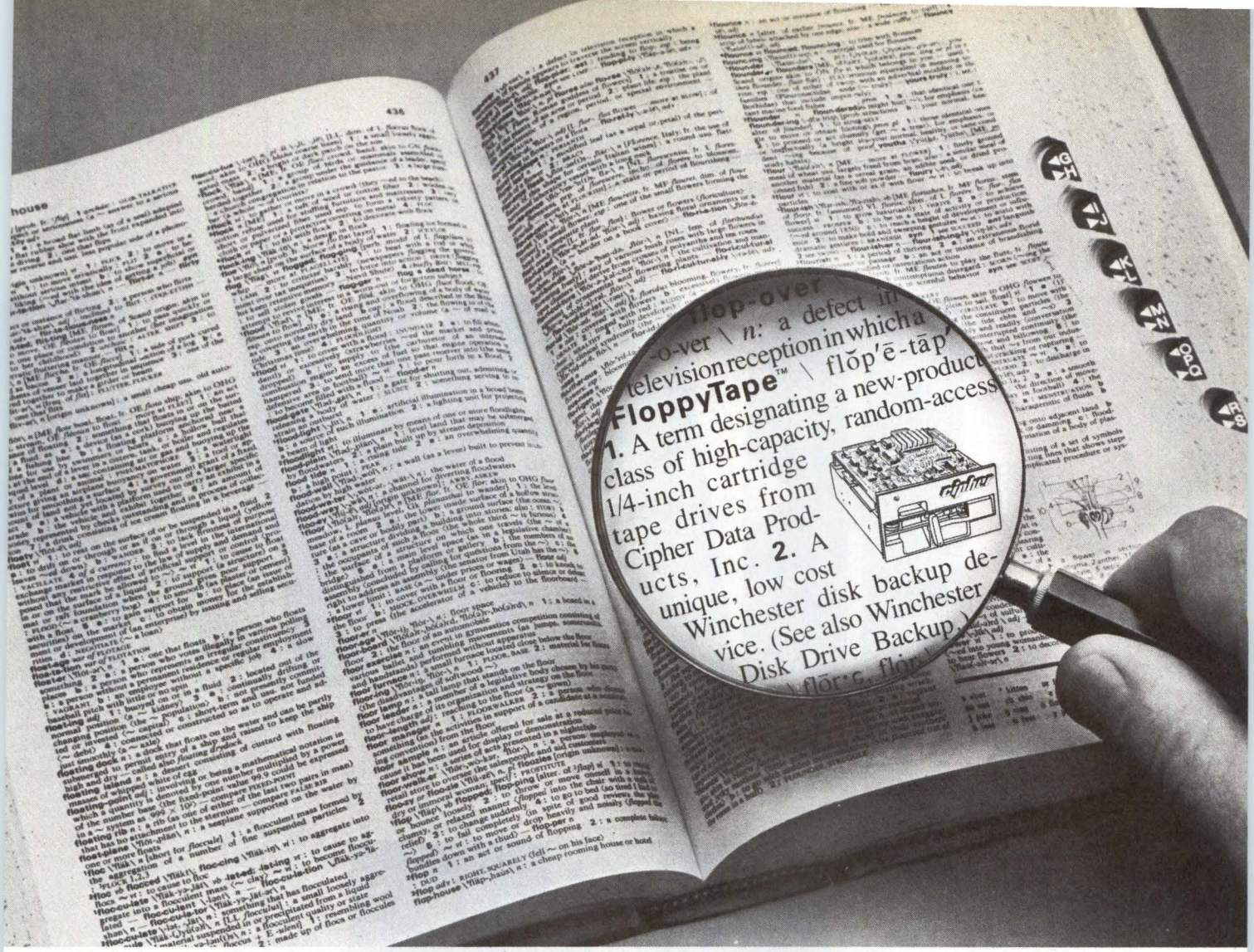
Continues on page 55



The Renaissance page printing system *uses a Delphax engine to produce output at 60 pages per minute.*



Output from the Anser 1 non-impact printer, *which is said to have a maximum print speed of 120 pages per minute.*



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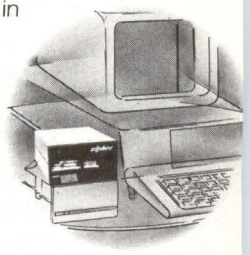

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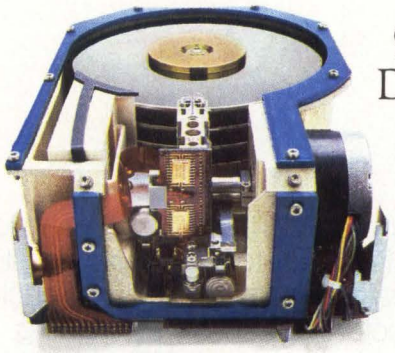

But thin-film media isn't the only reason to buy Evotek drives. With capacities up to 51.68 MB, they have such advanced features as high-torque precision motors. Superior brake force. Six-bearing linear actuator with a 49 ms average access time. Even an on-board microprocessor.

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As a letter quality printer (37 cps) the 7030 gives you high density double pass printing in a 24 x 18 matrix. You choose from almost 20 fonts such as Script, Courier and APL, plus you get proportional spacing, justification, auto underline, overprint, bold and a host of other features.

As a near letter quality word processor (75 cps) the 7030 uses a 12 x 9 matrix in a single pass mode.

As a data processor, the 7030 produces copy at 180 or 150 cps bidirectionally. When you need multipart forms, it gives you 6-part forms capability as well as user definable formats with programmable lengths, programmable vertical and horizontal margins and tabs.

As a graphics printer, the dot addressable 7030 has a resolution up to 144 x 144 dots per square inch, and offers a full complement of line drawing graphics.

The 7030 even makes available an enlarged character mode useful in producing custom labels. It also provides a complete printed status report of operating parameters or diagnostics when ordered by the operator. And its heavy duty print head and industrial quality construction are designed for long hard use.

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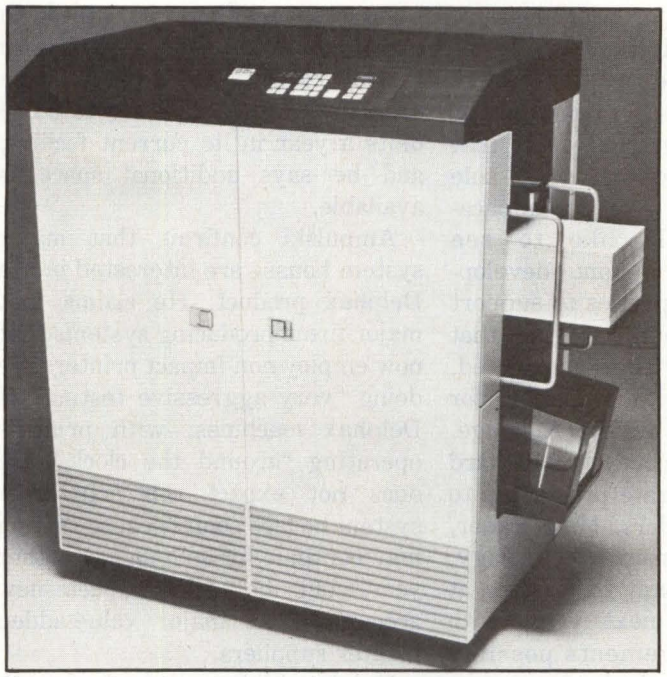
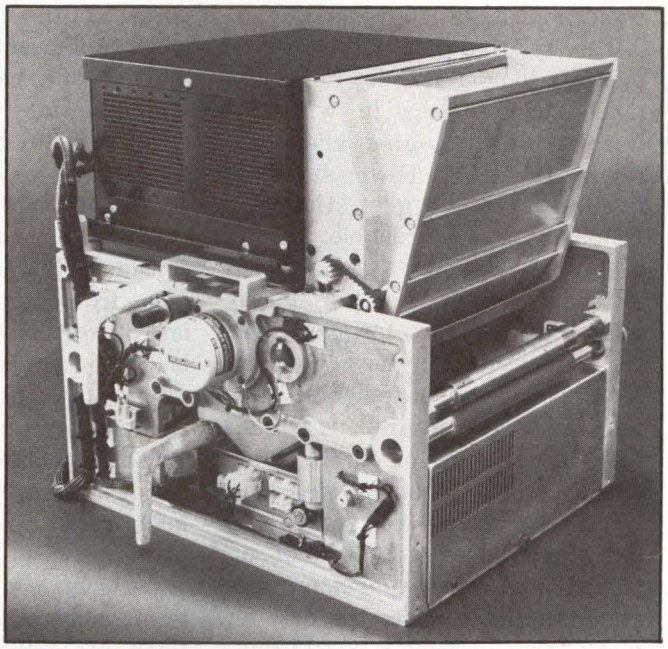


The Mercurion 1 from Southern Systems *is the first printer using a Delphax engine to reach the market.*



Delphax Systems offers its basic print module *with paper handling as a fully functioning printer with multiple font and forms generation capabilities.*

speed complement to the firm's line printers for IBM Corp., Digital Equipment Corp. and Prime Computer Inc. computer systems. Horn claims his company will have delivered 130 units by year-end.

Anser Technology, Fort Worth, Texas, has begun delivering a Delphax-based printer with capabilities for bit-map and MICAR (magnetic-ink-character-line) printing of checks and other financial documents. Anser, with configurations ranging in price from $95,000 to $250,000, has the fastest Delphax-based machine demonstrated. It has a modified A2460 module reaching a speed of 120 pages per minute. Check Technology, Minneapolis, has also designed a check-printing system with the ion-deposition module for check printing applications. The company has delivered six units ranging in price from $98,000 to $200,000 that incorporate collating and binding functions.

Renaissance Marketing Inc., Westbury, N.Y., has developed a standalone version of the Delphax printer in a joint venture with Miltope Corp., Melville, N.Y., a producer of militarized printers. Renaissance president Richard Murray says the company is aiming the printer, priced at $69,000 to $75,000, at the data-processing market and has recently shipped its first evaluation and custom-designed units. Miltope plans to market a militarized version.

Imagen Corp., Mountain View, Calif., and Quality Micro Systems, Mobile, Ala., have demonstrated printers employing a Delphax engine. Neither company had shipped units by press time. Both are interested in using the printing system with processors having much value-added graphics capability. These products will be based on others the two companies have marketed for lower speed laser printers.

OEMs consider the Delphax engine's printing speed to be most important. In addition, the cost of hardware for ion deposition is lower than that of laser xerography on a price/performance basis. Ion deposition is also simpler, asserts Ian Mallandar of printer research firm Advanced Technology Resources. "The process requires fewer steps and less complex hardware," he explains.

Other advantages of ion deposition include the use of a more durable drum, like the one Delphax uses, rather than a drum with a photoelectric surface. Ion deposition does not require a light-shrouded or air-conditioned environment as higher speed laser printers do, and the paper path is straighter.

While most agree that ion deposition can match laser xerography speed at lower cost, no one suggests that laser printers are about to be totally supplanted. "Electrophotographics techniques do have a lot going for them," says Mallandar. "Most important, a number of companies have gone five years or more down the learning curve and have the additional advantage of symbiosis with the

copier industry."

The relative maturity of laser printing compared to ion deposition points up an area in which all untried technologies are questioned: reliability. Fewer steps and fewer parts suggest that the Delphax engine is reliable, but end users do not know its track record. After having observed the Mercurion 1 in the field for more than three months, Southern Systems' Horn believes that reliability may not be as large a problem as some fear. "Every one of our beta test sites is still functioning; we've had no one wanting to return the printer," he says. "Most of our customers are first-time non-impact printer users, and for the first few weeks, they perceive it as a big risk. As long as they know they will get proper support, however, it is not going to worry them for very long."

Robert Wallace, president of Imagen, agrees that reliability should not be a long-term problem for Delphax. "Our in-house experience with the Delphax machine has been excellent; we haven't had a failure," he notes. "That could be a particular unit," he adds. "But we think the system is intrinsically reliable." Wallace notes, however, that suppliers of any new printing technology will have problems getting major system producers to commit to a printing device. "With all the non-impact product announcements you hear in terms of price, functions and volume production, especially from Japan, OEMs are uncomfortable about making any commitments," he says.

At 240 dots per inch, the resolution of Delphax printers is comparable to that of some laser printers, but lags behind newer models offering 300-by-300-dot-per-inch or greater resolution. Horn, whose company does not supply a laser printer, rates the print quality of the Delphax unit at "80 or 90 percent of the major laser printers, which still means it is far superior to that of any band printer." Mike Dow, senior vice president of Quality Micro Systems, feels that the Delphax resolution is acceptable for sophisticated graphics applications but would like to see considerably more font development from third parties to support ion deposition to the degree that laser printers have been supported.

Customers find the market for Delphax printers difficult to gauge. But many believe they will be hard pressed to accelerate production to keep up with orders. Mike Rader, president of Anser Technology, expects his company to produce at least 200 units next year, with licensing arrangements possibly increasing the number to 500. Southern Systems' Horn makes a conservative estimate of 600 to 800 units to be delivered by the company in 1984.

Delphax itself might be hard pressed to fill orders if such estimates prove true, although it is a problem Delphax president Gary Ampulski would welcome. "Our present production of over 25 machines per month will double within the next six months," he says. "Beyond that, we expect to ramp up production at an even faster rate." He believes the company can handle 2,000 to 3,000 units a year in its current facility, and he says additional space is available.

Ampulski confirms that major system houses are interested in the Delphax product. He claims that major firms producing systems that now employ non-impact printers are doing "very aggressive testing" of Delphax machines, with printers operating "around the clock." He does not expect contracts from system houses soon because testing may continue for as long as another year, but he does expect new accounts from major value-added printer suppliers.

Delphax plans to introduce additional products for use with the A2460 engine within a year, says Ampulski. "The A2460 offers a good point of departure," he says. "We could fairly easily make it 30 percent faster, for example, or offer a 40-page-per-minute version if we can find ways to significantly reduce the costs. We'll go in the direction the OEMs indicate they want."

—Edward S. Foster

Wang hopes to lower systems cost with 64K-byte DRAM

Driven by the need for more compact and less costly memory in its systems, Wang Laboratories Inc. has combined innovative packaging techniques and available parts to introduce a 64K-byte RAM module. The company hopes the new module will lessen the need for the 256K-byte parts expected from the Japanese. Wang plans to incorporate the part on its office-automation and personal-computer systems.

Wang claims that the module, called SIMM (single in-line memory module), more than quadruples the density of memory in a printed-circuit-board area while using standard mounting techniques. Wang asserts the SIMM is denser than 256K-byte memories and includes extra address pins to enable upgrading to both 256K- and 1M-byte dynamic RAM chips. The SIMM is available now. Prices will start at $4.50 for a plastic version and $5.50 for a ceramic version in

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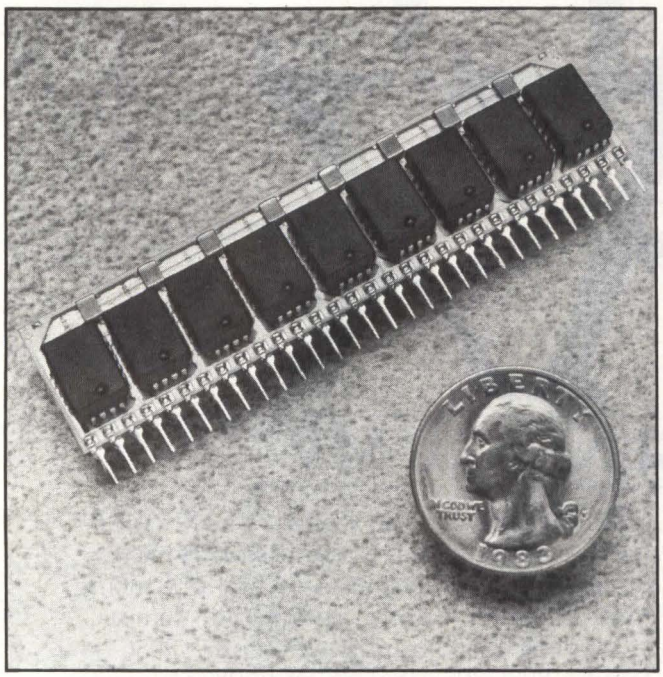
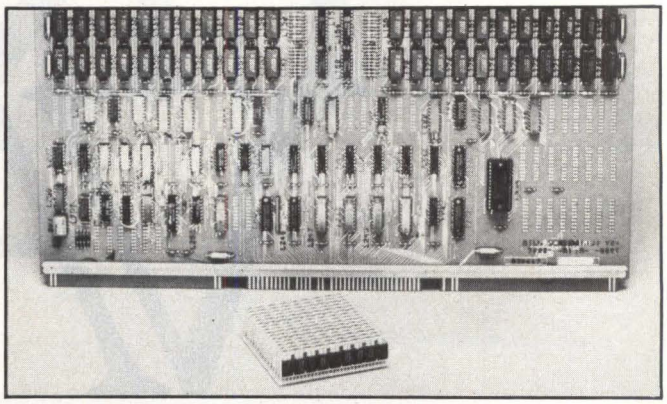




Wang's 64K-byte dynamic RAM module, *shown in the foreground against a VS computer system board, houses 1M byte, as does the board, but would take up 3 square inches (shown). The VS board includes error checking, while the SIMM would require four extra modules to perform error checking, adding 1 inch to the module's size.*

Wang's single in-line memory module *measures ¾ inches by 3 inches, and integrates nine 64K-byte dynamic RAM devices and related decoupling chip capacitors into 64K bytes of memory with parity.*

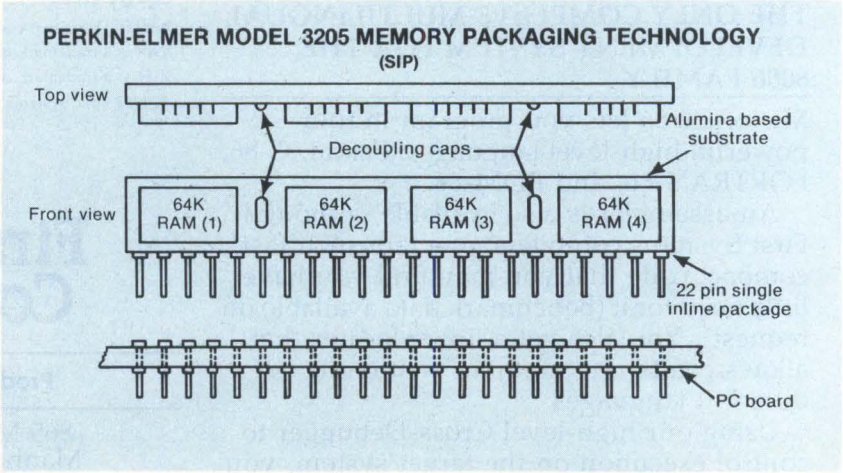
large quantities. Wang expects to use as many as 7 million dynamic RAMs in its products this year.

The SIMM measures 3 inches long by ¾ inches high. Nine (64K-bit) dynamic RAM chips totaling 64K bytes of memory plus parity error detection (the ninth chip), are mounted horizontally on one side of a single in-line package housing, which also includes related decoupling chip capacitors that prevent voltage spikes from adjacent memory chips. The capacitors are mounted under the chip in its third dimension. The module can be mounted directly or through sockets on a PC board and, through

P-E USES SIP 64K-BIT MEMORIES TO CUT COSTS

Before Wang Laboratories Inc.'s introduction of a 64K-byte dynamic RAM module using single in-line packaging technology, Perkin-Elmer Corp. became one of the first companies to use the technique. P-E adopted the techinque to help reduce the price of its model 3205 minicomputer, whose processor sells for less than $10,000.

The memory chip, supplied by Inmos and a Japanese source, uses four 64K-bit memory chips mounted in leadless chip carriers with a ceramic substrate and having 22 pins. Larry MacPherson, product manager for P-E's Series 3200 processors, estimates that the company was able to reduce physical memory-array size 75 percent by using the new packaging. A 4-inch-by-5-inch board houses 1M byte. The 20-square-inch surface compares favorably with the 80 square inches required for the same amount of memory in other P-E systems. A 1M- to 2M-byte memory board sells for $4,900.



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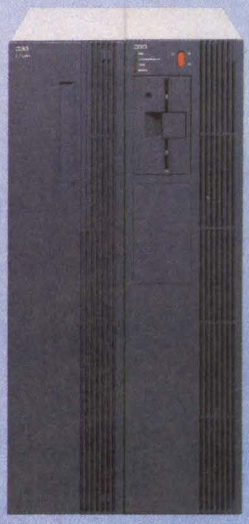

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CIRCLE NO. 37 ON INQUIRY CARD

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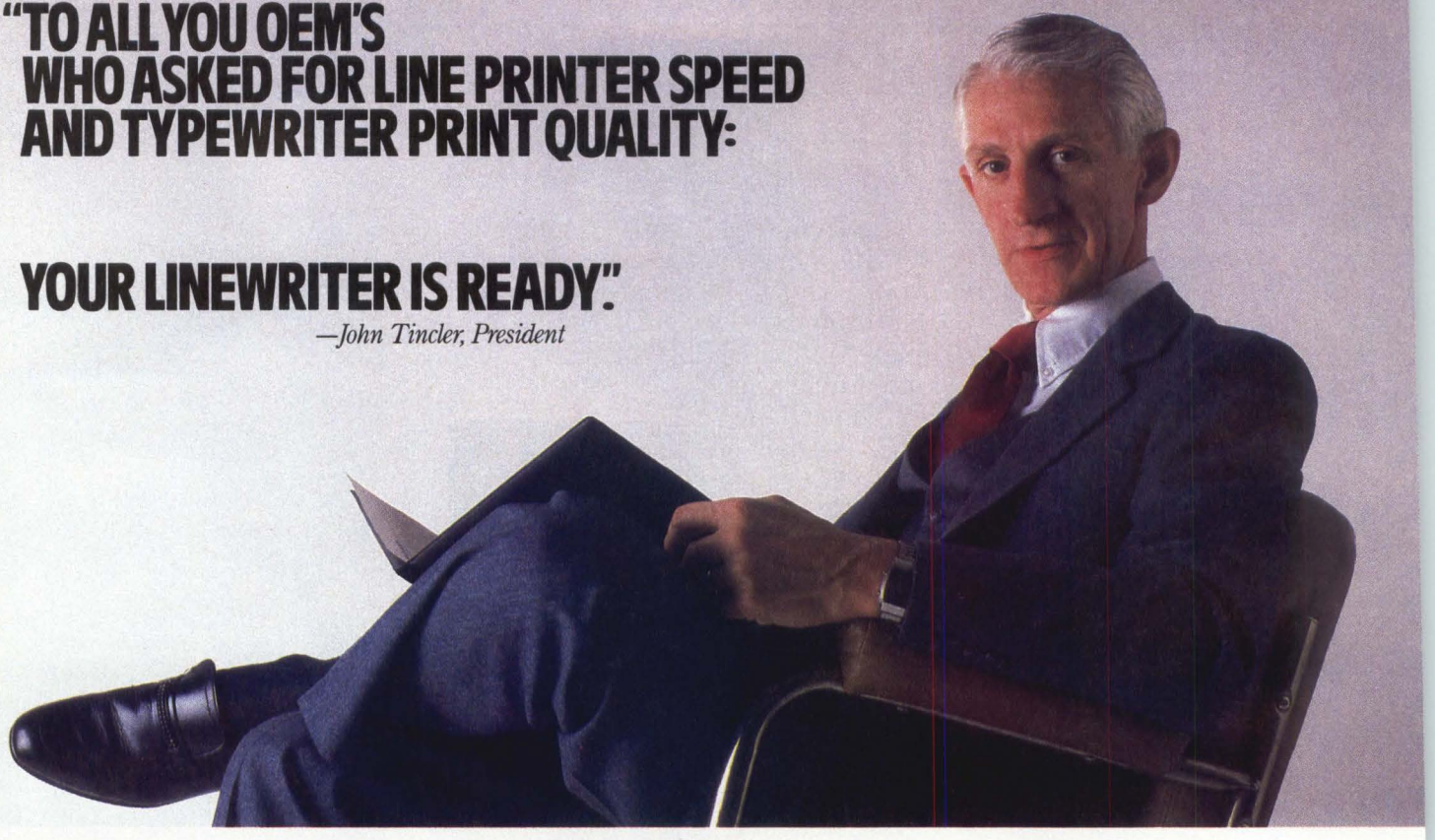

Recently we asked what you wanted most from the next generation of line printers. You told us in no uncertain terms: typewriter quality print at line printer speed; more reliability and less need for service.

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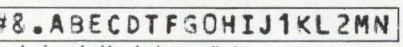
We can't describe the superior print quality—so we'll let you judge for yourself. Just look at the unbelievable difference between the Linewriter 400 and standard band printer samples.

Sample of Linewriter 400 quality.*



Sample of standard band printer quality.*

On top of that, the Linewriter is smaller, quieter, easier to operate and maintain, with the lowest cost of ownership of any 300-500 LPM line printer ever made.

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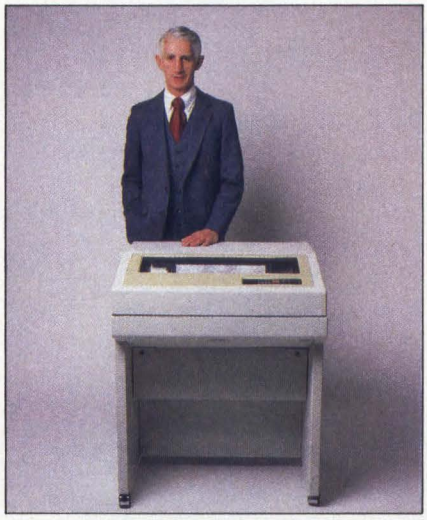

These include true linear free-flight hammers to eliminate character clipping (especially on multi-part forms); and slower, clockwise band rotation to reduce character smudging.

For reliability—LSI and VLSI electronics and up to 15 KV ESD immunity throughout. To improve throughput we included statistical printbands and early end of print. Then we finished it off with human-engineering features: extensive self-diagnostics and an alphanumeric display to pinpoint specific problems; resonating ribbon cassette that doubles ribbon life; 2860 hr. MTBF; 0.5 hr. MTTR and *no scheduled preventive maintenance,* plus a 55 dBa (optional) sound level.

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CENTRONICS® PRINTERS

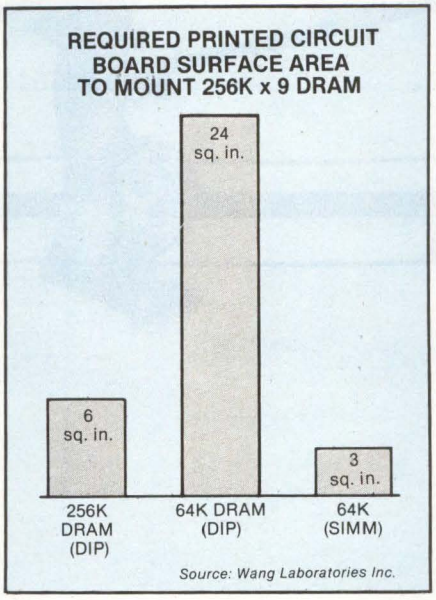
CIRCLE NO. 38 ON INQUIRY CARD

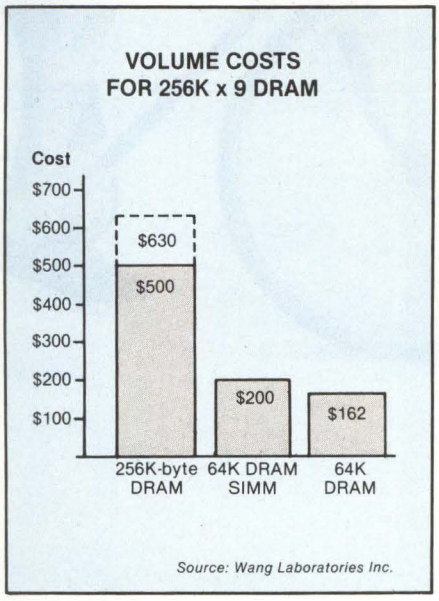
clustering of modules, as much as 1M byte of memory can be housed in a 3-inch-by-4-inch area on the board.

The hybrid technology, which uses two materials packaged in one module, was previously limited primarily to military applications requiring reliable parts, but at a premium. Wang's idea, notes James E. Clayton, principal microelectronics engineer, was to lower the cost of hybrid technology for commercial applications and implement it in high volumes so that other manufacturers could do the same. This meant a redesign and simplification of the technology for use in the module. Wang used a Calma computer-aided-design workstation to develop the thick-film technology circuit in three to four weeks. Overall SIMM development time was two months and cost about $3,000 for the first prototypes. Zenith Microcircuits Corp. assembled the hybrid prototypes for Wang. The module is one of two hybrid products Wang has developed, the other being a power driver module for printer hammers and stepper motors.

At the heart of the module is a mounting technology introduced by Texas Instruments Inc. during the past year. TI's package incorporates surface-mounting techniques and a plastic-leaded chip carrier. Clayton says leadless ceramic chip carriers, which use gold plating for attachment to the PC board, add 80 cents to $1 to the price of a component. The TI package is about one-half the size of a standard dual-in-line package component.

Clayton says the small-outline, integrated-circuit package adopted by most Japanese firms has a lower profile than the TI packaging. But the lower profile packaging has components on its side. Use of that packaging would not allow Wang to mount its components as tightly. However, Wang will decrease the height of the module from ¾ inches to 9/10 inches in the prototype board version so that the devices can fit in Wang's board slot.





Part of the reason Wang adopted TI's packaging, states Clayton, is that soldered ceramic pieces on fiberglass PC boards are believed to have a stress problem at their junctures, so plastic-leaded devices may make a better marriage. Because the TI part is new, however, Wang can continue to use ceramic leadless chip carriers until TI qualifies the part.

The module is targeted for eventual mounting on a two-sided PC board, and Wang has arranged the device's 18-pin sequence so that this can be done without blowing out the memory circuits. Now, all memories are mounted on one side of the carrier to keep costs down and facilitate repair, explains Clayton. However, the capacitors on the PC-board version will be mounted on the back of the carrier to lower the module's profile to 9/10 inches.

For now, Zenith will assemble the parts for Wang. However, both TI and National Semiconductor Corp. are interested in manufacturing the part for Wang and offering their versions to the merchant market to broaden commercial endorsement of the packaging technology.

—Lori Valigra

Honeywell touts product compatiblity for DPS micro

It's tough luck, but industry analysts say Honeywell Information Systems Inc.'s addition of three 16-bit microcomputers to its product line this summer will do little more than hold the company's minicomputer base, estimated by industry sources at about 15,000 installed systems.

"The problem is not the product," points out Dale Kutnick, analyst for market research firm The Yankee Group, Boston. "They've done it right—first. But that doesn't mean anything in this market. Everybody else is doing the same thing."

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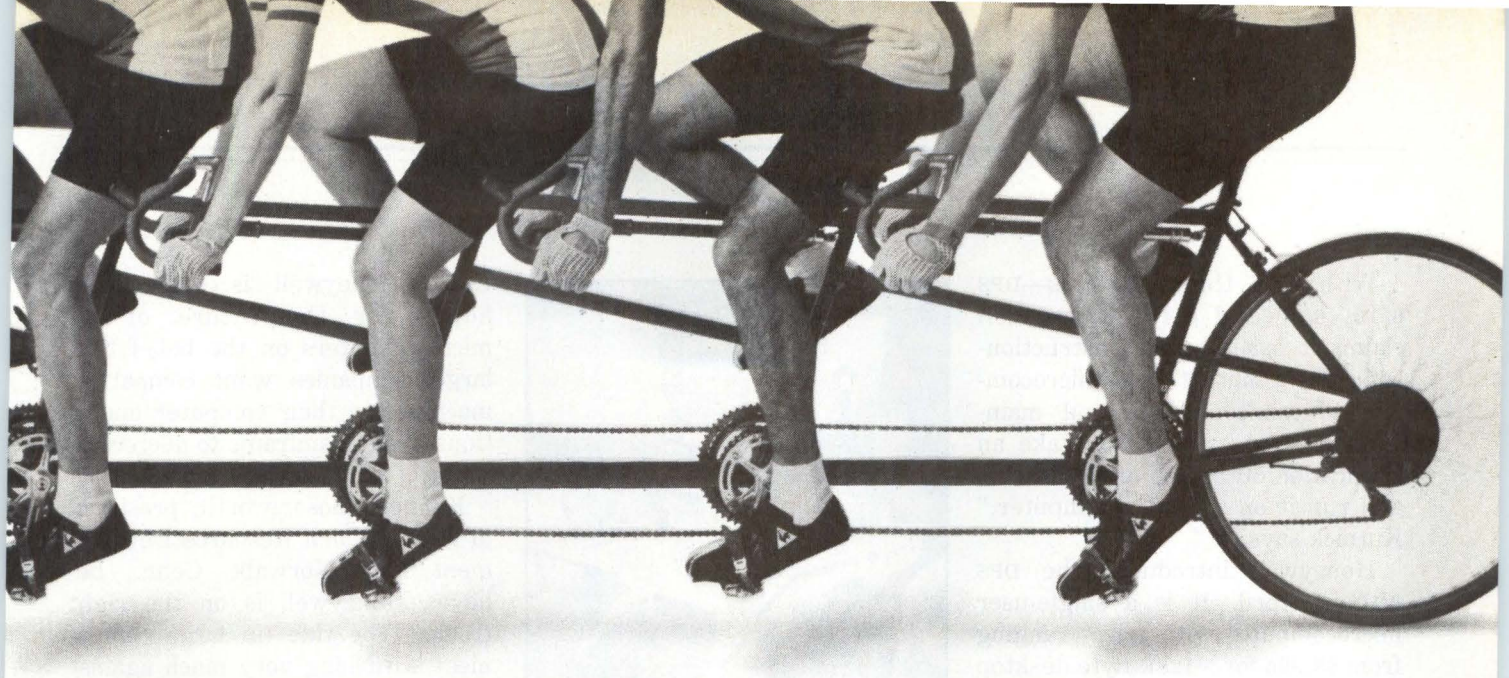

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CIRCLE NO. 39 ON INQUIRY CARD

With the three systems—DPS 6/10, 6/20 and 6/40—Honeywell claims it has achieved instruction-set compatibility for its microcomputers, minicomputers and mainframes. "You can actually take an application off a mini or mainframe and run it on the microcomputer," Kutnick says.

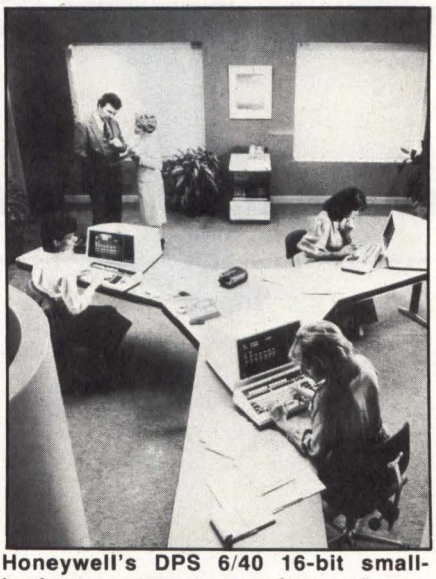
Honeywell introduced the DPS 6/10 in April. It is a single-user microcomputer with prices ranging from $3,995 for a 128K-byte desktop model to $9,995 for a 512K-byte floor-standing model with a 20M-byte, 8-inch Winchester disk drive.

Recently, Honeywell simultaneously introduced two other machines:

- The DPS 6/20, a multiuser microcomputer supporting as many as four users. The price for a 512K-byte model with one 650K-byte floppy disk drive, one 40M-byte Winchester disk drive, a diskette controller and five RS422 ports is $17,000.
- The DPS 6/40, based on a proprietary 16-bit microprocessor, is designed for heavy transaction-processing and data-communications applications. It has the internal bus structure of the DPS 6/96 32-bit superminicomputer and can handle as many as 28 VDTs and printers and four to 18 users. Price for the basic system—512K-bytes of memory, a 40M-byte Winchester disk drive, a 650K-byte floppy disk drive and support for four communications lines—is $27,000.

All three systems run Honeywell's General Comprehensive Operating Supervisor MOD 400 software, making them compatible with the rest of the company's computers.

The three microcomputers either can or will within six months support communications protocols such as Honeywell's distributed Systems Architecture, SNA and bisynchronous. SNA protocols are an example of what is delaying the systems' availability. SNA protocols will not be offered for the 6/20 until the second quarter of 1984.



Honeywell's DPS 6/40 16-bit small-business system *supports four to 18 users with as much as 1M byte of main memory (expandable to 2M bytes early next year) and can access more than 1G byte of on-line disk storage. It runs Honeywell's multifunctional MOD 400 operating system for concurrent transaction-processing, office-automation, program-development and data-communications tasks.*

An optional Intel 8086-based board running MS-DOS, CP/M-86 and GW BASIC is available for the 6/10 at $875. The three systems are based on Honeywell's proprietary Micro 6 chip, a reimplementation of the DPS 6 CPU.

Almost before the machine had been introduced, Honeywell announced that 1,000 of the 6/40s had been bought by Metropolitan Life Insurance Co., already a Honeywell customer. "This will be the largest Honeywell computer network ever installed for a commercial customer," claims Frank D. Jakubik, general manager of Honeywell Information Systems.

Honeywell is one of the first to achieve total instruction-set compatibility for its computers. Those also touting compatibility are Prime Computer Inc. and Data General Corp. Honeywell is staking its hopes for the future of its microcomputers on the belief that large companies want compatible machines in their computer operations, from mainframe to microcomputer.

Kenneth Bosomworth, president of International Resource Development Inc., Norwalk, Conn., believes Honeywell is on the right track. "The tide (in large companies) is turning very much against multiple-vendor mishmashes. If Honeywell is already involved in the computer operations of such large companies (with minicomputers), then they stand a very good chance of being accepted as the supplier of supermicros. But if Honeywell is not already an established supplier, they're going to be left out in the cold. I think Honeywell will have terrible trouble selling outside their existing user base."

Big companies that are limiting the list of approved microcomputer vendors usually specify no more than three vendors, Bosomworth says. Of the three, IBM Corp. is first, and Wang Laboratories Inc. is second. There is no clear choice for number three.

Honeywell's DSP 6 series comprises six machines, ranging from DPS 6/10 (single user) to the DPS 6/96 (32-bit superminicomputer). Prices range from about $4,000 to $40,000.

DPS 6 machines are network-compatible with IBM computers, as well as with Honeywell machines, says Frank J. Murphy, director of product marketing support for Honeywell.

Honeywell is offering price breaks for the smaller machines in the line, like the 6/20 and 6/40. Prices are about half the cost of the software licensed to run on the larger DPS computers. This sort of price break is a first for Honeywell, Murphy comments.

—James F. Donohue

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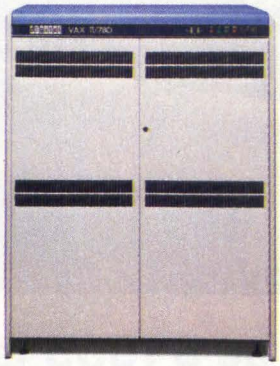
SC12/V—Emulates DEC's RK711 controller combined with multiple RK07 drives on the VAX-11 Unibus. SC21/V—Emulates DEC RM03 (80 MByte) and RM05 (300 MByte) storage subsystems.



SC31—A low cost solution that allows you to install and operate large capacity disk drives on the Unibus of any VAX. Handles drives with high transfer rates of 1.8 MBytes per second in the 500 MByte range. Gives the same or greater storage capability than DEC Massbus installations at a fraction of the cost.

FOR THE VAX-11/750...

SC750—This software-transparent, single-board controller allows you to add up to four large disk storage units (80 to 675 MBytes) directly to the internal CMI bus. The SC758 lets you add up to eight drives of storage off a single controller.

FOR THE VAX-11/780...

V-Master/780—A mass storage adapter that houses one or two SC780 disk controllers, TC780 tape controllers or a combination thereof. Provides an interface and control through the Synchronous Bus Interface (SBI) of your VAX-11/780. Each SC780 disk controller supports up to four disk drives (80 to 675 MBytes). The SC788 is also available to fit in the V-Master/780 chassis and supports up to eight disk drives.

Tape Products.

FOR THE VAX UNIBUS...

TC11/V—Combines with any standard tape drive and the Emulex VMS/UT software driver/diagnostic package to provide reliable, economical tape storage on all VAX-11s.

TC12/V—Handles every industry-standard "Pertec" formatted half-inch tape transport, including conventional NRZ/PE start/stop and 1600/3200 bpi start/stop streaming tape drives.

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users? Emulex, of course!

FOR THE VAX-11/750...

TC750—A single-board, software transparent controller that interfaces directly to the internal CMI to support 1-4 STC or 1-8 Pertec formatted type drives. Emulates DEC's TM03/TU77 with tape speeds up to 125 ips at 1600/6250 bpi. Supports both "old" and "new" GCR 6250 kinds of drives.

FOR THE VAX-11/780...

TC780—Fits in the V-Master/780 chassis to provide transparent emulation of DEC's TM03/TU77 through the SBI. Supports 1-4 STC or 1-8 Pertec formatted type drives at tape speeds up to 125 ips; 1600/6250 bpi. Both "old" and "new" GCR 6250 technology is supported. In addition, the TC780 is plug compatible with the TC750, offering users sparing convenience.

Communications Products.

FOR UP TO 16 LINES—CS21 SERIES...

CS21/F—Emulates the asynchronous portion of the DMF-32 for use on VAX-11s. Is software transparent with VMS Version 3.0 and above. Handles 16 lines per controller.

Statcon 21—Statistical concentration through the combination of the proven CS21 multiplexer with special microprogramming and the CM22/EX local statistical port concentrator. Handles up to 16 remote lines per statistical concentrator, up to 32 lines per controller.

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CS32/F—A single-board communications controller that's totally software transparent to DEC's new DMF-32. One CS32 can handle up to 128 lines per controller board.

Statcon 32—Combines the CS32 multiplexer with special microprogramming and the CM22/EX local statistical port concentrator. A single CS32 controller board handles an amazing 256 remote and local lines in this statistical concentration mode.

For more information on Emulex products for VAX, call toll-free: (800) 854-7112. In California: (714) 662-5600. Or write Emulex Corporation, 3545 Harbor Blvd., P.O. Box 6725, Costa Mesa, CA 92626.

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LinkData aims IBM MC68000 system at DIBOL market

LinkData Inc., a Union, N.J., start-up, has packaged IBM Corp.'s MC68000-based CS9000 laboratory computer with a proprietary operating system that is said to run DIBOL packages written for Digital Equipment Corp. PDP-11 minicomputers. The package, called LinkDOS, runs on the new version of the CS9000 that has been repackaged by IBM Instruments Inc., Danbury, Conn., for commercial applications. In its new version, the CS9000 is packaged without the integral printer and without the function keys of the laboratory model.

Emphasizing the combination of IBM hardware and DEC-compatible software, LinkData is targeting what founder and president John J. Fitzsimons estimates to be 450 commercial OEMs and 1500 systems houses that have used DIBOL programs under DEC CTS300 and 500 operating systems. LinkData has made a resale arrangement with Minicomputer Business Applications Inc., Montrose, Calif., to resell 15 of MCBA's leading accounting packages.

LinkData's packaged system based on the IBM Computer System 9000 *is claimed to run on the full range of DEC DIBOL software. List price of a typical two-user system with 256K bytes of main memory and a 10M-byte fixed/removable Winchester disk is $19,720.*

In addition, LinkData claims to be the first authorized Value-Added Reseller for the IBM product allowed to use two-tier distribution for the CS9000. LinkData is permitted to resell only to dealers who, in turn, sell to end users. Systems Management Inc., Chicago, previously emerged as the first VAR for the CS9000 laboratory model, announcing plans to market a version with the Pick operating system last fall. SMI officials say a product based on the commercialized CS9000 package used by LinkData will be ready for shipment late this summer.

The LinkData system, using the five Versabus slots of the CS9000, can support as many as 16 users. List price for a typical two-user system with 256K bytes of main memory and a 10M-byte fixed/removable Winchester disk is $19,720. A DEC spokesman says a micro PDP-11 with 256K-bytes of RAM, a 10M-byte Winchester drive, dual 800K-byte floppies, 2 VT100 terminals and operating system license lists for $14,115. LinkData says it is qualifying its first 15 dealers and expects to begin shipments in the fourth quarter.

—Geoff Lewis

A.B. Dick takes shot at VAX market with 32-bit UNIX mini

The hotly contested 32-bit minicomputer industry continues to attract new competitors hoping to get a share of the Digital Equipment Corp. VAX-dominated market (MMS, August, Page 54). Among the latest contenders is perhaps the most unexpected: A.B. Dick Co., the 99-year-old copier/duplicator firm. The Chicago firm, which has been active in word-processing markets since the mid-1970s, has introduced its first data-processing system and plans to make a name as an OEM UNIX computer manufacturer.

The A.B. Dick MC-30 was developed at the company's Phoenix, Ariz., Computer Development Center under a three-year program led by former Honeywell Inc. designer John Couleur. The product is aimed at fulfilling three requirements: to give A.B. Dick a more powerful host in its Loop network office systems, to provide a high-end CPU for British parent General Electric Corp. Plc's GEC Computers Ltd. minicomputer subsidiary and to enable A.B. Dick to enter the U.S. OEM systems market.

While the last requirement is admittedly an afterthought, it is nevertheless a serious undertaking, says Lyman C. Hevle, marketing director for A.B. Dick Systems Marketing division. Hevle contends that A.B. Dick will be a serious contender in the OEM systems market. "I'd like to sell 150 systems to OEMs in the first year and 1,000 in the second," he states. No OEM contracts have been signed yet, but

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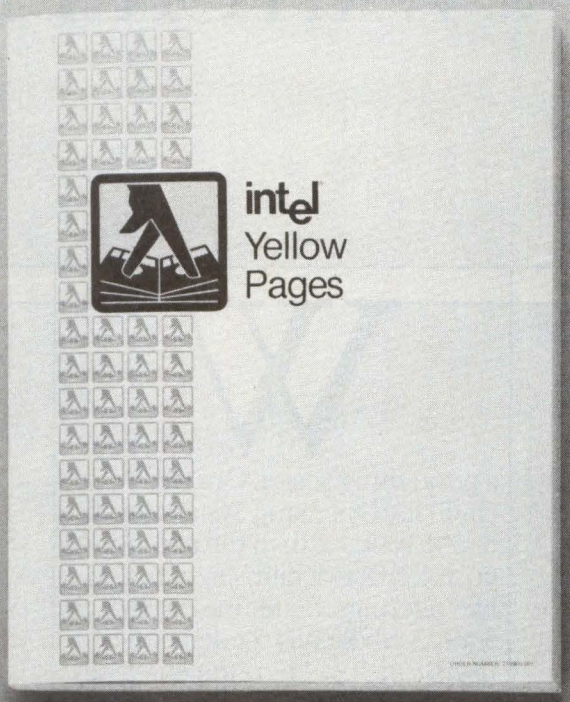

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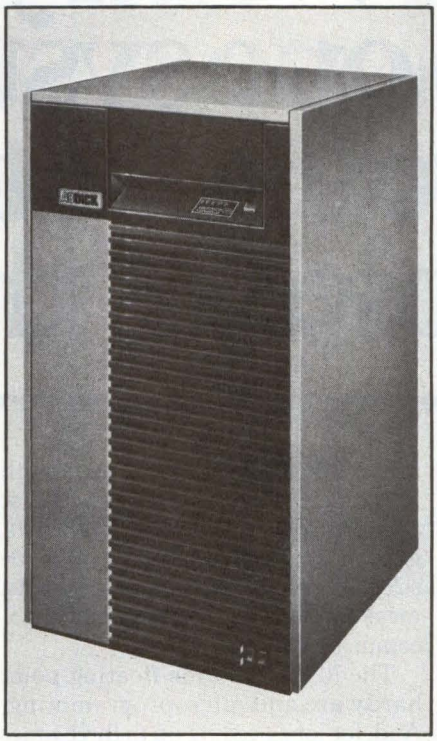
he claims that several prospects are "breathing heavy." Hevle would like one major computer manufacturer such as Burroughs Corp. or Honeywell, one CAD/CAM systems supplier and one communications switch manufacturer among A.B. Dick's OEMs.

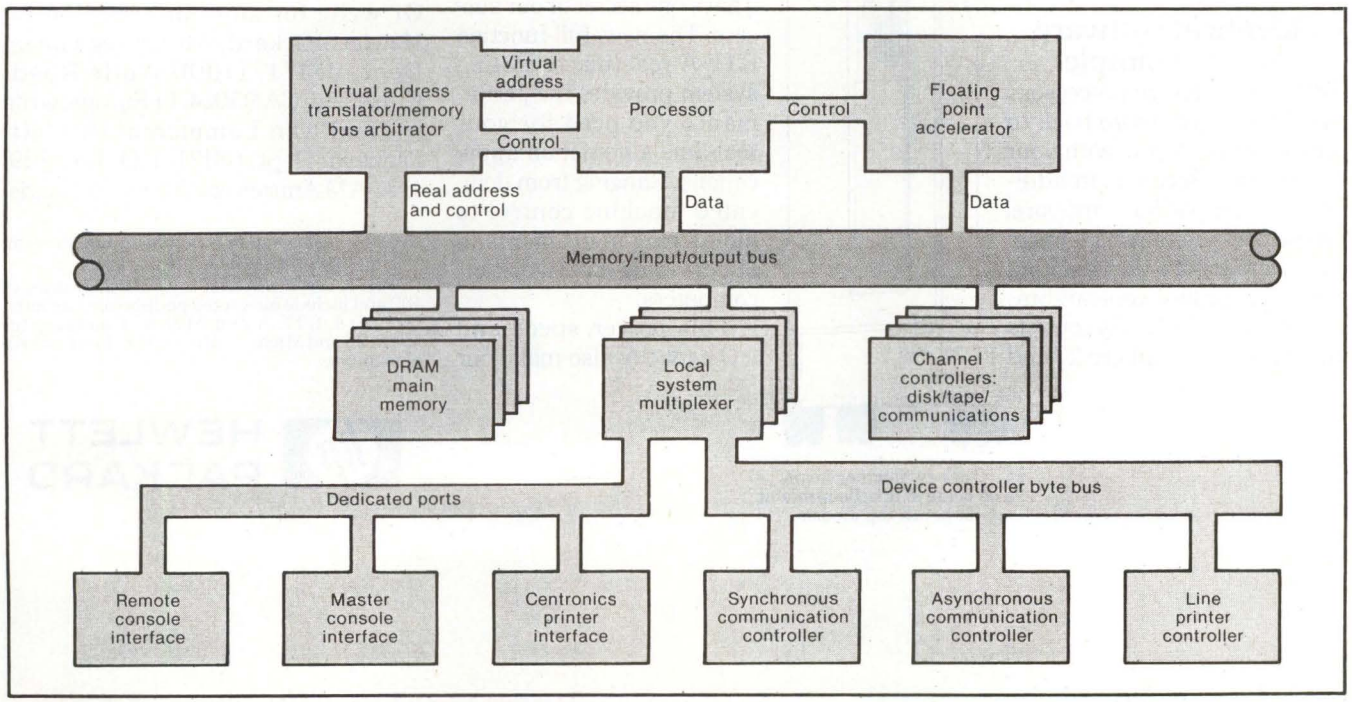
A basic MC-30 includes the CPU, 2M bytes of main memory, an SMD disk controller, a tape controller, a local system multiplexer, an operating-system license and a cabinet and sells for $59,800. The price does not include disk or tape drives, which he expects most OEMs to integrate themselves. However, the company will offer Priam disks and Cipher tape drives for customers who need integrated systems.

A.B. Dick is betting that the attraction for potential OEMs will be a 3.3-million-instruction-per-second raw processing speed and a pricing structure scaled 50 percent below the DEC VAX line. The MC-30 achieves these design goals, Hevle explains, by incorporating off-the-shelf TTL technology and forgoing cache memory to cut manufacturing costs. For high performance, the CPU is designed with an overlapping, four-stage instruction pipeline, which, company officials say, enables the system to initiate an instruction with each 300-nsec. memory cycle.



A.B. Dick's first minicomputer, the 32-bit MC-30, *comes in a 23.8-inch-by-44.75-inch cabinet that houses a two-board CPU and 25-slot card cage. A matching peripheral cabinet accommodates SMD interface disks and start/stop tape drives.*

A.B. Dick claims the system performs 32-bit binary additions at 3.3 MIPS and expects it to achieve approximately 2.8 MIPS in a typical business mix. The CPU is constructed with 16 general-purpose registers, eight interrupt registers and two floating-point registers. It supports bit, byte and word addressing, and its current version can access a maximum of 11M bytes of memory within the standard cabinet. The MC-30 architecture theoretically can support a physical addressing space of 4G bytes and an 8-trillion-byte virtual-address space. Hevle reports that the current $5,300, 1M-byte boards are constructed with 64K-bit RAM parts,



A 27M-byte-per-second bus links the A.B. Dick MC-30 CPU, memory and I/O processors. *The company claims that its first minicomputer product offers twice the performance of a DEC VAX-11/780 and is positioned for UNIX OEM suppliers.*

How can you develop one system and offer your customers a choice of three?

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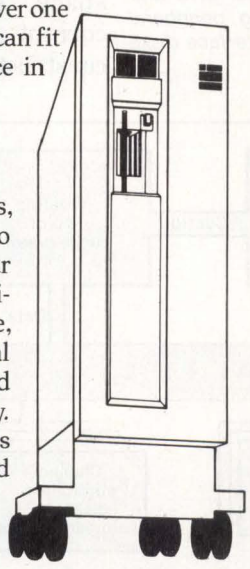
The Micro 27 adds floating point hardware and microprogramming. And, for jobs needing up to three times the power, our 3 MIPS Micro 29 has got what it takes.



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Prices are U.S.A. list in OEM quantities of 100 and include integrated peripherals, one interface card, RTE-A and 512Kb of memory for Micro 26 and Micro 27. Micro 29 includes 768Kb of memory.

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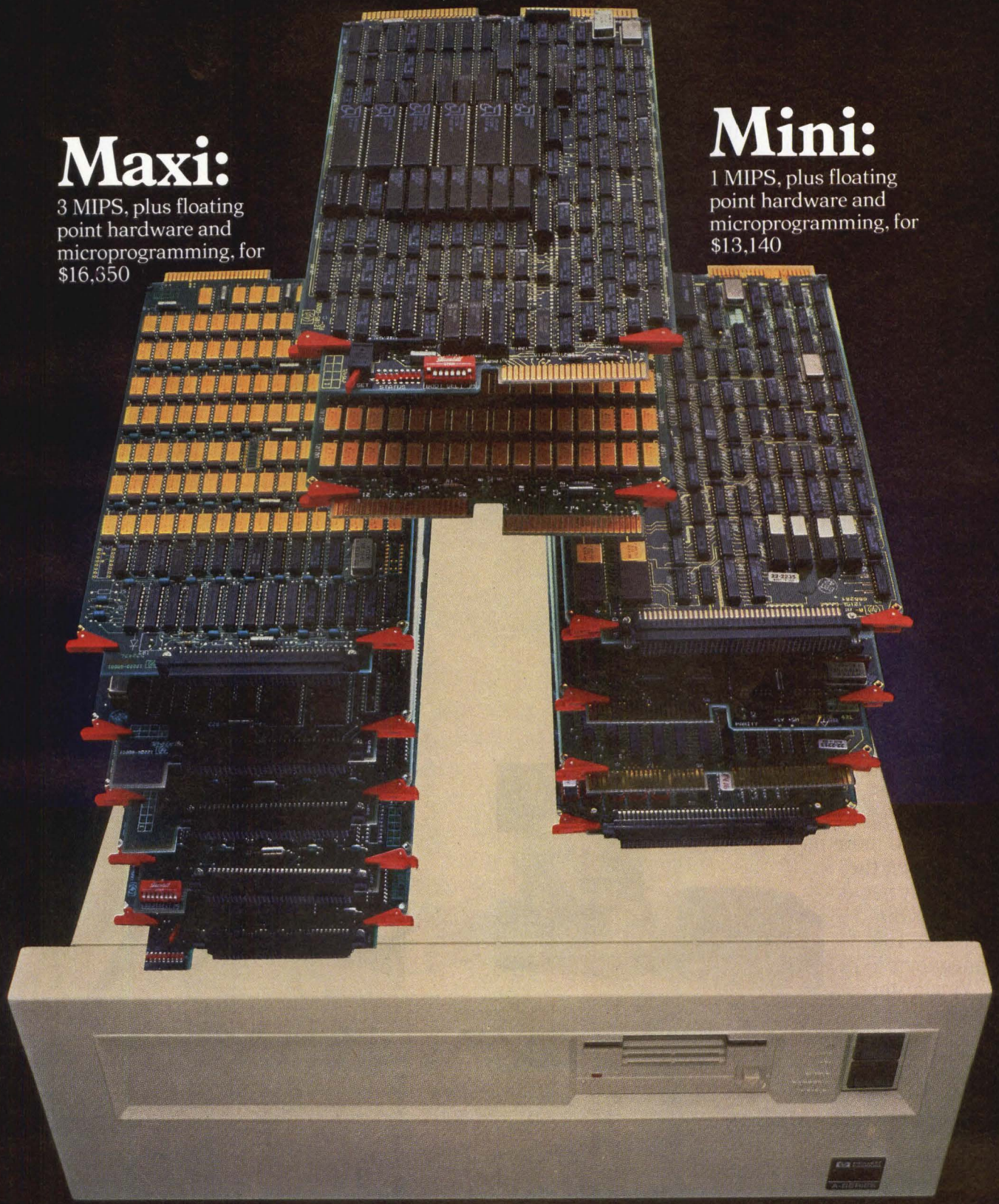
3 MIPS, plus floating point hardware and microprogramming, for $16,350

Mini:

1 MIPS, plus floating point hardware and microprogramming, for $13,140



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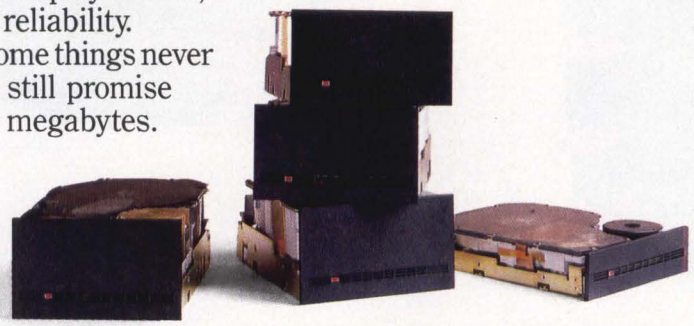

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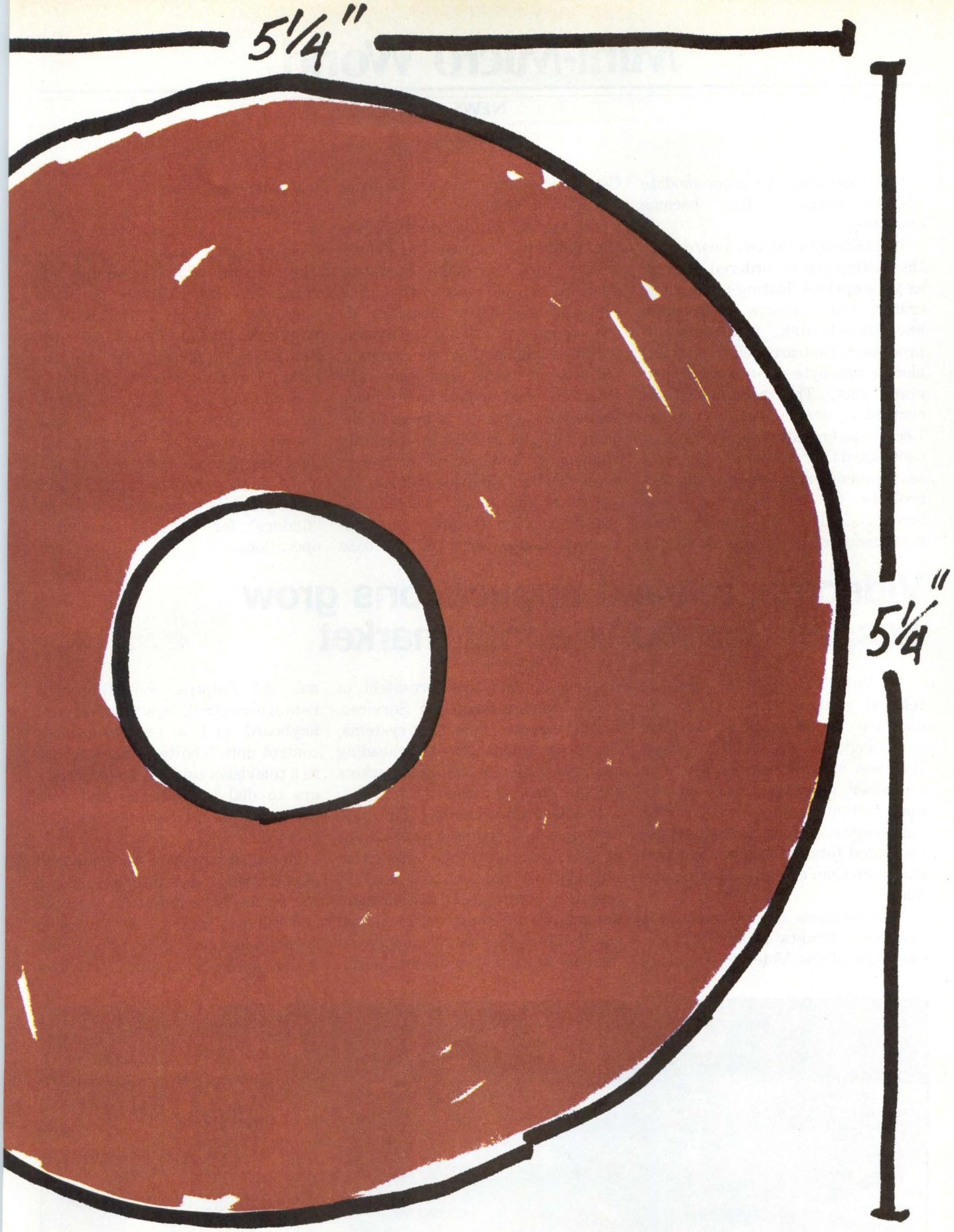

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but are designed to accommodate 256K-bit parts as they become available.

In addition to the two-board CPU, the system can be ordered with an as-yet-unpriced floating-point accelerator, and a choice of Motorola 6809-based disk, tape and I/O processors that are tied to the CPU along a 27M-byte-per-second proprietary bus. The communications controllers are connected via the Local System Multiplexer, a dual 6809 board that can support a mix of asynchronous and synchronous controllers for as many as 256 terminals. The multiplexer also accommodates 8-bit interfaces for Centronics-compatible serial printers and line printers.

The system will be offered in the U.S. only with IDRIS, the Whitesmiths Ltd. UNIX-like operating system. Hevle adds that the company may later introduce its own version of AT&T UNIX System V, but explains that the company decided on IDRIS two years ago when it was unclear how much support for UNIX would be available from AT&T. A.B. Dick is currently offering C and Pascal compilers while looking to outside vendors for FORTRAN and BASIC products. A COBOL package is under development in-house as is a database management system.

In England, GEC Computers Ltd. will manufacture and distribute the System 63, its version of the MC-30. The company will offer an updated version of the GECCL OS 4000 operating system, OS 6000, with FORTRAN. Plans for the MC-30's use in A.B. Dick office-systems configurations have not been disclosed.

Hevle says A.B. Dick will rely on a team of OEM salespeople who will operate out of the Phoenix headquarters. In addition, he expects A.B. Dick's reprographics and micrographics sales forces to act as "finders" for the new computer operation. —*Geoff Lewis*

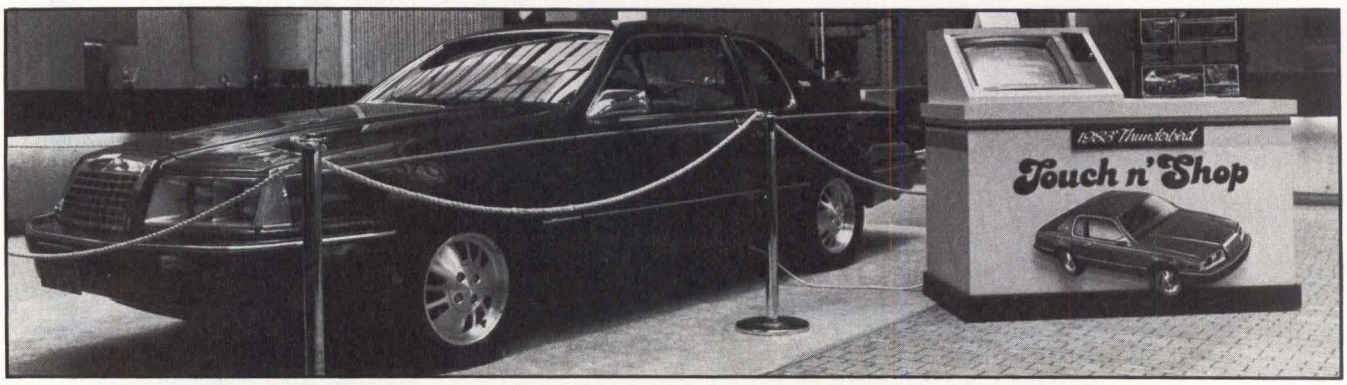
Videotex, teletext applications grow despite questions about market

At Videotex '83, the videotex/teletext industry tried recently to disprove its reputation as dual technologies in search of a market. Business applications, rather than consumer offerings, received the most attention at the three-day conference, which attracted an estimated total of 6000 participants and more than 60 exhibitors to New York.

"The business side of videotex is healthy," boasts Larry Pfister, chairman of the Videotex Industry Association and vice president of Time Video Information Services. Single-purpose videotex systems, Pfister continues, are spearheading the penetration of business markets for specific applications.

Product introductions for both consumer and business applications of videotex (two-way interactive information transfer) and teletext (one-way information distribution) dominated the conference. American Bell Inc., for example, displayed its new consumer videotex terminal, the Sceptre, consisting of a remote-control, QWERTY-layout keyboard and a decoder/encoder control unit. The terminal attaches to a television set, enabling consumers to dial up graphics and data information on home television screens.

Not surprisingly, Sony confirmed expectations that it intends to play a role in the U.S. market for videotex and teletext products by unveiling decoders compatible with the North American Presentation Level Pro-



This prototype videotex information system *at the Detroit Renaissance Center helped Cableshare Ltd. win a $70,000 contract from Ford to establish additional "Touch n' Shop" interactive displays.*

IBM-PC-compatible single board computers. $249 each!

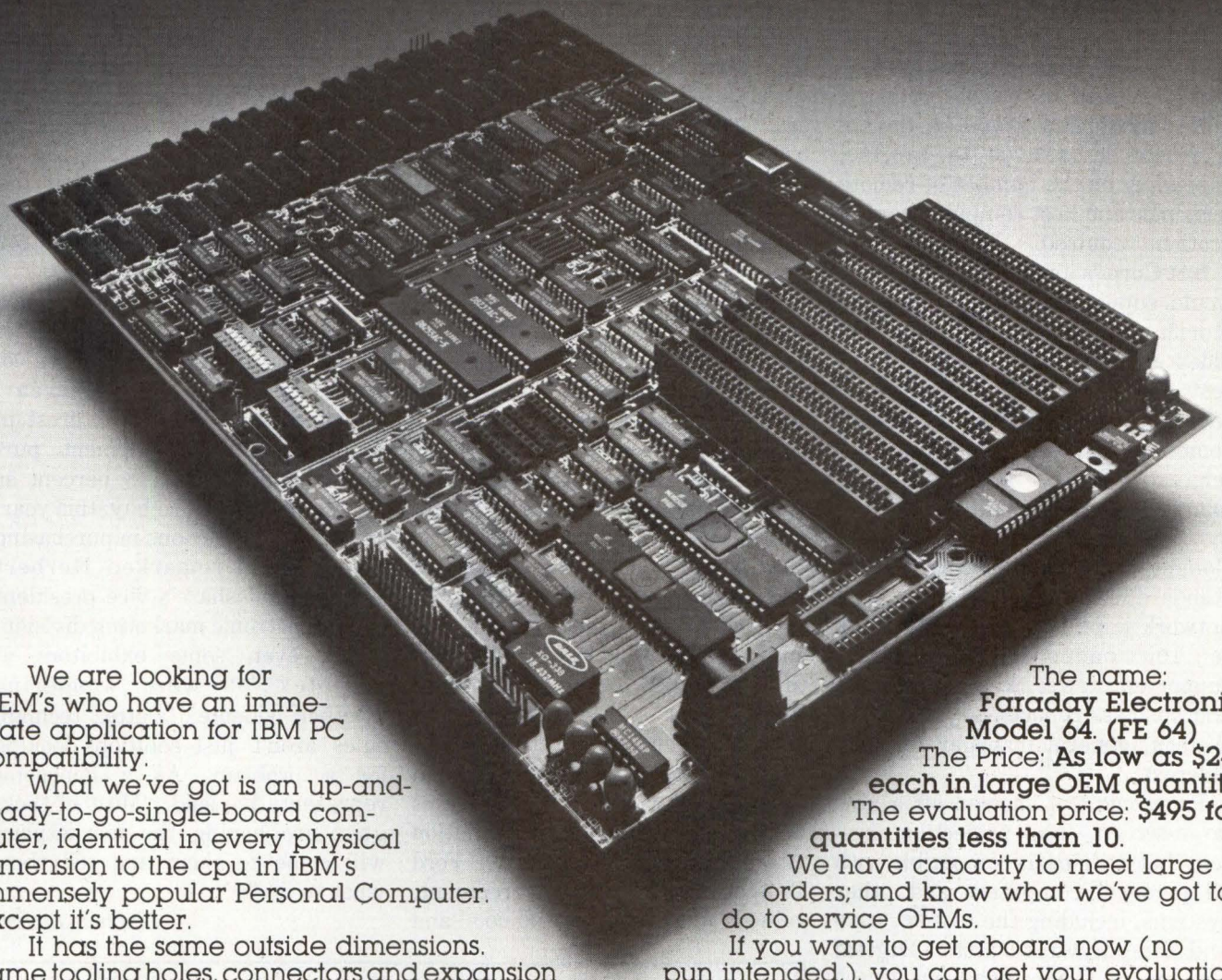
In large OEM quantities.

Standard features

- 8088 (4.77 MHz) CPU
- 64K bytes of RAM with parity
- 8K bytes of EPROM
- 2 serial ports, 50 to 9600 baud
- keyboard port (IBM compatible)
- 1 parallel port, 34-pin connector
- 5 expansion slots (IBM compatible)
- speaker port
- external reset port, 2-pin connector
- 8 levels of interrupts
- BIOS on ROM supports MS DOS, CP/M-86, concurrent CPM, and Qunix
- 8 1/2" x 12" multi-layered board

Options

- 256K (total) bytes of RAM with parity
- 32K (total) bytes of EPROM
- 8087 high speed math co-processor
- 4 additional 62-pin expansion slots



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tocol Syntax for videotex and the North American Broadcast Teletext System for teletext. The new decoders, the VDX-1000 and TXT-1000, complement Sony's other decoders, sold in the U.K. since 1979, and the Trinitron videotex terminal available in the U.S.

Radio Shack unveiled its VIS videotex and office-information system. Designed to operate with the TRS-80 model 16B computer, the VIS is priced at $13,700 to $36,100, depending on the number of remote terminals and host computer configurations required.

IBM Corp.'s announcement that it would support both European and North American protocols for videotex may have finally laid to rest any lingering problems with technical standardization among competing systems in the videotex/teletext industry. NBC-TV quickly followed up on the March decision by the Federal Communications Commission to adopt NABTS as the standard for broadcast teletext. The network is offering its affiliates 75 to 100 pages of advertiser-supported news, weather, sports and business reports, says Barbara Watson, general manager for NBC Teletext.

Panasonic Co. showed off a new large-screen, rear-projection system that it claims is compatible with all personal computers and other systems, including the IBM PC, 3279 and Displaywriter; the Digital Equipment Corp. Rainbow, VT100 and VT125 units; the Chromatics Inc. 1999; and the Ramtek Corp. 4027. A Panasonic representative says the company is expected to begin marketing a complete videotex/teletext system for $1200 to $1700 in the first quarter of next year.

Suppliers announced several joint ventures as they looked for ways to speed videotex and teletext services into business markets. Genesys Group, the Canadian system architect of Telidon, and Macrotel, a subsidiary of Empire Savings Bank of America, issued a release that described a telebanking service to be introduced to approximately 50 Empire corporate customers. Executives will be able to perform cash management, balance inquiries and fund transfers from executive workstations and personal computers. Genesys also announced that it has reached a marketing agreement with Mitsui, Japan's third-largest trading company, to market Telidon in Japan and portions of Southeast Asia.

Rockwell International and Norpak Corp. announced a joint venture for the development, manufacture and marketing of NAPLPS and NABTS chip sets and decoder boards for OEM customers. Decoder boards ranging in price from $150 to $250 are expected to be available in mid-1984.

Although a company spokesman declines comment, Cableshare Inc., a Canadian integrator of videotex and page-creation systems, is said to have signed an agreement with Ford Motor Co. to place two Microtex information-retrieval systems at the Detroit Airport and Renaissance Center. The systems will be used to display information interactively about the 1984 Ford Tempo automobile. The agreement, valued at between $60,000 and $70,000, is the first phase of a project at Ford to place interactive terminals at 4000 dealerships. The total value of the program could reach $30 million.

Business applications in the U.S. for videotex and teletext systems seem to be slowly moving out of the prototype, preoperational phase. But consumer applications for information-retrieval technologies are likely to remain dependent on the widespread introduction of personal computers into homes and adapted through inexpensive decoders or software packages for videotex/teletext applications.

Some exhibitors observed a marked difference in the goals of attendees compared to those of earlier conferences. This year, attendees showed more interest in applications and equipment purchases. "Last year, 15 percent at those here wanted to buy; this year, 50 percent are serious in purchasing equipment," remarked Herbert Woods, Cableshare's vice president of the electronic marketing division.

But even some exhibitors at Videotex '83 were wondering whether videotex/teletext technologies aren't just solutions looking for a problem. As a Panasonic representative said, "Most of these guys are hoping the marketplace will come to them and tell them what to do."

—Stephen J. Shaw

PRIME EXTENDS SUPERMINI LINE, CUTS PRICES

Prime Computer Inc. has expanded the high end of its Series 50 32-bit virtual-memory superminicomputers with a single-stream machine called the 9950. Prime claims the machine provides 50 percent greater system-level performance than the high-end multistreaming 850. Improvements include a five-stage synchronous pipeline design and very-high-speed emitter-coupled-logic circuitry. The 9950, packaged with 4M bytes of memory, a 300M-byte disk drive, a tape drive, a system console and the Primos operating system, sells for $392,500. The system has a maximum memory of 16M bytes and is compatible with all machines in the 50 series. Upgrades are available. Prime has also reduced prices on the 750 and 850 series and has introduced a new intelligent communications subsystem as well as a compact streaming-tape system for the low-end 2250.

The Perfect Complement

DEI® introduces a new dimension in magnetic tape cartridges. Total storage of data (at 6400 bpi/fci) is achieved with 555 feet of high grade ¼" tape.

This offers the end-user less expense for most applications by providing a lower cost per megabyte than other media types.

