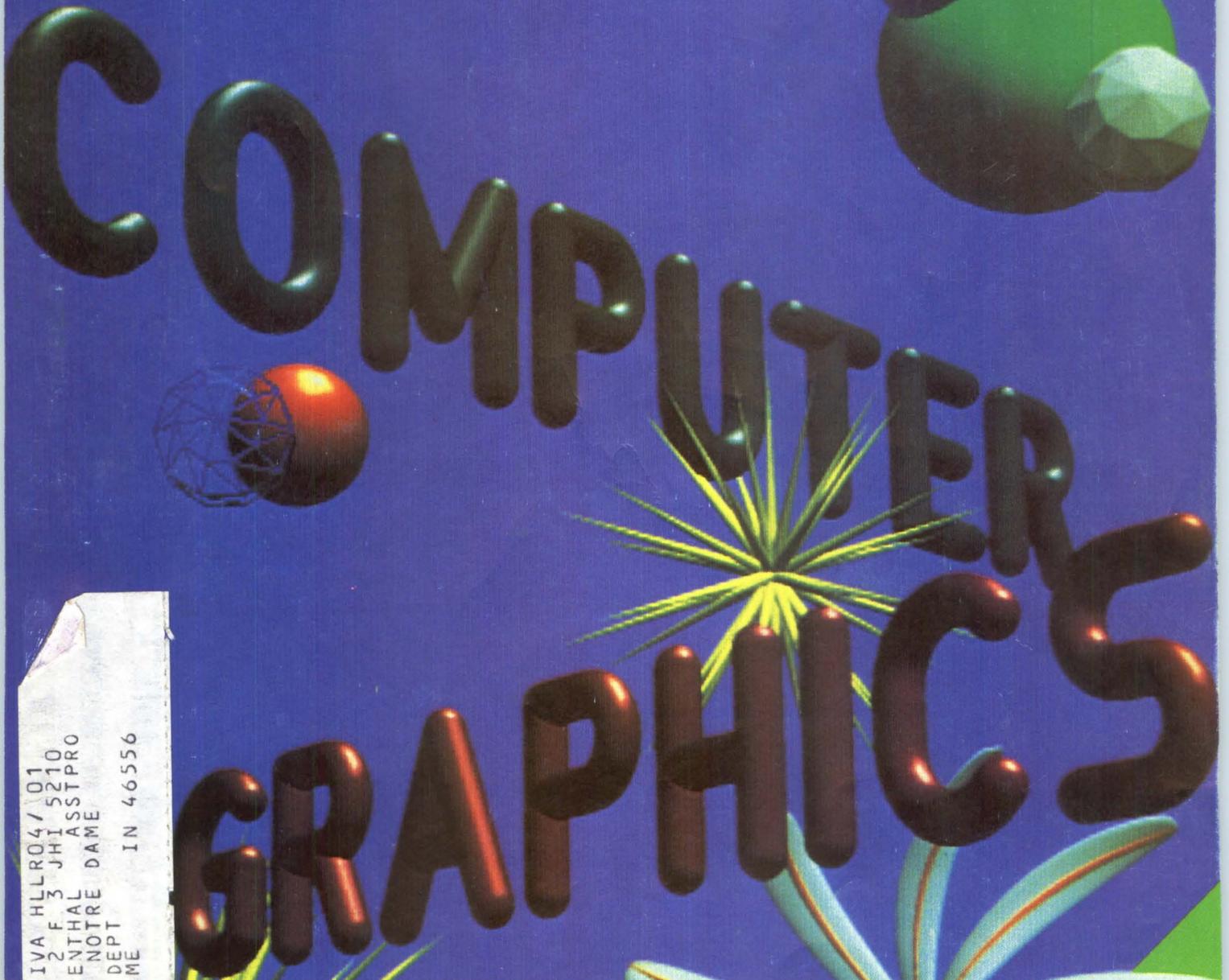


# Mini-Micro Systems

A CAHNERS PUBLICATION

JULY 1983

# COMPUTER GRAPHICS



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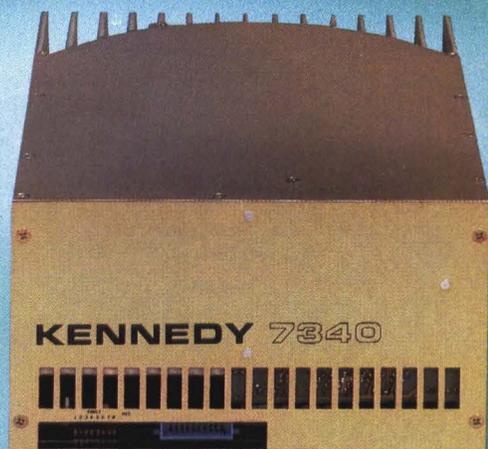
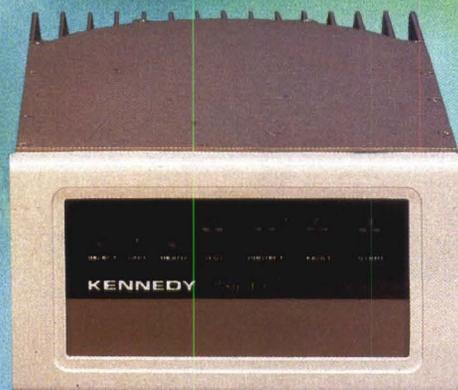
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# Mini-Micro Systems

## MINI-MICRO WORLD

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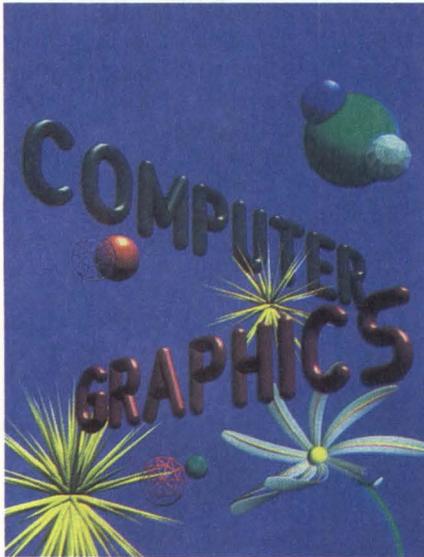
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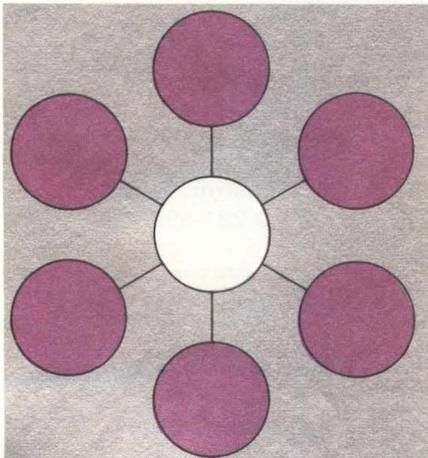
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Cover produced by Olin Lathrop, flower by Al Barr, courtesy of Raster Technology. Art direction and design by Vicki Blake.



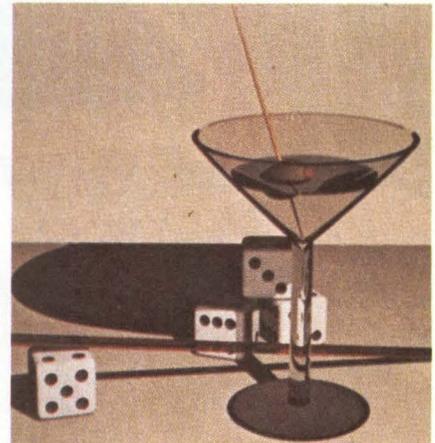
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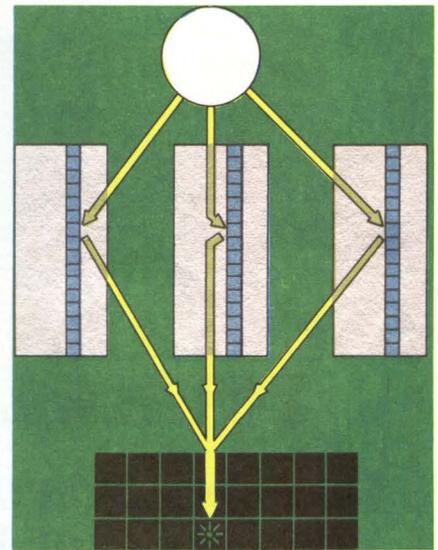
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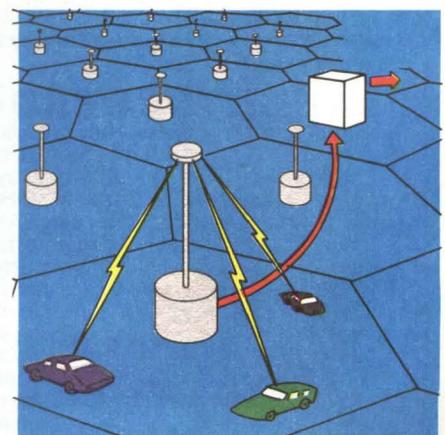
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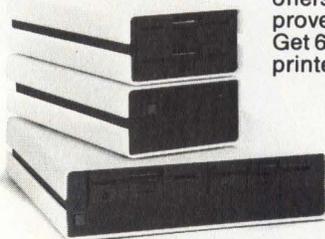
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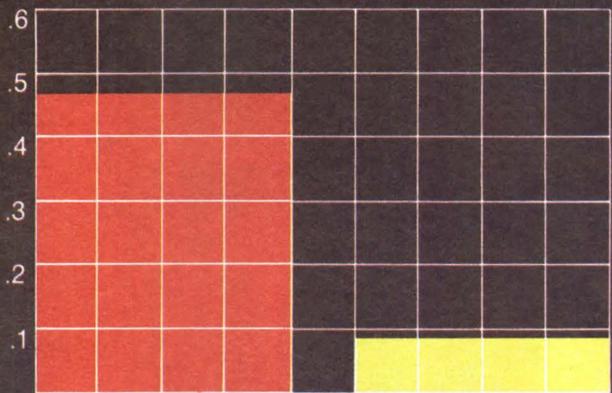
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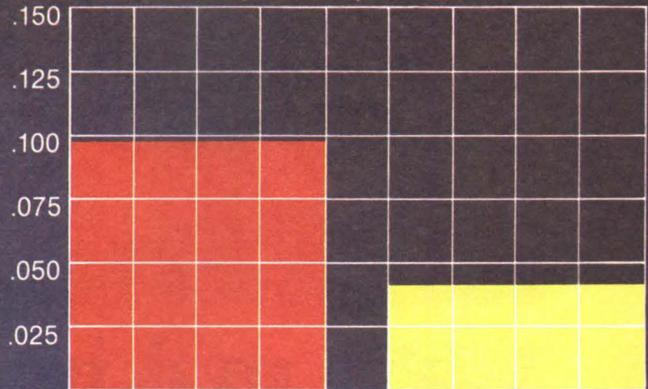
MIPS/SQ. FT.\*



CONCEPT 32/6780

VAX 11/782

MIPS/\$10,000\* (Equivalent System Price)



CONCEPT 32/6780

VAX 11/782

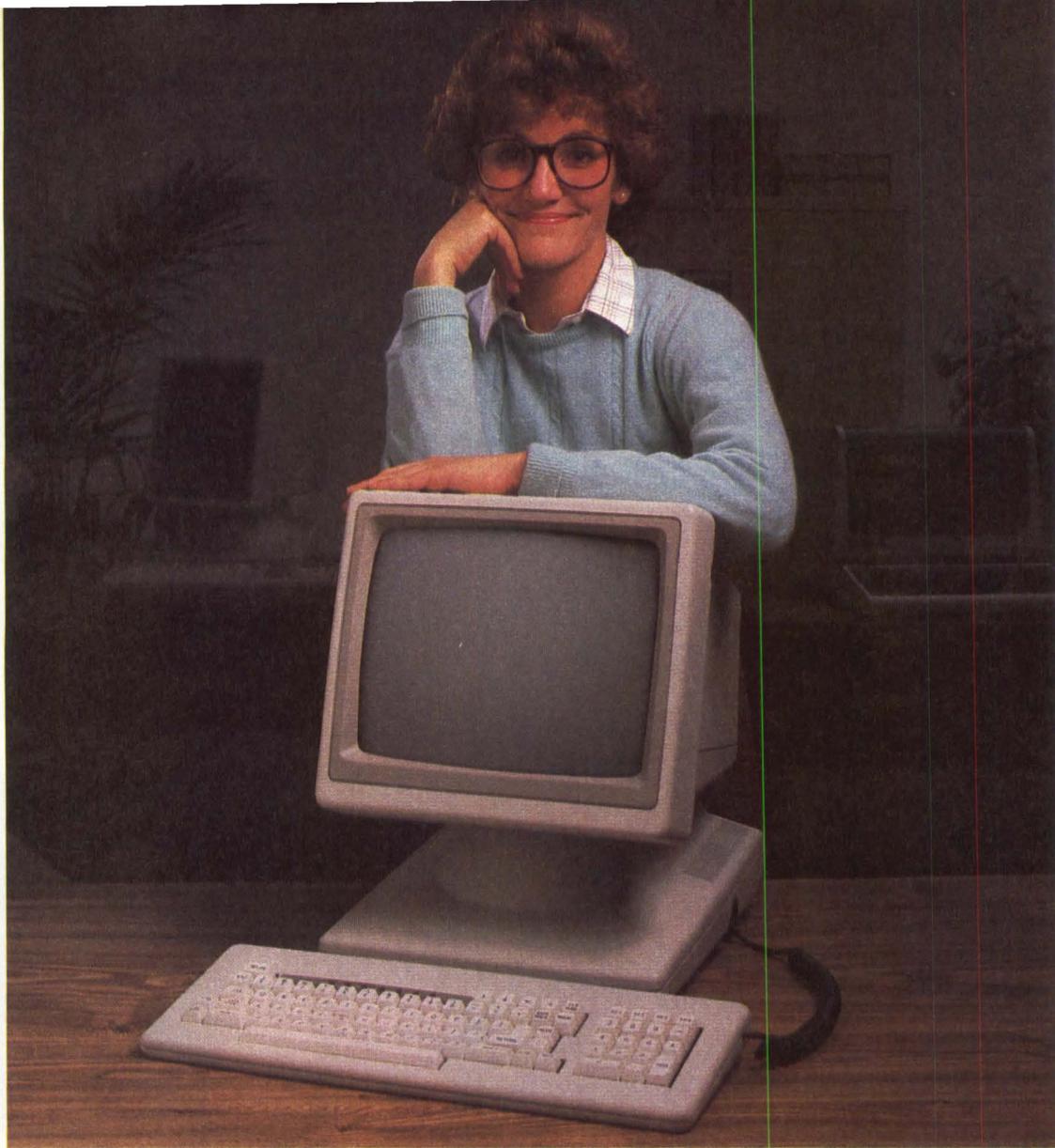
\* All chart data from published competitive information.

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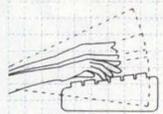
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# Breakpoints

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## **TANDON, DEC, MEMOREX SAID TO BACK ½-IN. TAPE**

Spurred by the efforts of the Quarter-Inch Cartridge standards groups—QIC-2 and QIC-24—an even weightier group may be mapping a strategy to manufacture a standard ½-in. tape cartridge. Sources say Tandon Corp., Digital Equipment Corp. and Memorex Corp. representatives have joined in an effort to reach a compromise before large volumes are manufactured. Tandon expects to begin production of its ½-in. tape drive (announced at this year's NCC) this summer at its MicroTech subsidiary in Campbell, Calif. DEC is reportedly working on a similar ½-in. tape drive with with a 5¼-in. form factor under the code name "Maya" in Springfield, Mass. With DEC and Memorex acting as second sources for the Tandon cartridge, a major roadblock to the drive's viability has been lifted.

## **PIXEL FOUNDER STARTS OVER WITH CADMUS**

Bill Southworth, who left the Pixel division of financially troubled Instrumentation Laboratories after it became a spin-off in March, has launched Cadmus Computers. Like Pixel, Cadmus is introducing a Motorola MC68000/UNIX system. The company has set up shop in a Lowell, Mass., mill dating from 1831 and has recruited former Digital Equipment Corp. product manager Bill Kiesewetter as marketing and sales vice president. Cadmus hoped to close a \$3.5-million venture-capital offering led by Citibank last month. It is beginning to roll out a product line that will range from a \$9500 graphics workstation to a \$28,900 graphics cluster with four 1024 × 800 CRT workstations, dual 65M-byte, 5¼-in. Winchester disk drives and a 16M-byte streaming-tape drive. In addition to the graphics products, the company will offer single- and multi-user general-purpose UNIX boxes aimed at commercial OEMs. The Cadmus hardware, which will be manufactured in Lowell, is based on designs developed in Germany by consulting firm PCS, which has sold 140 of its own UNIX systems and which has consulted for Siemens Corp., Nixdorf Computer Corp. and Tandem Computers Inc. Kiesewetter says Cadmus is putting its marketing emphasis behind a distributed UNIX approach that will use Ethernet to cluster 50 or more nodes. One possible fly in the ointment is a threatened lawsuit from Pixel president Tom Rosse, who reportedly sees Cadmus as a violation of Southworth's employment contract at Instrumentation Laboratories.

## **SECOND SOURCE FOR IBM'S 4-IN. MICROFLOPPY SAID TO BE IMMINENT**

The long wait for a second source for IBM Corp.'s 4-in. drive may be over. Atlas Ltd., a Hong Kong electronics manufacturer, reportedly will license the controversial drive and manufacture it through its U.S. floppy disk drive head subsidiary, Data Magnetics Co. Data Magnetics has reportedly been seeking financial assistance to ramp up production. IBM has made no public announcement about manufacturing plans since the drive was announced last spring, but rumors persist that the drive will be built into the company's forthcoming "Peanut" system.

## **PC-DOS-EMULATING CONCURRENT CP/M-86 DUE FROM DIGITAL RESEARCH**

Digital Research Inc., which recently announced PC-DOS support with its high-level languages, is expected to step up its marketing thrust further by announcing a PC-DOS-emulating Concurrent CP/M-86 by the end of this month. Planned for release in December is a fully ANSI-77-compatible version of FORTRAN. DRI also says its Personal BASIC will soon incorporate graphics. DRI has been collaborating with DEC on a smaller version of the VMS operating system; results of that project may be seen late this year. In addition, DRI plans to attack what it considers to be the virgin territory of the home computer ROM-cartridge software market.

# Breakpoints

---

## **ZILOG FILES COMPLAINT AGAINST NEC FOR IMPORTING Z80 LOOK-ALIKE**

Zilog Inc. has filed a complaint with the International Trade Commission in Washington against Nippon Electric Corp. of Japan. The complaint asks that NEC be enjoined from importing a chip that Zilog claims is a Z80 look-alike. The action follows a suit for patent infringement filed against NEC this year by Zilog in U.S. District Court in San Francisco. The ITC has the power to bar import of the chip, regardless of the outcome of the lawsuit.

## **NIPPON TELEPHONE & TELEGRAPH EXPANDING PRINTER TECHNOLOGY**

Nippon Telephone & Telegraph, the Ma Bell of Japan, is said to have developed a prototype of a color ink-jet printer based on a technology for controlling the ink spray with a cathode ray-type system. Reports indicate that the prototype can print as many as 10,000 dots per sec. and 180 x 180 dots per in. NT&T's computer division now produces equipment for internal use, but the organization may be interested in licensing its ink-jet technology to another Japanese concern.

## **COLUMBIA ADDS HARD DISK TO PC-COMPATIBLE PORTABLE**

Columbia Data Products Inc. plans to add a 5M-byte hard disk drive to its IBM PC-compatible VP portable, probably in time for unveiling at this fall's Comdex show. The drive will fit into a space typically occupied by floppy disk storage slots. Columbia marketing vice president Jack White says the company may also switch from an aluminum to a plastic shell to lighten the machine. With two floppy disk drives, the VP weighs 32 lbs., 4 lbs. more than the COMPAQ. Columbia, Columbia, Md., projects 1983 sales of \$50 million and is expected to go public in 1984.

## **STAR MICRONICS TARGETS DAISY-WHEEL PRINTER MARKET**

Star Micronics Inc. is said to be developing products for the low-end daisy-wheel market after success with its first product, the Gemenii 10 dot-matrix printer. The company is hoping to fill the price/performance windows in the daisy-wheel market for 20- to 30-character-per-sec. models priced at less than \$600 and 50- to 60-cps models priced at less than \$800. Star Micronics is the U.S. marketing arm of Star Manufacturing Group, Japan. It entered the printer market less than a year ago with the Gemenii 10 and ships nearly 15,000 units a month.

## **START-UP OFFERS DISK CACHE MEMORY BOARD**

Origin Inc., Los Angeles, has begun delivering sample units of its first memory product, the OR-88C disk cache memory board for Intel MDS Series 2, Series 3 and 800 Development Stations. The disk cache board works with the development station's floppy disk controller to provide 480K bytes of cache memory, according to Origin tests. One potential customer for the product is Intel.

## **BYTEL ENHANCES PROGRAM GENERATORS**

Bytel Corp.'s new release of its COGEN COBOL program generator is scheduled for third-quarter availability. The program generator features a data dictionary, the ability to alter permanently the way the system generates source code, data validation and generation of batch control programs. The package from the Berkeley, Calif., firm runs under PC-DOS, VAX/VMS and other systems and uses menus and prompts. Its five skeletal source-code modules—file maintenance, inquiry, report writing, initialization and batch processing—are open to modification. The entry-validation system allows as many as nine conditional statements. The batch programs read a master file and as many as 99 secondary files. COGEN 6.0 prices range from \$950 to \$7500.

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CONTROLLER	EMULATION	COMPATIBLE DRIVES	FORMATTED CAPACITY
<b>Q-BUS</b> Floppy: PM-XCV21 PM-XCV31 Disc Cartridge/ SMD/MMD: PM-DCV06A PM-DCV02A	RX02 RX03  RK06  RM02 RM05	Shugart/NEC/Qume. Single or double-density Shugart/NEC/Qume. Double-sided/double-density  CDC Phoenix CMD Drive or Ampex DFR9x Series (32, 64, or 96MB ea.) 80MB CDC 9762 SMD/80 CDC 9730-80 MMD/ 160MB CDC 9730-160 MMD 300MB CDC 9766 SMD/600MB CDC 9775 FMD/ (also any CDC-compatible SMD interface)	512KB per drive (x2) 1024KB per drive (x2)  Min: 28MB (2 logical RK06) Max: 8 logical RK06; up to 2 physical drives Min: 67MB (1 logical RM02) Max: 2 physical drives/4 logical RM02 (268MB total) Min: 256MB (1 logical RM05) Max: 2 physical drives/4 logical RM05 (1024MB total)
<b>Fixed (Winchester):</b> PM-FCV21  <b>Tape:</b> PM-CCV11A	RL01/02  N/A	Industry-standard, Seagate technology interfaced 5.25" Winchester drives with buffered seek  Cipher 'Quarterback'	Min: 104MB (1 RL02 or 2 RL01) Max: 41.5MB (4 physical drives/4 logical RL02) or any combination of RL01/02 up to 4 logical drives  20MB per 450-ft. cartridge
<b>UNIBUS</b> Floppy: PM-XC21 PM-XC31 Disc Cartridge: PM-DC06A  SMD (Removable)/ MMD (Fixed): PM-DC02A	RX02 RX03  RK06  RM02 RM05	Shugart/NEC/Qume. Single or double density Shugart/NEC/Qume. Double-sided/double-density  CDC Phoenix CMD Drive or Ampex DFR932 Series (32, 64, or 96MB ea.)  80MB CDC 9762 SMD/80MB CDC 9730-80 MMD/ 160MB CDC 9730-160MMD 300MB CDC 9766 SMD/600MB CDC 9775 FMD/ (also any CDC-compatible SMD interface)	512KB per drive (x2) 1024KB per drive (x2)  Min: 28MB (2 logical RK06) Max: 8 logical RK06 with up to 4 physical drives  Min: 67MB (1 logical RM02) Max: 268MB (4 logical RM02) Min: 256MB (1 logical RM05) Max: 1024MB (4 logical RM05)
<b>Tape:</b> PM-TC11B  <b>VAX</b> SMD (Removable) MMD (Fixed): PM-DCG03	TM11  RM03/ RM05/ RM80	Kennedy or Perlec 1/2-inch, 9-track, reel-to-reel; 12.5 to 125ips; 800/1600bpi  80MB CDC 9762 SMD/160MB CDC 9730-160 MMD (2 logical RM03 or 1 logical RM80)/300MB CDC 9766 SMD (1 logical RM05)/ 474MB Fujitsu M2351 (3 logical RM80)/600MB CDC 9775 FMD (2 logical RM05)/(also any CDC-compatible, SMD interface)	4 Tape Transports per controller  Min: 67MB (1 logical RM03) Max: 2048MB (8 logical RM05) Supports up to 4 physical or 8 logical drives

 **PLESSEY. ASK ANYBODY.**

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MINI-MICRO SYSTEMS/July 1983

CIRCLE NO. 9 ON INQUIRY CARD

9

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**CIRCLE NO. 10 ON INQUIRY CARD**

# Breakpoints

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## THE NEXT WAVE FROM TAIWAN: IBM PC-COMPATIBLES

Most Taiwan manufacturers are caught in a vise with the conflicting pressures of being behind in development and not being able to design their own computer systems while being accused of copying others. They are now looking at the IBM PC-compatible market as their next move after creating controversy in the Apple-compatible market. Apple Computer Inc. is suing about 11 companies in Taiwan, and about 100 Taiwanese companies are said to be making rip-offs of Apple products. But the Taiwan government is getting strict—closing down the imitators and not allowing them to export their products. A government source says, however, that it is difficult to control domestic Apple rip-offs. Those poised to enter the IBM PC-compatible world include large Taiwan concerns such as Taiwan Automation and MultiTech International. The IBM PC and Digital Equipment Corp. personal computer were announced in Taiwan in early June, and encouraged such development. Taiwan Automation, part of the large Mitac Group of companies, plans to have its IBM-compatible ready for introduction next month. The company believes the manufacturer that can control costs controls the IBM PC-compatible market. One of Taiwan's strengths has been low-cost manufacture because of an abbreviated product-design phase. The initial IBM PC-compatible release, including an 8088 chip, CP/M-86 or MS-DOS, 256K bytes of basic memory, a 1000- × 1000-dot, high-resolution display, a control board and both Winchester and floppy disk drives, is due next month. Forthcoming by year-end is a portable version using 5¼-in. floppy disk drives. The products will be key to Taiwan Automation's gaining market share in the U.S. Although about 60 percent of equipment sales were to Taiwan's domestic market this year, Taiwan Automation and Mitac's U.S. marketing branch are planning a major push into the U.S. next year. Included is a Taiwan Automation-designed microcomputer that will run Apple IIe software and aimed at the game and educational markets. If the company is successful, the Apple machine could sell as many as 150,000 units per year. Another company introducing an IBM-compatible is MultiTech International, a key manufacturer of Chinese-character microcomputers. The company is still in hot water with Apple over its MicroProfessor microcomputer. MultiTech is an IBM PC distributor in Taipei, but is planning a compatible version by year-end. Also on MultiTech's agenda is a plan to obtain a price difference of only \$100 between its Chinese and English versions of certain models of its personal computers. Historically, a Chinese version sells for three times more than its English counterpart.

Micro in-circuit emulator company Microtek Labs Inc. plans to enter the systems market next year with a model whose specifications are still being defined. One thing is clear, however: Microtek will avoid MS-DOS compatibility because of market competition. Instead, Microtek will probably employ CP/M-86 and aim the computer at vertical applications, but also use 8088 and 8087 co-processors.

## TECHFILES: A quick look at industry developments

**Printer files: Mannesmann Tally Corp.** was scheduled late last month to introduce a low-end dot-matrix printer, the Spirit. Retail price for the printer will be less than \$400. Targeted at the personal-computer market, Spirit prints 80 cps and uses a print head with square hammers for better horizontal and vertical line definition. An undisclosed offshore supplier manufactures the printer.... **C. Itoh Electronics** will soon introduce a portable thermal transfer printer to be used with portable computers. The product is said to have been demonstrated in Japan and will likely be brought to market before the end of this summer.... **Data-Type Inc.**, a producer of intelligent terminals, is introducing a color dot-matrix printer at Siggraph. The company's first printer product is said to be based on the

# Breakpoints

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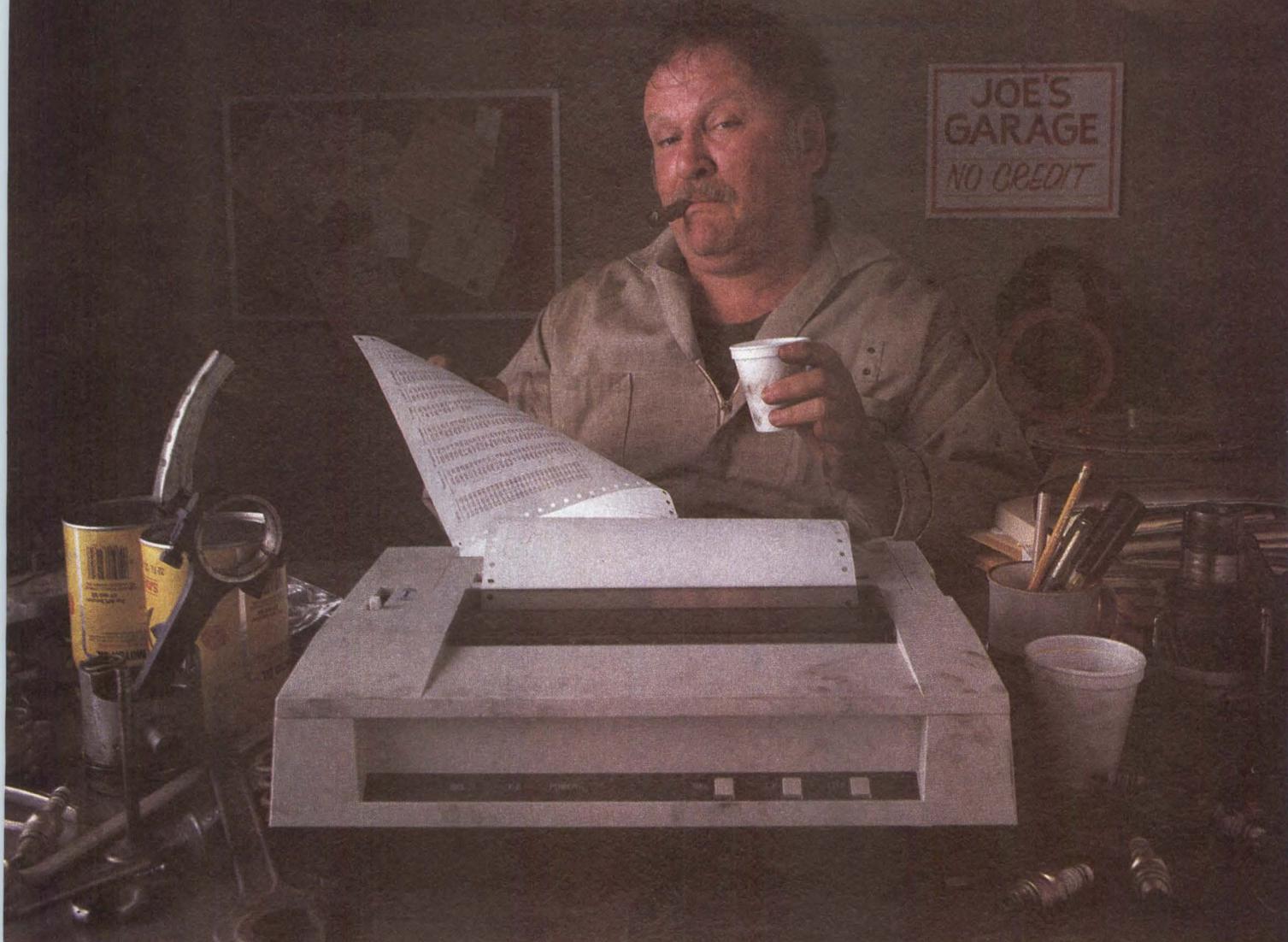
Infoscribe 1200 and to be aimed at the Tektronix-compatible market.... **Santec Corp.**, Amherst, N.H., has announced that it will receive a \$2-million investment from Nanjing Telecommunications Works, a government-owned manufacturing organization in the People's Republic of China. A joint venture between Santec and Nanjing is also planned to develop and produce printers. More than two-thirds of Santec's estimated 1982 sales of \$3.5 million were to overseas customers, partially because of the company's sophisticated dot-matrix technology, which allows for character sets of various languages.

**Random disk files: Shugart Corp.** will drop the SA1100 series of 8-in. Winchester drives from its line because the market window for the drives—announced in September, 1981—closed before any significant production began. The drive offered only 20M or 34M bytes on an 8-in. platter, which systems manufacturers no longer consider viable. Today's 5¼-in. drives offer 40M to 70M bytes of storage. Some announced drives have capacities of 380M bytes. Shugart shipped fewer than 1000 SA1100s after encountering production problems. Shugart's new president, Bill Bayer, has announced Shugart will concentrate in the meantime on 5¼-in. and smaller drives, leaving 8-in. development to its Xerox Corp. sister company, Century Data Systems. Shugart will continue to manufacture its SA1000 series of 8-in. drives, but will not add enhancements to any 8-in. drives.... **TeleVideo Systems Inc.** has become the first systems manufacturer to sign an exclusive contract for half-height 5¼-in. Winchester disk drives. The manufacturer of 16-bit personal computers estimates the value of the one-year contract with Miniscribe Corp. at \$20 million. TeleVideo declines to say what system will incorporate the new drive.... **Tandon Corp.** recently signed an \$80-million contract with Non-Linear Systems, manufacturer of the Kaypro portable computers, that will include some half-height drives, but also includes Tandon Corp.'s floppy and Winchester lines.

**Micro files: Data Base Research Corp.**, Anaheim, Calif., hopes to announce a PC version of the CHAMPION accounting software this month. The system features an automatic crash-recovery program. The system size may be less than 270K bytes.... **Sord Computer of America Inc.** plans to announce a microcomputer that runs a version of UNIX 5.0 as well as Sord's proprietary operating systems in October. Sord may retain the Xerox store as a distributor.

**Software files: Digital Research System Inc.** has reached an agreement with VisiCorp to support Visi<sup>On</sup> on CP/M systems. Under terms of the agreement, Digital Research will work with personal computer manufacturers to adapt the software to individual systems. Visi<sup>On</sup> is an interactive, graphics-oriented package that displays applications in windows and uses a mouse for cursor movement. The IBM PC and the DEC Professional Computer also support Visi<sup>On</sup>.... **Numerix Corp.**, Newton, Mass., claims its new 32-bit floating-point array processor is three times as fast as other array processors selling for less than \$100,000, including those from Floating Point Systems Inc. and CSP Inc. Numerix's MARS-432, one of the few array processors with a FORTRAN compiler, can be interfaced to Digital Equipment Corp. PDP-11s, VAX-11s, LSI-11s and Multibus-based host machines. Claimed overall computational speed is 30 million floating-point operations per sec. The system performs addition or multiplication in 100 nsec. and a 1024-point complex fast Fourier transform in 1.7 msec. Data memory physical address space is 16M words, and maximum physical memory is 64K words. DMA transfers occur at I/O bus rates of 20M bytes per sec. Data memory or write times are 100 nsec. The system provides seven-point decimal precision. Prices of a standard configuration with 64K words of data memory range from \$80,000 to \$100,000, depending on external interfaces and software options. OEM versions are available for around \$50,000.

# SURVIVAL OF THE FITTEST.



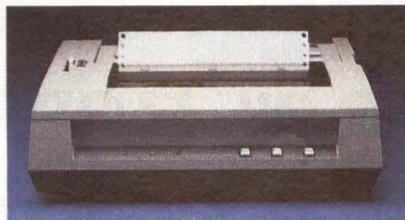
**A**sk major OEMS and they'll tell you that when it comes to reliable printers, the one they choose time and again is the C. Itoh 8510 Pro/Writer.

You see, many of today's printers achieve high speeds only by pushing their low-speed mechanisms to the limit of endurance. So what you seemingly gain in capabilities you lose in reliability.

C. Itoh's 8510 Pro/Writer, on the other hand, was designed from the very beginning to run at full speed (120 cps)—without breakdowns or noise. Its heavy duty stepper motor, base castings and synthetic-ruby print-head mechanism are built to take a lot of punishment. So you get superior print

quality throughout its 100 million-plus character life.

The 8510 also offers advanced paper handling features. You get bi-directional tractor and friction feed capability to handle paper widths from 4.5" to 10." Positive paper positioning for rapid bi-directional paper motion without short repetitive motions. Manual form alignment—even with power on. And a print line that can be easily



observed during printing.

Other features include built-in graphics with excellent resolution (144 x 160 dots per square inch). Five unique alphabets, eight character sizes. Mixed fonts during a single line pass bi-directionally. Variable form length, 6-channel electronic vertical formatting. The list goes on and on.

It's no wonder that so many major OEMs have selected the 8510 Pro/Writer design as their standard printer.

They know that in the real world, only the fittest survive.

For full details, contact C. Itoh Electronics, Inc., 5301 Beethoven Street, Los Angeles, CA 90066. (213) 306-6700.

CIRCLE NO. 11 ON INQUIRY CARD

**C.ITOH ELECTRONICS**

A world of Quality

# OUR SMALLEST ACHIEVEMENT IS THE INDUSTRY'S BIGGEST SUCCESS.

The Tandon 8" and 3½" Floppy Company is the world's largest producer of 8" ThinLine™ drives.

And now we're ramping up for high volume production of single and double-sided 3½" drives.

When we introduced the half-height 8" floppy drive, we expected system designers to go wild over it.

You did. Some of you stacked two of our drives to double system storage to as much as 3.2MB without increasing system size. Others took advantage of our small achievement to reduce system size instead.

Whatever you've done with our ThinLines, we want to thank you for having the confidence in them to give us an overwhelming lead in the half-height 8" market.

Now we're using our experience in making drives small to make them even smaller. Our new 3½" drives are now in

production in four versions. 500K byte single-sided and 1MB double-sided Tandon interface models. And Sony interface-compatible drives of the same capacities.

We plan on becoming the world's leader in 3½" the



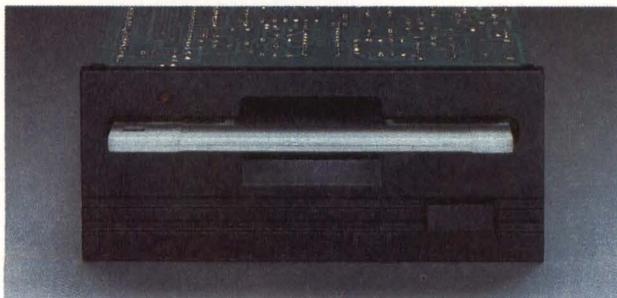
same way we became the world's leader in half-height 8". By focusing our energies on building more drives, better, at a lower cost than anyone else.

Like all Tandon companies, we start with a high degree of vertical integration. And an aggressive commitment to R&D no one can match.

We've also established ourselves in a brand-new facility with all the latest manufacturing and test equipment. So we can triple our current leading monthly production rate while ramping up to meet the burgeoning 3½" market.

Just because we've become a success by thinking small doesn't mean our plans are modest.

**Tandon**  
THE MOST SUCCESSFUL DISK DRIVE  
COMPANIES YOU EVER HEARD OF.



## TANDON 8" AND 3½" FLOPPY COMPANY.

Tandon Corporation, 20320 Prairie, Chatsworth, CA 91311, (213) 993-6644, TWX: 910-494-1721, Telex: 194794. Regional Sales Offices: Boston (617) 938-1916 • New York (201) 449-7720 • Atlanta (404) 934-0620 • Chicago (312) 530-7401 • Dallas (214) 423-6260 • Irvine (714) 675-2928 • Sunnyvale (408) 745-6303 • Frankfurt, West Germany 6107-2091, Telex 411547 • London, England (0734) 664-676 Telex: 848411. Distributors: Hall-Mark, Kierulff, Schweber.



# Dysan Diskettes Are Certified... Automatically

Because one thing  
your diskettes don't need  
is a personal touch.

Auto-load certification enables critical testing of each and every diskette, ensuring each and every user 100% error-free diskette performance. This unique process is one more way that Dysan goes a bit further. Auto-load certification also eliminates any possibility of handling errors.

## Background

Dysan does more to give you the assurance and quality you need. In fact, Dysan is the *only* diskette manufacturer using automatic, microprocessor-controlled certifiers to test and measure diskettes to parameters far beyond industry requirements. Dysan's exclusive "hands-off" method eliminates any possibility of handling errors and simplifies daily calibration routines. The result? Precision certification of each diskette. Exacting performance on your system. That's the Dysan difference.

## Other Benefits

Dysan goes a bit further in the testing process, too, certifying that each diskette is 100% error-free both *on* and *between* the tracks: and more tested

surface means greater data integrity and unsurpassed performance. A proprietary DY<sup>10</sup>™ lubricant guards against surface abrasion and resonance, which can hinder effective read/write performance. Advanced burishing techniques provide optimum head-to-disc interface by flattening even the most microscopic surface peaks.

The true cost of a diskette equals the purchase price *plus* the time you spend to fully load the diskette. Reliability translates into cost savings. That's why Dysan goes a bit further to make diskettes which are the most reliable that money can buy. You can select from a complete line of premium 8" and 5¼" diskettes, in single or double densities, certified on one or both sides.

DY<sup>10</sup> is a trademark of Dysan Corporation

CIRCLE NO. 14 ON INQUIRY CARD



# Three

## Third in a Series

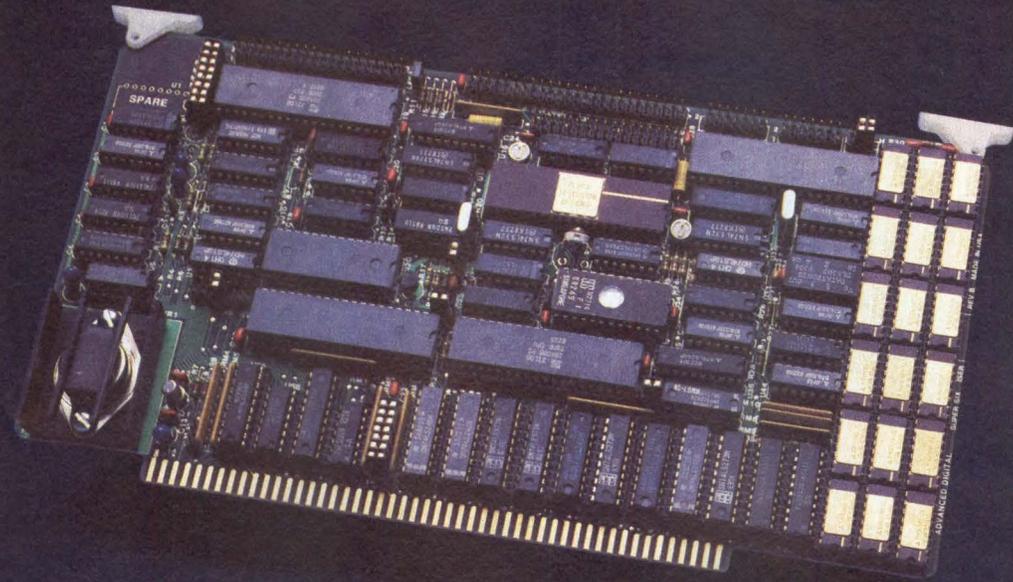
## Auto-Load Certification

**dysan** **Dysan**  
CORPORATION

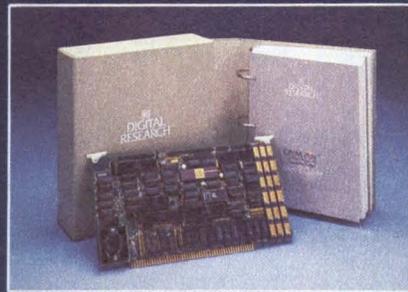
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MINI-MICRO SYSTEMS/July 1983

# SUPER SIX™



## SUPER SIX, THE FIRST 6MHz S-100 SINGLE BOARD COMPUTER TO SUPPORT BANKED CP/M™ 3.0

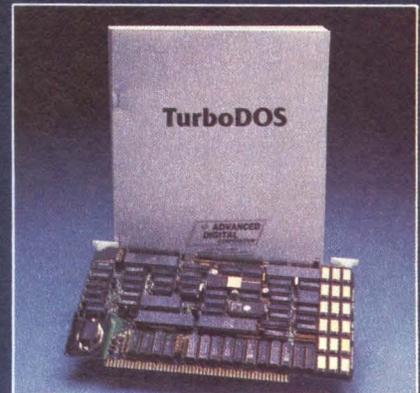


### SUPER SIX & CP/M™ 3.0 A PERFECT MATCH

Advanced Digital has found the perfect match to its powerful, high-speed SUPER SIX single board computer. It's Digital Research's new CP/M 3.0. Because of SUPER SIX's 128 KB of RAM, it is the only S-100 board to support CP/M 3.0 in the banked mode; or run CP/M 2.2 with 64 KB of extra buffer.

### SUPER SIX & TurboDOS™ ANOTHER PERFECT MATCH

When you combine the TurboDOS multi-user operating system with the 6 MHz SUPER SIX, you'll find your system running 1-1/2 times faster than



before. Add the 4 MHz or 6 MHz SUPER SLAVE™ processor board(s) and you will have the fastest multi-user, multi-processor system available today.

See the SUPER SIX at your quality computer dealer or contact:



12700-B Knott Street  
Garden Grove, CA 92641  
Phone: (714) 891-4004  
Telex: 678401 tab irin

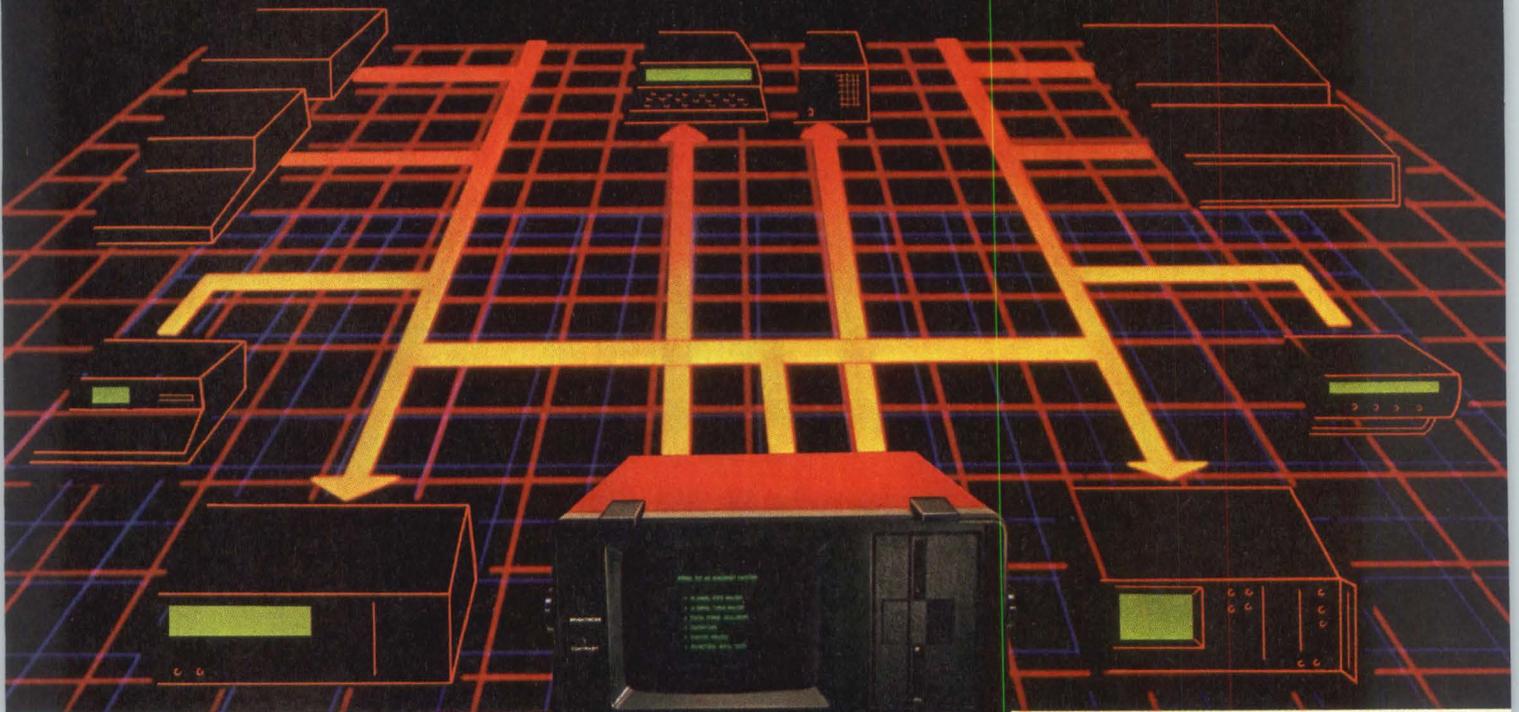
### SUPER SIX FEATURES:

- 128 KB of Bank — selectable RAM
- 6 MHz, Z-80B CPU
- DMA Controller
- 6 MHz, Z-80B DART (2 Serial RS-232 Ports)
- 6 MHz, Z-80B PIO (2 Parallel Ports)
- 6 MHz, Z-80B CTC (Clock Timer)
- Double/Single Density Floppy Disk Controller — Supports 8" and 5-1/4" Drives Simultaneously
- 2/4 KB of Monitor EPROM
- S-100, IEEE 696 Compatible

\*CP/M is a trademark of Digital Research Corp.  
TurboDOS is a trademark of Software 2000 Inc.  
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CIRCLE NO. 15 ON INQUIRY CARD

# The Electronic Workbench



## Now, a Logic Analysis System that puts a bench-full of instruments at your fingertips.

The NPC-764. It just makes good sense. When performing logic analysis and other measurement functions, you shouldn't have to face different sets of knobs, switches and dials. That's why we've developed the NPC-764, the Electronic Workbench. Now your analysis tasks are all done the same way—with a familiar ASCII keyboard and easy-to-use, self-prompting menus. Simple keystrokes are all it takes to run tests and record data on disk. And all logic analysis and other internal functions are ROM-based and ready to go on power up. No messy setups. No relearning of multiple instruments.

