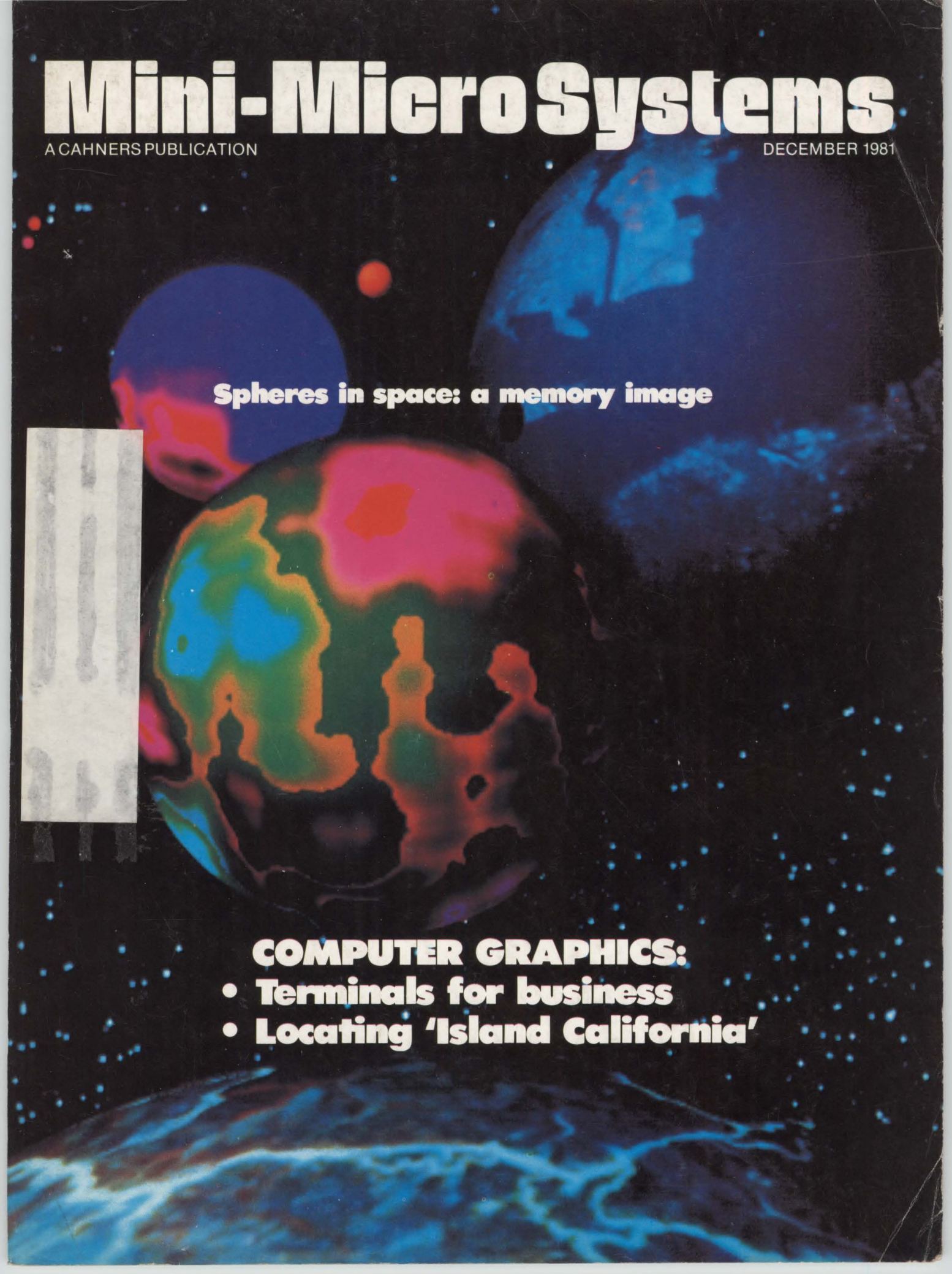
Mini-Micro Systems

A CAHNERS PUBLICATION

DECEMBER 1981

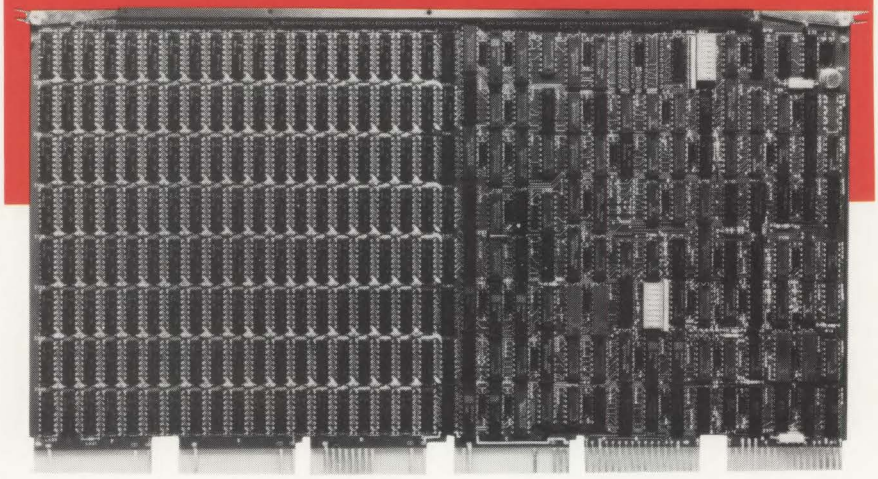


Spheres in space: a memory image

COMPUTER GRAPHICS:

- Terminals for business
- Locating 'Island California'

DEC®-COMPATIBLE SEMI ADD-INS



FROM THE LEADER

Look to the leader — Dataram — for your DEC-compatible semiconductor add-in memory. Offering not only the broadest, most complete line of semi add-ins, but the most capable...no matter what your yardstick. Compatibility, throughput, cost, power efficiency, size...no matter how you measure capability, Dataram DEC-compatible semi add-ins are the clear leader.

A leadership position earned by improving on DEC's price and delivery...and then adding features available from no one else in the industry.

The chart provides a glimpse at the industry-pacesetting family of DEC-compatible semi add-ins. Circle the reader service number below or, better yet, call us today at 609-799-0071, and we'll give you a close-up look at the products that have made us the leader.

DEC Mini	Dataram Add-In	Board Size	Maximum Capacity
LSI-11®	DR-115S	dual	64 KB
LSI-11	DR-215S	dual	256 KB
LSI-11	DR-113S	quad	256 KB
LSI-11	DR-213S	quad	1.0 MB
PDP®-11	DR-114S	hex	256 KB
PDP-11	DR-114SP	hex	256 KB
PDP-11	DR-214SP	hex	1.0 MB
PDP-11	DR-144S	hex	256 KB
PDP-11	DR-244S	hex	4.0 MB
VAX®-11/750 PDP-11/70	DR-175S	hex	256 KB
VAX-11/780	DR-178S	extended hex	512 KB
DECSYSTEM 2020®	DR-120S	extended hex	512 KB
PDP-8/A	DR-118S	quint	128 K x 12

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Dataram also provides core add-ins, core and semiconductor add-ons, memory system units, memory management, and a wide range of memory-related accessories for DEC users.

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CIRCLE NO. 1 ON INQUIRY CARD

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Innovation comes first with TI's 780 Series.

State-of-the-art technology is what makes TI's *Silent 700** 780 Series Electronic Data Terminal Family ideal for almost any application. These versatile terminals are real innovators when it comes to improving productivity and reducing communications costs.

Every model in the four-member 780 family features speedy 120 character-per-second thermal printing, TI's field-proven reliability and virtually silent performance.

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Imagine data terminals that not only offer you speed and versatility, but intelligent modems as well. Both TI's Models 785 and 787 Portable Data Terminals, weighing only 17 pounds each, are a smart choice. With their built-in intelligent modems, these responsive terminals can improve your communications efficiency.

The portable 785 offers an internal originate-only dual modem, and is capable of providing communications via its built-in acoustic coupler over normal phone lines with remote Bell 113A or Vadic 3400 modems. With the 787's unique triple modem, compatibility with Bell 103A, Bell 212A or Vadic 3400 modems allows you to achieve multi-speed communications via direct connection to a standard telephone data jack. And, both terminals feature automatic modem selection to determine the correct modem type, while automatic speed selection insures optimum transmission rates.

For any application requiring speed, input/output capabilities or intelligent modems, TI's 780 Series offers you innovation at it's best.

TI is dedicated to producing quality, innovative products like the *Silent 700* 780 Series Electronic Data Terminal Family. And TI's hundreds of thousands of data terminals shipped worldwide are backed by the technology and reliability that come from 50 years of experience.

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

For more information on the 780 Series Electronic Data Terminal Family, contact your nearest TI sales office or Authorized Distributor. Write: Texas Instruments Incorporated, P.O. Box 202145, Dallas, Texas 75220, or phone:

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Make MICROMATION's MARINER your entry-level system. System expansion is easy and inexpensive; plug in another Satellite processor card, connect a terminal, and you have multiprocessor, multitasking lift-off!

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

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

Program satellites with BASIC, COBOL, or FORTRAN, use them for word processing, general accounting, any of a multitude of tasks, each with complete independence.

And MARINER's M/LINK modem communicates at 2400 baud on standard voice-grade phone lines, using SDLC, BI-SYNC, or X.25. Sounds universal? MARINER is.

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

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

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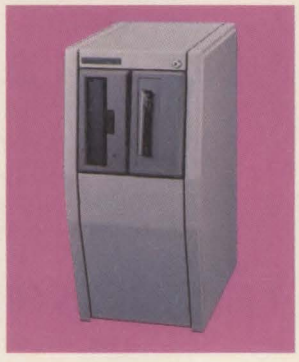
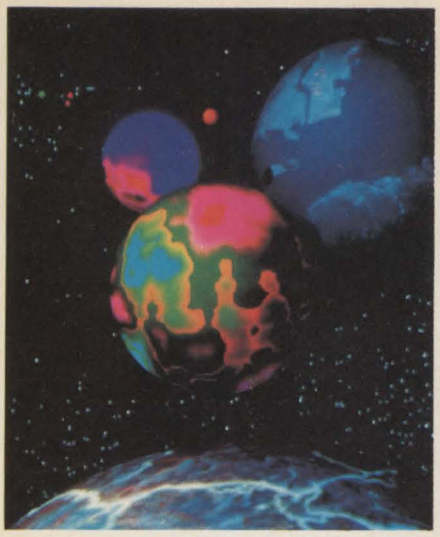


The background to the MARINER system is a photograph of the Lagoon Nebula, which can be seen with the aid of binoculars in the constellation Sagittarius.

MICROMATION

CIRCLE NO. 3 ON INQUIRY CARD



Subtleties of high-resolution color graphics make 3-D objects come alive. Cover photo of spheres in space was taken from a Raster Technologies Model One display processor with 512 × 512 screen resolution. The original image was created in memory by software written by Michael Potmesil of the Image Processing Laboratory at Rensselaer Polytechnic Institute, Troy, N.Y.

Page 39 . . . Organized software packages

Page 95 . . . . . Selecting color displays

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Mini-Micro Systems

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FEATURES

For feature highlights, see p. 79

MINI-MICRO WORLD

DEPARTMENTS

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

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

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

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

All of these products were conceived and designed to meet the need for reliable, low cost backup — for our systems or for any other system.

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DIGITAL RESEARCH MICROPRO JOIN IN SOFTWARE-PIRACY SUIT

In what is hoped to be a precedent-setting lawsuit, two of the largest companies in the μc software industry Digital Research, Inc., Pacific Grove Calif., and Micropro International Corp., San Rafael, Calif., jointly filed a suit in mid-November against two independent software distributors for trademark and copyright violations. Dataforce International and Data Equipment Corp., both of Sunnyvale, Calif., are charged with copyright and trademark infringement, unfair competition, breach of contract, theft of product and unfair enrichment. Digital Research, whose CP/M operating system has become an industry standard, and Micropro, whose Wordstar word-processing software is perhaps the most popular package of its kind, are asking a San Francisco, Calif., court that the defendants be ordered to stop their sales activities and that all copies of pirated products be destroyed. Further, the plaintiffs want all profits made from the bootlegged software to be reverted to the manufacturers. The suit asks for $1 million in punitive damages, treble damages for trademark violation and $50,000 for each infringed copyright. Company officials at Dataforce and Data Equipment could not be reached for comment at press time.

JAPAN KEEPS PRINTERS COMING TO THE U.S.

Activity is continuing in the low-end printer market in Japan, and a move toward higher quality output and full-featured printers is mounting. Nippon Electric Co., Ltd., Tokyo, Japan, is expected to begin shipping a very low-speed, low-priced printer to the U.S. in mid-1982. Tentatively called the 2003, the 8085 μp-based unit, aimed at personal-computer applications, houses one board with power supply, and prints at 20 to 25 cps. Price is expected to be $600 to $700 each in quantities of more than 1000.

C. Itoh & Co., Ltd., Tokyo, recently announced several printers for the U.S. market. The 132-column M-1550 will replace the Comet II dot-matrix printer, and probably will be available in the first quarter of 1982. The F-10-40 and F-10-55 daisy-wheel printers, operating at 40 and 55 cps, respectively, are quieter and more compact than the M-1550 and will replace 25- and 45-cps Starwriters. Another printer that may make its way to the states is the M-8600 dot-matrix printer, which has an 18-pin print head. The unit is designed for printing high-quality and Chinese Kanji characters. C. Itoh has also begun distributing Sharp Corp.'s model 300 continuous-stream ink-jet printer in Japan. The model was shown by Sharp at last year's National Computer Conference. It is not know if any Japanese companies will sell that printer in the U.S.

Sharp engineers recognize that drop-on-demand ink-jet printing is more cost-effective for four-color printing, and the company hopes to show such a prototype at the next NCC.

While OKI Electric Industry Co., Ltd. may stick to multiple pass, high-quality matrix printers rather than bring a 24-wire head model to the U.S., the company may begin showing a small, non-impact printer here in 1982. The Oki printer uses no lasers.

However, Fuji Xerox showed a prototype laser printer for OEMs at the Tokyo Data Show. That printer may be introduced formally next year in the U.S., the U.K. and Japan. Called the LXP, the device prints on plain paper at 40 pages per min. and can produce Kanji, graphics and alphanumerics.

Shinko Electric Co., Ltd., Tokyo, was scheduled to begin selling its SPL series thermal line printers in the U.S. after their debut at Comdex last month.

DEC DROPS HINTS ABOUT NEW PRODUCTS

Digital Equipment Corp. president Kenneth Olsen dropped his normally reserved manner regarding unannounced products and provided several broad hints of forthcoming DEC CPUS and peripherals at the company's recent annual meeting. The new products range from a DECsystem time-sharing system to the company's long-awaited personal computer, which apparently will incorporate a new version of the venerable PDP-8. Olsen also indicated that a hard disk will be added to the DECmate 278 stand-alone system and that more graphics capabilities will be added to the company's VDTs. Also included in DEC's product plans are new printers and VAX processors.

Breakpoints

DEC officials said that the company will not bring a nonstop PDP-11 computer system to the market despite an investment in engineering time and money that resulted in several running prototypes. Olsen said that the support, training and inventory costs of such a product would be too great in relation to its market potential. Instead, DEC is developing a redundant 32-bit VAX-based system, he says.

OMINNET GAINING IN LOCAL NETWORK RACE

Support for Corvus System's OmniNet local network is growing. Both Onyx Systems and CII Honeywell Bull of France have desk-top computers incorporating that hardware, and possibly two or three more μc companies will announce OmniNet licensing agreements at NCC. By then, Corvus will be shipping a second wave of add-on "transporter" interface boards that allow OmniNet to fit 90 percent of all μcs, including IBM personal computers and Unibus machines.

Also expected from Corvus in the spring is Constellation II, an upgraded version of the company's OmniNet-compatible software that allows two to 64 μcs to share as much as 80M bytes of disk space, multi-level file and user security and spooled peripherals. Constellation II will improve operating-system compatibility so that a UCSD Pascal user, for example, will be able to view the content of the CP/M user disk volume and have limited access to those files.

WESTERN DIGITAL'S FULL ADA COMPILER READY FOR TESTING

Two months ago, Western Digital Corp., Irvine, Calif., announced its MicroAda compiler (MMS, November, p. 32). Now the company says it will submit a full compiler to the U.S. Department of Defense for validation next summer. The compiler was scheduled to be demonstrated late last month in the company's Pittsburgh, Pa., office. If validated, it will be one of the first such products able to translate programs written in Ada into a computer-usable language. Western Digital's compiler reportedly translates Ada programs into P-code, which runs on the company's 16-bit MicroEngine machine. The company plans to offer a 100-percent refund on the MicroAda for customers wanting to move up to the full compiler when it is commercially available.

RAM-BASED SPEECH BOARD SWAPS VOCABULARIES

Telesensory Speech Systems, which began delivery of an EPROM-based, Multibus-compatible speech-synthesis board—the Speech 1000—in the spring, will unveil a RAM-based device this month. The new Speech 1100, also Multibus-compatible, includes 14K bytes of RAM that allows users to build vocabularies on-board and down-load them to floppy- or hard-disk devices. The 1100's speech capacity is 50 sec. (compared to 200 sec. for the 1000), and vocabularies can be swapped at will. Further vocabulary expansion is done via a piggyback board equipped with RAM or EPROM. Price for the Speech 1100 is $1500.

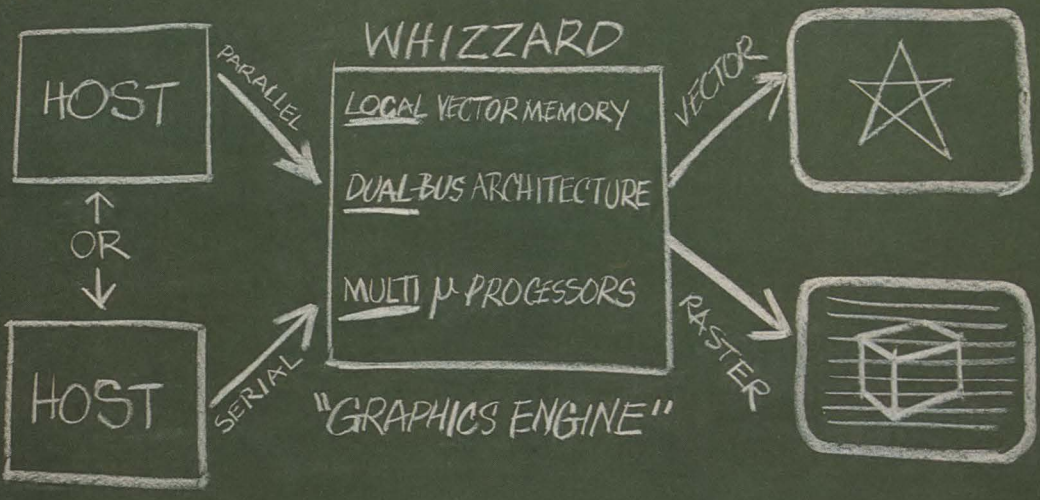
Telesensory is also initiating a phone-line vocabulary-development program. Using Teleword, the firm's 2000-word database can be accessed for a $15-per-hour hook-up fee, plus $2.50 per word. A customer for the service needs a display device with a modem and EPROM programmer or a μp development system for direct recording to a disk.

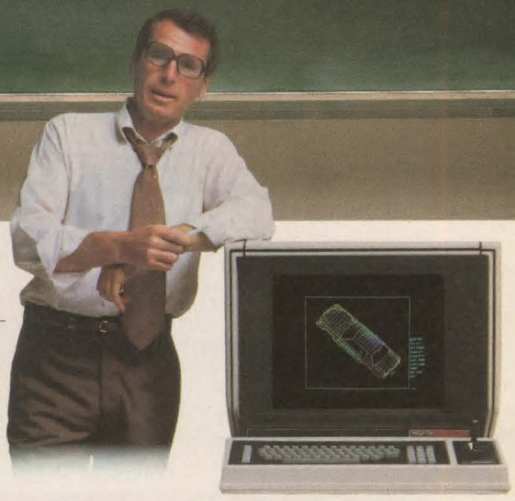
SIEMENS APPROACHES AGREEMENT OF EUROCARD

Siemens Corp is in final negotiations with an American manufacturer to produce Eurocard boards in the U.S. (see "Europe moving toward Eurocard standard," p. 18). In Europe, Siemens builds a family of Eurocard machines based on its own designs and configured around the Intel 8086, for which it is a second source. Eurocard is becoming a European standard for the computer-board market. While a Siemens spokesman in the U.S. acknowledges that the agreement is near, he won't identify the prospective manufacturer.

THE MEGATEK DIFFERENCE:

OFFLOADING THE HOST





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

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

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

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

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

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

See the Megatek difference. Call or write Megatek Corporation, 3985 Sorrento Valley Blvd., San Diego, CA 92121. 714/455-5590. TWX 910-337-1270. European Headquarters, Megatek, S.A., Avenue du Tribunal Federal, 34, CH-1000 Lausanne, Switzerland, Telephone: 41/21/207055, Telex: 25037 MEGA CH.

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

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CIRCLE NO. 6 ON INQUIRY CARD

VERBATIM, CDC—IN MEDIA DEAL?

A doubling of Verbatim Corp's stock price—to more than $40 a share—has rumors flying about the Sunnyvale, Calif., media maker. One source says the company may be working out a deal with Control Data Corp., whereby Verbatim would take over and operate the drive maker's media manufacturing facilities. This is unconfirmed, however, and a source close to Verbatim says that the rise in the stock price is probably a case of "expectations (in the industry) being out of line." He also discounts takeover possibilities because Verbatim founder Reid Anderson holds more than enough shares to hold off an "unfriendly" bid.

IDS, CENTRONICS LOW-END PRINTERS IN THE WORKS

Integral Data Systems, Inc.'s low-cost Prism color matrix printer, introduced formally last month, launched a line of printers scheduled to be introduced early next year. The new printers, with prices starting at less than $1000, are built modularly, says IDS, and Prism is the most fully configured version. Print speed for the forthcoming models ranges from 110 to more than 200 cps. Also due is a printer using an 18-wire head, which was shown as a prototype at this year's NCC. That printer may be released by the Milford, N.H., company at the upcoming NCC, and is still undergoing front revision to improve print quality.

New Hampshire neighbor Centronics Data Computer Corp. is still at least six months away from releasing the now-infamous Quietwriter printer. Company CEO Robert Howard says the product will initially serve as a terminal, which will lead Centronics into a new market. Neil Kleinfeld, vice president, marketing, planning and business management, conceded that millions of dollars are being kicked into the project, which employs 50 engineering, manufacturing and support personnel. Howard adds that the company received $5 million in additional Quietwriter funding from the three banks it does business with. He won't comment about whether the Quietwriter is the intended low-end product that will help the company regain its top position in the low-end printer market, but he admits low-end products are forthcoming.

EMULOG UNVEILS LOWEST PRICED TERMINAL

At Comdex, Emulog Corp., Fremont, Calif., unveiled the lowest priced CRT terminal to hit the market since Applied Digital Data Systems and Televideo Systems ignited the low-end price war last spring. (MMS, June, p. 33). Priced at $465, the Alpha Star terminal will be marketed to OEMs through Emulog's traditional sales force and to large end users via direct mail. The direct mail campaign will be handled by Phasor, Emulog's marketing subsidiary and will begin this month. The mail-order strategy was devised to eliminate dealer overhead and to pass savings on to customers. Other reasons for the terminal's low price, company spokesmen say, are that it is manufactured in Korea, and its snap-together design enables it to be assembled easily at Emulog's Fremont facility. The Alpha Star uses Televideo and Lear Siegler screen-format control codes, and communicates via RS232 or 20-mA current-loop interfaces. The terminal includes a tiltable, 80-character x 24-line, green-phosphor screen that displays upper- and lower-case characters with descenders. A detachable keyboard includes three functions keys and a built-in numeric keypad. Emulog sources say that OEM orders have been placed.

DATAPOINT ADDS THREE PRODUCTS TO ARC ELECTRONIC-OFFICE NETWORK

Datapoint Corp., San Antonio, Texas, has unveiled three products for its ARC (Attached Resource Computer) network that are designed to solidify the company's position as a single-source supplier of integrated electronic-office equipment. One product, a color-graphics business system lets users create and display color graphics with a controller, an input tablet and a 512 × 482 raster display. Optional equipment for the $30,000 system includes a matrix color printer, a 35-mm. camera system and a combination 35-mm. film/color-print system.

Datapoint's second new product, a 20-page-per-min., 480 × 240 dpi laser printer, is priced at $65,000. The third product is a μp-controlled facsimile interface that links Datapoint

computers and work stations to manual or automatic facsimile equipment. Price is $4950. The color graphics system is available now. Initial shipments of the laser printer and the facsimile interface are slated for mid-1982.

ADD-INS BRING CP/M, ENHANCED DISPLAY TO APPLE II, III

The number of CP/M-compatible products for Apple II and III personal computers is increasing. One of the latest entrants is a package of add-in boards and software from ALS, Inc., Sunnyvale, Calif. Called the Synergizer, ALS's package includes its Smarterm 80-column video board; Add-Ram, a 16K memory board; and Z-Card, a Z80-based device that provides CP/M compatibility to Apple hardware. Z-Card peforms a function similar to that of MicroSoft's Softcard, allowing users to switch between the board's Z80 and the Apple's 6502 μps. The device uses 33 percent fewer components than the Softcard because of a custom chip, says ALS. The package includes the company's enhanced version of CP/M, which, unlike the Softcard, is said to be slot independent in the Apple. Price for the Synergizer, including CP/M on diskette plus three boards, is $749. Apple III Synergizer software should be ready by January.

LOW-COST-GRAPHICS SYSTEM AIMED AT VLSI DESIGNERS

Avera Corp., Scotts Valley, Calif., will begin deliveries of the GS1220 stand-alone color-graphics system this month, aiming it primarily at VLSI and PC-board designers. The low-priced, dual 8086-based GS1220 includes a 13-in. raster screen that displays two tables of 256 colors each to provide 460 × 460 pixels of graphics. The $55,250 hardware also has full-color area-fill capabilities, layer differentiation and outline control. The Multibus-compatible GS1220 has two RS232C ports and an 8-in. Shugart Winchester-disk drive with 10M bytes of storage.

EPSON BRANCHES OUT IN JAPAN WITH COMPUTER FLOPPY-DISK DRIVE

Low-end printer market giant Shinshu Seiki Co., Ltd. (Epson), showed two small computers and a floppy-disk drive, all targeted at the Japanese market, at the October Data Show in Tokyo. The HC-20 hand-held computer, which looks like a Sony Typecorder, will be test-marketed in Japan. It includes a typewriter keyboard, Microsoft BASIC, ROM cartridge or microcassette, an 8K byte CMOS CPU, a 20-column × four-line LCD, a maximum of 16K bytes of RAM, and a built-in dot-matrix printer. Also shown was the QC-20 personal computer, which includes a CP/M operating system, a 4-MHz Z80 μP, 256K bytes of main memory and a 5 1/4-in. floppy-disk drive. Versions of the FT-20 thin terminal floppy-disk drive are also compatible with the HC-20, the TRS-80 model I, the Apple II and the NEC PC-8001. The drive includes 40 or 80 tracks, a 220-msec. average access time and a maximum of 1M byte of unformatted storage and 656K bytes of formatted memory. Approximate dimensions are 3.2 × 14 × 6.6 in. high, and weight is about 11 lbs.

RANDOM DISK FILES

The booming small-Winchester market continues to fuel the demands for read/write heads. Arjan Lalchandani, president and co-founder of Boulder, Colo., start-up **Saimag, Inc.,** plans to have prototype 3350-technology ferrite heads during the first quarter of 1982. . . . Jim Money, one of the founders of OEM thin-film-head pioneer Dastek Corp., has founded **CalMag Corp.,** Milpitas, Calif., and plans to offer low-cost thin-film read/write heads for 5 1/4-and low-end 8-in. Winchester-disk drives incorporating conventional oxide-coated media. The heads will use a three-rail configuration similar to 3350-technology "catamaran heads," and will incorporate 3370-style suspensions supplied by outside vendors. Evaluation heads that operate at 11,000 flux changes per in. are expected to be on the market early next year. . . . Another thin-film head entrant is San Jose start-up **Cybernex Corp.** Formed by several engineers from IBM Corp., Cybernex will also offer evaluation-unit heads for 5 1/4-in. OEM Winchester-disk drives in mid-1982.

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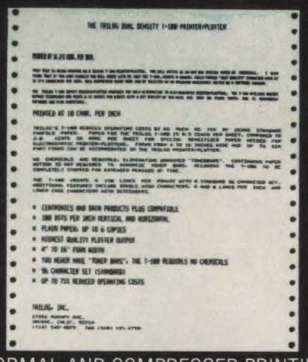
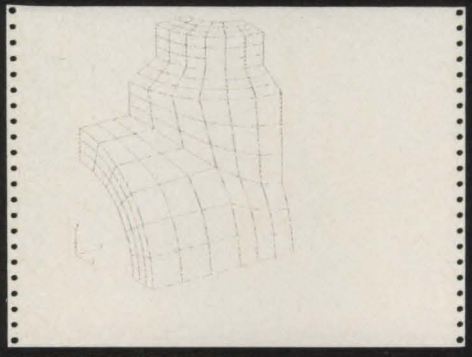
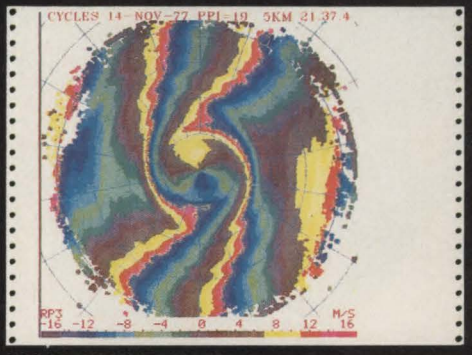


NORMAL AND COMPRESSED PRINTING

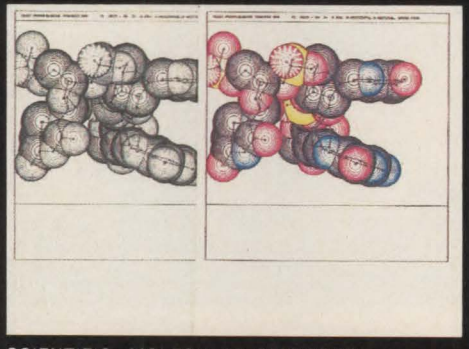
150 LPM AND 250 LPM



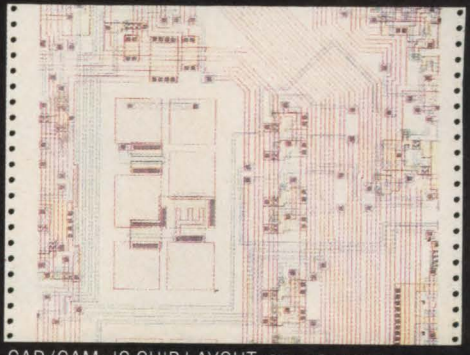
HI RES. STRESS ANALYSIS (PDA Eng.)



RADAR WEATHER MAPPING



SCIENTIFIC: MOLECULAR STRUCTURE (MIT)



CAD/CAM: IC CHIP LAYOUT (Silicon Systems Inc.)

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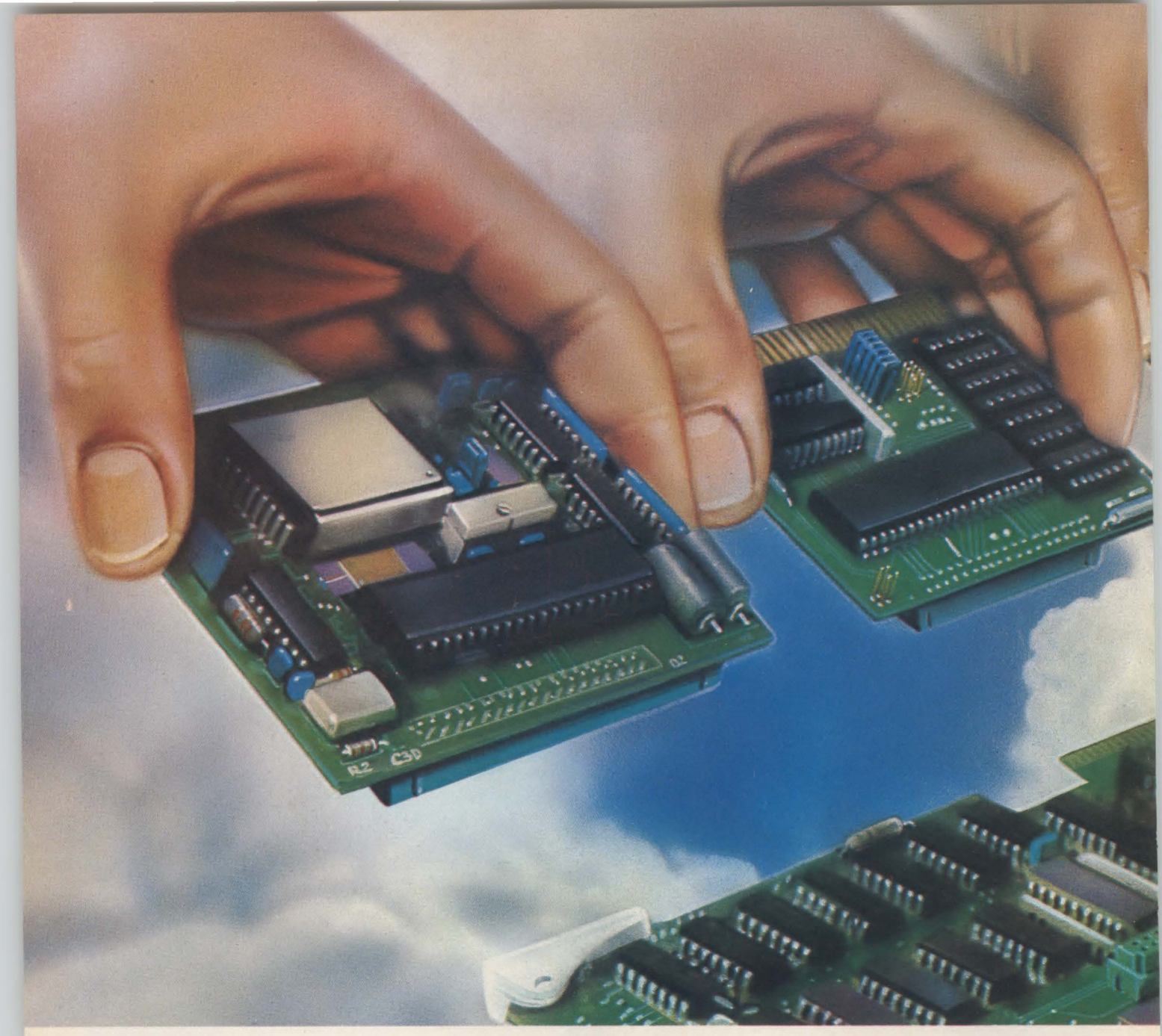

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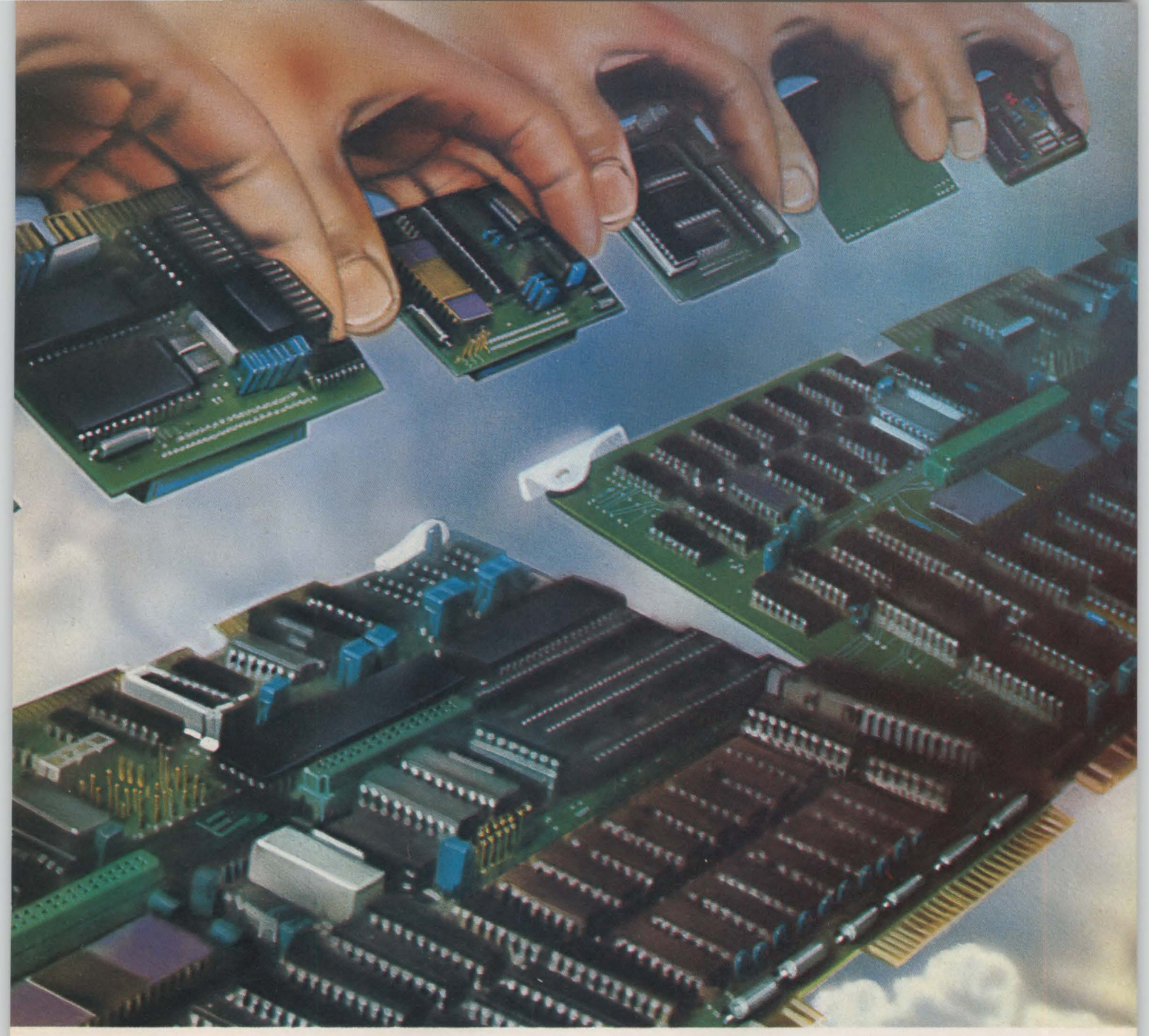

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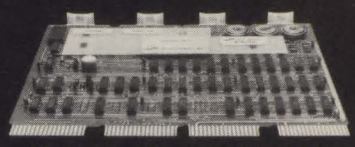

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Hi-G, IDS meet low-end printer competition head-on

While some manufacturers in the low-priced printer market have shied away from intensifying competition with Japanese companies (MMS, May, p. 27), a few are trying to beat the Japanese at their own game. Among those hardy souls are newcomer Hi-G, Inc., and veteran Integral Data Systems, Inc. Both companies are using manufacturing and marketing strategies aimed at meeting low-price pressures with high-quality, U.S.-made products.

Hi-G, based in Windor Locks, Conn., will enter the printer market this month with a line of low-cost, dot-matrix printers that are produced and assembled in-house. The two initial products, the 9/80 and 9/132, print bidirectionally at 150 cps (see "Sizing up Hi-G's low-cost matrix printer," p. 16). The 80-column model 9/80 is priced at $995, and the 132-column model 9/132 is priced at about $1100, both fully featured in single-unit quantities. Some 9/80 configurations are expected to be priced at less than $600 in 500-unit quantities. A $200 to $300 hobbyist printer will follow in the spring.

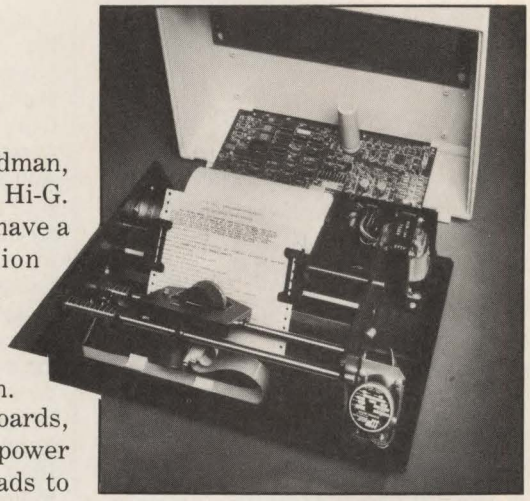
Thirty-year-old Hi-G is no newcomer to the electronics industry, having net sales of about $59.5 million in the year ended March, 1981, from its mainstay, the electronics-component and systems business. The company hopes to parlay its experience in manufacturing high-precision components into a successful printer business that will compete with such strong competitors as Epson America, Inc., and Okidata Corp.

"OEMs are thirsting for an American alternative for price and performance (in a low-priced printer)," claims Stephen H. Friedman, vice president of marketing at Hi-G. He believes the company will have a superior competitive position against domestic and foreign competition, because it is a manufacturing rather than merely an assembly operation.

"We have supplied PC boards, control solenoids, motors, power supplies and custom print heads to the printer OEMs for a number of years," he explains. "Epson came into the U.S. with heads and mechanisms and then went into the printer business. We need an American-made machine in the U.S. market with Epson's prices to take some business away from them." He believes Hi-G has the advantages of in-house production of components and subassemblies, incorporation of technological innovations, low overhead costs, quality control and uniformity of replacement print heads because of in-house calibration.

Despite Hi-G's in-house capabilities and low pricing, some of those who have talked to the company about the product remain skeptical. A primary benefit of the new printer line is that it incorporates a proven printer design, licensed from Tritel Corp., Irvine, Calif. Friedman credits Tritel vice president Donald R. McCombes with prompting Hi-G to produce a printer.

McCombes says Hi-G has the basic ingredients to compete with the Japanese in the low-cost printer market. "The problem most U.S. companies face in Japanese competition is that the U.S. companies are basically assemblers. Japanese companies make most components themselves and invest in expensive tooling to get large volumes. Hi-G also did this and sold the components to other printer companies," he says.



Hi-G hopes to compete head-on with Japanese vendors *in the low-cost printer market by decreasing manufacturing overhead and producing most of its own components.*

Hi-G's main task must be to build a reputation as a dependable supplier of a reliable product, he adds. He says the company already has such a reputation in its other markets. One handicap facing Hi-G, he says, is that its name is not established in the printer business.

Another potential problem, Hi-G's Friedman admits, is delivery times on printers. Although Hi-G is ready to ramp up quickly for volume production, it will not necessarily beat its competitors on delivery schedules. Delivery times are about 15 to 20 weeks. Hi-G is establishing distribution channels, and hopes to give distributors better margins than any competitor in the business, mainly because of its low overhead costs in manufacturing. Friedman intends to have 20 distributors within one year, and five by Jan. 1. Those five include ones in Los Angeles, Dallas, New York, Boston and Chicago. Distributors also will

stock modular printer parts.

Hi-G is targeting sales of the printer to small-business-system users who want a fully featured printer at low cost. Milford, N.H.-based IDS has selected the mid-range of the low-cost printer market on which to concentrate some forthcoming new products and marketing strategies.

"IDS recognizes the stiff competition with Japanese and American companies," says Peter Eisenhauer, IDS vice president of marketing and sales. To meet the competition, the company is rallying around three corporate strategies: careful product design and marketing, improving the company's overall productivity and delivering high-quality products.

"We must be careful with our products and market segments. IDS is a small, $20-million company competing against Japanese firms that are part of multibillion-dollar conglomerates, such as Epson and Okidata," he says. Eisenhauer is hoping to get a "reasonable" jump on Japanese competitors with forthcoming products that are performance-oriented, an area that will soon be addressed more strongly by the Japanese. "We're looking at printers priced at $900 to $2000, rather than those priced at $500 or $3000. Users of those products are concerned with performance and features, rather than just price."

The second area of concentration for IDS—company productivity—involves both product-design criteria and assembly-line employees. Eisenhauer explains that IDS is streamlining product design for manufacturability. This is one virtue extolled by Epson, which claims its printers literally fall together. Eisenhauer adds that IDS also is piggybacking earlier innovations onto new products to respond to market needs more quickly.

To obtain better workmanship and higher output per individual, IDS instituted a job-enrichment team (JET) concept in January. Rather than having each person on an assembly line handle only one component, individuals now work in teams, and each person is responsible for building an entire printer and for assuring its quality. Eisenhauer says productivity and quality have improved since the program began.

The third, and key, strategy is delivery of a high-quality, reliable product. "This was never at the level of consciousness of American manufacturers until they saw what happened in the automobile industry," he says. IDS has automated many of its operations, including a plant in Puerto Rico. —*L. Valigra*

SIZING UP HI-G'S LOW-COST MATRIX PRINTERS

Hi-G, Inc.'s first two matrix printers, the 9/80 and 9/132 in 80- and 132-column configurations, respectively, are based on designs by Tritel Corp. The 9/80 was designed exclusively for Hi-G, and will compete with low-end Japanese printers. The 9/132 design has been on the market for about six months, and is licensed from Tritel by other unspecified manufacturers.

Both Z80 μp-based products print bidirectionally at 150 cps in a logic-seeking mode. They use a nine-wire head, with all wires in a vertical row. The head is manufactured by Hi-G's Magnetec division. Print-head life is estimated at 300 million characters, and the head is field replaceable.

The printers use a 96-character ASCII set. Characters can be printed in expanded, condensed and double-density (two passes of the print head) modes on as many as six copies. Information can be printed in 10, 12, or 16 characters per in., and in 6 or 8 lines per in.

Other character sets and fonts are down-loadable from a mainframe. The printer includes a 1K RAM, 350-character buffer that can be optionally expanded to 3422 characters. The company intends to offer graphics later. Centronics-compatible, RS232C or current-loop interfaces are available.

The printers include a tractor-feed mechanism, and friction feed is optional. Also included are two stepper motors for horizontal and vertical drive movement. The printers contain no fans, and are said to be very quiet. They include self-test features. Both models can work on power supplies as low as 80V and, thus, during electrical brownouts.

Motorola, Mostek, Signetics in 16-, 32-bit bus pact

When semiconductor manufacturers get together to produce μps—as Intel Corp. and Advanced Micro Devices did recently for the 8086—more often than not, the system bus takes a backseat to the processor and the process.

But in an effort to broaden the usage of Motorola's M68000 16-bit μp, the Phoenix, Ariz., semiconductor maker, and Mostek Corp. and Signetics/Philips, both alternate sources for the 68000, have introduced a system bus said to support 16- and 32-bit hardware in single- and multiple-processor systems. The three have been joined by French telecommunications giant Thompson-CSF in a move that observers say will help strengthen the 68000's position in the market.

Called VME, the new bus struc-

ture and related board-level products will be available initially in Europe. First products are expected from Motorola. Signetics/Philips will follow within six months and Mostek by the end of next year.

VME is implemented on single and double Eurocards with pin and socket connectors that meet the so-called DIN standard. Both 92- and 192-pin cards can be mixed in a system, allowing address and data-bus expansion from 16 to 32 bits. Further, VME allows data transfers at 20M bytes per sec.

A second bus within VME has been proposed by Signetics/Philips that would act as a "local-area network within the card cage," say Signetics/Philips officials, to help distribute the functions of each card. The inter-intelligence bus, as the company has dubbed it, is not yet part of the overall VME definition because precise message protocols have not been determined.

The technical merits of the new bus aside, it is a significant marketing move. Officials at the three companies agree that VME will increase the 68000's penetration in Europe and establish a standard bus for the Eurocard form factor. In Europe, a source says, the 68000 will gain support, and VME may become a market force.

The impact of VME on the U.S. market is not as clear, however, and it may be complicated by the fact that two of VME's backers—Motorola and Mostek—have been supporting other buses for some time.

For Motorola, the introduction of VME could present difficulties, even though the company doesn't plan to bring it to the U.S. before 1983. The new bus is essentially a version of Versabus, the 68000 system interconnect structure introduced by Motorola 18 months ago. The two buses differ in one important respect: they are mechanically

IEEE, VME AND P896

The new 68000 system interconnect has not gone unnoticed by the IEEE, whose Computer Society has been working on μc systems standards for some time. The Society's P896 subcommittee has proposed a system bus not unlike VME or Versabus. But the IEEE has decided to take a closer look at both commercial buses. At a recent meeting, the Computer Society decided to seek a project authorization number that would give the go-ahead for further VME and Versabus study, and presumably lead to a standard, a move that will add credibility to what some observers say is Motorola's not-so-credible Versabus.

Meanwhile, the P896 subcommittee's 32-bit processor-independent bus continues to evolve. Chairman Andrew Allison says the specifications are "fairly solid," and it seems quite likely his group will have a draft proposing a bus that supports 32-bit address and data lines on a single 64-pin connector.

COMPARISON OF THE VME TO OTHER 16- AND 32-BIT BUSES

	VME bus	Multibus	Q-Bus	IEEE P896	VERSAbus
Bus type	Asynchronous non-multiplexed	Asynchronous non-multiplexed	Asynchronous multiplexed	Asynchronous multiplexed	Asynchronous non-multiplexed
Address width	24 standard 32 expanded	20 standard 24 expanded	16 standard 18 expanded	32 standard	24 standard 32 expanded
Data width	8, 16, 32	8, 16	8, 16	8, 16, 32	8, 16, 32
Board size	DBL 160 x 233.4 mm = 37344 mm² SGL 160 x 100 mm = 16000 mm² (standard Eurocard)	171.5 x 304.8 mm = 52273 mm²	214 x 263.4 mm = 56368 mm² 214 x 147.3 mm = 31522 mm²	Any Eurocard	9¼ x 14½ in.
Connector type	Pin & socket	Edge	Edge	Pin & socket	Edge
No. of pins on primary/secondary connector	96/96	86/60	38	64 or 96 on either	140/120
Power	+5, ±12, +5 standby	+5, ±12	+5, ±12, +5 B, +12 B	+5	+5, ±12, ±15
Interrupt levels	7	8	4	None (uses serial bus or write into CPU card	7
Arbitration levels	4	1	1	32	5
Multiprocessor?	Yes	Yes	No (master slave)	Yes (including system supervisor)	Yes
Error signals	AC fail, system fail, bus error	None	DC power OK power OK	ECC on bus, error result field	Same as VME
Special cycles	Read/modify/write block transfer access privilege lvls.	Lock	Refresh read/modify/write event interrupt	Read/modify/write, block transfer, split cycle, event cycle	Same as VME
Extendable modes for future	Yes (address modifiers)	No	No	Yes (command field)	Same as VME
Separate serial bus	Yes	No	No	Yes	Yes

EUROPE MOVING TOWARD EUROCARD STANDARD

The board computer market in Europe accounts for around 40 percent of the world total and is not much smaller than the market in the U.S. West Germany, which provides the largest chunk of business in Europe, is totally committed to the Eurocard standard for these boards. Scandinavia is likewise committed, while Britain and France are rapidly moving toward the standard.

Murray Freeman, μc marketing manager for Mostek in Europe, says these are some of the main reasons that his company's offensive in the 16-bit market will be armed entirely with Eurocard boards employing the VME bus specification agreed to jointly by Mostek, Motorola, Philips/Signetics and EFCIS of France.

Freeman adds, "The Eurocard standard is very well-defined. Eurocard racks are inexpensive and easily obtained, and Eurocard boards are easy to build because there is no gold-plating on them. They use pin and socket rather than edge connectors. Moreover, the biggest vendor in Europe we compete with is Siemens of West Germany with its Intel 8086-based Eurocard products."

Explaining why Mostek has no interest in manufacturing boards employing the Motorola-defined Versabus, Freeman explains, "Versabus uses a very large card format, is less modular than Eurocard, and the costs of adding devices, extra RAM, for example, are higher. Eurocard is catching on in the U.S., and all design and manufacture of our VME-based Eurocard products will be carried out at our Dallas facility."

Mike Hull, spokesman for Philips/Signetics at Philips world headquarters at Eindhoven in the Netherlands, echoes Freemans comments, adding, "The VME bus answers the requirements of all users better than Versabus. At Philips, we think that the agreement between the four companies on a Eurocard-based standard offers exciting prospects for European exporters."

Grenoble, France-based EFCIS, a subsidiary of French electronics giant Thomson-CSF, says it will introduce products based on the VME bus during 1982. Like Mostek and Philips/Signetics, EFCIS provides a second source for the Motorola 68000 μp family.

Motorola says it has picked up "a few" customers for Versabus-based products in the nine months since it started selling them in Europe, but those customers are mainly organizations committed to large boards. Motorola feels sure that VME boards will outsell Versabus in Europe.

—Keith Jones

incompatible. Versabus is implemented on 9¼- × 14½-in. boards, while VME is based on smaller, metrically measured Eurocards.

Motorola's Jeff Gorin, manager of product applications for microsystems, says that VME and Versabus complement each other and that the company has no intentions to stop supporting the latter. Each bus, he continues, serves a different set of applications. "VME is suited to I/O-intensive systems, while Versabus is better for computational and memory-intensive applications," he says.

Such versatility may mean very little to Versabus users, however. One source says that the Versabus users group "wants nothing to do with VME."

Martin Plotkin, chairman of the 80-member Versabus group disagrees, echoing Motorola's Gorin: "A bus is a way of implementing a system. It's a tool," he says. "Which is better? What's the application?" Users will choose the bus that meets their requirements, he says.

Mostek is in a similar situation. The Carrollton, Texas, company has supported the STD-bus with Pro-Log Corp., Monterey, Calif., since 1978. But, like Motorola, Mostek officials view the buses as complementary. Says Mostek's Frank Bruns, director of the VME product line, "STD is geared for low-end applications, VME for medium- to high-end systems."

The buses' suitabilities notwithstanding, the question remains whether a metrically sized board such as the Eurocard will be accepted by U.S. customers. Bill Holloway, systems marketing manager for the microsystems group at Signetics, thinks the demand (for Eurocards) exists in the U.S.

John Tisdale, marketing manager for the systems division at PC-board and connector manufacturer Augat, Inc., Attleboro, Mass., agrees. The Eurocard is in use in the U.S., he says, and it is gaining popularity. "Selecting a card size is an arbitrary decision," he says. "With so many varieties of cards in the U.S., users would probably appreciate a standard format." Augat is delivering both single and double Eurocards with DIN connectors, he says.

Motorola's first VME products include a 68000-based, single-board CPU, a 64K- and 256K-byte RAM board and a 20-slot chassis. Mostek's product plans include CPUs, serial and parallel I/O boards, memory and peripheral controllers. Signetics is not yet revealing its product lineup.

—Larry Lettieri

IN MEMORIAM

The editors and staff of *Mini-Micro Systems* extend condolences to the family and friends of Joseph J. Fischer, who died Oct. 14, and to the employees of Trilog, Inc., the company he co-founded three years ago. Fischer, an engineer with more than 20 years experience, was president and treasurer of the Irvine, Calif., vendor of color line printers and enhancement modules for Printronix hardware. He was 48 at the time of his death from an apparent heart attack.

Fischer is succeeded in Trilog's presidency by Raymond Melissa, a second company co-founder and Trilog chairman and CEO.

Fischer is survived by a wife and two daughters.

Most small system users think all microcomputers are created equal. And they're right. If you want performance, convenience, styling, high technology and reliability (and who doesn't?) your micro usually has a price tag that looks more like a mini. It seems big performance always means big bucks. But not so with the SuperBrain!

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You'll also get a full ASCII keyboard with an 18 key numeric pad and individual cursor control keys. Twin RS232C serial ports for fast and easy connection to a modem or printer. Dual Z80 processors which operate at 4 MHZ to insure lightning-fast program execution. And the list goes on! Feature after feature after feature.

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

Whether your application is small business, scientific, educational or just word processing, the SuperBrain is certainly an exciting solution to the small computer problem. And since you can easily expand it, you'll probably never outgrow it.

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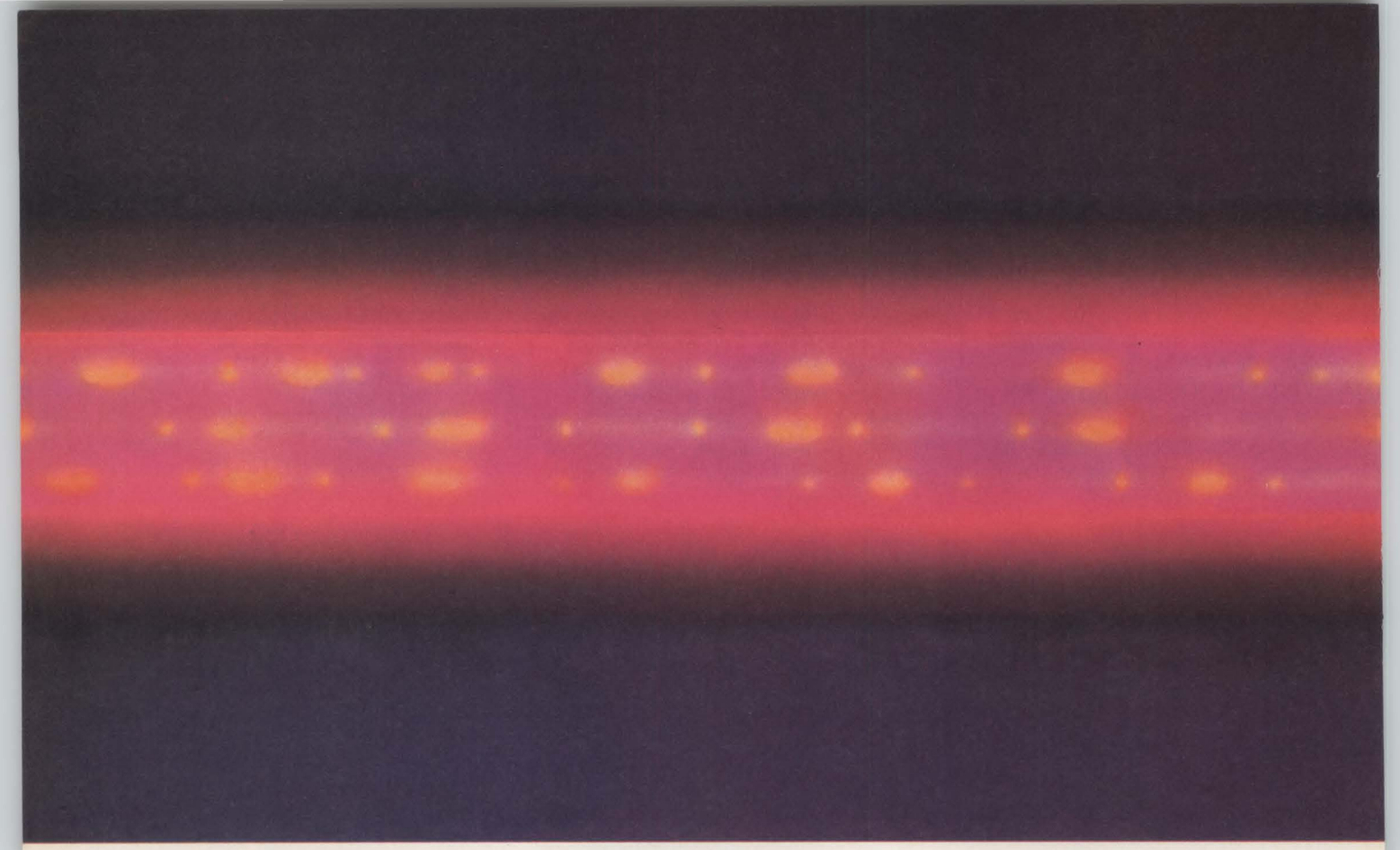
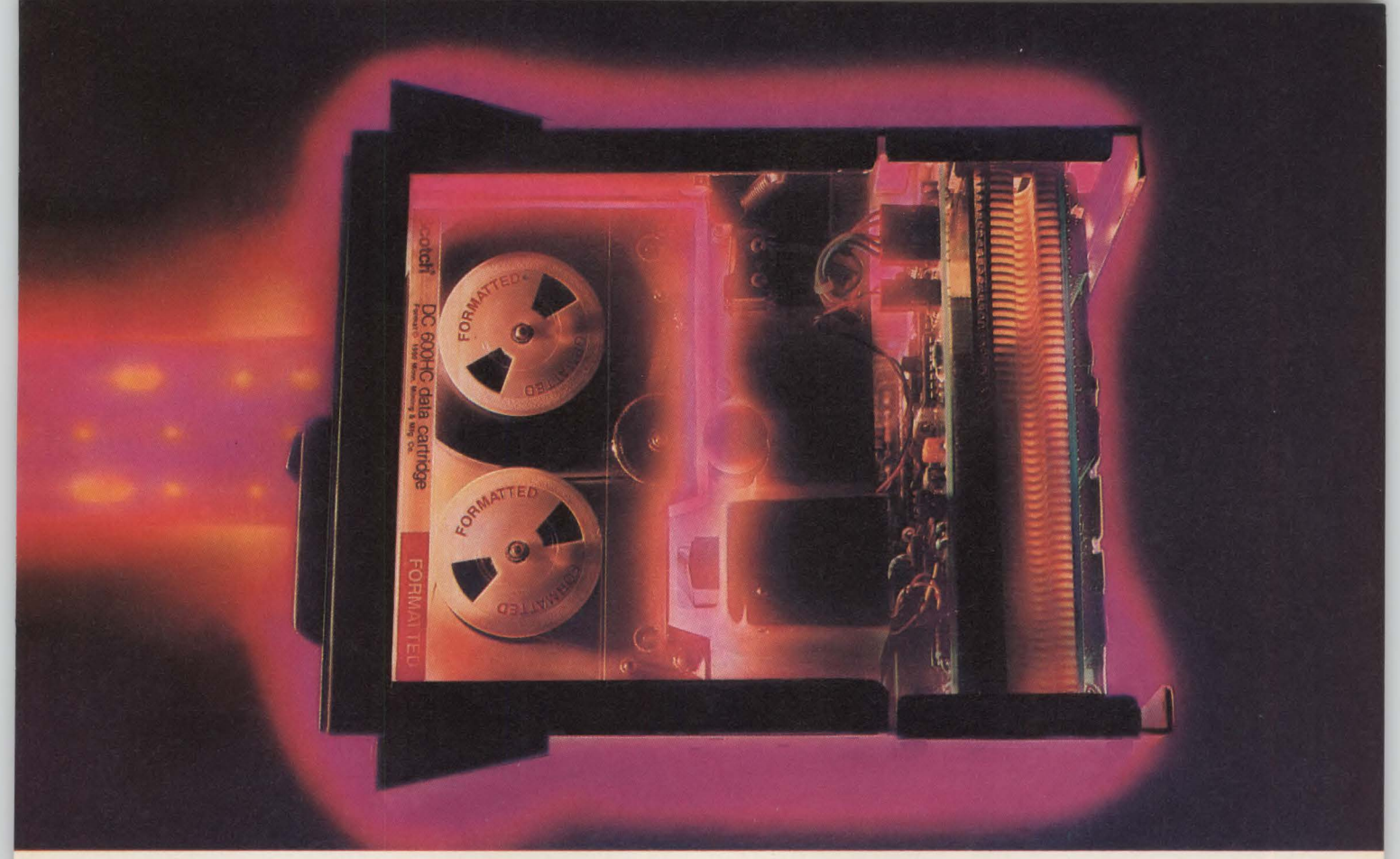
SUPERBRAIN™

CIRCLE NO. 10 ON INQUIRY CARD



It takes real nerve to compare our ¼" back-up system with ½" drives.

It also takes 67 megabytes.



HCD-75: so much for so little.

Presenting the only ¼" cartridge back-up system that'll go head to head with ½-inchers in the critical 30-70 Mbyte range.

The reason is simple. The 3M Brand HCD-75 Data Cartridge Drive System gives you 67 Mbyte per cartridge formatted. No other cartridge drive gives you so much capacity.

There's nothing medium about the medium, either. Each Scotch® DC 600HC cartridge is pre-recorded with permanent forward/reverse-reading block keys. They give you block-addressable storage. You get compact recording on all 16 tracks, with a density of 10,000 frpi, without rewinds.

The HCD-75 system, including drive and controller, is about one-fifth the size of a ½" tape drive. You don't have to put back-up and I/O plans on the back burner because of size constraints.

Interchange for the better.

Cartridges interchange quickly and easily. Tape-to-head alignment is ensured by a special sub-routine. It automatically aligns the read-write head and stepper motor controller to the tape edge each and every time the operator puts a cartridge in the system.

There's brain to this back-up, too. First, all its functions are handled through its controller. And second, there's minimal host involvement, so host time can be freed up for more critical functions.

All the reliability without high cost.

You can run one HCD-75 drive off the controller, or two, or three, or four. You still get all the reliability of the high-priced drives. The HCD-75 runs self-test routines to ensure proper operation. It gives you sophisticated error messages when faults are detected.

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Back-ups to go.

The total system—drive, controller, pre-formatted Scotch DC 600HC cartridges—is available to OEMs now. One at a time, or in evaluation quantities, you can take delivery on this reasonable, reliable, truly high-capacity alternative to ½" drives.

As close as your phone.

In fact, if you have been holding off on a back-up decision—or even if you haven't—make us put our back-up where our mouth is.

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Or write us at Building 223-5N, 3M Center, St. Paul, MN 55144.

3M hears you...

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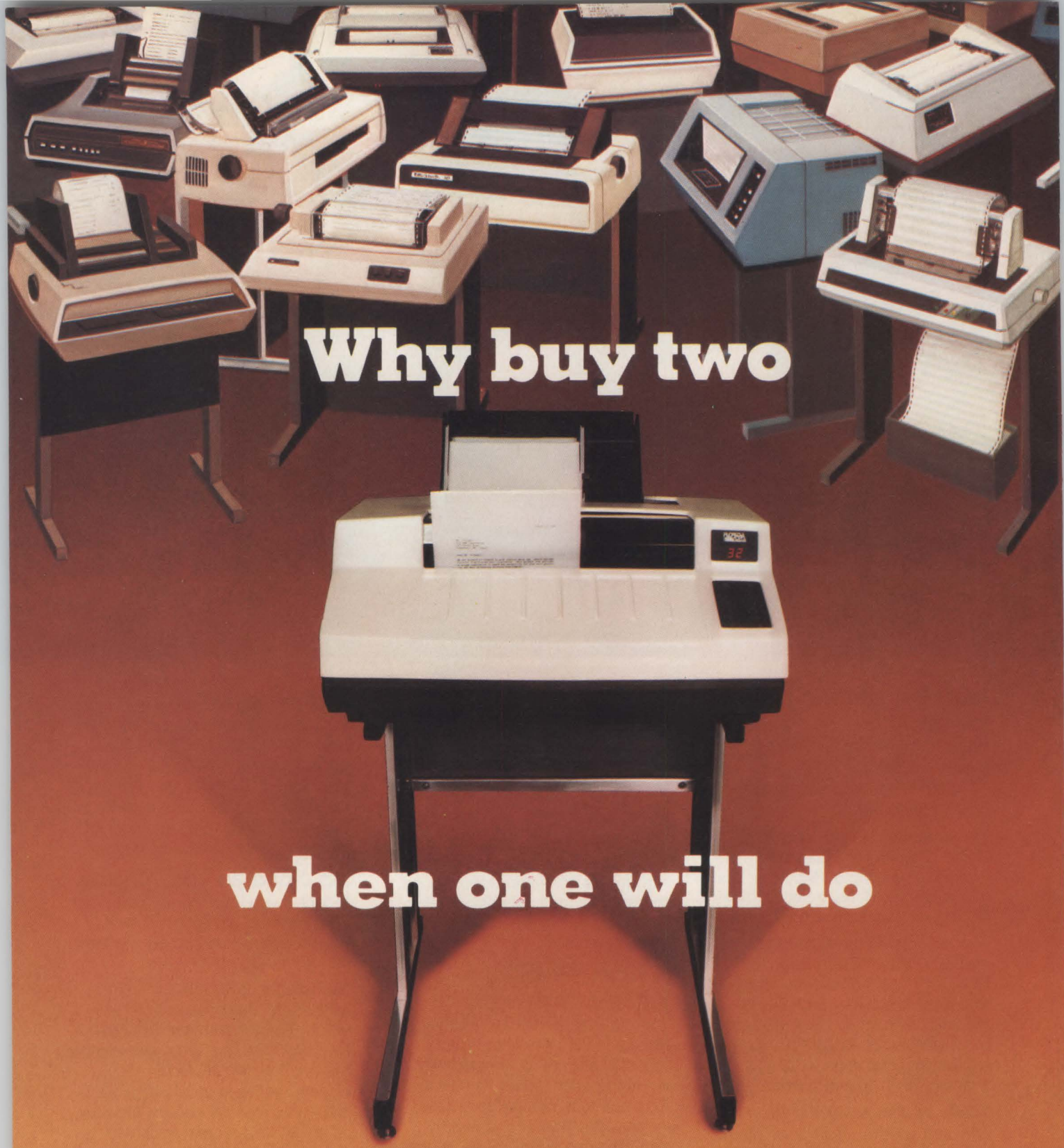
CIRCLE NO. 11 ON INQUIRY CARD



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when one will do

Data processing printing. Word processing printing. Graphics printing. Simple paper handling. Font flexibility. And, you have to do it all reliably fast. You can meet these current and future demands with two or more competitive printers. Or with one Florida Data Office Systems Printer.

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FLORIDA DATA

CIRCLE NO. 12 ON INQUIRY CARD

DEC introduces hardware/software team

In November, Digital Equipment Corp. launched a new attack on the single-board computer market with a teamed hardware and software product that provides three compatible processors from the firm's μc group.

What was once internally named the Tiny-11 and then the Falcon, has emerged as the Falcon SBC-11/21 single-board computer with a single chip, 40-pin 16-bit μp that executes the PDP-11 base-level instruction set. The Falcon processor is the low-end member of a three-processor μc family that also includes the mid-member LSI-11/2 and the high-end LSI-11/23.

The Falcon is aimed squarely at the 8-bit single-board computer dedicated-application market and carries an aggressive price tag of $790 in single-unit quantities and $521 in 100-unit quantities. Volume production is scheduled for next spring.

DEC's software offering, designed to help lift the Falcon off the ground, provides new development capabilities throughout the μc line. The software, named Micropower/Pascal is designed around Pascal. It provides a universal programming tool for the complete DEC μp family. It is licensed at $8500 for the development system and $30 per copy in 100-unit quantities for run-time licenses. Deliveries are scheduled for March, 1982.

While Micropower/Pascal can be used across DEC's μp family, the software is especially suited for developing dedicated applications running on PROM on the Falcon. "The Falcon expands DEC's product offerings into application areas where 8-bit, single-board computers have been used in the past," says Ted Semple, product planning manager for DEC's Microcomputer Product Group. "In terms of raw performance, the Falcon can execute the PDP-11 instruction set about twice as fast as the LSI 11/2 and it approaches the performance of an LSI 11/23," he says. The 11/23 has a performance that is about the same as DEC's PDP-11/34 small computer.

While the Falcon has a performance range nearly equaling that of the 11/23, the Falcon has fewer functional capabilities. It has a 16-bit address range and can address 64K bytes of memory, while the 11/23 has a 22-bit address range and can address 4M bytes. Falcon also lacks the capability for floating-point and arithmetic instructions, such as multiply and divide.

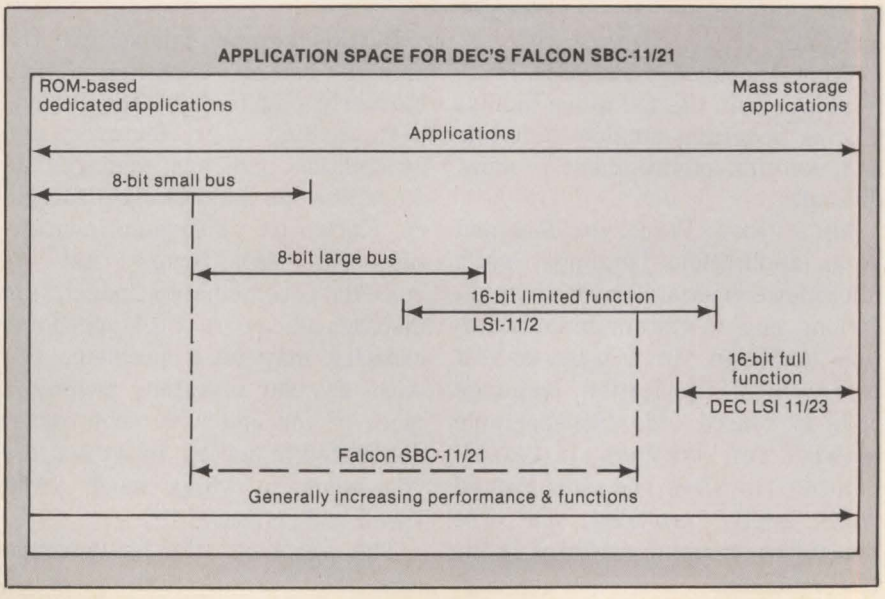
The board offers several methods of mixing RAM and ROM, making the Falcon well-suited to dedicated applications, Semple says. The board includes 4K bytes of RAM and battery-backup connections, as well as four 28-pin memory sockets for on-board PROM and/or RAM expansion. The total on-board memory capacity is as much as 32K bytes of PROM with 4K bytes of RAM or as much as 16K bytes of PROM with 8K bytes of RAM.