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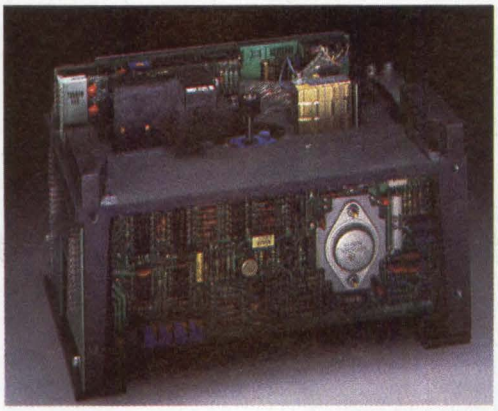

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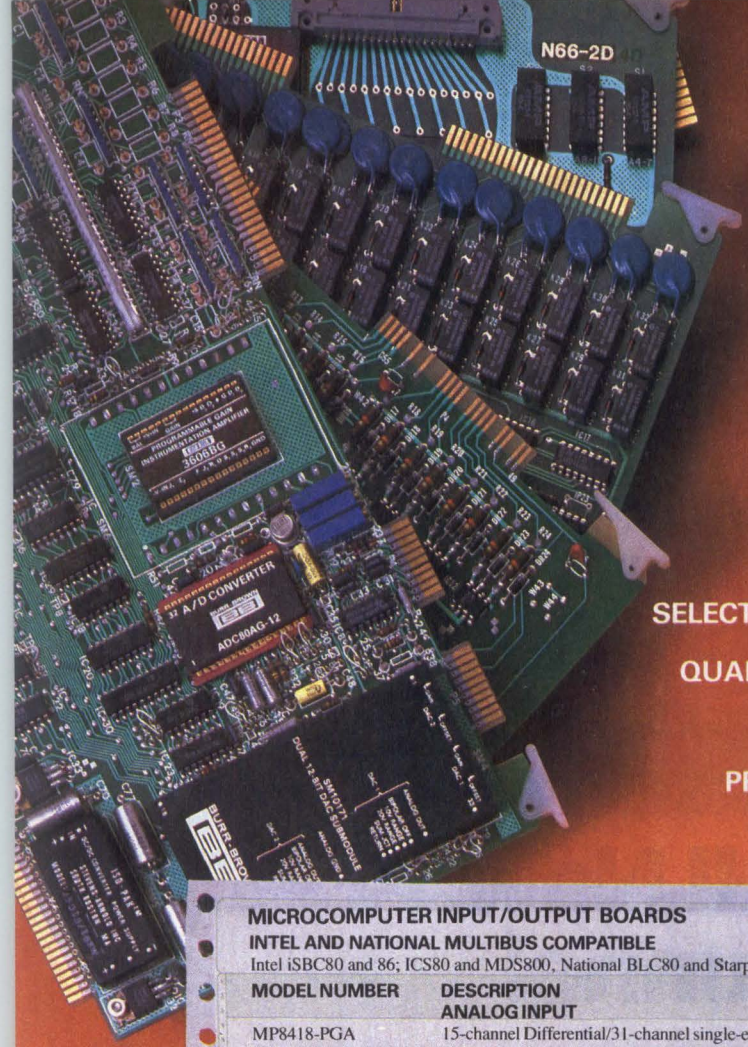

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MP8418-PGA-AO	15-channel Differential/31-channel single-ended input. Programmable Gain, 12-bit. 2-channel output, ± 10VDC
	ANALOG OUTPUT
MP8316-I	16-channel 0-20mA, 12-bit (common DAC).
MP8316-V	16-channel ± 10VDC, 12- bit (common DAC).
	SPECIAL PURPOSE INPUT
MP8430	16-channel RTD 3-wire (100 ohm or 1000 ohm).
	DISCRETE OPTICALLY ISOLATED INPUT
MP810	24-channel Dry-Contact Closure, 1.5mA Wetting Current at 24VDC.
	DISCRETE REED RELAY OUTPUT
MP802	32-channel Relay, 0.5A at 28VDC
	DISCRETE INPUT/OUTPUT
MP830-72	72-channel TTL levels. User configured in 8-channel increments of inputs or outputs.
MOTOROLA EXORCISER COMPATIBLE	
Motorola Exorciser, Rockwell System 65 and Synertek Systems.	
	ANALOG INPUT
MP7217	16-channel, single-ended, Fixed Gain, 12-bit.
	ANALOG INPUT/OUTPUT
MP7432-AO	32-channel Differential/64-channel single-ended inputs, Fixed Gain, 8-bit. 2-channel output, ± 10VDC, 8-bit (individual DACs).
	DISCRETE OPTICALLY ISOLATED INPUT
MP710	24-channel Dry Contact Closures, 1.5mA Wetting Current at 24VDC.
	DISCRETE REED RELAY OUTPUT
MP702	32-channel relay, 0.5A at 28VDC.
DEC LSI-11 COMPATIBLE	
LSI-11, -11/2, -11/23 PDP 11/03, 11/23	
	ANALOG INPUT
MP1216-PGA	16-channel Differential/32-channel single-ended, Programmable Gain, 12-bit.
ZILOG Z80 COMPATIBLE Z90, MCS	
	ANALOG INPUT/OUTPUT
MP2216-AO	16-channel Differential/32-channel single-ended inputs, Fixed Gain, 12-bit. 2-channel ± 10VDC outputs, 12-bit (individual DACs)

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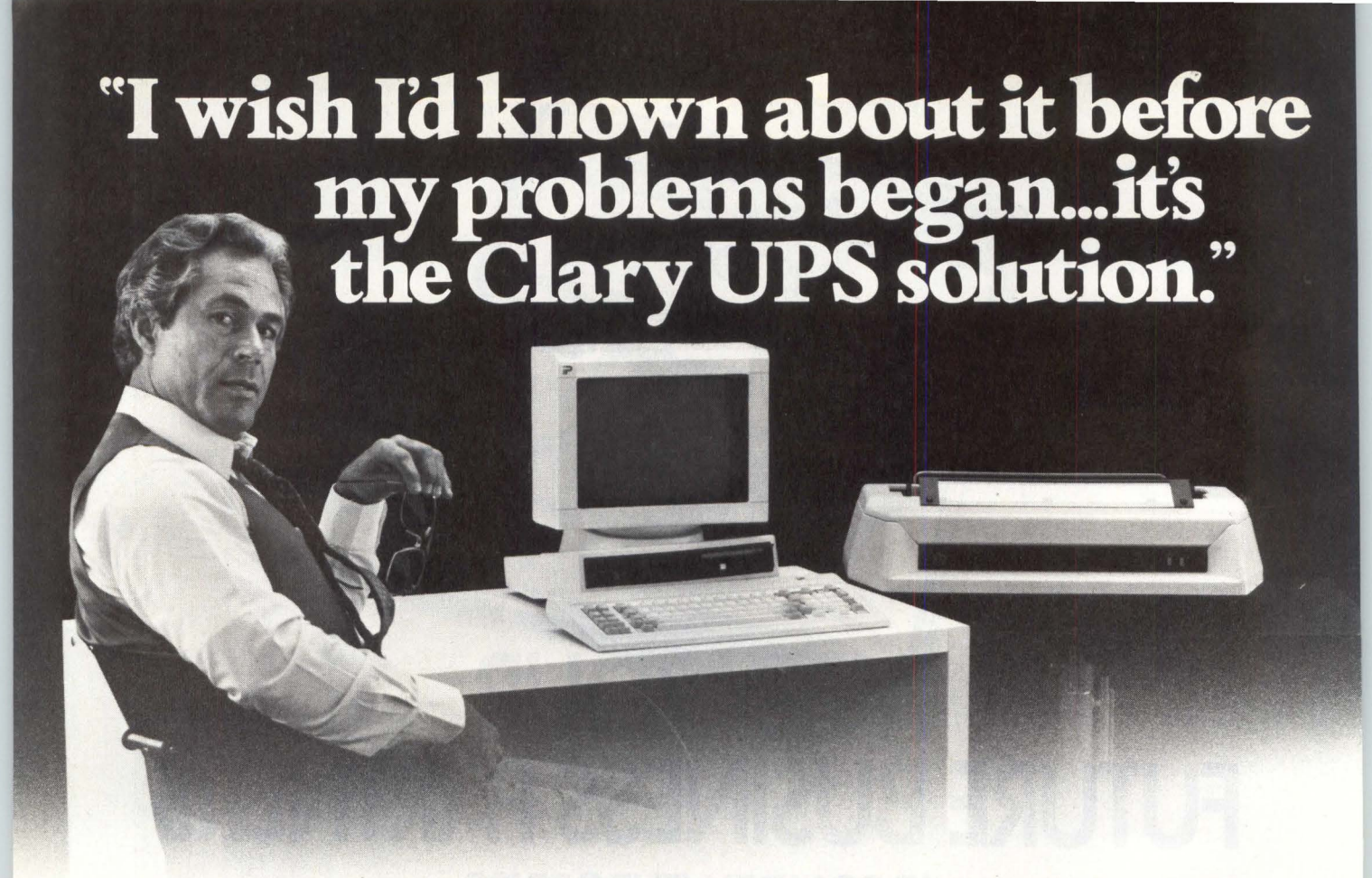

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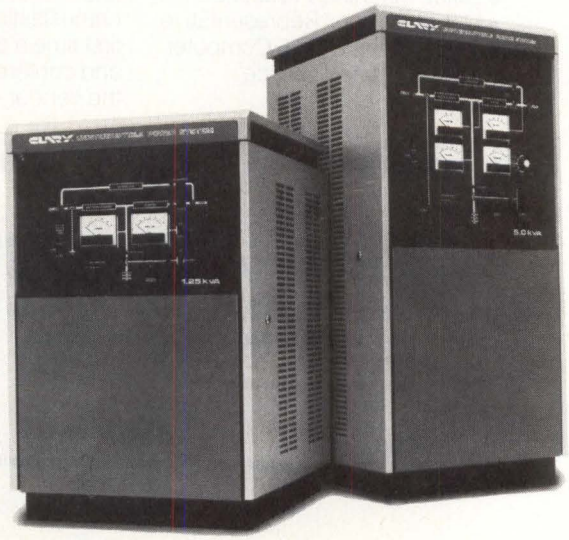


CIRCLE NO. 49 ON INQUIRY CARD

Mini-Micro World

CORPORATE AND FINANCIAL

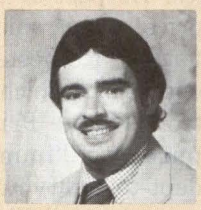
Centronics looks for revival with new line printer

After two years of financial woes, Centronics Data Computer Corp. is showing signs of recovery that might return it to a leading position in the printer industry. The Hudson, N.H., company recently posted its first profitable quarter since 1980, has gained added muscle through a Control Data Corp. investment and is attacking the impact printer market with several new products.

Although sales during the period ending April 3 were up $2.2 million over the previous quarter, they resulted in a slim $204,000 profit, reversing the $5.1 million loss shown for the previous quarter. "We have been trimming our company down and increasing our productivity while maintaining basically a consistent sales level," asserts Centronics president John Tincler. He explains that the swing of $5.3 million from the previous quarter reflects the positive effects

GUEST FORUM

A column for guest experts to speak out



Thomas R. Billadeau *is president of The Office Systems Consulting Group Inc., Cambridge, Mass., which performs extensive market research and competitive analysis. Mr. Billadeau also serves as editor of the* Automated Office Systems *newsletter.*

The impending death of dedicated word processors

By Thomas R. Billadeau,
Office Systems
Consulting Group Inc.

There has been controversy over the past several years about whether microcomputers with good word-processing software would overtake dedicated word processors. Until very recently, however, it seemed that this would not occur because microcomputer word-processing packages were difficult to use and did not compare in functionality with dedicated word-processing systems and because microcomputer hardware was not designed to support typing.

Things have changed recently, at least on one count. Several vendors now offer word-processing packages that run on microcomputers and that make them equal to or better than dedicated word processors. NBI Inc., which has been in the dedicated word-processing market for some time, now offers software to run on the IBM PC. A new company, Samna Corp., offers a package that runs on the IBM PC and several other popular microcomputers. Samna Word puts many dedicated word processors to shame.

The hardware problem still exists; microcomputer keyboards are not designed to accommodate typists comfortably. However, I contend that with the software problem solved, the hardware will soon conform. Industry estimates show that 15 percent of the buyers of office word processors purchased microcomputers for word processing last year. But that number may double next year. Long-term market projections must be adjusted accordingly because microcomputers are half the price of word processors.

The Office Systems Consulting Group Inc.'s research shows that dedicated full-function word processors will have to sell for less than $6,000 to compete effectively with word-processing packages on microcomputers. That may have started with IBM Corp.'s cutting Displaywriter prices by approximately 25 percent. Other vendors are apt to follow suit.

If the microcomputer can perform word processing equal in function to and substantially lower in cost than dedicated word processors, then who will purchase dedicated word-processing systems? Those who want the product support associated with dedicated word-processing vendors will in the short term continue to buy dedicated word processors. However, microcomputer vendors know that word-processing users require a high level of support, and the vendors will take the necessary steps to help customers better support themselves. Customers want support, but they are not willing to pay an unlimited amount of money for it. They may be willing to accept alternatives to traditional support.

However, some dedicated word-processing vendors feel that their products will survive no matter what happens in the microcomputer market. Companies like Lanier Business Products Inc., CPT Corp. and Dictaphone are basing their projections on old data. If they don't soon face the facts, they won't be around to face the facts.

of numerous cost-cutting and consolidation programs that have been implemented in the past two years.

Sales of $43.7 million for the quarter represented a healthy gain compared to the same quarter in 1982, which saw sales of $26.3 million. The loss in the comparable quarter of 1982 was $2.1 million.

Centronics' archrival, Dataproducts Corp., whose sales for the same period were $71.3 million, had a decline of more than 3 percent from the year before. But Dataproducts managed to post significant improvements in its bottom line (up $2.8 million from the same quarter last year), which Dataproducts president Charles Dickinson attributes to productivity programs.

Just how much Centronics has to cheer about in having edged into the black for one quarter is questionable —particularly as the figures represent sales of some products Centronics is now replacing. Success over the coming quarters will depend largely on the products the company is now bringing to market. For example, in upgrading its Printstation 350 series of high-end serial matrix printers with three models introduced in May, Centronics may get the jump on Dataproducts with its M series heavy-duty serial printers. The Linewriter 400, Centronics' newest line printer, may be even more significant to the company's future in that it represents the fruits of Centronics' connection with Control Data Corp.

High-quality print was top priority in the design of the Centronics Linewriter 400 *band printer. The company expects to garner significant OEM contracts for the printer.*

CDC, which last year purchased 35 percent of Centronics' stock, brought both capital and its line-printer expertise to Centronics. As part of the stock purchase price, Centronics acquired CDC's former Rochester, Mich., printer operation, which has become Centronics' Line Printer Division. The purchase "immediately cut our debt-to-equity ratio from 2:1 to 1:1," remarks Neil Kleinfeld, Centronics' vice president of marketing and planning. "Even while we were cutting cost, we were still able to increase R&D spending from 4 to 7 percent of our budget. We also acquired years of experience with band-printer technology, and the Linewriter 400 is the result."

Top priority in the design of the Linewriter 400, which will be followed by the Linewriter 800 this year, was print quality. "We questioned our existing customer base very closely about what they wanted in the next generation of line printers," Kleinfeld comments. "Print quality was what they mentioned the most, even more frequently than reliability." To improve print quality on the Linewriter 400, Centronics adopted a linear array of hammers to ensure right-angle strikes between the hammer and the paper. Other technical improvements, Kleinfeld notes, were made possible by essentially reducing band speed. He explains that by adding characters while slowing the band's rotation, Centronics achieved a faster dwell time when the hammer strikes the paper. The improvements allow the printer to average 400 lpm, with a top speed of 500 lpm.

As soon as Centronics announced the Linewriter 400, they made public their first sales contract for the new product—a one-year, $500,000 deal with M/A-Com Sigma Data, Rockville, Md. Centronics officials predict that the Linewriter series will garner several major OEM contracts in the next few months.

—Edward S. Foster

Financings

Digital Sound Corp., Santa Barbara, Calif., a manufacturer of an analog-to-digital conversion system for speech recognition, has received $2.5 million in venture funding to develop office-automation and telecommunications products.

Ferranti High Technology Inc., New York, a subsidiary of Ferranti Plc, London, has been formed to invest in U.S. companies. Ferranti expects the funds to provide the companies with technology or products for marketing in Europe. Ferranti has also received $12 million from the U.S. government under the Small Business Investment Act of 1958 and has $3 million of its own. Individual investments from the government funds are limited to $600,000.

Sydis Inc., which produces the VoiceStation office-automation system, has received $10 million in its second round of venture financing. New investors include General Electric Venture Capital Corp. and Citicorp Venture Capital Fund Ltd. Sydis, San Jose, Calif., received $2.75 million in its first round in March 1982.

Tabor Corp., a producer of 3¼-inch microcomputer floppy disk

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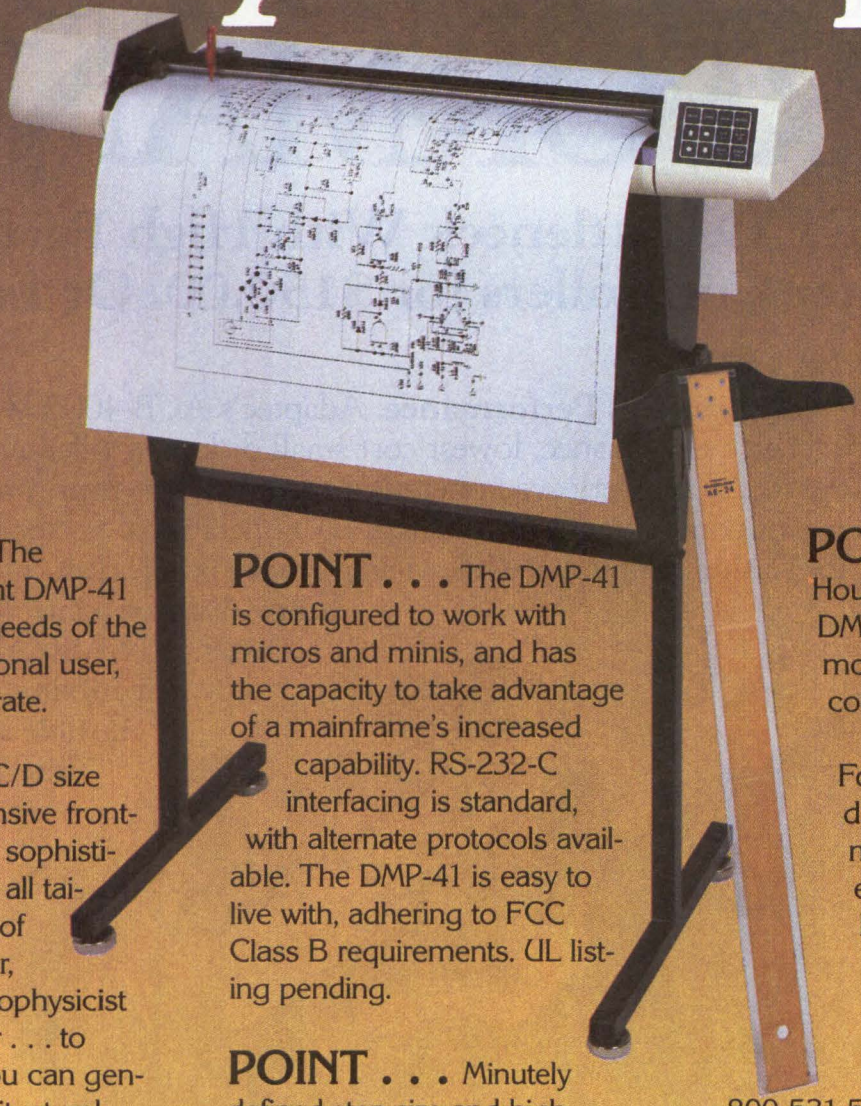

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CIRCLE NO. 52 ON INQUIRY CARD

drives, has completed its third round of financing. The Westford, Mass., company received $6.3 million from a group that includes Oak Investment Partners and L.F. Rothschild.

In transition

Docutel/Olivetti Corp. has sold its service operation to TRW Inc. and Applied Technology Ventures for approximately $13 million. TRW will provide service for all Docutel/Olivetti products marketed directly by Docutel/Olivetti's Financial Systems Division. The field-maintenance operation of the Office Products division will be shared by TRW and ATV.

Distribution/service deals

Prime Computer Inc. has acquired worldwide exclusive marketing rights to the LOCAM computer-aided process-planning system from British developer **Logan Associates Inc.,** Henley-on-Thames, England. Prime says LOCAM is aimed at discrete-manufacturing environments, and Logan will continue to develop the product as well as provide training and support.... **Mead Data Central,** Dayton, Ohio, and IBM Corp. will jointly market access to the Mead legal, financial, news and general-information database for the IBM PC, Displaywriter and 3101 terminal....Codex Corp. has signed a five-year OEM contract to sell and lease **Ungermann-Bass Inc.'s** Net/One LAN and CMX cable multiplexer....Info-Data Inc. will market its vertical software packages with **Zentec Corp.'s** 2020 multiuser microcomputer system that runs XENIX.

Wet ink

The Data Recording Instrument Co., Staines, England, is acquiring exclusive European manufacturing rights to 5¼-inch Winchester disk drives from at least three U.S. companies. They include **DMA Systems,** Santa Barbara, Calif., **New World Computer Co.,** Irvine, Calif., and possibly **Maxtor Corp.** (for its 140M-byte drive). A fourth deal would give Data Recording Instrument outside-U.S. manufacturing rights to a half-height, 3½-inch, 40M-byte drive from an unnamed West Coast company....**Drivetec Inc.,** San Jose, Calif., has signed a two-year, $3.1 million contract with Soroc Data Systems Inc., Anaheim, Calif., to buy Drivetec's 3.3M-byte 5¼-inch floppy disk drive....**Maxtor,** also of San Jose, will supply its 140M-byte 5¼-inch Winchester disk drive to Convergent Technologies Inc. for use in Convergent's Megaframe MC68000-based microcomputer system. Value of the contract is estimated to be as high as $20 million....**Mitsubishi Electronics America Inc.,** Torrance, Calif., in a three-year, $10 million contract, will provide the Sperry Corp. with 8-inch floppy disk drives.

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
American Software Inc.	year	4/30/83	16,090,000	3,319,000	.92
	year	4/30/82	8,754,000	644,000	.18
Analogic Corp.	9 mos.	4/30/83	90,861,968	10,278,699	1.18
	9 mos.	4/30/82	74,009,460	8,067,865	.96
Commodore International Ltd.	9 mos.	3/31/83	469,146,000	65,018,000	4.22
	9 mos.	3/31/82	206,336,000	28,051,000	1.82
Data General Corp.	36 wks.	6/4/83	557,100,000	12,500,000	1.05
	36 wks.	6/5/82	554,100,000	24,100,000	2.24
Dataram Corp.	year	4/30/83	16,182,000	1,267,000	.52
	year	4/30/82	20,059,000	1,414,000	.59
Gerber Scientific Inc.	year	4/30/83	117,247,000	4,517,000	.71
	year	4/30/82	114,756,000	3,373,000	.54
Interdyne Co.	6 mos.	5/3/83	386,366	134,716	.08
	6 mos.	5/3/82	583,583	8,687	1.16
Mohawk Data Sciences Corp.	year	4/30/83	363,624,000	12,045,000	.83
	year	4/30/82	333,945,000	15,647,000	1.16
System Industries Inc.	3 mos.	4/3/83	20,601,000	71,000	.02
	3 mos.	4/4/82	16,956,000	381,000	.10
Tano Corp.	3 mos.	4/17/83	6,718,000	(457,000)	(.34)
	3 mos.	4/18/82	8,667,000	156,000	.18
Volt Information Sciences Inc.	6 mos.	4/29/83	152,926,000	6,133,000	.92
	6 mos.	4/30/82	128,553,000	4,412,000	.70

Comments: Commodore International Ltd. noted that sales of its less-than-$400 Commodore 64 personal computers and VIC 20 home computers, recorded big gains. Sales for the third quarter more than doubled to $190.6 million from $82.1 million a year earlier. Net income increased to $25 million, or $1.62 per share, from $11.2 million, or 72¢ per share. **Data General Corp.** said orders were down from the 12-week period ending June 5 a year earlier, although the company's new top-of-the-line MV/10000 superminicomputer "has been well received," with a "significant number shipped." Total revenues of $188.7 million for the period were about even with the $189.0 million of a year earlier, while net income increased to $4.3 million, or 36¢ per share, from $3.5 million, or 32¢ per share.

17,381 WORDS O

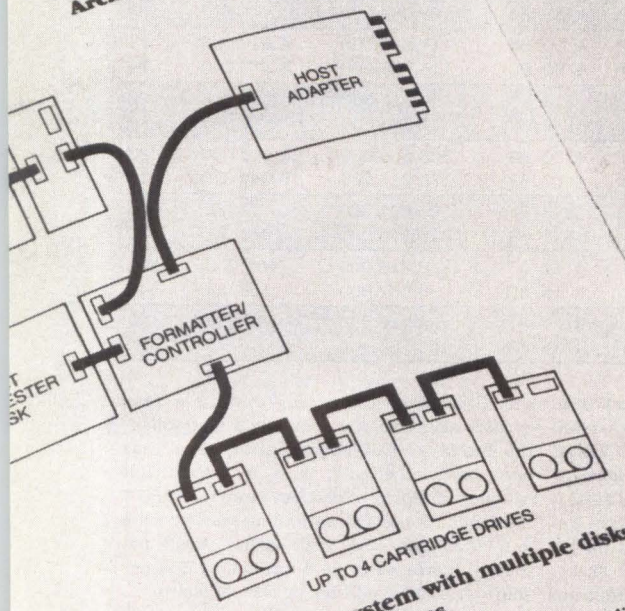

Figure 8-1 Mass-storage system with multiple disks and tape drives.

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

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

CONTROLLER HARDWARE

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

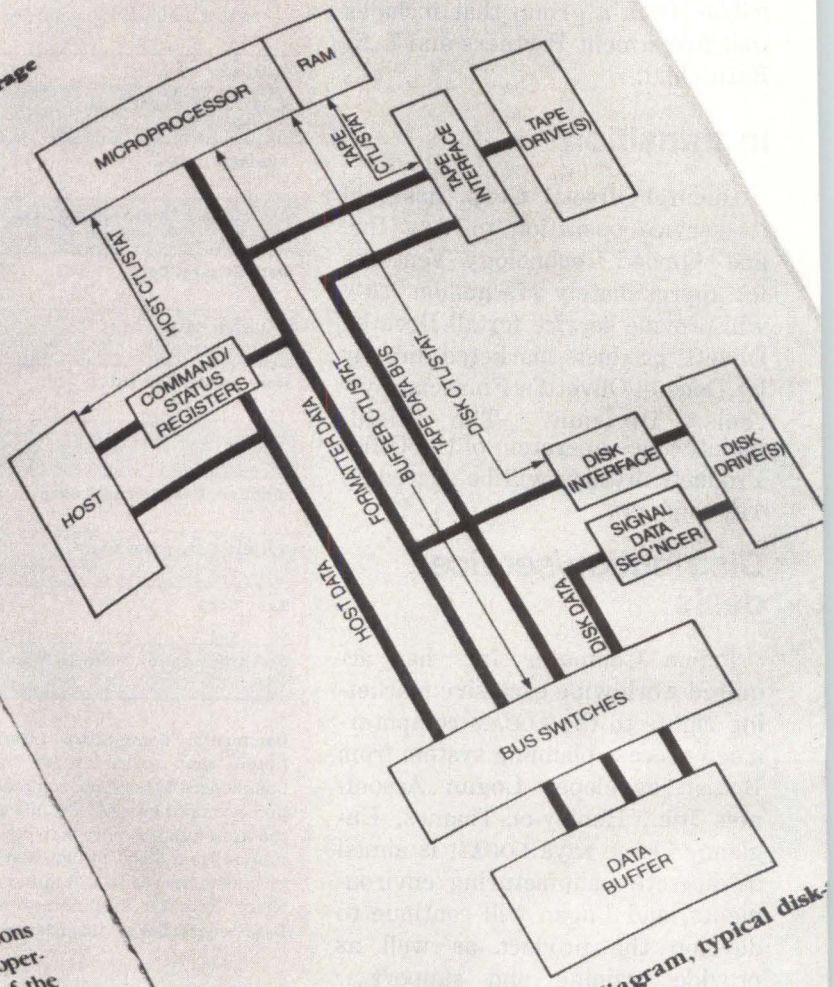

Figure 8-2 Block diagram, typical disk-

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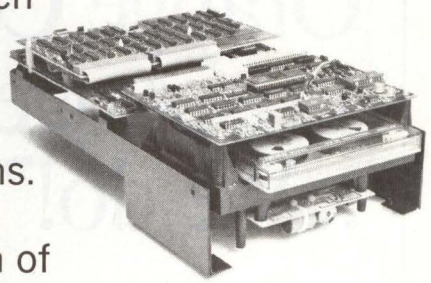

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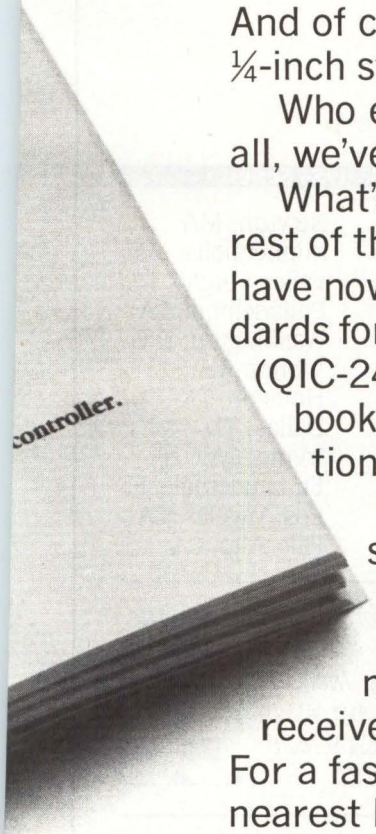

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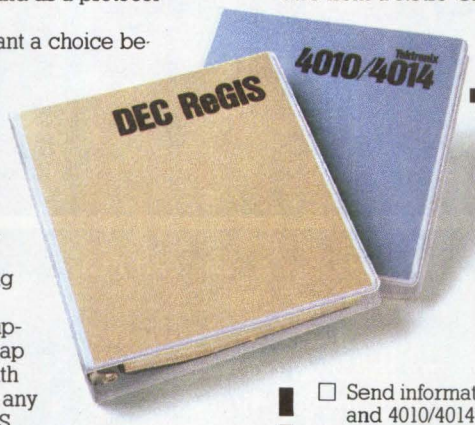

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Japanese independent software vendors push joint efforts with hardware makers

Japanese independent software vendors (ISVs) are making a major push to upgrade the quality and usability of business application packages in their domestic market. However, they face obstacles as large as, but different from, those faced by U.S. suppliers selling software to Japan. An estimated 50 percent of microcomputers in Japanese businesses are not used because of software that doesn't work. More than 10 multiproduct firms as large as IBM Corp. started the Japanese microcomputer industry, and they choose to retain proprietary operating systems. This makes standardization almost impossible. In addition, Japanese software documentation is generally inadequate. Another obstacle is that most software programs are custom written. Last but not least, there is little cooperation between ISVs and computer manufacturers.

Software firms wishing to sell successfully to Japanese business users must supply packages for the Kanji characters used in business, say Japanese industry participants (see "The challenge of Japanese Kanji," Page 98). This means that 7-bit ASCII programs must be rewritten to handle the 3,000 Kanji characters used in business and

SOFTWARE REVENUES IN JAPAN*

	Information Industry			Software			Computing Services		
	A	B	C	A	B	C	A	B	C
Computing services	32.8	11.7	11.9	3.8	4.3	12.9	56.3	12.1	11.9
Batch services	(28)	(10.2)	(11)	(3.5)	(3.7)	(11.9)	(47.8)	(10.7)	(11.0)
On-line services	(4.8)	(21)	(18)	(0.3)	(12.7)	(30.2)	(8.5)	(21.3)	(17.8)
Software development	33.2	27.2	26.7	61.2	25.9	27	10.7	33.5	25.3
Software product sales	1.5	33.7	23.8	3.2	29.1	20.4	0.2	124.9	—
Imported software product sales	(0.4)	(6.11)	(56.6)	(0.8)	(51.2)	(51.8)	(0.1)	385	(—)
Other services	9.8	15.3	15.3	14.2	13.1	15.3	6.2	19.6	15.5
Data punch	5.7	4.6	7.2	3.7	3.8	9.6	7.3	5	6.3
Hardware sales	6	52.7	36	5.8	34.4	22.8	6.1	70.3	51.1
Others	11	7.1	14.1	8.1	10.7	15.4	13.2	6.2	13.5
Total	100	18.1	17.7	100	21.2	22.2	100	15.7	14.6

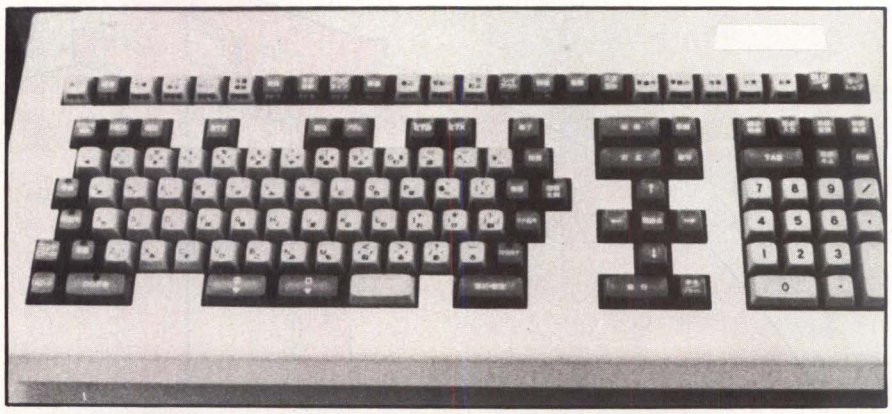
*As percent of 1981 total software sales. A is percent of total sales, B is growth rate against previous year, and C is growth rate from 1979 to 1981. Figures in parentheses are not included in totals. (Source: Japan Software Industry Association, Software AG Far East)

about 200 special symbols. Additionally, suppliers must incorporate functions into their software for the different business practices in Japan, emphasize Japanese software-development firms.

Japan's Microcomputer Software Association (MSA), comprised of 40 firms, is spearheading the effort to upgrade software quality and educate users. Figures compiled by Itsuo Uematsu, a member of the board of directors of Japan Soft Bank, Tokyo, a large ISV, show that 6,611 packages, of which 2,005 are game packages, were sold among the MSA's membership by March. The second highest category sold—1,253 packages—is education and evaluation/test software. Utilities and operating systems, supplied primarily by hardware members, accounted for 1,118 packages. The association's members thus want to refocus sales from games to business packages.

Only 35 percent of the association's membership has packaged software for business, most of which is distributed on 8-inch diskettes. Kazutaka Yano, general manager of association member CSK Software Products, Tokyo, estimates that sales of packaged software in Japan are about one-tenth as much as software sales for personal computers in the United States, which total about $850 million per year. He also imates that more than 90 percent of the packages in Japan are for the hobbyist market. "The association is not happy with the hobbyist concentration," he claims. The reason, he says, is that hardware and software companies are not working together for users to know (understand) software for business use." He points out that this is not the case in the United States. About 1 million small- and medium-sized Japanese businesses need ISV-produced software, according to figures from the Japan Information Processing Development Center.

Although hardware suppliers develop operating systems, they have recently begun subcontracting application packages to ISVs. There are about 180 ISVs in Japan, led by Computer Services, which has 4,000 employees and annual sales of 30



Katakana keyboards are used to input Japanese words phonetically. *A dictionary then translates the Katakana to Kanji character symbols in a word-processing system.*

THE CHALLENGE OF JAPANESE KANJI

Kanji software is a prerequisite for selling application packages in Japan. Input on a Japanese keyboard is done by using a complex Kanji keyboard, or, more popular on microcomputers, using a smaller alphanumeric keyboard with Katakana (Kana) phonetic characters.

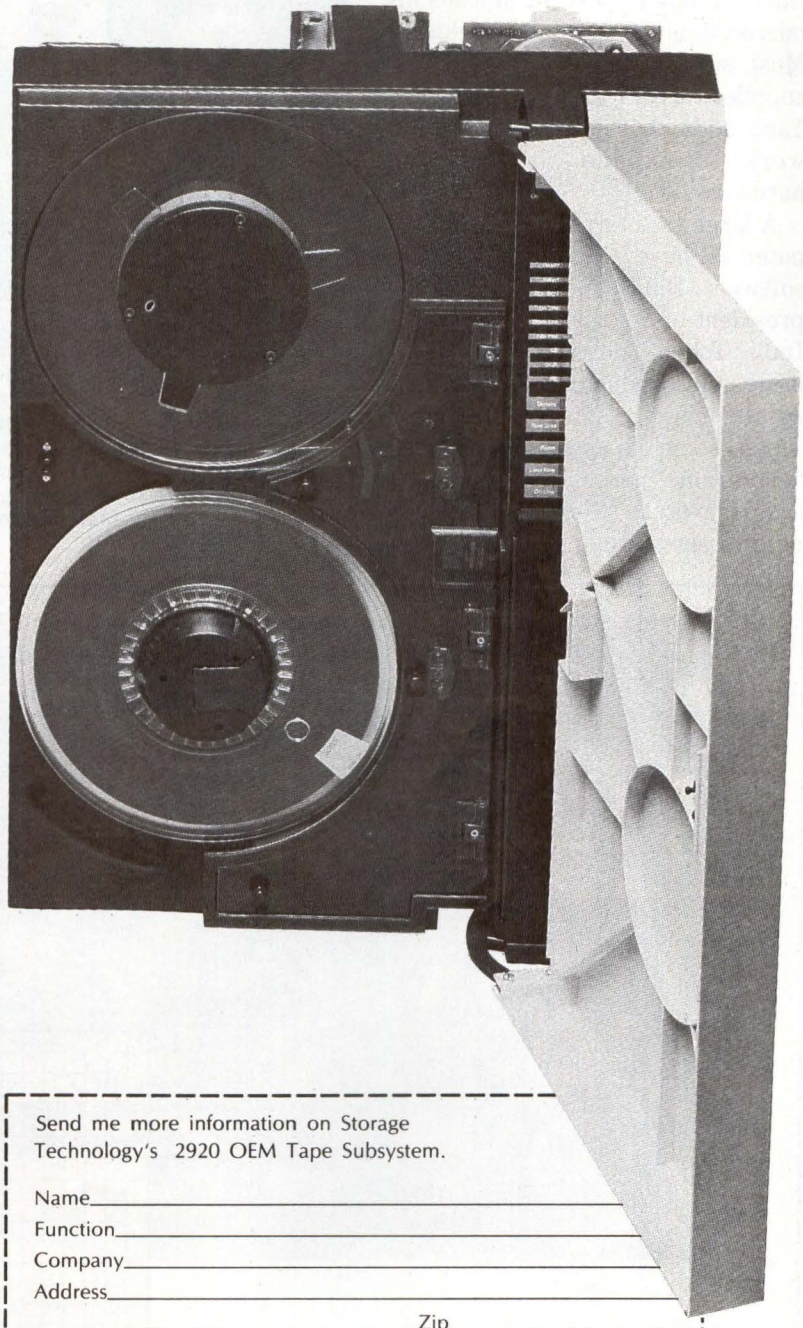
Unlike 7-bit ASCII, Kana requires an 8-bit character. The keyboard has an on/off "switch" key to activate Kana. To use the keyboard, an operator inputs a word by its phonetic spelling. A translation dictionary posts about seven Kanji words, and the operator must determine which, if any, are correct. The dictionary essentially identifies the "sound" of the different Kana combinations to get the proper word. Bill Smale, executive vice president of Software International Inc., Tokyo, says 60 percent of the software on Japanese word processors is intended for the dictionary function. Each Kanji symbol requires 2 bytes of storage in ROM, tape or disk. An average of 3,000 Kanji characters, plus 200 special symbols, is stored in memory. However, Kanji does not necessarily need a lot of space on a CRT screen because its symbols are more condensed than the English alphabet. Thus, "Tokyo" in Kanji is two symbols, one for Tok, meaning east, and one for yo, meaning capital, rather than the five letters in English. Kana is more difficult to work with than Kanji, and requires experimentation to get the proper word. Kana represents only 20 percent of the ways used to write Japanese, explains Smale. He notes that some companies, such as Digital Research Inc. and MicroPro International have their software adapted to accommodate 8-bit words.

IBM Corp.'s 5550 Kanji PC was a breakthrough because it allows one line of Kana to be input before translating the line to Kanji. Translation is typically done word by word. However, Smale remarks that Software International recently released its Kanshin package, which allows paragraph-by-paragraph translations.

Software International works with such U.S. firms as Ashton Tate and Chang Labs to prepare packages for the Japanese market.

Large System Tape Performance In A Small System Design

A 6250 bpi tape subsystem at traditional 1600 bpi prices.



Storage Technology's new 2920 OEM Magnetic Tape Subsystem provides large system GCR tape performance at prices in tune with today's small systems.

Whether you're **off-loading** a disk drive or performing a **sort/merge,** the 2920 performs equally well without special software modifications or time consuming repositioning.

Microprocessor adaptive controls eliminate the need for routine maintenance. Further cost-of-ownership savings accrue from a **5000 hour MTBF.**

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Storage Technology

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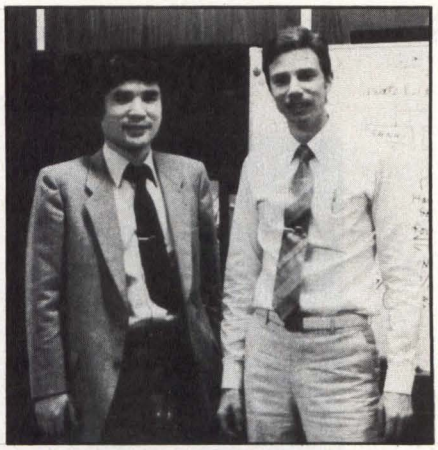
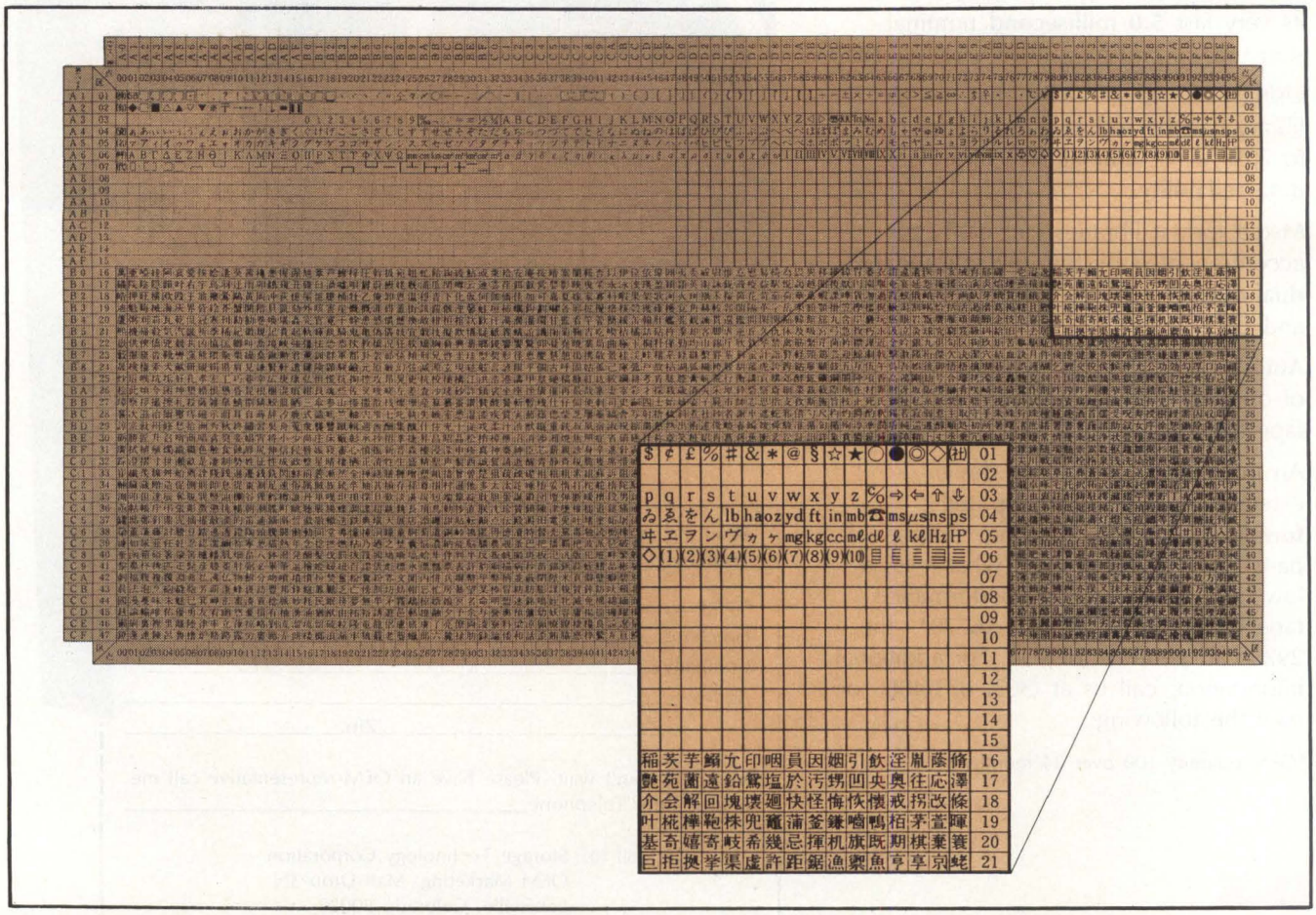
billion yen (about $130 million) for mainframe and microcomputer software. About 10 percent of sales are microcomputer software packages. Most subcontracts from hardware suppliers are for existing hardware, Yano adds, but he would like the work to expand to prototype hardware.

A large task for ISVs is to educate potential buyers about the value of software. Bill Smale, executive vice president of Software International Inc., Tokyo, notes that because large multiproduct companies started the microcomputer industry in Japan, some Japanese users have a "mainframe mentality": software is a "giveaway." "Software is beginning to show signs of improvement as a purchasable product," he observes. The mainframe (higher priced sale) orientation shows in the revenues generated by software in Japan. According to Kazuro Fujimoto, president of the Japan Software Industry Association and Software AG of Far East Inc., Tokyo, only 3.2 percent of revenues for 1981 from Japanese software houses were for off-the-shelf packages, while about 61.2 percent was custom-made software.



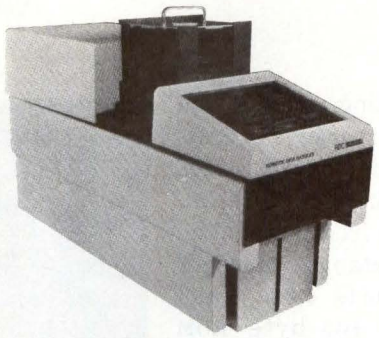
Bill Smale, executive vice president of Software International (right), *believes Japanese software should be developed in Japan, where software houses understand business practices and Kanji characters. Toshihiko Funayama, executive vice president of the company, is at left.*

Because most Japanese businesses use standalone microcomputers, word-processing and spreadsheet packages are more popular than database packages. But the MSA, along with Software AG and Software International, are making



Epson's QC-10 and QC-20 word processors *have a 31-by-96-character Kanji table to allow generation on screen of at least 2,976 characters, a Japan Industrial Standard number.*

LET OUR ROBOT'S FINGERS DO YOUR HANDLING



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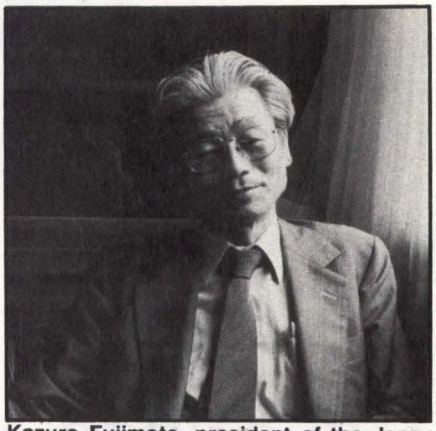
CIRCLE NO. 58 ON INQUIRY CARD

headway in educating users in the need for database packages. Software International is the sales representative of dBASE II in Japan, and Software AG recently introduced its Intes database manager there. Intes supports 4,096 Kanji characters on a 16K-byte ROM board, and can be used with Mitsubishi Corp.'s Multi 16 microcomputer attached to an IBM mainframe. The multifunctional package, explains Mizuo Nishibayashi, a system analyst at Software AG, includes functions for remote terminal linking of the microcomputer, file-transfer functions and graphics. The software also runs under the CP/M-86 operating system.

Additionally, MicroRIM Inc., Bellevue, Wash., signed a joint-marketing agreement with Mitsubishi and B-CON System Inc. to market MicroRIM's relational-database software in Japan. B-CON will convert MicroRIM software to Japanese. B-CON and Software AG are affiliated companies. The effort to standardize operating systems has been quelled by hardware manufacturers wishing to retain their proprietary operating systems and customer base. Software International's Smale estimates there are only about 25,000 installations of CP/M and CP/M-86 in Japan, and few of those can handle Kanji. Meanwhile, use of IBM's PC-DOS operating system may increase as a result of the introduction of the IBM 5550 Kanji PC.



Kazuro Fujimoto, president of the Japan Software Industry Association, *notes that most software packages sold in Japan in 1981 were custom made, and only 3.2 percent were off the shelf.*

Japan's NEC Corp. learned a bitter lesson about the U.S. market's low tolerance of proprietary operating systems when it introduced its Astra small-business computer. Because it used a proprietary operating system—ITOS—Astra did not fare well in the United States. As a result, the company did not use its proprietary PTOS operating system in the U.S. introduction of the Advanced Personal Computer. NEC instead used CP/M-86 with the system and later added MS-DOS 2.0 and UCSD p-system support. Sord Computer and Seiko also adopted U.S.-standard operating systems for their products. —*Lori Valigra*

(Editor's note: The concluding part of this series on Japanese microcomputer software will be in the October issue and focus on standardization efforts.)

Renewed trade act triggers U.S.-Europe export row

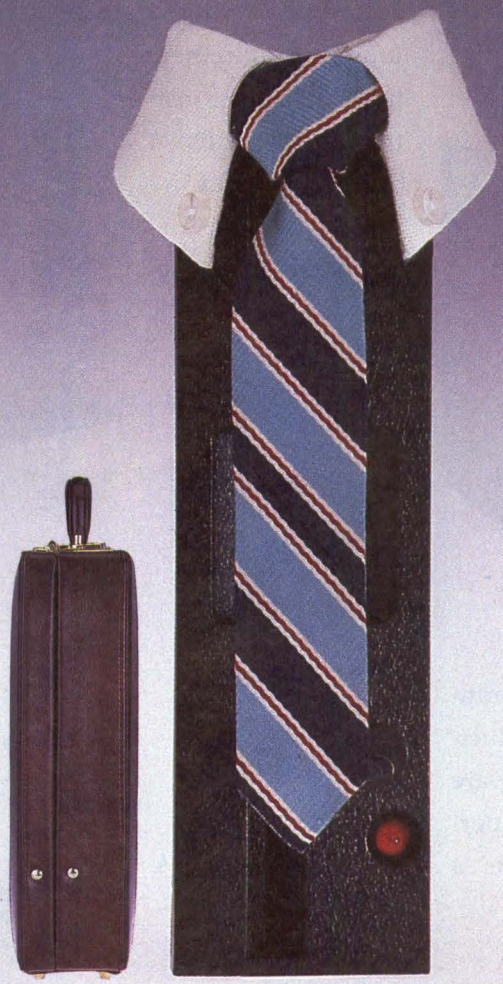
International trade in computers and other high-technology equipment is the basis of a disagreement between the U.S. government and the Common Market. Because the 1979 Export Administration Act (EAA) expires on Sept. 30, Common Market officials in Brussels, Belgium, fear that the new act now progressing through Congress will reinforce rather than diminish the most offensive aspect of the EAA—extraterritoriality for the United States.

The EAA restricts shipments of U.S.-originated high-technology products to the Soviet bloc and other politically sensitive areas. The act empowers the president to block export of some products to those countries considered foreign-policy and national-security risks. The act also enables the president to control the trade of overseas subsidiaries of U.S. companies and U.S. products and technologies traded by foreign companies. The affected companies must apply to the U.S. Department of Commerce in Washington for a license to re-export a U.S.-originated product, even if that product forms only part of a foreign system and accounts for only a fraction of the system's value.

In theory, the Commerce Department could deny granting an export license even if the system's U.S. hardware content consisted of nothing more than a microprocessor chip. Companies that fail to apply for a license or that re-export without a license can be fined or placed on a list that denies them access to U.S. technology.

The department fined International Computers Ltd. (ICL) $15,000 a few years ago. ICL had shipped Control Data Corp. disk drives as part of an ICL computer system to a police/military customer in South Africa, violating U.S. foreign policy.

WE'RE GOING PUBLIC WITH OUR HALF-HEIGHT FLOPPY!



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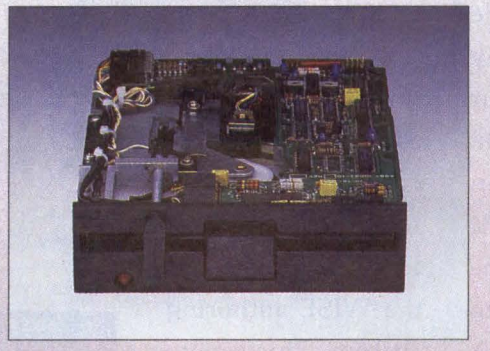

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INTERNATIONAL

Jeremy Strachan, head of group legal services at ICL, contends that the company paid the fine, mainly to avoid being placed on the denial list. Another reason was that, unless ICL paid, any ICL director setting foot in the U.S. could be arrested and charged under the EAA.

Opposition to the EAA in Europe started in 1982 when the U.S. government attempted to stop shipments from Europe to the Soviet Union for a massive gas pipeline. U.S. moves to prevent European companies from shipping products incorporating U.S. technology and to stop honoring contracts also incensed the Common Market. President Reagan conceded to the Common Market late last year, and market officials note that the new EAA may allow contracts to be completed on a future pipeline. But this concession may apply only to issues involving foreign policy rather than national security, and a 270-day time limit on completing a contract could be imposed.

The Common Market also cites other possible restrictions in the new act. Such legislation could ban foreign companies that violate the act from exporting to the United States, and could deny these companies supplies of U.S. products.

But even if the act were renewed in its current form, the Common Market would probably be hostile. Market ambassador to Washington, Sir Roy Denman, has pleaded the Common Market's case to the U.S. administration, and the market is urging governments of member countries to voice their dissatisfaction. Britain and West Germany raised the matter at the summit meeting in Williamsburg, Va., last May.

A change likely to be incorporated into the new act will be stronger U.S. Department of Defense influence over licensing. Another change would transfer the authority to enforce the act from the Commerce Department to the U.S. Customs Service. A third change in the act could be additional funding of $30 million for search-and-seize operations of goods without valid licenses. The Defense Department is believed to have seized numerous consignments to Europe over the past few months. Another feature of the new act could be fewer "military-critical technologies."

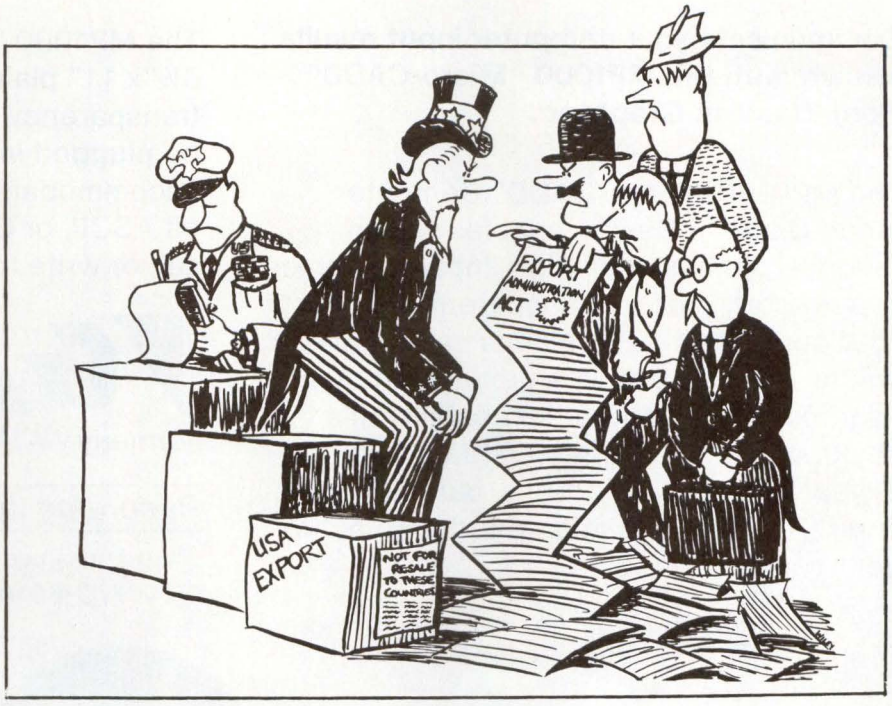

Illustration by Jim Wiley

Products affected by the EAA are shipped with documentation stating that they are not for re-export from the country of destination or not for re-export except to specified countries. Without the latter concession, all U.S. high-tech products shipped between European countries would need re-export licenses whenever they crossed a border.

Commerce Department officials in London suggest that the EAA helps to discourage companies in Sweden, Switzerland and Austria from exporting goods. These countries have few export restrictions because they do not belong to COCOM, a committee set up by countries allied to the U.S. COCOM compiles lists of products that its members voluntarily agree to ban from the Soviet bloc. COCOM nations, which include most Common Market countries, each maintain their own list of proscribed products, based largely on COCOM lists. The products on these lists require a license from an agency similar to the Commerce Department. But the license does not exempt a company from applying for a U.S. re-export license on an EAA-affected product.

Britain's Department of Trade and Industry, for example, warns in its instructions to importers, "Goods of U.S. origin may be subject to U.S. Export Administration legislation and may require separate U.S. re-export licenses, whether or not a U.K. export license is needed or granted." This warning has to be made despite Britain's COCOM-based product list. Exporters attempting to ship a product without a Department of Trade and Industry license by misdescribing

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OVERHEARD OVERSEAS

Beating the bushes in a $50 billion market

By Maureen O'Gara,
Contributing Editor, West Germany

The name of the game in Europe is means of distribution. Europe has suddenly awakened to the microcomputer with its high direct-sales cost, and pursuit of dealers or other third parties is heating up. The largest company—IBM Corp.—is having the same problems as the small ones, and thus is developing alternative distribution channels. Europe lacks a hoard of vendor alumni who are savvy about third-party marketing. With the possible exception of England, most vendors acknowledge that most of the available third parties are third rate.

Part of the reason for this is economics. Germany, for instance, lacks venture capital and an encouraging tax structure. It has an ultraconservative banking establishment largely unwilling to back a start-up manufacturer, let alone a distribution vehicle. France is trying to protect its computer industry with a politically decreed xenophobia for imported products.

The situation is particularly acute in Germany, supposedly Europe's largest market, though that perception is now probably undergoing re-evaluation. Would-be participants label it Europe's toughest market. The dearth of usual channels compelled IBM/Germany, for example, into a perhaps ill-advised—or at least premature—PC alliance with Metro, Germany's largest discount house. Metro had no high-technology experience, and initially did not provide software or support. As a result, it angered traditional dealers by undercutting them as much as 25 percent on the price of the PC. Since Metro may improve, the jury is out on whether IBM made a sound decision in the long term by signing the contract.

IBM's brethren are facing similar choices. In Germany, at least, companies such as Hewlett-Packard Co. and Digital Equipment Corp. are negotiating with local department stores for deals like the one IBM has with Sears Roebuck & Co. in the United States. HP, however, is less certain than DEC that such a conduit is advisable. Germans may adjust easily to buying their computers along with their socks. The stores—Horten's, Kaufhof's, Quelle's and Karstadt's—are looking for a low-overhead/high-turnover business. So, HP is thinking of breaking new ground using industrial distributors. DEC's other option is a company-owned retail-store chain, a risky business especially in Europe where the clientele is more used to handholding and less technology-minded than in the United States. Nonetheless, DEC opened a retail store last month in Geneva, Switzerland. It remains to be seen whether the concept improves DEC's lackluster performance in Europe.

And performance is what this is all about. So far, none of the big computer companies—not even IBM—have managed to predominate in the European microcomputer market. If there is a frontrunner, it's unprofitable Victor Technologies, which stole the European market lead with lessons learned at Commodore's knee. So for the giants, it's like playing the catchup game with Apple Computer Inc. in the United States years ago. This time though, they've got one hand tied behind their backs.

Maureen O'Gara *begins this month to write a column on European activities named "Overheard Overseas." Maureen is a five-year veteran of Computer Systems News, where she was a senior editor, the first West Coast bureau chief and, most recently, European bureau chief. Maureen works near Frankfurt, West Germany.*

the product are subject to a fine and a prison term.

ICL's Strachan notes that the products affected by the EAA far outnumber those on the COCOM list. "COCOM is regarded by Europe as a maximum but by the United States, as a minimum," he remarks. Little agreement exists between the U.S. and Europe in formulating a new COCOM list.

The European subsidiaries of U.S. companies appear to want exporting controlled by uniform COCOM rules enforced by the governments of their host countries rather than by the U.S. government through the EAA. For example, the U.S. Chamber of Commerce in London, whose members include Hewlett-Packard Co. and CDC, states that the new EAA "should require that the United States negotiate with its allies to redefine the items on the COCOM list, eliminate unilateral lists and apply pressure on allied governments to give full support to a streamlined and realistic list of prohibited items."

The chamber supports European opposition to the extra-territoriality of the current act and asserts that the new act should confirm the principle of international and U.S. law—that a corporation is a national of the country in which it is incorporated. The Chamber of Commerce adds, "Sanctions against individual business enterprises caught between conflicting government policies should not be tolerated."

But the DOD in Washington seems to believe that European governments are not tough enough in

restricting exports to the Soviet bloc and in enforcing COCOM rules. This year, Richard Perle, U.S. assistant defense secretary for international security policy, warned that high-technology products simply might not be allowed to leave the U.S. in the future.

Several publicized cases over the last few months involving the smuggling of computer equipment to eastern Europe could support the DOD's attitude. In one case, a Digital Equipment Corp. VAX system was shipped to Bulgaria, a close ally of the Soviet Union. Computer Maintenance Inc., Minneapolis, shipped the VAX with a valid license to a firm in West Germany. But the VAX then found its way to a British company on the U.S. denial list, which shipped it to Bulgaria.

—*Keith Jones*

Optical disks, microcomputers hold spotlight at Tokyo OA show

A notable showstopper at the recent 1983 Office Automation show in Tokyo was Matsushita Electric Industry Co. Ltd.'s Panafile optical-disk filing system, which the company says will hit the domestic Japanese market in October. The system boasts smaller media with a large capacity for image filing. It uses a front-loading 20-centimeter (7.8-inch) disk instead of the 30-centimeter (11.7-inch) disk developed by other Japanese firms, each storing 10,000 pages (210 millimeters by 297 millimeters (8.4-inch by-11.9-inch document). A basic system will sell for the equivalent of $58,000 to $112,000 (240 yen = $1).

A peripheral automatic changer that can handle as many as 50 optical disks gives the Panafile a capacity of 500,000 pages. The system is designed for use with a minicomputer to perform indexing and cross-referencing. Juichi Sakai of Matsushita Graphic Communication Systems says exports of the product are planned, but does not say when. Industry sources speculate that technical problems may delay domestic Japanese marketing until year-end.

Toshiba Corp. demonstrated its Tosfile 2100 optical-disk filing system, which also uses the 30-centimeter disks storing 10,000 pages each. The Tosfile can handle only one disk at a time, limiting its capabilities for referencing files. The system can, however, be linked to a microcomputer. A company spokesman says about 200 systems priced from $46,000 to $54,000 have been delivered in Japan since March 1982.

The system was developed to handle 257-millimeter-by-364-millimeter (10.3-inch-by-14.6-inch) documents, a standard page size in Japan but large and cumbersome by foreign standards. Last May, Toshiba introduced the Tosfile 2100R, which can reduce stored images and print the smaller legal document size favored in export markets. Toshiba's Toshiro Amemiya says samples of the system have been sent to at least four European and U.S. companies. Toshiba is looking for OEM partners and plans to begin exports in January, he says.

Five other Japanese firms join Matsushita and Toshiba in developing optical-disk filing systems. Sanyo Electric Co. Ltd. says it has delivered customized samples since last year, offering a disk that stores as many as 36,000 frames per side, with referencing done by a handheld computer. Sharp Corp. first showed its prototype last May in Tokyo, but hasn't set a target date for domestic release. NEC Corp. has announced a system with a 15,000- to 20,000-page-per-disk capacity that will debut in Japan this fall. Meanwhile, Hitachi Ltd. and Sony Systems are still developing optical-disk systems.

Observers at this year's show, held July 4-7, noted the appearance of a wide selection of small business computer systems with full Japanese language capabilities. Advances in office automation have been slow in Japan, partly because methods of adapting software for the complex written language have lagged far behind hardware technology. Japanese typically uses some 2,000 to 3,000 Kanji, or Chinese, characters with two sets of phonetic symbols.

Business is still conducted mostly with handwritten documents, resulting in a predilection among executives for facsimile devices and an aversion to keyboards. There are signs, however, that digital business communication may be coming of age in Japan, and some industry sources predict expanded domestic sales will give manufacturers a stronger base for hardware exports.

Typical of the trend, Seikosha Co. Ltd. introduced the 9500K, a Kanji version of a desktop computer system that has been on sale in the United States and other overseas

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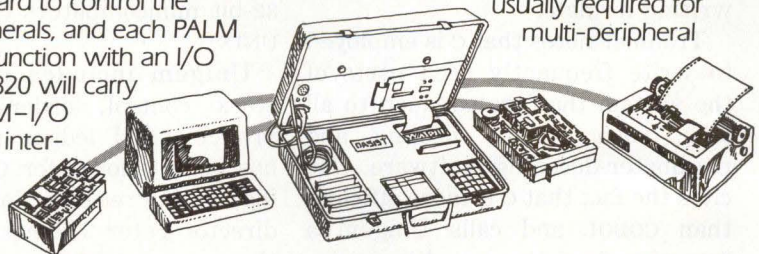

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markets since late 1981 under the Seiko brand name. The Japanese version previously had only Kana, or phonetic, capabilities. The 9500K uses three 16-bit processors (Intel Corp.'s 8086, 8087 and 8088) and a high-resolution CRT with an eight-color display.

Seikosha also displayed its aptly named "answer 3300," which spokesman Hajime Shimada says was introduced in July to compete head-on with IBM Corp.'s 5550 Kanji Personal Computer in Japan. The compact 16-bit microcomputer functions on two Intel processors, the 8088 and the 8085. With a 12-inch CRT screen, 256K bytes of memory, twin 1M-byte minifloppy disk drives, a standard keyboard and a printer interface, the 3300 retails for about $3,500. A 16-dot printer, designed to fit atop the CRT case, sells for an additional $500. Other peripherals such as a 24-dot printer and a 7.5M-byte Winchester disk drive are also available.

Although developed as a powerful Japanese word processor, the 3300 can be adapted for use as a personal or small business computer, says Shimada. A modified version is being developed for export, he says.

Sord Computer Corp. demonstrated its M68, which contains a 16-bit Motorola MC68000 processor and an 8-bit Zilog Z80A processor. Expected to be exported from Japan this year, the M68 was unveiled in May and went on sale in Japan in late June at $3,325 to $5,000, a Sord spokesman says. It is available with either minifloppy or 8-inch floppy drives and 5¼- or 8-inch hard disk drives, and comes with a 16-color CRT display with 640-by-400-dot resolution.

Sord, which expects sales to reach $85 million in fiscal year 1983, has the second-largest share of the Japanese domestic market in desktop computers, behind NEC. Sord announced in late June it had agreed to invest $1 million in a joint venture with the U.S. firms Charles River Data Systems Inc. and Envision Technology Inc.

—Karl O'Hara

European firms target UNIX business market

The emergence of UNIX as a multiuser operating system has prompted several European software houses to offer UNIX-based business software for commercial system integrators. For example, Precision Software Ltd., Worcester Park, England, offers a real-time accounting system called Unigem, which will be sold through an office in New York, according to the company.

Several other firms are eyeing the U.S. market. Tetra Data Systems Ltd., High Wycombe, England, sells a family of accounting packages written in C, Cgram Software, Swansea, Wales, provides a manufacturing system also written in C, and Root Computers Ltd., London, offers a user front-end menu system.

Precision Software managing director John Tranmer says Unigem offers large-machine transaction-processing facilities for its target minicomputer and microcomputer hosts. He lists Unigem's major features as automatic transaction recovery using a log file, function nesting—the suspension of one task while dealing with another—and a document database that enables a user to view all postings made to all ledgers in one document entry. Unigem can also be customized: a system installer can enter parameters defining data-entry and report-writing formats.

Tranmer notes that C is employed to write frequently used parts of the system that are common to all jobs, such as the nesting and parameter-decoding software. He cites the fact that C is more efficient than COBOL and calls Unigem a "marriage" of the two languages. COBOL was used to code the foreground data-entry program and externally compiled COBOL subroutines for file-opening and database-definition jobs.

Versions of Unigem for Motorola MC68000-based hosts will combine Level II COBOL from MicroFocus, Palo Alto, Calif. These packages can generate high-speed 68000 native code, with C-ISAM from Relational Database Systems Inc. Versions of Unigem for Zilog Z8000- and Intel 8086-based machines will use Ryan McFarland Corp.'s COBOL Version 2.0 because its run-time system is more compact than that of Level II, Tranmer says. RM COBOL Version 2 incorporates its own run-time system. Tranmer states that Precision Software is also targeting 32-bit minicomputers that can host UNIX.

Unigem includes modules for stock control, order processing, invoicing and ledger updating. It has been tailored for U.S. accounting, says Precision Software sales director Peter Thomas, who heads the company's U.S. marketing, Precision Software Inc. Thomas is seeking distributors in Atlanta, Chicago, California and Texas. He

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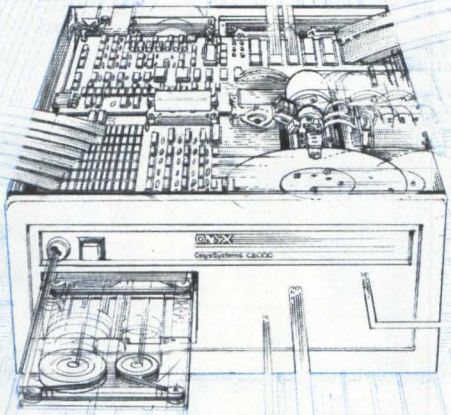
But these advantages will require intensive disk access, and superior memory management. In simple language, disk access must be as fast as possible, and the disk must have an unusual capacity to maintain complex file systems on-line at all times.

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.

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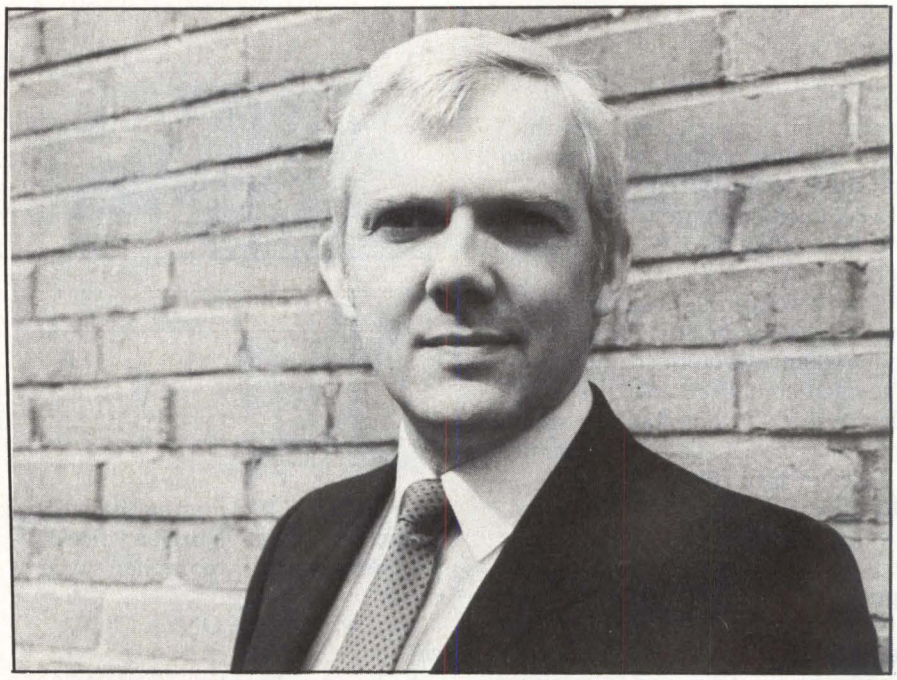
claims that hardware-independent, UNIX-oriented software houses with the ability to train dealers are ideal candidates. He also hopes to negotiate OEM deals with some microcomputer manufacturers. He quotes $1250 as the U.S end-user price for each Unigem module and $4300 for a complete system.

Thomas notes that the distributor network for Unigem will be separate from Precision Software's U.S. network of 21 distributors that sell the company's other main product line, software for Commodore Business Machines' B Series. Thomas believes some Commodore distributors could sell Unigem to users of the upcoming Z8000-based computers from Commodore. Tranmer says that revenues from Commodore products have to a large extent funded the development of Unigem.



John Tranmer, managing director of Precision Software, *notes that his company's Unigem real-time accounting software running under UNIX allows system installers to customize parameters defining data-entry and report-writing formats.*

UNIX consultant Jean Yates of Yates Ventures, Los Altos, Calif., says that although 12 U.S. companies already offer accounting software for UNIX, she does not rule out success for Unigem. One major potential competitor, Micro Business Software Inc., Chichester, N.H., admits that its Real World Business Software does not offer the automatic-recovery facilities offered by Unigem.

Tetra Data Systems has converted accounting software written in BASIC to C for Honeywell Level 6 minicomputers; this new software can run on UNIX hosts such as Fortune Systems Corp.'s 32:16. Tetra's managing director, Sean Dowling, reports that the company has developed a BASIC-to-C converter for the job. Packages cover order-processing, stock-control, invoicing and ledger-updating applications. Dowling believes the packages are only 15 percent less efficient when written in C than they would be in machine-dependent assembler-level code. Yates acknowledges that the Tetra packages should be more efficient than competitors' products written in the much more common COBOL. She notes that very few other packages written in C are available.

UNIX lacks strong file-handling ability, so Tetra developed an indexed-sequential-access method from scratch, declares Dowling. Some dealers are buying the ISAM separately to develop their own applications.

Cgram Software's manufacturing system, CMS, includes modules for materials and capacity planning, parts control and production control, announces Emrys Jones, managing director of software at Cgram. Analyst Yates believes CMS will be well-received in the U.S. because of the shortage of manufacturing packages running under UNIX. Most portable manufacturing software has been written for the Pick operating system, she remarks.

Root Computers, the British representative of Unisoft Systems, Berkeley, Calif., ports UNIX to 68000-based European microcomputers. The company also sells ROOTmap, which, it claims, replaces the cryptic commands provided by UNIX with a user-friendly front end, asserts Root product director Michael Kinton. The system provides menu and help-file creation facilities, an electronic-mail system and a personal diary. Yates believes ROOTmap will do well in the United States. "There is always a demand for menus," she comments. Root also plans to sell a product called ROOTlink, which is written in C. ROOTlink provides UNIX with the ability to interpret p-code commands from the UCSD p-System and execute them in a simulated UCSD environment.

—Keith Jones.