The NPC-764 includes a 48-channel State Analyzer and a 16-channel, high-speed Timing Analyzer. And, as optional plug-ins, a single-channel Digital Storage Oscilloscope, a 5-function Counter-Timer/Signature Analyzer, and bidirectional Serial Tester.

But the NPC-764 is more than just a multiple-function instrument. It also incorporates a GPIB controller and RS-232 MASTER/SLAVE capability. Standard. A common set of commands lets you control the internal analyzers and any GPIB- or RS-232-compatible devices you include in your setup—pattern generators, emulators, spectrum analyzers, PROM programmers . . .

And that's not all. The NPC-764 is a full desk-top computer, with floppy disk storage and a CP/M® operating system. Use it for

general-purpose computational tasks or the execution of commercially available CP/M programs.

The NPC-764, with all its internal measurement functions, requires less than *half* the investment of the equivalent instruments purchased separately. And the ASCII keyboard and menus are so user friendly it sets a new standard for the industry.

Not quite ready for all this capability? Start with our basic NPC-748. It provides exactly the same measurement functions, but 16 fewer state channels and no floppy disk drive. Upgrade easily to the NPC-764 at any time.

There's a whole lot more we'd like to tell you about the Electronic Workbench. For additional information, applications assistance or a personal demonstration, just give us a call: **(800)-NICOLET, (415) 490-8300** (Calif); TWX: **910-381-7030**. Nicolet Paratronics Corporation, 201 Fourier Avenue, Fremont, CA 94539.

\*CP/M is a registered trademark of Digital Research.

**CIRCLE NO. 16 ON INQUIRY CARD**

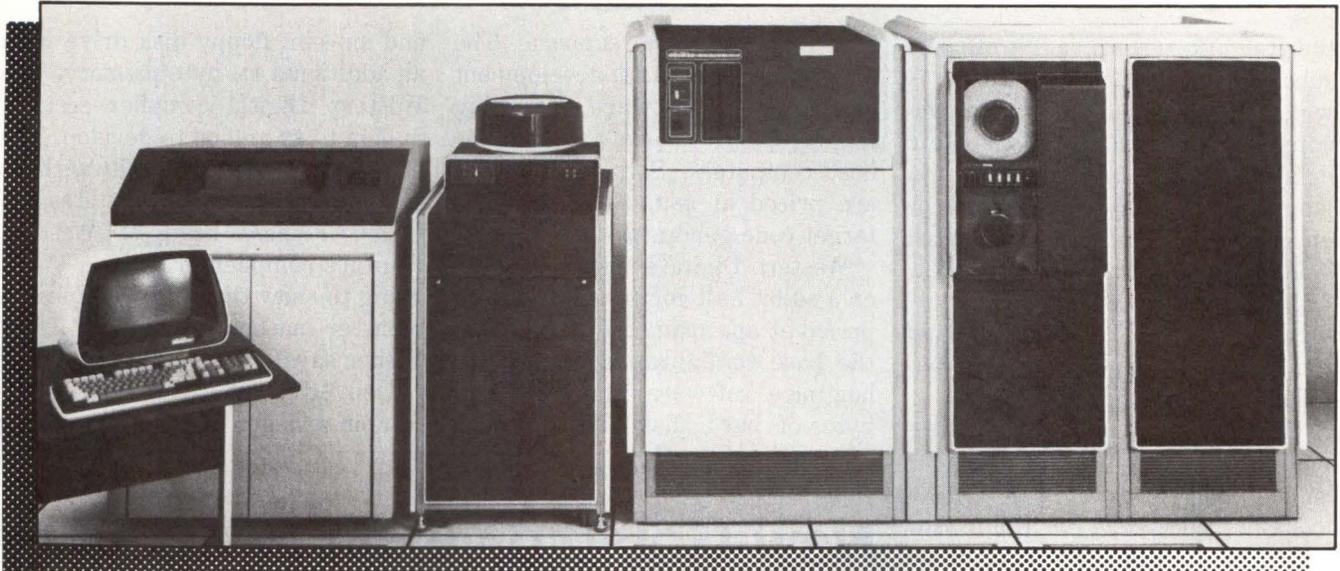
*Leading The Way In Analysis Technology.*



**Nicolet**  
Paratronics Corporation

# Mini-Micro World

NEWS



The Ada Work Center system above, to be marketed by both Data General and Rolm, includes DG's MV/8000 superminicomputer, Dasher system consoles and Rolm's Ada compiler. DG MV/4000 and MV/10000 models can also be used.

## Competition heats up for commercial Ada compiler

Just as two commercial computer firms announced a joint Ada language compiler system developed entirely with \$8 million to \$10 million of internal funding, the U.S. Army was forced to rebid portions of its more-than-\$17-million contract with Softech Inc. to develop a cross-compiler for Ada-language applications in the Army's embedded computer systems.

Three of the five target computers that the Softech compiler was designed to work with—the Rolm 1602 B and 1666, and the VAX-11/780 (with no operating system)—were withdrawn from the contract after the Softech compiler failed Army validation tests late last year. The unsuccessful test effort was blamed on integration problems that resulted in unacceptable levels of data error. It has delayed the Army's program for approximately eight months and moved officials at the Center for Tactical Computer Sys-

tems (CENTACS), Fort Monmouth, N.J., to initiate monthly reviews of the progress of the cost-plus-award-fee contract with California-based Softech.

A Softech spokeswoman confirms that Softech's Ada contract with the Army had been modified to retarget development work on the VAX and military computer family systems, but she cannot detail the nature of the difficulties experienced during the validation tests.

Elimination of the three co-generator host computers will cost Softech \$3 million in future funding. That portion of the contract will be rebid competitively in 1985 or 1986. "We're trying to limit our risk—both ours and Softech's," comments Joseph Kernan, CENTACS chief of the Software Technical Development Division.

Meanwhile, Department of Defense validation testing of three Ada compiler systems began in April at

the Ada Joint Project Office. The first system, an Ada language interpreter from New York University's Courant Institute, was the first to pass the 2000 validation tests. NYU's Ada/Ed, characterized as a prototype system, was funded jointly by CENTACS and DOD's AJPO.

An Ada software-development system developed by Rolm Corp. and hosted on the new Data General Corp. MV/10000 supermini began validation testing in early May and is expected to be the first production system to be certified after a month-long series of tests and evaluations. Western Digital Corp. claims to have had a compiler in production since December. The company started AJPO tests in June, says an AJPO official.

Western Digital was the first company to formally apply for validation testing. But an 18-week delay in receiving the American National Standards Institute's Ada standard caused a delay in the company's development schedule, according to Western Digital.

At a press conference to unveil

# Mini-Micro World

## NEWS

the Rolm/DG system, AJPO officials subtly needled Army counterparts while toasting the efforts of the commercial sector. "With their delays in developing their own Ada language, the Army will allow or encourage commercially validated Ada development," Air Force Lt. Col. Larry Druffel, AJPO director, wryly noted. "All I can do is applaud the efforts of these [Rolm and DG] folks."

Under a joint marketing agreement, Rolm and DG will offer the same family of Ada Work Center systems, consisting of Rolm Ada software to run on DG's 32-bit Eclipse series—MV/4000, MV/8000 and MV/10000. Ada applications can also be run on Rolm's 16- and 32-bit military specification MSE/800, MSE/14 and 1666B computers. Rolm's Ada Work Center system (MMS, January, p. 40) is designed as an Ada software-development facility that includes Ada development environment software, the compiler, as much as 8M-byte processor memory, a hard-copy console, a magnetic-tape unit, a disk drive and as many as eight terminal ports.

Rolm has long claimed that its development system will fully meet the recently completed ANSI 1815(A) 1983 specifications for the Ada compiler, and company executives are not timid in saying so. "We're the only fully compatible Ada system in the industry today," boasts Rolm vice president Dennis Paboojian. "DOD now has the Ada development capabilities that weren't anticipated until late 1984 or early 1985."

Rolm has conducted beta testing of its work center at Lockheed Corp. in California during the past year, but no orders have been taken for a production unit.

Prices for the Rolm/DG systems range from \$158,965 to \$409,665 for the basic work center, including

first-year software support. The license for the Ada development environment software, including the compiler, is available for the host computers. Software licenses are priced at \$82,800 and include target code generators.

Western Digital's system is based on a 16-bit host computer. It will be priced at approximately \$20,000 for the base configuration of the Ada language software, the CPU, 10M bytes of hard disk drive storage

and an 8-in. floppy disk drive with an additional 1M-byte memory. The Western Digital compiler cost \$1 million to \$2 million to develop. The effort was funded internally without any government moneys, states Dr. Gerry Fisher, head of Western Digital's compiler program. "We're going to show that you don't need a monster machine to support Ada," Fisher says.

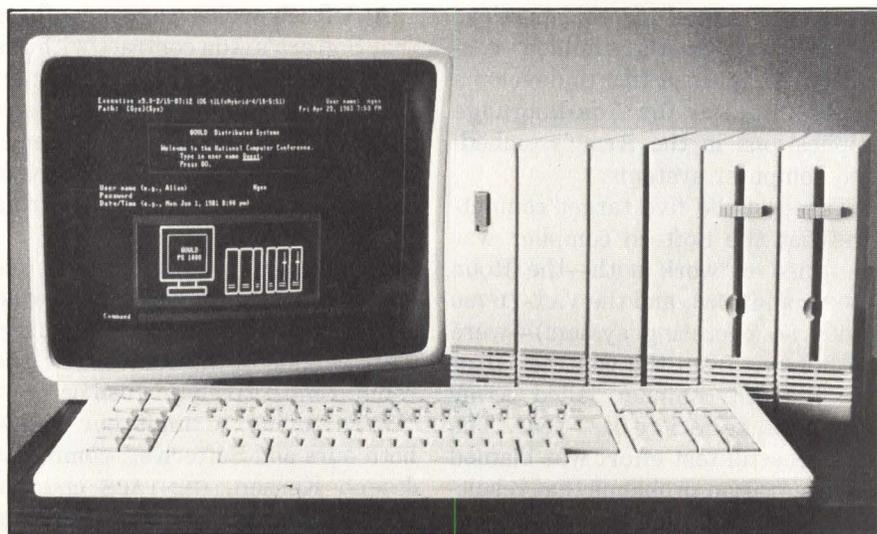
Deliveries of Western Digital compilers began last year, according

## New Gould division to market Convergent-based systems

Gould S.E.L. has begun its drive into the fertile computer-aided engineering market with a new organization assembled like an entrepreneurial start-up and a product line that relies heavily on OEM hardware provided by Convergent Technologies Inc. The new Distributed Systems business unit promises to be the first Gould operation to provide products span-

ning a range of requirements across the corporation's various electronics subsidiaries.

John Muczko, vice president for Distributed Systems, says, "We are literally a new venture. I drew up a business plan, and we had to get venture capital from the company to fund our development." The plan was drawn up last October, and Distributed Systems opened a shop



Gould S.E.L.'s Distributed Systems division will market the Power Series 1000 engineering workstation, which is based on Convergent hardware. Prices for the medium-resolution, bit-mapped display terminal will start at \$5700 in a dual-floppy disk drive version with 256K bytes of RAM and XENIX.

to the company. Customers using the compiler include the National Ocean Systems Center, the Center for Defense Analysis, Clemson University, Wright-Patterson Air Force Base, the University of Tokyo and a West Coast aerospace firm. Western Digital sees defense and space contractors as the largest market for the compiler in the near-term, says Fisher. But the company is eyeing process-control applications as the largest market.

"That's about three years off, though," he says.

The private-sector Ada development efforts are "exciting," comments AJPO's Druffel. Validation testing of compilers from Telesoft, Softech and others is not likely to begin until the second quarter of 1984. "They [Rolm, DG and Western Digital] have lapped the field," says Bob Mathis, AJPO technical director.

Following the test failure of the

Softech compiler, Army program management decided to concentrate development efforts on the Ada tool set and the compiler itself. The two remaining target computers are the VAX-11/780 with the VMS operating system and the Army's custom-designed military computer family with its NEBULA instruction set.

—Stephen J. Shaw

in January in a small office at a condominium project near S.E.L. headquarters in Fort Lauderdale, Fla.

The decision to approach computer-aided engineering is a strategic move that will take S.E.L. out of its real-time minicomputer niche for the first time in the company's 20-year history. It is also intended to bolster the parent corporation's position in the industrial-automation/factory-automation market. Timothy O. Gauhan, vice president of CAD/CAM industry service at Dataquest Inc., a Cupertino, Calif., market research firm, points out, "They [Gould] are eminently well postured to be a major force in the engineering automation market and a force in the engineering in particular. They have virtually all the parts General Electric has." With links to the Gould Modicon factory-automation subsidiary, the De Anza Systems Inc. image-processing subsidiary and the proposed acquisition of CAD/CAM supplier Graphics Technology, Distributed Systems is in a position to link systems for factory and engineering automation markets. Gauhan estimates the engineering workstation market alone will grow from \$21 million in shipments last year to \$448 million



**John Muczko, vice president of Gould S.E.L.'s new Distributed Systems division,** says, "We are literally a new venture. I drew up a business plan and we had to get venture capital from the company to fund our development."

by 1987, with S.E.L. competing against firms such as CAE Systems, Metheus Corp., Mentor Graphics and Daisy Systems.

Gould's entry into the engineering automation market revolves around an OEM agreement with Convergent Technologies that covers both the Convergent MegaFrame multiple-MC68010 supermicrocomputer and a new Convergent workstation based on the Intel 80186 and designated the Power Series 1000. Prices for the Power Series 1000 medium-

resolution, bit-mapped display terminal will start at \$5700 in a dual-floppy disk version with 256K bytes of RAM. The price includes the XENIX operating system. Gould plans to offer office-automation and personal-productivity packages under MS-DOS and CP/M-86 as well.

Gould S.E.L.'s 3000 series products are cluster controllers based on the MegaFrame. List price for an eight-user controller with an MC68010 CPU, an 80186 file processor and an 80186 application processor, 1M byte of main memory, a 50M-byte disk and floppy disk backup will be \$25,000, including UNIX.

Beyond the Convergent hardware, Gould will supply S.E.L. series 5000 processors and "power nodes," both of which will provide facilities for compute-intensive design applications. The 5000 is based on the Advanced Micro Devices 2901 bit-slice processor technology that S.E.L. implemented on the Concept 32/67 this year (MMS, June, p. 259). Unlike the 32/67, however, the 5000 has a dual-processor architecture with what Muczko calls "hints of redundant processing capabilities" and a demand paging scheme that provides 16M bytes of virtual-memory space in the basic 1M-byte version.

The 5000 will be offered in a design station configuration with a 19-in. color graphics CRT, an 80M-byte disk drive, a 1/4-in. streaming-tape drive, a keyboard and a tablet in a \$75,000 package. A similar 2901-based power node for back-end processing has a 2M-byte physical memory and can support Winchester disks with capacities as high as 600M bytes each. The power node will be custom configured, and prices are expected to start at about \$75,000, says a Gould spokesman. Other power nodes based on Gould processors will be available next year.

Muczko stresses that Distributed Systems will develop the CAE market as a separate business. "It appears to be a direct sales market. The products will be available to our existing customers, but not with the traditional OEM discounts," he explains. Gould plans to offer the system with a range of third-party engineering application software, including electrical, electronic and mechanical engineering and architecture packages. Muczko declines to identify which packages will be available when the systems start to be shipped early next year.

Muczko, who moved from his slot as vice president of marketing in February to devote all his energies to the new division, expects Distributed Systems to be a \$100-million business in 1986. He expects the rest of S.E.L. to grow to more than \$500 million in annual sales by 1986 from about \$200 million in 1982.

The division employs about 30 people in its headquarters and its Nashua, N.H., development facility. Muczko expects the staff to reach 50 by year-end, with 20 employees working on development and system integration in Nashua.

—Geoff Lewis

## New graphics advances to emerge at upcoming shows

As forests grow from small trees, trends spring from individual product introductions, and several noteworthy products will sprout at upcoming graphics shows. At the shows, Ramtek Corp., Genisco Computers, Megatek Corp. and Zentec Corp., will introduce new products that promise to offer a glimpse of future graphics trends, such as very fast frame buffers for higher performance.

Ramtek hopes to introduce a color raster display system at the Association of Computing Machinery's SIGGRAPH show July 25-29, to be held in Detroit. "Our main charter on this terminal was to be the fastest frame buffer around," says Ramtek's new products manager Mike Tyler of the display system. Part of that speed is obtained by using 150-nsec. RAM. But write times for the display surpass even memory read times because the raster processor grabs memory words in parallel and shifts them serially with fast, custom logic. The result, claims Tyler, is an average pixel write time of less than 40 nsec., creating a display that's 60 percent faster than the Evans & Sutherland Strokewriter and 35 times faster than Ramtek's previous fastest display, the 9400.

The system is also state of the art in resolution, using some of the first available monitors with 1280 x 1024 resolution at 60 Hz noninterlaced. The system can handle as many as 16 planes of image memory, and Tyler says double buffering for animation is possible in such applications as medical imaging.

Ramtek calls its new color raster display The Time Machine. The system should be easy to customize

because all software for protocols is RAM resident, loaded out of a Sony 3 1/4-in. floppy disk drive. Further, there's room for a number of MC68000-based option boards on the system's VME bus, with an interrupt-driven communications scheme implemented via 64K bytes of memory on each board that is in the address space of all the other processors.

The first option to arrive will be a display list processor, and Ramtek is expected to introduce drawing and graphics/array co-processors in 1984. Thus configured, The Time Machine will handle most of the functions of a solids-modeling display locally, including 3D coordinate transformations with clipping, hidden-line removal and variable light-source shading, in nearly real time. The drawing board option will sell for about \$15,000, and list price for the frame-buffer terminal is \$20,000. Although Ramtek won't reveal the specifications of the solids-modeling version, the company expects it to be fast. "Nobody in the aircraft pilot training market can simulate a day view of a landing in 3D," says Tyler, adding, "we're going to be close."

Another high-end introduction is due from Genisco at the National Computer Graphics Association show, June 26-30, to be held in Chicago. Genisco has solved the mystery surrounding the introduction last year of the 6100, a \$34,000 terminal that emulated a \$15,000 Tektronix system. One clue to the mystery was that the original cost figures for the 6100 were based on components bought in 10-piece quantities instead of in volume, says product marketing manager Dan

Jones. Now that costs have been refigured, the price has fallen to \$21,950. That reduction, coupled with the introduction of Gencor terminal-resident software, which performs most 3D graphics-manipulation functions specified in SIGGRAPH's Core recommendation as well as supporting the GKS standard, make the 6100 more competitive. This year, Genisco is taking the wraps off of the similarly priced 6200 family—two higher performance, rack-mount versions of the 6100 that better serve Genisco's traditional customer base of system integrators, says Jones.

The 6210's resolution is 1392 × 1024, interlaced, while the 6220 offers 768 × 512, noninterlaced. Both include 512K bytes of display-list memory, expandable to 1M byte, a 19-in. monitor, a detachable keyboard with an adjustable-rate joystick, an asynchronous serial host interface, six additional interactive device ports, a full-screen interactive cursor and display of as many as 4096 colors out of a palette of 16 million. DMA interfaces at 3M words per sec. are available for Digital Equipment Corp., Data General Corp., Perkin-Elmer Corp. and Gould S.E.L. terminals. Prices for the 6200 start at \$23,950 in single units.

Megatek had planned to introduce its 1645, a 1280 × 980 resolution, black-and-white version of its 1650 desk-top engineering terminal, at the National Computer Conference. But it may have saved the more significant introduction for one of the two graphics shows. Megatek vice president Hiram French says he expects to take advantage of the recent porting of 3D color software from DEC's VAX to IBM's 4300 series with a 50K-baud interface. French says the interface gives Megatek terminals an edge, since IBM's 3250 terminals and its color raster



**Genisco's new 6210 high-end graphics terminal features 1392 × 1024 interlaced resolution and can display as many as 4096 colors out of a possible 16 million on a 19-in. monitor. Maximum display list memory is 1M byte.**

emulators are limited to 9600 baud. "IBM, with its new pricing on the 4300, seems to be going after the VAX market; which means there's a new, virgin host for 3D color software that will be ported to the 4300s from DEC's VAX," says French.

Meanwhile, in the low-end graphics game, OEM terminal manufacturer Zentec plans to jump in at the NCGA show to challenge the recently introduced 640 × 480 member of Tektronix's Unicorn family, the 4107 (MMS, April, p. 22). Zentec will offer its own less-than-\$7000, 640 × 480 resolution, eight-color raster terminal with independent alphanumeric overlay. The terminal is based on the Intel 8086 and an NEC graphics display controller. Marketing vice president Mason Killibrew says Zentec's orientation toward customizing terminals to OEMs' specifications will be an advantage, given

Tektronix's apparent intention to sell Unicorn terminals only in vanilla versions. He also says that Zentec performs extensive burn-ins at the component, board and system levels. He believes that, because Tektronix has put the burden of component quality assurance on vendors and skips burn-in of assembled terminals, Zentec may be able to compete in price.

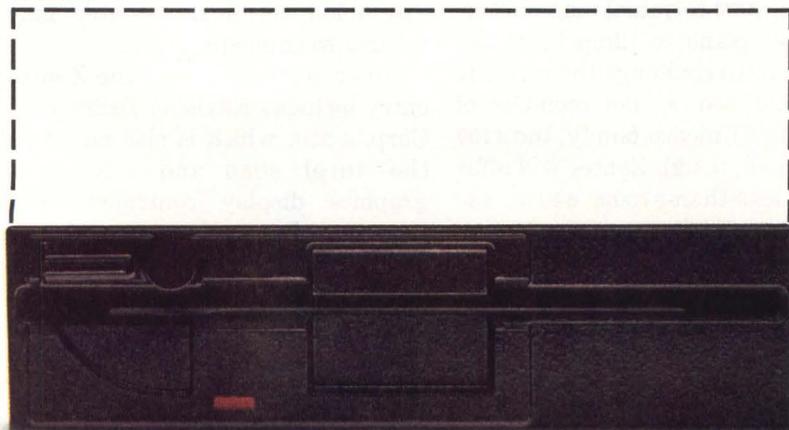
Other competition for the Zentec entry includes Envision Technology Corp.'s 220, which is also based on the Intel 8086 and NEC 7220 graphics display controller. But Zentec project manager Sue Vogtlin claims that write-control logic, which speeds the 7220's performance by allowing the chip to write simultaneously to several planes of memory, and an optional 8087 math co-processor give Zentec an edge.

—Kevin Strehlo

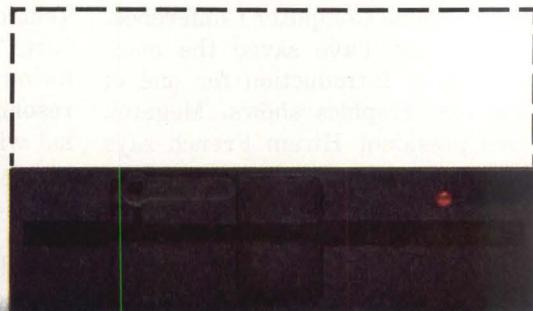
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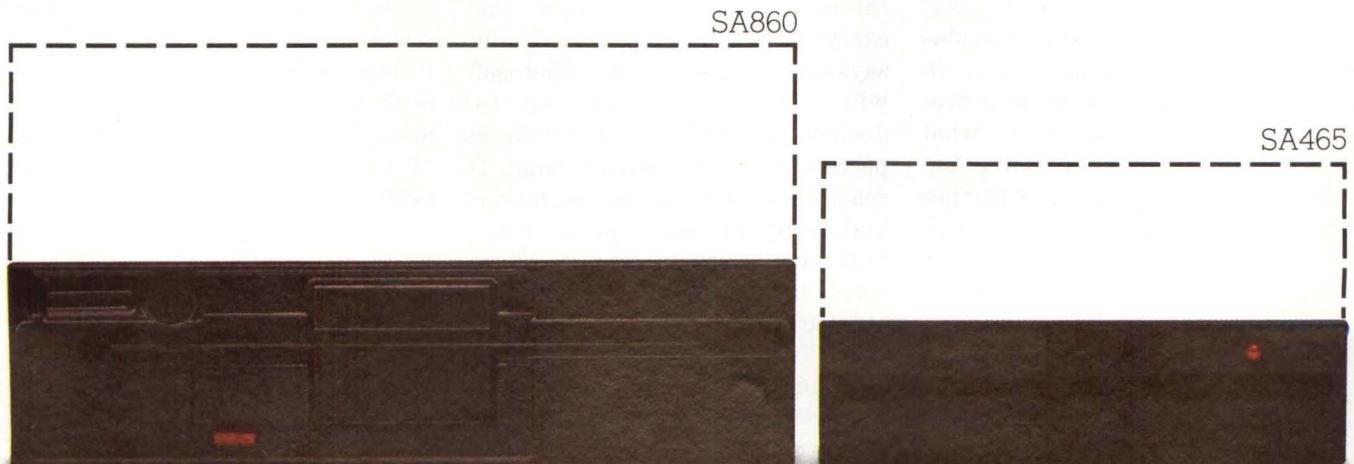
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### Microsoft's retail XENIX will test commercial thirst for UNIX

Microsoft Corp. this month plans to start filling retail store racks with end-user editions of its version of UNIX. The products—XENIX 3.0 for Apple Lisa and IBM PC systems with hard disks—could be a major test of UNIX's viability in the commercial market. The new versions are the result of three years of effort directed at getting XENIX to run on the top-selling microprocessors and a two-year OEM marketing effort.

XENIX product marketing manager Mark Ursino projects "conservative" shipments of around 20,000 units through year-end. He says that number could triple if the end-user XENIX packages take off in the market.

XENIX 3.0 is based on AT&T's UNIX System III and is scheduled for release to end users this month. Both OEM and retail versions have been upgraded with a menu-based command shell shared with the recently updated Microsoft MS/DOS operating system. XENIX 3.0 also supports an improved electronic-mail function using an RS232 interconnection, improved disk-loading routines and record locking, which was added to the previous release about six months ago. In addition to the system improvements, Microsoft has made what Ursino calls "marketability improvements" to propel UNIX further into commercial microsystems environments and to try making XENIX the leading version of UNIX in the microcomputer arena.

To make the system more attractive to microcomputer users and more compact, Microsoft has divided XENIX 3.0 into time-sharing, software-development and text-editing modules so that end

users do not have to purchase the full 8.5M-byte XENIX system. Assuming use of 160K-byte floppies for IBM systems, Ursino says, the time-sharing module would require 10 diskettes for loading onto the hard disk. The retail version will be accompanied by consumer-oriented documentation. Microsoft also plans to distribute various books and manuals for business and end-user programming, Ursino says.

The \$395 text-processing module includes UNIX T-roff and N-roff as well as the Vi visual shell. The software-development module is priced at \$495 and also includes Vi. Single-user versions of XENIX 3.0 for the Apple Lisa and IBM PC are priced at \$395, and multiple-user upgrades are \$695. For the IBM PC, Microsoft provides a plug-in memory-management card with the multi-user upgrade. Users must purchase third-party communications cards to get the ports to support three additional users.

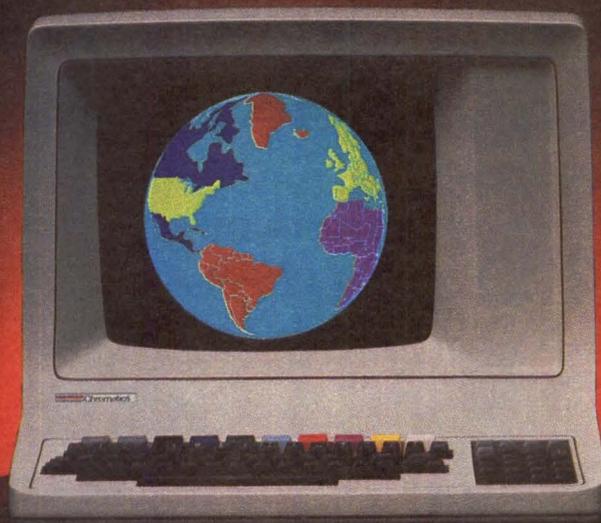
The end-user XENIX 3.0 package for Apple will be sold directly through Apple Computer Inc. major account sales representatives and through authorized dealers that carry Lisa this summer, Ursino says. In the IBM market, Microsoft will concentrate on the top 100 dealers that Ursino says handle 80 percent of the PC's sales volume. To reach them and dealers who market and support subsequent retail implementations of XENIX, Microsoft is negotiating a contract with a software-distribution start-up that specializes in UNIX products. Ursino declines to identify the new distributor, pending a public announcement by the principals, who are still employed at other companies.

With the retailing of XENIX and the addition of a common shell for it and the single-user MS/DOS operating system, Ursino sees Microsoft positioning itself as the leading purveyor of UNIX in the microcomputer market. Unisoft Corp. has implemented its UniPlus on a larger roster of 40 to 50 Motorola MC68000-based systems, including a version of the Lisa. But Ursino claims Microsoft has greater market penetration in terms of installations. The XENIX system, for example, was installed on approximately 5000 Tandy model 16 computers shipped in the first two months that XENIX was available on the MC68000, Tandy Corp. computer division vice president Jon Shirley says. The XENIX package reportedly is also being shipped on an estimated total of 500 Altos systems per month.

The IBM PC represents an even larger opportunity, Ursino points out. Unisoft president Jeff Schriebman concedes that the IBM PC and PC-compatible market may have more potential, but says Unisoft will maintain its lead in the MC68000-based systems market in which customers such as NCR Corp., Corvus Systems Inc., Callan Data Systems and Wicat Systems Inc. are expected to ship large numbers of multi-user systems. Schriebman declines to provide numbers, but asserts, "We are clearly the world leader in MC68000 ports." Unisoft also has a retail version of its UNIX package, which is marketed to Apple dealers through Unipress, East Hanover, N.J., a distributor specializing in UNIX products.

—Geoff Lewis

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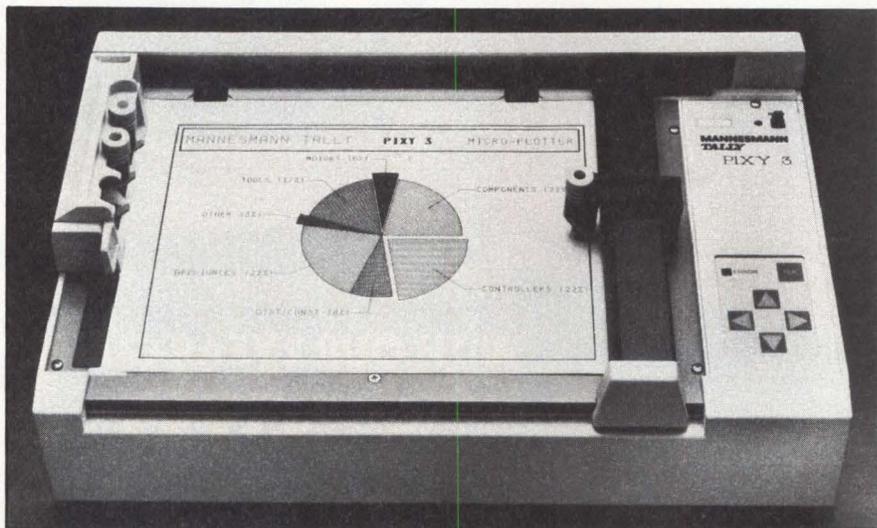
# Mini-Micro World

NEWS

## CalComp, Mannesmann Tally enter low-end plotter market

The growing demand for color business graphics hard copy continues to draw new players into the low-end pen plotter competition. California Computer Products Inc. (CalComp) and Mannesmann Tally Corp. have both recently entered the market with their first plotters targeted at personal computer users. Some observers expect the U.S. segment of that market to be worth as much as \$240 million in 1986.

The companies' introductions have little in common. CalComp, long a leading supplier of pen plotters for scientific and engineering applications, has chosen to make its first low-end introduction an eight-pen machine list priced at less than \$2000. Mannesmann Tally's product, the first plotter the printer manufacturer has produced, is a three-pen unit with a list price of



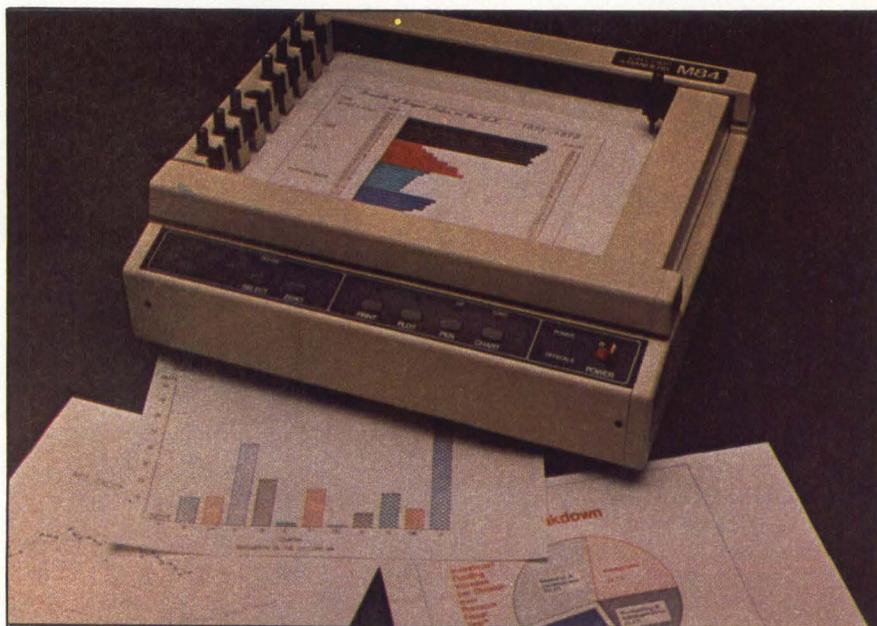
Mannesmann Tally Corp. officials believe their 3-pen Pixy plotter, priced at \$795, will be sufficient for most business graphics applications. The plotter, Mannesmann Tally's first, is manufactured by Watanabe.

\$795.

Ralph Kosoff, product sales manager at CalComp's Anaheim,

Calif., headquarters, says that the company's Model-84 is not targeted to compete with the lowest priced units, but instead to meet a need for high-quality graphics output at a price affordable to typical micro-computer systems users. "In a way, it's not much different from our approach to the CAD/CAM market," says Kosoff. "There too, you have vendors with less expensive product with which you give up a certain amount of quality, reliability and support. That is not the market we're looking at."

CalComp officials believe that the Model-84's eight pens will attract business graphics users. Company studies indicate that a typical chart or graph averages five colors. Kosoff says that one advantage CalComp expects in the crowded business graphics market will be established links to major software vendors. The Model-84 is supported by a number of software graphics



CalComp is entering the low-end pen-plotter market with the Model-84, an eight-pen unit with an end-user price of less than \$2000.

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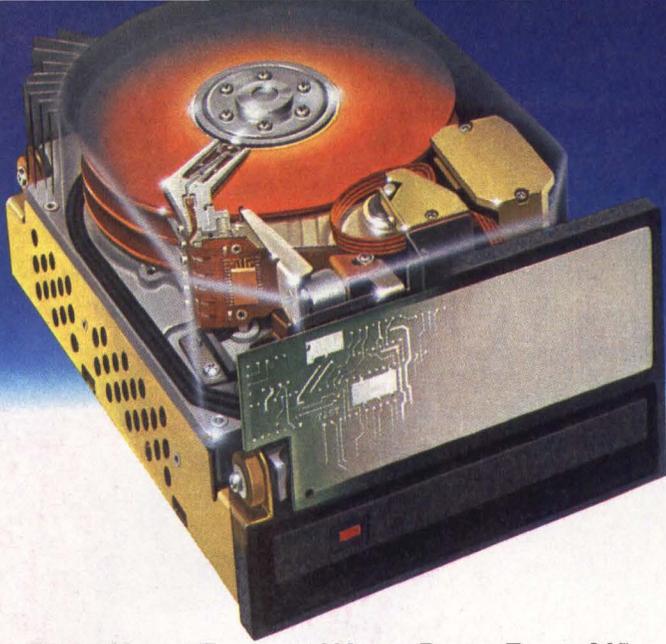
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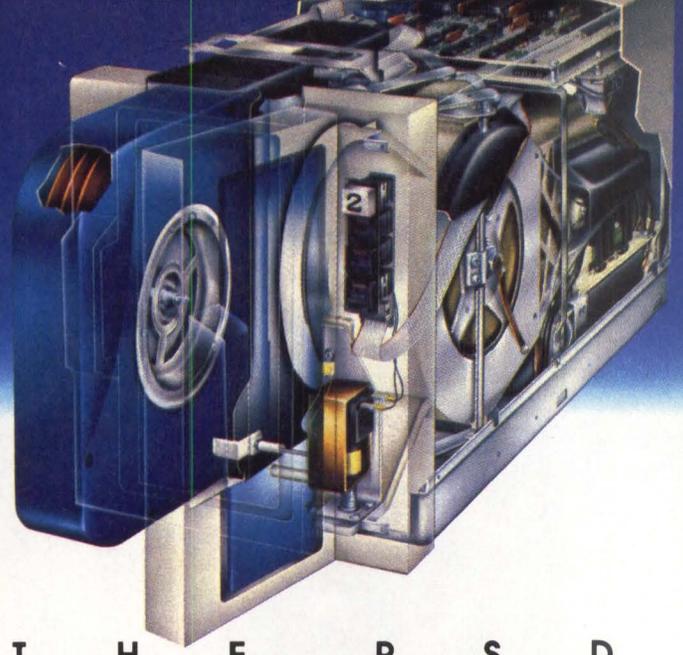
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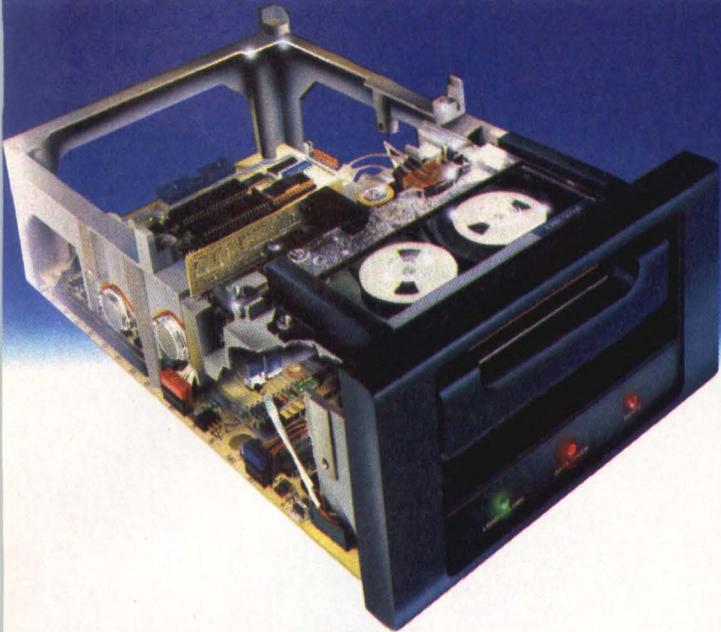
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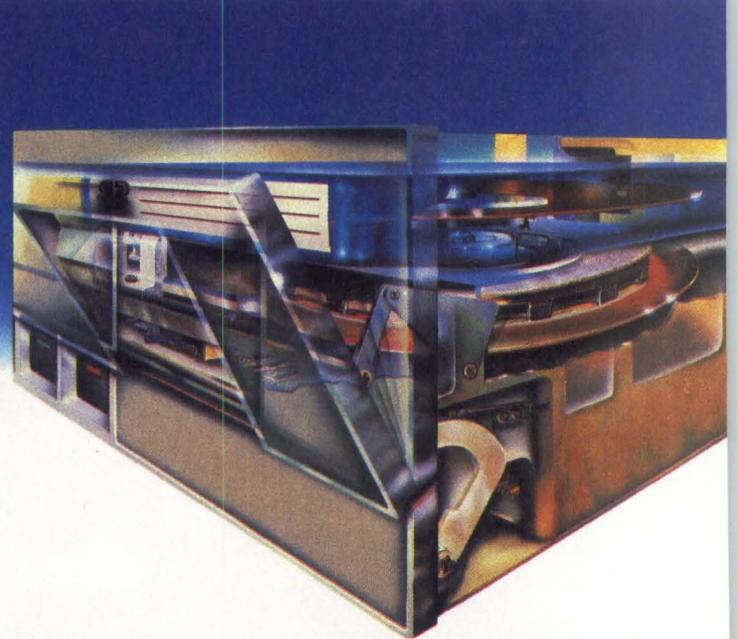
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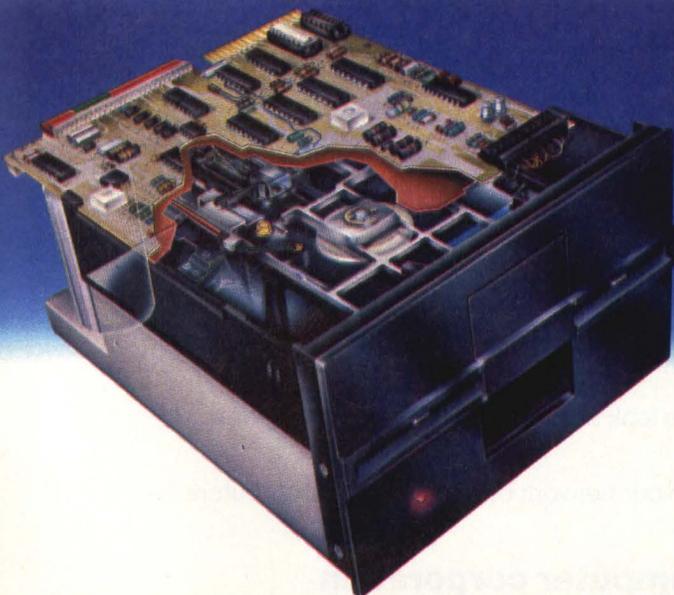
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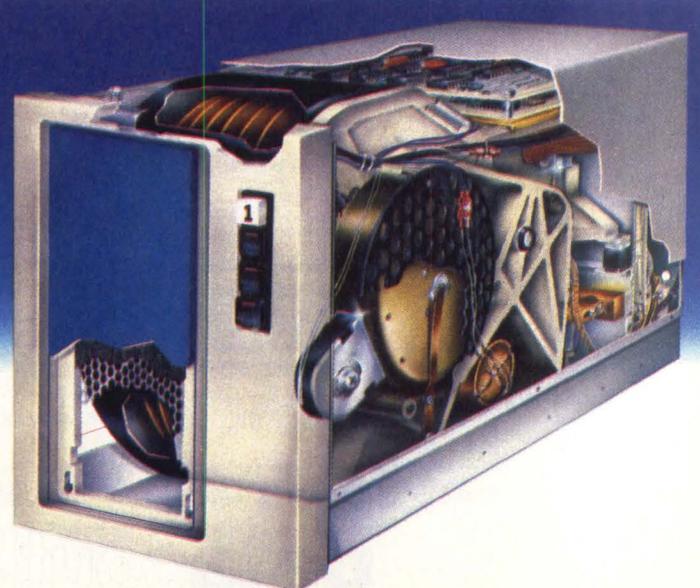
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MINI-MICRO SYSTEMS/July 1983



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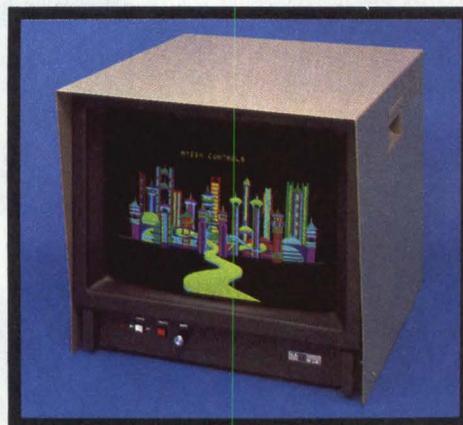
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## NEWS

packages such as Integrated Software Systems Corp.'s DISSPLA and TELL-A-GRAF, SAS/GRAPH and Digital Research's Graphics System Extension.

John Roberts, Mannesmann Tally's product manager for its new plotter, the Pixy, believes his company has made a significant price breakthrough in the low-end market. "To my knowledge, there is no other plotter on the market with three or more pens for under \$1000," he says. Mannesmann Tally's product designers settled on three pens, Roberts says, because their studies, unlike CalComp's, indicate that additional colors are not needed for most business graphics applications. "More than three colors tends to make a graph too complex, and the whole idea of graphics is to present information in such a way that it is simpler to digest," says Roberts. "Crosshatching and other patterns can be used when you have more than three variables. Our studies indicate such charts will be more aesthetic and effective than additional solid blocks of color."

Roberts realizes that many observers will wonder whether a printer company can produce a reliable plotter for such a low price. "Obviously we got some help," he says. "After we settled on our product specifications, we spent a great deal of time searching out the manufacturing expertise we needed in Japan." Roberts says plotter manufacturer Watanabe, which holds a dominant share of the Japanese market, proposed a design adapted from one of its x-y recorders. Mannesmann Tally has a worldwide exclusive on the Watanabe plotter, he says. The Pixy runs on graphics software packages including BPS Business Graphics, GraphTalk, Curve II and Transparent Data Systems.

While the marketing strategies of

### MEASURING THE PLOTTERS

	Mannesmann Tally Pixy	CalComp Model-84
Pen positions	3	8
Resolution	0.004 in.	0.004 in.
Plot speed	200 mm. per sec.	420 mm. per sec.
Plotting area	7 x 9.7 in.	8 x 11.3 in.
Media size	A, A4	A, A4
Media	Paper, film	Paper, film
Interface	8-bit parallel, RS232 (\$85 extra)	8-bit parallel, RS232, IEEE - 488

CalComp and Mannesmann Tally differ, market projections indicate there may be room for many approaches. Deanne Iwanaga, CalComp's manager of market analysis, believes that the annual growth rate for tabletop plotters will be 11.1 percent, peaking in 1987 at \$250 million in worldwide sales. In comparison, Iwanaga projects the growth of large flatbed plotters during the same period to be -5 percent.

CalComp's projections of the total market for tabletop plotters is rather pessimistic compared to those of many industry observers. Neil Kleinman of the Pacific Technology Center of research firm International Data Corp., believes the U.S. market for tabletop plotters will total at least \$240 million by 1986. "That is a conservative estimate," Kleinman adds. "In terms of units, we expect almost tenfold growth by 1986 from the estimated 28,850 U.S. shipments in 1982."

Kleinman believes that the tabletop units introduced in the last year can take advantage of the business graphics market. "We suddenly have a graphic hard copy device priced reasonably in respect to the total workstation," he says. "With a

personal computer or desk-top system, it now makes sense for users to have a plotter. At the same time, we're seeing software developments that are making the graphics relatively easy for such users. That's why we are pretty bullish on the market."

Kleinman believes the real pioneer in the market is Hewlett-Packard Co.'s 7470. "It showed desk-top computer system users they could get quality plotting, two pens and color," he says. With that introduction the market has opened, with suppliers offering multi-pen units, A- or B-sized drawings and other features for less than \$2000, Kleinman says. He sees the plotter market opening new distribution channels to U.S. manufacturers.

Kosoff expects CalComp to make 60 to 70 percent of the Model-84's sales to OEMs and the rest to end users. He acknowledges that many OEM customers for the low-cost plotter are a new market for CalComp. "They are putting together business graphics systems, whereas our marketplace has been primarily in the scientific, CAD/CAM and engineering areas," he says.

Mannesmann Tally will market the Pixy through OEM and distributor channels. —Edward S. Foster

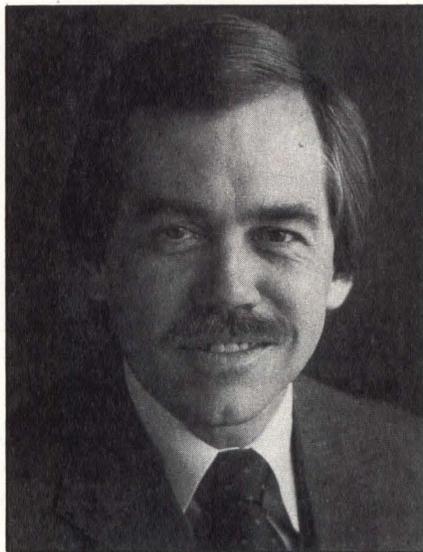
### Maxtor ST-506 enhancement may force 'interface-off' in high-capacity, 5¼-in. drives

In contrast to the bloody battle to achieve an 8-in. Winchester disk drive interface standard, the ST-506 interface for 5¼-in. rigid drives has been about as controversial as a congressional resolution endorsing Mother's Day. However, a new generation of 5¼-in. Winchester drives, which break through restricted capacity and other limitations of the ST-506 interface, threaten to open a new controversy. The controversy may also signal the end of the need for separate controller boards and drive interfaces.