The board also includes two asynchronous serial I/O ports with baud rates from 300 to 38.4 bps and are compatible with RS423 and RS232C standards. A 24-line parallel I/O port with two 8-bit data ports and one 8-bit control port is also available. A real-time clock operates at 50, 60 or 800 Hz. The board measures 5.2 × 8.9 × 0.5 in.

DEC will build the processor chip in Hudson, Mass., and has a second-source contract.

Micropower/Pascal was designed to solve some of the problems associated with producing software for real-time and development environments. In a real-time environment, software must operate and respond to μsec. timings in a uniform way. A development environment has no severe timing restrictions, but it must be flexible enough for programmers.

The software is based on Jensen and Wirth standard Pascal and includes extensions to aid implementation-language capabilities. With the extensions, the μc application can be written entirely in Pascal and can include direct manipulation of hardware devices



and interrupts. The package includes a global optimizing compiler, a modular operating system that can be executed out of ROM and a symbolic debugger, called PASDBG.

Micropower/Pascal application programs are developed on a PDP-11 system running the RT-11 Version 4 operating system. Because of the nature of RT-11 development is a single-user process.

An application program is moved to a target μc by writing the program into PROM and downloading it over a serial line or recording it on magnetic media.

An OEM developing a Micropower/Pascal application would:

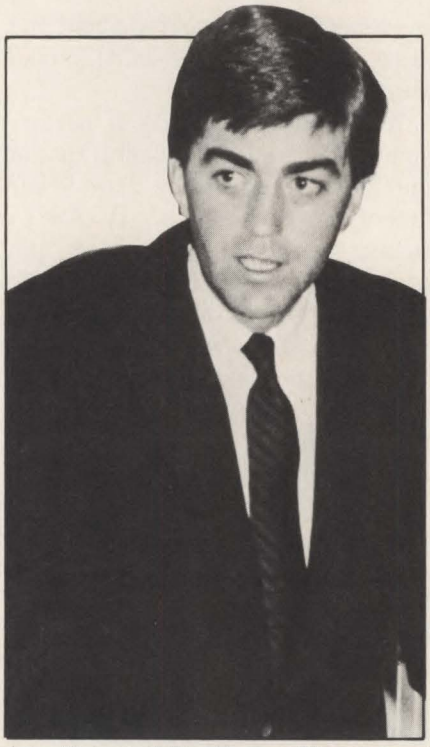
- design the application as a collection of program segments,
- enter the program segments with an editor under RT-11 XM,
- edit the program to reflect the target machine,
- compile the modules with the Pascal compiler,
- use the system's build utilities to create a memory image for the target system,
- debug the application on the target system with PASDBG,
- re-edit, recompile and rebuild any modules with programming errors and
- move the fully debugged program application to the target machine.

While Micropower/Pascal is transferable within the LSI Q-bus family, moving programs outside the Q-bus and non-DEC environment is more difficult.

DEC's VAX-11 Pascal was designed as an applications language, while Micropower/Pascal is both an applications and a system-implementation language. In a Q-bus-to-VAX move, most application language code is source code transportable between two compilers. In DEC-to-non-DEC transfers, the same ground rules apply, provided that the non-DEC equipment conforms to the ISO standard. *—Eric Lundquist*

Coexistence predicted for PBXs and local networks

Ladies and Gentlemen! Welcome to the world-title bout that will decide the office-automation champion!



John Malone of The Eastern Management Group *predicted a healthy future for both PBX and local-area network systems.*

In this corner, you've got the private branch exchange (PBX). Formerly a lightweight, the PBX has been adding new features and capabilities and has managed to move into the middleweight category. Known for its constant chattering, the PBX brags that its voice/data combination punch can dispatch all comers. Still, speed and capacity may be a problem. But with 225,000 investors owning a piece of you and with your corner dominated, if not led, by AT & T, are you going to worry much about speed and capacity?

The opponent: the heavyweight local-area network (LAN). Overall, LAN looks formidable, possessing lightning-fast speed and potentially vast capacity. Somewhat more reticent than the brash PBX, the LAN is becoming more vocal, and may soon begin to outtalk even the PBX. Despite its promise, however, the LAN has little experience in the ring, and with it's high base price, many investors are wary. The well-publicized split between the LAN's trainers—some preferring the baseband fighting method and others pushing the broadband technique—has also served to confuse quite a few fans.

Sources close to the match are predicting an unusual outcome. In this fight, where the rounds are measured in years, the final bell may not sound for either opponent, say the odds makers. Rather, both fighters may walk away, arm in arm, after learning to exchange information rather than blows. The savvy players—both users and equipment vendors—may be those, like Datapoint Corp., that hedge their bets by investing in both technologies.

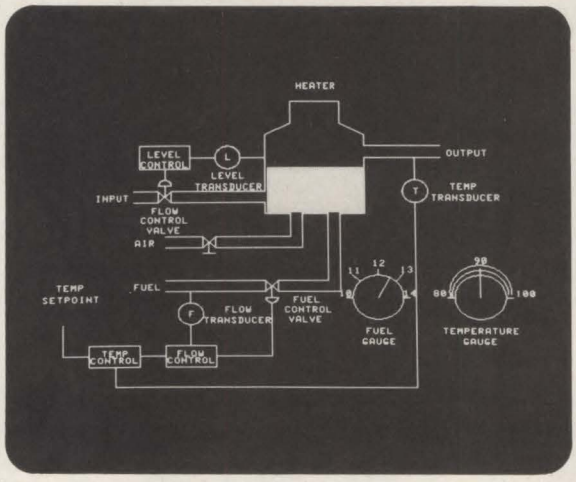
At the recent Tele-Communications Association (TCA) annual conference, John Madrid, president of the Marketing Programs and Services Group, Gaithersburg, Md., told industry consultants they had to stop viewing PBX telephone systems as a minor player in the office of the future. Madrid counseled his audience to pass through the technological maze presented by many office systems and to examine the functional capability of each system to meet users' application needs. By following this process, he believes the underrated PBX will be vindicated. "The phone system will remain at the core of the office," Madrid predicted. "You can't re-

There's already $50 million in software behind the HP 1000 L-Series microsystem.

What we just added makes it look even better.

Low-cost, high-performance graphics.

At only $10,800, Hewlett-Packard's Model 5 microsystem now includes an integrated HP 2623 graphics terminal (with built-in graphics printer) and our powerful Graphics/1000-II software. So you can picture your more demanding applications without the expense of add-on graphics.



Easy does it.

Graphics/1000-II uses straightforward, high-level graphics commands that let you concentrate on getting to the solution—without writing time-consuming subroutines. And, the device-independent software allows you to develop your applications without worrying about which peripherals will be used. This reduces development time *and* maintenance costs.

Big software. Small package.

The Model 5 is built around our popular two-board, ½ megabyte L-Series microcomputer. But don't let the system's small size fool you. You get a powerful, real-time, multiprogramming, multi-user operating system. And you can choose from among any of four languages for developing your programs—Assembly, Pascal, FORTRAN 4x or BASIC. There's also our advanced HP DSN networking software and our award-winning IMAGE data base management system. All of these packages are upwardly compatible throughout the entire HP 1000 line.

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The L-Series graphics microsystem is completely modular, so you can configure a system that precisely matches your applications. Hard discs and other peripherals (including a wide range of graphics devices) can be plugged in directly. And if there's ever a problem, you won't have to worry about multiple vendors. The entire system is backed by HP's full range of customer services, provided from 170 offices around the world.

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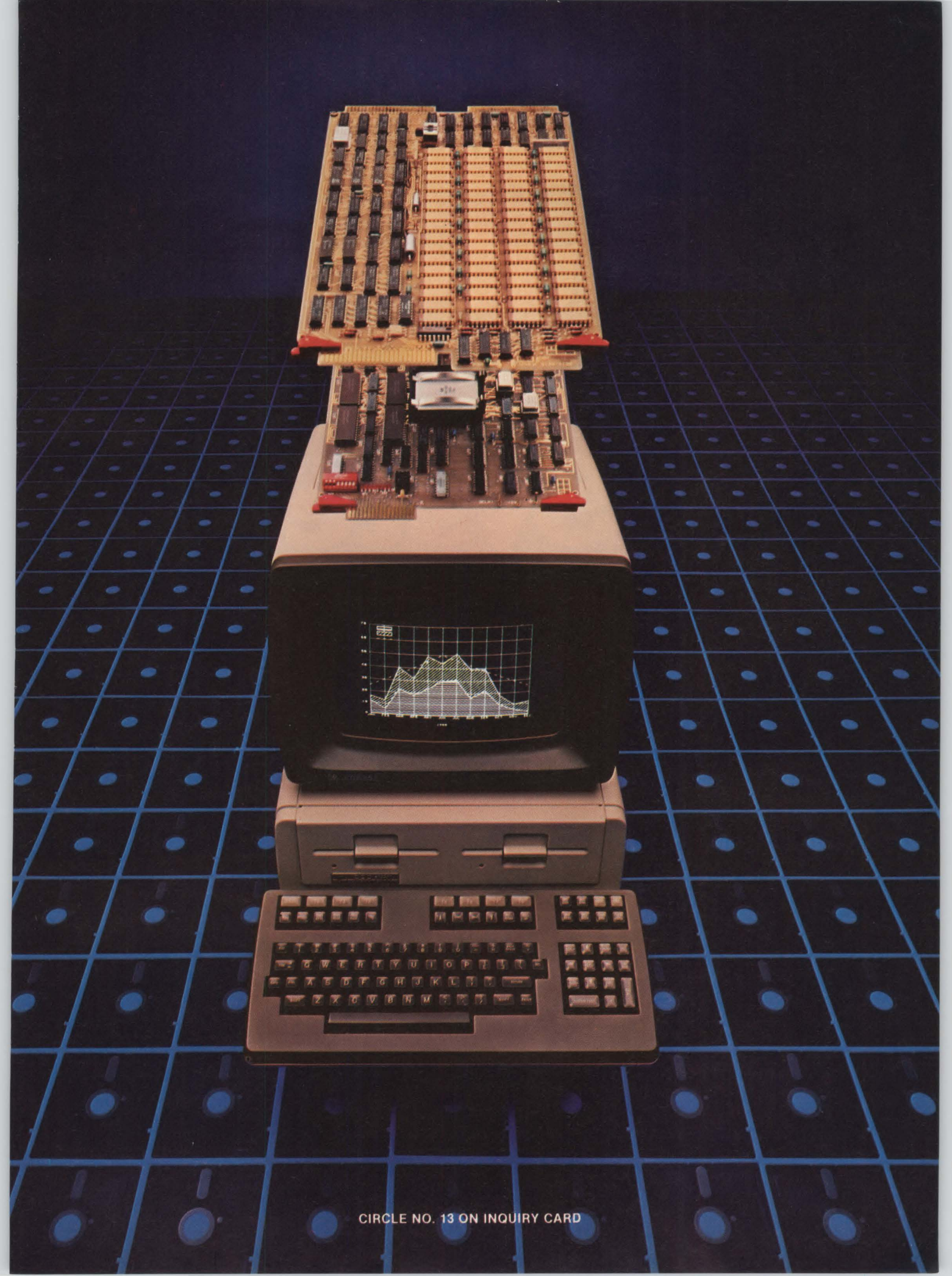

CIRCLE NO. 13 ON INQUIRY CARD

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Both versions of the TS 802 computer offer an easy-to-read green phosphor CRT display with an exclusive patented character resolution that spells goodbye to eyestrain. The telescreen gives you advanced editing with wraparound, smooth scrolling, special graphics characters, and versatile screen attributes. And the detachable keyboard can be placed conveniently anywhere you want it.

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CIRCLE NO. 14 ON INQUIRY CARD

Sapphire™ 160

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

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

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

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

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

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CIRCLE NO. 15 ON INQUIRY CARD

move it, and you can't replace it."

Some LAN vendors would probably question Madrid's viewpoint about the irreplaceability of PBXs, but marketing projections from the Eastern Management Group (EMG), Morris Plains, N.J., point to a healthy PBX future. Also speaking at TCA, EMG's president, John Malone, said the installed base of PBXs will grow from 225,000 today to 325,000 in 1990.

Although PBXs will survive, the composition of the market will change dramatically, says Malone. Quoting the results of his company's study, "The 10-Year Market for Interconnect PBXs," Malone said digital PBXs, which account for only 11 percent of the PBXs manufactured this year, will account for 99 percent of the systems produced in 1990. While the PBX market will grow overall, the analog segment is facing a rapid decline.

As PBXs grow in shipment value from about $2.1 billion in 1981 to about $6.3 billion in 1990, Malone said, other changes will occur. For example, the length of time a company keeps its PBX will drop from today's 10-year average to about seven years by 1990. And the much-ballyhooed 56K-bps simultaneous voice and data capability will enter the market, but only slowly. Malone said the lack of a large-scale demand for the high-speed voice and data traffic—expected to pick up around 1985—explains why Bell has yet to offer a product in this market.

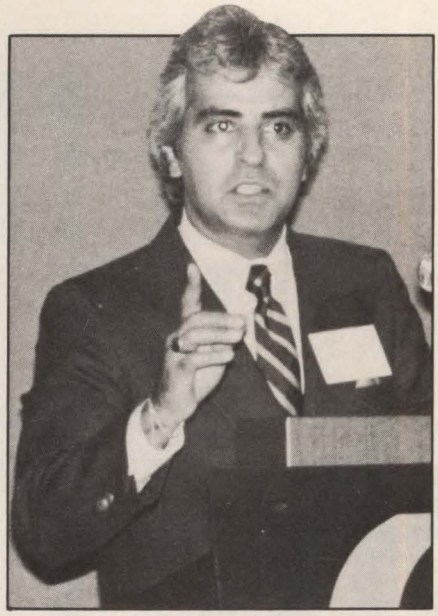
If PBXs have a bright future, few observers are willing to bet the phone-oriented systems will dominate the office as a super controller—completely excluding LANs from the picture. Malone also predicted impressive growth in LAN sales. With about 22 vendors involved in the market today, the upstart LANs can still claim only about 170 nongovernment installations, he said. But during 1985, Malone predicted, almost 3000 LANs will be installed; by 1990, the installation rate should reach 10,000 per year.

Network Analysis Corp.'s Morton Fortgang *saw few compelling reasons for users to opt for baseband local-area networks.*

Malone's figures also touch upon the split between baseband and broadband LANs. The single-channel baseband networks will take the initial lead, he said, representing 1600 of the LANs installed in 1985, compared to 1350 broadband networks. The multichannel broadband LANs, banking on their CATV technology and ability to carry voice, video and data traffic, should gain momentum by the end of the decade, however. During 1990, Malone's figures predict 5400 broadband LANs will be sold, compared to 4450 baseband LANs.

Although both baseband and broadband networks will be installed, the feeling expressed by speakers at the TCA show seemed to be more supportive of the broadband approach. Morton Fortgang, director of plans and programs for the Network Analysis Corp., Great Neck, N.Y., was in the broadband camp. He advised his audience to weigh carefully all the networking alternatives, including PBXs, but said baseband, limited in transmission distance to about 3000 ft. and incompatible with CATV technology, "is, for most users, self-limiting."

Fortgang said users should analyze their needs, both for the short- and the long-term, and should then write specifications for their ideal network. Once this is done, he suggested, users should install pilot systems, testing various vendors' products on a small scale to see how they meet requirements. "Today is not the time to put in a full system," he said, "unless you can fully define your requirements for the next several years."



John Madrid, Marketing Programs and Services Group, *said PBX markets are being driven by technology rather than by users' needs.*

Perhaps to the chagrin of the PBX and LAN vendors and to the relief of the users, none of the TCA speakers predicted complete dominance for either the PBX super controller or the voice-and-data LAN. Most observers said the two networking technologies will coexist in many companies, each providing its own functions and communicating with the other system when necessary.

Given this likely symbiosis, Malone had some advice for his PBX-oriented TCA audience. "There's a very low level of understanding about local-area networks among telecommunications managers," he said. "You must make an effort to understand the technology to develop successfully a master plan for the future."

—Dwight B. Davis

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CIRCLE NO. 16 ON INQUIRY CARD

Storage Tech takes on CDC with OEM Winchester

Storage Technology Corp., which recently discontinued its STC 2700 series of intelligent Winchesters, is reentering the OEM market with a challenge to Control Data Corp.'s domination of OEM sales of high-capacity 14-in. Winchesters. That challenge is in the form of a 675M-byte fixed-disk drive that matches CDC's 9775 drive in specifications and price (see chart).

Called the STC 9775, the new drive is a single-spindle adaptation of STC's IBM plug-compatible, two-spindle 8650. The 8775 uses the 8650's basic head-disk assembly, with an 8085 μp to convert the IBM-style firmware of the 8650's interface to the Storage Module Device (SMD) standard common to high-end OEM Winchester hardware. The 8085 μp also handles drive diagnostics, including a trap that logs 10 sense bytes for later evaluation when disk faults occur.

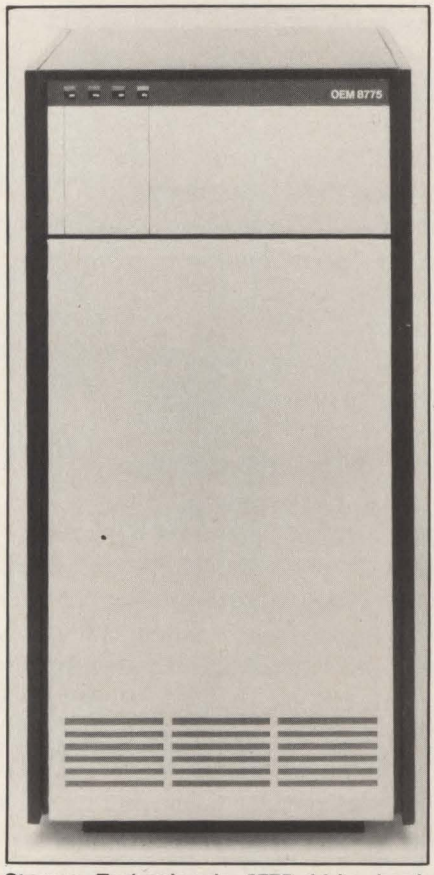
A source at STC says the 8775 will have an edge over the CDC 9775 because of superior diagnostics and because CDC has had shipping delays as long as 14 months for its drive. A spokesman for CDC says the delays may have occurred because of larger-than-expected demand for the drive, but says the company is aggressively addressing the problem. CDC claims that delivery times are now in the six- to nine-month range, and the company hopes to reduce them further during 1982.

Although the first 9775s shipped had no test or diagnostic facilities, the spokesman says, all units in the field have since been upgraded at no charge to include basic test capabilities. In January, the company will also begin adding two μps to provide more diagnostic capabilities, including linked and looped testing with a four-digit hexadecimal display. Free kits for the second upgrade will be available for 9775s in the field during the first and second quarters of 1982.

Two questions remain about STC's reentry into the OEM Winchester market. First, no controller is available for the new drive, says a company source, because an 11th line had to be added to the standard SMD 10-bit bus to accommodate addressing of the 1110 tracks that each of the two heads per data surface must access in the STC design. (The CDC drive needs only the standard 10 lines because each of its heads must access only 843 tracks per surface.) STC says several systems houses have expressed interest in developing a controller for the new drive, but no formal commitments have been made.

The other unresolved question concerns STC's delivery time for the 8775: STC says only that delivery schedules will be aggressive.

Farouk Al-Nasser, OEM disk marketing manager for STC, expects that evaluation units of the drive will be ready by February, and hopes the company will be shipping the product in quantity by mid-1982. The company is projecting production of 2000 or more units during 1983. —*Kevin Strehlo*



Storage Technology's 8775 14-in. hard-disk drive *is competing with CDC's 9775 in the high-end OEM Winchester market.*

STORAGE TECH'S 8775 AND CDC'S 9775: A SPECIFICATION COMPARISON

	Storage Technology 8775	Control Data 9775
Total capacity (M bytes—unformatted)	673	675
Data surfaces	15	20
Heads per data surface	2	2
Tracks per surface	2220	1686
Tracks per in.	957	660
Bits per in.	6425	6350
Actuator type	Linear, voice coil	Linear, voice coil
Average positioning time (msec.)	23	25
Data transfer rate (K bytes per sec.)	1198	1209
OEM price (100 units)	$16,645	$16,690

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

And now a new 32.2-Mb Winchester/Floppy System

DATA SYSTEMS DESIGN

More disk storage choices than you get from DEC.

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

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

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

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

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

Fully compatible three ways.

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

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

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

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

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

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

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

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

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

To match the capacity of the DSD 880's 31.2-megabyte winchester disk, for example, you'd need three DEC RL02

A choice of 4 floppy systems.

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

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

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

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

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

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

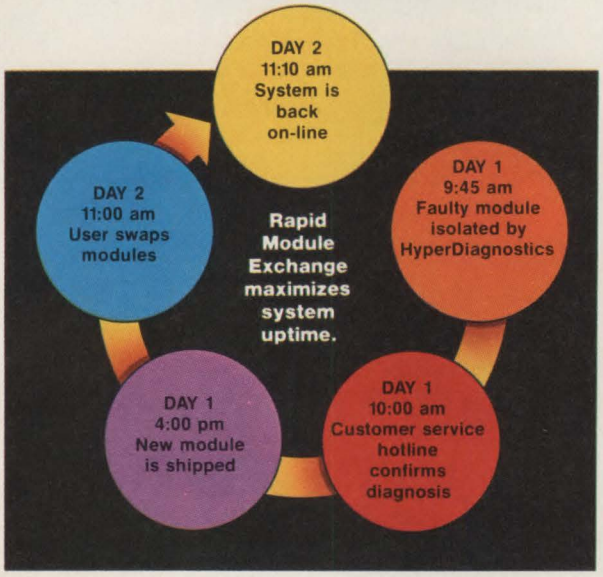
Choose DSD 440 for single-sided floppy storage with your LSI-11 or PDP-11.

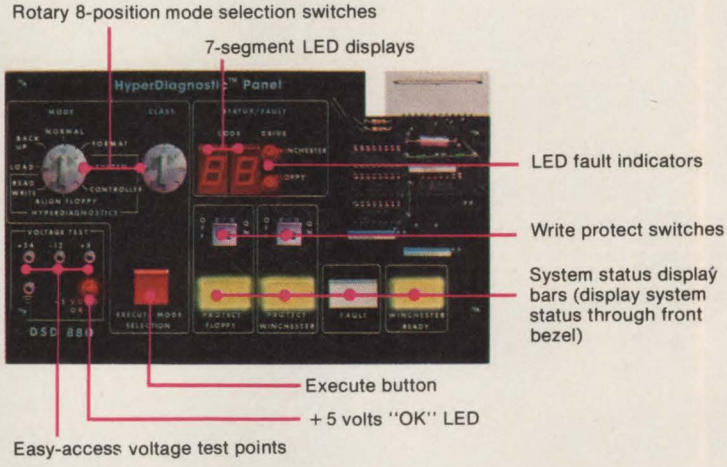
The DSD 440 is RX01 and RX02 software-compatible. It can transfer data 20% faster than DEC's RX02, and features built-in self-diagnostics for easy servicing.

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

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

More reliable performance and easier maintenance.





DSD 880 HyperDiagnostic™ Panel

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Data Systems

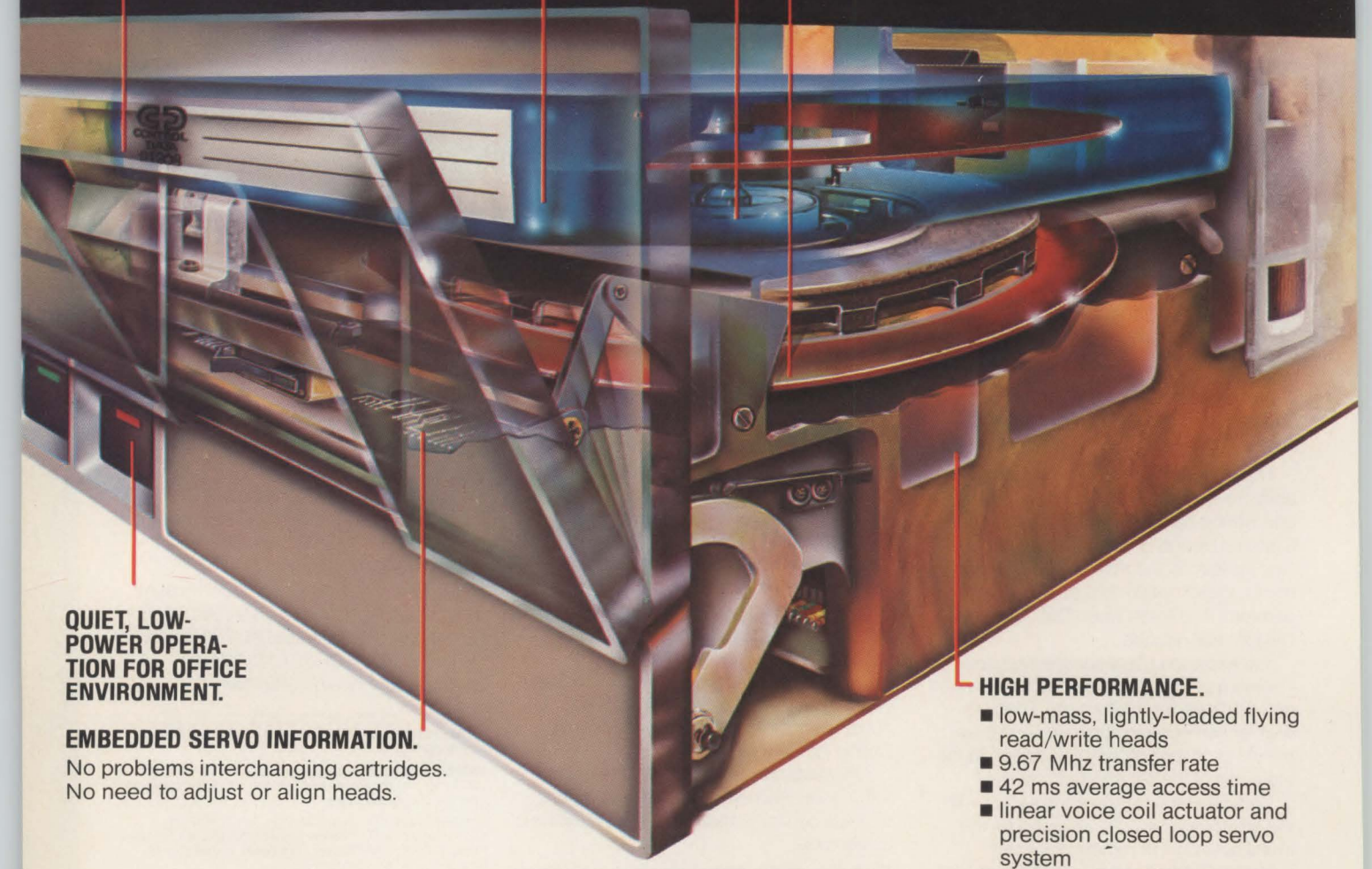
The LARK™

SOLVES BACK-UP AND OFF-LINE STORAGE PROBLEMS. Besides 8 Mbytes of *fixed* storage, Lark gives you 8 Mbytes of *removable* storage—per cartridge. Simplifies back-up and gives users both flexibility and growth capacity.

EQUIPPED WITH SMD INTERFACE. The 9455 Lark includes power and I/O module. And it's equipped with an SMD interface so you can use a common controller for the Lark and many other drives. But the 9454 Lark uses host power, and includes a new Micro Family Interface should you want to design your own controller.

COMPACT SIZE AND PACKAGING FLEXIBILITY. You can design smaller, more efficient systems. The Lark is the width of a floppy disc drive. In fact, you can mount two units horizontally or three vertically in a standard 19-inch rack.

EXCEPTIONAL RELIABILITY. Since the Lark is totally sealed during operation, no external air is forced across either the fixed module or cartridge disk surfaces.



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EMBEDDED SERVO INFORMATION.
No problems interchanging cartridges. No need to adjust or align heads.

HIGH PERFORMANCE.
- low-mass, lightly-loaded flying read/write heads
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Now—an 8 inch drive with REMOVABLE MEDIA

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CIRCLE NO. 17 ON INQUIRY CARD

CONTROL DATA

Addressing society's major unmet needs as profitable business opportunities

Software developers to provide more organized packages

The message to minicomputer and μc users is simple and pleasant: better software is on the way. As more small computers are installed to automate businesses, software developers are recognizing the importance of offering solid, effective packages with documentation and support. This means more cohesive and organized software development and distribution during the 1980s, said panelists at the recent Software Info show in Chicago.

"The minicomputer-software field is highly unorganized, but it will mature and settle through the 1980s," claims David W. Staples, senior consultant with Sarig Business Systems, Inc., a Reading, Pa., management-consulting firm. Part of the underlying problem, he says, is questionable ongoing support from entrepreneurial programmers whose personal problems may force them out of business. "The individual looking for a software package and how to maintain it generally is left to his own devices," he adds.

The role of software in automating businesses is increasing in importance, as small companies strive to gain an edge over competitors by reducing labor costs, improving employee productivity, improving customer service, increasing profits, controlling and reducing inventories and enhancing computer-system efficiency.

Many small companies lack the funds or means to develop software applications in-house, and prepackaged software could be a solution. Staples points to cost factors of 5:1 for developing software in-house versus buying a package. Available software may fill as much as 90 percent of an organization's needs, says Sarig's president Lynn W. Sarig.

Illustration by Jon McIntosh

Finding good software *will be less like searching for a needle in a haystack as more organized development spawns better conceived packages.*

Prepackaged software has the advantage of being a known entity, with known documentation and costs, while in-house software-development costs can only be estimated, Sarig says. The quality of available software varies from excellent to poor, he notes. Key problem areas are poor documentation, lack of integrated operation of different packages on one system, modifications and source-code availability.

Additionally, operational and installation procedures can be overwhelming. "There are many good software products out there, but some take a horrendous amount of time to install," Sarig says.

Distribution is an area to be watched by both users and suppliers. If a software product is not distributed quickly enough, its value may be diminished. Staples explains that most application software has a marketing window in relation to hardware. "If hardware is state of the art for two years, software written for that hardware is not viable unless it is adaptable or can be upgraded to new products."

From a software vendor's viewpoint, keeping pace with enhancements to installed systems can be tough. Staples provides an example of operating-system software that renders other application software obsolete, such as a user switching from a batch to an interactive computer.

Adaptability may not be as big a problem in the μc arena, in which software packages generally carry low price tags. "μC software is

portable because of (software) such as CP/M," says Peter A. Cunningham, president and founder of Input, an international consulting firm. As a result, Cunningham predicts, software will be disposable and will not be upgraded or maintained.

There are several other new twists in the μc market. One of the most noteworthy is μc penetration of very large organizations. Cunningham estimates that the market for personal computers and software in Fortune 50 and Fortune 500 companies alone will reach $5 billion in the next four years.

An end-user survey of Fortune 50 companies indicates that 40 percent of them probably will buy personal computer systems in the next five years, and 20 percent will do so within two years. Those companies, he says, represent several million managers, analysts and professionals. Cunningham says that users are becoming more knowledgeable and more demanding of computers. He predicts that in the next few years, each department in a large organization will have a programmer. With the growing use of μcs, software suppliers are catering to more user demands. "Few packages in the personal-computer software area were initially designed to meet user needs," Cunningham maintains, because most were written by technicians. This is changing, he says, and software companies and personal-computer suppliers are researching user needs and developing packages to meet those needs.

Cunningham says there are several thousand sources of personal-computer software now, but only a few are viable. Many software writers are moonlighters or work out of their garages. And, many have not researched the market and pricing and generally do not offer support or adequate documentation. "It is hard to build volume with a $100 package," he says.

Nonetheless, he expects some software companies to reach $100 million in value. "People see fortunes at the end of a very small rainbow," he says, pointing to the success of companies such as Personal Software, Inc., which developed VisiCalc. —*L. Valigra*

MINIBITS

DEC TAPS VT-100 MARKET

Digital Equipment Corp. is entering the personal-computer business by tapping into its installed base of VT-100 video-display terminals. For $2400 (single unit), a VT-100 can be transformed into the VT18X, a Z80-based stand-alone computer that operates under the CP/M operating system. Also resident on the PC board with the Z80 is 64K of RAM and 8K of ROM. The price also includes a dual 5¼-in. floppy-disk drive with 160,000 characters of data and program storage. A second dual floppy disk is priced at $1275. The CP/M software license and documentation is priced at $250.

After installation, the video-display terminal can be changed from its interactive mode to a stand-alone mode with a single keystroke. DEC claims an installed base of more than a 250,000 VT-100s.

TANDY TO OFFER VIDEOTEX SERVICE IN FORT WORTH

Beginning in early 1982, residents of Fort Worth, Texas, will be able to hook into a videotex network run by Tandy Corp. The maker of Radio Shack TRS-80 personal computers has yet to sign any information providers for its service, but the company says newspapers, financial institutions, airlines and other special-interest groups may join. A Tandy spokesman says data will be prepared for the network on a TRS-80 model II computer and then forwarded to another model II that will be linked to several phone lines through the company's Communications Multiplexer. A single model II could support a maximum of 16 lines, and additional model IIs would have to be added to the central videotex center if substantial numbers of users signed up for the service. An alternative to using multiple model IIs, the spokesman says, would be to incorporate more powerful Datapoint Corp. processors into the network within the context of the joint Tandy/Datapoint ARCNET venture. Tandy has yet to determine whether to charge a basic subscription fee for its videotex service, but will charge for access to certain items in the database. The company will also sell page space to advertisers. Users will be able to access the network through several devices, including Radio Shack's $399 TRS-80 videotex terminal, which has been on the market for more than a year. Tandy also sells a $1995 software package that lets a dumb terminal function as a videotex terminal.

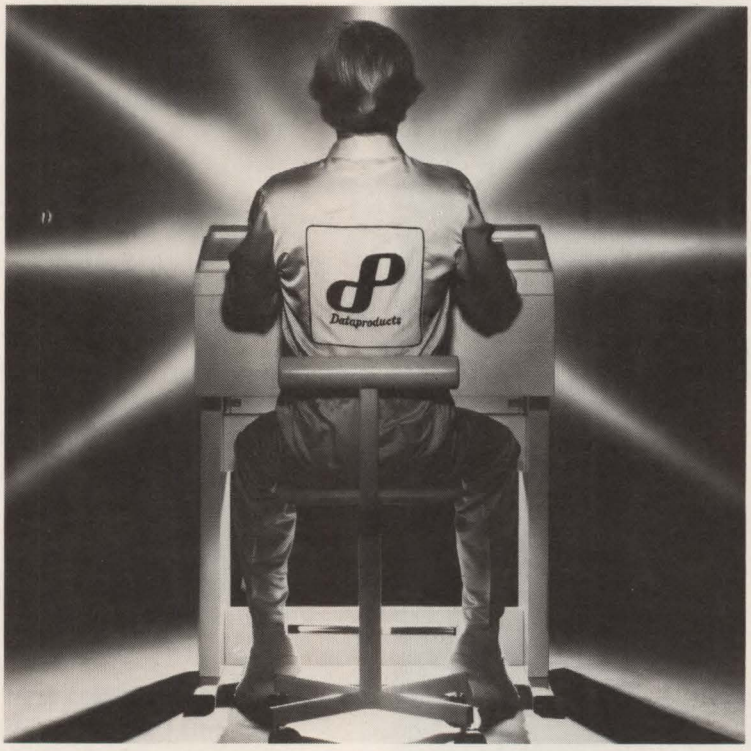
CA REDUCES PRICES ON PERIPHERALS

In a move the company says is the result of aggressive engineering-cost reductions in the designing, building and testing of peripheral products, Computer Automation, Irvine, Calif., is passing a savings of as much as 20 percent to their customers. The sharpest reductions are reflected in memories, with the price of a 1M-byte, 580-nsec. error-correcting memory reduced from $30,000 to $24,000.

At the Naked Mini Division, NM4 CPU prices average an 8-percent reduction, with NM-4/95 processors with 512K bytes of memory reduced from $18,000 to $16,000. Quad-density floppy-disk subsystems average an 18-percent reduction, with a dual-drive package, including controller, now selling for $3250.

In addition to these reductions, CA has added Control Data Corp.'s 32M-byte, 14-in. Phoenix cartridge-disk drive to its product line. Single-unit price is $11,000, with add-on cartridges priced at $8100 each.

TRUST YOUR PRINTER TO ITS MAKER.



Repair & Refurbishment, services you can depend on from Dataproducts.

You bought Dataproducts because you wanted the best printers in the business.

Now you can come to that same reliable source to keep your printers on the job.

We'll test your circuit boards on the most advanced automatic testing equipment and return them to factory specifications.

We'll restore any Dataproducts subassembly—even complete machines—to their original form, fit and function. (Ask for quotations for different levels of refurbishment.)

Normal turnaround for repairs is 30 days. Maximum. Expedite service cuts that in half: two weeks.

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CIRCLE NO. 18 ON INQUIRY CARD

Calendar

SHOWS & CONFERENCES

JANUARY

6-8 Sixth Topical Meeting on Integrated and Guided-Wave Optics, Pacific Grove, Calif., sponsored by Quantum Electronics and Applications Society of the IEEE and Lasers Technical Group of the Optical Society of America. Contact: OSA, Integrated Optics Meeting, 1816 Jefferson Pl., N.W., Washington, D.C. 20036.

12-15 Communication Networks Conference, Atlanta, produced by the Communications Networks Conference Management Group. Contact: Louise Myerow, Registration Coordinator, Communication Networks, Box 880, Framingham, Mass. 01701, (800) 225-4698.

15-16 "Microcomputers in Education," 10th Annual Math/Science Conference, Tempe, Ariz., sponsored by Arizona State University's College of Education and Department of Elementary Education and the Arizona Association for Educational Data Systems. Contact: Nancy Watson, Conference Co-director, 204 Payne Hall, Arizona State University, Tempe, Ariz. 85287.

20-23 Internepcon Japan/Semiconductor International, Tokyo, Japan, presented by the Cahners Exposition Group. Contact: Industrial & Scientific Conference Management, Inc., 222 W. Adams St., Chicago, Ill. 60606, (312) 263-4866.

21-26 The Southern Tier Personal/Small Business Computer Show, Binghamton, N.Y. Contact: Dallas DeFee, 48 Crary Ave., Binghamton, N.Y. 13905, (607) 729-5558.

21-26 43rd Annual National Audio-Visual Convention and Exhibit, Anaheim, Calif., sponsored by the National Audio-Visual Association, Inc. Contact: Nora McGillen, Exhibit Manager, NAVA, 3150 Spring St., Fairfax, Va. 22031, (702) 273-7200.

26-28 ASEE '82, Advanced Semiconductor Equipment Exposition, San Jose, Calif., managed by Cartlidge & Associates, Inc. Contact: Cartlidge & Associates, Inc., 491 Macara Ave., Sunnyvale, Calif. 94086, (408) 245-6870.

FEBRUARY

10-12 1982 IEEE International Solid-State Circuits Conference, San Francisco, sponsored by the IEEE Solid-State Circuits Council, the IEEE San Francisco Section and Bay Area Council and the University of Pennsylvania. Contact: Lewis Winner, 301 Almeria, Box 343788, Coral Gables, Fla. 33134, (305) 446-8193.

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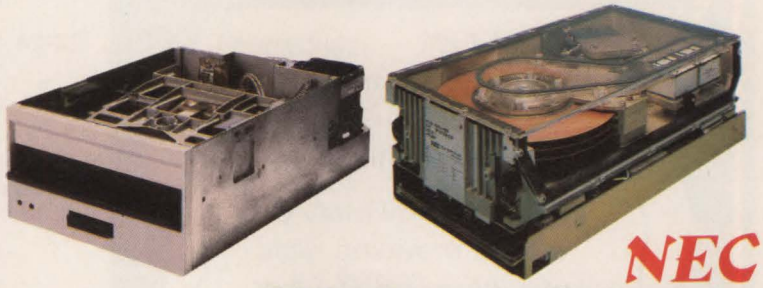

NEC

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

Our disks also give you extra margins which no competitive products can touch. Here's how.

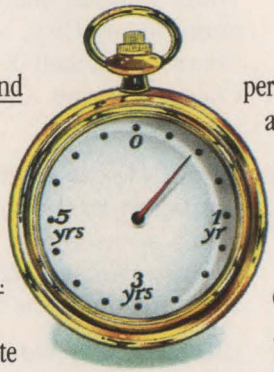
Built-in quality plumps up profits.

Take our NEC Soft-Touch™ dual-sided double-density 8-inch diskette drive. It gives you a media life of more than six million passes, nearly double that offered by other suppliers. The entire drive has a field-proven mean time between failure (MTBF) of 15,000 hours, nearly twice the industry average.

NEC technologically reduced the parts in our high-performance 8-inch Winchesters. As a result, we eliminated the need for periodic maintenance, extended MTBF to more than 12,000 hours (about five years of normal operation), and cut mean time to repair (MTTR) to 30 minutes.

Our 14-inch, 317 mega-byte high-performance Winchester has a field-proven 10,000-hour MTBF and an MTTR of only one hour. Plus, it offers optional off-line microprocessor-diagnostic capability.

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



Our Soft-Touch 8-inch diskette drive has a mean time between failure of 15,000 hours. That's nearly 5 years of normal use.

Our 15 years of disk-building experience pays off.

We know disks, we know how to build them, and we know how to keep them running. As a result, we've got features in our disks that give you, and your customers, years of hassle-free service.

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

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Because we manufacture almost every part in all our disks, we can assure the high tolerance engineering, rigid quality control in selection of raw materials, and attention to production details that guarantee you years of trouble-free operation.

Our significantly better diskette drive DOA rate reduces test and inspection time, saving you hundreds of dollars.

NEC Soft-Touch™ DOA rate: practically nil.

Other diskettes' DOA rate: as much as 10%.

CIRCLE NO. 20 ON INQUIRY CARD

Calendar

16-18 International Exhibition and Conference of Semiconductor Production Equipment, Weisbaden, West Germany, sponsored by Cartlidge & Associates, Inc., and Network, Ltd. Contact: Charles Yourd, Exposition Manager, Cartlidge & Associates, Inc., 491 Macara Ave., Suite 1014, Sunnyvale, Calif. 94086, (408) 245-6870.

22-24 Federal DP Expo, Washington, presented by The Interface Group. Contact: The Interface Group, 160 Speen St., Framingham, Mass. 01701, (800) 225-4620 or (617) 879-4502.

26-28 Computer Expo '82, Orlando, Fla. Contact: Tom E. Blayney, Executive Director, Adventure International, P.O. Box 1185, 377 E. Highway 434, Longwood, Fla. 32750, (305) 339-1731.

MARCH

3-7 Third Annual Microcomputer Week Conference, Jersey City, N.J., sponsored by Catalyst. Contact: Mitchell E. Batoff, Jersey City State College, Jersey City, N.J. (201) 434-2154 or 547-3094 or 3098.

7-10 TI-MIX (Texas Instruments Minicomputer Information Exchange) Conference, Las Vegas, Nev., sponsored by Texas Instruments Users Group. Contact: TI-MIX,, M/S 2200, P.O. Box 2909, Austin Texas 78769, (512) 250-7151.

8-12 DIDACTA '82, World Fair for School, Education and Training, Hanover, West Germany, sponsored by Hanover Fairs. Contact: Hanover Fairs Information Center, P.O. Box 338, Whitehouse, N.J. 08888, (201) 534-9044.

9-11 Federal Office Systems Exposition, Washington, D.C., sponsored by National Trade Productions, Inc. Contact: Joseph P. Rubel, National Trade Productions, Inc., 9418 Annapolis Rd., Suite 206, Lanham, Md. 20706 (301) 459-1815.

10-12 Fourth International Conference on Thermoelectric Energy Conversion, Arlington, Texas, sponsored by the Graduate School and the Electrical Engineering Department of the University of Texas at Arlington and the Fort Worth Section and Region V of the IEEE. Contact: K.R. Rao, Professor of Electrical Engineering, P.O. Box 19016, University of Texas at Arlington, Arlington, Texas 76019 (817) 273-2671.

22-24 Information Systems Education Conference, Chicago, Ill., sponsored by Data Processing Management Association Education Fundation. Contact: Dr. Stephen B. Weiner, Program Coordinator, 12611 Davan Dr., Silver Spring, Md. 20904 (301) 622-0066.

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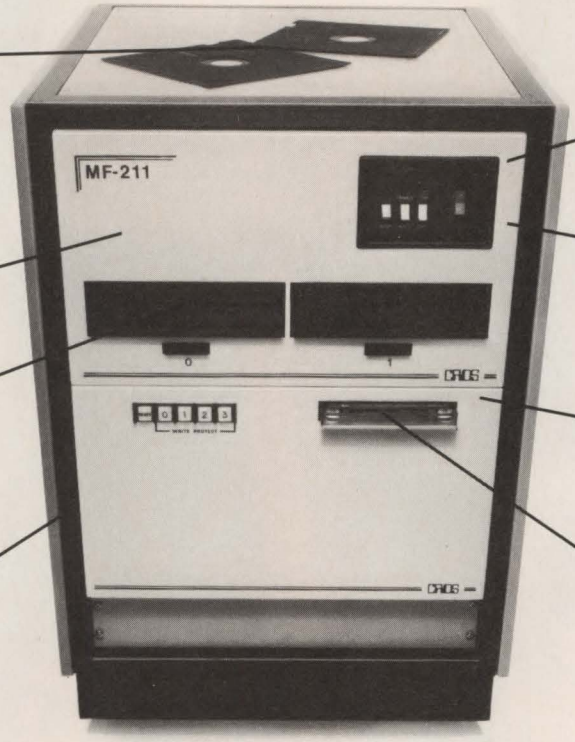

UNIX-compatible operating system, or DEC-licensed RT11V4

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

Chassis with eight-quad-slot backplane and power supply

Floppy disk controller, hard disk controller, and quad serial interface

Dual double-density floppy disk drives

20.8 megabyte Winchester hard disk (equivalent to four RL01s)

30-inch-high, office-style enclosure, including cabling

Optional cartridge tape backup

Guess Again.

The price tag on this remarkably potent LSI-11/23-based system is just $16,000. That's well below the combined list price of its components and probably a lot less than you'd expect to pay. And this is only one of a whole series of 11/23 and 11/2 configurations we're offering right now at special complete-system prices.

You don't have to give up security for low cost, either. These are carefully integrated and fully DEC-software-compatible systems, backed up by a free 90-day warranty, our very efficient and economical module exchange service policy, a complete documentation package, and our eight years' experience building DEC-compatible systems.

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MM12

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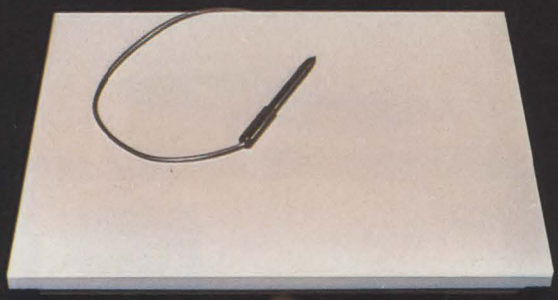

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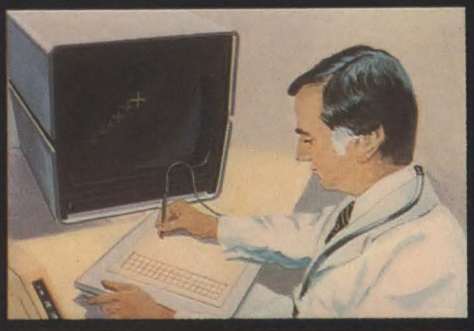

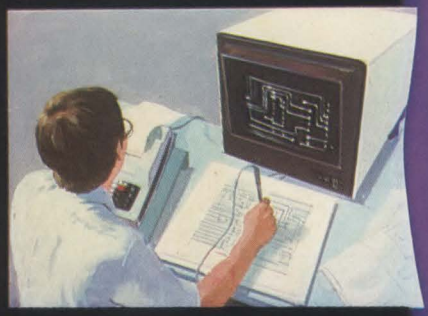

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CIRCLE NO. 24 ON INQUIRY CARD

Telecommunications reform—the Senate finally acts

After nearly a decade of false starts and hopes, the U.S. Senate has approved legislation updating the nation's antiquated communications law. But spokesmen for the computer industry say the Senate's long-awaited action is not all good news.

The legislation, S. 898, is a carefully crafted bill designed, say its sponsors, to improve communications by deregulating many services and products that they believe are competitive. The bill is riding the same deregulation track as that taken by legislation that dealt with the airline, trucking and railroad industries.

But the communications industry differs from its heretofore-regulated companions in one significant respect. In no other industry is there an entity with the financial, marketing and technological clout of the AT & T. And unlike previous legislation deregulating basic industries, much of S. 898 is devoted to how Bell will be treated within the new deregulatory framework.

The bill would require continued FCC review of Bell's "basic network services." In other words, AT & T's ownership of 80 percent of the long-distance network and 90 percent of telephone equipment constitutes such a staggering monopoly that continued regulation of its rates is required. But in areas where the FCC finds that "sufficient" competition exists, there would be no regulation.

Complicating this basically straightforward scenario is Bell's insistence that it be allowed to enter the potentially lucrative data-communications market as an unregulated software and hardware provider. Its first effort was through a clumsily worded piece of legislation introduced in 1978. Quickly dubbed the Bell Bill by its critics, the legislation would have allowed Bell to enter any market without regard for the regulatory or competitive consequences.

What finally passed the Senate last October was a far cry from the Bell Bill. Instead of granting AT & T unregulated status, S. 898 would grant the company entry into the market only through a "fully separate affiliate," or FSA. There are numerous restrictions on the FSA, as well as on AT & T's dealings with it. Included are prohibitions on joint bookkeeping and common board members. Business dealings between AT & T and the FSA are also limited.

Finally, both Bell and the FSA are prohibited from becoming "originators" of information passed through the regulated communications network. This provision of the bill was added at the insistence of the newspaper industry, which feared the rise of Bell as an originator of display advertising, or "electronic yellow pages." But the prohibition should also benefit any software provider that does not want to compete with Bell.

WASHINGTON BRIEFS

The computer industry has expressed its opposition to legislation designed to prevent fraud in government procurement practices. Computer and Communications Industry Association General Counsel David Cohen says the legislation would impose "enormous penalties" against contractors who unwittingly violated the law. He adds that the disclosure requirements of the bill are so vague that "not even GSA knows what must be disclosed."

The ability of communications networks to accommodate the needs of their customers to transmit data across international boundaries via satellite might be improved by a tentative action taken by the Federal Communications Commission. If approved, users will be able to access domestic satellites that can "see" antennas across the border in Canada and Mexico, provided the governments of these countries approve and if the transmission has been coordinated with Intelsat, the global satellite communications system. Until now, Intelsat has been unable to accommodate communications traffic with those nations.

The industry-wide exemption from the Service Contract Act was cited by outgoing Computer and Business Equipment Manufacturers Association Chairman James Mellor as his association's principal accomplishment of the past year. The act, which grants the Department of Labor authority to impose prevailing wage guidelines on all federal contractors, was the object of severe criticism by the computer industry.

"The rollback of this law not only preserved the employee's right to excel in this industry, it saved the government, and the taxpayer millions and millions of dollars in unnecessary and inflation-ridden costs that would produce nothing but more government paper," Mellor says.

Several Washington-based newsletters have indicated an interest in an announcement by Independent Publications, which intends to distribute such publications electronically via phone to readers using video terminals. The service, called Telenews, should begin operations soon and will charge readers an hourly access charge, with newsletters receiving a portion of the profits. Newsletters would not be charged for the service but must send material to the Pennsylvania-based service at their own expense.

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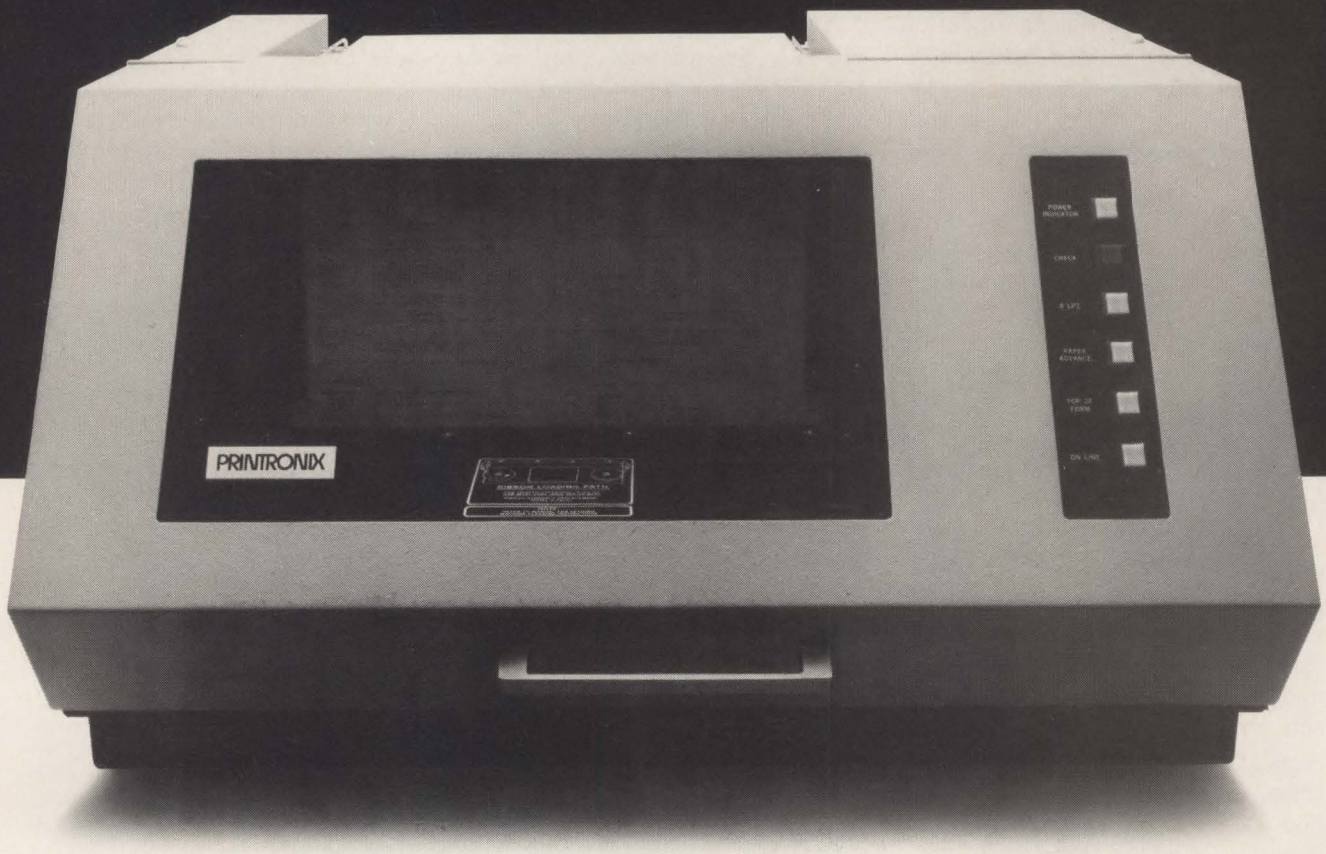

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CIRCLE NO. 25 ON INQUIRY CARD

Of equal significance to the computer industry is a major provision of S. 898 deregulating equipment on customer premises after three years. This proposal is offered on the assumption that sufficient competition in the manufacture and sale of end-user equipment exists, and, as a result, regulation is no longer necessary. With deregulation, all of the equipment Bell owns—ranging from the simple dial telephone to sophisticated switching equipment —would be transferred to the FSA.

Generally speaking, Bell approves of the bill the Senate adopted. Generally speaking, nearly everyone else does not. Most critics of S. 898 believe that far from deregulating the communications industry, new layers of regulation have been added. Because the FCC is required to oversee relations between AT & T and the FSA, a constant auditing of all dealings will be required. Many observers, including former FCC officials and at least one of its members, do not believe the commission can do this job. The General Accounting Office, the investigative arm of Congress, recently confirmed this view, with severe criticism of the commission's account procedures.

Added to the controversy that has surrounded this legislation is the feeling of major communications users that the bill's underlying premise is wrong—there is no effective competition in the telecommunications industry. One major user group, the International Communications Association, told Congress, "While competitive suppliers have made some penetration into a number of local or regional markets, they lack, for many reasons, the capacity to engage in widespread, effective competition with the dominant carriers."

If this is true, argues the ICA, deregulating AT & T, even through an FSA, would eventually lead to the survival of Bell as the only effective network for voice-, video- or data-communications services. For this reason, groups such as the Computer and Communications Industry Association (CCIA) have branded S. 898 as a "very important action against the interests of consumers, competition, the balance of trade and the vitality of a national communications network."

Fortunately for those who oppose S. 898 and Bell's point of view, it is unlikely that the House will go along with the Senate's action. For the past year, Telecommunications Subcommittee Chairman Tim Wirth (D.-Colo.) has been conducting hearings based on competition in the communications industry, seeking comments from user groups such as the computer industry. As this issue was going to press, Wirth and his subcommittee were preparing a report based on the testimony gathered during those hearings. Insiders said the report would confirm the views of many that there is not sufficient competition in telecommunications to justify the kind of deregulation contemplated by the Senate.

Nevertheless, Representative Wirth is as anxious as his Senate counterparts are to update the Communications Act. But in so doing, the House is likely to impose much stricter conditions on deregulation, including more restrictions on the operations of the FSA.

Such actions, in the view of the CCIA, do not go far enough. What it would like to see is a spinoff of assets into a new company that AT & T shareholders could create. Because it would not be a subsidiary of Bell, it would not have to endure the kind of regulatory oversight contemplated in S. 898. It could operate as any other unregulated telecommunications company, providing state-of-the-art networking and telephone equipment to its customers.

In a perfect world, such a spinoff might well occur. But Bell wants to hang on to as much of the action as it can, and it would likely oppose such an alternative. What is also likely is that Bell will oppose any further restrictions on relations between itself and the FSA, which could result in the same kind of legislative paralysis that has gripped Congress on this issue for the past decade.

—Arthur Hill

GRAPHICS MARKET TO HIT $4 BILLION BY 1985

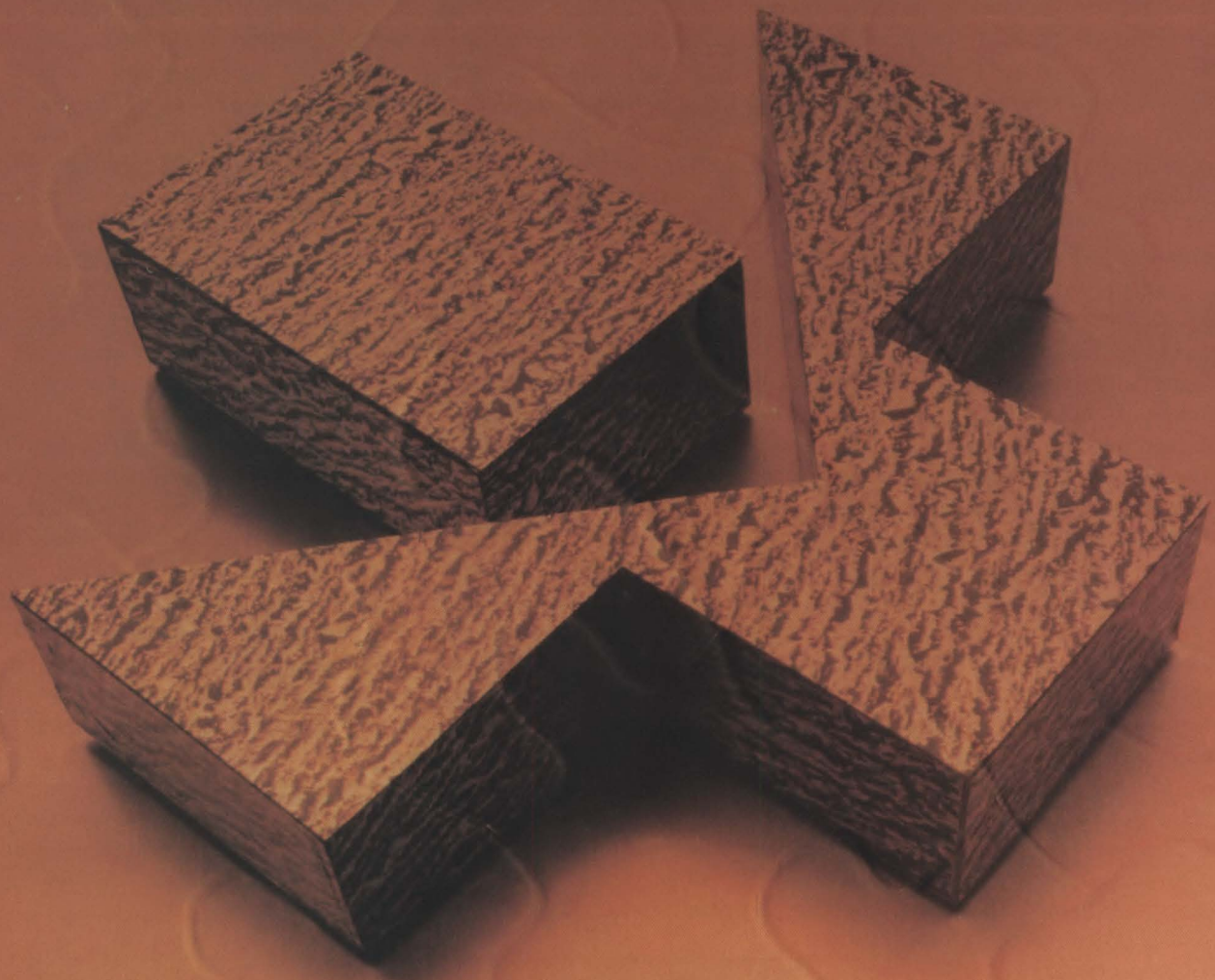
The market for μc-based graphics systems will reach $1.4 billion this year and is projected to more than double to $4 billion by 1985, according to a report by Strategic, Inc., San Jose, Calif. The report notes that the largest and fastest growing segments of the graphics market are business graphics and CAD/CAM.

Business-graphics systems, such as those from Hewlett-Packard Co. with VisiCalc Plus and from Apple Computer, Inc., with VisiCalc/VisiPlot, are expected to grow at 49 percent per year. The demand for improved productivity at a lower cost will give CAD/CAM a 36-percent-per-year growth rate.

Besides detailing market segments, the report analyzes technologies and strategies of hardware and software suppliers. Trends indicated by the report include a rapid decrease in cost and increase in capability of smaller systems as well as an increase in the availability of large-system graphics software for high-powered desk-top systems. In addition, the report predicts a movement toward graphics-systems standards, which will increase the market for such systems.

The report, entitled "Color and Graphics In Home and Business, #10," is priced at $1200.

All the pieces are in place.



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Electronics & Electrical Products

Stratus announces continuous-processing system

For the past seven years, users requiring computer systems that operate continuously, without fail, have turned almost exclusively to Tandem Computers, Inc. But now, Tandem has a competitor—newcomer Stratus Computer, Inc., Natick, Mass. In early November, Stratus introduced a multiprocessor system designed for continuous operation in critical applications, such as banking, credit verification, reservations and inventory control.

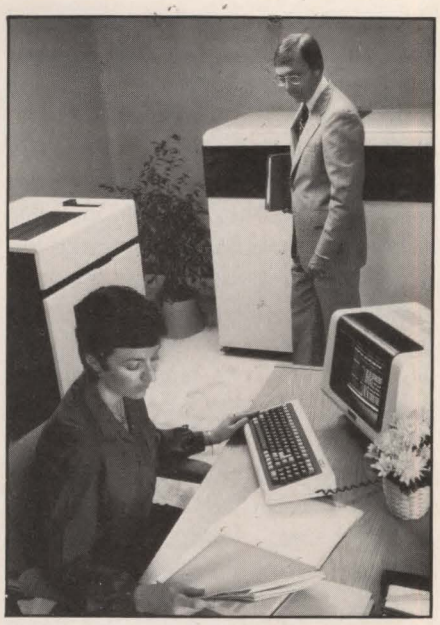
Called the Stratus/32 continuous-processing system, the product is designed for use in commercial, on-line, transaction-oriented applications. Vertical-applications programs will be written by systems houses or large customers.

Stratus president William Foster points to a variety of factors that necessitate using highly reliable systems. "There is an increasing trend from 10 years ago toward on-line processing with terminals and operators," he says, which has several effects on system performance. Foster says that with more computer power accessible to more users, there is a resulting increased exposure to computer failure. This factor is compounded in networks of computers, because of the systems' interdependence on each other. In addition, as the density of components increases, the chance of transient, or quickly passing but unpredicted, errors increases as well. Further, the cost of failure is growing because of the limited number of service technicians, he says.

To alleviate these problems, Stratus has quietly developed a continuous-processing system during the past one and one-half years. The system is based on multiprocessors, an approach the company claims does not cause performance degradation. The base configuration is called a processing module and measures 54 in. high × 24 in. wide. A module, including 2M bytes of redundant memory for a total of 4M bytes, a CRT terminal with redundant communication controllers, two 14-in. Winchester-disk drives, each with 33M-byte capacity and redundant controllers, a 1600-bpi streaming-tape drive, a VOS operating system written in PL/1 and a COBOL compiler, is priced at about $135,000.

Each processing module can be expanded to include as much as 8M bytes of totally redundant memory, 64 Televideo terminals, as many as 16 Winchester-disk drives in any mix of 33M, 66M or 158M bytes and two tape drives. Memory in the form of 64K DRAMs is priced at about $10,000 per megabyte. Each chassis houses 20 slots.

Additionally, the system can be expanded by adding as many as 32 independent processing modules, which can be hard-wired from as far as 750 ft. via a StrataLINK cable operating at 1.4M or 2.8M bytes per sec. Modules can be added while the rest of the system is running. One main module can power all modules linked in this manner. A maximum configuration includes 32 modules, 256M bytes of redundant memory, 73G bytes of disk storage, 2048 CRT terminals and 64 tape drives. Also available are remote X.25 networking capability, a file-management system, COBOL (ANSI '74, low-intermediate), BASIC (similar to Digital Equipment Corp.'s extended version) and PL/1 (ANSI '74, subset G) compilers, word- and text-processing software, debuggers and utilities. Bisynchronous, 2780, 7380 and HASP IBM protocols are available. SNA and SDLC are supplied by Industrial Computer Controls, Inc., Cambridge, Mass. Printers include 300-, 600- and 900-lpm models or an NEC Spinwriter.



Stratus Computer's continuous-processing system *is based on multiprocessors, so that each processor module is redundant.*

The company claims the Stratus/32 system has similar processing power to IBM Corp.'s 4341 mainframe and Prime Computer, Inc.'s 750 supermini, and generally better performance than Tandem's Non-Stop I computer. Stratus claims there are no performance penalties in its continuous system, because of the multiple processors.

Foster explains that in the 1960s, reliable systems used "hot backup," in which card decks were taken from one down system and physically moved to a functioning system. This approach was followed by using communications between computers for that function. In the 1970s, he explains, the approach shifted to "switched" hot backup, in which two computers performing different tasks communicate their transactions, thus keeping each other aware of what the other is doing.

The two systems share peripherals, and in case of a failure, the peripherals are switched over for control by the functional unit. Foster says Tandem uses this approach, which requires high software overhead and includes some performance degradation while the computers communicate.

Stratus's approach uses several processors, each doing one job, such as disk I/O or controlling the operating system. Each Stratus module contains a minimum of 18 μps, some of which are Z80As that control peripherals and some operating-system functions. In this way, the entire module is redundant in and of itself, in that it contains two identical sets of assemblies and two buses. One 15- × 19-in. board, for example, could house two sets of two 68000 μps, each of which functions as a CPU and has self-checking functions. Within each parallel set, one μp functions as an executive with operating system code, and one has user code. A second identical board is redundant. All boards are in sets of two. Each board is redundant in itself, and a second board has a second level of redundancy. A user can also choose only to back some functions, such as disk I/O.

Each module contains simultaneously running CPUs, which perform the same functions and run on the same 16-MHz clock. Upon failure, a CPU stops immediately. The second CPU is aware of the first's failure and tries to restart the first. If the failure continues, the second CPU continues working, and a message light alerts the operator as to which board has malfunctioned. The module has battery backup to keep memory alive in case of a power outage.

Stratus is establishing a direct sales organization for the U.S., and plans to have 10 salespeople in seven major cities by January. The company offers a 6-percent of sales price maintenance contract on its base configuration.

The company has attracted some impressive personnel from the major Massachusetts minicomputer manufacturers, including Prime Computer, Inc., Digital Equipment Corp., Honeywell Information Systems, Inc., and Data General Corp.

—Lori Valigra

3Com unveils controllers, links future to Ethernet

In the embryonic world of local-area networks (LANs), the Ethernet approach developed by Xerox Corp. has few peers in terms of developmental history and none in terms of market recognition. But as Xerox and its Ethernet partners —Digital Equipment Corp. and Intel Corp.—strive to institute a de facto LAN standard, opponents of the Ethernet specification seem to be growing in number.

Ethernet's critics question the viability of a single-channel, baseband network compared to multichannel broadband networks; some claim the token-passing access method has advantages over Ethernet's carrier sense multiple access with collision detection (CSMA/CD) approach; and still others say the $3000 to $4000 cost of interfacing each station to the network is too high to be economically feasible.

In the face of these, and other, criticisms, 3Com Corp., Mountain View, Calif., has introduced the first Ethernet controllers compatible with DEC's Q-bus and Unibus computers. The two controllers join the young company's line of networking products, including an Ethernet-compatible transceiver and UNET networking software designed to operate with systems running the UNIX operating system. Future products, says 3Com founder and chairman Robert M. Metcalfe, will further tie the company to the Ethernet approach.

Metcalfe is in a unique position to understand the ins and outs of Ethernet because he was its principal inventor at Xerox before founding 3Com. Depending on one's perspective, this background makes Metcalfe's endorsement either highly biased or highly credible. But even Ethernet's opponents won't argue with one of Metcalfe's crucial points: Over the next several years, Ethernet and it's attendant products will do very well.

According to 3Com's projections (see table), by 1986, the total Ethernet market will pass $3 billion, which will represent between 10 and 20 percent of the overall LAN market. Ethernet's success will result primarily from the marketing force generated by its three main backers, some observers claim. Such people, "are just damning with their faint praise," Metcalfe charges, when, by doing so, they are merely engaging in their own form of marketing. Regardless, Metcalfe has little doubt that a ready market exists for 3Com's Ethernet controllers.

Each of the two controllers consists of three basic elements: serial electronics, a 32K-byte, dual-ported memory and control logic. Compatible with Q-bus processors such as the LSI-11, 11/2 and 11/23 and PDP-11/03 and 11/23, the 3C200 is available on three double-height boards and sells for $2500 in

CAD/CAM GRAPHICS
The IBM System 360/370 user can get a grip on.

The Adage 4250 is a plug-compatible improvement on the costlier IBM 3250 Display. With superior graphics, local hard copy output — and a host of advanced, user-oriented features — the Adage 4250 is, quite simply, the best interactive display system available for use with large mainframes.

Basic 4250 System advantages include:

- More terminals per I/O channel, giving you a better ROI.
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- Data tablet input, which is more convenient, less tiring than light pen.

For demanding CAD/CAM applications, these special Adage 4250 features give you an even better grip on the toughest graphic problems.

Local hard copy — at the touch of a button. In seconds the 4250 interface captures and processes full, or partial, CRT images for plotter output from 8½" to 72" wide. No CPU interaction required.

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Microwave adapter — enables high-speed (1.544 Mbps) transmission between remote terminals and CPU via telephone, microwave or fiber optic links.

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CIRCLE NO. 27 ON INQUIRY CARD

	1981	1982	1983	1984	1985	1986
Number of Ethernets installed (500m)	150	1000	2800	6500	14,000	30,000
Number of Ethernet nodes	3000	20,000	56,000	117,000	252,000	540,000
Transceiver and controller ($000)	$9000	$40,000	$70,000	$99,450	$157,500	$243,000
Work station ($000)	$40,500	$202,500	$425,000	$675,000	$1,134,000	$1,935,000
Resource servers ($000)	$9000	$48,000	$115,200	$261,800	$516,600	$882,000
Total market	$58,500	$290,500	$610,200	$1,036,250	$1,808,100	$3,060,000

3Com Corp.'s forecast *for the Ethernet market.*

single-unit quantities. Configured on a single-, hex-sized board, the $3000 3C300 controller operates with such Unibus processors as the higher level PDP-11s and the VAX machines.