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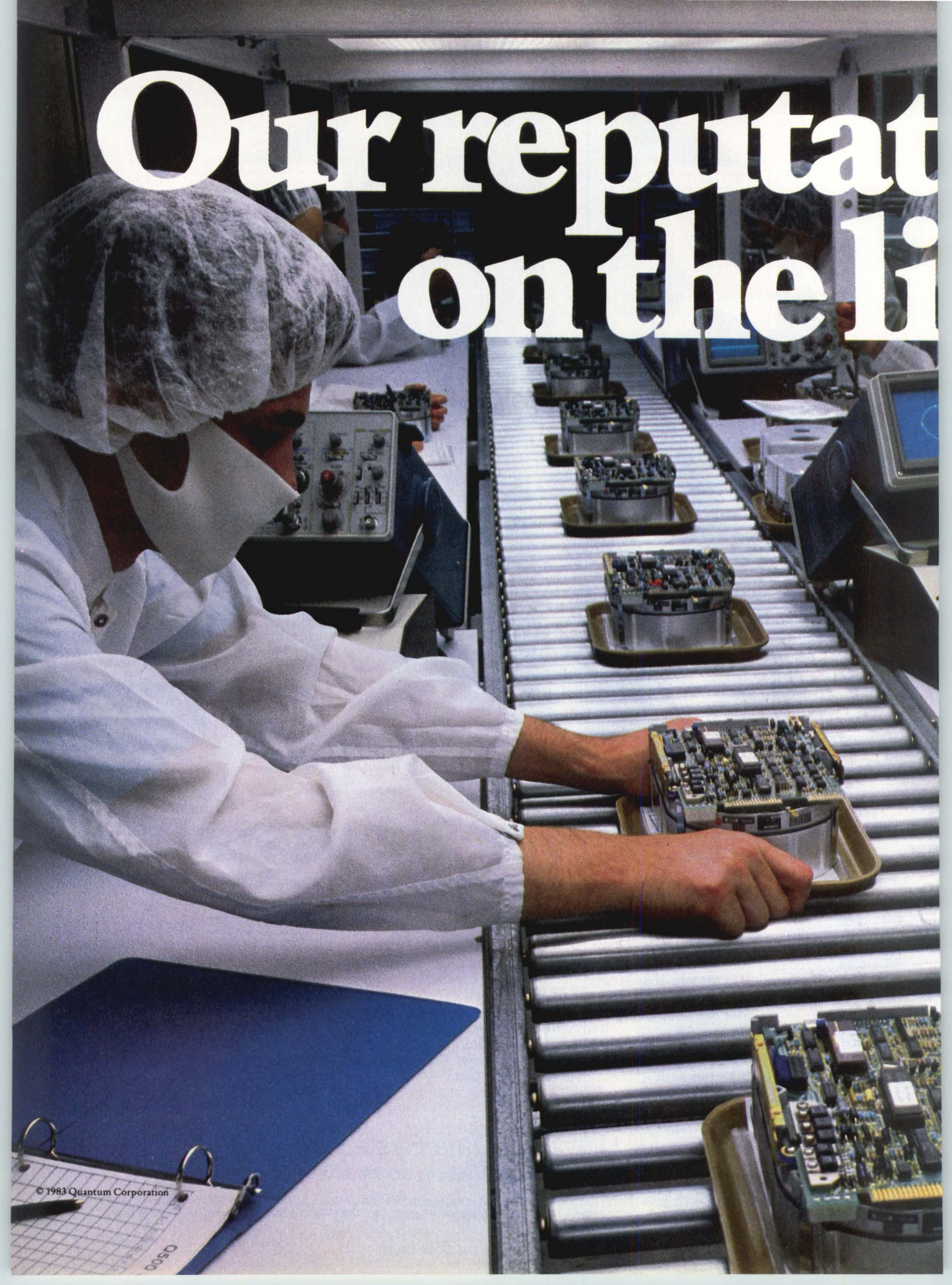
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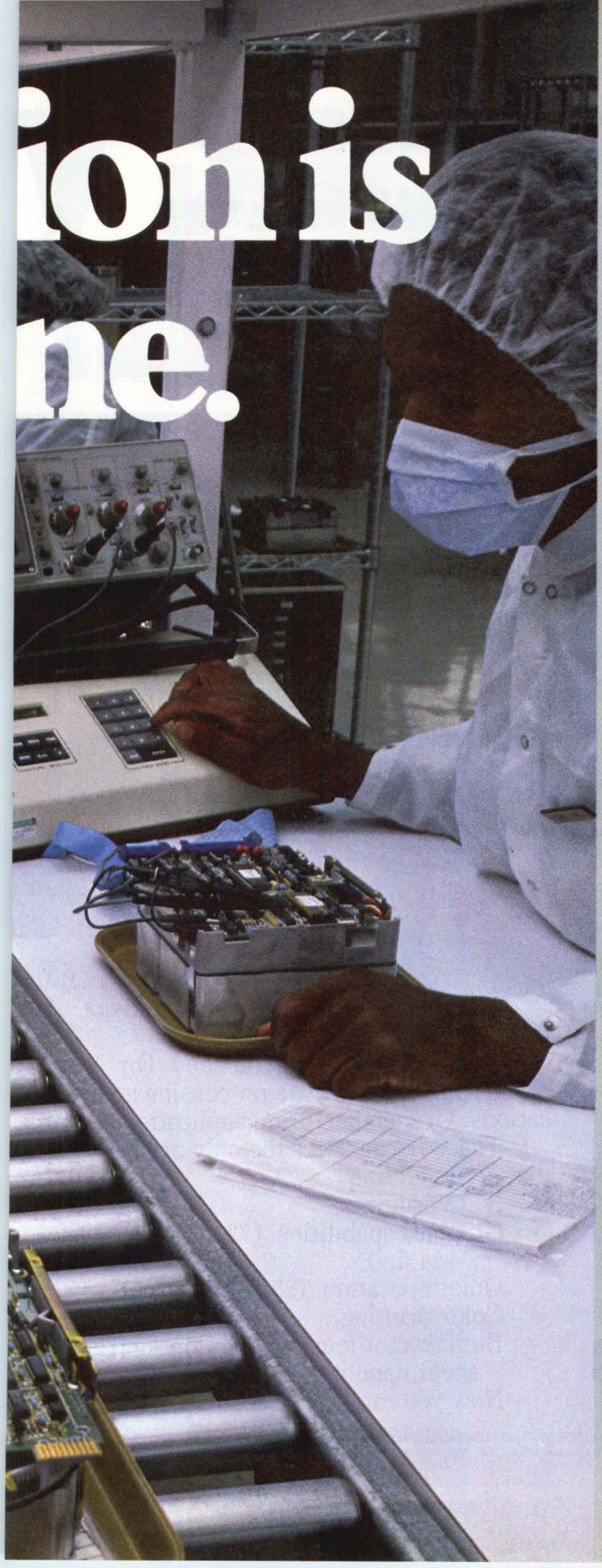

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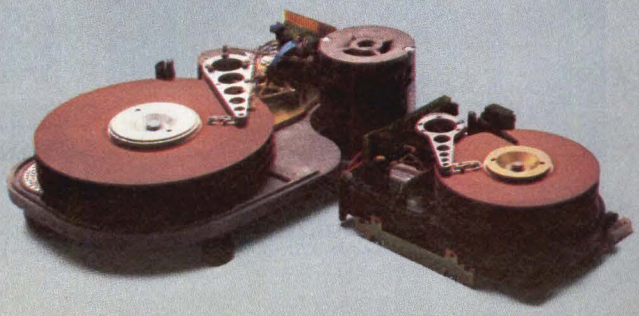

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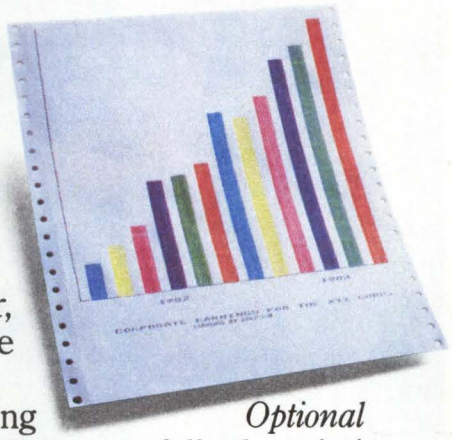

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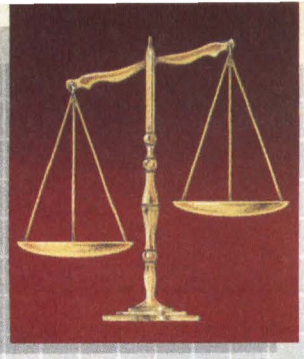

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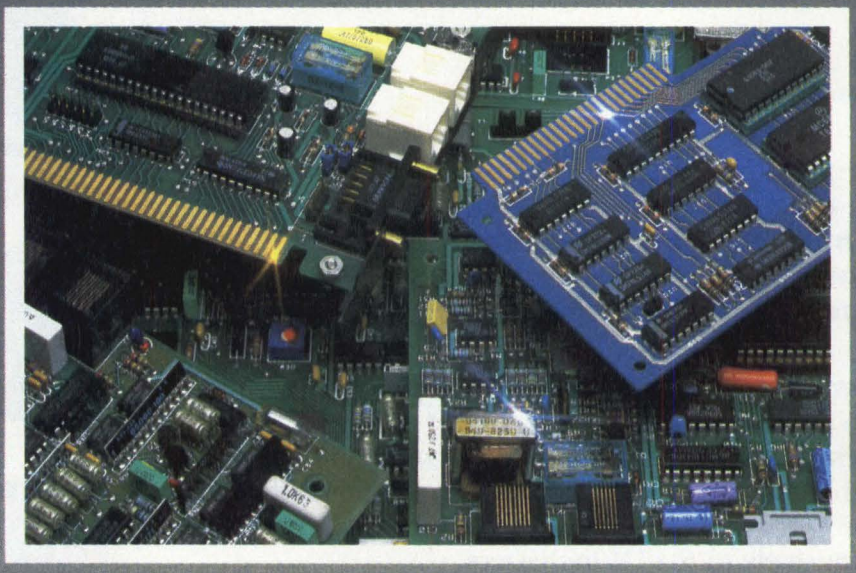

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CIRCLE NO. 69 ON INQUIRY CARD

Price cuts generate activity in flat-panel display markets

By Frank Catalano

Two years ago, the commercial viability of replacing CRT displays with plasma or electroluminescent flat-panel displays was questionable if not downright ludicrous. Aside from military and highly specialized commercial applications, CRTs could adequately handle most display tasks, which did not warrant the premium that users paid for flat-panel technology (MMS, December, 1981, p. 125).

Prices are declining now, however. As a result, analysts say, flat-panel suppliers will derive more revenues from commercial sales over the coming years. Two indications of the expanding commercial market are IBM Corp.'s spring introduction of end-user and OEM versions of a plasma display and the recent announcement by veteran CRT terminal supplier Tektronix Inc. of its involvement in the formation of Planar Systems Inc., Beaverton, Ore., a supplier of electroluminescent displays.

"The market is undergoing rapid and radical changes," notes Andres Despres, president of pioneer plasma display supplier Electro-Plasma, Millbury, Ohio. He adds that IBM and Tektronix will not only lend credibility to flat-panel technology, but will also help to define the commercial applications best served by flat-panel products.

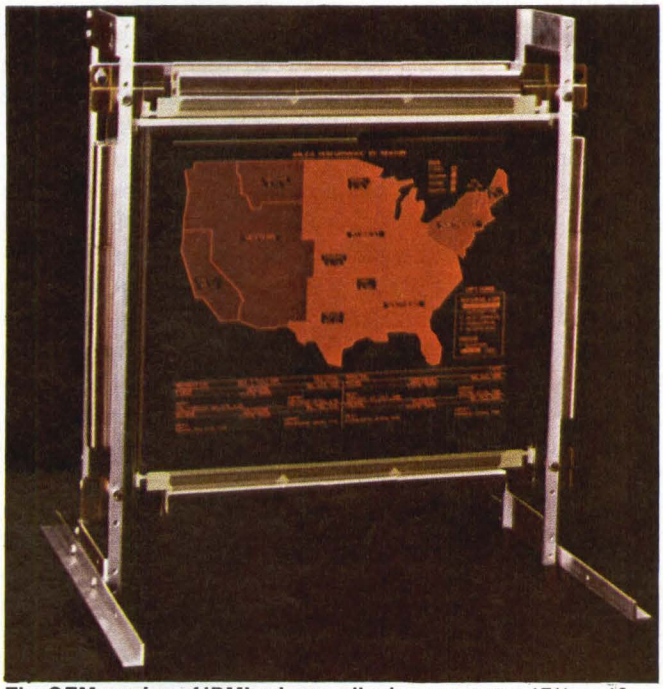
Both plasma and electroluminescent displays consist of a grid of electrodes sandwiched between two plates of glass. But while electroluminescent displays also include a thin layer of luminescent phosphorous film, plasma displays include a layer of light-emitting magnesium oxide and a gas-filled gap. In electroluminescent displays, an AC voltage applied to a pair of intersecting electrodes causes the phosphorous film to illuminate at the intersection. However, in plasma displays, the activated electrodes ionize the gas at the intersection, causing the magnesium oxide there to glow.

Because the ionized gas in plasma displays causes the magnesium oxide to glow continuously, these displays do not require refresh and are virtually flicker-free. As a result, plasma technology provides for high-resolution displays measuring as much as 1m. diagonally. Electroluminescent displays require refresh, and they typically have an 80-Hz refresh rate, so no flicker is apparent in displays measuring less than 6 in. diagonally.

John O'Boyle, vice president of the components division of research firm Gnostic Concepts Inc., Menlo Park, Calif., says the 1983 market for plasma and electroluminescent displays will not reflect significant growth when compared with the 1981 market, but adds that the market will grow over the next three years. In estimating market size, Gnostic Concepts includes only the sales of displays for integration in end-user computer systems. O'Boyle says the market for electroluminescent displays was nonexistent in 1981 but should be worth about $5.4 million by the end of this year. The plasma-display market, he adds, totaled $16 million in 1981 and will grow to only about $24 million by year-end. He also projects that by 1986, the electroluminescent-display market will be worth approximately $86 million in sales, and the plasma-display market will total approximately $102 million.

Traditional markets

Functionally, flat-panel displays offer users several performance and packaging features beyond those



The OEM version of IBM's plasma display *measures 17¼ × 10 × 3 inches and weighs 27 lbs. While IBM is targeting its end-user system for desk-top applications in the company's 3270 terminal series environment, the 581 can be integrated into systems operating in any environment. Prices start at $3400.*

Grid Systems' portable microcomputer *incorporates a Sharp electroluminescent display. Emulating DEC VT100 or IBM 3270 systems, the Compass can be used as an intelligent terminal in the office or as a portable computer on the road. The Sharp display provides users with graphics and alphanumerics capability and enables the Compass to fold into a 2- × 11½- × 15-inch package.*

available from CRT displays. Because they are flat, they fit into compact systems for which CRTs would be too large. They are also more durable than CRTs and consume less power. But because plasma and electroluminescent products are priced as much as 10 times more than CRTs, they have for the most part been integrated only into systems for specialized applications. These systems include point-of-sale terminals, industrial monitoring-and-control devices and scientific instrumentation.

The limited commercial market has forced flat-panel suppliers to rely for their bread and butter on the military establishment, which will pay the higher price for flat-panel products. This is because a military environment demands durable, compact and portable systems for use on battlefields. Suppliers such as Photonics, Luckey, Ohio, Japan's Sharp Corp. and Electro-Plasma sell products directly to the Department of Defense or through DOD OEMs such as Motorola Inc., Interstate Electronics, Science Applications Inc. and Rockwell International. Those OEMs configure such military systems as transparent map-overlay displays, portable computers and instrumentation displays for aircraft and submarines.

Prices on the decline

Although the military market has helped many flat-panel suppliers survive, it may soon take a backseat to the commercial market. No longer limited to specialized systems, flat-panel products are being incorporated into desk-top business systems as well as portable microcomputers. "The market is opening up now because of a price/performance breakthrough on the part of flat-panel suppliers," says Michael French, director of communication studies at Quantum Science Inc., New York, a market research and consulting firm.

While list price for a 240- × 320-pixel electroluminescent display from Sharp was more than $1200 in 1981, a similar unit now sells for about $625 in quantity. A 256- × 512-pixel plasma display from Electro-Plasma sold for $1500 in quantity two years ago but sells for $1000 this year.

Glen Edens, vice president of market development at Grid Systems Inc., a Mountain View, Calif., supplier of portable microcomputers that incorporate the Sharp display, says Sharp has been able to trim the price of its displays through the economies of high-volume production. Two years ago, Sharp had the production capacity to manufacture only 100 electroluminescent displays a month but has since built a $130-million facility with a 200-unit-a-month capacity.

Electro-Plasma's Despres says that price reductions for plasma products are the result of technological advances in the electronics to drive the displays. While it once took two diodes and a resistor to drive each line of a 512-pixel display, it now takes only 32 Texas Instruments Inc. integrated circuits to drive the entire screen. "The electronics driving plasma displays used to be bulky and costly to assemble," notes Despres. "The TI IC has significantly reduced the cost and intricacies of the job. Everything else associated with plasma display is pretty standard stuff."

But despite the technological advances, plasma displays are still priced almost twice as high as electroluminescent displays. Quantum Science's French attributes plasma's higher price to the costs of low-volume production. While Electro-Plasma manufactures about 2000 plasma displays a year, Sharp manufactures that many electroluminescent displays per month. "Plasma displays have the potential of being priced lower than electroluminescent displays, but that potential won't be reached until production volumes pick up," says French. He adds, however, the caveat that production volumes won't pick up until sales volumes increase. "I think IBM's commitment to plasma may help overcome that chicken-and-egg situation," he says.

IBM aims plasma display at 3270 users

IBM introduced its 3290 end-user plasma terminal and its 581 OEM version in March. While the 3290 includes everything from the display glass to the power supply, the 581 includes only the glass and drive electronics. Both units have screens measuring 19 in. diagonally that can display 9960 characters in a 160-character × 62-line format. List price of the 3290 is $7100, with

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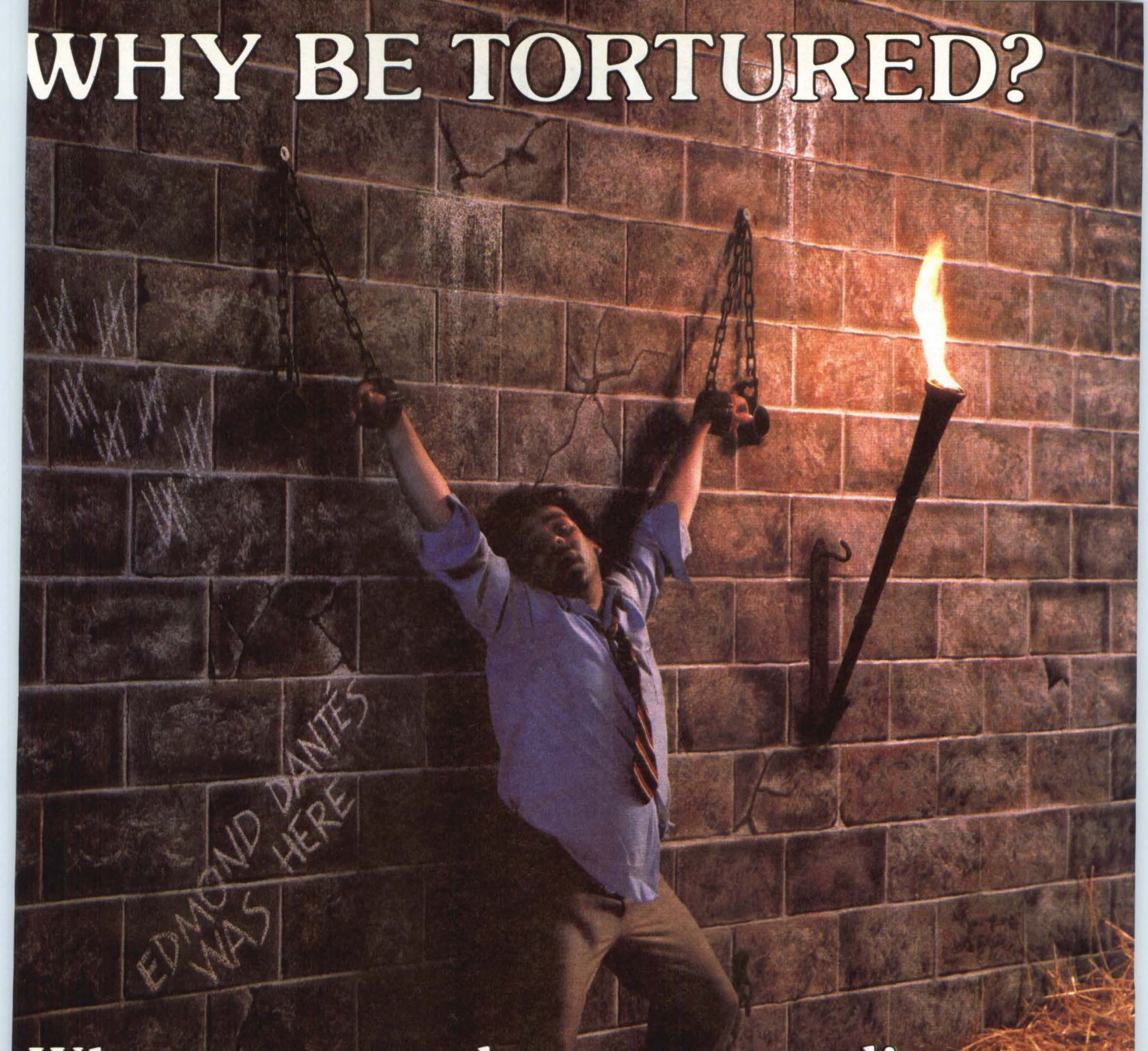

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quantity discounts as high as 30 percent available, while the 581 is priced at $3400, with quantity discounts as high as 40 percent available.

In defining the market for the displays, an IBM source says that the 3290 is designed to operate in the company's 3270 terminal series environment. IBM had installed more than 2 million 3270 series displays by this year. The IBM source says the 3290 is intended for applications that demand a large display, alphanumerics and graphics, durability and ergonomic design. The display has been tested to have a mean time between failures of 40,000 hrs. and occupies 60 percent less space than a comparably equipped CRT display. The 3290's screen can be divided into four 1920-character quadrants, and four host computers can concurrently address each quadrant. This allows an application to be displayed in text form in one quadrant, for example, graphic in another and both text and graphic in a third. The fourth quadrant could be used to display the final output. "With the rise of the information age, we're finding that professionals require capacity in terms of the amount of information they can view on a single display," says the IBM source. "We're providing this capacity, and we feel it will be of benefit to a number of companies."

IBM hopes to define the plasma-display market with the 3290 and to create enough interest on the part of large OEMs that they will integrate the 581 into their own product configurations. "IBM supplies the technology behind the basic 581 display as well as the manufacturing capability," says the source. "All the OEMs have to do is design the display into their own product configurations."

EL displays ensure portability

While IBM contends that plasma displays are best for integration into desk-top workstations, James Hurd, president of Tektronix-funded Planar Systems and former manager of the solid-state research lab at Tektronix, says that electroluminescent displays are best for portable microcomputers such as the one offered by Grid Systems. "We're targeting our product at system integrators who will take the display and integrate it into a new product concept," says Hurd. "We think the Grid Systems product is a good example of what the technology allows."

Grid Systems' portable microcomputer folds into the size of a notebook measuring 2 in. thick, 11½ in. wide and 15 in. deep. Packaging considerations prompted the company to use a flat-panel display instead of a CRT, although Grid Systems' Edens says that the ruggedness and clarity that flat panels provide are also important. "A CRT just would not allow us the form factor that we thought was necessary to ensure portability," he says. "I think the value that the flat panel adds to the system justifies the higher cost that the units entail."

Edens says that form-factor considerations were also involved in the company's decision to use electroluminescent rather than plasma displays. Because electroluminescent displays consume less power than plasma displays, they don't require large power supplies that could increase system weight.

Quantum Science's French says the portable-microcomputer market is expanding, and electroluminescent displays will play a key role. "There is a growing popularity of portable computers in the market, and most of the major personal-computer suppliers are working on portable products," says French, "I think the lower performance products priced below $1000 will be either CRT or liquid-crystal-display based, and most of the high-end products like Grid Systems' Compass will incorporate electroluminescent displays."

Planar Systems' Edens agrees. He says that once the firm reaches full production capacity, it will ship 10,000 to 100,000 electroluminescent displays each year for integration into portable systems. "The market is there for portable computers," says Edens. "We don't see a significant risk in banking on that market."

Formed in May, Planar Systems is shipping prototypes of its 80-character × 24-line display. The technology for the Planar display was developed at Tektronix, but Tektronix opted to help start a company rather than incur the costs of manufacturing a new product in house. Prices have not been set, but Hurd expects the display to be priced competitively with the Sharp product. He says that the price should drop to less than $500 within three years.

French says that as new plasma and electroluminescent display products are introduced, they will generate additional market interest in flat-panel technology. As sales volumes increase, prices will drop. How much prices will decrease, however, is up for speculation, but French says flat-panel displays will eventually sell for only twice as much as CRTs. "There is a market out there of people who would pay a reasonable premium for the size features, performance characteristics and durability offered by flat-panel products," he says. "But that reasonable premium has its limits." □

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CIRCLE NO. 72 ON INQUIRY CARD

Manufacturers work out last RFI kinks as final FCC deadline approaches

By Dwight B. Davis

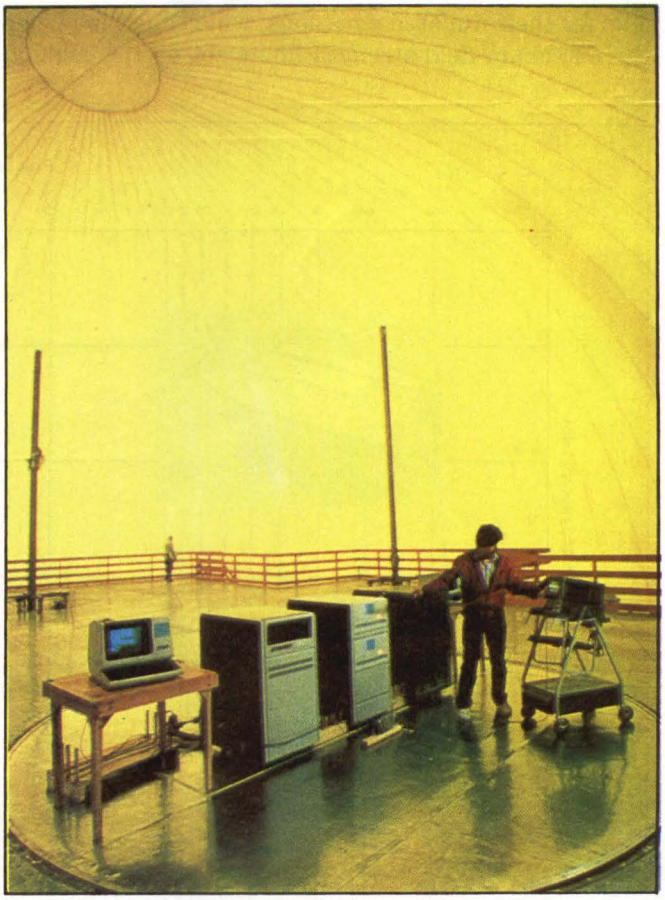
The Federal Communications Commission (FCC) will soon complete its phased implementation of regulations that limit the amount of radio frequency interference (RFI) permissible from computers and peripheral equipment. As of Oct. 1, any digital product that generates timing signals or pulses at rates greater than 10,000 cycles per second must comply with the FCC's regulations, which have been in force for newly designed devices since 1981. While many manufacturers are taking the RFI specifications in stride, surveys by the FCC's investigative branch have indicated widespread non-compliance with the rule. Because those familiar with the regulations find them reasonable and easy to implement, the lack of compliance is often attributed to ignorance of the rule or misinterpretation of the regulation.

"We think the technical limits of the FCC regulation are very fair," says Dave Brown, FCC program manager at Digital Equipment Corp., Maynard, Mass. He notes that DEC and other computer companies were actively involved in setting these limits and the implementation schedule through their participation in the Computer and Business Equipment Manufacturers Association, which has worked closely with the FCC since early in the formulation process. Steve Baldwin, product regulations manager for the computer groups at Hewlett-Packard Co., Palo Alto, Calif., shares Brown's satisfaction with the regulation—known as FCC Rule, Part 15, Subpart J. Baldwin cautions, however, "I'm not sure that just reading the regulations and trying to sort them out will make it clear as to what's required. The regulations are fairly complex, because of the nature of radio-frequency emissions."

The best source for interpreting the regulations is the FCC itself, which has issued several rulings to clarify the confusing parts of the regulations. An FCC panel formed to answer questions and give guidance has handled 600 to 700 inquiries, says Julius Knapp, an electronics engineer in the FCC's RF Devices branch. Other sources of information exist, but not all are reliable, says Glen Dash, president of Dash, Straus and Goodhue Inc., an electromagnetic-interference testing and consulting firm in Boxboro, Mass. "Many people passing themselves off as experts in this field really aren't," he cautions. "What has hurt the industry is that there have been a great number of people peddling a great amount of misinformation."

Rules as preventive medicine

In 1979, when the FCC first began to implement rules limiting the RFI of computers and peripherals, the number of cases involving such interference was not overwhelming. But some complaints about computer interference were serious enough to prompt concern, says Knapp at the FCC. "One notable case was interference to an aeronautical navigation system at a military airport from some electronic cash-register systems," he says. And, although the spectrum of



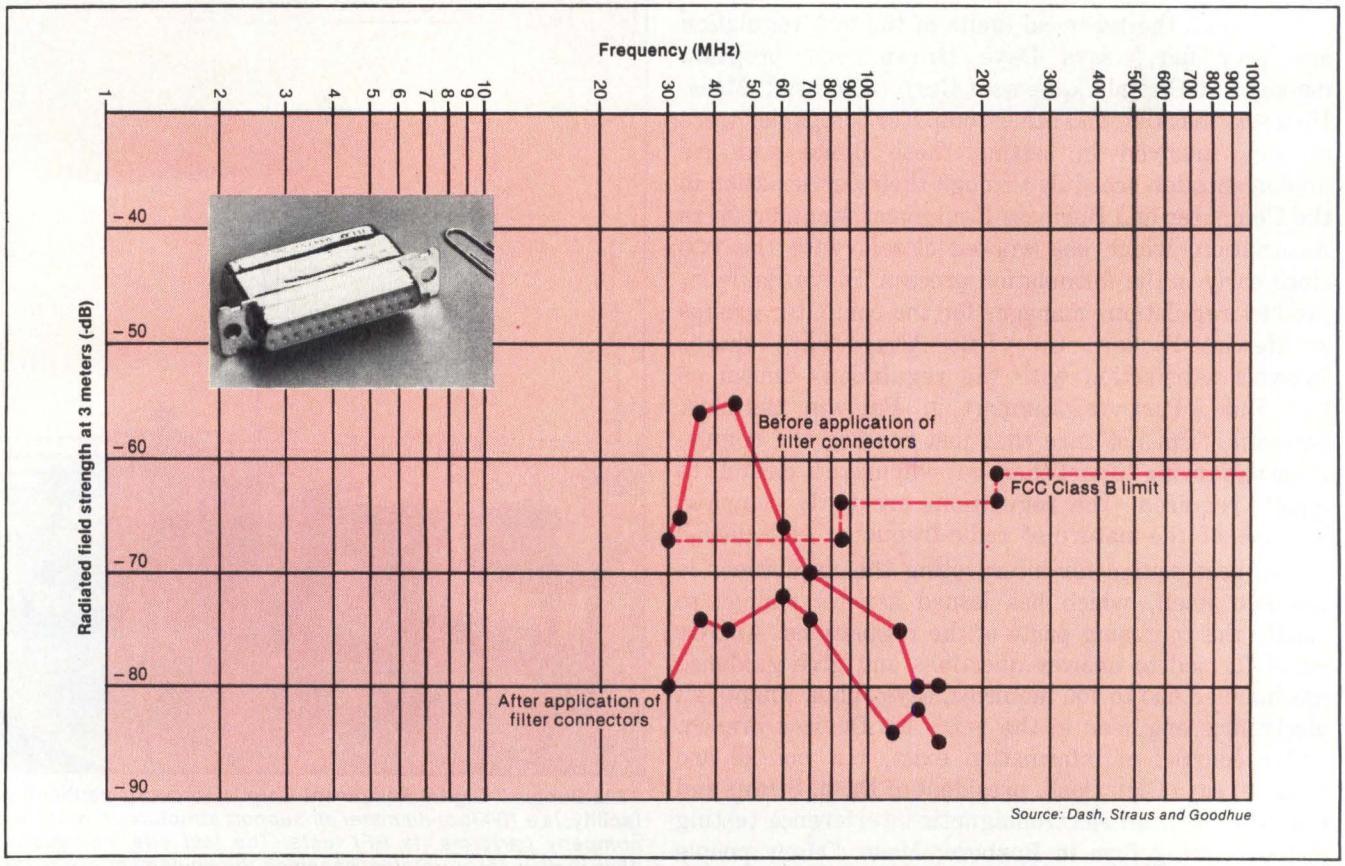
"The Bubble," Digital Equipment Corp.'s corporate verification facility, *is a 100-foot-diameter air-support structure, in which the company performs its RFI tests. The test site includes an 18-inch-diameter turntable, on which the equipment under test can be rotated to determine the worst-case RFI configuration, and a large ground plane, on which the entire test station rests.*

radiation regulated by the FCC is not considered a health hazard, interference with police radios, hospital equipment and other sensitive systems could prove life threatening.

Joseph Casey, chief of the FCC's field operations investigation branch, believes the commission acted wisely by instituting its rules when it did. "There may not have been a large national problem of interference caused by computing devices (when the rules were written)," he says, "but we realized there was potential for that problem. If you were to take the general interference levels that were being produced by pre-regulation computers and project that across the number of computers in the marketplace today, we would have had major interference problems had we waited until today to start making the regulations."

The FCC regulations break the market into Class A industrial/commercial devices and Class B consumer devices. Devices are tested across a range of 30 to 1,000 MHz for their radiated emissions, which must fall below the maximum field strength limits set by the commission. Devices must also adhere to specified line-conducted emission limits, which set the maximum voltage that the equipment can feed back along the power line (see tables, Page 137). Because they are designed for mass markets and are likely to be ubiquitous, Class B devices must meet stricter requirements for RFI emissions than their commercial cousins. Also, the FCC scrutinizes Class B products such as personal computers more than Class A equipment because of Class B's greater potential for widespread interference.

Along with their tighter emission requirements, Class B products must be "certified" by the FCC. Manufacturers of these products must test them to ensure that they fall within the FCC guidelines and must submit the test results to the commission. The FCC typically issues a certification if the test results are satisfactory, although it can request a sample product for testing in its own labs if questions exist. Class A devices need only be "verified," meaning the manufacturers must test the products and must submit the



Emitted radiation from a graphics tablet, *initially more than 10 decibels above the FCC's limits for Class B mass-market devices, complies with the regulation after the addition of three ITT Cannon filter connectors (inset). The filter connectors are placed on the tablet's two I/O ports and on its power-supply connection.*

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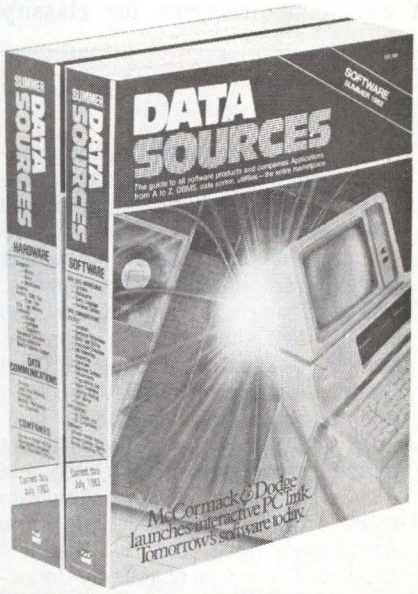

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CIRCLE NO. 73 ON INQUIRY CARD

results of the tests only on demand by the FCC. Class B and Class A products must also carry proper labels indicating they have been certified or verified, respectively.

One confusing aspect of the FCC regulations is a lack of clear-cut directives for classifying equipment as Class A or Class B. "In trying to come up with the criteria for what's a Class B product, we usually look at the price/performance aspect," says HP's Baldwin. At DEC, Brown says, the entire personal-computer line, including the business-oriented Professional, will be Class B certified. "We made a decision when we went

TESTING FOR RFI THE FCC WAY

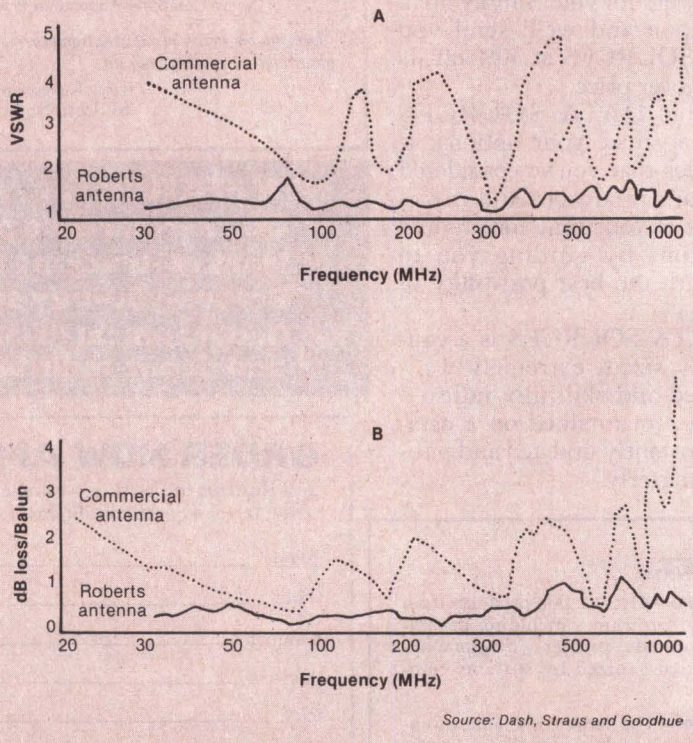
Mimicking Federal Communications Commission testing may be the most confusing task for computer and peripheral companies striving to comply with the FCC's regulations limiting radio-frequency emissions. The FCC employs both indoor and outdoor test sites, but the sites are neither complex nor expensive, Glen Dash, president of the Dash, Straus and Goodhue Inc. consulting firm, says. "Some people have spent millions of dollars on test sites, but they've got lots of misinformation from so-called experts," Dash says. "Some companies have put in anechoic chambers, which is absolutely unnecessary. In fact, they're liable to be inaccurate. Others are using automated equipment to do the testing. The FCC doesn't use it, and you're apt to make mistakes if you go to automation."

Automated testing equipment is prone to error because an important aspect of testing is physically moving attached devices and cables to obtain worst-case readings of emitted radiation. The level of radiation can vary considerably, depending on the cable orientation, Dash says, and the cable movement is most effectively performed by manual methods.

Test equipment employed by the FCC includes a spectrum analyzer, a preamplifier, analyzers and filters. (For outdoor testing, a receiver with a quasi peak detector is used instead of the spectrum analyzer.) A custom-built dipole antenna detects emitted energy. Dash says many companies don't know that the FCC antenna is custom-built, and this has resulted in widespread inability to duplicate the FCC's test results.

Commercially available antennas cause standing waves to develop on the feed cable between the antenna and the receiver, Dash explains. "Depending on how long the cable is, you get different results," he says, "so people are getting results all over the map. The FCC ran into that problem and resolved it with their own antennas 30 years ago. They just hadn't told anybody."

The designer of the FCC's antennas, Wilmer Roberts, now heads Roberts Instrument Corp., a joint venture with Dash, Straus and Goodhue. FCC-type antennas are available from Roberts Instrument. Manufacturers can obtain Document OST-55 from the FCC's Office of Science and Technology for more details on setting up an FCC-type test site.



Source: Dash, Straus and Goodhue

Antennas manufactured by Roberts Instrument Corp. *exhibit better voltage standing wave ratio characteristics and better loss characteristics than most commercial antennas. These graphs from an FCC study compare a Roberts antenna with an Empire DM-105 antenna. VSWR (Graph A) measures the variability in the output of an antenna when it is connected to varying lengths of cable. For example, a VSWR of 3:1 means that the voltage received by an antenna from the same signal source can vary by a factor of 3. Because of this variability, companies using commercial antennas with high VSWRs may have difficulty in duplicating FCC test results. Antenna losses (Graph B), to be acceptable for FCC measurement, should be less than 1 decibel per balun. (A balun, short for balanced/unbalanced, is a type of impedance-matching radio-frequency transformer.)*

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into the personal-computer business that we were going to certify all our equipment to meet the Class B levels," he says. Brown also notes that manufacturers can verify industrial/commercial equipment at either Class A or B level, and some of DEC's commercial terminals have met the Class B spec and are so labeled.

Even the FCC's investigative branch isn't always certain about the necessary classification for some products. With its focus on Class B products, the FCC's 25 field offices and 13 nationwide monitoring stations are conducting spot-checks of electronics and computer retail stores. A survey last year indicated that about 30 percent of the devices checked—including various electronic devices such as cordless phones and FM receivers as well as computing devices—failed to meet the Class B standards. Placing a product in Class A or B "is something we try to stay away from from an enforcement standpoint," Casey says. "When a question comes up, we'll go back to the people who made the rules in the Office of Science and Technology and present the question to them."

Casey points to ignorance of the regulation, particularly at the retail level, as a primary reason for the 30-percent failure rate in compliance. When violations are found, the FCC issues letters of citation, which Casey describes as "mainly an educational step." The letters cite the violation, explain the regulation and offer the FCC's help if more clarification is needed. The letters also order a halt to the manufacture and sale of the illegal products and threaten fines—which can reach $2,000 per day per violation—if the letters of citation are ignored.

Manufacturers carry main liability

Although retailers, distributors and others involved in the sale and distribution of computer products can receive citations for handling products in violation of the FCC's rules, the main responsibility for complying with the regulations rests with the device manufacturers. "The manufacturer is the one responsible for verification," says Dash. "If you're anywhere else in the stream of commerce, including end user, you're not liable for FCC violations unless you know or have reason to know that the equipment is in violation." Dash notes, however, that no one can afford to be complacent about the FCC rules. "Some of the first marketing citations the FCC sent went to end users who had reason to know the equipment they owned was in violation of the rules," he says.

If manufacturers have labeled their equipment as conforming to the FCC regulations, other parties selling or using the equipment aren't expected to retest the equipment to ensure that the labels are accurate. System integrators who buy tested and labeled modules such as CPUs, printers and terminals and connect them to form systems also are not obliged to test the entire system. The FCC isn't overly concerned about the possibility that the connection of verifed devices into a larger system may result in a product that no longer meets specifications, says Knapp. "There is some risk involved that the entire system might not meet the regulation," he says. "But when you weigh that against trying to test every time you make one change in a device in a system, it seems like that's an unfair burden, considering the small risk involved." He notes, however, that integrators doing such work as building their own chassis and adding their own electronic components must perform RFI tests on their systems.

At HP, Baldwin says, "We feel that we have an obligation to OEMs to provide them with enough RFI data from our own measurements to help them in their design." Many of HP's OEMs weren't aware of the regulations or didn't understand their impact, he says, and HP has tried to inform these companies about the requirements. "We've already used our own test facilities to test some OEM products, and we will probably continue to do so," Baldwin says.

For companies such as DEC and HP, each with hundreds of products that fall under the FCC regula-

EMI REQUIREMENTS FOR CLASS A (INDUSTRIAL) EQUIPMENT

Radiation limits:	Frequency (MHz)	Distance (m)	Field strength (μV/m)
	30-80	30	30
	88-216	30	50
	216-1000	30	70

Note: Class A measurements may be made at any distance between 3 and 30m, if the test results are scaled inversely with the distance. For example, at 3M, the allowable field strength in the frequency range to 88 MHz would be 300 μV/m.

Conducted (power line) limits:	Frequency (MHz)	Maximum voltage (μV)
	0.45-1.6	1000
	1.6-30	3000

EMI REQUIREMENTS FOR CLASS B (MASS MARKET) EQUIPMENT

Radiation limits:	Frequency (MHz)	Distance (m)	Field strength (μV/m)
	30-88	3	100
	88-216	3	150
	216-1000	3	200

Conducted limits: From 0.45 to 30 MHz, the maximum voltage fed back to the line at any frequency must be less than 250 μV.

Source: Dash, Straus and Goodhue

tions, testing is tedious but manageable. And meeting the FCC limits has had no major impact on the price of products. "There have been no significant price changes because of the regulation," says DEC's Brown. At HP, Baldwin says, new products designed from the breadboard stage to meet the FCC limits usually do not cost any more than their predecessors. "But if you have an existing product you must modify to comply, it does cost more," he says. HP is allowing a few products to die prematurely rather than be retrofitted to meet the FCC spec.

One of the main functions Dash, Straus and Goodhue provides is consultation about how to modify products to meet the RFI limits, says company president Dash. "Most people come to us for inexpensive fixes," he says, noting that such fixes usually cost less than 1 percent of the selling price of the equipment. Class B device modifications sometimes cost 2 percent to 3 percent of the total price, Dash says, because the selling price for these products is much lower than that for Class A commercial products.

Manufacturers have many techniques to reduce the radiated and conducted power-line emissions of computers and peripherals. Brown explains that DEC chose to work at the cabinet level—adding metal shielding to the cabinets if necessary—rather than modifying the boards and modules within the cabinets. DEC has also implemented an I/O bulkhead, through which all cables entering the cabinet must pass. Because I/O ports are primary sources of RFI leakage, the I/O bulkhead design permits DEC to focus on just one opening to control the emissions.

Because they act as transmitting antennas, I/O cables themselves are the main source of radiation from computer systems. One approach to solving this emission problem is to use shielded cables, but these aren't always feasible, Dash says. "You need some direct connection between the shielded cable and the metal chassis—a 360-degree boot," he says. "There are a lot of cases where you can't use shielded cable because many connectors, such as ribbon-type connectors—don't lend themselves well to shielding." He also cautions that devices connected to the other end of shielded cables must also be shielded, because the cables shunt any CPU-generated radiation to the attached devices.

Manufacturers can employ filtered connectors instead of or with shielded cables. Filtered connectors cut the problem radiation on each lead conductor passing through the I/O connector. This solution can be expensive, however, especially for Class B devices. This is because, unlike shielded cable, as the number of leads increases, so do the number of filters and the cost.

A possible solution to the high cost of filters is capacitor array products, such as those marketed by AVX Corp., Myrtle Beach, S.C. A single array plate can have holes to accommodate as many as 100 connector pins, each of which is filtered. AVX claims an array capacitor costs only 25 percent to 30 percent as much as an equivalent number of individual tubular capacitor/ferrite filter pins. Dash agrees that the AVX arrays have great potential, but he says the company should also sell the array capacitors mounted in connectors, a task currently left to the purchasers of the arrays.

Another modification that reduces radiation at the board level is the use of board-level bypass capacitors. This is an inexpensive solution for personal computers, for which filters and shielded cables might not be practical, Dash says. A bypass capacitor has a lower impedance both back to the power supply and in radiation into space than the thin circuit wires they bypass. The bypass capacitors draw problem radiation from the circuit, and may eliminate the need for filters and shielding at the cabinet and cable level.

Blessing in disguise

Designers of new systems can sometimes avoid shielding and filtering radiation by reducing a circuit's current magnitude, reducing cable lead lengths and reducing a system's operational frequency. These design techniques, along with retrofit fixes, may have the added benefit of improving a computer system's operation, says Baldwin at HP.

"When we design products to have low emissions," he says, "we've found that errors in data and inexplicable bugs seem to be reduced." Baldwin says HP doesn't have any figures to support this, but that reports from divisional staffs indicate that a product's overall reliability improves with the RFI fixes.

Improved reliability may be the carrot that goes with the FCC's stick of fines and penalties, but either way, computer and peripheral manufacturers must soon meet the RFI regulations with all their products—new and old designs. Knapp at the FCC is understanding of those struggling to meet the deadline. "We're still in a start-up phase of the program, and it's such a large industry that it's natural there are people coming on board late," he says. "Eventually though, I think we'll see a very high rate of compliance.

Dash agrees, noting, "Two years from now, everyone will comply with this requirement. There won't be any problems. People will know what to do, and it will be absolutely routine. It's in getting from here to there that the problem lies." □

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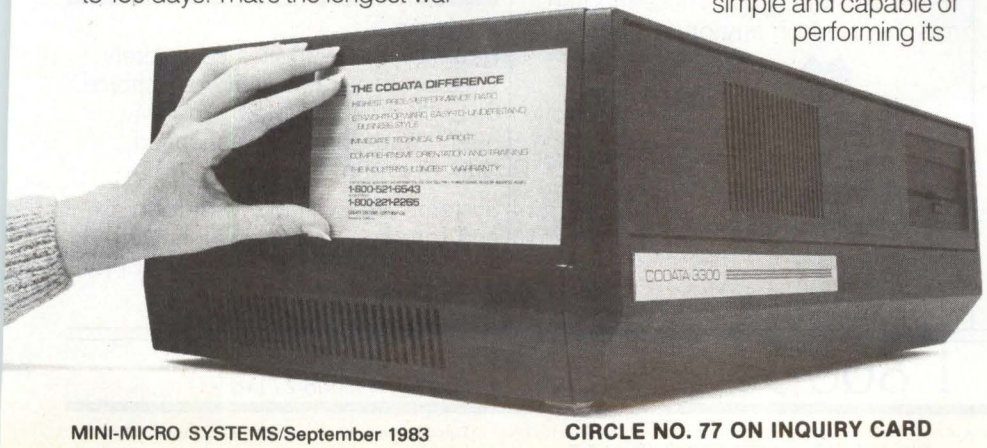

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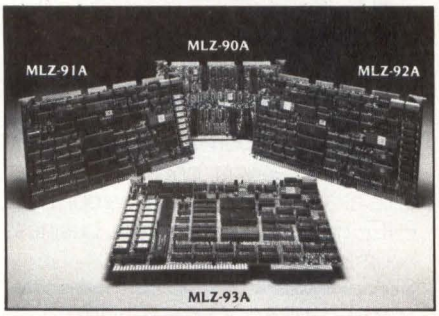

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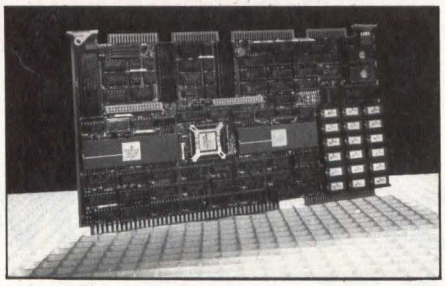

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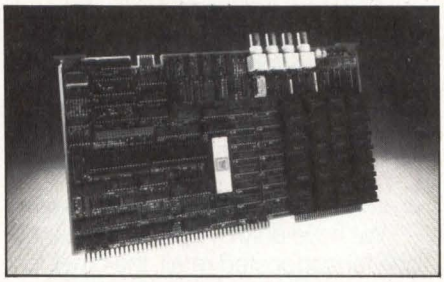

MLZ-VDC intelligent 640 x 480 x 4 color graphic controller based on the NEC 7220 controller chip with on-board Z-80 CPU, DMA controller, and user definable FIFO interface to Multibus.™ Users may display up to 16 colors from a 4K palette. Up to 1024 x 1024 x 3 interlaced also available.

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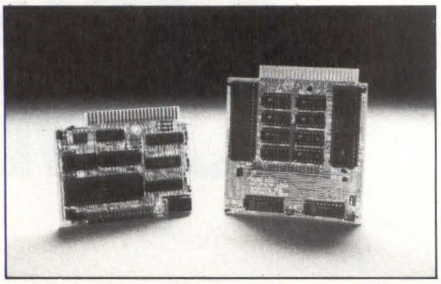

The SBX-FDIO can control up to four single or double sided, single or double density 5¼ inch or 8 inch floppy disk drives. A software toggle allows both 5¼ inch and 8 inch drives to be intermixed on the same cable!

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CIRCLE NO. 78 ON INQUIRY CARD

Automated material-handling systems streamline management of goods

By Sarah Glazer

Computer-controlled material-handling systems are the connective tissue between work centers in the automated factory. A quantum leap away from the days of wheelbarrows and forklifts, today's systems can automatically move goods through a factory, signal robots to start working or feed material into other automated machinery. And what may be more important, software in some material-handling systems can track inventory to a degree never before possible. Software can pinpoint the location of parts and finished products and also can share this information with manufacturing and accounting databases to improve their accuracy.

Ties between material-handling systems and other components of the automated factory, such as numerically controlled machine tools, flexible manufacturing systems and robots, are becoming more common, says Luis Chong, a senior consultant for research firm Arthur D. Little, Cambridge, Mass. "The major material-handling vendors are really pushing to integrate handling systems with other factory systems," he says. "The flexibility of the systems is increasingly due to the use of software and electronics."

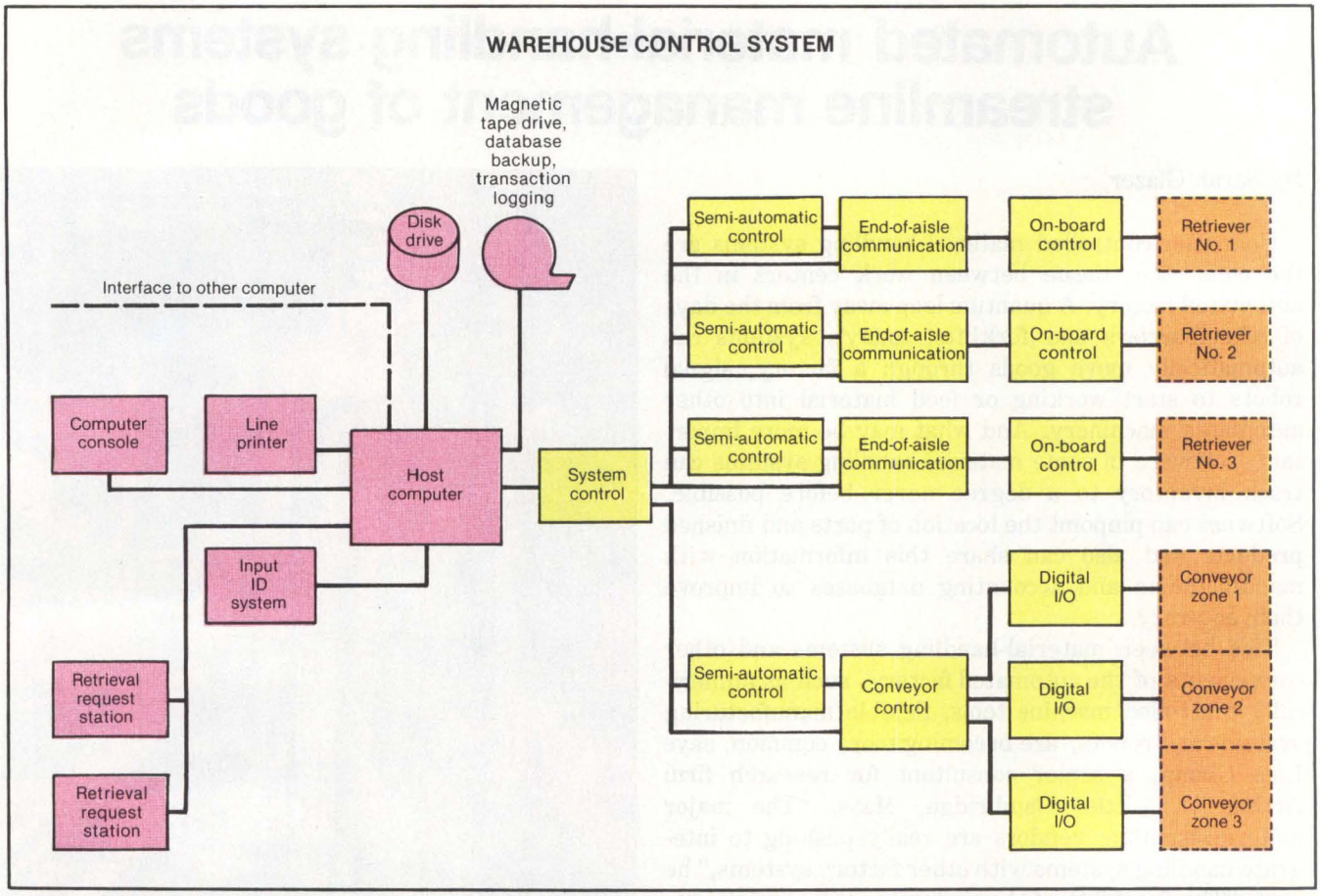
But moving goods within factories is only one application for computer-controlled material-handling equipment, claims industry analyst Mitchell Quain of the New York investment firm Wertheim and Co. An even larger market exists today in warehousing—about $500 million in 1983 compared to only $200 million for factory material-handling applications this year, he estimates. However, he predicts the relationship will reverse in the future and emphasizes, "The factory is the growth area, not warehousing."

The mini-load AS/RS *(like the one shown here) is considered by most suppliers of material-handling systems to be their most standardized piece of equipment. Yet marketing manager Roy Ferrari of Harnischefeger admits that software must be customized even for the mini-load. "I don't think we'll ever reach the point where we can say, 'Here's a standard software package,'" he says.*

Three categories of equipment

Although sophisticated material-handling systems often include several types of equipment, computer-controlled systems fall into three general categories: automatic storage-and-retrieval systems (AS/RSS), automatic guided-vehicle systems (AGVSs) and conveyors and monorails. Automatic storage-and-retrieval systems, used in warehouses and small storage areas, usually have rows of racks for storing material as densely as possible, reports Aaron Albert, vice president of RGTI Systems Software, New York, which specializes in material-handling software. Aisles in an AS/RS are just wide enough for a stacker crane, which moves on a track and can place goods into or pull them from the racks. They are typically available in two sizes. A full-unit version handles pallet-sized loads weighing about 6,000 pounds, while a mini-load version usually handles plastic trays measuring only 2 by 4 feet and weighing no more than 750 pounds. Mini-load trays are often partitioned to hold as many as 100 types of small parts.

"Saving space used to be the big selling point for stackers," remarks Albert, "but the real savings are in knowing where things are." In addition to controlling



This warehouse-control system *has three main components. The group of blocks at upper right represents a storage-and-retrieval system. The blocks at lower right represent a conveyor system. The two systems are integrated at the system-control block (center) and are controlled by the host computer (near the center of the third group of blocks). The host computer in this system is a minicomputer, dedicated to the warehouse-control operation but able to communicate with a central mainframe. (Source: Jervis B. Webb.)*

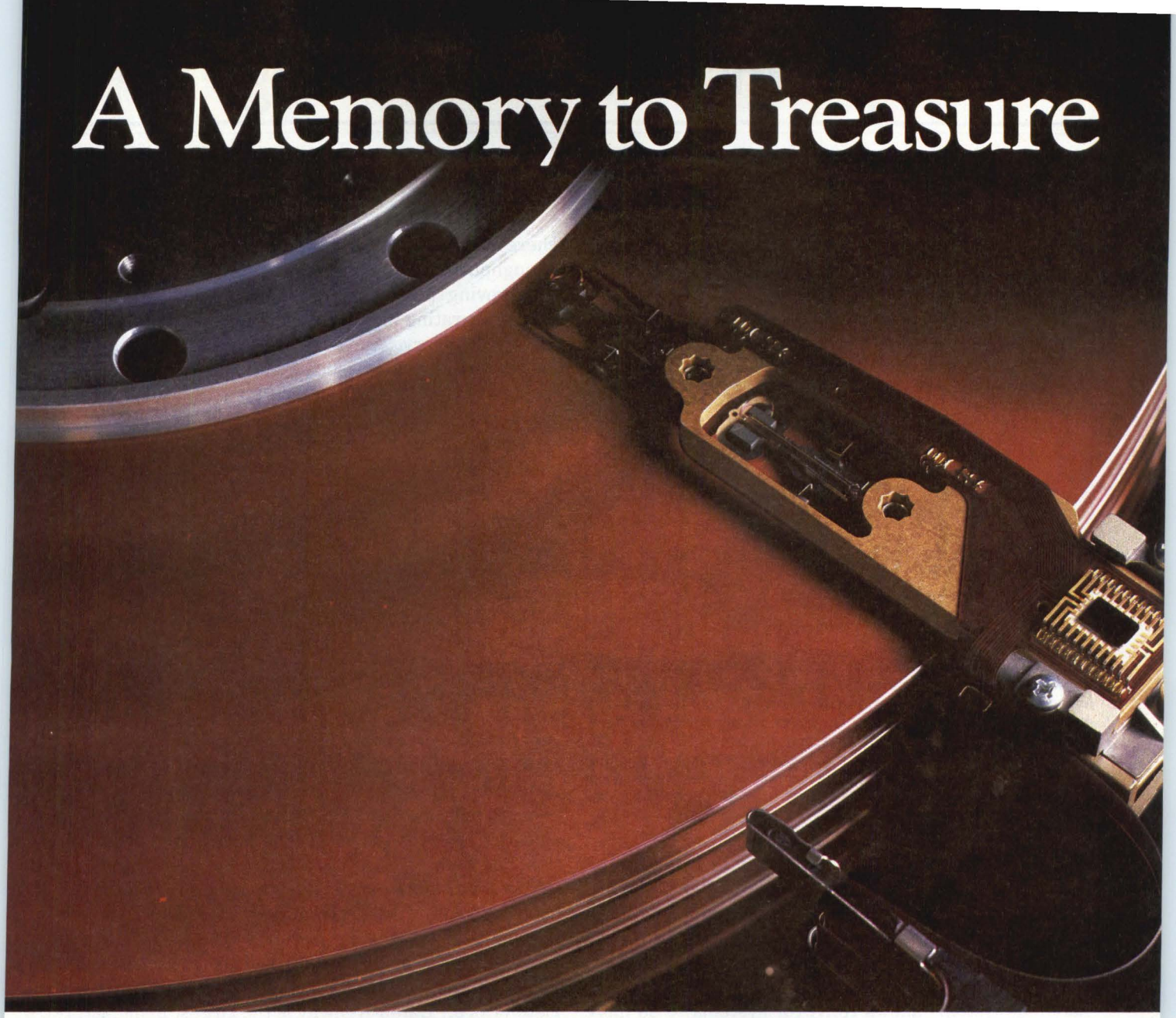
the movements of the stacker, the microcomputer or minicomputer—depending on the system's size—may store an inventory database, he explains. The database can be tied directly to mainframe databases for manufacturing and financial planning. Many companies want a material-control system integrated with overall business planning rather than just a modern warehouse, Albert reports.

The second type of computer-controlled equipment, automatic guided-vehicle systems, carry goods around both warehouses and factories. "AGVSs can have a lot of intelligence," contends Dick Hays, an engineering manager for SysteCon Inc., Duluth, Ga., a material-handling consulting firm. This intelligence can be in the form of sensors on the vehicle that tell it, for example, when to pick up a load or if an obstruction is in its path. The intelligence can also reside in a central computer that integrates the functions of the vehicle with those of an AS/RS or an automated assembly line.

Vehicles run on tracks, follow the path of a reflective chemical painted on the floor or are radio or microwave controlled, says Blake Flint, president of Barrett Electronics, Northbrook, Ill., a leading manufacturer of AGVSs and a subsidiary of Mannesmann AG, Düsseldorf, Germany. Flint explains that AGVSs can be dispatched manually or by computer control and can be monitored on a CRT in a foreman's office. SysteCon's Hays believes that an AGVS, more than any other single piece of equipment, can most easily raise a company one level in automation. "It can go into an existing environment," he explains, "and can span distance relatively cheaply."

The third category of equipment, conveyors and monorails, can be quite intelligent, says George Ramsden, vice president of sales for Jervis B. Webb Co., Farmington Hills, Mich., a leading manufacturer of conveyors. "Power-and-free conveyors operate like a railroad with switches," he explains. "You can direct

A Memory to Treasure



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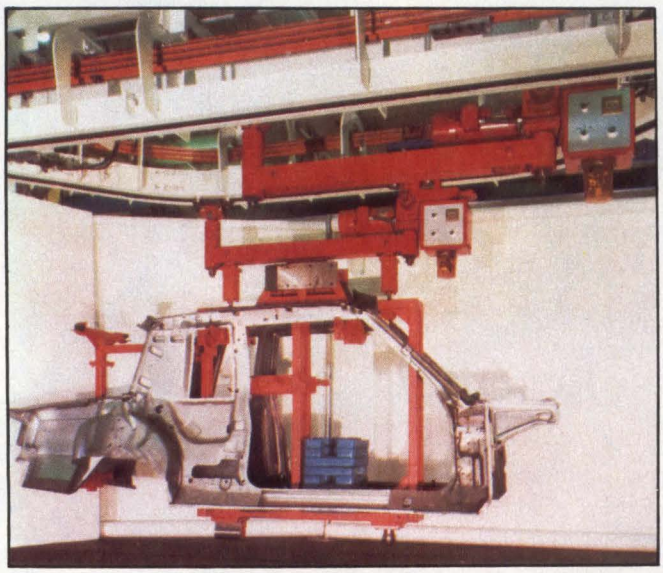

This overhead, power-and-free conveyor system, *typical of material-handling systems installed in factories, could be used with manual or automated assembly lines. Most assembly includes some manual work, says George Ramsden, of Jervis B. Webb Co. "Although the assembling of some rather sophisticated office equipment is now being done without any human hands, it requires a lot of robots—and a lot of volume to justify a lot of robots," he adds.*

individual loads to different locations, all under computer control." This sometimes involves automatic identification systems such as bar-code readers that scan coded labels to sort goods as they move along the conveyor. Integrating information-handling and material-handling systems allows conveyor systems to do more than move material, says Ramsden. Now they can "have material in the right place at the right time," he adds.

Factory-automation support structure

Manufacturing philosophies have changed radically over the last 10 years, contends Edward Budill, president of Hartman Material Handling Systems Inc., Victor, N.Y., a division of Allis-Chalmers. Rather than optimizing a process with backup inventory, he explains, "Today, there's a strong emphasis on reducing inventory." But without a cushion of parts and subassemblies, the availability of materials at every point in the manufacturing process becomes more crucial than ever. "If you're going to spend money for flexible manufacturing systems and so forth, you're a fool not to put in a sophisticated material-handling system to support it," Budill says. He agrees with industry estimates that materials in a factory are in process 5 percent of the time and are handled or stored where material is between operations, you will increase throughput," Budill maintains.

Improving methods for material handling may require integrating handling equipment with other automated machinery. An AGVS can take material from a stacker crane in a warehouse, carry it to the factory floor and signal a robot to pick up a part and place it into a numerically controlled machine tool. After the part is machined, the robot takes it off of the tool and puts it back on the carrier, which then moves it somewhere else.

Material-handling equipment suppliers are usually responsible for providing the interface between systems, says Ramsden of Jervis Webb. They sometimes provide software used by the robot or the machine tool in the interface, but more often they merely send a signal that material is in place, he explains. Even with the simpler task, Ramsden sees the lack of communication standards in the factory as a problem. "We've worked with a number of different robot companies, and we have to work with every one differently," he says. Hartman's Budill notes that AGVSs also lack standards. Hartman doesn't manufacture its own vehicles but often includes them in systems. "We must approach every AGVS vendor as a new job in integration," he says.

Factory automation's biggest impact on the material-handling industry is in reducing the size of storage systems and tying them closely to the manufacturing process, says Scott Grover, product manager for AS/RS at Eaton-Kenway, Salt Lake City. A subsidiary of Eaton Corp., Eaton-Kenway is the largest manufacturer in the overall material-handling market, according to Wertheim and Co. "As more factory automation takes place, we see smaller storage segments being integrated with manufacturing centers rather than big $20-million storage centers like we built in the past," says Grover. A small storage segment might consist of a two-aisle AS/RS for storing subassemblies and the raw material that will be added to them at the next stop on the assembly line.

The tie-in between storage systems and assembly or manufacturing systems has led to the use of fault-tolerant computers (which contain redundant circuitry to prevent breakdowns) in some material-handling systems, says Webb's Ramsden. "We get quite a few requests for fault-tolerant systems," he says. He believes this stems from the trend toward small inventories. Albert of RGTI agrees: "Once you've pared inventory down to a half-day supply, it's very important to have access to it." This is one reason he calls integrating material handling into the automated

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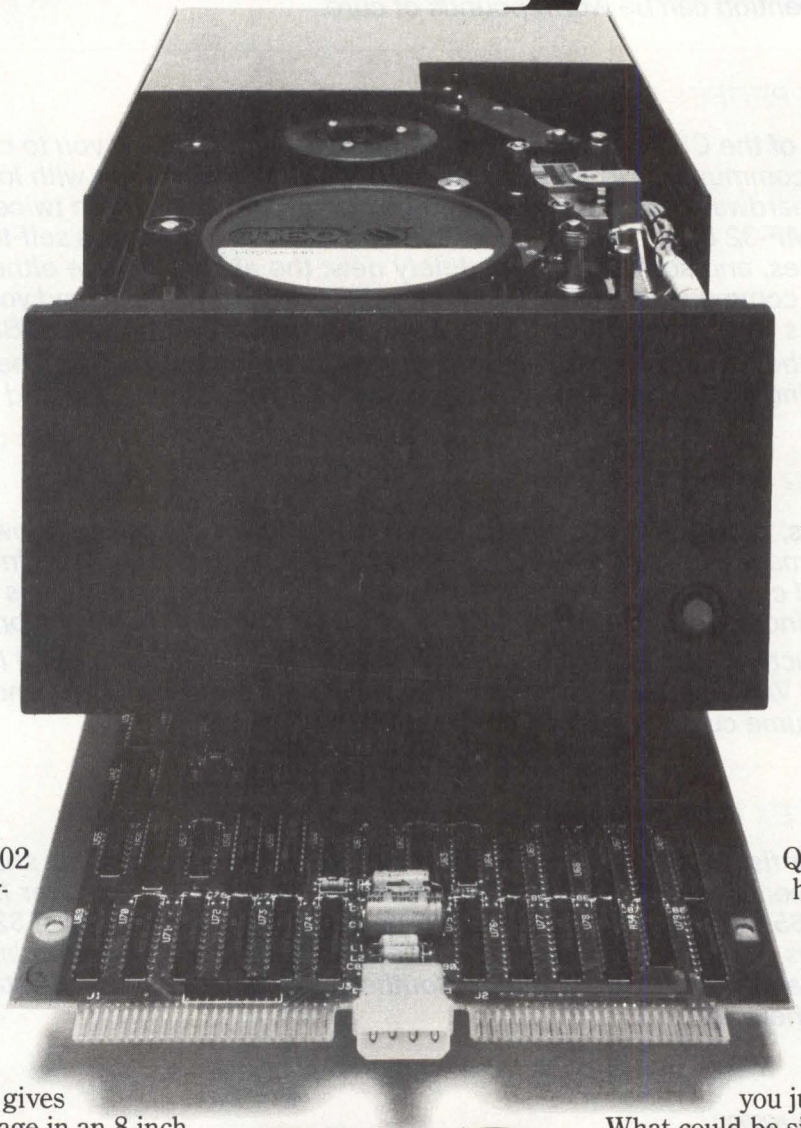

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factory "an extremely rigorous computer application."

Although many systems are highly automated, some facets of material handling are not. One such job, picking small parts out of trays and bins, is almost always done manually, says Roy Ferrari, a marketing manager at Harnischefeger Corp., Milwaukee. He describes a factory in which kits are assembled to be transported to points on an assembly line. A database specifies the contents of the kits and directs a stacker crane to remove bins from storage automatically and take them to one location. But removing the parts and labeling the completed kit is done manually. Vendors of robots with vision capabilities have produced systems with some bin-picking skills (MMS, November, 1982, Page 201).

For some jobs, however, Ferrari says, "you still need people all the way along the line." Albert of RGTI notes that some computer-controlled stacker cranes are designed so that a person can ride them and reach into bins to remove the parts listed on a CRT.

Sharing data with the front office

In the factory described by Harnischefeger's Ferrari, front-office software for material requirement planning orchestrated the assembly of parts kits. The MRP software knows the products to be worked on in an upcoming week, explains Ferrari, and passes the lists of parts needed to the minicomputer that controls the storage system. This integration (called closing the loop in MRP), in turn, makes the overall MRP system more accurate. Rather than operating on the assumption that its requests are carried out, the MRP system can base its data updates on what actually happens.

Many sophisticated systems that integrate several kinds of material-control equipment are directed by high-level computer control, says Lloyd Robertson, vice president of marketing for Litton Unit Handling Systems, Florence, Ky., the material-handling division of Litton Industries. "Just recently, we've done two jobs that included doing the MRP system for a host computer," he says. He admits that doing such complex software is unusual for Litton.

Arthur D. Little's Chong believes most closed-loop MRP systems are still on the drawing boards. "We have seen some MRPs with pick lists," he says. "The technology is here, but not too many companies are actually doing it."

Material-handling computers may also share data with front offices for accounting, as does the minicomputer that controls a food warehouse described by SysteCon's Hays. This minicomputer also communicates with a mainframe that gathers sales orders from information relayed by salesmen through touch-tone telephones. The mainframe checks a customer's credit rating, verifies the shipping address and then sends the order to the warehouse minicomputer, he says. When the order has been automatically pulled and a laser scanner has told the minicomputer the cartons are loaded on a truck, the mini prints an invoice and relays this information to the mainframe, he continues.

This information sharing makes warehouses more efficient, but advances in warehousing software itself are also leading to change, says Hays. "If a computer can recognize where each load of a product is in a warehouse, that saves both time and space," he says. Rather than reserving part of the warehouse for each type of product, the computer can direct each load to the first available slot. "Computers are making warehouses smaller," Hays says with their "ability to locate a product anyplace, know where it is and track it."

Software remains a problem

Even though advances in software make material-handling systems more useful, producing the programs is a problem because almost all systems are customized. "You can't clone the systems," says Robertson of Litton. For software that directs equipment, "you'd be lucky to have 50 percent in common between two companies," he estimates. He believes there is almost no common ground in inventory-control software.

Grover of Eaton-Kenway says his company tries to develop software modules to use as building blocks, such as one that controls conveyor tracks. "But if a J.R.

LEADING SUPPLIERS OF AUTOMATED MATERIAL HANDLING SYSTEMS

	AGVS	Unit load AS/RS	Miniload AS/RS
Allis Chalmers (Hartman)		x	x
Clark	x	x	x
Conco Tellis	x	x	
Eaton-Kenway	x	x	x
Harnischefeger		x	x
Lear Siegler	x	x	
Litton UHS		x	x
Mannesmann (Barrett)	x	x	x
Munck		x	x
Portec	x		
Raymond	x	x	
SPS Technologies	x	x	x
Jervis B. Webb	x	x	

Source: Arthur D. Little

Case or an IBM asks for an off-the-shelf software package, it doesn't exist," he says, "because J.R. Case and IBM operate so radically differently from each other."

The labor costs of producing software are becoming a greater portion of overall system cost as well, say most industry observers. "When you include the cost of software," says Ramsden of Jervis Webb, "the percentage of cost of the control system has increased a great deal over the years."

In addition, software is the source of a persistent problem in the material-handling industry: late deliveries of systems. Suppliers acknowledge that debugging software causes most delays. "Delivery is a big part of being successful in this business," says Litton's Robertson. With penalty clauses that withhold money until a system is up and running, he adds, "software debugging is always a big part of your money in a contract."

Hartman's Budill thinks the nature of programming makes it prone to delays. "People can think just so fast," he says, noting that writing software is primarily manual. "You can't just throw money at programming if it is behind," says Budill. "It's not necessarily productive to add more people at a later stage."

Arthur D. Little's Chong points out that despite the persistence of late deliveries, producing software is getting easier as suppliers grow more experienced. "In the beginning, software was one of the big stumbling blocks," he says. But attempts to create reusable software modules are helping. "We see a trend toward more standardized software," Chong says. He adds that this more than anything else will reduce the problem of being unable to deliver systems on time. □

LOOKING AHEAD IN MMS

Be sure to watch for these editorial highlights in coming issues of Mini-Micro Systems.

- The November issue will include MMS's annual report on computer terminals.
- MMS's Fall issue of Peripherals Digest will also appear in November.