Maxtor Corp., a year-old start-up in Santa Clara, Calif., has taken the lead in organizing an industry-wide effort—with the added muscle of mighty Control Data Corp.—to establish a standard for high-performance drives. At last year's fall Comdex, Maxtor announced a 5¼-in. drive with a precedent-setting 140M-byte capacity, which strains the limitations of the ST-506 interface. A new standard is essential to the company's latest plans to market a family of products with capacities as high as 380M bytes. The new drives incorporate an enhanced version of the ST-506 that doubles the data-transfer rate of the ST-506 to 10M bits per sec. and switches to 2/7 run-length-limited recording codes.

Seagate Technology, which pioneered the 5¼-in. Winchester drive in 1980, had the foresight to distribute the ST-506 widely to other disk drive and controller manufacturers, preempting any other interface from emerging until now. More than 200,000 drives have been manufactured in the past three years with an ST-506 interface.

Most manufacturers agree that



*"If the ANSI standard were that good, it would have been more widely accepted," says Maxtor's Skip Kilsdonk.*

the ST-506 data-transfer rate of 5M bps is too low for drives that store more than 30M bytes. Most agree that for the best performance and cost efficiency, data separators—now built into controllers—must reside on the drive.

From there, the controversy ensues as manufacturers differ on which approach will best achieve the desired result. Although the Enhanced Small Disk Interface proposed by Maxtor has been endorsed by 25 additional companies, the support is unified.

The Small Disk Interface committee held four meetings beginning immediately after last fall's Comdex. Attendance dropped slightly after each meeting as some participants disagreed with the interface specifications, expressed doubts about giving Maxtor a public boost by supporting the interface or simply lost interest. "There are definite problems in getting any group of diverse individuals to

agree on something," one committee member says. "Remember that a camel is a horse designed by a committee."

Many significant market forces, including Tandon Corp., a major supplier of low-end 5¼-in. Winchesters, Xebec Systems, the largest supplier of controllers for 5¼-in. drives, and Seagate, are conspicuously absent from the list of 26 companies supporting the interface.

Xebec president Jim Torreson, the most vocal opponent of the ESDI, says because of the inherent performance limitations of the ST-506, there is little to be gained by simply enhancing the interface. He claims that when Seagate developed the ST-506, it wasn't interested in high performance, but instead in high volume and low cost. "They said, 'To hell with performance; give us low cost,'" he notes. "That's not anything against Seagate; they proved they could do really well with the ST-506 for their 5M- and 10M-byte drives."

Seagate admits to shortcomings in the ST-506 interface when used on high-performance drives. However, the company is not prepared to jump on the ESDI bandwagon. Instead, Seagate is reserving the right to update the ST-506 itself, join Torreson's opposition group or eventually endorse ESDI. "We are working with our on-board customers to establish what interface they want," says Seagate vice president of marketing Scott Holt. "We're not ruling anything out."

Despite the controversy, there is little argument that a new interface is needed. Even controller manufacturers admit that the data separator—not part of the controller—should be housed on the drive. However,

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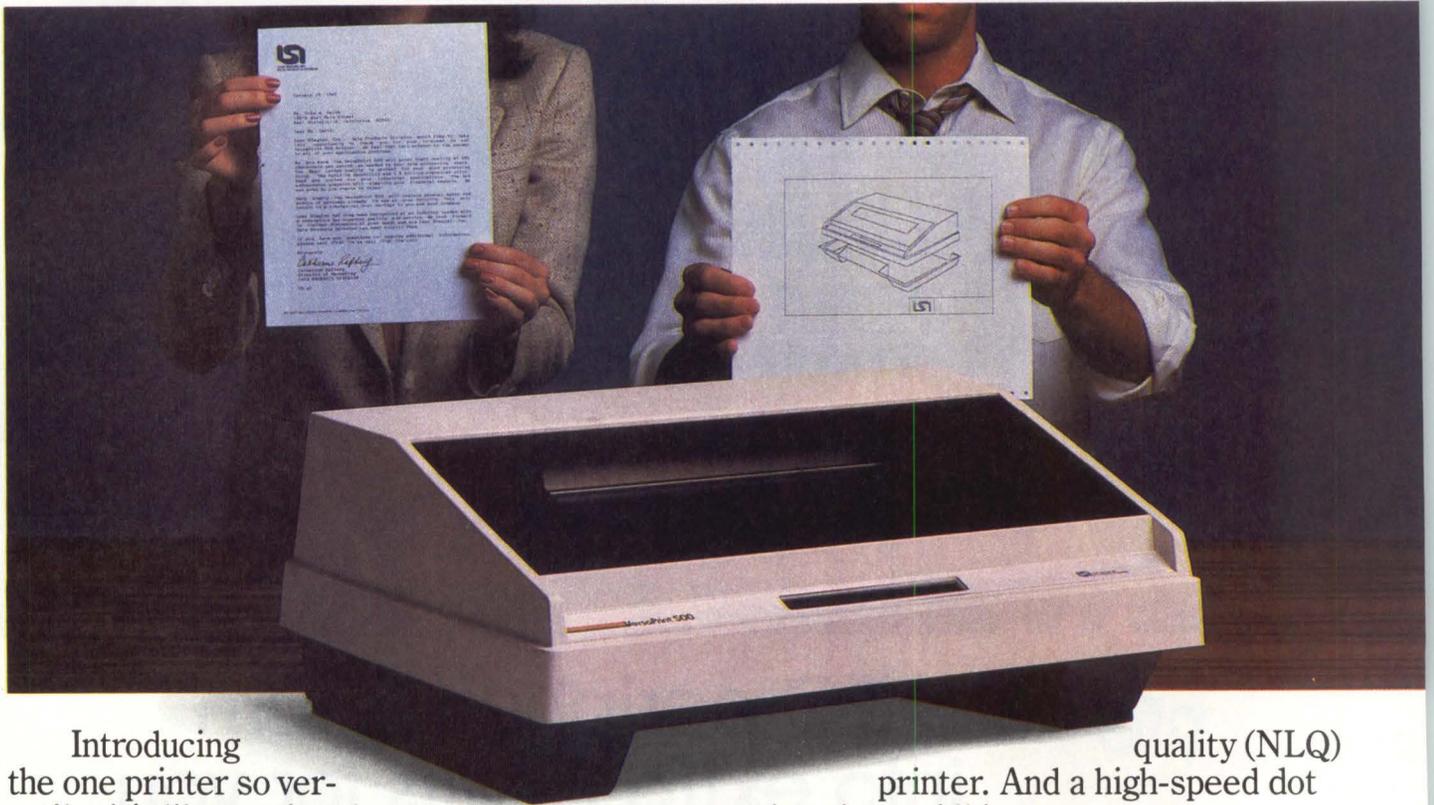
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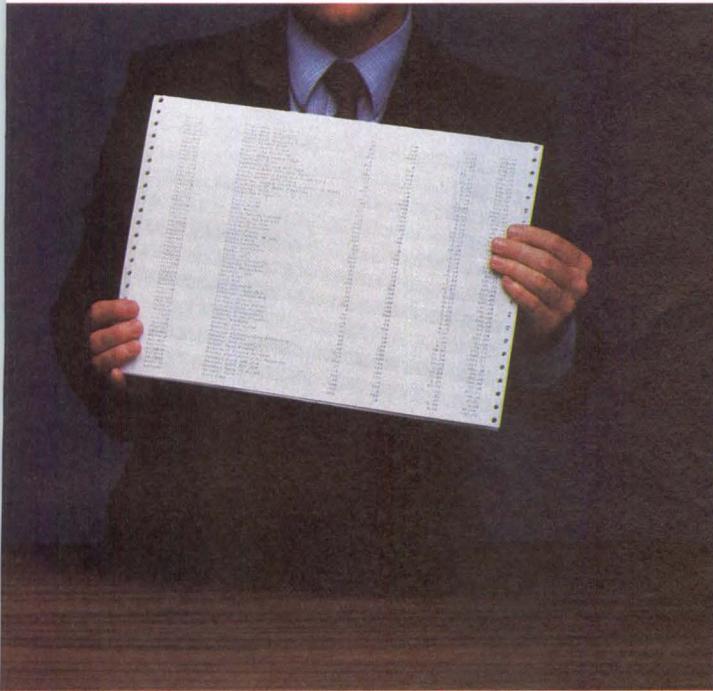
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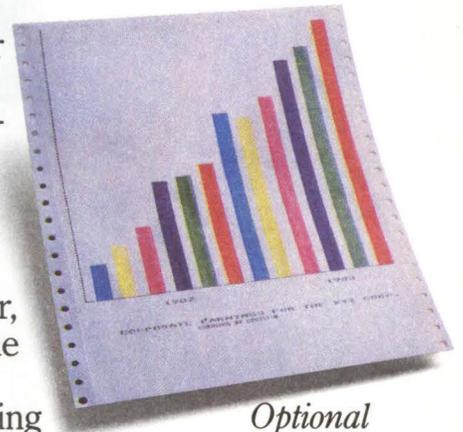
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# Mini-Micro World

## NEWS

putting the separator on the drive would force manufacturers to recruit more highly skilled talent that was previously limited to controller houses. It would also cause controller manufacturers to suffer price erosion. But that is the least of the worries for controller manufacturers.

Evotek Corp., Fremont, Calif., a two-year-old manufacturer of high-performance Winchester drives, gave lukewarm endorsement to ESDI. The company plans to announce a drive at this year's fall Comdex with the entire drive controller on the drive, eliminating the need for both a controller board and a drive interface. "Those controller companies who recognize trends will begin to think about becoming chip makers rather than board companies," says Jose Ramos, director of marketing at Evotek. "Those who don't will find a rapidly declining market for their products."

However, Data Technology Corp. marketing vice president Mike Kirby points out that separate controller boards will still have a role, especially in applications in which a user needs various backup devices. In addition, the drive interface is less costly than the host interface to the CPU, which will still be required.

Seagate vice president of engineering Doug Mahon notes that drive manufacturers may have a difficult time finding the available real estate in a tight 5¼-in. form factor to house the four chips for the on-board controller. As a solution, Xebec's Torreson suggests reengineering the 8-in. ANSI interface for high-performance 5¼-in. drives. He has offered to redesign the ANSI 8-in. interface to fit the Maxtor drive and other high-performance drives. Such a redesign could be easily implemented "in a matter of

months," Torreson says, at a very low cost. "We have already paid our dues on the ANSI interface; it's just sitting there ready for us to use. For about \$5 in parts, we can adapt it to 5¼-in. drives," he says.

Torreson says Maxtor's ST-506 enhancement would strain future controllers and drives built to the interface. He says the ST-506 is working overtime to achieve a 5M-bit-per-sec. data-transfer rate, and pushing it to 10M bps as Maxtor proposes would prove disastrous. "As you start going up to 10M bps, you roll off a drastic increase in the bit error rate," he says.

Maxtor's marketing director, Skip Kilsdonk, disagrees. He says the ESDI has taken enough strain from the interface to allow it to accept the full 10M-bps transfer rate. He doesn't believe the ANSI interface is the answer either. "If the ANSI standard were that good, it would have been more widely accepted," he says. "I don't see that many ANSI interfaces around, even in the 8-in. market."

Torreson, however, believes he is on the right track and plans to organize a separate group of

companies—including some notable exclusions from the ESDI, such as IBM Corp., Digital Equipment Corp. and Hewlett-Packard Co. Torreson has suffered some defections from his ranks, however. Two companies believed to be in his camp—Priam Corp. and Micropolis Corp.—appeared on the list of 26 supporters of ESDI.

Priam's about-face resulted from its plans to reintroduce a high-performance 5¼-in. Winchester first announced at the 1982 National Computer Conference and later withdrawn. The redesigned drive is expected to have an increased capacity of more than 50M bytes and thus will require a high-performance interface. The ESDI is the only one available.

Micropolis, meanwhile, has also endorsed the ESDI as a "step in the right direction," says Bob Mortensen, application engineering manager at Micropolis. However, he adds, the company has no plans for a product made to the interface specification "unless there is an unexpected demand from our customers."

—Robert A. Sehr

## Naked Mini 186-based micro follows shifting market

The introduction at the National Computer Conference by the Naked Mini Division of Computer Automation Inc. of the Intel 80186-based OMNIX 186 multi-user system emphasizes that the Irvine, Calif., division was named in a bygone era. The new product is neither "naked" nor "mini," yet it is to be the big gun in a campaign to gain and retain customers committed to CA's proprietary software. It will simultaneously make a play for the system house business going to companies

such as Altos Computer Systems that emphasize industry-standard operating systems.

The 80186-based CPU board at the heart of the OMNIX 186 is also expected to boost Naked Mini's more traditional board-level business when it is unbundled this year.

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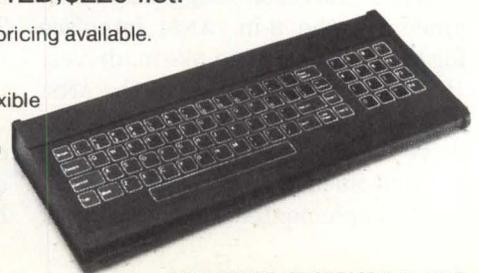
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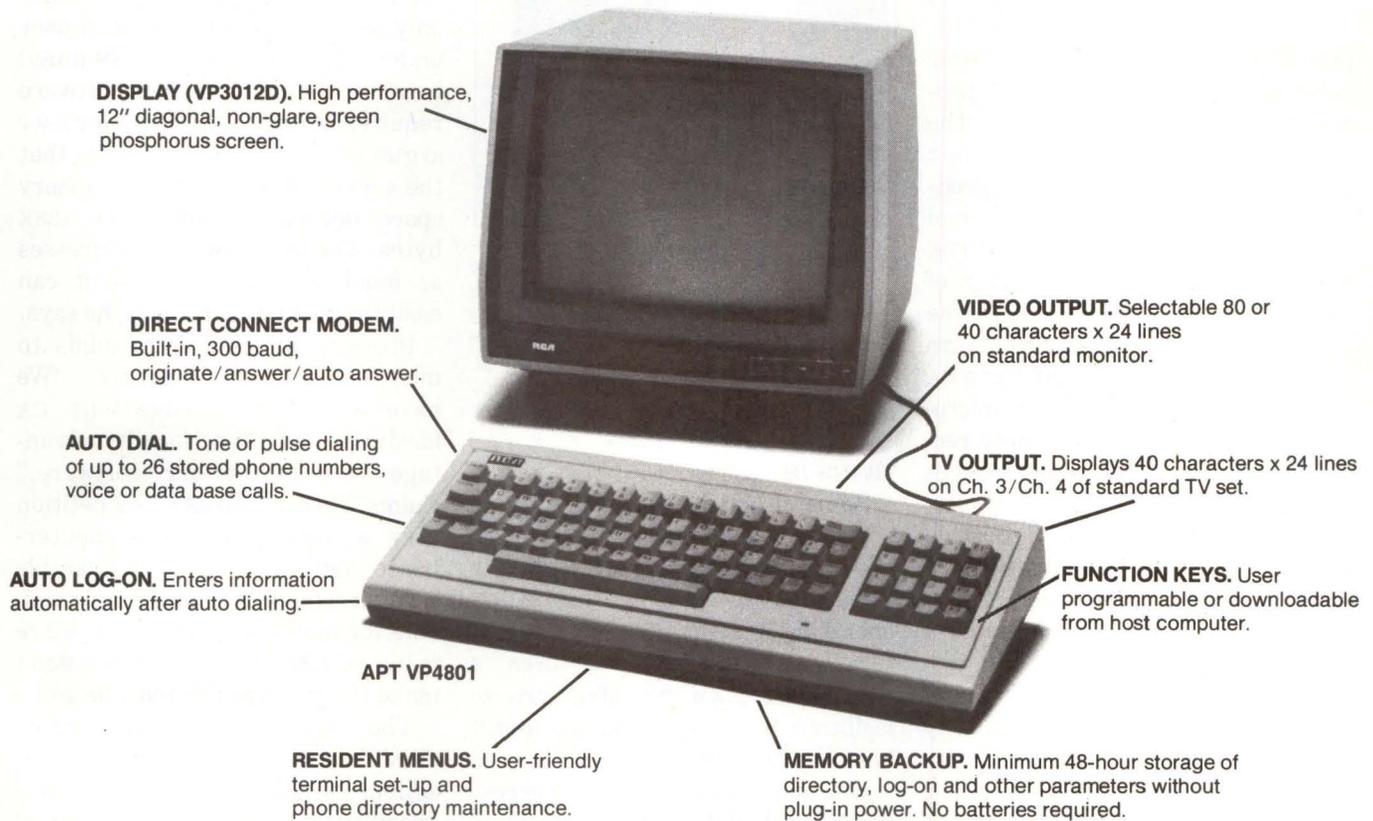
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# Mini-Micro World

## NEWS

processors by the major semiconductor houses has swept microcomputers past low-end minis. The Intel 186, which CA rates as a 0.7-million-instruction-per-sec. processor, outperforms the lower two-thirds of CA's mini-based processors, for example. And the "naked" in the division's name is a problem because board-level products, which held a minority share of the minicomputer business in 1979, now claim just a small sliver of the pie, says Skip Bushee, vice president of market research firm InfoCorp, Cupertino, Calif. "The CA announcement of a complete micro-processor-based system simply recognizes the reality of the market today," says Bushee.

A basic OMNIX 186 configuration includes 384K bytes of RAM, four serial ports, a 5M-byte, 5¼-in. Winchester disk drive and a 1M-byte floppy drive for a suggested single-unit list price of \$8990. The OMNIX 186 retains compatibility with the OMNIX workstation introduced last year as well as with the rest of Naked Mini's line of single-board computers. It runs CA's TRANS-BASIC language under the proprietary OPUS-1 operating system.

But Brian Middleditch, Naked Mini's manager of marketing for business systems, stresses the importance of the new system's ability to run CP/M-86, Concurrent CP/M-86 and MP/M-86 as well as MS/DOS (as a task under OPUS-1), giving CA its first product for OEM system packagers committed to industry-standard software. "We have a general business package running under OPUS-1," says Middleditch. "But the attraction of the 186 is that we can augment the application base so much faster by going with third-party MP/M programs than we can by developing applications ourselves using



**Computer Automation's Naked Mini division** is addressing the shifting computational performance range with a 186-based system multi-user system called OMNIX 186. The basic configuration includes 384K bytes of RAM, four serial ports, a 5M-byte, 5¼-in. Winchester disk drive and a 1M-byte floppy drive for a single-unit list price of \$8990.

TRANS-BASIC."

Some of Naked Mini's customers, however, are more interested in the less expensive horsepower suddenly available to run CA's OPUS-1 operating system. OPUS-1, like the Pick operating system, uses a multikeyed ISAM file structure to facilitate and speed writing compact business applications.

One such customer, Dave Ferren, vice president of software development for Distributor's Data Management Systems, Addison, Texas, thinks the OMNIX 186 will boost sales of a turnkey package he designed for wholesale office-supplies distributors. "CP/M offers no real advantage to us," Ferren says, explaining that the transportability of DDMS's software unchanged to the OMNIX 186 is the real attraction. "We figure our software will run about five times faster under the 186 than under the two Naked Mini 4/30 processors we use for our 20-terminal, five-printer system," he says.

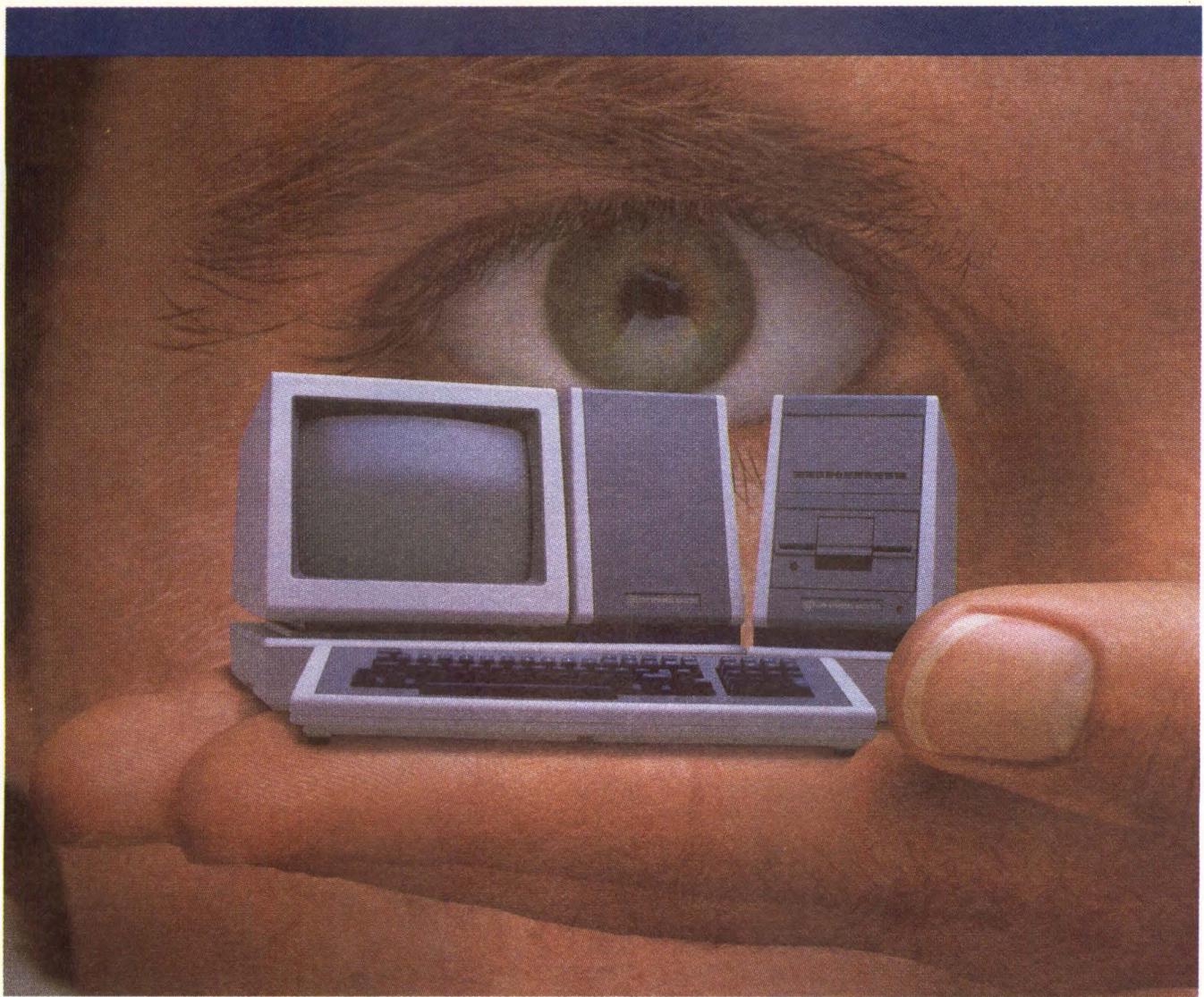
Ferren says most of the speed increase is the result of the Naked Mini architecture's use of only two registers for byte comparisons, compared to the 186's 10. "But the thing I like about the 186 more than

the speed is its memory capability," he says. Ferren is pleased with his current CA minicomputer-based system. He emphasizes that it takes only 8K bytes to support each user under OPUS-1 and TRANS-BASIC because the table-driven software requires storage space only for user argument strings. But he notes that the 4/30 quickly uses up its memory space because it addresses 128K bytes. The 186, however, addresses as much as 16M bytes, so it can easily support 40 terminals, he says.

DDMS is jumping from minis to micros to remain competitive. "We have a real price edge with CA hardware and a functionality advantage because of our software," claims Ferren. DDMS's competition uses a variety of minicomputer-based hardware. "But comparable software tools are becoming available for microcomputers, and we're going to lose that edge if we don't make the jump to the 186," he adds.

The OPUS-1 operating system allows a second CPU board to be added. CA has also included a board based on its proprietary 0.17-MIPS 4/04 microprocessor to handle I/O for as many as 16 terminals and printers. The Intel 8087 floating-point co-processor is optional. Although usually added to systems aimed at scientific applications, the 8087 also significantly speeds some TRANS-BASIC applications.

The 8-MHZ version of the 8087 to work with the 8-MHZ 186 part is not due in quantity from Intel Corp. until the year-end, however. That means a 186-based board-level product will probably wait in the wings until then because of the importance of the 8-MHZ version's extra number-crunching power to Naked Mini's engineering customers. Also probable by year-end, says Middleditch, is a version of the OMNIX 186 that OEMs can unbundle down to the chassis. —Kevin Strehlo



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### Precision Visuals' mainframe graphics software migrates to MC68000-based micro

A mainframe software package from Precision Visuals Inc. is being made available on an MC68000-based, Multibus microcomputer running UNIX. The DI-3000 package is a library of 160 FORTRAN subroutines that implement the Siggraph Core recommendation for device-independent graphics; it also is a tool box for graphics-application development that supports 3D transformations, interactive selection of color and such CAD/CAM essentials as a pick function and segment support. The porting of the package to an MC68000-based computer indicates that such a machine has the computing power and, more significantly, the software tools, to make large-scale sophisticated microcomputer applications feasible.

Precision Visuals chose to implement the package on a microcomputer then in prototype form to test its software. The microcomputer chosen is Cosmos Computer Inc.'s Lyra, which, in a minimum configuration includes a 20M-byte Winchester drive, 0.5M bytes of main memory, an 8-in. floppy disk drive

for backup and a full UNIX operating system including the Berkeley enhancements. That configuration sells for \$16,500. A monitor is not included in the price. To run the system, a user must purchase Silicon Valley Software's FORTRAN 77 compiler for \$600. The DI-3000 is priced at \$2275, including two days of training at Precision Visuals in Boulder, Colo.

Microcomputer access to mainframe-quality graphics is already available through Integrated Software Systems Corp. (ISSCO) and Graphics Software Systems software that allows microcomputers with an integrated display, such as IBM Corp.'s Personal Computer, to emulate a low-resolution graphics terminal. ISSCO has also ported its device-independent Disspla and Tel-A-Graf presentation-graphics software to run stand alone on the MC68000-based Apollo Domain. Apollo itself markets and supports a FORTRAN subroutine library based on George Washington University's public domain Core graphics package that runs under Apollo's

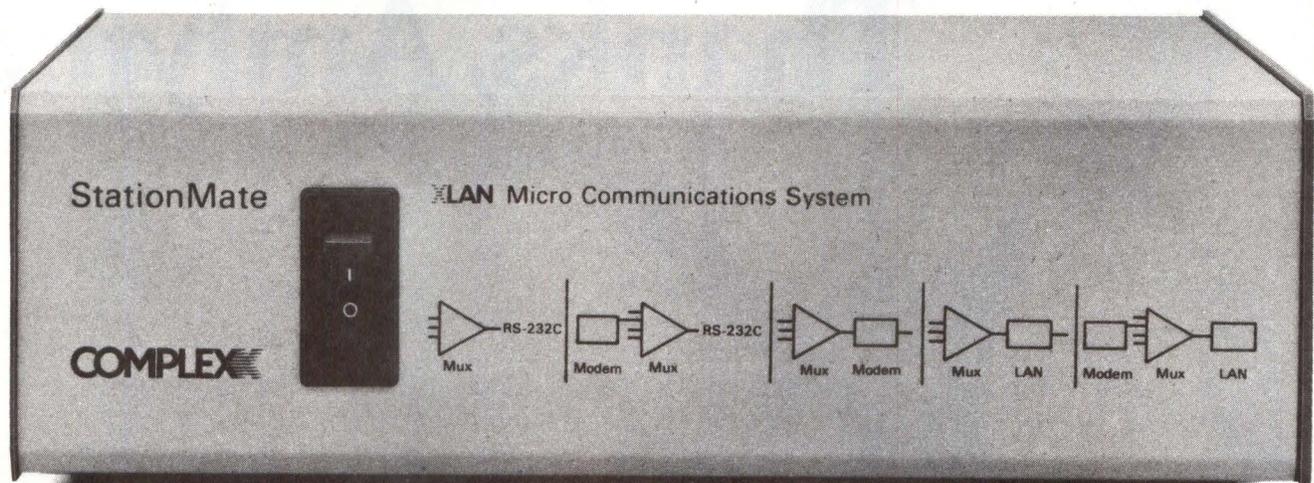
proprietary Aegis operating system. "The key for us," says Precision Visuals' president, Jim Warner, "was a robust, FORTRAN 77 compiler that really worked, a linking loader that could handle enough subroutines and strong development utilities, such as a symbolic debugger." Silicon Valley Software's FORTRAN fit the ANSI-77 bill, while Unisoft's Uniplus+ operating system, a subset of UNIX System III, provided an adequate linking loader and solid utilities.

Paul Inman, Precision Visuals' software engineer who transported the package to an early Cosmos prototype, says the choice of Beta-site hardware and software conditions for the initial move to micros was intentional, a study in worst-case feasibility. "Ports to mature MC68000-based machines with decent FORTRAN compilers should be a cinch," he says. The several machine-dependent routine in DI-3000 have been rewritten in C, and Inman says they will require only fine tuning to run on the 68000-based UNIX machines Precision Visuals is considering. Precision Visuals' OEM agreement with Cosmos involved an up-front licensing fee and royalties in the three figures per CPU instead of the five figures Precision charges for the software on a mainframe. But the agreement leverages the firm's sales and support through Cosmos. There will be no direct contact between Precision Visuals' and Cosmos's customers. "We've always prided ourselves on end-user support," says Warner, "but we have to adjust to this new market. By 1985, we expect 20 percent of our revenues will come from microcomputer annuities."



Precision Visuals Inc.'s graphics package for MC68000-based microcomputers is compatible with more than 40 output devices. The library of 160 FORTRAN routines allows such functions as 3D transformations, interactive selection of color, a pick function and segments support to be performed.

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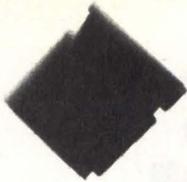
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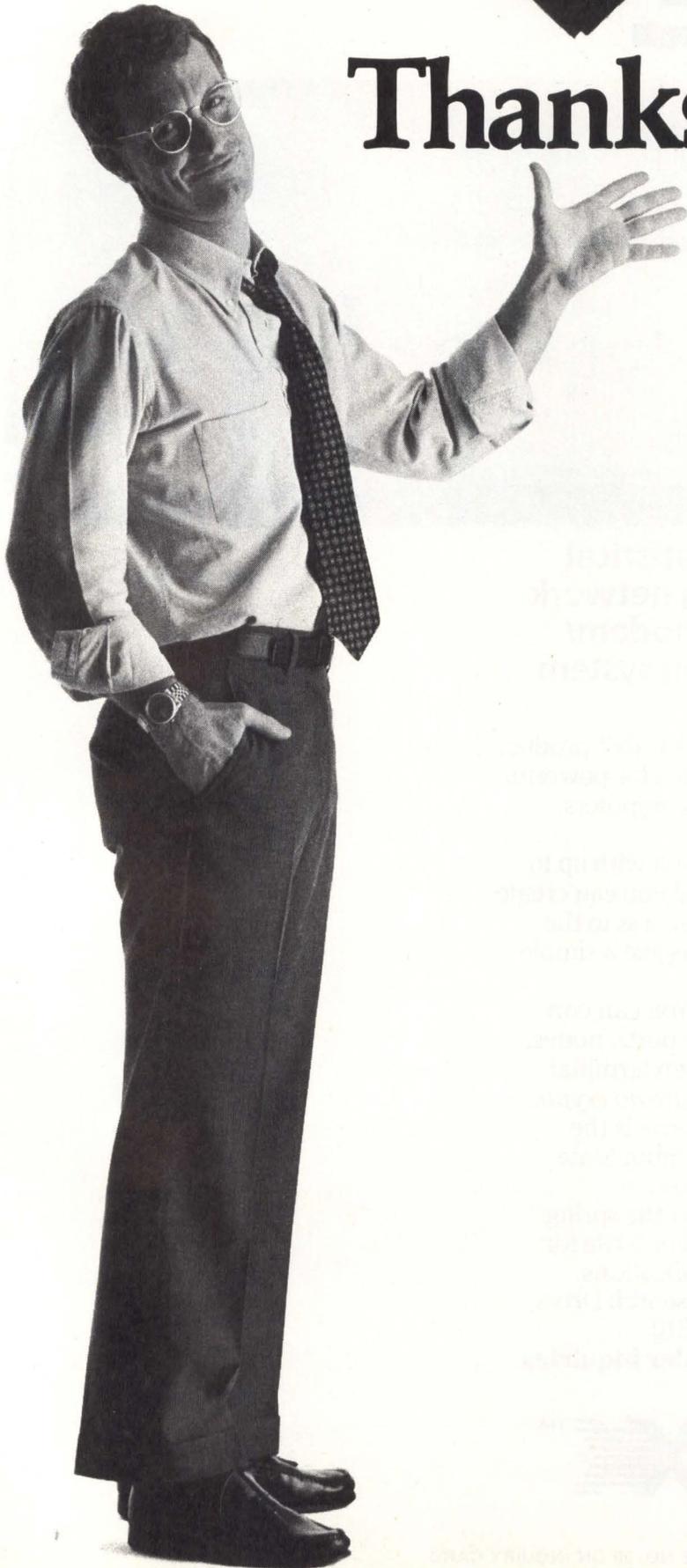
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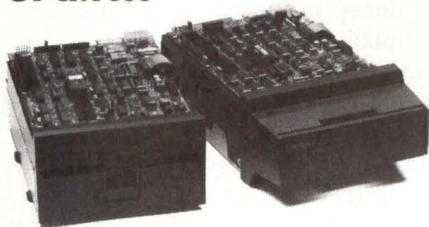
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## NEWS

Most of the company's \$8 million in annual revenues now comes from large companies. Bell Laboratories uses DI-3000 in all its computing centers, for example, and all of AT&T's documentation is produced on a film recorder output device using DI-3000 as the software base. Warner thinks the new portability of DI-3000 application source code

from mainframes to microcomputers is an edge for both Precision Visuals and microcomputers that run DI-3000. He says MIS managers in large organizations appreciate the fact that mainframe graphics applications can run on the workstations that are creeping into the department level.

Precision Visuals marketing vice

president Don Van Dyken believes the company's Core graphics will be a strong marketing tool for vendors of MC68000-based microcomputers. "It's tough to tell all those look-alike boxes apart," he says. "Manufacturers that incorporate powerful graphics will have a marketing edge."

—Kevin Strehlo

## NEC broadens printer line with dot-matrix models for OEMs

NEC Information Systems Inc., a major competitor in the fully formed character printer arena, has entered the U.S. OEM market with a series of 18-pin dot-matrix machines priced to compete with nine-pin printers.

NEC's Pinwriter dot-matrix printer family was launched with the announcement of the P1 model. Scheduled for production deliveries in June, the P1 offers 180-cps printing in draft mode, 90-cps in high-density mode, 80 print columns and a Centronics-type interface.

Evaluation units of two additional models, the P2 and P3, were to be available in June, with full production quantities expected by the fourth quarter of this year. The P2 will add a 35-cps near-letter-quality mode and an IBM PC interface to the standard Pinwriter features, and the P3 will offer the same features plus 136 print columns. End-user, single-unit prices for the P1 and P2 are \$799 each, and price of the P3 is \$1250.

All three models employ 18-pin print heads. Bruce Thatcher, NEC director of peripherals marketing, believes the P1 is the first 18-pin-head dot-matrix printer priced at less than \$1000. "The design is a proven technology that NEC has been using in Japan for



**NEC's Pinwriter, the company's first dot-matrix printer in the U.S., is part of a series from Japan that parallels NEC's fully formed character thimble printers.**

years," he says. "The greatest benefit in having an 18-wire head comes in the throughput it offers, although that may not show up when measuring characters per sec." He claims that, with the 2 x 9 staggered pin array, the printer can produce densities in one pass for which other printers (1 x 9 pins) would require a dual-pass mode.

NEC previously marketed dot-matrix printers only with the company's microcomputer systems. The company hesitated to commit to the crowded market for low-end dot-matrix printers, but Thatcher believes the Pinwriter is priced for the high-end personal computer market. He claims that the Pinwriter offers a solution to personal computer OEMs, system

integrators and end users that need high speed, high quality and business graphics. "With the multiple printing modes, users can obtain the speed and performance for higher volume printing requirements such as data processing, high-density output and nearly unlimited font flexibility for graphics applications in one low-cost multifunction printer," says Thatcher.

All three Pinwriter models include 10-pitch pica, 12-pitch elite, and 17-pitch condensed printing; proportional spacing; international characters; and graphics symbols. The printers produce a 7 x 9 matrix character in high-speed mode and a 13 x 9 character for high density. The P2 and P3 produce characters as dense as 26 x 18 for near-letter-quality requirements.

Historically, NEC has concentrated on vertical integration of its product line, and NEC Corp. in Japan has long had dot-matrix printer models corresponding to each daisy-wheel printer series that the company has introduced in the U.S. The company will broaden its dot-matrix line, Thatcher says. "This is the low end of the spectrum. The requirements for future products will be for higher speed, greater density and smaller

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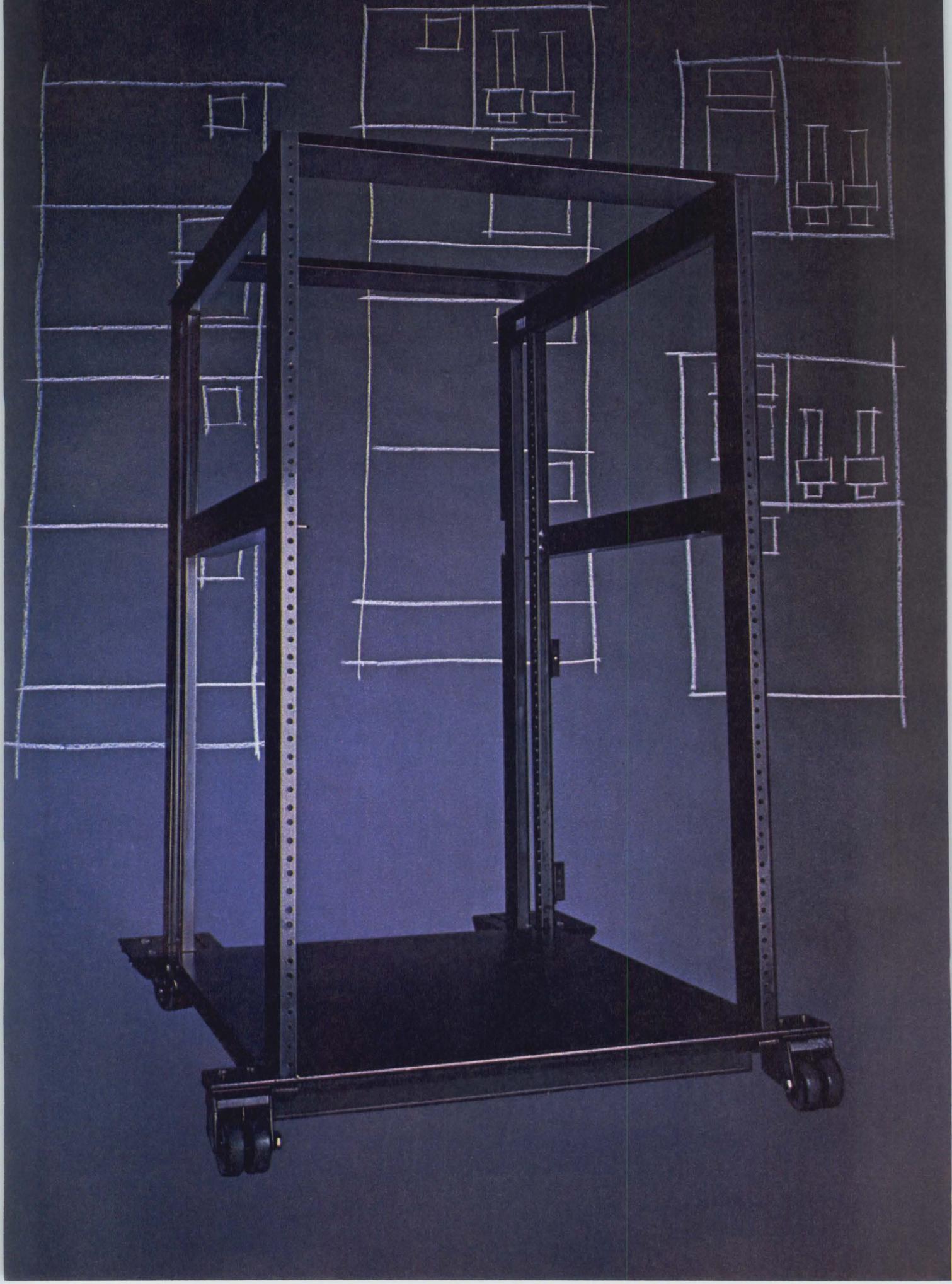
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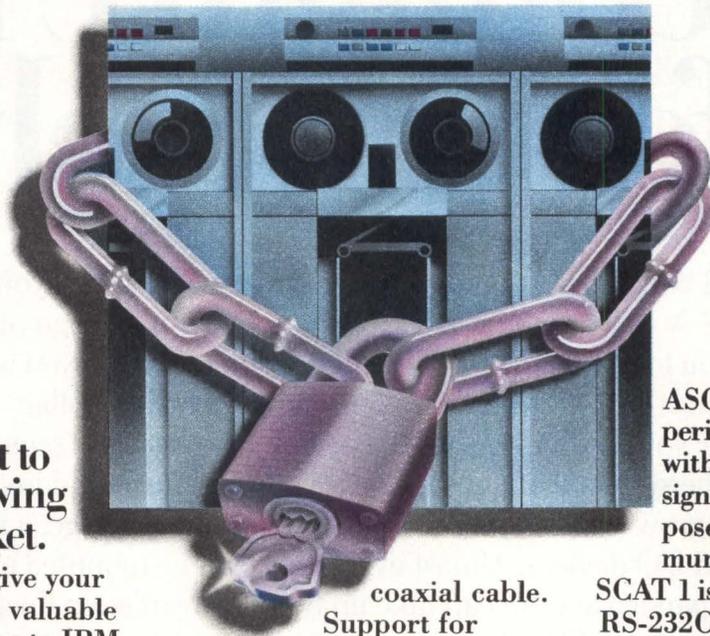
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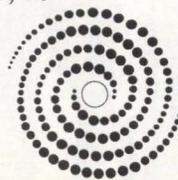
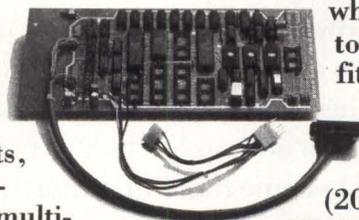
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# Mini-Micro World

## NEWS

dots," he says. Thatcher says NEC will not use less than 18 pins, but is considering using 24 pins for some applications.

Thatcher is not certain that

dot-matrix printers offer the best long-term solution to color hard-copy requirements, but he does expect the NEC dot-matrix line to offer color soon. "Other technolog-

ies like ink-jet and thermal transfer may still be a little too exotic for the marketplace," Thatcher adds.

—Edward S. Foster

## Matsushita finds way to erase optical disks; Burroughs erases program

Matsushita Electric Industrial Co. Ltd. has given optical-disk-system technology a major boost with its announcement of the first erasable optical-disk recorder system.

Meanwhile, Burroughs Corp. has tossed out its \$20-million investment in optical-disk technology by shutting down its development program just as it was on the verge of manufacturing its first products. "We have concluded that an optical-disk system cannot be manufactured at a reasonable cost at this time," says a Burroughs spokesman. "That is not to say we have abandoned the technology; we will continue our research efforts."

Industry sources say Burroughs could have manufactured an optical-disk peripheral at a reasonable cost. What it apparently cannot do is to commit \$30 million more to selling the peripheral.

A commitment of \$30 million may not seem like much to a \$4-billion company, especially after that company had invested \$20 million in the technology. However, Burroughs posted a loss in earnings for its fourth quarter of 1982, and 1982 profits were marginal. As a result, it had a cash-flow problem.

In addition, it was faced with the embarrassment of not having a system or an interface to hook up to the optical disk after five years of effort. However, Memorex Corp., a Burroughs subsidiary, had a number of systems in the IBM plug-

compatible market to which Burroughs' prototype optical disk would interface. Memorex officials were eager to acquire optical disks for the company's oil-exploration customers that required the disks' multi-gigabytes of archival storage.

Faced with the embarrassment of manufacturing a peripheral that could be hooked only to systems of its number one rival—IBM Corp.—Burroughs opted to shut down the program. As a result, Storage Technology Corp. will be the only manufacturer of optical disks for the IBM plug-compatible market. "This gives STC a clear shot at the PCM market, since they are the only one other than Burroughs close to a product," says Ed Rothchild, a consultant and editor of *Optical Memory Newsletter*, San Francisco.

Rothchild says Burroughs could have raised the money to keep the program despite its financial difficulties. The company had the option of forming an R&D partnership or getting venture capital to keep the optical program going as an outside start-up.

Instead, Burroughs closed the Westlake Village, Calif., plant where the optical disks were being made and fired 50 of its 70 employees. Of the 20 staff members left, 10 were key engineers and technicians who will continue research in optical media. That program is likely to be merged into Memorex in Santa Clara, Calif. The other 10 employees were offered

jobs elsewhere in Burroughs. It did not take long for word to reach recruiters from other companies. RCA Systems Division, Cherry Hill, N.J., for example, made offers to 10 Burroughs engineers the next morning.

Left behind in Westlake Village was a new clean room and a business plan that called for the Optical Memory division to more than repay its investment within six years. The plan estimated that, by 1990, the Optical Memory division would bring \$4 billion in additional revenues, doubling Burroughs's current revenues. "It figures," says one disgruntled ex-employee. "Burroughs used to be the number-one supplier of microcomputers until it abandoned the program in 1979. That was the year personal computers began to take off."

Meanwhile, STC, CDC-Phillips, and Shugart Associates' Optimem programs are forging ahead. The companies are hoping to make product announcements by year-end. The Shugart Optimem product with its 12-in. platter is the lowest priced of the group. It is expected to sell for around \$6000 in large quantities.

CDC-Phillips also plans to sell a low-end optical-storage product, slightly above the Optimem price range. At the high end, RCA Systems plans a double-sided, 16-in. platter storing 9.3G bytes. Eastman Kodak Corp. is working on a 16-in. platter with 5.6G bytes on each side

# Mini-Micro World

## NEWS

of a two-sided platter. In comparison, the STC product to be introduced this year is expected to store about 4G bytes.

Matsushita introduced one of the more promising products to emerge from optical-storage technology. Until the introduction of

Matsushita's product, all optical-storage systems had been write-once/read-many-times products, unlike magnetic media, which allows continuous erasures and re-recording. Like nonerasable optical disks, the Matsushita product uses tellurium suboxide and two semi-

conductor lasers with one focusing lens. The lasers can simultaneously erase and record.

A few submetals, such as germanium, indium and lead, are mixed into the tellurium suboxide. This allows the recording materials to become reversible between the crystalline and the amorphous phases as the laser beam burns through the metal. In the recording and playback, the crystalline phase with high reflectivity converts itself into the amorphous phase of low reflectivity.

Most observers, however, are skeptical, believing that the Matsushita announcement is little more than a technology rather than an actual product. Matsushita does not estimate when computer links will be available, when delivery dates will be or what prices will be for the optical recorders. But the company does expect cartridges for the recorder to sell for about \$20.

Rothchild of *Optical Memory Newsletter*, however, notes that nonerasable optical cartridges sell for around \$20 and predicts that prices for erasable cartridges are more likely to begin at \$750 until production quantities are available. In addition, erasability has not been a prime requirement of optical disks. Many customers requiring large amounts of archival storage, such as banks and government agencies, prefer nonerasable disks.

Ultimately, the recorders will compete at the low end with CDC-Phillips, Optimem and Japanese manufacturers such as Toshiba Corp. and Sony Corp. Sony is said to be preparing an erasable product for announcement this summer.

The test for the recorders will be in the consumer market, in which optical-disk recorders, with their superior resolution and media durability, will compete against videotape recorders.