As required by the Ethernet specification, the controllers perform parallel-to-serial and serial-to-parallel conversions, buffering of data during transmission and reception, framing of message packets, data encoding and decoding plus collision and error detection. Both controllers support 3Com drivers for the RT-11 and RSX-11 operating systems as well as UNET for UNIX systems. A driver for VMS is also available for the 3C300 device, which, unlike the 3C200, provides hardware address recognition.

3Com designed the controllers' 32K-byte, dual-ported memory to serve both as a buffer for Ethernet packets and as additional storage space for a host CPU, says company president L. William Krause. The maximum allowable packet size on Ethernet is approximately 1526 bytes, Krause explains, so the 32K-byte memory is allocated in 2K-byte segments for buffering. Few Ethernet applications require more than four buffers, he says, leaving 24K bytes of storage for use by the host processor. Using the dual-ported architecture, the host can run its operating system out of this excess memory, Krause says, while the controller simultaneously performs Ethernet transmission activities.

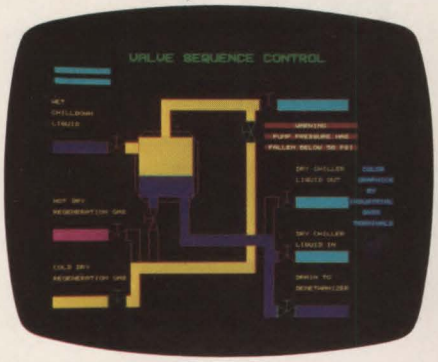
With the 3C200 Q-bus controller already available and the 3C300 product scheduled for shipment next month, Krause predicts 3Com will ship between 100 and 200 controllers per month over the next year. He points out that about 250 companies have purchased rights to Ethernet for a nominal charge and that more than 50 companies have already bought Ethernet transceivers from 3Com. Chairman Metcalfe says Ethernet could eventually develop into the industry's largest plug-compatible market.

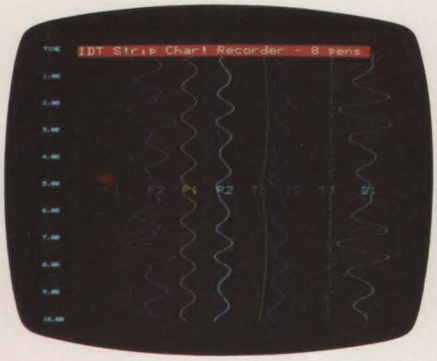
Should LAN standards develop that fail to incorporate the exact Ethernet specification, Metcalfe says, "We go with Xerox, DEC and Intel." At least Ethernet is a single standard, he says, while claiming the standards proposed by the Institute of Electrical and Electronics Engineers 802 Committee will encompass almost 500 configuration options. "Everybody will be able to claim they're 802 compatible," Metcalfe says, "and nobody will be able to communicate."

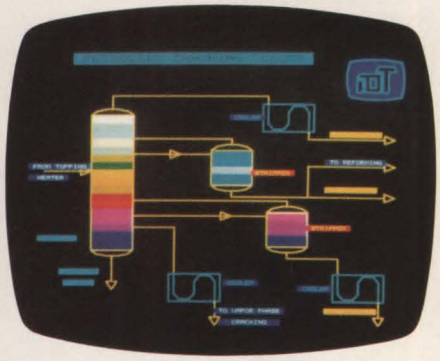
Those token-passing proponents who raise the specter of heavily loaded Ethernet networks jamming with constant collisions simply ignore tests that show Ethernet performing well under heavy load conditions, Metcalfe claims. He also complains that many token/CSMA/DC comparisions are slanted. "Token systems are not one, but many systems," he says. "Ethernet is always compared to the strongest token contender in any argument."

In the end, Metcalfe says, Ethernet's strength centers on a characteristic that other competitors can't match—the multivendor support. Other LAN vendors, such as Wang Laboratories Inc. and Datapoint Corp., "are making a marketing mistake" by keeping their networks proprietary, he says. "And although there are some applications for which Ethernet is not well-suited, there are very many applications where Ethernet is the most efficient solution available." *—Dwight B. Davis*

Bubble Breakthrough







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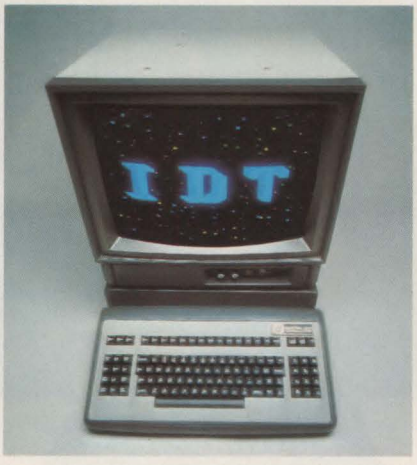
The IDT 2200, with bubble memory storage in the terminal, establishes a new standard in color graphics capability and reliability. Non-volatile bubble memory allows you to retain permanent displays in the terminal, and ensures data integrity even in the harshest environment. Bubble memory unburdens your host computer of memory requirements and dramatically reduces transfer time to the terminal. With its increased megabit capacity, you can build and store permanently an entire library of pictures and subpictures in the terminal.

PLOT 10* software compatibility is now available. A new hardware vector generator draws vectors 10 times faster. New front access design permits easy maintenance, plus room for three full-color display memory planes.

IDT 2200 with bubble memory. The newest reason why we're earning a reputation for cost-effective performance in color graphics terminals.



- **Highly reliable. Ruggedly designed for long life and low maintenance in industrial environments.**
- **Non-volatile memory provides megabit capacity within the terminal for a library of pictures and subpictures.**
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CIRCLE NO. 28 ON INQUIRY CARD

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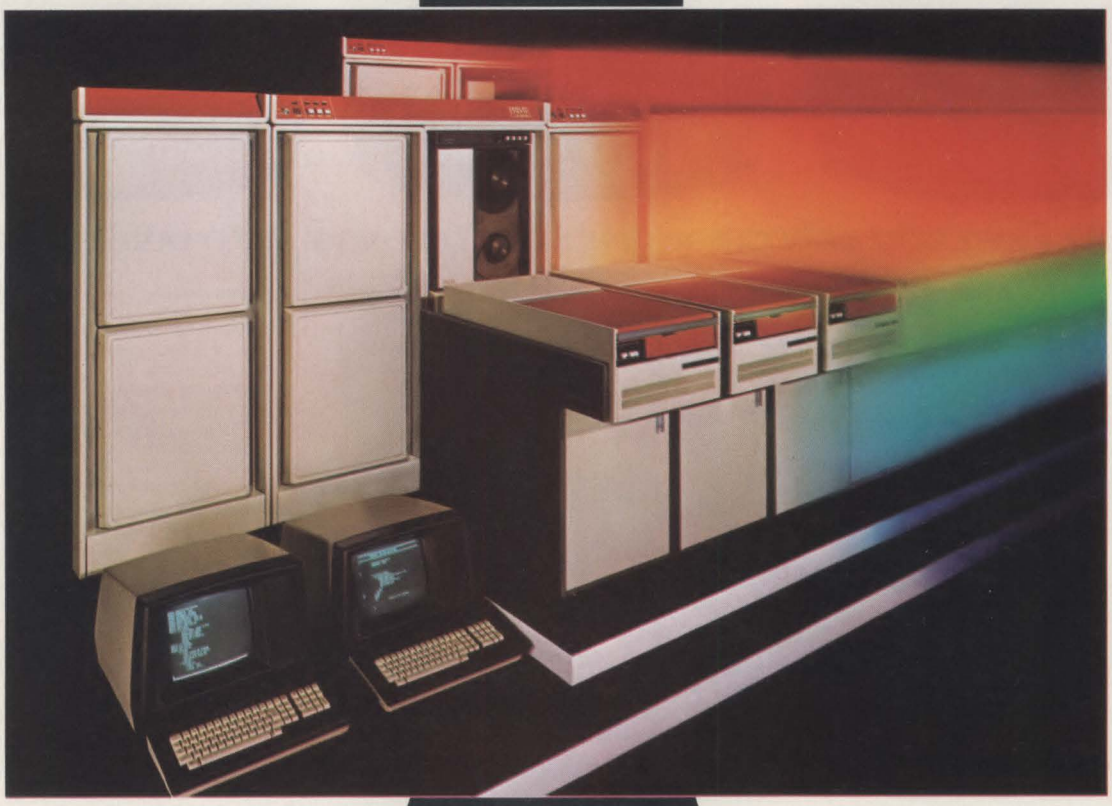

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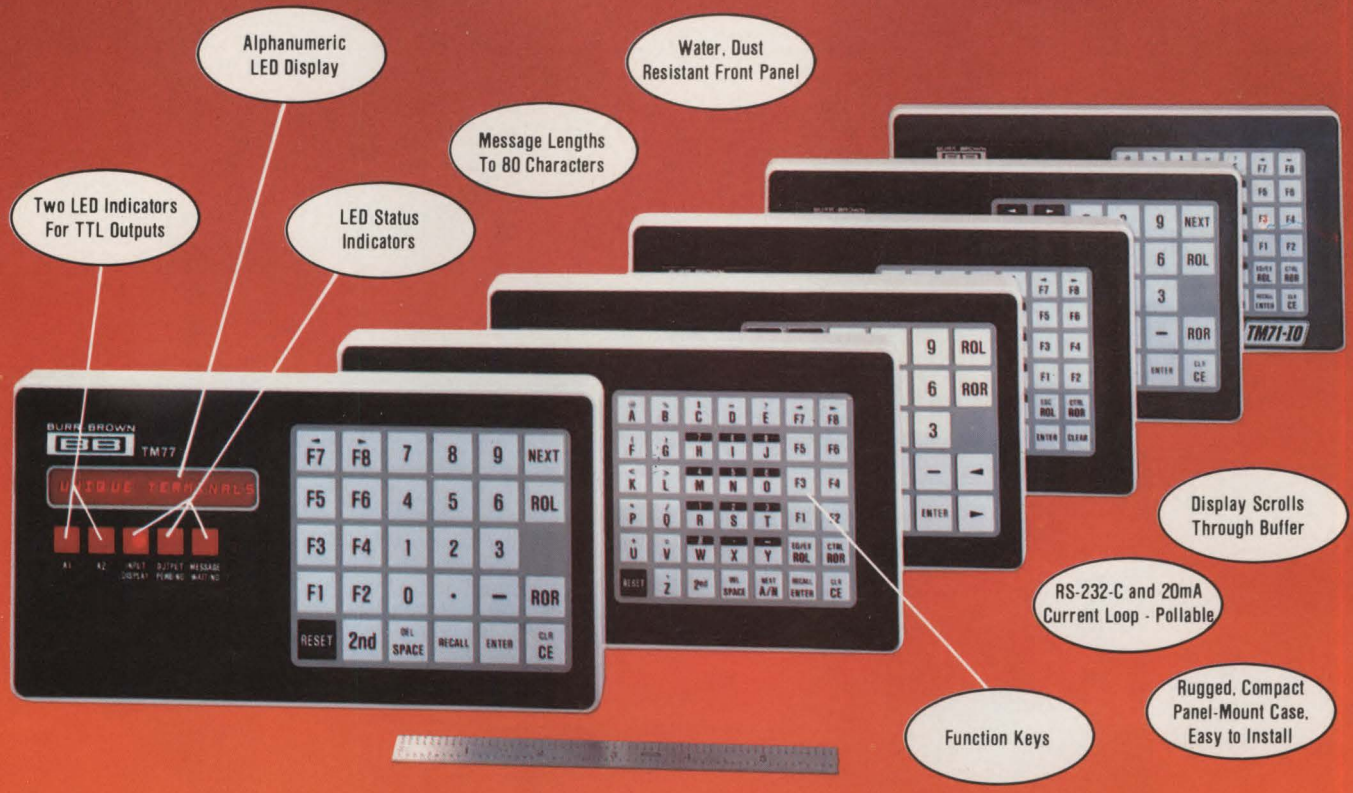

Model	Alpha Display Characters	Baud Rate	Data Buffers	Keyboard	Function Keys(2)	Features	Supply Voltage
TM71	16	110-19200	320 Characters(1)	Alpha	14	Full feature	+5VDC
TM77	16	110-19200	320 Characters(1)	Numeric	14	Larger keys	+5VDC
TM71-I/O	16	110-19200	320 Characters(1)	Alpha	14	TTL I/O	+5VDC
TM77-I/O	16	110-19200	320 Characters(1)	Numeric	14	TTL I/O, larger keys	+5VDC
TM70	12	300 & 1200	36 Characters	Alpha	8	Low cost	+5VDC
TM76	12	300 & 1200	36 Characters	Numeric	8	Larger keys	+5VDC

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C 4

CIRCLE NO. 30 ON INQUIRY CARD

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To create virtually any hardware combination, just make your selection and plug up to 10 STD BUS boards into the Matrix 100. Within minutes, you'll be ready to start the application software.

Included within the industrial quality, rack-mountable chassis are an eight-inch 512KB floppy disk drive and a complete power supply. A CP/M* compatible operating system is also available that will enable you to work with an extremely large number of pre-written programs.

As for the future, Matrix 100 is just the first member of a complete user-configurable computer family. A family that will include a dual floppy disk drive version plus another with a 5¼ inch hard disk Winchester as well.

If all of this sounds enticing, the price will make it even more so. Because by buying only and exactly what you need, you can make the system components learning curve work for you. Without cutting corners. Find out how. Write Mostek Corporation, 1215 West Crosby Road, MS 509, Carrollton, Texas 75006 (214) 323-1829. In Europe, contact Mostek International at (32) 2.762.18.80. In the Far East, Mostek Japan KK (03)-404-7261.

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CIRCLE NO. 31 ON INQUIRY CARD

Centronics introduces mid-range office-printer family

Centronics Data Computer Corp., Hudson, N.H., which has borne the brunt of a mountain of criticism about its troubled 700 series printers during the past year, introduced a family of mid-range matrix printers in early November. Designed to work in office environments, the Printstation 350 series may ease some user fears about follow-on products. The family includes three members, which will be priced around $1500 each in end-user quantities, with OEM discounts available.

"These are industrial-quality printers repackaged to be attractive to the office market," says Paul Preo, director of advanced products at the company. He explains that the Printstations are different in design than the company's 700 line in that they are smaller, lighter and quieter. He adds that, over time, the family may become the next generation of the 700 series.

In designing the 350, Centronics devoted considerable thought to paper handling, Preo says. The printers handle data-processing fanfold paper, cut sheets as wide as 12-in. wide and forms with as many as six parts. The standard paper-handling mechanism was developed by Centronics. Preo says forms can be removed from the printers without sacrificing the next sheet of paper, which is important in offices. Cut-sheet forms are inserted from the top in a rear pinch roller mechanism. Preo explains that such feeding mechanisms typically are available as options from a third party.

The three family members are the 353, 352 and 350. The high-end, 132-column 353 can be set to 80 columns by adjusting the margin tractors. It operates bidirectionally at 200 cps and produces high-quality output in a dual pass at 50 cps. The dual mode is switch- or down-line selectable.

The 353 also includes a three-digit LCD that alerts operators to the printer's 27 functions. The LCD and dual-mode printing are unique to the 353. Functions include an RS232 or a Centronics parallel interface, as many as 10 character styles, 110- to 19.2K-bps baud rates, tabs and margins.

All the family members include pin-addressable graphics and a nine-wire head producing a 7 × 8 matrix. The ninth wire is for underlining. The 353 includes a 4K RAM buffer, which allows a 132-column CRT-terminal screen to be dumped into the printer. Single-unit price for the 353 is $2495. The 353 intended for use in data-processing operations that also require high-quality word-processing output, Preo says.

The model 352 has the same features as the 353, except the 352 cannot print in dual mode. It is geared for office data processing and has a 2K RAM buffer. Single-unit price for the 352 is $1795.

Preo refers to the model 350 as the building block for the other two models. It is based on a bus I/O concept, which means that OEMs can add a board to customize the printer. For example, OEMs can specify a control interface, a buffer size, character sets and a protocol. The 350 is a high-volume product, Preo says, and is priced at more than $1000 in 100-unit quantities.

All three printers are based on the 8085 μp. They are designed to compete with mid-range printers operating at 150- to 210-cps for data-processing applications, such as those offered by Texas Instruments Inc., Mannesmann Tally Corp. and Dataproducts Corp., Preo says.

Designed to be sold worldwide, the family includes a power supply that handles 50- or 60-Hz and 110V or 220V. The printers meet VDE, CSA, UL and FCC standards requirements, Preo says. In the past, Preo explains, Centronics developed separate models for the U.S. and for Europe. The printers include US ASCII and seven international character sets.

The printers are designed for easy repair, and have an MTTR of 30 min. and an MTBF of 3000 hours. Both the head and the ribbon cartridge snap in and out for replacement. Each printer includes four sub-assemblies—two boards, the mechanism, which is supplied by Brother International of Japan, and the power supply. The model 350, however, includes only one board, with the other supplied by the OEM. A 20-mA current-loop interface is optional.

The products and follow-on family members will be sold through direct sales, OEMs and distribution channels. Centronics will develop an on-site maintenance plan. Preo says the product might not be serviced in the company's walk-in centers because the printer weighs about 45 lbs.

—L. Valigra

NEXT MONTH IN MMS

- What you should know about print bands before selecting a band printer.
- A new low-cost serial printer from a components manufacturer that now prefers to "do its own thing."

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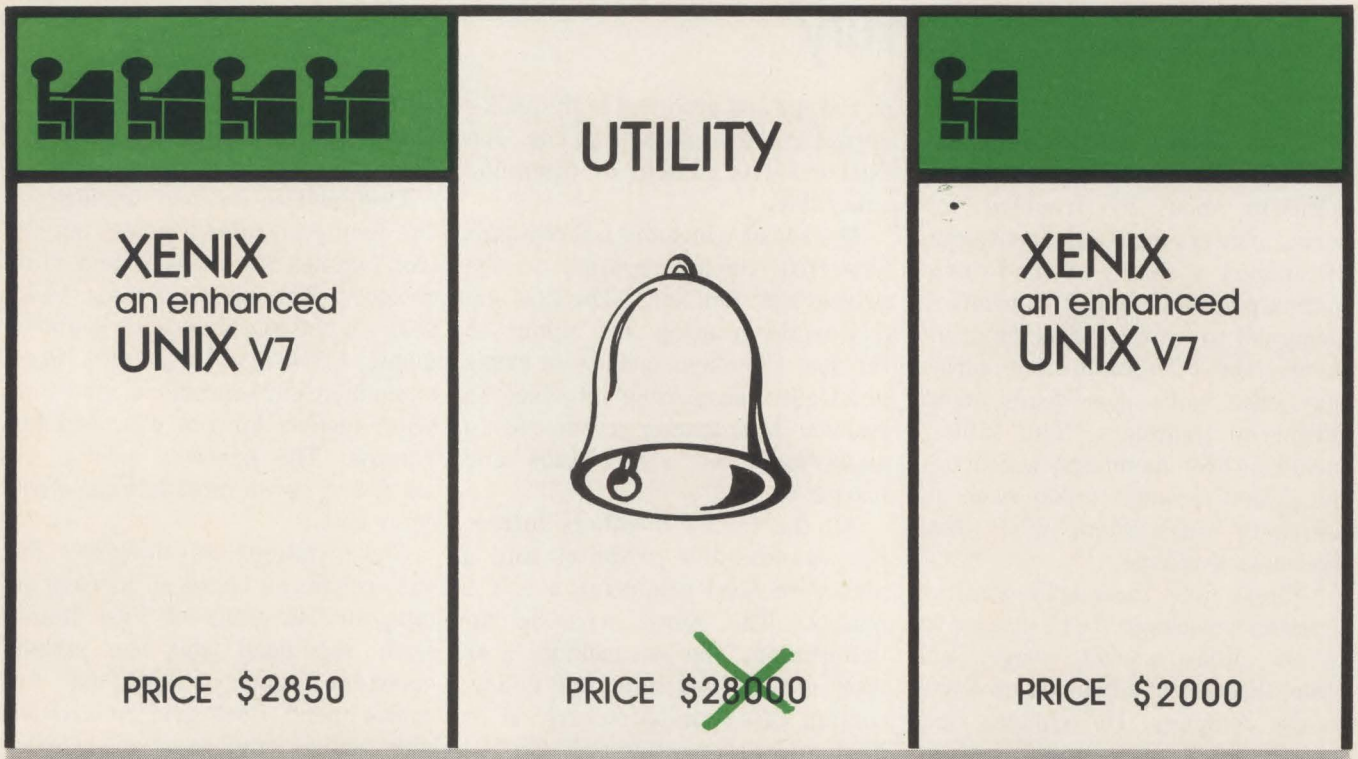

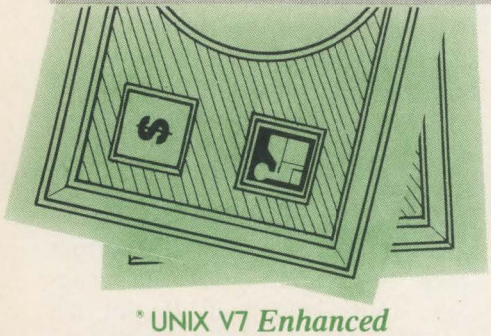

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CIRCLE NO. 32 ON INQUIRY CARD

ICL moves to strengthen U.S. market

The largest wholly owned European computer manufacturer, ICL, Inc., has maintained a presence in the U.S. computer market since the late 1960s without making much of an impact. Company funds for expanding sales activities have gone into other territories, and ICL's small U.S. sales force has had nothing more exciting to offer customers than two or three small-business systems.

But ICL's prospects in the burgeoning U.S. market for distributed-computing systems now look brighter following the introduction of a local-network-linked, multiple-work-station configuration, called Distributed Resource Systems 20. Developed and built at ICL's only U.S. manufacturing facility in Utica, N.Y., DRS 20 is already being actively sold in most parts of Europe and will be available to U.S. customers, says ICL's new worldwide marketing operations director, Peter Bonfield. Formerly the manager of the calculator products division of Texas Instruments Inc., Dallas, Bonfield is cautious about how marketing the DRS 20 will be handled in the U.S., but he says that OEM deals with some large distributors are possible. Bonfield says that inquiries about DRS 20 from potential U.S. OEMs or large end users will be welcomed by ICL president Tom Woodhill, who is based at ICL's Dallas office.

Incorporating as many as eight Intel 8085-based function processors and programmable in COBOL, BASIC and Pascal, each DRS 20 work station operates as a stand-alone file-processing system or connected to as many as 15 other DRS 20 work stations via Microlan, ICL's proprietary local-area network. Using coaxial cable, Microlan transfers data at 1.25M bits per sec. and enables work stations to exchange information and share files.

Microlan also connects a subnetwork to other manufacturers' proprietary local-area networks, including those conforming with the Ethernet standard. Microlan work stations link directly into a wide-area network that operates to IBM Corp.'s SNA standard or to ICL's Information Processing Architecture (IPA). ICL plans to introduce a higher performance local network for DRS 20 when IEEE standards emerge.

The DRS 20 work-station architecture provides separate function processors that are dedicated to local- and wide-area-networking operations. The system also includes a dedicated processor for controlling CRT-terminal and keyboard functions, a file processor for accessing disk storage and an applications processor for executing high-level language code.

Together, these elements form what ICL calls the distributed resource architecture, and their interaction is coordinated by the DRS 20 work station operating system, distributed resource executive (DRX). The application-processor segment of DRX supports CIS COBOL from Micro Focus and Microsoft BASIC. The distributed text manager (DTM) package is available for text processing. It uses data files common to other DRS software so that users can integrate text- and data-processing applications.

So far, ICL has announced three work stations for DRS 20, all with 2000-character screens. The model 40 includes two 8-in. floppy-disk drives, each with a 1M-byte capacity. ICL sources say the model 40 is less expensive than the System 23 announced by IBM in August, and offers more capabilities. ICL sources also say that the model 40 "compares favorably" with the CS/20 from Data General Corp. and the HP 125 from Hewlett-Packard Co.

Smaller than the model 40, the DRS 20 model 10 lacks file-processing capabilities but sells for less than half the price of the larger system.

The high-end model 50 provides fixed-disk storage capacities of 16M or 27M bytes. Competitors of that

The DRS 20-series model 50 file-processing system from ICL, Inc., *with an optional work-station desk (foreground), provides fixed-disk storage capacities of 16M or 27M bytes.*

system include H-P's HP 250, Wang Laboratories, Inc.'s 2200 and Digital Equipment Corp.'s Datasystem 150.

DRS 20 work stations can also incorporate a hardware/software feature called retained mode manager (RMM), intended to allow users to run programs written for the ICL 1500 series remote batch terminal. There are 20,000 worldwide users of that system, many of them in the U.S.

The 1500 is manufactured at ICL's Utica plant where it was developed when the facility belonged to the Cogar Corp., which was acquired by ill-fated Singer Business Machines. Singer Corp. sold SBM in the mid-1970s, and ICL bought the Utica plant, thus acquiring the SBM user base in Europe. Although TRW Corp. began servicing the SBM base in the U.S., ICL has built its own U.S. base of new users for the SBM products for which it acquired manufacturing rights. The Utica plant builds the ICL/9600 series of point-of-sale terminals and the ICL System Ten 320, both of which were developed from SBM systems. Systems built in Britain and sold by ICL in the U.S. include the System 25, a new System Ten-compatible configuration, and the ME 29, a replacement for the ICL 2903/4 line that competed successfully in Europe with the IBM System 3 family in the mid-'70s.

The least expensive of the SBM-derived systems are priced from $30,000 and sold directly to end users. The marketing approach with the less expensive DRS 20 systems, however, will be geared toward OEMs. ICL has introduced an arrangement in Europe called Trader Point, which targets sales to distributors, systems integrators and on-line service bureaus. ICL is also considering extending the Trader Point arrangement to the U.S., but the company lacks in-depth nationwide coverage. Consequently, a few deals with large nationwide OEMs may be favored over many agreements with local distributors. ICL maintains offices at 12 locations, including Dallas, Chicago, New York, Atlanta, Pittsburgh and Oakland, Calif.

In the long run, ICL is likely to make its presence in the U.S. small-systems market more keenly felt. The company is concentrating its resources more heavily in that market rather than on further internal development of its 2900 series mainframes, which have never been sold in the U.S.

Under a deal announced in October, ICL is acquiring high-performance logic circuitry for future 2900s from Fujitsu of Japan rather than continuing to burden itself with the substantial development costs of high-speed chips. ICL lost an estimated $150 million in its last financial year, which ended Sept. 30. That loss was the result of over-staffing and of the recession in Europe, especially Britain, where ICL derives 50 percent of its sales.

The company has kept afloat with a $400-million loan guarantee from the British government and has laid off 5000 employees, nearly 20 percent of its work force. The company sees this as a way to save more than $100 million a year. Additionally, ICL's new managing director, Robert Wilmot, who was a director of the British subsidiary of Texas Instruments Inc. before joining ICL in May, has declared his commitment to boosting the non-mainframe side of ICL's operations.

—Keith Jones

Systems show exposes U.S. firms to Europe

Small U.S. computer-equipment manufacturers hoping to gain a foothold in the diverse but large European market should look to the Systems exhibition in Munich, Germany, as a showcase for their products. That's the general consensus among firms that have participated in the exhibit, organized jointly by the U.S. Department of Commerce and Munich representatives, since the show's inception 10 years ago. At this year's event in October, the Commerce Department presented the show's organizers with the 1797 Thomas Jefferson Diplomatic Medal to celebrate 10 years of cooperation. This was the first presentation of the medal to an industrial fair.

Over that 10-year period, the biennial Systems exhibition grew from a modest affair into an extravaganza covering more than 55,000 sq. meters of floor space in eight of the huge exhibition complex's 20 halls. The 660 exhibitors at Systems '81 attracted 44,000 visitors, 42 percent more than Systems '79. Participants were primarily from West Germany, Austria and Switzerland. More than half of the booths were taken by German-owned companies, but most of these were end-user systems suppliers. A close look at the hardware revealed a preponderance of U.S.-built equipment. Moreover, in addition to the 60 U.S. firms sponsored by the Commerce Department, 30 more had their own booths, and 50 more, mainly those well established in Europe, were represented by their West German subsidiary companies. They include computer-industry household

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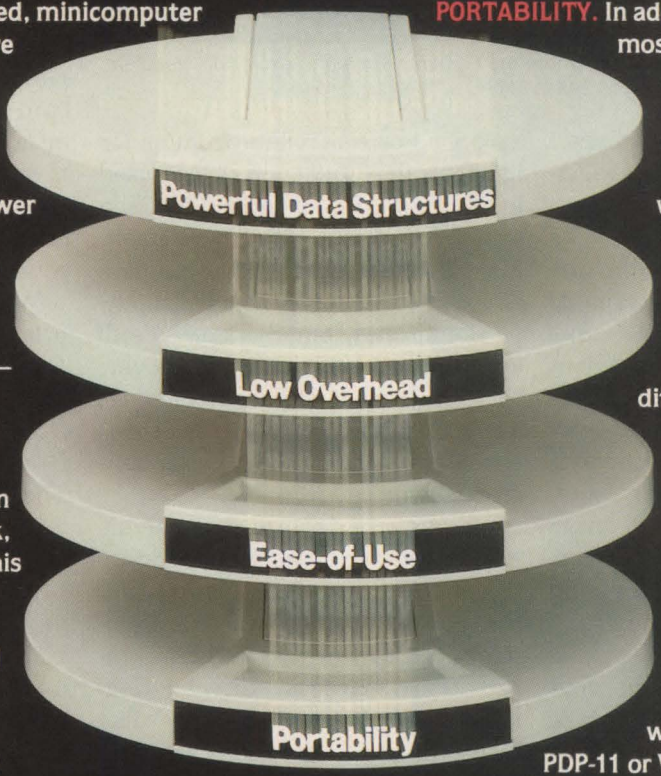

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CIRCLE NO. 33 ON INQUIRY CARD

Marien Platz *is in the heart of Munich, where the Systems computer exhibition was held. More than 44,000 visitors attended this year's show.*

names Digital Equipment Corp., Data General Corp. and Hewlett-Packard Co.

One of the U.S. firms making its European debut at the exhibit was add-on memory-board and terminal manufacturer, Piiceon Inc., San Jose, Calif. Company vice president John Closley said, "This has been good exposure for us. We signed our first German distributor on the first day and met two other good prospective distributors, one from France and the other from Benelux (an economic union comprising Belgium, the Netherlands and Luxembourg)."

Systems '81 was also the first European exhibition for Martha Biddle, international marketing manager for the Datasystems Division of Wespercorp, San Diego, Calif. Acquired by Wespercorp in January, line-printer-controller manufacturer Datasystems already supplies several European OEM customers and distributors. "We have never seen them before," Biddle admitted, "so we have come here to say hello."

Disk- and tape-drive-controller builder Emulex occupied a booth at Systems for the first time in 1979 and found several distributors. "DEC systems are big in Europe," said Emulex international marketing vice president James Martin. "For example, Olivetti's headquarters at Ivrea, Italy, has just ordered 1300 Unibus controllers from us for handling disk and tape drives used in their DEC-based branch-banking systems." About the show itself, Martin commented, "There is less action than at the National Computer Conference, but Systems is still an exciting exhibition. Moreover, the Department of Commerce does a superb job. It would cost me three times as much to take a booth here on my own."

Magnetic peripheral manufacturer Kennedy Co., is already established in the European market, but the company still uses the Commerce Department's facilities. International marketing director Kenneth Goodman said, "The Department of Commerce arrangement not only costs less, but also makes life easier because the Department organizes everything. However, because of our size in Europe, we may take a separate booth at Systems '83." Goodman explained that his company's main purpose for reappearing at the show was to talk to big existing and potential OEM customers from all over Europe. "Our West German distributor, Kontron, which has its own large booth at the show, deals with smaller OEMs," Goodman said.

Winchester-disk-drive builder Micropolis already boasts a European headquarters at Reading, England, but the firm made its debut at Systems. European operations manager Terry Ostridge found the show's attendance lower, but the quality of visitors higher, than he had expected, an impression shared by others. "We came here to meet our West Germany customers and to demonstrate our new 2M-byte floppy-disk drive," Ostridge explained.

The quality of visitors to Systems also attracted SD Systems, Dallas, Texas, which gained dealers in West Germany and Switzerland at Systems '79 and met at least 65 potential dealers at this year's show, said Ralph Garcia, director of international sales. Garcia commented, "We chose Systems because of the high-quality attendees, and we will definitely come to Systems '83."

William Nimee, vice president of product planning at Charles River Data Systems, Inc., said that he talked to prospective distributors from Norway, Denmark, Austria, Greece, Italy, England and India. The Natick, Mass., firm made its Systems debut at the 1979 show and returned this year with a line of DEC-compatible disk subsystems and the Motorola 68000-based Universe computer system. "This is a big show, and all the big firms are here," said Nimee. "It is a useful gathering of West European system integrators and software developers, and the attendance is very high-grade."

The Department of Commerce handles all the freight, booth construction and promotion for exhibitors and provides space in multiples of a standard 3m. × 4m. module. Joy Pollard, spokeswoman for the Department in West Germany, explains that prospective participants can make arrangements through the Department's offices in Washington, D.C. Jurgen Tillack, chief organizer of the Systems show, says that there will be "no problem" in providing extra space for a bigger U.S. exhibit at Systems '83. —*Keith Jones*

Minicomputer TOTAL®

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CIRCLE NO. 34 ON INQUIRY CARD

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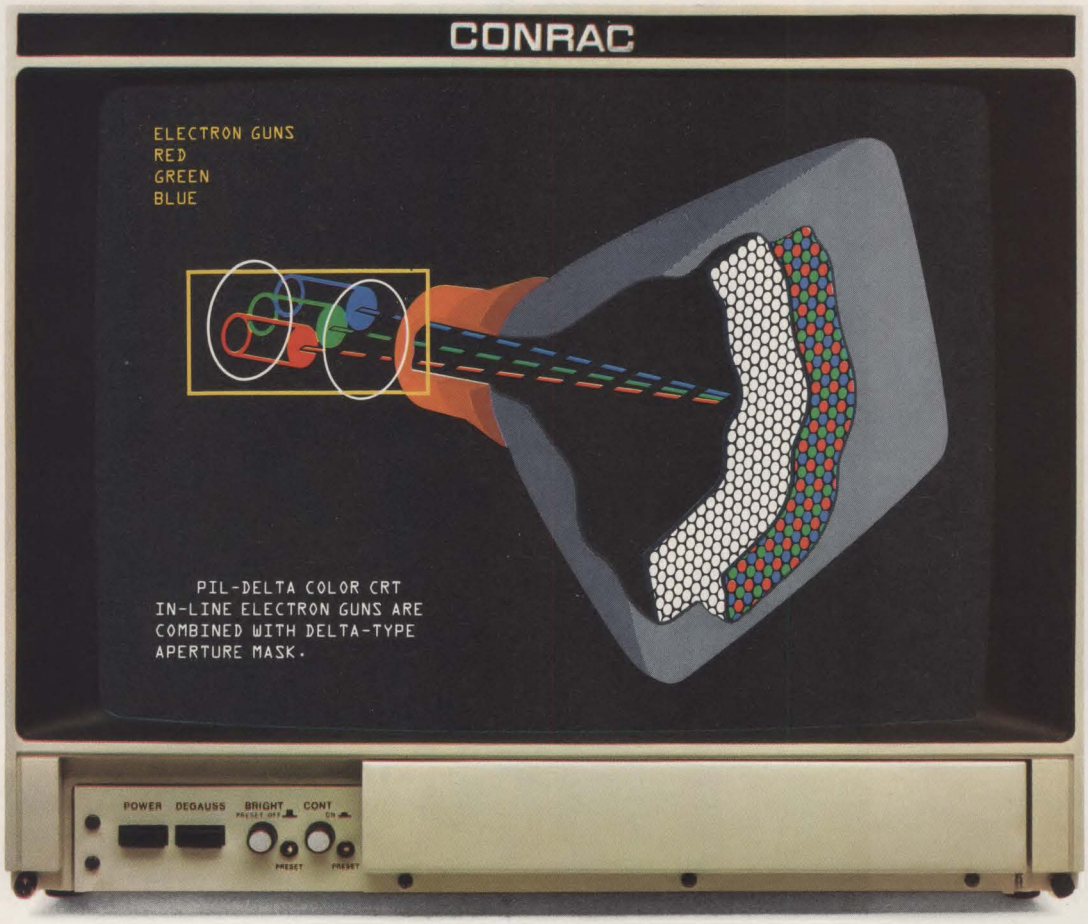

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CIRCLE NO. 35 ON INQUIRY CARD

Tektronix plans a more aggressive stance in graphics

Faced with increasing competition, Tektronix, Inc., is adopting a more competitive stance in the market for graphics-display terminals.

Tektronix pioneered this market nearly 10 years ago with the introduction of its low-cost ($3995) model 4010 direct-view storage-tube (DVST) terminal. Since then, however, competition has sprung up on all sides. Now, says the head of the company's information display division (IDD), Wilsonville, Ore., Tektronix intends to respond faster to the rapidly changing demands of the graphics-terminal market and is making aggressive plans to recapture lost ground.

"We've been too complacent," says Jon Reed, president and general manager of the division. "We sat back in the Oregon woods and got out-marketed." Tektronix's complacency is the result of a number of factors. Perhaps the most visible has been the company's reluctance to shift emphasis from DVST terminals and to focus more attention on hardware-based color raster-scan technology. "Everyone was convinced that our future was with storage-tube terminals," he concedes, "but the market has been telling us something else. Perhaps that has something to do with our present situation."

Reed stresses that storage-tube terminals will be in the Tektronix product mix for some time. But he believes that to be a credible factor in the market for graphics terminals, Tektronix must also promote a line of color raster-scan hardware. One such color terminal, the 4027, was announced two years ago for distributed data-processing applications in which it would be linked to a host computer via 9600-bit-per-sec. phone circuits. But the device is too slow, Reed says. "It takes too long to refresh the screen. It's a marginal product."

The 4027 will not be abandoned, however. Due this fall was an upgraded version called the 4027A, which operates at three times the throughput rate of the older device. Users can buy the "A" version for $10,000 in single-unit orders.

But despite the new hardware, Tektronix appears determined to focus IDD's credibility toward the scientific and engineering communities that have traditionally been the core of the company's customer base. "Low-cost $4000 to $5200 color CRT terminals for business applications are not out of the question at Tektronix," says one observer, "but the company appears determined to push the other applications first."

Whatever the application, however, Reed says, Tektronix graphics hardware will increasingly be used in a systems environment. "We're looking at the whole issue of compatibility with local-area networks and with large-scale mainframe databases," Reed says. "We want to take advantage of the universality of our PLOT-10 software."

For local-area networks, Reed says, Tektronix will shoot for the 802 standard proposed by the IEEE, and will probably adopt the higher level protocols under development at the International Standards Organization and ANSI. "We will use an industry standard—not a Tektronix standard," he says.

He cautions, however, that Tektronix is not committed to any one standard.

Reed also points to the need to shift information back and forth between graphics databases, and points out that Tektronix's interest in local-area networks is being merged with its interest in promoting the use of graphics systems in distributed data-processing environments. A key element here is interaction with IBM mainframes. "We have projects under way aimed at developing IBM compatibility," he says. Tektronix also plans to enhance the performance of multi-terminal graphics systems through the use of shared-disk drives

Meanwhile, Reed plans to take advantage of the autonomy granted IDD to the greatest extend possible. In addition to more independence in

Tektronix, Inc.'s 4909 file-management system *allows shared access to large-capacity mass storage by as many as 10 4050 series desk-top computers and features public and private work spaces, indexed files, concatenated volumens and variable-length volumes.*

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product planning, Reed says, IDD now has more flexibility in pricing its products. "We're changing our discounting policies," he explains. "In particular, we plan to let smaller companies order what they want." Tektronix didn't like working with smaller companies in the past, he says, but that attitude has changed.

As a result of this reevaluation, Tektronix is moving from concentrating solely on what it calls market leaders, systems houses that buy complete Tektronix configurations, and industry leaders, such as IBM, that buy storage tubes only, and toward supporting smaller operations, such as those that buy Tektronix hardware and add applications-level software or those that incorporate Tektronix hardware into turnkey systems. —*John Trifari*

TEKTRONIX'S 4909 COMPRISES CMD

The move toward integrating graphics-display hardware into dedicated systems has led Tektronix, Inc., to develop a centralized file-storage hard-disk subsystem for its 4050 series desk-top computers. Called the 4909, the subsystem comprises a 14-in. Control Data Corp. cartridge-module drive (CMD) with 32M to 96M bytes of fixed storage tied to a 16M-byte removable disk cartridge and a Tektronix-designed formatter and host adapter.

Tektronix's Information Display Division (IDD) will also supply an integral DC-100 (0.15-in.) tape-cartridge drive with the 4909 when first shipments begin early next year. Also included will be utility software routines that will permit users of the company's 4907 floppy-disk-based subsystems to convert existing files or that will specify where modifications to the files formatted for the 4907 must be made to map data from one drive to another.

Tektronix does not see the 4909 specifically as an upgrade for the lower capacity floppy-disk-based subsystem, however. "The 4909 represents a new area of business for us," says one company executive. "We feel that CMD-based subsystems will find their way into CAD/CAM applications, while the 4907 will continue to be used for lower capacity data-acquisition work."

The 4909 works with as many as 10 4050 desk-top computers interconnected via an IEEE-488 interface bus. The company reportedly is looking at other methods of interfacing the 4909, but hardware development has not begun.

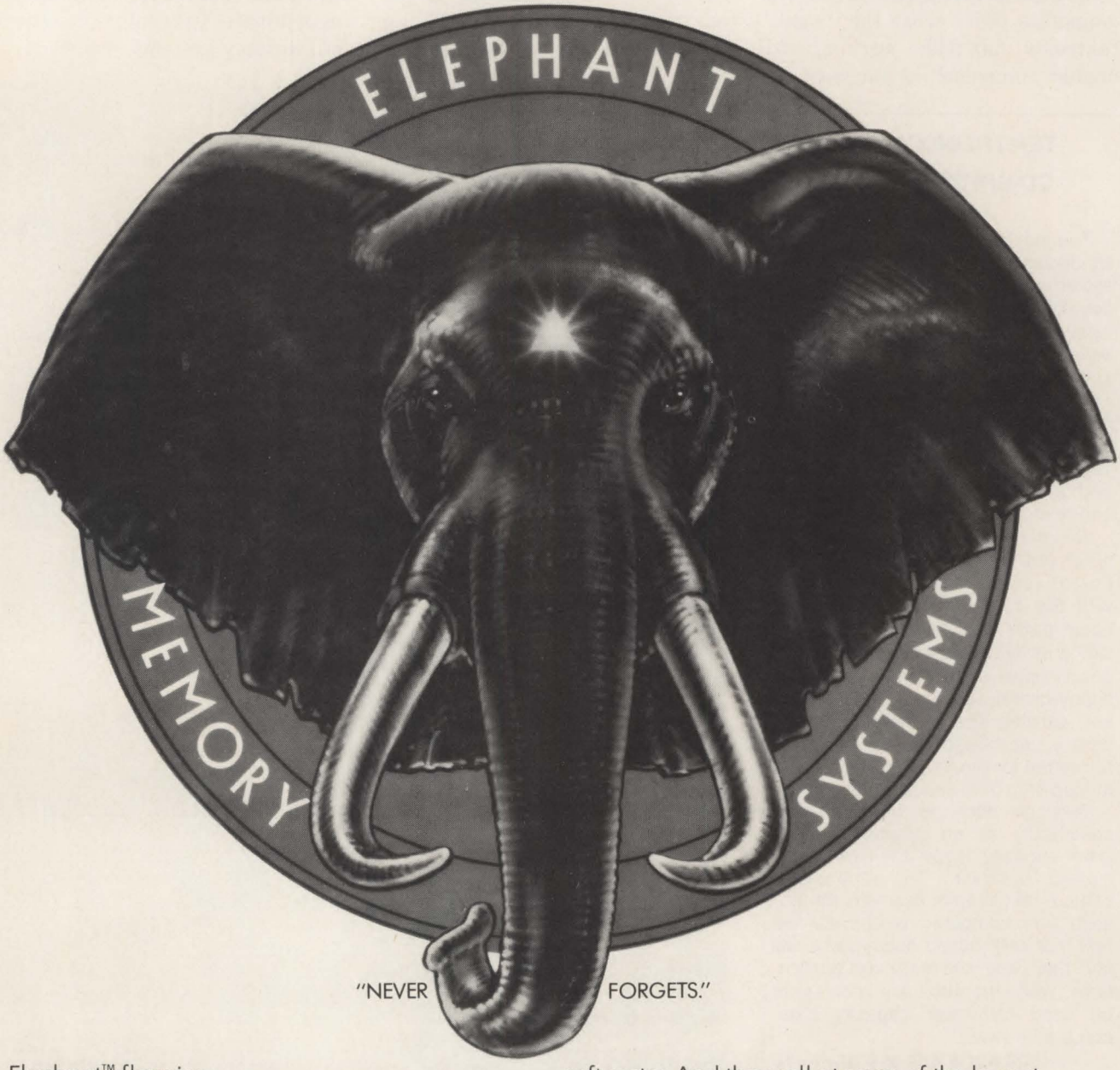
Prices for the 4909 range from $25,000 to $37,000. For applications requiring more than 96M bytes, Tektronix offers the 4909C, an auxiliary cabinet designed to handle two additional 32M- or 96M-byte drives.

BOX SCORE OF EARNINGS

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

Company	Period		Revenues	Earnings	EpS
Apple Computer	year	9/25/81	334,783,000	39,420,000	.70
	year	9/26/80	117,126,000	11,698,000	.24
Aydin	9 mos.	9/26/81	75,458,000	4,851,000	1.39
	9 mos.	9/27/80	75,593,000	5,290,000	1.53
Computer Automation	3 mos.	9/30/81	16,252,000	202,000	.10
	3 mos.	9/30/80	18,206,000	137,000	.07
Comshare	year	6/30/81	82,903,000	1,487,000	.35
	year	6/30/80	70,831,800	4,054,700	1.07
CPT	3 mos.	9/30/81	30,012,000	3,349,000	.21
	3 mos.	9/30/80	19,496,000	1,799,000	.13
Data General	52 wks.	9/26/81	736,900,000	50,700,000	4.78
	52 wks.	9/27/80	653,900,000	54,700,000	5.20
Dataproducts	6 mos.	9/26/81	129,306,000	4,132,000	.47
	6 mos.	9/27/80	125,418,000	7,845,000	1.03
Dicomed	9 mos.	9/30/81	5,412,071	431,170	.29
	9 mos.	9/30/80	3,703,187	421,903	.54
Digital Equipment	year	6/27/81	3,198,099,000	343,297,000	6.70
	year	6/28/80	2,368,045,000	249,861,000	5.45
Four-Phase Systems	9 mos.	9/30/81	168,072,000	5,329,000	.95
	9 mos.	9/30/80	143,838,000	3,854,000	.75
Hazeltine	9 mos.	9/30/81	108,308,000	3,004,000	1.46
	9 mos.	9/30/80	97,907,000	3,698,000	1.81
Informatics	12 mos.	9/30/81	139,409,000	4,426,000	1.90
	12 mos.	9/30/80	123,606,000	5,989,000	2.71
Intel	9 mos.	9/30/81	589,058,000	22,794,000	.51
	9 mos.	9/30/80	635,348,000	73,884,000	1.69
Intelligent Systems	6 mos.	9/30/81	12,048,000	1,513,000	.54
	6 mos.	9/30/80	8,309,000	582,000	.29
Lear Siegler	3 mos.	9/30/81	367,160,000	15,920,000	.96
	3 mos.	9/30/80	347,198,000	14,040,000	.88
Logicon	6 mos.	9/30/81	30,070,000	977,000	.97
	6 mos.	9/30/80	26,973,000	1,069,000	1.11
Magnuson Computer Systems	9 mos.	9/30/81	25,582,000	(2,832,000)	(.57)
	9 mos.	9/30/80	20,654,000	2,442,000	.67
Memorex	9 mos.	9/25/81	582,502,000	(33,796,000)	(5.10)
	9 mos.	9/26/80	560,482,000	(26,204,000)	(3.93)
Micom Systems	6 mos.	9/30/81	23,067,000	3,336,000	.53
	6 mos.	9/30/80	12,696,000	1,474,000	.27
Micro Z	6 mos.	8/31/81	2,099,218	487,040	.10
	6 mos.	8/31/80	1,199,144	157,313	.03
NBI	3 mos.	9/30/81	19,273,000	2,235,000	.24
	3 mos.	9/30/80	11,272,000	1,109,000	.14
Tandem Computers	12 mos.	9/30/81	208,397,000	26,549,000	.72
	12 mos.	9/30/80	108,989,000	10,687,000	.35
Texas Instruments	9 mos.	9/30/81	3,157,300,000	71,800,000	3.06
	9 mos.	9/30/80	2,988,100,000	158,400,000	6.90
Westercorp	3 mos.	9/30/81	3,095,700	189,800	.14
	3 mos.	9/30/80	2,283,600	304,700	.23

REMEMBER.



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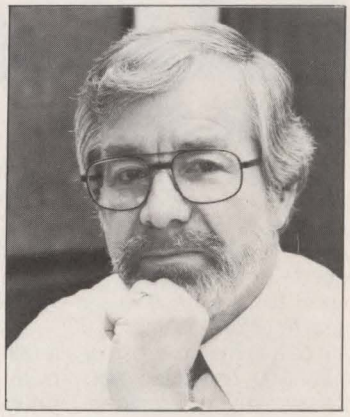
CIRCLE NO. 37 ON INQUIRY CARD

The business of graphics



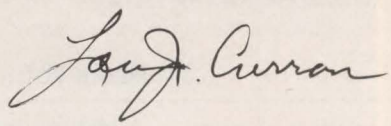
The computer industry has recognized the need for hardware manufacturers to make products more "friendly," or easy to use. CRT terminals are probably the best example of computer devices that vendors can sell more easily if they minimize problems such as operator eyestrain caused by screen glare and backaches traceable to keyboard and screen designs. In short, human factors engineering of man-machine interfaces—ergonomics—has become good business in the computer industry because users are requesting it.

A similar pattern is emerging in computer graphics. Once regarded primarily as an esoteric art form, achievable only with large mainframes, the graphic output of computer data is becoming a tool that small-system suppliers will increasingly need as business applications demand it. Scientific and engineering applications, especially computer-aided design, already employ sophisticated graphics; the next big market will be in business applications such as econometric modeling and sales forecasting.

This issue embodies *Mini Micro Systems'* third annual special report on computer graphics. The 1979 report suggested that the '80s would see graphics expand beyond scientific and engineering usage into the business world. Last year, executive editor Alan Kaplan asserted in an introduction to the report that commercial computer users, convinced of the utility of the graphs and charts that computers can produce, were "falling all over themselves" to get low-cost graphics.

And the beat goes on. The tone for this year's report is set in the graphics-terminal product profile article, "Graphics gets down to business," p. 81. Pat Kenealy, who has joined the staff of *Mini-Micro Systems* since he wrote the profile, points out that industry analysts are bullish about the prospects for graphics terminals, forecasting an annual growth rate between 35 and 60 percent over the next several years. Significantly, Pat reports that most of the new units sold will be in the low- to medium-priced range from $3000 to $35,000.

That message won't be lost on vendors of small-computer systems; the more alert among them are scrambling to develop or acquire a competitively priced graphics capability to offer with their systems.



Lawrence J. Curran
Editor-in-chief

Letters

A LOGICAL CHOICE

To the editor:

I enjoyed reading Malcolm Stiefel's article, "Choosing a small, multi-user business computer" (MMS, June, p. 87). I'd like to submit an addition to your already-extensive list of available products.

Logical Machines are English-programmed computers that provide business owners with a simple alternative to conventional computer software. Users can transfer their business routines to the Logical machine without dealing with application languages, rigid programs or expensive modifications during system expansion.

CORRECTION

An article in the September issue ("Tektronix graphics on a low budget," p. 78) contained inaccurate information about a product from Selanar Corp., Santa Clara, Calif. The article reported that a Selanar circuit board that provides a graphics capability for the Digital Equipment Corp. VT-100 CRT terminal "replaces the video board in the VT-100 or VT-103." In fact, the Selanar board does not substitute for anything in the VT-100 or VT-103; it is installed in an open slot in the terminal's card cage. The article also contained a typographical error regarding the Selanar product's resolution, which should have been shown as 240 vertical dots by 1224 horizontal dots.

Selanar officials were also disturbed because they believe the article's context suggested an unfavorable comparison between their product and one from Digital Engineering, Inc. They feel their product should be compared with Digital Engineering's VT640 board for use with the VT-100/103, not with the RG512 board from Digital Engineering, which was mentioned in the article.

It was not the intention of *Mini-Micro Systems* to compare the performance of the three products mentioned in the story, but to show that there are low-cost alternatives to the widely accepted Tektronix 4010 series displays. The editors regret the inaccuracies.

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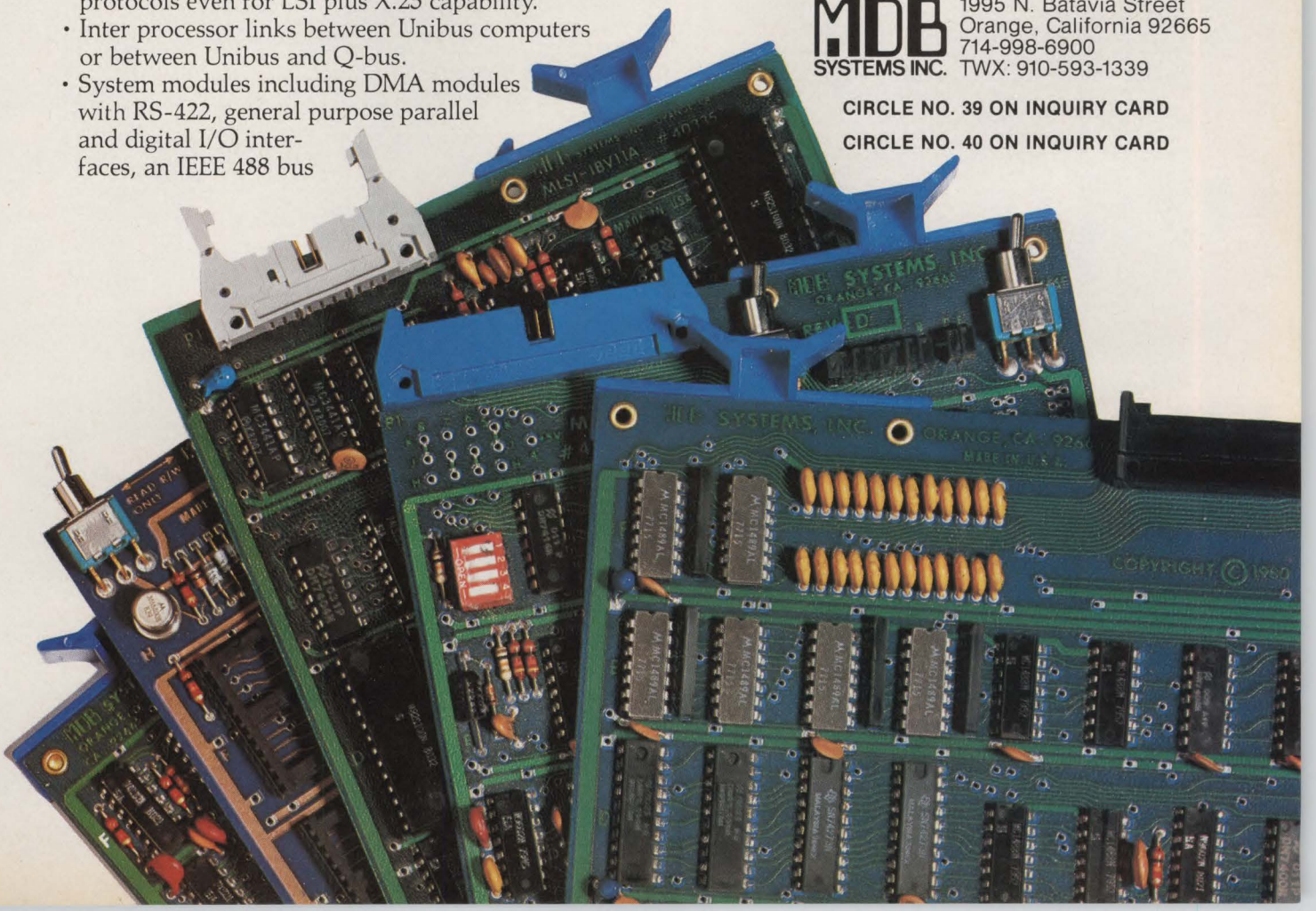

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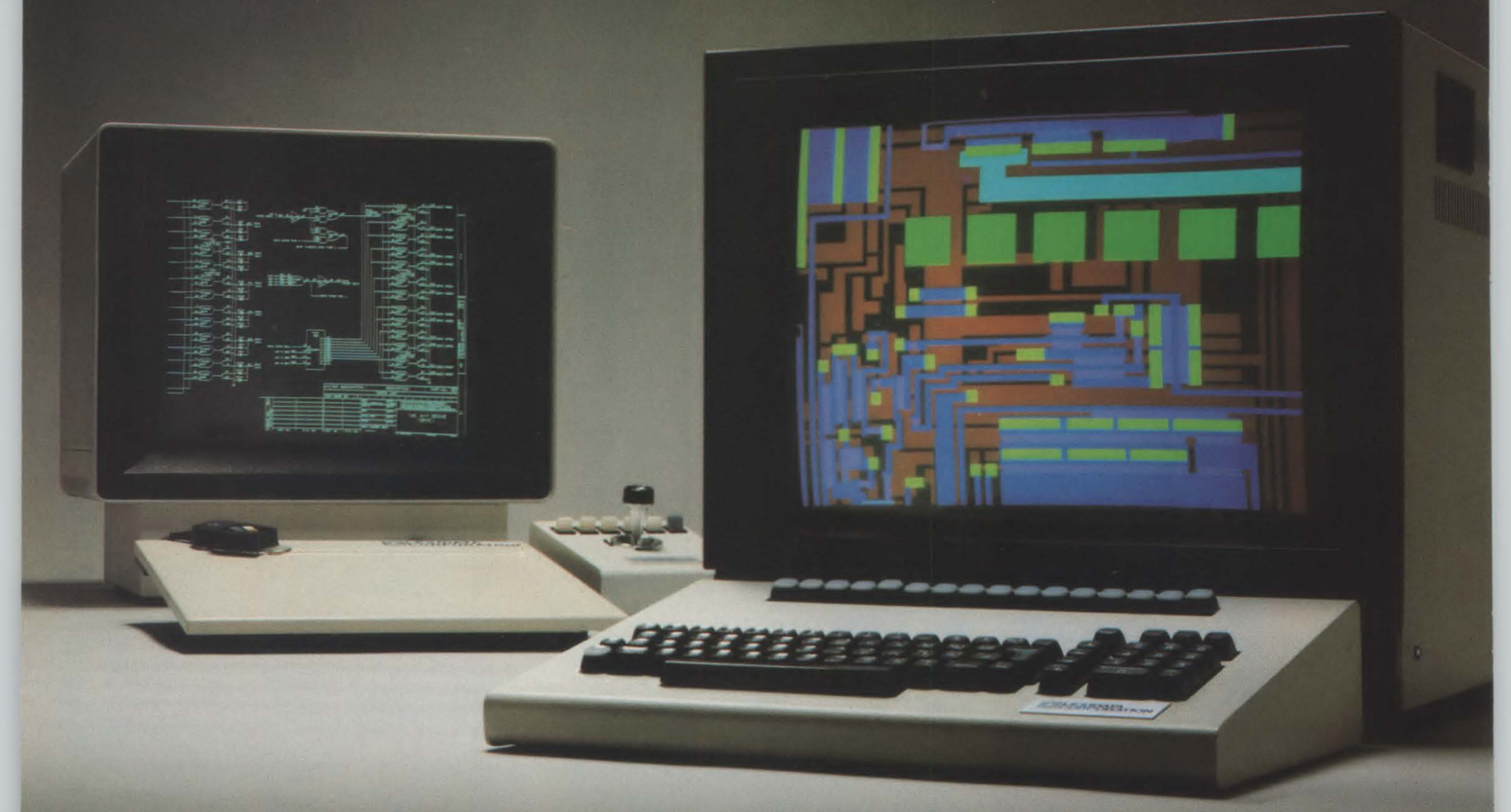

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Letters

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R.L. Newsome
Director of Marketing
Logical Machine Corp.
Sunnyvale, Calif.

'A MISREPRESENTATION'

To the editor:

We read with great horror Malcolm Stiefel's article on SBCs (MMS, September, p. 121). "A misrepresented selection of μc boards" would have been a more appropriate title.

Some of the computers listed do not meet basic criteria for SBCs, which are integrated board-level systems with processor, memory and I/O ports (for example, Digital Equipment Corp. has not released an LSI-11 SBC). Each product we are familiar with was listed with at least one erroneously described characteristic. What credence can we place in the others?

Perhaps we should feel relieved that our own products did not appear. Announced in December, 1979, the PCP-11L was the first general-purpose slave SBC for DEC's LSI-11 family. It received widespread press coverage, except in MMS.

Our second-generation design, the PCP-11E, exemplifies a major trend neglected in the article: loosely coupled parallel processors

Letters

operating within a unified framework. This concept forms the core of recent advances, such as Intel Corp.'s iAPX 432.

With a 4-MHz Z80 CPU, 16K bytes of RAM, as much as 24K bytes of ROM, two multi-protocol serial channels, 8 bits of parallel I/O, four programmable clocks and a 16-bit inter-system bus interface, the PCP-11E dramatically enhances the processing capability of LSI-11 systems. Its ROM-resident programming language and operating system (a proprietary Nortek product called SPICE) eliminates the need for conventional software cross-development tools.

Evan L. Solley
President
Nortek, Inc.
Portland, Ore.

VALUE OF SBCs

To the editor:

I read with interest Malcolm L. Stiefel's article on single-board computers (MMS, September, p. 121). It is refreshing to see that after all the publicity about the new personal computers that someone realizes the value of SBCs.

I was somewhat disheartened to find that one of the pioneers in the success of the single-board computer was overlooked. Hudson Digital Electronics, Inc., Allamuchy, N.J., has been supporting the AIM, SYM and KIM single-boards with software and hardware since approximately 1975. Customers include such companies as General Electric Co. and Argon National Laboratories.

HDE's systems are known for their ruggedness and durability. We have found their development software and their customer support to be excellent.

Bradley C. Rinehart
President
Keystone Data Consultants, Inc.
York, Pa.

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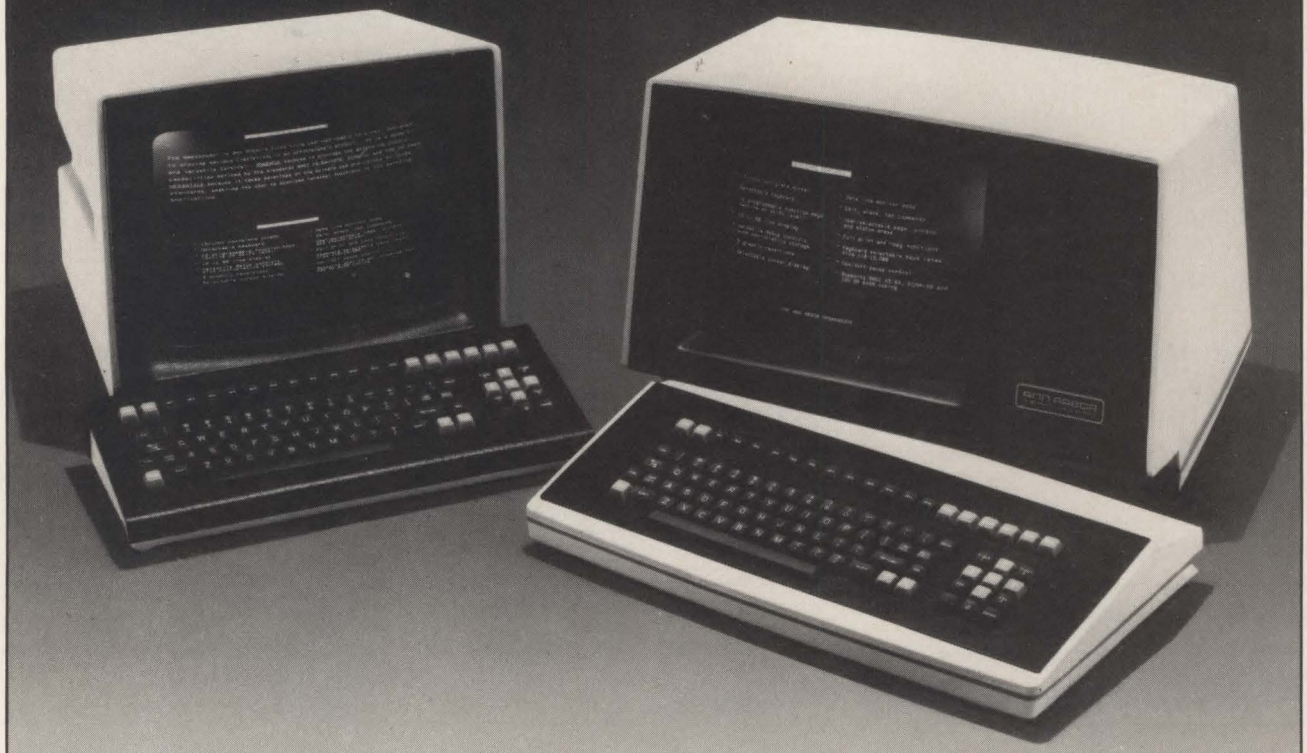

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- 13 Erase controls
- 12 Edit controls, including the ability to locally rearrange data on the screen
- 13 Send controls and modes, including Meta Key Mode for 8-bit data transmission
- 10 Print controls and modes, including local and remote copy, and print format control
- 11 Receiving modes, including slow scroll and pause
- 11 Operator convenience modes, including selectable cursor
- 6 Setup lines permit review and control of terminal modes, send and print parameters and diagnostics
- 48 Function keys hold up to 64 down-loaded strings for transmission or internal execution
- Supports ANSI X3.64, ECMA-48, and ISO DP 6429 coding
- Ann Arbor quality throughout
- And much, much more!

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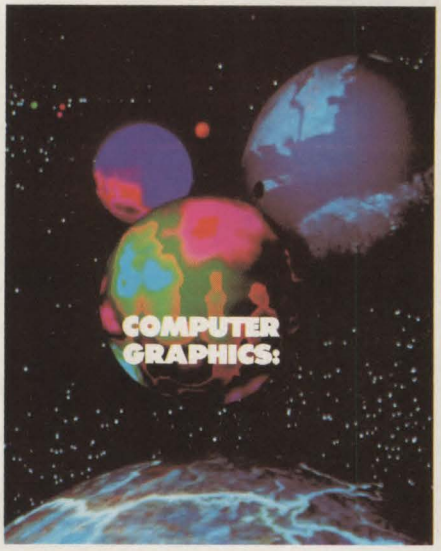
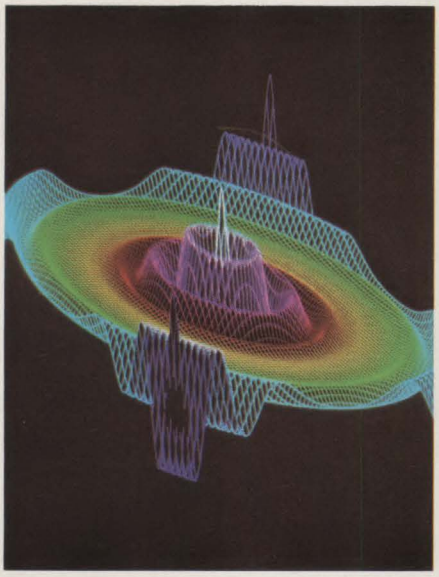
CIRCLE NO. 50 ON INQUIRY CARD

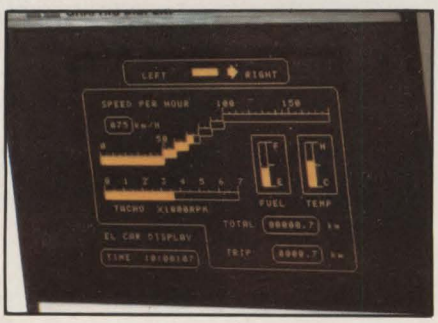
FEATURE HIGHLIGHTS



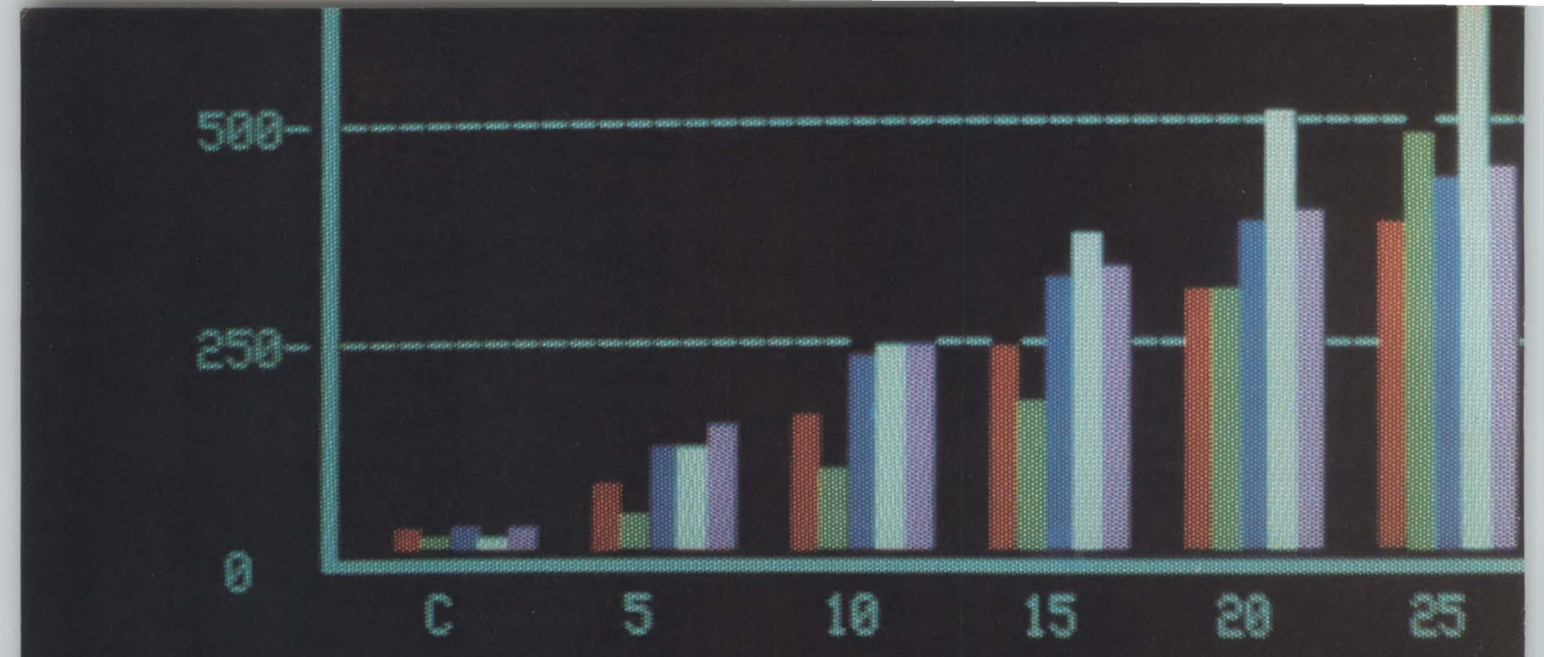
81 Just as minicomputers and distributed processing took data processing out of the central computer center, the current generation of graphics terminals promises to bring the excitement and productivity of graphics out of the design center and into the hands of engineers, plant managers and, most important, businessmen. Turnkey graphics systems selling for hundreds of thousands of dollars have yielded huge productivity gains in design and manufacturing operations, and general-purpose graphics terminals streamline financial control, plant management and strategic planning, bringing graphics to middle managers as well as to staff engineers. Technologically, the future for graphics looks rosy even in the computer industry, in which increasing price/performance ratios are the rule rather than the exception. For an in-depth look at the emerging markets and technologies for computer graphics—including comprehensive product listings—see the lead-off article in this special report, beginning on p. 81 . . .