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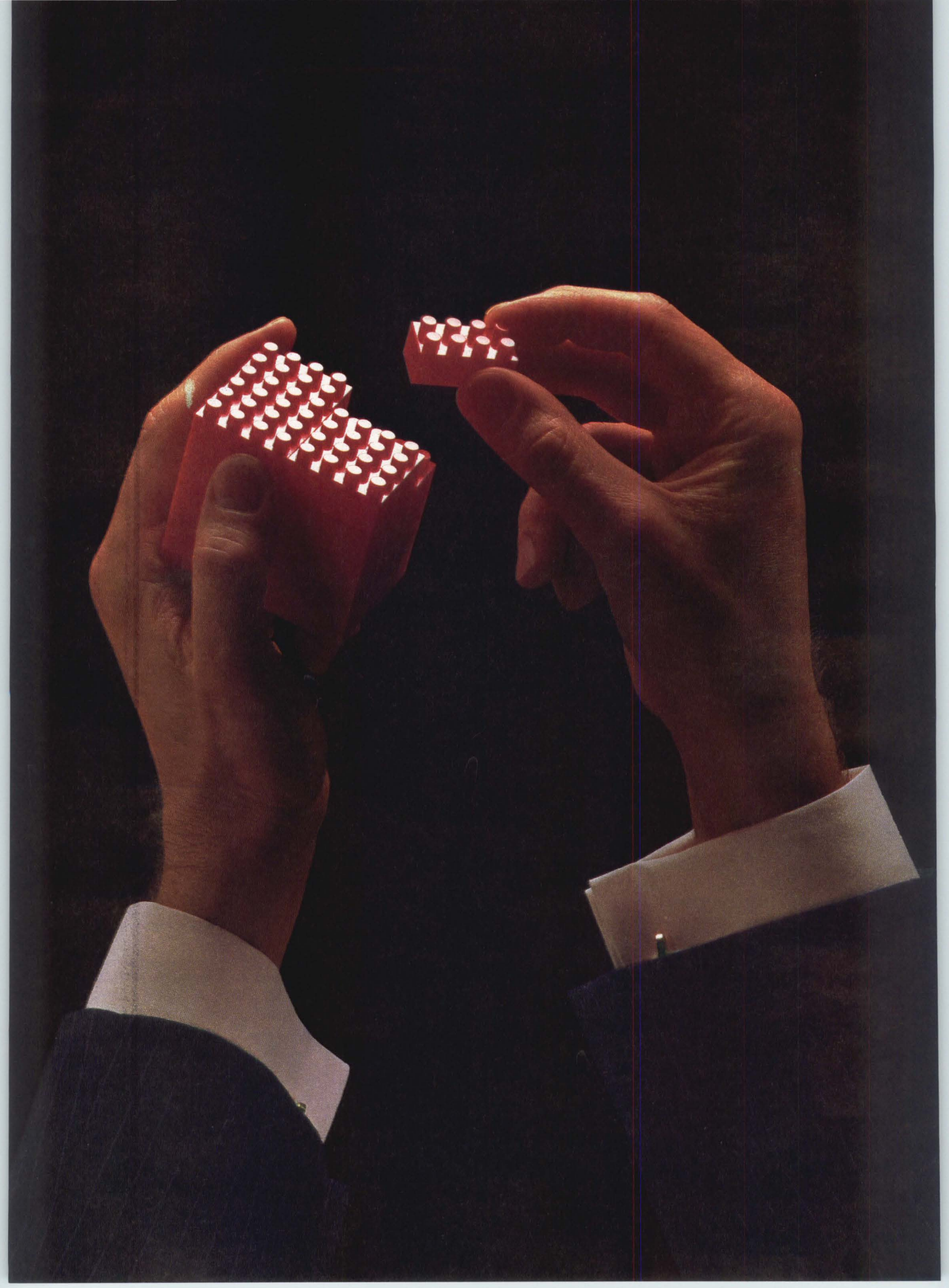

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Open Systems also means that future products will fit quite nicely into our present distributed processing systems. So growth-path compatibility and product upgrades should be a snap.

You'll also be positioned to take advantage of breakthroughs in VLSI, while your competition is still toying with the idea.

When you put it all together with Intel Systems, it clicks: lower risks, shorter schedules, state-of-the-art performance, easier customization, future compatibility, and a solid place to put your money.

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Whether you're the president of the company, or just a kid on the way up.

To learn more about Intel's Open Systems, attend one of our Executive Seminars. Call us at (800) 538-1876. In California, (800) 672-1833.

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THIS IS NOT THE MOST AMAZING PART.

By any measure of modern achievement, a nine-pound, 16-bit, battery-powered business computer is quite amazing. The attachment of a five-pound correspondence-quality printer makes it even more so.

The Gavilan mobile computer is the first ultra-portable system designed for complete field automation. It lets professionals on the move type, compute, store, recall and print hundreds of pages of information practically anywhere, without the need for electrical hook-up or external battery packs.

BUT THIS IS.

The key to the Gavilan's success as a stand-alone mobile computer lies below its surface. The Gavilan operating system has made possible two advancements that make it the first completely viable computer for mobile professionals.

The first is its fully integrated software. Yes, fully integrated. Its CapsuleWare™ software programs are contained within storage capsules that plug interchangeably into the computer.

No other microcomputer offers the degree of software integration afforded by the Gavilan shared data format of CapsuleWare.

The complete set of CapsuleWare programs includes CapsuleWord™ word processing, CapsuleCalc™ calculation & analysis, CapsuleOffice™ portable secretary, CapsuleComm™ communications and CapsuleForm™ forms processing.

Secondly, the Gavilan's primary user interface is not the keyboard, but instead, a built-in pressure-sensitive touch panel that not only selects, but executes, commands. With the full capabilities of a mouse, this simple "point and tap" interface all but replaces the keyboard in normal computing operations.

For the end user, the combination of these two features totally eliminates the need to key-in complicated computer commands to enter and exit separate programs, and manipulate menu items or data.

For the value-added OEM, this means being able to establish a totally new market niche with a uniquely competitive product.

LEAVE YOUR COMPETITION BACK IN THE OFFICE.

Suddenly, the practicality of the Gavilan system is creating a demand for vertical market software packages from the widest diversity of mobile professionals ever—from field auditors to field correspondents, sales representatives to service representatives, insurance agents to industrial engineers, architects to anthropologists.

The ability to write and print-out reports and letters, send and receive electronic transmissions, work up a spreadsheet analysis or simply store vast quantities of data in the field is capturing the imaginations of professionals who never before considered a computer a viable working tool away from the office.

SOFTWARE IN A CAPSULE— A POWERFUL NEW INNOVATION REWARDS UNLIMITED DEVELOPMENT OPPORTUNITIES.

The Gavilan mobile computer was built for the broadest range of applications program development. Programs can be written by OEMs or end users. In MS/DOS or Gavilan's own operating environment. On 3½" microfloppy diskettes or CapsuleWare.

So whether you're an end user or an OEM, we've made it amazingly easy for you to take the next step in hardware and software: mobile computing.

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CIRCLE NO. 85 ON INQUIRY CARD

IBM's largest educational grant is aimed at upgrading manufacturing technology

Citing what company chairman John R. Opel calls a critical need to improve American manufacturing technology, IBM Corp. has launched a $50 million program consisting of hardware donations and educational grants to graduate schools of engineering. The program—IBM's largest single contribution to educational institutions—includes $40 million worth of IBM 4341 computers, CAD/CAM workstations, peripherals and software. The remaining $10 million is in the form of cash grants to five as-yet-unidentified universities to develop graduate engineering curricula in manufacturing automation. "America must improve its productivity to compete in worldwide markets, therefore, American engineers must design products for lowest cost, highest quality manufacturing," Opel says. He adds that current university CAD/CAM equipment is obsolete. Dr. Lewis M. Branscomb, IBM vice president and chief scientist, explains, "The United States has leadership capability in this area, but the universities are having a difficult time responding quickly enough to changing manufacturing methods, and the problem is exacerbated by antiquated equipment."

With IBM equipment and software donated by major CAD/CAM software houses, the 20 universities in the program can develop programs to train graduate engineers in manufacturing and design methods and to help advance manufacturing engineering. "In addition to teaching current methods, the program will embed the concept of interdisciplinary manufacturing methods in university curricula, pressing the bounds of the technology," Opel says.

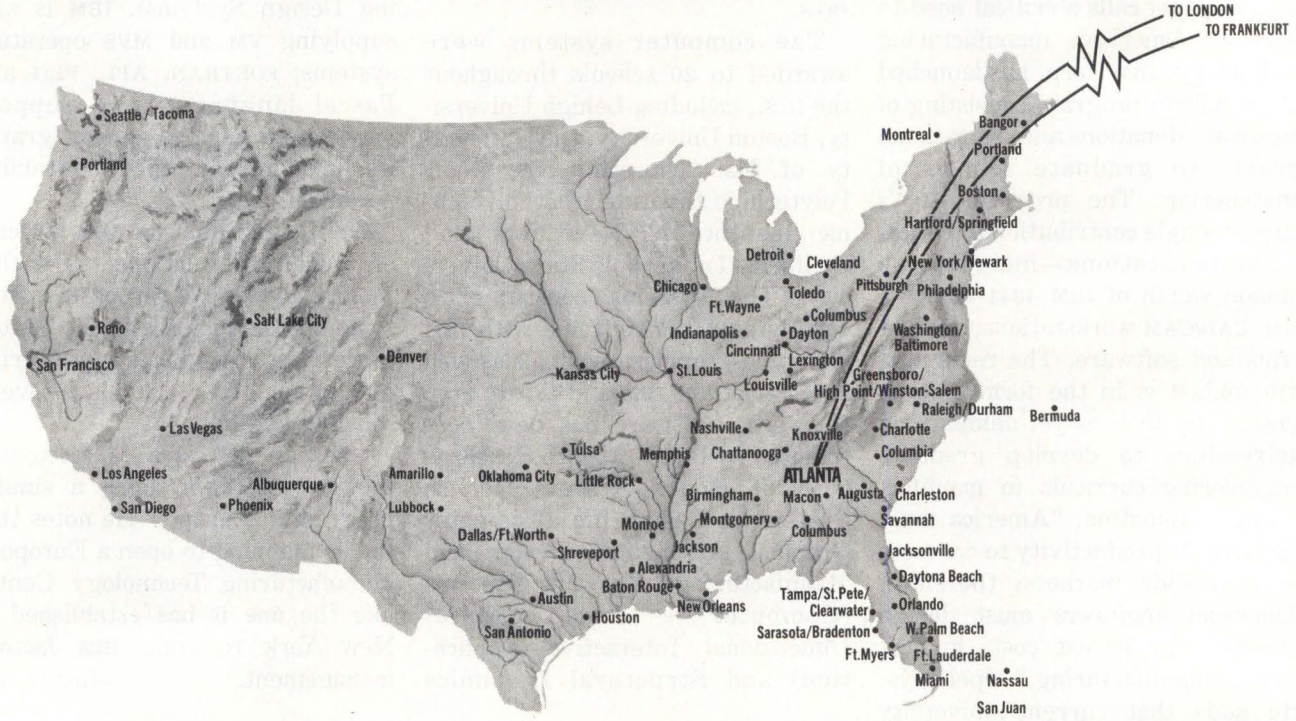
The computer systems were awarded to 20 schools throughout the U.S., including Lehigh University, Boston University, the University of Massachusetts, Rensselaer Polytechnic Institute, the Polytechnic Institute of New York and California Polytechnic State University. The systems consist of a 16M-byte 4341 mainframe with IBM disks and graphics terminals as well as a variety of IBM and third-party software. Software has been contributed by Bell Northern Research (Circuit Board System Design System 2), Cadam Inc. (Computer Graphics Augmented Design and Manufacturing), Dassault Systems (Computer - Aided Three-Dimensional Interactive Application) and Structural Dynamics Corp. (Computer Aided Engineering Design Systems). IBM is also supplying VM and MVS operating systems; FORTRAN, APL, PL/1 and Pascal languages; and support applications such as general graphics, development, office and training packages.

Dr. Louis Robinson, IBM director of university relations, says that IBM received 172 proposals from some 200 universities in the United States with graduate engineering programs after proposals were solicited last fall.

Opel says, "We are still discussing the possibility of doing a similar program in Europe." He notes that IBM is planning to open a European Manufacturing Technology Center like the one it has established in New York to train IBM factory management. —*Geoff Lewis*

CAD/CAM equipment *supported by IBM 4341 mainframe computers is part of a $50 million educational contribution IBM is making to U.S. universities to upgrade graduate engineering programs in manufacturing technology.*

DELTA'S MAPPED OUT A WAY TO SOLVE 10,000 OF YOUR CARGO NEEDS.



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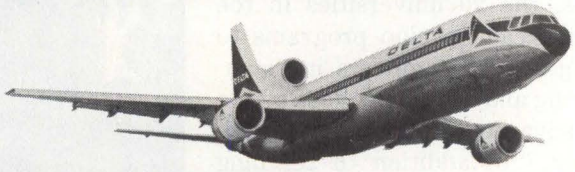

DELTA AIR CARGO. READY ALL·AROUND.

HP and Fluke introduce microcomputers for factory testing

Tagged as instrument controllers, new microcomputers from Hewlett-Packard Co., Fort Collins, Colo., and John Fluke Manufacturing Co., Everett, Wash., are rugged enough to control test equipment in factories, say their manufacturers. The HP Series 200 model 20 is based on Motorola Inc.'s 16-bit microprocessor, the MC68000; the Fluke 1722A is based on Texas Instruments Inc.'s 16-bit chip, the TMS 99000. Each computer can be rack mounted and has slots for connecting instruments and optional bubble-memory cards for harsh environments. Each also has controls designed for unskilled operators.

The Fluke 1722A has a touch-sensitive panel—a clear overlay in front of the 9-inch graphics CRT screen. The panel's 60 fingertip-sized areas can be programmed so that an unskilled operator can run a test system directly from the display, says product manager Mark Mullins.

In addition to the standard 64K bytes of RAM, optional memory cards can be plugged into any of five option slots to provide a maximum of 2.6M bytes of RAM. Optional communication cards, each with two interfaces, can be plugged into three of the five slots for connecting test instruments. One IEEE-488 port and one RS232C port are standard, and bit-parallel interfaces are available.

Bubble-memory cards in increments of 256K or 512K bytes can provide as much as 1.3M bytes of non-volatile file storage. Other mass-storage options are a 400K-byte floppy disk and a Winchester

A COMPARISON OF MICROCOMPUTERS USED FOR INSTRUMENT CONTROL

Unit	Memory: RAM standard, bytes (maximum)	Mass storage, bytes (options)	Standard interfaces (options)	Languages	Software packages	Price*
Instrument controllers						
Fluke 1722A	64K (2.5M)	400K floppy (512K bubble, Winchester)	IEEE-488 RS232C (bit parallel)	BASIC FORTRAN, assembly	Calibration, data acquisition	$8,000
HP Series 200 Model 20	640K (7M)	(Single and dual 270K microfloppies 527K floppies, 5M Winchester, 128K bubble, 256K EPROM)	IEEE-488 (RS232C, bit parallel)	BASIC, Pascal	Engineering, management	$8,700 ($10,220 with 5¼-in. floppy disk drive)
HP Series 200 Model 16	128K (768K)	Dual 270K microfloppy (270K microfloppy; 400K, 1M floppies; 5M Winchester)	IEEE-488 (RS232C, parallel)	BASIC, HPL Pascal FORTH	Engineering, management	$7,385
IBM 9000	384K (5M)	(327K, 1M floppies; 5M, 10M Winchesters)	IEEE-488, RS232C, bit parallel	BASIC, FORTRAN, Pascal, assembly	Laboratory	$7,905
General purpose						
DEC Micro PDP-11	256K (4M)	400K floppy, 10M Winchester (10M hard disk, floppies, tapes)	RS232C (IEEE-488, parallel)	BASIC, FORTRAN, Pascal, assembly, COBOL, others	Management, engineering, database, networking	$12,000
IBM PC	64K 640K	320K floppy (10M Winchester)	RS232C (IEEE-488)	BASIC, FORTRAN, Pascal, assembly, others	All kinds	$3,900

Source: HP for Series 200 model 20; Fluke for all others

*For base units with ASCII Keyboard, display, IEEE-488 interface, BASIC and mass storage as described.

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They're available in either DEC®- or Multibus®-compatible versions. And there are lots of advantages to both.

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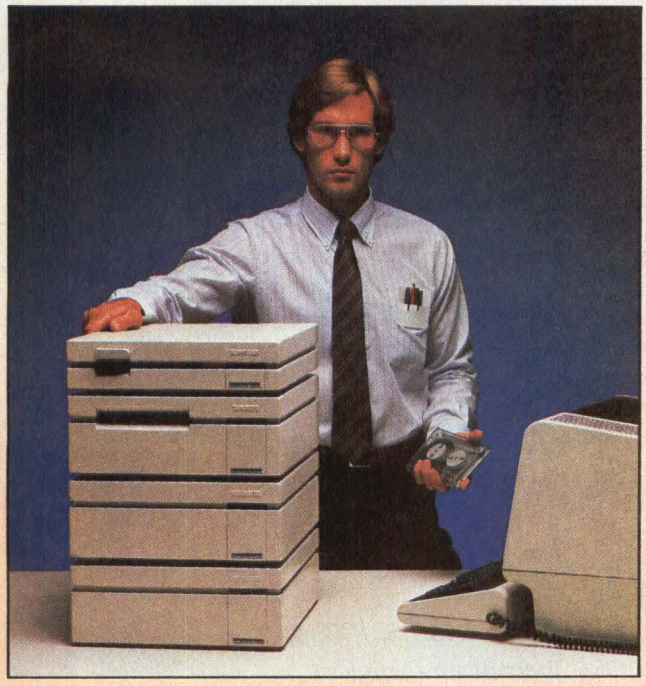

Either way you get greater flexibility to configure just the right system. And the easy upgradability to expand it whenever you like.

But perhaps one of the most important advantages is that you can protect your software investment—and your customers'—because inside, you're still selling the same system. You'd just never know it to look at it.

Which brings up another point.

Underneath that slick, compact exterior is the very latest in storage technology. 8" slimline floppy drives. High capacity, highly reliable 8" Winchesters. Compact ¼" cartridge tape drives. And the best high performance controllers in the business. (Packaged systems are also available without controllers at your option.)

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But you just watch. You start marketing your systems in our StacPac modules and your competition will say you have an unfair advantage.

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A FULL CAST OF STAR PERFORMERS

The Esprit product line has the right performer for every terminal role. It begins with *Esprit I,* an editing terminal at a conversational price. This basic Esprit presents crisp, clear video in comfortable green phosphor on a 12" diagonal screen. The integral typewriter keyboard has a 14-key numeric pad with alternate function key modes. *Esprit II* delivers additional editing features, plus the convenience of a detached keyboard; enhancements you'll appreciate in data entry. *Esprit III* meets a wide range of terminal applications. It costs much less than a TVI 925, but gives a significantly stronger performance including line drawing graphics, a broad repertoire of video attributes and editing commands, 22 user definable function keys and an optional 4-page display memory. *Esprit III COLOR* delivers the full Esprit III performance in eight brilliant colors.

There's an Esprit that's ready to star in all your terminal roles. Auditions are being held by your Esprit dealer right now.

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disk that will be available in mid-fall.

Interpreted BASIC is standard, and compiled BASIC, FORTRAN and assembly language are available options. The 1722A will also run programs from disks developed on the 1720 instrument controller, Fluke's earlier microcomputer, based on TI's 8-bit chip, the TMS 9900.

Prices for the 1722A start at $7,450, and volume discounts are available to both OEMs and end users.

The HP Series 200 model 20 has features such as the 32-bit internal architecture of the MC68000 and built-in I/O drivers that make it well-suited to instrument control, claims product manager Yoshio Kano. It has 15 option slots, eight for memory cards only, which expand internal memory to 2M bytes, and seven more for either memory cards or communication interface cards. By using the HP 9888A bus expander, a user can access as many as 31 slots, increasing memory to more than 7M bytes and the number of interface slots to 24. Communication support for IEEE-488 interfaces is standard, and support for RS232C and bit-parallel interfaces is optional, says Kano.

HP also offers an EPROM card and programmer board for use in harsh environments. For execute-only applications, the EPROM card allows 256K bytes of code storage.

Users have a choice of two keyboards or can design their own keypad for dedicated applications by using a custom keypad interface card. Another interface card lets users transfer data from an HP hand-held or portable computer.

Either a 9- or 12-inch CRT terminal is available as are single and dual floppy-disk drives in 8-, 5¼- and 3½-inch formats. Also available are Winchester disk drives.

According to HP, programs written on other Series 200 computers will run on the model 20. The instrument controller also supports the HP Shared Resource Management network and can share data and peripherals with the HP 9845, the HP 9000 and other Series 200 products.

With the CRT terminal and the keyboard only, the model 20 has a base price of $6,035. The model 20S development system, which also includes 512K bytes of additional RAM and BASIC and Pascal languages, is priced at $8,700. Disk drives, operating software and other peripherals are extra. Discounts are available for OEMs and end users.

— *Sarah Glazer*

The HP Series 200 model 20 instrument controller *is an addition to the company's family of MC68000-based microcomputers. Among the product's specialized features for instrument control are multiple option slots for connecting instruments, an optional bubble-memory card and an EPROM card for use in harsh environments.*

Infosphere unveils software-development system for industrial applications

A real-time development system for Digital Equipment Corp.'s Falcon SBC-11/21 computer and intended for industrial applications was announced by Infosphere Inc., Portland, Ore. Called Sphere, the system supports program development for such applications as robotics, data acquisition, computer-aided testing, system diagnostics and process control and monitoring.

The Falcon, introduced by DEC less than two years ago, is a 16-bit single-board computer that uses the T-11 processor, supports the PDP-11 base-level instruction set and has an LSI-11 bus interface.

David Sharon, vice president of marketing at Infosphere, notes that Sphere cuts typical costs of hardware and software to develop application programs for the Falcon from $50,000 to less than $5,000. He adds that Sphere also helps reduce software-development costs by cutting the number of steps a programmer must take to generate a program. "We view the Falcon as a nice board, performance-wise," says Sharon. "But we thought that a lot of systems houses and OEMs wouldn't be able to afford it because of the huge hardware and software investment that was needed to develop applications."

Typical systems used to develop software for the Falcon require users to generate programs on a $30,000 DEC LSI-11/23 computer, notes Ron Braithwaite, a technical-support manager at Infosphere. He adds that once generated, programs must be tailored for Falcon implementation using $10,000 to $20,000 worth of software that includes emulators, cross compilers and cross assemblers.

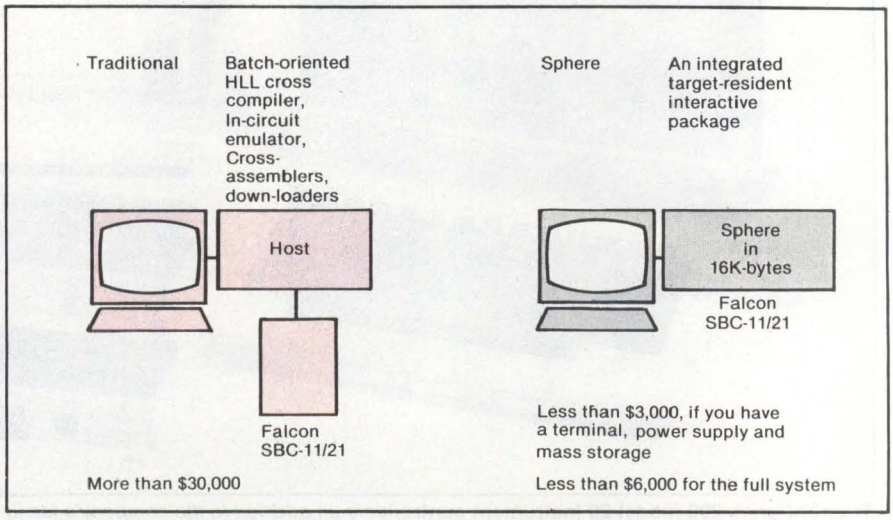
Using Sphere, programmers develop software directly on the Falcon without using the host. In addition, the system cuts software-development time by allowing users to detect errors interactively during development through line-by-line debugging and implementation. The application program developed with Sphere can be placed in PROM after compilation and testing. Changes can be implemented by programming a new PROM and, as a result, program maintenance can be accomplished at the application site. "We're providing all the tools so that a user can develop his application, debug it, burn it into PROM and then run it all on the Falcon," notes Braithwaite.

Sharon says that because Sphere is intended for development of real-time software, it is suited for industrial software development. Industrial systems, he claims, must constantly monitor whether events have occurred on the factory floor—whether a valve has been turned on or off, for instance—and react to disruptions in the production process. Because real-time software constantly checks resources, it can interrupt tasks and execute programmed subroutines in unusual situations.

Two Sphere configurations are available. The Falcon Sphere development system is priced at $6,695 and includes a Falcon computer, a VT103 terminal, a power supply, a mass-storage unit, the Sphere programming license, an I/O and memory expander, 16K bytes of user RAM, an I/O distribution panel, an EPROM programmer, a four-slot backplane, a manual and technical support. The less expensive Falcon Sphere programmers kit, priced at $2,995, includes only a Falcon computer, the Sphere programming license and development aides.

Infosphere has installed 30 Sphere systems for such companies as Kimberly Clark, Union Carbide and DuPont.

—Frank Catalano



By developing software directly on the Falcon, *Sphere users can save both time and money compared to developing programs first in a host.*

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The keys to your success, now and for the future, are flexible systems with a breadth of languages that protect your software investments. These languages save you time, minimize effort, and give you a powerful tool, particularly useful for the many end users looking at updating their hardware.

Considering all this; consider the Pixel 80. Not only do we have a catalog of programming languages and developmental aids that is unmatched in the 68000-Unix™ world, we have a wide range of data base management systems, word processors, spread sheets, and ready-made applications packages.

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LOOK TO THE FUTURE.

Something to consider: while the Pixel 80 almost matches the VAX 780 in raw computing power, it is less than half its price. Yet, as attractive as our price/power ratio is, we maintain that the ultimate reasons for considering us are our unmatched range of languages and great software support. Because, when the technological fall-out has fallen out, the ones still standing will be the ones who know the most, and speak the best. With Pixel 80 you've already got a good jump on the future.

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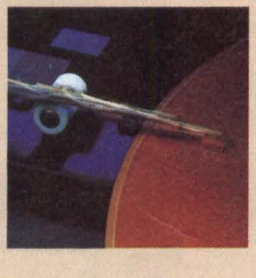
Superior Data Integrity

The Whitney suspension, first introduced to OEM markets by Amcodyne in 1982, is the most stable read/write platform in the industry, yielding an improvement in air bearing stiffness of 50 percent over traditional Winchester suspensions. Accompanied by a low-mass slider, the Whitney suspension resists bounce, pitch and roll. This improved head-to-media compliance and resultant higher-resolution signals translate into unexcelled data reliability. Coupled with a proprietary head-loading technique, the Whitney mechanics maintain head and disk interface quality over the product life. Additionally, the drive's fully-retracted heads eliminate the major cause of Winchester DOAs —head-disk chattering during shipment and handling.

Winchester Cleanliness

The Arapahoe 7110 does not compromise Winchester cleanliness and reliability just because it has a removable disk. When the cartridge is removed, the fixed-disk chamber is sealed by a proprietary active hub seal around the spindle. With the cartridge installed, only the cartridge interior is part of the clean air system. The HDA chamber is purged to a Class 50 environment within 45 seconds of power-up. Air quality within the positively-pressurized plenum chamber is maintained by a recirculating air filter that provides 20 times the scrubbing capacity of other fixed or removable drives.



Assured Cartridge Interchangeability

Although there are slight variations in the way ANSI-standard cartridges are seated on the spindle, absolute tracking accuracy and data reliability are assured by an embedded servosystem and an electronic centering technique that offsets the effect of disk runout. Thus, the user can confidently interchange cartridges from one drive to another.

Ease of Integration

The Arapahoe 7110 is a reliable solution to some of the more challenging integration problems encountered with today's storage subsystems. One peripheral can do the work of three—data storage, file transportability/archiving, and backup. That yields compactness, fewer integration headaches and lower life-cycle costs.

Call now to schedule an immediate evaluation of one of the most innovative OEM products in years from the people who made rigid disk removability work.

Inset photos depict the Whitney Suspension (at left, top), retracted head launch (at left, bottom), active hub seal (at right, top), and the recirculating air filter (at right, bottom).

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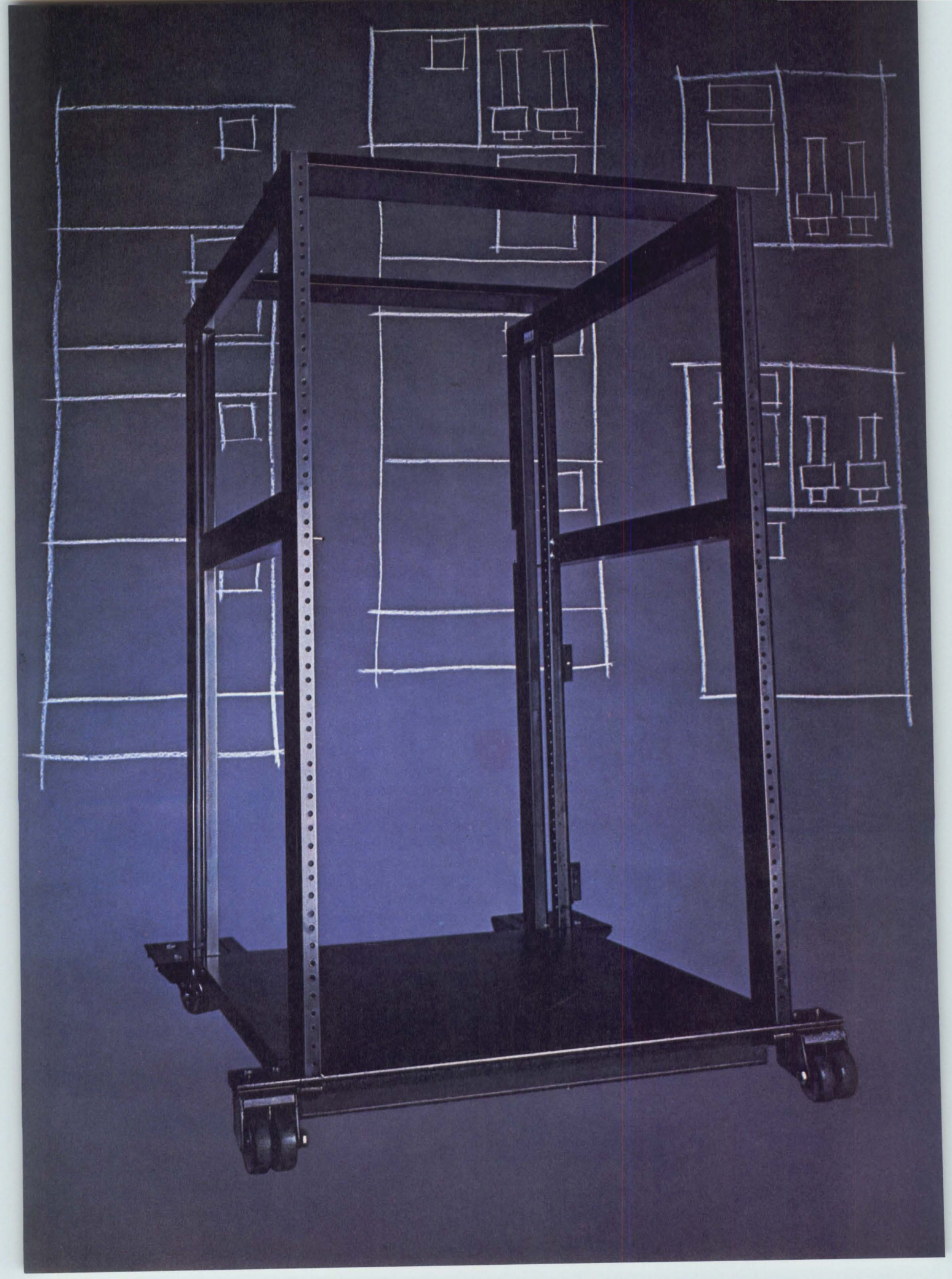

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The great price/performance story of the Series/1 and its technical superiority go a long way toward explaining its popularity across the country, in everything from stand-alone data processing on Main Street, to distributed processing nodes in peer or host-attached networks, to communication controllers for local networks.

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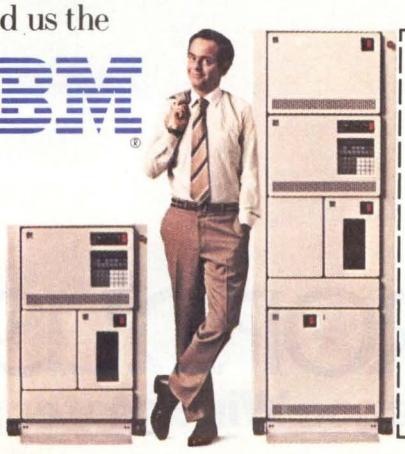

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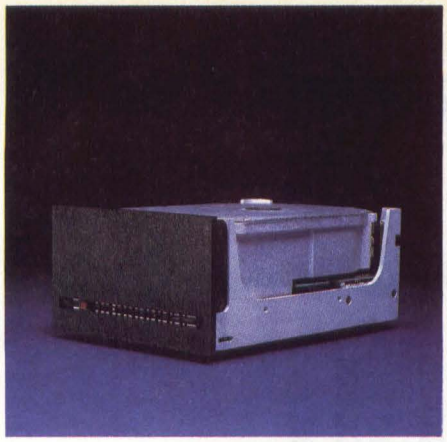

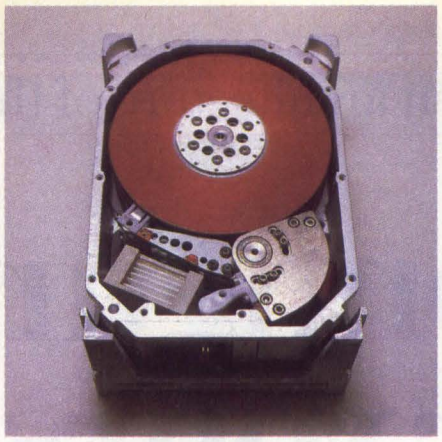

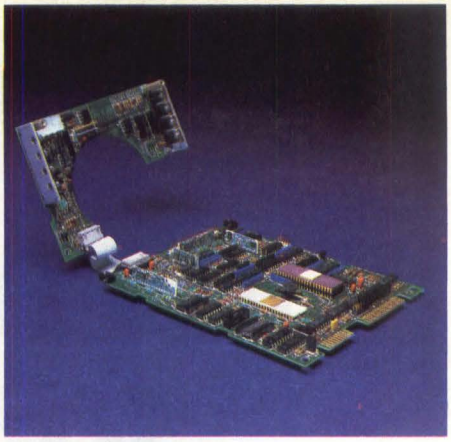

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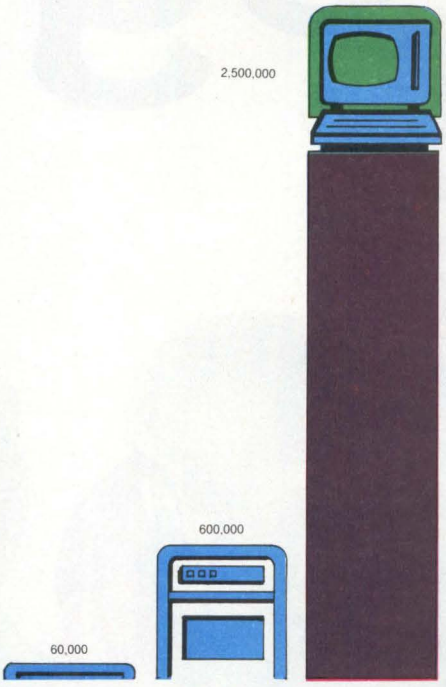
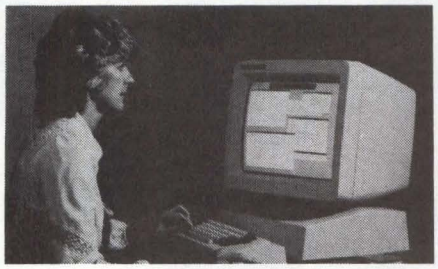
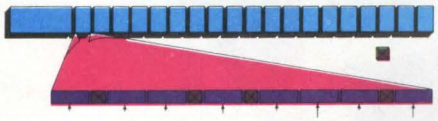
FEATURE HIGHLIGHTS



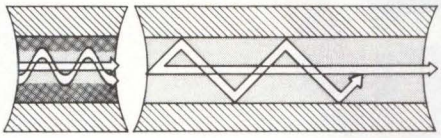
SOFTWARE: In *Mini-Micro Systems'* June issue, we concentrated on electronic spreadsheet packages for microcomputers. **Minicomputer spreadsheets** hold the spotlight in this issue. More than 40 vendors and their products are outlined beginning on p. 172. . .Modularity—the partitioning of structures into well-defined units—is a powerful design concept that Niklaus Wirth, the creator of Pascal, used to produce a new language called **Modula-2.** The language, which is described in detail on p. 183, allows system programmers to write clear and efficient code without resorting to "kludges"or language extensions. . .Microcomputer hardware proliferation has created vast opportunities for software specialists. In 1982 alone, application package sales topped $160 million and are expected to reach more than $25 billion by 1988. A leading software supplier explores the variety of **marketing techniques** available for these packages starting on p. 191. . .A fundamental feature of both UNIX and XENIX operating systems is a hierarchical file system that hides hardware-dependent details such as block size and sector location from application programs and end users and provides a uniform user interface. An introduction to Altos Computer Systems' **ALTOS-NET II software,** which extends this hierarchical file system to local-area networks, begins on p. 197.



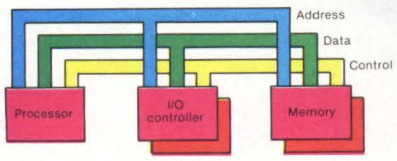
ARTIFICIAL INTELLIGENCE: Traditionally an academic field, artificial intelligence is finally starting to attract the attention of bottom-line-oriented business managers. Using heuristic approaches and novel programming environments, the AI approach to **"expert systems"** constitutes an exciting and profitable new class of computer applications. See p. 207 for further details.



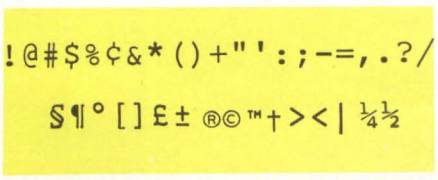
MAGNETIC MEDIA: A new **media-translation system** from Applied Data Communications Inc. promises to solve the problem of incompatible media formats. Outlined on p. 217, the Trans/Media 500 utilizes a slave microcontroller to translate physical differences between source and destination diskettes.



DATA COMMUNICATIONS: Vendors are discovering that a new medium, **fiber-optic cable,** can better meet the needs of customers in many LAN applications. See p. 225 to learn more about how this cable can expand your system's capabilities.



MINICOMPUTERS: The growth of Honeywell Information System Inc.'s Level 6 and DPS 6 systems allowed planned enhancements to the Megabus. Turn to p. 235 for more information on the **Extended Megabus,** which features a wider data path, faster response and functional and physical compatibility with the original Megabus design.



OFFICE AUTOMATION: A new generation of compact, inexpensive and intelligent **OCR page readers** have system integrators all fired up. DEST Corp.'s WorkLess Station, a desktop unit that sells for less than $10,000 is one of the first of this new breed. The offering is profiled on p. 243.

Leapfrog

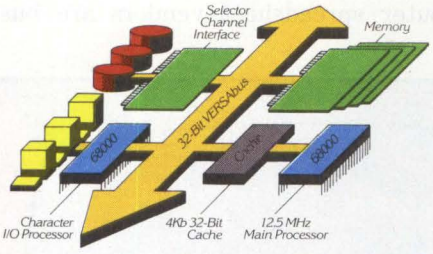
to 32 bits!

The 32-Bit Advantage

For OEMs and system integrators, getting the jump on the competition means leapfrogging to the most advanced technology available. Today, that means making the jump to 32-bit architecture. Now. When it can give you a decisive advantage.

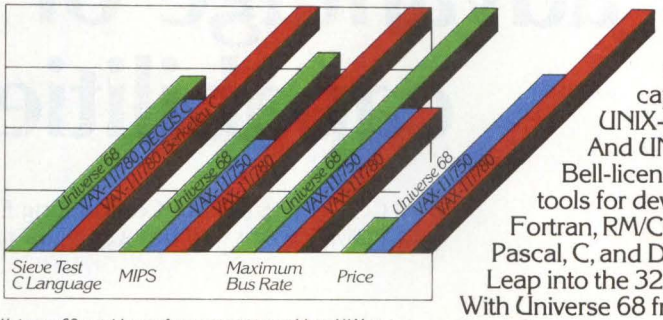
32-Bit Memory on a 32-Bit Bus

The Universe 68/05 is a true 32-bit system because it handles 32-bit data transfers in parallel on its 20Mb/sec VERSAbus, while most 68000-based machines are still limping along with 16-bit buses. With the next generation of processors (like the MC68020), a full 32-bit bus will be a requirement on *all* systems. VERSAbus is there now, and it's non-proprietary.



32-Bit Cache, 12.5MHz 68000

Our new Universe 68/05 is the first commercial product built *and delivered* using the new 12.5MHz 68000 microprocessor. Its 4Kb 32-bit cache memory virtually eliminates wait states, while a separate 68000 I/O processor offloads the main 68000. Its MIPS rate – 1.25 million instructions per second – outstrips a VAX 11/750 that costs several times as much.



Universe 68 provides performance comparable to VAX, at a price far below VAX.

32/64-Bit Hardware Floating Point

Our new IEEE-format hardware floating point unit handles 32- and 64-bit operands fast. In fact, with floating point performance in the 40-50K flops range, it holds its own very nicely with VAX-level machines. Yet the Universe 68's price tag is only a fraction of a VAX's.

The First 32-Bit System Under $10,000

The Universe 68/05's under-$10,000 OEM-quantity-one price includes 32-bit central processor, 10Mb Winchester, 1.26Mb floppy, 256Kb RAM (expandable to 3Mb), and four serial I/O ports (expandable to 64). You can build multiterminal systems around a 68/05 at a cost-per-user that will embarrass workstation systems. For even more horsepower and expandability, you can hop over to the compatible Universe 68/37 or 47.

The 32-Bit, Real-Time, Bell UNIX

UNOS, our multi-user, multi-language operating system, brings real-time, transaction-oriented capabilities to the UNIX-compatible world. And UNOS now runs Bell-licensed UNIX System III tools for development. Plus Fortran, RM/COBOL, BASIC, Pascal, C, and DBMS. Leap into the 32-bit future now. With Universe 68 from Charles River Data Systems.

UNIX™ NOW RUNS ON UNOS™

☐ Send me "The Insider's Guide to the Universe," an informative 24-page discussion of the technical concepts behind the Universe 68 family of computers.

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CHARLES RIVER DATA SYSTEMS

CIRCLE NO. 92 ON INQUIRY CARD

SOFTWARE

Minicomputer spreadsheets take advantage of hardware capabilities

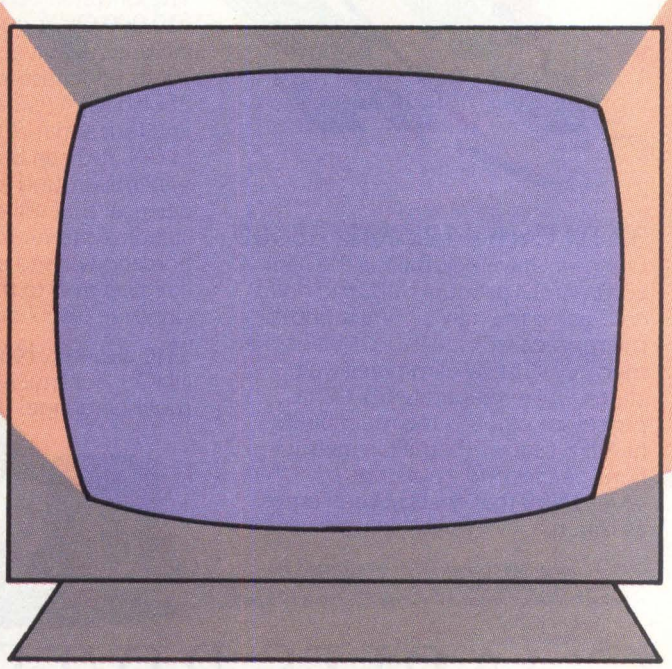
MALCOLM L. STIEFEL, Contributing Editor
and DAVID R. SIMPSON, Associate Editor

Packages are similar but improving steadily

VisiCalc and its variations have spurred many me-too advances in electronic spreadsheet packages. When MMS last looked at spreadsheets (MMS, June, p. 205), we concentrated on electronic spreadsheet packages designed for microcomputers. A second generation of packages aimed at microcomputers has now hit the market, with impressive entries from Context Management Systems, Lotus Development Corp., Microsoft Corp. and VisiCorp, among others. Although these packages have been stealing the thunder from minicomputer-targeted spreadsheets, the latter have not stagnated. Minicomputer spreadsheet vendors are busy

	A	B	C	D	E	F	G	H
1	This is a Sample SuperCalc Worksheet							
2								
3		Jan	Feb	Mar	Apr	May	Jun	Total
4	ASSETS							
5	Acct s Receivable	1000 00	1050 00	1102 50	1157 63	1215 51	1276 28	6801 91
6	Cash	300 00	500 00	525 00	551 25	576 81	607 75	3062 82
7	Unsold Goods	250 00	262 50	65 63	289 41	303 88	319 07	1490 48
8								
9	Total Assets	1550 00	1812 50	1693 13	1998 28	2098 20	2203 11	11355 21
10								
11	LIABILITIES							
12	Acct s Payable	1000 00	916 67	840 28	770 25	706 07	647 23	4880 49
13	Storage Costs	50 00	50 00	50 00	50 00	50 00	50 00	300 00
14	Labor	100 00	105 00	110 25	115 76	121 55	127 63	680 19
15	Materials	50 00	52 50	55 13	57 88	60 78	63 81	340 10
16								
17	Total Liabilities	1200 00	1124 17	1055 65	993 90	938 39	888 67	6200 78
18								
19	NIBT	350 00	688 33	637 47	1004 38	1159 80	1314 43	5154 43
20	Dep Allowance	100 00	100 00	100 00	100 00	100 00	100 00	600 00
21	Taxable Income	250 00	588 33	537 47	904 38	1059 80	1214 43	4554 43
22								
23	Taxes(@30%)	75 00	176 50	161 24	271 31	317 94	364 33	1366 33
24								
25	Net Income	275 00	511 83	476 23	733 07	841 86	950 10	3788 10

A typical electronic spreadsheet, *adapted from sample templates provided to users of SuperCalc, shows a six-month projected balance sheet. The user enters text, numbers and formulas into cells of the spreadsheet matrix. Columns are assigned letter names (A, B, C...), and rows are designated by numbers (1, 2, 3...). The user enters the raw data via keyboard into the assets and liabilities cells (Rows 5 through 7 and Rows 12 through 15) and the depreciation cell (Row 20) for each month, and specifies the appropriate formulas for Rows 9, 17, 19, 21, 23 and 25 to compute net income. Totals for each row are accumulated in Column H. If the user changes some of the raw data, the program automatically recalculates the values of all formulas. Thus, the user can postulate several alternative business strategies and obtain the effect of each strategy on net income without delay.*



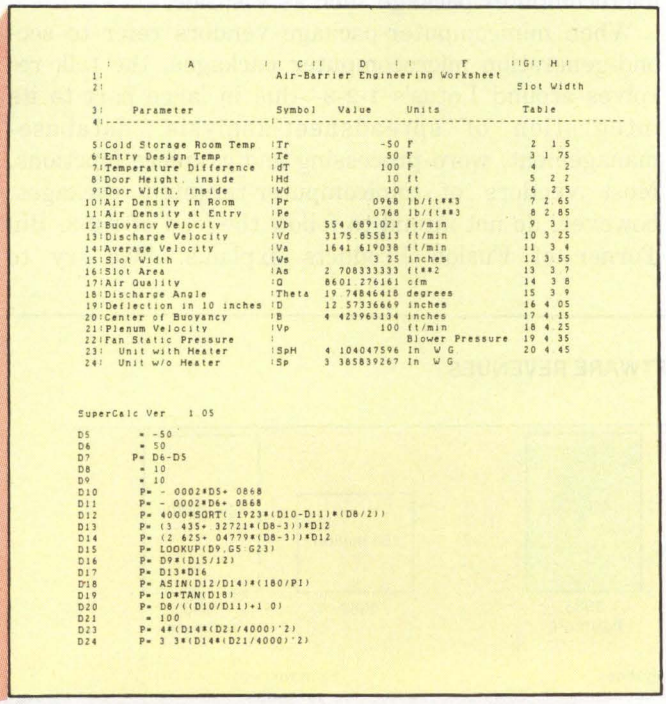
developing more and better packages that capitalize on the advantages of minicomputer hardware.

The advent of the second generation

The leaders in the first generation of microcomputer spreadsheet packages are clearly established: VisiCorp, the pioneer, which has sold more than 400,000 copies of VisiCalc; Sorcim Corp., which had the foresight to implement SuperCalc on CP/M-based micros; Microsoft, whose Multiplan package has been adopted by Digital Equipment Corp. for use with its Professional and Rainbow series personal computers; and MicroPro International Corp., whose CalcStar is a stablemate of WordStar, the versatile and popular word-processing package.

Coming along fast, however, is a new generation of spreadsheets. The newcomers include the 1-2-3 package from Lotus, Cambridge, Mass., and the MBA package from Context Management, Torrance, Calif. These companies, along with VisiCorp, are leading the way with packages that integrate spreadsheet, database-management, word-processing and graphics functions.

The new packages run on 16-bit computers with 128K bytes or more of main memory and are designed to overcome the fundamental limitations of the first generation: insufficient memory and lack of compatibility with complementary packages. For example, SuperCalcRelease 1, a first-generation package, writes two types of files on a disk: an internal spreadsheet image file and a print-image file. The print-image file consists entirely of ASCII characters and can be read and manipulated by a word-processing program or a database-management system, but not by SuperCalc itself. In other words, the data flows only in one direction: from the spreadsheet to the outside world. Complementary packages cannot create files that SuperCalc Release 1 can recognize.



```
   !        A          !!   C !!     D     !!       F       !!G!! H !
 1!                          Air-Barrier Engineering Worksheet
 2!                                                          Slot Width
 3!    Parameter          !Symbol   Value      Units          Table
 4!-----------------------!-------------------------------------------
 5!Cold Storage Room Temp  !Tr            -50 F                 2  1.5
 6!Entry Design Temp       !Te             50 F                 3  1.75
 7!Temperature Difference  !dT            100 F                 4    2
 8!Door Height, inside     !Hd             10 ft                5  2.2
 9!Door Width, inside      !Wd             10 ft                6  2.5
10!Air Density in Room     !Pr         .0968 lb/ft**3           7  2.65
11!Air Density at Entry    !Pe         .0768 lb/ft**3           8  2.85
12!Buoyancy Velocity       !Vb    554.6891021 ft/min            9  3.1
13!Discharge Velocity      !Vd    3175.855813 ft/min           10  3.25
14!Average Velocity        !Va    1641.619038 ft/min           11  3.4
15!Slot Width              !Ws           3.25 inches           12  3.55
16!Slot Area               !As   2.708333333 ft**2             13  3.7
17!Air Quality             !Q    8601.276161 cfm               14  3.8
18!Discharge Angle         !Theta 19.74846418 degrees          15  3.9
19!Deflection in 10 inches !D     12.57336669 inches           16  4.05
20!Center of Buoyancy      !B     4.423963134 inches           17  4.15
21!Plenum Velocity         !Vp             100 ft/min           18  4.25
22!Fan Static Pressure     !                   Blower Pressure  19  4.35
23!  Unit with Heater      !SpH   4.104047596 In  W G           20  4.45
24!  Unit w/o Heater       !Sp    3.385839267 In  W G


SuperCalc Ver   1.05

D5       = -50
D6       = 50
D7       P= D6-D5
D8       = 10
D9       = 10
D10      P= - .0002*D5+ .0868
D11      P= - .0002*D6+ .0868
D12      P= 4000*SQRT( 1923*(D10-D11)*(D8/2))
D13      P= (3.435+ .32721*(D8-3))*D12
D14      P= (2.625+ .04779*(D8-3))*D12
D15      P= LOOKUP(D9,G5:G23)
D16      P= D9*(D15/12)
D17      P= D13*D16
D18      P= ASIN(D12/D14)*(180/PI)
D19      P= 10*TAN(D18)
D20      P= D8/((D10/D11)+1.0)
D21      = 100
D23      P= 4*(D14*(D21/4000)^2)
D24      P= 3.3*(D14*(D21/4000)^2)
```

The versatility of a typical spreadsheet *is demonstrated in an example from a SuperCalc package. The sample pertains to engineering calculations for an air-conditioning and heating problem. The data and formulas in Cells D5 through D24 are listed below the spreadsheet printout. [Note the use of trigonometric functions (tangent, arcsine) and algebraic operations (square root, square) as well as standard arithmetic operations.] To illustrate a typical calculation, the formula in Cell D15 uses the table in Columns G and H. The value in Cell D9 (inside door width = 10 ft.) is matched against the entries in Column G. The program copies the corresponding argument, the slot width of 3.25 in., from Column H into Cell D15.*

Widespread acceptance of the Data Interchange Format, developed by Software Arts for VisiCalc, has largely surmounted this barrier. Second-generation spreadsheet programs can now read and write DIF files, which can in turn be manipulated by word-processing and database-management packages.

The memory limitation has been solved by the advent of 16-bit processors, which can handle the large memory spaces needed to accommodate complex spreadsheets. In addition, some companies offer memory-expansion boards aimed at VisiCalc users. For example, U-Microcomputers Inc., Stamford, Conn., provides a board that gives the Apple II an 80-column display and adds 128K bytes of template memory space. Omega Microware Inc., Chicago, has an Apple II memory board that brings the total RAM to 136K or 256K bytes. At the same time, spreadsheet vendors have been improving the memory utilization of current products.

Most packages provide methods of passing data from one template to another. In the new packages, such as MultiPlan, built-in commands facilitate the transfer of summary information from detailed, subordinate spreadsheets to high-level spreadsheets on which global information is collected. For example, daily sales results for individual territories may appear on detailed spreadsheets, while monthly totals for each region may be carried forward to a summary sheet on which national results are shown. MultiPlan also boasts a built-in alphanumeric sort routine that can sort the rows of a spreadsheet using data in any column as the sort key. Version 2 of SuperCalc, which has just been released, also offers a sort routine.

As a result of one-upmanship, features of these spreadsheet packages have steadily improved, while

differences have eroded. For example, all packages provide arrow keys to move the cursor up, down, left or right and offer a method of naming a cell to which the cursor can move directly. In VisiCalc, the command >B6 will move the cursor to Cell B6. In SuperCalc, the command is =B6, and in MultiPlan, it is GR6C2 (Go to Row 6, Column 2). A MultiPlan user can also give a cell a name. If Cell R6C2 is given the name "roan," the command Groan will move the cursor to that cell.

The need for integration came from the experiences of first-generation users, who needed to manipulate tables—which had been created in a database-management system or by a text processor—with a spreadsheet. Until now, spreadsheets have lacked the data-retrieval capability of database-management systems, and DBMSs don't have the flexibility to create or change data and formulas. Spreadsheets also have very limited text-editing capability, the forte of word-processing packages. Integration of these functions will be the hallmark of the second generation of microcomputer-based spreadsheet packages.

Minicomputer packages hold their own

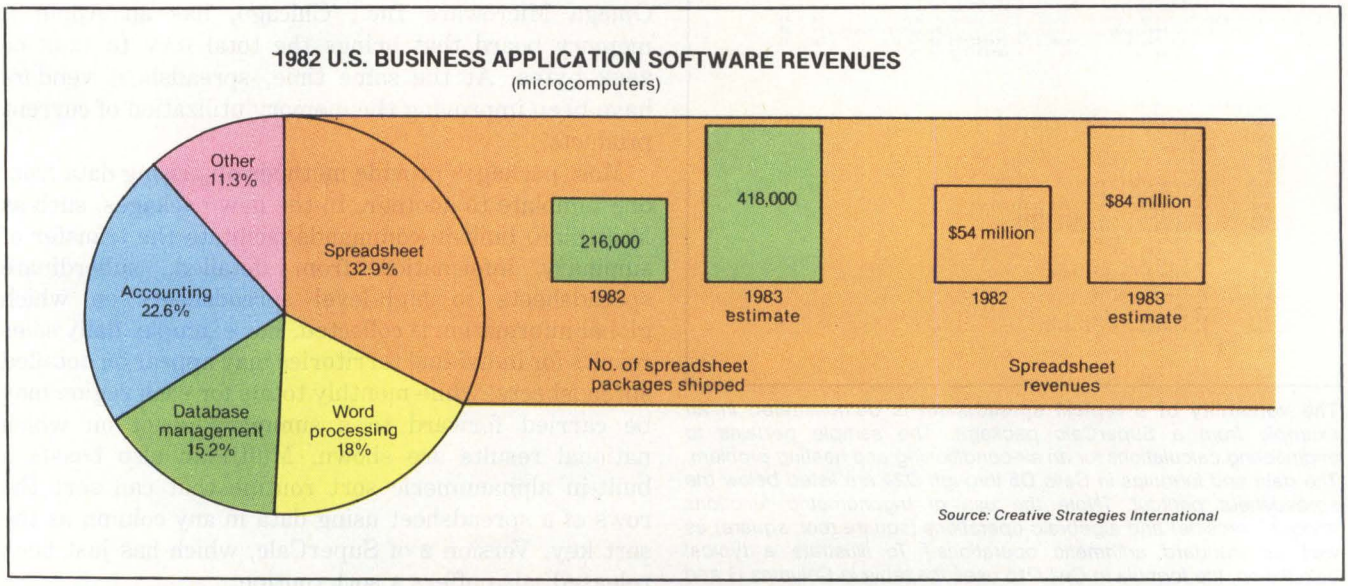
At the low end of the purchasing spectrum, buyers are often influenced more by software availability than hardware characteristics. A small-business owner may buy Apples simply because VisiCalc runs on them. But in large corporations, spreadsheet packages rarely influence hardware purchases. More often, large corporations already own a variety of minicomputers, mainframes and microcomputers, so they want spreadsheet packages that can be easily integrated into their hardware. This is where minicomputer-oriented packages come into play.

Most of the minicomputer packages listed in MMS's directory were introduced after VisiCalc. Not surprisingly, software developers retained many of the features of the microcomputer packages. "We looked closely at VisiCalc and the other packages," says Bruce Camber, director of corporate development at Para Research, "and kept many of the better features, such as the high-level math capabilities, but also added some characteristics lacking on the microcomputer packages." Para Research's Easy Calc takes full advantage of the error-detection capabilities of the IBM System/34, and can perform batch calculations on five or six models at once.

The main advantage of minicomputer packages over microcomputer packages is that minicomputer packages have more available memory. Fusion Products' Fusion/3 spreadsheet, running on IBM System 34, 36 and 38 machines, has as much as 5G bytes of disk space.

Minicomputer packages offer an impressive number of cells. Access Technology's Supercomp 20, for example, can have a maximum of 1000 columns × 1000 cells. When using Supercomp on a virtual-memory machine, a user can work with all 1 million cells. Minicomputer Modeling's DATA*MODEL package has a maximum of 500 columns × 30,000 rows, or 15 million entries, compared to a maximum of 16,256 entries for a typical microcomputer package such as VisiCalc.

When minicomputer-package vendors refer to second-generation microcomputer packages, the talk revolves around Lotus's 1-2-3—due in large part to its integration of spreadsheet-analysis, database-management, word-processing and graphics functions. Most vendors of minicomputer-targeted packages, however, do not intend to follow the lead of 1-2-3. Bill Turner of Fusion Products explains, "We try to



Spreadsheet packages *accounted for 32.9 percent of total U.S. revenues for microcomputer-oriented business application software packages in 1982. That year, 216,000 spreadsheet packages were sold; in 1983, 418,000 will be sold. Total revenues for spreadsheet packages in 1982 were $54 million; in 1983, that figure will grow to $84 million.*

concentrate on providing a good handshake between packages." Some vendors, however, such as Access Technology, do plan to offer integrated packages before year-end.

Although vendors agree that 1-2-3 is good, most feel it falls short in large, corporate environments. Access Technology, for example, has developed its Supercomp 20 package specifically for supporting corporate decision making. Supercomp 20 can run on systems from DEC, Data General Corp., Prime Computer Inc., Honeywell Inc. (Level 6) and Perkin-Elmer Corp. To stay ahead, the firm is expanding downward with versions for DEC Professional computers and upward with versions for IBM Series 4300 and 370 mainframes.

Most minicomputer packages take full advantage of multiuser capabilities. Although approaches vary, most are similar to Datamate's EasyCalc, in which there is one user per file. Moreover, a Spreadsheet Interchange Format allows one file to be copied into another. In addition, a central file, which users can access, is maintained on disk. Users can then manipulate the data at their own CRTs and read it back into the central file, which automatically updates all information. Protection mechanisms to prevent users from accessing or changing parts of the central file can also be set.

Packages targeted for minicomputers will continue to benefit from advances in microcomputer packages and vice versa. Microcomputer spreadsheet packages will feature more powerful command files, better memory utilization and increased integration of functions. Forthcoming minicomputer packages, in contrast to the current crop, will be as easy to learn as microcomputer packages (a drawback until recently) and will be transportable from microcomputers to mainframes. □

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

DIRECTORY OF SPREADSHEET SUPPLIERS

Company	Package	Required hardware/ operating system	Price	Circle no.
Access Technology Inc. 6 Pleasant St. South Natick, Mass. 01760 (617) 655-9191	Supercomp, Supercomp 20	DEC; DG; HP; Prime; Honeywell Level 6; Perkin-Elmer UNIX	$750 to $4800	824
Accountech Systems 28104 Orchard Lake Rd. Farmington Hills, Mich. 48018	Finplan	IBM System/32, /34, /38	$1350 to $2450	825
Addison-Wesley Publishing Co. Inc. 1 Jacob Way Reading, Mass. 01867	Micro-DSS/Finance	Apple II and III; IBM PC; Radio Shack TRS-80	$1500	826
Antech Inc. 788 Myrtle St. Roswell, Ga. 30075 (404) 993-7270	Cope-II	TI Model 1; DEC PDP-11/23; Xerox 820; IBM Datamaster, PC	$750	827
Business Planning Systems Inc. Two N. State St. Dover, Del. 19901 (302) 674-5500	PLAN80	CP/M; CP/M-86; MS/DOS	$495	828
Chang Laboratories Inc. 10228 N. Stelling Rd. Cupertino, Calif. 95014 (408) 246-8020	Micro Plan	CP/M	$495	829
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Comshare Target Software 1935 Cliff Valley Way, Suite 200 Atlanta, Ga. 30329 (404) 634-9535	Target Plannercalc	CP/M	$195	831
Context Management Systems 23868 Hawthorne Blvd. Torrance, Calif. 90505 (213) 378-8277	MBA	IBM PC	$695	832
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Ferox Microsystems Inc. 1701 N. Ft. Meyer Dr., 6th Flr. Arlington, Va. 22209 (703) 841-0800	Micro-DSS/F; Mini DSS/F	Apple II and III; IBM PC; Radio Shack TRS-80; DEC Professional 325, 350	$1500	838
Finar Systems Ltd. 6000 E. Evans, Suite 2-300 Denver, Colo. 80222 (303) 758-7561	Worker	DEC PDP-11, VAX 11		839
Fusion Products Inc. 317 Miller Ave. Mill Valley, Calif. 94941 (415) 381-1340	Fusion/3	IBM System/34, /36, /38	$1500	840
H & A Computer Systems Inc. 30 Hotaling Pl., Suite 204 San Francisco, Calif. 94111 (415) 434-3517	Calc/1	IBM Series 1 EDX	$1500	841
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Peachtree Software Inc. 3445 Peachtree Rd., N.E., 8th Flr. Atlanta, Ga. 30326 (404) 239-3000	Peachcalc electronic spreadsheet	CP/M	$375	852
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Saturn Systems Inc. 6875 Washington Ave., S., Suite 218 Minneapolis, Minn. 55435 (612) 944-2452	Saturn-Calc	DEC PDP-11 and VAX RT-11, RT-11 TSX, RSX, RSTS, VMS, CTS-300	$489–$1956	822
Software Arts Inc. 27 Mica La. Wellesley, Mass. 02181 (617) 237-4000	TK!Solver	Apple II; IBM PC		854
Software Products International 10343 Roselle St., Suite A San Diego, Calif. 92121 (619) 450-1526	Procalc	CP/M; UCSD Pascal; UNIX	$290	855
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VisiCorp 2895 Zanker Rd. San Jose, Calif. 95134 (408) 946-9000	VisiCalc	Apple II and III; Atari 800; Commodore Pet; HP personal computers; IBM PC; DEC 350; Radio Shack TRS-80	$250	863
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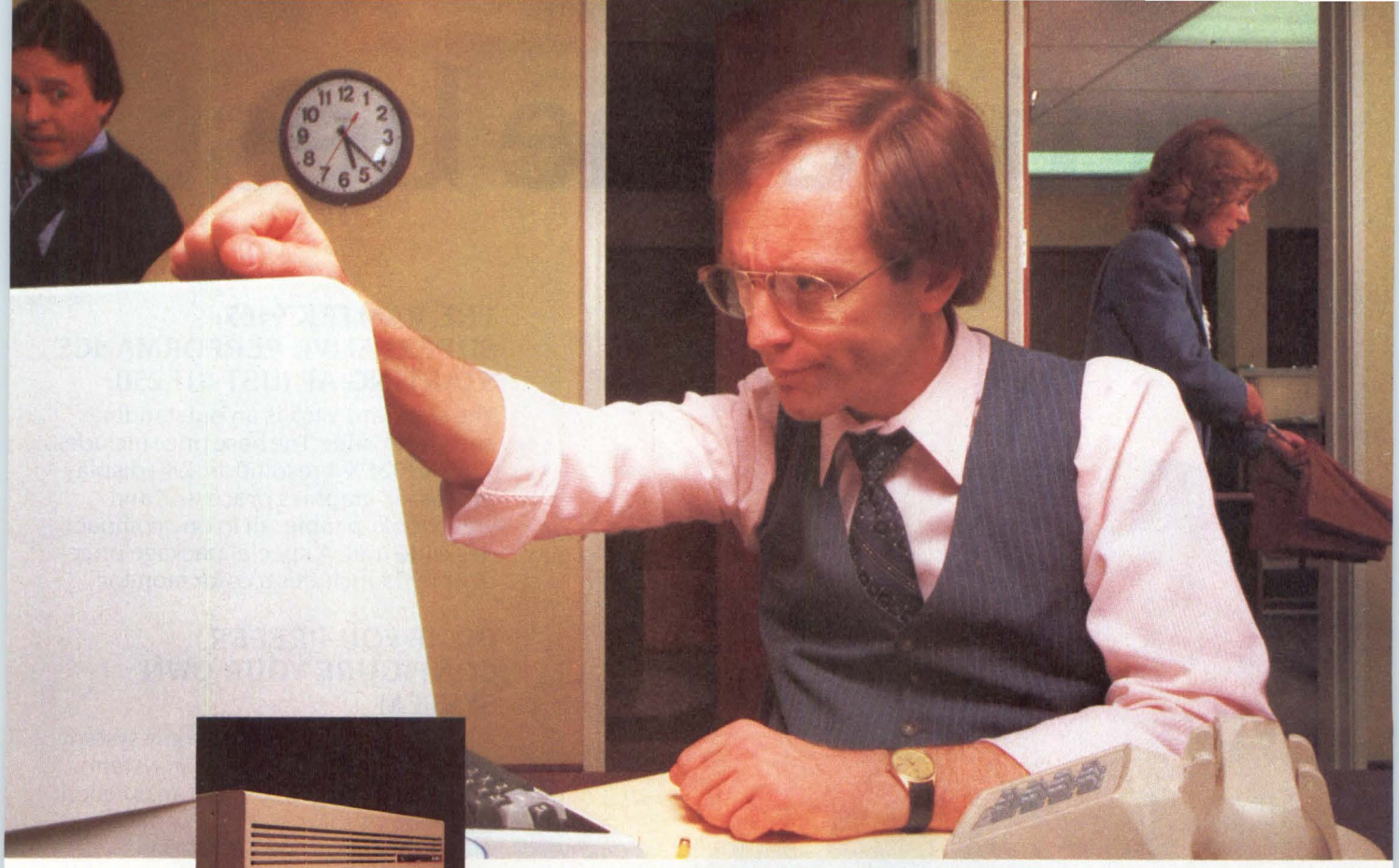
Westico 25 Van Zant Norwalk, Conn. 06855 (203) 853-6880	Minimodel	CP/M	$495	823



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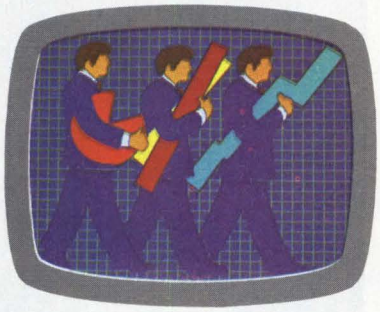

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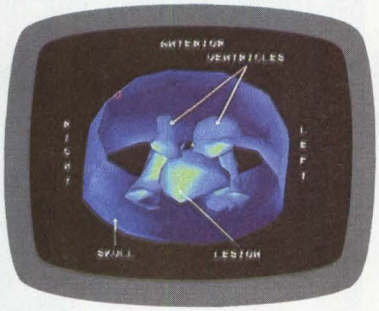

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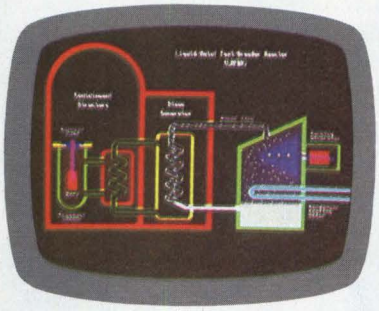

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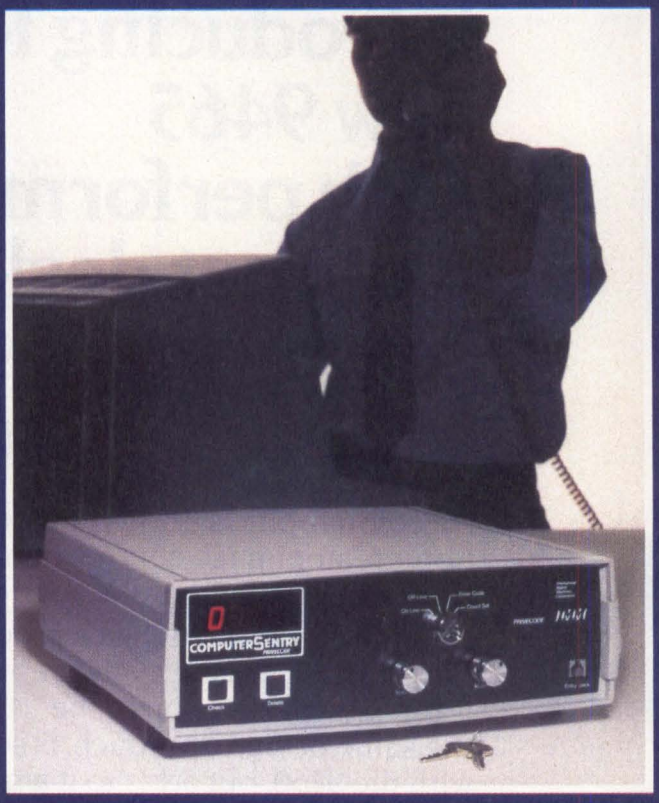

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New language combines the best of Pascal with modular programming and low-level facilities

Modula-2: Pascal's powerful heir

A. WINSOR BROWN and RICHARD E. GLEAVES, Volition Systems

Modularity—the partitioning of structures into well-defined units—is a powerful design concept in everything from office furniture to distributed computing systems. In designing modular software systems, computer scientists have evolved the concepts of information hiding and encapsulation. Niklaus Wirth, the creator of Pascal, merged these concepts with Pascal's data and control structures to produce a new language called Modula-2.

While preserving the general flavor of Pascal, Modula-2 includes features that address the need for modular design, low-level machine access and improved syntax and semantics. These features allow mini and microcomputer system programmers to write clear and efficient code without resorting to "kludges" or language extensions.

Modules: the software 'black box'

Modules are the key feature of Modula-2. Just as procedures group related statements, modules group related variables and procedures. Modules hide the irrelevant details of internal variables and procedures and allow selected variables to retain their values throughout program execution (see "How modules enhance development of large software systems," p. 184). A module can access variables and procedures declared in another module only if the variable and procedure names are "exported" by the module that declares them and "imported" by the module that references them. This is especially useful in systems programming. For example, modules that relate to I/O devices can export I/O procedures while hiding I/O port addresses, state variables and other entities.

IDENTIFIER	FUNCTION
WORD	A data type compatible with all variables occupying one machine word, used to write routines that operate on multiple data types. ARRAY of WORD can be used in the same way for data types occupying more than one word.
ADDRESS	A data type to perform arithmetic on memory addresses and to implement dynamic storage allocation.
ADR (x)	A procedure that returns the address of variable x.
SIZE (x)	A procedure that returns the number of bytes occupied by variable x.
TSIZE (T)	A procedure that returns the number of bytes occupied by variables of type T.

Low-level data types and procedures *are imported from module SYSTEM, which is built into the Modula-2 compiler. A module can be identified as machine-dependent by the presence of WORD, ADDRESS, ADR, SIZE or TSIZE in the module's IMPORT statement.*

Most Modula-2 implementations furnish standard library modules to allow program portability. Standard library modules handle input/output, file access, memory management, process scheduling, procedure invocation and mathematical functions. Some Modula-2 implementations also contain library modules for database management, graphics and other facilities tailored to the application environment.

Library modules are divided into two sections: definition and implementation, which are compiled and stored separately. A definition module specifies procedures of the library module available to systems and applications programs. An implementation module contains the code and data that perform the library module's operations. Separating definition and implementation allows programmers to define modules before implementing them, facilitating software development by programming teams. Definition modules enable the Modula-2 compiler to detect and flag faulty program interfaces, avoiding a problem that has long bedeviled multi-programmer projects. Decoupling definition and implementation also allows Modula-2 to exercise a simple form of module version control: changing a module's implementation has no effect on the rest of the system, but altering a module's definition invalidates all programs that use the module.

Low-level facilities

Pascal's standard data types and procedures were designed for machine-independent programming. While this has encouraged program portability, it has also invited abuse by system programmers who perform machine-dependent programming by relying on various kludges. A common example is using integer variables to access fixed memory addresses through structures popularly known as "trick records."

Modula-2 permits machine-dependent programming by providing a module called SYSTEM, which contains standard data types and procedures that represent the underlying machine (see table, p.183). Variables can be declared to reside at fixed memory addresses, allowing access to memory-mapped device registers. Another machine-dependent feature of Modula-2 is the BITSET type. BITSET is a set whose elements are individual bits in a machine word. Variables of type BITSET can be used to manipulate bits clearly and efficiently using such operators as set union, intersection and exclusive-OR.

HOW MODULES ENHANCE DEVELOPMENT OF LARGE SOFTWARE SYSTEMS

Information hiding is a software design concept whose purpose is to reduce interaction between sections of a program. Reducing the interaction between program sections lessens the likelihood of difficult-to-trace errors called "side effects." Such errors occur when operations performed in one section of a program have an unintended effect on another section of the program. Side effects are especially troublesome in developing and maintaining large programs requiring many programmers, such as operating systems, compilers, database managers and graphics processors.

Modula-2 hides information using structures called modules. Modules are similar to Pascal BEGIN/END blocks with two key differences:

- Modules impose tighter restrictions on interaction between program sections.
- Modules can create variables whose values are preserved for the duration of a program.

The Modula-2 program shown is a random number generator that illustrates the power of modules. The program uses three nesting levels: module Outer (blue), module Inner (green) and procedure Getrand (yellow). Because Getrand is declared on line 7 within Inner, the internal details of Getrand are hidden from Outer, so there is no way that code in Outer could inadvertently alter the operation of Getrand. However, module Outer can *call* Getrand to generate a random number (line 16) because module Inner "exports" Getrand in the EXPORT statement on line 4.

The module structure of the program also preserves the value of the variable Seed. Although Seed is used within procedure Getrand (lines 9 and 10), it is declared outside the procedure (line 6). If Seed were declared within Getrand, its value would be reinitialized on each call to Getrand, so Getrand would return the same value each time—not a good random number generator.

—*R. R. F.*

```
1  MODULE Outer;
2    VAR r : INTEGER;
3    MODULE Inner;
4      EXPORT Getrand;
5      CONST InitVal = 22;
               Incr = 1221;
               Divisor = 3443;
6      VAR Seed : INTEGER;
7      PROCEDURE Getrand ( ) : INTEGER;
8      BEGIN
9        SEED := (Seed + Incr) MOD Divisor;
10       RETURN Seed;
11     END Getrand;
12   BEGIN
13     Seed := InitVal;
14   END Inner;
15 BEGIN
16   r := Getrand ( );
17 END Outer;
```

Module Inner allows module Outer to access procedure Getrand.

Compute new "random" number using previously computed value, which has been preserved in the variable Seed.

Module Outer calls procedure Getrand.

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For example, the exclusive-OR operator, denoted by "/", can be used to reverse the bits in a word (A5A5 / FFFF=5A5A) or to set a word to all zeros (A5A5 / A5A5=0000). Modula-2 programmers can express constants in octal or hexadecimal as in the above example.

System programmers often want to convert data from one type to another without changing the value of the data. While Pascal allows type conversion only between character and integer types, Modula-2 allows conversion between any two types as long as the machine representations occupy the same amount of storage.

Improved syntax and semantics

Modula-2 contains features not available in Pascal that improve program clarity and execution speed: constant expressions, shortcut evaluation of Boolean expressions, arrays dimensioned at run time and enhanced control structures.

Constant expressions in Modula-2 can be used anywhere constants can. They are especially helpful in declarations of symbolic constants such as: *CONST WorkdaysPerWeek = DaysPerWeek - WeekendDaysPerWeek*. They speed program execution because they are evaluated at compile time; they increase program clarity because they provide a simple method of specifying program parameters.