—Robert A. Sehr

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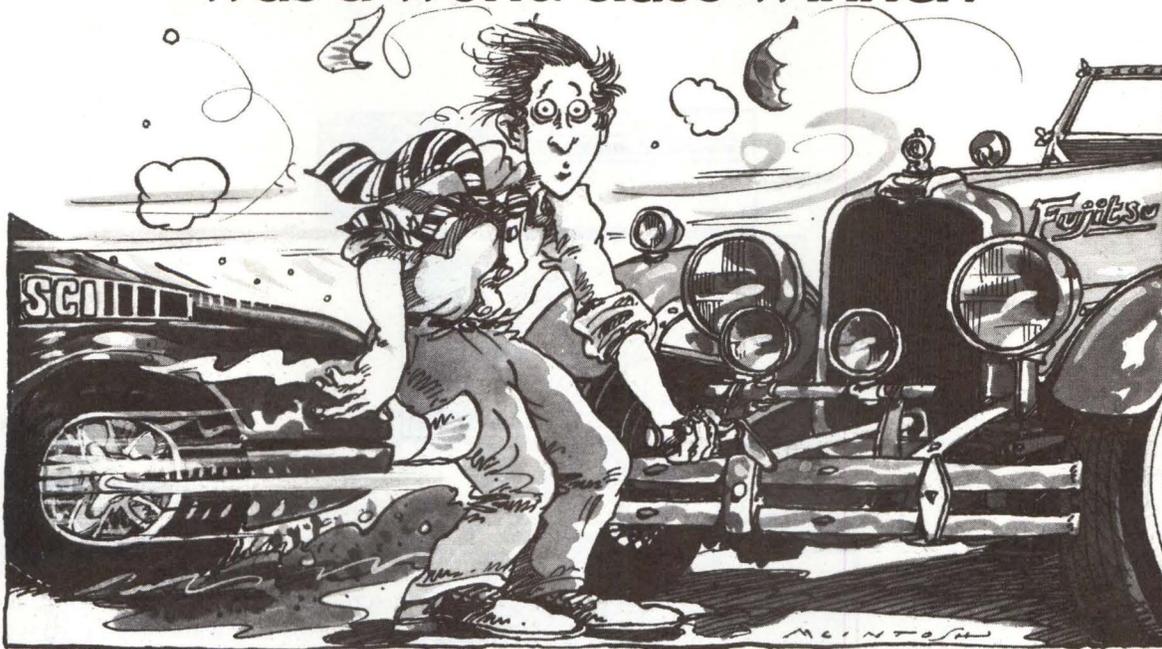
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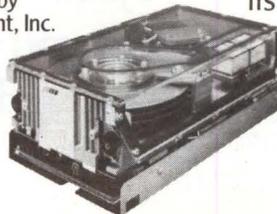
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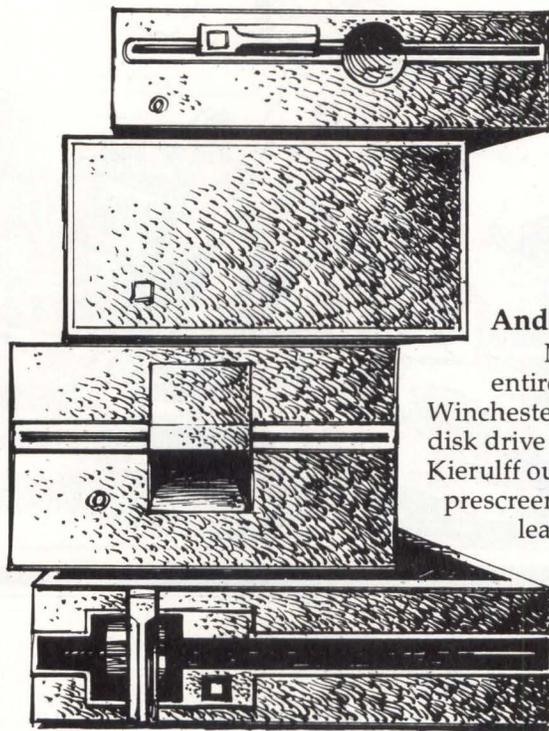
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# Mini-Micro World

NEWS

## Intel, NCR collaborate on 1M-bps LAN

Intel Corp. and NCR Corp. have disclosed an 18-month joint development effort that has produced a low-speed local-area networking technique using data grade twisted-pair wiring. The network is expected to sell for about one-fifth the price of the 10M-bps Ethernet system. MIRLAN (mid-range local-area network) is scheduled to make its first commercial appearance on "soon to be announced" NCR products, probably CRT terminal clusters, says NCR president and chief executive Charles E. Exley Jr.

Operating at speeds as high as 1M bps over twisted-pair or CATV coaxial cable, MIRLAN is aimed at workstation clusters, bank terminal systems and other installations in which multi-drop wiring has been too slow and too complex. It is not aimed at personal-computer networks and will not be offered on NCR's DecisionMate in the near future. "OmniNet [from Corvus Systems] is satisfactory for personal computers, but for transaction processing, we see collision detection as an essential requirement," Exley says. Because the network is similar to Ethernet, Exley says, NCR expects MIRLAN to be used in departments that are hooked into larger local-area networks via a 10M-bps Ethernet "backbone."

Exley says NCR hopes to propose MIRLAN as a candidate for the IEEE 802 standard at the 1M-bps level. MIRLAN has many features of the Ethernet-based standard, which the IEEE committee has adopted at the 10M-bps level including CSMA/CD media access, baseband transmission and Manchester encoding. MIRLAN specifications call for connections of as many as 40 devices per segment, with each segment as

long as 4000 ft. Repeaters can be used to extend a single network to 12,000 ft.

Intel will initially offer MIRLAN interface components, which include

the Intel 82586 controller chip currently offered in the Ethernet market and the 82501 serial interface chip. Intel vice chairman Robert N. Noyce says that the MIRLAN design will enable Intel eventually to produce a single-chip controller/interface. —Geoff Lewis



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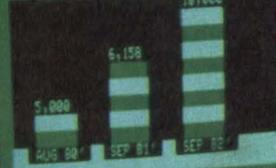
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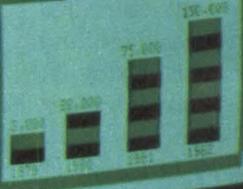
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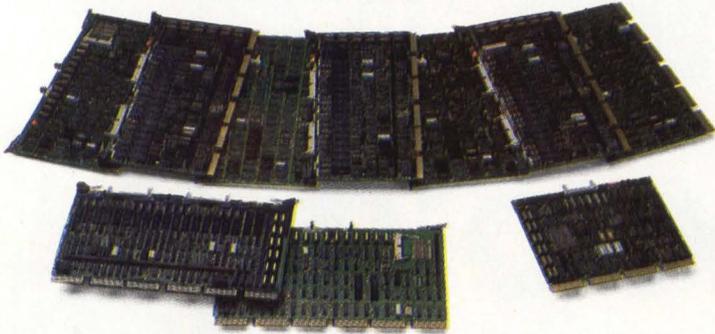
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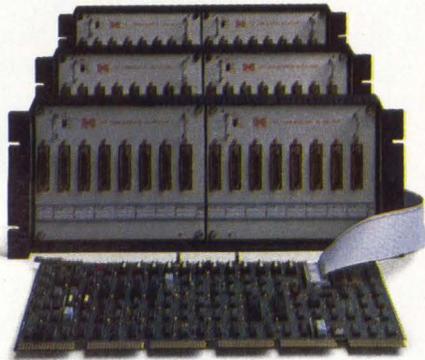
 **TeleVideo Systems, Inc.**

# Five reasons why DEC users should buy Emulex communications controllers.



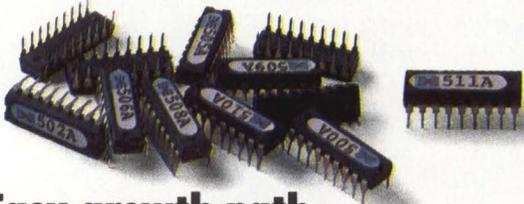
## Broad product line featuring our new DMF-32 emulation.

Nobody covers LSI-11, PDP-11, and VAX-11 users' needs like Emulex. More than 15 software-transparent controllers emulating DH11, DZ11, DV11 and DMF-32. All deliver improved line-handling capabilities, in a smaller package, at lower costs.



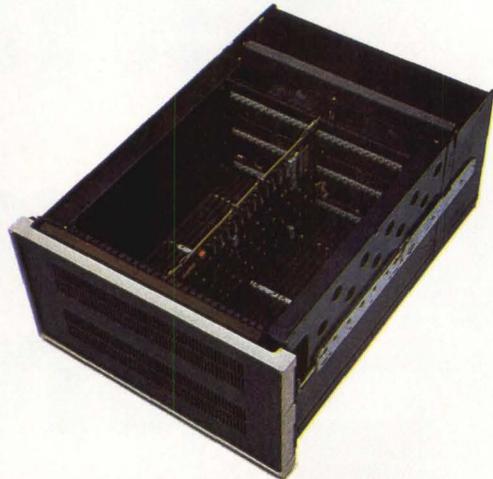
## More channels.

Emulex's new DMF-32 emulation is typical. One controller board handles up to 64 lines, vs. only eight per DEC module. And Emulex offers *all* lines with modem control, not just two. For even more lines, Emulex's Statcon Series is the answer. We simply add a low-cost port concentrator, so that with one controller board you can connect up to 256 remote *and* local terminals.



## Easy growth path.

As your system grows, upgrading is simple with Emulex controllers. Just change PROM sets. Example: DH to DMF for \$350. In addition, Emulex's advanced microprocessor architecture is consistent throughout the product line. Think of the inventory savings.



## Fewer backplane slots.

Emulex communications controllers pack so much capability onto each board that fewer boards are needed. Take a 64-line DH11 emulation. Emulex does on one board what it takes DEC to do on 36. Think of the savings in rack space, to say nothing of price.



## Lower prices.

For instance, a DEC DH11 controller lists at \$8,950 per 16 lines, with expansion chassis costing \$3,000 or more. Compare that to Emulex's CS11/H at \$4,500 for the first 16 lines and \$3,000 for each additional 16 lines. At 64 lines, you suddenly have savings of about \$23,000 and a lot of extra slots to boot.

Don't speculate with your communications controller dollars. Invest in Emulex. Phone toll free: (800) 854-7112. In California: (714) 662-5600. Or write: Emulex Corporation, 3545 Harbor Blvd., P.O. Box 6725, Costa Mesa, CA 92626.



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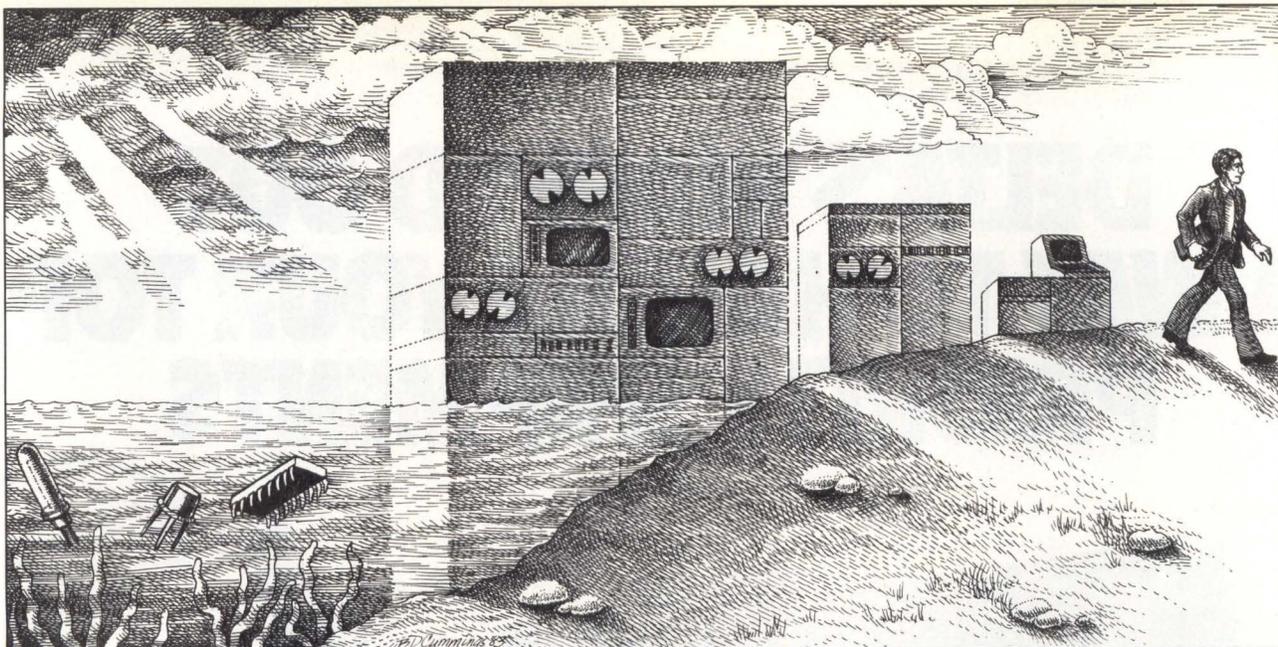
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Yet, in today's business, a substantial workforce has been largely overlooked by the computer industry: the mobile professional.

They are the executives, salespeople and field-support personnel that spend many of their workdays doing battle against the competition away from their desks—far from the comforts, conveniences and computing aids of the home office.

## THE HAZARDS OF THE ROAD.

The mobile professional spends hours on planes, trains and in taxis traveling to business meetings.

Only to have to return at a later date with the typed contract. Or mail in the revised report. Or call back with the final numbers.

Office automation simply hasn't moved fast enough for the mobile professional.

Between paper, pencils, pens, files, triplicate carbon copy order pads, calculators, dictation recorders, appointment diaries, phone books and a picture of the twins, the mobile professional charges off dragging half an office across thousands of miles of territory every year.

## SOMETHING, INDEED, MUST CHANGE.

Clearly, what's needed is a viable alternative. A mobile computer designed specifically for the rigors of the road.

Taking the thinking professional's approach, we believe a mobile computer has to be a powerful and complete ultraportable. One that fits easily inside a briefcase. And

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It stands to reason that it must have an adequately large display screen, a full-sized keyboard, a correspondence-quality 8½" x 11" or legal page printer and microfloppy disk drives for memory.

Necessity would also suggest an integrated modem, for two-way data communication via standard telephone lines.

All in a package that weighs in at less than 14 pounds.

## THE HARDEST PART IS THE SOFTWARE.

But by far, the most important feature of a truly useful mobile computer is its software. It has to be fully confusion-proof, using familiar graphic symbols, rather than complicated computer-talk, to guide the user through each step.

It also has to offer a full complement of practical application programs, including a personal secretary, word processing and financial planning. Developed precisely for the professional demands of the mobile professional.

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# Mini-Micro World

CORPORATE AND FINANCIAL

## DEC PC alumnus beefs up Franklin for possible IBM-compatible portable

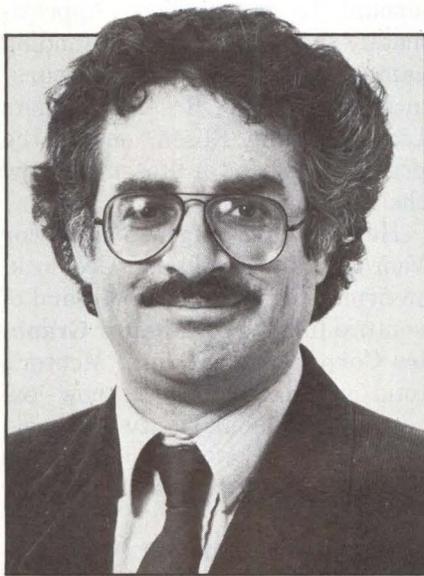
Franklin Computer Corp., once considered just another Apple Computer Inc. clone, is being closely monitored by the personal computer industry as it begins to move away from Apple's shadow. With the hiring last spring of several key research and development personnel, Franklin has indicated that it intends to become a major independent personal computer supplier.

Franklin's first big move was hiring Avram Miller, former manager of Digital Equipment Corp.'s Professional computer program, as executive vice president of manufacturing and engineering. A month after Miller arrived, he lured William L. Sydnes away from his position as development manager for the Personal Computer at IBM Corp. Sydnes was rumored to be working on the low-end Peanut model. He assumes the post of vice president of engineering at Franklin. Miller is confident that Sydnes will build an engineering organization at Franklin that will be "second to none." He says Sydnes has a proven track record in developing superior products on tight schedules.

Apple has inadvertently helped boost Franklin into the market. Apple's requests for a preliminary injunction barring Franklin from producing and selling the ACE series of Apple II- and IIe-compatible computers had at presstime been unsuccessful and have only resulted in tremendous free advertising for the Cherry Hill, N.J. company. As of last fall, Franklin's annual sales rate was less than \$10 million, but now it projects sales in excess of \$60 million for fiscal year 1983. The



**William L. Sydnes, Franklin's new vice president of engineering,** was development manager for IBM's Personal Computer and was rumored to be working on the Peanut low-end model.



**Avram Miller, Franklin's executive vice president of manufacturing and engineering,** was formerly manager of DEC's Professional computer program. He has been recruiting high-priced engineers to Franklin and beefing up its production capacity.

number of employees since last fall has grown from less than 100 to more than 400. Further, the two-year-old firm, which has received \$8 million in two rounds of private venture-capital funding, is expected to go public soon.

Many industry analysts are impressed by Franklin's rapid rise. "Franklin has been growing like crazy," remarks Egil Juliussen, of Future Computing Inc., Richardson, Texas. Juliussen expects Franklin to capitalize on its popularity by developing an Apple II- or IBM PC-compatible portable computer. "Since IBM doesn't have one, it's a very good idea," he says. Producing Apple-compatible computers is "a sound business decision," notes Aaron Goldberg, an analyst with International Data Corp., a Framingham, Mass., market research firm. "But getting Avram Miller is a coup. He's a very bright and intensely dynamic man."

Miller says he accomplished his goals in his 2½ years managing DEC's Professional program, and it was time for a change. He makes no secret of the fact that his next goal is to control a major computer-manufacturing company. But at DEC, he says, "There was no way to have it all. [DEC president] Ken Olsen wasn't going to give me his job."

At Franklin, Miller has surrounded himself with proven, high-priced talent from DEC, IBM and other top companies, and is gearing up for very large-scale production.

A few weeks before hiring vice president of engineering Sydnes, Miller recruited Vahram Erdekian, from DEC, where he had been responsible for the strategy and

# Mini-Micro World

## CORPORATE AND FINANCIAL

implementation of DEC's personal computer manufacturing program. Erdekian becomes Franklin's vice president of manufacturing.

Franklin has also hired a technical director from IBM, and Miller says he has added several people from IBM to Franklin's staff. He plans to continue to bolster the 40-member engineering staff with the best available talent.

Franklin's manufacturing operations will be consolidated this summer into a 134,000-sq.-ft. facility, and a 44,000-sq.-ft. administrative building has also been built. Franklin recently purchased a VAX-11/780 for CAD/CAM. Plans call for the company to open a manufacturing plant in Europe this summer.

Last summer, Franklin shipped 1000 units per month and projected that number to jump to 3500 by this March. Miller says shipments far exceed that projection. To handle the large inventory, an HP 3000 running an ASK Systems materials-requirement-planning system has been installed.

Apple compatibility will not be Franklin's main focus. "We did not come here to copy someone else's product," Miller maintains. New Franklin products may include portable computers, networking and clustering products and software. Marketing manager Ed Golderer hints that Franklin's next offering, due by early 1984, will be IBM compatible as well as Apple- and CP/M-compatible like the ACE 1200. "We want to be the company having the greatest mass software appeal," Golderer says. Miller says developments will happen quickly because he has mapped out his game plan.

—David A. Bright

### In transition

Instrumentation Laboratory Inc.'s **Pixel Division** will become a separate corporation that is expected to go public this month. Instrumentation Laboratory shareholders of record as of Jan. 28 will receive shares in Pixel after registration is completed. Thomas A. Rosse, president of Instrumentation Laboratory, will provide additional financing. The capital will be used to expand Pixel's sales organization and for research and development. Pixel was acquired by Instrumentation Laboratory in June, 1980, and shipped its first MC68000-based microcomputer a year ago. Instrumentation Laboratory, in turn, has been acquired by Allied Corp.

### Financings

**COMPAQ Computer Corp.**'s recent \$20-million third round of venture financing brings the total amount to \$30 million. Approximately \$8 million of the new funding came from previous investors, including Sevin Rosen Partners Ltd. Benjamin Rosen, one of the principals of Sevin Rosen, is now chairman of COMPAQ.

Headed by original investor Venrock, Sutter Hill and Greylock, 15 firms provided the third round of venture funding for **Mentor Graphics Corp.**, Portland, Ore. Mentor's total investment capital now exceeds \$10 million. The two-year-old CAD/CAM workstation OEM uses Apollo Computers Inc. distributed systems.

**Synapse Computer Corp.**, a Milpitas, Calif., manufacturer of fault-tolerant minicomputers has completed a \$12-million private placement of convertible preferred stock. The funding was the company's fourth in its three-year history.

Investors include Sevin Rosen Partners and the IBM Corp. and Kodak pension funds.

### Distribution/service deals

**3Com Corp.**, Mountain View, Calif., has signed at least 25 retail stores to distribute its EtherSeries networking products for the IBM PC. Businessland, FuturByte of Montreal and independent ComputerLand stores are among the distributors.

### Wet ink

**Alphacom's** multi-year contract to provide Timex Computer Corp. with thermal printers is worth an estimated total of \$54 million, with the first year valued at approximately \$15 million.... **Momentum Computer Systems International** will purchase more than \$4 million worth of 5¼-in. Winchester disk drives from **Atasi Corp.**, San Jose, Calif. The drives will be used with Momentum's MC68000-based microcomputers.... **MPI** has been awarded a two-year contract to deliver more than \$20 million worth of its 5¼-in. floppy disk drives to Rana Systems, Chatsworth, Calif. Rana offers the drives as add-on peripherals for Apple, Atari and other personal computers.... In its largest commercial order to date, **Wang Laboratories Inc.** has committed to supply General Electric Co. with more than \$20 million in office-automation equipment. The one-year contract covers Wang OIS, VS and personal computer systems. GE previously had more than \$30 million worth of Wang equipment installed.

### Quarterly report

**Digital Equipment Corp.** says

*Text continues on page 72*

MINI-MICRO SYSTEMS/July 1983



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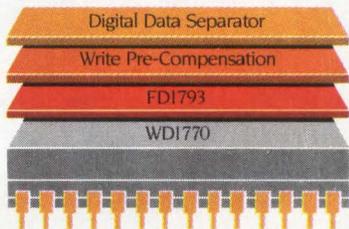


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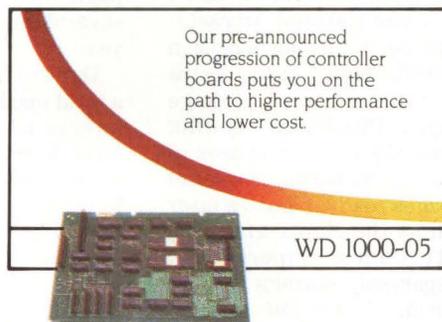
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Our new WD1000-05 is no stripped-down model, either. It includes our remarkable VLSI WD1010 Winchester Disk Controller, and WD1100-II Support Device. There is on-board sector buffering, data separation, write precompensation and error-checking, too. All on one board, designed to mount atop a 5 1/4" drive.

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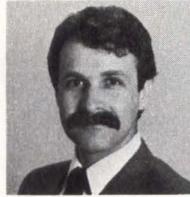


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### GUEST FORUM

A column for guest experts to speak out



David Henry Goodstein is director of Inter/Consult, a Cambridge, Mass., consulting firm specializing in traditional and emerging information and media industries. He is the principal author of the recently released study: "Electronic Technical Publishing, Technologies and Markets to 1989."

## Electronic technical publishing— doing well by doing good

By David Henry Goodstein  
Inter/Consult

What's black and white and grows 500,000 pages a minute? The world's supply of technical documentation, according to a study by Bell Laboratories almost a decade ago. Technical documentation—the step-child of the computer industry—is about to come of age.

Documentation is a tedious, expensive affair. In the 1960s, my programming peers used to recommend a good IBM/360 Theory of Operations manual in lieu of sleeping pills for restless nights. Indeed, they were monuments to bad taste, reproductions of output from line printers with tiny drawings pasted in. Our local service center had a full-time staff of three experts whose job was to interpret the cryptic contents of these mighty tomes. Monthly packages of looseleaf technical updates sat in piles or boxes.

The discrepancy between state of the art and state of the documentation was occasionally infuriating, mostly just irritating and on rare occasions amusing. However, there are more serious implications. A major study by an Armed Forces group several years back showed that as much as 25 percent of pages of repair documentation for weapons systems were out of date at any given moment. This means that when it's time to fix the nuclear warhead, there may be a 1 in 4 chance that a manual has outdated data.

New technology for creating and manipulating text and image data in electronic form is about to come to the rescue. Once-mundane technical documents will be created on a Lisa/Star-like workstation that shows text in typographic font images. Line

art, business graphics and even pictures will be summoned off of smart databases or created on the same terminal.

Spot color will be a part of everyday documents. Page images will be transmitted as high-quality electronic mail. If hard copy is needed, it will be laser-printer output. The same files can, if necessary, be sent to phototypesetters or high-resolution printing plate recorders. Documentation will even take the form of a self-contained database located inside the equipment it describes. Service personnel will plug in multiterminal briefcase workstations and be prompted through diagnostics and repairs that include animated instructional sequences on how to use unfamiliar tools. The database will be perennially correct, since engineering updates will be automatically incorporated.

Sound futuristic? All this is possible with the new integrated systems for electronic technical publishing. The cresting wave of high-powered 16- and 32-bit chips has been washing exciting products ashore for some time.

Consider Apollo Computer Inc.'s Domain, a hyper-powered workstation that has been turning heads in the CAD world. Now, \$5000 extra adds the SCRIBE software package from Unilogic, Pittsburgh. SCRIBE takes as input separate databases of text and images. Its output is a set of formatted pages ready to go to a laser printer such as the Xerox 2700 or a high-quality Camex Supersetter, which transparently outputs to both 240 line-per-in. Canon LBP-10s and 1000-lpi Monotype Lasercomp engines. Suddenly, the Apollo has become a full-fledged documentation workstation. It will be joined by

others soon.

A half-dozen well-underwritten start-ups have emerged in ETP in the last half-year. Names such as Impress, Textet, Xyvision, Imagitex or Qubix are not household words. But the founders' former companies, including Applicon Inc., Compugraphic Corp. and Itek, certainly are in the big leagues. These new companies will be joined by large ones (perhaps even AT&T) in developing efficient ways to create, merge and manipulate usable documents out of the vast domains of information created daily by installed systems.

It behooves companies to be aware of ETP both as a significant potential improvement in their operations and as a major growth market. Recent studies by our clients indicate that the life cost of a single page of technical documentation can be as high as \$400 per page! For some companies, documentation is the largest single expenditure outside of personnel. One software company found they spent 10 percent of their annual revenues on the books that explain the software packages' mysteries. A new system using a \$50,000 pagination package will save them several hundred thousand dollars a year.

Our studies indicate there could be a total market as high as \$7 billion for integrated document systems by 1989. Exciting? We think so. Certainly those companies that are involved in processing words or images should be aware that they are offering solutions to one node on the total network of needs. They should probably be giving careful consideration to the strategic implications of the total process, as companies such as Xerox Corp., IBM Corp. and Apple Computer Inc. are doing.

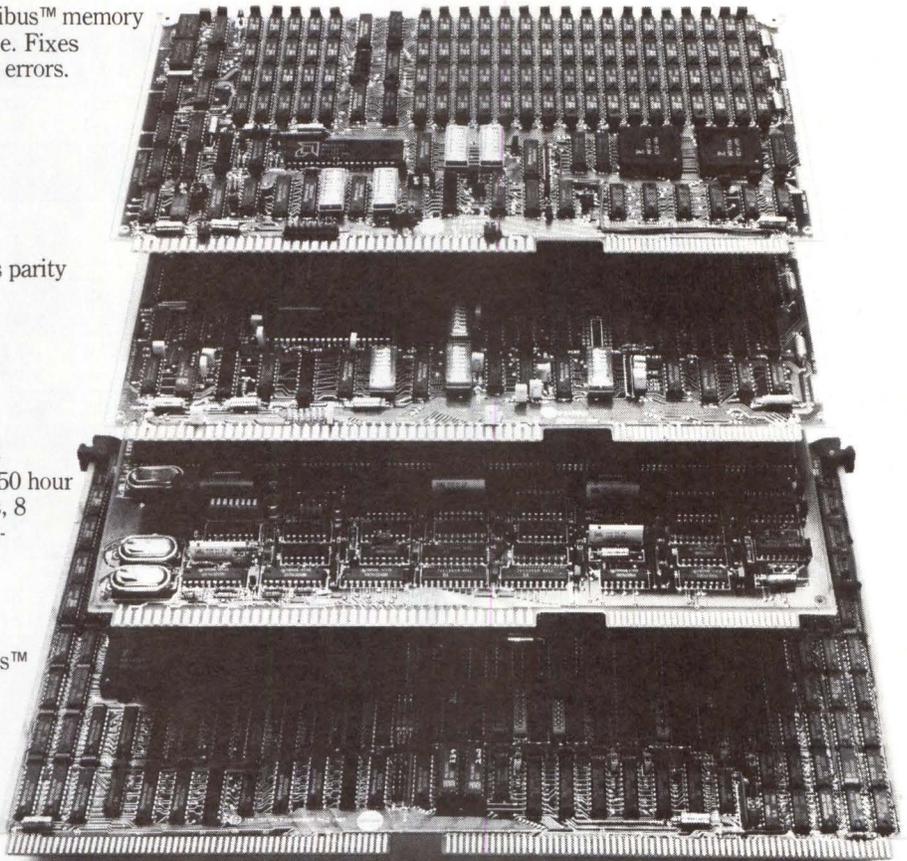
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 **PLESSEY**

# Mini-Micro World

## CORPORATE AND FINANCIAL

Text continues from page 66

that manufacturing start-up delays in its personal computer line were part of the cause for lower than expected revenues for the quarter that ended April 2. Revenues for the quarter were \$1.1 billion, about even with the \$1 billion of the same period a year earlier. Nine-month revenues increased to \$3 billion from \$2.8 billion. Net income for the quarter dropped to \$79.8 million, or \$1.40 per share, from \$107.5 million, or \$1.94 per share, a year earlier. Net income for the nine-month period plummeted to \$197.6 million, or \$3.50 per share, from \$295.4 million, or \$5.33 per share, a year earlier. The company says lower than anticipated equipment sales, manufacturing costs that were not offset by product sales, price reductions and high research and engineering expenses adversely affected earnings.

### Personalities

Digital Research Inc. chief operating officer **John Rowley** has been promoted to president, succeeding founder Gary Kildall, who remains chairman and chief executive officer. Kildall will continue his involvement in the company's research and development efforts.

### Industry monitor

Digital Equipment Corp., the world's second-largest computer manufacturer, has broken into the *Fortune* 100 listing for total revenues. DEC's sales of \$3.9 billion for the fiscal year ended July 3, 1982, ranked it number 95, up 42 places from fiscal 1981, when it recorded revenues of \$3.2 billion. DEC ranked number 32 in net income at \$417.2 million, and number 8 in earnings-per-share growth, 31.2 percent, over the 10-year period.

### BOX SCORE OF EARNINGS

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

Company	Period	Revenues	Earnings	EpS
<b>Altos Computer Systems</b>	9 mos 3/26/83	53,568,000	5,652,000	.43
	9 mos 3/26/82	36,201,000	4,312,000	.38
<b>Aydin Corp.</b>	3 mos. 4/2/83	37,394,000	3,312,000	.70
	3 mos. 3/28/82	23,532,000	1,401,000	.30
<b>Centronics Data Computer Corp.</b>	3 mos 4/31/83	43,700,000	204,000	.02
	3 mos 3/28/82	26,328,000	(2,083,000)	(.33)
<b>Emulex Corp.</b>	9 mos. 3/27/83	21,015,186	3,585,312	.64
	9 mos. 3/28/82	10,788,511	1,523,137	.33
<b>Fortune Systems Corp.</b>	3 mos 4/1/83	20,766,832	3,340,182	.17
	3 mos 4/2/82	20,861	(2,030,151)	(.14)
<b>General Datacomm Industries Inc.</b>	6 mos 3/31/83	38,848,000	535,000	.08
	6 mos 3/31/82	25,258,000	(1,274,000)	(.19)
<b>Genisco Technology Corp.</b>	6 mos. 3/31/83	15,047,033	481,080	.21
	6 mos 3/31/82	13,126,126	514,160	.26
<b>Harris Corp.</b>	9 mos. 4/1/83	1,051,337,000	44,167,000	1.40
	9 mos 3/26/82	953,701,000	61,161,000	1.96
<b>Hazeltine Corp.</b>	3 mos. 3/31/83	28,693,000	1,855,000	.30
	3 mos. 3/31/82	27,086,000	1,225,000	.20
<b>Honeywell Inc.</b>	3 mos 4/3/83	1,324,000,000	22,200,000	.98
	3 mos 4/4/82	1,261,000,000	55,500,000	2.48
<b>Lexidata Corp.</b>	6 mos 3/31/83	11,248,500	(372,000)	(.07)
	6 mos 3/31/82	13,804,200	1,634,100	.32
<b>Lundy Electronic &amp; Systems Inc.</b>	9 mos. 3/31/83	24,357,000	1,171,000	.69
	9 mos. 3/31/82	19,554,000	750,000	.65
<b>NCR Corp.</b>	3 mos. 3/31/83	781,352,000	34,073,000	1.25
	3 mos. 3/31/82	753,554,000	30,780,000	1.15
<b>Prime Computer Inc.</b>	3 mos. 4/3/83	120,504,000	8,540,000	.27
	3 mos 4/4/82	103,222,000	10,635,000	.35
<b>Prodigy Systems Inc.</b>	3 mos. 3/31/83	2,750,000	85,000	.07
	3 mos. 3/31/82	1,595,000	58,000	.05
<b>Ramtek Corp.</b>	9 mos. 3/31/83	32,510,000	1,457,000	.52
	9 mos. 3/31/82	33,428,000	1,908,000	.72
<b>Solid State Scientific Inc.</b>	3 mos. 4/1/83	7,824,000	(1,141,000)	(.55)
	3 mos. 4/4/82	9,182,000	(1,508,000)	(.73)
<b>Texas Instruments Inc.</b>	3 mos. 3/31/83	1,174,000,000	7,100,000	.50
	3 mos. 3/31/82	1,078,500,000	27,700,000	1.17

**Comments:** **Altos Computer Systems'** third-quarter sales rose 62 percent to \$20.5 million from \$12.6 million for the same quarter of the previous year. Earnings for the quarter rose 73 percent to \$2.3 million, or 16¢ per share, from \$1.3 million, or 12¢ per share, a year earlier. The company attributed the sales gain to healthy production deliveries of its new MC68000-based microcomputer, which was introduced last fall. **Fortune Systems Corp.'s** earnings included an extraordinary credit of \$1.3 million, or 7¢ per share, for the tax benefit relating to 1982 operating losses. Fortune, which manufactures MC68000-based systems, says it has eliminated short-term debt and has working capital in excess of \$100 million, including \$90 million from the company's

initial public offering. The company also says it has a \$20-million line of credit from the Bank of America and will invest more money than had been planned in research and development this year. Raster graphics display manufacturer **Lexidata Corp.** rebounded from a poor first quarter to show a profit of \$149,000 or 3¢ per share, in its second quarter. Earnings were still down, however, from \$937,000, or 16¢ per share, a year earlier. Sales for the period were \$6.7 million, as opposed to \$7.3 million a year earlier. While **Harris Corp.'s** orders in its Information Systems, Communications, and Semiconductor sectors increased slightly, Government Systems' nine-month orders were up more than 40 percent over the same period last year, the company says.

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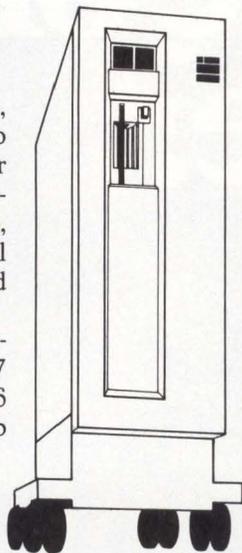
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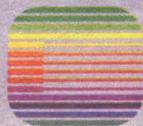
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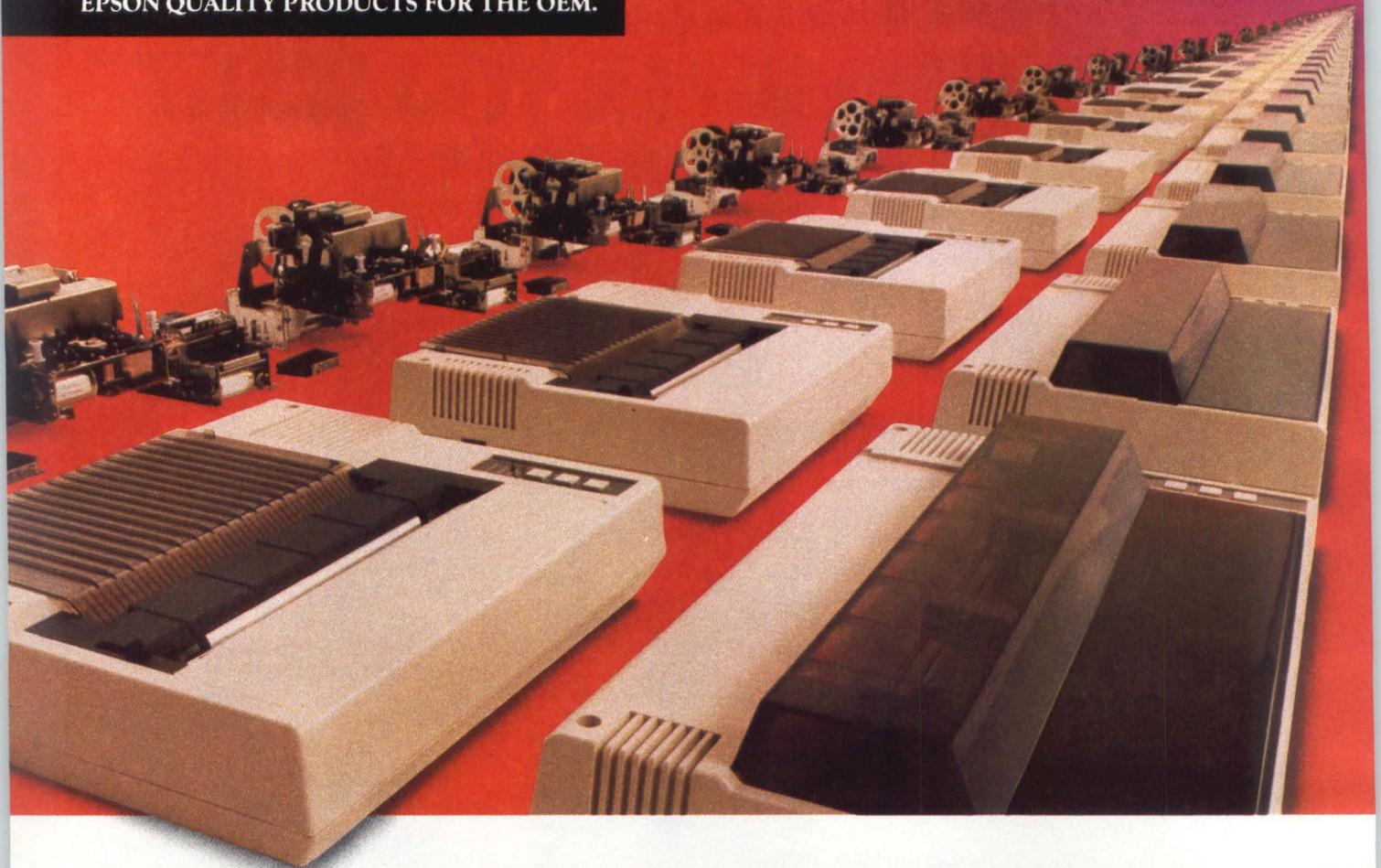
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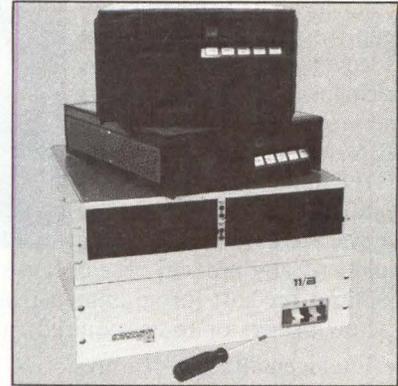
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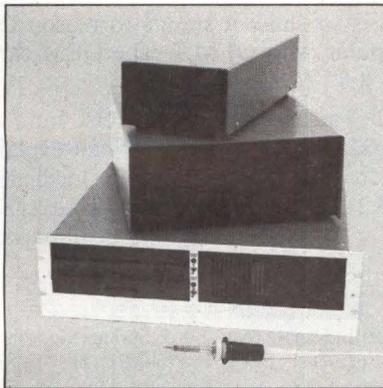
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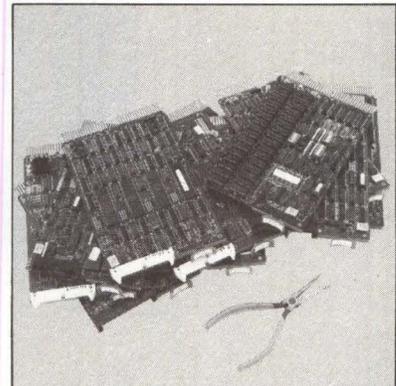
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# Mini-Micro World

INTERNATIONAL

## Europeans will join forces in fifth-generation research program

Those who still think that the evolving fifth-generation computer technology is strictly for academics may change their viewpoints dramatically by this October. That's when European Community governments are expected to give the green light to a \$1.5-billion research program for fifth-generation technology called ESPRIT (European Strategic Program of Research and Development in Information Technology). The program's goal is to unite European computer companies in the face of a common threat from Japan, which has also initiated a fifth-generation research program (MMS, October, 1982, p. 141). The European Community is contributing one-half of the \$1.5-billion, and participating companies are expected to fund the remaining half.

The European Commission, the European Community's main administrative body in Brussels is organizing ESPRIT. Commission officials say the Council of Ministers, the decision-making group comprising senior government ministers from each member country of the community, will vote on the project in October. The council's approval is likely since ESPRIT is the result of a council meeting in June, 1982, during which information technology was called "an urgent subject for increased action."

Total expenditure of the project could substantially exceed \$1.5 billion, the sum for the first five years. ESPRIT, like Japan's fifth-generation program, is intended to run for a decade.

The European Community's com-

mitment to fifth-generation work is more solid financially than that of the Japanese government, which has agreed to contribute only \$50 million for the first three years. However, MITI, Japan's trade and industry department, is pressing the Japanese government for at least \$500 million. The European Community hopes that Europe's main weakness—the fragmentation of its industry and markets—will not hinder pan-European cooperation because of the "pre-competitive" nature of the research work.

ESPRIT's five main research areas are software, advanced information processing, office automation, computer-integrated manufacturing and advanced microelectronics.

The software projects include the development of portable tools and a

### BRITISH \$500-MILLION RESEARCH PROGRAM WILL COMPLEMENT ESPRIT

While the European Community's ESPRIT research program for fifth-generation technology awaits lift-off, the British government has given the go-ahead for its own \$500-million advanced computer research program. The Alvey program closely resembles ESPRIT in structure, although government officials say it is designed to complement the European Community's scheme. This assurance should alleviate community officials' anxieties that efforts to encourage pan-European computer research have been hindered by member countries that prefer to support their own national programs.

Alvey participants will receive government funds totaling \$300 million, but the participants are expected to contribute as much as 50 percent of the cost of each project.

The four main technologies Alvey will study are VLSI, software engineering, the man/machine interface and

intelligent knowledge-based systems. The largest chunk of the Alvey expenditure, about \$140 million, is for VLSI research.

A short-term aim of the more-than-\$100-million software-engineering program involves the UNIX operating system, a product not in ESPRIT's plans. Alvey plans enhanced database and communications facilities for UNIX, which will ultimately lead to the Information Systems Factory. The ISF will be a computer system, including both hardware and software, with an integrated set of tools for system development. It will include subsystems for prototyping, life-cycle programming support, accessing databases of reusable hardware and software components and communications over local- and wide-area networks.

The man/machine interface program, for which as much as \$70 million has been allocated, will include

development of flat-panel displays, also an important part of ESPRIT's research. Alvey plans to produce a color display with a resolution of 240 pixels per sq. in. within five years.

One difference between Alvey and both the Japanese and the ESPRIT programs is that Alvey places less emphasis on intelligent knowledge-based systems. Funding for that program is less than \$40 million. Its main thrust is toward improving a technology emerging from research laboratories—expert systems.

Despite the enthusiasm for Anglo-Japanese fifth-generation research expressed by Kenneth Baker, Britain's information technology minister, there will be no active cooperation between Alvey and the Japanese program, says a spokeswoman for the British government's department of industry.

# Mini-Micro World

INTERNATIONAL

standard program-writing workstation designed to interface with local and wide-area networks. Also planned are validation and enhancement techniques covering the lifetime of a program and a software-production and maintenance-management system.

In the advanced information-processing area, the Europeans will look at advanced speech- and image-recognition systems, including advanced parallel architectures and very-large-scale-integration circuitry. The Europeans will also give much attention to expert systems. They plan to develop workstations for nonprocedural languages, such as Prolog and LISP. Plans also include work on "knowledge information-management systems," including a prototype machine for processing imprecise non-numeric information and languages for representing and manipulating knowledge rather than precise numeric information.

Like the Japanese, the Europeans will investigate and develop five categories of innovative computer architecture. The categories are database machines employing new architectures, "ultracomputers" with thousands of interconnected elements, machines designed to host data-flow program structures, highly parallel nonprogrammable specialist processors and inference machines for "deductive" operations—a key fifth-generation concept. Research on query languages for non-specialists is another target in the advanced information-processing research.

The office-automation program goals include establishing a standard European system, including communications protocols and specialized integrated circuitry, for integrating and processing voice, data, text, graphics and video. Other projects are planned for

hardware technologies such as multifunctional flat-panel displays, hard-copy printers and high-capacity, rewritable, optical-disk storage systems.

Work on filing systems will include content addressability and accessing loosely structured information with data, text, graphics and other media.

Computer-integrated manufacturing embraces computer-aided design, manufacturing and testing. The European Community sees it as the most urgent area for action. One of the program's main goals is to develop a chip set for robot control comprising three integrated circuits—for axis interpolation, axis control and servo interfacing. The project will also work on new operating systems for robot applications.

Imaging systems for feeding manufacturing control equipment is another important research topic. Work is expected on processing tactile, thermal and acoustic "images" as well as visual information and

on processing 3D images. Another aim is to establish "advanced development centers" for collaboration between industry and the academic community.

The advanced microelectronics program will emphasize development of design and production tools for ICs with submicron geometries. One project will study how to achieve four layers of metal interconnect patterns on a chip. Another will work on advanced CAD techniques to produce tools to enable a device with 10,000 gates to be custom designed in only five days. Further work could lead to the development of 50,000-gate devices in the same amount of time.

The advanced microelectronics area, like the office-automation sector, will study flat-panel-displays. The aim of the study is to produce displays ranging in size from 3 × 5 cm. (about 1.2 × 2 in.) to 1m. × 1.5m. (about 39 × 59 in.).

—Keith Jones

## ISO's workstation ergonomics subcommittee progresses

The International Standards Organization, under the auspices of West Germany's Deutsches Institut für Normung (DIN) and the British Standards Institution, has progressed further toward universal ergonomics standards by asking one of its subcommittees to formulate rules for computer workstations. The SC4 subcommittee of ISO's TC159 international technical committee held its first worldwide meeting this June in Manchester, England.

Peter Crabbe, a technical officer at BSI and organizer of the June meeting, notes that it discussed mainly administrative arrange-

ments. Information about the meeting can be obtained from the American National Standards Institute in New York. "After the June meeting, there may not be another full meeting for two or three years," says Crabbe, "but individual working groups will meet quite often at locations that could be anywhere in the world."

Asked about the relevance of the existing DIN 66234 workstation standards to the proposed ISO rulings, Crabbe says that DIN is regarded as "a possible model." But he notes that standards bodies in other parts of Europe are not entirely in agreement with all

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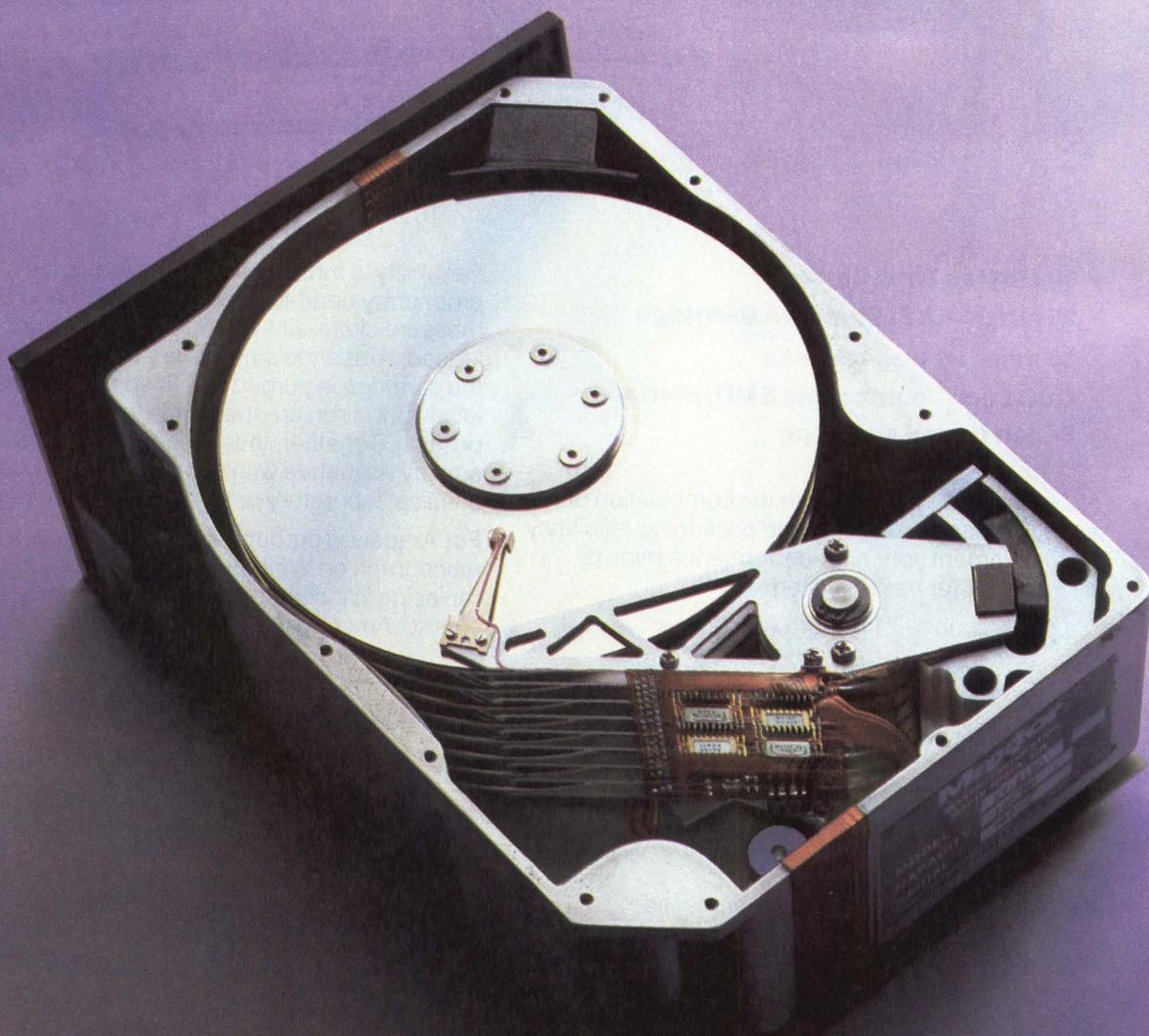


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aspects of DIN. (DIN, the German version of ANSI, is generally regarded as the most advanced organization in the formulation of precise human-factors specifications.)