Display technologies can be classified into four major categories, with a number of features influencing their performance. It is vital to know the trade-offs involved in each to select the best display for an application. For a selection guide, see the article on p. 95 . . . To support the many new applications for computer graphics, Raster Technologies' Model One raster-scan color-graphics controller uses a 64K RAM architecture that incorporates a dual-mode image memory system with a display technique called pixel-averaging and a hardware pixel arithmetic-logic unit. A complete examination of the Model One starts on p. 101 . . . Digitizer purchases often are based on manufacturers' published specifications of resolution and accuracy. Although these specifications are good indicators of a digitizer's capabilities, they aren't the only factors that influence the ultimate accuracy of a digitizer system. The terms "resolution" and "accuracy" have fallen victim to misinterpretation. For an accurate interpretation, see p. 111 . . . One interesting application of computer graphics has been the mapping of continental drift. For a fascinating look at how the earth's continents were formed—and at what's ahead in the next 50 million years—see p. 116 . . . Genisco Computers has introduced Space Graph, which is believed to be the first commercially available 3-D graphics display-system viewable directly. It holds huge implications for the future of graphics technology. A description starts on p. 121.



125 Functionally, flat-panel displays offer a viable alternative to CRTs for computer-terminal applications, and are more advantageous in systems where space considerations play a fundamental role in design. But complicated drive electronics coupled with low-volume production make flat panels expensive and limit their terminal applications to military and very specialized commercial users. Most observers agree that, until prices come down, the market for flat-panel terminals will remain small compared to that for CRT terminals. For a complete analysis, see assistant editor Frank Catalano's report on p. 125.



Money-back guarantee for computer professionals:

Buy factory-direct from Intelligent Systems.

It took hard work and experience for you to become a leader. Same here. Founded in 1973, we were the first company to ship 20,000 color graphics units. We sell to computer professionals—not through computer stores. So, if you don't need a salesman to tell you what you need, try this unique offer:

A factory-direct, money-back guarantee for our 3650 color graphic desktop computer with 56K of memory for only $1995—plus your choice of either an internal 5¼" 92K Floppy Mini Disk Drive for $395, or an external 8" Floppy Disk Drive for $895! (These prices good only with this offer.) You can buy only one unit before 12/31/81, cash with order. Use it for 30 days; if you're not sold on the merits of your color graphic computer, return it. We will refund the full purchase price and your only cost would be transportation charges to and from Norcross, Georgia.

Why such a dramatic offer? Intelligent Systems was built around the needs of computer professionals. We sell primarily through OEM's and want to introduce the dynamics of color graphics to professionals like yourself—so you can help us introduce color graphics in your company.

Features Included for $1995:
• 56K total memory, 32K user RAM, 4K disk buffer RAM, 4K refresh RAM, 16K ROM (includes extended disk BASIC) • 13" raster scan color CRT • 8 foreground colors w/blink and 8 background colors • 64 col./32 line • 64 ASCII & 64 graphics characters • 128H x 128V graphics w/point, bar & vector generators • RS232C port • Buffered bus connector • 72 key professional keyboard • User's Manual & sampler disk • Factory Warranty: 90 days parts & labor

And Your Choice of:
• Internal 5¼" 92K disk drive: $395 • External 8" 295K disk drive: $895 (These prices good only with this offer.)

Options Include:
• 101 key keyboard: $100 • 117 key keyboard: $250 • blank 8K board for add-on EPROM: $75 • One-year Factory Service Contract: $350

Software Available: BASIC is standard; you can add Fortran for $75. Text editors, assemblers, other utilities available. Also, hundreds of additional programs, including ColorCalc,™ ColorGraph,™ as well as programs for education, accounting, WP, statistics, etc.

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Unretouched photos of screens.
This offer, not available through computer stores, expires 12/31/81. U.S. domestic prices.

CIRCLE NO. 51 ON INQUIRY CARD

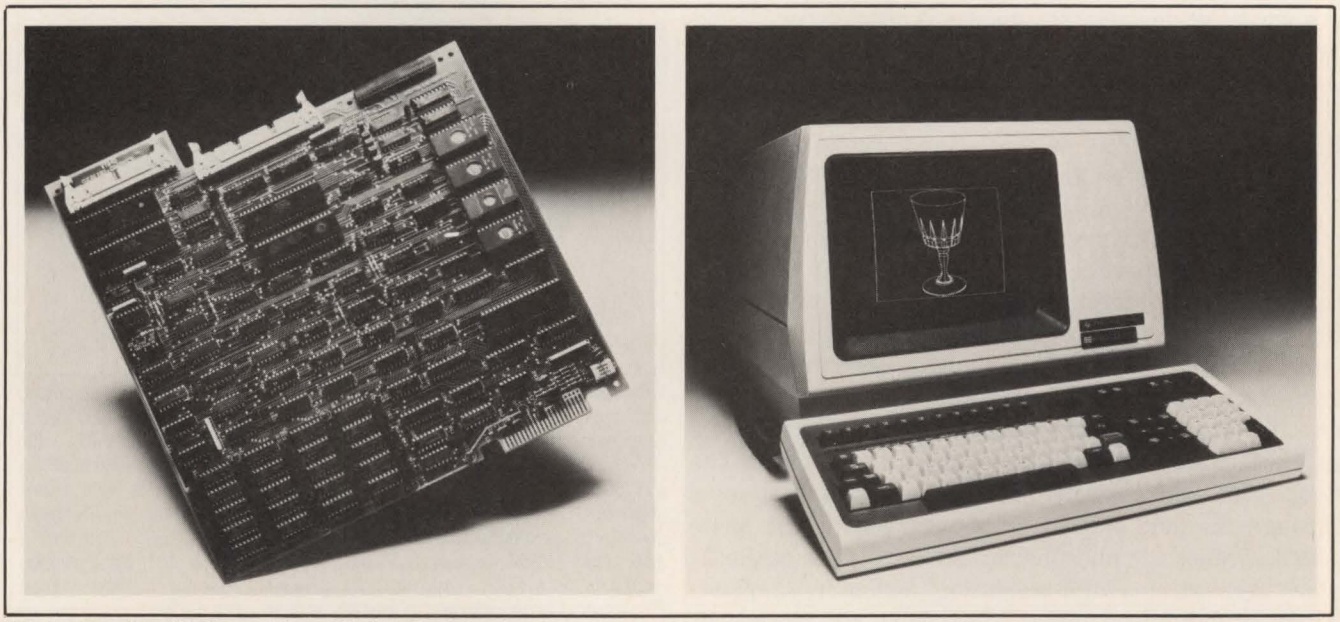
Graphics gets down to business

PATRICK KENEALY, GML Corp.

More middle managers are using graphics as terminal prices continue to decline

Just as minicomputers and distributed processing took data processing out of the central computer center, the current generation of graphics terminals promises to bring the excitement and productivity of graphics out of the design center and into the hands of engineers, plant managers and, most important, businessmen. Turnkey graphics systems selling for hundreds of thousands of dollars have yielded huge productivity gains in design and manufacturing operations, and general-purpose graphics terminals streamline financial control, plant management and strategic planning, bringing graphics to middle managers as well as to staff engineers.

Technologically, the future for graphics looks rosy even in the computer industry, in which increasing price/performance ratios are the rule rather than the exception. Barring revolutionary improvements, the storage tube should fade if not flicker away over the next five years, while raster and stroke-refresh systems gain in resolution and drop in price as a result of better tubes, 16- and 32-bit graphics processors and falling memory prices. When multicolor raster-scan



"Retro-Graphics" PC card from Digital Engineering, Inc., *Sacramento, Calif., is an add-in graphics processor board for field-upgrading alphanumeric terminals. At left is DE's latest offering, the RG-1000 "generic" board for a range of popular VDTs. Earlier boards were designed specifically for the Lear Siegler ADM line, the DEC VT-100 and the TI OPTI 940 (r.).*

The same forces that made businessmen advocate distributed data processing will make them advocate distributed graphics terminals over centralized graphics systems.

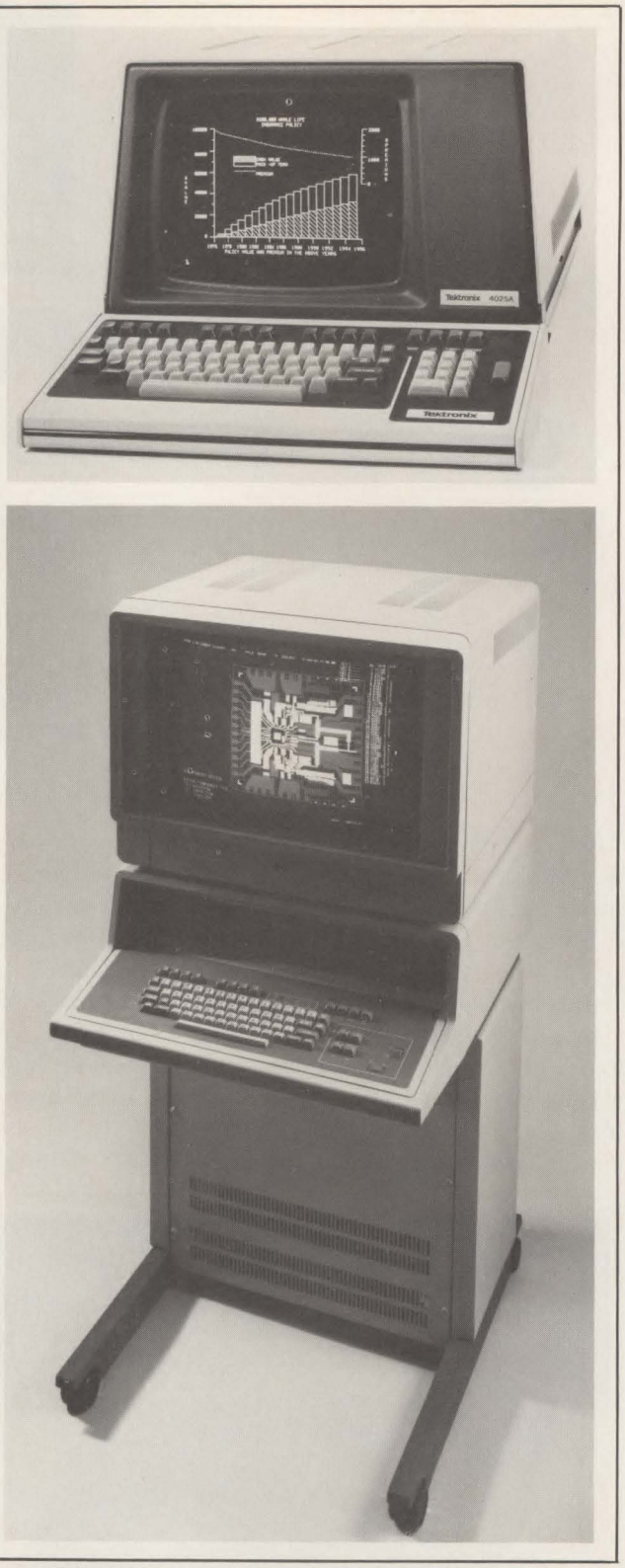
systems achieve resolution comparable to the two- or few-color stroke writers, raster-scan terminals will be appropriate for every application. Even now, it is the favorite for color applications and is outselling the lower resolution, two-color, stroke-refresh terminals. Manufacturers assure us that technology will provide ever better multicolor hardware and software, and the market research houses say that the business world is ready to buy.

Industry analysts are bullish on the market potential of graphics terminals, forecasting annual growth rates in units shipped of 35 to 60 percent. An overwhelming majority of the new units and the largest share of new graphics revenue will come from low- to medium-priced graphics in the $3000 to $35,000 range. Like computers and minicomputers before them, graphics terminals will be used more and more by business and clerical people than scientists and engineers. Graphics promises to help business decision makers as much as CAD/CAM helped design engineers and as much as word processing helped secretaries. Business will become the largest application for graphic terminals and vendors will listen to their new customers.

The display technologies

A graphics terminal has two main components: a primary input device (usually a keyboard) and a primary output device (the display screen). The keyboard, well-suited to entering hard numbers, is often complemented by a joystick or other more graphic input devices. The display is often accompanied by a hard-copy device. Virtually all graphics terminals use one of three major display technologies: direct-view storage tube, vector or stroke refresh or raster scan. Each technology has strengths and weaknesses that make it better suited for some applications than others.

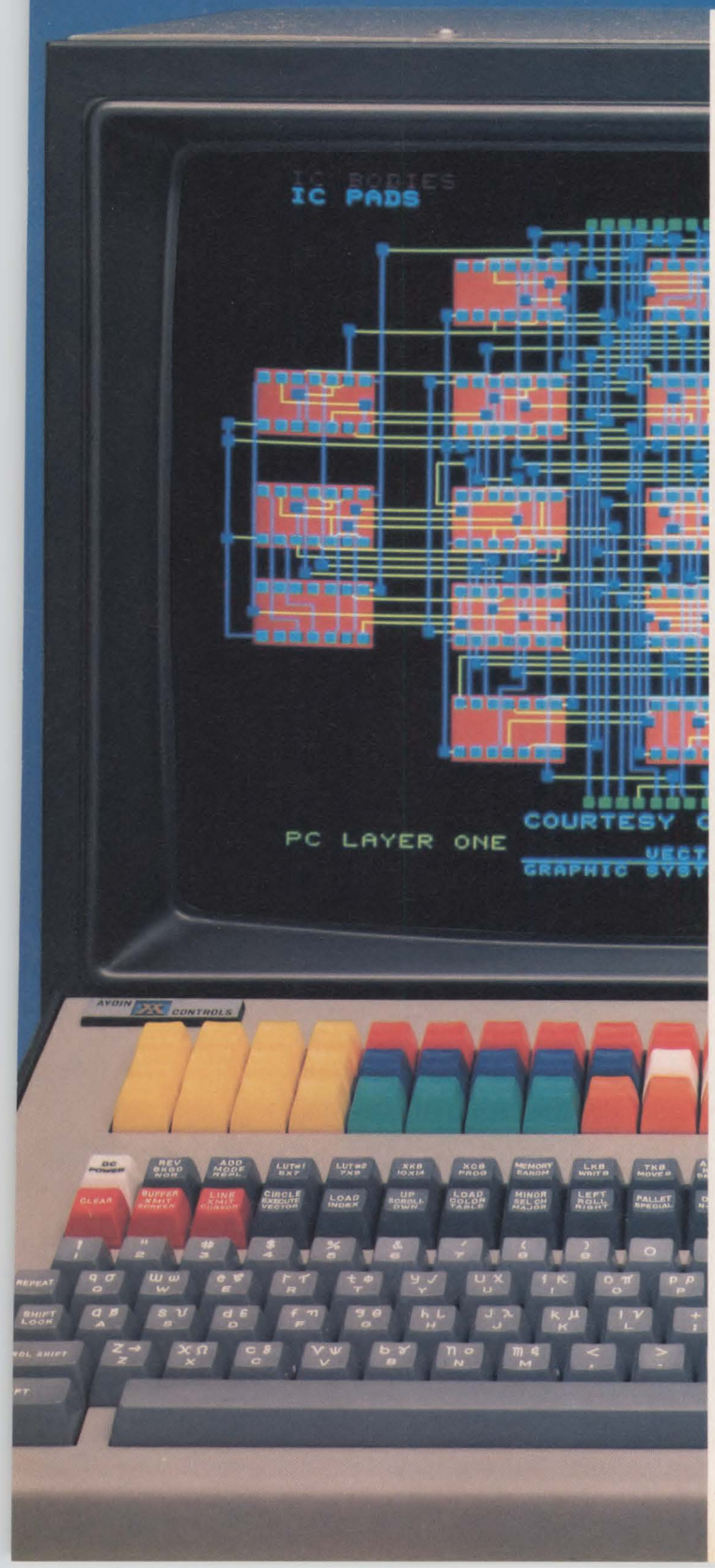
Storage-tube technology for graphics terminals was pioneered by Tektronix, Inc., which introduced its model 611 storage tube in 1968. The company continues to champion storage-tube technology and offers more than six models with visible resolutions of as much as 2000 × 2000 points. Storage tubes use two electron guns to create and maintain graphic images. The write gun builds an image as a series of random vectors on a grid electrode embedded in the display tube's face. The flood gun emits lower energy electrons that pass through the grid only at points charged by the write gun and cause the phosphor on the face of the screen to glow, generating a high-resolution, flicker-free, bright-green-on-dull-green image. The flood gun keeps the image on the screen, but the "stencil" on the electron grid fades in a matter of minutes, and the write gun



Newest Tektronix graphics terminals *are the 4113 (b.), introduced last month, and the 4025A (t.) and 4027A additions to the 4020 series of monochromatic and color-raster displays. The 4113 is a 640 × 480 (60-Hz, non-interlaced) eight-simultaneous-color raster display for $16,500. It supports the Siggraph core standards for zoom, segments and markets, and can be upgraded to 16 simultaneous colors (by adding a fourth bit plane) for another $1500. The 640 × 480 pixel 4025A, at approximately $5200, has a 16K-byte display memory base (48K in the 4027A), graphics macros, locally defined circles and arcs, clipping firmware and an optional (standard on the 4027A) full-screen crosshair cursor for which coordinates are entered via the keyboard. Field-installable board options (about $600) upgrade 4020 series terminals to 4025/4027 performance levels.*

Quickens Your Draw

Aydin user-oriented, full-color graphic systems let you tackle complex design and processing projects quickly and easily.



Aydin 5216 high-resolution multiprocessor-based color graphic systems lead the industry in fulfilling the needs of intricate process control CAD/CAM, simulation, C³I, image processing and many other sophisticated applications.

Versatility is the result of the Aydin growing family of hardware and 2D, 3D, imaging and CORE software modules. The 5216 gives you both the flexibility and programmability to design and implement your ideas efficiently and economically; a true man-machine interface. For example, AYGRAF instruction sets provide both standalone and distributed processing capabilities to support 2D graphics in a standardized manner. The 3D system, which supports standalone and host-driven applications, is designed to give the user the full benefit of sophisticated graphics, all with interactive control that doesn't burden the host computer.

Aydin modular design also means that you can customize the 5216 to your strictest requirements, easily expand memories, add storage and utilize various user-programmable lookup tables. In addition, a host of interactive devices are available, including joysticks, trackballs, graphic tablets, touch panels and lighted or non-lighted function keys.

It all adds up to a user-oriented 5216 color system that is a reliable, flexible and economical solution to your graphics and image processing needs. Quicken your draw with Aydin, the industry leader in high-resolution, intelligent color graphics. For more information, contact Aydin Controls, 414 Commerce Drive, Fort Washington, PA 19034. Tel.: 215-542-7800. (TWX: 510-661-0518.)

Leadership Features:

• High-performance multiprocessor bus architecture • Pixel or graphic DMA block mode data transfer (800 nanoseconds per 16-bit pixel) • Multiple pixels per word • Wide selection of display formats up to 1024 x 1024 x 16 • Video processing through lookup table RAM at bit rates to over 40mHz • High-speed hardware vector and character generation • Four sizes of alpha characters • High-speed hardware math • Both parallel and serial peripheral interfaces available • User programmable • 16-Bit microprocessor.

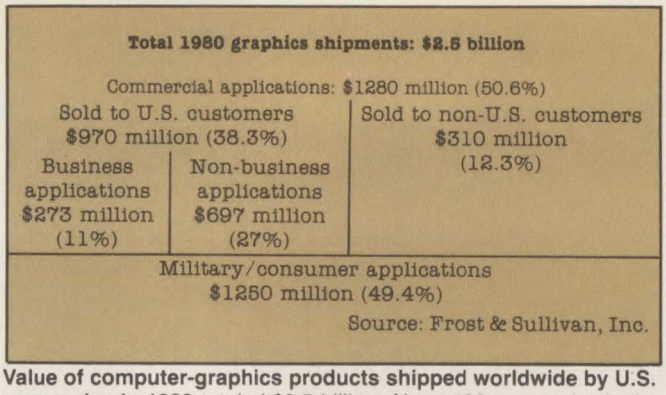
AYDIN CONTROLS

CIRCLE NO. 52 ON INQUIRY CARD

Industry analysts are bullish on the market potential of graphics terminals, forecasting annual growth rates in units shipped to 35 to 60 percent.

must periodically redraw it.

The capacity of the storage tube eliminates the need for expensive refresh circuitry and display memory to map points to the screen. As a result, storage tubes are inexpensive, and most sell for $4000 to $12,000. Previous problems with storage tubes have been short tube life (approximately 2000 hours), low contrast, low brightness and low interactivity (because images must be totally redrawn if even small changes are made). In recent years, storage tubes have been refined to provide better brightness and contrast, and tube life



Value of computer-graphics products shipped worldwide by U.S. companies in 1980 *totaled $2.5 billion. About 100 companies in the U.S. supply computer graphics equipment for business applications, and market researcher Frost & Sullivan estimates that 60 percent of those revenues are accounted for by only five suppliers (IBM, GE, Tektronix, Hewlett-Packard and Calcomp). By 1989, Frost & Sullivan expects that business graphics will represent about 40 percent of the commercial computer-graphics market ($5.8 billion of a $14.5-billion market).*

REPRESENTATIVE BUSINESS AND GENERAL-PURPOSE GRAPHICS TERMINALS

Manufacturer	Model	Introduction date	Display screen; resolution	Displayable colors	Memory (K bytes)
Advanced Electronic Design	AED512	1980	13/19-in. raster; 512 x 512	256	32-256
Aydin Controls	5216	6/79	19-in. raster; 1024 x 1024	8	32-1000
	5217	1/79	13-in. raster; 720 x 480	8	4-32
BMC, USA	IF-800/20	1981	12-in. raster; 720 x 240	8	
Calcomp	IGT-100	6/77	15-in. raster; 1024 x 680	1	
Chromatics	CG Series	6/79	13-, 15-, 19-in. raster; 512 x 512	8	96-132
	CGC-7900	11/80	19-in. raster; 1024 x 768	8	128
Colorgraphic	MVI-7	8/81	13-, 15-in. raster; 720 x 288	8	Refresh only
Control Data	795 Digigraphic	2/80	21-in. stroke refresh; 1024 x 1024	1	
Data General	Dasher D280C	8/81	13-in. raster; 560 x 240	8	
	Dasher G300	3/81	12-in. raster; 640 x 240	1	
Datamedia	Colorscan 10	1981	12-in. raster; 640 x 240	8	
Datapoint	9680	11/81	13-in. raster; 512 x 480	16	128-156
Digital Equipment	GIGI	5/81		8	
	VS11 series	5/80	19-in. raster; 512 x 512	16	Refresh only
DY-4 Systems	VGT-100	in production	15-in. raster; 640 x 240	1	
Genisco Computers	G-1000	8/80	19-in. raster; 1024 x 792	1	16
	GCT-3000		Raster; 1280 x 1024	8	
Hewlett-Packard	2623	1981	Raster; 512 x 390	1	
	2647A	5/78	12-in. raster; 720 x 360	1	32
	2648A	7/77	11-in. raster; 720 x 360	1	Refresh only

1. Dynamic functions: zoom, pan, etc.
2. Virtually all have printer interfaces
3. All prices include keyboard (KBD), standard display, graphics generator, BASIC software, interface, standard memory

COMPUTER GRAPHICS REVENUE FORECAST BY PRODUCT, 1980–1989 ($ million)

Product	1980	1989	% compound growth
Storage display	$ 15.0	$ 13.3	– 5%
Stroke/refresh display	2.0	6.5	14
Raster display	87.5	1,746.5	40
Large-screen display	3.0	31.8	30
Other display	1.5	7.3	19
Digitizer	5.0	25.8	20
Light pen	1.0	2.3	10
Voice input	—	5.2	40
Pen plotter	37.0	220.1	22
Electrostatic plotter	8.0	142.0	38
Film hard copy	24.0	130.7	21
Laser/jet plotter	11.0	116.6	30
Matrix printer	1.0	10.6	30
Software	8.7	190.9	40
Systems	10.0	2,366.4	80
Slide-making services	35.0	488.3	34
Time-sharing	22.5	257.0	31
Consulting/other	1.0	13.2	34
Total	**$273.2**	**$5776.5**	**40%**

Source: Frost & Sullivan, Inc.

now averages 4 to 6 years of constant use. Storage-tube manufacturers have also developed a technique called write-through to make terminals more interactive. In write-through, the write gun continually draws an image on the phosphor, but with insufficient energy to store it. The resulting image can be changed or "selectively erased" without having the entire screen redrawn. Some systems permit color write-through, giving the constantly redrawn image one color (usually amber) and the stored information another. Because storage tubes have slow drawing speeds, constantly redrawn write-through images flicker badly, but they do give users a modest level of interaction, and are being improved.

Vector-refresh displays produce sharp, high-resolution drawings because, like storage tubes, they draw pictures from point to point using random vectors. The writing beam is controlled by analog X and Y deflection

Software[1]	I/O devices from vendor[2]	Off-line storage	Price[3]	Notes	For more information circle no.
Graphics primitives, dynamic functions	KBD, joystick, tablet, matrix printer, screen camera	Diskette, Winchester disk	$16,100	Includes 128K-byte RAM, joystick, firmware	386
Aygraf 2D, 3D graphics functions	KBD, joystick, light pen, trackball, matrix plotter	Cartridge disk	$19,975	Includes 32K-byte RAM	387
Graphics characters	KBD, light pen	No	$2995	For process control	388
Charting functions, graphics characters	KBD, light pen, matrix printer	Diskette cartridge ROM	$6950	Includes diskette drive, matrix printer	389
Graphics primitives	KBD, tablet, matrix plotter		$13,500		390
Graphics primitives, dynamic functions	KBD, light pen, Xerox 6500 screen camera	Disk, diskette	$16,670	Includes 15-in. display, 132K-byte RAM, diskette drive	391
Graphics primitives, dynamic functions	KBD, light pen, joystick	Disk, diskette	$14,995	Includes 128K-byte memory	392
Graphics primitives	KBD, light pen	No	$3500	Extra memory needed for circle and ARC generation	393
Graphics primitives, dynamic functions	KBD, light pen			Includes light pen for use with CDC computers	394
Graphics primitives	KBD	No	$3805		395
Trendview business package, graphics primitives	KBD, matrix printer	No	$7400	Emulates dasher D200	396
Charting functions, graphics primitives	KBD	No	$3795	A DEC VT-100/VT-52 emulator	397
Business functions, graphics primitives	KBD, tablet, matrix printer, screen camera	No	$30,000	Includes tablet instead of KBD STD for use with Datapoint ARC Systems	398
Graphics primitives	KBD, tablet, printer	No	$5000	User must provide display monitor	399
Graphics primitives	KBD, joystick	Diskette, disk, magnetic tape	$13,600	Includes joystick for use with DEC systems	400
Plot 10- compatible	KBD, matrix printer	No	$2988		401
Plot 10- compatible	KBD, light pen, matrix printer		$9995	Emulates Tektronix 4010 with selective erase	402
	KBD, light pen, matrix printer		$14,550		403
Business graphics	KBD, thermal printer	No	$3750	Integral thermal printer optional	404
Business graphics, graphics primitives	KBD, pen, matrix plotters	Cartridge tape	$8950	Functions as a stand-alone μc	405
Business graphics, graphics primitives	KBD, pen, matrix plotters	Cartridge tape	$5950		406

Manufacturer	Model	Introduction date	Display screen; resolution	Displayable colors	Memory (K bytes)
Hitachi	H-7000	4/78	19-in. raster		7
HMW Data Systems	Data-color	1/81	14-in. raster; 480 x 240	27	
HMW Enterprises	9001-IGT	7/79	13-in. raster; 640 x 288	8	8
Human Designed	Concept series	1978	12-in. raster; 264 x 72	1	Refresh only
IBM	3279	10/79	14-in. raster; 760 x 384	7	
IMLAC	Series II	1980	19-in. stroke refresh; 2048 x 2048	1	64
Industrial Data Terminals	IDT-1800	9/80	19-in. raster; 512 x 256	8	Refresh only
	IDT-2000	3/80	19-in. raster; 512 x 512	8	Refresh only
	IDT-2200	7/81	19-in. raster; 512 x 512	8	Refresh only
Integrated Data Systems	ID-400	5/79	13-in. raster	16	2
	ID-800 series	7/81	13-, 19-in. raster	16	2
	ID-212	7/81	12-in. raster	16	2
	ID-1200	1/82	13-, 19-in. raster	16	4-128
Integrated Terminals	801	8/81	12-in. raster; 160 x 96	8	6-10
Intelligent Systems Corp.	3600	10/80	13-in. raster; 128 x 128	8	8-32
	8001G	1973	19-in. raster; 192 x 160	8	13
	8001I	11/80	19-in. raster; 480 x 384	4319	96
	8300	10/80	13-in. raster; 192 x 160	8	8-64
Interstate Electronics	PD series	1980	12-in. plasma; 512 x 512	1	64
Lexicon	Lexiscope 4000	1981	Raster; 560 x 500	1	
Matrox Electronics	CTM-300	6/81	12-in. raster	8	2
Megatek	Whizzard 6240	1979	19-in. raster; 512 x 512	1	64-128
	Whizzard 6245	1980	19-in. raster; 1024 x 1024	1	64-128
	Whizzard 6250	1979	13-in. raster; 512 x 480	1	64-128
	Whizzard 6255	1980	19-in. raster; 1024 x 1024	8	64-128
	Whizzard 7210		21-in. stroke refresh; 4096 x 4096	1-5	64-192
	Whizzard 7245	1980	19-in. raster; 1024 x 1024	1	64-192
	Whizzard 7250	5/80	19-in. raster; 512 x 512	16	64-192
	Whizzard 7255	5/80	19-in. raster; 1024 x 1024	16	64-192
	Whizzard 7290	5/81	21-in. stroke refresh; 4096 x 4096; and 21-in. raster; 512 x 512	1-5	64-192
MQI Computer	Autograph 150		12-in. raster; 512 x 250	1	

1. Dynamic functions: zoom, pan, etc.
2. Virtually all have printer interfaces
3. All prices include keyboard (KBD), standard display, graphics generator, BASIC software, interface, standard memory

Software[1]	I/O devices from vendor[2]	Off-line storage	Price[3]	Notes	For more information circle no.
256 graphics symbols	KBD, plotter	Diskette	$11,000		407
Graphics characters	KBD, light pen	Diskette			408
Graphics primitives	KBD, light pen, joystick, trackball, matrix printer, video copier	Disk	$10,000	OEM (quantity 100) price	409
Graphics characters	KBD	No	$1575	APL KBD optional	410
Graphics primitives	KBD, matrix printer	No	$3805		411
Graphics primitives, dynamic functions	KBD, light pen, tablet, video copier	No	$15,750	Storage-tube emulation is available	412
Graphics primitives, macro-graphics	KBD, light pen, matrix printer	No	$7490		413
Graphics primitives, macro-graphics	KBD, light pen, matrix printer	No	$10,600		414
Graphics primitives, macro-graphics	KBD, light pen, matrix printer	Bubble memory	$11,495		415
Graphics characters	KBD	No	$2855	OEM (quantity 25) price	416
Graphics characters	KBD	No	$2090	OEM (quantity 25) price; 19-in. version is $3075	417
Graphics characters	KBD	No	$1695	OEM (quantity 25) price	418
Graphics characters CP/M, BASIC	KBD	No	$2485	OEM (quantity 25) price; 19-in. version is $3395; functions as stand-alone μc	419
Graphics characters	KBD, light pen	No	$3000		420
Chart graphics, graphics primitives	KBD, matrix printer	Diskette	$1995		421
Chart graphics, graphics primitives	KBD, matrix printer	Diskette	$2745	$2120 cash in advance	422
Chart graphics, graphics primitives	KBD, matrix printer	Diskette	$4460	$3695 cash in advance	423
Chart graphics, primitives graphics	KBD, matrix printer	Diskette	$3560		424
Graphics primitives	Touch panel, joystick	Diskette			425
DG, HP commands	KBD	No	$3240	Includes light pen; designed for use with Data General computers	426
Graphics characters, graphics primitives	KBD	No	$2940		427
Wand 6200, graphics primitives, dynamic functions	KBD, joystick, tablet, matrix printer, screen camera	No	$14,900	Includes joystick, 64K-byte RAM	428
Wand 6200, graphics primitives, dynamic functions	KBD, joystick, tablet, matrix printer, screen camera	No	$17,900	Includes joystick, 64K-byte RAM	429
Wand 6200, graphics primitives, dynamic functions	KBD, joystick, tablet, matrix printer, screen camera	No	$17,500	Includes joystick, 64K-byte RAM	430
Wand 6200, graphics primitives, dynamic functions	KBD, joystick, tablet, matrix printer, screen camera	No	$31,500	Includes joystick, 64K-byte RAM	431
Wand 7200, graphics primitives, dynamic functions	KBD, joystick, tablet, matrix printer, screen camera	No	$25,000	Includes joystick; 5-color, 16-grey-shade beam-penetration terminal	432
Wand 7200, graphics primitives, dynamic functions	KBD, joystick, tablet, matrix printer, screen camera	No		Includes joystick	433
Wand 7200, graphics primitives, dynamic functions	KBD, joystick, tablet, matrix printer, screen camera	No	$35,000	Includes joystick, 128K-byte RAM	434
Wand 7200, graphics primitives, dynamic functions	KBD, joystick, tablet, matrix printer, screen camera	No	$60,300	Includes joystick, 128K-byte RAM	435
Wand 7200, graphics primitives, dynamic functions	KBD, joystick, tablet, matrix printer, screen camera	No	$40,000	Includes 1 stroke, 1 raster display, 2 KBDs, 2 joysticks	436
Graphics primitives	KBD	No	$2590		437

Resolution has historically been a problem with raster displays, resulting in "jaggies" and "stair-stepping" of diagonal lines.

signals generated by a graphics processor from a display memory of numerical coordinate data. The screen phosphor has a relatively high persistence but still fades quickly, so images must be constantly redrawn. The image is redrawn or refreshed from the display list every 1/30 or 1/60 sec., and user-driven (by

Manufacturer	Model	Introduction date	Display screen; resolution	Displayable colors	Memory (K bytes)
North Star Computers	Advantage		12-in. raster; 640 x 240	1	84
Ramtek	6211	6/81	13-in. raster; 640 x 512	16	46-58
	6212	1980	13-in. raster; 640 x 512	16	46-58
Sanders Associates	Graphic 7		21-in. stroke refresh		
SCION	Microangelo		15-in. raster; 512 x 480	256	
SRA Communications	SEMIGRAF 240	6/78	13-in. raster; 512 x 256	8	
Tektronix	4006	11/75	11-in. storage tube; 1024 x 780	1	No
	4010-1,4012, 4013	1975	11-in. storage tube; 1024 x 780	1	No
	4014-1, 4015-1	1974	19-in. storage tube; 1024 x 780	1	to 32
	4016-1	6/78	25-in. storage tube; 4096 x 3120	1	to 32
	4025A	11/77	12-in. raster; 640 x 462	1	to 64
	4027A	6/78	13-in. raster; 640 x 462	8	to 224
	4051, 4052	1973	11-in. storage tube; 1024 x 780	1	to 64
	4054	4/79	19-in. storage tube; 4096 x 3125	1	to 64
	4112	1980	15-in. raster; 640 x 480	1	to 672
	4113	1981	19-in. raster	8-16	
	4114	1980	19-in. storage tube; 4096 x 3120	1	to 800
Telecrafters	CDT-7001	6/80	13-in. raster; 512 x 256	8	8
	MCD 4001B	1979	13-in. raster; 512 x 256	8	4
Terak	8510/A	1981	12-in. raster; 320 x 240	1	64
	8600	1981	13-in. raster; 40 x 480	64	
TRW-Fijitsu	Facom 9430	9/81	14-in. raster; 1024 x 800	1-8	128
Vector Automation	Graphics 80	2/80	21-in. stroke refresh; 4096 x 4096	1	32-256

1. Dynamic functions: zoom, pan, etc.
2. Virtually all have printer interfaces
3. All prices include keyboard (KBD), standard display, graphics generator, BASIC software, interface, standard memory

light pen, for example) and program changes are reflected with every refresh cycle. Fast deflection circuitry and special graphics processors are used to increase drawing speeds and reduce flicker far beyond the range of write-through storage tubes, but complex image flicker is apparent on even the most expensive systems.

While most vector terminals are monochromatic, two multicolor vector-refresh technologies are available. One, beam penetration, uses a few different-colored phosphors deposited on the tube face. Varying the energy level of the write beam causes it to penetrate a

Software[1]	I/O devices from vendor[2]	Off-line storage	Price[3]	Notes	For more information circle no.
Graphics primitives, dynamic functions, CP/M	KBD, matrix printers	Dual diskettes		Stand-alone μc including diskettes	438
CGL: graphics primitives; dynamic functions	KBD, light pen, tablet, matrix printer, screen camera	No	$5995	Desk-top terminal	439
CGL: graphics primitives; dynamic functions	KBD, light pen, tablet, matrix printer, screen cameras	No	$10,000	Expandable modular terminal	440
CGL: graphics primitives; dynamic functions	KBD, light pen, tablet, matrix printer, screen cameras	No			441
Graphics			$2495		442
Graphics characters, curve generator	KBD	Diskette			443
Plot 10, TCS and IGL: graphics primitives, dynamic functions and applications	KBD, thumbwheel, tablet, joystick, plotters, video copiers	Cartridge tape	$3600	Thumbwheel cursor control	444
Plot 10, TCS and IGL: graphics primitives, dynamic functions and applications	KBD,thumbwheel, tablet, joystick, plotters, video copiers	Cartridge tape	$5900	Thumbwheel cursor controls; 4012 adds lower-case characters; 4013 adds APL characters	445
Plot 10, TCS and IGL: graphics primitives, dynamic functions and applications	KBD, thumbwheel, tablet, joystick, plotters, video copiers	Cartridge-tape diskette	$1475	Both units feature write-through; 4015 has APL characters for $16,900	446
Plot 10, TCS and IGL: graphics primitives, dynamic functions and applications	KBD, thumbwheel, tablet, joystick, plotters, video copiers	Cartridge-tape diskette	$18,000	Includes write-through	447
Plot 10, TCS and IGL: graphics primitives, dynamic functions and applications	KBD, thumbwheel, tablet, joystick, plotters, video copiers	Cartridge-tape diskette	$5200		448
Plot 10, TCS and IGL: graphics primitives, dynamic functions and applications	KBD, thumbwheel, tablet, joystick, plotters, video copiers	Cartridge-tape diskette	$10,000		449
Plot 10, TCS and IGL: graphics primitives, dynamic functions and applications	KBD, thumbwheel, tablet, joystick, plotters, video copiers	Cartridge-tape diskette	$6295	Faster than 4010; 4052 is $9900	450
Plot 10, TCS and IGL: graphics primitives, dynamic functions and applications	KBD, thumbwheel, tablet, joystick, plotters, video copiers	Cartridge-tape diskette	$20,100	Continuous write-through optional	451
Plot 10, TCS and IGL: graphics primitives, dynamic functions and applications	KBD, thumbwheel, tablet, joystick, plotters, video copiers	Cartridge-tape diskette	$9600		452
Plot 10, TCS and IGL: graphics primitives, dynamic functions and applications	KBD, thumbwheel, tablet, joystick, plotters, video copiers	Cartridge-tape diskette	$16,500	Includes diskettes	453
Plot 10, TCS and IGL: graphics primitives, dynamic functions and applications	KBD, thumbwheel, tablet, joystick, plotters, video copiers	Cartridge-tape diskette	$17,500	Includes write-through	454
Graphics characters, graphics primitives	KBD	No	$6600	Extended graphics optional	455
Graphics characters, graphics primitives	KBD, joystick, light pen, trackball, matrix printer	Diskette	$7500	Extended graphics option is $5000	456
Graphics primitives, dynamic functions	KBD	Diskette	$8350	Includes diskette	457
Graphics primitives, dynamic functions	KBD, joystick, DEC-compatible printers	No	$16,500		458
Tektronix 4012-compatible	KBD, light pen, thermal printer	Diskette	$7490	Includes light pen; optional color display is 512 x 400	459
Graphics primitives, dynamic functions	KBD, light pen, tablet, joystick, video copier, matrix plotter	No	$24,500		460

Technologically, the future for graphics looks rosy even in the computer industry, in which increasing price/performance ratios are the rule rather than the exception.

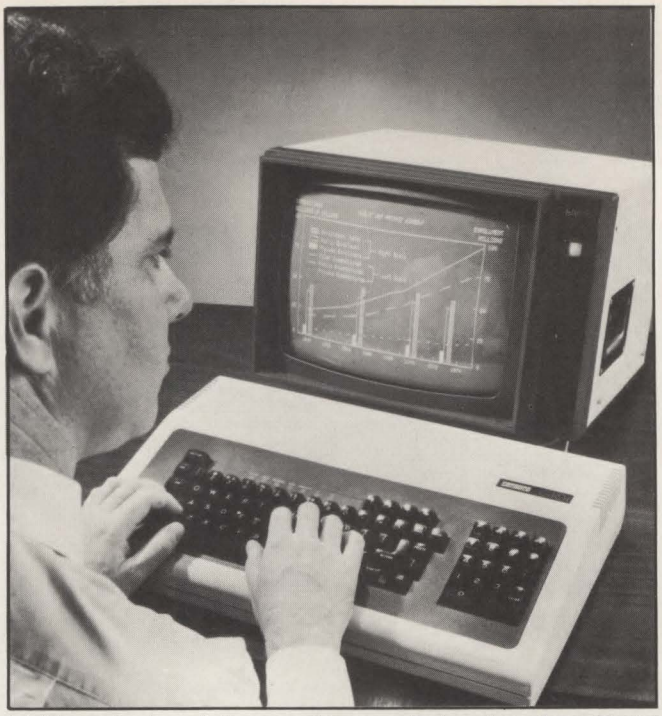
few levels of phosphor and produce dim but multiple colors. The second method, a hybrid technology, uses three write guns with supporting circuitry along with a three-color triad phosphor mask like those found on color TV sets. Evans and Sutherland Co. uses this hybrid technology in its inexpensive CAD/CAM systems, but, like most other color stroke-refresh technologies, its price makes it inappropriate for general-purpose graphics terminals. Vector-refresh systems have great resolution, brightness and interactivity, but suffer from some flicker and low color adaptability. The most expensive stroke-refresh systems overcome these problems with more and faster electronics and memory, but low-priced improvements remain in the future with the availability of inexpensive 16- and 32-bit graphics processors and 64K RAM chips.

Raster-scan terminals draw images as a series of horizontal scan lines. A write beam sweeps the screen from left to right, energizing points called pixels on that row of the phosphor screen. At the end of a scan line, the beam is turned off and returns to the left side of the screen one scan line down, much like the return action of a typewriter. After the last line has been drawn, the beam is repositioned in the upper left corner of the screen and a new series of scans begins.

Some raster-scan displays use an interlaced scanning technique. In these displays, the first set of scans draws half the image on every other scan line and then returns to the top of the screen and draws the rest of the image on the even-numbered lines. This method takes two passes to draw one image but results in less perceived flicker. The refresh rate of a raster display usually corresponds to the AC power frequency the terminal uses, giving most non-interlaced displays a 60-Hz refresh rate and most interlaced displays a 30-Hz rate.

The data displayed in a raster-scan system are stored in a memory called a bit map. A single bit map provides 1 bit of memory for every point on the screen. Because a bit can have a 1 or 0 value, it can turn the constantly scanning write beam on or off at 1-pixel intervals to provide a black-and-white image. By making the display list many bits "deep," that is, by describing each pixel with many bits, pixels can have attributes such as gray scale, blinking and color.

Resolution has historically been a problem with raster displays, resulting in "jaggies" and "stair stepping" of diagonal lines. Raster-scan devices offer easy color capability, good brightness and selective erase. Raster-tube technology and memory prices have made 1024 × 1024 point terminals affordable and 512 × 512 point terminals less expensive than storage tubes. As tube technology improves and memory prices fall, 2048 × 2048 and 4096 × 4096 raster terminals will become commercially possible, and the raster-scan tube's resultion will be good enough for virtually all graphics applications.



Intelligent keyboard: New graphics terminal package from Digital Equipment Corp. *specifically designed for the education market provides economical interactive graphics. Called GIGI (General Imaging Generator and Interpreter), the unit is packaged in a keyboard that can be used with a user-supplied video monitor to make a terminal for use with DEC's PDP-11, VAX-11 and DECsystem-20 computers. GIGI has both color and black-and-white capabilities, depending on the monitor used.*

Secondary I/O devices

While graphics terminals use different technologies for display or soft-copy output, they share a common primary input device: a typewriter keyboard augmented by one or more pads of function keys for cursor control and graphics. The two most common secondary input devices are joysticks and light pens. Joysticks, similar in appearance and function to airplane controls of the same name, move the cursor in the direction a user pushes it. Light pens allow users to pick up the cursor and move it around the screen, and to "write" on the display screen. Other analog I/O devices include the trackball, a stationary ball that is rolled to move the cursor, and the mouse, which a user wheels around a table to generate similar cursor movements.

Hard-copy devices that are most important for graphics terminals include pen plotters, matrix printer/plotters and CRT copiers. Like display prices, hard-copy-device prices vary with resolution, speed and color capability. Most such devices connect through standard interfaces and should be chosen on the basis of quality, price and intended application, not necessarily because they are made by the terminal vendor.

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Until recently, graphics-terminal manufacturers offered little if any applications software and constantly changing, poorly documented firmware and system software.

The final hardware component of a graphics terminal is its local storage (not display memory). Most graphics-terminal vendors offer some combination of Winchester-disk, floppy-disk, cartridge-tape or tape-cassette storage. Users should buy only as much local storage as they need and should rely on their minis or mainframes for off-line storage in the same way that most graphics terminals rely on them for memory and processing. Secondary I/O and storage options are to graphics terminals what air-conditioning and power steering are to automobiles: former convenience options that users have come to rely on but often eliminate for financial reasons.

Software makes hardware practical

Buyers of expensive turnkey graphics systems are usually offered comprehensive software from their hardware vendors or have the in-house expertise to develop graphics routines using FORTRAN or assembly language. Until recently, graphics-terminal manufacturers offered little if any application software and constantly changing, poorly documented firmware and system software. Most graphics-terminals makers provide a graphics-programming language that offers a set of graphic commands or primitives, such as "circle," "bar," "fill" and "label." A number of independent software houses offer CAD/CAM packages to run on popular terminals (MMS, September, p. 24). Popular business graphics software packages are available from ISSCO (Displa, Tel-A-Grah), SAS Institute (SAS/Graph) and a number of major time-sharing houses. Programs such as VisiCalc, which combine graphics functions with statistical routines for regressions, curve smoothing and trend projections, are optimized for general-business applications, while others add symbol creation functions for design and process monitoring.

Standardizing graphics hardware and interfacing has come slowly, despite the efforts of SID, EIA, IEEE, ANSI and others. But graphics software is becoming standardized along guidelines developed by the Association for Computer Machinery's special interest group for graphics (ACM/Siggraph). Many of the major graphics hardware vendors have embraced the Siggraph core standards, which standardize common graphics functions and their labels as a step toward device-independent graphics software. Standardized device-independent software will allow many users to program their own systems and exchange software more freely.

A glowing future

The same forces that made businessmen advocate distributed data processing will make them advocate distributed graphics terminals over centralized graphics systems. They will demand standardized high-level graphics programming languages just as they demanded higher level programming languages for minicomputers in the early 1970s. Executives will use field service and reliability as buying criteria just as they do when purchasing any other expensive and indispensable piece of office equipment.

DISPLAY TECHNOLOGY TRADE-OFFS

Feature	Storage tube	Vector scan	Raster scan
Resolution	high (to 4096x4096 points)	high (to 4096x4096)	low (to 1024x1024)
Flicker	low	high	low
Brightness	low	high	high
Selective erase	some	yes	yes
Color capability	none	some	yes
Cost	low	medium to high	low to medium

While large CAD/CAM systems will remain as diverse as ever, business graphics systems will be designed for two major applications: information graphics and presentation graphics. Information graphics, also called data-display graphics or chart graphics, will be provided by very inexpensive (less-than-$10,000) systems with a desk-top keyboard-display package, business software, such as VisiCalc, and a hard-copy device. These systems will explore and solve everyday management and planning problems and will be as common as office copiers. They will use low- to medium-resolution (typically 512 × 512) raster displays to provide eight or more colors at a low price.

Presentation-graphics terminals will use raster and stroke-refresh technology to achieve display resolution worthy of corporate war-room presentations. They will offer more advanced 3D graphics functions, hard-copy units for true camera-ready output and more simultaneous colors. Presentation-graphics terminals will be correspondingly more expensive and less numerous. While simple chart-graphics terminals will be widely dispersed through executive offices, presentation-graphics terminals will be shared by many users and will be concentrated in corporate graphic-design departments.

The evolution of graphics terminals will depend on display technology improvements, falling component costs and the development of standardized high-level graphics software. As business becomes the largest customer for graphics terminals, terminal vendors will start to customize their products for daily and presentation-graphics applications. ■

Patrick Kenealy is an editor of Terminals Review and Display Pricing Strategy Service, published by GML Corp., Lexington, Mass.

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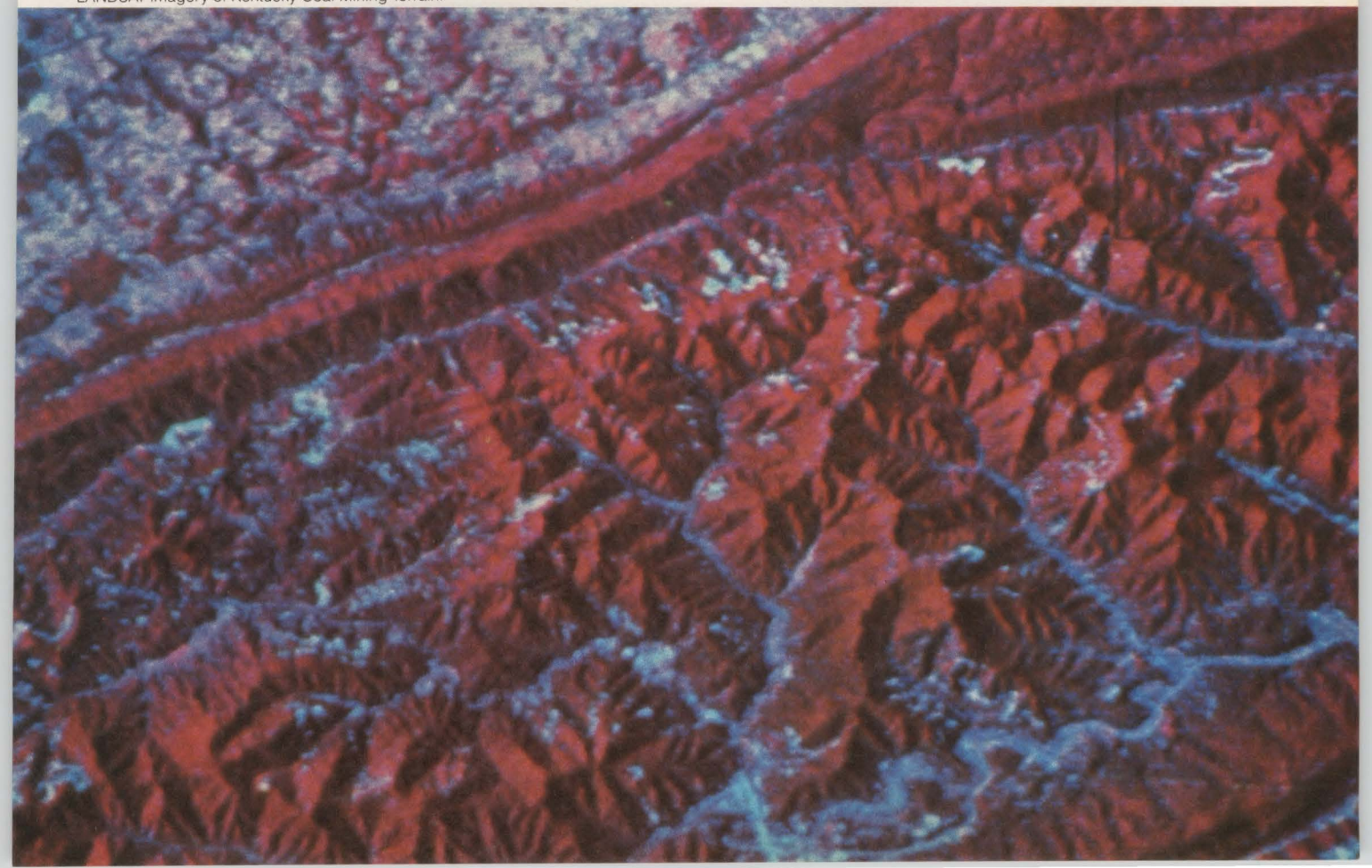

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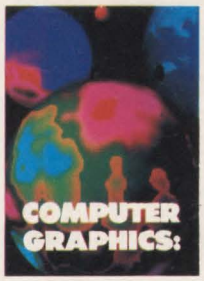


Selecting a high-performance color display

HOWARD OKAMOTO, Ramtek Corp.

Raster scan, with its high resolution and color capability for 3D representation, is finding an increasing number of applications

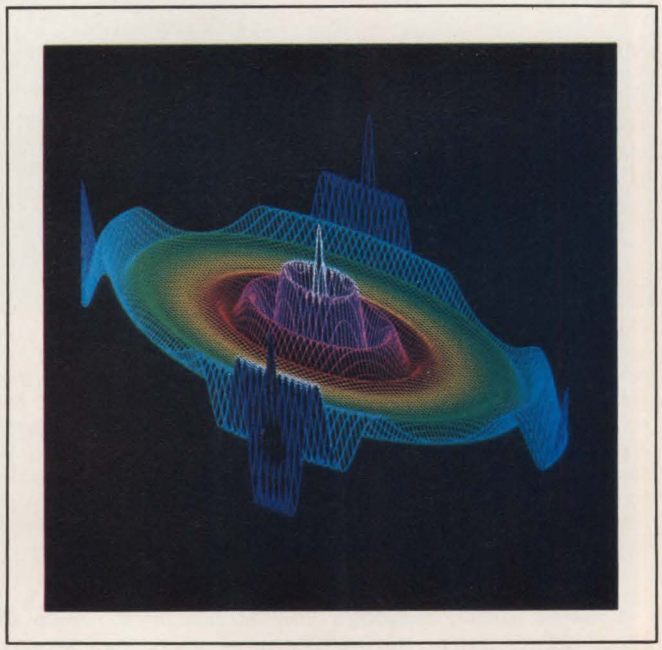
Display technologies can be classified into four major categories, with a number of features influencing their performance. It is vital to know the trade-offs involved in each to select the best display for an application.

Each of the display technologies—storage tube, stroke writer, plasma panel and raster scan—uses either random or point-by-point addressing.

Display technologies and addressing approaches

Storage tubes magnetically deflect an electron beam to "pencil in" an outline of an image on the face of a CRT-terminal screen. The image is stored on the face of the tube in phosphors, which glow when excited by the beam. The storage tube uses random addressing, allowing it to draw diagonal vectors and curves smoothly.

The storage tube's principal disadvantages are minimal color, dimness and, in some cases, the inability to modify part of the image without entirely redrawing it, which can take as long as 1 min. for complex displays.



Two high-resolution applications *are imaging, which is represented by the photo of one of Jupiter's moons taken from the Voyager I spacecraft (l.), and a line-drawing of a wire basket. These examples employ 1000-line, high-resolution monitors.*

Storage tubes magnetically deflect an electron beam to 'pencil in' an outline of an image on the face of a CRT-terminal screen.

Also, tube life is short—typically 2000 hours—and CRT-terminal replacement is expensive.

Stroke writers also use random addressing, except here, the picture is constantly redrawn (refreshed) from memory.

This constant refreshing means a brighter, more interactive image—ideal for modeling, simulation and other applications in which 3D objects are drawn in outline form, or in which rotating movement must be shown. The trade-off is increasing flicker, the result of a slowing refresh rate as more vectors are added to the screen. Limited color, an expensive option, is a recent addition to stroke-writer technology.

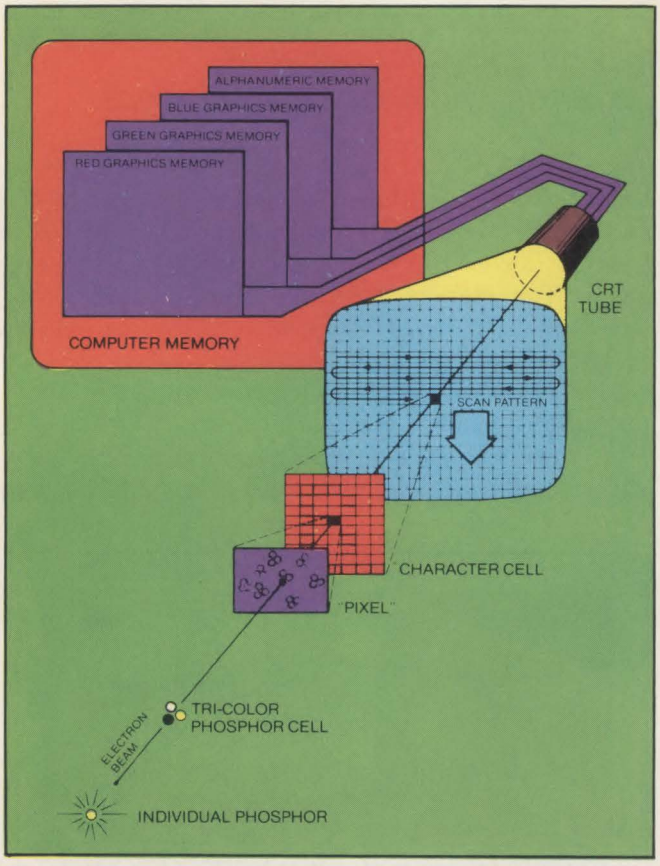


Fig. 1. The color-raster monitor *comprises the video interface electronics and CRT. In combination a raster-scan pattern is traced across the face of the tube. A pixel is the smallest distinguishable area in an image displayed on a CRT monitor, and the greater the number of pixels, the higher the resolution. In color systems, each pixel consists of three points of phosphor: red, green and blue. An electron beam, or gun, sweeps the screen top to bottom, one line at a time. At each address, it turns on or off, singling out one color of phosphor at a designated intensity, thus building the image, graphic or alphanumeric information required.*

Plasma panel displays consist of three layers of glass plates, with the middle layer containing closely spaced holes filled with gas. Electrical conducting strips on the two outer plates cause the gas to glow at selected points. Plasma displays are limited to one color and have lower resolution than other technologies. However, these rugged and flat panels are well-suited to the severe mechanical stresses of military applications.

Raster-scan technology uses an electron beam to scan across and down the screen, turning on and off at addressable points. Raster scan is the only one of the four technologies to offer an almost-unlimited palette of colors and gray-scale values. Furthermore, raster devices can reproduce solid objects. They cannot, however, handle rapid motion as well as stroke writers because raster scan must redraw an entire screen, while stroke writers re-draw only the elements being altered.

Raster-scan uses either point-by-point or character-graphics addressing. Point-by-point (bit-mapped systems) address individual pixels; character graphics address character blocks.

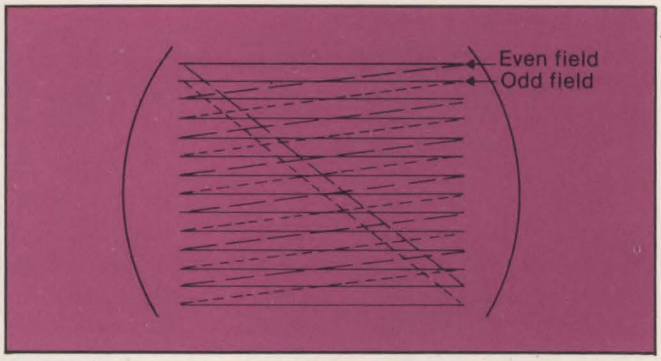


Fig. 2. In the interlaced pattern traced by a raster monitor, *the electron gun scans the lines of the even and odd fields in alternate passes down the face of the CRT screen. In a repeat field, or non-interlaced pattern, the same lines are refreshed each time.*

Performance criteria

All four display technologies center on resolution and speed. Raster-scan performance criteria, however, also include interlacing, phosphor persistence, flyback time, pixel rise time, video bandwidth and underscanning/overscanning.

Resolution, the ability to address and resolve individual dots, is expressed as the number of pixels across a horizontal line and down a vertical row. Resolution of 256 × 256, or 65,536, is considered low. High-resolution color is 1280 × 1024, or 1,310,720, pixels.

Interlacing occurs when each set of alternate phosphor rows ("fields") is refreshed at every second pass of the beam, providing higher image addressability. If the same lines of the CRT are refreshed each time, the monitor is said to be operating in the repeat-field (non-interlaced) mode. A monitor in the non-interlaced mode has less flicker, but also lower resolution.

Applications that display many closely spaced horizontal lines, especially if they are to be viewed under fluorescent light, are more prone to flicker. Designers gain increased resolution at the cost of increased flicker; hence, the choice of interlaced or non-interlaced

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To minimize flicker, most monitors for graphics applications match phosphor persistence to the refresh rate.

monitor depends on the application. Some monitors operate in either mode.

To minimize flicker, most monitors for graphics applications match phosphor persistence to the refresh rate. On the other hand, imaging systems often use short-persistence phosphors to permit rapid image motion without "smearing" the image on the screen.

Flyback time is a measure of how long it takes for the electron beam to return from the left side of the screen at the end of each row of pixels (horizontal flyback), or from the bottom right corner to the top left corner of the screen at the end of each field (vertical flyback).

Rise time is a measure of how long it takes for the electron-beam voltage to reach its peak and excite the phosphor dot completely. Rise time must be fast enough to reproduce horizontal and vertical lines at equal intensities. State-of-the-art rise time is about 7 nsec. (Fig. 3).

Video bandwidth requirements are more stringent for digital systems than for analog systems. In analog systems, bandwidth need equal only the highest fundamental frequency of the video signal. Designers should look for video bandwidth that can pass the odd harmonic frequencies—at least the third, preferably the fifth—while simultaneously suppressing even frequencies. This will produce the required sharp-pixel rise time.

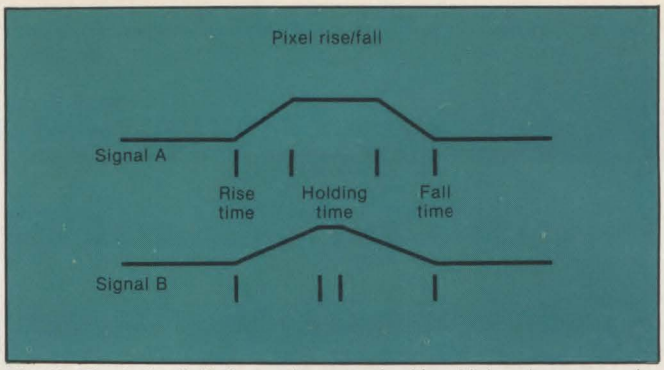

Fig. 3. Pixel rise/fall time—*the speed with which a beam can be turned from off to desired intensity and back to off—directly affects monitor picture quality. Signals A and B have the same total pixel time, but B, with its longer rise time and shorter holding time, fails to excite the phosphor fully. This failure causes a variation in the brightness of the vertical lines. The true throughput of a monitor is a function of the pixel rise/fall time and the horizontal/vertical retrace time.*

Underscanning/overscanning is the amount of an image visible on screen. Broadcast TV operates in an overscan mode, in which the image shown on a TV is bigger than its screen. For computer graphics, all information must be contained on the screen. ■

Howard Okamoto is director of business development, Ramtek Corp., Santa Clara, Calif.

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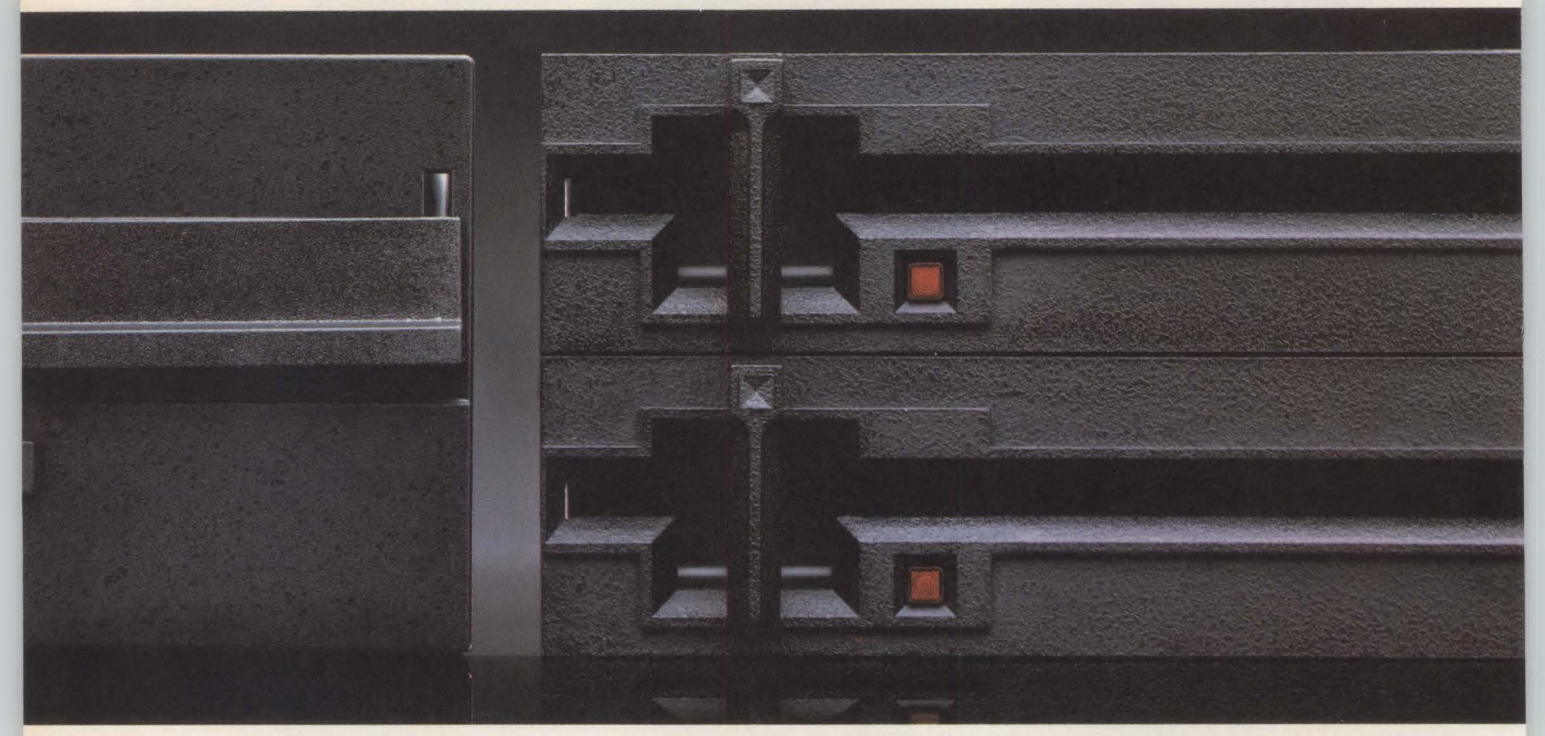

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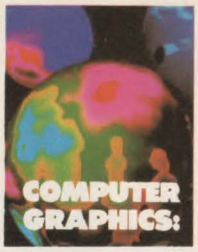


Using raster scan in color graphics

LOUIS DOCTOR, STEPHEN COIT, Raster Technologies

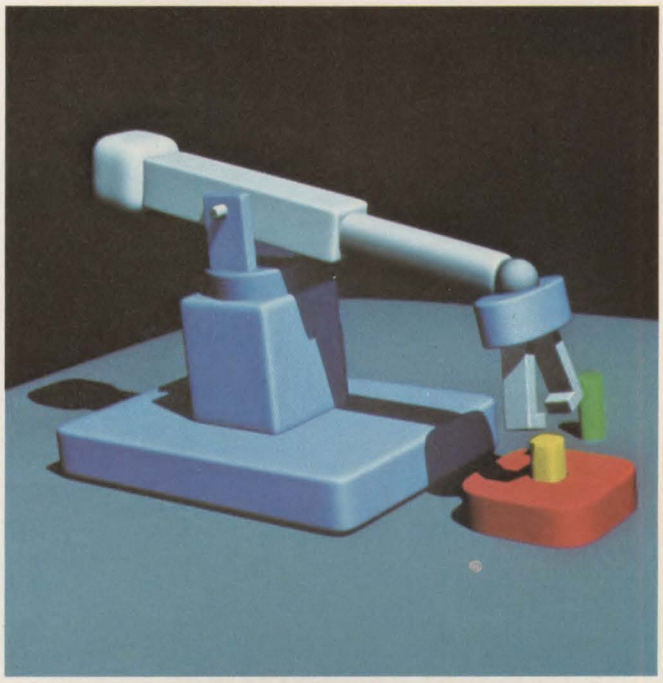
Lower costs of new raster-based systems will open new applications, including office automation, entertainment, advertising and education

New applications of computer graphics, such as solids modeling for CAD, land-resource analysis and computer animation, are merging conventional line-drawing techniques with those of image processing and image snythesis. To support these applications, Raster Technologies' Model One raster-scan color-graphics controller uses a 64K RAM architecture that incorporates a dual-mode image memory system with a display technique called pixel-averaging, a hardware pixel arithmetic-logic unit (PALU) and other hardware and firmware performance assists.

Examining the architecture

In operation, Model One forms the heart of an interactive computer-graphics work station. The work station is configured with a display controller, a high-resolution color CRT terminal, local interactive devices and a host computer interface (Fig. 1). The application program resides in the host computer system and sends data to and from the display controller to update and control the displayed image and communicate with the interactive devices at the work station.

The heart of the Model One controller is a 16-bit Z8002 CPU (Fig. 2). Imaging and line-drawing applications on 1024 × 1024 arrays require arithmetic processing on 9- or 10-bit coordinates. An 8-bit μp isn't fast enough for these applications, but the register-oriented Z8002 is optimized for the fast register-to-register arithmetic required for coordinate computations.



Shading and shadowing enhance the 3D presentation of objects *such as this robot arm. The imaging mode of Raster Technologies' Model One allows selecting from 16 million hues and intensities to help achieve this effect.*

To supply the image-memory capacity necessary for high-performance graphics applications at economical per-bit costs, Model One uses 64K RAM chips. Graphics applications have been demanding increasing amounts of image memory, yet the cost-per-bit of these image

The color photos in this article were taken directly from a Raster Technologies Model One display processor using a Dunn Instruments model 631 camera at the Center for Interactive Computer Graphics, Rensselaer Polytechnic Institute, Troy, N.Y.

Dual-mode resolution enables a 500-line video monitor to be used for line-drawing and imaging applications.

memory systems has been high because of the use of the industry-standard 16K × 1 RAM chips. In the quantities required for imaging graphics, 16K RAMs demand a substantial amount of PC-board space and power.

The 64K × 1 RAM chip offers significantly reduced cost-per-bit for the overall system, plus a significant saving in PC-board real estate. But the RAM chip poses a design problem: As the number of chips in the memory system is reduced, the number of bits that can be accessed in parallel also drops (Fig. 3). In the case of 64K RAMs, screen refresh alone results in having to read from the image memory so often that image memory is unavailable for update more than 70 percent of the time.

Model One overcomes this problem with a single-ported memory architecture that uses every available screen-memory cycle. Screen memory has two tasks: to refresh the display and to receive updates from the system. Performing both jobs is a problem using 64K RAM bandwidth, which is only one-quarter the bandwidth of a 16K RAM-based system.