In compound Boolean expressions, Modula-2 evaluates only subexpressions that could affect the value of the full expression. For example, in the Boolean expression: *x AND (y OR z)*, if *x* is false, Modula-2 does not evaluate further because the full expression must be false. Since compound Boolean expressions do not incur a performance penalty at run time, Modula-2 programmers can use them freely and need not create artificial nesting levels as Pascal programmers commonly do.

In Modula-2, a dimension of an array used as a formal parameter in a procedure declaration can be determined at run time rather than at compile time. Thus, programmers can write utility programs that perform operations such as sorting and searching on arrays of any size.

Modula-2's control structures include ELSIF, CASE-ELSE, RETURN and LOOP-EXIT features (see "Can understand this program?" right). The ELSIF clause in the IF-THEN-ELSE structure eliminates unnecessary levels in nested conditions. The addition of an optional ELSE clause to the CASE statement provides a catchall for values of the case selector not explicitly identified, allowing programmers to specify action conveniently for all possible values of a variable. The RETURN statement permits premature exits from a procedure, simplifying programs that process error conditions.

CAN YOU UNDERSTAND THIS PROGRAM?

Modula-2 programs have an English-like readability that can be self-documenting. Shown is an excerpt from an actual program that "tells a story" and illustrates Modula-2's clear control flow, conspicuous keywords and conducive identifiers.

For more information on Modula-2, consult the contact designated by the program. ETH Zurich is the University in Switzerland in which Niklaus Wirth created Pascal and Modula-2. The Modula Research Institute is a nonprofit group affiliated with Brigham Young University, Provo, Utah. Volition Systems, Del Mar, Calif., offers Modula-2 compilers and support systems.

```
BEGIN
  IF YourLanguage = Modula2 THEN
    LOOP
      Success;
    END
  ELSIF WantToUseModula2 THEN
    CASE YourProcessor OF
      6502, 68000, 8080, 8086, 9900, Alp2, AppleII :
        Contact: = VolitionSystems;
      PDP11, Lilith :
        IF Location = USA
          THEN Contact : = ModulaResearchInstitute
          ELSE Contact : = ETHZurich
        END
      ELSE
        REPEAT
          Contact : = ETHZurich;
          Contact : = ModulaResearchInstitute;
          Contact : = VolitionSystems;
        UNTIL Satisfied;
    END
  ELSE
    WHILE NOT Investigating (Modula2) DO
      Suffer; Suffer; Suffer
    END
  END
END ControlStructures.
```

The LOOP statement repeats a body of code indefinitely. When combined with one or more EXIT statements, the LOOP statement permits programmers to test loop-controlling conditions anywhere in the loop body, providing a more general control structure than WHILE or REPEAT-UNTIL statements.

By increasing the efficiency and understandability of programs, Modula-2 features benefit system integrators who have a stake in software quality and reliability. □

A. Winsor Brown is vice president of Volition Systems, Del Mar, Calif. A principal on the ANSI/IEEE Joint Pascal Committee, he has contributed to the development of Pascal standards.

Richard E. Gleaves is a software engineer at Volition Systems. A former member of the UCSD Pascal Project, he has participated in developing several commercial versions of Pascal.

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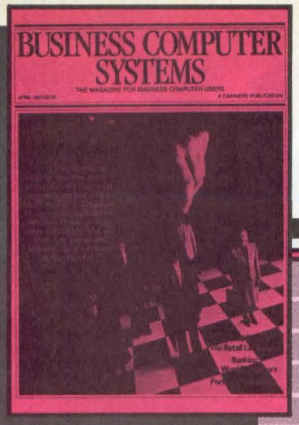

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- 79% of our readers' computers are company-owned
- 70% plan to upgrade their systems
- 54% plan to purchase a new computer
- 71% plan to purchase software
- 50% plan to purchase peripherals and supplies

Business Computer Systems is read regularly by a 3 to 1 margin over the next publication.

Publication	% Read Regularly (3 out of 4 issues)
Business Computer Systems	80%
Byte	24
Computerworld	19
Datamation	19
Desktop Computing	4
Interface Age	7
Infoworld	17
Personal Computing	26

Business Computer Systems is preferred 8 to 1 as the information source on the use of computers in business applications.

Publication	% of Respondents
Business Computer Systems	48%
Byte	6
Computerworld	6
Datamation	6
Infoworld	5
Personal Computing	5
Interface Age	2
Desktop Computing	1

Business Computer Systems is the first publication to view the business computer market as a whole — not just a microcomputer market, not just a personal computer market, not just a small computer market — but all of these when used in business applications.

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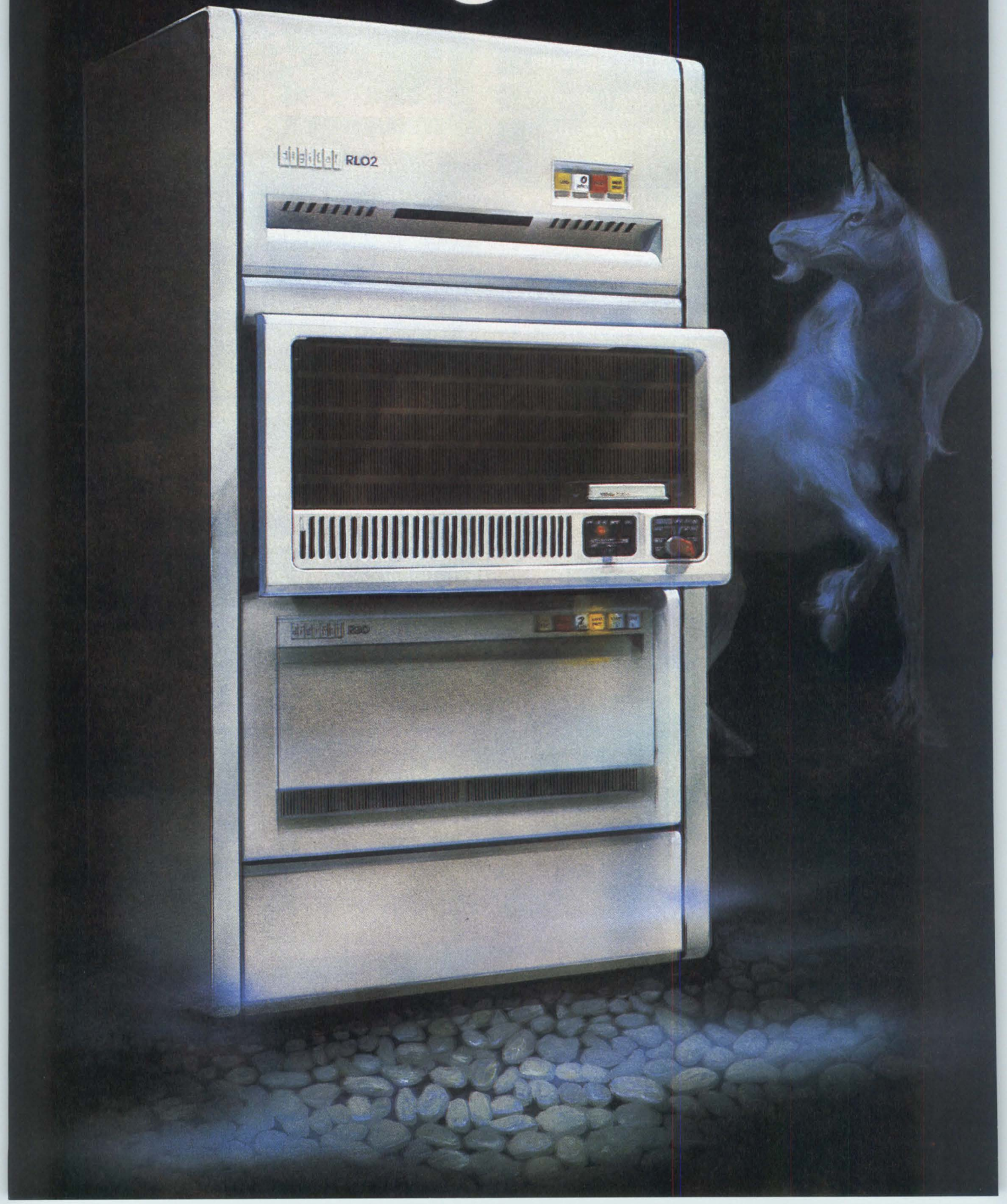

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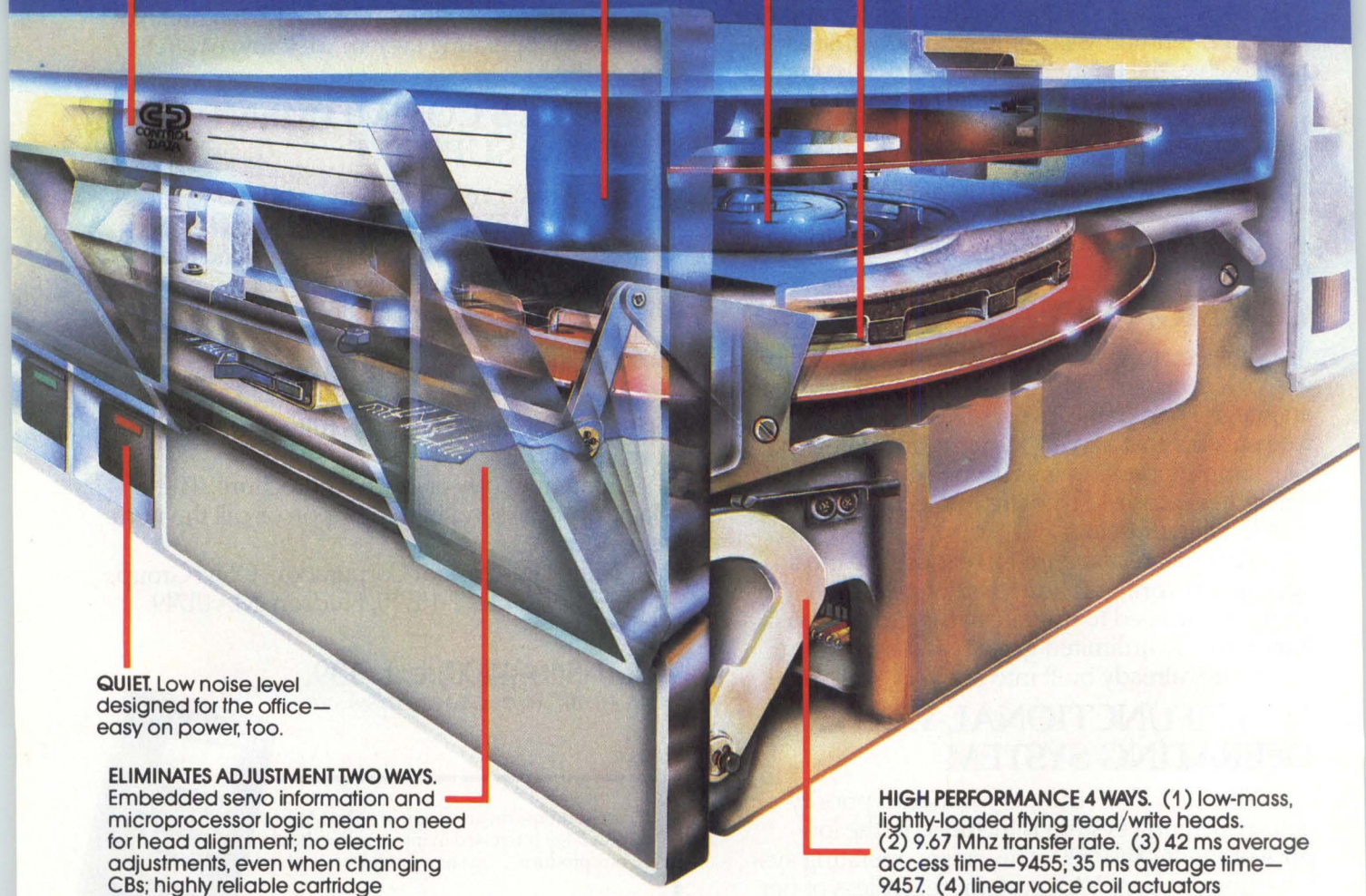

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Capitalizing on the microcomputer software boom

CHARLES G. MILDEN, State of the Art Inc.

A variety of marketing methods exists for software developers, marketers and vendors

Industry sources predict that sales of microcomputers will increase 50 percent per year during the next two years to more than 8 million units sold in 1985. Hardware proliferation has created vast opportunities for software specialists, particularly those that have experience in developing packages for minicomputers. In 1982 alone, sales for microcomputer application packages topped $160 million. The market is expected to reach more than $25 billion by 1988.

Software developers can enter the market in a variety of ways: retail stores, software publishing, direct marketing to distributors and retailers and through independent sales organizations and OEMs. But any interested firm or individual should look closely at how the market has evolved as well as how to enter it.

Hardware revolution sets the stage

Radio Shack and Apple Computer Inc. introduced the first commercially successful personal computers in 1978. These computers weren't serious business machines, however, and it wasn't until 1981 that microcomputer evolution became a revolution with the introduction of IBM Corp.'s 16-bit PC. The move from minicomputers and mainframes is now well under way.

Technology improves every year, and prices drop dramatically. Take a 16-bit microcomputer, add a Winchester disk drive with as much as 50M bytes of storage capacity, and you've got a low-cost solution for business applications that only minicomputers could do before. The recession also made its impact on the market. Many companies experiencing a business slump put off major capital purchases, such as minicomputers, and took the less expensive alternative of buying microcomputers. Almost 2.5 million microcomputers were sold in the United States in 1982 (Fig. 1). Within the next two years, mainframe sales will be surpassed by personal computer sales in *actual dollars*, not just units.

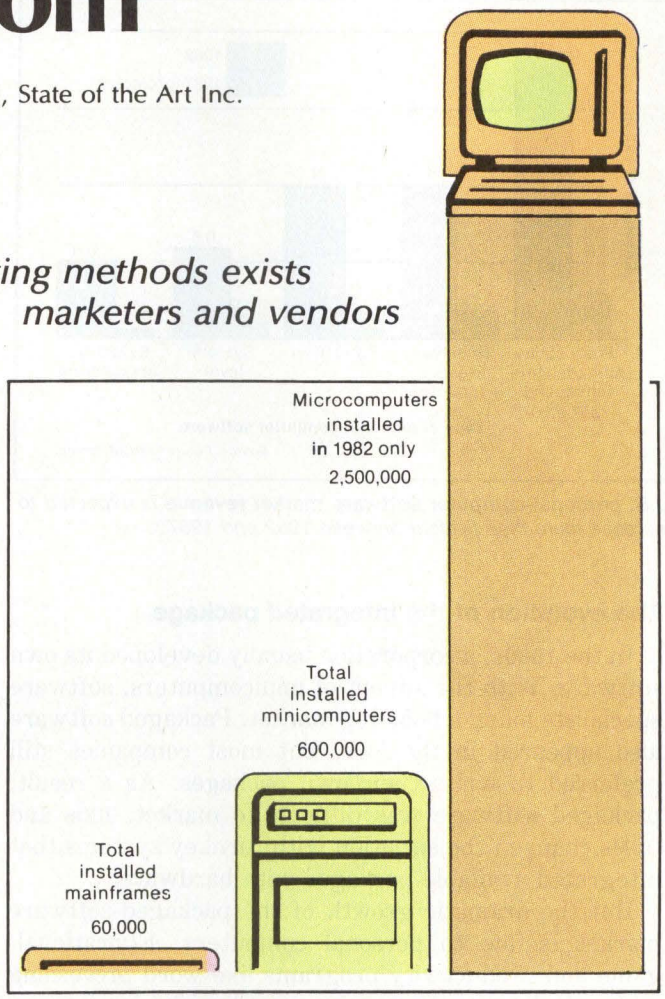
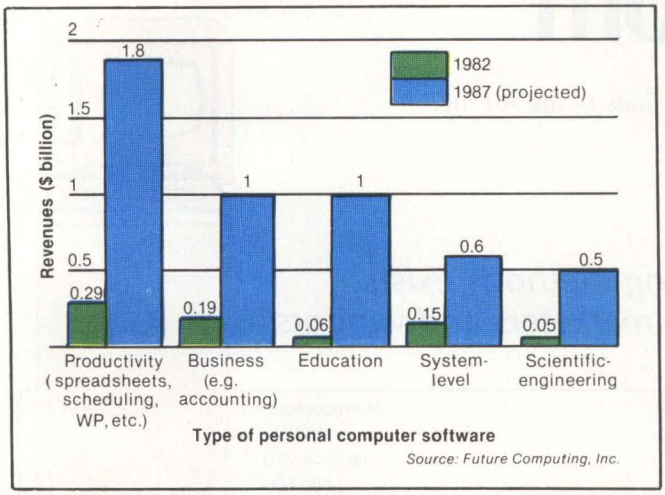


Fig. 1. The number of microcomputers installed in 1982 *(2.5 million) accounted for nearly 80 percent of the total number of U.S. computer installations.*

Who's buying all those machines? One growing segment of the market is Fortune 1000 corporations. By the end of 1982, some 300,000 microcomputers had been installed in large companies, a number expected to reach 9 million by 1992, according to International Data Corp.

Ten years ago, software developers were moving in the direction of George Orwell's *1984*, in which everything relies on a master computer that rules all. Now the future bears more resemblance to the information revolution depicted in Alvin Toffler's *The Third Wave*, in which personal computers play a predominant role.



U.S. personal-computer software market revenue *is expected to increase more than fivefold between 1982 and 1987.*

The evolution of the integrated package

In the 1960s, a corporation usually developed its own software. With the advent of minicomputers, software specialists found a booming market. Packaged software also appeared in the '60s, but most companies still preferred to write their own packages. As a result, packaged software was difficult to market. ISOs and OEMs changed the situation with turnkey systems that integrated available packages with hardware.

But the dramatic growth of the packaged-software market is due to personal computers. Educational, game and productivity programs like word processing and spreadsheets were written not by minicomputer or mainframe specialists, but by college students and businessmen. In the late 1970s and early 1980s, the personal computer was introduced into corporate MIS departments by young managers who found using VisiCalc easier than pushing pencils around conventional spreadsheets. While senior managers reviewed proposals from large computer companies, their younger colleagues began using personal computers for word processing and electronic mail. Minicomputer specialists continued to concentrate on such things as improving integrated accounting on their machines, but personal computer software was sneaking up behind them, slowly expanding into the traditional business market.

The first generation of accounting software for microcomputers came from the hobbyist environment and lacked the audit trails and system integrity necessary to gain wide acceptance in the business community. But once hardware and operating systems matured, mature software quickly followed. Improved accounting functions, inventory control, database management and more complex spreadsheets all hit the mass market in early 1981, as did some specialized software for vertical markets.

The current trend toward integrated accounting/business packages arrived with 16-bit microcomputers. These programs combine several packages into one program and require more power than is available from 8-bit microcomputers. Integrated software truly enables microcomputers to compete with minicomputers. Integrated packages also offer software developers greater challenges as well as potential profits.

How software specialists can cash in

Having determined the size and profitability of the market, software specialists face a variety of options:

- **Retail computer stores** are the major outlets for microcomputer software. These stores were originally high-risk ventures. But at least 4000 such stores now exist, with independent dealers dominating the market. Today, some successful computer stores specialize in personal-computer software, and a number of established retailers, including Sears Roebuck and Co. and Macy's, have started personal-computer "business centers."

A recent study by Newton-Evans Research Co., Sykesville, Md., predicts that 36 percent of all personal computers purchased by Fortune 1300 corporations in the next two years will be bought from retail stores. The same survey predicts that the average number of personal computers in these firms will more than double from 70 to 166 by the end of 1984 (Fig. 2).

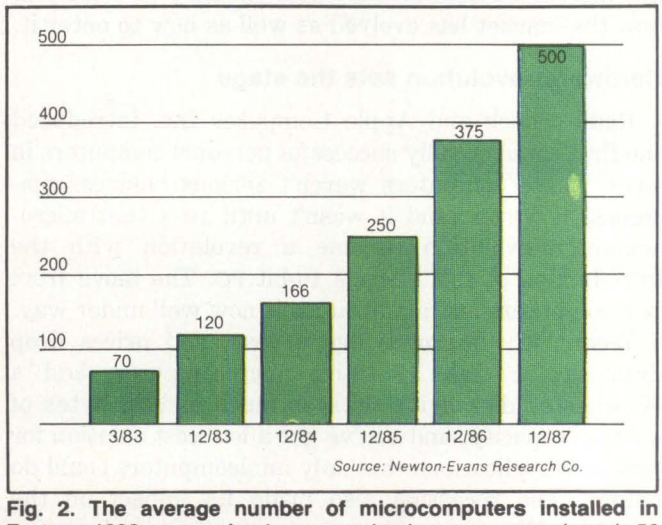


Fig. 2. The average number of microcomputers installed in Fortune 1300 companies *is expected to increase approximately 50 percent per year. A total of 53 percent of these firms' data-processing/management-information-systems executives cite "application software" as the key decision-making influence in purchasing units.*

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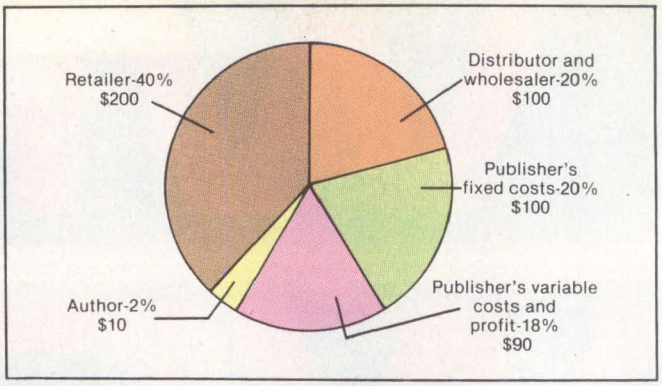


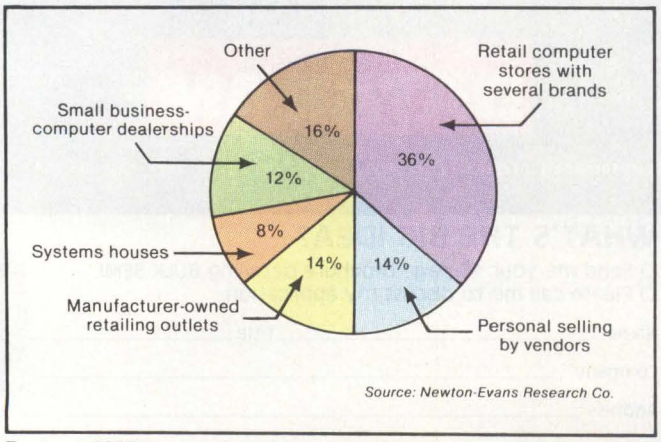
Fig. 3. Retail sales breakdown of a typical $500 software package *shows that the retailer receives about 40 percent ($200), which covers inventory, training, overhead and profit. The distributor or wholesaler receives 20 percent ($100) to cover sales, support, distribution and profit. The publisher gets about 38 percent, which covers fixed costs (20 percent) such as packaging, documentation, diskettes, shipping cartons, advertising, distributor and dealer training and profit (18 percent). The author usually receives only 10 percent of the publisher's* profit *(about $10) dollars, although some publishers offer as much as 20 percent.*

• **Software publishers,** such as Software Publishing Corp., Lifeboat Associates and VisiCorp, develop and market programs written by programmers or other authors. Software publishers are similar to book publishers in that they usually require a finished product. If they accept it, they assume the job of producing it for mass distribution.

The major problem with this approach is the royalty breakdown. Minicomputer packages sell for around $2000, while most microcomputer software packages have a top retail price of $500. Although that seems attractive, a breakdown reveals a small share for the programmer/author. For a $500 package, an author gets about 2 percent, or a royalty of $10 (Fig. 3). Therefore, the market for the program must be sufficiently broad to make substantial profit. The more specialized a product, the less willing a publisher will be to risk the investment. Poor-selling software has the same impact on a software publisher as a poor-selling book has on a book publisher—only bestsellers make money.

• **Marketing a product directly to distributors or retailers** is a high-risk, capital-intensive venture. While it can be very lucrative, it takes an initial investment in excess of $1 million to introduce a business-oriented software product nationally through this channel. The investment goes toward developing the package, preparing documentation and selling the package to distributors and retail stores. The only way around this financial obstacle is to seek venture capitalists and sacrifice some equity.

• **Entering the market via ISOs and OEMs** is a low-risk, potentially profitable approach, particularly if the program developer has already produced specialized business applications on minicomputers. Most microcomputer manufacturers have an ISO or OEM program similar to those of minicomputer manufacturers. By contacting the manufacturer and jointly testing the package, the author can get manufacturer approval and a place on the manufacturer's list of recommended software. This leads to volume sales to retail stores and to the ISOs and OEMs that make volume purchases of a specific microcomputer. The author decreases his own marketing costs, but relinquishes marketing exclusivity.



Fortune 1300 companies acquire microcomputers from a variety of sources. *(Retail computer stores differ from small-business-computer dealerships in that the dealerships sell directly through a sales force, while retail stores are walk-in sales centers.*

Another approach is to work with a software publisher that assists in developing a package, and provides a family of integrated products and established ISO programs. Suppose, for example, an author has an inventory package that was written for hotel applications and designed to run on minicomputers, and he wants to rewrite it for microcomputers. To sell it on a large scale, he also wants to integrate it with payroll, accounting and spreadsheet programs to produce a complete business package geared toward hotel management. Companies like State of the Art Inc. can provide development tools, such as file utilities and program generators, to assist the author in developing the package for the microcomputer market. These companies usually feature a complete family of products into which the author can integrate his package. Financial arrangements vary, but the author can generally expect a 7-percent to 10-percent royalty on the publisher's profits, as well as the profits from his own sales.

Using another firm's application programs and development tools can be advantageous. Technology changes so rapidly that the use of up-to-date tools may be the best insurance against writing programs that are outdated before they reach the mass market. □

Charles G. Milden is president of State of the Art Inc., Costa Mesa, Calif.

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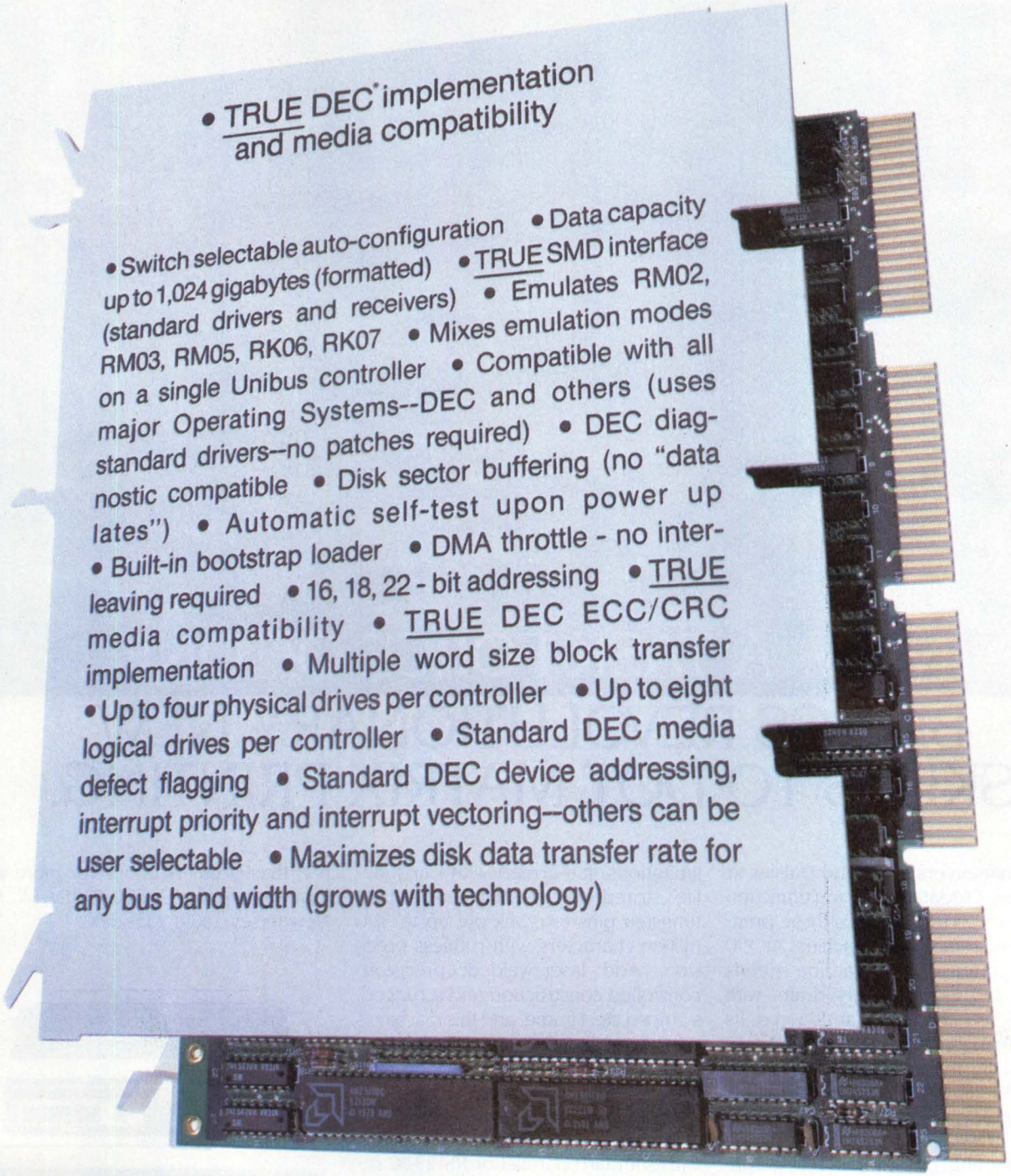

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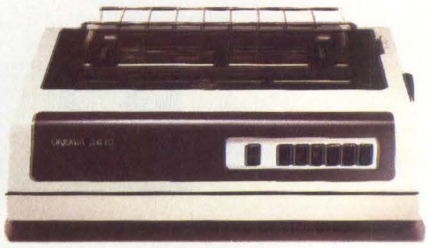

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Extending UNIX to local-area networks

PETER KAVALER and ALAN GREENSPAN,
Altos Computer Systems

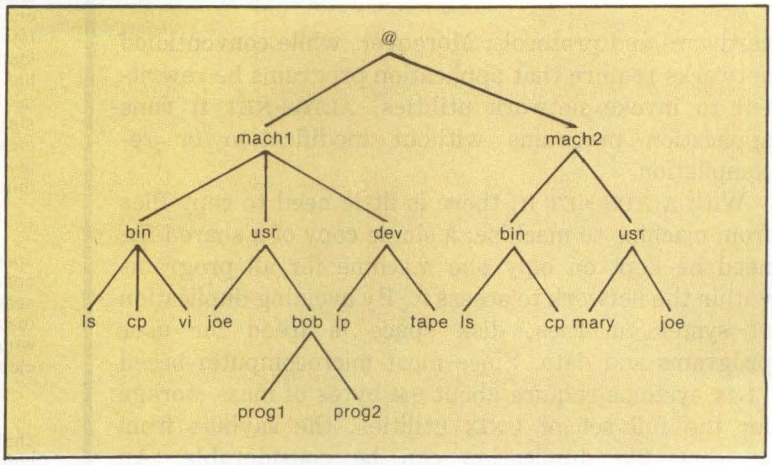

Fig. 1. The @ directory *is ALTOS-NET II's extension to XENIX's hierarchical file system. Traditionally, XENIX files on separate machines are linked by utilities that confine network functions to file transfer and remote log-on. But the @ directory establishes a new root on the tree, enabling all utilities and applications to function throughout the network.*

The UNIX operating system—together with derivative products such as Microsoft Corp.'s XENIX—is rapidly becoming a standard for 16-bit microcomputers, providing a rich set of development tools and a solid base for running application software. A fundamental feature of both UNIX and XENIX is a hierarchical file system that hides hardware-dependent details, such as block size, record length, sector location and type of disk drives, from application programs and end users. This design provides a uniform user interface, but one that is confined to a single machine.

ALTOS-NET II software, which runs with XENIX on Altos Computer Systems' 8086-based microcomputers, extends the hierarchical file system to local-area networks. It allows transparent remote file access and remote processor execution, making it possible to build a network of XENIX-based systems that appears to be a single large computer. Network users can save substantial disk space by sharing files and can transport application programs to the network with minimal modification.

Enhancing the file system

The XENIX file system is an inverted tree with leaf nodes corresponding to data files, programs and devices; branch nodes corresponding to directories; and the root of the tree corresponding to a "root directory." Users can access a node by specifying its location in the tree using a *pathname*—a sequence of node names separated by slashes. A pathname beginning with a "/" descends the hierarchy from the root directory. For example, the pathname */usr/bob/prog3* represents the file *prog3* within user Bob's directory. The command *cd* simplifies pathnames by designating a "current directory" as the starting point for pathnames not beginning with "/". If the current directory in the above example were */usr/bob*, the desired file could be represented by just *prog3*. However, in either case, file access is limited to a single machine. Inter-machine communication in UNIX or XENIX has required network utilities that have permitted file transfer and remote log-on, but little else.

ALTOS-NET II introduces a directory, called the "@ directory," one level above the root directory of each system in the network (Fig. 1). The @ directory enables users and application programs to access any file in the network using standard XENIX commands. For example, a user on the machine named *mach2* can use the pathname *@mach1/usr/bob/prog3* to access the *prog3* file on the machine named *mach1*. The user's only concern is the logical locations of the files within the file system hierarchy. Just as UNIX and XENIX hide the physical storage media and file-access methods from users, ALTOS-NET II hides the underlying network

ALTOS-NET II software enhances the XENIX kernel, allowing user-transparent access to remote files and processors

hardware and protocols. Moreover, while conventional networks require that application programs be rewritten to invoke network utilities, ALTOS-NET II runs application programs without modification or recompilation.

With ALTOS-NET II, there is little need to copy files from machine to machine; a single copy of a shared file need be kept on only one machine for all programs within the network to access it. By avoiding duplication of system utilities, disk space is freed for user programs and data. Since most microcomputer-based UNIX systems require about 8M bytes of mass storage for the full set of UNIX utilities, the savings from avoiding file duplication can be considerable. An ALTOS-NET II configuration of 10 machines with 80 percent of system utilities on only one disk would save as much as 60M bytes across the network.

ALTOS-NET II also permits the use of a low-cost disk-less workstation on the network. For example, the Altos 186-VDU has a 14-inch bit-mapped screen, an 80186 CPU and as much as 512K bytes of RAM—but no local disk storage. Such a workstation would be of little use on a conventional network because it could be used only to log onto another machine by emulating a terminal. But with ALTOS-NET II, another computer can act as a "file server" for one or more disk-less workstations by downloading the XENIX kernel and

System call	Purpose
File control	
access	Determine accessibility of file
chmod	Change mode of a file
chown	Change owner and group of a file
fstat	Set file status
ioctl	Control device
link	Link to a file
mknod	Make a directory or a special file
stat	Get file status
umask	Set file-creation mode mast
unlink	Remove directory entry
utime	Set file times
File access	
create	Create a file
open	Open for reading or writing
seek	Move read/write pointer
read	Read from file
write	Write to a file
close	Close a file
Process control	
chdir	Change default directory
chroot	Change root directory
exec	Execute a file
exit	Terminate process
fork	Spawn new process
setgid	Set group ID
setuid	Set user ID

The 24 system calls *that handle file control, file access and process control are intercepted by ALTOS-NET II, which determines if a call has network implications.*

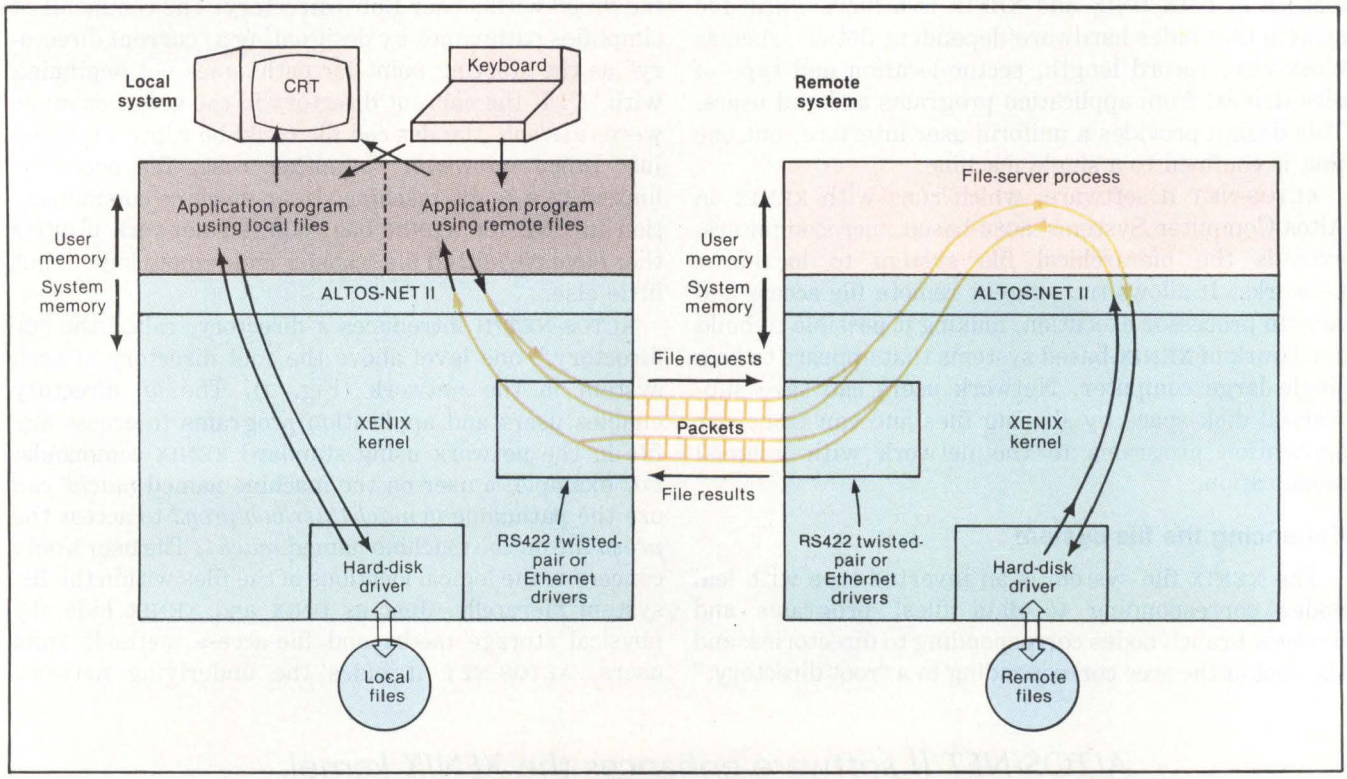

Fig. 2. Remote-file access *involves the same user interface as local-file access. ALTOS-NET II software intercepts each file request from an application program and determines whether the file is on the local or remote system. If local, the software passes the file request to the local operating-system kernel for normal processing; if remote, it transmits a packet to a file-server process on the remote system. From the standpoint of the remote system, the file-server process behaves as an application program requesting a local file.*

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Specification		WST Model Number (FDD)									
		100-8	200-8	100-5	200-5	111-5	121-5	211-5	221-5	112-5	212-5
Media Size (in.)		8.0	8.0	5.25	5.25	5.25	5.25	5.25	5.25	5.25	5.25
Heads (number)		1	2	1	2	1	1	2	2	1	2
Access:											
Track-to-Track	(msec)	3	3	20	20	5	3	5	3	20	20
Average	(msec)	91	91	275	275	80	110	80	110	275	275
Unformatted Capacity (Kbytes)	(FM)	400	800	125	250	125	250	250	500	125	250
	(MFM)	800	1600	250	500	250	500	500	1000	250	500
Track Density (TPI)		48	48	48	48	48	96	48	96	48	48
Drive Size (in.)	Height	4.5	4.5	3.25	3.25	3.25	3.25	3.25	3.25	1.62	1.62
	Width	8.55	8.55	5.75	5.75	5.75	5.75	5.75	5.75	5.75	5.75
	Length	14.25	14.25	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0

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sharing its file system. A 40M-byte file-server machine attached to four disk-less workstations would more economically provide each with 10M-byte storage than would separate disk drives and controllers.

Design trade-offs

All programs running under UNIX must make calls to the operating-system kernel when they require main-memory allocation, process creation and termination or file access. A typical UNIX implementation supports about 60 such calls to the operating system, of which 24 have networking implications (see p. 198). ALTOS-NET II software residing in the kernel intercepts these calls immediately after the request is made and determines whether to process the calls locally or remotely (Fig. 2). If the request is for a local resource, it is passed to the kernel for normal processing. But if the user program is requesting a resource on a remote machine, ALTOS-NET II constructs a request packet and transmits it over the network. A file-server process on the remote machine receives the request, calls its own kernel for processing and passes the results back to the requesting machine.

For each process having at least one remote open file, a corresponding process, residing on the remote machine, services the requests on its counterpart's behalf. This process is created when a program opens its first file on a remote machine and is terminated when the program closes its last remote file. Moreover, the creation and termination of processes occur automatically; neither users nor application programs are aware of it. There is a brief delay when a new file server is created; after that, the lag time resulting from network transactions is negligible (see "Benchmarking ALTOS-NET II," left).

Altos chose the implementation technique of invoking file-server processes that interact with a layer of software inside the OS kernel.

A special concern arises in implementing record and file locking in ALTOS-NET II. If a remote system goes down before releasing a locked resource, each file-server process periodically polls its corresponding requester process. If the requester fails to answer several consecutive polls, system failure or cable disconnection is assumed, and the server process releases all locks and terminates.

Altos chose the implementation technique of invoking file-server processes that interact with a layer of software inside the operating-system kernel over several other alternatives. One alternative could link the kernels on the various machines and forgo using file-server processes. Under this scheme, UNIX i-nodes, the primitive and normally hidden data about the location of files on a disk, would be passed from kernel to kernel. This approach suffers from the heavy amount of i-node traffic on the network, which could cause lengthy delays. Also, by passing UNIX internals over the network, the inclusion of other operating systems on the same network is all but impossible.

Another possible approach uses file-server processes but moves the interface layer from the kernel to a library of routines that is linked with each application program. Although such an implementation appears attractive because of the relative ease of debugging

BENCHMARKING ALTOS-NET II

Several performance measurements have been made on an operational ALTOS-NET II system. The system contained two Altos 586 systems connected by an RS422 twisted-pair cable. The Altos 586 system is based on a 10-MHz 8086 processor; the standard system comes with 512K bytes of main memory, an 8089-based hard disk controller, a 10M-byte hard disk (with an average seek time of 85 msec.) and a Z80-based communications processor. The Z80 controls the transmission and reception of packets on the network cable, and as many as five ASCII terminals attached to the system. The network uses the SDLC mode of the Zilog SIO chip and standard RS422 drivers to transmit data at 800K bps.

The measurements show the time required to load and run the *cp* file-copying utility. Benchmark 1 is the "control case" that employs no network requests. Benchmarks 2, 3 and 4 are "worst-case" network tests in that virtually no local processing is done between disk and network requests.

Benchmark 1:
cp big1 big2 — Copy 315K bytes from big1 to big2 on the same machine.
CPU time = 6.9 seconds; Real time = 32 seconds.

Benchmark 2:
cp big1 @dept2/big2 — Copy 315K bytes from the local machine to a remote machine.
CPU time = 10.7 seconds; Real time = 48 seconds.

Benchmark 3:
cp @dept2/big2 big1 — Copy 315K bytes from a remote machine to the local machine.
CPU time = 6.6 seconds; Real time = 43 seconds.

Benchmark 4:
cp @dept2/big2 dept2/big2 — Copy 315K bytes from a remote machine to the same remote machine.
CPU time = 10.2 seconds; Real time = 80 seconds.

Benchmarks 2 and 3 indicate that it is slightly more efficient to read from a remote system than to write to a remote system; this is due to the effects of XENIX's read-ahead buffering algorithms. Benchmark 4 shows the worst-case performance that can be expected from a disk-less workstation.

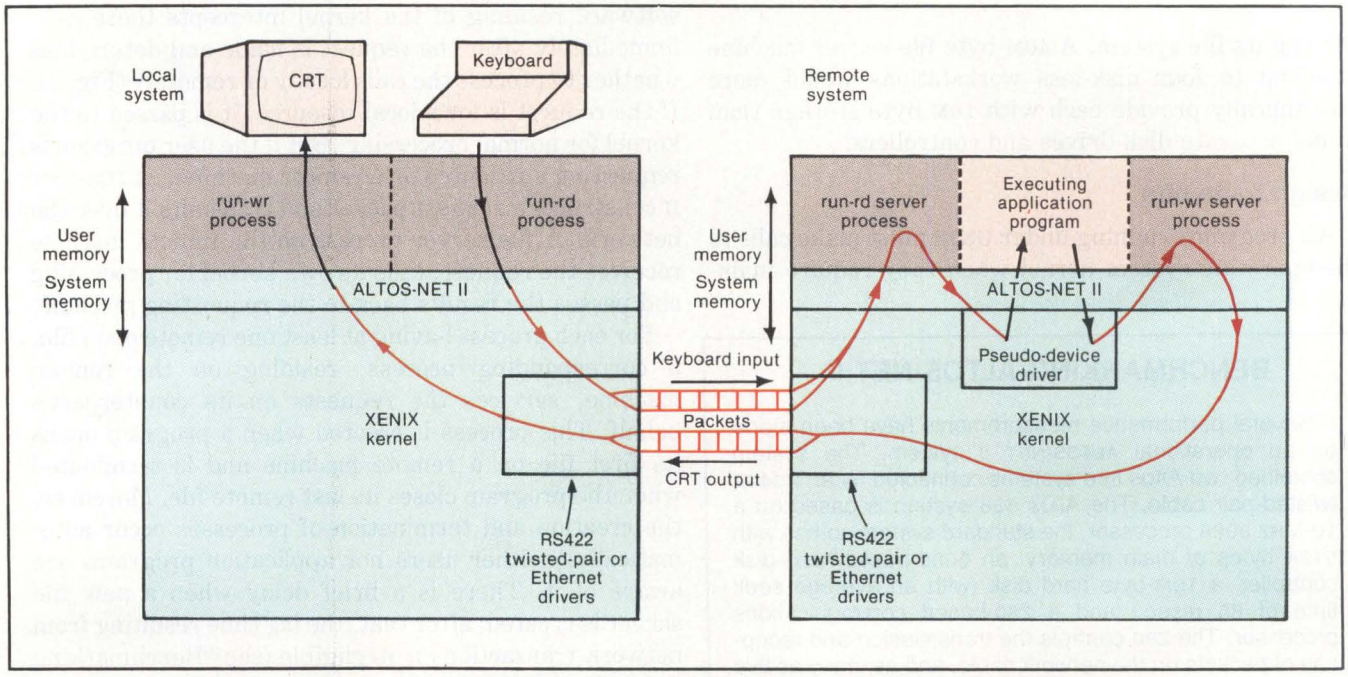

Fig. 3. Remote-program execution *is directed by ALTOS-NET II's* run *utility, which creates four processes that read and write packets transmitted between systems. Once the* run *utility is invoked, the user interface for remote processing is identical to the user interface for local processing. In the remote system, a pseudo-device driver communicates with the application program, functioning as a "logical" keyboard and CRT for the application.*

software outside the kernel, the interface layer of about 8K bytes of code would have to be included with each application, causing a significant reduction in memory available for user programs. Moreover, all applications would have to be relinked with the new library before they could function in the network.

Remote-processor execution

ALTOS-NET II supports remote-processor execution, which works with remote-file access. A network can contain as many as 32 Altos 8086- and MC68000-based systems. Mixing processors allows specialization; for example, some processors can be configured with large memories, while others offer floating-point capability.

An ALTOS-NET II utility called *run* executes a program on a remote processor yet makes it appear as if it were executing locally. The utility is especially applicable to large networks containing a variety of computers that are each capable of running a different set of applications. While running a program on a remote computer, a user can access files from yet a third machine.

The *run* utility works by initiating four processes and using a pseudo-device driver to exchange information between local I/O devices and the remote processor. When a *run* request is made, the utility sends a start-up packet to the server machine, and both the *run* utility and *run* server processes split into two subprocesses: *run-wr* and *run-rd* on the requesting machine and *run-wr-server* and *run-rd-server* on the server (Fig. 3). The *run* utility then sends a set of packets to the server containing the name of the program to be executed, the user's security information and the user's working directory. All keyboard input from the requester is constructed into a packet and sent to the *run-wr-server* on the remote machine, which writes it to a pseudo-device driver in the kernel. Similarly, screen output is sent from the driver to the *run-rd-server*, which constructs a packet and transmits it back across the machines to the *run-rd* process. In both cases, the pseudo-device driver acts as the stand-in for the user's terminal.

At the lowest level of communication, both transparent file access and remote-processor execution use a subset of Xerox Corp.'s Internet packet-exchange protocol to assure reliable data transmission. Because this protocol is relatively simple, ALTOS-NET II implements it entirely within the kernel for maximum network efficiency. □

Peter Kavaler is product manager for networking communications, and **Alan Greenspan** is a software engineer with Altos Computer Systems, San Jose, Calif.

Will Fujitsu's SCSI INTERFACE Please Stand Up?

For some time now, the disk drive industry has talked about the SCSI Interface. But all this talk has resulted in very little action. Until now. Today a leader in the SMD market is offering their OEM customers the option of the SCSI Interface. That leader is Fujitsu America Inc.

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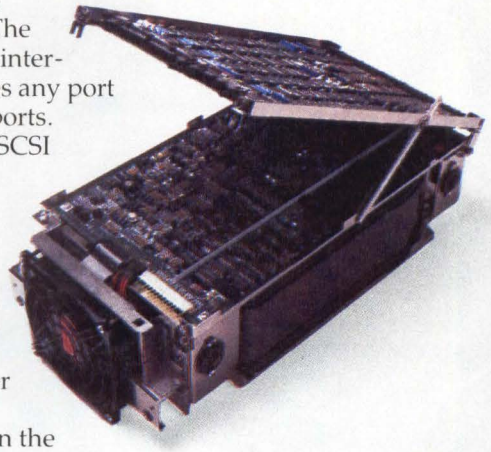

Fujitsu America now offers the state-of-the art SCSI interface option on the high performance 8" M2312 drive which has a capacity of 84 MB and an average positioning time of 20 ms. Previously this drive was only available with an SMD interface.

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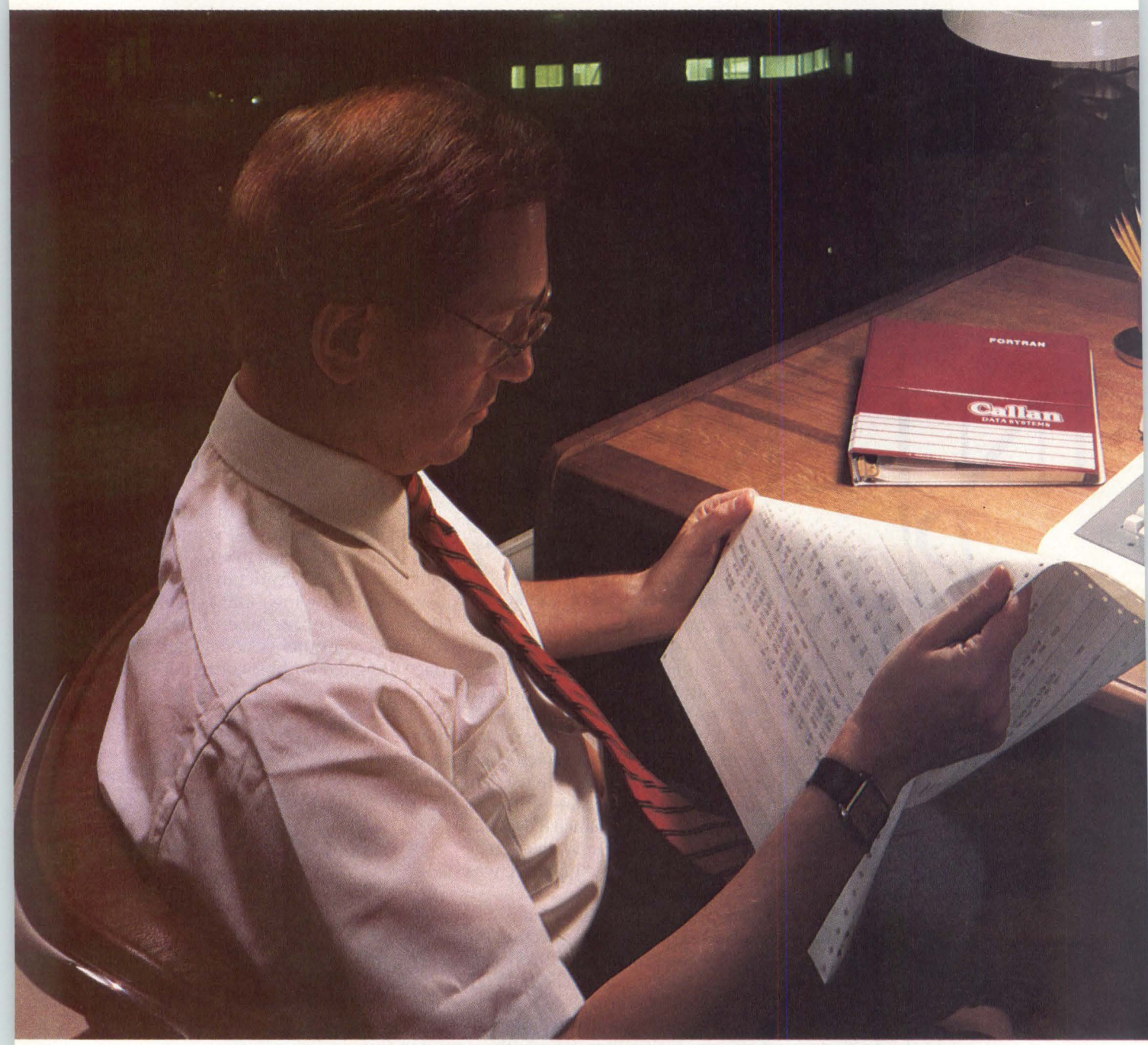

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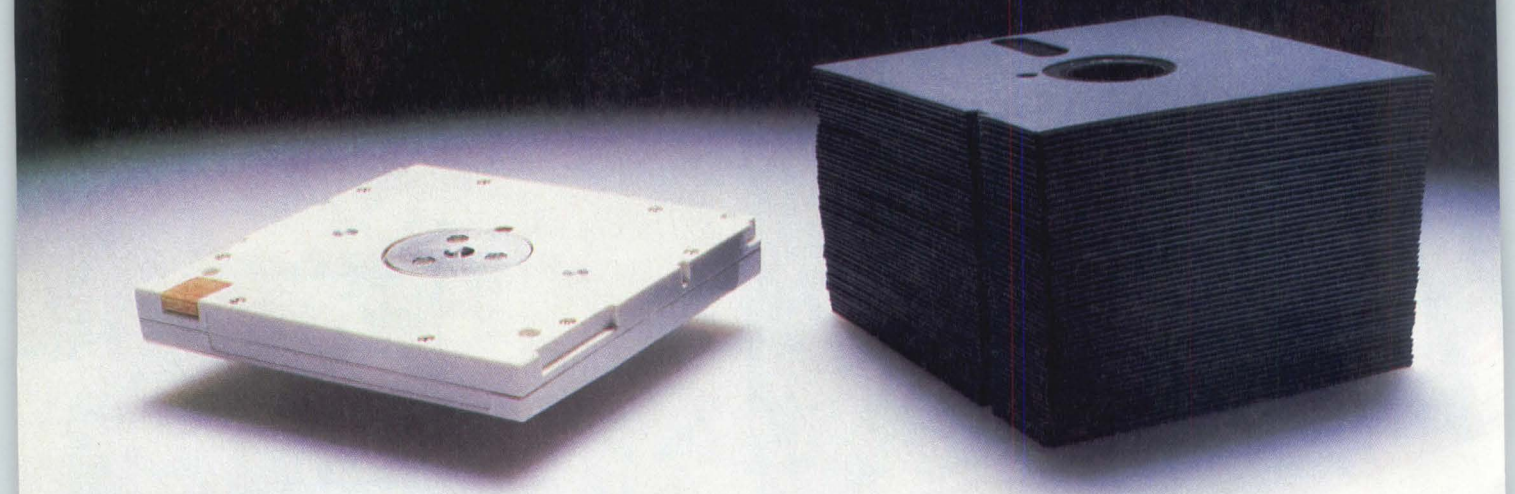

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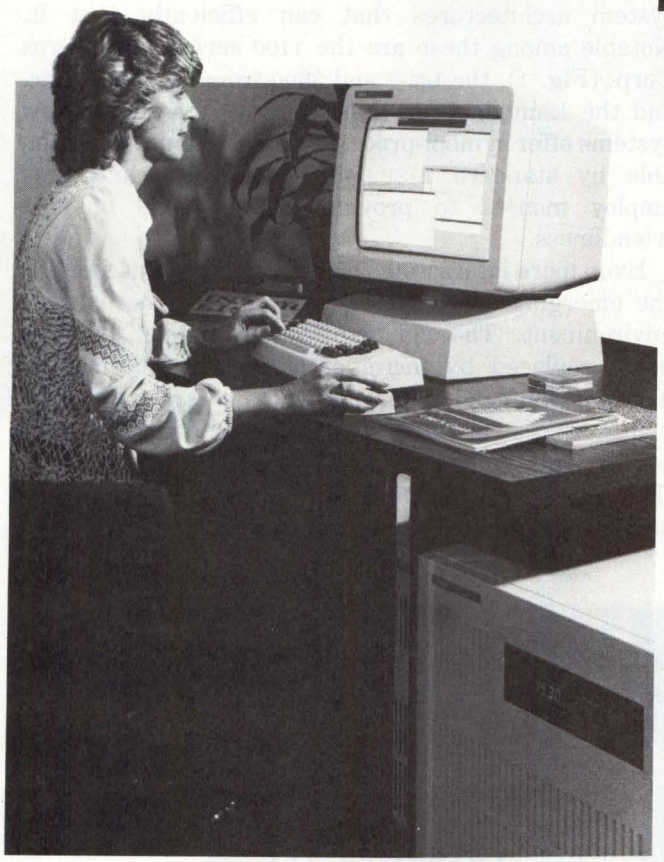

Fig. 1. The Xerox 1100 computer system *provides an interactive LISP programming environment with 8M bytes of virtual address space. Standard features include a 23M-byte disk, a network interface and a 1024- × 808-pixel display. A three-button mouse (under operator's right hand) supplements a 64-key keyboard.*

The 1982 conference of the American Association for Artificial Intelligence demonstrated that artificial intelligence, traditionally an academic field, is finally starting to attract the attention of bottom-line-oriented business managers. The percentage of attendees from private industry was higher than ever, and the exhibition included several real products complete with specification sheets and model numbers.

Although artificial intelligence is a diverse field, including natural-language processing and computer vision, most progress in AI has been achieved by using computers to simulate human experts in narrowly defined subjects. Using heuristic approaches and novel programming environments, these "expert systems" constitute an exciting and profitable new class of computer applications.

Three kinds of knowledge

Most computer systems represent a distillation of task-specific knowledge that can be implemented as a set of programs and data structures. For example, in a simple industrial-control system, all the necessary "knowledge" might be stored in the form of a few values in a program table. But for a machine to be intelligent, it must incorporate not only factual knowledge, but also heuristic and "meta-knowledge."

Heuristic knowledge consists of intuitions, judgment rules, pet theories and inference procedures that, in concert with factual knowledge about a subject, allow a human expert to exhibit intelligent problem-solving behavior. While it has a vaguely procedural flavor about it, heuristic knowledge is much more abstract than what is generally called "software."

Meta-knowledge is even more general and abstract. It is perhaps best described as a nonsymbolic awareness of how to think—how to approach and organize an unfamiliar problem so that both heuristic and factual knowledge are effectively applied.

The more heuristic knowledge a system has, the less it must search for a specific datum. The less searching it

must do, the less bogged-down it will be when confronted with a highly associative task such as visual pattern recognition. The more meta-knowledge a system has, the more it can learn from experience and refine its behavior.

The essence of knowledge engineering is the integration of factual, heuristic and meta-knowledge into a practical system. There are various approaches, ranging from collections of "production rules" (IF-THEN structures) to relatively passive "semantic networks" consisting of knowledge entities whose interrelationships are defined by lists of properties and linkages. Whatever the approach, a key issue is the naturalness of expression in both the "teaching" of the system and in its subsequent application.

Novel programming environments

The advent of knowledge processing has spurred new programming environments that facilitate problem solving. A significant development is the resurgence of LISP—one of the oldest surviving computer languages. Developed by John McCarthy of the Massachusetts Institute of Technology's Artificial Intelligence Lab in 1958, LISP has become the most widespread implementation language for intelligent systems. Possessing major philosophical differences from most computer languages, it has spawned development of specialized system architectures that can efficiently host it. Notable among these are the 1100 series from Xerox Corp. (Fig. 1), the LM-2 and 3600 from Symbolics Inc. and the Lambda from LISP Machine Inc. These new systems offer symbol-processing performance unattainable by standard LISP implementations, and they employ mouses to provide a high level of user friendliness.

Even more interesting than the new LISP machines is the emerging concept of an integrated programming environment. The old "edit-compile-debug" cycle is being replaced by incremental compilation, maintenance of command histories to undo errors and display managers to provide dynamic windowing that is conceptually similar to pieces of paper on a desk top (Fig. 2). Such intelligent development tools portend signficant increases in programmer productivity.

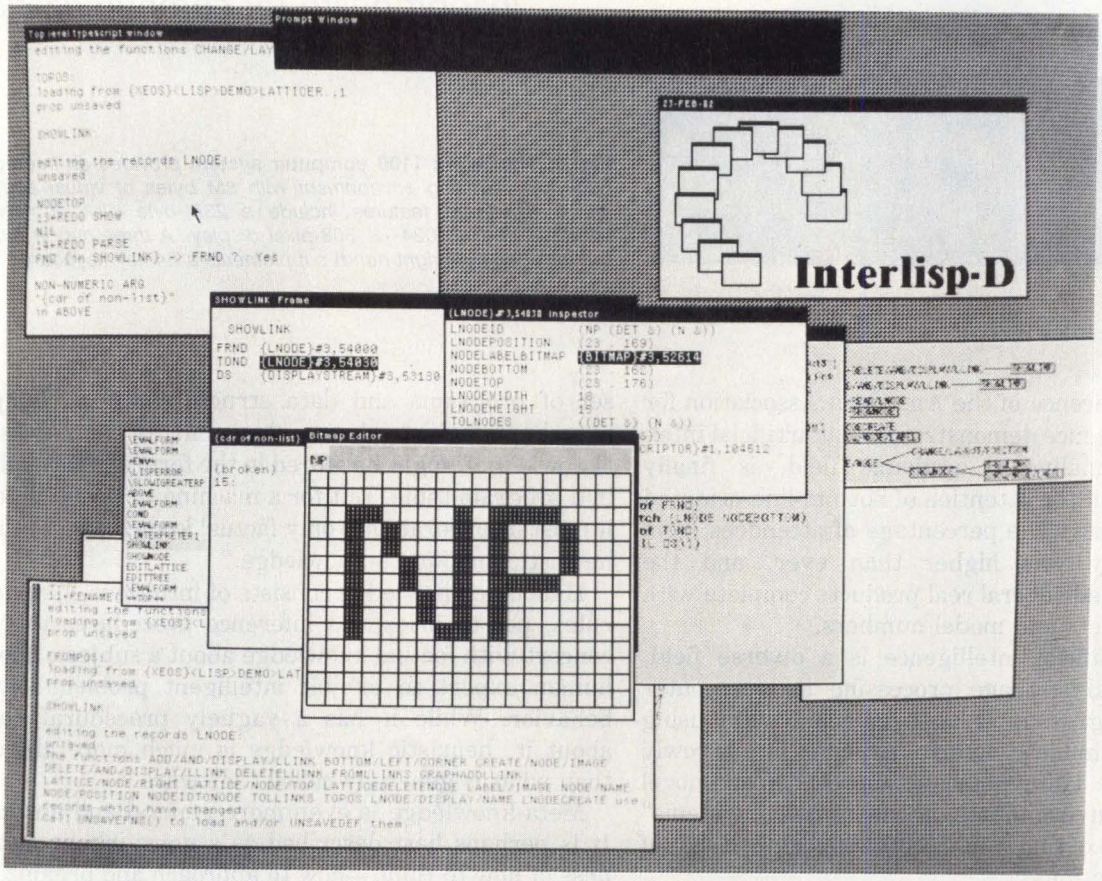

Fig. 2. Display "windowing" on the Xerox 1100 *allows several user tasks to be represented graphically in a way that reveals their interrelationships. Each task can be modified and redisplayed without global recompilation. A record is kept of all commands and their results, so that the user can back up and undo operations without the havoc that might normally be expected.*

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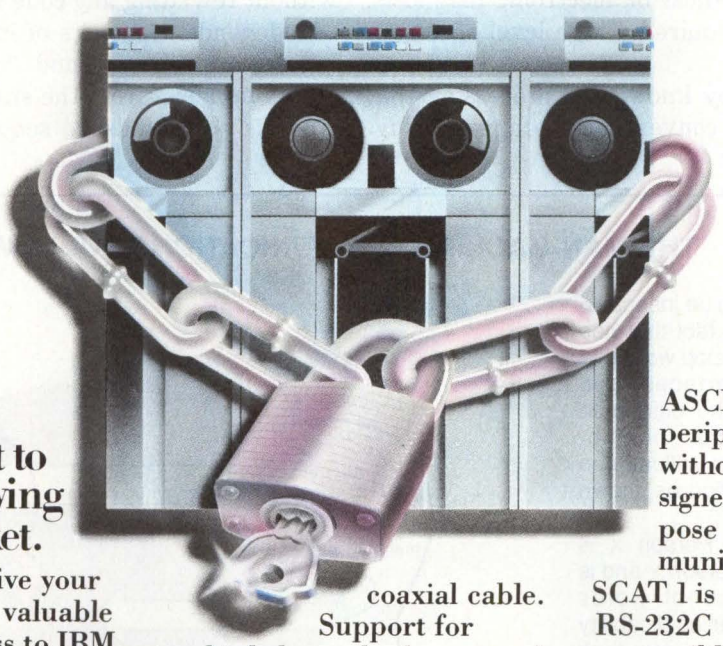

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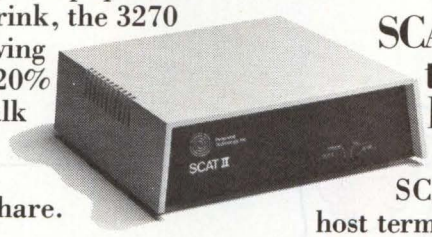

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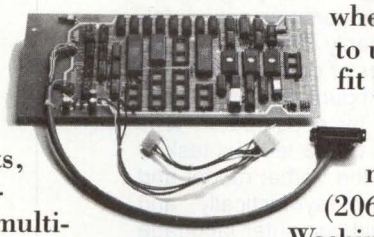

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Intelligent expert systems

The most practical applications of knowledge processing are in building systems geared to narrowly defined applications, such as medical or electronic diagnosis, that traditionally have required a high level of human expertise.

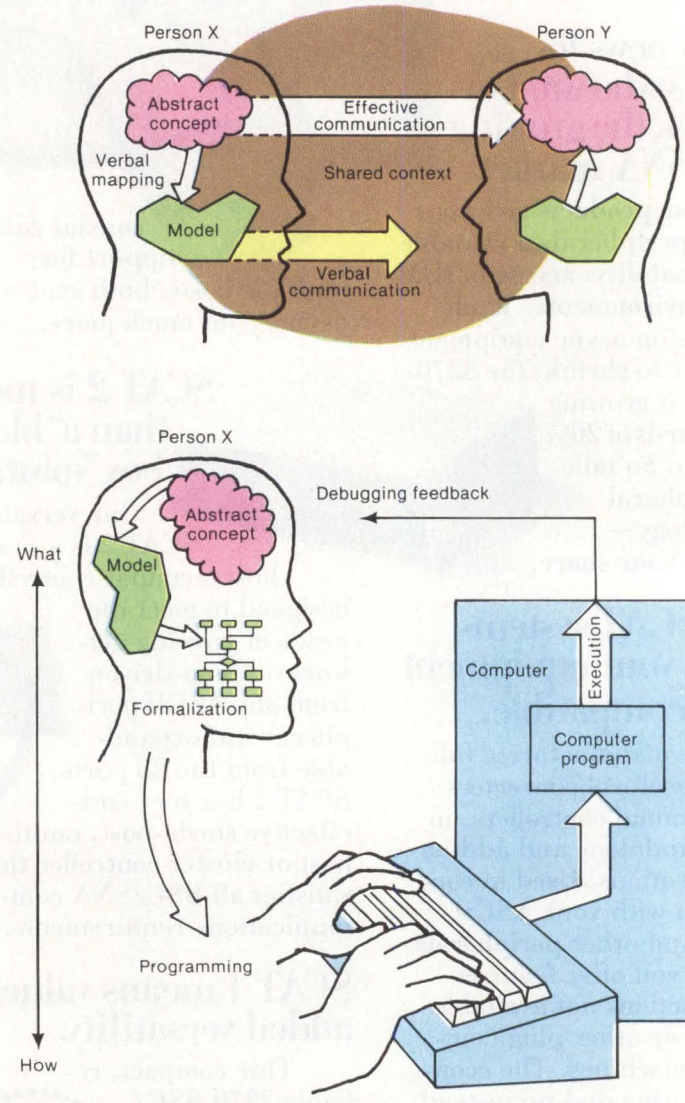
Expert systems employ knowledge processing that differs dramatically from conventional data processing. In conventional data processing, problems are solved through explicit algorithms in a procedural language. For example, database manipulation is performed through predefined operations on a data structure. This approach lends itself well to automating routine processes and organizing predictably interrelated data. But knowledge processing implies a different structural flavor. New facts and relationships can be added without rewriting any code because they take the form of independent packets of information. The distinction between "program" and "data" almost entirely dissolves because, from the standpoint of the application, there is no established sequential procedure. Internal

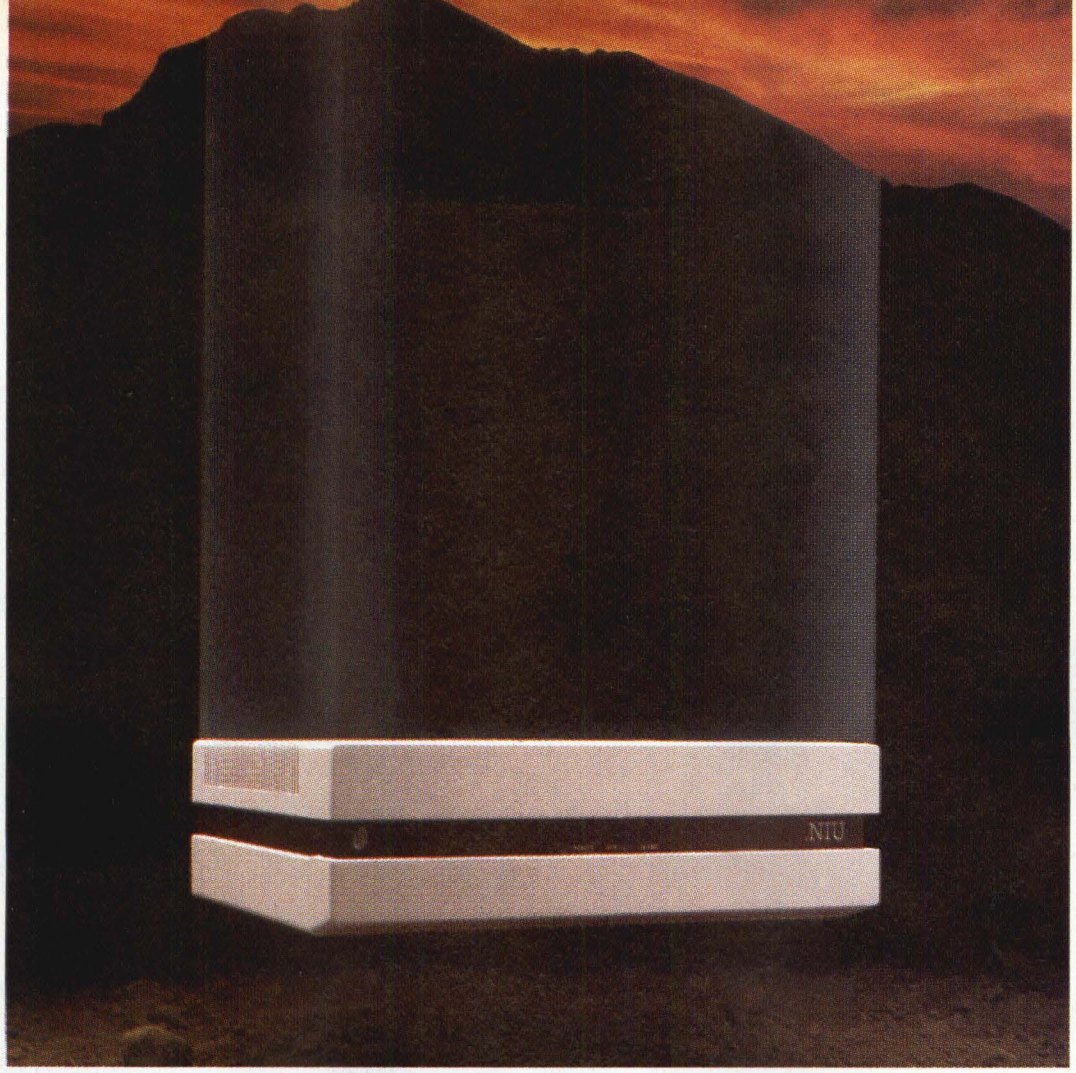
THE MAN-MACHINE COMMUNICATION PROBLEM

Language is proving to be inseparable from intelligence—a fact that has stymied attempts to develop workable natural-language interfaces and translation programs. The difference between human and human-computer communication is illustrated by the upper and lower figures shown here.

In the upper figure, Person X is expressing an idea to Person Y and is delivering a sequence of words chosen not only for their applicability to the "model" but also for their appropriateness to the listener. The choice of words is made on the basis of the *shared context,* a constantly growing body of knowledge that links the participants. If X is successfully fitting the words to the context, then Y can create a corresponding model of the idea and gradually project it "upward" into abstract conceptual space. New information is added to the shared context throughout the conversation. If X misjudges the shared context, communication falters; if X suddenly changes it, the result is laughter or confusion.

In the lower figure, Person Y has been replaced by a computer. X is now confronted with a tedious task: X must formalize the verbal model and express it in a syntactically and semantically rigid computer language without a shared context. X begins with an idea of *what* X wants the system to do, them dons a formal intellectual straitjacket to tell it exactly *how*. This gives rise to the idea of a *what-how* spectrum, with microcode and assembly language near the bottom *(how)* and human dialog near the top *(what)*. Until a shared context can be created, human-computer communication will continue to be awkward. Thus, AI techniques are prerequisite for a truly friendly system.





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to an expert system is an infrastructure of inference procedures, probably written in a symbolic programming language such as LISP. But this infrastructure operates exclusively at the meta-knowledge level. All knowledge associated with the application itself is embodied in a flexible and relatively unstructured database. Given a sufficiently limited application domain, this approach permits a system to draw inferences from its stored knowledge in ways that were not anticipated at the time of its creation. Further, the expert system can explain its conclusions, deal with incomplete input data and know enough about what it *doesn't* know to generate follow-up queries.

These capabilities suggest a class of applications quite distinct from those normally considered for computerization. Teknowledge Inc. points out, "Knowledge systems are particularly useful in situations where expertise is scarce, different parts of the expertise are distributed among many people or the expertise is simply not available on a reliable or continuing basis."