Human factors consultant Tom Stewart of office systems consultancy Systems Concepts Ltd., London, reinforces Crabbe's point. He notes that standards formers in France, for example, do not like DIN's rulings on the dimensions of workstation desks. Stewart says the DIN rulings in general are considered too strict and precise, citing its rulings on character shapes as an example.

Crabbe at BSI adds that some aspects of the DIN standard are still in the draft stage, including those relating to character perceptibility and the workstation lighting and positioning in an office environment. Those that have passed the draft stage and are published cover character shapes, the grouping and formatting of data and the coding of information. Information coding embraces factors such as contrast, screen colors, symbol size and the frequency of flashing elements on the screen.

DIN's rulings favor a positive display with dark characters on a light background. One U.S. CRT manufacturer already following this



**A dark-on-light display, such as the one (shown) on TEC's ET80, is favored by Deutsche Institut für Normung standards. A 70-Hz refresh rate is employed to reduce flicker on the ET80.**

specification is TEC Inc., Tucson, Ariz., whose ET80 display shows black characters on a white background. Company product planner Hans Daniel claims this feature (reverse video) can improve operator productivity as much as 90 percent by reducing reflection. To reduce flicker, TEC uses a 70-Hz refresh rate on the ET80, compared with the 30 to 60 Hz on CRTs using light characters on a dark background.

ISO is not the only international standards group interested in human-factors standards. The European Computer Manufacturers Association also has a technical committee, TC 28, drafting human-factors proposals. ECMA secretary

general Dara Hekimi says ECMA will publish a technical report on ergonomics guidelines by the end of this year. He stresses that ECMA is interested in setting guidelines, rather than standards, but expects ISO to use the report in its standards work. The guidelines will cover areas such as keyboard dimensions, screen luminescence, character size and screen movability. Hekimi notes that TC 28 includes representatives from U.S.-based ECMA members as well as Europe-based members.

Although little workstation ergonomics legislation has been passed in Europe, the Hamburg, West Germany injury insurers association, Verwaltungs-Berufsgenossenschaften, has had its DIN-related rules added to the West German equipment safety laws. A copy of the rules is available from V-B for about \$20.

Some parts of the DIN workstation standard 66234 can be obtained in the U.S. from Ann Boles at publisher Heyden and Son Inc., Philadelphia. They are available only in German and include three parts, which sell for \$15 each and cover character shapes, character perceptibility and character grouping, respectively. Another part sells for \$19.50 and covers information coding.

—Keith Jones

## British seek U.S. users for VAX/VMS AI software

It is not surprising that the computer industry is looking to academia for software to support a technology still strongly influenced by academic institutions—artificial intelligence. One AI-oriented software package, POPLOG, which was developed at the University of Sussex, Brighton, England, for use

on Digital Equipment Corp. VAX/VMS minicomputers, is aimed at U.S. users. POPLOG combines the POP-11, LISP and Prolog languages with a powerful editor called VED. POPLOG is being used on VAXs at several European companies. Applications include constructing expert systems and image-recognition software for

military and robotics products.

POPLOG's group leader at Sussex, Dr. Aaron Sloman, describes POP-11—a virtually unknown language in the U.S.—as more verbose but easier to use than the much more familiar LISP. He notes that LISP is being used by POPLOG users only for teaching, but sees no serious obstacles to LISP applications being developed with POPLOG. He believes that LISP and POP-11 comple-

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ment the third POPLOG language—Prolog. “POP-11 and LISP can be used for manipulating lists and arrays,” Sloman says, “while Prolog can handle the higher level parts of an application.” He cites Prolog’s ability to derive inferences from relationships.

Sloman explains that all three languages are incrementally compiled into one intermediate language, which is then compiled into instructions for the host machine. Although the VAX/VMS operating system is the only host environment, Sloman says a Berkeley 4.2 UNIX implementation on VAX and a 4.2 version on an MC68000-based microcomputer will be available soon. The machine on which the implementations will be made has not been selected. Sloman says VED exploits the incremental nature of the compiler to allow a user to make compilations without leaving the editor. The user can indicate the language to be compiled by extending the name of the program with the suffixes “.P”, “.LSP” or “.PL”.

Users support Sloman’s claims about VED. David Connah, picture analysis project leader of the research laboratories of NV Philips, Redhill, England, says, since VED is written in POP-11, its facilities can be modified by a user, and its features can be added to application programs written in POP-11. Connah’s group is using POPLOG in stored-model picture-analysis work for robotics applications.

Brian Dougherty of missile builder British Aerospace, Hatfield, England, points to VED’s ability to edit many files simultaneously as a strength. Connah says POP-11 is like Pascal, but has all the features of an AI language without the “unnatural-looking” syntax of LISP. “LISP has too many square brackets,” Connah remarks, adding that Philips is unlikely to use LISP. The Prolog



**Dr. Aaron Sloman, POPLOG group leader at the University of Sussex, Brighton, England, believes the POPLOG artificial-intelligence package for the VAX/VMS computer is sufficiently debugged and safe for installation by U.S. users.**

part of POPLOG probably will be used later, he adds.

Martin Merry, AI section head at Marconi Research, Chelmsford, England, says POPLOG was selected because Prolog is needed for the expert-system shells his team is developing for use by various divisions within Marconi’s parent, General Electric Co. Ltd. Merry’s team is also using the POP-11 part of POPLOG, despite the fact that the team has no previous experience with the language. “It took us about a week to get to a level of familiarity

similar to Pascal,” Merry says. “We have yet to use other POP-11 facilities such as pattern matching. POP-11 is definitely good for processing arrays.”

British Aerospace also lacked POP-11 experience, says Dougherty. He says the POP-11 self-teaching facilities have been beneficial, and his team is beginning to “get into Prolog.” Details of the team’s work are secret, but they involve software development for tank and airplane recognition.

Sloman is confident that U.S. users can install POP-11 without help from a local support group. He points to the system’s extensive teaching and help files and the availability of source code to end users. Sloman says plans are in the works to strengthen POPLOG’s appeal to nonacademic users. Those plans include a handbook to complement the on-line teach and help files and maintenance documentation for end users. The U.S. price for POPLOG will be the same as in the U.K.—about \$5000 for the complete system. —Keith Jones

## Fiber-optic modem supports parallel-to-serial conversion

The large, diverse population of system integrators that use Centronics 600 series-compatible printers and terminals are potential users of a fiber-optic modem designed to handle Centronics parallel interface protocols. The product is being offered to the U.S. market by Systems Production Ltd., Farnborough, Hampshire, England, which is supplying—on an OEM basis—a unit conceptually similar to one offered by Versatec Inc.

Called the 5008 parallel data modem, the product is aimed

primarily at remote printing applications demanding immunity from electromagnetic interference, which is one advantage of fiber-optic technology. The 5008 also lifts speed limitations. It employs multiplexing techniques to convert 8-bit Centronics data and handshaking signals, such as busy and acknowledge, to serial bit stream for transmission over a single fiber-optic duplex cable. An identical transmitter/receiver at the other end of the line converts the bit stream back to parallel signals, rendering the link transparent to

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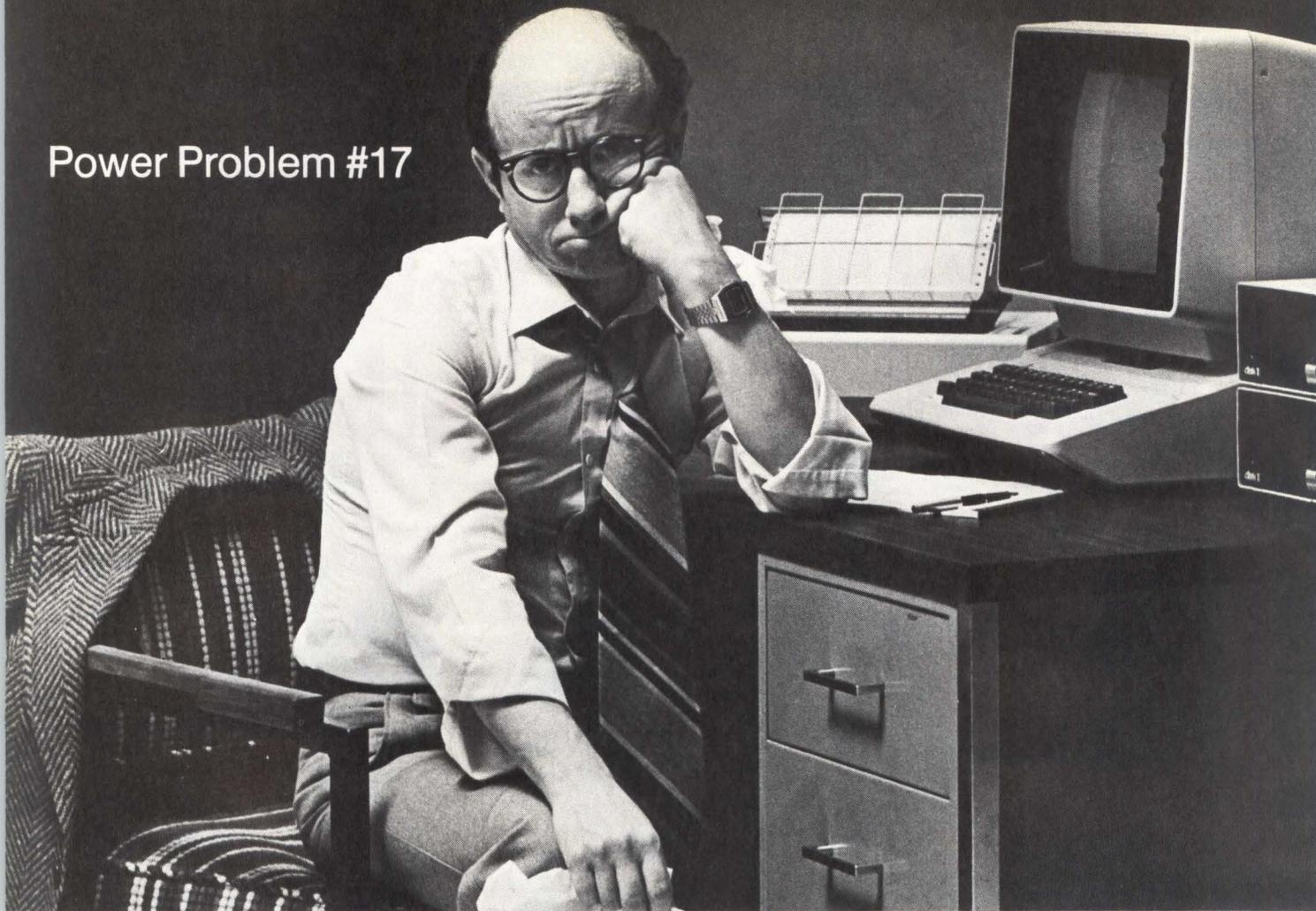
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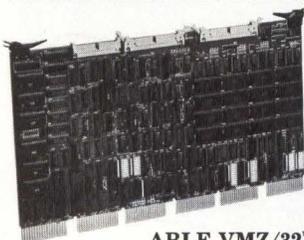
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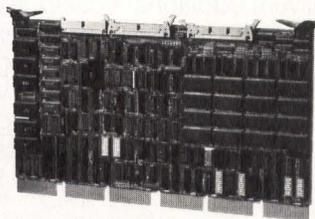
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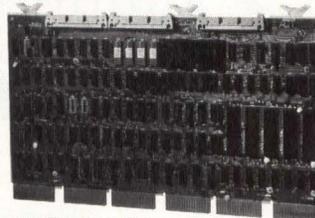
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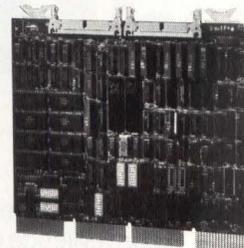
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the host computer and the terminal and eliminating the need for an RS232 interface.

One observer of the fiber-optic market, Don Gooding, senior analyst at The Yankee Group, Boston, notes that a number of U.S. companies are selling fiber-optic data modems at lower prices than that of the 5008. But he knows of no other product offering parallel-to-serial conversion. There are modems that provide parallel-to-serial conversion for conventional twisted-pair links, but they do not offer the data-security advantages inherent in fiber optics, such as immunity from line tapping.

Canoga Data Systems, Canoga Park, Calif., quotes \$495 as the price for its CSA 100 modem, which comes with one RS232 interface. It supports full-duplex communications at speeds as high as 100K bits per sec. Phalo Optical Systems,

Chatsworth, Calif., charges \$525 for the rack-mounted version of its lowest priced modem, the ODS 201.

Gavin Dyer, a manager at Systems Production, says his company's U.S. marketing plans will probably include OEM deals with manufacturers of Centronics-compatible printers. Under the agreement with Versatec, Systems Production is supplying a modem that Versatec will sell as the Fiber Optic Link. The modem is designed to handle Versatec protocols, but employs multiplexing techniques that are fundamentally similar to the 5008's for parallel-to-serial and serial-to-parallel conversion. Matt Warner, a support specialist with Versatec, Santa Clara, Calif., says the Fiber Optic Link will be available this or next month.

Versatec could not find a U.S. manufacturer with a modem accepting parallel input, Warner says.

## ENGLISH FIRM OFFERS OPTICAL DATACOMM DEVICE

European firm E.E.L., East Cowes, Isle of Wight, England, is attacking the U.S. market with an optical data-communications device. A subsidiary of Westland Helicopters Ltd., E.E.L. plans to sell the Data Link in the U.S. initially through Western Technologies Inc., Winston Salem, N.C., a Westland marketing subsidiary. E.E.L. offers a laser system called the Data Link, which comprises two identical full-duplex transmit/receive units priced at less than \$5000 each. The product is targeted at applications in which one data source is moving and could thus stretch or break a physical cable link. Maximum data rate for the Data Link is 19.2K baud.

E.E.L. manager Steve Tutton acknowledges that some U.S. manufacturers offer laser data-communications equipment with higher speeds. But he notes that the Data Link conforms with eye safety regulations specified by the British Standards Institutions. Those regulations render the product safe even if

its beam shines directly into a user's eyes.

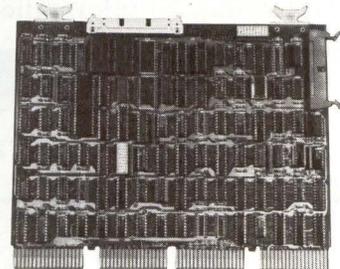
Data Link is equipped with a 20-mA current-loop interface. Tutton says the Data Link was developed for internal use in collecting test data from models of prototype Hovercraft on towing tanks.



*E.E.L.'s Data Link laser system combines two identical full-duplex transmit/receive units, each less than 1 ft. high. The link is useful in applications in which one data source is moving, and eliminates the possibility of a physical line's stretching and breaking.*

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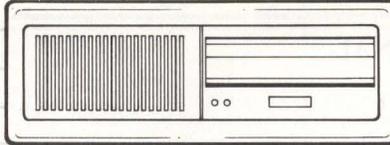
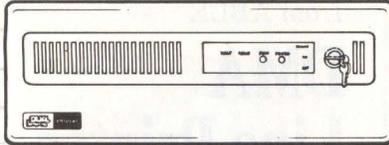
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"The Fiber Optic Link has been specifically designed to handle Versatec's parallel language," he says. Systems Production's Dyer notes that the agreement with Versatec prevents Systems Production from selling the unit to users of Versatec plotters or competing electrostatic plotters.

The 150K-byte-per-sec. speed of the Fiber Optic Link is an important feature. The speed approaches the speed of Versatec's plotters. The 5008 offers similar speed, but speed is less vital to vendors and users of Centronics-compatible units whose applications involve only alphanumeric printing. Dyer points to benefits other than error-free, secure communications, including the cost savings of using a single fiber-optic cable that can run several miles rather than using telephone lines or twisted-pair wires with repeaters every 1000 ft.

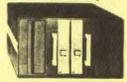
David Goddard, U.K. support manager with Versatec, worked with Systems Production on the development of the Fiber Optic Link. He estimates that using fiber-optic cable costs only one-third to one-fourth the cost of conventional twisted-pair wires. The major expense is the cost of the two 5008 units—about \$3000.

George Fritkin, marketing vice president of Canoga Data Systems, a leading fiber-optic modem manufacturer, says that his company offers no Centronics-compatible unit like the 5008. He says Canoga has no plans to offer such a product, and believes no substantial market exists for it. But Richard McCaskill of Phalo Optical Systems, another major vendor, says Phalo Optical is test marketing a unit like the 5008. Hinting at a possible deal with Systems Production, he says he would "like to talk" to Systems about its product.

—Keith Jones

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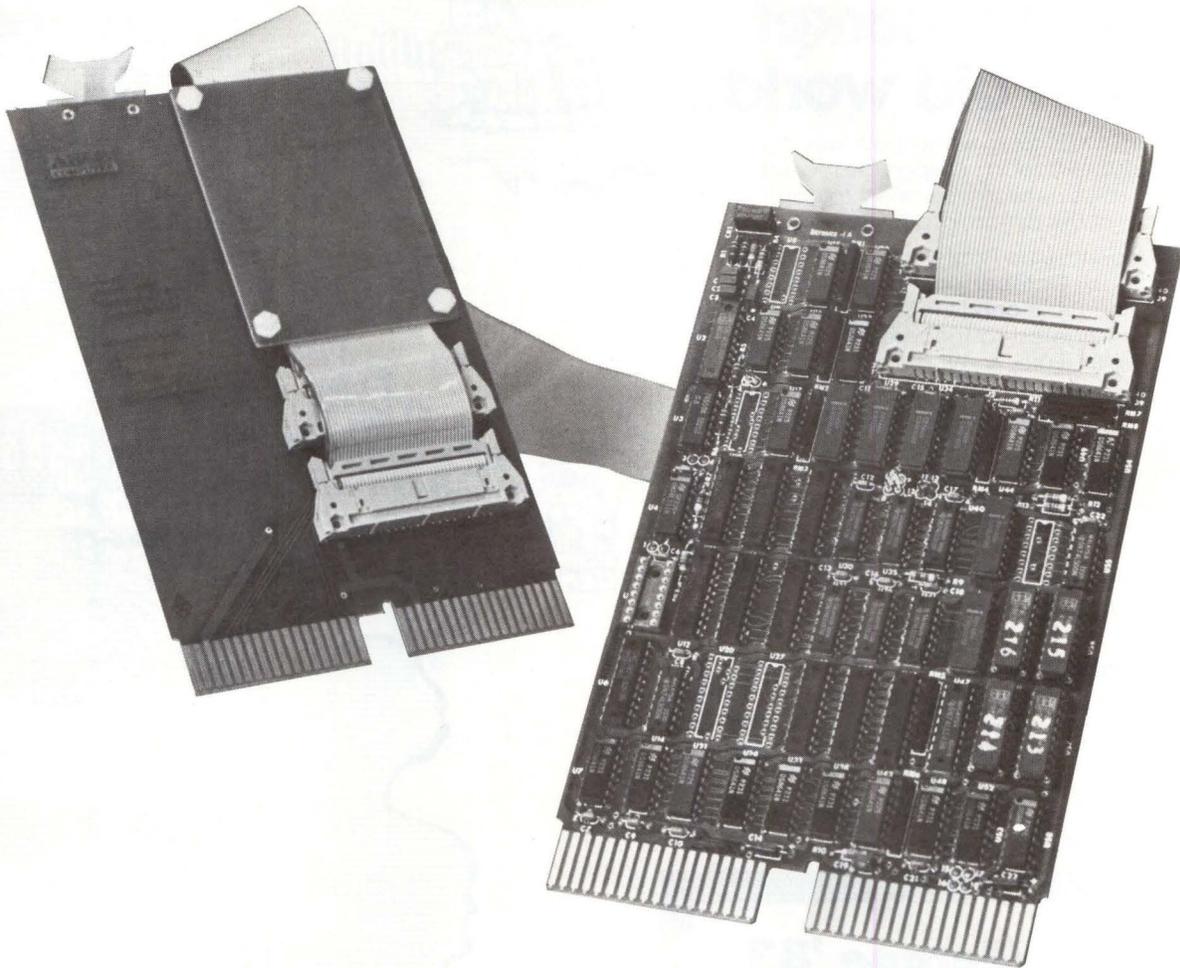
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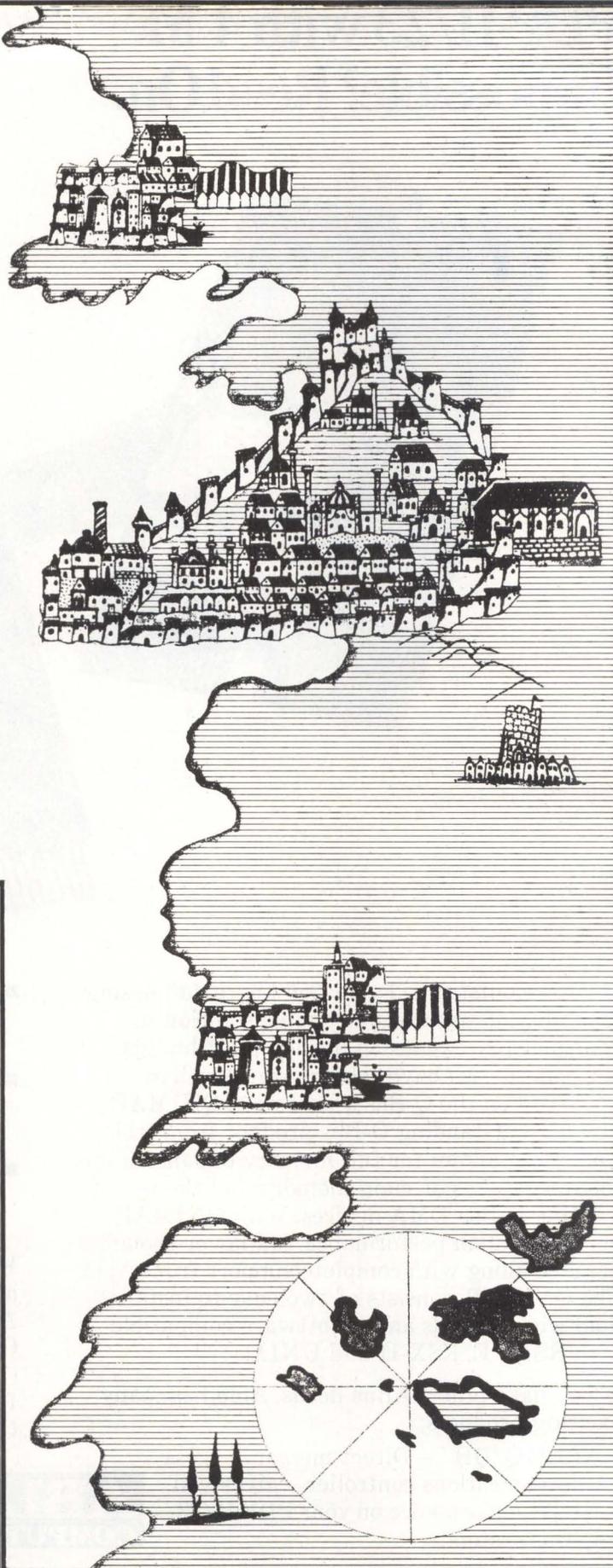
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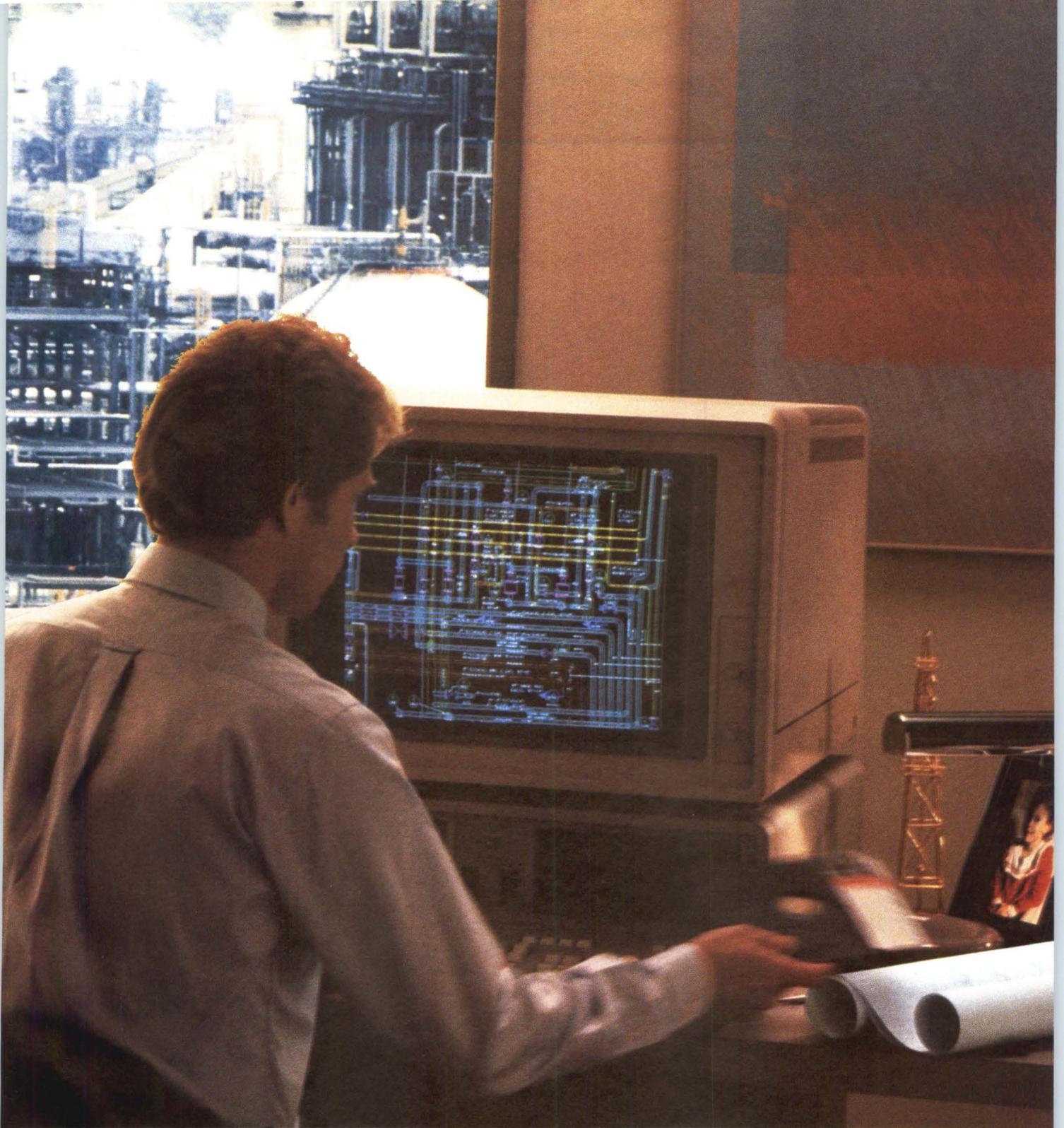
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- For high-resolution color graphics and lower costs, Tektronix uses TI's TMS4416 64K DRAM in its top-of-the-line graphics terminal (*Page 2*).
- TI's comprehensive choice for microprocessor-based systems: 64K DRAMs, static RAMs, controllers, and comparators (*Page 3*).
- First low-cost 64K DRAM chip carrier doubles the density of DIPs and provides all the advantages of TI plastic J-lead design (*Page 4*). ▶

# TI's new memory

125 MHz pixel-rate performance. With memory part count cut by 75%. And cost savings more than 50%. The unique TMS4416 16K × 4 DRAM from Texas Instruments is the first 64K dynamic random-access memory (DRAM) in the world that could provide this performance at that price. And that's why it was chosen for the new, advanced Tektronix 4115B Computer Display Terminal.

Designed for the most demanding CAD/CAM applications, the Tektronix 4115B features a high-resolution color raster-scan display. This 60-Hz, non-interlaced, flicker-free display provides resolution of 1280 × 1024 pixels. Up to 256 colors can be displayed at one time from its palette of 16 million colors!

## System-wide cost savings

By upgrading from four 16K devices per single in-line package to one TMS4416 ByFour\* DRAM (see photo), Tektronix cut costs by more than 50% and memory part count by four times.

System costs also were lowered, due to fewer interconnects and support circuits. This reduced inventory, cut power requirements, and enhanced reliability.

## Lower power, higher reliability

With one 5-V power supply at 130 mW per 64K, the TMS4416 significantly cut power consumption. This increased power supply margins and reduced noise. Plus, lower heat dissipation and fewer interconnects improved system reliability.

Equally important, TI met Tektronix's critical delivery schedule.

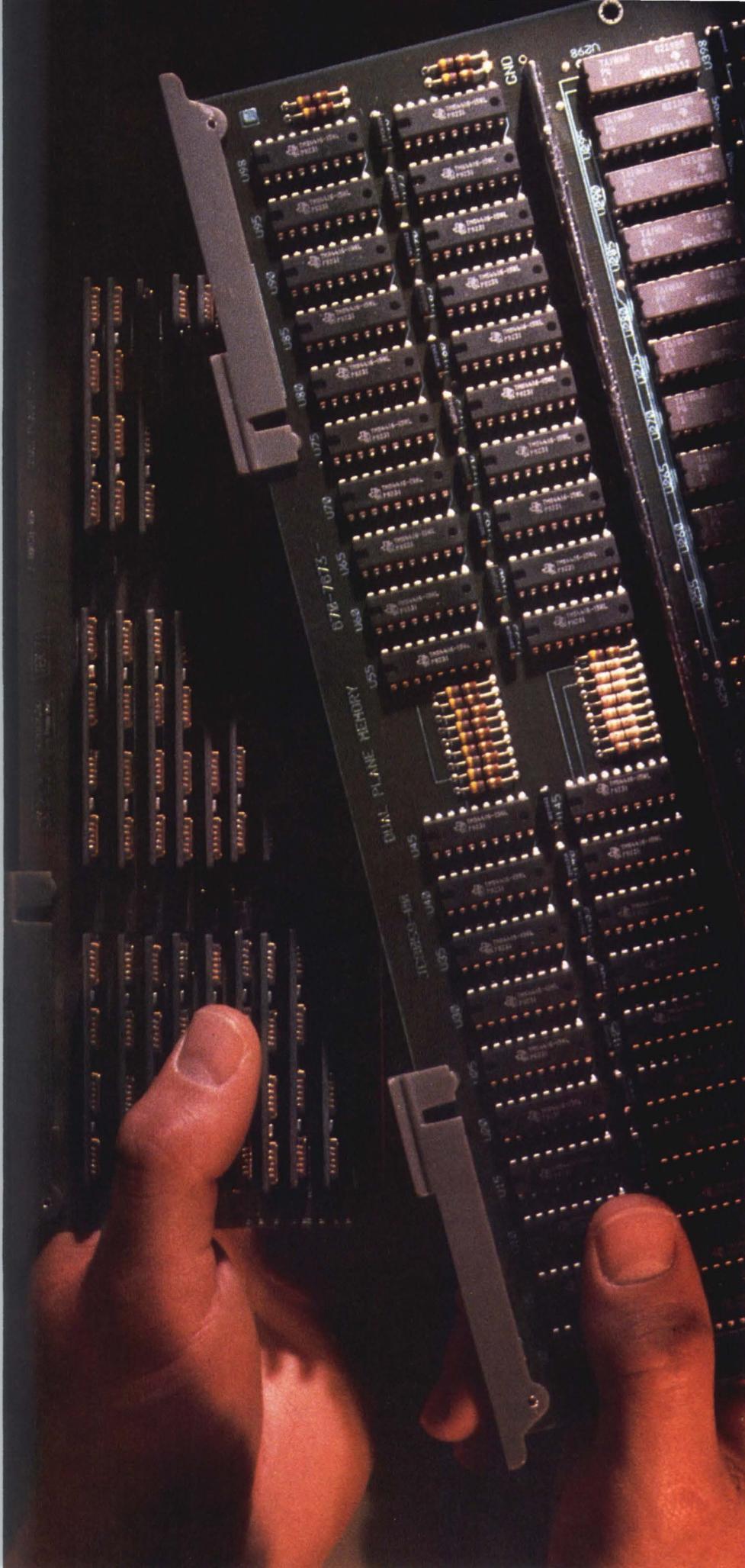
## Meets many design needs

Where can the TMS4416 help you? In personal and small business computers. Intelligent terminals requiring 16K- and 32K-byte memory modularity. Single-board microcomputers. And more.

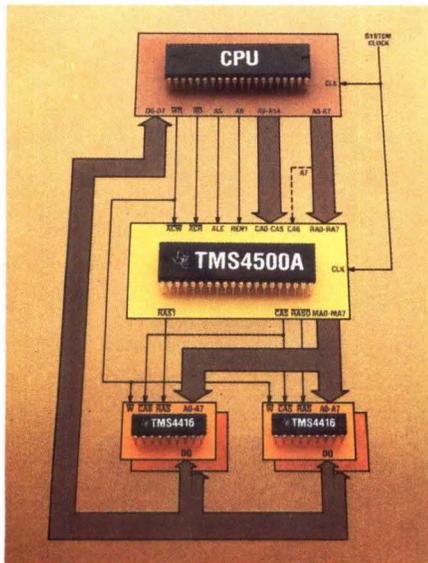
The output/enable feature makes interfacing the TMS4416 with microprocessors simple. ■

◀ **An exceptionally "clean solution,"** TI's TMS4416 16K × 4 DRAM enabled Tektronix to reduce memory component count by four in its new 4115B Computer Display Terminal. Each TMS4416 replaced four 16K devices mounted on a single in-line package.

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# 16K x 4 DRAM cuts costs by 50% for Tektronix.



For a cost-effective, low-power memory system that uses minimum board space, combine the TMS4416 or the TMS4164 64K DRAM with the TMS4500A.

## One TI chip links DRAMs with CPUs.

TI's TMS4500A DRAM controller saves design time and IC costs.

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Highly versatile, the TMS4500A interfaces with all popular microprocessors. And is compatible with DRAMs from 4K up—from any manufacturer.

Think of the board space and time savings and power reductions possible when you combine TMS4416 or TMS4164 64K DRAMs with a TMS4500A.

Using the TMS4500A, you can easily handle up to 256K bytes per controller with TMS4416s or TMS4164s. With additional decodes, you can go to 512K bytes and more.

For details on the TMS4500A, check number 1 on the next page. ■

## TI's fast 64K DRAM just got faster.

Now, TI's pacesetter TMS4164 64K x 1 DRAM comes in a still speedier version. Our new TMS4164-12 provides 120-ns access time, 230-ns cycle time, and just 175-mW typical power consumption per device. Two other speeds also are available: 150 and 200 ns.

We've also taken another positive step. To increase board density and lower costs, the TMS4164 now can be yours in 0.285 in. x 0.425 in. plastic chip carriers.

Like the TMS4416, the TMS4164 requires only a single 5-V power supply. This—combined with fewer sense amplifiers—reduces power dissipation and increases system reliability.

In addition, both the TMS4164 and the TMS4416 employ interlocked internal clocks, which provide more precise timing sequences. This allows all chips to run at maximum speeds without the danger of race conditions. And these clocks reduce power consumption by ensuring that each clock is activated only as long as necessary.

When you need high-quality 64K DRAMs, rely on TI's two outstanding choices. For high speed and low power, select the TMS4164. For high bandwidth and modularity, choose the TMS4416. Both are cost effective. Easy to design with. And state of the art.

For more information on the TMS4416 and TMS4164, check number 2 on the coupon. ■

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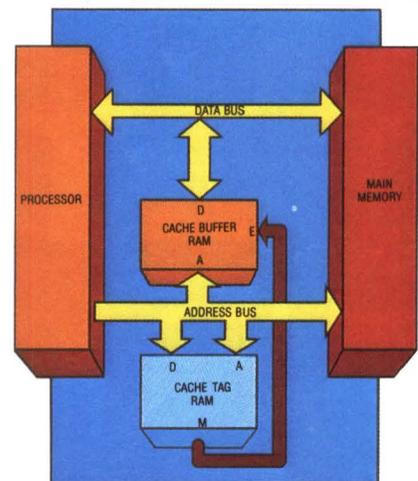
and single 5-V power supply. And operates at 120, 150, 200, or 250 ns with 385 mW maximum power dissipation.

For more facts on the low-cost TMS4016, check coupon number 3. ■

## New cache-tag comparator speeds system throughput.

TI's new TMS2150 cache address comparator can improve high-performance microprocessor or bit-slice system throughput by up to three times. Plus reduce cache memory IC count, board area, power dissipation, and cost.

With the TMS2150, no wait states need to be implemented in microprocessor access cycles in response to slower-cycling DRAMs. The TMS2150,



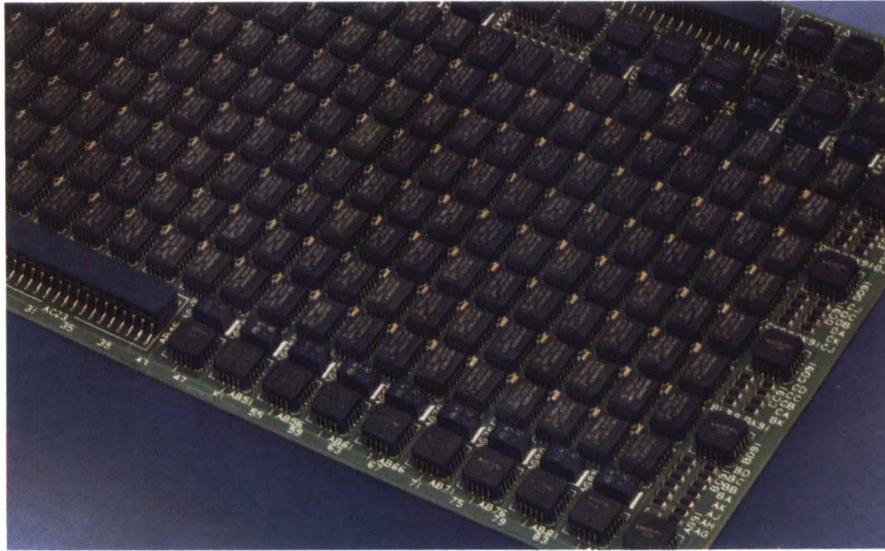
High-speed cache memory systems utilizing the TMS2150 will enable high-performance microprocessors to set new cost-performance standards with large, low-cost dynamic main memory.

in combination with high-speed static RAMs, completes an entire high-performance cache memory system. With a maximum 45-ns delay from address to match valid, the TMS2150 can provide TTL performance at one-tenth the part count and 10% the power.

Operating from a single +5-V power supply, the TMS2150 consists of a high-speed 512 x 9 static RAM array, parity generator and checker, and a 9-bit high-speed comparator.

For more specifics, check number 4 on the coupon. ■

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# Mini-Micro Interpreter

An analysis of news, issues and trends affecting the computer industry

## Committees, vendors chase elusive networking standards

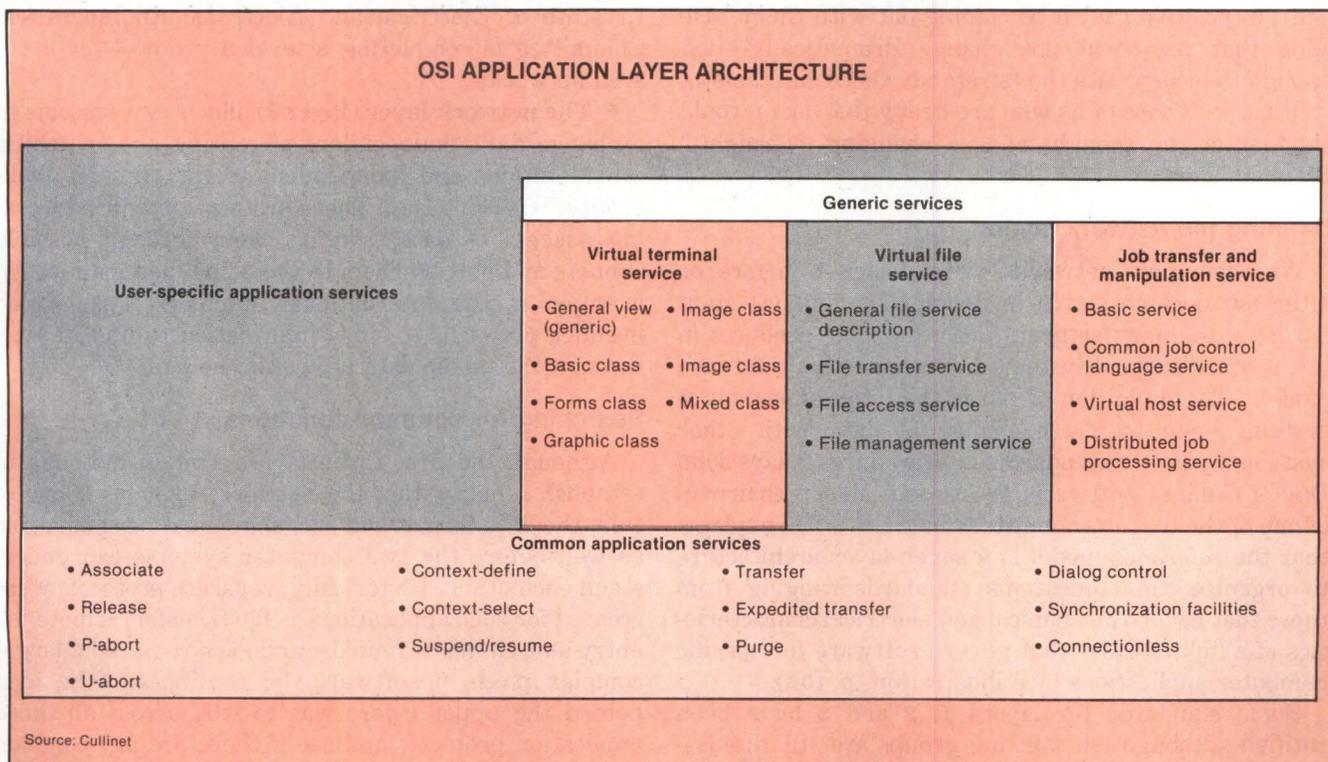
By Sarah Glazer

When two people talk, psychologists tell us, they depend as much on tone of voice, eye contact and other nonverbal cues to communicate as on words themselves. It's ritualized, learned behavior. And the most ordinary conversations can differ dramatically from culture to culture. So it is when computers talk to each other. The ritual of establishing a link, starting, stopping and verifying transmission must be followed exactly if communication is to take place. And as with human cultures, the entire process can differ dramatically from network to network.

Until very recently, a lack of communication between different manufacturers' networks was the rule. Significant differences in manufacturers' communications protocols kept their networks virtually incommunicado. As networking became more common and as increasing numbers of companies used equipment from more than one manufacturer, machine-to-machine communication

becomes even more complicated.

Various companies and groups have devised proprietary networks to satisfy specific communication requirements. Some of the more widely used networking schemes are IBM Corp.'s Systems Network Architecture, Digital Equipment Corp.'s DECnet, the Department of Defense's Arpanet and Xerox Corp.'s Xerox Network System, says Ralph Dement, manager of strategic planning for DEC's distributed systems group, Tewksbury, Mass. "Basically, the networks all provide the same services," he says. "However, each of us has taken a different tack as to how we wish to implement the services our products provide in a networking environment." Reflecting these differences, each type of network has its own protocols. "They all differ," Dement explains, "in the nature of the way the fields are set out, how big the fields are and what information is within a field." While this tailoring may give each kind of network a character well-suited for particular environments, it makes straightforward communica-



Historically, people developed protocols to facilitate communication among computer systems for different applications. These protocols are often large, complex pieces of software, and if a new system is brought in, a whole structure must be developed for it. The aim of the application layer, as of the three layers below it, is to reduce redundancy by pulling out common functions and making them standard.

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# The Interpreter

tion among networks impossible.

Exactly how this incompatibility will be overcome is still unclear. Although most industry observers are confident that standards for network communications will appear soon, they are divided on the source of these standards: whether they will be released by the International Standards Organization or be de facto standards, determined by which computer company has the largest share of key markets.

In the de facto camp is Dale Kutnick, director of market research at The Yankee Group, Boston, a research firm specializing in communications. He says IBM's SNA is the predominant de facto standard and will remain so. Whereas SNA is a comprehensive architecture, other de facto standards may emerge for specific environments. "All the minicomputer vendors are announcing SNA products," he says, "and the market for independents will be in subnetworks to SNA."

Championing the ISO approach is Sheldon Blauman from Boeing Computer Service Co., Seattle. Blauman founded the Network Users Association, a nationwide group that deals with networking problems, and serves as head of the NUA's standards committee. "IBM has been one of the drivers of the standards process," he says. "They're heavily committed to the ISO protocols, and I'm positive they'll be coming out with them." He adds that SNA will not change dramatically—just enough to incorporate the ISO standards within the SNA structure. "Those of us who are heavy IBM users would shudder at the thought of SNA changing overnight," Blauman says.

## Defining the network layers

Whether their networks were designed before or after ISO became active in developing network standards, most manufacturers describe their products in terms of ISO's Open Systems Interconnection reference model. "The definition of OSI is the interconnection of systems open to the exchange of data with other systems by use of standardized procedures," says John Day of Cullinet Software, Westwood, Mass., chairman of one of the OSI subcommittees in the U.S. He explains that the reference model is a seven-layer architecture to organize communications standards ranging from those that govern mechanical and electrical characteristics of a link to those that govern software for specific computer applications (see illustration, p. 106).

Some standards for layers 1, 2 and 3 have been ratified, although ISO working groups are still discussing additional proposals for these layers. Robert Blanc of the National Bureau of Standards, Washington, D.C., explains that the first three layers define the interface

between a host computer and the network. "They establish a link between one computer and another computer somewhere in the network," he says.

- **The physical layer (layer 1)** "provides mechanical, electrical, functional and procedural characteristics to establish, maintain and release physical connections," says Day of Cullinet. The physical layer covers the kind and number of wires, the kind of signals and the voltages that can be used. Day cites RS232 and V.28 as examples.

- **The data link layer (layer 2)** includes ensuring that data get from one computer to another. "We can send information in the 'send-and-pray' mode or can send it in a mode that gives some indication that the information has been delivered," says Paul D. Bartoli, a supervisor of international standards planning for American Bell, Lincroft, N.J. He notes that the earliest protocol in common use was binary synchronous, in which the receiver must acknowledge each packet of information before another can be sent.

An example of a more recent layer 2 protocol is High Level Data Link Control, says Day of Cullinet. Using HDLC, computers in a network can send information simultaneously, each sending a number of packets before waiting for acknowledgement. In the U.S., the Institute of Electrical and Electronic Engineers 802 Committee is completing a level 2 protocol for local-area networks.

- **The network layer (layer 3)** allows two systems to exchange data "independent of routing and switching considerations and independent of the transfer technology," explains Day. These protocols handle addressing packets of data, routing them through possible subnets and getting them to their final destination. An example is the international standard X.25, which includes protocols to allow information to find its way through the public data networks, he adds.

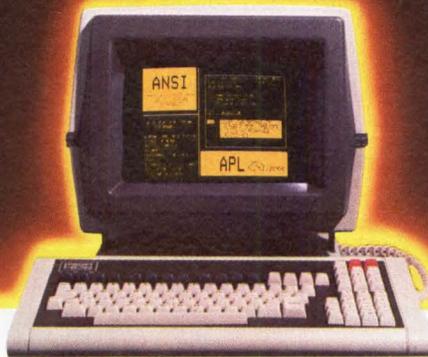
## Searching for common functions

Although the first three layers contain methods to establish a link within the network, explains Blanc of NBS, the data format and exchange must be compatible as well before the two computer systems can understand each other. Historically, separate protocols were created for such applications as file transfer, remote job entry and virtual terminals, and each required a large, complex piece of software, he continues. "The idea behind the upper layers was to look across all those application protocols and see if there are any common functions that can be pulled out and defined so they don't have to be repeated," Blanc says.