The solution lies in the efficient use of the internal timing of the raster display, which spends 70 percent of its time writing horizontal scans. During this period, the image memory must be available for display refresh. The remaining 30 percent of the time is "blanking time"—when the beam is off while it is being moved to a new position for another write—and is used to update the memory image. During these intervals, Model One performs reads, writes and other system functions. But because these intervals are so short,

Examples of full-color imaging using 24-bit-per-pixel resolution. *These "super-quadric" solids are building blocks for complicated sold shapes used in mechanical CAD.*

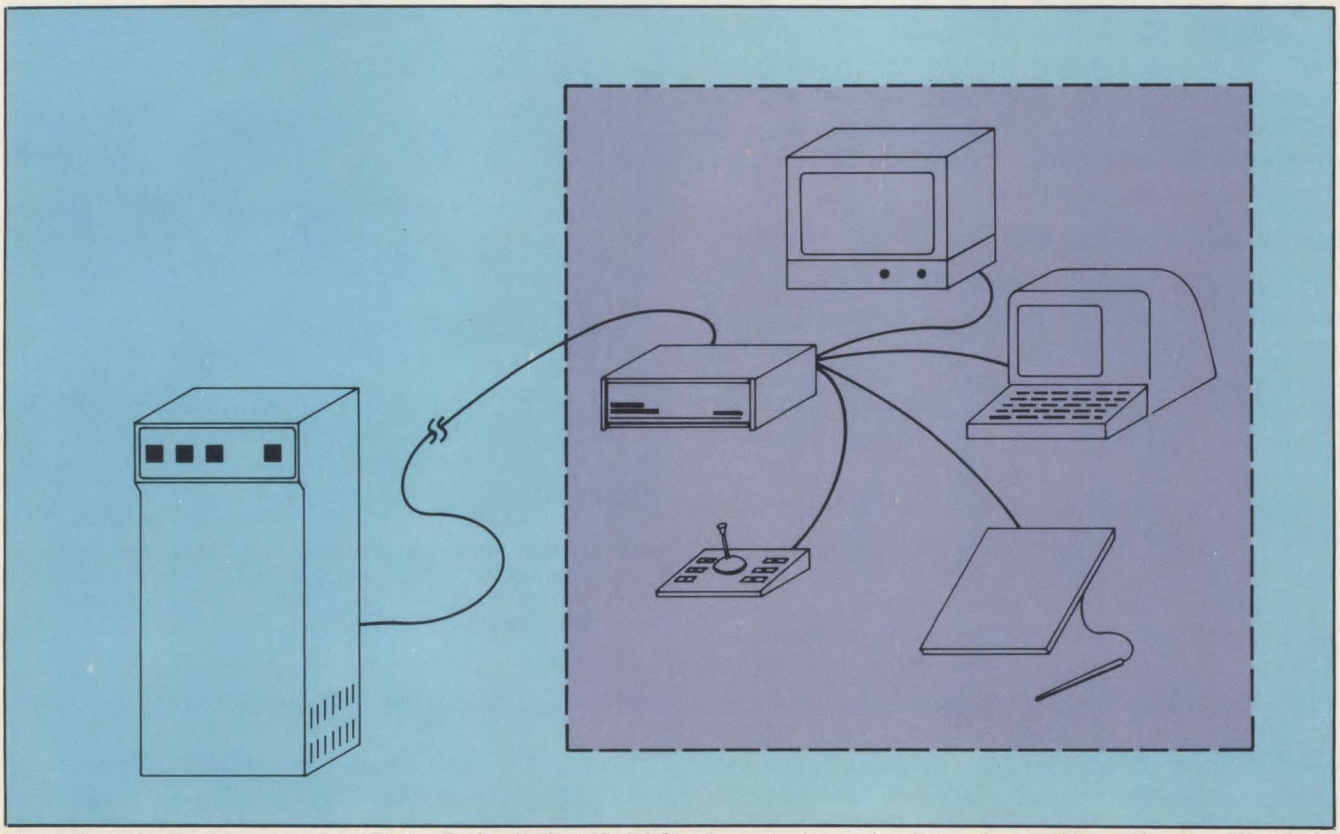


Fig. 1. A display processor such as Raster Technologies' Model One *forms the heart of an interactive graphics work station. The display processor receives a command stream from the host computer and thereby updates the displayed image and controls the local interactive devices. The display controller off-loads the host computer by providing local intelligence and a rich graphics command set.*

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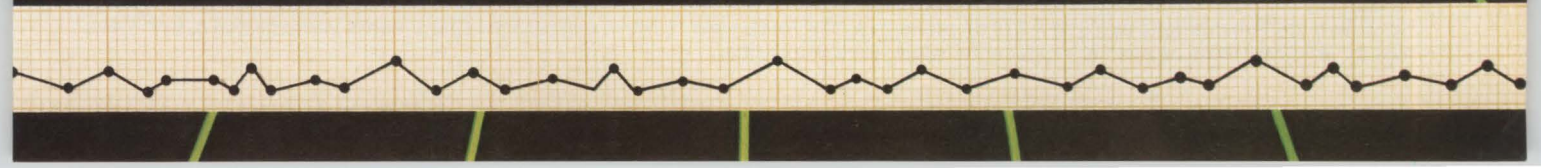
Variance:

$$V(Y|X) = V\left(\sum_{j=1}^{K}\beta_j X_j + \epsilon\right) = V\left(\sum_{j=1}^{K}\beta_j X_j\right) + \sigma^2$$

$$= \sum_{j=1}^{K} X_j^2 V''(\beta_j) + \sum_{i=1}^{K}\sum_{\substack{j=1 \\ i\neq j}}^{K} X_i X_j \mathrm{cov}''(\beta_i, \beta_j) + \sigma^2$$



To answer the need for both high-resolution line drawing and full-color imaging, Model One uses a dual-mode image memory.

extremely fast vector generation is required.

Vector generation is traditionally performed in firmware or software. Model One, however, uses a hardware vector generator to achieve the performance needed for its memory architecture by off-loading the iterative process of digital line generation from the CPU. The average writing rate of 1.45 μsec. per pixel—faster than firmware or software designs—is an added benefit because vector-writing commands are among the most frequently used in graphics applications.

Application-development flexibility is especially critical for a system serving diverse graphics markets. Model One offers application-development tools, including a translator that monitors the commands Model One receives, and single steps through the command stream. In addition, Model One supports a 3D CORE-standard FORTRAN library to maintain industry software compatibility.

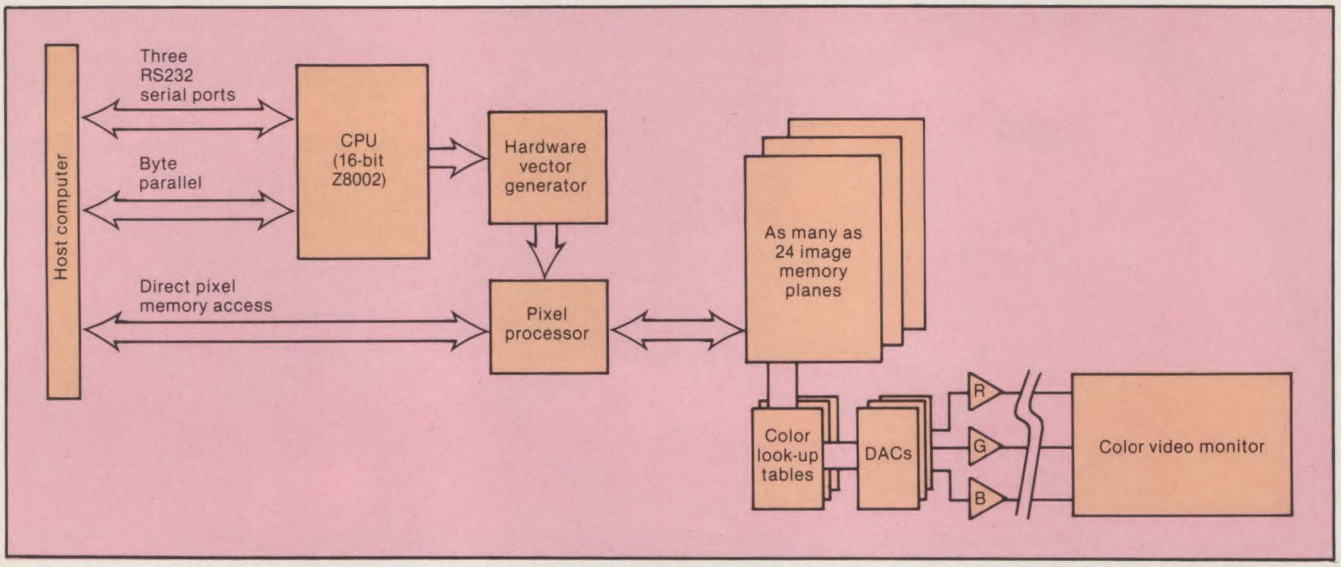


Fig. 2 Internal architecture of the Model One *is based on a 16-bit Z8000 μp and an image memory of as much as 768K bytes using 64K RAM chips.*

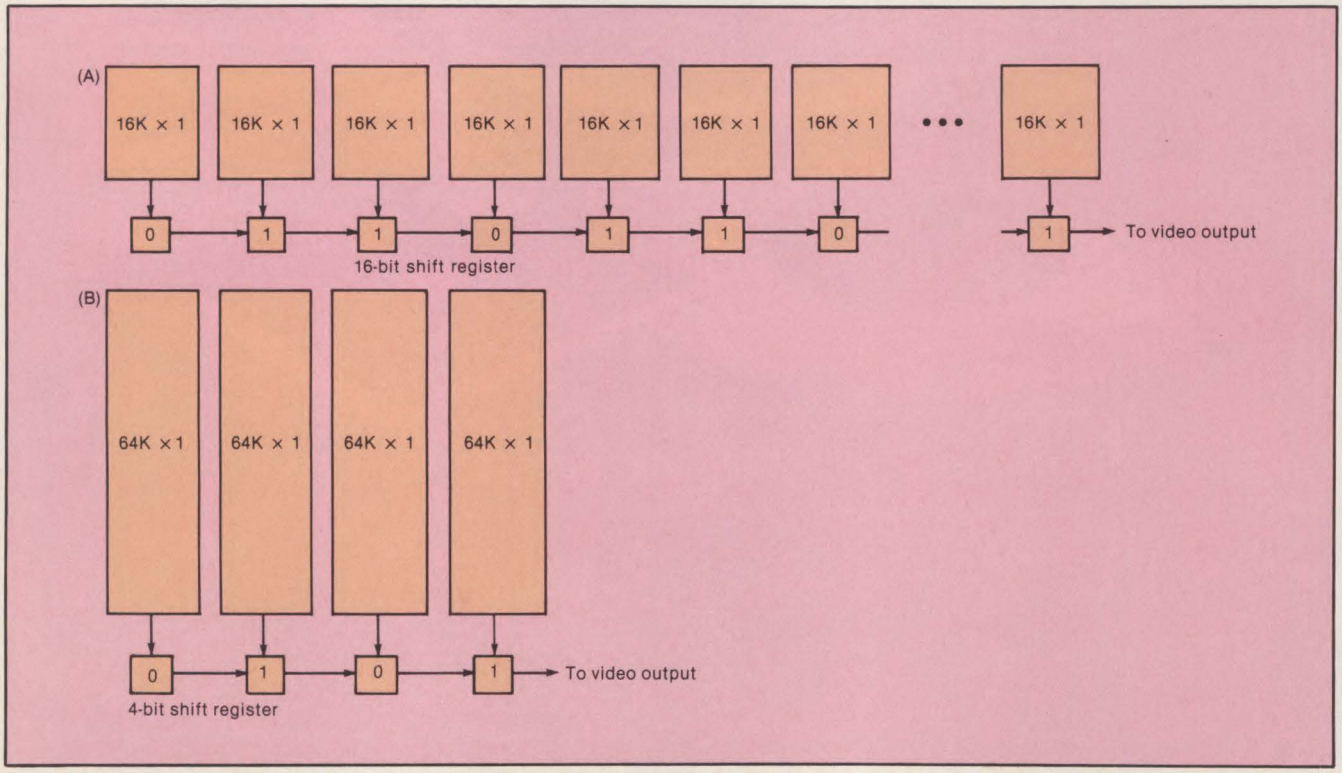


Fig. 3. Two implementations of a 512 × 512 bit plane. *In* **a,** *16K RAMs yield 16 bits in parallel each time a read is performed. In* **b,** *64K RAMs must be read four times as often to produce the same video output rate.*

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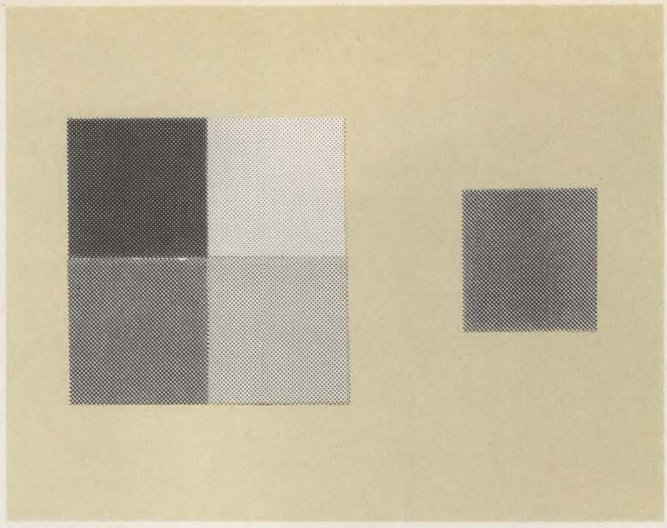

Fig. 4. Pixel-averaging is used to compress digitally encoded image data *into fewer pixels for display. By applying pixel-averaging to a 2 × 2 array of pixels from the 1024 × 1024 array, the resulting 512 × 512 image retains most of its information and, therefore, still produces a high-quality display on the video monitor.*

Dual-mode image memory

Model One enables users to select, via software, one of two memory-image array configurations for line-drawing or imaging. Many electrical and mechanical CAD applications call for high-resolution line drawing with only limited use of color. Many new applications also must be able to use the display controller as a full-color imaging system, with a richer array of colors and intensities. For line drawing, a 1024 × 1024 × 6-bit memory image is appropriate, but for full-color work, a 512 × 512 × 24-bit memory configuration is frequently required. A growing number of hybrid applications, such as solids-modeling, benefit when both configurations are available in one system.

To answer the need for both high-resolution line drawing and full-color imaging, Model One uses a dual-mode image memory. In one mode—line-drawing—image memory is a 1024 × 1024 high-resolution array, 6 bits deep. This configuration provides 64 simultaneously displayable colors, adequate for most line-drawing and presentation-graphics applications.

In the imaging mode, the memory is a 512 × 512 array, 24 bits deep. In this configuration, Model One provides a choice of 16 million color hues and intensities, thus meeting the needs of applications in which smooth-shaded objects are represented or complex image-processing techniques are used.

A FORTRAN-callable subroutine switches Model One from one mode to the other, permitting graphics-application developers to include both line-drawing and imaging components in application software. When the mode-change call is issued, Model One automatically performs three operations. It shifts the coordinate address space for (−256, +255) to (−511, +512) or

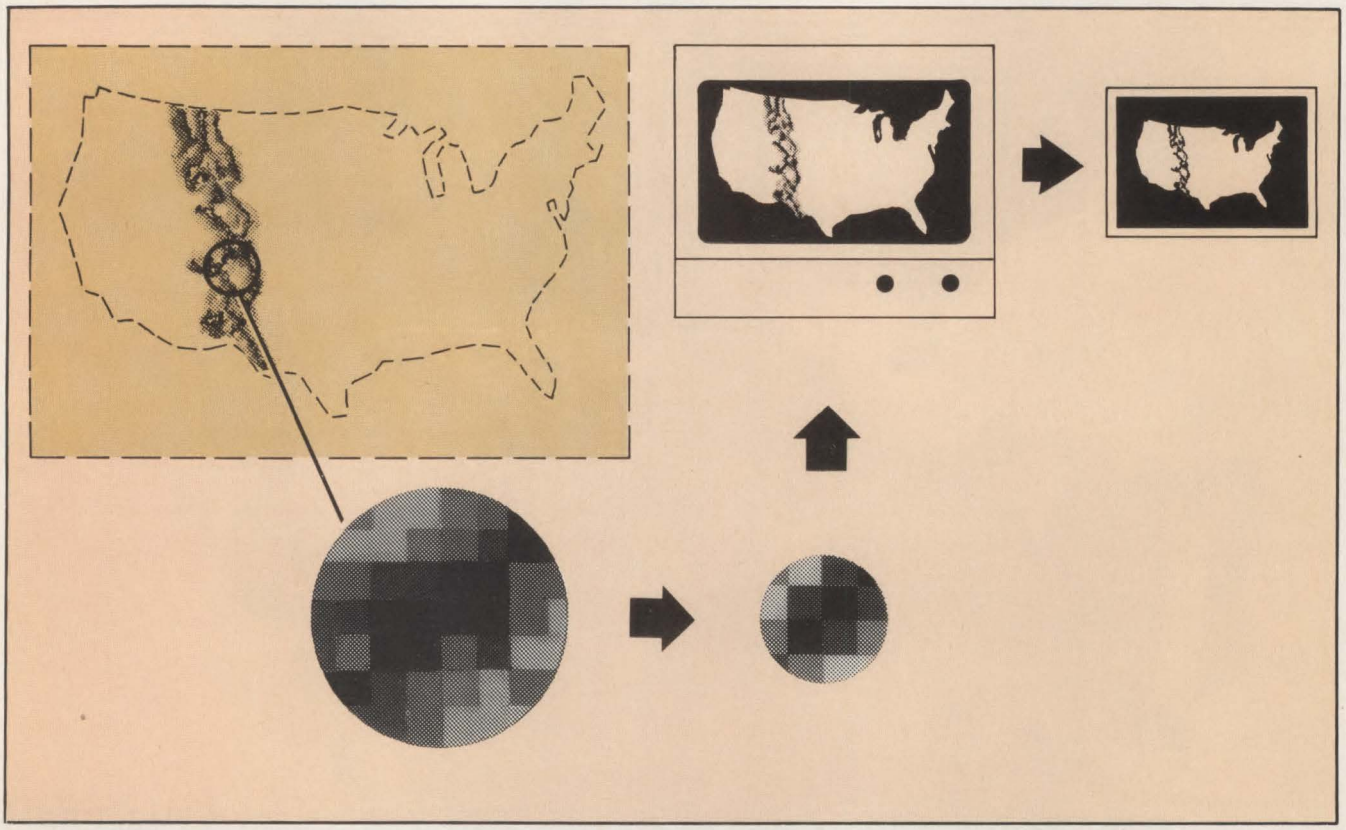

Fig. 5. Pixel-averaging permits a 500-line video signal to display an entire 1024 × 1024 pixel array. *The image that results often exhibits some degree of anti-aliasing and can produce better hard-copy output.*

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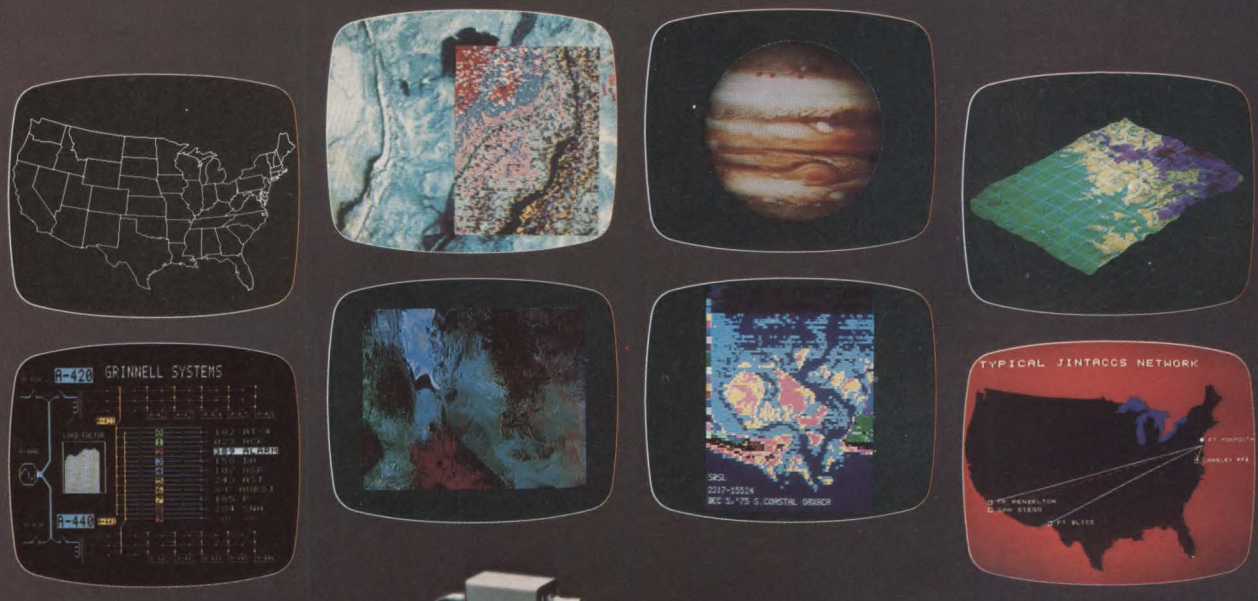

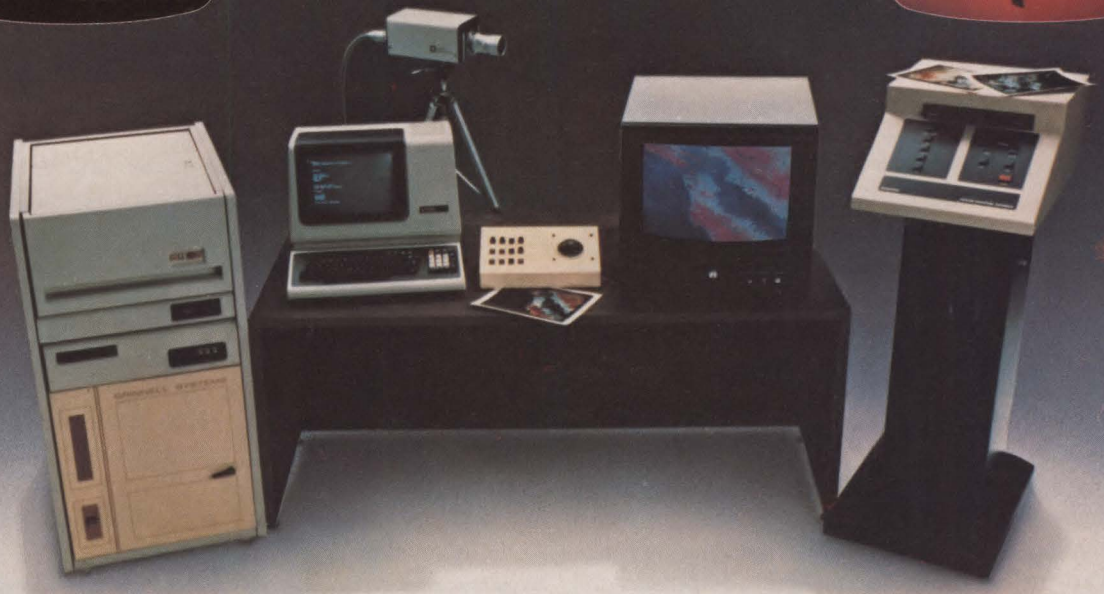

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Model One provides standard hardware zoom factors of 1:1, 2:1, 4:1 and 8:1.

vice versa); it shifts from accepting 24 bits of color to accepting 6 bits (or vice versa); and, for a 1024 × 1024 array that will be viewed on a 500-line video monitor, it begins pixel-averaging the display.

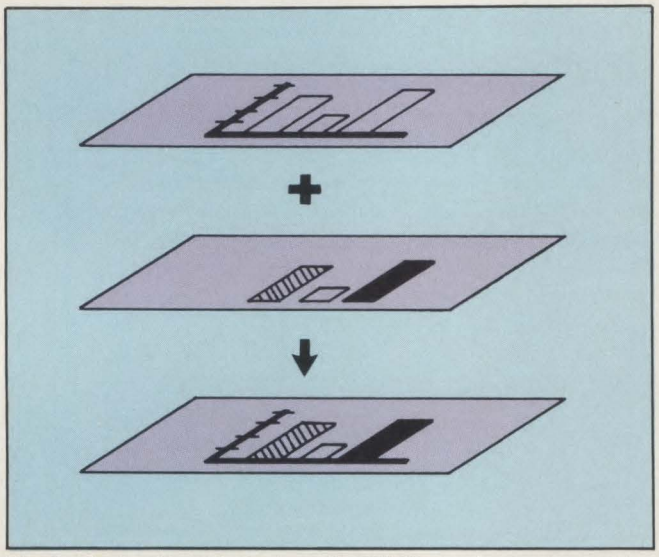

Fig. 6. Pixel arithmetic-logic unit (PALU) *can be used to add or subtract component parts of an image. Other logic functions, including AND, OR and Exclusive-OR, are helpful in manipulating bit planes in image memory.*

Pixel-averaging

Dual-mode resolution enables a 500-line video monitor to be used for line-drawing and imaging applications. The 500-line display can cause difficulty when using the 1024 × 1024 addressing mode: only one-fourth of the information content of a 1024 × 1024 pixel image array can be displayed on the 512 × 512 video monitor.

To display a 1024 × 1024 pixel array on a 500-line video display monitor, the Model One uses pixel averaging. In this process, a 2 × 2 array of adjacent image memory pixels are intensity-averaged to form a single screen pixel for display. In this way, the entire 1024 × 1024 array can be viewed on the 512 × 512 display (Figs. 4 and 5).

The pixel-averaged display has many of the characteristics and advantages of a 1000-line output medium. To users who must retain broadcast compatibility or those with price-sensitive, high-resolution applications such as presentation graphics, pixel averaging results in a lower system cost and an increase in funtionality. Because Model One supports pixel averaging in hardware, no changes to the applications program are required; the technique is transparent to applications designers and system end users.

Model One also provides standard hardware zoom factors of 1:1, 2:1, 4:1 and 8:1. In 1024 addressing mode, at all scale factors other than 1:1, hardware pixel-averaging is unncessary because a 512 × 512 or smaller window can be displayed on the 500-line CRT directly. Pixel replication is not performed on the first level of zoom (from 1:1 to 2:1) as the display changes automatically from the pixel-averaged 1024 × 1024 window to the 512 × 512 pixel-wide window.

Pixel arithmetic-logic unit

Imaging and general-purpose graphics applications frequently require that a simple arithmetic or logic function be performed between image memory bit planes and incoming pixel values to supplement the default insertion mode for incoming pixel values. The most common of these functions are addition, subtraction, logical AND, OR and Exclusive-OR. Arithmetic and logic operations are useful in performing nondestructive or temporary writes (Fig. 6).

Pixel arithmetic could previously be performed in the host (resulting in a substantial I/O bottleneck), in software resident in the display processor (at the expense of speed) or by a special-purpose image processor in a stand-alone image-processing system.

In Model One, the pixel arithmetic-logic unit (PALU) performs this function. The PALU gives Model One faster execution of the most commonly used pixel functions and entry into more complex pixel-processing operations, such as depth-buffer algorithms for hidden-surface removal and image-processing problems.

The PALU functions of Model One benefit designers of interactive applications by providing the write-through modes useful for rubber-banding and drag. In addition, imaging and animation applications can use the add and subtract modes for local intensity manipulation.

Moving beyond traditional markets

New raster-scan architectures such as that of Model One, using state-of-the-art hardware available at low cost, will significantly reduce application-dependent compromises between resolution and color quality. Along with advances in display monitors, raster-scan systems promise to combine full-color, high-resolution, high-performance vector generation and imaging capabilities with strong interactivity—and all at a low per-station price.

The high price of graphics devices has limited their use so far to applications with quick payback: CAD, land-resource imaging and medicine. The low price of newer raster-based systems—Model One sells for $10,800 to 18,800—will open new applications, such as office automation, entertainment, advertising and education. Today's markets may represent only a small share of the total graphics market by the end of the decade; the remainder will come from applications yet to be developed. ■

Louis Doctor and **Stephen Coit** are president and marketing director, respectively, of Raster Technologies, Troy, N.Y.

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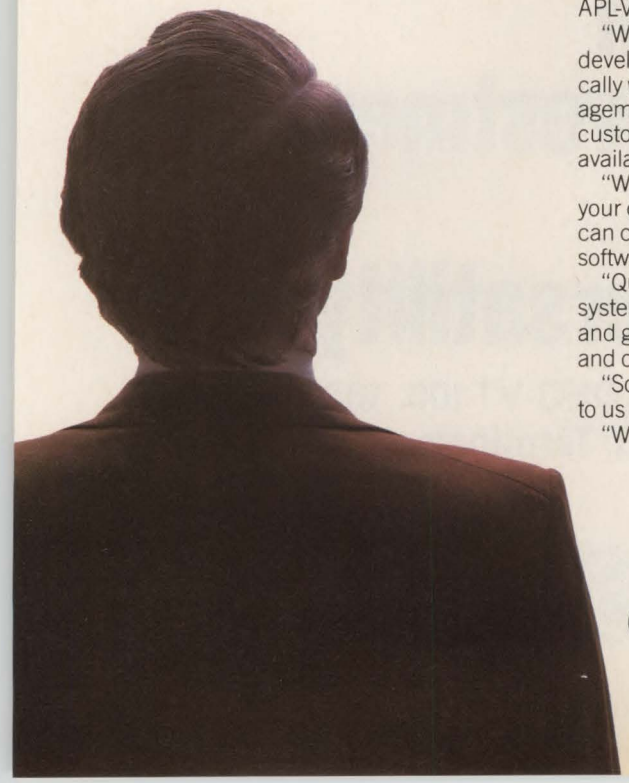

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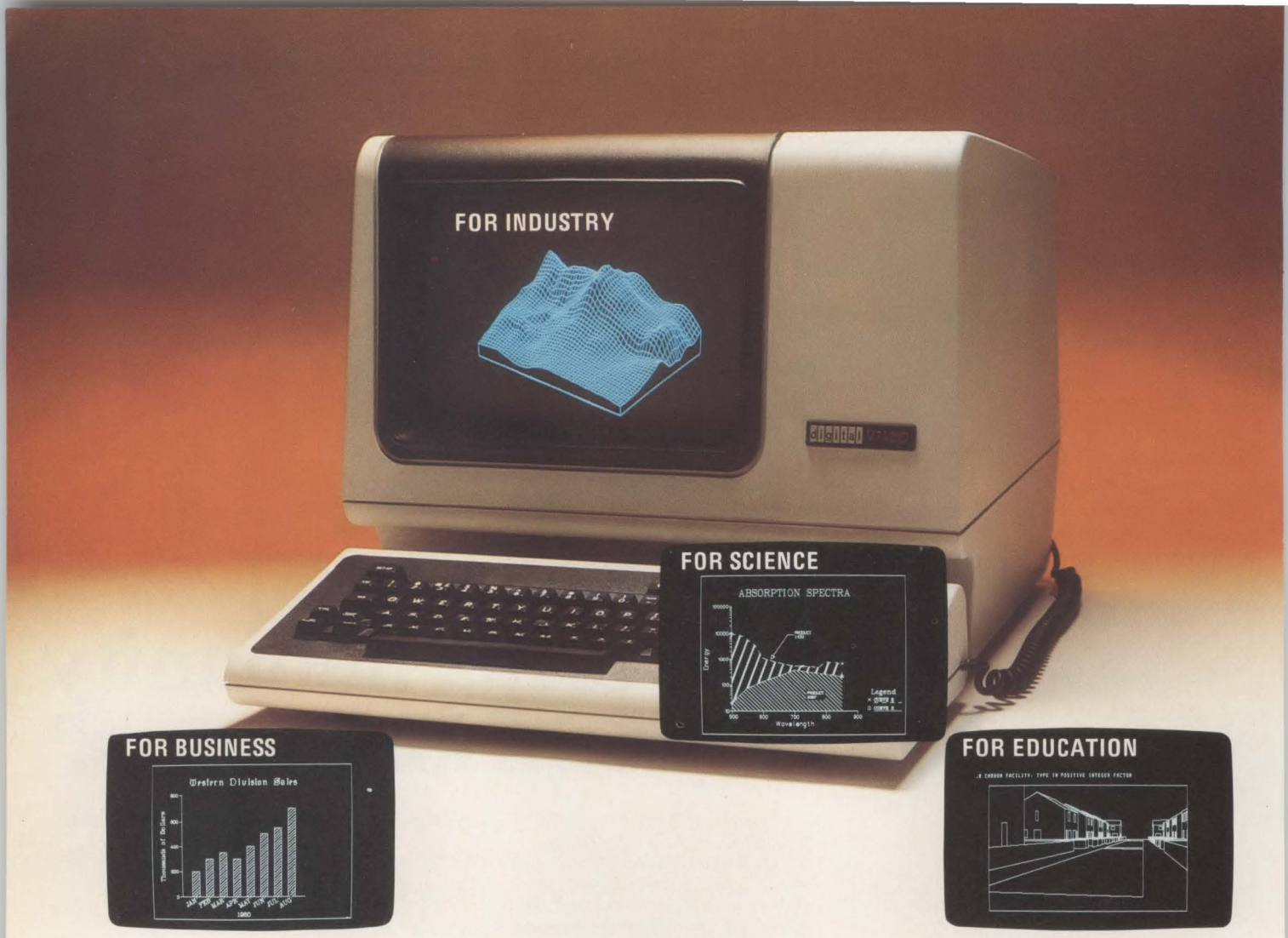

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CIRCLE NO. 64 ON INQUIRY CARD

Understanding digitizer resolution and accuracy

KATHY DUNN, Summagraphics Corp.

Buying wisely sometimes involves looking beyond the manufacturer's specifications

All too often a digitizer purchase is based solely on a manufacturer's published specifications of resolution and accuracy. Although these specifications are good indicators of the capabilities of a digitizer, they are not the only factors that influence the ultimate accuracy of a digitizer system. The terms "resolution" and "accuracy" have fallen victim to misinterpretation.

Resolving resolution

Resolution is the smallest change in measured value to which an instrument will respond. When applied to digitizers, resolution is the smallest unit of detectable movement in the digitizer output. It represents the number of addressable locations in a given area.

Manufacturers publish specifications of resolution in inches, millimeters and/or lines per inch. A specification of 0.005 in. means that there are 200 addressable points (lines) per in. in each X and Y axis. Thus, a user can expect to attain as many as 40,000 distinct locations within any 1-in. sq. area on a tablet surface.

Resolution depends on the ability of the electronics to interpolate many locations between the wires in the tablet grid; it does not directly depend on the number of wires in the grid. A digitizer with grid wires spaced at ¼-in. intervals might achieve a resolution as high as 0.001 in., depending on the technology employed.

Digitizer manufacturers produce tablets of various resolutions, the most common being 100, 200, 400 and 1000 lpi. Many units also afford 0.1-mm. (approximately 256-lpi) and 0.025-mm. (approximately 1000-lpi) resolution and can include internal switches to select English- or metric-formatted output.

In selecting a digitizer, resolution should always be considered in terms of its application. A common misconception is that the digitizer with the greatest resolution (0.001 in.) is best suited for every application. Generally, the greater the resolution the greater the price, the greater the number of addressable points and the longer the output character string. With this in mind, consider a menu-selection application in which an 11- × 11-in. tablet is interfaced to a low-cost μc.

Price should be considered first. A 0.001-in.-

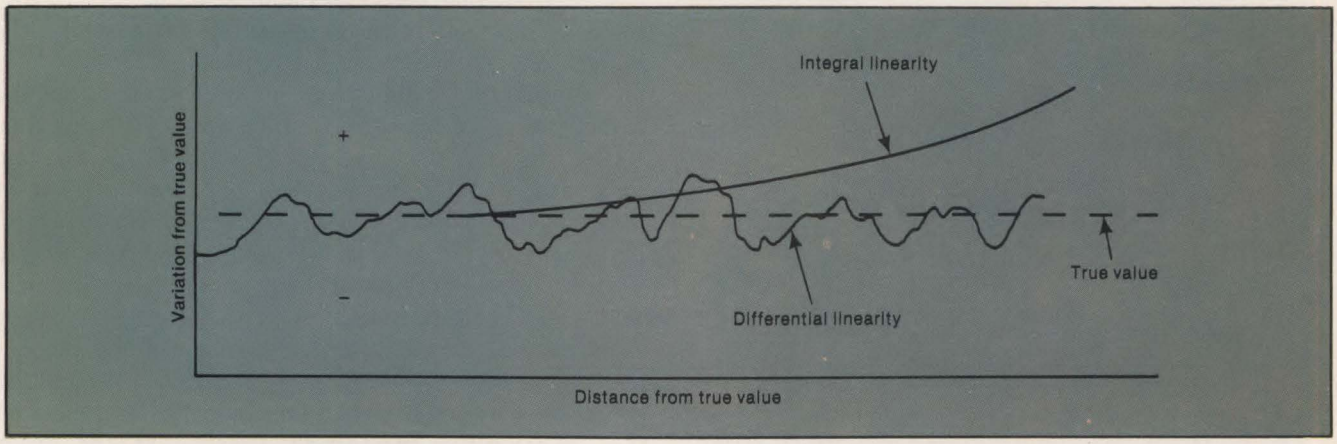


Fig. 1. Linearity is the precision with which a digitizer reads out all points on an axis compared with the true values. *If the deviation occurs in specific increments, that is, in a predictable pattern ("intergral linearity"), it can be compensated for. If the deviation is random and, therefore, unpredictable ("differential linearity"), it cannot be compensated for. Differential linearity is a digitizer's worst enemy.*

Resolution depends on the ability of the electronics to interpolate many locations between the wires in the tablet grid; it does not directly depend on the number of wires in the grid.

resolution tablet may cost twice as much as a 0.005-in.-resolution-tablet and probably as much as the μc with which it is used. Buyers should choose only as much resolution as they need for their application.

They should then consider the application—data input via a menu overlay composed of 1-in. boxes. A touch of the transducer (stylus or cursor) to any point in a box registers the appropriate selection by sending an XY coordinate within the coordinate range for that box. With more than 40,000 addressable points for each menu box, a 200-lpi-resolution tablet is more than adequate for this application.

Lastly, output should be considered. With greater resolution tablets, the output character string is longer, that is, a 0.005-in. unit emits an eight-digit string—XXXX,YYYY—whereas a 0.001-in. unit transmits a 10-digit string—XXXXX,YYYYY. The longer character string slows transmission and requires more storage. This is often not feasible when interfacing to μcs, which tend to be slower and contain less memory than minis or mainframes. The higher resolution tablet with the longer character string may also be undesirable when an application requires that the information be transmitted via modem or used in a time-sharing network.

High resolution is critical for other applications, such as cartography in which aerial photographs or slides are digitized. A small digitizing error on a photograph could result in a large error on the final map on which the scale is large—typically 60,000:1.

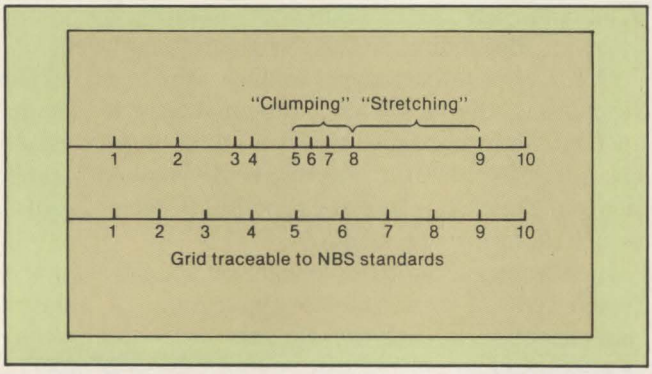


Fig. 2. Scale is the ability of a digitizer to match the readings for the 0 point and any endpoint to a standard. *In testing for uniformity of scale, digital coordinates are compared to standardized grid coordinates. Inconsistencies in scale may result in "clumped" or "stretched" coordinate increments.*

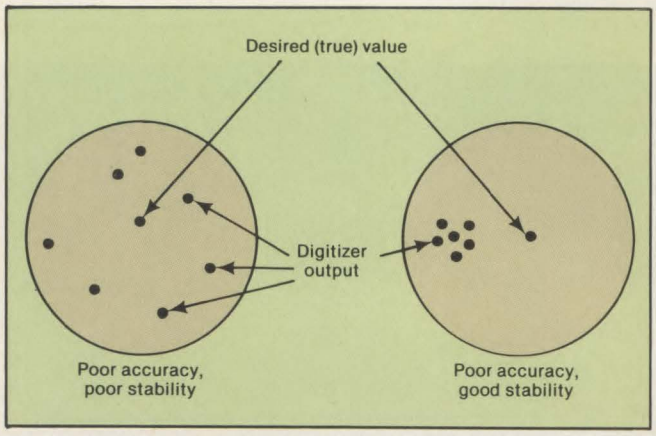


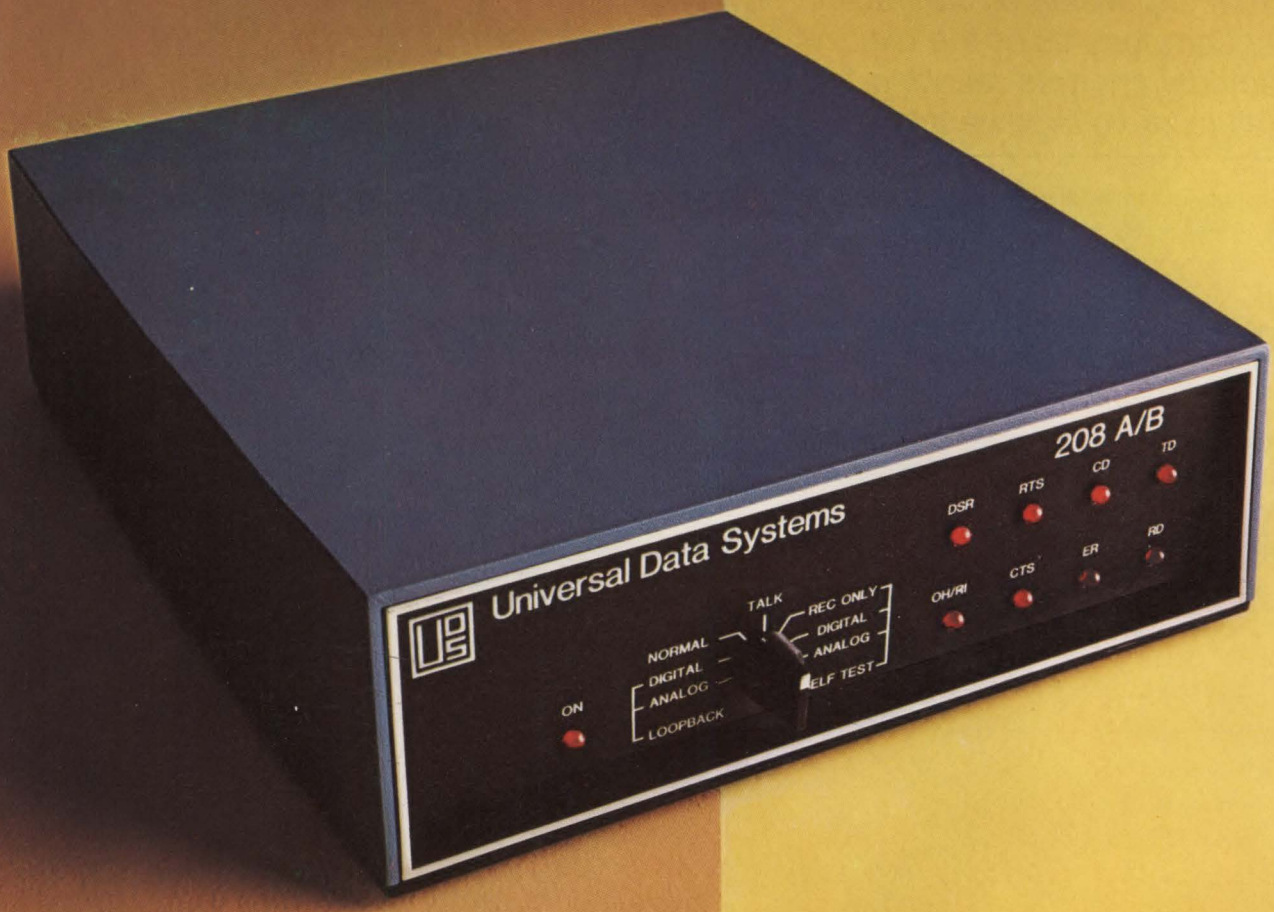
Fig. 3. Stability is digitizer output consistency for the same location over a period of time while the transducer is held in place. *Both long-term (drift) and short-term (jitter) stability are tested to determine digitizer accuracy. A unit may have good stability in that coordinate readings vary only slightly from one to another, yet poor accuracy, as these readings vary greatly from the true value.*

Inaccuracies about accuracy

Accuracy is the closeness with which an instrument reading approaches the true value of the variable being measured. Manufacturers' published specifications of digitizer accuracy are statements of how close the coordinate reading from the digitizer is to the actual location or true value.

Accuracy is determined by placing a grid traceable to the National Bureau of Standards on a tablet surface and comparing the electronic reading from the digitizer to the physical grid location. Accuracy is the maximum deviation derived by taking numerous readings and is expressed in relative terms, ±0.010 in., for example. Several factors contribute to the accuracy specification:

- Resolution: A specification that must always be considered in determing the accuracy specification.
- Linearity: The precision with which a digitizer reads out all points on an axis compared with the true values represented on an NBS grid, for example. Several linearity tests are run to determine the accuracy specification (Fig. 1).
- Orthogonality: The squareness of the X and Y axes.
- Scale: The ability of a digitizer to match the readings for the 0 point and any endpoint to a standard such as the NBS grid (Fig. 2).
- Axis straightness: The ability of the digitizer to maintan the same reading in one axis while the transducer is moved along the other axis.
- Stability: The ability of the digitizer to output the same reading for the same location over a period of time while the transducer is held in place. Short- and long-term stability are tested. Short-term stability, or jitter, is often characterized by fluctuations in the least significant bit. Long-term stability, or drift, is caused by thermal expansion or contraction of physical components of the digitizer and electrical changes resulting from temperature or voltage variations (Fig. 3).
- Repeatability: The ability of the digitizer to output the same coordinate reading for a specific location while the transducer is repeatedly touched to the exact location, removed and retouched.
- Calibration system: The accuracy tolerances of the



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Long-term stability, or drift, is caused by thermal expansion or contraction of physical components of the digitizer and electrical charges resulting from temperature or voltage variations.

testing instruments must also be considered. The mylar grid used to check coordinate outputs typically has a ±0.003-in. accuracy tolerance. Most optical scales are accurate to ±0.0005 in. or better.

• Transducer eccentricity: The variation in digital readout when a cursor is rotated 360° about a given point.

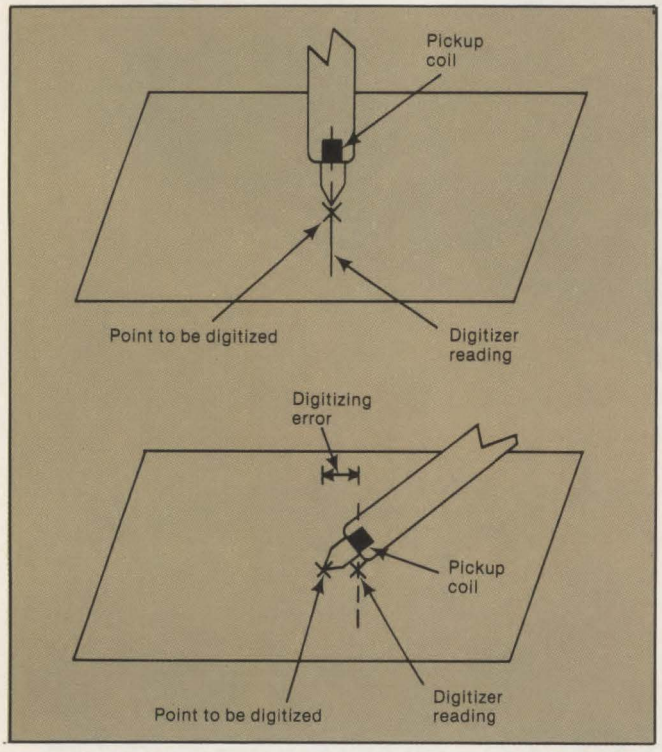

Fig. 4. Stylus position affects the accuracy of coordinate output. *An operator should hold the stylus in a position vertical to the desired point.*

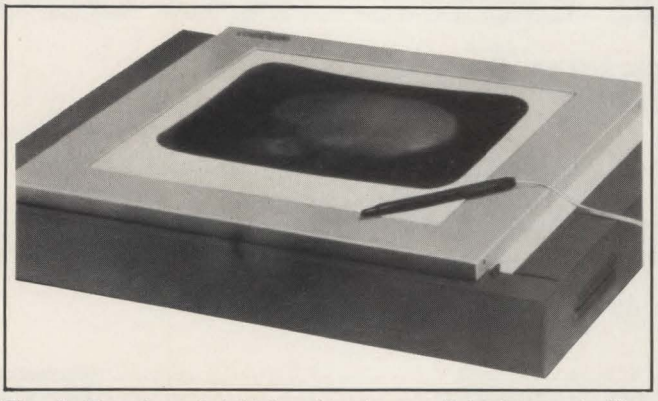

Fig. 5. Translucent tablets placed over light boxes *facilitate operator digitizing precision in applications using x-rays or other films. Units containing built-in light boxes also allow greater operator positioning accuracy when digitizing drawings or maps produced on mylar.*

• Hysteresis: The variation in digital readout when a point is approached from one direction versus being approached from another direction.

If any of the factors listed above is greater than any other, that tolerance becomes the dominant specification figure.

Several other factors influence the performance or absolute accuracy of a digitizer system. One of the most important of these, and most often overlooked, is the ability of a human operator to position the stylus or cursor precisely. The operator should be able to align a cursor crosshair to within ±0.005 in. However, in a production environment, typical operator positioning skill drops to ±0.015 in. as a result of fatigue, eyestrain and time constraints.

Cursor-crosshair width should also be considered. Crosshair sights in most cursors are 0.004 in. wide. If an operator digitizes with a stylus, other considerations must be made. The pick-up coil on a stylus is typically located on the edge of the pen housing, not on the tip of the ballpoint. Thus, position tilt of the stylus can affect the accuracy of readings, reducing operator positioning skill to ±0.025 in. (Fig. 4). On hand-drawn artwork, the width of the lines to be digitized is also a consideration. A line drawn with a very fine pencil is about 0.008 in. wide, and a ballpoint-pen line is about 0.014 in. wide. Magnifying cursors can facilitate cursor positioning but cannot assure precision because even the human eye has resolving limitations (typically 0.005 in.).

Also affecting an operator's ability for precise digitization is the type of tablet used. Five tablet surfaces are available—opaque, translucent, back lit, water clear and rear projection. Selecting an ergonomically designed tablet can reduce operator eyestrain and fatigue. In digitizing x-rays or drawings on mylar paper, translucent tablets are placed over light boxes or back-lit units with self-contained diffused lighting (Fig. 5). Rear-projection units with special diffusing surfaces dramatically reduce eye fatigue in applications in which slides or movies are projected onto a vertically positioned tablet.

The digitizer-system environment is also a key factor in system accuracy. Depending on the technology used, some digitizer units are affected by temperature, humidity, dust, drafts and even the electrical noise produced by a nearby terminal.

The material to be digitized is also a consideration. With some technologies, coordinate output is affected when conductive materials—metallized strip charts or drawings made with pencil or india ink—are digitized. Output may vary with other technologies if a metal or an aluminum ruler is placed on the surface for aid in digitizing. ■

Kathy Dunn, marketing/communications coordinator at Summagraphics Corp., Fairfield, Conn., was previously product support specialist for four digitizer product lines at the company.

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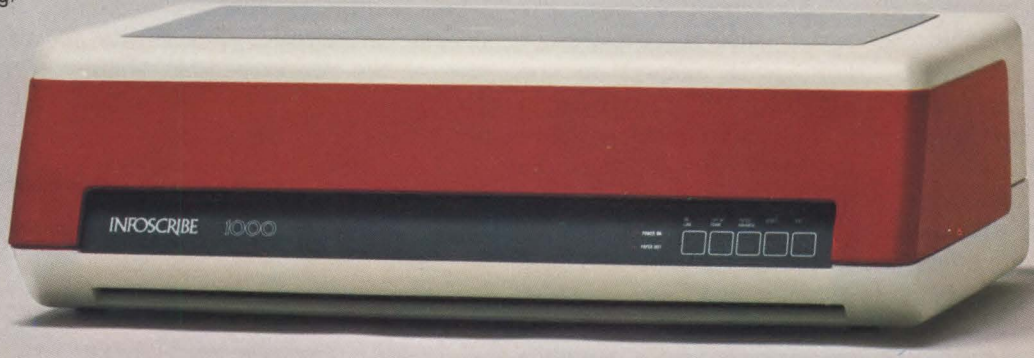

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CIRCLE NO. 66 ON INQUIRY CARD

Mapping continental drift by computer

DAVID FREEDMAN, GML Corp.

Researchers are using a computer-animated film to show the movement of the continents over the past half billion years

When it was first suggested early in this century that the Earth's land masses were broken, wandering remains of a single, ancient "supercontinent," scientists were skeptical. The fact that pieces of paper in the shape of the continents could be rearranged and roughly fit together like a jigsaw puzzle was hardly accepted as conclusive proof. Today, the idea of continental drift is considered fundamental among earth scientists, and as their understanding of the phenomenon has improved, so have their methods of demonstrating it. Instead of pieces of paper, some researchers now use computer graphics to reconstruct the movement of the Earth's enormous plates.

The outer surface of the earth is a layer of crust divided into about a dozen contiguous sections. As forces from deep in the Earth cause these plates to rotate, the continents "drift" with respect to one another. Although a given continent might move only a few inches each year, the distance traveled becomes considerable after a few hundred million years, as the pictures on these two pages illustrate. These pictures are hard-copy stills taken from a computer-animated film by Dr. Sigmund Snelson and associates at the Shell Development Company in Houston and the University of Chicago. The 5-min., black-and-white film follows the movements of the continents over the last 500 million years, showing the formation of the supercontinent of Pangea and its later breakup into the continents as we know them today.

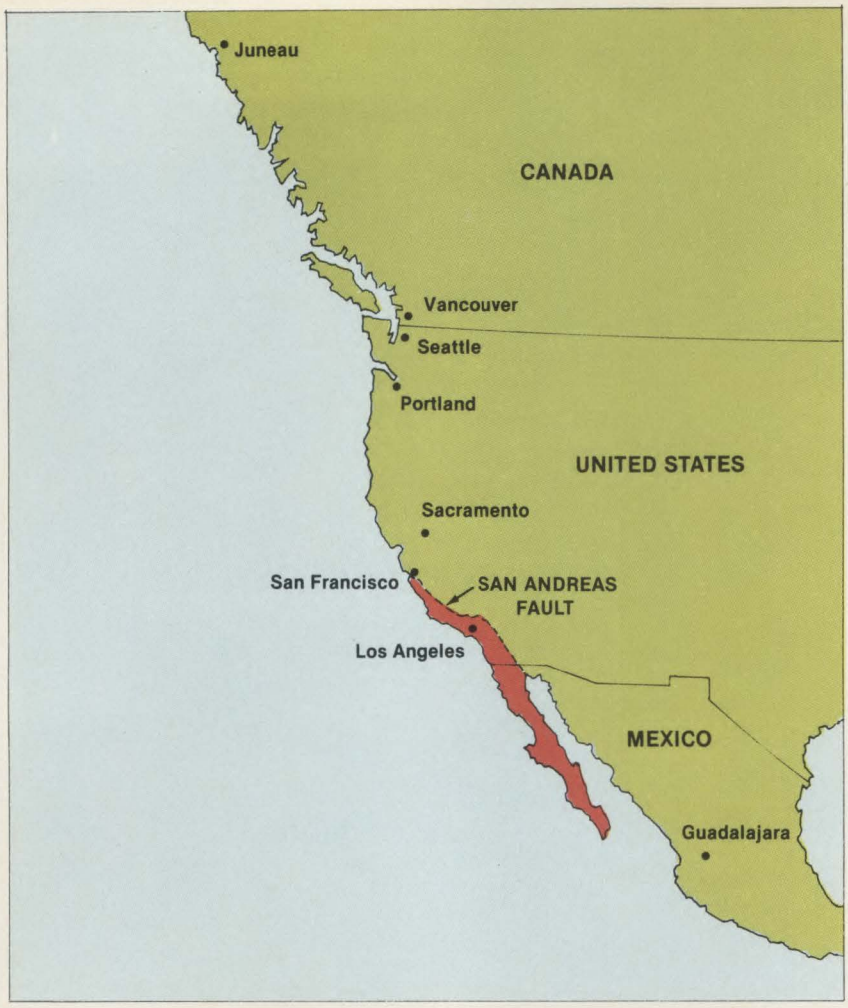
The movie was filmed in real time directly from the screen of an Adage display terminal, used with a Harris minicomputer, a Tektronix 4014 terminal and a Versatec electrostatic plotter. It is based on previously published reconstructions, using data ranging from fossil evidence to the magnetic orientation of rocks. Although the film does not itself represent new information on continental drift, the animation allows researchers and students to grasp more easily the dynamic and time-related aspects of the phenomenon. The subject is well worth grasping: virtually all geological events are in some way related to continental drift, including mountain-range formation and earthquakes. Scientists can also use the technique to provide a picture of future continental movement (see "California split," p. 118).

Snelson and his colleagues plan to make other films when additional data are available. Such films will provide an increasingly accurate and detailed illustration of the processes that shape the surface of our planet. ■

David Freedman is an editor/researcher at GML Corp., Lexington, Mass.

Computer-animated film begins with the Earth as it was 500 million years ago *(1), with the continents bearing little resemblance to the continents of today. Over the next 300 million years, the continents drifted together (2 and 3) to form the supercontinent of Pangea (4). Pangea then broke up into the present continents (5), and by 50 million years ago, the planet appeared much as it does today (6).*


Siberia
Laurentia
Baltica
(1) 500 million years ago
(4) 200 million years ago ("Pangea")
Siberia
Laurentia
Baltica
Kazakhstania
Gondwana
(2) 400 million years ago
North America
Eurasia
Africa
South America
Antarctica
(5) 100 million years ago
Siberia
Kazkhstania
Laurussia
Baltica
Iran
Baltica
Gondwana
(3) 300 million years ago
North America
Eurasia
Africa
South America
Antarctica
(6) 50 million years ago



(A) The West Coast today

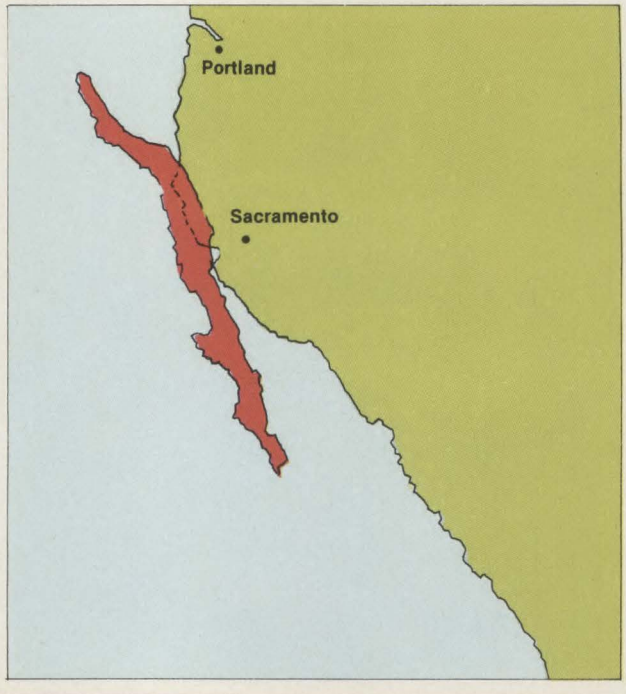
CALIFORNIA SPLIT

The phenomenon of continental drift involves the movement of enormous plates of the Earth's crust. Entire continents are typically carried along with this movement, but, in some cases, one part of a continent may lie on one plate while the rest lies on a different plate. The inevitable result: the continent is ripped apart by the slow but steady plate rotation. Such is the case in California.

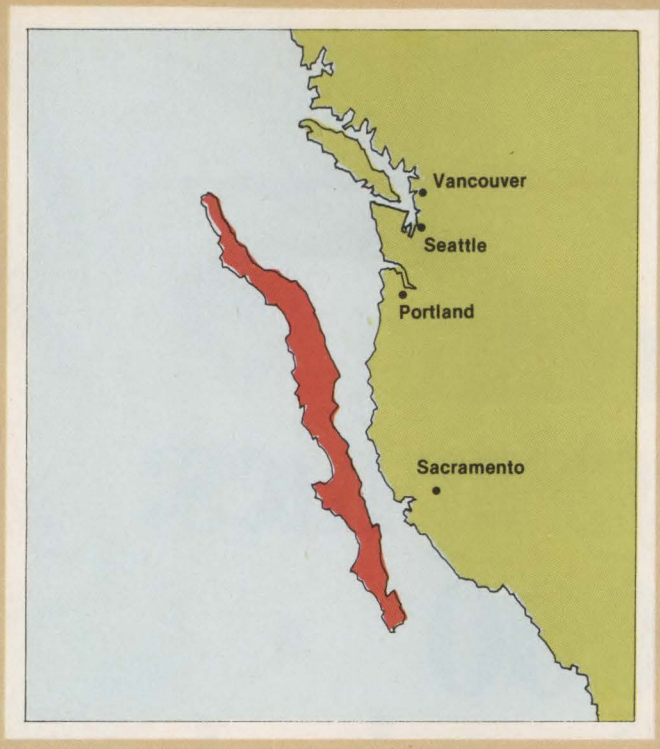
The San Andreas Fault marks the boundary between two plates. Because the two plates are moving in opposite directions, everything west of the Fault will eventually be carried away from mainland U.S. Where will this wandering chunk of sunbelt end up? Probably in Alaska, according to these computer-generated pictures. The pictures were plotted at the Massachusetts Institute of Technology, Cambridge, Mass., by geophysicist Linda Meinke, using Hypermap software developed at the University of California at San Diego. If given enough data, this software can map past or future land movement down to the warping of streets.

While people alive today need not worry about Los Angeles tumbling into the sea in their lifetimes, Californians must live with another, more immediate consequence of living near the boundary of two plates: earthquakes. Otherwise, Western California residents who like to plan ahead—say 50 million years ahead—might well invest in some warm clothes.

(B) 10 million years from now

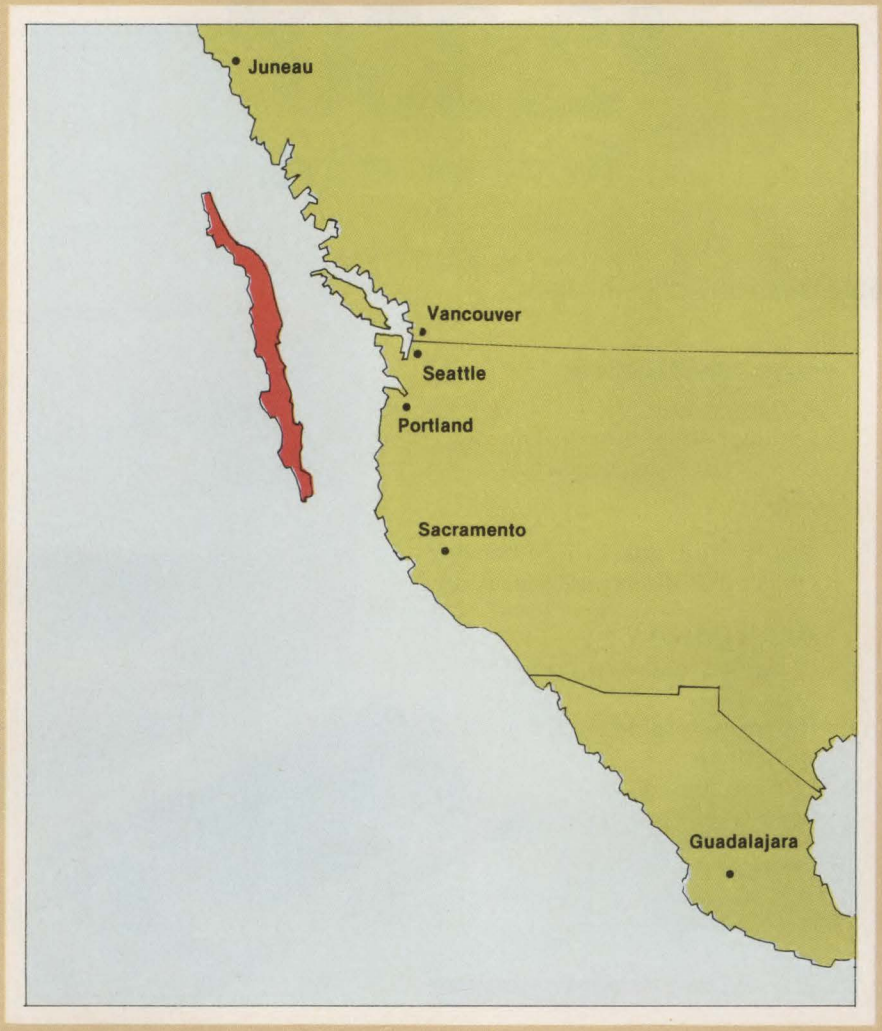


(C) 20 million years from now



(D) 30 million years from now

(E) 40 million years from now



(F) 50 million years from now

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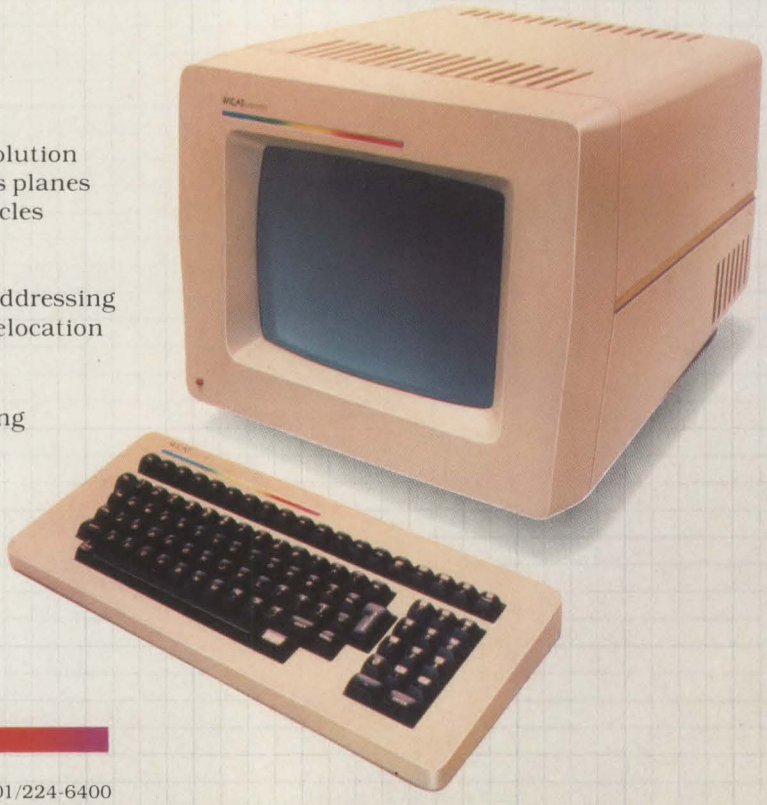

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CIRCLE NO. 67 ON INQUIRY CARD

Graphics system displays true 3D images

HANK STOVER, Genisco Computers Corp.

SpaceGraph couples a high-speed computer with a vibrating and deforming mirror to produce space-filling displays

Space Graph, believed to be the world's first commercially available 3D graphics-display system viewable directly, has been introduced by Genisco Computers Corp., and it holds huge implications for the future of graphics technology. The system combines a unique but simple optical technique with advanced graphics electronics to produce images and graphics with space-filling characteristics.

Pictures, contours, vectors and alphanumeric data can be displayed in black and white or on a continuous gray scale in a volume of 20 × 25 × 30 cm. An operator can move his head to see changing angles of the image as if it were a solid object, and can manipulate the image with a keyboard or other interactive device. The resolution of the system is equal or superior to that of 2D displays.

Advantages of 3D displays

SpaceGraph is the first true 3D system, unlike many that perform 3D constructs from 2D images. Constructs however, are not space-filling.

Actual 3D graphics have been produced experimentally for years in the form of stereopticons, holograms and the like. But these laboratory techniques have not been translatable into commercial products because of prohibitive costs, unrealistic manufacturing requirements, lack of interactivity with the image, small viewing area, the need for special viewing aids and, especially, the lack of compatibility between optical techniques and computer technology. Despite these barriers, attempts to produce 3D graphics have continued because of its significant, sometimes indispensable, advantages:

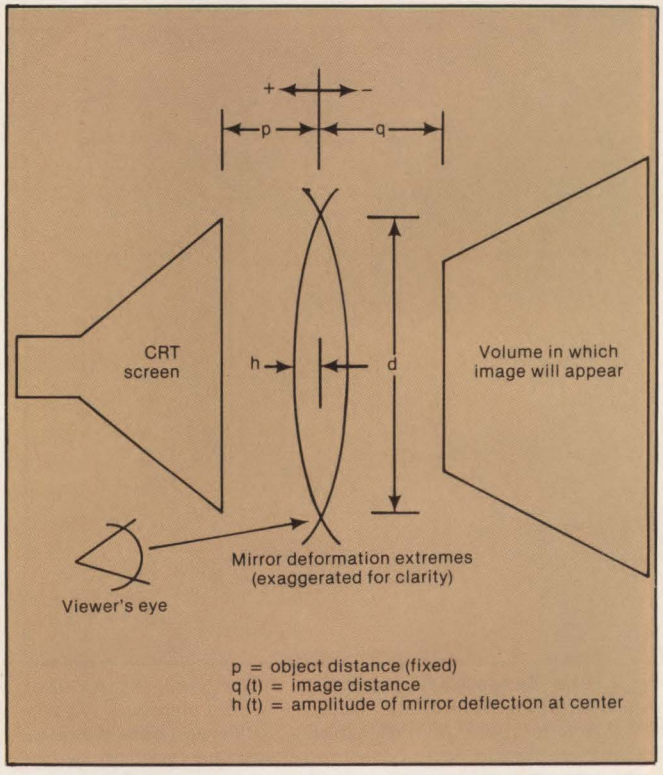
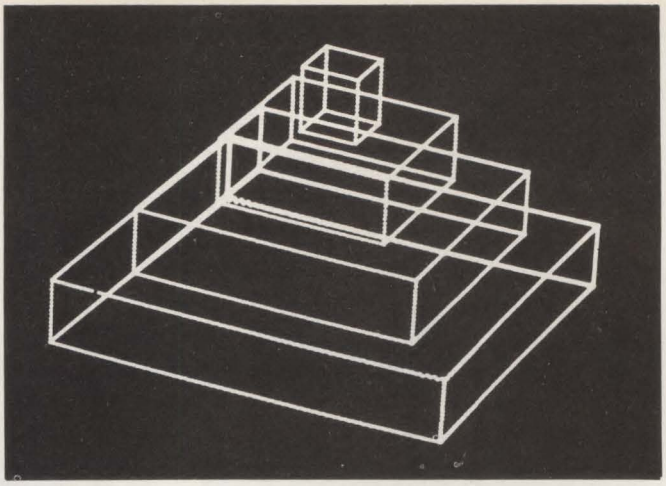


Fig. 1. SpaceGraph works by reflecting *the CRT image in a 40-cm. diameter plastic plate mirror that vibrates at 30 Hz. The vibrations cause the mirror to take on convex and concave spherical shapes, thus varying its focal length. Mirror movement is only ± 2mm. at the center. A special high-speed computer synchronized with the mirror slices the dimension (depth) into 32,768 time planes in 1/30 sec., placing voxels (dots) on the CRT. The voxels are timed to appear at the proper depth, thereby creating a space-filling three-dimensional image that changes with viewer position, just as it would if the actual object were being examined.*

An operator can control any portion of the graphics-mode sequence with keyboard commands and can request a wide range of interactive operations.

- **Objectivity.** A 3D image does not require a viewer's biases to interpret depth cues. Therefore, an image can be viewed objectively even without previous knowledge of the subject.
- **3 D plotting.** Using brightness as one parameter, each point on a 3D display can represent four variables, such as temperature, humidity, wind speed and direction; therefore, interdependencies are clearly visible.
- **Display of previously undisplayable data.** Subjects such as fluid flows and complex structures with internal movement can be shown.
- **Dimensional matching of graphics to subject.** Interacting with a 3D image is natural: curved lines are curved, and through holes can be seen through. A viewer can deal directly and quickly with the meaning of data rather than first having to interpret it.



3D views of a pyramid *taken from camera angles several inches apart show what a viewer sees as he changes his position by that distance. The CRT display was not rotated to achieve the 3D effect (which is diminished by its 2D representation here).*

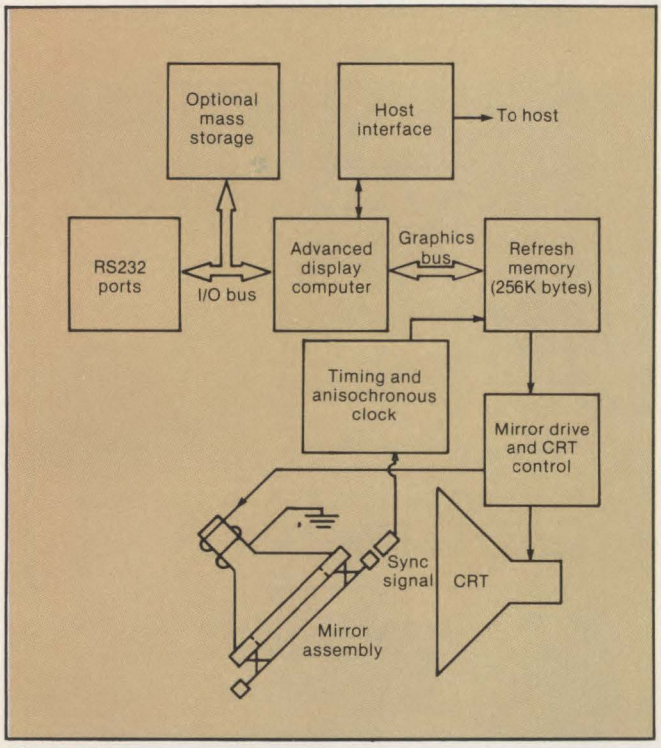


Fig. 2. The SpaceGraph system *is a complete display unit housed within an operator's console. System elements include the system computer (incorporating program and data memory, the memory timing and control logic and the monitor control logic), refresh memory and control, the mirror with associated controls, CRT monitor, power supplies and operator controls. Available options include host interfaces, mass storage and additional refresh memory.*

These benefits make a 3D display highly desirable in many fields. Early applications include geophysical exploration and seismology, computer-aided-tomography (CAT) scanning, CAD, oil-reservoir management, molecular research, training and education, military command and control, antisubmarine warfare, ultrasound diagnostics, air-traffic control, process control and meteorology.