Also suitable for expert systems are operations in which there is a heavy dependence on experts who are overworked to the point at which considerable delays in production are caused. In engineering, this often occurs when the "resident wizards" spend an inordinate amount of time with repair personnel, sales representatives, potential customers and vendors simply because the experts are the only ones who know a company's

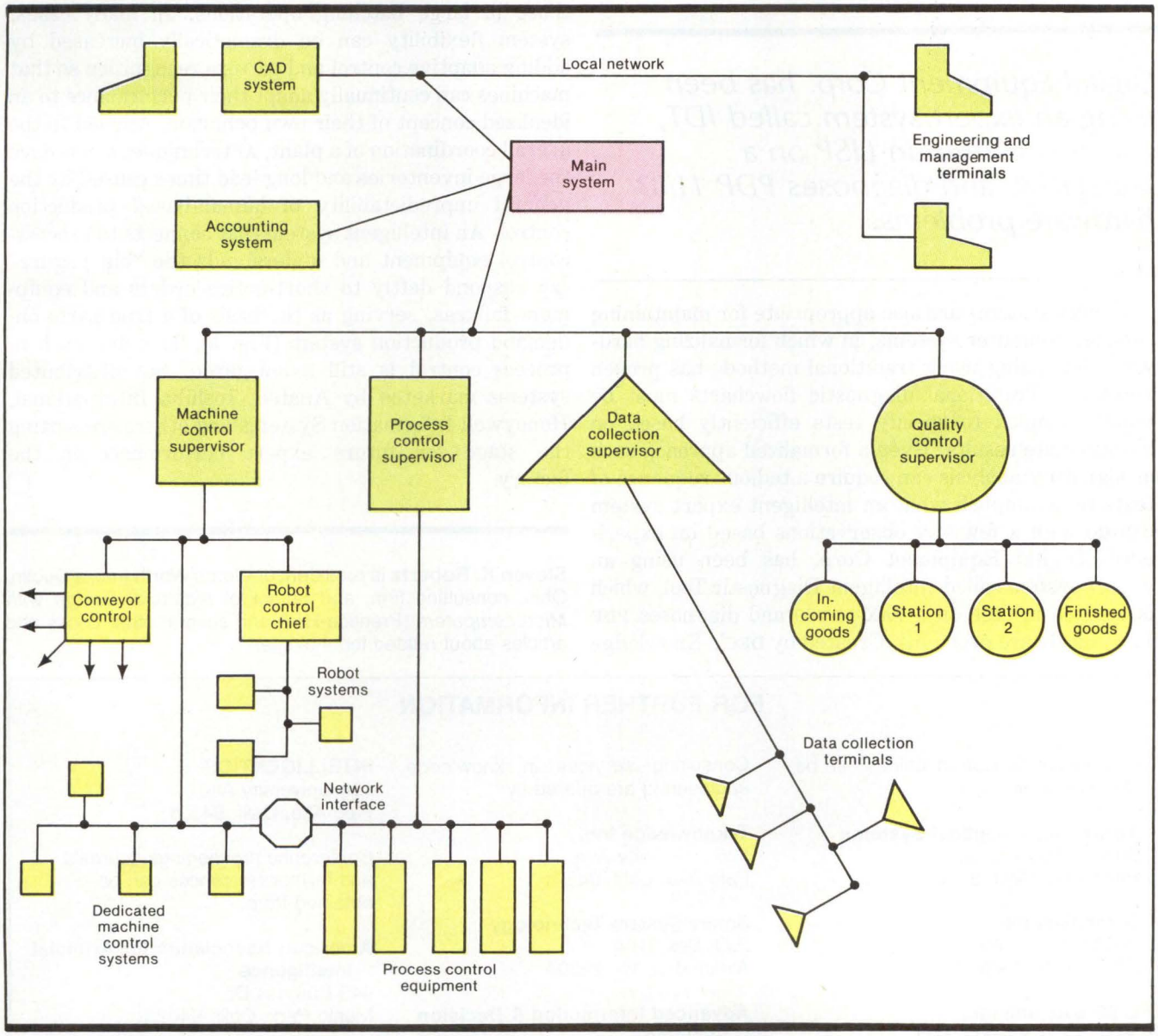

Fig. 3. A factory-wide hierarchical network *contains high-level systems that are isolated from the details of subordinate tasks. The main system, which in many conventional designs carries the entire processing load, serves here only to schedule and control global activity at a relatively abstract level. This is an ideal environment for implementing artificial-intelligence techniques, since the hierarchical network can host real-time "smart" software without compromising process-control response time.*

product well enough to answer everybody's questions.

In electrical engineering, expert systems are becoming justifiable in VLSI design, printed-circuit-board layout, high-level machine diagnostics and customized system configuration. VLSI design is profiting from the application of knowledge-engineering techniques. Work under way in Palo Alto, Calif., at Xerox's Research Center and at Stanford University is enabling a knowledge-based system to become an expert assistant for VLSI designers. Knowledge is derived from the Mead and Conway textbook, *Introduction to VLSI Systems* (Addison-Wesley, 1980), and from examples provided by human practitioners.

Digital Equipment Corp. has been using an expert system called IDT, which is written in LISP on a VAX-11/780 and diagnoses PDP 11/03 hardware problems.

Expert systems are also appropriate for maintaining complex computer systems, in which formalizing hardware debugging using traditional methods has proven awkward. Traditional diagnostic flowcharts must be highly complex to specify tests efficiently based on intermediate results. Even a formalized approach such as signature analysis can require a tedious sequence of tests to accomplish what an intelligent expert system can do with a few key observations based on experience. Digital Equipment Corp. has been using an expert system called Intelligent Diagnostic Tool, which is written in LISP on a VAX-11/780 and diagnoses PDP 11/03 hardware problems. Created by DEC's Knowledge Engineering Group, South Lawrence, Mass., IDT runs tests, interprets the results and suggests specific card replacements to an on-site technician. The system learns from experience, considers human opinions and applies statistical information so that testing is biased toward frequent problems.

Other applications suitable for expert systems are those in which large quantities of routine data must be monitored closely by a highly knowledgeable expert for a suitable combination of conditions that may represent a problem. This situation is common in the control of critical industrial processes such as nuclear power plants, turbines and large furnaces. A pattern of activity may suggest imminent failure, even though no alarm conditions exist. Such applications are complicated by the need for quick judgments and responses.

Installations that can profit from knowledge engineering include distributed process-control systems such as those in large batching operations. In many cases, system flexibility can be dramatically increased by adding adaptive control and pattern recognition so that machines can continually adapt their performance to an idealized concept of their own behavior. Applied to the overall coordination of a plant, AI techniques can reduce the large inventories and long lead times caused by the general unpredictability of human-based production control. An intelligent system that connects to process-control equipment and understands the "big picture" can respond deftly to short-notice orders and equipment failures, serving as the basis of a true parts-on-demand production system (Fig. 3). This approach to process control is still avant-garde, but distributed systems marketed by Anatec, Toshiba International, Honeywell Information Systems and others are setting the stage for future expert performance in the factory. □

Steven K. Roberts is president of Words'Worth Inc., a Dublin, Ohio, consulting firm, and author of *Industrial Design with Microcomputers* (Prentice-Hall) and several other books and articles about related technologies.

FOR FURTHER INFORMATION

Information on LISP machines can be obtained from:

Xerox Electro-optical Systems
300 N. Halstead St.
Pasadena, Calif. 91107

Symbolics Inc.
9600 De Soto Ave.
Chatsworth, Calif. 91311

LISP Machine Inc.
3916 S. Sepulveda Blvd.
Culver City, Calif. 90230

Consulting services in knowledge engineering are offered by:

Teknowledge Inc.
525 University Ave.
Palo Alto, Calif. 94301

Smart System Technology
P.O. Box 9164
Alexandria, Va. 22304

Advanced Information & Decision Systems
201 San Antonio Circle, Suite 286
Mountain View, Calif. 94040

INTELLIGENTICS
124 University Ave.
Palo Alto, Calif. 94301

Conference proceedings, journals and further references can be obtained from:

American Association for Artificial Intelligence
445 Burgess Dr.
Menlo Park, Calif. 94025

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Universal diskette reader resolves different formats

BILL OTT and JERRY RUOFF, Applied Data Communications Inc.

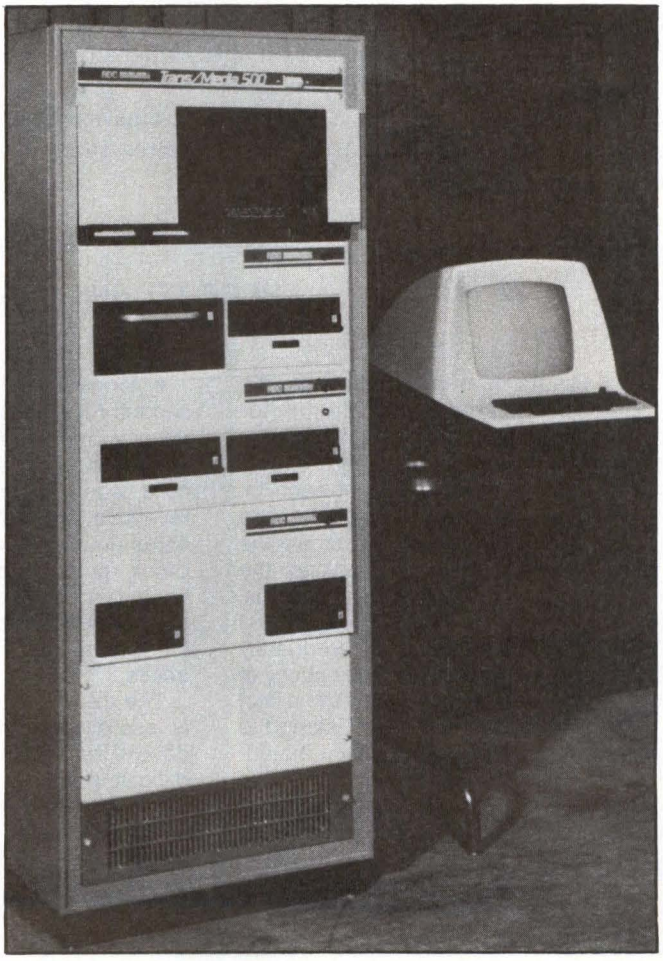
Programs, text and databases can be transported across system boundaries

Different file directories, floppy disk sizes, densities, encoding techniques and timing margins can cause big problems for system integrators and end users who want to use the same floppy disk with different computer systems. New high-capacity disks and uncommon data formats also present logical and physical incompatibilities.

One solution to these problems is the Trans/Media 500 media-translation system from Applied Data Communications Inc. It solves the problem of incompatible media formats by using a Z80A microprocessor and BASIC translation routines to resolve logical format differences. A slave microcontroller translates physical differences between the source and destination diskettes.

Resolving logical differences

The Z80 host processor is bused to 64K bytes of RAM; 4K bytes of EPROM; and controllers for floppy disk drives, magnetic-tape drives, 10M-byte hard disks and line printers. The processor is also linked to four serial asynchronous I/O ports and a fifth port that drives the system keyboard terminal (Fig. 1).



A typical Trans/Media 500 configuration *includes a Cipher Data F880 nine-track, 1600-bpi streaming-tape drive, an 8-in. Memorex 651 floppy disk drive, three 8-in. Shugart 850 drives, a 5¼-in. Shugart 450, a 5¼-in., Micro Peripherals B52 and a Lear Siegler ADM 3A terminal. This configuration is priced at $32,900; the base price of the TM-500 is $15,800.*

The TM-500 is designed for diskette-to-diskette translation, but can also handle as many as four 800- or 1600-bpi tape drives and as many as two 10M-byte hard disks as I/O media. When the system is used as the front end of vendor-integrated turnkey systems (such as phototypesetters, laser printers and computer-output microfilm), the translated output files are sent directly to the host equipment over one of the asynchronous ports.

If the translated data are targeted for systems with floppy disk drives, the TM-500 directs the output to the appropriate disk size. The system accommodates 8-, 5¼- and 3½-in., hard- and soft-sectored, single- and double-sided, single- and double-density, and frequency-modulation, modified-FM and modified-MFM recording diskettes (see "Three techniques for writing a disk," below). Virtually any source/destination combination of floppies, magnetic tape or hard disks is possible.

The host processor manipulates the formatted data files from the source media for input to the destination media. The format-shuffling routines are written in BASIC. Under control of the format-translation programs, the system translates information in four phases. It reads sectors from the source disk to obtain file-directory information, locates source files and their descriptive parameters, such as length, where the file starts, which sectors it occupies and all other data that define source files, creates a file on the destination disk and reads the source records and replicates them as destination files.

Sectors are read one at a time and buffered in RAM. Before being written to their destinations, records are processed by character- or string-translation routines or by any available programmed routines. Each source/destination pair requires an individual task and a specific BASIC program. A total of 90 programs that translate between the most popular disk, tape and port formats is available. Each TM-500 system includes a user-selectable set of six of these programs.

Custom programs can be written on-site or ordered from the factory. The application programs run under Applied Data Communications' MICRO DOS BASIC and typically can be written within a week.

Translating physical differences between floppies

A "formatter subsystem," based on a machine-language program, resolves the physical differences between input and output media. The subsystem is configured with an 8X300 microcontroller, local RAM, ROM and controllable hardware elements (Fig. 2). The formatter off-loads control data from the host and enables the system to read and write more than 230 data formats. Control information for 20 physical parameters is down-loaded from the host in four blocks. The first block establishes physical format parameters, such as the technique for reading or writing data, the number of holes punched in the disk (if it is hard sectored), the number of sectors to be written per track, the number of bytes per sector, the sizes of gaps

Fig. 1. The media-translation system architecture *includes an 8-bit Z80A microprocessor, 64K bytes of RAM, 4K bytes of EPROM and controllers for a wide variety of I/O devices. These elements are linked via an Applied Data Communications proprietary bus. The Z80A resolves logical differences, and the formatting subsystem handles physical differences between diskettes.* ►

THREE TECHNIQUES FOR WRITING A DISK

• **Frequency modulation** is the earliest successful technique for encoding data. The two rules for FM data recording are that there should be a pulse in the middle of each bit cell that contains a logical ONE and that an additional pulse must mark the start of each bit cell, making the technique self-clocking and, thus, very stable.

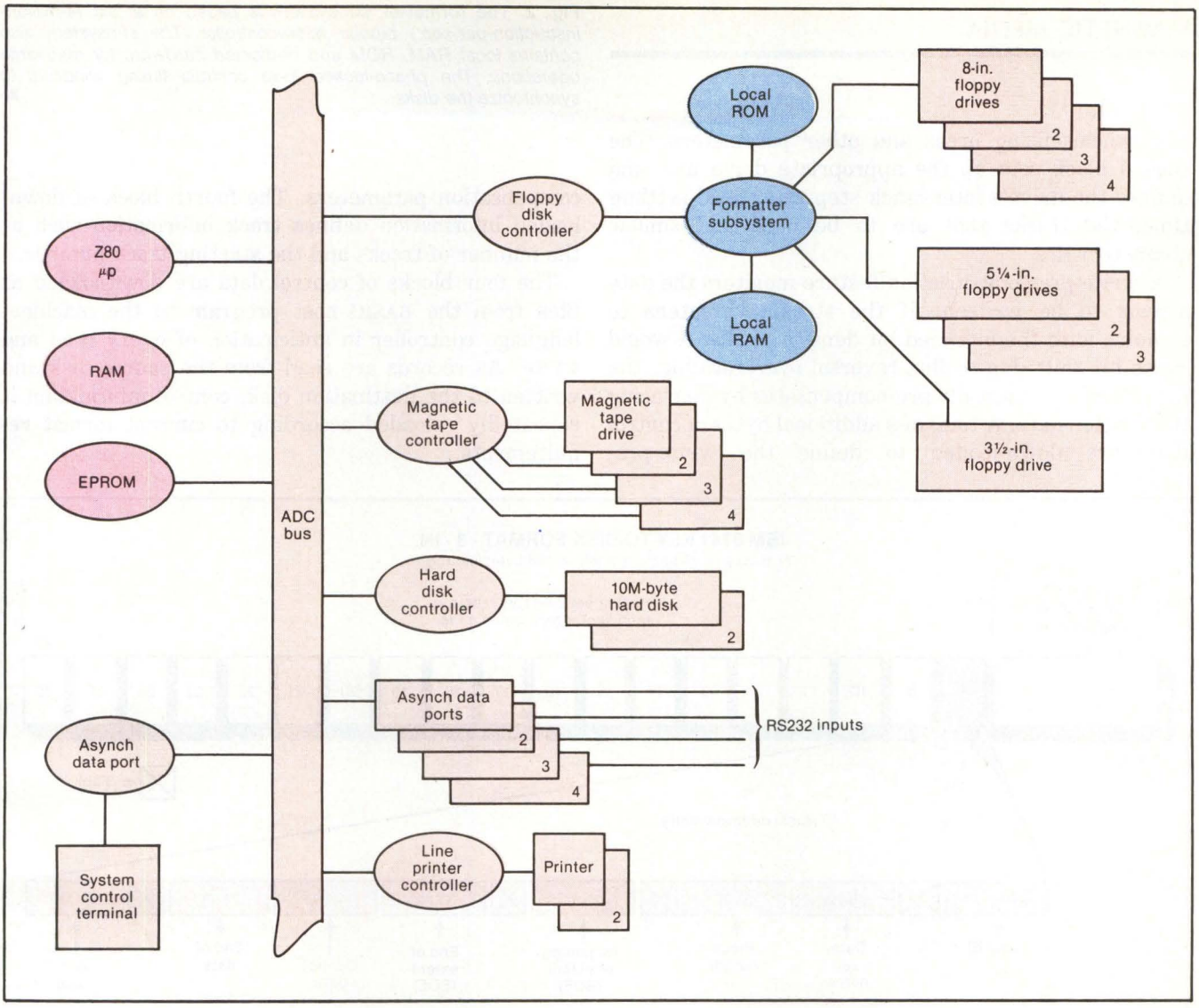
The technique is called "frequency modulation" because the frequency of read pulses is modulated by the mix of ONEs and ZEROs appearing along the recorded track. The primary advantage of FM recording is the stable clocking of the drive's read electronics; the primary disadvantage is an inefficient use of recording space. Disk density is decreased because of the space used by the clock pulses.

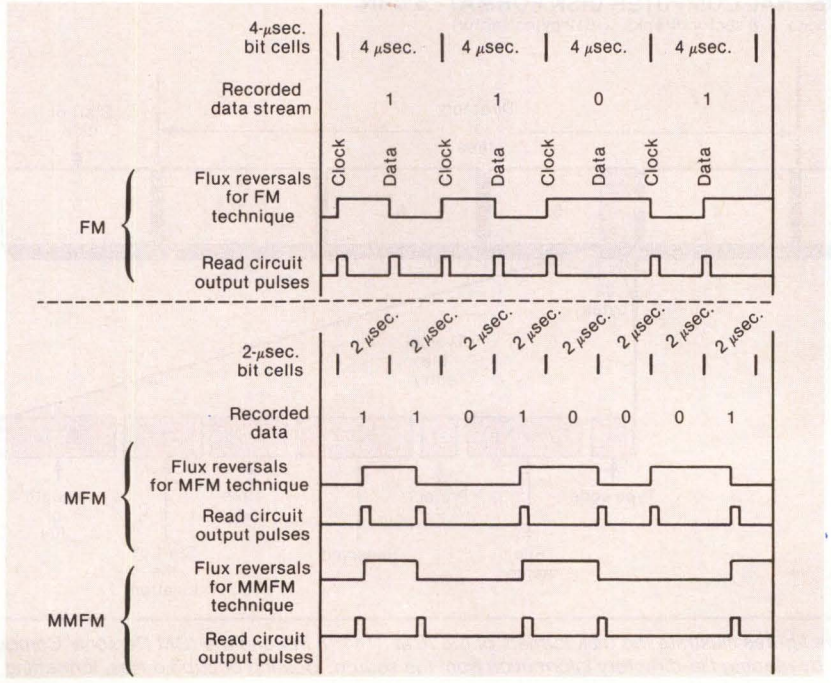
• **Modified FM** modifies FM's second rule to increase the useful bit density on recorded tracks. MFM records clock pulses only between bit cells when there are no data flux reversals within the cell. This eliminates double pulses for each bit cell. Clock pulses appear only at the beginning of cells containing ZEROs that follow other ZEROs. This doubles the information capacity of recorded tracks.

The disadvantage of this technique is less accurate timing control of the drive's read circuits, making it more difficult to decode data properly. This requires more complex timing circuits, which translates into higher cost. However, the benefits of more memory capacity and a higher data rate justify the increased price.

• **Modified MFM** was developed to decrease bit shift due to flux reversal overcrowding, which occurs when overcrowded bits on a magnetic media begin to push themselves out of position. This phenomenon is largely a result of high linear bit density. In MMFM recording, FM's first rule—a pulse in the middle of a bit cell defines a ONE—remains the same, but the second rule is modified to reduce the incidence of overhead clock pulses. If three ZEROs appear in a row, a clock pulse is recorded only at the beginning of the second bit cell.

Timing diagrams for three recording techniques *illustrate the advantages of MFM over FM recording—twice the data density and fewer read-circuit pulses. The slight advantage of MMFM over MFM recording does not justify the added cost.*





The intent of MMFM was to improve the read margins for still more density, but the use of MMFM became a moot point when IBM Corp. adopted MFM and established it as a de facto standard. MMFM's additional data capacity and lower error rate were not cost-justified.

In addition, semiconductor firms entered the market by introducing integrated-circuit controller chips that are programmable for FM and MFM, but not for MMFM. MMFM technique has fallen into disuse because of costly drive electronics, stress on the read circuits, the availability of off-the-shelf ICs for FM and MFM and IBM's de facto standard.

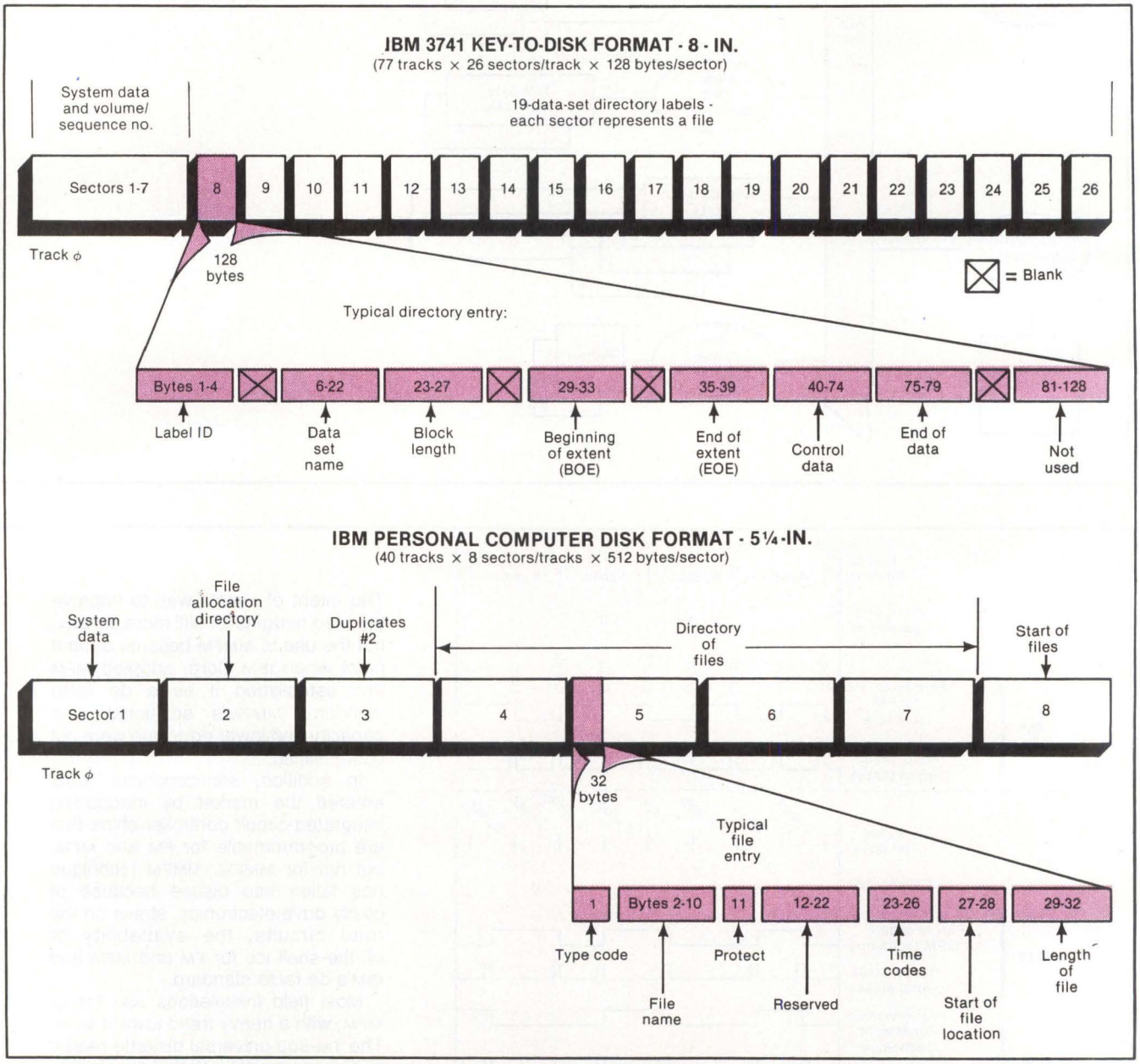
Most field installations use FM or MFM, with a heavy trend toward MFM. The TM-500 universal diskette reader can accommodate all three recording techniques.

Fig. 2. The formatter subsystem *is based on a fast (4-million-instruction-per-sec.) bipolar microcontroller. The subsystem also contains local RAM, ROM and dedicated hardware for read/write operations. The phase-locked loop controls timing windows to synchronize the disks.* ►

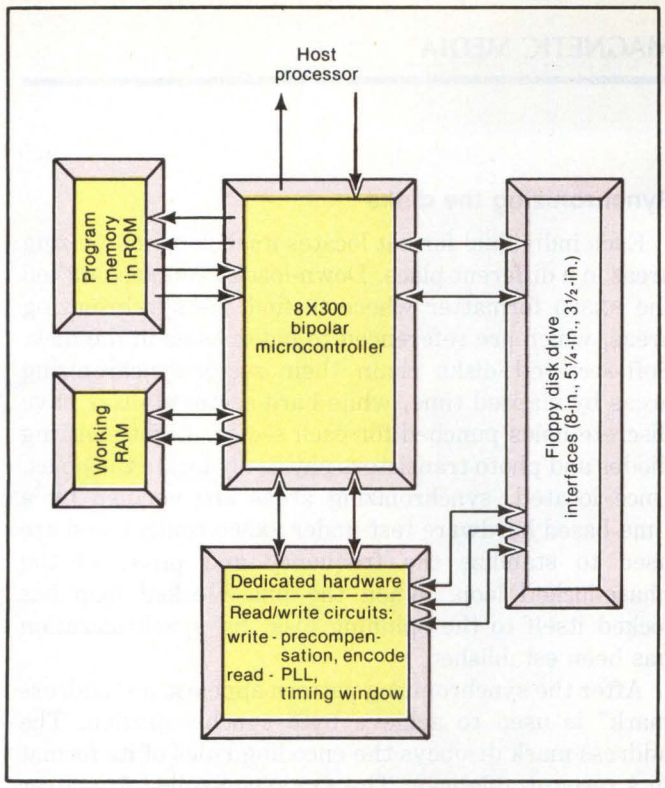
and synchronizing areas and other parameters. The second block sets up the appropriate drive unit and defines the drive's inter-track step rate, head settling time, the tracks that are to be used and similar characteristics.

A write-pre-compensation feature monitors the data stream to be written. If the stream threatens to combine with the intended bit density so that it would cause bit shift due to flux-reversal overcrowding, the formatter automatically pre-compensates by displacing the written data. A total of 8 additional bytes of control data are down-loaded to define the write-pre-compensation parameters. The fourth block of down-loaded information defines track information such as the number of tracks and the starting track number.

The four blocks of control data are down-loaded as files from the BASIC host program to the machine-language controller in anticipation of every read and write. As records are read from the source disk and written to the destination disk, control information is repeatedly reloaded according to current format requirements.



Formats vary widely, even within IBM. *The above figures illustrate the disk formats of the IBM 3741 (8 in.) and the IBM Personal Computer (5¼ in.). The TM-500 resolves the different formats by reading file-directory information from the source, locating occupied files, formatting the destination disk and transferring the source records to the destination disk.*



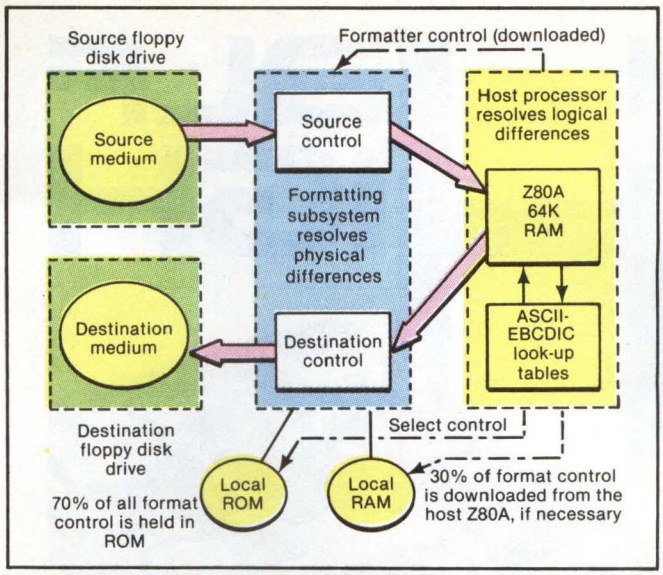


Fig. 3. The translation process between two floppy disks *begins with the formatting subsystem reading the file directory information from the source medium. Formatter control information is downloaded from the host. Source records are buffered and manipulated in the Z80A under control of BASIC translation programs. Records are then written to the destination medium via the formatting subsystem according to physical requirements.*

Control files down-loaded to the microcontroller's RAM evoke subroutines stored in ROM. About 70 percent of all formatting control is held in this firmware; the balance is down-loaded from the host's BASIC program when needed and is executed directly from RAM (Fig. 3).

Read/write control is exercised at the drive level by dedicated hardware in the formatter subsystem designed around a phase-locked loop that is time-locked to a synchronizing pattern on the disk in use.

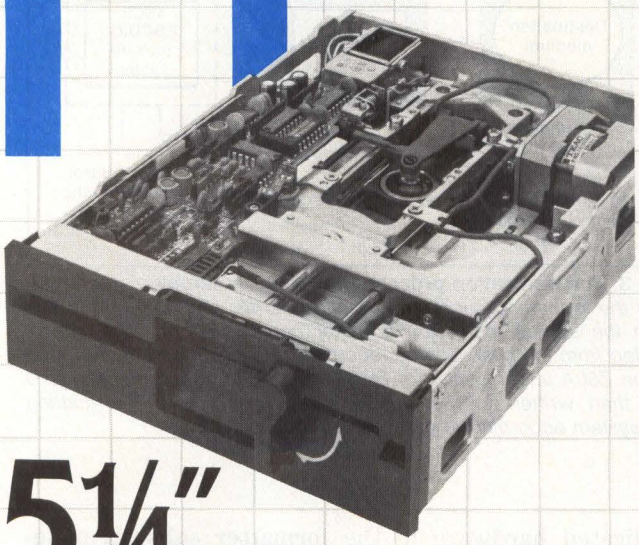
The phase-locked loop controls the timing windows through which valid ONEs and ZEROs are read from the disk in use.

CP/M machine	Tracks per in.	Recording technique: FM	Recording technique: MFM	Disk size (in. diameter)	No. of tracks	Sectors per tracks	Bytes per sector	Sector interface scheme*	Directory location (track no.)	Directory size (bytes)
Digital Research (original)	48	•		8	77	26	128	n = 5	2	2048
IBM - double side	48		•	8	77	8	1024	3	2	8192
IBM - single side	48		•	8	77	8	1024	2	2	4096
Intertec Superbrain	48		•	5¼	35	10	512	1	2	2048
Osborne I	48	•		5¼	40	10	256	1	3	1024
North Star	48		•	5¼	35	10	512	4	2	2048
Televideo - double side	48		•	5¼	40	18	256	0	2	2048
Xerox 820	48	•		5¼	40	18	128	10	3	1024
DEC personal computer	48		•	5¼	40	9	512	4	2	2048

* Logically adjacent sectors separated by (n) physical sectors to reduce the effects of latency time.

All CP/Ms are not created equal. *Applied Data Communications' newest announcement is a selection of off-the-shelf software packages that resolve the differences in CP/M operating systems as implemented in the above computers. Prices range from $500 to $1000.*

HALF HIGH



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Synchronizing the disks

Each individual format locates its disk-synchronizing areas in a different place. Down-loaded control data tell the 8X300 formatter where to find the synchronizing areas, which are referenced to index holes in the disk. Soft-sectored disks chain their sector-synchronizing areas by elapsed time, while hard-sectored disks have discrete holes punched for each sector. Light-emitting diodes and photo transistors physically locate the holes. Once located, synchronizing areas are verified by a time-based hardware test under 8X300 control, and are used to stabilize the frequency and phase of the phase-locked loop. When the phase-locked loop has locked itself to the spinning disk, bit synchronization has been established.

After the synchronizing pattern appears, an "address mark" is used to achieve byte synchronization. The address mark disobeys the encoding rules of its format in a recognizable way. The 8X300-controlled formatter seeks the address mark and begins reading the source records as meaningful data.

When writing output data to the destination disk, the TM-500 operates in reverse, constructing the new format according to specifications established by the sponsoring firm. The BASIC program in the system's Z80 host down-loads control data to the formatter subsystem to locate synchronizing areas, address marks and other elements of the required destination format. No modifications are made to the software in transit. □

Bill Ott is vice president of transmedia products and **Jerry Ruoff** is vice president of engineering at Applied Data Communications Inc., Tustin, Calif.

NEXT MONTH IN MMS

The October issue of Mini-Micro Systems spotlights memory systems. MMS will cover both main (semiconductor) memory and external magnetic storage devices, concentrating on new memory management architectures and small Winchesters.

Other editorial features will include:

- A survey article, complete with extensive charts of manufacturers' offerings will address memory including disk emulators and printer buffers.
- A look at Shugart's new optical disk drive, which packs 1G byte onto a 12-inch disk.

Imaging in Motion

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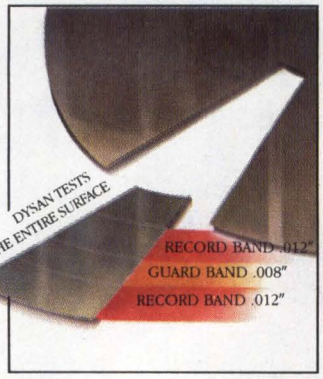

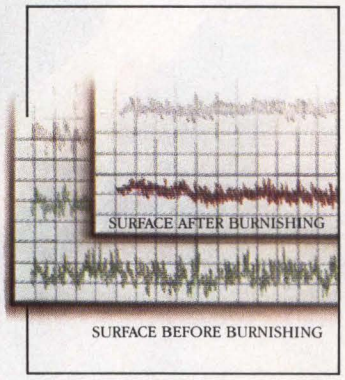

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CIRCLE NO. 114 ON INQUIRY CARD

Fiber optics shine in local-area networks

DAVID FREEDMAN

Coaxial cable isn't obsolete yet, but light is replacing electricity in many network applications

Although there is no shortage of local-area network schemes, most retain one element: the electrical wire. The twisted-pair wire and coaxial cable can no longer be taken for granted, however, as many vendors discover that a new medium, fiber-optic cable can better meet the needs of customers in many LAN applications. Using laser light rather than electricity to transmit information, fiber-optic cables are available in several networking products, and their use will grow dramatically as emerging innovations bring their cost down and expand their capabilities.

Why fiber optics?

A fiber-optic cable is a bundle of thin, coated-glass rods (Fig. 1). Light introduced into one end of a rod travels the rod's length, emerging at the other end. Just as variations in electrical current traveling through a wire relays information, so can variations in light intensity traveling through a fiber-optic rod. In theory, a fiber-optic cable can replace a wire in virtually any application; all that is required are electronics and optics able to translate variations in current into corresponding variations in light, and vice versa. Such equipment is readily available but, depending on the application, can range from hundreds to thousands of dollars—an expensive addition to what might be less than $100 worth of twisted-pair wire. Thus, moving to fiber optics makes sense only when there is a distinct advantage to doing so.

There are several potential advantages to fiber optics over wire, some of which are particularly important in LANs. Fiber optics support higher data rates than do coaxial cable—as much as 50M bits per sec. and higher.

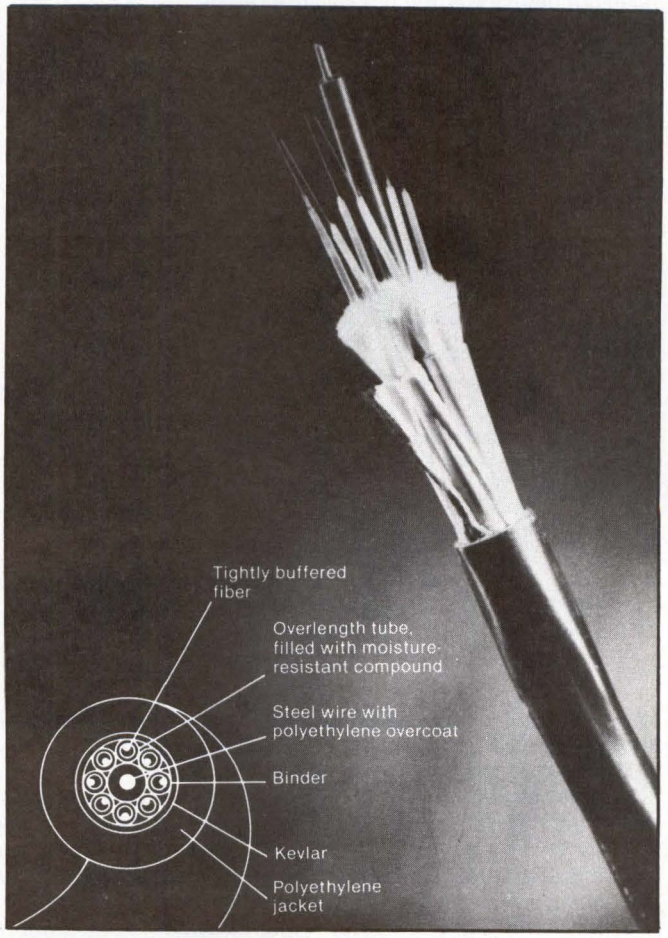


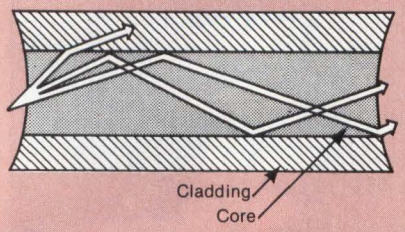
Fig. 1. Fiber-optic cable from Siecor Corp. *consists of fused bundles of glass rods that transmit light from end to end. The cable pictured comprises eight fiber bundles with a central steel wire for stiffness.*

George Colony, of research firm The Yankee Group, feels that fiber optics' virtually unlimited bandwidth makes it the medium of choice in fast switching applications. "Fiber will replace twisted-pair wires in PBX," says Colony. Fiber-optic cables can also be longer than wire; coaxial cables generally become unreliable at lengths appproaching 2 km., while fiber-optic cable lengths of 10 km. and more are feasible.

Unlike currents in conventional wire, the light in fiber-optic cables is not affected by electromagnetic interference. Even heavily shielded coaxial cables can suffer message distortion and even physical damage from EMI, particularly near heavy machinery or sources of power. Howard Salwen, president of fiber-optic LAN vendor Proteon Associates Inc., Waltham, Mass., claims that one aluminum manufacturer's coaxial cable burst into flames as a result of induced currents from the manufacturing process, and the cable near a Lawrence Berkeley Laboratory synchrotron was "obliterated." Both LAN users, says Salwen, switched to fiber-optic cable. Vendors interested in meeting the U.S. military's Tempest equipment specifications may also require fiber optic's EMI protection.

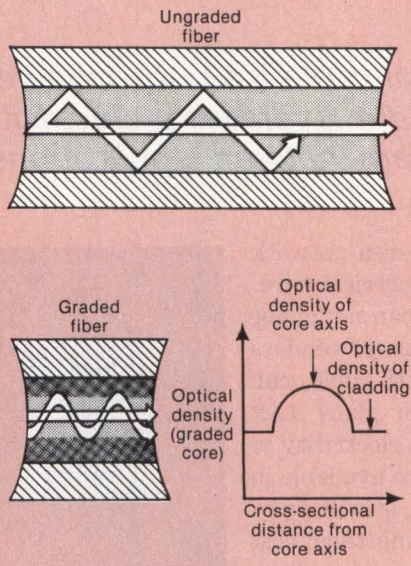
SENDING LIGHT BY CABLE

The first to develop an idea of using a light beam for communications was Alexander Graham Bell in 1880. Bell's "photophone" incorporated a pair of mirrors between which a focused beam of sunlight was relayed. The distortion in the beam caused by a person speaking into one of the mirrors varied the resistance of a selenium detector at the other mirror; this varying resistance modified the current driving a speaker. The development of the laser in the '60s and of fibers of sufficient transparency in the early '70s led to a more practical form of light communications—the fiber-optic cable.



Optical fiber *consists of a core surrounded by a cladding of lower optical density. Light entering the core at a sufficiently shallow angle with respect to the core axis will be reflected back into the core, traveling through the core until it emerges at the other end. If the light enters at too sharp an angle, it will escape the core into the cladding.*

The basic operating principle of fiber optics relies on a phenomenon called internal reflection. When light passing through a material reaches a less optically dense material (that is, a material in which the speed of light is greater), the light is completely reflected back into the first medium, provided the light hits the barrier between the media at a shallow enough angle. By constructing a glass fiber so that its core is slightly more optically dense than the outermost layer, called cladding, light can be sent careening through a curving fiber for miles without suffering an unacceptable loss of intensity.

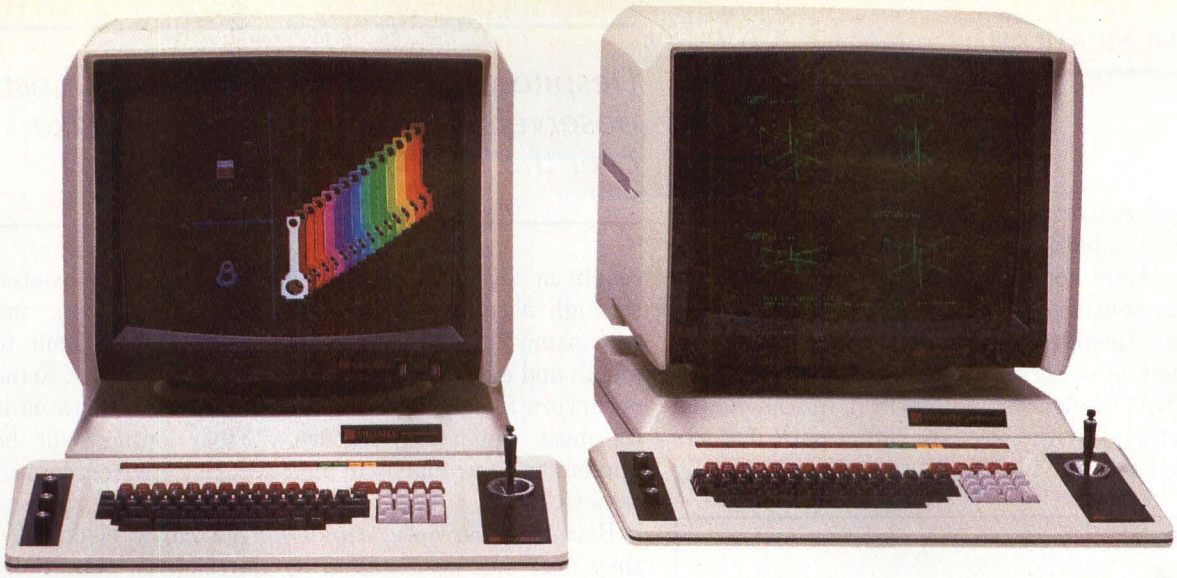


Modal dispersion *is a form of pulse spreading caused by the different path lengths of light rays entering a core of uniform optical density at different angles. A ray traveling straight through such an ungraded core will arrive before a ray that reflects off the sides. A graded core fiber has a varying optical density, so rays travel faster as they approach the cladding, reducing the difference in arrival times. Rays entering graded cores at an angle follow a curved path resulting from the continuously varying refraction.*

Most fiber-optic communications systems use gallium arsenide lasers, solid-state devices hardly larger than a pinhead. LEDs can provide a less expensive light source, but the small wavelength (9×10^{-10}m.) and high powers (0.5 mW) obtainable with solid-state lasers make them the choice for high-speed fiber-optic data communications. Using lasers, the limiting factor of data rates becomes one of pulse spreading. A pulse of light is a variation in intensity representing 1 bit of data. If this pulse is blurred—that is, made longer—then the maximum rate of data transfer is correspondingly slowed.

There are two significant sources of pulse spreading in fiber optics: modal dispersion and wavelength dispersion. Modal dispersion is caused by light entering the fiber core at different angles. If the core is of a constant optical density, then a light ray traveling straight through the center of the core will arrive before a ray entering at the same time but reflecting many times off the sides of the fiber in its trip. Modal dispersion is limited by varying the optical density of the core, so that light travels faster as it moves away from the core axis. The increased speed of light transmission compensates for the longer path taken by the rebounded rays. Consequently, the rebounded rays arrive at about the same time as the slower traveling rays that take a more direct path.

The other source of pulse spreading, wavelength dispersion, results from the fact that the speed of light through a medium varies with wavelength. If two rays of unequal wavelengths enter a fiber simultaneously, the longer wavelength ray will arrive first. Wavelength dispersion can be reduced by using a light source with a small bandwidth; the gallium arsenide lasers used have a bandwidth of about 2×10^{-9}m., limiting wavelength dispersion to an acceptable level.



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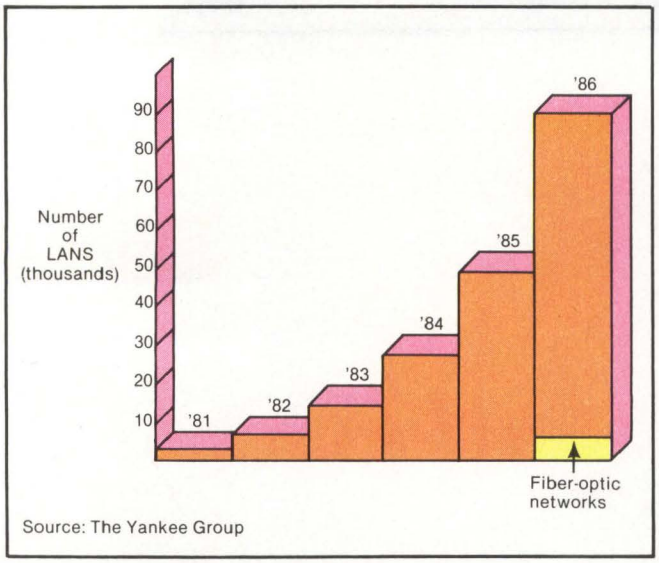
CIRCLE NO. 115 ON INQUIRY CARD

Despite fiber optics' advantages, most observers feel it is not about to take over the LAN market—not yet.

For the same reason that it is not subject to external EMI, fiber-optic cable also does not radiate EMI. This feature is important not only for Tempest requirements and use near sensitive equipment, but for security requirements. Despite shielding, coaxial cable can radiate enough of a signal to permit passive taps—connections that deflect some portion of the signal without interfering with the main signal path. Efforts to tap the light beam in fiber-optic cables generally result in signal destruction. Signals can be routed through active taps, which intercept the beam and retransmit it, but such taps are far more difficult to install and easier to detect than are passive taps. Some observers feel fiber optics' near-tamperproof status is its most important feature. "Fiber optics will be implemented primarily in high-security environments," says Colony.



The number of LANs installed by 1986 *is expected to reach 90,000. Of these, only 3 to 5 percent are expected to be based on fiber optics, but that figure could grow close to 100 percent by the end of the century.*

Because fiber-optic cables do not carry electricity, they need not be installed by electricians, potentially leading to significant savings in installation costs. And the absence of electricity also means an absence of sparks, making fiber optics the preferred medium when flammable material and gasses are present. A Las Vegas casino is said to have run a fiber-optic cable through a gas main to simplify routing.

Another advantage to fiber-optic cable is that it weighs less than conventional wire; coaxial cable can often be replaced by an equal length of fiber-optic cable weighing less than one-tenth as much. While this lighter weight is not a significant consideration in most applications, the U.S. army has used it in a jeep-to-soldier communications system. An infantryman able to carry 400 ft. of coaxial cable can carry 2 km. of fiber-optic cable, and the fiber optics' radiation-free operation reduces the chances of detection.

Fiber-optic options

Despite fiber optics' advantages, most observers feel

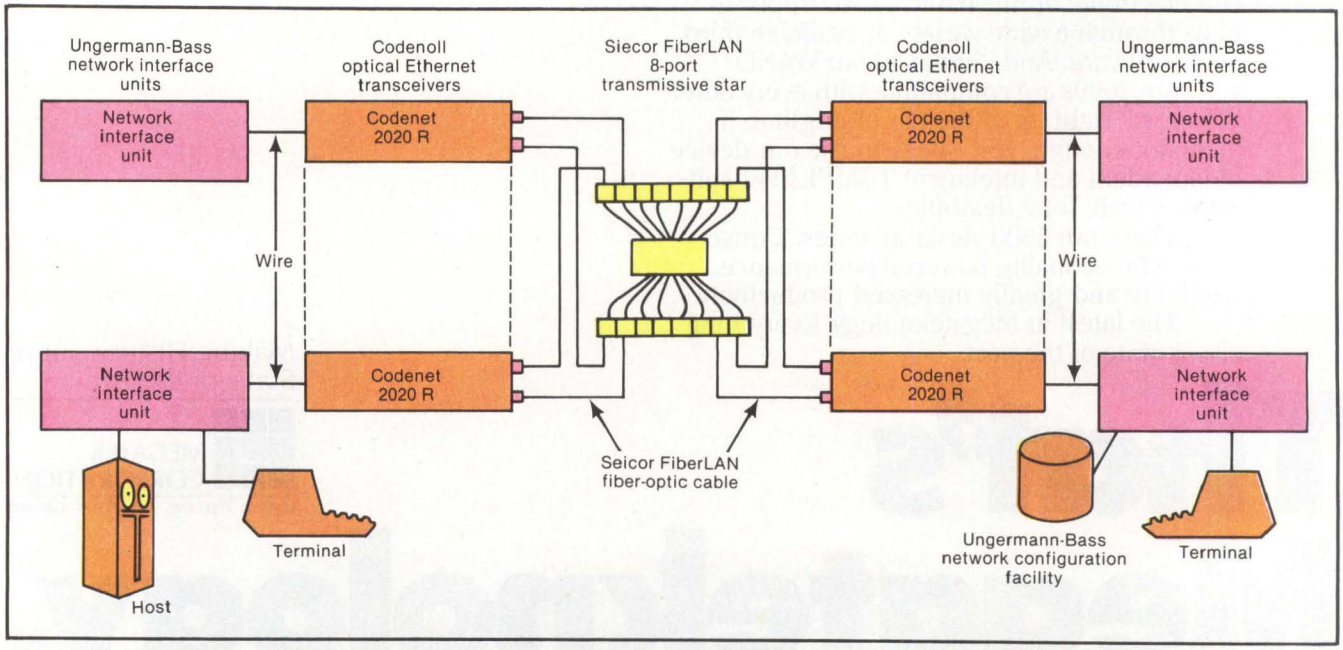


Fig. 2. Fiber-optic-based network from Codenoll Technology, Ungermann-Bass and Siecor FiberLAN *connects nodes via Ethernet plugs to optical transceivers. The node hardware and software regard the network as standard Ethernet equipment, requiring no modification.*

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it is not about to take over the LAN market—not yet. Colony predicts that only 3 to 5 percent of all networks will be based on fiber optics by 1986. But he also points out that the LAN market will surpass $500 million by then, so the fiber-optics share of this market will be far from insignificant. A number of vendors, hoping to get a jump on this market, have brought out fiber-optic network products.

Codenoll Technology Corp., Yonkers, N.Y., offers Ethernet plug-compatible fiber-optic products. The Codenet-2020 transceiver can be used with any hardware and software used with coaxial Ethernet, the company claims; the fact that the connections are fiber optic rather than coaxial cables is transparent to the system. Application engineer Carl DeMarco says the product is targeted at OEMs requiring extended length, high reliability or secure networks, and points out that Codenoll has developed a network in conjunction with Ungermann-Bass and Siecor-FiberLAN, a division of Siecor Corp. (Fig. 2). At a cost of $1100 per node in single units, with OEM discounts available, the Codenet 2020 is not far out of line from many coaxial-based Ethernet node connectors.

DeMarco claims the company will introduce an analog fiber link priced in the vincinity of $3500 per link, within a few months. Codenoll is also developing a chip-set version of the Codenet-2020.

Fig. 3. Optical multiplexer from Gandalf Data *connects as many as eight terminals to a fiber-optic cable.*

Proteon's Salwen feels that bus networks such as Ethernet do not take advantage of fiber optics' features; his company offers a ring network available with fiber-optic links. "Almost everything in fiber optics is unidirectional," says Salwen, "and Ethernet uses two-way taps." Salwen points out that ring networks can more easily be designed with fail-safe and security features than can bus networks, better complementing fiber optics' reliability and security. Proteon's fiber-optic link is priced at $1450 in quantities of 10, but Salwen claims that equipment prices are not a primary factor in selecting a network. "All this talk about which medium is more expensive is irrelevant," he says. "Most companies find it's more expensive to pull the cable than the cost of the entire network."

Other companies involved in fiber optics include Gandalf Data Inc., Wheeling, Ill., which offers fiber-optic data links and a multiplexer for point-to-point transmissions (Fig. 3), and NEC Information Systems Inc., Fujitsu America Inc. and Digital Equipment Corp., offering fiber-optic options for some of their products.

Some observers say that impending innovations in fiber-optic technology could eventually make coaxial cable obsolete as an LAN medium. "By the end of the century," says Colony, "fiber optics will be the LAN medium." American Micro Devices Inc. and National Semiconductor Corp. are working on fiber-optic link chips that would dramatically reduce costs, according to The Yankee Group's Dale Kutnick. Kutnick also expects to see the development of passive taps, which would lower connection costs but compromise security.

In the meantime, fiber optics will probably remain strongest in high-security and industrial applications and as high-speed point-to-point data links. Many network users will consider implementing fiber optics only on those parts of the network in which coaxial cable could prove unreliable, such as nodes located on the factory floor or outside of a building. Such hybrid networks can prove an effective compromise between fiber optics' reliability and coaxial cable's lower connection costs. □

David Freedman is a former associate editor for *Mini-Micro Systems.*

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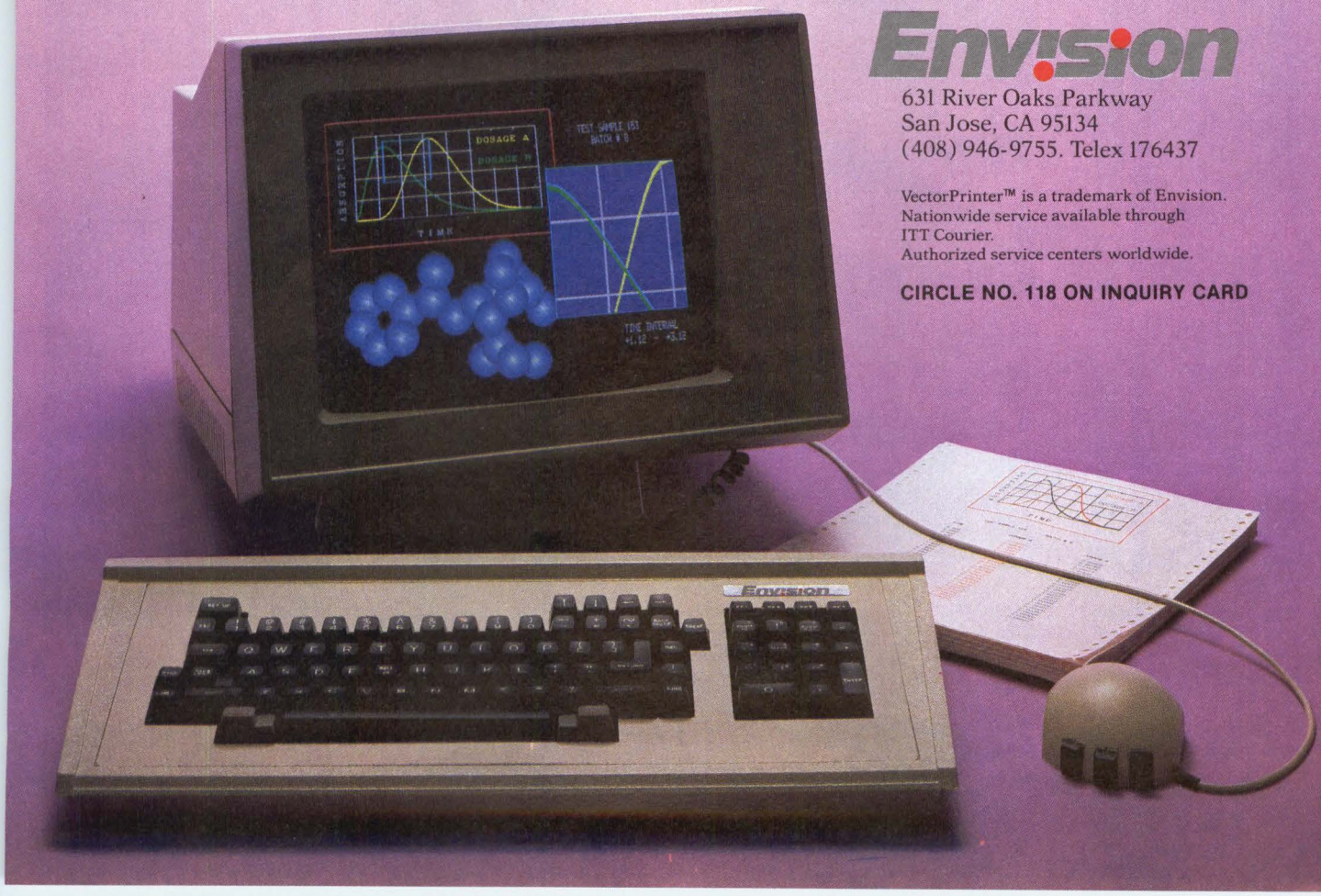

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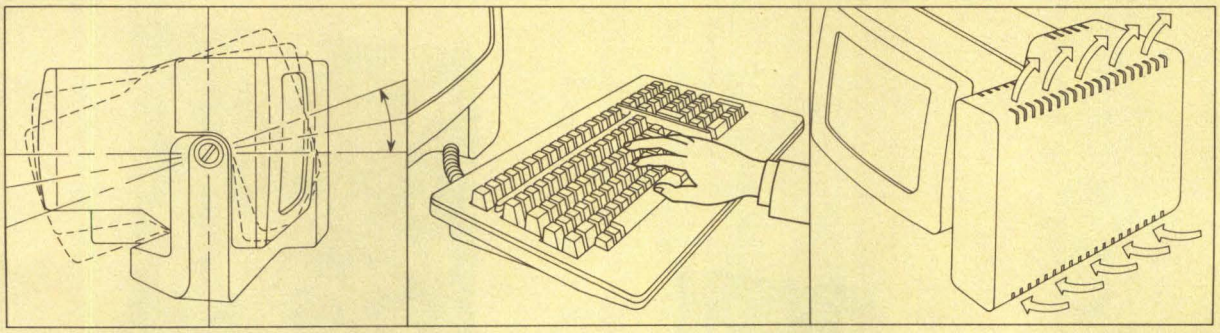

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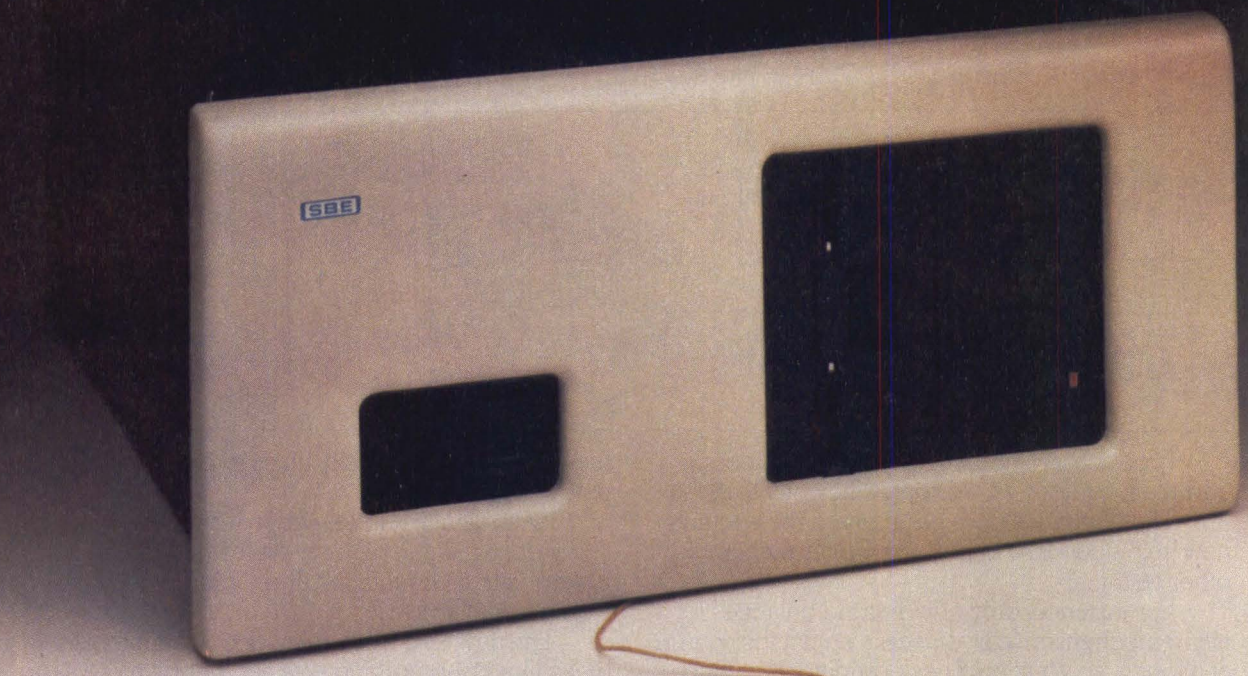

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Extending the Megabus

JIM JENDRO, Honeywell Information Systems Inc.

Enhancements to 16-bit bus boost performance, retain compatibility and allow 32-bit transfers

The growth of Honeywell Information Systems Inc.'s Level 6 and DPS 6 systems has required the enhancement of the Megabus, the system bus used to connect the processor, memory and I/O controllers. Larger memories, additional I/O controllers and particularly the move from 16- to 32-bit processors have led to the Extended Megabus, featuring a wider data path, faster responses and functional and physical compatibility with the original Megabus design.

Two conflicting trends directly affect the Megabus. One is the growth of system size and the corresponding increase in average distance between units. The DPS 6/96, for example, uses 39 bus slots, eight times as many as the first Level 6 model 33, and Megabus architecture places the CPU farthest from memory.

The other trend is toward higher performance processors and the increased I/O to support them, which imposes higher average and peak loads on the Megabus.

The use of 32-bit processors with the DPS 6/92 through DPS 6/96 necessitated 32-bit data paths to memory and high-speed I/O. Redesign of all I/O units to use a 32-bit bus structure would have been costly and time-consuming, and would require the support of two controller sets. Bus adapters would have added cost and could have limited throughput.

Original Megabus design

All functional units on the Megabus are interconnected via a common set of address, data and control signals (Fig. 1). A total of 24 address lines permits directly addressing a maximum physical memory of 16M bytes. The Megabus itself does not contain active components. All logic to control Megabus dialogue is evenly distributed over all functional units on the bus. All positions on the Megabus are physically and logically equivalent for configuration flexibility. The large physical address space and easy configuration features of the Megabus simplified design of the Extended Megabus.

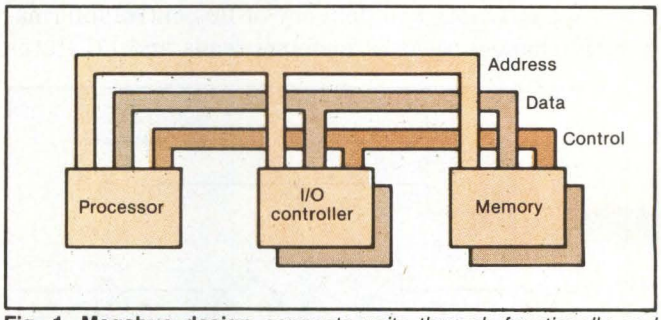


Fig. 1. Megabus design *connects units through functionally and electrically identical contacts. Address, data and control signals are accessed in the same way by all units.*

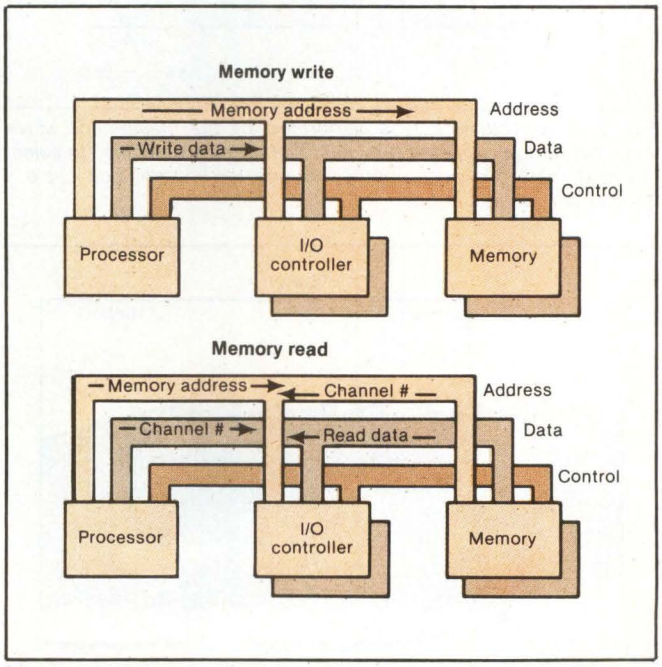


Fig. 2. Megabus memory transfers *occur over address and data leads. During a memory read, the address and data leads carry different information on the request and response cycles. The processor identifies itself by channel number on the data leads during the request, and recognizes its channel number on the address leads during the response. During a memory write, the address and data leads are used to specify an address and carry data.*

Addressing. The address leads serve double duty on the Megabus. They identify a byte address during memory references and a channel number during other bus sequences (Fig. 2). The channel number identifies the processor or I/O unit that is the destination of a bus transfer.

Data exchange. The Megabus uses 16 data leads, plus byte parity, to carry information between units and to identify the information requester. Megabus operation is asynchronous, with the timing of each cycle controlled solely by the units exchanging information. The unit initiating a bus cycle is called the master, and the respondent is called the slave. Exchanges that do not require a response consume only one bus cycle. Single-bus-cycle exchanges include memory writes, interrupt attempts and delivery of I/O control information. Exchanges such as memory reads and I/O status requests consume two bus cycles, one for the request and one for the response. These concepts were retained for the Extended Megabus, although a new multiple-cycle burst-mode exchange was added.

Control signals. These signals distinguish memory references from I/O requests, as the address leads are used for both purposes, allow handshaking between units during a bus cycle, and determine which unit has priority for the bus service. This is also true for the Extended Megabus, although signals have been added for new functionality, and the priority mechanism has been revised.

All bus cycles are self-contained. The master and slave complete the cycle whether or not the desired

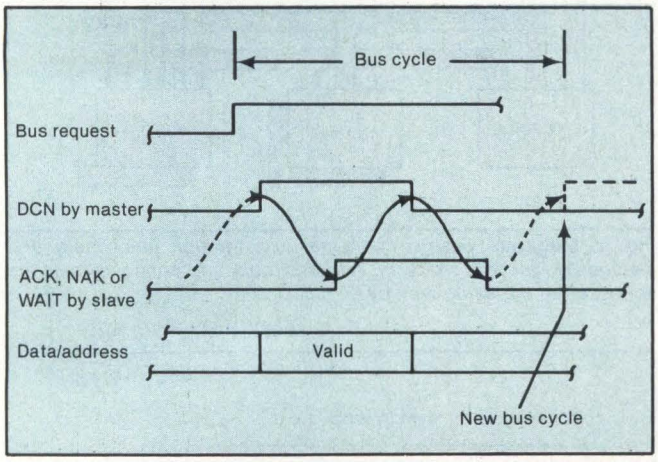


Fig. 3. Bus-cycle timing *is performed by the master and slave involved, without a central bus controller. Priority resolution to select the next master is accomplished during the current bus cycle if another unit wants the bus.*

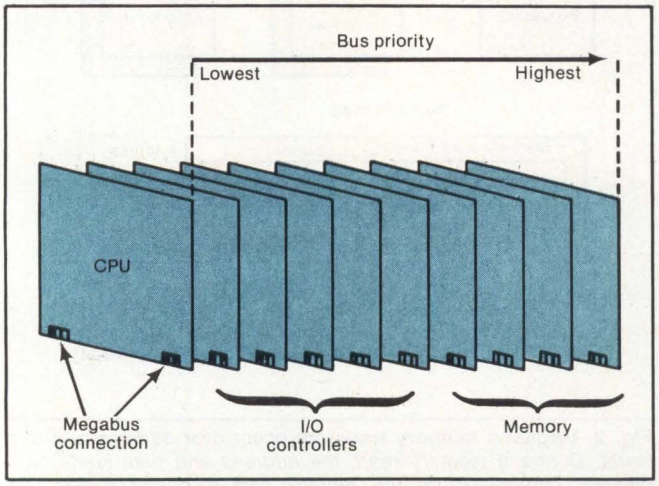


Fig. 4. Bus service priority *is linear from processor to farthest memory controller. Memories are assigned high priority to allow completion of memory read responses as quickly as possible, freeing the memory for further requests.*

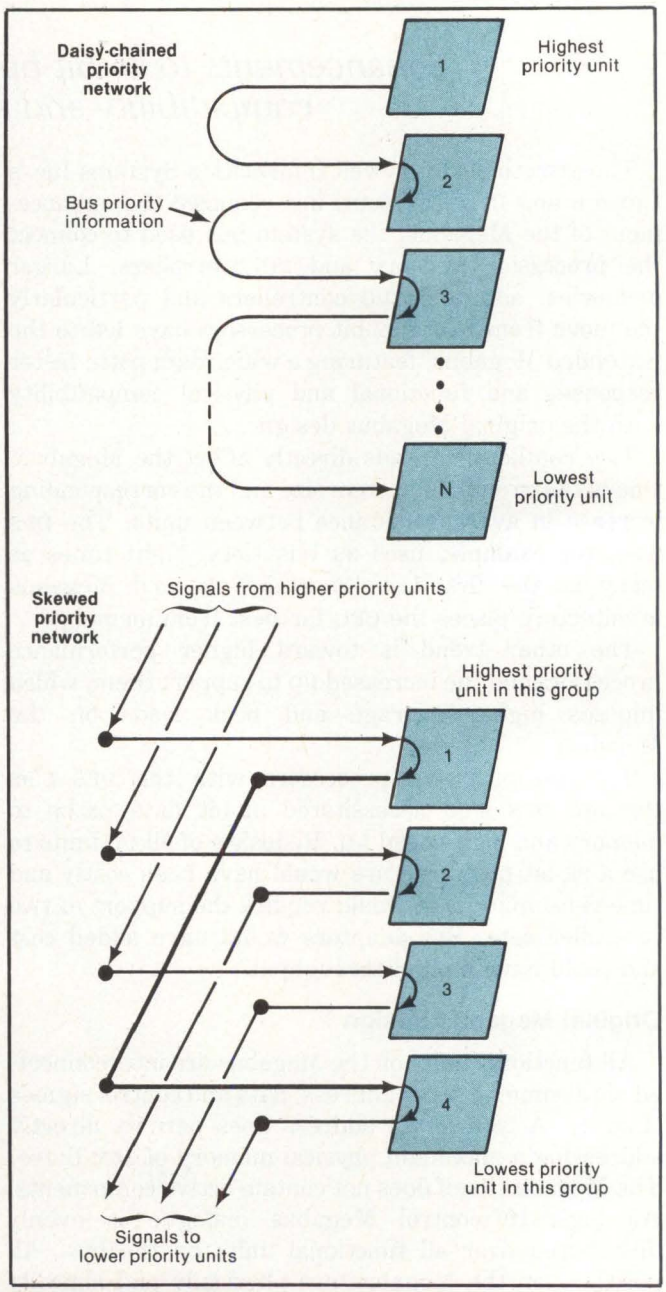
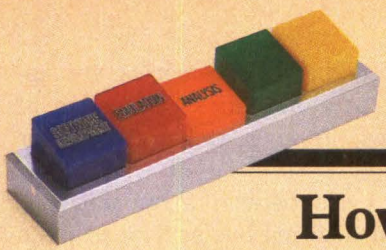


Fig. 5. Daisy-chained priority mechanism *produces delays as each unit receives and passes on the priority information. Skewed priority network resolves priority in groups of 10 (four units are depicted here for simplicity). Unit 1's "service not requested" signal (boldface line) is passed directly to unit 4 without passing through units 2 and 3.*



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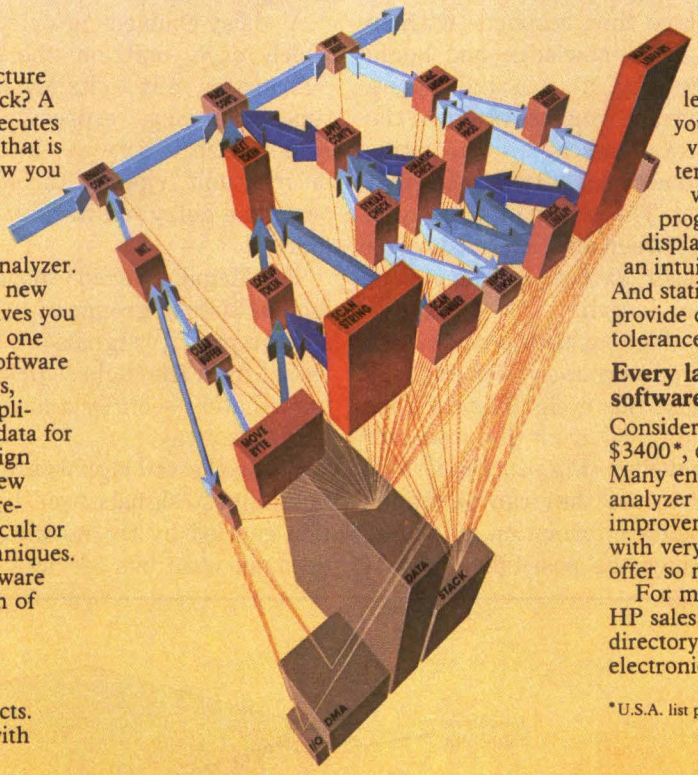

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information has been exchanged. When a master is granted a bus cycle by its priority logic, it uses the Data Cycle Now signal to start the cycle, and places the slave's address on the address leads. The address leads contain a channel number during an I/O unit or processor reference. The slave then responds with an ACK, NAK or WAIT signal to acknowledge and begin termination of the bus cycle (Fig. 3). ACK indicates a positive response by the slave and implies receipt of the information transferred. NAK indicates a negative response or rejection of the bus cycle. WAIT implies that the slave is temporarily busy. The length of a bus cycle is sensitive to the distance between master and slave on the Megabus and, to a lesser extent, to component tolerances and total Megabus length.

Priority resolution. The Megabus uses a network of priority-resolution signals to determine which unit will be allowed to initiate the next bus cycle. The network imposes a linear positional priority from the processor to the farthest memory controller (Fig. 4). Processors are assigned low priority because they can be stalled for bus service without losing information. I/O units have higher priority to reduce the possibility of data overflow or underflow conditions. Memories are assigned highest priority to allow quick completion of memory read responses, freeing the memory for further requests.

Shortly after a bus cycle begins, a "window" is opened in which any unit desiring bus service places a request via a common bus-request signal. At the end of this window, it is determined which of the requesting units has priority and will be granted use of the next bus cycle.

A daisy-chained priority mechanism (Fig. 5), in which each unit on the Megabus passes priority information only to its lower priority neighbor, can be time-consuming, especially in large configurations. Under such a scheme, information from the highest priority unit "ripples" through every unit, each with its own time delay, on its way toward the lowest priority unit.

The Megabus avoids this delay by effectively arranging bus slots in groups of 10 for priority resolution. The several priority signals are physically skewed so that a signal from the highest priority unit in a group can be immediately seen by a lower priority unit several bus positions away.