- **The transfer layer (layer 4)** contains one such set

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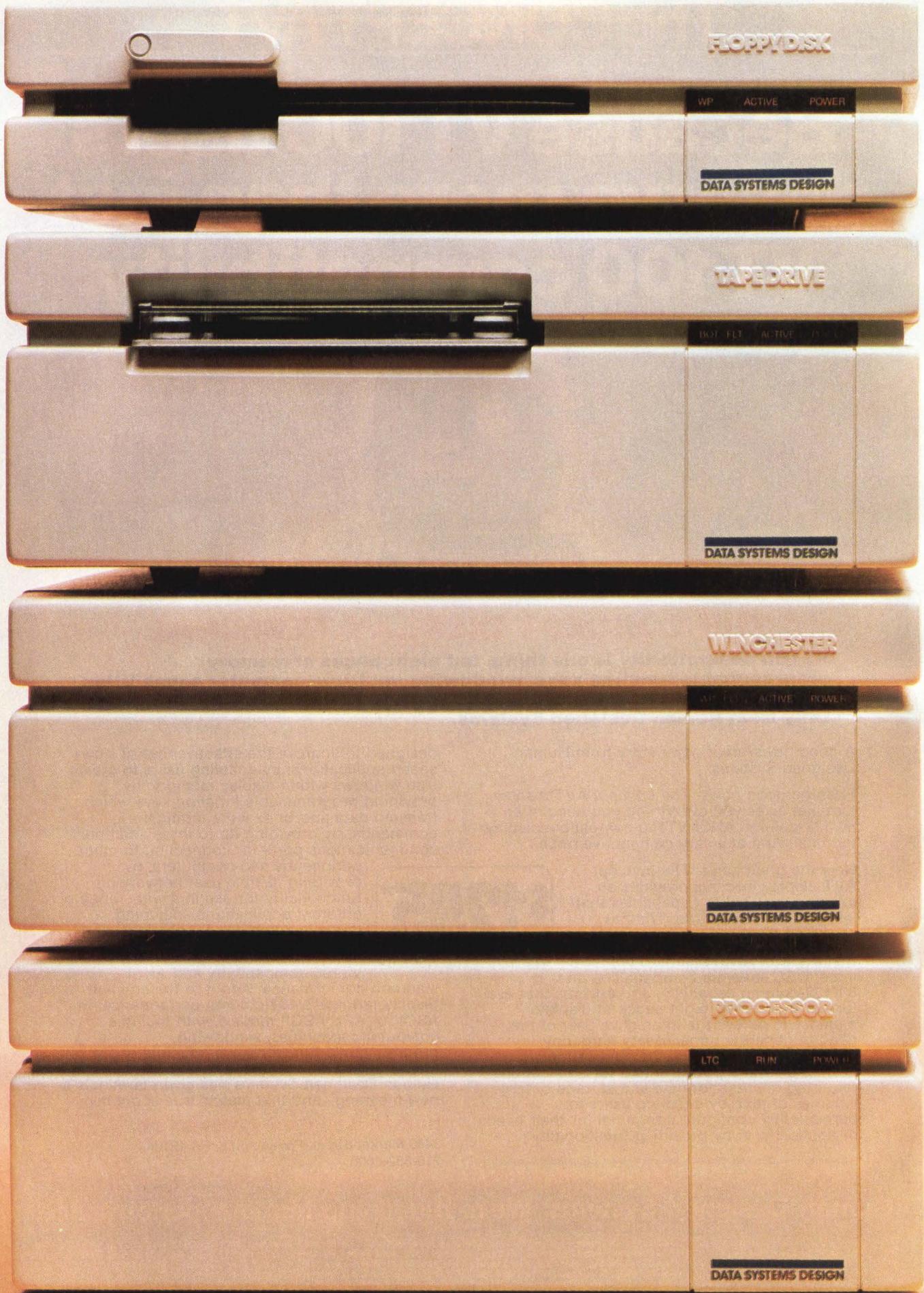
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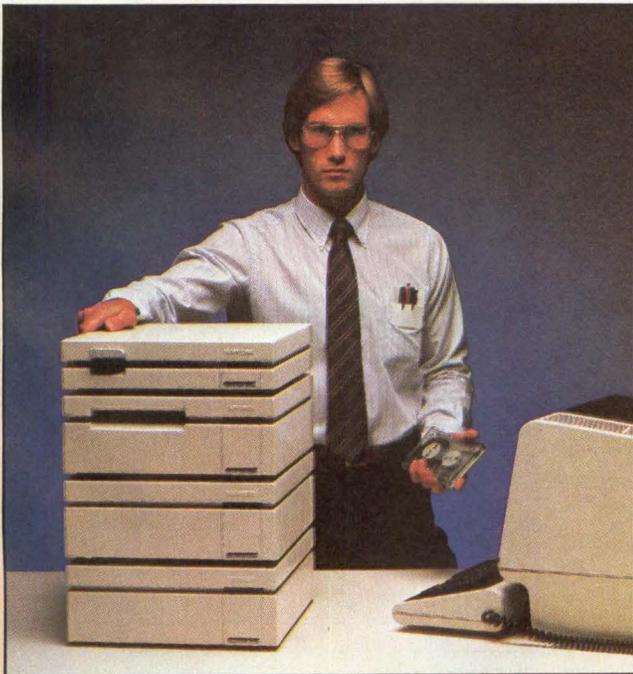
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# The Interpreter

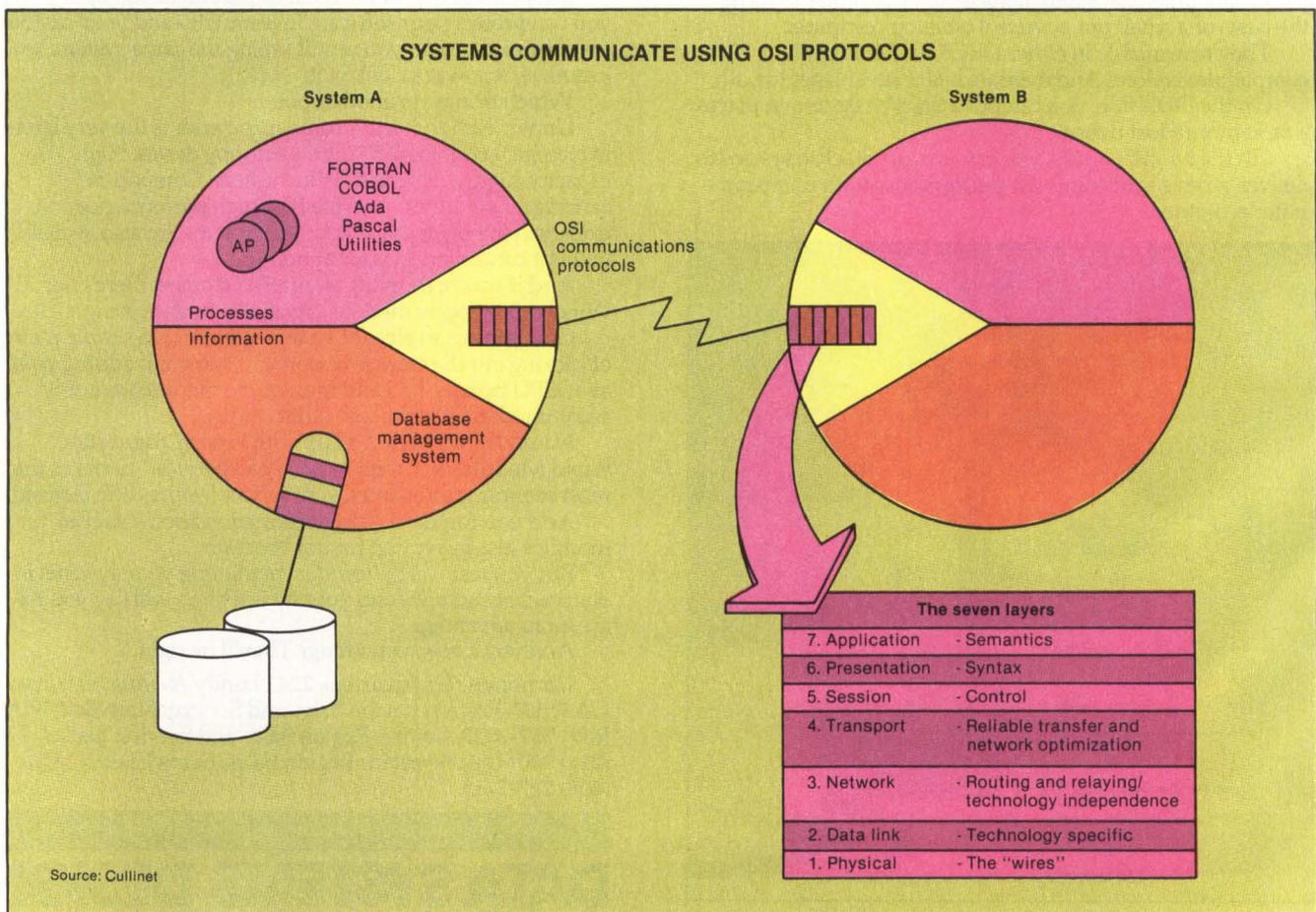
of functions—those for end-to-end error and flow control. “They make sure that the receiving end is ready to receive, that the sending end is ready to send, that the connection is established, that nothing has gone wrong during this process, that the connection is torn down and that both sides know it’s torn down at the same time,” Blanc explains.

Although standards are not yet released, voting on an ISO draft proposal for the transport layer should be complete by July. “You could pick up the draft transport document today and start looking at implementing it,” says Cullinet’s Day. In addition, the NBS is planning a demonstration of the transport level for the summer of 1984 that will include computer systems from a number of companies. Blanc says of the transport layer, “Agreements have been reached,” although he emphasizes that it was difficult because these protocols will have a major effect on how well the overall system works.

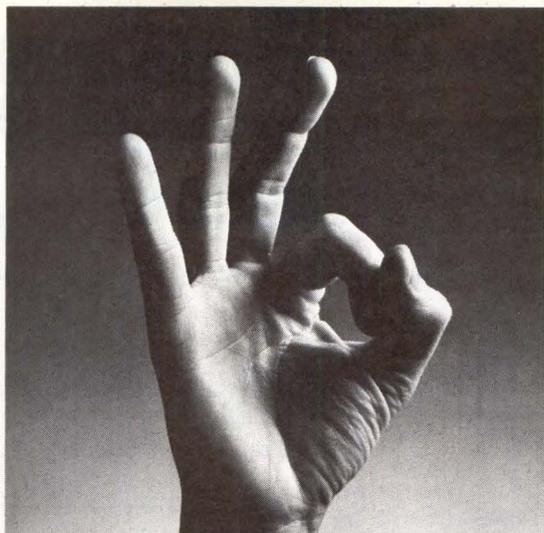
- **The session layer (layer 5)** synchronizes and structures the data exchange to augment services available from the transport layer, says Day. It orchestrates the session itself once the computers are ready to start. Day expects this standard to be final at about the same time as the one for layer 4. Voting on a draft proposal should also be complete by July.

Blanc characterizes these middle layers as the most complex from a standards maker’s point of view because they attempt to be the most universal. “At the lower layers, the protocols are technology dependent,” he says, “and at the highest layers, they might be more application dependent.”

- **The presentation layer (layer 6)** defines the form of data at its source, during transfer and at its destination. “Data is stored differently in different types of computer systems for different applications,” says Blanc. Each network must have a common format into which data can be translated for exchange.



**Standardized communication protocols** would allow computer systems to exchange information even if other software in the two systems is incompatible. Although there wouldn't necessarily be seven pieces of software to conform to the seven layers, says Paul Bartoli of American Bell, the system would have to be able to provide the communication services shown here.



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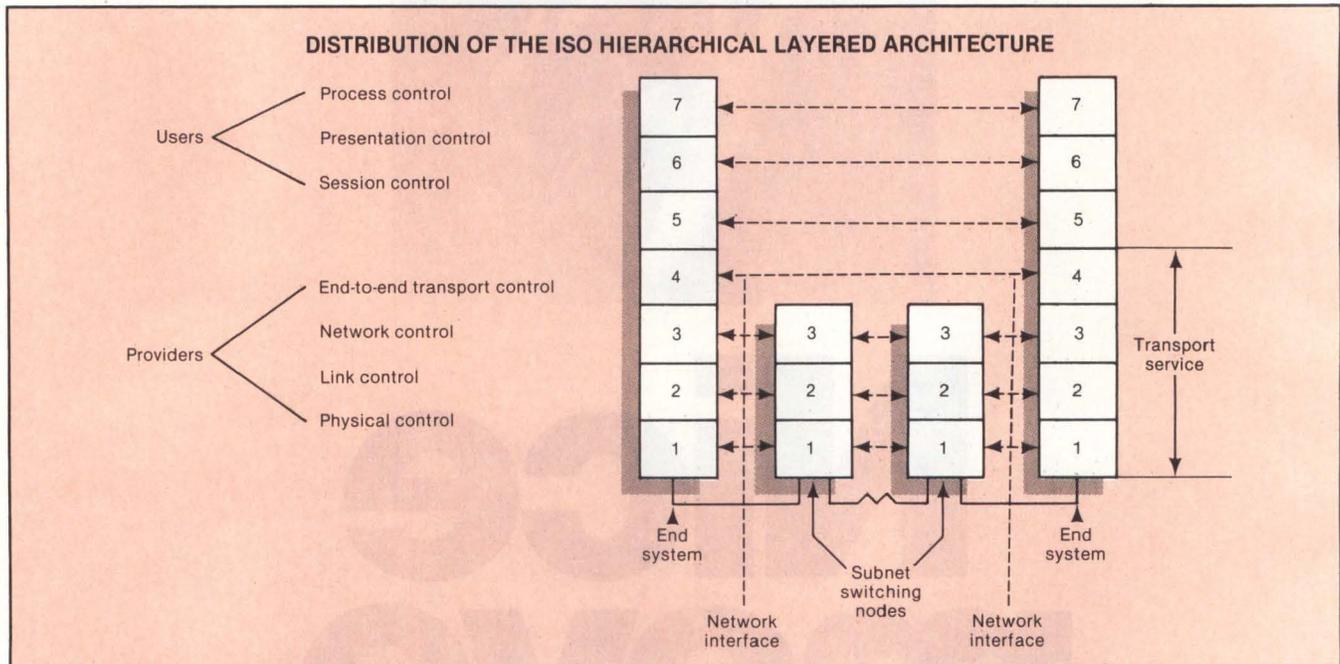
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# The Interpreter



Only the lower layers of the OSI model deal with the actual routing of information through the network. At the upper levels, end users need protocols that will make their data understandable to the receiver at the data's final destination.

"Unfortunately," Blanc notes, "you can't define one such transformation for all applications." He believes there will be several presentation protocols. A standard for the presentation layer is not yet in the draft proposal stage, but Cullinet's Day believes it will be "technically stable" by early fall.

• **The application layer (layer 7)** provides those communication services directly available to a computer application, says Bartoli of American Bell. "There are some common elements available no matter what the application is," he notes, "for example, the ability to set up a connection into the network." In addition, there are several commonly used communication functions such as file transfer, remote job entry, graphics and virtual terminal. The aim of standardizing these functions is to reduce redundancy. "It won't be necessary for a particular application to define file transfer, for example, because it will be taken care of by common application services," Bartoli explains.

Cullinet's Day says draft proposals for application-layer protocols will start appearing by this fall. When the standards are ratified, the aggregate international market "will provide incentive to develop those standards and put them in off-the-shelf computer products," says Blanc of NBS.

## The de facto standard

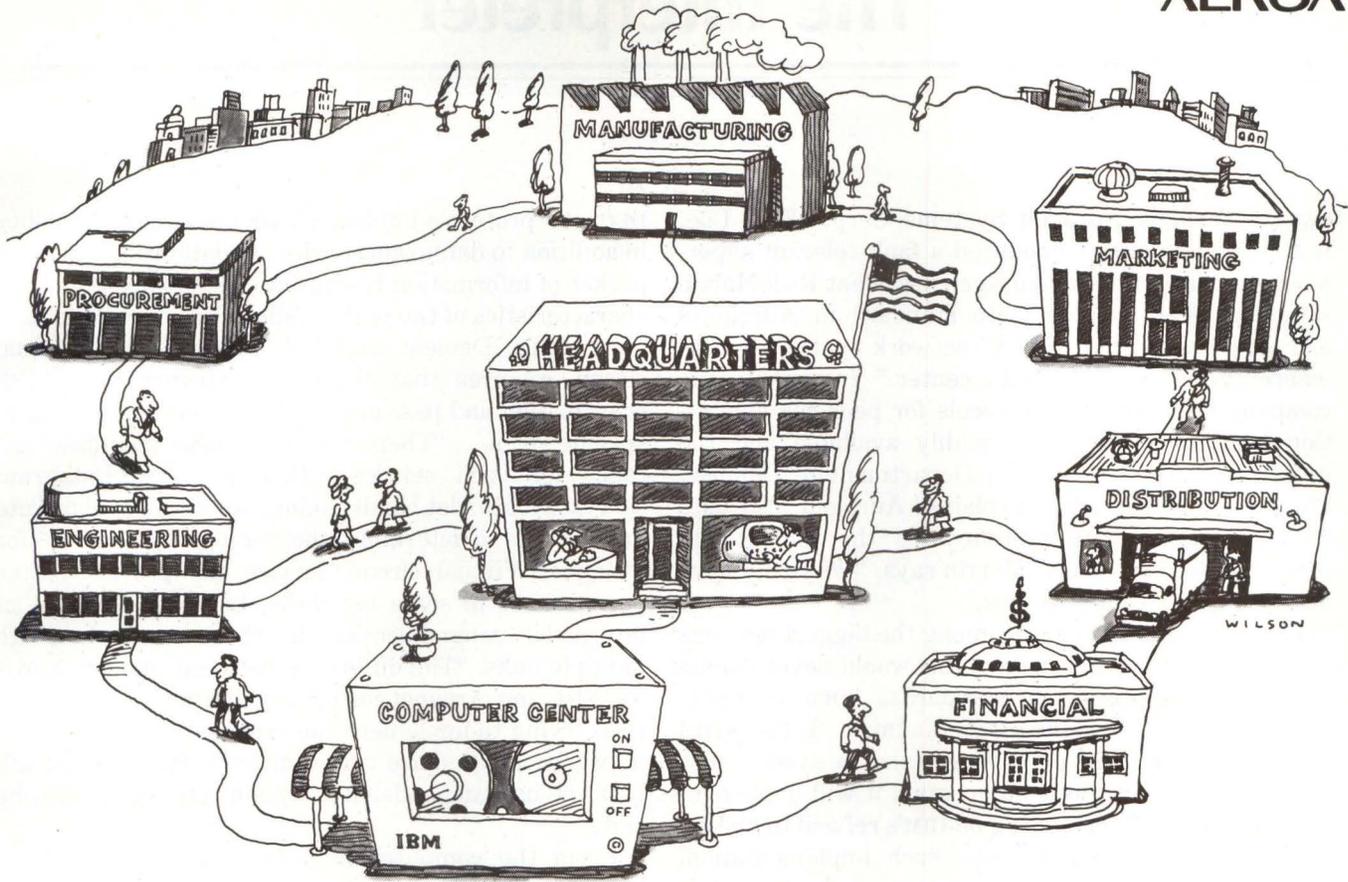
Although ISO activities are going full tilt, even their most enthusiastic supporters concede it will be more

than a year before upper-level OSI protocols will be available. "I think you're going to be able to buy these protocols starting in 1985," says Blauman.

"That's too late," says the Yankee Group's Kutnick of the OSI timetable. By 1985, he says, 55 to 60 percent of IBM's large customers will have networks under SNA. "OSI will have to get closer to SNA rather than vice versa," he says. Non-IBM networks, he predicts, will be "subnetworks to SNA," and he points to a proliferation of SNA-gateway products from other computer vendors as proof. Among these gateways are products from DEC, Data General Corp., Hewlett-Packard Co., Honeywell Information Systems Inc., Burroughs Corp. and Tandem Computers Inc.

Larry Twaits, product manager for DEC's SNA gateway, which became available as a DECnet product this spring, says the market for the gateway consists of DEC's largest customers. He says DEC tried but failed to integrate parts of its architecture directly with SNA. "The two networks are very, very different; they just don't do the same things," Twaits says. He calls the gateway "a function translator." The two architectures are so different, it's impossible to map layer into layer by simply translating DEC protocols into SNA protocols. Facing these problems fuels DEC's commitment to developing standards, he explains. "General interconnection is good for DEC and for our business," says Twaits.

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# The Interpreter

own network is Auragen Systems Corp., Fort Lee, N.J., which recently announced a fault-tolerant super-microcomputer system. Auragen president Rick Martin says that SNA is a de facto standard in Auragen's market because "our kind of network typically exists where there's one big data center." Internally, the company uses Arpanet protocols for peer communication because software is readily available and the protocols, developed for the Department of Defense, are not proprietary, he explains. Auragen also uses X.25 protocols if its system uses the public data network. But externally, Martin says, "We really have only to be able to talk to IBM."

Despite SNA's dominance among the biggest network users, some observers believe IBM would never use its weight to suppress OSI standards. "IBM is really pushing for OSI," says the NUA's Blauman. "It takes IBM longer because it's so much larger and its system is so much larger, but there's no question it will implement the standards." Commenting on IBM's refusal to make a public policy statement about such implementation, Blauman says, "IBM would never make a public announcement, but you don't need one."

Day of Cullinet has a more cynical view of IBM's voluntary implementation of OSI standards. "They say they'll make a seven-layer system to comply, but I guess they'll be dragged to it kicking and screaming," he says. He does believe, however, that IBM will eventually move toward OSI.

"Historically, IBM has been very active in standards issues," says Kenneth Bosomworth, president of International Research and Development Inc., Norwalk, Conn. They have opposed standards in some cases, he says, and sabotaged them in others. "Yet there are times," he adds, "when they've been against standards but have finally capitulated and gone along with them." He believes in this area that both SNA and the OSI model will be adjusted somewhat to reach a compromise.

## The products—present and future

Because of the lack of standards, implementations of network software differs considerably. Most are closely tied to specific hardware, available either from computer manufacturers for their own networks or from manufacturers of network controllers.

The differences in software, says DEC's Dement, are less a matter of the kinds of services provided than of "how rich a family of services you have—whether you have options between two protocols." As an example, he compares DECnet's protocols with those for the Xerox Network System. The Xerox NS protocols provide a pure datagram service, he says, while

DECnet's protocols implement virtual circuit capability in addition to datagram service. In datagram service, a packet of information is sent into the network, and the characteristics of the path it follows are developed as it goes along, Dement explains. In contrast, a virtual circuit requires that the two participants establish coordination and pass data back and forth according to specific rules. "There are advantages and disadvantages for each service," Dement says. Datagram service avoids a lot of handshaking, but requires elaborate mechanisms to determine whether a packet arrived, for example. Virtual circuit service can provide better performance in some networks, but requires a lot of internodal communication in those networks with multiple links. "The difference between DECnet, Xerox NS, SNA and Arpanet vary," says Dement. Because of this, trying to implement the same service in different networks may require very complex software, especially if one user depends on a certain class of service, he adds.

From the computer manufacturers, the need for interconnection grew out of their traditional business, but interconnection represents the primary business for other companies. One such company, Associated Computer Consultants, produces a variety of protocol processors to link DEC minicomputers with a number of manufacturers' mainframes. A new product described by ACC's Gary Krall is an "X.25 Ethernet bridge," which he says will allow several Ethernet local-area networks to communicate across the public data networks. "In doing this, we're following the OSI model in some respects," Krall says, "But we're also implementing the NS standards by Xerox, where they're used in the Ethernet environment." Krall adds that ACC is an active supporter of standards activities.

Blauman of the NUA anticipates a time when users will be able to obtain standard communication protocols from a variety of sources. He predicts that products conforming to OSI will be available within two years from "quite a few sources"—third-party manufacturers and mainframe manufacturers. Blanc from NBS notes that the lower level protocols such as Ethernet are being implemented on LSI chips, thus reducing the cost of network interfaces.

Higher level protocols won't be as simple to implement, says Blanc, but should also be available as off-the-shelf products. Kutnick of the Yankee Group agrees, but he predicts these packages won't first come from independent software vendors. Communications products, he says, will continue to come primarily from companies that supply hardware. □

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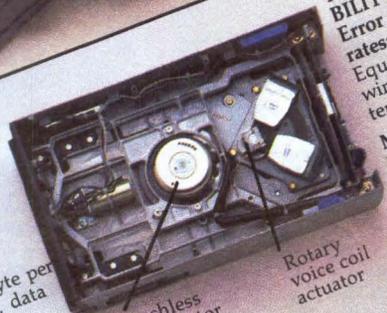
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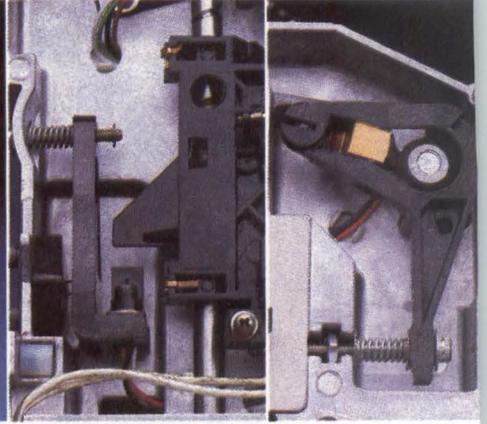
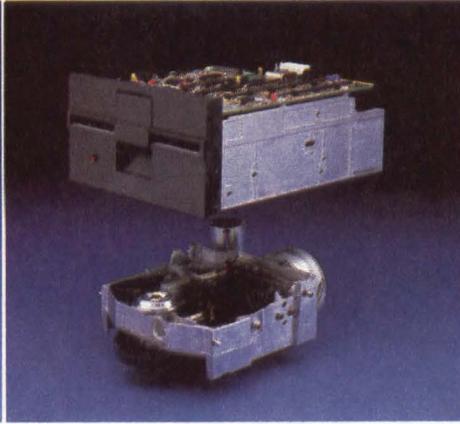
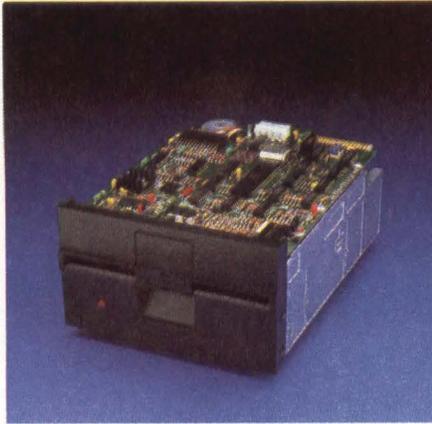
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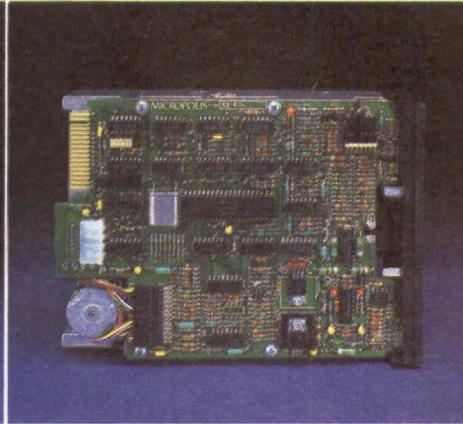
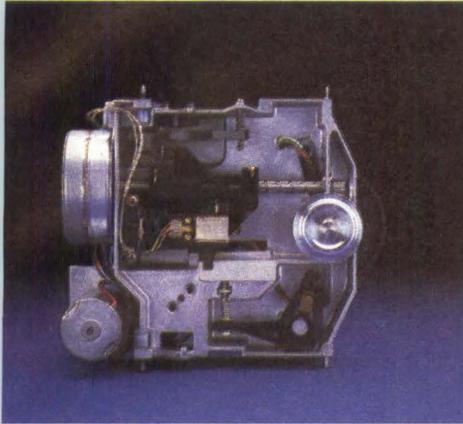
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# The Interpreter

## Advanced CMOS technology overtakes established NMOS applications

By Kevin Strehlo

The semiconductor industry is in the midst of switching its basic technology from NMOS (N-channel metal oxide semiconductors) to CMOS (complementary MOS). While this transition will not enhance computer systems to the same degree as earlier advances in circuit fabrication—the switch from tubes to transistors was revolutionary, for example—it will make possible computer systems that are smaller, more reliable, more powerful and truly portable.

CMOS was once considered a specialty technology whose usefulness was limited to such applications as digital watches, in which the need for low power consumption was overriding. CMOS offered the lowest power consumption available as well as high noise immunity, the ability to operate across the full range of temperatures required for military use and relative insensitivity to logic upsets caused by random alpha particles. However, compared to competing silicon technologies, CMOS was much slower, permitted fewer devices within a die area and sold for a premium.

The new high-speed generation of CMOS circuits is as fast and nearly as compact as other technologies and only slightly more expensive. The key to this performance improvement is the semiconductor industry's scaling down of design rules. At line widths less than 1.5 microns, the chip dimensions of CMOS will theoretically approach that of NMOS.

Because it generates less heat, CMOS will be a major factor in the next generation of microprocessors, which will cram huge numbers of circuits onto single slices of silicon. Use of more conventional NMOS technology for these dense chips would cause heat buildup and result in unacceptably low part reliability and possibly even meltdown of an ordinary package.

The lower heat generation of CMOS also makes it better suited than NMOS to the larger and more tightly packed memory boards of desk-top computers. While NMOS boards often need cooling fans, CMOS typically needs only convection cooling. In some cases, CMOS boards can be sealed, eliminating problems caused by the intrusion of dust or users. And the power supply, which occupies as much as 50 percent of the total system board in an NMOS/TTL system, takes up only 10 percent in a CMOS system.

CMOS has other ramifications for system power supplies. Because CMOS can tolerate a wide range of voltages, designers can use less regulated and therefore less expensive power supplies. And because CMOS can operate satisfactorily with a power supply voltage of 3V—the output of lithium batteries likely to be used in portable products—a report from Gnostic Concepts Inc., Menlo Park, Calif., predicts 3V will replace 5V as the industry standard in the mid-1980s.

### An industry-wide trend

The movement to CMOS technology is broad based.

NMOS TO CMOS COMPARISON			
Parameter	Multibus	STD bus	Series/800
Technology	NMOS	NMOS	P <sup>2</sup> CMOS <sup>TM</sup> /CMOS
Temperature range	0°C to 55°C (32°F to 131°F)	0°C to 55°C (32°F to 131°F)	-40°C to 85°C (-40°F to 185°F)
Board size (in. (cm.))	6.75 × 12.0 (17.21 × 30.5)	4.5 × 6.5 (11.4 × 16.5)	3.9 × 6.3 (10 × 16)
Supply voltage	+5VDC, ±12 VDC	+5VDC, ±12 VDC	10 VDC to 18 VDC
Power dissipation (watts)	20	7.5	.24
Speed	2 MHz to 5 MHz	2 MHz to 5 MHz	1 MHz to 4 MHz
Connector type	Card edge	Card edge	Positive contact

Source: National Semiconductor

The advantages of CMOS semiconductor technology, as compared to NMOS technology, include operation across wider temperature ranges, lower power consumption and, in the case of the National Semiconductor Series/800 implementation, greater compactness.

# The Interpreter

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Intel Corp., which reached its prominent position in the semiconductor industry via NMOS technology, plans to convert its products to CMOS within the next five years. Both National Semiconductor Corp. and start-up Integrated Device Technology predict CMOS will be the mainstream semiconductor workhorse during the rest of the '80s and into the '90s. Motorola Inc.'s first full 32-bit microprocessor, the MC68020, will be a CMOS processor. And Zilog Inc., an NMOS holdout that prides itself on conservatism, is developing a 2-micron CMOS technology for production of its Z80000 32-bit microprocessor by 1986.

Although the switch to CMOS will be nearly total, it will not be disruptive. This new generation of CMOS is NMOS to which chip designers have added a few carefully selected CMOS functions to achieve the best of both technologies.

CMOS is a blend of N-channel technology, which uses a negative electric field to control the flow of electrons in a transistor, and P-channel, which uses a positive electric field. Classic CMOS pairs equal numbers of N- and P-channel transistors to achieve a balanced circuit that draws power when the circuit is working but not when it is in a wait state. Power usage in classic CMOS is therefore less than one-sixth that of NMOS in a working state and 100 times less at rest.

But many chips dubbed CMOS use this P- versus N-channel balancing act for no more than 10 percent of the devices on the chip. Adding these few P-channel circuits is not difficult: the chips are produced on what are essentially NMOS processing lines, and the few additional steps needed for P devices don't significantly complicate the process, which already has almost a dozen steps.

An example of the quasi-CMOS chip is Motorola's full 32-bit member of the MC68000 microprocessor family, the MC68020. Scheduled to be sampled late this year or early next, the 68020 will be fabricated in what Motorola calls HC (high-density complementary) technology. P-channel devices will be used discriminately where most of the chip's power is consumed—the clocks, the memory-address decoders, the control store, the arithmetic-logic-unit and I/O ports, for example—but account for only 7 or 8 percent of the total devices on the chip. This is enough to solve the heat-dissipation problems in the more-than-300,000-device part without much additional expense for the larger dies necessary for true CMOS. "If we made the 68020 in true CMOS with a 50:50 P/N ratio, it would be too big to manufacture," says a Motorola spokesman.

Other 16- and 32-bit microprocessors are on the way from other suppliers. First to arrive will be chips from

Harris Corp.'s Semiconductor Products Division, Melbourne, Fla., which is scheduled to sample a CMOS version of Intel's 8086 this year and eventually a CMOS version of Digital Equipment Corp.'s J-11 microprocessor implementation of PDP-11 architecture. Cole Rada, director of marketing for National Semiconductor's NSC16000 family, says a CMOS version of the 16032 will be implemented in silicon this year, with initial production slated for the second half of 1984. Meanwhile, Intel will deliver CMOS iAPX 286s no later than 1985, says Pat Brooks, Intel's manager of new product introductions. Zilog, however, is not slated to produce a CMOS 32-bit Z80000 until 1986.

CMOS microprocessors using 8-bit words have been available for many years. The RCA classical-CMOS 1802 microprocessor was the first such product and is still in wide use, mainly for applications in extremely harsh environments. The 1802 has survived trips into boiling oil deep in oil wells at temperatures of 200° C and into space. It can be put to sleep and awakened; that is, unlike quasi-CMOS microprocessors, it is a static device. It also drains about 100 times less power in standby mode than quasi-CMOS devices do. The 1802 has an unusual architecture, however, and it is likely that more system designs will be won by CMOS versions of mainstream NMOS microprocessors.

One of the first available products of this new generation was National Semiconductor's NSC800 CMOS microprocessor. The NSC800 is not a true, static CMOS chip; the company used a 40:60 P-to-N transistor ratio to keep die size down. Yet the company claims that the NSC800 provides most of the low-power, high-temperature advantages of classical CMOS and that, for example, it operates over the military temperature range of -55° to +125° C. The NSC800 provides the speed and instruction set of the Z80A microprocessor, tied to the multiplexed address/data bus of the 8085, while dissipating only about 5 percent of the power consumed by either of those popular 8-bit processors. National Semiconductor suggests the NSC800 for rugged electrical environments, extended temperature ranges and applications in which a small package or the ability to run on battery backup power is required. The company has also introduced a board line based on the NCS800 called the Series/800 (see table, p.115).

Other available 8-bit CMOS microprocessors include Rockwell Corp.'s 6502, which uses 3-mm. geometry rather than its predecessor's 5-mm. design rules. It thus is smaller and operates faster than the original NMOS chip.

One of the first memory components to use the new approach to CMOS is Intel's prototype 64K-byte dynamic

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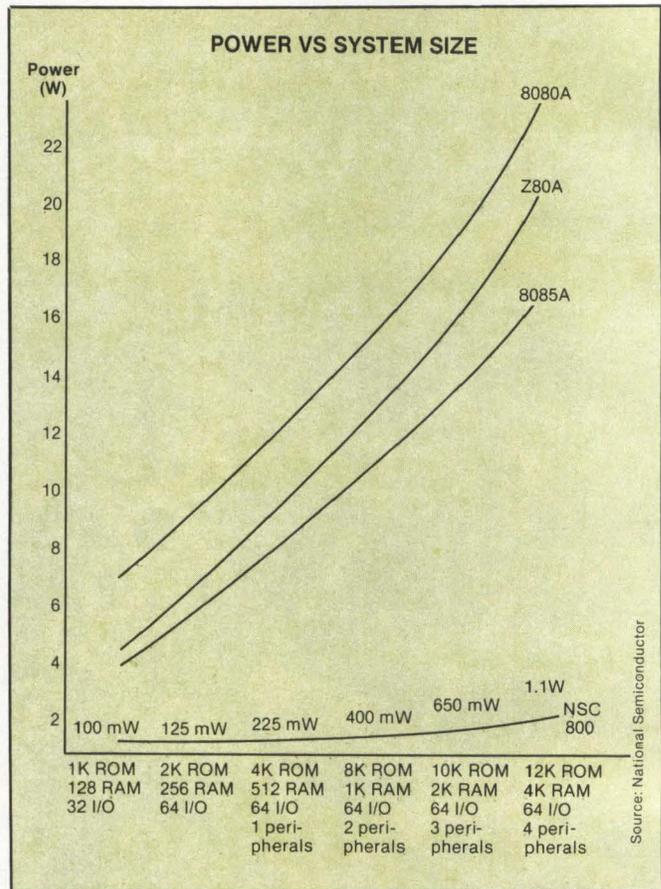
RAM. The prototype is based on Intel's CHMOS (complementary high-performance MOS) process, which leverages the company's long-term experience with NMOS, but adds P-channel devices in chip areas of high power consumption. The prototype is said to offer several advantages over earlier Intel 64K-byte dynamic RAMs built in HMOS. It runs at one-half the operating power and one-fifth the standby power of its HMOS equivalent, and its soft error rate is immensely improved. With this improvement, the 5500 hours between soft errors expected in a 1M-byte HMOS memory are extended to 250,000 hours by switching to CMOS.

Another improvement made possible by the reduced power consumption of CMOS is a data-access method Intel calls Ripplemode. "The use of CMOS allows us to keep the column address latches on all the time without burning the prohibitive amount of power that would be required to do that using NMOS," explains Intel's Brooks. "As a result, those column addresses flow right through, and we consequently get consecutive bits of data out at a rate of 40 nsec. per bit." Brooks says Ripplemode is similar to page-mode access on Intel's earlier 64K dynamic RAM. "But the best we can do with page mode is about 120 nsec. per bit," says Brooks. The 25-MHz bandwidth made possible by Ripplemode makes the new dynamic RAM attractive for applications and devices requiring high data-transfer rates, such as data logging and the frame buffers of graphics terminals.

But CMOS may have an even more dramatic impact on RAM. A study by Gnostic Concepts Inc. predicts that, by 1985, CMOS static RAMs will offer higher performance at a lower price than any dynamic RAMs. If true, it puts Integrated Device Technology, Santa Clara, Calif., in a very good position as manufacturer of the highest performance CMOS static RAM available. IDT produces a 16K-byte static RAM organized as 4K x 4 that is rated at a 45-nsec. access time. And because of the low power dissipation of CMOS parts, IDT began production this year of a 64K static RAM produced by combining four 16K static RAMs on a standard-sized package with JEDEC pinout.

Intel's Brooks says customers interested in designing Intel's iAPX 286 processor into high-performance engineering workstations are also interested in the new CMOS RAMs. He also cites interest in portable applications, and says that interest will intensify when full families of 16-bit processors and peripheral chips are available. Intel's director of corporate communication, Stu Sando, says, "If you have one chip in CMOS, that's fine, but you really begin to see the system-wide benefits when the rest of the solution is there too."

Microprocessors and RAMs aren't alone in going to



The advantages of CMOS semiconductor technology, as compared to NMOS technology, include operation across wider temperature ranges, lower power consumption and, in the case of the National Semiconductor Series/800 implementation, greater compactness.

CMOS. CMOS may have its most immediate impact in semicustom logic. Semicustom logic was once the province of large system manufacturers, such as IBM Corp. and Digital Equipment Corp., which used it in house, and small specialty IC makers, such as Interdesign, Exar and International Microcircuits Inc. More than 30 companies are now in the semicustom logic business, and projections of its eventual importance vary. Dataquest predicts that it will have a 20-percent market share by 1990, while Mackintosh International Ltd., Luton, Beds, England, predicts a 40-percent share of the semiconductor business by 1990.

The incentives for converting TTL circuits to ICs are lower fabrication costs in volume production, lower field-service costs due to increased reliability and reduced power and heat dissipation. Even small manufacturers of systems and boards can move to custom IC design. The move is the result of a new generation of CAD tools that reduces the time for an

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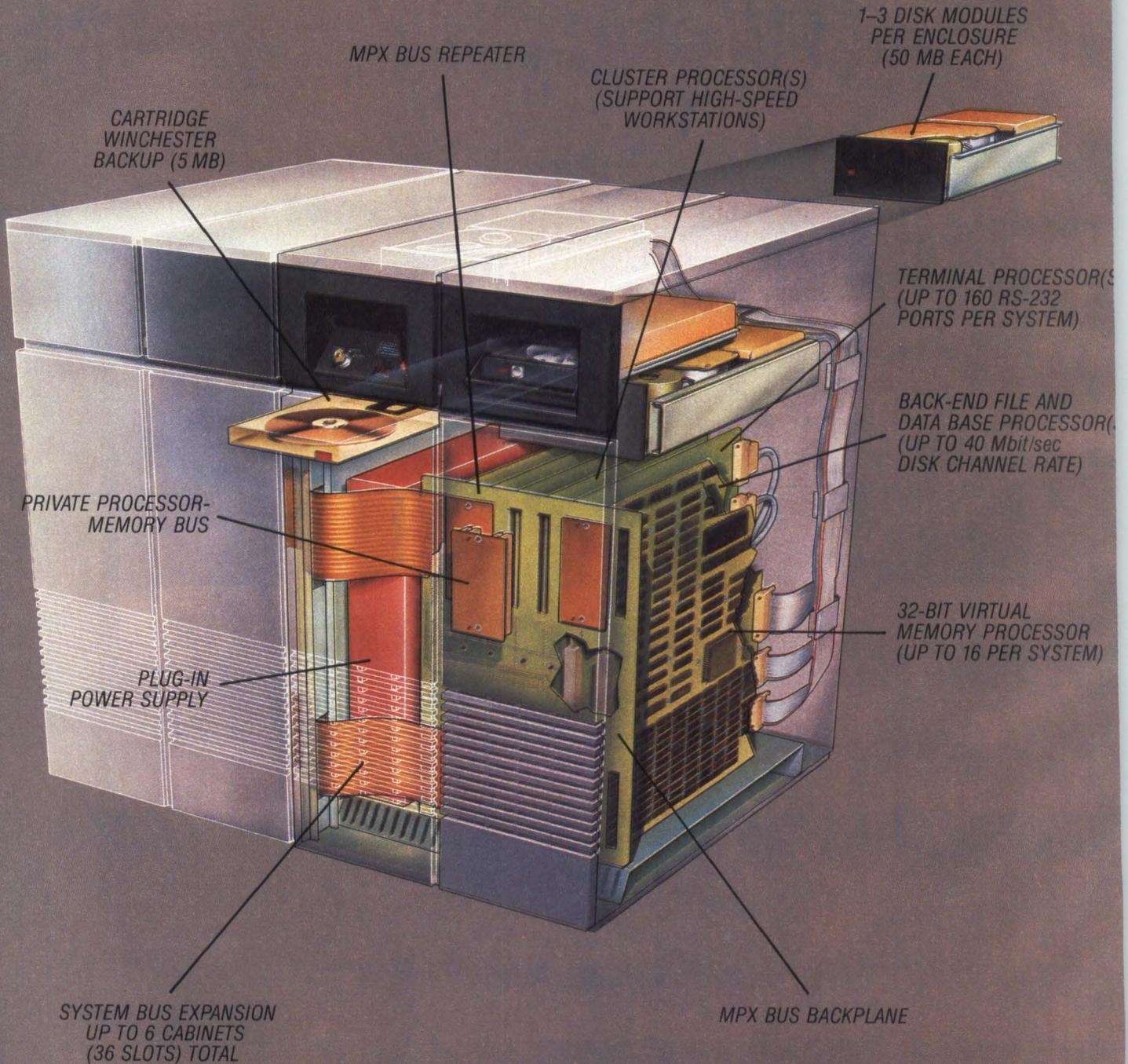
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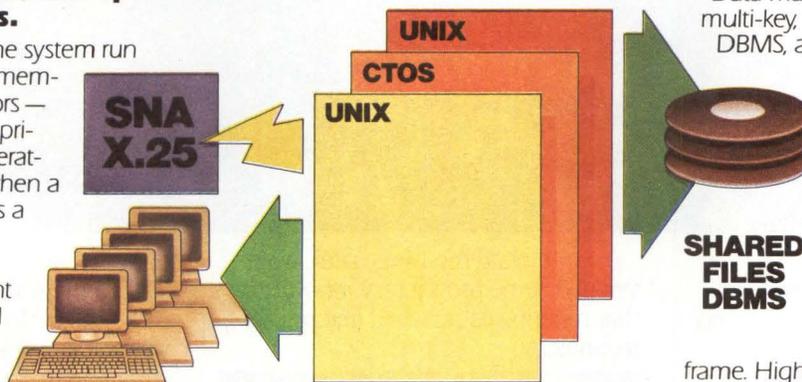
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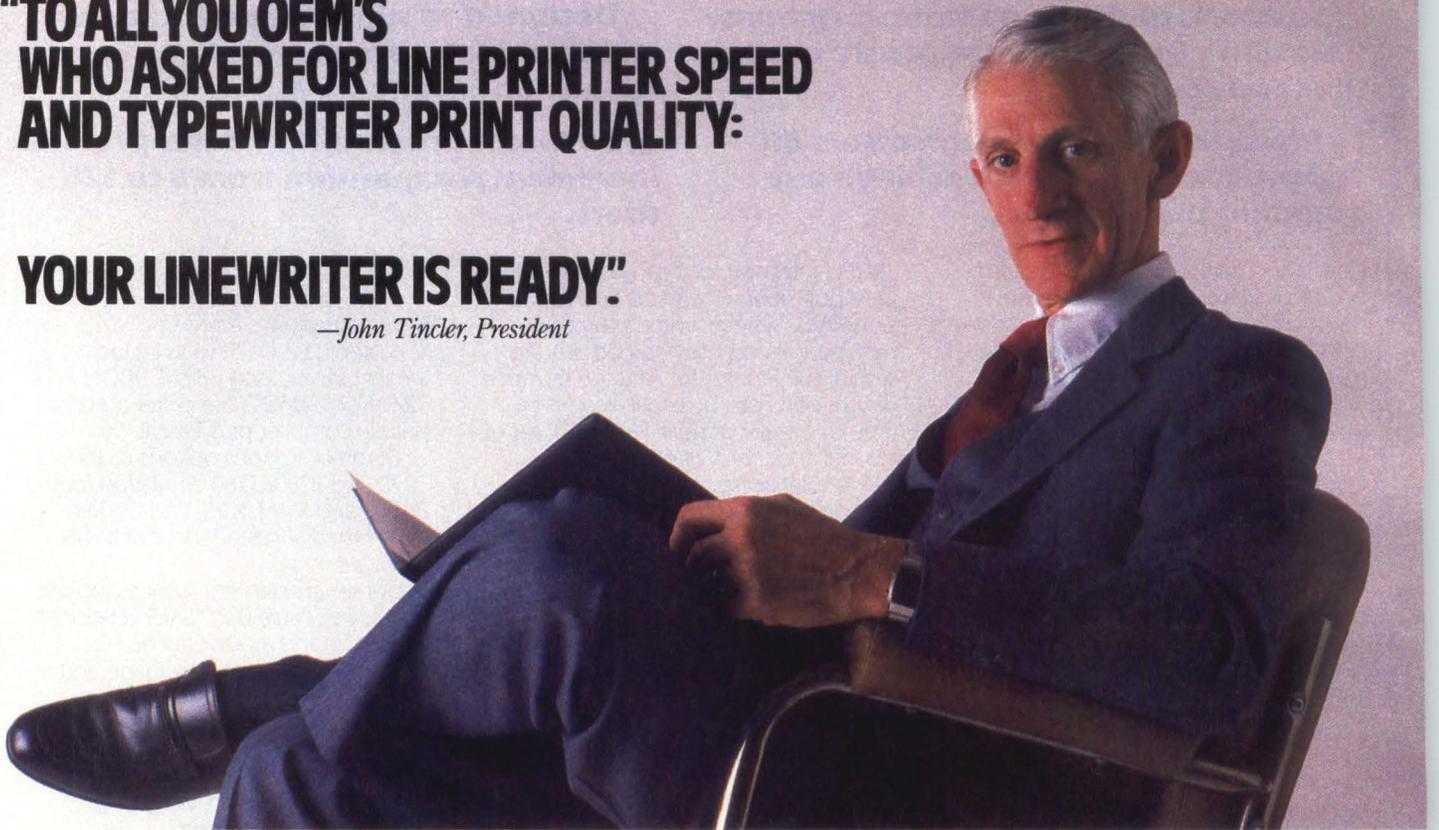
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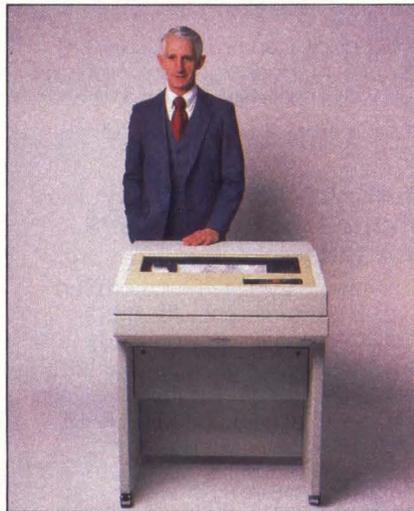
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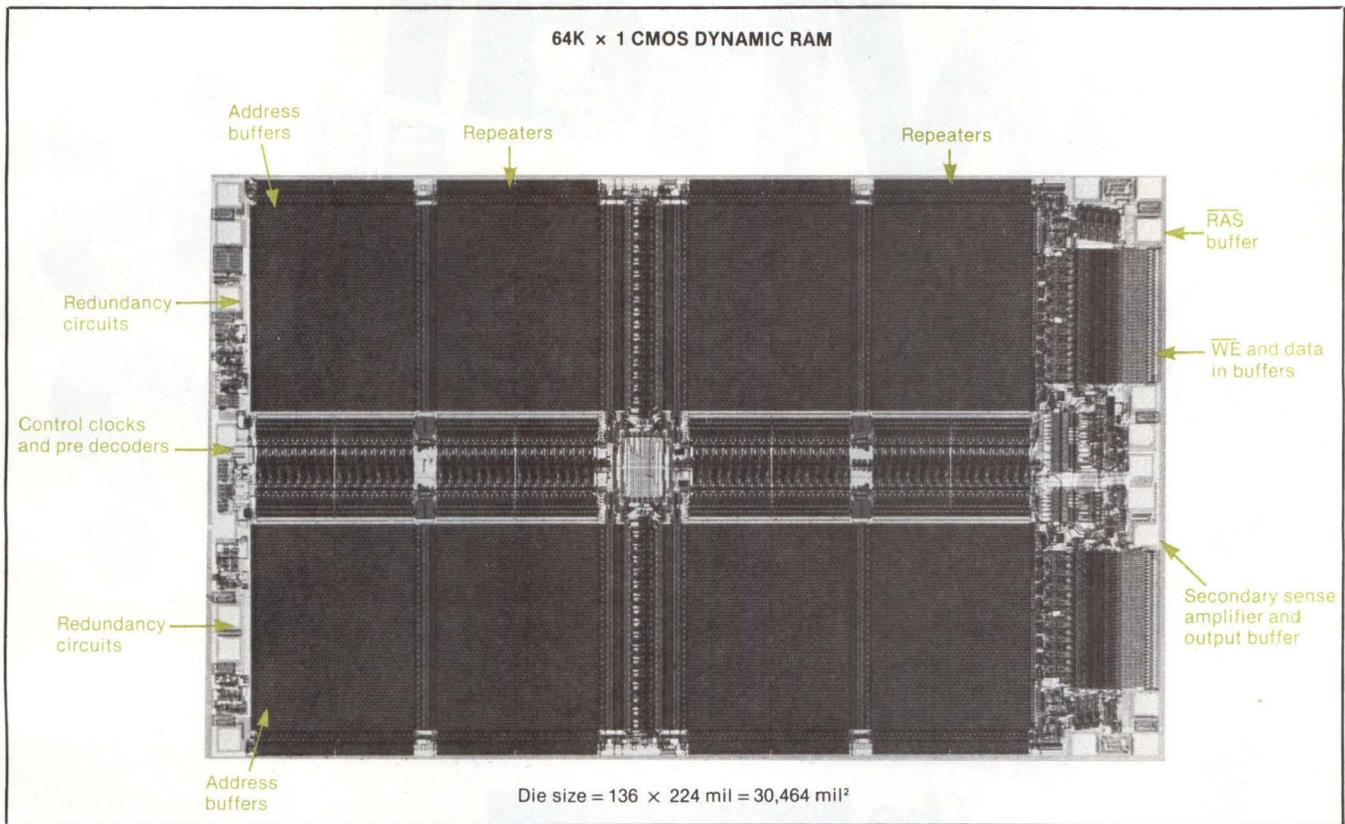
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# The Interpreter



**Intel Corp.'s prototype CMOS 64K-byte dynamic RAM** uses one-half the operating power and one-fifth the standby power required by Intel's 2164A NMOS 64K-byte dynamic RAM. It also offers higher cell capacitance for improved resistance to soft errors, faster serial access and relaxation of critical timing requirements as compared to NMOS. Intel claims the CMOS part, due to be introduced in early 1984, will enhance overall system throughput by as much as 20 percent. (WE = write enable; RAS = row address strobe; mil = 1/1000 of an inch)

average custom IC design to approximately six months and reduces the cost to around \$75,000, according to VLSI Technology Inc.