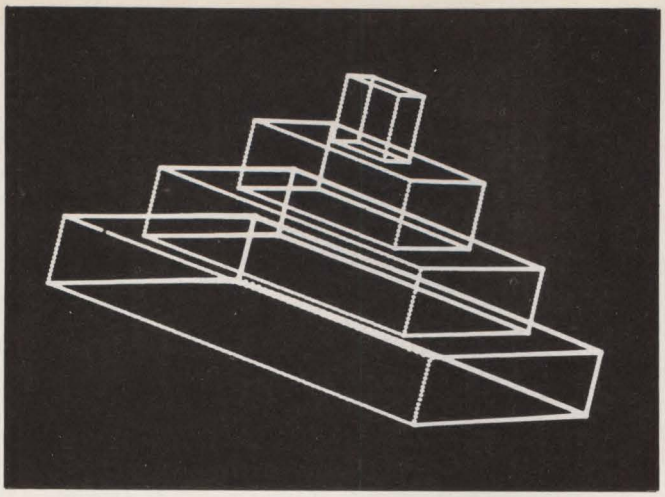
How SpaceGraph works

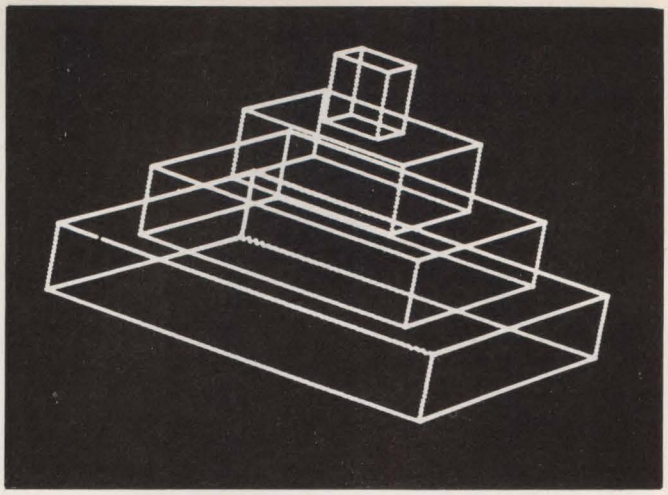
SpaceGraph produces 3D images and grahics by reflecting a standard CRT image in a vibrating, variable-focal-length mirror (Fig. 1). A high-speed graphics computer coordinates the timing of the image on the CRT screen with the position of the mirror, so that individual planes of the object or scene are reflected at progressively deeper positions of the mirror image. The retentive characteristics of the human eye bind the planes together and, by refreshing each plane at a 30-Hz rate, the graphic image appears to be suspended in space.

SpaceGraph has only two moving parts: the mirror and its drive. The driving power of the mirror plate is a very reliable high-fidelity woofer that requires only a few watts of power. At the same time, using a standard CRT as the main optical device enables SpaceGraph to interact fully with the computer as a standard system does but still achieve true 3D images.

Computer makes it possible

SpaceGraph might have remained an R & D dream were it not for the system's electronics package. While SpaceGraph can be controlled by a host computer, the system also contains a high-performance graphics processor. Thus, the high-speed graphics functions of SpaceGraph can be performed locally at the terminal, thereby increasing the system's responsivenss and interactive capabilities. The Genisco-designed G-6000 computer is a processing system that incorporates a bipolar bit-slice/ALU with a direct-decoding programmed logic array, and permits instruction times as fast as 160 nsec. The computer includes a set of more than 140 instructions, among which is a power block-transfer capability. This instruction allows the transfer





of as much as 128K bytes at a single command at speeds as high as 3 MHz between the host and the G-6000, the G-6000 and the graphics-refresh memory (256K bytes) or between host and refresh.

Dual-mode system operation

SpaceGraph functions in two modes. The first is graphics, which displays "stick figures"—vectors and points in a 3D array such as might be used in CAD. The other is image, which shows pictures or images as would be required for CAT data.

In graphics mode, the SpaceGraph system receives initial graphics-display data from an external source, typically a host computer. The data are decoded and converted to generate display parameters for one or more dual-ported refresh memories. These memories are scanned 30 times per sec. to produce the display. To envision the graphics mode, a user can imagine the Z axis (depth) divided into 32,768 time slices, each an XY plane. Vectors are drawn and points plotted by illuminating one picture element (the 3D term is "voxel," for volume element) per plane in as many as 32,768 planes. The element can be located anywhere in a 4096 × 4096 XY plane. There are more than one-half trillion possible voxel positions of which any 32,768 can be displayed at one time.

An operator can control any portion of the graphics-mode sequence with keyboard commands and can request a wide range of interactive operations. Vectors, characters and points can be added or deleted, intensified or blinked with a three-axis joystick and the keyboard commands. Special software performs automatic scaling and centering to provide maximum use of the available volume.

In image mode, image display data are transferred directly from a host computer to the SpaceGraph refresh memories over a high-speed DMA channel. Complex 3D images are shown as planes of data (each plane appearing flat), one behind the other. Both the size of the XY planes and the number of planes in Z are user selectable. The capacity in the image mode is 262,144 voxels per refresh cycle. The matrix size of each plane can vary from 64 × 64 with 64 planes to 256 × 224 for four planes. The number of voxels in the X dimension is variable in increments of 16; the number of lines in the Y axis is variable in integers.

Keyboard controls allow deleting any number of planes from the front or back to provide a clearer view of inner volumes. Planes can be selected sequentially in any block size to provide a means of scrolling through the volume. The scanning rate is controlled by keyboard entries. A control is also provided to vary the distance between planes.

In both graphic and image modes, each pixel of a plane has an 8-bit intensity value. A programmable translation table allows real-time selection of any 128 shades of gray for each voxel. The translation table can be programmed so that any voxel or group of voxels can be blinked or blanked on command. Thus, a user can intensify, de-intensify or blink any area of the 3D graphic image for ease of recognition.

The graphics and image modes can be combined by writing the graphics during the forestroke of the mirror and the image during the backstroke. This allows images, graphic structures and characters to be intermixed.

Three software modes

SpaceGraph is designed in both hardware and software to act as a satellite work station that can off-load the graphics functions from the host. In some applications, the system acts as a stand-alone terminal. The system functions in three software modes: a display-terminal mode, in which data is played back from either remote or local mass storage; an interactive mode, in which commands are received through a keyboard or other device through the SpaceGraph computer; or in a combination mode that allows receiving commands under host control with some functions performed at the G-6000 and some at the host. The last mode is ideal for users who have applications software in the host but still want to take advantage of the local interactive capability of the SpaceGraph system. ■

Hank Stover is vice president of SpaceGraph, Genisco Computers Corp., Costa Mesa, Calif.

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TERMINALS

Exploring flat-panel technology

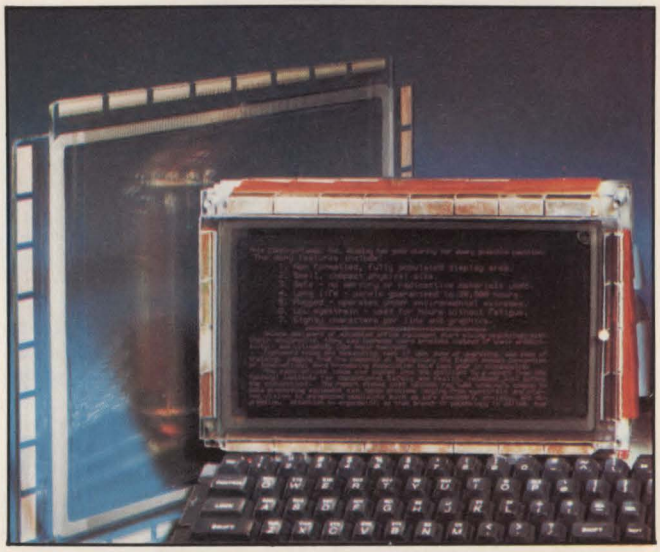
FRANK CATALANO, Assistant Editor

These CRT alternatives are finding a ready military market and a limited commercial one

Functionally, flat-panel displays offer a viable alternative to CRTs for computer-terminal applications, and are more advantageous in systems where space considerations play a fundamental role in design. Of the various technologies on the market—plasma, electroluminescent, light-emitting diode, liquid crystal and vacuum fluorescent—plasma and electroluminescent are receiving the most attention in the computer industry. Complicated drive electronics coupled with low-volume production make flat panels expensive, however, and limit their terminal applications to military and very specialized commercial users. Most observers agree that, until prices come down, the market for flat-panel terminals will remain small compared to that for CRT terminals.

Despite the near-term limited market, companies as large as Burroughs Corp., Sharp Corp. and Fujitsu America, Inc., and as small as Electro-Plasma and Photonics Technology are supplying panels to system integrators who tailor the units for resale to both military and commercial users. And even the giants, including IBM Corp. and Nippon Electric Co., are building the displays in-house, offering them as options for their commercial computer systems.

IBM's flat-panel terminals are available with the company's retail and banking systems and are targeted for high-volume-usage applications. Q-1 Corp., Hauppauge, N.Y., is entering its seventh year of incorporating flat-panel terminals into systems for sales to small businesses and credit unions. Doug Doxey, sales manager for the company, says that customers appreciate not only the durability of the displays but also the space savings they provide. Other companies, such as General Digital Corp., East Hartford, Conn., and Science Applications, Inc., La Jolla, Calif., sell systems with flat-panel terminals to industrial customers for use in factories and on oil-drilling platforms—applications in which ruggedness is more important than price.



Electro-Plasma supplies AC plasma displays *such as the 1.9-in.-deep RS 256/512-1 (above). The display, which includes the glass and display electronics, has a 4.1- × 8.25-in. active area and handles both graphics and alphanumerics with a resolution of 62 pixels per in. Prices start at $3450.*

The price differential

"There's about a 10:1 price ratio between flat-panel displays and CRTs," notes Ken Bosomworth, president of International Resource Development, Inc., Norwalk, Conn. "Until that ratio narrows, the flat-panel market will consist of specialized users."

Phil Shires, vice president of marketing and sales at

'There's one feature that a CRT cannot have, and the lack of that feature makes it awkward in certain applications—a CRT cannot be flat.'

Lear Siegler, Inc., Anaheim, Calif., says that a basic CRT sells for about $100, and in volume purchases, prices can get as low as $60 a unit.

In contrast, prices for a 256- × 512-pixel AC plasma display from Electro-Plasma, Millbury, Ohio, start at $2450 for a single-unit order and $1500 for quantity orders of more than 1000. A Sharp 240- × 320-pixel electroluminescent display sells for $2800 in single-unit quantities, and, because Sharp does not have its displays in full production, quantity discounts are not available.

Although flat-panel displays are typically compact, *Photonics is manufacturing large-screen AC plasma units for military applications. Assembled by Magnovox, the largest terminal (l.) measures 1m. diagonally and contains 2 million light-emitting pixels. The other one measures 17 × 17 in. and contains 1 million pixels.*

Although high prices detract from the appeal of the technology, terminal manufacturers are not writing off the future of flat-panel products. Mel Snyder, vice president of marketing and sales for Televideo, Inc., San Jose, Calif., calls flat-panel terminals "products of the future," adding that his company is particularly interested in electroluminescent technology. Lear Siegler's Shires says that Lear Siegler is in the "evaluation mode," deciding which technology to pursue and how that technology will be applied. "Give us three years," he says.

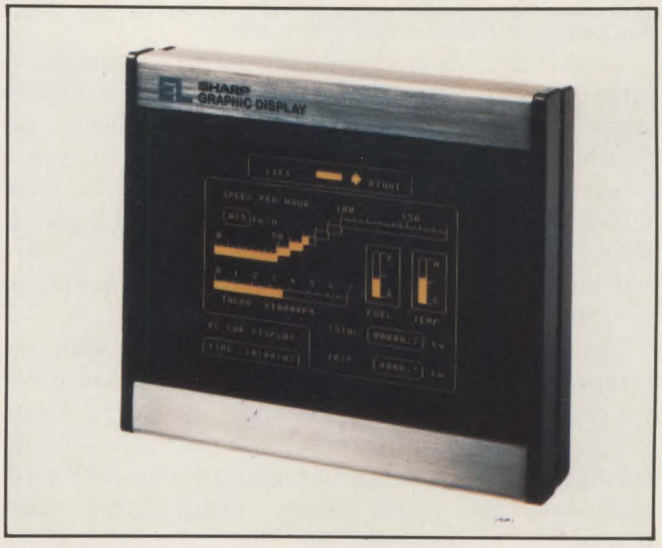
Using flat panels on the battlefield

While the commercial market goes through its development stages—as research aimed at lowering production costs continues and as system integrators design flat-panel displays into terminal products—flat-panel suppliers must rely heavily on military contracts for their bread and butter. Unencumbered by commercial concerns and able to base purchasing decisions on utility rather than price, the military was first to recognize the value of flat-panel technology. Elliott Schlam, head of the display division of the U.S. Army's Electronics Research and Development Command (ERADCOM), Fort Monmouth, N.J., says the Army decided 12 years ago that it had to use automated data-processing equipment on the battlefield rather than rely on antiquated means of communication, such as teletypewriters, walkie talkies and hard-copy message deliveries. Flat-panel displays, rather than CRTs, are playing a major role in the military's communications scheme.

"Running a war is not much different from running a large corporation with many branches and divisions in various locations," says Schlam. "But the Army doesn't have the luxury of a big office building in which people sit at their personal work stations with nice, fancy terminals." He adds that battlefield communications would be handled in remote locations—under a tree or in a foxhole—frequently with bullets flying overhead. A battle unit, he says, needs a rugged, portable terminal that can withstand shock, vibration and a wide temperature range, one that will not consume much power and will have a long life. Considering those criteria, CRTs do not match up to flat-panel displays.

"That was our rationale for getting into flat-panel terminals," says Schlam. "CRTs are fine for an office environment but not very practical on the battlefield."

Among the various flat-panel display terminals used in the military is a portable μp-driven unit that fits into a briefcase-type package. Built by Hycom, Irvine, Calif., a subsidiary of Sharp, the system is intended for a variety of functions, including command and control, intelligence-data relay, radar display, air-traffic control and ballistic calculations. "It would be something that the operator could close up quickly during an attack and then move 2 miles down the road to a better location," Schlam says.



Sharp sells two electroluminescent displays *in the U.S. through Hycom. The 7-in. diagonal, 128- × 512-line ED-7128 (above) displays graphics and alphanumerics and sells for $2900 in single-unit quantities.*

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While the commercial market goes through its development stages, flat-panel suppliers must rely heavily on military contracts for their bread and butter.

Other flat-panel terminals being built for the military include large-screen displays for use in command centers, small displays that can be incorporated into hand-held computers, transparent map-overlay displays and instrumentation displays for aircraft and submarines.

The military has contracted not only with companies that supply the flat-panel glass and associated drive electronics but also with system integrators who buy the displays and incorporate them into militarized products. Such companies include Motorola, Inc., Interstate Electronics, Science Applications, Inc., Singer's Librascope Division, Rockwell International Corp. and General Telephone & Electronic Corp.

"There would not be as much research and development going on if the military wasn't there," says Larry Tannas, a professor of display technology at the University of California at Los Angeles, and a manager of thin-film technologies at Aerojet Electro Systems, Azusa, Calif. Aerojet has a contract with ERADCOM to build the display for a μp-based, hand-held, electroluminescent terminal, which is being assembled by Magnovox.

"Display devices are the most expensive computer elements in terms of development and production," says Tannas. "The lead time is painfully long, the engineering investment is high, and the economics are just not there. The commercial community is so busy making money on μps and memories that it doesn't have time to think about the long-term profits that can be made from CRT replacements."

Tannas adds that there is a "why-bother?" attitude in the industry concerning flat-panel displays. "CRTs can do everything that we would want a display to do—alphanumerics, color and graphics—and the cost is low," he says. "But there's one feature that a CRT cannot have, and the lack of that feature makes it awkward in certain applications—a CRT cannot be flat."

The chicken-and-egg dilemma

This why-bother? attitude has discouraged some flat-panel manufacturers from concentrating on commercial sales. For example, Interstate Electronics, Anaheim, Calif., which buys AC plasma panels from Electro-Plasma, sells 98 percent of its systems to the military.

"Unless there's a miraculous decrease in the price of plasma technology, I don't think we'll be moving into the commercial market for a number of years," says Don Poulos, a marketing vice president with Interstate. Poulos attributes the high cost of flat-panel display technology to expensive drive electronics and low-volume production.

"The biggest reason why flat-panel display terminals are so expensive is that they are still built in small quantities compared to CRTs. There are no economies

EXAMINING PLASMA-DISPLAY TECHNOLOGY

Of the two most viable flat-panel display technologies available for computer-terminal applications, plasma and electroluminescent, plasma displays are more prolific, having been on the market longer than electroluminescent displays. Recent introductions of electroluminescent units from Sharp, however, are receiving wide attention from military and commercial users because of their low power requirements, small size and attractive price.

Plasma displays come in AC and DC versions. AC displays, supplied by Photonics, Electro-Plasma and Fujitsu, and also built by IBM in-house and sold with the company's banking and retail systems, offer inherent memory and, therefore, do not require refresh. Unlike their DC counterparts, AC units are flicker-free and provide high resolution in displays measuring as much as 1m. diagonally. Their drive circuitry is complicated compared to that of DC displays, however, adding to their price.

Although the electronics of DC units are less costly than that of AC displays, DC displays are limited in line-length capabilities because of flicker, say industry observers. Burroughs, the leader in plasma display technology, a DC-plasma supplier since the mid-1960s, will release a new product commercially early next year, which, the company says, will overcome line-length constraints. Called the Self Scan with Memory (SSM), the display incorporates an AC memory layer that handles refresh and thus eliminates flicker. Brian Escher, a marketing manager with Burroughs, says that the SSM combines the performance advantages of AC displays with the cost advantages of DC displays and that it will be a major boost to the flat-panel market.

But the U.S. Army's display expert, Elliott Schlam, says electroluminescent technology is the one to follow. "I'm an impartial observer whose job is to provide the Army with the best means possible to meet its display objectives," notes Schlam. "In a point-by-point comparison of plasma and electroluminescent displays, electroluninescent models weigh less, consume less power and are priced lower than plasma displays." Although plasma displays have been designed into military terminals over the past 10 years, Schlam says, most future contracts under his control will be for electroluminescent displays.

He might have trouble getting those units in quantity, however. Sharp manufactures only 100 units a month, and Hycom, the Japanese company's U.S. affiliate, receives only four of those units for distribution. Sharp plans to go into volume production next year.

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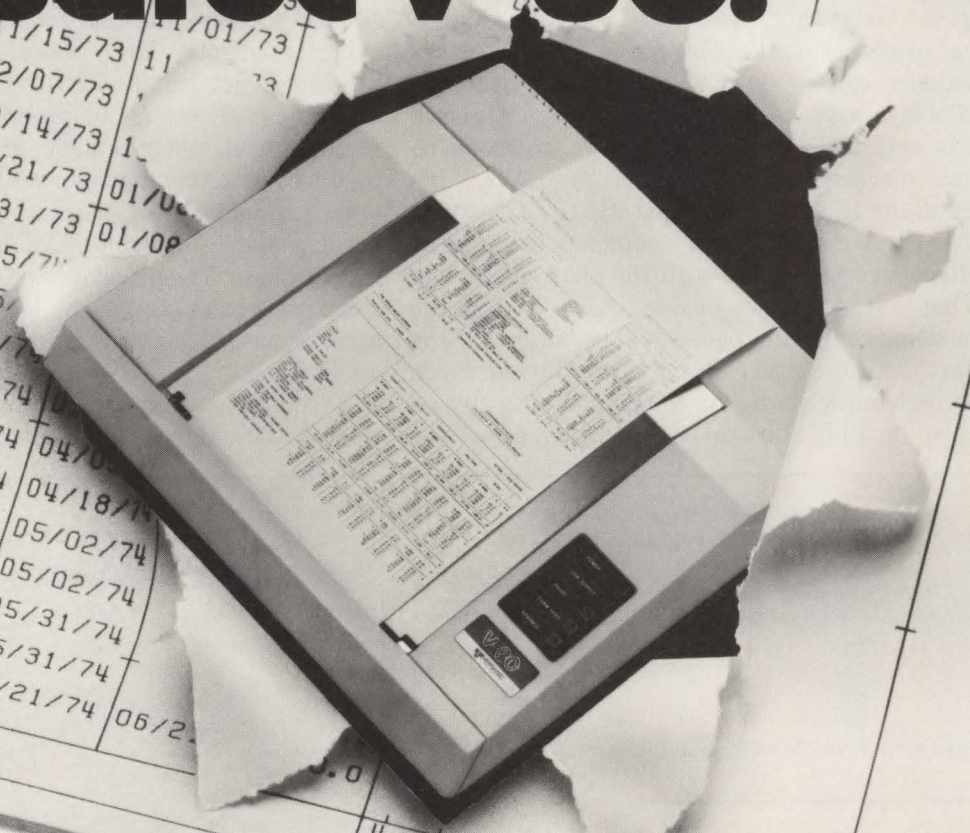

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'There's about a 10:1 price ratio between flat-panel displays and CRTs.'

realized from mass production," he says. "It's a chicken-and-egg sort of thing. The commercial market is so limited because manufacturers can't produce a lot of these things, but manufacturers can't produce a lot because the market is so limited."

Photonics, Luckey, Ohio, an AC plasma-display supplier, has a contract with the U.S. Navy to provide 2000 units over the next three years, and has no interest in marketing products commercially. Don Wedding, a consultant with the company and a marketing professor at the University of Toledo, says that Photonics can produce 30,000 512- × 512-pixel plasma displays a year, but that the market for such displays is only in the 700-a-year range. "There's no commercial market for that product," he says. "It's been around for 10 to 15 years, and it's about time we accept that there may never be a commercial market."

IRD's Bosomworth agrees with the chicken-and-egg scenario but takes exception to Wedding's view that the commercial market for flat panels will never open. Says Bosomworth, "There's a learning curve during which there's a high initial cost. As a manufacturer, you'd have to plan on a big start-up cost and then a cost per unit that would decline dramatically as production quantities went up." Bosomworth admits, however, that the cost of drive electronics has to come down before the market for the displays opens.

Estimated flat-panel display market* (U.S. shipments—$ million) 1980-1990

Word- and data-processing application	Military	Consumer
1980	15	—
1982	80	—
1985	130	—
1990	320	130

*Displays with more than 200 characters

Inroads are being made in that direction. One development is a 32-channel IC from Texas Instruments Inc. that significantly reduces the display-drive electronics. Where it once took two diodes and a resistor to drive each line of a 512 × 512 display, it now takes only 32 TI ICs.

"We're definitely headed in the right direction," says Bosomworth, "but it will probably be the mid-1990s before we get there."

Defining the market

However, Joel Orr of Orr Associates, Inc., a computer-graphics consulting firm, says that despite costs, a commercial market exists for flat-panel products, and manufacturers should not ignore that market. "There are applications in the commercial world where flat-panel terminals can be cost-justified because of their size, durability and low power consumption," says Orr. "The problem is in defining the market and then getting products out there."

According to IBM's market definition, flat-panel displays are best suited for high-volume applications in which space is an important factor. The company offers AC plasma displays with its 3600 series of retail and banking systems, and, says an IBM source, plans to continue looking at flat-panel technology for future product offerings.

"The width and depth dimensions of plasma displays make them more advantageous than CRTs in certain situations," says the IBM source. "They also offer the ability to display large characters with a degree of brightness not found with CRTs."

Although Fujitsu's AC plasma display is still in its market-development stages in the U.S., Hide Iida, product marketing manager with Fujitsu, says that the unit is already being marketing widely in Japan and used primarily in point-of-sale terminals that tie into mainframes. "The product itself is not an economic item compared to a CRT," he says. "But in high-use applications, such as a POS-terminal, the added cost can be justified."

Hycom sells two Sharp electroluminescent displays in the U.S. Although Hycom sells the displays primarily to

A COMPARISON OF TECHNOLOGIES

Characteristics	Ac thin-film EL	Ac plasma	Dc plasma
Largest physical size (in.) at X resolution (lines/in.)	3.5 × 4.7 at 69 5.1 × 6.4 at 100	17 × 17 at 60 8.5 × 8.5 at 60	4.7 × 8.3 at 33 9.4 × 12.6 at 25
Largest number of elements	512 × 640	1024 × 1024	240 × 320
Highest resolution (lines/in.) at X size (in.)	500 at 0.2 × 0.2	83 at 17 × 17	51 at 4.2 × 5.6
Display brightness (fL) at 1/500 duty cycle (est.)	10	25	2
Contrast ratio	20:1	30:1	30:1
Luminous efficiency (lm/W) excluding drivers	4	0.1 to 0.3	0.2
Estimated average power (W) consumption for 512 × 512 at 80 lines/in. (including drivers)	125	1000	1000
Element memory	Yes	Yes	No
Element response time	μsec.	μsec.	
Life (hours to 50% brightness)	<20,000	<10,000	<10,000
Basic panel color	Yellow/orange	Orange	Orange
Multicolor	Red/green/white	Any phosphor	Any phosphor

Source: Northrop Electronics

International Resource Development's forecast *for flat-panel display shipments is based on today's technology and pricing trends.*

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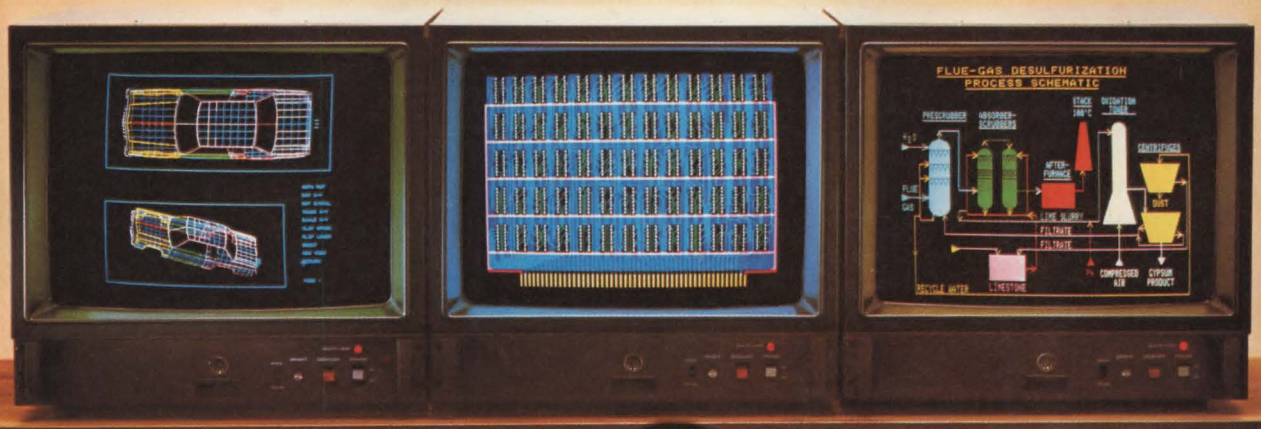

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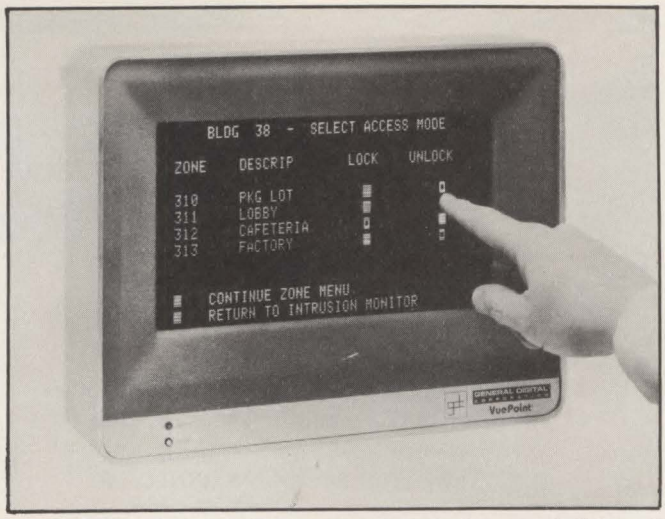
'CRTs are fine for an office environment but not very practical on the battlefield.'

the military, the first large-scale commercial order was recently placed for a portable terminal that will be used for such applications as field service, diagnostics and electronic mail, says Riley Holly, an assistant vice president for the company. "It will be like an Apple (computer) in a suitcase," says Holly. "The price should be comparable to what a small Apple would cost, but the user will be able to carry the system around with him." He says that the unit will be battery-run and that it may use CMOS nonvolatile memory.

A DC plasma display terminal, marketed by General Digital Corp., is being used for applications such as an instructors' controller in advanced aircraft simulators, a metal-rolling-mill controller, an automated electronic testing device, an executive desk-top information-retrieval terminal and a control and monitoring device in manufacturing and food-processing plants. Called the VuePoint, the terminal incorporates a Burroughs Corp. display, the Self Scan II, and uses a touch-sensitive screen overlay that elminates the need for a keyboard.

Saul Kuchinsky, a past director of advanced self-scan memory displays at Burroughs and now president of Quantum Systems, a consulting firm that specializes in flat-panel displays says there are "literally thousands" of applications for flat-panel terminals in the commercial market. He adds, however, that the problem is not with the technology so much as with conservative management policies. "One company—probably a Japanese company—will have success with flat-panel terminals, and all of a sudden everyone will get involved," he predicts. "Cautious companies need proof of someone else's success." Kuchinsky estimates that within five to 10 years, flat-panel display terminals will account for 25 percent of the display market. ■



General Digital's VuePoint flat-panel terminal *uses a Self Scan II DC plasma display from Burroughs Corp. The terminal, incorporating a touch-sensitive overlay, is sold primarily to industrial users for monitoring and control functions. Prices start at $3500.*

Eclipse brightens the memory-management picture

JIM VERES, Data General Corp.

Data General Corp.'s 32-bit computer family provides logical capacity of 4G bytes

Memory management—the architectural measures to control a computer's memory space—has historically suffered from insufficient addressability and inadequate protection for system and user software. Techniques to overcome these weaknesses range from practically none, common on low-end minicomputers and μcs, to complex methods used on 32-bit systems.

Some of the most sophisticated of these techniques are incorporated in Data General's Eclipse MV family of 32-bit processors, which combine virtually limitless logical memory capacity with considerable protection. The Eclipse accomplishes these achievements with five techniques: three to increase address space and two to protect the programmer and the operating system so they can share space with no interference from each other.

Increasing address space

To increase memory, the Eclipse uses a demand-paging virtual memory, page tables and modified and reference bits. The Eclipse MV, based on true 32-bit architecture, has a logical memory of 4G bytes. To accommodate this large address space, each memory location is backed up in secondary storage. Sections of the logical address space are brought into and out of physical memory as required. This movement is governed by the operating system, and users need not concern themselves with it.

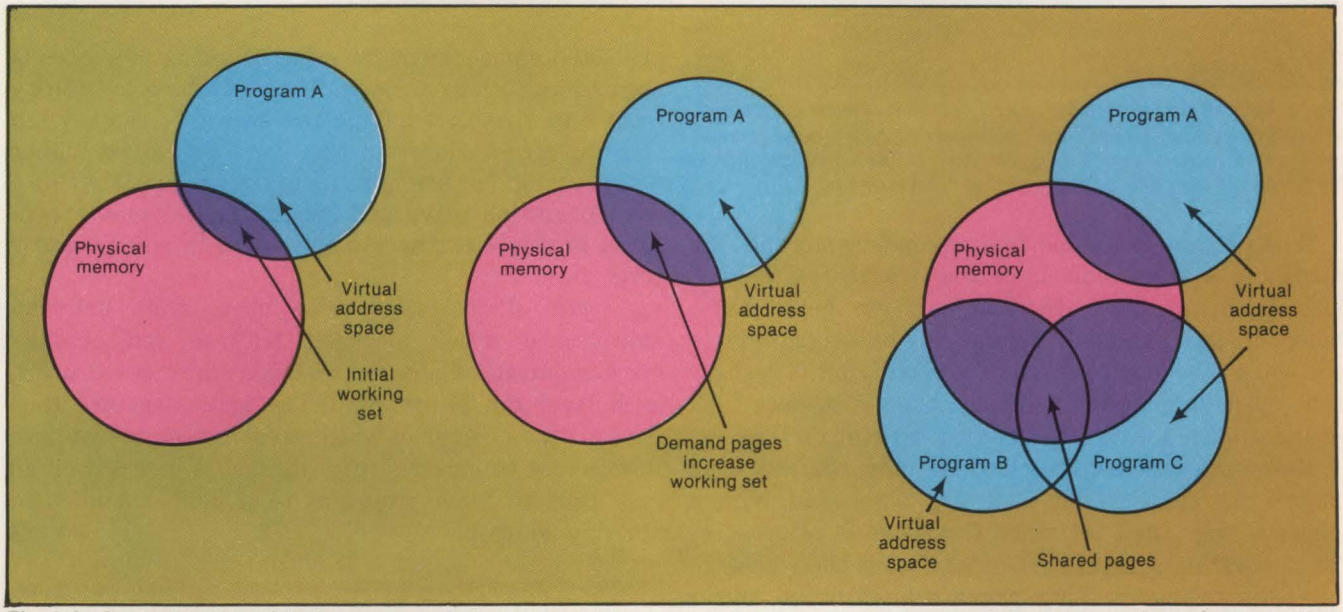


Fig. 1. In demand paging virtual memory, *only that portion of the program that is running (working set) is brought into physical memory (top), enhancing address-space management. As the program continues to run, pages are added to the working set, increasing its size (middle). The bottom diagram is a classical time-sharing situation, with users sharing a working set.*

Single-level page tables accelerate programs requiring less than 1M byte of memory.

The basic unit that is moved into and out of memory is called a page, which is approximately 2000 continuous bytes of logical memory. The ability of the system to furnish pages of information as necessary is called *demand paging virtual memory* (Fig. 1). To indicate whether and where a page is in physical memory, the system uses page tables. Single-level page tables accelerate programs requiring less than 1M byte of memory, the typical minicomputer requirement. For those requiring more, double-page tables are used.

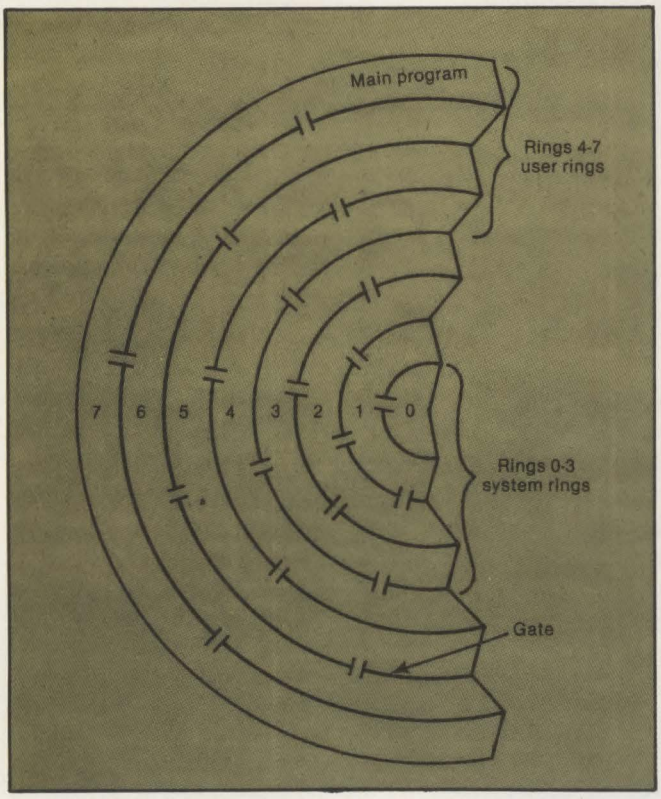


Fig. 2. Eclipse ring structure *permits user and operating system to share virtual address space with protection for both. The seven-ring structure is hierarchical; a program may access only the logical memory in its own ring or in any higher numbered ring.*

When a page is needed from secondary storage, the operating system pulls it in and overwrites the one already in memory. If changes have been made, however, they are noted on a modify bit—a flag that is set when a page is changed. The modify bit is read by the operating system during page transfers. All changes made to the page are then written on the disk.

Reference bits keep track of the most recently used pages. A reference bit is a flag associated with a physical page, and set when that page is referenced. The operating system periodically reads the reference bits, discarding or filing pages seldom or no longer used. Without this type of information, the operating system must either guess or try to simulate a reference bit. Other systems periodically delete all pages, thereby forcing users to reload the pages needed. Providing a reference bit ensures that the operating system makes intelligent decisions.

Memory management is improved on the Eclipse because the operating system keeps only those pages being used in physical memory. The unused pages are left on disk. Programs can be executed even though there is not enough physical memory to accommodate their entire contents.

The Eclipse has two devices to increase protection: an eight-level hierarchical ring structure and a cross-ring gate structure. The *ring structure* is imposed on the address space to let the user and the operating system share a virtual address space with a secure,

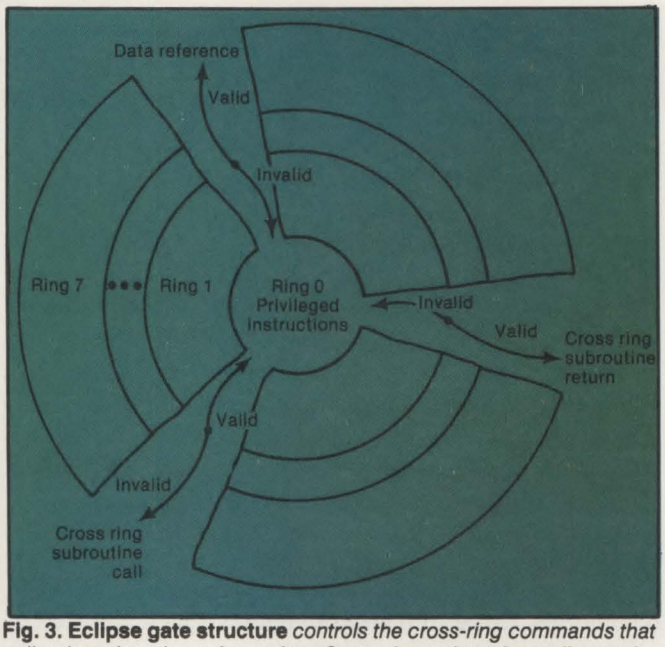


Fig. 3. Eclipse gate structure *controls the cross-ring commands that call subroutines in an inner ring. Cross-ring subroutine calls can be made only to lower numbered rings; cross-ring subroutine return calls and data reference calls are valid only to higher numbered rings.*

protected environment for each. The ring structure is hierarchical: Rings are numbered according to priority from 0 to 7, with 7 having the lowest priority. Each ring can access addresses only in its ring and a higher priority ring. For example, a program running in ring 0 can execute all privileged instructions, while a program in ring 6 can access only those in rings 6 and 7 (Fig. 2).

A *gate structure* prevents users from entering subroutines at an incorrect address and possibly causing damage. Gates are specified addresses at which each level can be entered. The gate structure thus governs the manner in which programs or subroutines flow across boundaries (Fig. 3), and is imposed on all ring calls to force programs to a defined and valid starting address. ■

Jim Veres is Data General Corp.'s product-design engineer for the Eclipse family of products.

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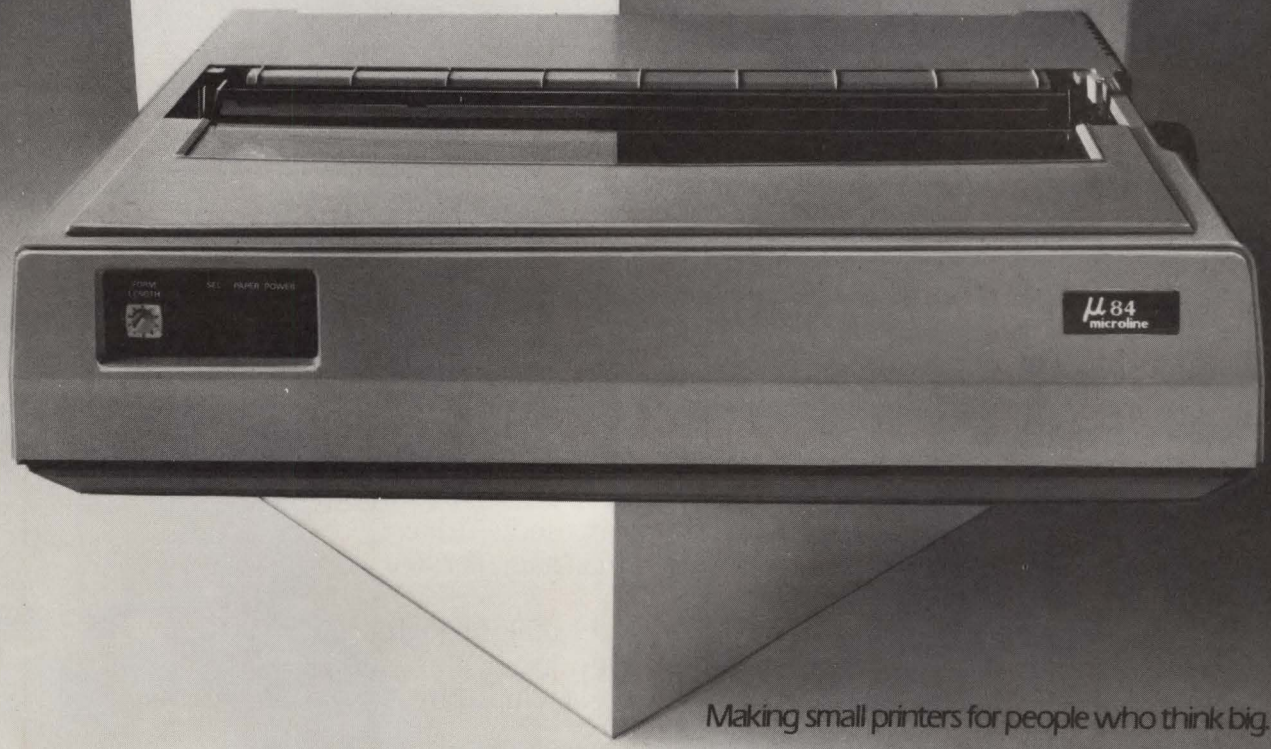

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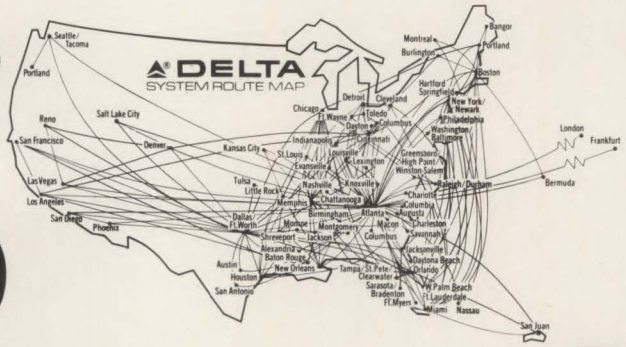

MICROCOMPUTER SOFTWARE

Segmented architectures hamper high-level languages

ROBERT E. NOVAK, Extel Corp.

But using a large programming model sidesteps the difficulty with only a minor penalty

Some 16-bit μps, including the Zilog Corp. Z8000 and the Intel Corp. 8086, present problems in using them with high-level languages because of the μps' segmented architectures. The fundamental problem these processors pose is that they offer two ways to perform a subroutine call because the CPU architecture supports subroutine calls to subroutines in both the same segment and other segments. Using one type of call exclusively limits program size; using only the other type costs time and memory.

Developers at Extel Corp. tried five approaches to solving the segmentation problem before settling on one solution—use of a large programming model—that despite a minor penalty, is both practical and economical. But before discussing the various remedies, an understanding of the types of subroutine calls and the difficulties they entail is essential.

The fact that there are two different-sized subroutine calls causes difficulties. An inter-segment call—the longer type—is one to a subroutine that resides in a different 64K segment. Fig. 1 shows the difference between the two types of calls by using the equivalent assembly language for the C code. Fig. 2 shows the forms of the intra-segment call and the inter-segment call. Because of the difference in the size of these instructions, code generation for the compiler is extremely difficult. It is impossible for the compiler to know at compilation time which type of subroutine call to generate. In addition, it is undesirable to generate the longer form of the instruction because this increases execution time for each subroutine call by nearly 50 percent.

There are five possible solutions to the addressing problems when using a high-level language to generate

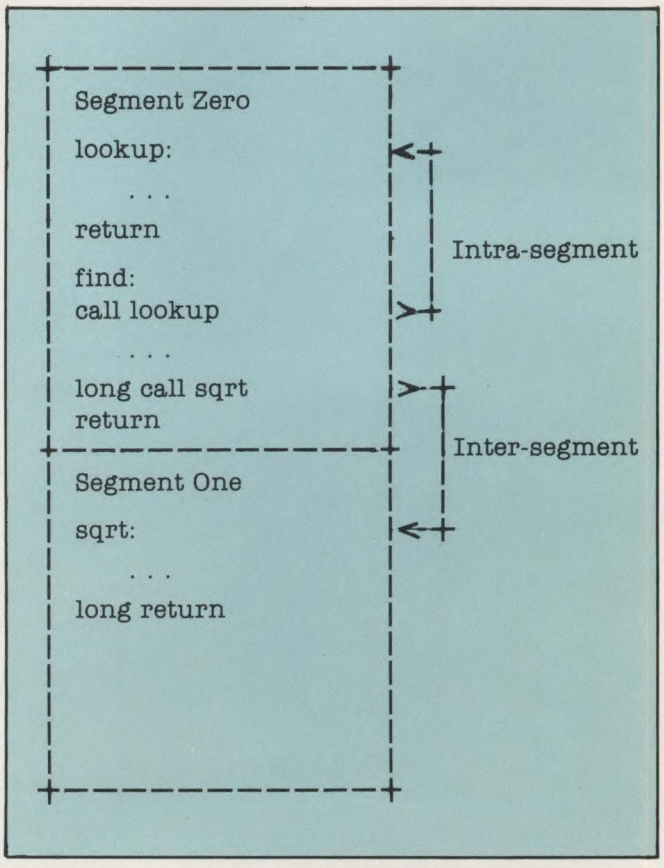

Fig. 1. Two types of subroutine calls, *including an intra-segment call, or one placed to the same 64K segment, and an inter-segment call, or one placed to another segment.*

Because subroutine calls vary in size, the linkage editor must adjust all relative branches around the subroutine calls.

code for a processor with a segmented addressing structure:

- Changing the source language,
- Using a small programming model,
- Using a large programming model,
- Using a compilation model or
- Adding a linkage editor to a compilation model.

Changing the source language involves adding directives ("pragmas" in the Ada language) to it. Pragmas hint to the compiler which type of subroutine call to generate. An example of what the source code might look like in C language is shown in Fig. 3.

Changing the source code is undesirable for three reasons. First, the addition of a #segment pragma changes the definition of the source language. As a result, a user would be using a nonstandard variation of the language. Second, it is difficult to move a program

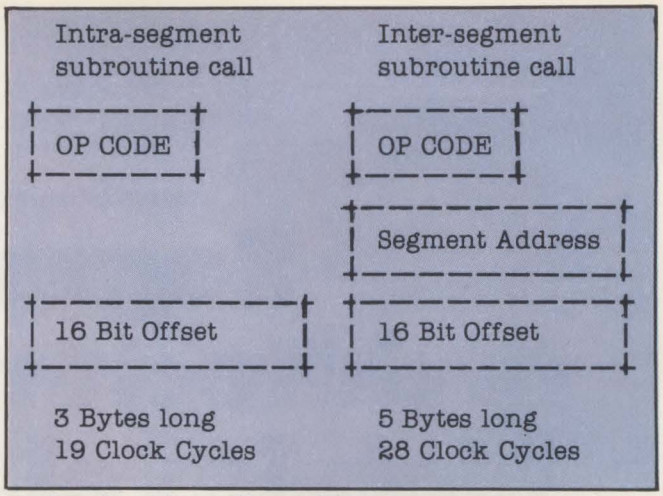

Fig. 2. A comparison of forms of the two types of subroutine calls *shows the size difference between them.*

```
$segment code1
int lookup() ;

$segment code2
float sort() ;

$segment code1
int find(array,value)
int array[] ;
int value ;
{
     int index ;
     float newvalue ;

     index = lookup ( array, value ) ;
     •
     •
     •

     newvalue = sort ( index ) ;
     return newvalue ;
```

This construct defines the segment in which the lookup program will be found, as well as the type of information for the lookup program.

At this point the compiler knows that the lookup function is in the same segment as the program being compiled. Therefore, the short form of the subroutine call can be used.

At this point the compiler knows that the sort function is in a different segment than the one for which the program is being compiled. Therefore, the long form of the subroutine call can be used.

Fig. 3. C language version *of a sample of source code.*

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Changing the source language involves adding directives to it. Pragmas hint to the compiler which type of subroutine call to generate.

from one segment to another. In addition to changing the source file of the single subroutine, the user would need to track down all of the references to that routine and verify that the pragma was modified in each reference. Third, the compiler has no clue as to whether the program that called this subroutine is in the current segment or in another segment. Therefore, the compiler has no clues as to whether it should generate an inter-segment or an intra-segment return.

Using small programming model directs that the compiler generate only intra-segment subroutine calls. This approach eliminates the problem caused by two types of calls, but limits the size of the entire program to 64K of code. Because so many programs need more than 64K, the small programming model approach was rejected.

Using a large programming model directs that the compiler generate only inter-segment subroutine calls.

```
SEGMENT Code1
                    lookup
                    find
                    proga
                    progb

SEGMENT Code2
                    progc
                    progd
                    sqrt

SEGMENT Data1
                    table1
                    table2
                    termopt
```

Fig. 4. This sample linkage editor input *shows how a user might describe the system load to the linkage editor. The SEGMENT directives define each of the segments used in the system load. The names following each SEGMENT directive are those of the subroutines and/or data tables to be placed in the segment defined by the segment directive. Thus, when fid calls sqrt, the linkage editor knows that it must generate a long subroutine call.*

This remedy both solves the original problem and allows the program to use the full address space of the processor. But the side effects are that inter-segment subroutine calls and returns take about 50 percent longer, and need 2 bytes of additional memory. This approach still was considered promising, but Extel continued to search for a solution without these disadvantages.

Using a compilation model requires a two-pass compiler. The compiler treats all the subroutines that

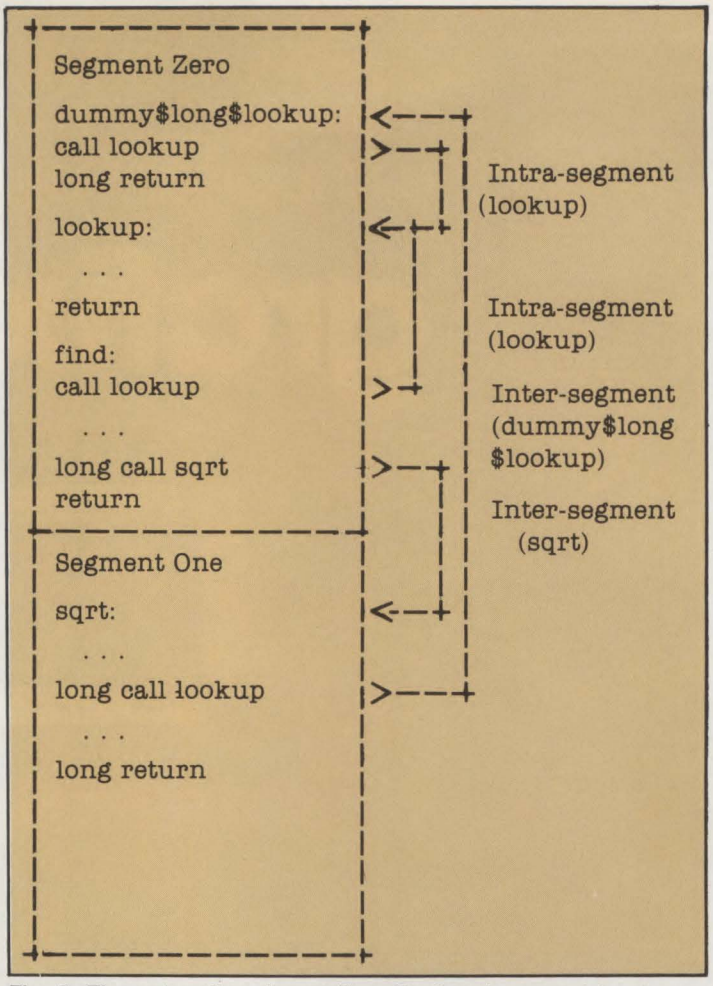

Fig. 5. The subroutine dummy$long$lookup *is created by the linkage editor to allow the sqrt subroutine to place a long call to lookup.*

are compiled together in the same chunk of source code (a "package") as being in the same segment. In addition to solving the problems of the previous methods, this approach generates optimum code for subroutine calls. But it has its own drawbacks. First, it increases compilation time by at least 20 percent. Second, it is impossible to check whether a subroutine internal to a package is referenced from some other package of subroutines. In addition, it is unclear which subroutine in the package will be the external entry point for all the routines in the package.

Developing a compiler, linkage-editor package

To overcome these problems, Extel devised a special version of the compiler and a smart linkage editor. The compiler generates a pseudo-opcode for subroutine calls and returns. A user then provides the linkage editor with a description of how programs are to be arranged in memory, that is, into which segment each subroutine is to be placed. For example, the input to the linkage editor might resemble that shown in Fig. 4. This is reminiscent of the format of linkage-editor directives to IBM linkage editors for controlling placement of program overlays. Although this innovation also generates optimum code in terms of subroutine calls, it proved to have several drawbacks for the implementers of the

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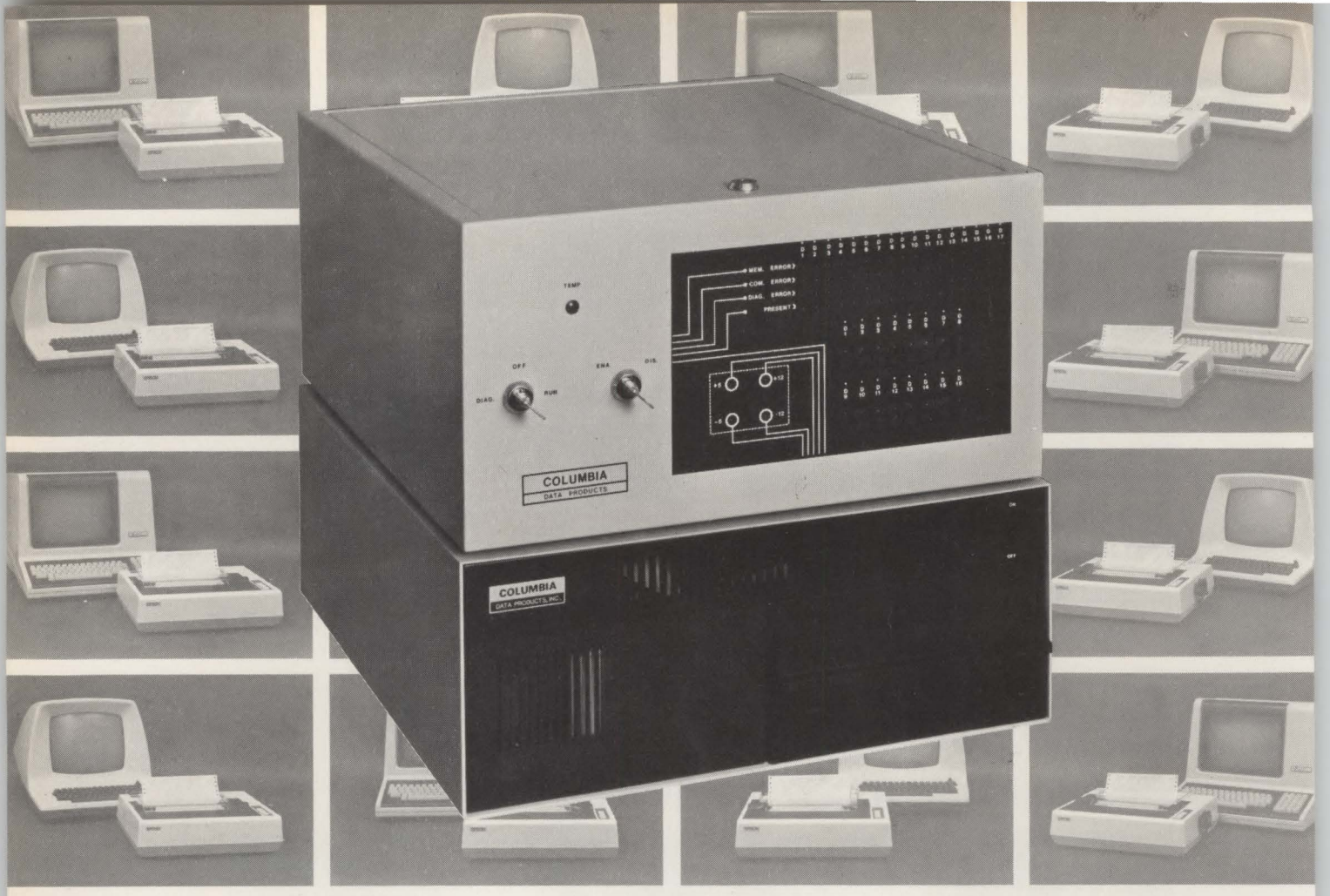

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An 'inter-segment-callable' dummy routine would accept an inter-segment call, place an intra-segment call to the real subroutine and do an inter-segment return to the callers from the other segment.

linkage editor, which must be very complex to handle a variety of situations. First, it must generate the proper type of subroutine call to replace the pseudo-op. Because subroutine calls vary in size, the linkage editor must then adjust all relative branches around the subroutine calls.

```
SEGMENT Code1
EXTERNAL
                    lookup
INTERNAL
                    find
                    proga
                    progb
SEGMENT Code2
INTERNAL
                    progc
                    progd
EXTERNAL
                    sqrt
SEGMENT Data1
EXTERNAL
                    table1
                    table2
                    termopt
```

Fig. 6. Complex linkage editor input sample *shows how a user might describe the system load to the linkage editor. The SEGMENT directives define each of the segments in the system load. The names following each SEGMENT directive are those of the subroutines and/or data tables to be placed in the segment defined by the segment directive. The names following the command EXTERNAL are visible outside the segment and are always accessed by long subroutine calls. The names following INTERNAL are invisible outside of the segment and are always called with short subroutine calls.*

In addition, the linkage editor must ascertain whether any subroutine is called from another segment. If it is, the linkage editor must either make all calls as inter-segment calls so that the proper type of subroutine return is performed for all calls (but this reduces intra-segment call throughput), or it must generate an "inter-segment-callable" dummy routine, which would accept an inter-segment call, place an intra-segment call to the real subroutine and do an inter-segment return to the callers from the other segment (Fig. 5). Users who do not want to have the linkage editor generating hidden subroutines could complicate the linkage editor input to allow the user to define which subroutines are to be known beyond the immediate segment (Fig. 6). A compiler/linkage editor package was considered best.

However, because a complicated linkage editor is not yet commercially available, and the drawbacks of the compilation model were considered unacceptable, Extel returned to the large programming model to determine how drastically its exclusive use would affect throughput and memory use in the design. First, a static analysis of the program used in one of Extel's Z80-based Telex CRT/printing terminals, the B-315, was performed. The source code was found to contain 1089 subroutine calls.

Next, a dynamic analysis of the B-315 software was performed. The terminal was set up to receive a continuous stream of messages over the communications port and store them in memory. A Hewlett-Packard Co. logic analyzer (1611A/Z80) counted the

```
                Intra-segment call

  200 nsec.
x  19 clocks
   3.8 μsec./intra-segment call
x 5919 calls/sec.
   22.4 msec./sec.*

                Inter-segment call

  200 nsec. clock
x  28 clocks
   5.6 μsec./inter-segment call
x 5919 calls/sec.
   33.1 msec./sec.*

*Number of msec. of each sec. of real time
consumed making subroutine calls; equal to
percent of real time.
```

Fig. 7. Exclusive use of inter-segment calls *increases subroutine call-execution time dramatically, but the overall overhead is increased only 10 msec., just 1 percent of overall overhead.*

times a subroutine call was executed in a series of 10-sec. intervals. Considering both unconditional and conditional subroutine calls over a number of trials, it was determined that the software was executing an average of 5919 subroutine calls per sec. Assuming similar real-time software would execute a similar number of subroutine calls under a similar load, the resulting times were calculated for the Intel 8086.

A 10.7-msec.-per-sec. overhead exists for using inter-segment calls exclusively—a penalty of less than 1.1 percent of the total system real-time (Fig. 7). After adding the overhead for the inter-segment return statements, the penalty is still less than 2 percent of real-time overhead. ■

Robert E. Novak is senior engineer at Extel Corp., Northbrook, Ill.

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The machine-independent UCSD Pascal* p-System gives you access to readily available, third-party Pascal software. Provides runtime support for execution of UCSD Pascal high-level language, and full capability to develop your own programs. Includes powerful screen-oriented editor, UCSD Pascal compiler, file handler, 9900 assembler, linker, disk utilities, and EIA terminal configuration capability.

TM990 Amplus† software

Gives you easy access to TI's functionally configured component software series, including Realtime Executive, File Manager, and HDLC communications. These can be linked with Microprocessor Pascal to develop fast, flexible "process control" programs.

The TM990 Amplus system provides complete menu-driven support to develop and execute programs in 9900 assembly language and, optionally, Microprocessor Pascal and Configurable Power Basic. It includes text editor, powerful host execution debugger, 9900 family assembler, link editor, text formatter, disk utilities, download for EPROM programmers, and EIA terminal configuration.

Dual-purpose hardware kit

The TM990/602 kit includes a table top enclosure, CPU module, RAM memory, floppy-disk controller, power supply, fan and cable. It can be used to develop programs with either software package. Just add a terminal and a disk drive.

An added bonus: After developing your software, you can use the 602 kit as your target system. The TM990/602 kit costs $4990‡; the p-System software, $600‡; the TM990 Amplus system, $700‡.

For a free hands-on demonstration, visit your nearest TI Distributor System Center. Or, for more information, write to: Texas Instruments, P.O. Box 202129, Dallas, Texas 75220.

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CIRCLE NO. 81 ON INQUIRY CARD

APPLICATIONS

An Apple for the teacher

A student-achievement monitoring program that runs on Apple II μcs saves money, boosts efficiency

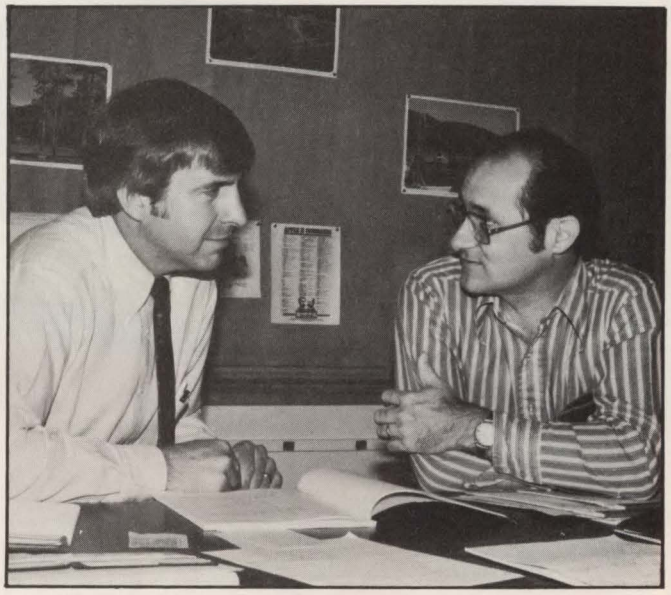
A computer program that tests the achievement of high school students in a Minnesota public school system is attracting widespread attention. The Comprehensive Achievement Monitor (CAM) program was originally written to run on a large computer system, but the high costs associated with mainframes prompted data-processing specialists in the Hopkins, Minn., school district to convert CAM to run on Apple II μcs.

Called Apple-CAM, the program has been developed into a complete software and docoumentation package for sale to other districts and includes detailed achievement objectives for a number of classroom subjects from elementary through high-school grades. Apple-CAM has been purchased and is being used successfully by more than 40 school systems across the country. As time permits, the Hopkins data-processing staff conducts demonstrations of the Apple-CAM program and provides consultation for interested educators. Lee Rodel, data-processing specialist for the Hopkins school district explains that the schools are not in the business of selling Apple-CAM for profit but to make the information as widely available as possible at minimal cost.

The Hopkins district takes pride in the development of Apple-CAM because a number of large-system specialists said it was an impossible challenge. The Apple II/card reader/CAM software package has enabled school systems with limited budgets to take advantage of the latest in educational μc programming, with the potential of adding other processing capabilities at minimal additional cost.

Getting to the core

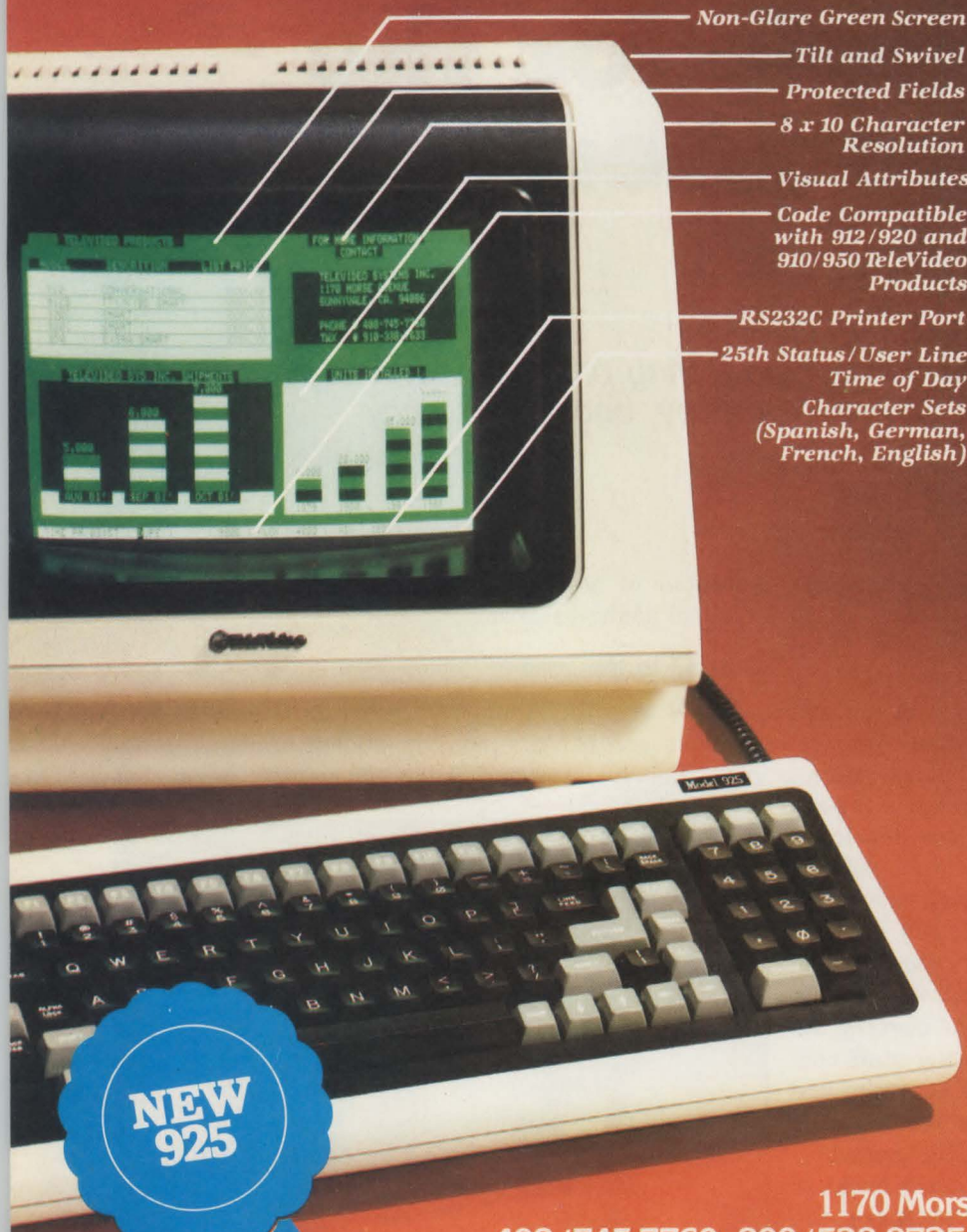
Rodel says the Apple-CAM program is used to help students and parents monitor student academic progress, pinpoint stronger skills and identify areas that



Lee Rodel (l.) and Charles Boody *discuss dissemination of the Hopkins Public School district's Apple-CAM program. Disks and documentation are offered to schools around the country.*

The Performance Leader....

Model 925



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CIRCLE NO. 82 ON INQUIRY CARD

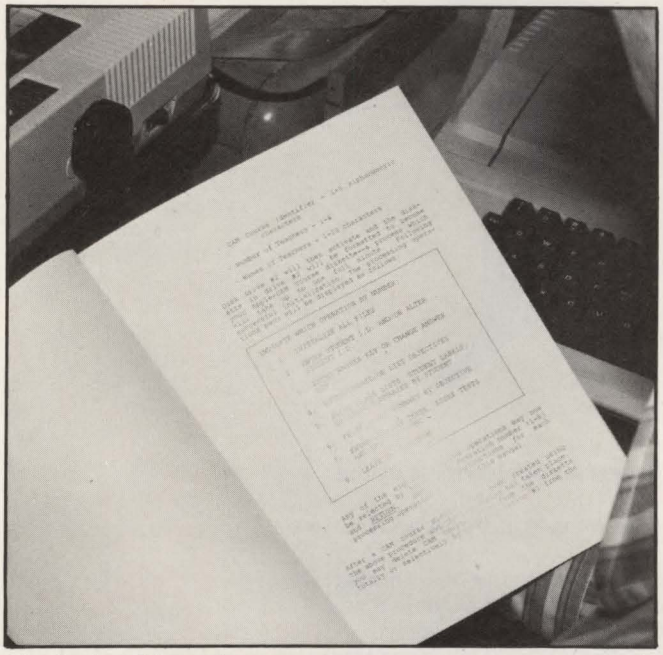
The Apple-CAM program is used to help students and parents monitor student academic progress, pinpoint areas of strength and identify areas that merit additional study.

merit additional study. Apple-CAM also helps teachers and administrators target curricular areas for special emphasis.

Apple-CAM's developer, software specialist Charles Boody, says the program provides several reports to facilitate instructional decision-making. One is a progress card for students, which provides the results of each test, and gives a cumulative summary of previous tests in that subject. Teachers receives a report for each test showing areas of strength and weakness and a summary report showing progress to date.

Hardware facilitates testing

The initial versions of Apple-CAM relied on keyboard input of student responses from an answer sheet. This process was slow, and users indicated interest in a more efficient data-entry method. The Apple-CAM developers tested several card readers with the Apple II and eventually settled on a hand-fed mark/sense reader from HEI, Inc., for input. They found the HEI reader to be an accurate, dependable device, at a price within the range of the other hardware required for Apple-CAM.



The Apple-CAM user's manual *has been written for educators with no computer experience. All formatting and report generating details are handled by the software.*

The HEI reader uses a standard 80-column card format and LED/photo-transistor for optical sensing to read a variety of pencil or pen colors in varying densities—an important factor for classroom use. The reader has in internal card drive that accepts hand-fed cards and passes them over an optical read station at a controlled speed. The HEI reader interfaces with the Apple II μc via a standard RS232 interface card, such as the Apple high-speed serial interface card.

Apple-CAM software has been adapted to accept input from the HEI reader as an alternative to keyboard input. Users can design student-response cards of various lengths to suit a particular test format. Student test responses are marked in pencil on a standard-width mark/sense cards and passed through the reader. The reader will handle as many as 30 student answer cards per min. Manual keyboard entry required 30 sec. or more per student depending on length of test.