These skewed signals are separate from the common bus-request signals used by every unit. The information carried by the network from a unit is: "This unit does not want bus services, and neither does the n-th

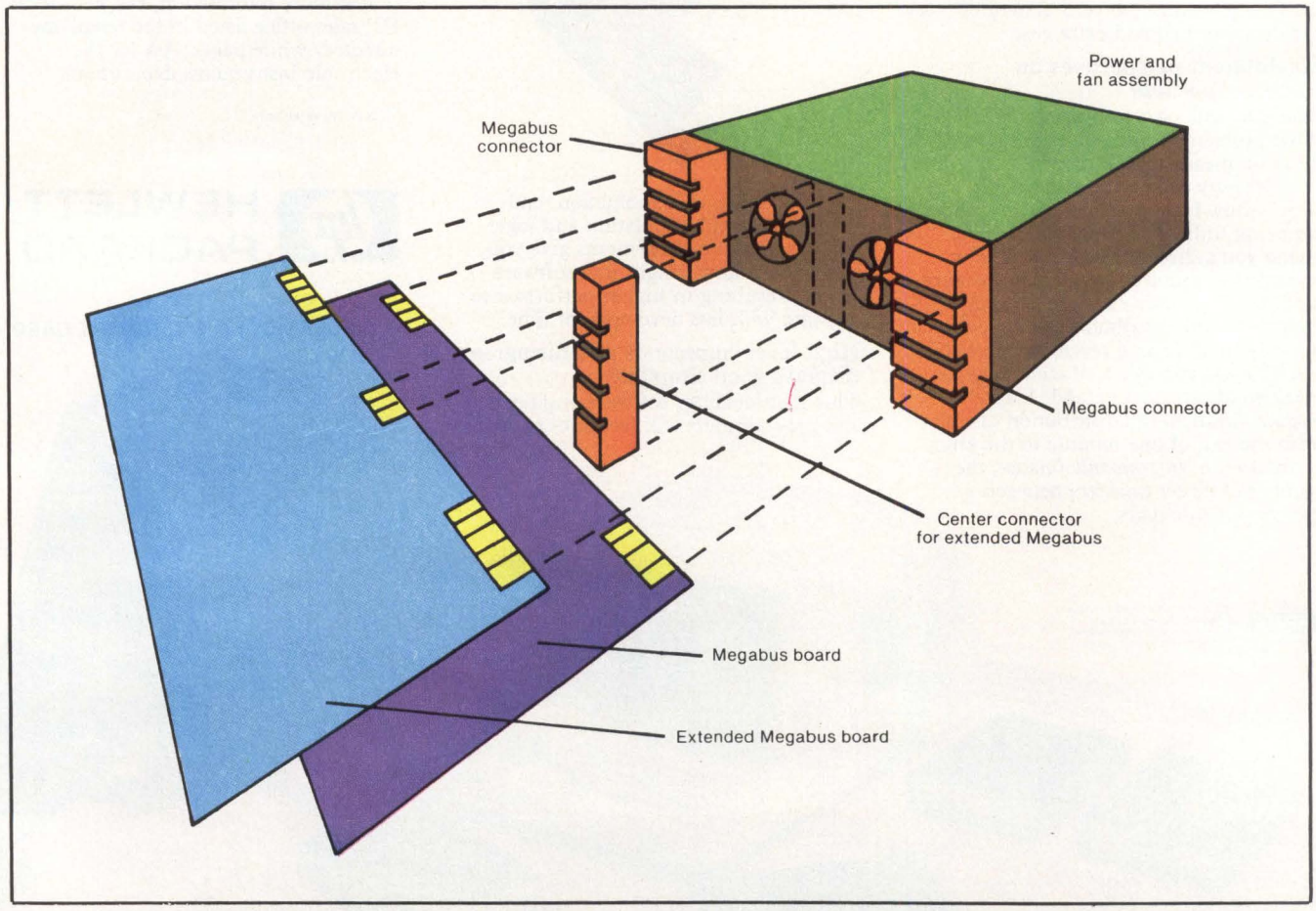

Fig. 6. Extended Megabus connections *are implemented through an added center connector carrying additional data and control leads. The center connector is configurable on a single-bus-slot basis.*

When critics rate you tops, what do you do for an encore?

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*"The VISUAL 50 is the most promising new terminal to come out so far, especially in light of its price."**

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Feature Comparison Chart *

Feature	ADDS 60	**VISUAL 50**	TeleVideo® 925	Zenith 19	Wyse 100
Style	4	**4**	4	3	5
Overall Quality	2	**5**	3	4	3
Keyboard	3	**5**	2	4	2
Rollover/false keying	5	**5**	3	4	4
Video Quality	1	**5**	4	4	3
No. of attributes	5	**5**	5	2	5
Attribute method	2	**5**	2	4	2
Suitability for micros	2	**5**	3	5	3
	24	**39**	26	30	27
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*MICROSYSTEMS—March 1983
**THE ERGONOMICS NEWSLETTER—August 1982

Meet the VISUAL 55

The VISUAL 50, widely acclaimed as the best performing low cost terminal in the industry, is a tough act to follow. But the new VISUAL 55 extends its predecessor's performance even further by adding 12 user-programmable non-volatile function keys, extended editing features and selectable scrolling regions ("split screen").

Both the VISUAL 50 and VISUAL 55 offer features you expect only from the high priced units. For example, the enclosure is ergonomically designed and can be easily swiveled and tilted for maximum operator comfort. A detached keyboard, smooth scroll, large 7 x 9 dot matrix characters and non-glare screen are only a few of the many human engineering features.

Another distinctive feature of the VISUAL 50 and VISUAL 55 is their emulation capability. Both terminals are code-for-code compatible with the Hazeltine Espirit,™ ADDS Viewpoint,® Lear Siegler ADM3A and DEC VT52.® In addition, the VISUAL 55 offers emulations of the Hazeltine 1500/1510 and VISUAL 200/210. Menu-driven set-up modes in non-volatile memory allow easy selection of terminal parameters.

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unit above in priority." This information is leapfrogged several units at a time, rather than a unit at a time.

Granting of the next bus cycle is accomplished via logic in each unit. All units logically compare the priority network signals and the unit's own bus-request signal. Only the highest priority unit can have a true bus-request signal and all true priority network signals, and that unit is granted the next bus cycle.

The Extended Megabus

The Extended Megabus is a functional and physical superset of the Megabus, and peripherals designed for the Megabus are directly attachable to the Extended Megabus, providing upward I/O compatibility in the Level 6 and DPS 6 systems.

The original Megabus consists of two connector stacks, one at each side of the rear motherboard edge. The space between the connectors is open, allowing for forced airflow over the logic boards. The connectors contain all the regular Megabus data, address and control signals. The Extended Megabus has a third, narrower connector centered between the original two to carry additional data and control signals (Fig. 6). The width of the center connector is narrow enough that it does not appreciably affect airflow. Physical compatibility is provided in that the center connector can be removed, making the slot identical to the Megabus.

The data leads on the original Megabus are numbered 0 to 15, bit 0 being left-most, and of highest order, and carrying the left-most 2 bytes of a 32-bit data transfer. The Extended Megabus adds new data leads numbered 16 to 31, which always contain the right-most 2 bytes of a 32-bit transfer. New control signals uniquely identify 32-bit-wide transfer requests and responses. A master using 32-bit transfers must make a positive "double-width" request using the DBWD signal and check for a "qualified-response" signal, RESQ, from the slave during the bus cycle. Both a DBWD request and an RESQ qualifier must occur to invoke a 32-bit transfer.

A DPS 6/90 series processor that makes a DBWD request but does not receive a RESQ (or a subsequent DBWD on a read response) will assume that only a 16-bit-wide transfer has occurred. This feature accommodates references to the last 2-byte word "owned" by a memory controller. In this case, the memory can respond only with 2 bytes left-justified onto the original data leads. The processor must then make an additional request for the next two, which will be answered by the "next" memory controller. This feature has also allowed checking of DPS 6/90 series processors using 16-bit Megabus memories.

DPS 6/90 series memories are designed to write, or extract and deliver, 4 bytes in parallel only if so requested by the master using DBWD. The memory will then respond with RESQ during the request and again with DBWD during a memory read response. Regular Megabus I/O controllers and other masters without the center Extended Megabus connector have no access to DBWD or RESQ, and the new memories will assume 16-bit transfers left-justified onto the original data leads. This preserves Megabus compatibility and allows construction of systems with both 16- and 32-bit components.

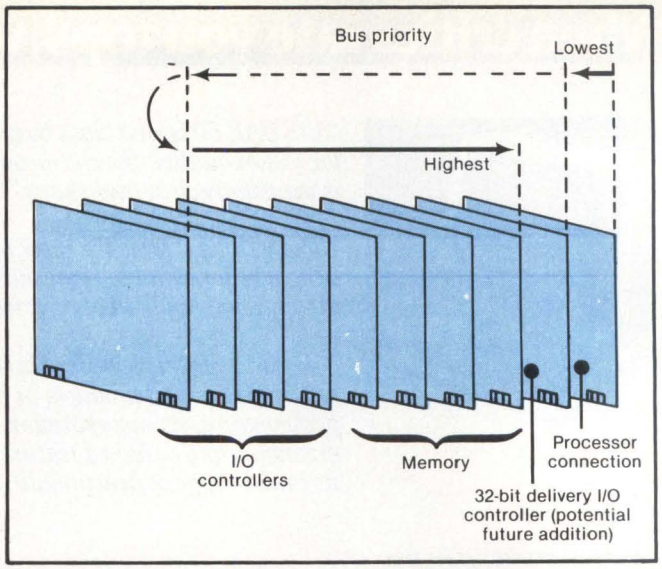

Fig. 7. Redesigned Megabus priority logic *allows processor and 32-bit I/O to be closer to memory without changing priority. Priority signals are driven "backward" across processor and 32-bit I/O.*

This design also allows upgrading in the field. For example, DPS 6/76 systems that use 16-bit processors, I/O and memories can be field-upgraded to full 32-bit DPS 6/94 systems by changing only the CPU and memory. The original I/O units and physical bus structure of the DPS 6/76 are preserved during the upgrade.

The Extended Megabus allows the processor to be placed physically closer to the memory, reducing the average bus-cycle time between those units. This is accomplished by using a spare lead on the Megabus and redesigning the bus priority logic for DPS 6/90 series processors and future controllers. The redesign allows the bus priority network to be driven "backward" beyond the normal memory end of the Megabus without changing Megabus priority (Fig. 7).

The Extended Megabus and new memories allow an I/O unit to read as many as 32 bytes with a single request, delivered in eight consecutive 32-bit-wide transfers. DPS 6/90 series memories are interleaved in 32-bit segments, allowing a single memory controller to initiate and complete such a burst read. □

Jim Jendro is manager of planning and marketing analysis at Honeywell Information Systems Inc. Billerica, Mass.

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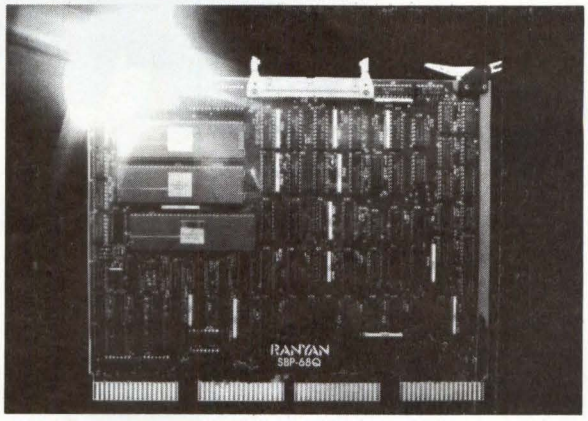

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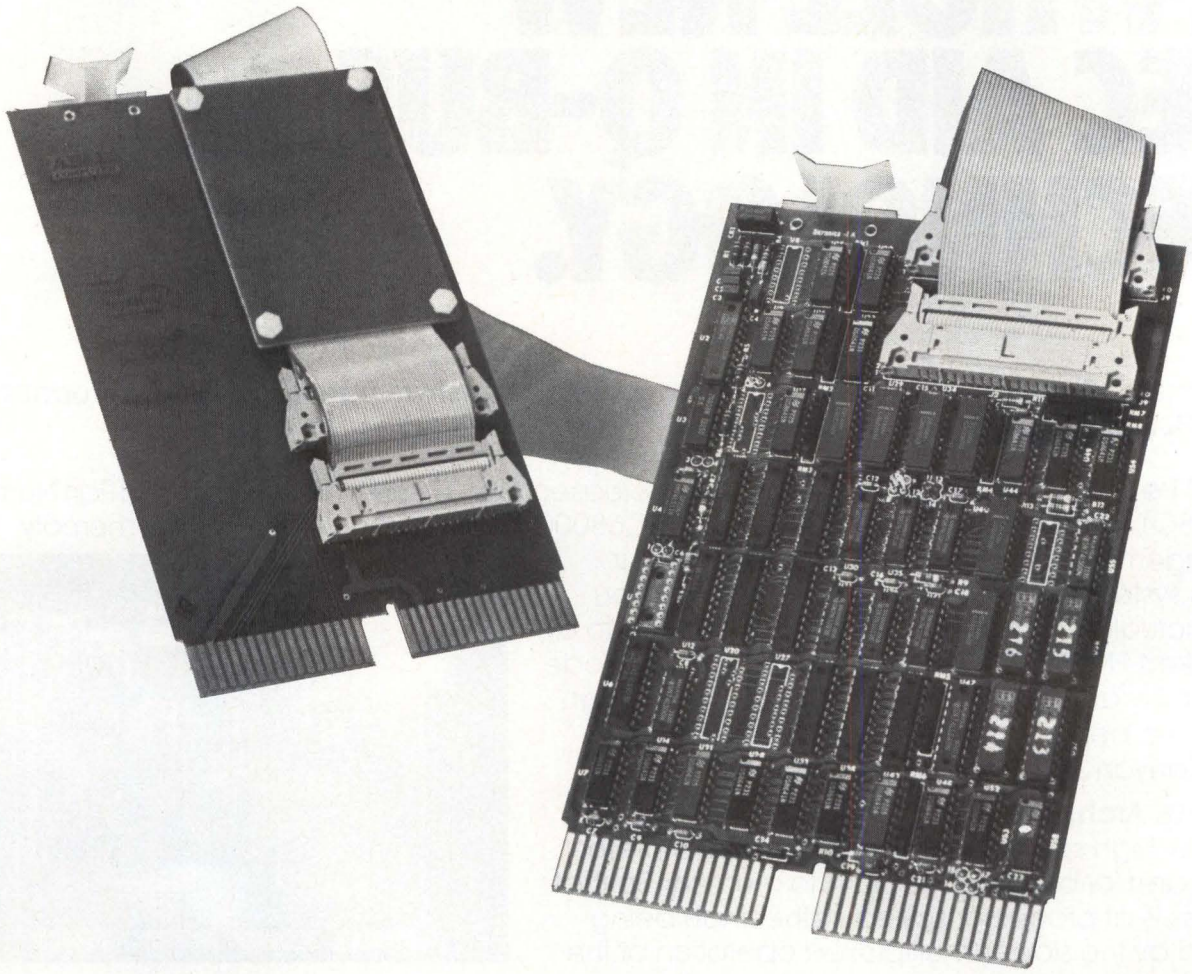

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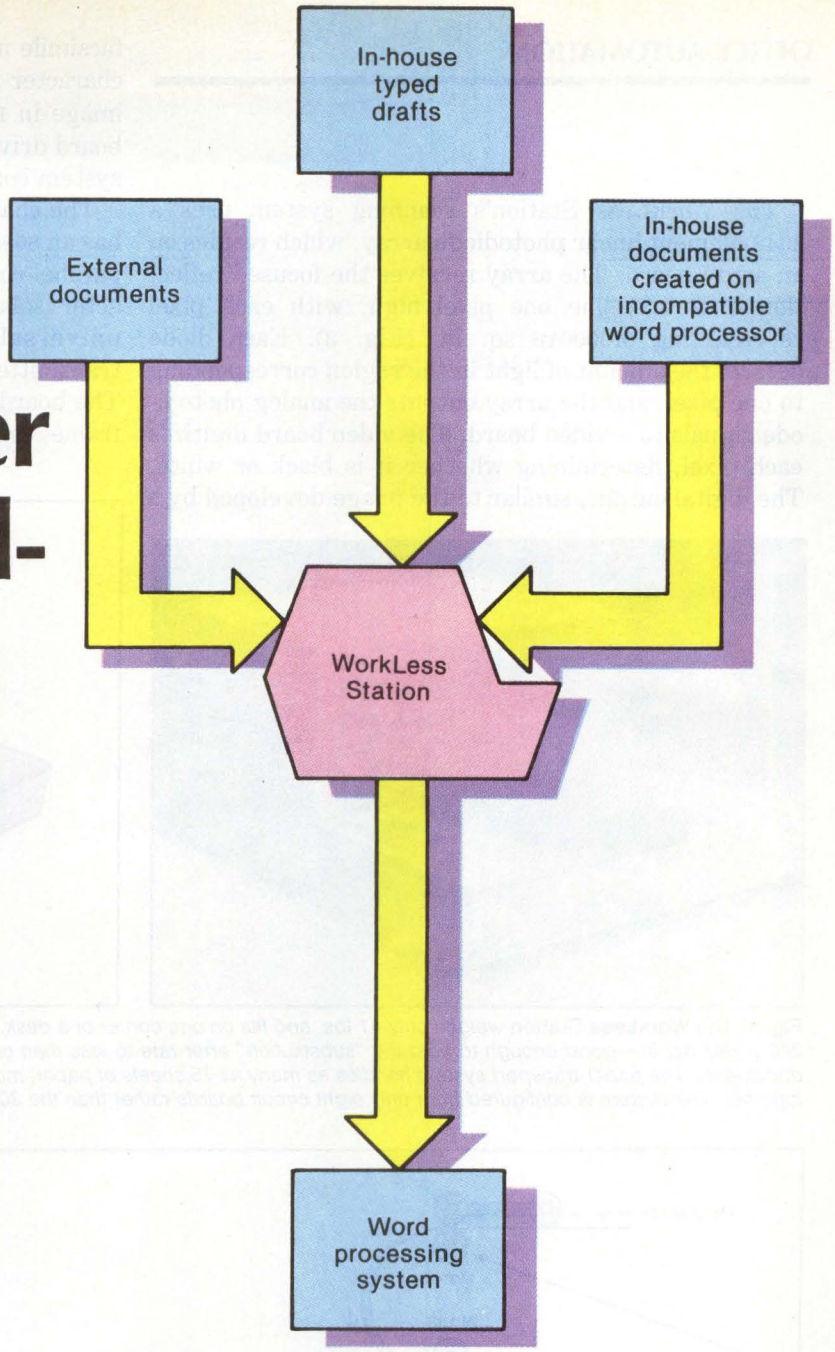
OCR page reader eases word-processing bottleneck

RICHARD MATTHEWS, DEST Corp.

Desk-top unit reads eight generic type styles and formats text for word processors



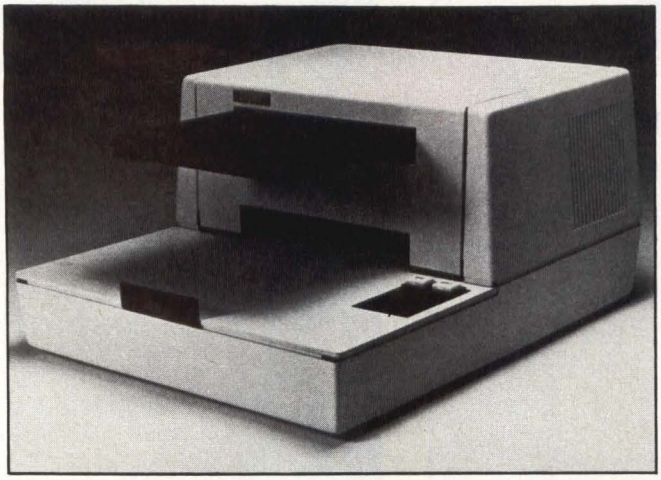
Reducing the word-processing bottleneck. *DEST Corp.'s WorkLess Station inputs text 20 times faster than a word-processing operator. This is especially helpful in such offices as law firms, publishers and government agencies that process many externally generated documents and in-house drafts produced by ordinary typewriters. The WorkLess Station can also serve as an interface between incompatible word processors: the source system prints a document, and the WorkLess Station reads it into the target system.*

Designers of word-processing systems and multifunction office workstations increasingly are looking to optical character recognition as an important supplement to conventional word processing. Until mid-1982, OCR page readers, priced at more than $20,000 and larger than floor-model copiers, were of little interest to system integrators. But a new generation of compact, inexpensive and intelligent devices has changed that. Typical of the new breed is DEST Corp.'s WorkLess Station, a desk-top unit that sells for less than $10,000. The WorkLess Station has a compact design, provides automatic operation, recognizes more than 100 characters from each of eight type styles and inserts formatting codes for word processors.

The WorkLess Station (Fig. 1) is only one-eighth the size of most OCR page readers. Compactness is achieved by employing only eight circuit boards (Fig. 2) instead of the 30 to 40 boards commonly used in OCR devices.

The WorkLess Station's scanning system uses a 2048-element linear photodiode array, which resides on an array board. The array receives the focused reflection of a text line one pixel high, with each pixel representing 0.000016 sq. in. (Fig. 3). Each diode detects the amount of light in the region corresponding to one pixel, and the array outputs the analog photodiode signals to a video board. The video board digitizes each pixel, determining whether it is black or white. The digital output, similar to the image developed by a facsimile machine, passes through a control board to a character-isolation board that stores the facsimile-like image in RAM. Besides relaying the data, the control board drives the paper feeder and has DIP switches for system configuration.

The character-isolation board is the primary CPU. It has an 8085 microprocessor, a DMA controller, serial-to-parallel conversion logic, 32K bytes of EPROM for character-isolation subroutines, 32K bytes of RAM and a universal synchronous/asynchronous receiver/transmitter for communications with the host system. The board isolates each character into a 24- × 32-pixel frame, compensating for skewed and bowed lines, close



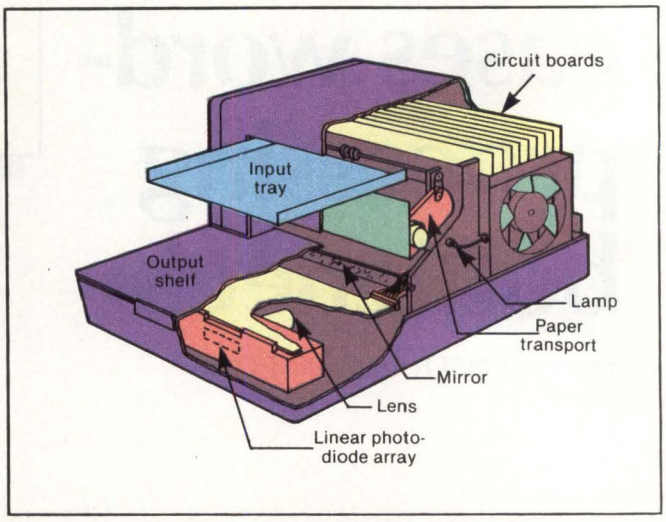


Fig. 1. The WorkLess Station *weighs only 41 lbs. and fits on one corner of a desk. A 2048-element photodiode array provides resolution of 240 pixels per in.—good enough to hold the "substitution" error rate to less than one character in 20,000 even when reading photocopied documents. The paper-transport system handles as many as 75 sheets of paper, maintains page sequence and rejects sheets that are stuck together. The system is configured from only eight circuit boards rather than the 30 to 40 boards of most OCR devices.*

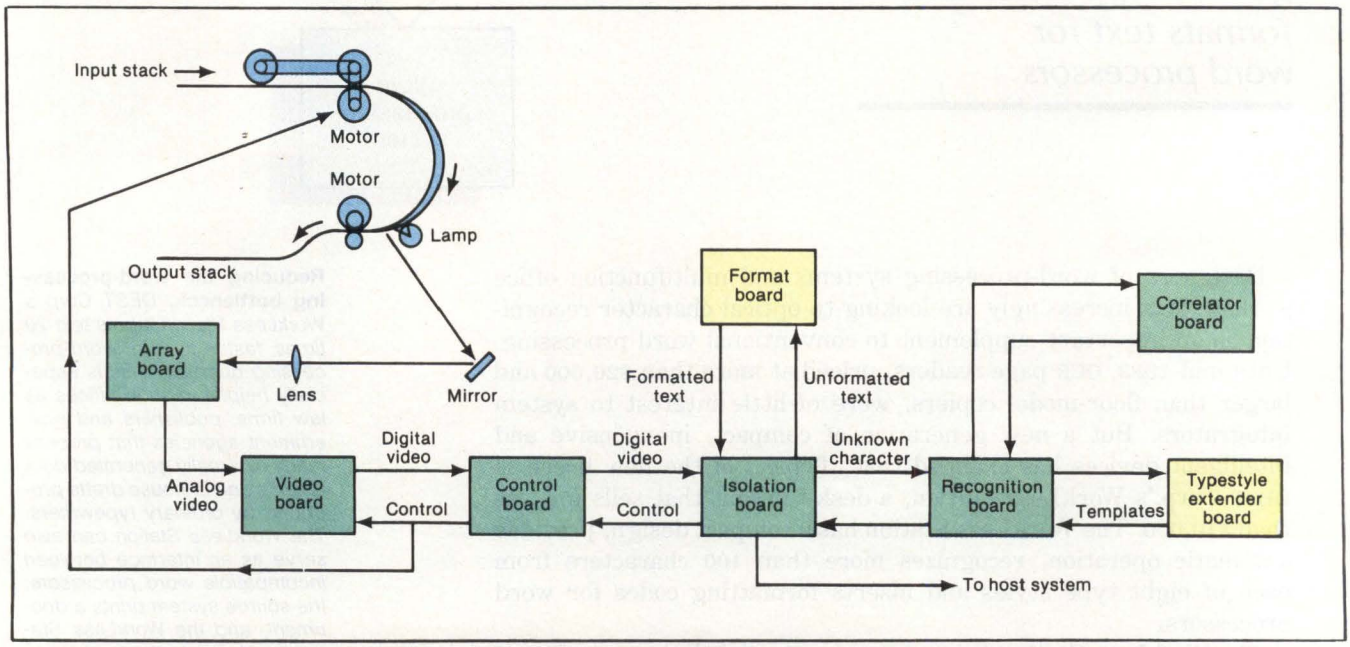
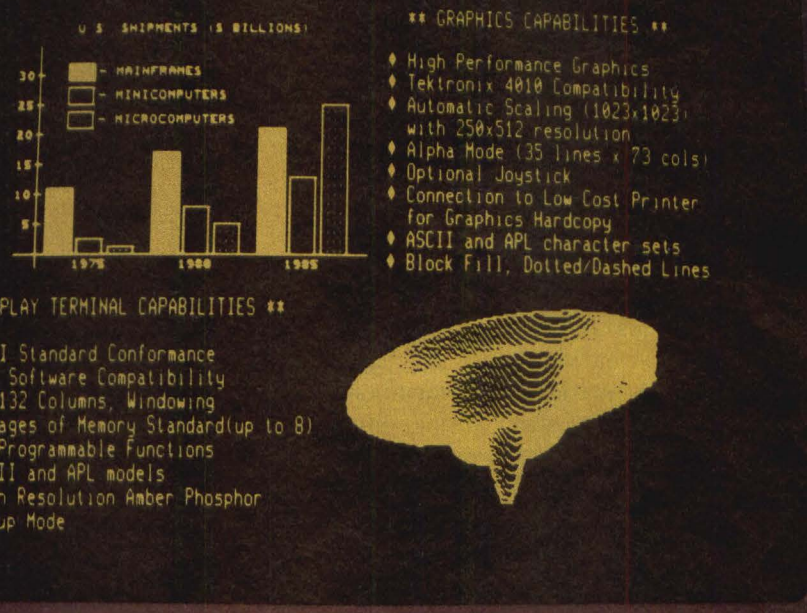


Fig. 2. Eight circuit boards *control the WorkLess Station's operation. Rollers feed one sheet of paper at a time into the system. Light from an internal lamp reflects off of the page and off of a mirror and passes through a lens that focuses the text image onto a photodiode array. The photodiode array generates analog signals that are digitized into an array of black or white pixels. Characters are isolated and recognized using stored templates for matrix matching. Character strings can be sent directly to the host system or routed to the format board to provide text formatting that facilitates word processing.*

A PICTURE'S WORTH:



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and touching characters and intruding underlines.

The isolated character is sent to a recognition board. In conjunction with a correlator board, it compares characters with stored templates. The recognition board contains RAM for the unknown character and 16K bytes of EPROM to store the recognition program for the Courier 10 type style, the most commonly used in business. A type-style-extender board has sockets for seven optional 16K-byte EPROMs to recognize additional type styles.

When text has been identified, it can be sent either to the host system in page-image form, using asynchronous or bisynchronous communications, or to an optional format board. The format board codes the text for a particular word processor, preparing it for editing or filing.

Automatic operation

The WorkLess Station needs a human operator only for starting the system and clearing occasional paper jams. The system adjusts automatically for variations in type style (Courier 10 and 12, Letter Gothic, elite, Prestige elite, pica, Prestige pica, OCR-A and OCR-B), pitch, page skew (as much as ¼ in.), paper-and-ink contrast, line spacing and page size (6 × 6 in. to 8½ × 14 in.). In addition, the unit's self-diagnostic software watches for failure modes. If it detects a malfunction, it alerts an operator via a message panel and prompts him to take one of five steps: call a service technician; clean the recognition window; clear a paper jam; remove an unreadable page caused by degraded copy, improper type style or an upside-down page; or check communications with the host system.

Type-style and character recognition

The WorkLess Station is unusual in that the type-style-recognition programs stored in EPROM are generic (Figs. 4, 5). There are generally more than 100 characters in a type style. However, most OCR systems are limited to character recognition of a specific type element—about 80 to 90 characters. In these systems, several recognition programs are needed just to handle the Courier type elements. But in the WorkLess Station, each type style is a composite of a family of type elements. The eight generic type styles incorporate approximately 95 percent of the type elements typically used in an office.

Key to the WorkLess Station's accuracy is a proprietary character-recognition scheme that accommodates ink splatter, copier specks and stroke-width variations that caused critical problems in many previous OCR systems. The WorkLess Station matches unknown characters with stored templates using a matrix-matching technique. Comparisons that fail to meet a required threshold are rejected until the best known-to-unknown character match is made. If two character templates both meet the matching threshold, one of the two must have a significantly better match than the other to be accepted. Otherwise, digital filtering normalizes the character's stroke widths and "removes" copier specks by ignoring patterns smaller than the dot on an "i."

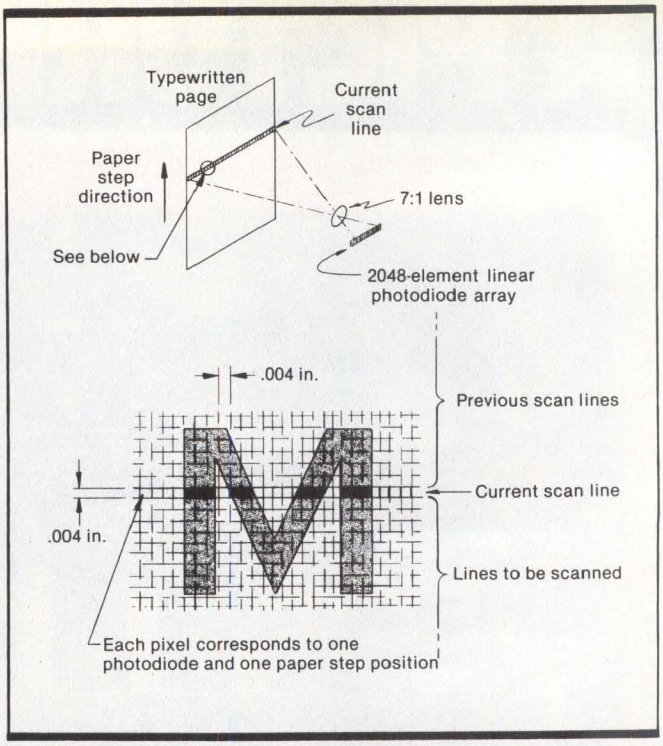

Fig. 3. Optical scanning. *A 2048-element linear photodiode array detects light from a line one pixel high, with each pixel representing an area on the page of 0.000016 sq. in. Each text character occupies a 24 × 32 pixel frame.*

Compactness is achieved by employing only eight circuit boards instead of the 30 to 40 boards commonly used in OCR devices.

After digital filtering, the unidentified character is again compared with stored templates. If a match still cannot be made, the system employs context resolution to distinguish among characters of similar or identical shape. In some type styles, the digit 1 and the letter "l" and the digit 0 and the capital letter "O" are indistinguishable. In these cases, the WorkLess Station determines the character by the same method used by a person. For example, "$56.10" and "will" each have two characters that sometimes are not recognizable on the basis of shape. In the first example, there is a neighboring numeric character "6" (the period/decimal is not sufficient information), and therefore the system determines that a one and a zero follow the decimal. In the

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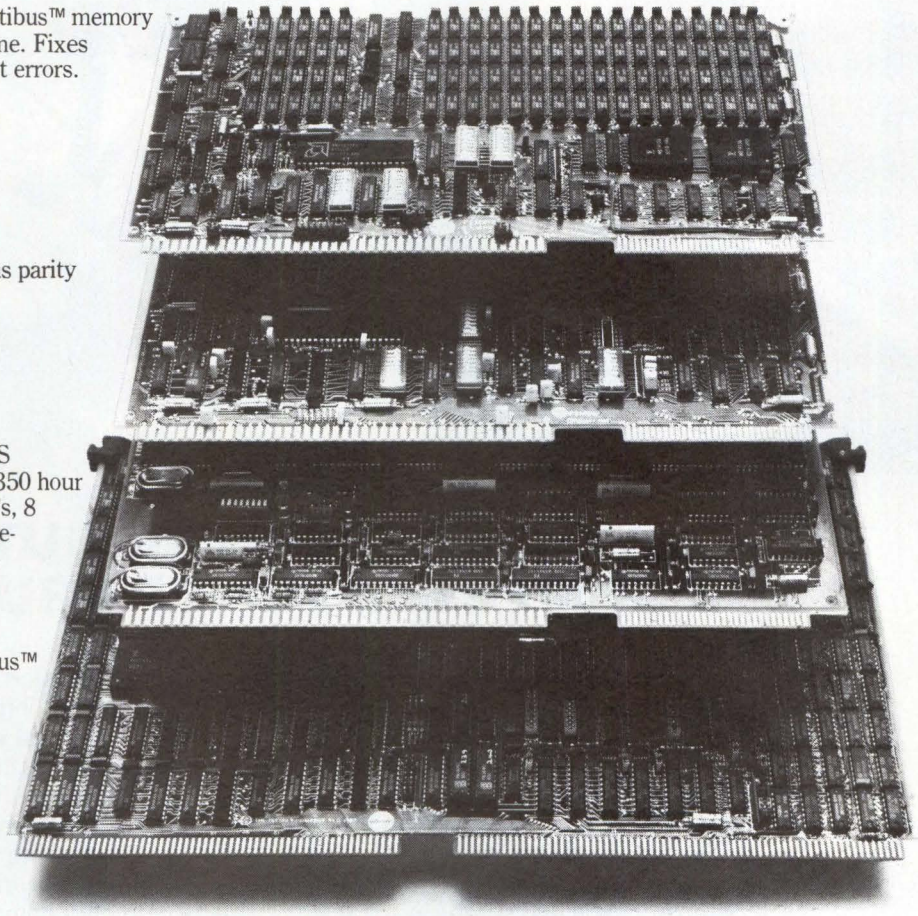

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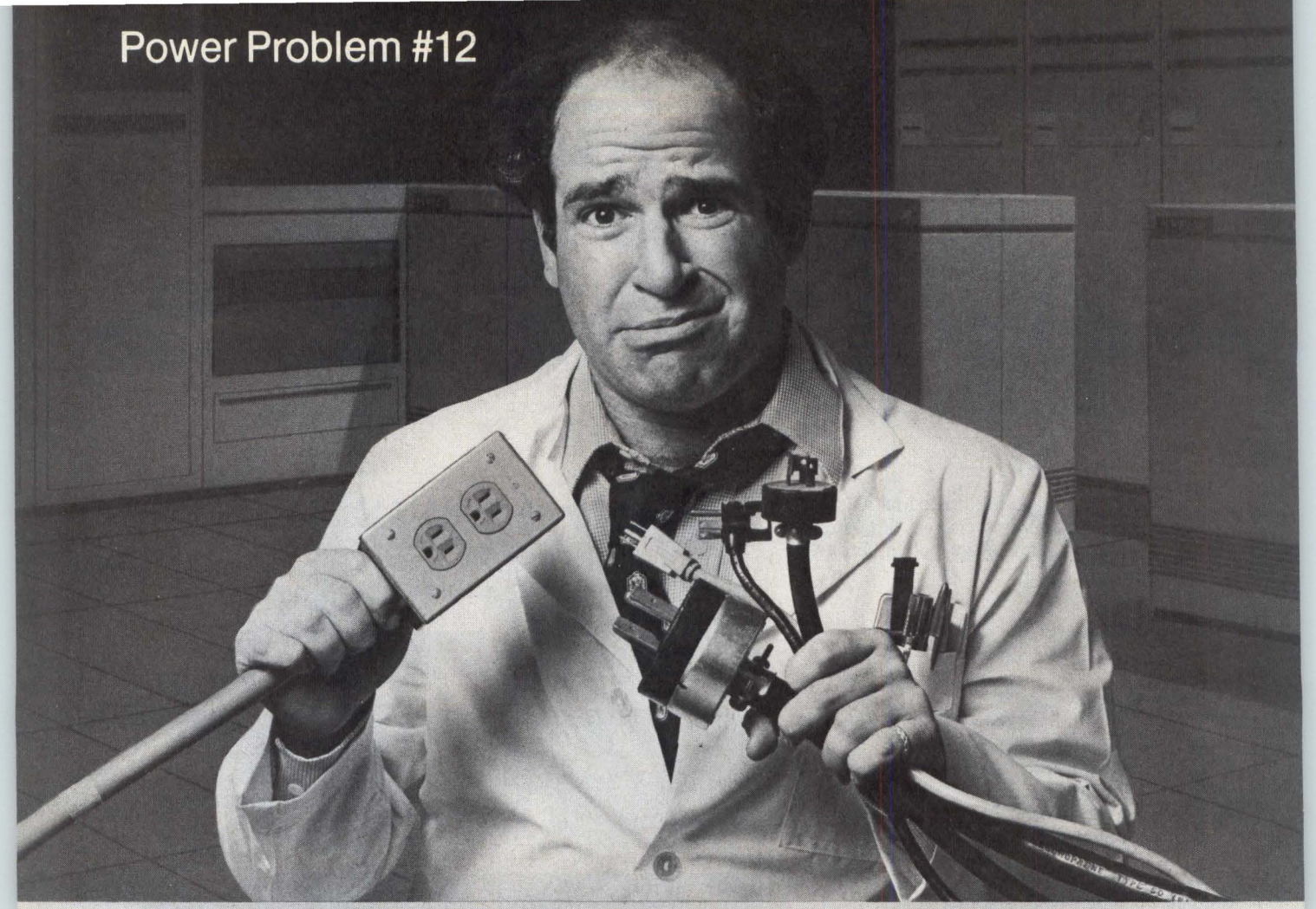

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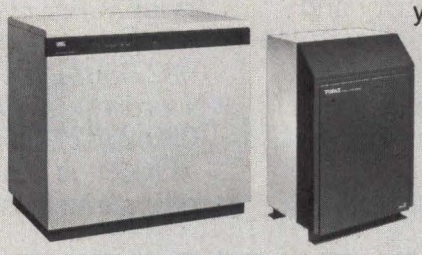

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second example, the neighboring lowercase "i" causes the last two characters to be interpreted as alphabetic.

If, after digital filtering and context resolution, the system still cannot identify a character, the 8085 microprocessor sends a rejected-character code to the host computer. Once the complete text has been processed and transmitted, the word-processing operator can search the text for the rejected-character codes and make the correct decision. Rejected characters typically occur about once in 2000 characters. Characters that are improperly "recognized," and hence do not result in rejected-character codes, occur only once in 20,000 to 30,000 characters.

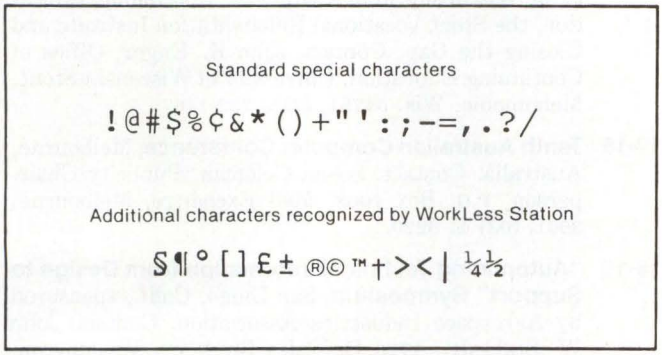

Fig. 4. The WorkLess Station character set *includes the special characters found on most type elements (top) and several others (bottom). Most OCR systems recognize only 80 to 90 characters and cannot handle the characters shown at the bottom unless an operator loads an alternate character-selection program that invalidates some of the "standard" characters. The WorkLess Station solves the problem by recognizing more than 100 characters from each type style, allowing automatic processing of documents containing mathematical, legal and other speical symbols.*

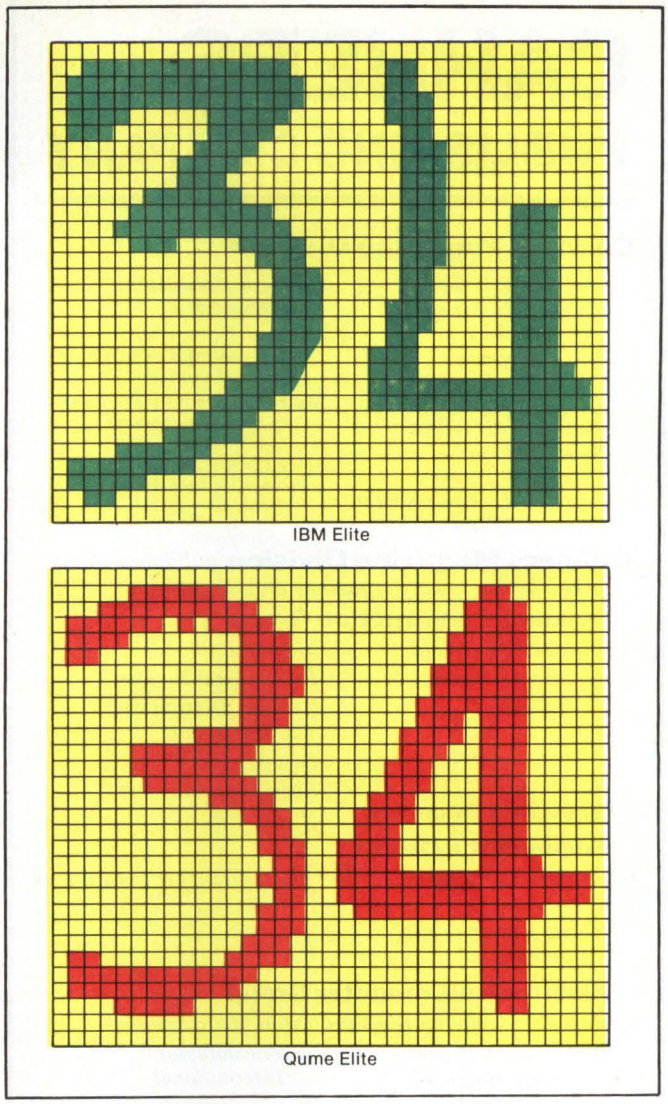

Fig. 5. Character fonts from different vendors are seldom identical. *For example, one IBM elite type style uses a flat-topped 3 and an "open" 4, while one Qume elite type style uses a round-topped, 3 and a "closed" 4. To resolve these differences, many OCR systems require a separate character-recognition program for each vendor's type style. The DEST WorkLess Station addresses the font problem by incorporating generic type styles that encompass each vendor's offerings. In the example shown, the WorkLess Station's Elite program has separate templates for the IBM and Qume versions. In cases in which versions of a character differ only slightly, the WorkLess Station uses a single "compromise" template close enough to each version to assure recognition.*

Text formatting

The WorkLess Station can be ordered with a format board that sends text pages to the host system with all the special formatting commands necessary for editing, filing and transmission. Format boards are available for the Wang Laboratories Inc. WPS/OIS/VS Alliance, the IBM Corp. Displaywriter, the CPT Corp. 8000/8100/8500, the Exxon Office Systems Corp. 510/520, the Xerox Corp. 860, the NBI Inc. 3000/OAsys 8 and 64 and the Lanier Business Products Inc. LTE-3 word processors. DEST is developing custom interfaces for other word-processing systems.

The format board inserts codes into the text stream to indicate the location and type of each format function: tab setting, centering, paragraphing, indenting, underlining, end of page, end of document, line-spacing change and left and right margins. The codes are inserted by a translation program stored in the on-board EPROM. During formatting, text pages are stored in the format board's 24K bytes of RAM.

The WorkLess Station can also be ordered with a "universal" format board that inserts all formatting codes included in the ASCII character set. While this configuration results in more word-processing "clean-up" than a format board tailored for a specific word processor, it allows the WorkLess Station to function with any host system containing an RS232 interface. □

Richard Matthews is vice president of engineering at DEST Corp., San Jose, Calif.

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12-14 "Discovery '83: Computers for the Disabled" Conference, Minneapolis, sponsored by the University of Wisconsin-Stout's Office of Continuing Education, the Stout Vocational Rehabilitation Institute and Closing the Gap. Contact: John K. Enger, Office of Continuing Education, University of Wisconsin-Stout, Menomonie, Wis. 54751, (715) 232-1167.

12-15 Tenth Australian Computer Conference, Melbourne, Australia. Contact: Susan Coleman, Publicity Chairperson, P.O. Box 4063, Mail Exchange, Melbourne, 3001, (03) 41 6220.

13-15 "Automating Technical Information from Design to Support" Symposium, San Diego, Calif., sponsored by Aerospace Industries Association. Contact: John W. Stahl Jr., 1725 De Sales St. N.W., Washington, D.C. 20036, (202) 429-4635.

13-15 1983 Federal Computer Conference, Washington, D.C., sponsored by Federal Education Programs. Contact: Federal Computer Conference, P.O. Box 368, Wayland, Mass. 01778, (800) 225-5926 or (617) 358-5181.

13-15 Mini/Micro Midwest '83, Chicago, sponsored by Regional Units of the Institute of Electrical and Electronics Engineers and the Electronic Representatives Association. Contact: Nancy Hogan, Communications Coordinator, or Kent E. Keller, Communications Counsel, Electronic Conventions Inc. 8110 Airport Blvd., Los Angeles, Calif. 90045, (213) 772-2965.

14-16 Southern California Regional Users Group Conference, San Diego, presented by SCRUG. Contact: Jane Knight, SCRUG, 574 E. Madison Ave., El Cajon, Calif. 92020, (619) 442-1848.

15-18 Second Annual Twin Cities Computer Show and Software Exposition, Minneapolis, produced by Northeast Expositions. Contact: Northeast Expositions, 822 Boylston St., Chestnut Hill, Mass. 02167, (617) 739-2000.

16-18 COMPUFAIR Seattle, Seattle, sponsored by Compufair Inc. Contact: Tom Ikeda, Compufair Inc., 909 N.E. 43rd St., Suite 302, P.O. Box 45218, Seattle, Wash. 98105, (206) 633-3247.

16-18 Great Southern Computer & Electronics Show, Jacksonville, Fla., presented by the Great Southern Computer & Electronics Shows. Contact: Great Southern Computer & Electronics Shows, P.O. Box 655, Jacksonville, Fla. 32201, (904) 384-6440 or 353-0418. Also to be held Oct. 7-9, Orlando, Fla.

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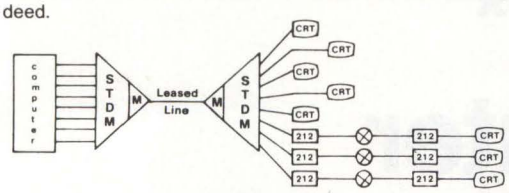
THE DATA DETECTIVE #5

The Case of the Phantom Sign-Off

When I arrived on the scene, everyone was milling around, waiting for a deceased application program in a remote computer to be put back on-line. It appeared that someone had sent a sign-off character sequence to the remote computer that inactivated that program for all users. There were many users, all connected directly or via 212 modems to a multiplexer and then through a leased line to the computer. All users claimed to be innocent of the dastardly deed.



A preliminary inquiry revealed that either BYE, followed by carriage return, or control C, or control B, could cause the observed computer demise. There had been several similar incidents in the past and tempers were fraying. Probing questions disclosed that the phantom sign-off only occurred when a dial-in user was on the system, but a more persistent grilling revealed that the dial-in users were blissfully unaware of anything amiss because the sign-off always occurred after they had hung up. Now I knew the culprit. When a dial network connection is abruptly terminated, it takes time for the modem at the TDM end of the line to detect the loss of carrier. As the carrier level decays, and noise on the open line predominates, the modem receiver demodulates phantom data which, of course, being random, sooner or later mimics one of the sign-off characters. Eventually the modem, realizing carrier is truly lost, clamps its receiver and hangs up.

The phantom was dispelled by raising the carrier detect level so that loss of carrier happened sooner, thereby increasing the odds against generating a bogus sign-off character. A better solution was to use a 212 modem which featured a long space disconnect option, in which a spacing signal tells the central site modem to clamp its receiver before carrier drops. —R.G

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19-21 **Third Annual Videodisc/Optical Disk Conference,** New York, sponsored by Meckler Communications. Contact: Mark Roseman, Meckler Communications, Department D, 520 Riverside Ave., Westport, Conn. 06880, (203) 226-6967.

19-23 **IFIP Congress '83, 9th World Computer Congress,** Paris, sponsored by the International Federation for Information Processing. Contact: Philip H. Dorn, Dorn Computer Consultants Inc., 25 E. 86th St., New York, N.Y. 10028, (212) 427-7460.

21-25 **SICOB,** Paris, organized by the SICOB Advisory Committee. Contact: Caroline Brownstone, (415) 347-1152, or David Bunzel, (408) 947-4665.

22-24 **Second Annual Rocky Mountain Computer Show and Software Exposition,** Denver, produced by Northeast Expositions. Contact: Northeast Expositions, 822 Boylston St., Chestnut Hill, Mass. 02167, (617) 739-2000.

23-24 **First Annual Dakota Computer Fair,** Bismarck, N.D. Contact: Stephen Cobb, Dakota Computer Fair '83, P.O. Box 7036, Bismarck, N.D. 58502, (701) 224-0166.

26-28 **Maecon/83 Electronic Show and Convention,** Kansas City, Mo., sponsored by Kansas City and St. Louis Sections of the IEEE and the Heart of America and Spirit of St. Louis Chapters of the ERA. Contact: Maecon/83 Professional Program Committee, c/o Dale Litherland, Director of Education, 8110 Airport Blvd., Los Angeles, Calif. 90045.

26-28 **Sixth European Conference on Electrotechnics,** Brighton, England, organized by the Institution of Electrical Engineers, sponsored by the Convention of National Societies of Electrical Engineers of Western Europe and Region 8 of the IEEE. Contact: The Manager, Conference Services, Institution of Electrical Engineers, Savoy Place, London WC2R OBL, U.K., (01) 240-1871, ext. 222.

28-29 **Ottawa Computer & Office Automation Show,** Ottawa, Canada, presented by Industrial Trade Shows of Canada. Contact: Industrial Trade Shows of Canada, 20 Butterick Rd., Toronto, Ontario M8W 3Z8, (416) 252-7791.

SEPTEMBER 29 - OCTOBER 1

CP/M '83 East, Boston, sponsored by Digital Research Inc. Contact: Northeast Expositions, 822 Boylston St., Chestnut Hill, Mass. 02167, (800) 841-7000 or (617) 739-2000.

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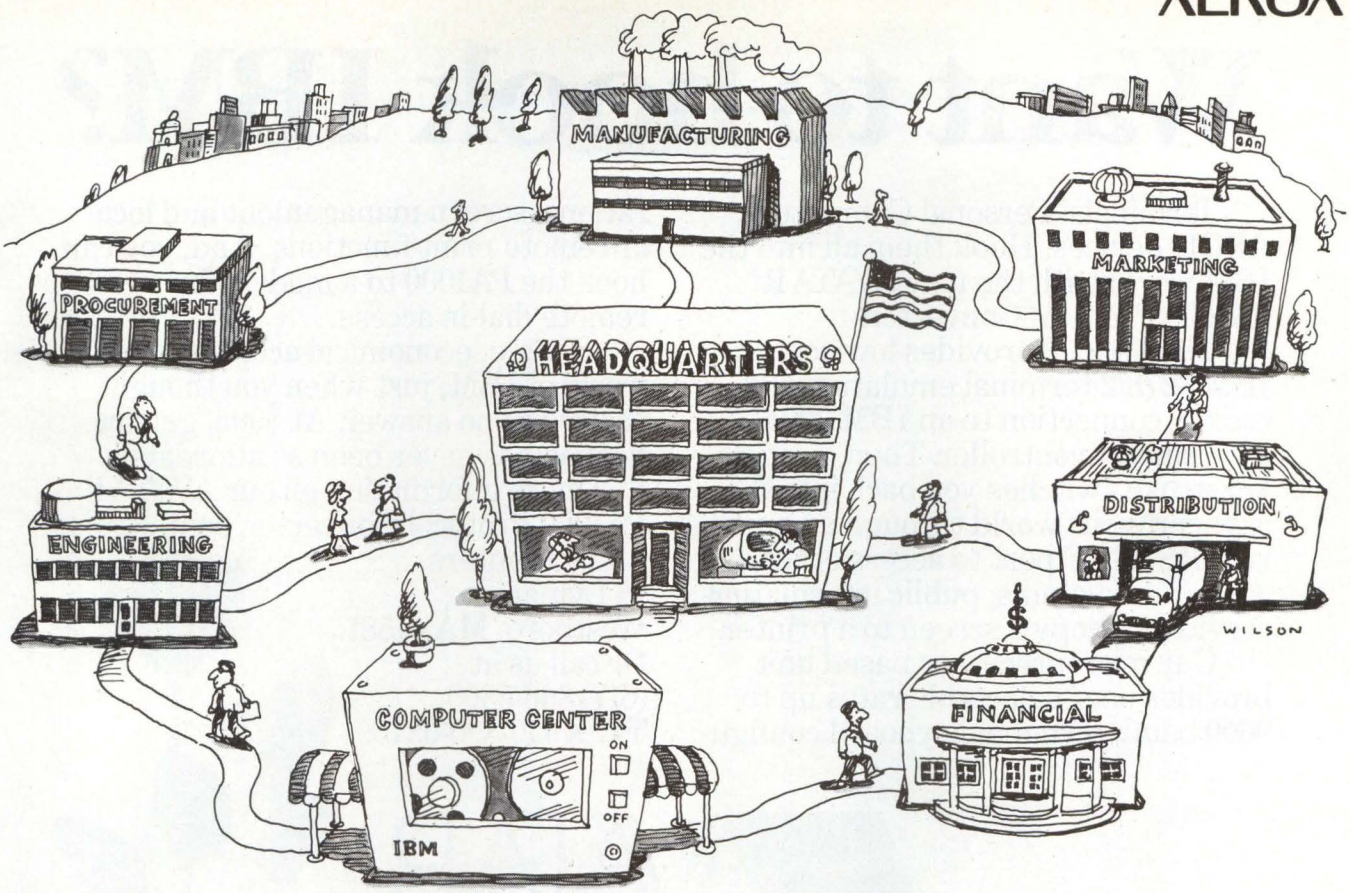

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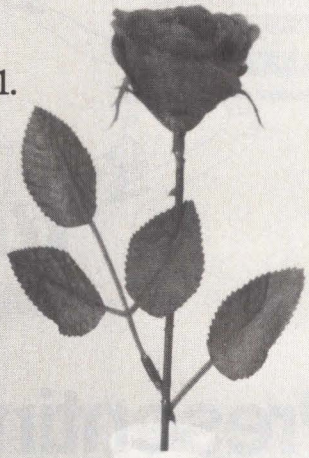

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SYSTEMS

Fault-tolerant system features UNIX

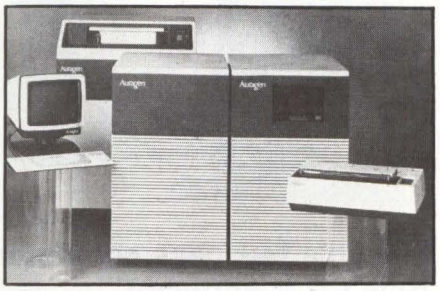
Auragen Systems Corp. has announced the first system that combines the Motorola 68000 microprocessor family, the UNIX software family and fault-tolerant architecture—the three emerging standards of the 1980s.

The Auragen 4000 system is organized into clusters connected by dual 16M-byte-per-sec. system buses. A fault-tolerant system must consist of at least two clusters, and each cluster is a complete computer system in its own right. There are four types of processor within each cluster: work, executive, communications and disk/tape. A cluster must have at least one work processor and one executive processor. Overall organization of the Auragen 4000 is shown in the figure.

Auragen's software offerings include AUROS—derived from Bell Laboratories UNIX System III, but modified for fault tolerance—the COBOL, FORTRAN, Pascal, BASIC and C programming languages; and communications protocols. Also offered by Auragen are a set of transaction-processing tools, including a menu processor, a screen manager, a relation DBMS with query and the Transaction Processing Management System, which enables programmers to write single transactions for a single-user environment. The system then integrates them into the run-time environment of many transactions and many users.

Auragen's approach to fault tolerance is based on saving all the inputs to a process and saving the sequence of the inputs to that process.

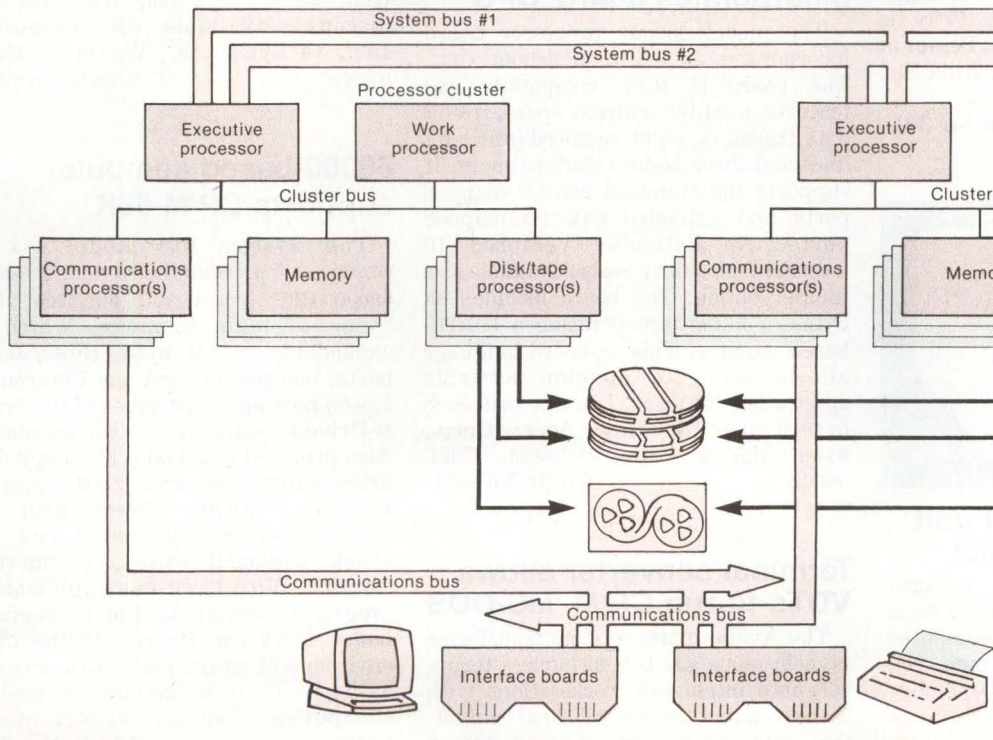
Every inter-processor message is sent to the receiver, the receiver's backup and the sender's backup. The receiver processes the input while the backup stores the message. If there is a failure, the backup of the failed process is activated to process the input as it was stored. The operating system switches automatically to live input when the stored queue is depleted and prevents duplicate output messages from being sent. For that reason every inter-processor message is sent to the sender's backup. To keep open access to the outside world when controllers fail, dual paths to peripherals and communications ports are provided.



The Auragen System 4000 32-bit super-minicomputer *has UNIX, programmer-invisible fault tolerance and an easy-to-use collection of software-development tools.*

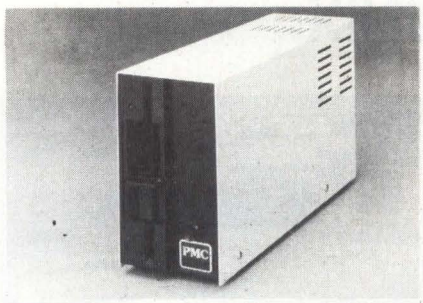
Prices for a two-cluster Auragen 4000 system with 152M bytes of mass storage start at $138,000. **Auragen Systems Corp.,** 210 Sylvan Ave., Englewood Cliffs, N.J. 07632. **Circle No 300**

HARDWARE ORGANIZATION OF THE AURAGEN 4000.



New Products

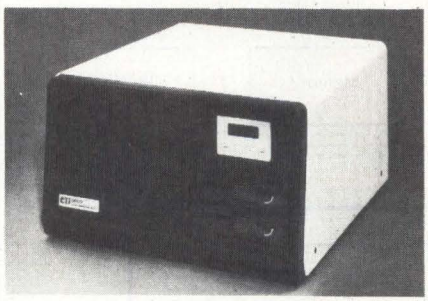
SYSTEMS



Portable business computer runs CP/M software

Measuring 3½ × 6 × 13 in. and weighing 8 lbs., the portable MicroMate computer converts any asynchronous dumb or smart terminal to a CP/M microcomputer. The MicroMate features a Z80A microprocessor, 128K bytes of bank-switched RAM, an integral 320K-byte, 5¼-in. floppy disk drive, two 50- to 19.2K-baud serial ports, an 8-bit parallel port suitable for a Winchester disk drive, a Centronics parallel printer port and a connector for as many as three external disk drives. The computer runs the CP/M 3.0 operating system and includes the T/Maker III software package that features electronic spreadsheet, word-processing, list-processing, file-management, data-transfer and bar-chart-generation capabilities. Price is $995 in single-unit quantities. **Personal Micro Computers Inc.,** 475 Ellis St., Mountain View, Calif. 94043.

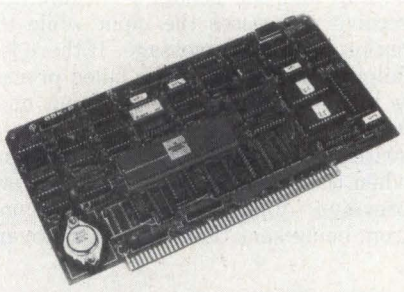
Circle No 301



3270 terminal-control unit has personal computer

The model CTi 3000 is a 3270-compatible terminal-control unit with an integral, multi-user personal computer. This multiprocessor-based system controls host communications, memory, storage devices and I/O devices. Multi-user capability is provided through the incorporation of one or more dedicated processors that allow a user to select from CP/M-86-, MP/M-86- or MS-DOS-compatible programs for local processing. The base unit includes a single processor and 128K bytes of memory and can support information to four to eight workstations, depending on device type. Expansion options include support for as many as eight or 16 devices, depending on device type, as much as 756K bytes of memory and as much as 10M bytes of Winchester disk storage. Prices begin at $5990 for IBM 3274 compatibility without local processing capability. **CTi Data Corp.,** 5275 North Blvd., Raleigh, N.C. 27604.

Circle No 302



S-100 processor board incorporates 8-MHz CPU

The model 68000P processor board incorporates an 8-MHz MC68000L CPU. The board is IEEE compatible and features a 24-bit address space, 16-bit data transfers, eight vectored interrupt lines and three 16-bit counter/timers. It supports the standard 256 I/O mapped ports and extended 64K I/O mapped ports. An extended vectored ID interrupt capability is also available as a jumper option. The board includes 8K bytes of PROM incorporating a FORTH-based monitor. This on-board language allows users to develop ROMable application software. Price is $349 each in OEM quantities. **Inner Access Corp.,** 517-K Marine View, Belmont, Calif. 94002.

Circle No 303

Terminal converter allows VDTs to run CP/M, MS-DOS

The Avatar TC100 system transforms asynchronous and IBM 3278-class terminals into intelligent workstations with both CP/M and MS-DOS personal computing capabilities. The Avatar TC100

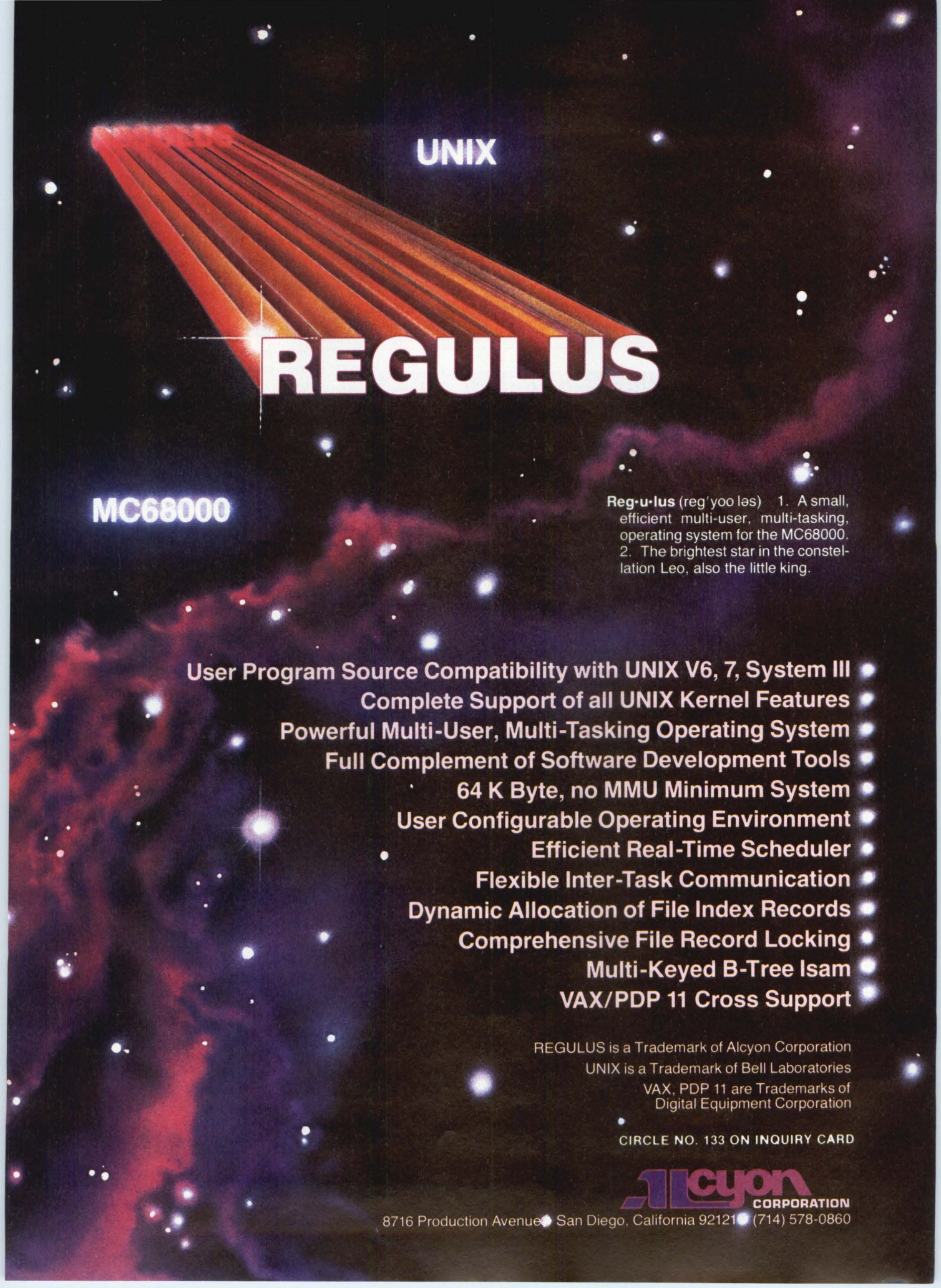
features a single-board, shared-memory architecture with a Z80 and an 8088 microprocessor and 128K bytes of dynamic RAM, expandable to 256K bytes. The TC100 includes ports for connection to host computers, local printers and corporate and public information databases. It also includes communication and software utilities for file and data transfer. The system is available with one or two 800K-byte floppy disk drives or an integrated Winchester/floppy disk system with Winchester disk capacities of 5M, 10M or 20M bytes. The TC100 runs all standard CP/M, CP/M-86 and MS-DOS software. It includes the CP/M and CP/M-86 operating systems, WordStar and CalcStar application programs and CBASIC development software. Single-unit prices range from $2195 to $6295, with quantity discounts available. **3R Computers Inc.,** 18 Lyman St., Westboro, Mass. 01581.

Circle No 304

68000-based computer supports CP/M-68K

The System 816 model 68K is configured around the vendor's 8-MHz 68000 CPU board and features 256K bytes of main memory, which is expandable to 1M byte, three serial ports, one parallel and one Centronics/Epson port and 1.5M bytes of the firm's M-Drive/H solid-state disk emulator. Also provided is a dual 8-in. floppy disk drive subsystem with 2.4M bytes of storage. Software offered with the system includes mapFORTH and CP/M-68K packaged with a C run-time library. With CP/M-68K, application programs written in the C language under UNIX can be run in the CP/M environment on the model 68K. Price is $8995, with OEM discounts available. **CompuPro,** Oakland Airport, Calif. 94614.

Circle No 305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User Program Source Compatibility with UNIX V6, 7, System III
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Comprehensive File Record Locking
Multi-Keyed B-Tree Isam
VAX/PDP 11 Cross Support
REGULUS is a Trademark of Alcyon Corporation
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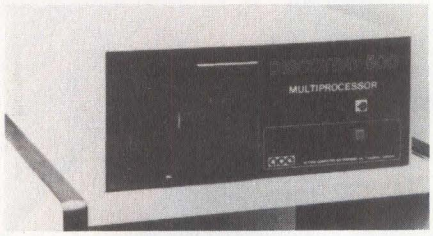
New Products

SYSTEMS

Multiprocessor computer supports seven users

The Discovery 500 desk-top multiprocessor computer simultaneously serves as many as seven user terminals and two printers. A built-in 5¼-in. Winchester disk drive is available with as much as 20M bytes of mass storage. One or two half-height, 5¼-in. floppy disk drives with storage capacities as large as 640K bytes provide backup. The Discovery 500 can be configured as a single-user system powered by a Z80A CPU with 64K bytes of RAM running the CP/M-80 operating system. Additional user processors can be added in any mix of



Z80A-based, 8-bit processors or 8086-/8087-based, 16-bit processors with 128K bytes of on-board RAM each. The 16-bit processors run CP/M-86 and can be expanded to include 1M byte of RAM each. The Discovery 500 supports BASIC, Pascal, COBOL and FORTRAN and runs CP/M-80- or CP/M-86-compatible programs. Prices range from $6995 to $7295 for single-processor, single-user systems and from $8295 to $14,295 for multiprocessor, single- or multi-user systems. **Action Computer Enterprise Inc.,** 430 N. Halstead St., Pasadena, Calif. 91107. **Circle No 306**

SONEX kills printer noise beautifully.

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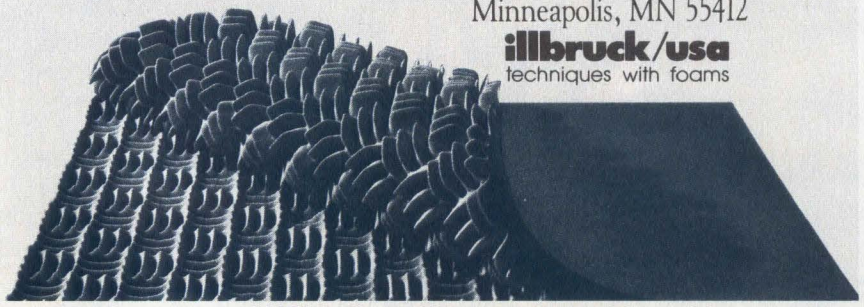

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CIRCLE NO. 134 ON INQUIRY CARD

Workstation runs Data General software

The Hare Brain 32-bit, MC68000-based, multi-user computer gives Data General users state-of-the-art hardware and software technology while preserving their software investment. Users can run programs on the Hare Brain and communicate with DG machines. The Hare Brain features a UNIX-like operating system and a variety of programming languages including COBOL, Pascal, BASIC, FORTRAN 77, APL, Assembler, C and SIBOL. The Hare Brain is priced at $16,995 including 512K bytes of parity memory, seven RS232 ports, a 16-bit parallel port, a calendar clock with battery backup, a 30M-byte Winchester disk drive, a 660K-byte floppy disk drive, the UNIX-like operating system with a choice of one programming language, an IEEE-796 Multibus-compatible bus structure and a range of interface options. **Wild Hare Computer Systems Inc.,** P.O. Box 3581, Boulder, Colo. 80307. **Circle No 307**

RODIME's exciting new dimension... 3½"

Introducing the ultra-compact, 3½" Winchester disk drive with up to 10 megabytes formatted capacity

There's an exciting new dimension to Winchester disk drives. With one-fourth the volume of a standard 5¼" Winchester disk drive and the same height as a half-height 5¼" drive, our new RO 350 3½" Winchester disk drive brings high capacity storage (up to 10 megabytes formatted) to applications you never thought of before. Its light weight, low power requirements and 85 millisecond access time open up a whole new world of Winchester applications. Portable computers. Compact desk top systems. Intelligent terminals. Point-of-sale terminals. Industrial controllers. Navigation and guidance systems. Portable instrumentation. (In fact, there are few places our light weight, ultra-compact 3½" Winchester disk drives can't be used.)

A new dimension of design versatility

The RO 350 gives you tremendous freedom and flexibility in designing systems. Take a look at the number of ways this compact approach can work:

- Uses industry-standard ST506 interface which makes it compatible with all major 5¼" Winchester controllers.
- Is a compact 3½" drive for those tight spots other drives cannot fit.
- Directly replaces half-height 5¼" disk drives (with Rodime sub-frame).
- When faced with space problems, the RO 350 plus controller card will fit into the same space as a standard 5¼" Winchester disk drive.
- Two RO 350 drives easily fit in the same space as a standard 5¼" Winchester disk drive.

A new dimension of technical excellence

RODIME's reputation for technical excellence is further enhanced with the design of this ultra-compact Winchester disk drive. Using advanced large-scale integration, the entire electronics for the drive are on a single, compact board. In addition to its compact size and weight (about one-third the weight of a standard 5¼" drive), there are other design innovations. Power consumption is only 13 watts—half of a 5¼" drive's power requirements. Access time is 85 milliseconds. The rugged design of the RO 350 translates to high resistance to shock, an important consideration for portable computer systems.

Our no-nonsense tradition

Our ultra-compact, 3½" Winchester disk drive continues our no-nonsense tradition. It's a philosophy that has made our family of 5¼" Winchester disk drives, with capacities up to 54 megabytes, the preferred drives of OEMs and system integrators worldwide. It's a philosophy built on quality, reliability and performance.

To find out how our new 5 and 10 megabyte 3½" Winchester disk drives can add a new dimension to your system design, or for details of our entire Winchester disk drive line, call or write today.