Daniel Queyssac, president of the U.S. subsidiary of Italian semiconductor firm SGS Semiconductor Corp. in Phoenix, concludes that semicustom logic will become more important. He says the technology of choice is CMOS. "Fast CMOS is replacing TTL and will be the dominant technology for logic in five years' time," Queyssac predicts.

SGS licenses CMOS technology from Toshiba and CAD system technology from LSI Logic Corp., Milpitas, Calif. Other companies with CMOS gate-array offerings similar to SGS's include Texas Instruments Inc., Motorola Inc., National Semiconductor, the Microtechnology division of Storage Technology Corp., RCA Corp. and Mostek Corp. Early this year, Intel also got into the act using its CHMOS process with ZYMOS Corp.'s CAD system to establish a standard cell library that includes Intel's 80C49 microcontroller core and more typical flip-flops and shift registers.

One interesting consequence of this new generation of technology, says Ralph Cognac, director of marketing for IDT, is that every new generation spawns a group of companies. "The first semiconductors were germanium diodes and transistors, made by tube companies, such as RCA, Bell Labs, Westinghouse and so on," says Cognac. "The next generation was silicon diodes and transistors, which spawned a new group of companies—Fairchild, Motorola, TI—that made the original transistor guys fade into the semiconductor sunset. The next generation was NMOS, which gave us AMD, Synertek, Intel, National and Mostek. We think there's a new revolution under way—high-speed CMOS—and we're pretty sure that some of today's big boys will be left behind."

But Intel's Sando doesn't see CMOS writing that scenario on the wall. "All of today's large semiconductor companies are moving to CMOS," he says, "and its advent won't have an impact on which companies are here to stay." □

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# The Interpreter

## Pioneering university/industry venture explores VLSI frontiers

By Dwight B. Davis

It's easy for system integrators and computer end users to take for granted continued advances in very-large-scale integration as well as the cost/performance benefits these advances allow. After all, progress in VLSI has occurred so rapidly that the scientific and technical barriers impeding this progress must seem very small to many observers. In fact, each step forward comes only through tremendous expenditures of capital and thousands of hours of research, and the investment of time and money increases with the scale of integration. Japan, which has surpassed the U.S. in several areas of VLSI technology, has made many of its advances only by pooling the resources of government, industry and universities to meet the rigorous demands of VLSI research.

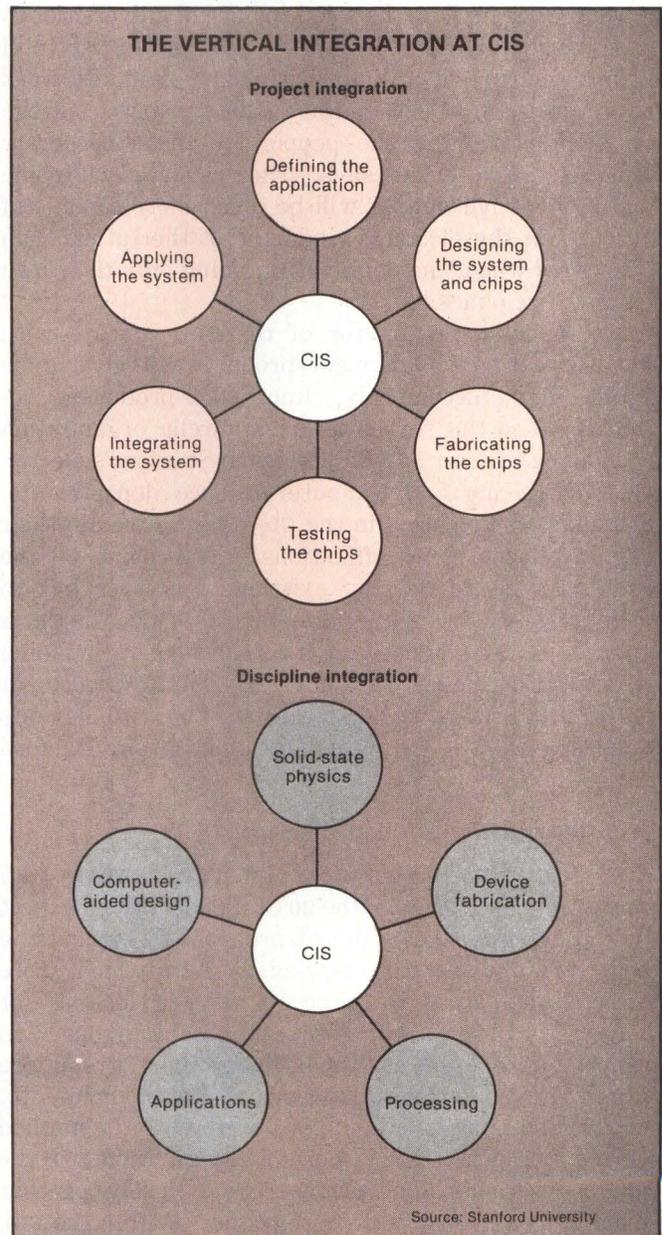
Such resource pooling is limited in the U.S. because of antitrust regulations and because of each company's desire to keep its research proprietary. But universities are increasingly serving as the crucibles within which corporate scientists can interact with each other and with university faculty and students. As such cooperative programs take hold, the participants believe university-based research will increase in importance, and expect that graduates exposed to the programs will better meet industry's needs for skilled personnel.

### The Center for Integrated Systems

Industry-sponsored programs in semiconductor research are in operation at a number of U.S. college campuses, including the Massachusetts Institute of Technology, the University of California at Berkeley and Carnegie-Mellon University. The university that pioneered college/industry cooperation, however, is Stanford University, which instituted its Center for Integrated Systems in 1981. The CIS has attracted 20 corporate sponsors, each of which has contributed \$750,000 to the center for use during its first three years of operation. (The sponsors are General Electric Co., TRW, Hewlett-Packard Co., Northrop, Xerox Corp., Texas Instruments Inc., Fairchild Semiconductor, Honeywell Inc., IBM Corp., Tektronix Inc., Digital Equipment Corp., ITT Systems Inc., GTE, Motorola Inc., United Technologies Corp., Monsanto, AMI-Gould and Philips Signetics.)

Aside from its early courtship of corporate sponsors,

Stanford's CIS has distinguished itself by its interdisciplinary approach to semiconductor research, says Les Vadasz, senior vice president in charge of corporate



Stanford University's Center for Integrated Systems has taken the "integration" part of its name to heart. The CIS, which is pursuing research in semiconductor VLSI, is merging computer science, information science and physical science. Each CIS participant is expected to generate applications, which will drive the development of new systems, circuits, devices or processes.

# The Interpreter

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strategic staff at Intel Corp., Santa Clara, Calif. "If you look at integrated circuits," he says, "they are more and more becoming integrated systems. We're looking to the Center for Integrated Systems to place physicists, chemists, electrical engineers, computer scientists, software people and hardware people in a common environment so that their work will be much more applicable to very complex VLSI realization."

Vadasz says it isn't the sole province of universities to combine several disciplines in the pursuit of VLSI; Intel had previously set up interdisciplinary teams to work on its projects, he notes. But industry must scout the universities to find the people for these corporate research teams. Vadasz says, "The graduates who come out of this environment will be much more capable of working in the electronic industry of the future than graduates who come out after pursuing only their own narrow disciplines."

John Linvill, co-director of the CIS, concurs with Vadasz, noting, "Our main product will always be people and, secondarily, knowledge-producing research." The CIS serves as an umbrella organization covering a number of laboratories in Stanford's electrical engineering and computer science departments. Students participating in the CIS program retain their regular department affiliations. "The point of the center is not to destroy existing structures but to facilitate their strengths," Linvill says. Once the CIS is operational and housed in its 71,000-sq.-ft. building (construction began this spring), Linvill expects at least 30 students with doctorates and 100 with master's degrees with CIS exposure to graduate from Stanford each year.

## Foundations for applied research

Aside from their need for qualified graduates to staff corporate research labs, the 20 CIS sponsors also expect the research at the Stanford program to expand the body of fundamental knowledge from which more directed research can proceed. "We're looking for something beyond what we can obtain in our own proprietary operations," says George Pake, group vice president for corporate research at Xerox, Palo Alto, Calif. Pake contrasts the CIS program with the method of cooperation in Japan, where, he says, "Industry, the universities and the government work closely together even on relatively applied programs." Within the CIS, he says, "We will work together in developing the basics, advancing the technologies to devise new ideas for the future that are rather broad in their applicability. We will still expect the various companies to proceed on their own with various proprietary pushes."

The chance to have early and ongoing access to the basic research within the CIS is one of the main reasons the corporate sponsors joined the program. Each company will send visiting scientists to Stanford to work with CIS faculty and students—and with other companies' scientists—on research projects.

A question yet to be answered is how scientists from competing companies will cooperate with each other when working on project teams. Mark B. Barron, vice president of research and development at GE's Calma Co. subsidiary, Santa Clara, Calif., isn't optimistic. "We really haven't interacted with other companies that much, and I doubt that it will happen," he says. Other corporate participants believe that the basic nature of the CIS research will help lessen the concerns companies may have about sharing scientific knowledge and skills.

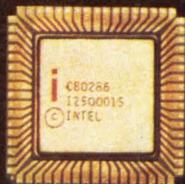
Intel's Vadasz says a typical project team might consist of a professor, some graduate students and two researchers from different companies. "I would like to think that those two individuals, while they are at the CIS, will talk openly and do the best they can to advance the project," he says. "And the results of that project should be available to all the sponsors, under some terms and conditions. If you start looking at this from a parochial point of view, you end up not gaining anything."

## Expenses of semiconductor research

Semiconductor research by its nature—with requirements for sophisticated fabrication equipment, computer-aided-design systems and ultra-clean rooms—is expensive. Xerox's Pake notes, "It is difficult for any one university to put together a program like the CIS on its own because the equipment is exceedingly costly and the plant is quite substantial. It's important to have a few of these centers, though, because training students in a really modern technological setting is extremely important."

Stanford has always received substantial government support for its semiconductor research, but the corporate contributions have enabled the CIS to begin construction of the building that will combine equipment and personnel in a single environment in which the center's goals can be pursued. These goals are not inconsequential; a CIS fact sheet enumerates several of them: "to carry out fundamental research in areas relevant to VLSI systems; to develop design automation capability and computer-managed fabrication facilities including E-beam and X-ray lithography and laser E-beam annealing; to conceive, fabricate and test VLSI systems for most effective computation, communication

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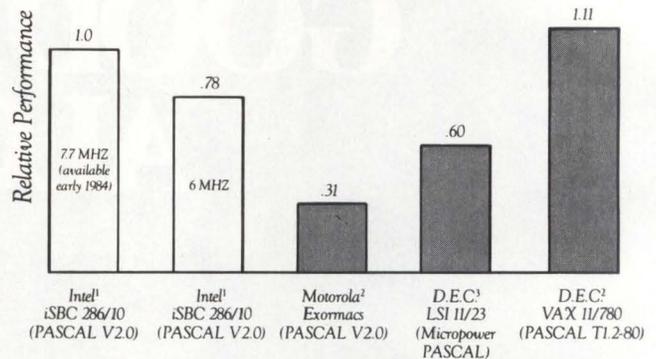
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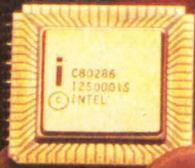
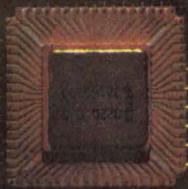
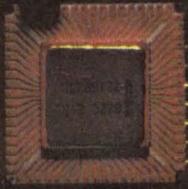
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# The Interpreter

and control functions."

While the goals are general, some products will likely emerge from the CIS laboratories. Linvill notes that more than a decade ago, he invented the opticon reading aid for the blind. The device, produced and marketed by Telesensory Systems, required custom ICs. "The making of the custom integrated circuits for that device was the project that initiated the integrated circuit laboratory at Stanford," Linvill explains.

He says the CIS has no guidelines detailing how any CIS products with commercial viability will be handled, but the sponsors are exploring such issues through a Sponsors Advisory Committee. Calma's Barron says the committee has discussed various patent arrangements that might be instituted between the companies and the university. But, he notes, "The patent is more likely to be for generic technology than for an actual product."

Barron says the CIS has produced software tools that some of the companies are using within their proprietary design processes. "For example, the center has a modeling program that models the process used to fabricate ICs," he says. "We use that modeling program within GE to guide the development of our own devices. Generic tools such as this are very important to the companies."

John Doyle, vice president of research and development at HP, Palo Alto, Calif., also believes the production of commercial products from the CIS will be limited. For instance, he notes, HP and other companies routinely produce chips with as many as 450,000 on-board circuits, and he doubts that higher levels of integration will first occur in university labs. "But some of the inventions that make further integration possible, some of that science, may well come out of universities and then get applied," he says.

## Maintaining academic freedom

The presence of industry in force on a university campus generates fears that academic freedom and integrity may be abrogated. The CIS sponsors, however, profess no desire to tamper with the center's independence. "Industry, by and large, is very sensitive to the issue of academic freedom," says Doyle. And, even though the Sponsors Advisory Committee is expected to help steer the CIS research activity to some degree, the final authority to choose the research rests with the university. "No university should ever accept restrictions on the way it conducts or promulgates its research," says Xerox's Pake. "The clear advantage for the corporations working with the CIS is that they will have an earlier and deeper awareness of what the research results are."

CIS co-director Linvill also discounts any problems with industry interference within the program. "Exactly the same concerns were raised when federal money in large amounts first came into engineering schools for graduate research programs in the early '50s," he says. "We have learned by a process of mutual adjustment to work very effectively with large government." Linvill admits the university has less experience in dealing with corporate sponsors, but he believes the problems associated with industry funding are less complex than those encountered in government. "All the questions of military security don't have to be addressed," he says.

Linvill hopes that funding from industry may someday approach the level of government funding. Much government funding is in response to research proposals from faculty members, and Linvill believes professors will look more to industry for such directed funding in the future. Several CIS sponsors fund directed research at various universities. Barron at GE's Calma explains the common rationale for such funding, noting, "Essentially, we have more programs that we're interested in doing than we have the in-house people to do them with." While this directed research may be more proprietary than that occurring in open programs such as the CIS, Barron says, "Normally, we don't fund things that we consider to be highly proprietary. We generally would fund things of the blue-sky type that are more long-term in nature. So if they don't succeed, we really don't lose a lot in terms of our own product development."

But narrow research projects and more limited semiconductor programs lack the essence of a multidisciplinary environment, which represents a key strength of broad-based programs such as the CIS. "A major intangible benefit of the center is the technical and professional stimulation that will come to our people who work there," says Pake. "With all these corporations, plus Stanford, participating, there should be quite a powerhouse of brainy people in that place. It's hard to overemphasize the value to a technical individual to be put into that kind of a stimulating environment."

Intel's Vadasz believes that, through cooperative programs like the CIS, universities will further advance semiconductor technology. "Historically, universities and industry in this area did not have a close coupling," he says. "Now that we are seeing a much better environment in which companies are sponsoring various university programs, the university activities will become much more relevant to our business. There's a tremendous technology resource at the universities, which, if we do our job right, will do a lot of good for the whole industry." □

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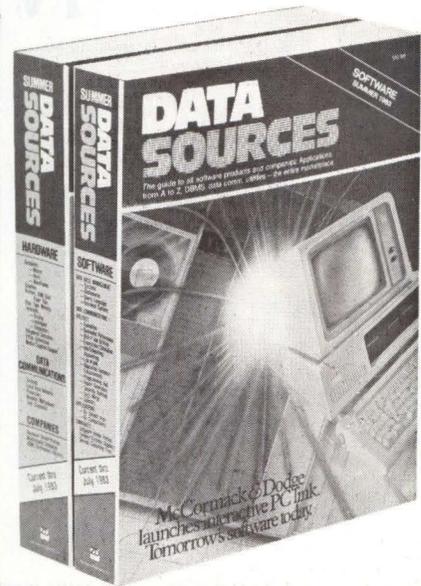
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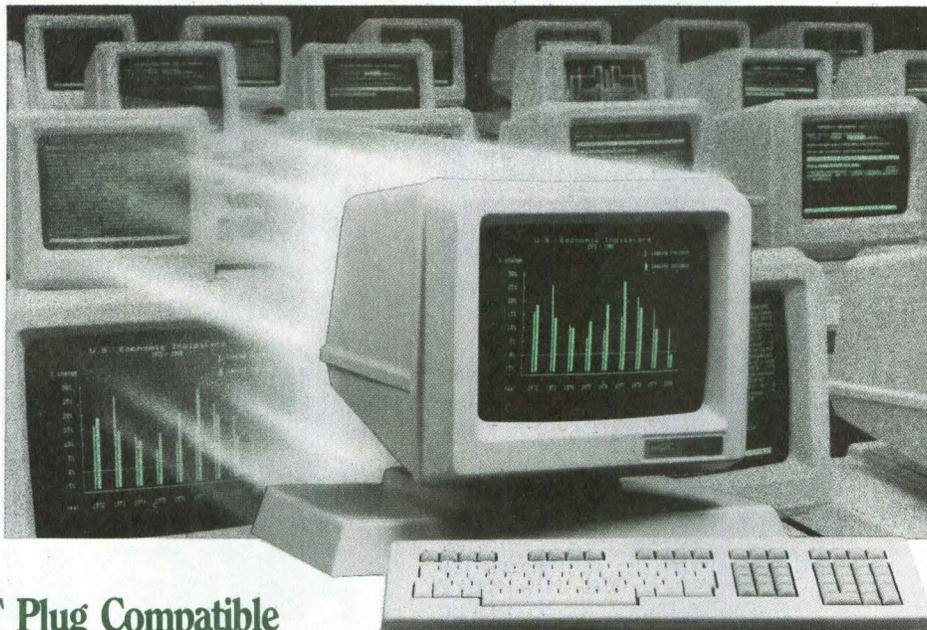
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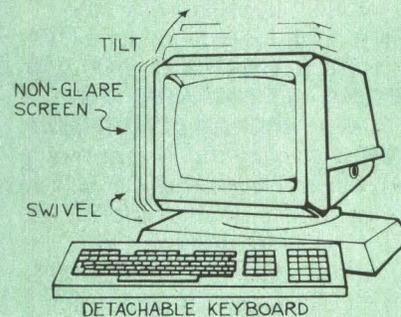
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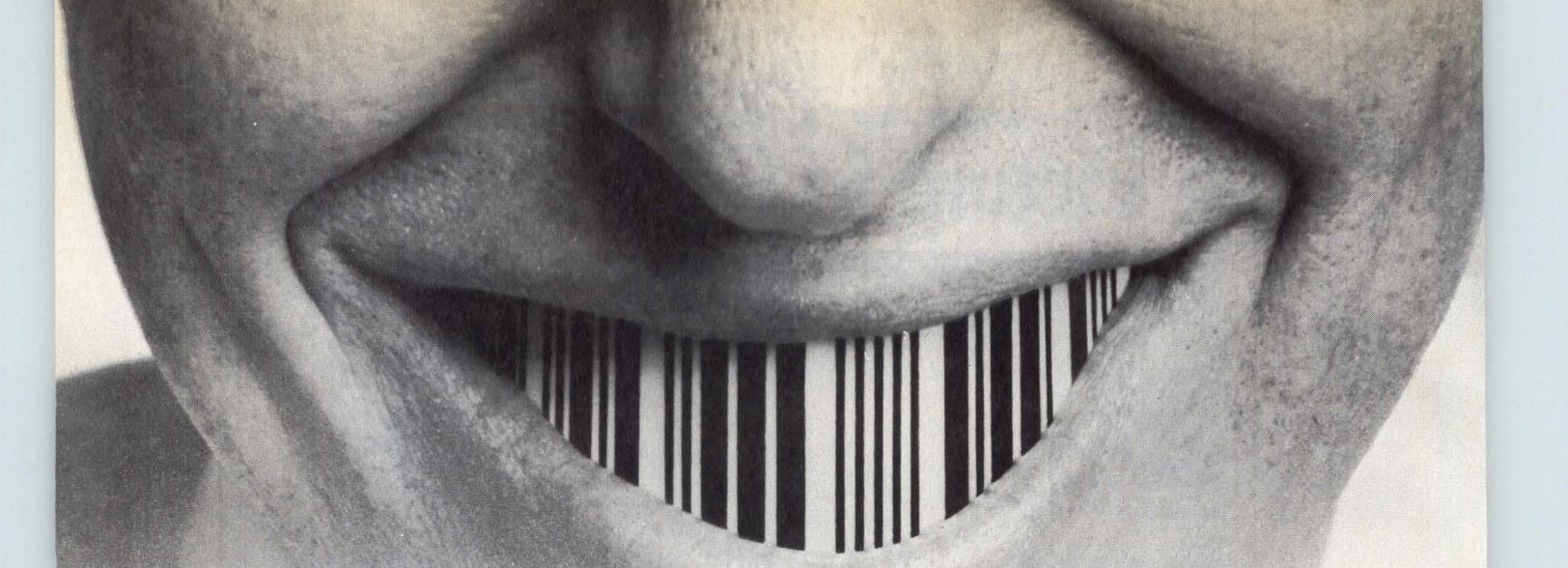
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# Systems in Manufacturing

Exploring the use of computers in the factory

## Value-added system integration plays key role in driving robot market

By Frank Catalano

Preceding the Robot 7 conference and exhibition in Chicago last April, newsstands were filled with magazines and newspapers carrying cover or front-page articles about robots. When show time came, so did the radio and television news teams in numbers usually reserved for royal weddings.

Unfortunately for suppliers, however, robots are hotter in the media than they are in the market. Lingering effects of the recession and Japanese competition are impeding market growth, and analysts say those impediments won't soon disappear. But robot vendors could make industry problems non-issues if they supply value-added systems engineering with their products.

"Robotics isn't the business of robots anymore; it's the business of robot systems," says Laura Conigliaro, a market analyst with Prudential-Bache Securities Inc., New York. "It's the old story about end users looking for solutions to their problems, not just for devices." Those value-added solutions, she says, include tooling, gripper design, vision and sensing systems, application software and pre- and post-installation support.

Among the companies particularly geared to add such value are large factory-automation systems suppli-

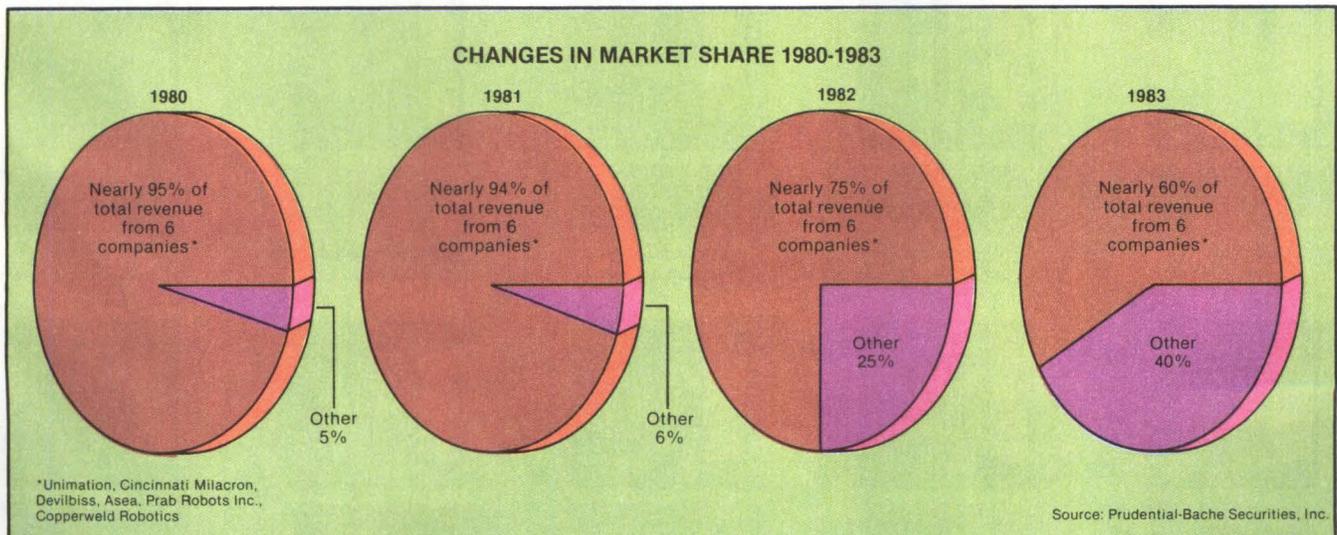
ers, robot-specialized vendors that address niche applications with turnkey systems and third-party system houses that design custom systems for end users or offer robots as options to other systems such as material-handling or test-and-inspection systems.

Gerald Michaels, director of the robotics study team within the Computer Integrated Manufacturing group at Arthur D. Little Inc., Cambridge, Mass., says that as robots are tied increasingly into factory networks, companies with roots in the computer industry will play key roles in driving the robot market by providing hardware and software interfaces to other factory systems.

### The market and competition

Although the robot market totaled \$155 million in sales in 1981, Conigliaro says it grew to only \$195 million in 1982. She projects that by year-end, yearly sales will total \$205 million to \$250 million. Michaels at ADL projects that by 1987, the robot market will grow at a 28-percent annual rate and will be worth \$700 million.

In the short term, Conigliaro says, the 1981/1982 recession is affecting the growth of the robot market by limiting the amount that manufacturers can afford to spend on capital goods. But, she adds, the recession may benefit suppliers in the long term. "The recession

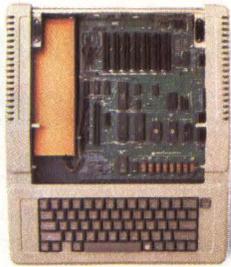


The combined market share of the six oldest vendors in the domestic robot market dropped by almost one-third between 1980 and 1983. Their share will continue to drop as the market becomes more competitive.

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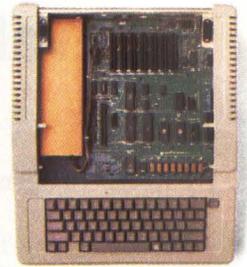
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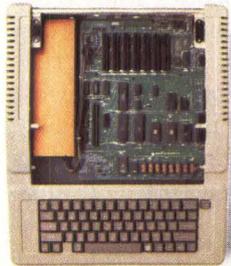
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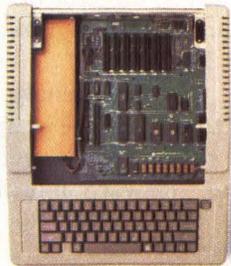
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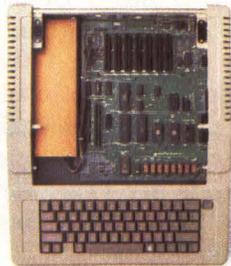
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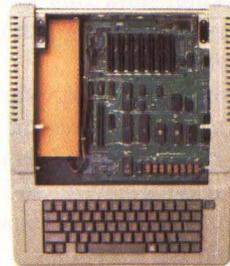
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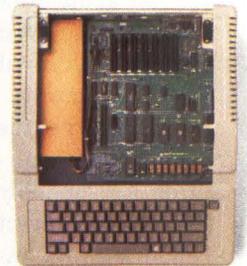
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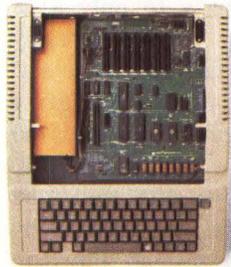
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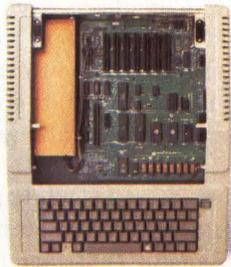
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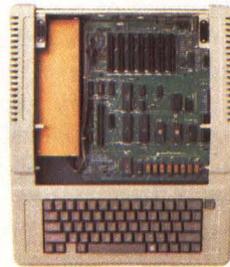
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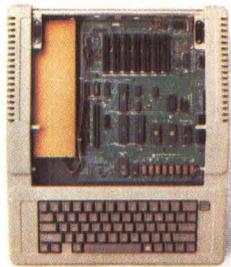
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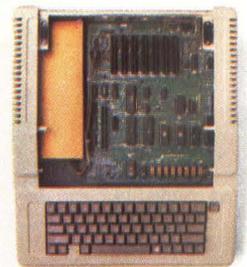
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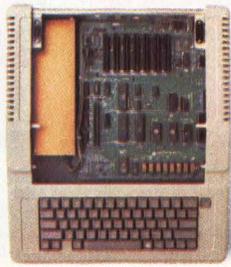
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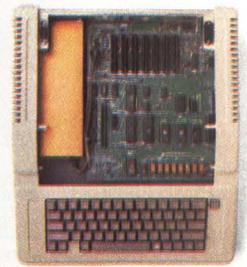
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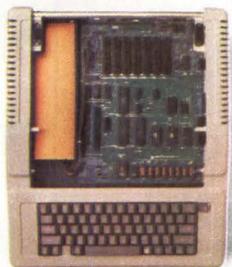
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HCI Data  
Agricultural software



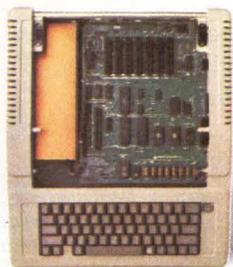
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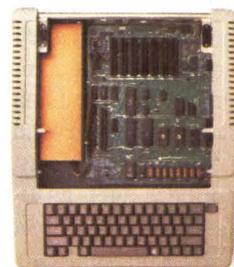
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# Systems in Manufacturing

has only served to prove the importance of cutting production costs," she says. "Manufacturers may start to look upon capital spending as more of an asset now rather than as an inevitable cost of doing business."

More menacing than the recession to established robot suppliers are new companies entering the market and chiseling away market shares. In 1980, six companies—Unimation, Cincinnati Milacron, DeVilbiss, Asea Inc., Prab Robots Inc. and Copperweld Robotics—commanded 95 percent of the market. But within two years, the market was divided among more than 50 suppliers. The combined market share of the six vendors declined to 75 percent by 1982, and Conigliaro estimates that their share will decrease to about 60 percent by year-end.

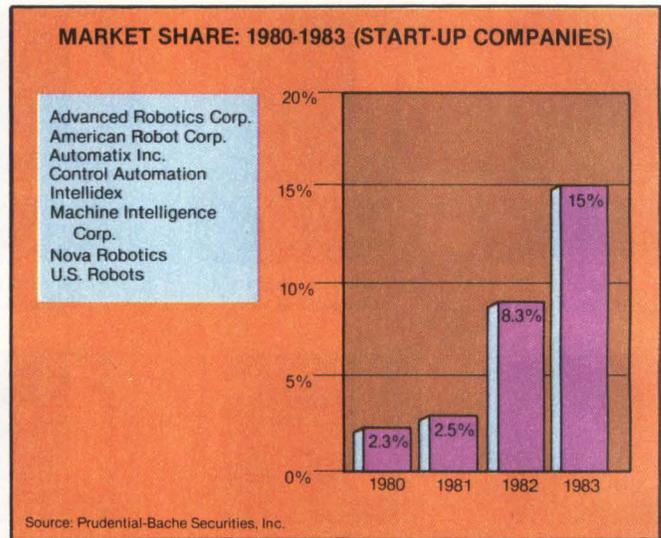
Among the recent market entrants are large system suppliers such as IBM Corp., General Electric Co. and Westinghouse Electric Co. (Westinghouse now owns Unimation, and the Westinghouse share of the market is included under Unimation's heading), as well as small robot-specialized start-ups such as American Robot Corp., Automatix Inc., Control Automation, Intellidex, Machine Intelligence Corp. and U.S. Robots.

But besides domestic competition, U.S. robot vendors must worry about Japanese competition. "On a product-to-product, price-to-price basis, Japanese robots are of exceptionally high quality," notes Conigliaro. "Were end users in the U.S. interested in simply purchasing a robot at the lowest possible price and willing to do their own engineering, application software, hardware and software integration and support, most of our domestic robot companies would be unable to compete." But Conigliaro believes that, rather than design systems themselves, most manufacturers will pay a premium for added application expertise.

## Robot-specialized vendors

ADL's Michaels notes that most companies in the robot industry providing system expertise are robot-specialized vendors. Most turnkey systems still require extensive customization, although that is changing, he says. "Even if robots are being installed to do a specific application, every installation has to be considered a custom job with different tooling and software considerations," he says. "But as a vendor begins installing a number of systems into a specific application, spray painting, for example, he starts to see commonality among those installations."

Automatix, Billerica, Mass., offers turnkey systems for arc welding, inspection and assembly. Philippe Villers, company president and founder, says his company keeps prices low by narrowing in on a few



The above companies are the leading new entrants to the robot market in terms of their share of the market, says Laura Conigliaro, an analyst with Prudential-Bache Securities Inc. Their combined share began growing substantially last year and will continue throughout 1983.

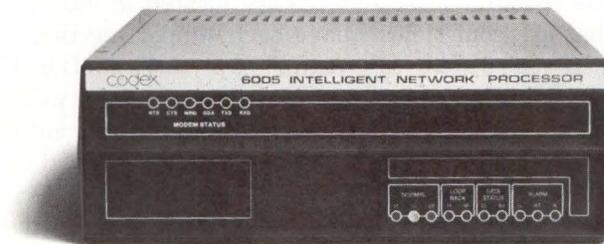
areas of specialization. "Our business is modular turnkey robotic systems, and our normal approach includes everything from conceptualization to training to actually putting the systems into the production mode," says Villers. "We offer a small selected number of robots, and the major elements in our systems intended for similar applications are repetitive. That gives us cost and performance advantages compared to what we would have if we took on a variety of applications. We're experts in a few areas."

Other companies providing turnkey systems include Intellidex, Corvallis, Ore., which offers wafer-handling and Winchester disk-head-assembly systems, and Control Automation, Princeton, N.J., which offers printed-circuit-board assembly systems.

## Factory-automation systems providers

While robot-specialized vendors offer only robot systems and a few vision systems, factory-automation system companies offer a variety of factory systems that may include CAD/CAM, vision and sensing, computer numerical-control, programmable-control and factory-networking systems. "We're trying to give customers a total systems solution—the one-stop shopping kind of thing," says Charles Lamb, manager of automation systems engineering at GE. "Maybe a user wants to put a robot in today, another one next month and eventually some computer numerical-control machine tools. We provide that customer the capability to

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# Systems in Manufacturing

expand with systems that will all be able to compete with one another. I'm not saying that all of the pieces fit together yet—most of our robots can't talk to one another at this point—but most manufacturers are not ready for integration today and are just installing their first robots. We're working on all the problems, and when users are ready, we'll be ready too."

Along with providing a variety of factory systems, GE offers consulting and planning services to help end users decide which processes to automate. The company also provides system implementation and support.

One criticism users have of factory-automation system companies such as GE is that after buying one of GE's 11 robots or a system from the company's CAD-specialized subsidiary, Calma, users are locked into the GE solution. When users want to expand, they are forced to expand with other GE products. Lamb counters that criticism, saying that GE recognizes that other systems are on the market that are sometimes more appropriate for an application. "If you're going to be in the factory-automation systems business, you've got to recognize that there is already an invested base of products that customers have installed," he says. "We will work with these products and integrate them into our systems approach for the customer."

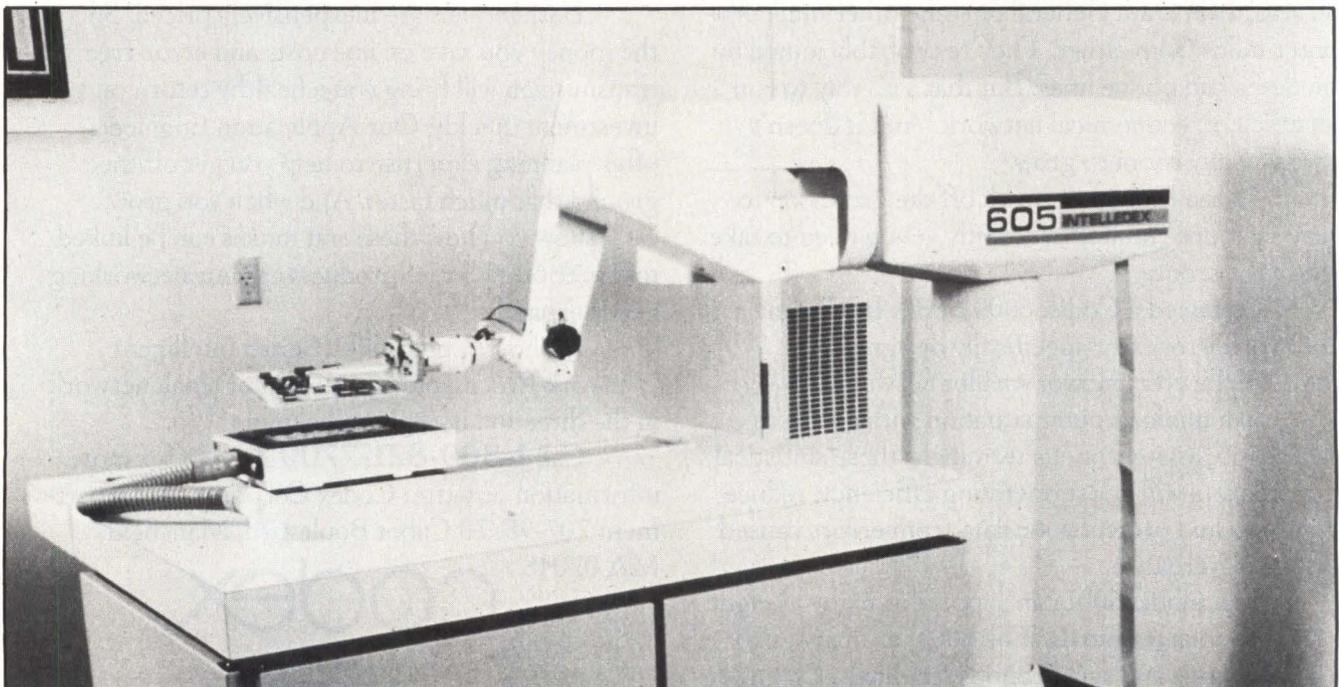
Jim McDonald, division director of industrial automation at IBM, says his company has only recently entered the robot market but has been providing other

factory-automation systems for years. Such systems include CAD/CAM systems, manufacturing-resource and material-requirements-planning packages, factory terminals, high-speed communications channels and the computers that control these systems. "If you look at all the elements of a factory-automation system, we have them," he says. However, unlike GE, IBM does not provide system engineering assistance with its robots, depending instead on value-added remarketers.

## Third-party systems companies

IBM's VARs fall into two categories: those that provide optional IBM robots with their normal product lines in applications, such as conveyer systems and circuit-board test systems, and those that custom design robot systems for customers and incorporate IBM's and others vendors' systems, depending on the application. "Our VARs are located in various parts of the country and have been supporting their own lists of customers for years," says IBM's McDonald. "Usually, they've come out of the machine-tool world and have been designing systems around fixed automation. They know their customers as well as the ins and outs of factory applications. We provide them with expertise in computer controls, software and electronics. It turns out to be a complementary arrangement."

Marvin Minzen, president of Design Technology, Burlington, Mass., says that third-party systems



The Intellidex 605 robot is incorporated into a Zehntel PC-board test system. Besides designing turnkey systems in-house, Intellidex depends on third-party system houses like Zehntel to integrate robots into systems.

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# Systems in Manufacturing

houses like his company are a logical avenue for high-volume robot suppliers to take in getting their systems on the market. "A company like IBM can't devote its energy to installing a customer's robot system because its objective is to move as many robots as it can," he says. "Instead, IBM turns to companies that have been designing automation for years, are familiar with customers' needs and have automated parts-handling skills."

Some small robot-specialized companies also depend on third parties to incorporate robots into systems. Zehntel Inc., Walnut Creek, Calif., offers the Intellidex 605 system as the material-handling component of PC-board testing products. Stan Mintz, Intellidex president, says his company fosters such arrangements with other third-party systems houses. "We can't be experts in every application that our robot may be suited for," notes Mintz. "Instead, our company concentrates on providing turnkey systems in applications that we are most qualified to handle and in which we can sell the most robots. The third-party people can handle the rest."

ADL's Michaels says that older companies have production application experience because most of those companies evolved from the machine-tool, spray-painting and welding industries. That experience, he says, is a key to those companies' market success. In the coming years, however, users will want more than stand-alone automation islands that perform one task but do not tie into other factory systems.

Michaels says that some newer robot vendors that have evolved from the computer industry are best-suited to serve those integration needs. "Computer-oriented robot companies realize that their robots are going to have to be a part of future factory networks," he says. "They will be the leaders in bringing that technology into robots to allow that to happen." Those technologies, he adds, include high-level programming languages, sophisticated computer controllers with great computing capabilities and network interfaces. Although robot vendors are working on the technologies, their implementation is still some years away, says Intellidex's Mintz. "Users have to learn to walk, before they can learn how to run," he says. □

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## HP's 64000 Logic Development System...

# How it blasts through software BOTTLENECKS

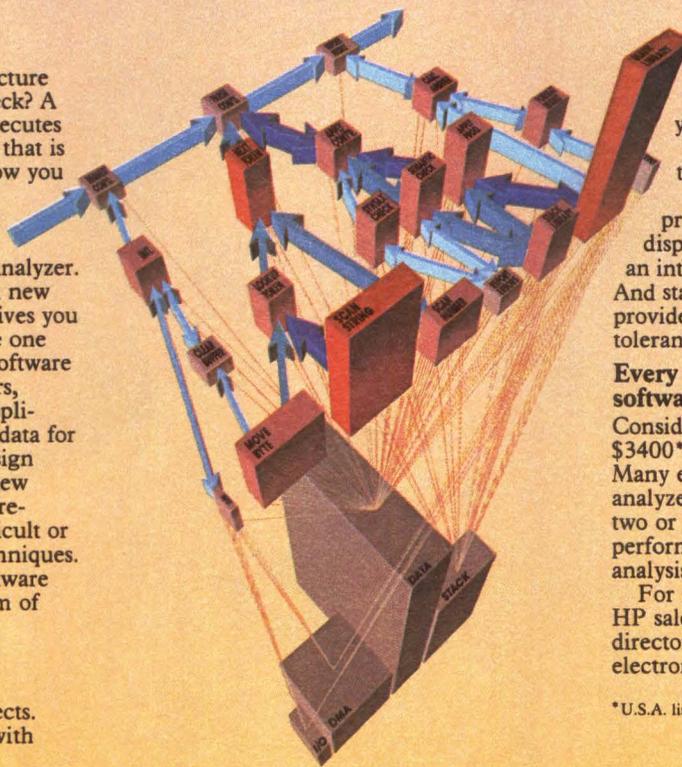
How would you like to have a picture that identifies a software bottleneck? A picture taken as your software executes in real time? Via a measurement that is completely nonintrusive? Well now you can do all that. Via a low-cost subsystem for HP's 64000 Logic Development System called the 64310A Software Performance Analyzer.

But that's not all this powerful new software tool can do for you. It gives you a perspective on software like the one shown to help you characterize software through benchmarks of processors, operating systems, algorithms, application programs, etc. It provides data for intelligent hardware/software design trade-off decisions. It gives you new insight into software debugging, revealing interaction problems difficult or impossible to spot with other techniques. And it can put a spotlight on software inefficiencies that rob your system of performance and add extra cost.