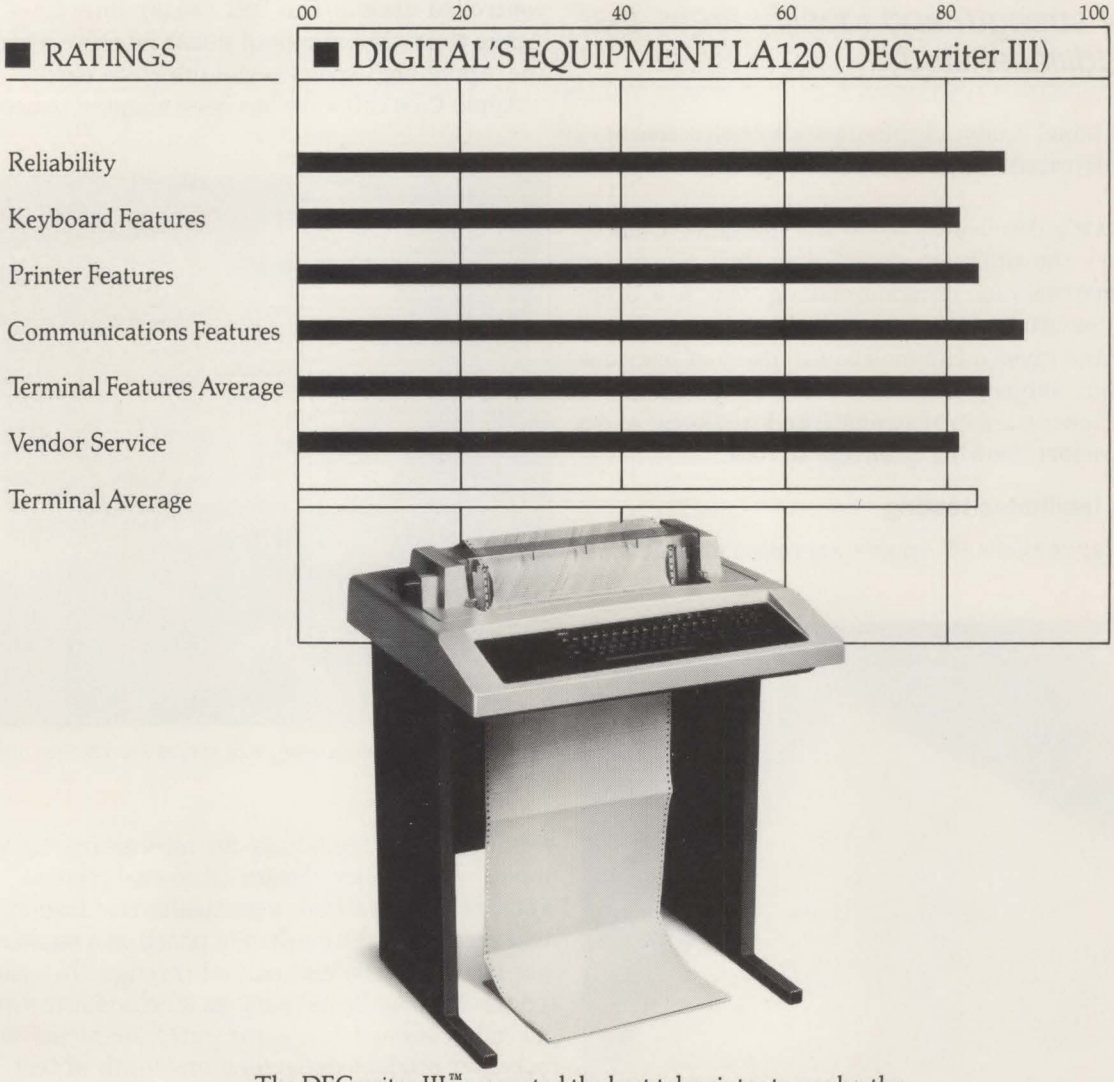
Apple-CAM is menu-driven, *with simple prompts for operators.*

One satisfied buyer, Dr. Jerry Olson, superintendent of the St. Clair, Minn., school district, says the HEI reader eliminates the need for keyboard entry of student test responses. "We're finding," he explains, "that the card reader makes the program more attractive to teachers, especially if they're not familiar with μcs or don't have time to enter a lot of data manually at the keyboard."

Apple-CAM use is being expanded to include testing in science classes, and Olson reports that teachers are showing considerable interest in other subject areas. A minimum competency test using Apple-CAM is under development and is expected to be implemented in the near future.

"We find the Apple-CAM reports to be excellent tools for both the teacher and the student," Olson continues. "Our students respond particularly well to printed progress reports, and the computer serves as a motivational tool. Apple-CAM gives them access to information that was not available before." ■

DECwriter III users are happier.



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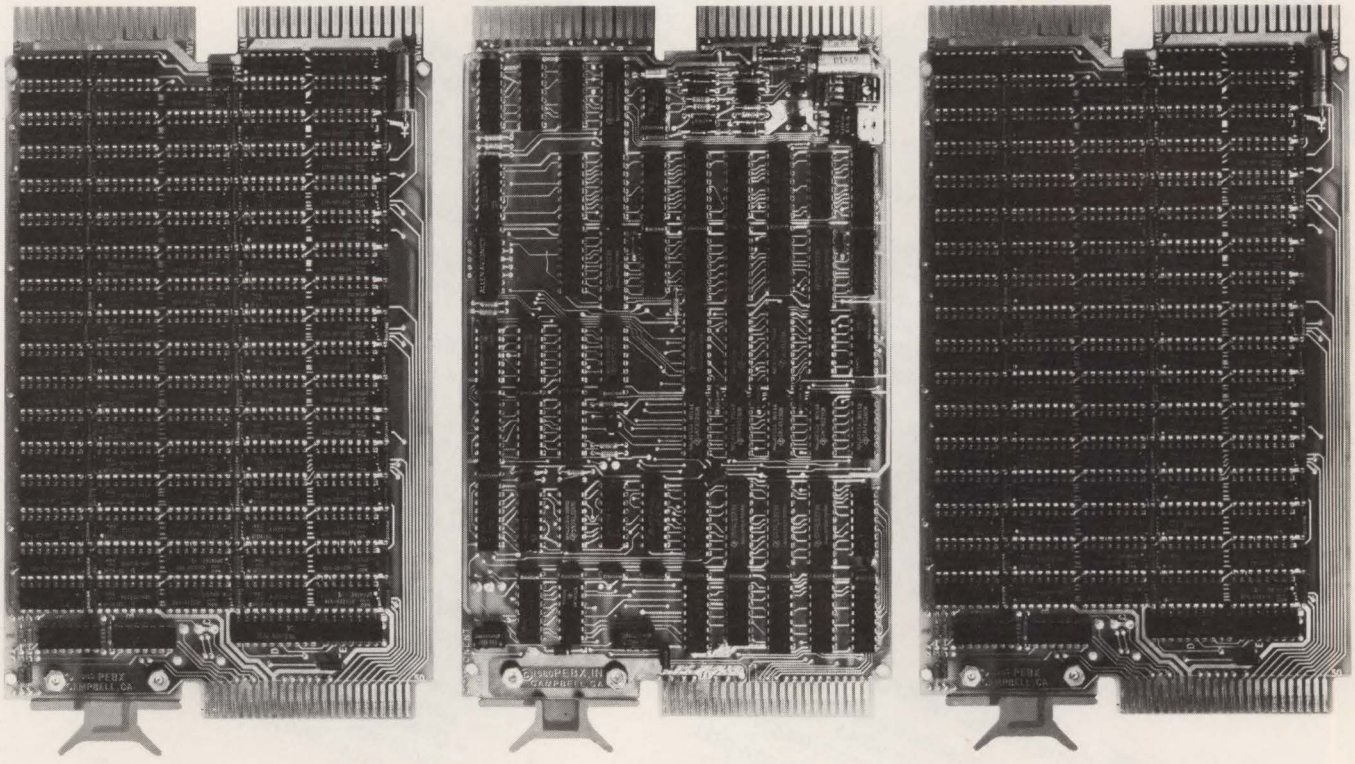

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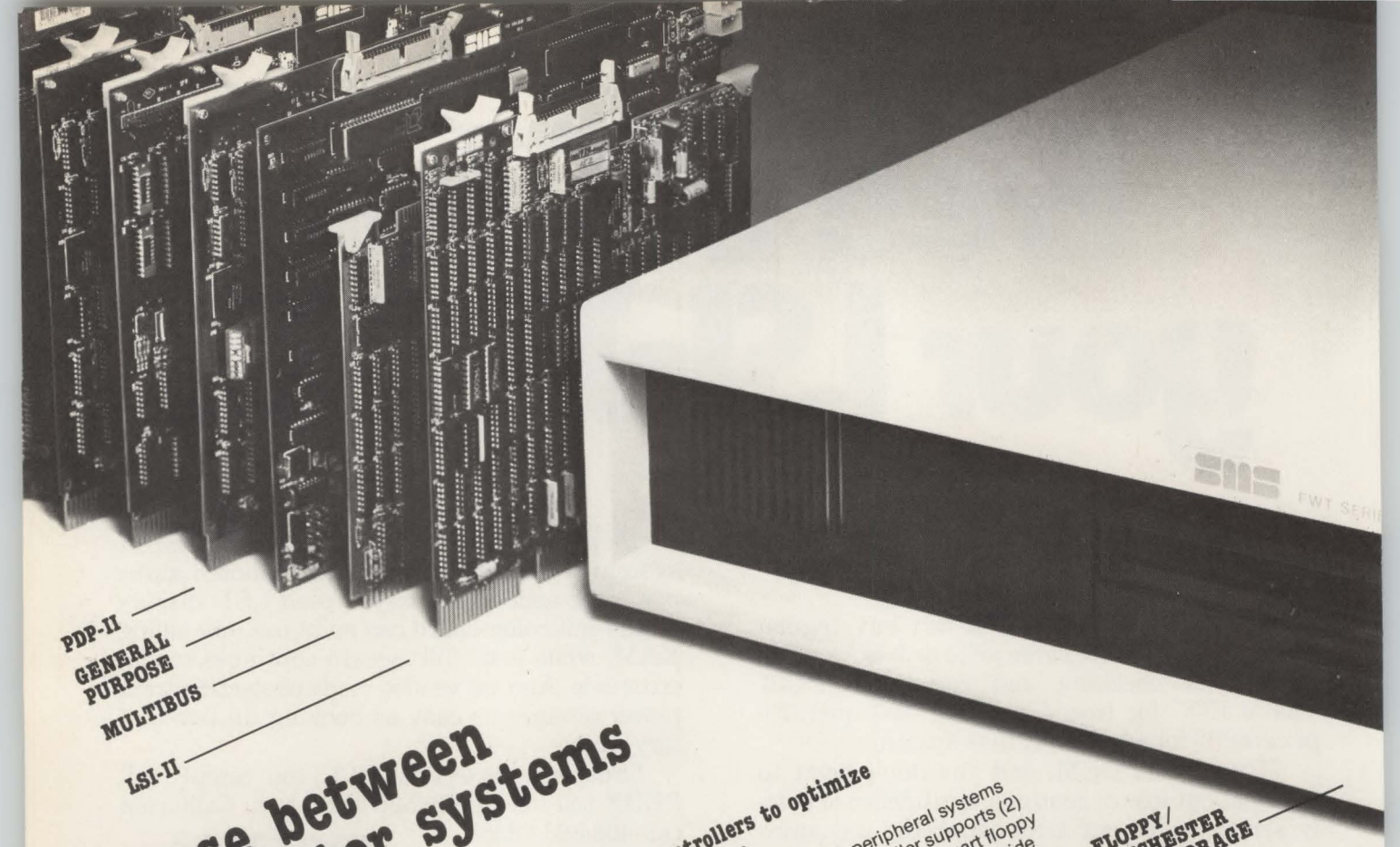

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- High performance data transfer of up to 543K bytes/sec.
- Emulates DEC RX02 floppy disk controller.
- Automatic recognition of RX01, RX02 and IBM diskette formats.

INTEL MULTIBUS

- Single Multibus compatible PC board requires only 5A (max.) @ 5 volts.
- Direct connection to (2) Shugart/Quantum and (2) Shugart floppy disk drives. Eliminates external data separator board.
- Interface and command compatible with INTEL iSBC 215A and iSBX 218 controller boards.
- Supports IBM and INTEL iSBC 202 diskette formats.

GENERAL PURPOSE

- Single board controller requires only 5A (max.) @ 5 volts.
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Timeplex concentrator addresses 'lower tier' users

In an attempt to penetrate a market it has barely scratched in the past—users with small- to medium-sized minicomputers and remote, asynchronous terminals—Timeplex, Inc., has introduced a family of inexpensive data-concentration systems. Called the E/Series, the data concentrators consist of a four-, eight, 12- or 16-channel asynchronous statistical multiplexer/concentrator, an optional integral synchronous statistical multiplexer and an optional series of high-speed integral modems.

Timeplex maintains it has simplified the task of setting up point-to-point communications networks for inexperienced users by combining all necessary functions into a single box. To reach and support these users most effectively, the Rochelle Park, N.J., manufacturer has signed up one Canadian and 12 domestic distributors to market and service the modular units.

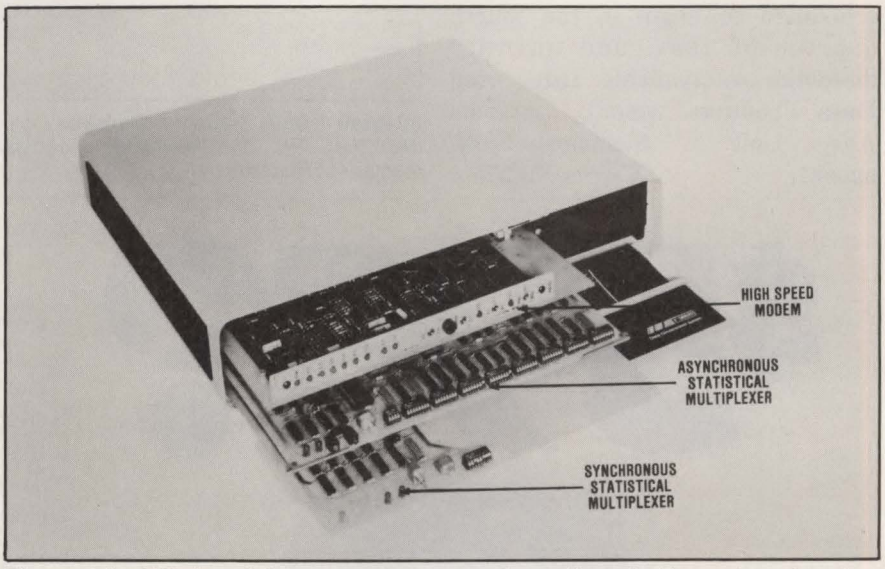
Incorporating a 16K-byte buffer, the E/Series devices also have built-in diagnostics and automatic self-test features in both the multiplexer and the modem modules. Timeplex will offer several optional interfaces to link the host-end concentrator to minicomputer buses, including those from Digital Equipment Corp., Data General Corp., Hewlett-Packard Co., Prime Computer, Inc., IBM Corp. and Perkin-Elmer Corp.

A Timeplex spokesman says a major advantage of the E/Series over other data concentrators on the market is the new device's ease of service and its simplicity in allowing parameter changes. Speed-data code and traffic-flow control for each asynchronous channel are independently selectable by flipping DIP switches behind the face of the unit. Channel parameters can also be set from a master E/Series system, which down-line loads changes without interrupting data flow on other channels.

To prevent errors over noisy telephone lines, the data concentrators constantly monitor transmissions. If errors occur, the transmission is automatically repeated. Each unit also has a traffic-flow-control function that automatically halts transmissions from a computer or an intelligent terminal when the buffer memory nears its capacity.

Prices for the four-channel and eight-channel units without integral synchronous multiplexers or modems start at $1650 and $2250, respectively. At the other extreme, a four-channel model with a statistical multiplexer and an integral 9600-bps modem sells for $6440. An eight-channel version with these modules sells for $7040.

Timeplex, Inc., One Communications Plaza, Rochelle Park, N.J. 07662. **Circle No 374**



The modular E/Series of data concentrators *can be configured with a variety of modems and can support four to 16 asynchronous channels.*

Single-board μc emulates DG's Nova

The MiniMate, a single-board, 16-bit machine, reported to be the fastest processor yet to emulate Data General Corp.'s Nova, has been developed by Integrated Data Products, Anaheim, Calif. Representatives of the company claim their offering is six times faster than DG's Eclipse and four times faster than various Point Four Corp. models.

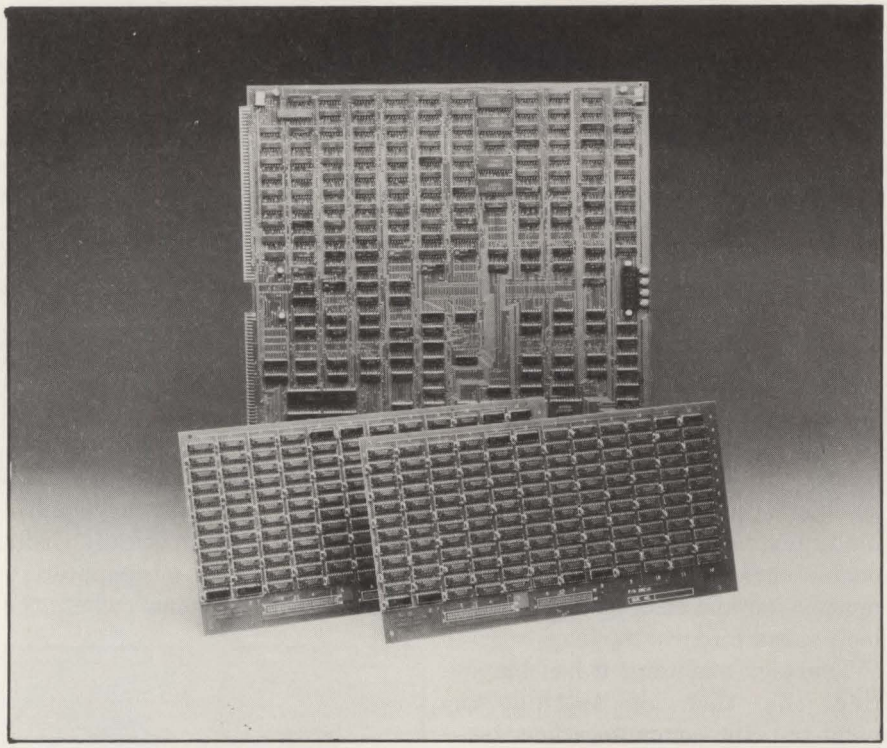
The MiniMate is available in complete-system or board-level configurations, and offers a number of options. The system configuration includes a CPU with 64K bytes of memory (expandable to 128K bytes), a power supply and an enclosure. As a board-only computer, it is plug-compatible with any foreign chassis using a 5V power supply.

Standard features include a 100-nsec. arithmetic-instruction execution time, a 200-nsec. load-and-store time and a 55-nsec. memory-access time. DMA-transfer time is

800 nsec., which is comparable to DG's Nova 3. The backplane includes nine slots, a priority-encoding feature and a slot-selectable slow-speed channel.

The MiniMate is software-compatible with a variety of operating systems, including IRIS, RDOS, BLIS/COBOL and VMOS. Prices for a board-only version with a 64K-byte memory are $5025, and $7125 with 128K bytes. The complete system with a 64K-byte memory sells for $7875, and $9975 with 128K bytes.

The MiniMate can also be purchased with a MiniMeg solid-state cache-memory system. With the 512K-byte MiniMeg, a 64K CPU is priced at $13,175. The 128K CPU sells for $15,275. Deliveries are scheduled to begin in the fourth quarter of 1981, and quantity discounts are available. **Integrated Data Products,** 3156 E. LaPalma Ave., Unit A, Anaheim, Calif. 92806. **Circle No 375**



Integrated Data Products' MiniMate *includes two memory boards, which mount directly onto the CPU. The MiniMate is compatible with DG's Nova and has a 100-nsec. memory-access time.*

Public comment asked for OCR-B ANSI standard

In accordance with ANSI procedures that require a five-year review of the approved standards, American National Standards Committee X3 Technical Group on OCR Font Design proposes that X3.49-1975 be reissued in its entirety, without changes.

The 1975 standard presents an alphanumeric character set for use in optical character-recognition (OCR) systems. This standard is the second of two on character sets for machine printing, the other being X3.17-1981 Character Set and Print Quality for Optical Character Recognition (OCR-A). Both character sets include numerals, upper- and lower-case characters and special symbols.

In the design of character shapes for OCR, it is possible to exchange conventional appearance for OCR reading performance (for example, insensitivity to degradation of printing and simplicity of required OCR device design). For the numeric and upper-case character sets of OCR-A, the emphasis is on OCR reading performance, while for OCR-B, emphasis is on conventional appearance. The objective is to provide a choice for users—optimized reading performance or conventional appearance.

The standard is available for public review and comment for a four-month period ending February 13, 1982. Copies can be obtained, if orders include a mailing label and advance payment of $10.25, from American National Standards Institute, Inc., 1430 Broadway, New York, N.Y. 10018. **Computer and Business Equipment Manufacturers Association,** 1828 L St., N.W., Suite 1200, Washington, D.C. 20036.

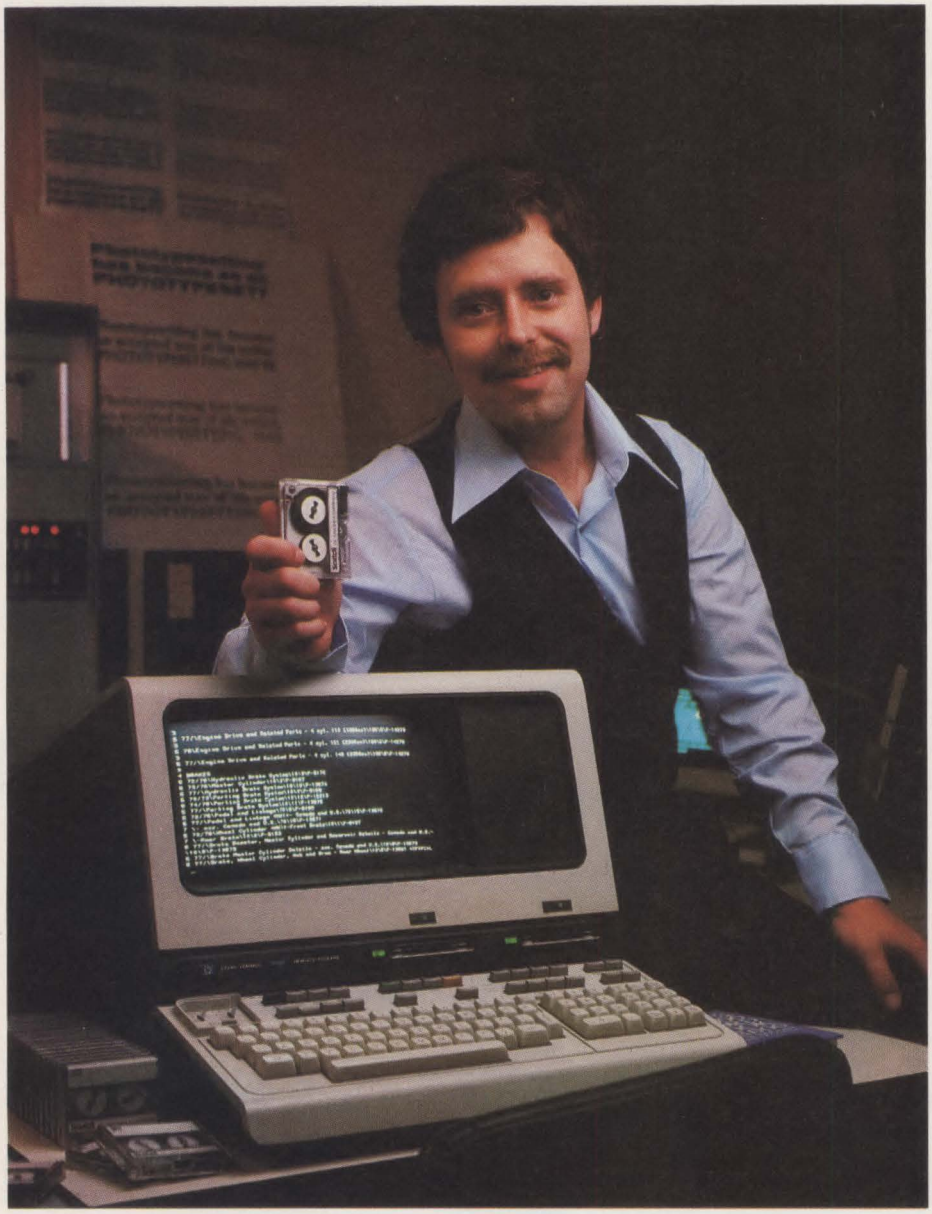
Circle No 376

Software turns typesetter into computer

A software package, introduced by Itek Graphics Products, Rochester, N.Y., enhances the capabilities of Quadritek phototypesetters. Itek licensed the software, called Quad Basic, from M.J. Benningfield, a Dallas printer.

The package is compatible with Quadritek systems having a minimum of 16K bytes of RAM,

"Our reputation rests on digits, decimal points, and details. We wouldn't trust them to anything less than Scotch® Brand Data Cartridges."



Bill Birkett, Vice President, Trade Graphics, Inc., Livonia, Michigan

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Scotch Data Cartridges are available in miniature DC 100A, the standard-size DC 300A and now, an extra-length DC 300XL with 50% more storage capacity. They are compatible with most cartridge systems including Hewlett-Packard, IBM, NCR, Tektronix and TI.

To find out where you can find Scotch Data Cartridges or virtually any other data recording medium, call toll-free: 800-328-1300. (In Minnesota, call collect: 612-736-9625.) Ask for the Data Recording Products Division.

If it's worth remembering, it's worth Scotch Data Recording Products.

3M

CIRCLE NO. 86 ON INQUIRY CARD

expandable to 72K bytes. Available with floppy-disk or cassette-tape media, the package sells for $500. Itek plans to market Quad Basic to the more than 6000 Quadritek users in the U.S.

Itek representatives acknowledge that the introduction of Quad Basic moves the company into the personal computer market, but add that Itek will not actively participate in that market. "This product won't change Itek's course," says Don Malagama, vice president for graphic equipment sales.

R.C. Pinckney, product sales manager, says the two booklets included with the package—"A Programmer Reference Manual" and "An Introduction to BASIC"—are sufficient to meet support needs of Quad Basic users. "For $500, we don't feel we can go out and help each user individually," he explains. "But we are trying to establish a users group to allow them to share developments with each other, and we will support Quad Basic through user publications." **Itek Graphic Products,** 811 Jefferson Rd. Rochester, N.Y. 14692. **Circle No 377**

Telecomm system manages phone costs

Following a two-year development period and extensive testing at five user sites, the Databank telecommunications processor system is now commercially available from General Dynamics Communications Co. Developed primarily by GDCC's Com Dev subsidiary, Sarasota, Fla., Databank can run as many as 16 programs simultaneoulsy and can support systems containing as many as 2000 stations.

User-programmable from 110 to 9600 bps, Databank supports as many as 10 standard RS232C ports and limits program access to specific ports. Various users can simultaneously tap the processor's memory via high-speed printers or CRT terminals.

The St. Louis, Mo.-based GDCC says Databank can effectively monitor and control phone traffic. Those are important capabilities, the firm says, given recent increases in WATS and other long-distance phone costs. With Databank, companies can bill appropriate departments for phone use. Via a station-message-detail-recording (SMDR) feature, the system also produces reports on, for example, all calls over a specific baseline cost, or summarizes telephone charges by department and type of telephone facility used.

Three programs are offered with Databank. DMA II, a call-accounting program stores and prices as many as 200,000 call records. Reports can be made by date, trunk and group, minimum cost, minimum duration and start and stop time of day.

Facility Management Report II further analyzes call records processed by DMA II. Reports include frequently dialed numbers; hourly usage in table, plot or bar-graph form; traffic analysis with peg count; and WATS analysis. The third program, PABX Directory I, permits printer or CRT-terminal access to the company directory by name, department or alternate stations.

The Databank system includes as many as three rigid- or floppy-disk drives, a user-accessible disk-operating system and a modem port for remote-program loading, call polling and disgnostics. GDCC technicians at two Technical Assistance Centers and GDCC field personnel can use the remote diagnostic feature to monitor almost all Databank operations, should any problems occur. **General Dynamics Communications Co.,** 12101 Woodcrest Executive Dr., St. Louis, Mo., 63141. **Circle No 378**

PERQ®

The unshared computer

10 Mbs on the Ethernet highway.

Now, for the first time, there's a network capable of keeping up with PERQ's extraordinarily fast processing and response time. With Ethernet,™ PERQ® gives you instantaneous access to all resources on the network, such as files, printers, other I/O devices—even other mainframes—plus all the speed of a dedicated single-user computer.

In real terms, what it means is this. Instead of taking as long as 44 seconds to transmit 10 pages of data, the transfer takes place in .042 second. In the 4.4 seconds it would take a conventional network to send one page of War and Peace, with PERQ and Ethernet, you could send the entire thousand-page novel.

The PERQ single-user, microprogrammed computer system is truly unshared. PERQ gives you all the power of a mainframe, executing over 1 million Pascal Q-codes per second in user-modifiable microcode, but without the wait time associated with time-shared systems. Need more computing power? Just add more PERQs. The high-resolution display is unmatched. The display's 800,000 addressable points are completely refreshed 60 times per second.

PERQ with Ethernet. A revolutionary computer. A revolutionary network. To find out more, write or call us today at 412-621-6250.

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Offices in Hartford, Washington, D.C., Atlanta, Pittsburgh, Chicago, Dallas, Los Angeles.

EUROPE, ASIA, NEW ZEALAND, AUSTRALIA, SOUTH AFRICA: contact your local office, International Computer, Ltd.

JAPAN: Rikei Corporation, Shinjuku Nomura Bldg., 1-26-2 Nishishinjuku. Shinjuku-ku, Tokyo 160 . Japan. (345) 1411.

CIRCLE NO. 87 ON INQUIRY CARD

Medical systems offer 10M-byte multiprocessor

The Expansion 6000 medical system and the Expansion 6000 contractor system are based on the vendor's 208K-byte memory multiprocessor with a minimum of 10M bytes of storage, a sealed Winchester disk, magnetic tape-cartridge backup, automatic power-fail backup and restart and remote-diagnostic capabilities. A basic system, including the computer, a TC 850 terminal, 150-cps, a TI-810 printer and software, sells for $35,872. Maintenance is $375 per month. **Reynolds + Reynolds,** Dayton, Ohio 45401.

Circle No 379

Ultimate announces two computer systems

The models 1000 and 2000 computer systems consists of Release 10 of the vendor's Ultimate operating system, a peripheral processor, an LSI-11 processor, a 64K-byte MOS memory. The model 1000 has a 10M-byte fixed disk, a cartridge-tape drive, a printer port and three communications ports. The model 2000 has a 33M-byte fixed disk, a microstreaming tape drive, a printer port and three communications ports. Prices for the models 1000 and 2000 are $29,000 and $33,500, respectively. **The Ultimate Corp.,** Clark, N.J.

Circle No 380

System prints letters, produces documents

The Cyberscribe III letter- and document-production system retrieves master file data from a central computer database for life-insurance offices. The system recalls and prints letters and reports from a file of standard letters and reports; recalls portions of letters and reports from a file of standard paragraphs or pages, assembles them into letters and reports and prints the assembled versions; and updates formats when needed. The system includes the vendor's information manager office-automation system with the Cyberscribe III software feature, plus compatible interface software for the master-file host computer. The interface-host-software computer runs on any IBM-compatible computer system, models 360, 370, 3000 or 4300, with any version of OS, OS/VS, DOS or DOS/VS. **Cybertek Computer Products, Inc.** 6133 Bristol Parkway, Culver City, Calif. 90230.

Circle No 381

Honeywell announces airline terminals

The model 1510 stand-alone video-display system and the model 1530 large-cluster terminal-processing unit are intended for use in airline reservation centers, airport and city ticket offices and travel agencies. The user-programmable model 1510 offers as much as 16K bytes each of EPROM and RAM addressable memory. It comprises a 12-in. screen and keyboard and displays as many as 2000 characters in 15 or 25 lines × 64 characters and 13 or 25 lines × 80 characters. The model 1530 connects multiple terminals to a host computer and supports as many as 16 VDU1501 video-display terminals. The model 1510, including 6K bytes of EPROM and 4K bytes of RAM, sells for $3000, plus a monthly maintenance fee of $30. The model 1530, with 8K bytes each of EPROM and RAM is priced at $6245, plus a monthly maintenance fee of $33. **Honeywell Inc.,** 200 Smith St., Waltham, Mass. 02154.

Circle No 326

JUST CONNECT AXIOM'S EX-850 PRINTER TO THE VIDEO INPUT OF VIRTUALLY ANY CRT DISPLAY AND INSTANTLY PRINT WHAT YOU SEE.

The Video Un-Interface

Imagine, instant hard copy of anything displayed on the CRT of your graphics terminal, video monitor or TV set... with absolutely no hardware or software interface.

And we mean anything — complex graphics, alphanumerics in any size or font, foreign symbols and hieroglyphics — whatever is on the screen.

That's because this amazingly simple printer operates from the composite video input of the CRT display. Just connect two wires and start printing.

IBM, Tektronix... You Name It

Nowhere will you find a printer that does what the $1495 EX-850 does. For example, it provides hard copy for many Tektronix graphic terminals at about 1/4 the cost of competitive printers. And the EX-850 plugs directly into the coax connector on IBM's 3270. You name it, the EX-850 will print it.

For Banks, Insurance Companies, and Others — The Electronic Notebook

The compact EX-850 is the ideal companion for CRT terminals in banks, insurance companies and a multitude of other businesses. It provides low cost hard copy at a teller's window, an executive's desk, or on the production line floor. At $1495 (less in quantity) you can afford to equip every terminal with an EX-850 VideoPrinter.

A Complete Graphics Printer

No stripped-down model, the EX-850 is a complete stand-alone printer including case, power supply, video printer controller, low paper detector, bell and paper roll holder. Maintenance is minimal, too. The printhead is self-adjusting and there are no inky ribbons to change. And every Axiom printer is backed by our nationwide distribution and service centers in the USA and 18 foreign countries.

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CIRCLE NO. 88 ON INQUIRY CARD

Ask introduces business-graphics system

The MANMAN integrated business-graphics system produces line, bar and pie charts for use with the vendor's MANMAN manufacturing and financial-management software. The system charts purchase-order dollar commitment, vendor performance, work-in-progress summary, work-center capacity, gross requirements, resource capacity and projected inventory value. The system consists of a Hewlett-Packard 7221T eight-color graphics plotter for producing hard copy or transparencies and an H-P 2648A CRT terminal for color graphics display, H-P's DSG/3000 software-utility tool that allows programmers to design their own charts and the vendor's graphics program that, with the H-P tool, draws from the MANMAN database to produce a graph. The pen plotter sells for $7250, or $5300 without paper advance, the CRT sells for $6250 and the software sells for $6300. The complete system sells for $25,470. **Ask Computer Systems, Inc.,** 730 Distel Dr., Los Altos, Calif. 94022.

Circle No 382

AM Varityper introduces three comp/edit systems

The comp/edit 5900 phototypesetter enables an operator to set type at 150 lpm. The unit includes 2208 type fonts on-line in 16 typestyles and 138 sizes. The unit permits input from 10 or more off-line sources. It features a 17-in., 40-line CRT screen that simultaneously displays more than 2000 characters, with scrolling of as many as 8000 characters. The models 5410 and 5310 enable operators to set type at 50 to 70 lpm. The units feature a 12-in. CRT screen that displays 12 lines of copy or as many as 768 characters. Model 5410 contains 2208 type fonts on-line, while the 5310 system includes 552 on-line fonts. The model 5900 is priced at $26,950, the 5410 unit at $19,995 and the 5310 at $17,995. **AM Varityper,** 11 Mount Pleasant Ave., E. Hanover, N.J. 07936.

Circle No 383

Honeywell announces airline terminals

The model 1510 stand-alone video-display system and the model 1530 large-cluster terminal-processing unit are intended for use in airline reservation centers, airport and city ticket offices and travel agencies. The user-programmable model 1510 offers as much as 16K bytes each of EPROM and RAM addressable memory. It comprises a 12-in. screen and keyboard and displays as many as 2000 characters in 15 or 25 lines × 64 characters and 13 or 25 lines × 80 characters. The model 1530 connects multiple terminals to a host computer and supports as many as 16 VDU1501 video-display terminals. The model 1510, including 6K bytes of EPROM and 4K bytes of RAM, sells for $3000, plus a monthly maintenance fee of $30. The model 1530, with 8K bytes each of EPROM and RAM is priced at $6245, plus a monthly maintenance fee of $33. **Honeywell Inc.,** 200 Smith St., Waltham, Mass. 02154.

Circle No 325

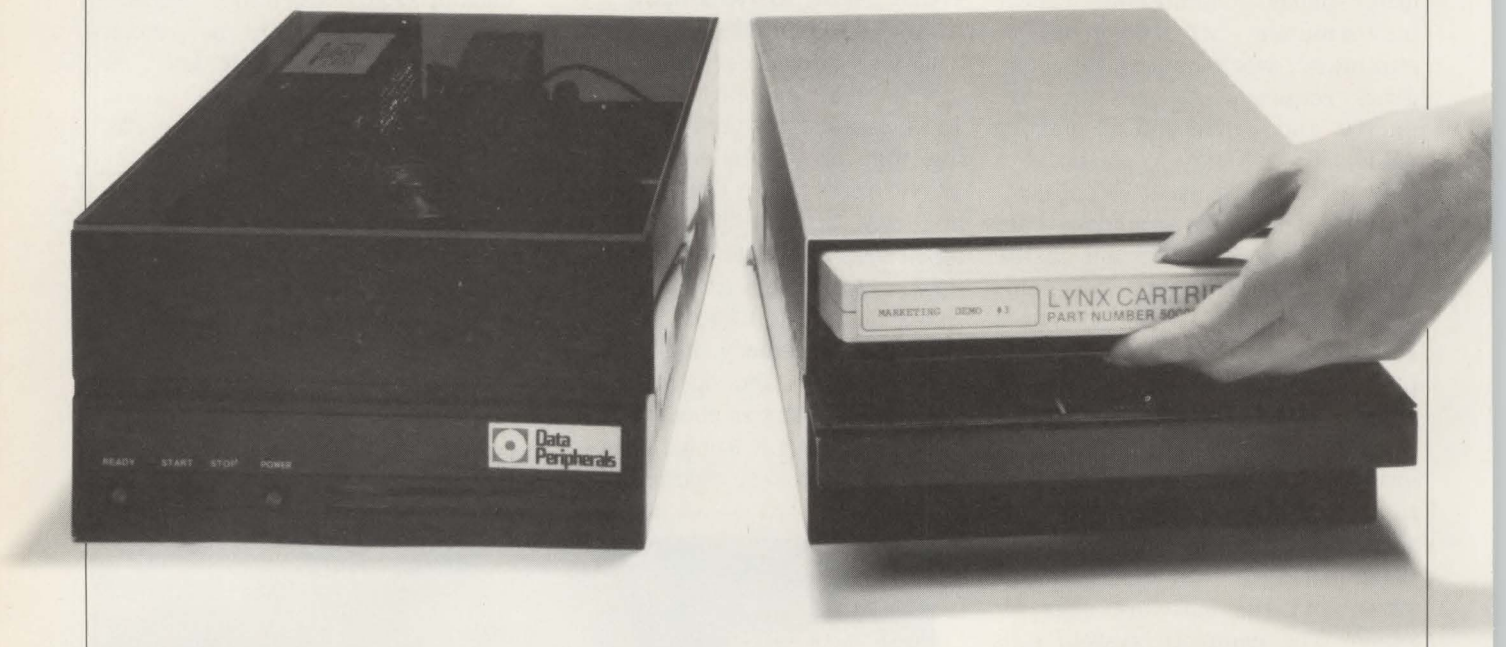
NEXT MONTH IN MMS

- A product profile of line printers.
- An analysis of the teleprinter market.
- A rundown (with comprehensive tables) of available serial printers.

EVOLUTION

PUMA-40MB
Fixed Media Winchester

LYNX-10MB
Removable Winchester Cartridge



DATA PERIPHERALS LYNX AND PUMA. A NEW BREED OF DISK DRIVE EVOLVES TO CONQUER TODAY'S DATA STORAGE ENVIRONMENT.

The newest step in the evolution of data storage combines the best features of its predecessors: the reliability of Winchester technology and the convenience of disk cartridge removability.

Data Peripherals' LYNX provides 10 Megabytes of formatted storage on a single, removable 8″ cartridge. The PUMA offers 40 megabytes of formatted storage capacity in a fixed 8″ Winchester drive. Both units are the same size and shape as standard 8″ floppy drives.

Together, they provide the storage and backup performance demanded in today's business computer environment.

PUMA and LYNX are data and interface compatible, so they can be easily and economically designed into your system using our DP910 controller. Compact and identical in size, they mount either vertically or horizontally.

Both units incorporate highly evolved technologies that ensure the trouble-free performance you demand. Key features like linear voice coil technology with embedded servo. Microprocessor control of servo, spindle, and interface functions to completely eliminate field adjustments. And DC-only power requirement for flexibility in worldwide applications.

Production units are available now, so call us for details. In the evolving world of storage systems, LYNX and PUMA are the natural selection.

The new breed of disk storage system.

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Sunnyvale, CA 94086
(408) 745-6500

In Boston: (617) 329-3654

In U.K.: X-Data, Ltd. Slough, Berks. 753-49117

CIRCLE NO. 89 ON INQUIRY CARD

Zilog offers BASIC interpreter

The model Z8671 single-chip μc system includes a BASIC interpreter masked onto the chip's 2K bytes of internal ROM. The system uses BASIC/DEBUG, which features direct access to hardware registers and memory, hexadecimal and decimal I/O and calls to machine-language routines. The Z8671 offers six levels of vectored interrupts, fast instruction execution, efficient memory use, I/O and bit-manipulation capabilities and system expansion. Memory-expansion ability provides as much as 124K bytes of ROM or RAM. Other features include a full-duplex UART for communication with a program-development terminal, selectable 110- to 19.2K-bps baud rates, +5V operation and TTL-compatible pins. The Z8671 comes in a 40-pin plastic dual-in-line package and is priced at $24.63 in quantities of one to 10. **Zilog, Inc.,** 10340 Bubb Rd., Cupertino, Calif. 95014.

Circle No 384

68000 development system is PDP-11-compatible

The CMS-16/DS1 development system for DEC PDP-11-compatible computers consists of a 68000 CPU board with on-board firmware, a serial I/O board and cabling and a nine-slot Multibus card cage with power supply and protective enclosure. The unit can be used as a pass-through system connected between a CRT and a host PDP-11; a user unplugs the CRT from the host, plugs it into an I/O port on the CMS-16/DS1 and connects a second RS232 cable from a second port to the PDP-11 terminal input. Programs can then be down-loaded to the 68000. As a back-end processor, the system is connected to the PDP-11 via a separate port. Commands must pass through the PDP-11 operating system. A 68000 cross-assembler is provided on 8-in. disks in RT-11 format for program development. Price is $6995. **CM Technologies, Inc.,** 525 University Ave., Palo Alto, Calif. 94301.

Circle No 385

NEXT MONTH IN MMS

January will bring the sixth annual printer issue of Mini-Micro Systems, including supplier directories intended to be clipped and saved. Included in the feature article package will be:

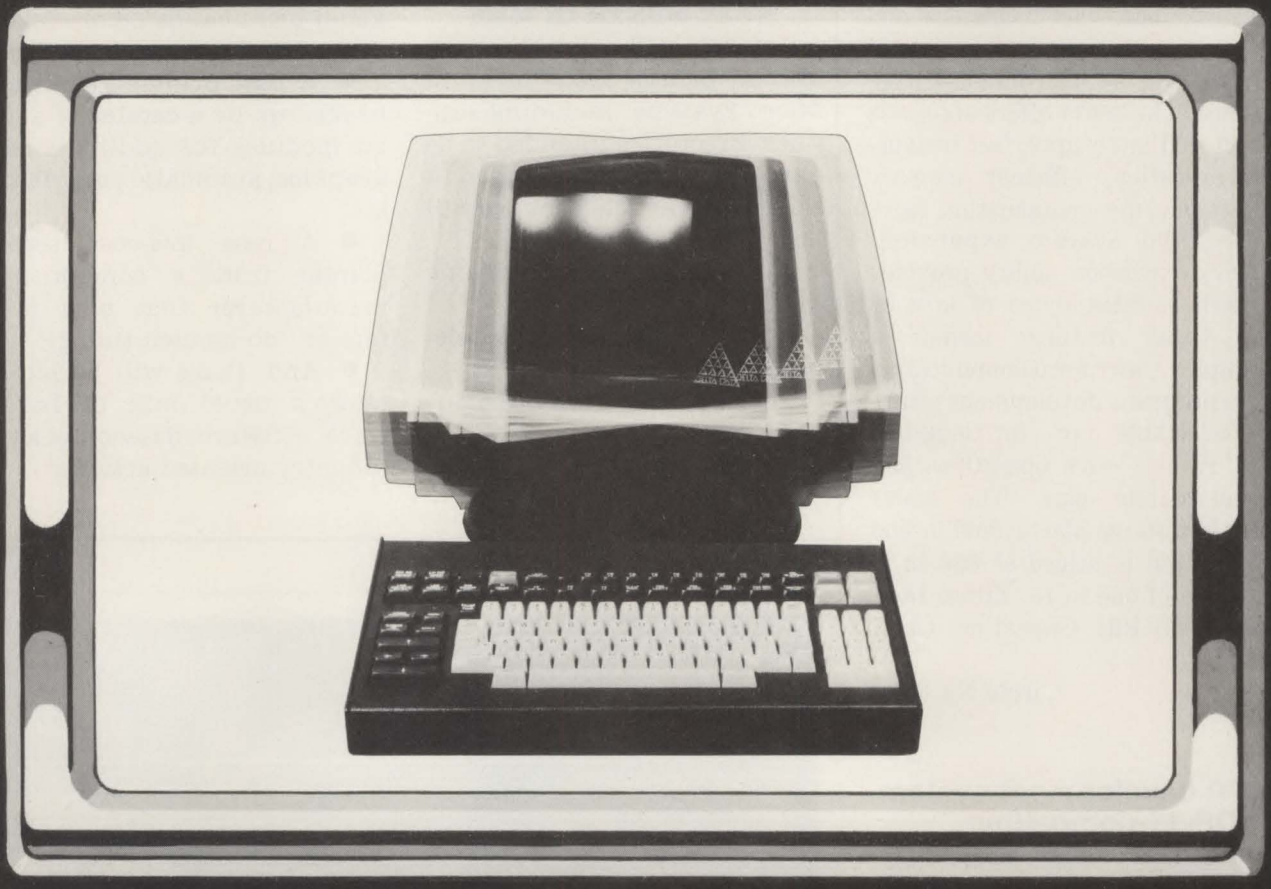
- A product profile of line printers.
- An analysis of the teleprinter market.

There also will be other articles on:

- What you should know about print bands before selecting a band printer.
- A new printer "system" backed up by a catalog of add-on modules for adding color, graphics, automatic paperfeed, etc.
- A new low-cost serial printer from a components manufacturer that now prefers to "do its own thing."
- And, there will be Mini-Micro's usual mix of hardware, software, datacomm and industry-oriented articles.

A new angle to improve your terminal system . . .

Introducing the DELTA 2100 full feature ASCII terminal



Any way you look at it, this new terminal offers greater flexibility for your terminal system — in performance and cost-effectiveness.

- New high quality plastic case
- New high resolution 12" monitor
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- Many custom engineered features plus private labeling policy for large system applications

Need a new angle to enhance your terminal system while adding sales appeal and lowering costs? Check out the DELTA 2100 today. Just tell us about your system requirements or request full technical literature.

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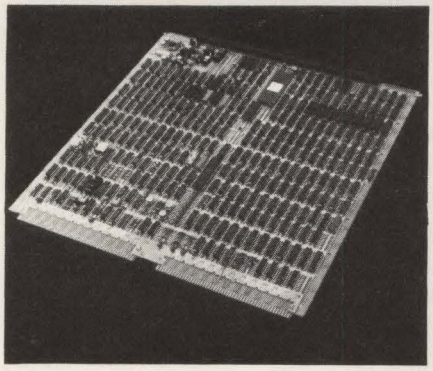
CIRCLE NO. 90 ON INQUIRY CARD

graphics



Octek announces image processor

The model 2010 programmable image processor for automated-inspection and image-processing applications digitizes video input in real time using direct memory access. Features include FORTRAN-callable host-resident driver routines, a 16-bit μp that controls board functions using assembly language with an optional cross-assembler and the ability to create command macros by down-loading host-assembled code to a 4K-byte RAM. Other features include raster-generated images displayed from a 320K-bit memory, a synchronized, dual-ported image memory that produces a 320×240 or 320×480 display with a 16-gray scale and I/O memory-translation tables that allow gray-level processing from within a program or interactively using a keyboard. Price is $4875, with OEM discounts available. **Octek Inc.,** 7 Corporate Place, S. Bedford St., Burlington, Mass. 01803.

Circle No 372

IMI offers stroke-refresh system

The IMI-500 graphics processing and display system refreshes 32,000 short vectors at 40 frames per sec. and allows real-time 3D viewing of complex objects and structures. The system operates in a stand-alone mode or as an intelligent peripheral to a minicomputer. Features include variation of perspective, clip and zoom, portrayed on a 21-in. video monitor; the ability to accept 24-bit floating-point numbers in the data-input stream; and stroke-graphics-generated characters. Communications with an external host computer are through a serial, DMA or parallel-interface connection. Software includes a CP/M operating system and a grahics editor with assembly-language- or FORTRAN-callable routines. A dual-disk system with operating software is priced at $55,500. **Interactive Machines Inc.,** 2500B Townsgate Rd., Westlake Village, Calif. 91361.

Circle No 373

System provides remote viewing

The model GDS-2000 large-audience-viewing, remote-terminal display system uses a video camera mounted behind a pivot-hinged optical hood. The assembly mounts directly on the display with the ability to swing it to one side to view the terminal directly. The model GDS-2000A features variable-image magnification from one to 2.5 through the use of two fixed lens. The Model GDS-2000PTZ is fully

automatic at a remote location in both magnification and image-area selection. Magnification is continuously variable from one to six. Prices range from $2920 to $9710. **Jodan Technology, Inc.,** P.O. Box 362, Lexington, Mass. 02173.

Circle No 324

New Products

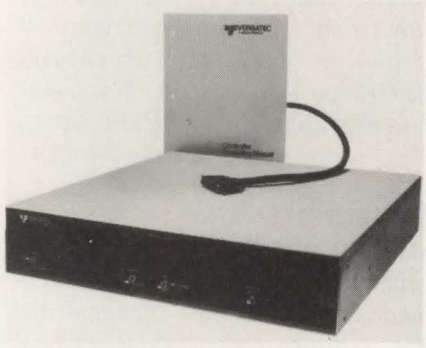
BIS offers graphic document digitizer

This graphic document digitizer uses a line-scan camera moved over a source document to digitize graphical information. The camera uses CCD analog sensing and is controlled by a stepping motor. Threshold discrimination of the video signal uses non-linear amplification and automatic feedback adjustment of the clipping level. FIFO buffering in the controller smoothes the camera motion, by speed-averaging the data transfer rate to a host computer. Other features include the ability to handle documents as large as 8 in. × 6 ft., 200-ppi resolution in both axes and data consisting of the position and direction of each transition between light and dark. Prices begin at $20,000, including documentation and specifications for the 16-bit parallel interface. **Business Information Systems, Inc.,** 4248 Bluebonnet Dr., Stafford, Texas 77477.

Circle No 360

Versatec announces raster data translator

This raster data translator enables the vendor's 200-ppi printers/



plotters to draw with 100-ppi resolution data. The rack-mounted or desk-top interface can be connected between the vendor's interfaces/controllers and printers/plotters. When a user switches the device to translate mode, incoming raster data is doubled horizontally and vertically in hardware. Incoming 100-ppi data can be plotted on a 200-ppi machine; incoming 200-ppi data can be passed through transparently or translated to double-plot size. Users also can select a hardware-algorithm circuit that smoothes duplicated data by adding points to jagged lines. Three buffers store as much as 1024 bytes of data. Print data is passed through transparently. I/O port configuration blocks can be switched for TTL or long-line I/O. Price is $1900, with OEM discounts available. **Versatec,** 2805 Bowers Ave., Santa Clara, Calif. 95051.

Circle No 361

Only from Computer Memories... More than 19 Megabytes in a 5¼" Winchester

Conventional, performance-proven head design

We've shipped hundreds of our high capacity CM 5000 units already. We told you nothing could beat them. For capacity. For reliability. For cost effectiveness.

Now something has. It's the CM 5000 itself! Consider these features:

Five megabytes formatted per disk

- Capacities of 6.38, 12.76 and 19.14 megabytes, unformatted
- Lowest cost per megabyte in the marketplace
- Identical mounting to standard 5¼" floppy drives
- Interface compatible with readily available controllers.
- No-hysteresis positioning system
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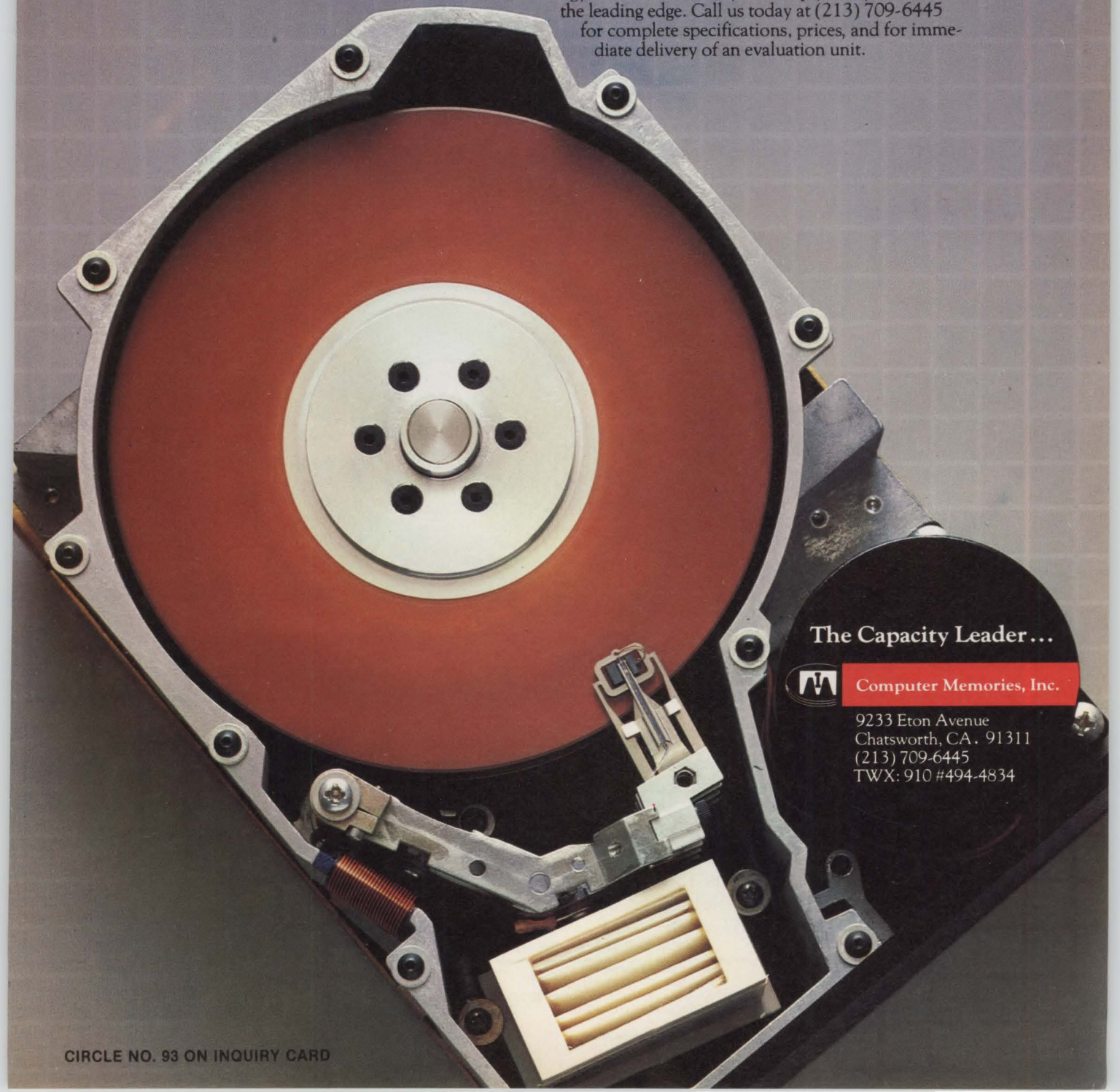
- Step-pulse buffering

These and many other outstanding features all add up to the leading edge of Winchester technology. Find out how they can keep your systems on the leading edge. Call us today at (213) 709-6445 for complete specifications, prices, and for immediate delivery of an evaluation unit.



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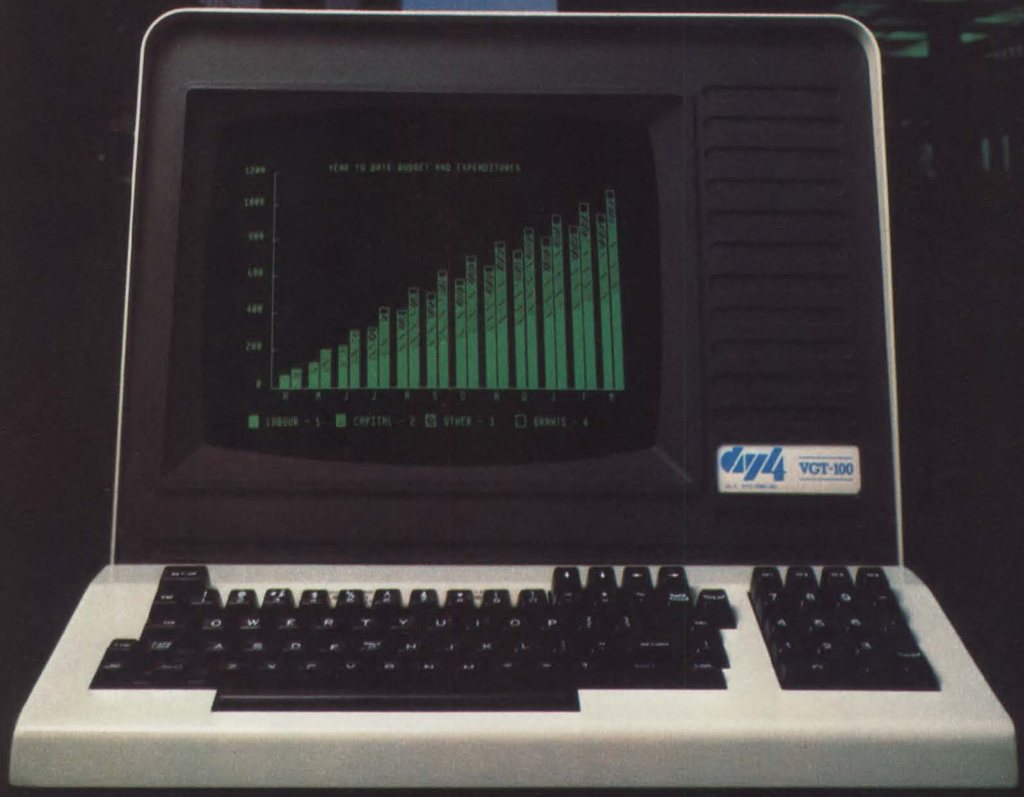
CIRCLE NO. 93 ON INQUIRY CARD

THE ARCHITECTURE IS DIFFERENT. THE CONCEPT IS THE SAME.



Just as the modern office towers hum with activity within their glass walls, so the *VGT-100* contains maximum activity within its compact space.

Through the latest microprocessor and LSI technology, the *VGT-100* creates innovative graphics on a spacious 15-inch screen; offering 640 x 240 plotting resolution with 80 x 24 lines. (132 x 18).

The VGT-100 stands well on its own, featuring a detachable keyboard allowing for greater flexibility and has VT-100 as well as Tektronix Plot 10[R] compatibility.

Contact us for a full list of features as well as information on the new *VGT-100H* (640 x 480).

Let us build one for you!

CIRCLE NO. 94 ON INQUIRY CARD

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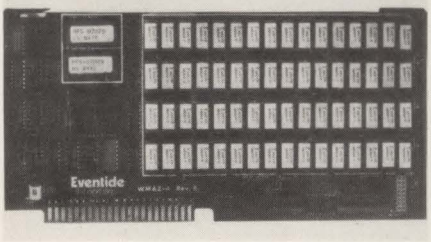
memories

Eventide offers 512K-byte memory

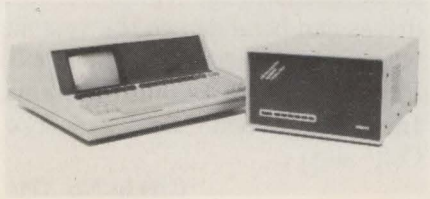
The 512K-byte WMAZ-4 memory board for Hewlett-Packard 9845 series desk-top computers features an embedded security code that can be read by the proprietary program. If the code is missing or incorrect, the program cannot run. The board also offers an optional programmer's utility package ROM that provides additional BASIC



keywords, including XREF, MAP, CHANGE, FIND, DUMP ALPHA and MSI. Other features include the ability to collect more than 1 million data samples at data rates as high as 100 KHz and the ability to speed computations by storing lookup tables instead of performing repetitive calculations. The 512K-byte board sells for $6500, a 256K-byte version sells for $4250, and the utility ROM adds $700 to either version. **Eventide Clockworks, Inc.**, 256 W. 54th St., New York, N.Y. 10019. **Circle No 352**

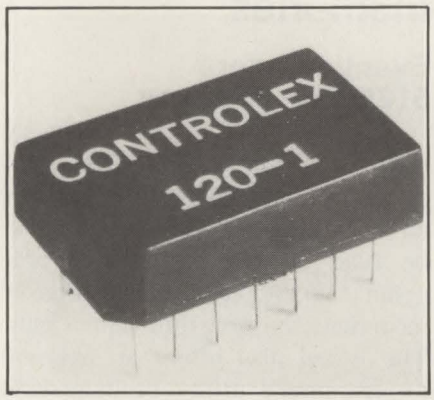
MSC offers Winchester subsystems

The 5M-byte 9800H Winchester-disk-storage subsystem for Hewlett-Packard series 80 desk-top computers and other IEEE 488-bus-based systems is plug-compatible and software-transparent to H-P's series 80, 9826, 9835, 9845, 10001, 125 and 250 computers. The stand-alone system consists of a Seagate Technology 5¼-in. Winchester-disk drive, a single-board controller based on the vendor's 9000 series micromodule and a 115V/230V power supply. Features include 22-bit error detection, 11-bit error correction, a 256-bit data buffer, single-command disk initialization and switch-selectable bus address. Price is less than $4000. **Microcomputer Systems Corp.**, 432 Lakeside Dr., Sunnyvale, Calif. 94086. **Circle No 353**



Nonvolatile core memory stores μp data

The model 120 nonvolatile 4-bit array core memory module stores a status word upon power shutdown or loss and retains it infinitely. The unit operates with +5V and uses TTL logic chips. In a typical application, a μp I/O port accesses the 120 in response to power-down. Data are loaded sequentially in four cycles and sequentially loaded on bring-up through the I/O port. The unit is packaged in a 14-pin DIP, and is available as a core module or with support circuitry on a 1- by 2-in. PC



board adapter that plugs into a host. Cycle time is 1 μsec. Options include longer word lengths, including 8 bits, and parallel access. Price is $6.90 in OEM quantities. **Controlex Corp.**, 16005 Sherman Way, Van Nuys, Calif. 91406.

Circle No 370

Laredo unveils memory for μcs

The 5M-byte LS525 memory system incorporates a 5¼-in. Winchester-disk drive, the LDOS disk operating system, a linear power

supply and the LSI 500 series controller. An off-board host adapter enables the unit to be connected to almost any CPU or bus. As many as three additional Winchester-disk drives can be added to the system, with no software modifications. Price is $3750. **Laredo Systems, Inc.**, 669 Giraudo Dr., San Jose, Calif. 95111.

Circle No 371

370÷311=IV

Announcing the new math for OEMs

IBM 370 software goes right into our System 311 hardware. That equation gives you four big advantages.

I. Total IBM compatibility. Both the 311 and 312 use the 370 instruction set and run DOS/VS, DOS/VSE, OS/VS1 and VM/370 System Control Programs. That equation conserves your investment in hardware, software and staff training.

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

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

IV. Nationwide support. You can support users yourself, or take advantage of a Four-Phase service contract. We have over 1000 service personnel in more than 130 locations across North America.

If you like the way the new math adds up, call us at 1-800-528-6050 extension 1599 (in Arizona call 1-800-352-0458 extension 1599) and ask for our brochure on the Systems 311 and 312. Or complete the coupon below.

Four-Phase Systems, M/S 52-10A7, 10700 N. De Anza Blvd., Cupertino, CA 95014

Name _____ Title _____

Company _____

Address _____ City _____

State _____ Zip _____ Phone _____

Four-Phase Systems
The Distributed Processing Company
10700 North De Anza Blvd., Cupertino, CA 95014.

CIRCLE NO. 97 ON INQUIRY CARD

National offers add-in RAM for μcs

The 512K-byte BLC-0512 add-in RAM card for the vendor's series 80 μcs includes 0.5M bytes of 64K dynamic RAM MOS memory. The card is available with or without parity, and features an on-board CSR 16-bit register to store parity information that can be written or read as one 16-bit word or 2 sequential bytes. Selectable interrupts can be used to indicate parity errors or a parity-error signal. The card operates in 8- or 16-bit data buses, 20- or 24-bit memory addressing and 8- or 16-bit I/O addressing. Price is $3475, with quantity discounts available. **National Semiconductor Corp.,** 2900 Semiconductor Dr., Santa Clara, Calif. 95051.

Circle No 368

Parity card checks memory integrity

The MP100 memory parity card for S-100 bus systems maintains a continuous check on the integrity of a computer's memory during execution of software. The card stops a program when erroneous data are fetched by the CPU. The card consists of parity-generation circuitry and 4K to 64K bytes of RAM. Other features include the ability for the CPU to read a bus interface, the ability to read data sampled on the same clock edge as the CPU and board disable and force error for functional verification. Options include interrupt, non-maskable interrupt, infinite wait, reset and force instruction and an on-board hex display that shows failed-memory locations. **Echo Communications Corp.,** 1708 Stierlin Rd., Mountain View, Calif. 94043.

Circle No 366

ROM kits increase Digitalker vocabulary

The models DT1056 and DT1057 speech ROM kits add 131 words to the vendor's "Digitalker" speech-synthesis system, expanding its vocabulary to 274 words. Both kits comprise two 65K-bit roms. The DT1056 also includes the Digitalker speech-processor chip. The kits can be used with mechanical switches or with μp systems, and require an amplifier and a speaker. The DT1056 sells for $85, and the DT1057 sells for $40, both in quantities of one to nine. **National Semiconductor Corp.,** 2900 Semiconductor Dr., Santa Clara, Calif. 95051.

Circle No 367

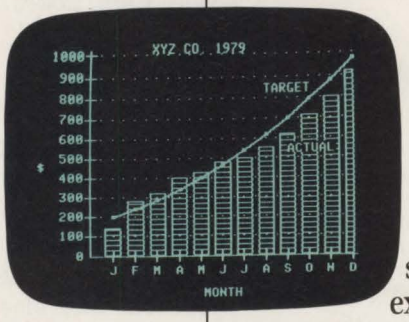
Three good reasons why professionals pick Apples.

1 In research

Apple personal computer systems help you collect, store and analyze data as fast as you can load a disk and execute a program. Because more than 200 companies offer software for Apple, you have the largest program library for manipulating your data in the personal computing world. Need special programs? Use any of Apple's development languages — BASIC, FORTRAN, Pascal.

2 In engineering

Apple personal computer systems let you define models, make tradeoffs and refine prototypes. Want to study cause and effect of several variables? Apple computes new results instantly and displays them in colorful, easy-to-read graphs, charts or plots on a video monitor.



3 In production management

Apple personal computer systems make it easy to gather data, analyze productivity, measure yields and facilitate all phases of production control. Want to speed up repetitive tasks?

Rely on Apple's word processing capabilities to write, edit and print your reports.

Apples grow with you.

Whichever system you pick, Apple never locks you into a single configuration. You can use up to four or eight I/O accessory expansion slots to add an IEEE bus, Apple's Silentype™ printer, a modem or a graphics tablet. Add memory up to 64K bytes or 256K bytes. Add up to four or six 5¼" disk drives without adding any overhead.

And the Apple *III* is now available with ProFile™ — a new 5-megabyte hard disk.

For support, service and the best extended warranty in the industry — Apple is the answer. If you have any other questions about why Apple is the pick for the professional in engineering,

	Apple II	Apple III
Maximum Memory Size	64K bytes	256K bytes
Screen Display	40 column (80 column with peripheral card) 24 lines Upper Case	80 column 24 lines Upper Case/Lower Case
Screen Resolution (B&W)	280 x 192	560 x 192
Screen Resolution (Color)	140 x 192 (6 colors)	280 x 192 (16 colors)
Keyboard	Fixed	Programmable
Numeric Key Pad	Accessory	Built-in
Input/Output	8 Expansion slots	4 expansion slots plus built-in: disk interface RS-232 interface Silentype™ printer interface
Disk Drives	Add-on one to six drives	One drive built-in, plus interface to support three more drives Plus one to four 5 megabyte ProFile disks
Languages	BASIC, Fortran 77, Pascal, Assembly, Pilot	Enhanced BASIC, Fortran77, Pascal, Assembly
Typical Configuration Pricing	CPU, 48K RAM, single disk drive, B&W (12") monitor, Applesoft BASIC $2495.	CPU, 128K RAM, integrated disk drive B&W monitor (12"), SOS, Enhanced BASIC $3940.

see your nearest Apple computer dealer or call 800-538-9696. In California, 800-662-9238. Or write Apple Computer, 10260 Bandley Dr., Cupertino, CA 95014.

apple

CIRCLE NO. 99 ON INQUIRY CARD

New Products

Monolithic unveils FIFO memory ICs

The models 67401A and 67402A, two-port, word-serial FIFO memory ICs, are organized as 64 words × 4 bits and 64 words × 5 bits, respectively. Both guarantee a 15-MHz data rate and have TTL input pins located opposite corresponding TTL output pins. The 67402A provides 4 bits, plus 1 bit for parity checking or end-of-frame marking, enabling designers to use two FIFOs to build a 9-bit system. The models C67401A and C67402A can be cascaded to form a memory of 128 words or more, or they can be connected in parallel to form word widths of 8 bits or more. Prices for the 67401A and 67402A start at $32.57 and $41.14, respectively, in commercial versions, and $48.86 and $61.71, respectively, in military versions, all in quantities of 100 units or more. **Monolithic Memories,** 1165 E. Arques Ave., Sunnyvale, Calif. 90486. **Circle No 257**

National introduces PROM/ROM board

The BLC-464 PROM/ROM expansion board provides 16K to 128K bytes of memory and is compatible with any series 80 computer via a standard Multibus interface. The unit is also compatible with systems that use as many as 24 address lines, and it accommodates 8- and 16-bit data paths and 16 PROM/ROM devices, including the 1K × 8 2758, the 2K × 8 2716/2316, the 4K × 8 2732/2332 and the 8K × 8 2764/37000. The unit features four address lines on a P2 connector, minimum 35- to 1435-nsec. access times, on-board DIP switches, option blocks and Berg jumpers. Price is $570 in single-unit quantities, with volume discounts available. **National Semiconductor Corp.,** 2900 Semiconductor Dr., Santa Clara, Calif. 95051.

Circle No 369

Ultra *FAST* BASIC Compiler

CB80,™ Compiler System's new native code Basic compiler, offers maximum speed and flexibility in creating applications to solve today's business problems.

CBASIC™ compatible: As an addition to the CBASIC family, CB80 has all the features of CBASIC (14 digit accuracy, long variable names, stream and record I/O, multiple line functions) plus these extras:

- Relocatable machine code • 32K byte strings
- Nested IF statements • ON ERROR GOTO
- Variable type declarations • CALL statement with parameters • EXTERNAL and PUBLIC functions
- Local variables in functions • Alphanumeric labels • Record LOCK and UNLOCK

Expand your versatility. CB80 includes our LK80™ linker. It allows you to create programs in separate modules and easily combine them. Powerful CHAINING capabilities, multiple library scanning, and easy linkage to assembly routines, are all part of LK80.

CP/M® and MP/M II™ compatible: CB80 supports the popular CP/M and MP/M II operating systems. CB80's record LOCK and UNLOCK, combined with its superior speed makes it a natural for multiuser environments.

Increase productivity and profits. Faster execution boosts system throughput and maximizes your computer's resources—an essential user feature. Coupled with reduced programming time, CB80 definitely improves your bottom line benefits.

For your free CB80 brochure and licensing details, call us at (408) 649-3896, or write us today.