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CIRCLE NO. 135 ON INQUIRY CARD

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New Products

SYSTEMS

Single-board computer has triple bus structure

The model DBC-1880 modular single-board computer incorporates Intel's iAPX 188 CPU. The on-board system architecture features a triple bus structure including an IBM PC-compatible internal system bus with on-/off-board expansion capabilities that accommodates any add-on board designed for the IBM PC; a multi-master Multibus interface that permits configurations in which the DBC participates in multiprocessor architectures as a master, slave or intelligent slave; and a dual-port memory bus that communicates with the internal system bus and the Multibus. Other on-board features include serial and parallel I/O, floppy disk control, as much as 64K bytes of ROM and 256K bytes of RAM and an I/O expansion connector. Prices start at $795 in single-unit quantities. **Systemathica Consulting Group Ltd.,** 4732 Wallingford St., Pittsburgh, Pa. 15213. **Circle No** 308

Time-sharing system features hard disk storage

Challenge Systems' CS1000 line of single-user, small-business computer systems now includes a multi-user model. The multitasking, multi-user CS1000 can support as many as three workstations simultaneously. Using a dual 8-bit microprocessor architecture and a high-speed data link, the CS1000 features as much as 30M bytes of hard disk storage, as much as 384K bytes of RAM, the CP/M and MP/M operating systems and print and keyboard buffers. High-level languages including Microsoft BASIC, COBOL, and Pascal and Assembly are available. Single-unit prices of the CS-1000 range from $7600 to $14,600, depending on configuration and options. Single-unit prices of the single-user systems start at $3995. **Systems Sales International Inc.,** 1016 La Posada, Suite 164, Austin, Texas 78752. **Circle No** 309

Color graphics system interfaces with IBM, P-E

The System 1500 multistation is a system of distributed computer graphics workstations. The System 1500 controller performs all graphics-related functions and supports one to four workstations. The System 1500 provides real-time 2D and 3D transformations such as rotation, translation and zoom. Transformations can be combined in any order, saved, restored and stacked for structured image definitions. The workstations can be placed as far as 200 ft. away from controller and can be configured for local or remote operation. In a local configuration, the controller can be as far as 200 ft. away from the host computer. The System 1500 is also offered with a choice of 32-bit parallel interfaces for IBM, Perkin-Elmer, or Digital Equipment Corp. processors. Prices for the System 1500 controllers start at $19,900. **Spectragraphics Corp.,** 10260 Sorrento Valley Rd., San Diego, Calif. 92121. **Circle No** 310

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IEEE-488 ½-inch magnetic tape recording systems.

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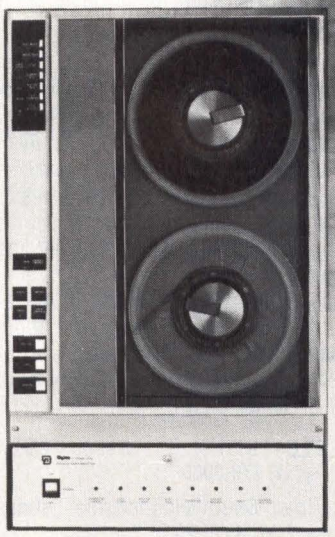

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Business Planners to Electronic Companies

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Joint Study Mission To Japan For Business Microcomputer Software

December 4 - December 16, 1983
Tokyo, Japan

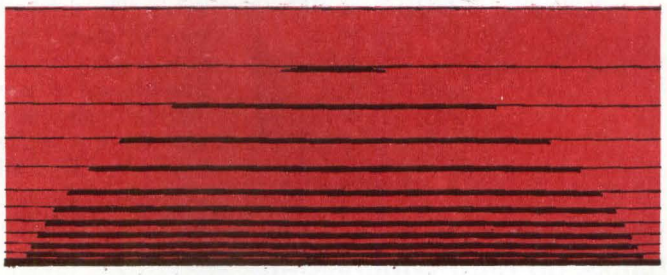
Mini-Micro Systems magazine and the Technology Transfer Institute are sponsoring a joint study mission to Japan to promote understanding of, and provide the groundwork for, setting up joint ventures to develop business microcomputer software for both the U.S. and Japanese markets. Leading the mission is Richard J. Matlack, president of InfoCorp, a Cupertino, Calif. market research and competitive analysis firm specializing in microcomputer systems. Co-participant is Lori Valigra, Senior Editor, News, for Mini-Micro Systems.

Who Should Attend:

- U.S. and European software development firm executives wishing to produce software for sale in Japan.
- U.S. and European executives of hardware manufacturing companies needing information on the type of hardware necessary to support Japanese software.
- U.S. and European systems integration house executives who need to know what the systems requirements are among Japanese users.
- U.S. and European third party marketeers wishing to sell and buy microcomputer systems in and from Japan.
- Data processing executives in multi-national firms.

Why Attend:

- To understand how to serve the needs of the Japanese software market through a comprehensive study mission covering the state-of-the-art in operating systems, languages, software standardization efforts, and applications requirements for the Japanese market.
- To obtain a market overview for Japanese microcomputers and business software.
- To understand end user applications needs for word processing, spreadsheet, accounting, and database packages.
- To talk with independent software vendors in Japan and share information about their strategies.
- To learn about the technical requirements to convert or rewrite software for Japan.
- To learn about the practical considerations of setting up a joint venture.



Objectives:

- To understand the Japanese software market and identify market opportunities. The need for joint ventures, and suggestions about how to get started, will be emphasized.

Major Topics:

- Overview of Japan's microcomputer market
- Applications
- Operating systems
- Languages
- Software conversion
- Distribution and support
- How to start a joint venture

Format:

- Formal presentations
- Business meals
- Company visits
- Individual meetings

Dates:

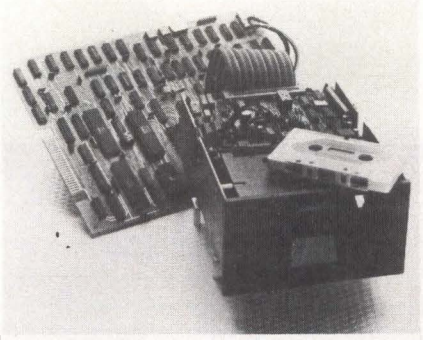
The formal program begins Sunday, December 4 and ends on Tuesday, December 13. Three business days are available for individual meetings through Friday, December 16.

Lodging, Registration, Scheduling, Fees:
Contact Mr. Hideaki Hashizume, General Manager, TTI, One Penn Plaza, Suite 1411, 250 W. 34th Street, New York, N.Y. 10119, (212)947-2648. Telex: 420057;TTIUI

CIRCLE NO. 138 ON INQUIRY CARD

New Products

DISK/TAPE

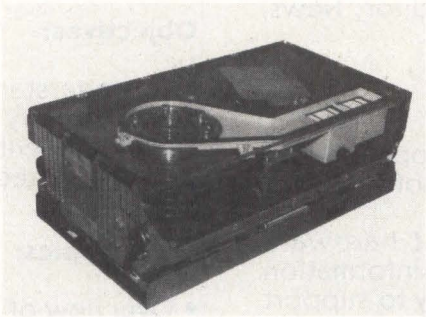


Digital cassette tape drive backs up mini Winchester

The Winchester Repeater Series WR-100 streaming-tape drive is a QIC-02-compatible digital cassette recorder with a 10M-byte formatted capacity. Overall dimensions and operating voltages of the drive are identical to those of 5¼-in. Winchester disk drives. The drive operates at a read/write tape speed of 30 ips and features a data-transfer rate of 24K bytes per sec. Recording density is 6400 flux transitions per in. Available as an option with the Series WR-100 is an intelligent interface and a microprocessor-based intelligent controller. The WR-100 can handle as many as four 10M-byte tape drives, reading or writing data in a streaming mode. Evaluation systems, including the Series WR-100 cassette drive, the intelligent interface and the interconnecting cable, are priced at $1495 each. **Raymond Engineering Inc., Raycorder Products Division,** 217 Smith St., Middletown, Conn. 06457. **Circle No 311**

Half-height floppy drives feature three bezel sizes

The PICO RFD 485 (48-tpi) and RFD 965 (96-tpi), double-sided, 5¼-in. floppy disk drives are half the height of a standard minifloppy drive. Measuring only 1.61 in. high behind the bezel, these new drives allow users to expand system capacities by replacing one full-sized drive with two half-height drives. The bezel is removable and interchangeable with three sizes that can be installed in the field. One model provides complete interchangeability with full-sized units. The RFD 965 stores 1M byte, and the RFD 485 stores 500K bytes. The drives have a data-transfer rate of 250K bytes per sec. Average access times are 94 msec. for the model RFD 965 and 80 msec. for the model RFD 485. In small OEM quantities, prices are $260 for the RFD 965 and $210 for the RFD 485. **Ex-Cell-O Corp., Remex Division,** 1733 E. Alton St., P.O. Box C19533, Irvine, Calif. 92713. **Circle No 312**

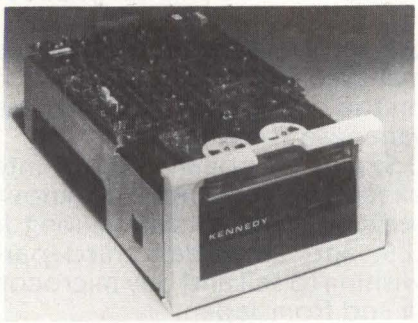


Winchester disk drive stores 167M bytes

The model D2257 8-in. Winchester disk drive provides as much as 167M bytes of unformatted storage capacity with an average access time of 20 msec. and a data-transfer rate of 1.2M bytes per sec. Initially offered with an SMD interface for ease of integration with existing controllers, the basic D2257 features address mark detection, detail error status reporting and a mounting frame bracket. A dual-port option is available. MTBF for the drive is more than 12,000 power-on hours; MTTR is less than ½ hr. Price is $3675 each in quantities of 100. **NEC Information Systems Inc.,** 5 Militia Dr., Lexington, Mass. 02173. **Circle No 313**

Mass-memory systems use 200M-byte tape cartridges

The Bank microcomputer mass-memory system features removable tape cartridges able to hold as much as 200M bytes of data. It emulates the micro-Winchester disk drive and is approximately the same size and price. However, the media is in the form of a continuous loop of 100-track magnetic tape encased in a cartridge approximately 5½ in. square × 1½ in. thick. Cartridges are available in 200M-, 100M- and 60M-byte capacities. Applications include archival storage or replacement for other types of on-line storage for which speed requirements are not high. The Bank can address and load individual files onto a disk or into the computer and can perform all the tasks associated with streaming-tape drives. When fitted with a 200M-byte cartridge, it takes an average of 10 sec. to find data. Once the data are found, transfer occurs at speeds as high as 60K bytes per sec. If greater speed is required, an entire file can be transferred from the Bank to a disk or to the computer itself. Single-unit price is $2195. **Corvus Systems Inc.,** 2029 O'Toole Ave., San Jose, Calif. 95131. **Circle No 314**



Fixed-head drive stores 50M bytes

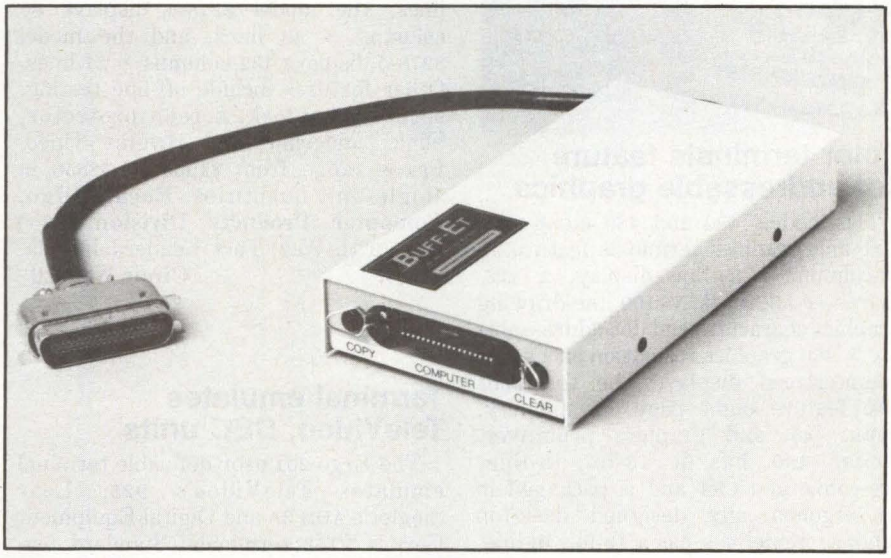
The model 6470 seven-track cartridge tape drive uses fixed heads to reduce mechanical complexity and improve read and write data reliability. The drive has a formatted storage capacity of 40M bytes with a 450-ft.-long tape cartridge or 50M bytes with a 600-ft.-long tape cartridge. The model 6470 employs self-clocking group-code recording with a 10K-bpi recording density and a 375K-bit-per-sec. data-transfer rate. Writing and reading speeds are 37.5 ips, while rewind speed is 90 ips. Other features include selective erase and an internal diagnostic technique that allows tape ramp and speed adjustment in the field without using an oscilloscope. In OEM quantities, the model 6470 is priced at $1100 each. **Kennedy Co.,** 1600 Shamrock Ave., Monrovia, Calif. 91016. **Circle No 315**

HARDWARE REVIEW

Printer buffer for IBM PCs found easy to use

The PC Buff-Et in-line Centronics parallel printer buffer designed for use with IBM Personal Computers is available in models with 16K-, 32K- and 64K-byte capacities. Prices range from $249 for the 16K-byte model to $329 for the 64K-byte model. *Mini-Micro Systems* tested the 64K-byte model connected to an Epson MX-100 printer and found it to be an easy-to-install, reliable product.

The PC Buff-Et has an "in-cable" configuration that allows easy installation. The cables are clearly labeled "printer" and "computer" and plug directly into these devices. The PC Buff-Et requires a 9V to 12V AC adapter for use with Epson printers. An AC adapter is easy to find, but finding one that has a tip small enough to fit into the hole in the buffer's enclosure is not. The AC adapter should be sold with the buffer.



Renaissance Technology's PC Buff-Et in-line Centronics parallel print buffer *connects easily to an IBM PC with its plug-in cables and connectors.*

Operating the PC Buff-Et is simple. We used our printer as we normally would, and the PC Buff-Et performed with no problems during our three-month evaluation. The table shows the results of an informal "time-saving" test we conducted using the PC Buff-Et. We printed four text files and measured the time it took for the buffer to fill with text, the time it took to print the text and the text size. The results show that the PC Buff-Et operates roughly 4.5 times faster than our 80-cps Epson MX-100 printer. For example, printing a document slightly longer than 10 pages on the Epson printer (at an average throughput of 39 cps) without the PC Buff-Et ties up the IBM PC for approximately 9 min. Printing the same document with the PC Buff-Et also takes 9 min., but the IBM PC is free to do other tasks after 2 min., the time it takes to fill the buffer. For documents less than 64K bytes long (about 30 pages long), the PC Buff-Et saves roughly 78 percent of the normal waiting time for an 80-cps printer. Our tests indicate a throughput rate of roughly 175 cps for our (parallel) buffer. Comparing this figure to the throughput rate of printers with other speeds indicates the buffer's benefits with other hardware.

The PC Buff-Et also features a copy facility that allows users to print multiple copies of a document by pressing the copy button on the PC Buff-Et's side. An emulation mode allows NEC 8023A-C, Computer International Prowriter, C. Itoh 8510 and Epson MX-80 and MX-100 printers to emulate IBM's PC printer. This is done by setting dip switches in the PC Buff-Et and the printer, as explained in the PC Buff-Et manual. Users can upgrade the PC Buff-Et's storage capacity by installing memory chips. The manual gives the RAM part numbers from a dozen manufacturers and includes installation instructions.

The 10-page manual explains how to install, operate and upgrade the PC Buff-Et. It also covers pin assignments, specifications and dip-switch settings for the emulation mode.

Other models of the Buff-Et can be ordered for other computer/printer combinations. Versions of the Buff-Et for use with serial printers are priced at $30 less than corresponding parallel models. **Renaissance Technology Corp.**, 1070 Shary Circle, Concord, Calif. 94518. **Circle No 358**

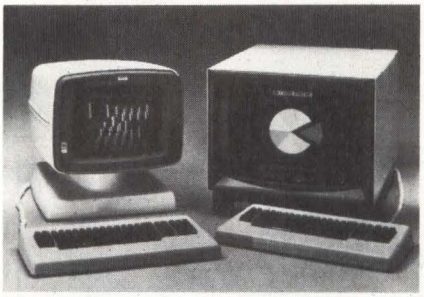
—Steven Frann

BUFFER TIME SAVING TESTS

Document	Buffer fill time (secs.)	Print time (secs.)	Text size (characters)	Printer buffer performance ratio	Buffer fill time (characters per sec.)	Print time (characters per sec.
TODO	9	37	1551	4.1	172	42
BOATTEXT	29	133	4962	4.6	171	37
SAM	30	130	5179	4.3	173	40
COHLER	86	416	15013	4.8	175	36

New Products

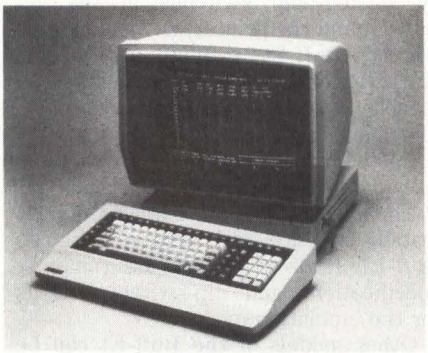
TERMINALS



Color terminals feature dot-addressable graphics

The models 480 and 489 eight-color text and graphics terminals feature an 80-column × 24-line display, a 128-character ASCII set, VT100 line-drawing graphics characters and dot-addressable 640 × 480 graphics resolution on a 60-Hz noninterlaced display. The terminals also feature eight pages of memory, zoom, pan and graphics primitives. Model 480 has a 13-in., in-line, pre-converged CRT and is packaged in an ergonomically designed desk-top cabinet. Model 489 has a 19-in., in-line, pre-converged CRT and is packaged in a metal cabinet with an internal chassis that is suited for standard 19-in. rack mounting. Single-unit prices are $5000 for the model 480 and $5500 for the model 489, with quantity discounts available. **Colographic Communications Corp.,** 2379 John Glenn Dr., P.O. Box 80448, Atlanta, Ga. 30366.

Circle No 319



Display stations are IBM-compatible

The model 8278 display stations are compatible with the IBM 3278-2, -3, -4 and -5 series terminals. The 8278 family features quiet operation with no cooling fan, front-mounted operator controls for the 15-in. tilt-and-swivel display screen and a detachable keyboard with non-glare keycaps and palm rest. All four models operate in SNA and non-SNA structures and can be attached to the vendor's 4270 series of IBM-compatible remote and cluster controllers. The model 8278-3 displays 80 columns × 32 lines, the model 8278-4 displays 80 columns × 43 lines, and the model 8278-5 displays 132 columns × 27 lines. Other features include off-line testing, security keylock, screen protector, blink, underline and reverse video. Prices range from $1999 to $2556 in single-unit quantities. **Racal-Milgo, Computer Products Division,** 6250 N.W. 27th Way, Fort Lauderdale, Fla. 33309. **Circle No 320**

Terminal emulates TeleVideo, DEC units

The Ergo 201 user-definable terminal emulates TeleVideo's 925, Lear Siegler's ADM 3A and Digital Equipment Corp.'s VT52 terminals. Standard features include 16 host-definable or user-programmable function keys, five video attributes and a custom mode that allows users to define the terminal's control codes and escape sequences and save these designations in nonvolatile memory. Other features include two-speed smooth scroll and a detached keyboard with LEDs. Characters are displayed in a 7 × 9 matrix with true descenders on a 12-in. green, nonglare screen with a screen-saver feature. Options include amber phosphor, two pages of memory, an alternate character generator and a graphics board with PLOT10 and Regis capability. Single unit-price is $695. **Micro-Term Inc.,** 1314 Hanley Industrial Court, St. Louis, Mo. 63144. **Circle No 321**

Flat-panel display terminal meets military specs

The model 2500 MS tactical plasma display system combines flat-panel display technology with MIL-SPEC packaging techniques. The terminal displays 50 lines of 80 characters using a 5 × 7 matrix and 32 lines of 64 characters using a 7 × 9 matrix. A total of 32 special symbols on a 16 × 16 field and 32 symbols on an 8 × 8 field are also available. A variable page size buffer for as many as 15 pages and having a total capacity of 7680 bytes is part of the system. An 8K × 16-bit PROM and an 8K × 16-bit RAM provide customer firmware and down-loadable software storage. An RS422 interface is standard, while RS232C and MIL-STD-188C interfaces are optional. Options include a keyboard with standard ASCII or special key sets as well as touch-panel, joystick, trackball and data-tablet manual-entry devices. Prices vary, depending on options selected. **SAI Technology Co.,** 4060 Sorrento Valley Blvd., San Diego, Calif. 92121. **Circle No 322**

Teleprinter fits into half a standard-sized briefcase

The portable model 707 teleprinter fits into half of a standard-sized briefcase, offers AC or battery-powered operation and weighs only 6 lbs. excluding the battery pack. The optional battery pack is installed internally in the model 707, can handle a normal daily print load in a portable application and can be recharged overnight. The teleprinter features 5 × 7 thermal matrix printing at 45 cps and a typewriter-like keyboard with full-travel keys. It prints an uppercase and lowercase ASCII character set with true descenders. It prints on 8½-in.-wide roll paper and features print formats of 80 columns per line for standard computer reports or 132 columns per line for 12-month financial data. The model 707 also has an integral, direct-connect, Bell 103-compatible, 300-baud modem. An acoustic coupler is optional. An optional Auto Access solid-state software cartridge allows a user to set up his own directory of phone numbers and log-on sequences. Price is $695 in single-unit quantities. **Texas Instruments Inc., Data Systems Group,** P.O. Box 402430, H-646, Dallas, Texas 75240. **Circle No 323**

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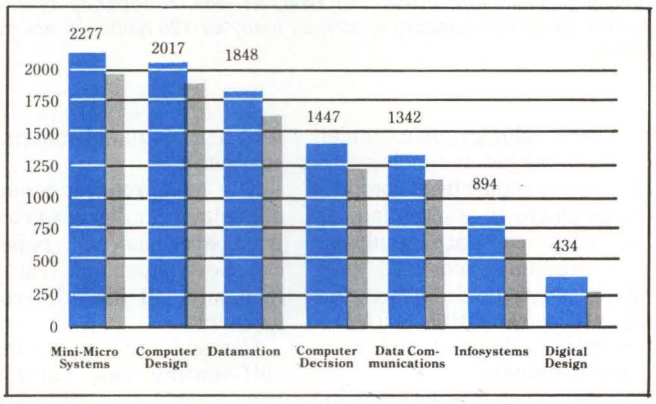

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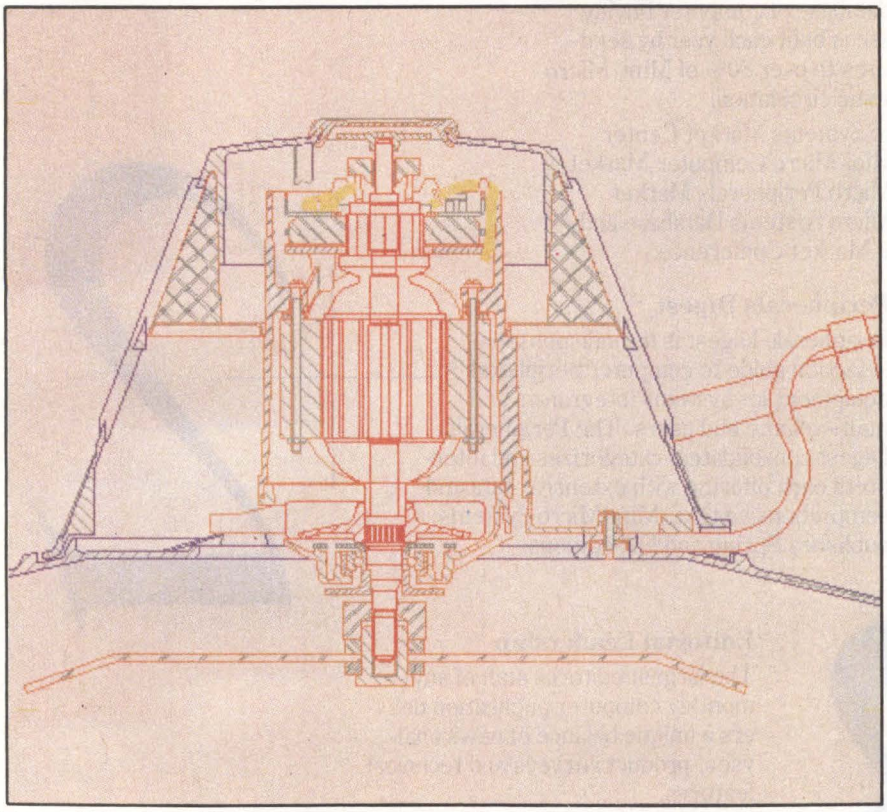
New Products

PRINTERS

Low-cost, color graphics copier uses ink-jet technology



Tektronix Inc.'s model 4695 color graphics copier *uses on-demand ink-jet technology. Ink is supplied from separate cartridges containing yellow, cyan and magenta, which can be mixed to print the colors red, green and blue, as well. A separate black-ink supply is provided. In addition to the standard colors, as many as 125 halftones are available under program control.*

The model 4695 color graphics copier uses on-demand ink-jet technology to produce eight-color copies from computer graphics displays. It is intended for applications such as data analysis, presentation graphing and CAD previewing. With its parallel interface, the model 4695 is plug-compatible with the vendor's models 4105, 4107 and 4109 color graphics terminals.

The copier can place 120 dots per in. horizontally and vertically, allowing as many as 1280 × 960 dots per A-sized (8½- × 11-in.) image. The 4695 makes copies at a speed of 1024 × 4 dots per sec., or about 2.5 min. per page for a typical copy from a 4105 terminal. The unit also functions as a bidirectional matrix printer offering print speeds of 20 cps. The vendor-designed ASCII font uses a 12 × 16 dot matrix to form each character.

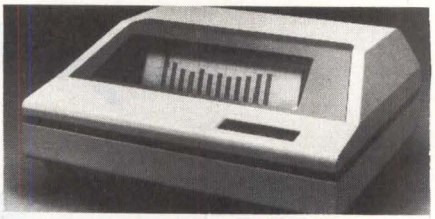
The 4695 produces copies on a variety of media including A/A4 cut-sheet paper, transparencies and paper rolls. The cut-sheet paper and transparencies are manually fed into the copier as on a typewriter.

Convenience features include snap-in, self-sealing ink cartridges and a front-panel light that indicates when ink in each 2.5-cc. cartridge is low. Cartridges can be replaced when a copy is in process, and then the copy can be completed.

Price is $1950 in single-unit quantities. **Tektronix Inc., Marketing Communications Department,** Mailing Station 63-635, P.O. Box 1700 Beaverton, Ore. 97077. **Circle No 316**

Printer features graphics, multiple character fonts

Full graphics capability with various dot densities and multiple letter-quality character fonts are now available on the model MT 1800 multifunction printer. This high-duty-cycle matrix printer is designed for small-business systems with large print runs. It offers letter-quality printing at 50 cps and draft printing at 200 cps. With the multiple-character-set feature, the printer accesses two resident letter-quality fonts. The graphics option offers three dot densities to achieve different dump sizes and tone gradations from gray to solid black. The MT 1800 features snap-in cartridge-ribbon replacement, condensed or double-width characters, an operator-replaceable print head and numerous form-control features. Single-unit price is $1995, including graphics and an alternate character set. **Mannesmann Tally,** 8301 S. 180th. St., Kent, Wash. 98032. **Circle No 317**



Matrix printer/plotter features high resolution

The model 4160 line printer/plotter produces high-resolution engineering and scientific graphics printouts and bar-code and scanning system labels. With a 0.10-in.-diameter dot size and 40-percent overlap of each dot onto each adjacent dot, the printer features a resolution of 160 × 168 dots per in.—more than double the resolution attainable on standard printers. The plot rate is 2300 dot rows per min. at the maximum plot width of 13½ in. Translated to standard drawings, this means the 4160 can produce a detailed A-sized (8½- × 11-in.) drawing in approximately 40 sec. and a B-sized (11- × 17-in.) drawing in about 75 sec. Bar-code labels printed on the 4160 meet the requirements for MIL-STD-1189 and 129H labels and all DOD/LOGMARS requirements. Single-unit price is $5380. **Printronix Inc.,** 17500 Cartwright Rd., P.O. Box 19559, Irvine, Calif. 92713. **Circle No 318**

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New Products

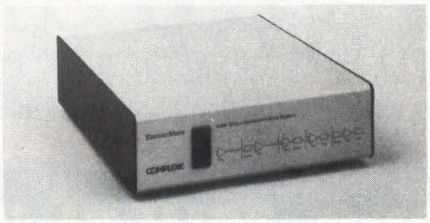
DATACOMM

Modem transmits at 2400 bps

The model 224 modem, designed for full-duplex communication on two-wire circuits, transmits data at 2400 bps. It also operates at 1200 bps in a fall-back mode compatible with the Bell 212 standard. The modem conforms to the proposed CCITT V.22 bis specification. Price is $1995 in single-unit quantities. **Codex Corp.,** 20 Cabot Blvd., Mansfield, Mass. 02048. **Circle No 324**

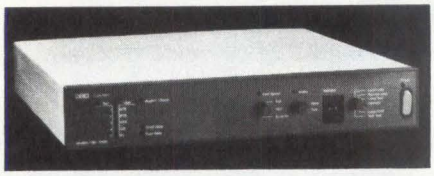
Modem operates at 1200 baud

The SSM TransModem 1200 operates at 110, 300 or 1200 baud in half- and full-duplex modes. It features auto answer/auto dial, automatic speed detection, touch tone and pulse dialing and log-on and password storage. Included with the TransModem 1200 is a 6-ft. RJ11 telephone cable. The TransModem 1200 can be used with any computer having an RS232 interface. Single-unit price is $695. **SSM Microcomputer Products Inc.,** 2190 Paragon Dr., San Jose, Calif. 95131.
Circle No 325



Device implements networking functions

The StationMate communications system combines a statistical multiplexer, an intelligent modem with automatic dialer and a local-area-network interface into a single device. All three can be used independently or together in various configurations to accomplish networking functions. The StationMate uses standard American Bell X.25 communication protocol. Its three-channel statistical multiplexer is compatible with all popular RS232C interface ASCII peripheral devices and features a 16K-byte segmented buffer and auto baud for easy interfacing to user devices. The StationMate's modem can be used as a fourth remote-user port. This Bell 103J-compatible modem offers 300-bps, full-duplex operation. StationMate can also be used as a network-interface unit for the vendor's XLAN local-area network, a carrier-sense-multiple-access LAN system that supports a 1M-bit-per-sec. bus rate. XLAN uses shielded, twisted, two-wire cable and supports as many as 64 network nodes with as many as four ports per node over distances as long as 5000 ft. Other StationMate features include menu-driven setup and configuration, two levels of password security, automatic detection and retransmission for transmission media errors and diagnostic capabilities. Single-unit price is $1450. **Complexx Systems Inc.,** P.O. Box 12597, Huntsville, Ala. 35802.
Circle No 326



Intelligent modem features diagnostic capabilities

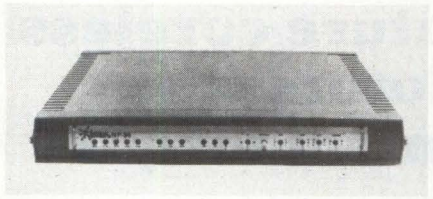
The model 7164-0100 microprocessor-based modem includes built-in diagnostics that can be initiated at the front panel of the modem or externally by NPDA-compatible software in a host processor. This SNA-compatible, fully synchronous modem operates over voice-grade leased lines and transmits in full-duplex mode over a four-wire circuit at 4800 bps. It adheres to CCITT recommendations V.27, V.26 and V.29 as well as RS232, V.24 and V.28. Single-unit price is $3700, with quantity discounts available. **NCR Comten Inc.,** 2700 Snelling Ave. N., St. Paul, Minn. 55113.
Circle No 327

Auto-answer/-dial modem has low parts count

The Auto Dial 212A modem automatically dials/answers and transmits at 300 or 1200 baud. It operates in full- or half-duplex modes and contains an audible phone-line signal-monitoring system. The modem is Bell 103/113/212A and Hayes dialing protocol compatible.

The modem's self-test system and multiple DIP switches permit any user to install and adapt the Auto Dial 212A to virtually any computer or terminal. The Auto Dial 212A also features a low parts count for low cost and high reliability. Three vendor-developed microprocessors compress the entire range of modem functions within 12 ICs, all contained on one PC board. Price is less than $600 in single-unit quantities. **U.S. Robotics Inc.,** 1123 W. Washington Blvd., Chicago, Ill. 60607.

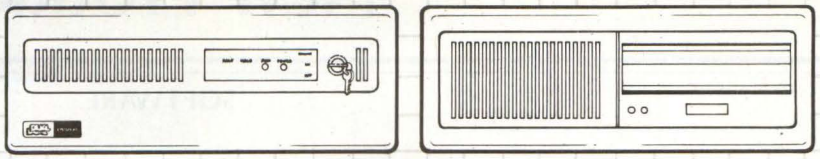
Circle No 328



Synchronous modems operate at 9600 bps

Designed for full-duplex, point-to-point applications, the NP-96 and NP-48 are V.29-compatible modems. The NP-96 operates at 9600 bps and provides fallback at rates of 7200 and 4800 bps when line conditions will not support the 9600-bps rate. The NP-48 operates at 4800 bps. Both modems feature front-panel indicators to display line status, diagnostic information and configuration information. Line-status indicators include request to send, clear to send, carrier detect, transmit data and receive data. Diagnostic indicators are signal quality, test mode and error. Configuration indicators display currently set baud rate. LSI implementation allows all circuitry including power supply to be mounted on a single PC board. Prices are $2750 for the model NP-96 and $1800 for the model NP-48. **Network Products Inc.,** P.O. Box 13239, Research Triangle Park, N.C. 27709.

Circle No 329



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New Products

SOFTWARE

Word-processing for DEC Professional computers

The CT*OS/PC word-processing package runs under the P/OS operating system on Digital Equipment Corp.'s Professional 325 and 350 computers. It is written in Macro-11 machine language for efficient memory usage and processing speed. The menu-driven package features global search and replace, cut and paste, list processing, ASCII file handling, stored text libraries, right-justified margins, on-screen math and user-defined keys to invoke special word-processing functions. A single system license is priced at $950. **Compu-Tome Inc.,** 234 E. Colorado Blvd., Pasadena, Calif. 91101.

Circle No 330

Decision-support system runs on IBM PC

Graph 'n' Calc, a decision-support and display tool for use with IBM Personal Computers, is menu driven, accesses VisiCalc and Desktop Plan files and can call charts up from diskette in slide-show fashion. Graph 'n' Calc divides the screen into three windows. The spread sheet appears in the upper half of the screen, the command window is below that, and a scratchpad for changing parameters appears at the bottom. All commands are entered with a single keystroke. Graph 'n' Calc uses the Data Interchange Format system to transfer data between the program, Desktop Plan and VisiCalc. Data can also be entered manually or selectively retrieved from Graph 'n' Calc files on diskette. Some math functions provided are multiple linear regressions, exponential smoothing, variances and standard deviation. Graph 'n' Calc runs under PC-DOS and requires 64K bytes of RAM, a standard monitor and an IBM graphics card. Hard copy can be generated on Epson America's MX series dot-matrix printers with the Graphtrax option and Hewlett-Packard Co.'s two-pen plotters. Single-unit price is $199. **Desktop Computer Software,** 303 Potrero St., 29/303, Santa Cruz, Calif. 95060. **Circle No** 331

Utility develops screen-oriented software

The Smartscreen utility for use with Apple Pascal simplifies the development and use of screen-oriented software. To create a form, a user just types the form on the screen as he wants it to appear in his application. Major features of Smartscreen include flexibility in defin-

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ing edit masks for each input field; a one-stroke help screen for each field; the ability to read a field as integer, real or string; and a single procedure to blink or reverse a field or screen area. Smartscreen supports 40- or 80-character displays and requires 5K bytes of memory. Price is $75 in single-unit quantities. **Smart Systems Inc.,** 499 Sulky Lane, Frederick, Md. 21701.

Circle No 332

Package links IBM PCs, DEC minis

The PC-Link software package provides terminal compatibility between IBM Personal Computers and Digital Equipment Corp. minicomputers. With the PC-Link software, an IBM PC emulates DEC private and ANSI X3.64-1977 standards. PC-Link accesses a full range of DEC software through the PC including editing, electronic-mail, forms-management and system-monitoring facilities. PC-Link features text file transfer and a redesigned keyboard and function-key layout. Price is $40. **Screenware Corp.,** P.O. Box 3662, Nashua, N.H. 03061.

Circle No 333

Communications software for design workstation

The VTERM software package works with the vendor's DASH-1 schematic designer to transfer electronic schematic data from an IBM Personal Computer to DEC VAX or PDP-11 systems. (The DASH-1 converts an IBM PC into a low-cost workstation that automates circuit and schematic design of systems composed of ICs and discrete components.) VTERM allows the IBM PC to emulate a DEC VT100 terminal so that schematic data captured by the DASH-1 can be transferred to the DEC mainframe for processing and passed to other CAD/CAM systems or for central data storage. Data on screen or residing in the DEC host can also be loaded onto a PC diskette or printed on the PC printer. VTERM is priced at $200. **FutureNet Corp.,** 21018 Osborne St., Canoga Park, Calif. 91304. Phone (213) 700-0691.

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CIRCLE NO. 146 ON INQUIRY CARD

New Products

SOFTWARE

System integrates many facilities

The Metafile software system integrates database-management, word-processing, spread-sheet, report-generation, communications and application-development facilities under a single language. With Metafile, a user can prepare reports, menus, documents, data-entry forms, letters, spread sheets and procedures; merge data with text to generate reports and mailing lists; link spread sheets to data files or other spread sheets; combine information into multiple-screen windows to form composite reports; and generate custom applications for a wide range of needs. Interactions can be inpromptu through the keyboard or programmed. Function menus and prompt-assisted commands make Metafile easy to learn and use. Metafile runs on an IBM PC with 64K bytes of RAM and at least one 320K-byte floppy disk drive. Price is $1995 in single-unit quantities. **Sensor-based Systems,** Olmstead Federal Building, Chatfield, Minn. 55923.

Circle No 335

Assembler is compatible with 8086/8088 processors

Designed to process the full structured assembly language specified by Intel, the model ASM87 relocatable macro assembler is compatible with Intel's 8086 assembler and supports the 8087 chip. The assembly language processed by this assembler features high-level constructs, code macros and structured data types. The assembler features relocation, user-specified segment names, symbolic and relative addressing, forward references, complex expression evaluation and cross-reference listing. The assembler can generate data in several number-based systems as well as ASCII character codes. The program is written in FORTRAN IV for compatibility with most popular host computers. Price is $2200 including a linking loader. **Microtec,** P.O. Box 60337, Sunnyvale, Calif. 94088.

Circle No 336

Database manager runs on IBM PC

Intended for design and development of business and management applications, the Quad-PC relational database-management system runs on an IBM Personal Computer under the PC-DOS operating system. It supports color displays for data-entry screen definition, menus and reporting. The package performs mathematical calculations, handles database updates and generates reports, accessing as many as 10 data files at once. Files can be indexed on key values or record locations. Users can design data-entry screens interactively, defining the placement and characteristics of field prompts, fields and literals. $695. **QuanTecka Research Corp.,** 6902 220th Southwest, Mountlake Terrace, Wash. 98043. Phone (206) 771-2488.

Circle No 337

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Mini-Micro Systems documents buying power. We've compiled a database of over 13,000 buying centers which enables us to produce two of the most comprehensive reports available anywhere.

These reports define and detail the buying activity among computer resellers (third party OEMs) and sophisticated end users. If you're competing in this market, you need to know who is buying what equipment and why. Our reports will help you. We document computer buying power. And detailed knowledge is power.

Mini-Micro Systems' 12th Annual Mini-Micro Market Report presents a collection of perspectives allowing the reader to see how computer manufacturers fare by:

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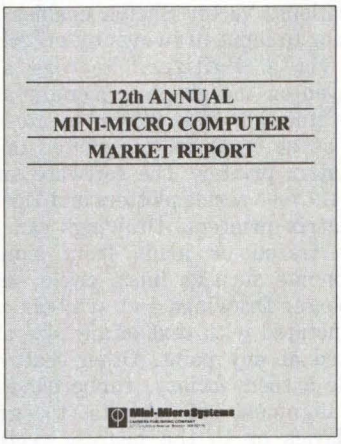
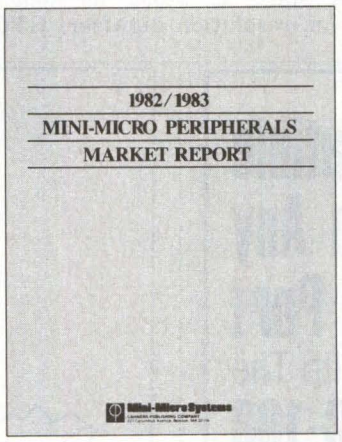
- Price categories
- Site penetration
- Primary vendor status (and the reasons why)

The **Mini-Micro Market Report** also includes purchasing data on:

- Fail-safe systems
- Database management systems
- Networking





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- Printers
- Add-in Memory
- Media
  - Floppy Disks
  - Computer Tape
  - Printer Ribbon
- Tape Drives
- Terminals
- Modems
- Computer bus standards
- Computer operating systems

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New Products

SOFTWARE

Ethernet protocol package for DEC computers

The Network Systems protocol package runs on or with DEC PDP-11 and VAX-11 computers under the UNIX, RSX-11 and VMS operating systems. The package is said to be compatible with many Ethernet controllers and to implement Xerox's Internet Transport Protocol and Remote Procedure (Courier) Protocol. It enables an application programmer to name, locate and use high-level processing services in a distributed environment. Host- and controller-resident versions are offered. The package features a C language interface, multi-user access and transparent packetization and de-packetization. Price is $4500 per copy for as many as four copies; additional copies are priced at $2500 each. **Associated Computer Consultants,** 720 Santa Barbara St., Santa Barbara, Calif. 93101. Phone (805) 963-4907.

Circle No 338

CAD option for the IBM PC

The Vector Sketch CAD software package for the IBM Personal Computer is suitable for business-graphics, space-planning, construction, architectural, mechanical-design and electrical-design applications. Vector Sketch enables an operator to input drawings by entering data via a digitizer. Vectors are displayed on the graphics monitor and can be stored on disk, plotted in sizes as large as 24 × 36 in. or printed on a dot-matrix printer. The software supports HP 7000 series plotters and Epson dot-matrix printers. Drawings can be freely traced or made from simple components such as lines, circle, arcs and boxes. Drawings and symbols can be annotated with text of any size and inserted at any point. Other features include a zoom facility, rubberbanding and alignment of objects to grid boundaries or to the nearest vector. Prices start at $2995 including a 0.001-in.-resolution digitizer. **GTCO Corp.,** 1055 First St., Rockville, Md., 20850. Phone (301) 279-9550.

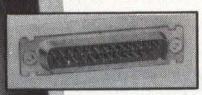
Circle No 339

Project manager runs on HP-3000 computers

Designed around an interactive relational database-management system, the ProjectALERT project-management system provides nontechnical users of HP's HP-3000 computers with a means for planning, scheduling, monitoring and controlling projects based on work-breakdown structures. PERT and Critical Path Method techniques can be used to build project networks. Milestones are defined in Gantt charts. The package also features use of color graphics and libraries for storing networks. $12,000. **Computer Resources Inc.,** 5333 Betsy Ross Dr., Santa Clara, Calif. 95054. Phone (408) 980-9898.

Circle No 340

Add IBM Format-Compatible Magnetic Tape To Any RS-232 Port With The IBEX STC-100



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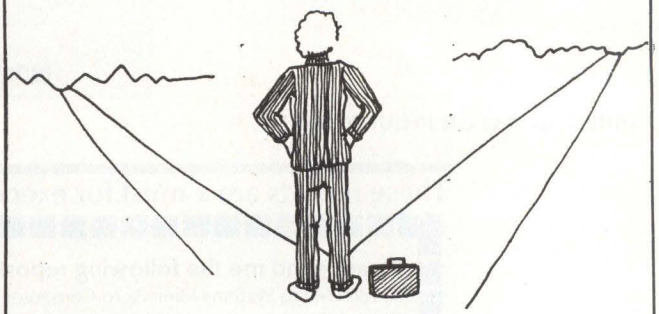

Turn To Mini-Micro Systems Career Opportunities Section

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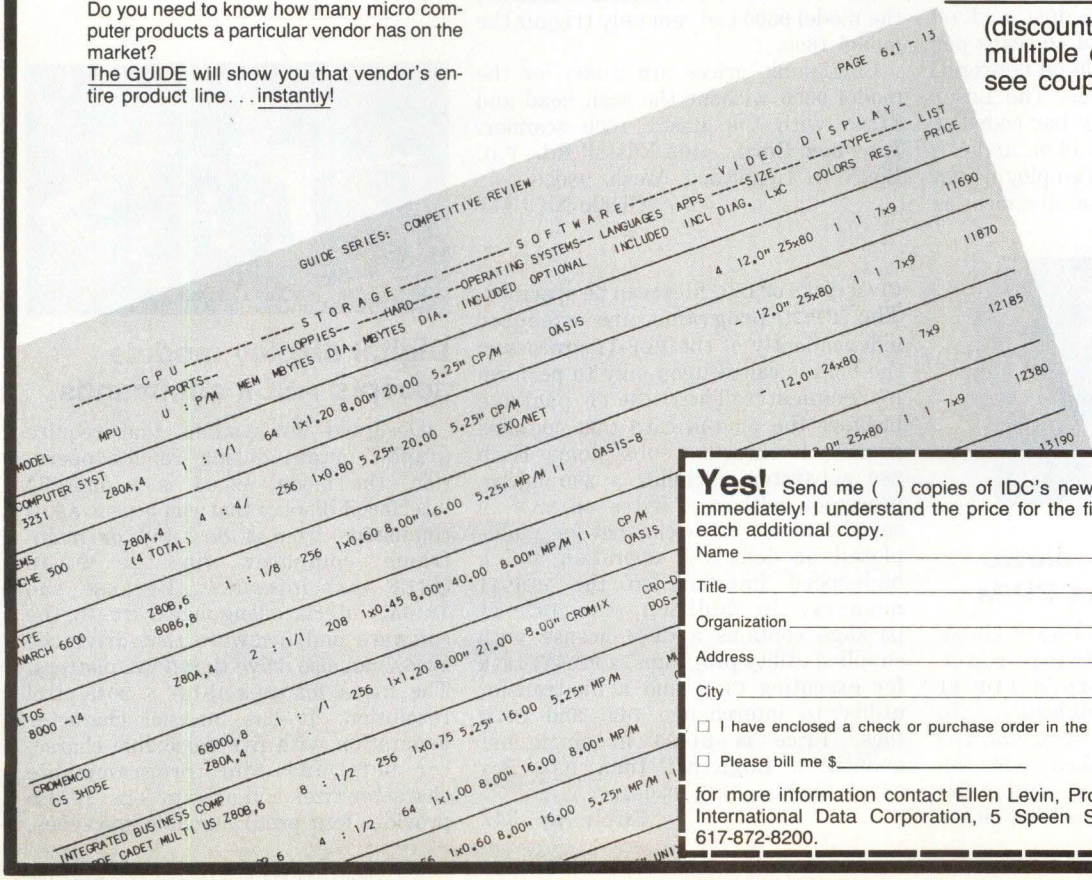
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MODEL	CPU: MPU	PORTS: U	PORTS: P/M	STORAGE: MEM MBYTES	STORAGE: FLOPPIES: DIA.	STORAGE: HARD: MBYTES	STORAGE: HARD: DIA.	SOFTWARE: OPERATING SYSTEMS: INCLUDED	SOFTWARE: OPERATING SYSTEMS: OPTIONAL	SOFTWARE: LANGUAGES: INCL DIAG.	APPS	VIDEO DISPLAY: SIZE	VIDEO DISPLAY: TYPE: LxC	VIDEO DISPLAY: COLORS	VIDEO DISPLAY: RES.	LIST PRICE
COMPUTER SYST 3231	Z80A,4	1	1/1	64	1x1.20	8.00"	20.00	5.25" CP/M	OASIS			4	12.0" 25x80	1	1	7x9	11690
EMS CHE 500	Z80A,4 (4 TOTAL)	4	4/	256	1x0.80	5.25"	20.00	5.25" CP/M EXOS/NET					12.0" 25x80	1	1	7x9	11870
YTE NARCH 6600	Z80B,6 8086,8	1	1/8	256	1x0.60	8.00"	16.00	5.25" MP/M II	OASIS-8				12.0" 25x80	1	1	7x9	12185
LTOS 8000 -14	Z80A,4	2	1/1	208	1x0.45	8.00"	40.00	8.00" MP/M II	CP/M OASIS				12.0" 24x80	1	1	7x9	12380
CROMEMCO CS 3HDSE	68000,8 Z80A,4	1	/1	256	1x1.20	8.00"	21.00	8.00" CROMIX	CRO-D DOS-				12.0" 25x80	1	1	7x9	13190
INTEGRATED BUSINESS COMP DE CADET MULTI US Z80B,6		8	1/2	256	1x0.75	5.25"	16.00	5.25" MP/M									
		4	1/2	64	1x1.00	8.00"	16.00	8.00" MP/M									
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CIRCLE NO. 151 ON INQUIRY CARD

New Products

SUBASSEMBLIES

Laser bar-code reader is for industrial applications

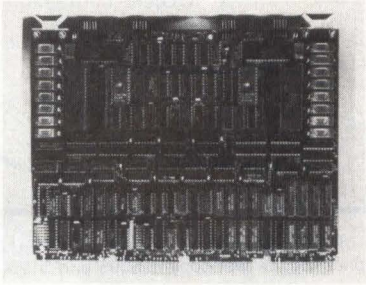
The model 9500 laser reader for industrial bar-code applications is designed to work with the vendor's Laser 1600 hand-held scanner. It features a 100-percent duty cycle, three industrial operation modes and user-configurable communication protocols. It can be connected in series with a CRT terminal or operate as a stand-alone unit or in multiple mode with the vendor's model 9160A port concentrator. It has two I/O ports, each with switch-configurable RS232C, RS422 and 20-mA current loop. Users can configure the 9500 for point-to-point communications or ACK/NAK handshake or poll select protocols, and error-checking and automatic retransmission are available. The host computer can activate the 9500's front-panel audio jack to provide audible verification of data acceptance.

The Laser 1600 scanner combines impact tolerance with a retrodirective helium-neon scanning system. The fully sealed Laser 1600 is resistant to damage from rain, water spray, dust and oil mist. It has a scan rate of 40 scans per sec. and can read bar code on nonrigid, uneven or curved surfaces. The Laser 1600 can scan low-density bar codes at distances as far away as 12 in. and can read higher density codes employing 7.5 mil bars (9.5 cpi Code 39) at distances as far away as 6 in. For operations in which fixed mounting of the scanner is desired, the model 9500 can remotely trigger the model 1600.

Intermec's model 9500 laser reader and the Laser 1600 hand-held scanner *are suited for shipping and receiving, warehousing, work-in-progress, quality-control and package-tracking applications. Designed for use in harsh environments, the Laser 1600 has shock-mounted internal components and an impact-absorbing rubber strip around the outside of the housing.*

Single-unit prices are $1095 for the model 9500 without the scan head and $1595 with the Laser 1600 scanner. **Intermec Corp.,** 4405 Russell Rd., P.O. Box C-N, Lynnwood, Wash. 98036.

Circle No 341



Plug-in processor allows PDP-11s to execute CP/M

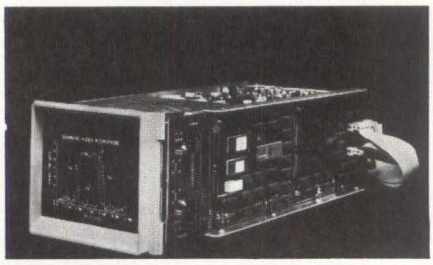
The UCP-11 plug-in processor allows off-the-shelf CP/M programs to be run on Digital Equipment Corp.'s PDP-11 computers without modification. To activate CP/M on the DEC terminal, the supplied CP/M task is invoked under the DEC computer's operating system. A list device and as many as four disks, either CP/M disks or DEC files, can be specified. The CP/M programs are executed independently of the PDP-11 processor; the host is called upon only to perform I/O requests. The UCP-11 package includes the plug-in card that contains as many as three Z80 subsystems. Each Z80 subsystem includes a Z80 microprocessor with 64K bytes of RAM, a serial line interface channel for mulitplexed or dedicated operation and a high-speed interface to the PDP-11 memory. In addition, the UCP-11 package contains a CP/M license with supplied utility programs, a PDP-11 task for executing CP/M and a file-transfer utility to interchange DEC and CP/M files. Price is $1495 in single-unit quantities. **Logicraft Inc.,** P.O. Box 3475, Nashua, N.H. 03061.

Circle No 342

Video terminal controller emulates DEC VT100

The model MK8801 CRT-80E video terminal board is a microprocessor-based video terminal controller system that emulates the DEC VT100 terminal. The card features several enhancements to the standard VT100 specifications including a printer channel, protected fields, seven European character sets, a built-in ASCII character set, 16 user-defined characters and a 120- × 132-point graphics standard. The board supports the RS170 composite-video and discrete-video/sync formats. Other features include a programmable-font PROM for as many as 768 characters, keyboard-programmable user options stored in EAROM and five programmable attributes on a per-character basis. Single-quantity price is $456. **Mostek Corp.,** 1215 W. Crosby Rd., Carrollton, Texas 75006.

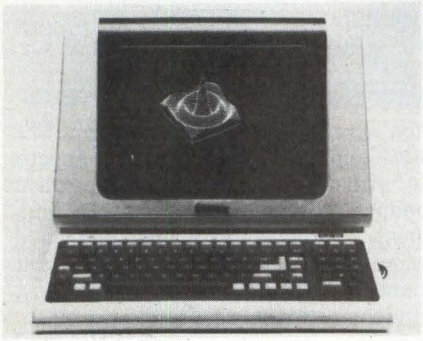
Circle No 343



Digital display module accepts ASCII commands

Designed for systems that require graphic output during remote operation, the model 1346A is a digitally interfaced display that can accept ASCII commands from a desk-top or mainframe computer via the HP-IB (IEEE-488) interface. Because the 1346A's interface language is HP-GL, the software and firmware that drive the 1346A can also drive the HP-GL plotters. The 1346A features 1513- × 2048-pixel resolution. It has internal character generation with five selectable character sets and four programmable character sizes and orientations. It also provides four programmable line types,

a plot mode and four programmable beam velocities. The four programmable writing speeds can be combined with three programmable intensities to provide as many as 12 intensity levels. Other features include an 8K × 16 bit-refresh memory, self-test and two-port I/O architecture. Price is $4250 in single-unit quantities. **Hewlett-Packard Co.,** 1820 Embarcadero Rd., Palo Alto, Calif. 94303. **Circle No 344**



Graphics emulate Tektronix 4010/4014

The SG-900 graphics board field-installable upgrade for TeleVideo 925 and 950 terminals uses the standard TeleVideo 925/950 interface and features Tektronix 4010 and 4014 emulation. The Tektronix 4014 emulation mode features 660- × 250-dot resolution on an 8- × 5-in. screen, large addressable plot area (4096 × 4096), vector variation (dot/dash lines), full-page break, point plot, vector plot, incremental plot and Tektronix Plot 10 compatibility. The SG-900 also features two pages of independent memory, vector and raster graphics capabilities and a DEC graphics printer interface. Price is $1095 in single-unit quantities. **Selanar Corp.,** 4212 N. Freeway Blvd., Sacramento, Calif. 95834.

Circle No 345

Add-in memory boards come in three versions

The model TMM40020 high-density, Multibus-compatible dynamic RAM module features a 197-nsec. access time and 303-nsec. cycle times. Offered in 128K-, 256K- and 512K-byte versions with or without parity checking, the TMM40020 operates in an address space as large as 16M bytes and supports word transfers as well as high-, swap- and low-byte transfers. The lower and upper memory addresses are independently selectable in 4K-byte sections. The user can also select 256-bit or 4K-byte I/O and a 20- or 24-bit address bus. Other features include LEDs to indicate an error condition and optional battery backup and ROM overlay. In 10-unit quantities, prices range from $860 to $1669 each. **Texas Instruments Inc., Semiconductor Group,** P.O. Box 401560, Dallas, Texas 75240. **Circle No 346**

VMEbus MEMORIES

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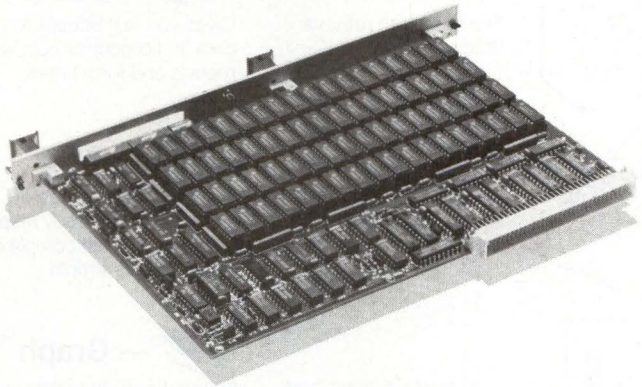

Compatible with the VME/10 microcomputer system and MVME210 memory board, the MM-6000D is a high density memory that can employ either 64K or 256K DRAMs. A jumper option selects either 64K or 256K DRAM operation.

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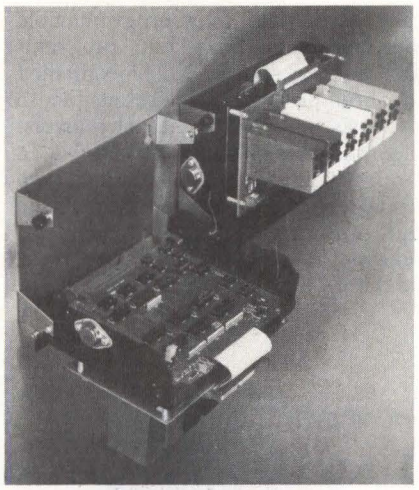
The SRP24 is a 24-channel I/O peripheral that provides an optically isolated, industrial-level, contact-sensing and load-switching interface for common control computers. Each SRP24 supports as many as six Quad Pak I/O modules. As many as 64 SRP24s can be connected to the host computer on the same 50-line ribbon cable for as many as 1536 channels of control. The address of each SRP24 unit is set with on-board jumpers. The 24-line communication bus transfers 3 bytes of information, 1 byte each for address, data and control. The SRP24's communications port is compatible with the 24-line PIO ports of most common microcomputers including Multibus, Microbus, STD bus, DEC and others. Price is $350 in single-unit quantities. **Adatek,** P.O. Box 1339, Sandpoint, Idaho 83864.

Circle No 347



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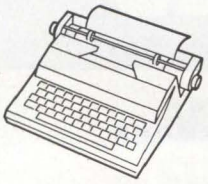

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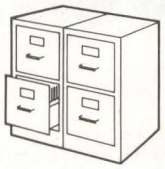

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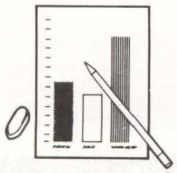

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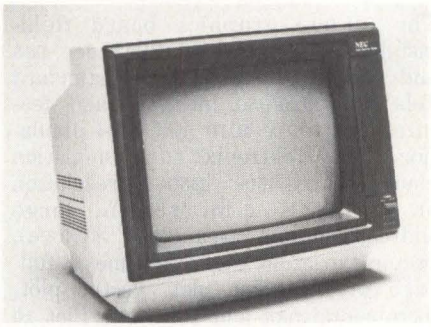


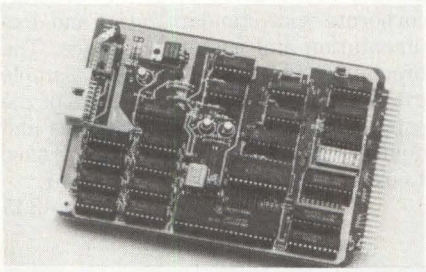
Color monitor is IBM PC compatible

The model JC-1216DFA RGB color monitor is compatible with the vendor's PC-8000, PC-8800 and IBM PC home computers. Its 12-in. diagonal CRT screen features a resolution of 640 dots horizontally and 240 lines vertically at 60 Hz or 640 dots horizontally and 280 lines vertically at 50 Hz. Easily accessible brightness, horizontal-hold and vertical-hold controls are provided. The monitor weighs less than 5 lbs. and measures approximately 16 × 13 × 14 in. for easy portability. Single-unit price is less than $500. **NEC Home Electronics USA,** 1401 Estes Ave., Elk Grove Village, Ill. 60007.

Circle No 348

Color graphics controller has four modes

The ANC-7350 color graphics CRT controller can be used in video systems in which data on a raster-scanned color monitor are desired. This STD bus-compatible card generates all necessary video, control and synchronization signals and controls the storage, retrieval and refresh of display data in the on-board 16K-byte memory. The

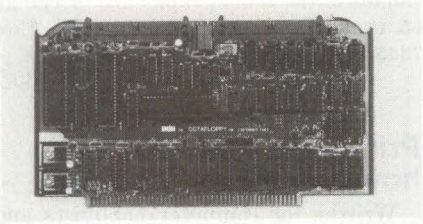


unit features four video display modes: graphics I, graphics II, multicolor and text. The text mode provides 24 40-character rows in two colors. The multicolor mode provides an unrestricted 64 × 48 color-dot display using 15 colors plus transparent. The graphics I mode provides a 256- × 192-pixel display for generating pattern graphics in 15 colors plus transparent. The graphics II mode, an enhancement of the graphics I mode, generates more complex color and pattern displays. Single-unit price is $344. **Antona Corp.,** 13600 Ventura Blvd., Sherman Oaks, Calif. 91423.

Circle No 349

Floppy disk controller handles eight drives

The ADS Octafloppy floppy disk controller is an S-100-compatible slave card that provides as much as 9.6M bytes of on-line storage via two strings of four drives. It controls 5¼- or 8-in., single- or double-density, single- or double-sided drives using Western Digital's WD2797 single-chip controller and companion DM1883 DMA controller. It appears to the host computer as 16 I/O ports with optional extended device addressing. Programmed I/O or temporary master access transfers as large as 64K bytes can be performed anywhere in the 16M-byte address space. An on-board wait-state generator allows the floppy disk controller to be used in systems with an 8-MHz bus. Interrupts



for transfer complete and error conditions are optional. Software drivers are provided for CP/M 2.2, OS-9 and FLEX. Single-unit price for the assembled and tested version is $495. **Ackerman Digital Systems Inc.,** 110 N. York Rd., Suite 208, Elmhurst, Ill. 60126.

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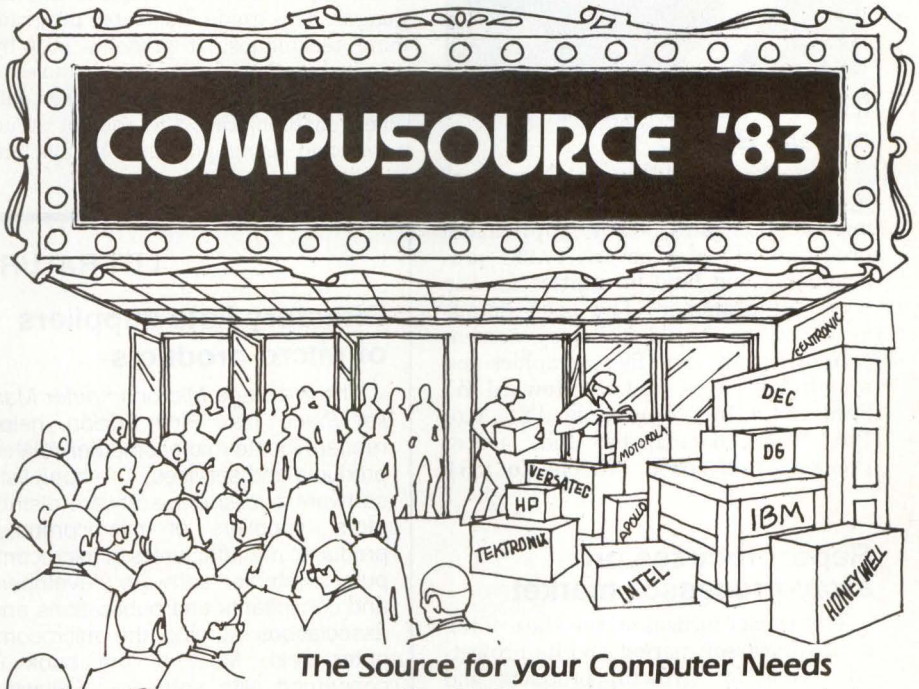

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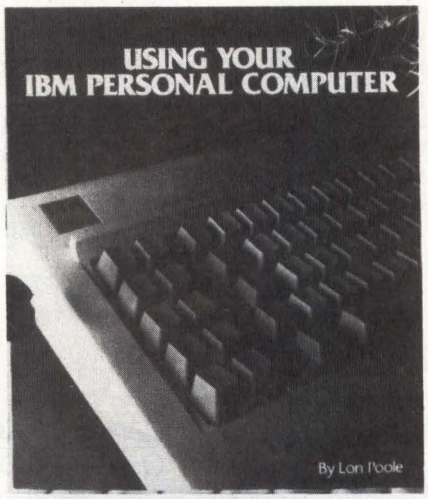

IBM PC users' guide covers BASIC

"Using Your IBM Personal Computer" by Lon Poole instructs readers how to use PC-DOS and start application programs. It also covers BASIC programming and built-in utilities for the BASIC programmer. The book details keyboard input, video display screen, printer output, disk files, graphics and sound. 326 pages. $16.95. **Howard W. Sams & Co. Inc.,** 4300 W. 62nd St., P.O. Box 7092, Indianapolis, Ind. 46206. Phone (317) 298-5400. **Circle No** 351

Report focuses on array-processor market

This report focuses on the state of the array-processor market and its projected trends for growth, products and competition. The 90-page report includes graphics, charts and tables. $3500. **Business Development Group Inc.,** P.O. Box 3044, Stanford, Calif. 94305. Phone (415) 941-4001.
Circle No 352

Bibliography lists 276 new books

The 16th edition of the *Annual Bibliography of Computer-Oriented Books* lists more than 1200 books from 170 publishers. The bibliography separates the books into 61 categories and catalogs them according to type (reference, textbook, handbook) and style of presentation (programmed instruction, case study or narrative). All introductory books published before 1980 are deleted from this year's edition, and 276 new books are added. Copies of the bibliography are priced at $5 each. **Computing Newsletter,** Box 7345, Colorado Springs, Colo. 80933.
Circle No 353

Primer on C details how to write programs

Written for computer hobbyists and professionals, *The C Primer* by Les Hancock and Morris Krieger examines the C language, demonstrates how to read and write programs in C and shows how the language can be used as an alternative to other high-level languages. This guide illustrates programming techniques. It presents step-by-step instructions for such procedures as writing declarations; specifying data types; manipulating the control structures; and using pointers, arrays and structures. Single-copy price is $14.95. **Byte Books/McGraw-Hill Book Co.,** 1221 Avenue of the Americas, New York, N.Y. 10020. **Circle No** 354

Graphics software tools described in brochure

DI-3000 device intelligent graphics software tools are outlined in a four-page, color brochure. The brochure includes explanations of device intelligence, modularity and networking, corporate-wide standardization and documentation and customer service. The brochure, which also includes sample graphic images, lists key features of the software and compatible machines and devices. **Precision Visuals Inc.,** 6260 Lookout Rd., Boulder, Colo. 80301.
Circle No 355

LITERATURE THAT COSTS

Directory lists suppliers of micro products

The 207-page *Microcomputer Market Place 1983,* First Edition, helps readers locate microcomputer-related products and services. The book lists software publishers, software distributors, suppliers of microcomputer products, manufacturers of microcomputer systems, software developers and consultants and publications and associations serving the microcomputer field. Most of the book is concerned with software. Following the directory section on software publishers, 12 chapters index software packages according to hardware/operating system compatibility and business, home, recreational, educational, scientific, utility and special applications. Within each broad catagory, specific applications are identified, and the names of companies that publish software for each application are listed alphabetically. Suppliers of microcomputer products are similarly indexed according to the type of hardware peripherals that can be added to a microcomputer system such as boards, disks, disk drives and modems. Completing the book is a 1983 calender of events and meetings. Single-copy price is $75. **Gale Research Co.,** Book Tower, Detroit, Mich. 48226. **Circle No** 356

Catalog describes more than 10,000 packages

The Software Catalog is a continuously updated reference service for information about the availability, price, applications and compatibility of packaged software. Each spring and fall edition of *The Software Catalog* describes more than 10,000 software packages. In addition, summer and winter updates are available. The catalog indexes software by computer system, operating system, programming language, microprocessor, subject and application and key words and program names. The indexes are cross-referenced with a unique International Standard Program Number that allows a user to start from any known reference point. The indexes are indicated by tabs on the page edge and descriptive running heads. An earlier edition of *The Software Catalog* was published as *The International Software Directory.* Two versions are available: one for microcomputers and one for minicomputers. Single-copy prices start at $69. **Elsevier Science Publishing Co.,** 52 Vanderbilt Ave., New York, N.Y. 10017. **Circle No** 357

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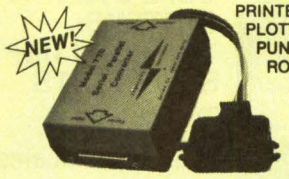

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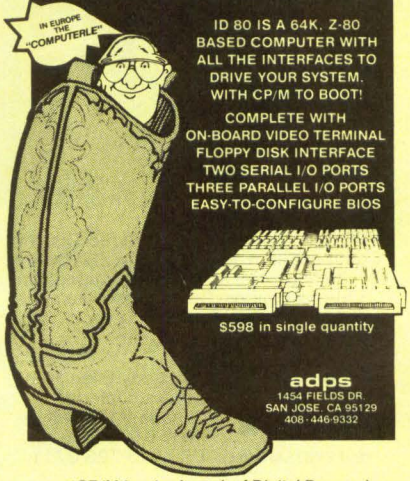

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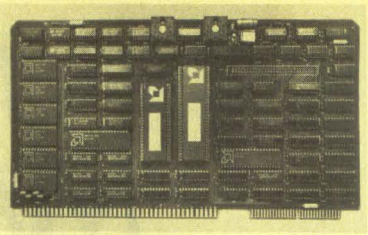

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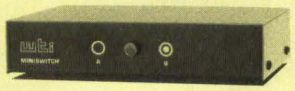

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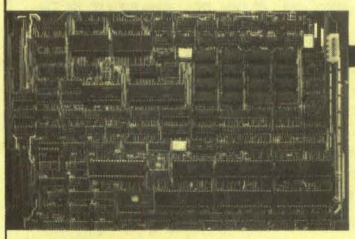

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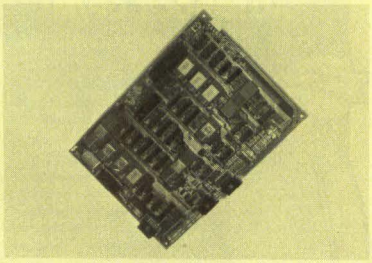

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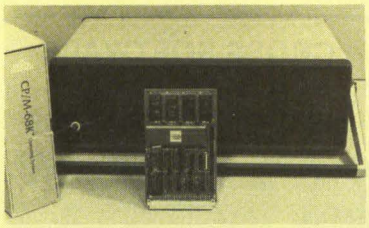

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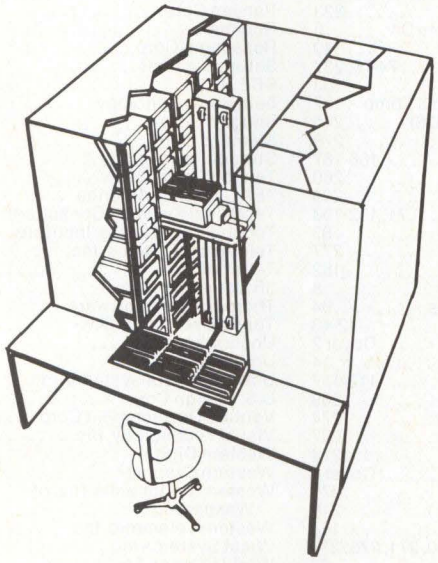

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Advertisers Index

Able Computer 242
Adaptec, Inc. 88-89
Advanced Digital Corp. 206
Alcyon Corp. 259
Alpha Data, Inc. 4
Altos Computer Systems 215
Amcodyne 164-165
Ampex Corp., Memory Products Div. 9
Anadex, Inc. 229
Applied Data Communications (ADC) 101
Archive Corp. 92-93
Bridge Communications 199
Burr-Brown Corp. 82
Business Computer Systems 187
C. Itoh Electronics 17
Cadmus Computer Systems 50-51
Cahners Publishing Co. 250
Callan Data Systems 204-205
Cambridge Digital Systems (Div. of Compumart) 33
Centronics Data Computer Corp. 62
Century Data Systems (A Xerox Co.) 143
Charles River Data Systems 170-171
CIE Systems 39
CIE Terminals 10
Cipher Data Products, Inc. 49
Clary Corp. 84
Codata Systems 139
Compaq Computer Corp. 1
CompuPro 136
Compusource 281
Computer Memories 76-77
Computer Technology Group 273
Control Data Corp.—OEM 190
Corona Data Systems 34-35
CPX 123
Data Electronics, Inc. 81
Dataram 20, 193
Data Set Cable 272
Data Sources 129-131
Data Systems Design 158-159
Davong Systems 90
Delta Airlines 156
Digi-Data Corp. 125
Digital Engineering 95
Digital Equipment Corp. 188-189
Disc Instruments 148
Dual Systems 271
Dylon Corp. 262
Dysan Corp. 47, 224
Emulex Corp. 68-69, 145
Envision 231
Esprit Systems, Hazeltine Terminals Div. 160
Evotek 52-53
ExpoConsul International 251-253
Falco Data Products 212
Faraday Electronics 79
First Systems 57
Fujitsu America, Inc. 203
Gavilan Computer Corp. 154
General Electric Co. 41
Glasgal Communications 254
Gould Inc., DeAnza Imaging Div. 223
Gould Inc., S.E.L. Computer Systems Div. 5
Heurikon Corp. 140
Hewlett-Packard 74-75, 237
Hi-Tech Peripherals 103
Houston Instrument Div. of Bausch & Lomb 87
Human Designed Systems, Inc. (HDS) 245
Ibex Computers Corp. 276
IBM Corp. 166-167
Illbruck/USA 260
Innovative Electronics 230
Intel Corp. 71, 152-153
Interface '83 83
International Data Corp. (IDC) 277
International Mobile Machine 182
Interphase Corp. 8
Invitational Computer Conferences 94
Iomega 42-43
Kennedy Co. ..... Cover 2
Leading Edge Products 14
Lear Siegler, Inc. 116-117
LinkData 269
MDB Systems, Inc. 274
Megatek Corp. 227
Method Systems Inc. 274
Micom Systems Inc. ..... Cover 4
Micro Memory Inc. 279
Micro Pheripherals Inc. (MPI, Calif.) 216
Micropolis Corp. 168
Mini-Micro Systems 270, 271, 275, 276
MPI (Utah) 67
Namiki Precision Jewel Co. 272
NCR, OEM Marketing Div. 60-61
Nicolet Paratronics Corp. 36
North Star Computer 126
NTTR Systems 109
Oasys 274
Okidata Corp. 196
Onyx Systems 111
Oregon Software 6
Pac Tec Corp. 177
Peripheral Technology 209
Pixel (Instrumentation Laboratory) 163
Plessey Microsystems 247
Plessey Peripheral Systems 13
Plexus Computers 64-65
Priam 133
Qantex (Div. of North Atlantic Ind.) 54
Quantum Corp. 114-115
Rabbit Software Corp. 31
Racal-Vadic, Inc. 120
Ramtek Corp. 180-181
Ranyan Corp. 241
Rodime 261
Rosscomp Corp. 146
Saturn Systems 280
SBE, Inc. 234
Seagate Technology 118-119
Shugart Corp. 26-27, 185
Siemens Corp. 134-135
Storage Technology 99
Tandon Corp. 18-19
TEAC Corp. of America 222
Technical Systems Consultants 72
Technology Transfer Institute 263
TeleVideo Systems, Inc. 232-233
Teltone Corp. 179
3R Computer Corp. 256
Thoroughbred Software 59
Topaz Electronics Div. 248
Ungermann-Bass 211
Unitronix 7
Universal Data Systems, Inc. 113
U.S. Design Corp. 29
Venture Development Corp. 262
Visual Technology, Inc. 239
Western Digital 45
Western Graphtec 106
Western Peripherals Div. of Wespercorp ..... Cover 3
Western Telematic, Inc. 4
Wicat Systems Inc. 104
World Storage Technology 200
Wyse Technology 149
Xerox Computer Services 255
Xidex 150-151
Zilog, Inc. 96

See pp. 286-291 for Career Opportunity Advertisers
See p. 285 for Computer Consultants Corner
See pp. 283-284 for Mini-Micro Marketplace

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