DIGITAL RESEARCH®
P.O. Box 579, Pacific Grove, California 93950

Europe: Vector, Int'l., Leuven, Belgium, 32(16)202496
Far East: Microsoftware Assoc., Tokyo, Japan, 03-403-2120

CBASIC™

Solving complex business problems with *BASIC* simplicity

CIRCLE NO. 108 ON INQUIRY CARD

To your host CPU our Winchester Disk backup looks just like your Winchester Disk.

Now, costly interface designs are eliminated when you specify EPI's STR®-Stream. That's because this compact, reliable 1/4" cartridge incremental recorder has a system designed interface that emulates both the power requirements and interfacing of Winchester disks. Interfaces available include PRIAM, ANSI, nine track tape and DEI funnel* look-alikes.

STR®-Stream offers the highest data integrity (< one soft error in 10^9 bits), and unit-to-unit compatibility of any recorder in its class. To achieve this, it utilizes a wide write track, narrow read track, read-after-write circuitry and CRC verification.

The recorder stores up to 17 Mbytes (unformatted) on a DC-300XL cartridge, yet takes up no more physical space than an 8" floppy.

Each STR®-Stream comes complete and ready to plug into your compatible controller. Domestic U.S. price is $1115 in quantities of 100.

EPI, with more than 10 years experience moving tape, has the technology and resources to back you and your Winchester disks.

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

Let EPI remember for you.

ELECTRONIC PROCESSORS INCORPORATED

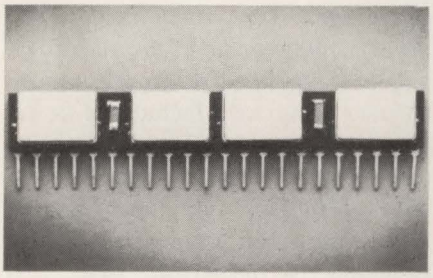
E1/2

*Trademark of Data Electronics, Inc.

CIRCLE NO. 109 ON INQUIRY CARD

EDI offers 64K × 4 RAM

The EDH-4464 65.5 × 4 bit dynamic RAM appears to the system as four parallel 64K × 1 dynamic RAMs, with common CAS and RAS and separate D_{in}/D_{out} lines. Features include single-supply operation, ±10 percent tolerance on the power



supply and on-substrate capacitors. The unit requires 1.2W of power in operating mode and 110 mW in standby. The unit is packaged in a 22-pin SIP and sells for $91 in 100-unit quantities. **Electronic Designs, Inc.**, 230 Eliot St., Ashland, Mass. 01721. **Circle No 258**

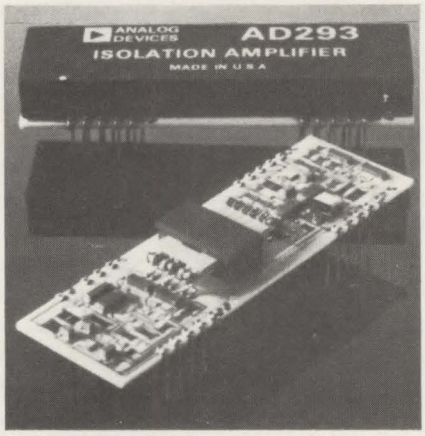
Memory board is LSI-11 compatible

The NS23M 256K-byte dual-wide dynamic NMOS RAM card is compatible with DEC's Q-bus series, LSI-11, LSI-11/23 and PDP-11/-3 systems. The card operates with or in place of the DEC MSV11-D and the MSV11-E series semiconductor memory cards and can be installed in H9273-A or DDV11-B backplanes. Features include 22-bit addressing and memory capacity ranging from 64K × 16 without parity to 128K × 18 with parity. Prices for the 128K-byte depopulated version and the 256K-byte fully populated version are $1020 and $1505, respectively, with quantity discounts available. **National Semiconductor Corp.**, 2900 Semiconductor Dr., Santa Clara, Calif. 95051. **Circle No 259**

components

Analog Devices unveils isolation amplifiers

The models AD293 and AD294 isolation amplifiers use screened transformers. The AD293 offers a maximum common-mode voltage rating of ±2500V, peak, and the AD294 offers a maximum of ±8000V, peak. Both are packaged in hermetically sealed 40-pin ceramic DIPs. The AD294 offers protection from lethal ground faults and defibrillator pulse inputs as high as 8 KV, peak. The AD293 is available in A and B versions; A grades feature maximum linearity error of ±0.1 percent, and B grades feature maximum linearity error of ±0.95 percent. Prices start at $69 and $79 for the AD293 and AD294, respectively, in quantities of one to nine. **Analog Devices Inc.,** Route 1 Industrial Park, P.O. Box 280, Norwood, Mass. 02062.



Circle No 339

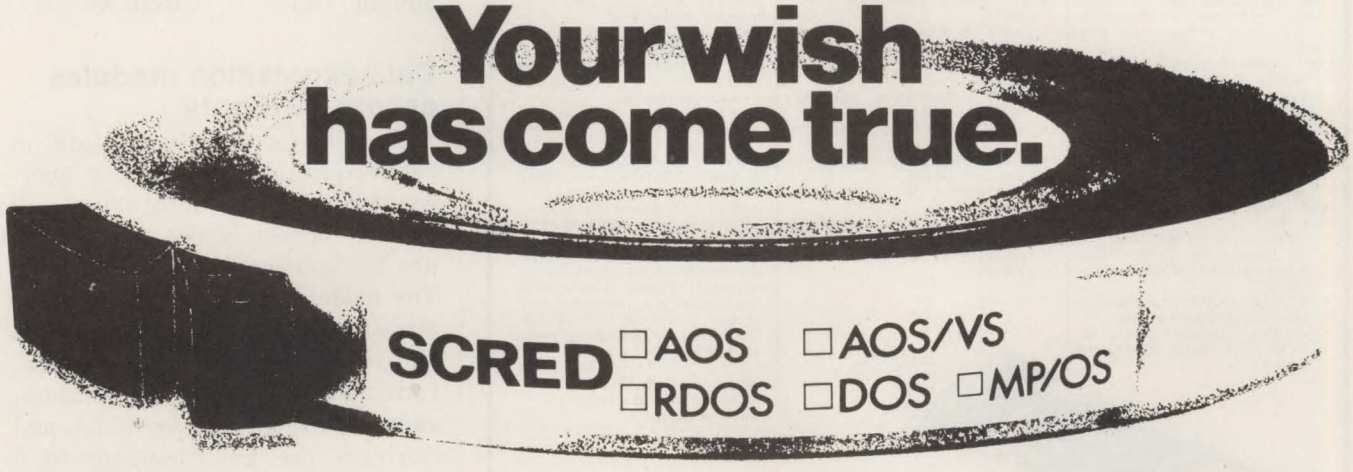
Analog I/O boards are STD compatible

The 12-bit RTI-1260 input card, the 12-bit RTI-1262 output card and the 10-bit RTI-1226 input card for data-acquisition and control applications are STD-bus compatible. All models are memory mapped, require no external components or DC/DC converters and feature jumper-selectable input and output ranges. The 1260 includes 32 single-ended (16 differential) input channels, an on-board DC/DC converter, an instrumentation amplifier and a monolithic 12-bit A/D converter. The 1262 includes a DC/DC converter and four 12-bit D/A outputs, which settle to ±½ LSB in 25 μsec. The 1226 includes a DC/DC converter, 16 single-ended (eight differential) input channels, an instrumentation amplifier and a monolithic 10-bit A/D converter. The RTI-1260 is priced at $440, the RTI-1262 is priced at $400, and the 1226 is priced at $280, all in quantities of 25 to 49. **Analog Devices, Inc.,** Route 1 Industrial Park, P.O. Box 280, Norwood, Mass. 02062.

Circle No 340

What's on your wish list for a DG screen editor?

- ☐ True Screen Orientation
- ☐ Easy-To-Use Single Mode Design
- ☐ Doesn't Require Data General CRT
- ☐ Uses Features of Intelligent Terminals
- ☐ Good Dialup Performance
- ☐ Optimized Display Rewriting
- ☐ Random Access To Pages
- ☐ Usable by Non-Programmers
- ☐ Literal Search/Change
- ☐ Token Search/Change
- ☐ Pattern-Match Search/Change
- ☐ Features for Document Preparation
- ☐ Case Sensitivity Control
- ☐ Margin Control
- ☐ User-Definable Keystrokes
- ☐ Single-Key Macro Capability



SCRED–the text editor from Rational Data Systems

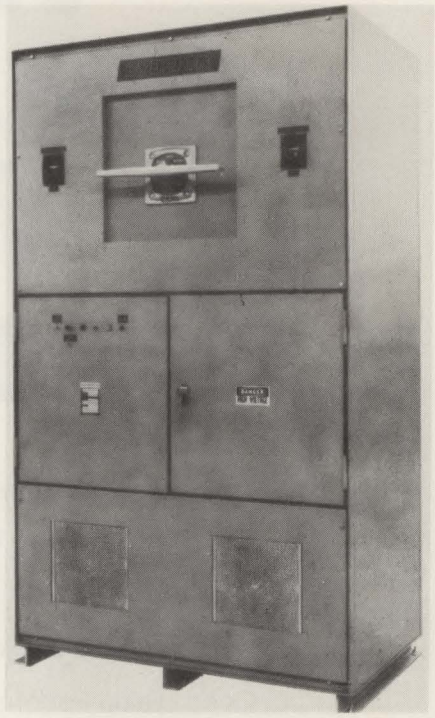
Rational Data Systems 205 East 42 Street New York City 10017 212/697-5855 TWX 710-581-6016

CIRCLE NO. 112 ON INQUIRY CARD

data acquisition

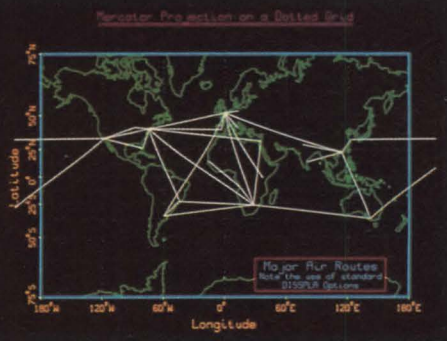
Cyberex unveils transfer switches

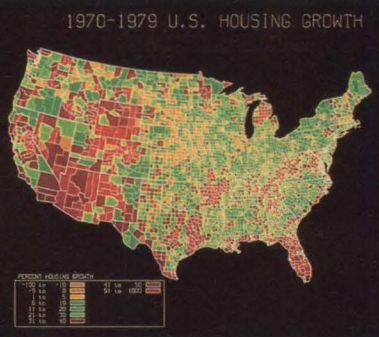
This line of static automatic transfer switches, when used with two synchronized incoming power lines, provides protection to sensitive critical loads, such as computers, process controls and communications gear. In the event of a significant fluctuation of outage of a power source, the switches sense the disturbance and transfer the load to an alternate source in less than ¼-cycle. Integral logic circuitry monitors voltage and synchronization. The switches are available in single-phase versions for 120V and 480V with capacities of 10 KVA to 144 KVA and in three-phase versions for 120V and 208V or 277V and 480V at 30 to 830 KVA. **Cyberex, Inc.,** Mentor, Ohio. **Circle No 337**

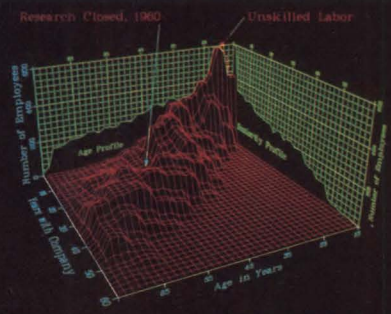


Data-acquisition modules accept 16 inputs

The ADAM family of add-on data-acquisition modules for energy-consumption monitoring and control connect minicomputers and μcs to data-acquisition equipment. The modules accept as many as 16 analog inputs from analog devices and transducers, such as temperature sensors, flow-rate sensors, current sensors and joysticks, and converts the input voltage to a digital value with a resolution of 8 bits. ADAM is available with an interface for the TRS-80 expansion interface for $190 or with an RS232 asynchronous interface for $250, with quantity discounts available. **Small System Design,** P.O. Box 4546, Manchester, N.H. 03108. **Circle No 338**







48 Bit Virtual Memory Power Plus Publication Quality Graphics

PORTABLE GRAPHICS MAINFRAME

The PGM is a cost effective innovative device for implementing massive FORTRAN programs (up to 4 megabytes in size). Not only is the full DISSPLA graphics package available, but also INTERACT, a truly interactive and self teaching program for non-programmers. Create your own publication quality graphics with INTERACT. In fact, with the exception of the photograph, everything on this page was created using the SUPERSET PGM.

48 BITS

The PGM leapfrogs 32 bit machines with its 48 bit precision. The 11+ digit decimal floating point precision of the PGM is almost double the 5-6 digits of 32 bit computers. 48 is divisible by 3,4,6,8,12,16 and 24. The PGM is at home in Octal, hexadecimal, full ACSII and 6 bit character codes. It interfaces 8 bit micros, 16 bit minis and 12 bit A/D converters perfectly.

STANDALONE COMPUTER, DISTRIBUTED PROCESSOR OR DEDICATED CONTROLLER.

The PGM operates both as a dedicated machine or a node to a central mainframe. Optional sum checking is provided for data integrity in Host communications. RS232, IBM 2780, DCT 2000, and other protocols are supported. The PGM can provide DISSPLA facility to users of a mainframe without incurring mainframe memory or execution overhead.

Have your own mainframe at your fingertips anytime you need it. No more waiting for a port in a multi-user environment. The PGM's minicomputer price makes it an ideal device for either a dedicated controller or an interactive workstation. Prices start at $27,000.

SUPERSET inc.

10633 Roselle Street
San Diego, CA 92121 (714) 452-8665

A typical workstation might consist of:

1. A plotter for hard copy (Houston Instruments, Zeta, Calcomp, etc.).
2. The final graphics can be transferred to a tape, for a Dicomed microfilm unit, Xynetics flatbed, Zeta drum plotter, or for backup purposes.
3. The SUPERSET PGM with 5 RS232 ports, 29 Megabyte Winchester disk and up to 393 Kilobytes of error correcting memory.
4. A color monitor (Chromatics, AED, etc.) or a high resolution monochromatic terminal (Tektronix, Megatek, etc.).
5. A digitizing tablet (Houston Instruments, Summagraphics, etc.).
6. An inexpensive console CRT terminal (Hazeltine, Zenith, etc.).

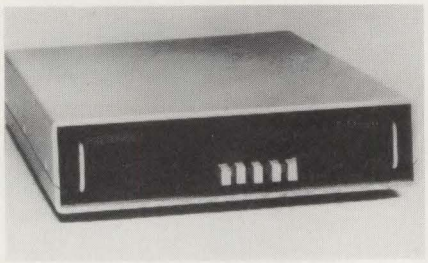
CIRCLE NO. 114 ON INQUIRY CARD

New Products

datacomm

Prentice offers Bell-compatible modem

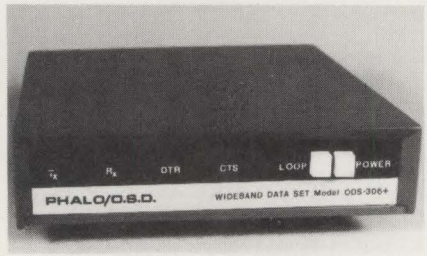
The TriModem for central-site and switch-selectable applications is compatible with Bell 103 and 212 and Vadic 3400 modems. Features include a μp-controlled circuit that



buffers the busy-out signal; continuous, automatic, self test when in idle mode; a fault-alarm signal; manual and automatic self-test; an end-to-end test; an integral self-test generator; a local analog loopback; and local and remote digital loopback. The unit operates in automatic or manual answer mode by connecting a handset to a modular plug. **Prentice Corp.,** 266 Caspian Dr., Sunnyvale, Calif. 94086. **Circle No 333**

Phalo/O.S.D. unveils fiber-optic data set

The model ODS-306+ 5-MHz wideband synchronous data set is plug compatible with CCITT V.35 standards and with the IBM 3274 remote-channel unit to repeaterless distances as far as 5 km. Features



include a handshaking protocol through the link and three-level, built-in automatic test circuits that provide a remotely activated data-loopback mode. The device checks the transmission path for loss of signal, signal quality and level. The unit also offers synchronous/asynchronous data transmission at speeds as high as 5M bps and 300K bps, respectively, switch-selectable clock rates of 40.8K, 57.6K, 230K, 460K and 1.344M bps. Prices are $1000 for a stand-alone version and $900 for the rack-mounted version. **Phalo/O.S.D.,** 9240 Deering Ave., Chatsworth, Calif. 91311.

Circle No 334

Prentice announces V.22-compatible modem

The P-V.22 data modem for international communications and private-network users has two-wire, full-duplex capability, data rates of 1200 and 600 bps in the synchronous mode and 1200-, 600- and 0 to 300-bps rates in the asynchronous mode. The unit conforms to CCITT V.22 standards. It features front-panel diagnostic controls and analog, digital and self-test signal-generation indicators. Prices are $949 for a rack-mounted unit and $1034 for a stand-alone unit, in single-unit quantities. **Prentice Corp.,** 266 Caspian Dr., Sunnyvale, Calif. 94086. **Circle No 335**

Integrated Design unveils modem for S-100 bus

The 1200-bps 202C/S-compatible Modem-Plus for the S-100 bus features an on-board modem UART with selectable word format. The address-selectable, originate/answer unit includes hardware pulse-dialing, 16-digit memory for re-dial and modem sense and control lines using polling methods. Version A provides a second on-board UART with selectable word format connected to an RS232 I/O port. Version B provides modem interrupts to the processor in place of the additional RS232 port. Price is $595. **Integrated Design Engineering, Inc.,** P.O. Box 16307, St. Louis, Mo. 63125.

Circle No 336

The One Printer Solution for the Two Printer Problem.

HIGH SPEED DATA PROCESSING

The new Dual-Mode 200 brings speed and uncompromising print quality to business and professional applications.

Financial statements, inventory reports, labels and more are printed at data processing speeds from 165 cps to 250 cps.

Fully adjustable tractors and a friction feed platen provide precise forms handling for pinfeed and single sheet paper.

Complete "Dot Control" graphics is standard with resolution to 120 x 144 dots per inch.

Interfacing is easy with both E.I.A. RS-232C serial and an ASCII parallel port.

LETTER QUALITY WORD PROCESSING

The Dual-Mode 200 also features letter perfect print you will be proud to use for business letters and reports. Letter Mode speeds range from 42 cps to 60 cps.

The standard Titan 10 pitch font is complemented by an array of optional fonts including Elite 12 pitch, italics, proportionally spaced, OCR-A, scientific and foreign character sets.

Up to 12 font selections may be stored in the printer and interchanged while printing.

The Dual-Mode 200 accepts standard daisywheel print commands for word processing system compatibility.

It's the perfect solution for the two printer problem.

The Dual-Mode 200 Printer for the one printer office.

Call or write today for complete specifications and O.E.M. pricing.

malibu
Electronics Corporation

2301 Townsgate Road, Westlake Village, CA 91361, (805) 496-1990

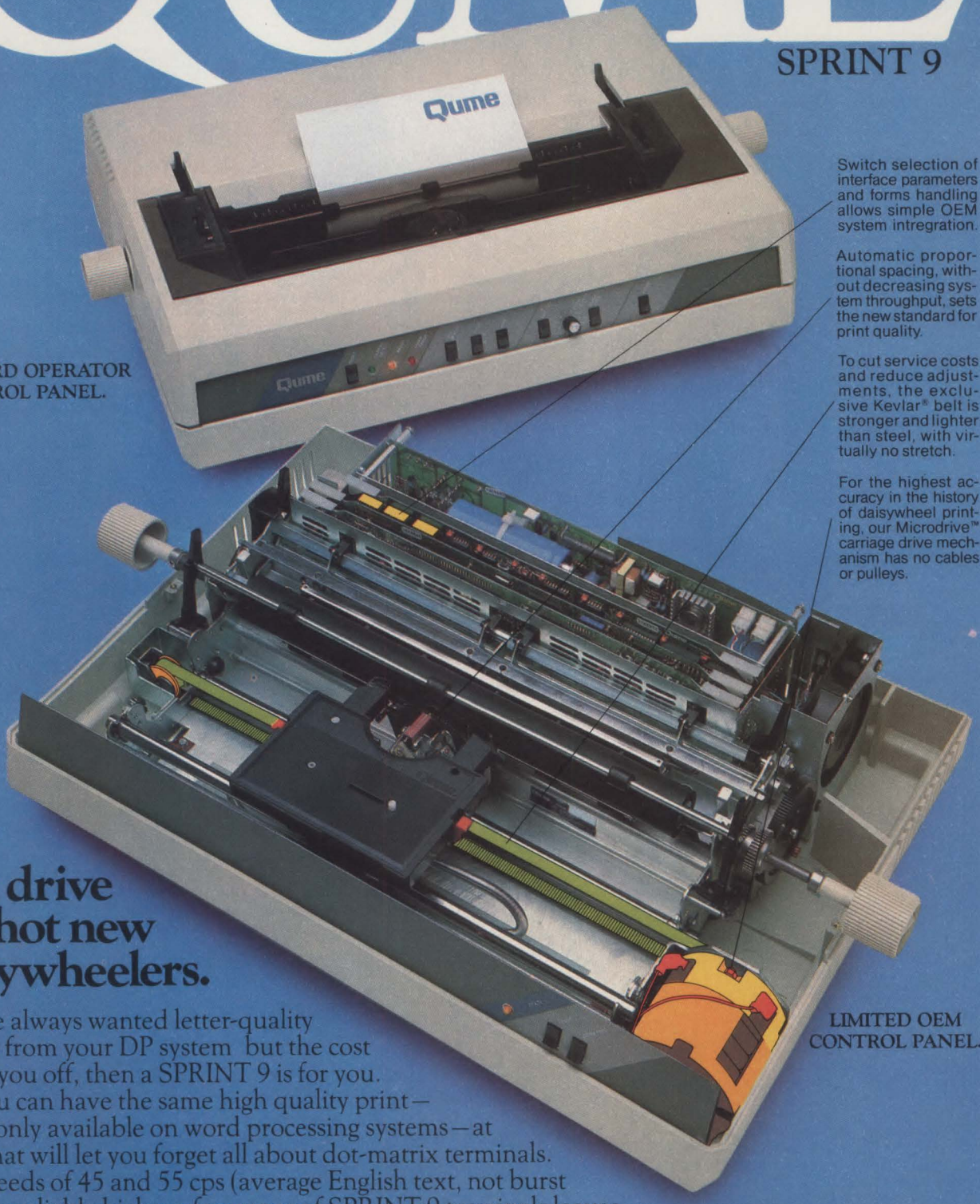
a subsidiary of Datametrics Corporation

CIRCLE NO. 116 ON INQUIRY CARD

DOTS DO IT BETTER™

QUME

SPRINT 9



STANDARD OPERATOR CONTROL PANEL.

Switch selection of interface parameters and forms handling allows simple OEM system intregration.

Automatic proportional spacing, without decreasing system throughput, sets the new standard for print quality.

To cut service costs and reduce adjustments, the exclusive Kevlar® belt is stronger and lighter than steel, with virtually no stretch.

For the highest accuracy in the history of daisywheel printing, our Microdrive™ carriage drive mechanism has no cables or pulleys.

LIMITED OEM CONTROL PANEL.

Test drive our hot new daisywheelers.

If you've always wanted letter-quality printing from your DP system but the cost has put you off, then a SPRINT 9 is for you. Now you can have the same high quality print—usually only available on word processing systems—at prices that will let you forget all about dot-matrix terminals. With speeds of 45 and 55 cps (average English text, not burst rate), the reliable high performance of SPRINT 9 terminals leaves the crowd behind. Prove it to yourself with a test drive. Call or write Qume at (408) 942-4000. 2350 Qume Drive, San Jose, California 95131.

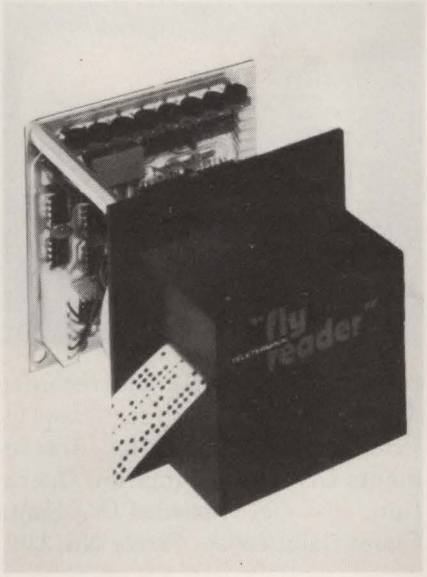
CIRCLE NO. 117 ON INQUIRY CARD

Qume®
A Subsidiary of ITT

data entry

Teleterminal introduces paper-tape reader

The Fly Reader III 300-cps paper-tape reader employs a stepper-motor tape drive and a fiber-optic light-distribution system to read any eight-level, 1-in. tape bidirectionally, including mylar, paper or oiled paper with transmissivity as high as 60 percent. The tape drive, an integral sprocket/stepper motor assembly, allows for character-at-a-time reading at speeds from 0 to 300 cps. A 25,000-hr. lamp feeds a fiber-optic distribution system, which is directed to nine silicone phototransistors and then fed to Schmitt triggers that provide a minimum of ⅔ full-scale noise immunity. A 5¼- × 19-in. RETMA panel and fan-fold trays are optional. The unit sells for



$250 with electronics and $210 without electronics, in 100-unit quantities with a three-year warranty. **Teleterminal Corp.,** 390 Portsmouth Ave., Greenland, N.H. 03840. **Circle No 332**

design aids

Biomation unveils logic analyzer

The T12 communicator enables two logic analyzers to exchange data over a telephone line to permit remote service of digital electronic equipment. The unit includes a 1200-bps half-duplex modem, which conditions signals before the movement of data over a telephone line via a μp-based controller. The controller manages the interface between an internal modem and the GPIB interface of the logic analyzer. Features include automatic self-test, built-in voice-transmission, automatic-answering and error-detection/retransmission protocol operating modes. The T12 allows troubleshooters to program and set up measurement parameters on an analyzer, transmit the instructions to a customer's analyzer, make

recordings and have the recorded data communicated for display. Price is $3250. **Gould Inc., Instruments Division, Biomation Operation,** 4600 Old Ironsides Dr., Santa Clara, Calif. 95050. **Circle No 330**

Millennium introduces integration station

The 9516 microsystem integration station and debug station supports 8085A, Z80A, 8021, 8041, 8048, 8049, 8050, 6801, 6803 and

6809 μps. Features include transparent real-time operation in a dual-bus structure for real-time control and monitoring. The dual bus allows access to the logic-trace analyzer for set-up and display without stopping emulation. The unit's 24-bit address, 16-bit data bits of status and 24-bit externals have an expansion capability for 32 bits of address and 32 bits of data to support 32-bit processors. High-speed static memory operates at 90 nsec. **Millennium Systems, Inc.,** 19050 Pruneridge Ave., Cupertino, Calif. 95014. **Circle No 331**

Other printers make pie charts. Ours make pie charts you can sink your teeth into.

Epson.

Most printers will give you simple graphs and charts — so long as you don't want too much detail. Epson printers, on the other hand, start out with correspondence quality printing, an unequalled reputation for reliability, and a remarkably low price, and then back it up with the most precise, sophisticated and versatile graphics capabilities in their class.

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Our MX-80 Type II and 136-column MX-100 give you 60/120 dots per inch horizontally and up to 72 dots per inch vertically; our MX-82 gives you high density graphics that can precisely place up to 10,368 dots in a square inch. That's resolution enough for even the fussiest user.

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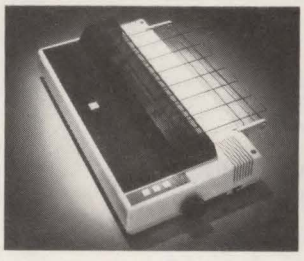

Epson. OEM. That's about as clear as we can say it in words. But we could draw you a picture.

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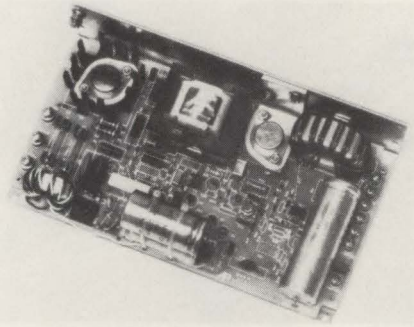
CIRCLE NO. 122 ON INQUIRY CARD

power supplies

Preston Scientific offers instrumentation amplifiers

The XWB series 80 instrumentation amplifiers feature gain linearity within ±0.005 percent, gain accuracy within ±0.01 percent, gain stability within ±0.01 percent for six months at one temperature, bandwidth from DC to 100 KHz and common-mode rejection of 150 dB at DC and 130 dB at 60 Hz. Other features include common-mode voltage to 350V DC or peak-to-peak AC, zero drift as low as 0.5 mV per °C and noise (RMS) less than 1 mV RTI at 1-KHz bandwidth. Options include dual outputs, programmable gain and bandwidth, calibrate relay and bandwidth filters. **Preston Scientific, Inc.,** 805 E. Cerritos Ave., Anaheim, Calif. 92805.

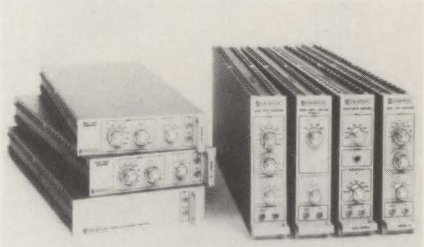
Circle No 328



Adtech offers switching power supply

The single-board model USB 5-10 5V, 10A, open-frame switching power supply has a user-selectable line range of 90 to 135V AC or 180 to 270V AC and a line frequency of 47 to 440 Hz. Efficiency is more than 72 percent at full load, 115 or 230V AC and 25°C. Other output specifications include compensation for as much as 0.5V line drop, output overvoltage protection, crowbar fixed at 6.25 ± 0.75V and output current limitation to 150 percent or less. Input is provided through three stand-off terminals, and output is through six standoff terminals. Options include a power-fail warning signal, a DC input and a pre-load for regulation to zero output current. Price is $99 in single-unit quantities. **Adtech Power, Inc.,** 1621 S. Sinclair, Anaheim, Calif. 92806.

Circle No 329



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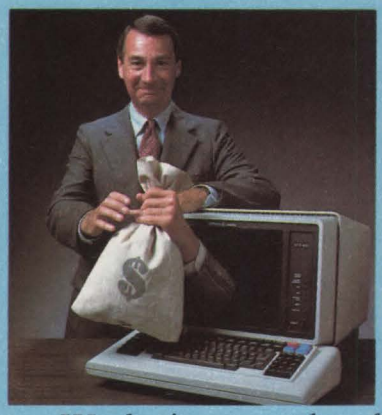

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Or call toll-free **800/854-7517** *(8:00 a.m. to 4:30 p.m. PST). In California, call 714/557-9398 collect.*

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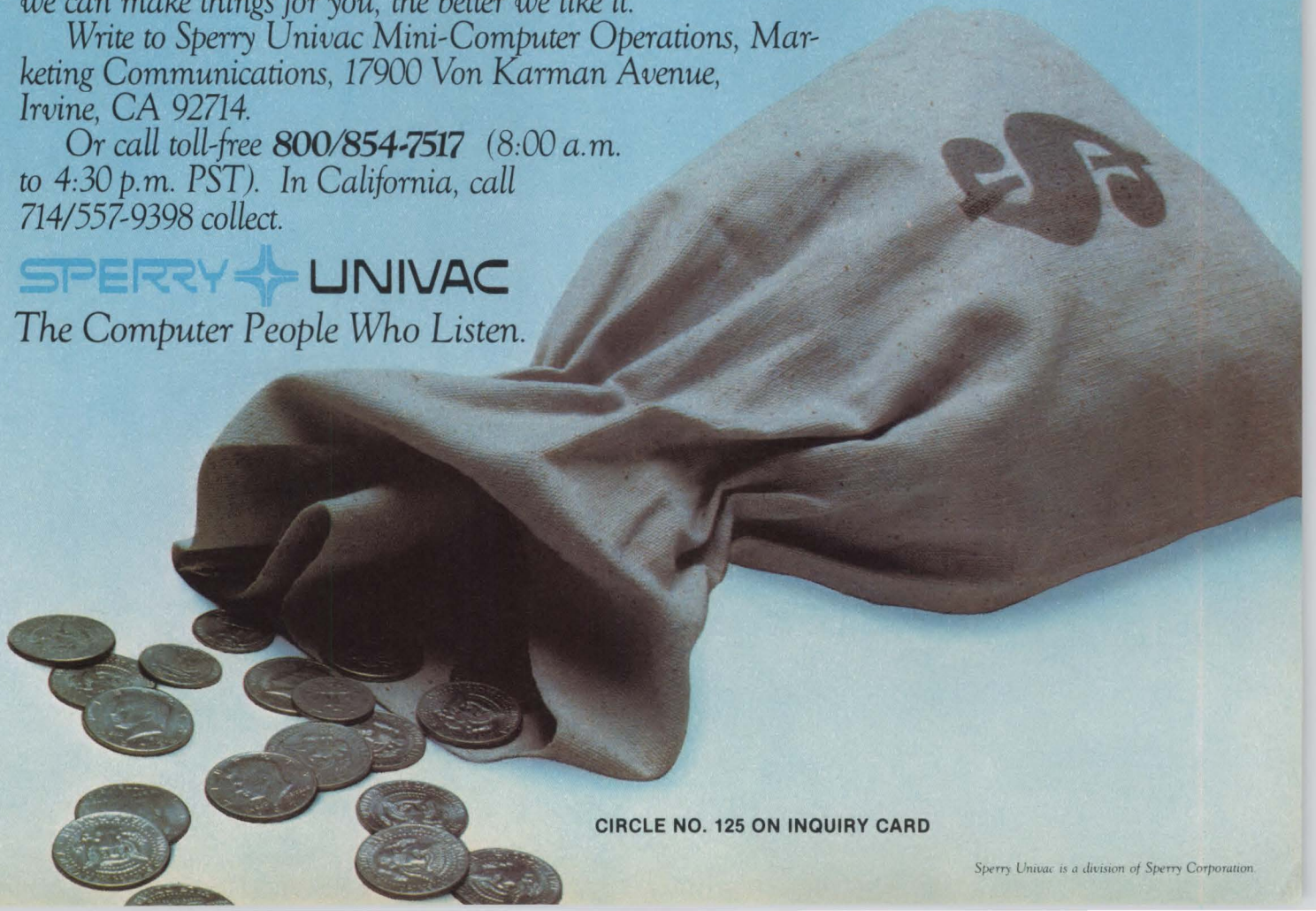

CIRCLE NO. 125 ON INQUIRY CARD

Sperry Univac is a division of Sperry Corporation.

TOMORROW'S TAPE TRANSPORT IS HERE TODAY

Introducing DATUM's New "Gemini" Multifunction Tape Transport

TWO FUNCTIONS — ONE DRIVE

Until now, data processing managers have been forced to make a choice between a tape drive that performs transaction processing effectively or one that will load and unload disk files at a rapid rate. Now, for the first time in the industry, DATUM offers you a single transport uniquely matched to both functions...the DMF-1000 Gemini.

For day-to-day transactions, the Gemini operates as an industry-standard, 45-ips drive. For disk backup, streaming mode can be selected by software command. Transfer rates are monitored, and if data fails to keep pace at 125-ips streaming speed, the drive automatically reverts to 45-ips to provide optimum efficiency.

A TECHNOLOGICAL FIRST

The DATUM DMF-1000 Gemini is a major breakthrough in the evolution of magnetic tape transports. The result of an extensive two-year development program, the Gemini is the ideal solution fo those users requiring both 45-ips transaction processing and high-speed disk file backup. DATUM's Gemini eliminates the need for compromise by meeting the demands of two different operating environments with a single entity. Gemini...tomorrow's tape transport...is here today.

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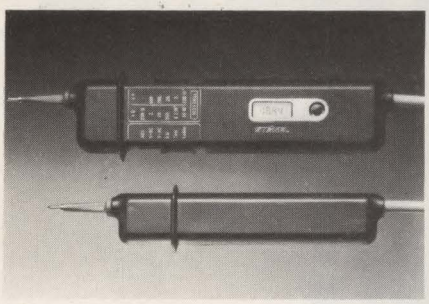


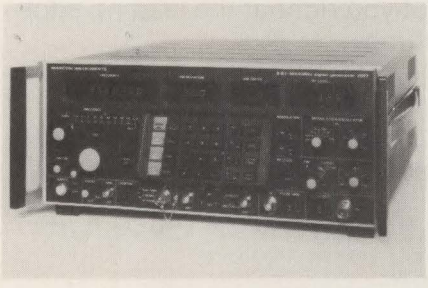
Steinel announces digital multimeter

The Digi-check hand-held multimeter includes an integrated battery charger and power supply and a built-in 3½-in digit display. The unit features DC voltages from 0.1 mV to 500V, AC voltages from 10 mV to 500V, resistance from 0.1 ohm to 20 meg, automatic polarity indication, auto zero and input impedance to 10 meg ohm. Price for the meter is $169; an optional carrying case sells for $10. **Steinel, a Division of Energy Electronic Products Corp.,** 6060 Manchester Ave., Los Angeles, Calif. 90045.

Circle No 327

Marconi announces signal generator

The model 2017 10-KHz to 102-MHz low-noise signal generator includes a GPIB that enables the device to provide testing as part of a bench-top system or in an ATE



assembly. The unit features a cavity-tuned oscillator that provides sideband noise at more than −136 dBc per Hz at 20-KHz offset in the 256- to 512-MHz range, +19-dBm output level across the full frequency range, pulse-modulation facilities that provide rise times of less than 25 nsec. and carrier suppression in the pulse-off mode. Other features include memory facilities, frequency sweep for spurious pulse measurements, a GPIB counter function, FM deviation as high as 2.56 MHz, AM to 99 percent, a choice of calibration units and output-level accuracy of ±1 dB up as high as 512 MHz. Price is $17,100. **Marconi Instruments, a Division of Marconi Electronics Inc.,** 100 Stonehurst Ct., Northvale, N.J. 07647. **Circle No 322**

Omega unveils digital thermometer

The model 870 hand-held digital thermometer features dual-input configuration and low-power LSI

devices with a 15-mm. LCD. The unit includes an adapter for subminiature thermocouple connectors and a thermocouple sensor with a banana-plug, jack-type input. Other features include an analog output, a built-in ice point, temperature range of −40°F to 1999°F and −40°C to 1370°C, 0.1° resolution to as much as 200° and sensor interchangeability. **Omega Engineering, Inc., Omega Group Co.,** P.O. Box 4047, One Omega Dr., Stamford, Conn. 06907. **Circle No 323**

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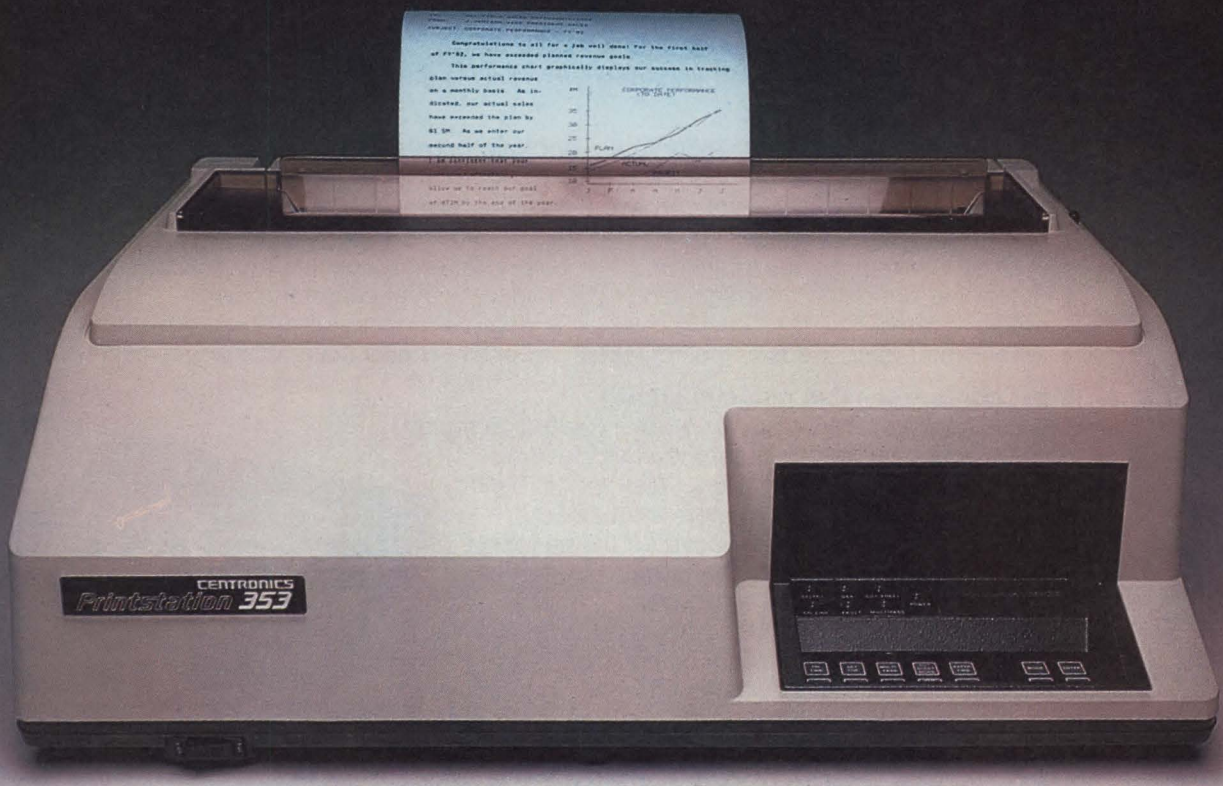

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If all you look at is the handsome, office-styled cover you'll miss the real beauty of its functionality, its revolutionary paper handling design and its list of standard features that even competitors' "options" lists can't match.

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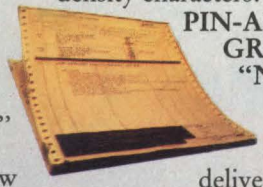

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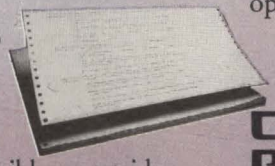

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State-of-the-industry

If you are marketing to the minicomputer and microcomputer markets, the *1981 Mini-Micro Computer Market Report* is *must* reading. It gives you the key market trends in each and every product category. With it, you can:

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The lightweight, compact terminal is easily attached to your computer and is available with or without the color monitor. Software command transparency for Tektronix Models 4010 thru 4015, and compatibility with Compeda's 'Dragon' software is, of course, provided.

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CIRCLE NO. 130 ON INQUIRY CARD

1981 THE YEAR OF AED

Program provides word-processing functions

Fastext, an interactive full-screen text processor, combines word-processing and text-editing functions. It runs on the DEC PDP-11 under RSX-11 or RT-11, or S & H Computer Systems' TSX-PLUS supporting VT-52 and VT-100 terminals. It includes a search-and-replace function that accepts UNIX-like regular expression notation. It also allows all or part of a matched text to be inserted into a replacement string. Word-processing functions include user-defined multiple or single tab stops, separate left and right margins, cut and paste, overtype, justification and wrap. Single-site licenses sell for $750 to $950. **Glenn A. Barber & Associates, Inc.,** 110 W. Broadway, Suite 304, Glendale, Calif. 91204.

Circle No 341

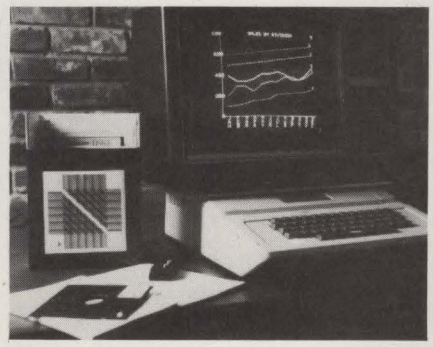
CAD software provides 3D solids modeling

The ITS-10 3D design and drafting package is intended for automotive, aerospace, industrial, architectural and general mechanical-design applications. The package provides solids modeling and a CAD database. Objects or models are described by areas, volumes, holes and voids, combined into 3D representations. ITS-10 runs on DEC VAX, Prime and IBM 32-bit computers. Lease rate is $2750 per month; a fully paid-up lease sells for $87,500. **MARC Software International, CAD Marketing Department,** 525 University Ave., Palo Alto, Calif. 94301.

Circle No 342

Financial package offers report writing, graphics

The Micro-DSS/Finance financial-modeling and -planning language runs on Apple II computers with Pascal. Functions include calculation of depreciation, internal rate of return, net present value, amortization, break-even analysis, tax-table lookup and tax-loss carry-forward. DSS/F calculates when to switch depreciation types and solves simultaneous equations. The report



writer provides decimal-placement reporting, commas inserted between thousands, brackets around negative numbers and centered headings. A color-graphics package is included for slide presentation on the monitor. Price is $1500, including a manual and a graphics-display monitor. **Addison-Wesley Publishing Co., Inc.,** Computer Software Marketing, Reading, Mass. 01867. **Circle No 344**

Real-time executive is available for Intel μcs

REX-80/86, a real-time executive for iAPX-86/88 processors, has core functions, including inter-task synchronization, asynchronous-event coordination, interrupt handling and memory management. Additional facilities, such as time-based synchronization and co-processor synchronization, can be added from the system macro library. REX-80/86 is compatible with most development systems, including Intel MDS, GenRad 2300, Tektronix 8002 and DEC PDP-11 (with cross assemblers.) It uses less than 4K bytes of ROM and 512 bytes of RAM. A priority interrupt controller and real-time clock are required. The package sells for $2750 in object-code format and $12,250 in source-code format. **Systems & Software, Inc.,** 2801 Finley Rd., Suite 101, Downers Grove, Ill. 60515. **Circle No 345**

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CIRCLE NO. 132 ON INQUIRY CARD

Programs support 8051 development

Supporting applications development for Intel Corp.'s 8051 μp, Microbench 8051 programs operate on DEC PDP-11, LSI-11 and VAX computers. Included are a relocating assembler, a linking loader, a librarian and an object-file formatter. The assembler, compatible with the Intel opcode and operand formats, supports extensive macro and conditional assembly capabilities, cross-reference listings and a system macro library. The loader provides linkage facilities, selective loading from libraries and directives for specifying ROM/RAM alignment boundaries. The object-file formatter produces binaries in formats compatible with PROM programs and emulation systems, including equipment manufactured by Intel, Tektronix, Millenium Systems, Data I/O, Prolog and SMS. Perpetual license fees start at $1900. **Virtual Systems, Inc.,** 1500 Newell Ave., #406, Walnut Creek, Calif. 94596.

Circle No 346

Program measures TRS-80 disk speed

RPM measures the rotational speed and variation of disk drives on the TRS-80 models I and III. A user can see the speed, percent error and history of speed-variation on any minifloppy connected to a TRS-80. Read-outs given in real time are shown in numbers, percents, words and graphs. Any drive can be selected with one keystroke. RPM automatically shows all speed ranges and can recover from severe errors without a system reset. The documentation also explains how to adjust the speeds of most popular minifloppy drives. RPM is available on diskette for $24.95. **Prosoft,** P.O. Box 839, N. Hollywood, Calif. 91603.

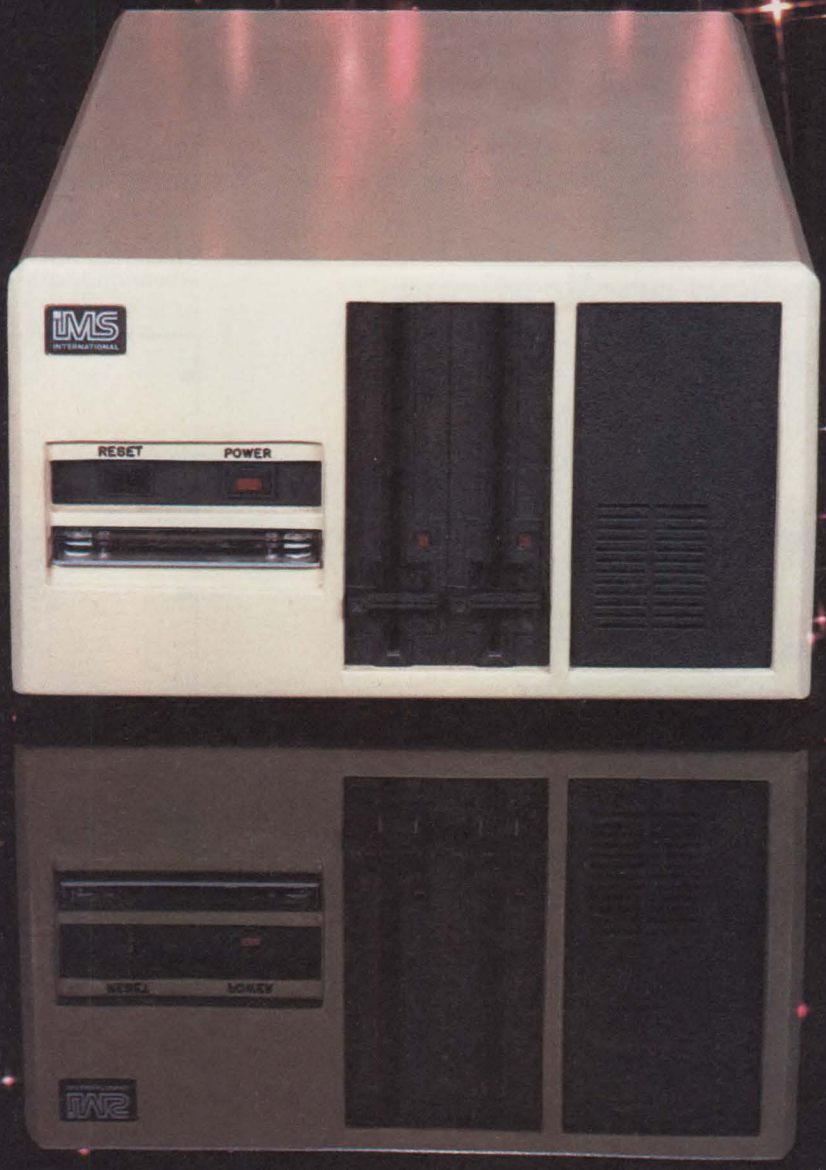
Circle No 347

Best & Midcom unveils VAX DH-11 driver

The VAX DH-11 driver permits DEC VAX computers to interface with devices via the DH-11, a PDP-11 unit. DMA data transfers unload terminal interrupts from the CPU. Line-transfer speed as high as 19.2K bps and split-speed capability are supported. Each driver handles 16 ports, controlling modems and line characteristics. The driver enables VT-100, VT-52 and intelligent terminals to be interfaced to the VAX. The driver also provides normal VAX user-terminal capabilities to Able's DMAX/16 and Supermax DH/DM. **Best & Midcon Data Systems,** 1940 N. Tustin, Suite 117, Orange, Calif. 92665.

Circle No 348

Announcing
A Media Event From IMS



Configuration shown includes two slimline double sided, double density drives, 40 M byte Winchester subsystem with tape back-up.

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CIRCLE NO. 135 ON INQUIRY CARD

New Literature

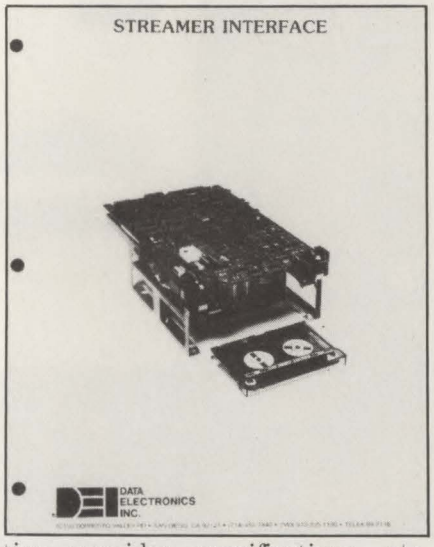
Brochure describes Teradyne products

The A300 Analog LSI Test System, its PASCAL/STEPS software and the Test System Manager second-level computer are described in three brochures. The A300 brochure details modular hardware and modular, high-level software combined with dedicated hardware and a multilevel architecture. The software brochure describes PASCAL/STEPS, and the Test System Manager brochure describes a second-level computer that permits the A300 to be used for independent and parallel testing, programming and information gathering. **Teradyne Inc.,** 183 Essex St., Boston, Mass. 02111.

Circle No 354

Manual describes tape-drive interfacing

Design factors for interfacing the Streamer ¼-in. digital-cartridge streaming-tape drive are presented in a 60-page manual. The publication provides specifications, I/O-signal requirements, timing diagrams, format and a description of operational modes. **Data Electronics, Inc.,** 10150 Sorrento Valley Rd., San Diego, Calif. 92121.



Circle No 355

Literature highlights display terminal

The features of the concept 108 series display terminal are described in this four-color brochure. The publication details the terminals' 80 × 132 column display, nonvolatile memory, eight pages of display memory and user-specified functional capabilties. One page details product specifications of the display and keyboard hardware, standard functions, operating modes and options. **Human Designed Systems, Inc.,** 3700 Market St., Philadelphia, Pa. 19104.

Circle No 356

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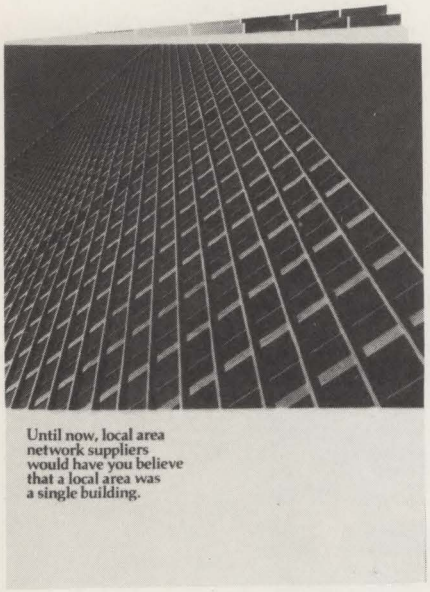
CIRCLE NO. 137 ON INQUIRY CARD

New Literature

Amdax brochure details local-area networking

A general introduction to CableNet and how it can be used by companies or businesses considering a communications network are provided in an eight-page brochure. Written in nontechnical language, the publication details CableNet's use of broadband coaxial cable, its network range of 2000 sq. miles, its ability to connect as many as 16,000 devices as far as 50 miles apart and its ability to support simultaneous transmission of data, video and voice on one cable. **Amdax Corp.,** 160 Wilbur Place, Bohemia, N.Y. 11716. **Circle No 349**



Brochure features electrostatic plotters

Applications, principles of operation and specifications for a line of electrostatic plotters are described in a color, eight-page brochure. The brochure details the products' applications, including CAD, geotechnical plotting, mapping and business graphics. Visuals include 14 color photos, a diagram depicting principles of operation, a model-selection chart and a table of key specifications. The publication also describes interfacing, plotting software, related products, service and support. **Versatec, a Xerox Co.,** 2805 Bowers Ave., Santa Clara, Calif. 95051. **Circle No 350**

Textbook details MC68000 programming

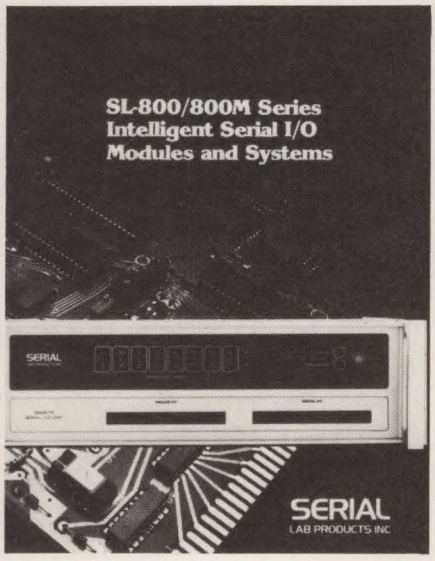
An overview of the Motorola 68000 16-bit μc, is provided in *The 68000: Principles and Programming*, by Leo J. Scanlon. The 238-page book details the 68000's design background and registers and guides readers through fundamental and complex programming tasks. A set of 25 programming examples includes ones for math, list and look-up table operations. The book describes the system's pins in functional groups, the processing states, privilege states and exception structure. It also summarizes interfaceable support circuits and fundamental I/O operations and surveys available hardware and software for support products. The nine-chapter book sells for $14.95, plus $1 for shipping and handling. **Group Technology, Ltd.,** P.O. Box 87, Check, Va. 24072. **Circle No 351**

Booklet outlines computer products

More than 1000 computer products are detailed in a catalog. The 64-page booklet describes magnetic media, printer ribbons, computer forms and binders, word-processing supplies, CRT furniture, media storage, microfiche systems and forms equipment. The catalog also lists hardware peripherals, prices and ordering information. **UARCO Computer Supplies,** 121 N. Ninth St., P.O. Box 948, DeKalb, Ill. 60115. **Circle No 362**

Guide examines digital I/O units

A line of remote, serial I/O units is described in a brochure. The 10-page booklet covers the units' RS232C/RS423 communications interface; ASCII-based command set; automatic, built-in diagnostics and DEC RT-11-compatible software-applications packages. The brochure also provides photos, diagrams and specifications and lists applications and accessories. **Serial Lab Products Inc.,** P.O. Box 766, Marlboro, Mass. 01752. **Circle No 364**



LITERATURE THAT COSTS

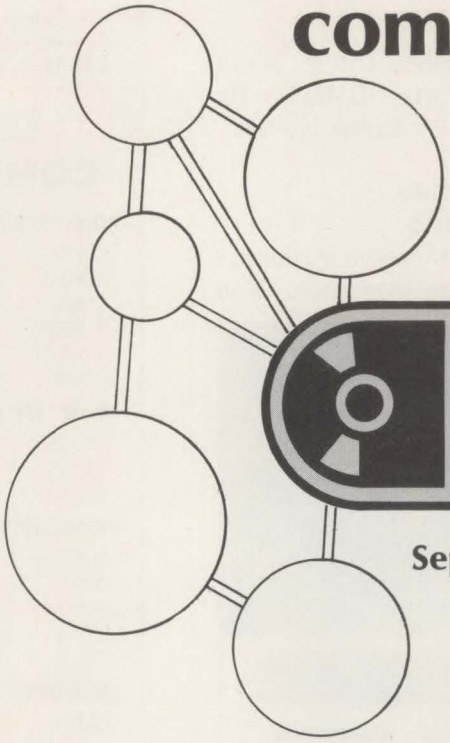
Catalog lists computer products

Data about the information-processing industry are compiled in "Data Sources," a reference guide. The 1460-page publication lists computer hardware and software products, services and supplies. Published quarterly, the reference details mainframes, minicomputers, small-business systems, disk and tape drives, memory devices, terminals, word-processing systems, magnetic media, supplies, furniture, modems and multiplexers. More than 7000 software product listings in the first issue include data-management and communication products; utilities, compilers, aids and system software; and applications software. Single-issue price is $20, and a one-year subscription sells for $60. **Data Sources,** 20 Brace Rd., Cherry Hill, N.J. 08034. **Circle No 363**

Report examines datacomm architecture

The IBM data-communications architecture is examined in *IBM's SNA: User Impact.* The 160-page report discusses the system's scope and evolution, new communications technologies, SNA compatibility, the host software lock-in and integrated network control. The $395 publication also details SNA migration, products from non-IBM vendors and system enhancements. **Communications Solutions, Inc.,** 4040 Moorpark Ave., Suite 200, San Jose, Calif. 95117. **Circle No 365**

Don't get lost in broad-based computer shows . . .



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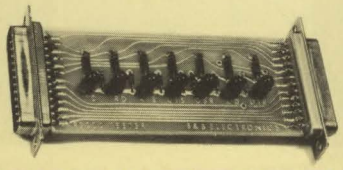

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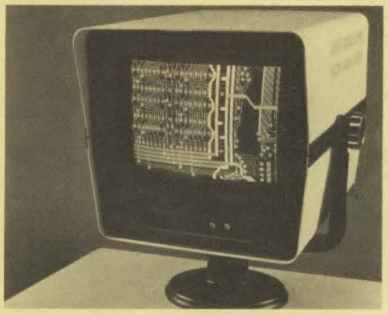

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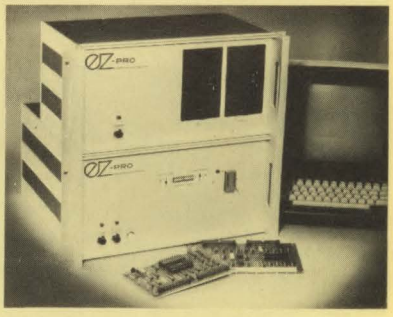

The EZ-PRO Development System supports In-Circuit emulation of over 30 microprocessors at full rated clock speed and without wait states. Processors supported include the 6800, 6802/8, 146805E2, 6809, 68000, Z80, Z8001/2, 6502/12, 6503-15, 3870/2/4/6, 8X300, 8080, 8048 family, 8085 and 2650. All bit slice devices are also supported. Prices start at $8500 for a complete system including one In-Circuit Emulator and all required software.

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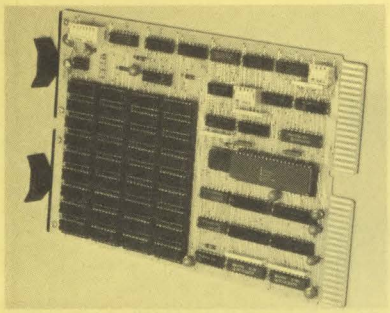

256K BYTE MEMORY AND CPU OFFER. The VML128P is an LSI-11 compatible memory. It provides 256KB of dynamic parity RAM on a double-height card. The board also offers full parity control with a self-contained CSR. Features include 22-bit addressing, on-board refresh, 5 volt only power and low power consumption. Price is $1995 in unit qty. and for a limited time with an LSI-11/23 CPU for $3750. Computer Extension Systems Inc., 17511 El Camino Real #131, Houston, TX. 77058 (713) 488-8830.

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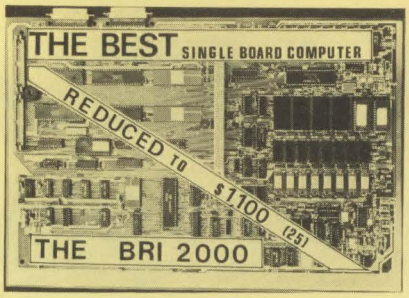

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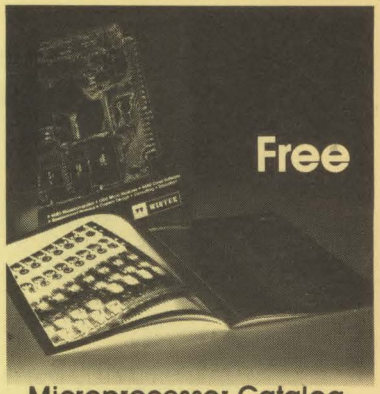

Microprocessor Catalog

40 page catalog of 6800 single board computers, interface modules, SPRINT 68 control computer/development system, WIZRD multitasking DOS, assemblers, compilers, BASIC, cross assemblers, cross compilers, custom engineering, OEM applications software.

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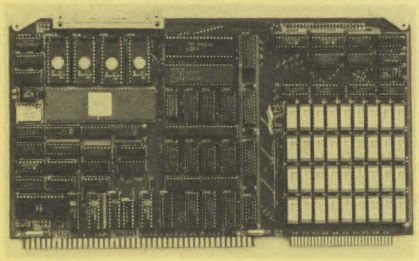

68000 MULTIBUS SINGLE BOARD COMPUTER. The PM68K combines an 8 MHz 68000 processor with up to 256K bytes RAM and 32K bytes EPROM, 2 level memory management, 2 multi-protocol serial I/0 ports, 5 16-bit timers, multi-master capabilities and a single +5v power requirement to provide reliable, high speed and low cost processing. UNIX, ADA and PASCAL software will be available in the first quarter of 1982. **PACIFIC MICROCOMPUTERS, Inc.,** PO Box A81383, San Diego, CA 92138 (714) 565-2727.

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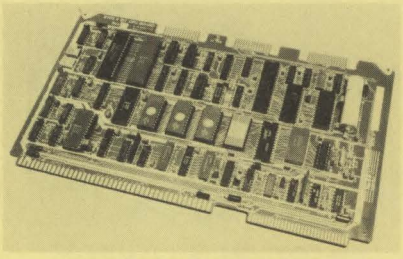

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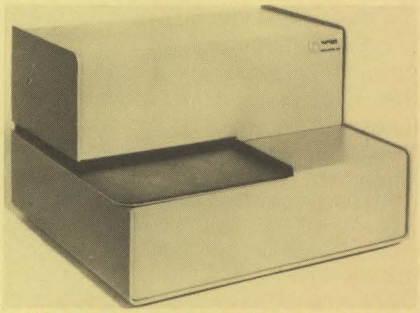

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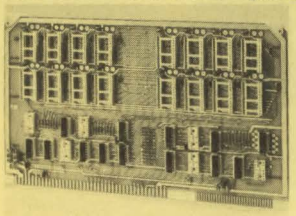
PROM BOARD $295



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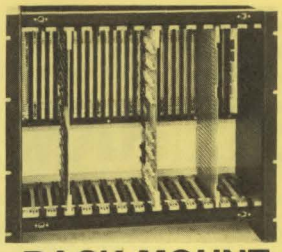

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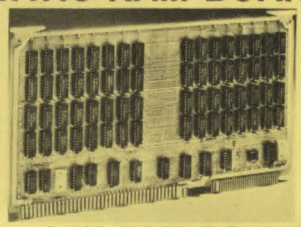
STATIC RAM BOARD



4 and 8K RAM BOARDS ARE MULTIBUS COMPATIBLE

Multibus: Intel trademark

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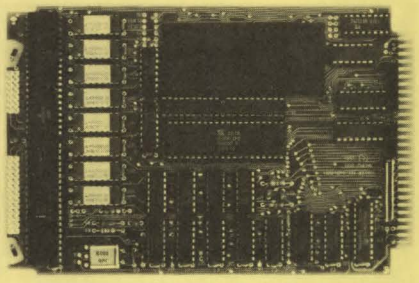

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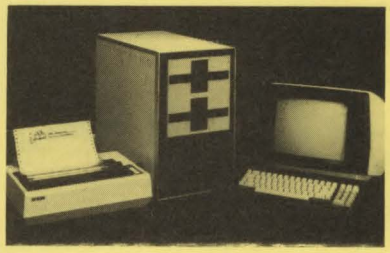

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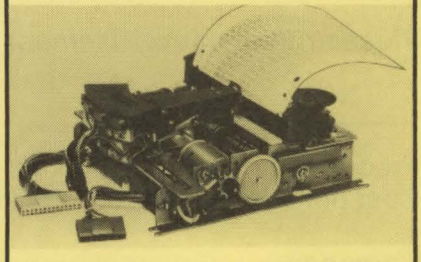

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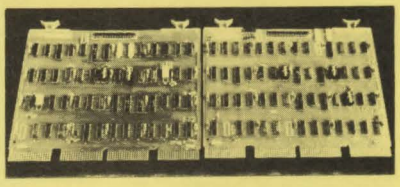

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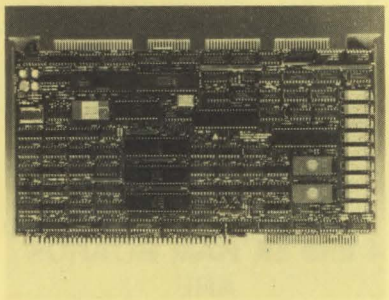

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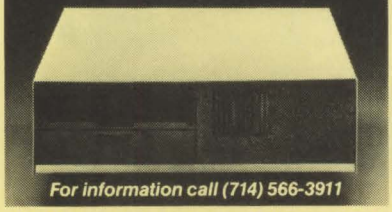

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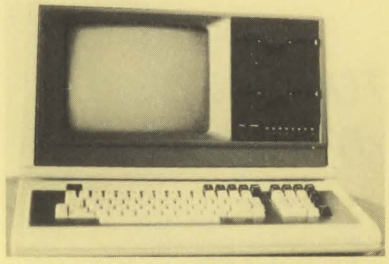

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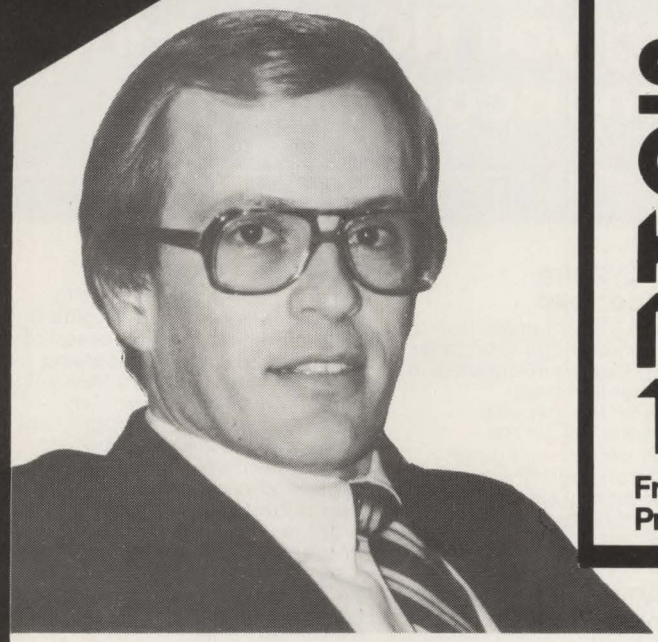

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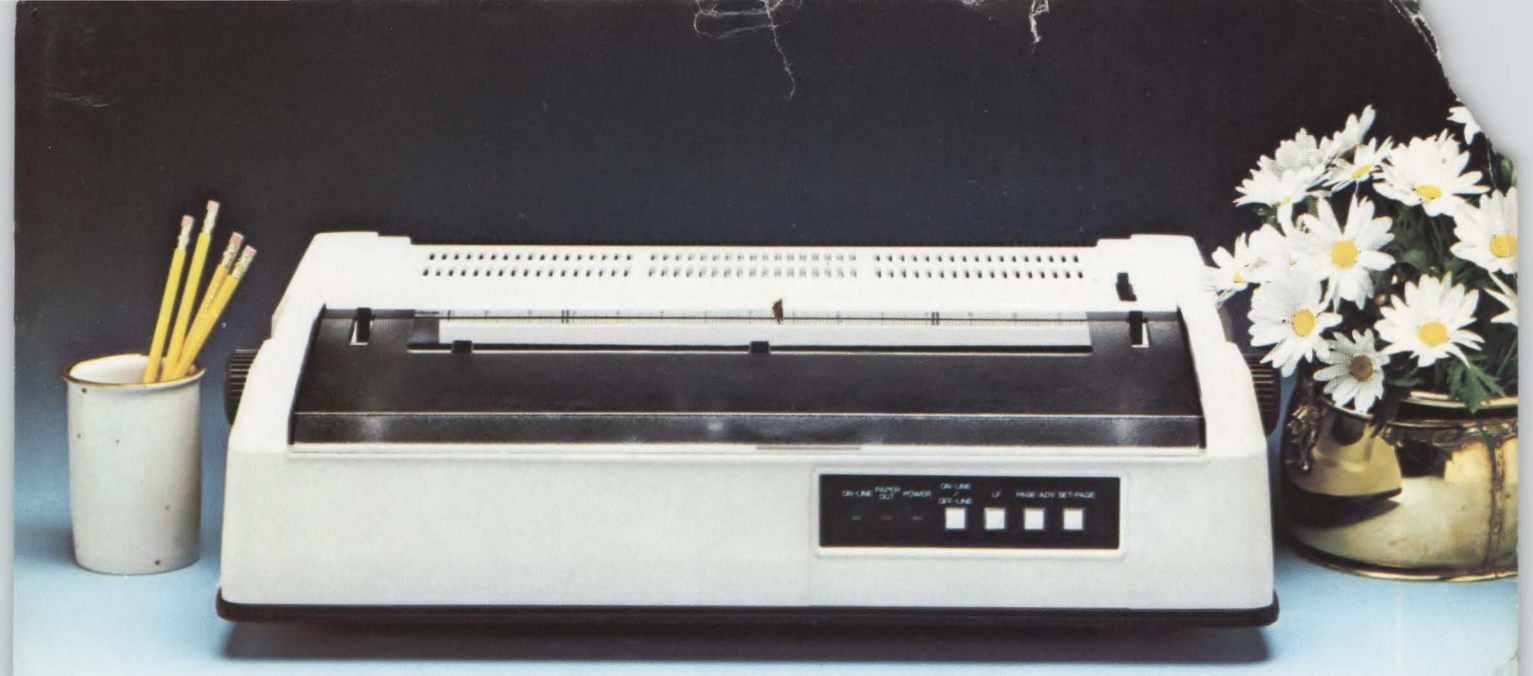

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