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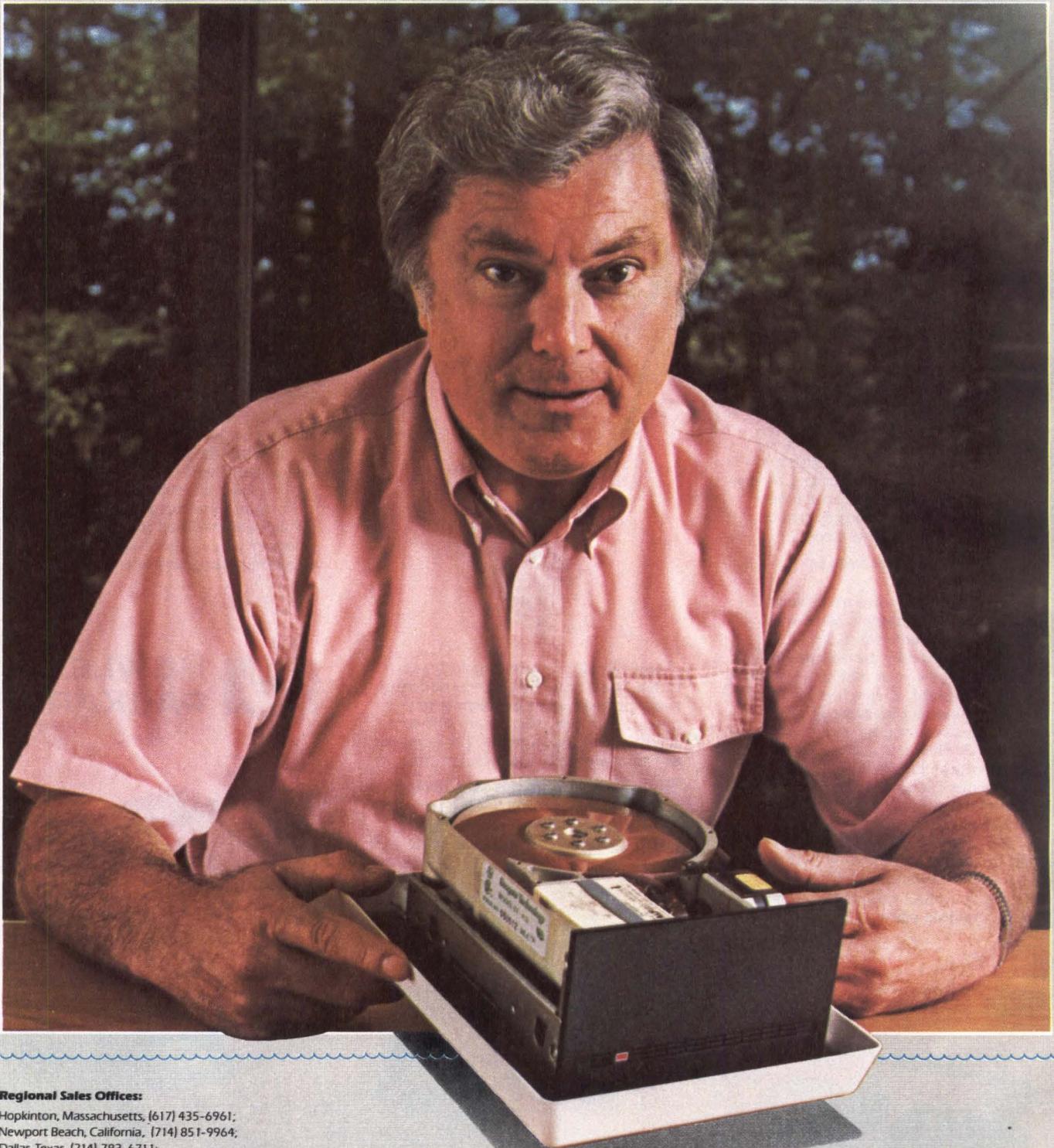


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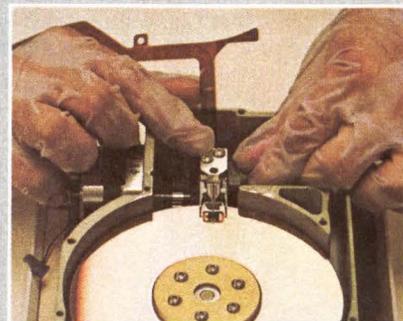
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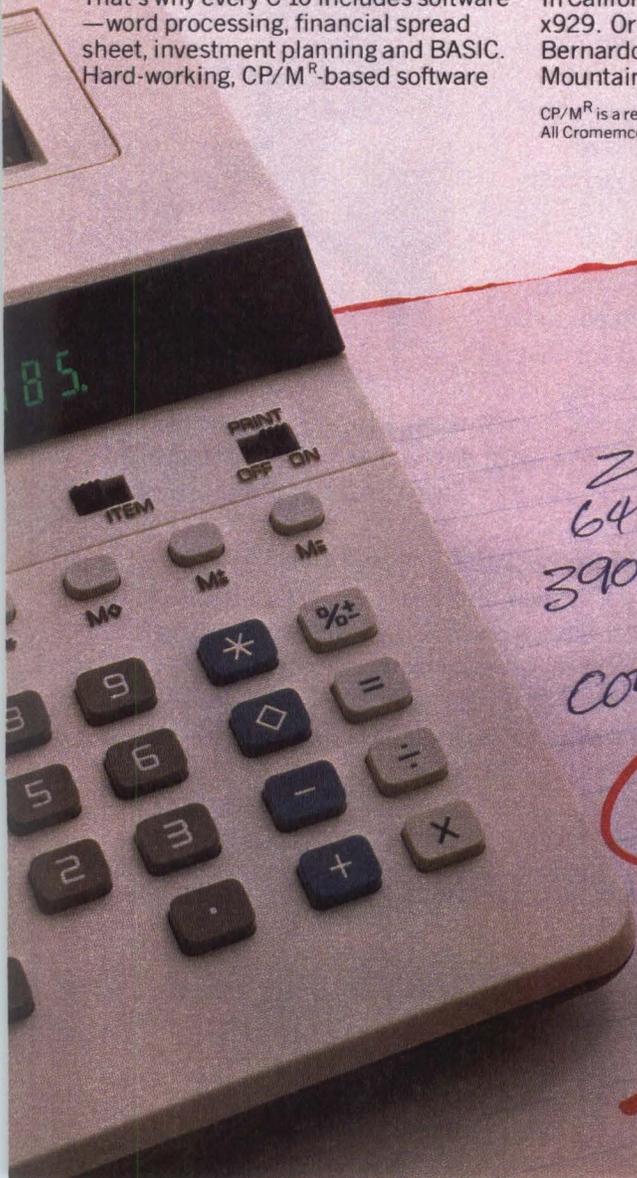
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# Systems in Manufacturing

## Control Automation robot works with any controller or programming language

A new robot designed to handle precision-assembly applications is available from Control Automation Inc., Princeton, N.J. Called the Mini-Sembler, the robot is intended for such tasks as inserting odd-shaped components onto printed-circuit boards, as well as assembling such electronic devices as calculators, small motors, disk drives, switches and keyboards. Customers include GTE, Hewlett-Packard Co., Magnavox, NCR Corp. and Tektronix Inc.

The Mini-Sembler is available with the HP 9915A microcomputer—the industrial version of the HP 85 system—which is programmed in BASIC and serves as the robot's controller.

Mike McCraley, director of marketing at Control Automation, says that because the Mini-Sembler's mechanical arm receives its instructions in ASCII code via an RS232 serial data port, a user can configure a system using any computer as the robot controller and can use any language to program the system. Although Control Automation wrote the robot commands in BASIC, a user who wants to use FORTRAN, for instance, can assign FORTRAN names to the BASIC commands and then use a compiler to translate his program in ASCII strings that the robot can understand. With this feature, McCraley points out, end users or system integrators are not locked into any one robot vendor's hardware/software solution.

"The early robot suppliers developed egocentric systems revolving around their respective controllers that had to be programmed using the robot vendor's own language,"

he says. "The user was short-changed because if he had more than one robot and each robot was supplied by a different vendor, his programmers had to learn a number of new languages. Worse yet, each robot had its own controller that couldn't communicate with the next robot's controller."

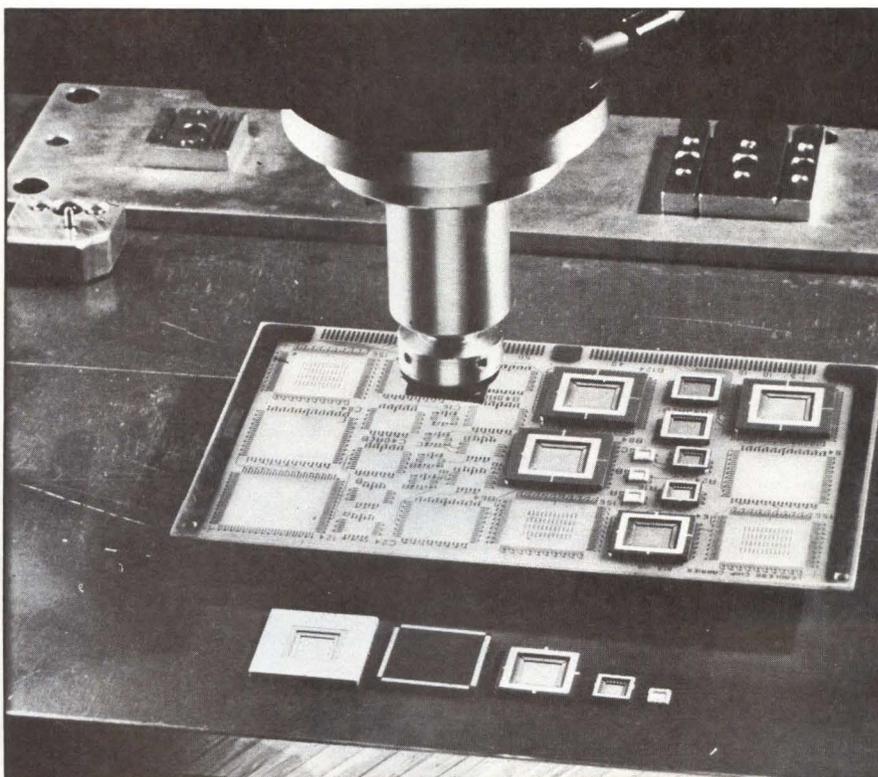
Control Automation offers the HP 9915A as an option with the Mini-Sembler because of its price/performance capabilities. "But," McCraley states, "if a customer wants to use a DEC VAX computer instead and program that system in Pascal, FORTRAN, FORTH or whatever, he has the option with our robot."

An Intel 8086 microprocessor,

housed in the Mini-Sembler's mechanical arm, coordinates the motions of the robot's four servo-powered axes. Each axis is controlled by an Intel 8051 microprocessor. The Mini-Sembler can lift as much as 5 lbs. with a precision of  $\pm 0.001$  in.

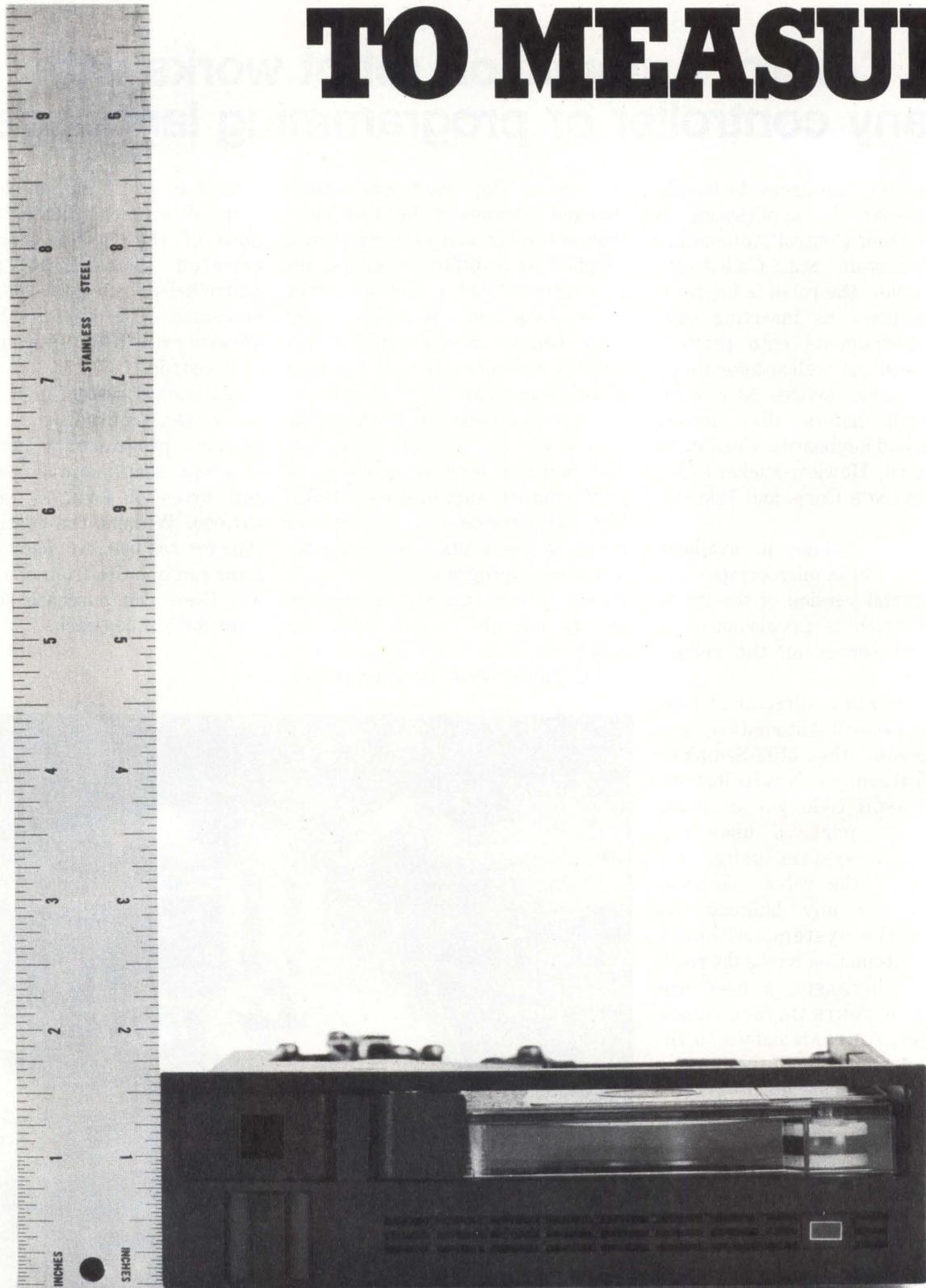
A standard system, including the HP 9915A controller, a teach-pendant programming unit, self-checking, real-time diagnostics and 16K bytes of RAM, is priced at \$37,000. Without the controller, it sells for \$35,000. As many as three arms can operate from one controller. Users can purchase additional arms for \$24,000 each.

—Frank Catalano



Control Automation's Mini-Sembler robot can be controlled by any computer and programmed in any language. It is targeted to precision-assembly applications.

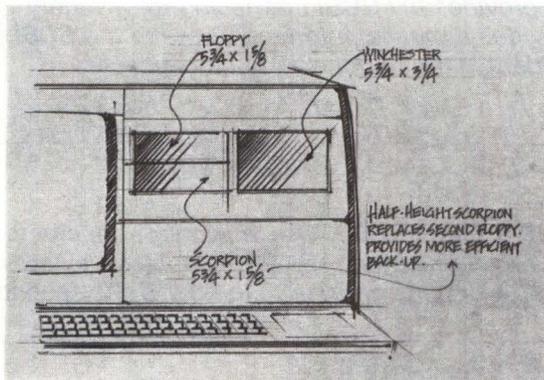
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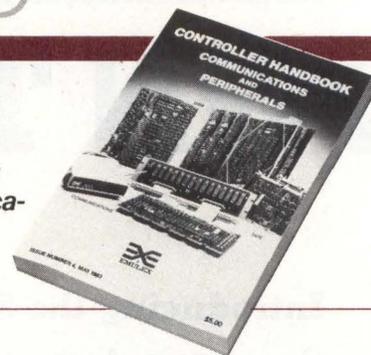
CIRCLE NO. 81 ON INQUIRY CARD

# EMULEX TALKS DEC

5

## WE WROTE THE BOOK ON DEC COMPATIBILITY...

The new *Emulex Handbook (Issue No. 4)* is hot off the press. It tells you everything you need to know about all Emulex disk, tape and communications controllers, including the celebrated new products introduced at NCC. Call or write to receive your free copy.



## NEW PRODUCTS, PART I...

The UC01 has arrived! This single-board emulating host adapter provides full SCSI interfacing for a variety of controller/disk drives to DEC LSI-11 computers. The UC01 provides a parallel interface between the SCSI bus and the CPU. This allows up to seven controllers, usually resident in the peripheral, to be connected to each host adapter.

## NEW PRODUCTS, PART II...

Emulex has something for PDP-11 and VAX-11/730 environments, too. Our new SC31 is a universal emulator for interfacing high-speed, high-density disk drives to these popular DEC computers. The SC31 handles almost any industry standard SMD disk drive in the 80 to 675 MByte range, with transfer rates up to 1.8 MBytes/second.

## NEW PRODUCTS, PART III...

Don't think we overlooked VAX-11/750 and 780 users. For you, we've introduced two new disk controllers that will enhance your system's mass storage capability. The SC758 is a single-board controller that embeds directly into the backplane of a VAX-11/750. The SC788 is a single-board controller that plugs into the Emulex V-Master/780 Mass Storage Adapter, which installs as a sub-chassis within the VAX-11/780 CPU. Each controller board handles up to eight physical disk drives, ranging in capacity from 80 to 675 MBytes. Transfer rates up to 1.8 MBytes/second are supported by both controllers.

## WE'VE GOT IT ALL FOR TAPE...

When you think of tape, think of Emulex. Our prices are competitive, our products reliable. We introduced the industry's first quad-sized TS11-compatible tape coupler series. For LSI-11 users, there's the TC02. For PDP/VAX-11s, try the TC12. Both models can handle every type of industry-standard formatted 1/2-inch tape transport. From conventional start/stop to streamers.

## FOR THE RECORD...

The Emulex TC01 disk controller has a calculated MTBF of 41,000 hours. But in statistics compiled in field operations between 1980 and 1982, its actual MTBF was a whopping 164,930 hours! That's the equivalent of 31 years between failures, with the system in operation for 102 hours each week.



3545 Harbor Blvd., P.O. Box 6725,  
Costa Mesa, California 92626,  
Toll-Free (800) 854-7112, In Calif. (714) 662-5600.

# Systems in Manufacturing

## Martin Marietta Data Systems expands manufacturing software line

With the introduction of three new software products plus a broadening of the host computer types that can support its packages, Martin Marietta Data Systems, Greenbelt, Md., has intensified its drive into the market for manufacturing information systems. The new packages—MAS-Payroll, MAS-Personnel and MAS-Project Planning—join the established MAS-Manufacturing package in the firm's modular application systems lineup. The software runs on Digital Equipment Corp. VAX minicomputers and IBM Corp.'s 303X, 308X and 4300 series (including the 4321 SSX) mainframes. All except the project-planning module run on Hewlett-Packard Co.'s HP 3000 minicomputers as well.

In announcing the products, Gerald W. Stanley, vice president of application products, noted that all the packages are transportable among the various supported computers. Access modules and strategic system software must be acquired for each computer model, but the application code and the user interface remains constant from machine to machine. Stanley believes the software's compatibility with a number of popular computers will give the MMDS packages an advantage over packages from the computer vendors, who typically support their software only on their own machines. John P. Rohal, executive director of product marketing, says the company's Fortune 1500 customers are likely to have mixed-vendor systems, with central IBM mainframes tied to DEC and HP minis in subsidiaries or within divisions.

Another key selling point for the

MMDS products, Stanley believes, is the company's complementary remote computing services. Because all the announced packages can be run on the time-sharing service, he says, new customers can set up their operations using the vendor's remote computers and easily switch to an in-house operation.

The MAS-Manufacturing system is the same as a previous product, but it now runs on VAX and SSX systems as well. Prices for the VAX and HP 3000 implementations range from \$21,000 to \$75,000 depending on the number of modules acquired. Modules include master production scheduling, inventory control, manufacturing or shop-floor control, purchasing, cost control and engineering control.

Priced from \$19,000 to \$39,000, the MAS-Payroll software includes transmittal, payroll register, paycheck or statement of pay, tax listings, W-2 forms and 941 reports. Other features are automatic bank deposit, check reconciliation, automatic check reversal, internal balancing, audit trail and automatic deduction entry.

MAS-Personnel permits a manufacturer to consolidate personnel

data into a central, organized file. The system automates detail record keeping and provides for benefits administration; labor relations; report generation; training-skills inventory; applicant-reporting manpower planning; wage administration; and EEOC, ERISA and OSHA regulations. The package sells for \$19,000 to \$59,000.

The MAS-Project Planning package provides network scheduling; multiple-resource allocation, tracking and projection; "what-if" analysis, graphics; and flexible reporting formats. Priced at \$100,000, the package allows reports and plots to be processed while users perform other tasks on the system.

Manufacturing software likely to join the MAS family includes decision support, financing, sales and marketing and engineering and design packages, says Stanley. The engineering and design functions are expected to bring MMDS into the CAD/CAM market, he says. Another planned move is to integrate various microcomputers into the systems able to run the company's software, but when this expansion will occur is not known.

—Dwight B. Davis

## Uniq introduces manufacturing system for DEC computers

Called SPIDER II, this modular closed-loop, net change manufacturing planning and control system from Uniq Digital Systems, Batavia, Ill., runs under the UNIX operating system on Digital Equipment Corp.'s VAX and PDP-11 series

computers. In addition, the DEC-MATE II word processor and DEC personal computers such as the Professional 350 can be used as workstations.

SPIDER 11 includes four basic accounting modules developed by

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Reprints of articles which have appeared in Cahners' magazines can easily become an important means of increasing your marketing results. This complete reprint service is available to you at a very low cost.

There are innumerable ways Cahners' reprints can be of vital assistance to your company's total marketing program. They are exceptionally valuable promotion pieces, particularly when you use them as part of a Cahners' Direct Mail Program.

Here are some uses which just scratch the surface of the many ways you can make reprints go to work for you and build your company's profits.

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These are just a few of the ways you can strengthen your company's position as a leader in your market. Fast, high-quality service for all your reprint needs are available through Cahners' Reprint Service.

## Mini-Micro Systems

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## Systems in Manufacturing

MiniComputer Business Applications Inc.: general ledger, accounts receivable, accounts payable and payroll. Also available are office- and factory-management packages developed by Uniq, such as the Unicalq 3D electronic spread sheet, the Unify database manager, an on-line factory time-recording system and electronic mail.

The modular structure of Spider II allows a manufacturer to expand or to modify the system after it is installed. The system is flexible and resistant to obsolescence because of its compatibility with the versatile

UNIX operating system, claims Uniq president Charles E. Richter Jr.

The basic system, including the four accounting modules and UNIX, is priced at \$65,000. Additional packages are in the \$3000 to \$6000 range, and quantity discounts are available.

Uniq Digital Systems, until recently called Digital Systems House, is an authorized DEC computer distributor. The company specializes in turnkey manufacturing and distribution systems based on VAX and PDP-11 computers.

## HP adds quality-management software to MPN family

Quality Decision Management/1000 from Hewlett-Packard Co., Palo Alto, Calif., is an application software package for statistical quality control. It can help manufacturers find problems in the manufacturing process involving materials, workmanship and the process itself according to the company.

The package collects, analyzes and displays variable and attribute data from the manufacturing process and from product-test work stations. Detecting and correcting problems early can increase levels of quality and productivity and minimize costs associated with scrap, rework and work stoppages, says Gaylan Larson, division manager of HP's manufacturing and productivity division.

Using QDM/1000, quality-assurance and manufacturing engineers and production managers can get information in the form of control charts, histograms and scattergrams to identify problems and relationships between the process, materials, workmanship

and product defects. The software package runs on an HP 1000 minicomputer with the RTE-6/VM operating system and is suitable for a number of industrial-automation applications, says HP. These include incoming inspection, electronic product test, history-tracking and quality early-warning systems.

The company claims a menu-driven, fill-in-the-blanks approach allows engineers without programming experience to configure and implement the package. Data can be collected manually by user-defined CRT transactions on HP terminals, automatically from HP's family of desk-top computers or both. Users can view color graphs and tabular reports on CRTs or in hard-copy form from plotters and graphics printers.

This software product is part of HP's Manufacturers' Productivity Network, which also includes materials management, production management, processing monitoring and a programmable controller link. QDM/1000 sells for \$40,000 in the U.S. Delivery is eight weeks.

# Performance runs in our family.



At WICAT, our primary objective is performance. This attitude has created today's most comprehensive line

of super-micro computers. In terms

SYSTEM 220  
8-48 USERS



SYSTEM 160  
1-12 USERS

of breadth of product, software

support, and perhaps most importantly, reliability, WICAT is a performance company.

WICAT has created a family of supermicro computers versatile enough to meet virtually any computing requirement. Our systems support from 1 to 48 users, 256K to 14 MB of main memory and from 10 MB to 474 MB of disk storage. So from the fast single user desk top S-150 to the powerful rack mounted S-220,

WICAT provides the strength, speed, and flexibility to perform according to your company's unique requirements.

In the course of just two years, we have been successful in providing WICAT's customers with two operating systems (MCS and UNIX),

performance. Our software designers have concentrated on producing tools which formerly existed only in the mainframe or mini-computer environment.

This performance story began with the introduction of the first 68000 based microcomputer and now includes the installation and support of thousands of systems worldwide. Consider this a personal invitation to call us and get more information about the WICAT family.



SYSTEM 155  
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SYSTEM 200  
8-32 USERS



MG 8000

T-7000

9 programming languages, as well as word processing, data base management systems, a virtual electronic spreadsheet, and the WISE authoring system. This is per-

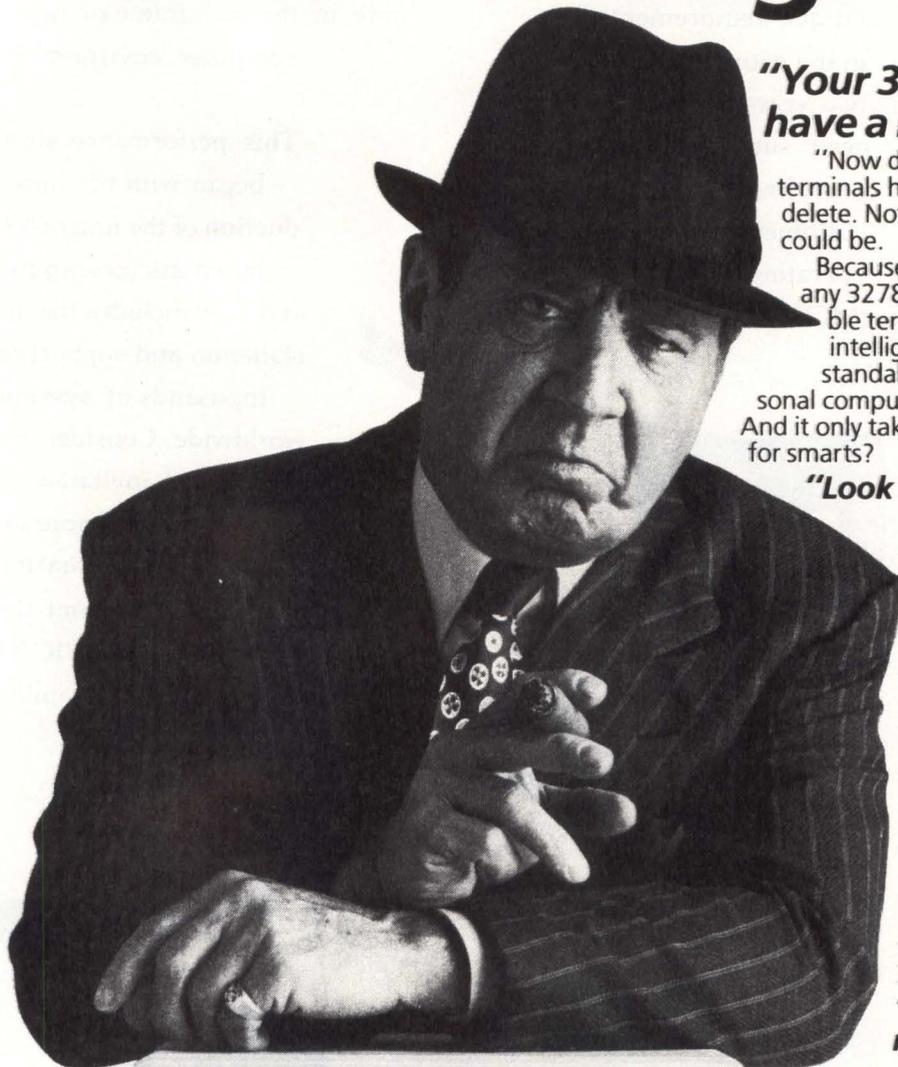


SYSTEM 150  
1-6 USERS

**WICAT**systems

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# **"Okay, IBM, you're smart. But you're not smart enough."**



**"Your 3278 and 3178 terminals  
have a lot on the ball. But."**

"Now don't get us wrong. We know your terminals have local storage. Cursor editing. Line delete. Not bad, IBM. But not up to where they could be.

Because our new AVATAR TC3278 can take any 3278, any 3178, or any IBM plug-compatible terminal and move it up past smart, past intelligent and turn it into a functioning standalone interactive workstation with personal computing capability. For not much money. And it only takes five minutes to install. How's that for smarts?

**"Look at these plusses, IBM."**

"This TC3278 gives you all that power with your existing terminal. So it takes less space, requires less maintenance. There's no retraining because people work on their familiar IBM equipment.

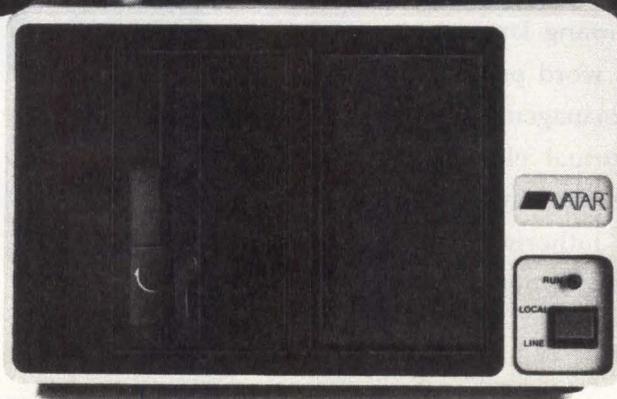
Your terminal will be able to communicate with your main database, with other non-IBM host computers in your organization, even with public databases, to ensure you're using consistent and accurate information.

Our TC3278 comes complete with its own word processing and electronic spreadsheet software, fully functional on your existing 3278 and 3178 terminals.

**"We're going to make you  
more productive."**

"The name of the game is that this AVATAR TC3278 is going to increase your productivity, IBM. For not much money and no trouble at all.

Contact one of our guys for more information. Write 3R Computers, 18 Lyman Street, Westboro, MA 01581. Or call us at (617) 366-5300.



## **AVATAR™**

**Making IBM smarter since 1983.**

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CIRCLE NO. 84 ON INQUIRY CARD

# COMPUTER STORE SELLS ONE MILLIONTH LEMON

## Store closes on day of celebration

PHILADELPHIA, PA—The Fruit Tree Computer Store was honored today as the first computer dealer to sell one million Lemon personal computers. Festivities were momentarily interrupted, however, when receivers for the banks appeared and seized all Fruit Tree assets, including the historic millionth Lemon.

"We were really squeezed," said Fruit Tree President Y.B. Bitter bitterly. "Personal computers with floppy disk software just don't have enough bite for important business applications. We wanted to get into real business oriented micros. But where were we going to get the applications software? It doesn't grow on trees!"

When asked if he had contacted Trac Line, Bitter was evasive. "Trac Line?" he responded. "Is that something like a tangerine?"



## TRAC LINE has software solutions for business.

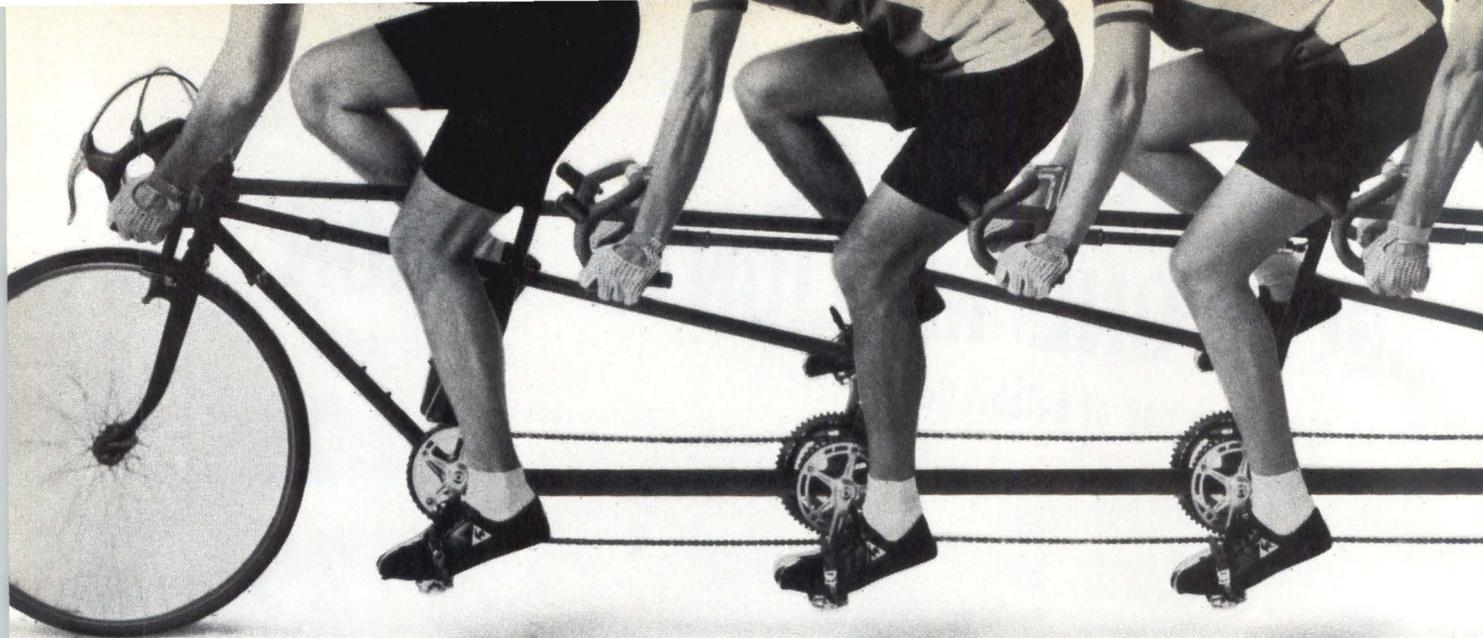
Trac Line Software Inc. offers proven business software, designed specifically for wholesalers and manufacturers. The packages, available on Oasis, are designed to run on multi-user 8 and/or 16 bit microcomputers with a minimum 10 megabyte hard disk—Dynabyte, Altos, Onyx, IBC, Compupro and many others. These fully integrated programs are decision driven to produce edited reports rather than yards of tabular data. Users call them the best solution for the problems of managing a business. Systems houses and dealers call them the best solution for staying in business.

Contact Trac Line Software Inc. at 51 Alpha Plaza,  
Hicksville, N.Y. 11801, (516) 935-7500.

### **TRAC LINE**<sup>®</sup>

We're the software solution for your business.

CIRCLE NO. 85 ON INQUIRY CARD



## A simple analogy that explains why Plexus

The division of labor.

A very simple idea that says when you divide a job up among a lot of people or machines, the job goes faster.

In our case, this principle translates to a multiprocessor architecture, up to seven, to be exact.

And that's the reason our family of four UNIX™-based systems will get you where you want to go. Very quickly.

### **Multiprocessors. No waiting.**

Most commercial UNIX-based systems being peddled these days rely on a single processor to do everything. No wonder they drag their feet as system loading increases.

Not us. We're all speed. All the time.

We distributed the UNIX operating system to where it does the most good.

Our 16-bit Intelligent Communications Processors rush terminal I/O to and from as many as 40 users. While also

taking care of low level communications so as not to interrupt the CPU.

Our 16-bit Mass Storage Processors handle disk I/O chores. So you get fast disk access and can keep data bases and important files easily accessible.

The performance that results is close to that of a VAX™ 11/780.

And costs about \$200,000 less.

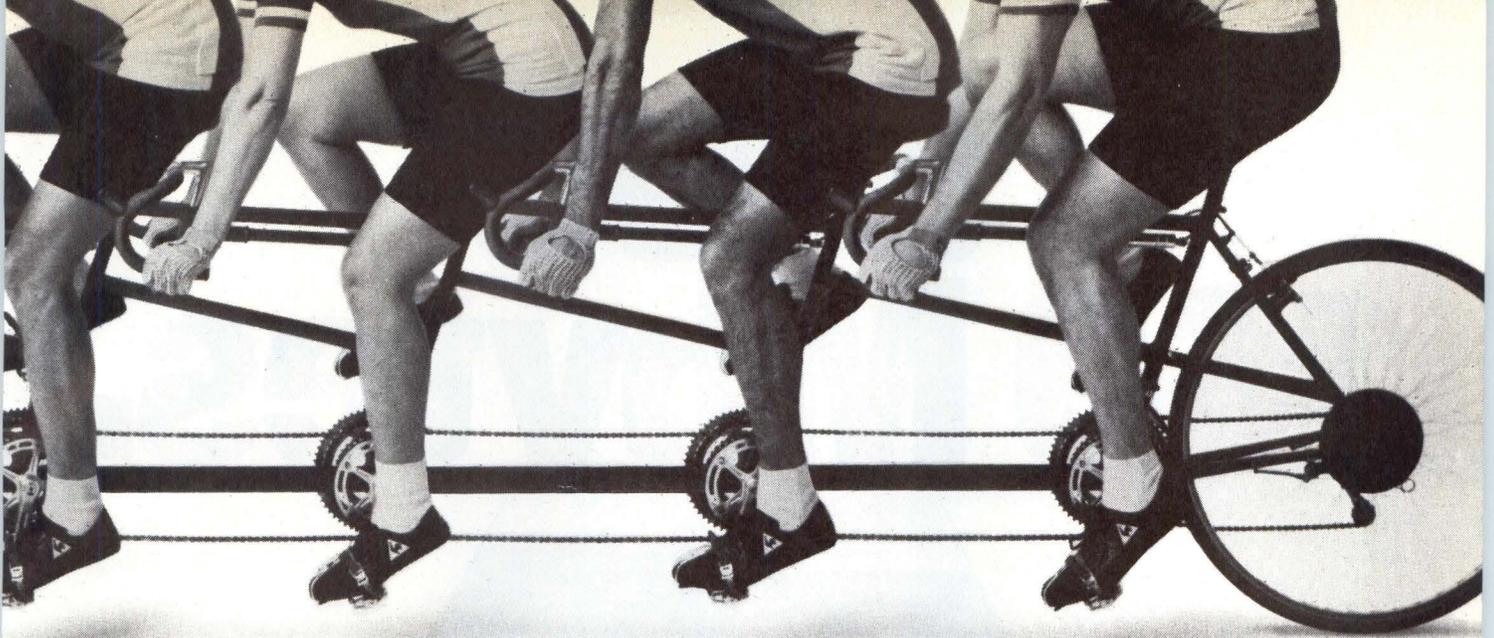
### **The Plexus Family. Speedsters all.**

There's our Z8000 series, the economical 16-user P/25, or the 40-user P/40.

Or choose the newly introduced P/35 or P/60 models for 32-bit performance.

They're both based on the 12.5 MHz MC68000. With the addition of a few, shall we say, high performance modifications.

Like an on-board 4K cache memory. 16K of high-speed on-board RAM. A high-speed memory map. And a 32-bit memory path.



## has the fastest Unix-based systems.

All of which help boost performance even further. Giving your system enough stamina to run multi-user applications at full speed all day long.

### **Plus more standards as standard equipment.**

There are times when performance isn't everything. There's growth, too.

That's why we've included the MULTIBUS® standard for board-level expansion.

Plenty of serial RS232C ports for terminals of all kinds.

And standard software packages like COBOL, Pascal, BASIC, and C. Plus access to hundreds of third party UNIX packages.

### **We're right behind you.**

No one, but no one, supports UNIX and you as completely as we do.

You'll get full software engineering

support, UNIX software maintenance, and even a software referral service for all your OEM programs.

Plus a field engineering force that can help you take the lead in your field, no matter what it is.

### **Want a race?**

Come run a benchmark on one of our Plexus systems. To set one up, just call 408-988-1755, or write us at: Plexus, 2230 Martin Avenue, Santa Clara, CA 95050.

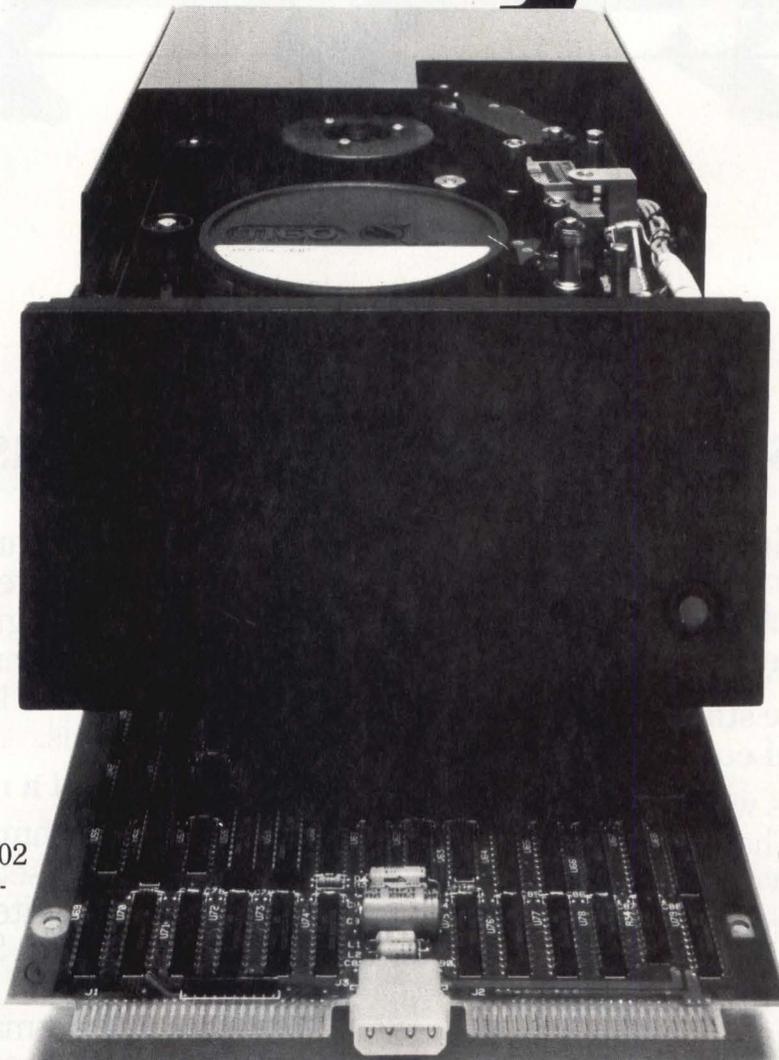
You'll see a performance feat no other commercial UNIX-based system can match. Which is understandable. We go so fast because we've got more going for us.

**IPLEXIUS**  
Built for speed.

VAX is a trademark of Digital Equipment Corporation. UNIX is a trademark of Bell Laboratories. MULTIBUS is a registered trademark of Intel Corporation.

**CIRCLE NO. 86 ON INQUIRY CARD**

# Save 160 Mbytes.



The D161 QIC-02 tape drive is the perfect matching mass storage device for your Winchester.

Quite a claim, true. But we can back it up.

Only the D161 gives you 160 MB of storage in an 8-inch envelope. And it's the only 1/2-inch tape drive that's compatible with industry-standard QIC-02 specifications.

In short, the D161 is the answer for applications which require more capacity than traditional

QIC-02 based hardware. And, of course, it features the reliability and interchangeability of 1/2-inch tape. To top it off, with the D161,

you just plug and go.

What could be simpler?

For a test drive, write for details on our Evaluator Package. See for yourself how easy it is to go from 20 to 160 MB in under 20 minutes.

After all, you've got nothing to lose.

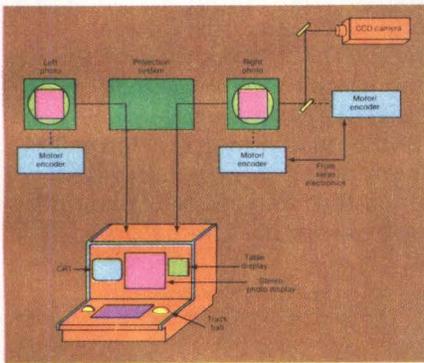
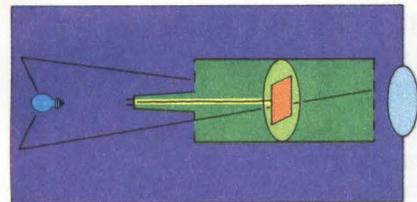
# QIC.

## ROSSCOMP

**We're backing up your future.**

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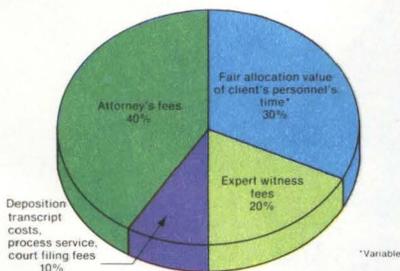
# FEATURE HIGHLIGHTS



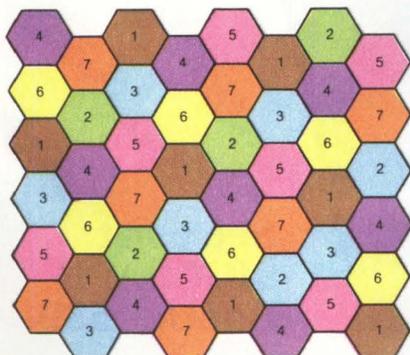
**GRAPHICS: "Graphics workstation"** means many things to many people, but the homogeneity of recent hardware developments is giving the term a new definition. To learn more, turn to p. 165 and consult MMS's survey of more than 80 graphics-workstation vendors and their products. . . Graphics hardware represents a much smaller percentage of system cost than it once did. Consequently, graphics users are paying increased attention to the cost of writing and maintaining software. **Software compatibility** across product lines has thus become a prerequisite for success. See p. 189 for more information. . . General Electric Co. has produced a **single-gun projector** that uses a light valve instead of a CRT. The PJ 5055, which houses the electronic gun and light valve chamber, a Xenon lamp and a projection lens, throws monitor-sharp color images onto 25-ft.-wide screens. For a closer look, see p. 197. . . Motorola's VME/10 is an example of an industry trend toward development systems with flexible, low-cost graphics capabilities. An analysis of this **desk-top micro** for OEMs in the industrial and scientific markets begins on p. 207. . . The **Traster stereo satellite** from Matra Technology integrates parallax data from binocular images into apparent 3D images that can be viewed through eyeglasses with correspondingly polarized lenses. Turn to p. 214 for further details.

**STORAGE:** Until recently, system integrators haven't been able to store more than 1M or 2M bytes in half-height minifloppy disk drives. Those people will be happy to find that Drivetec Inc. has produced a **"SuperMinifloppy,"** which packs 3.3M bytes and can also operate as a lower capacity industry-standard drive. The offering is profiled on p. 219.

**LAW:** The 1980s have been marked by numerous lawsuits from parent companies to spin-offs that present competitive challenges. The parent company claims protection rights based on patents, trade secrets and general laws against "unfair competition." The result has been lengthy, expensive trials that end in dubious decisions. See p. 231 for a look at **high technology and the law.**



**DATA COMMUNICATIONS:** As fast as the hardware is shrinking, the market for portable computer equipment is growing. Many applications involving such equipment depend on remote communications via telephone. But on-the-road data communications presents numerous problems. A new mobile-phone scheme, called **cellular radio**, detailed on p. 239, should add new momentum to the portable computer-equipment market.



# Picture the best...

## **THE RAMTEK 9465: SUPERLATIVE PERFORMANCE STARTING AT JUST \$11,250.**

The standard 9465 is an outstanding entry level value. The base price includes: 1280 X 1024 X 4 resolution, Z80 display processor, graphics processor, and video lookup table, all in one compact desktop unit. Add our color monitor for a package price of \$14,995.

## **OR, IF YOU PREFER, CONFIGURE YOUR OWN SYSTEM.**

Alternately, the 9465 can be any system you want it to be. It's ideal for systems integrators, making possible an excellent match up of color graphics capabilities with applications needs. Options include: 1280 X 1024 resolution in 4-bit increments up to 16 bits, Z80 or MC68000 display processor, high-speed coordinate transforms, pixel formatter, host interfaces, peripherals, video generators, and a variety of monochrome or color monitors.

Prices are in U.S. dollars.

Z80 is a registered trademark of Zilog Inc.  
MC68000 is a registered trademark of Motorola, Inc.

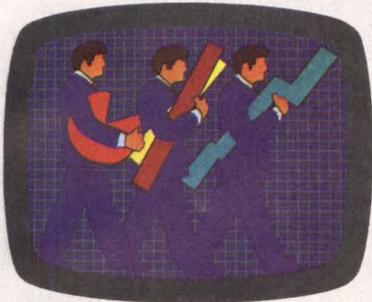


**See us at  
SIGGRAPH,  
Booth # 539**

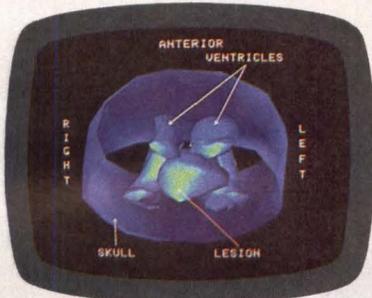
Solids Modeling System PADL  
Sandia National Laboratories

# for less.

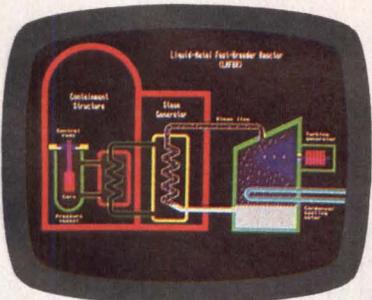
...for CAD and  
business applications.



...for imaging  
applications.



...for C&C and  
process control.



...and beyond.



Digital Scene Simulation by Digital  
Productions. Los Angeles, CA  
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## Introducing Ramtek's new 9465 high performance, low-cost deskside colorgraphics and imaging system.

No colorgraphic system provides you higher resolution, greater image control, or more capabilities for the money than Ramtek's new 9465.

If that sounds a lot like a repeat description of the pace-setting, Ramtek 9460 Series, it should. The 9465 is the latest extension of the 9460 concept. It shares the same design approach, is software compatible with the 9460, but adds to it a new compactness and economy.

This deskside system is available in an economical off-the-shelf version or can be user-configured, allowing you to tailor the 9465 to a wide range of applications needs. As an added benefit, the modular design of the 9465 allows for easy on-site upgrades.

Don't pay more. Don't get less. For literature and complete specifications, call our office nearest you. Or, contact us at 2211 Lawson Lane, Santa Clara, CA 95050. (408) 988-1044.

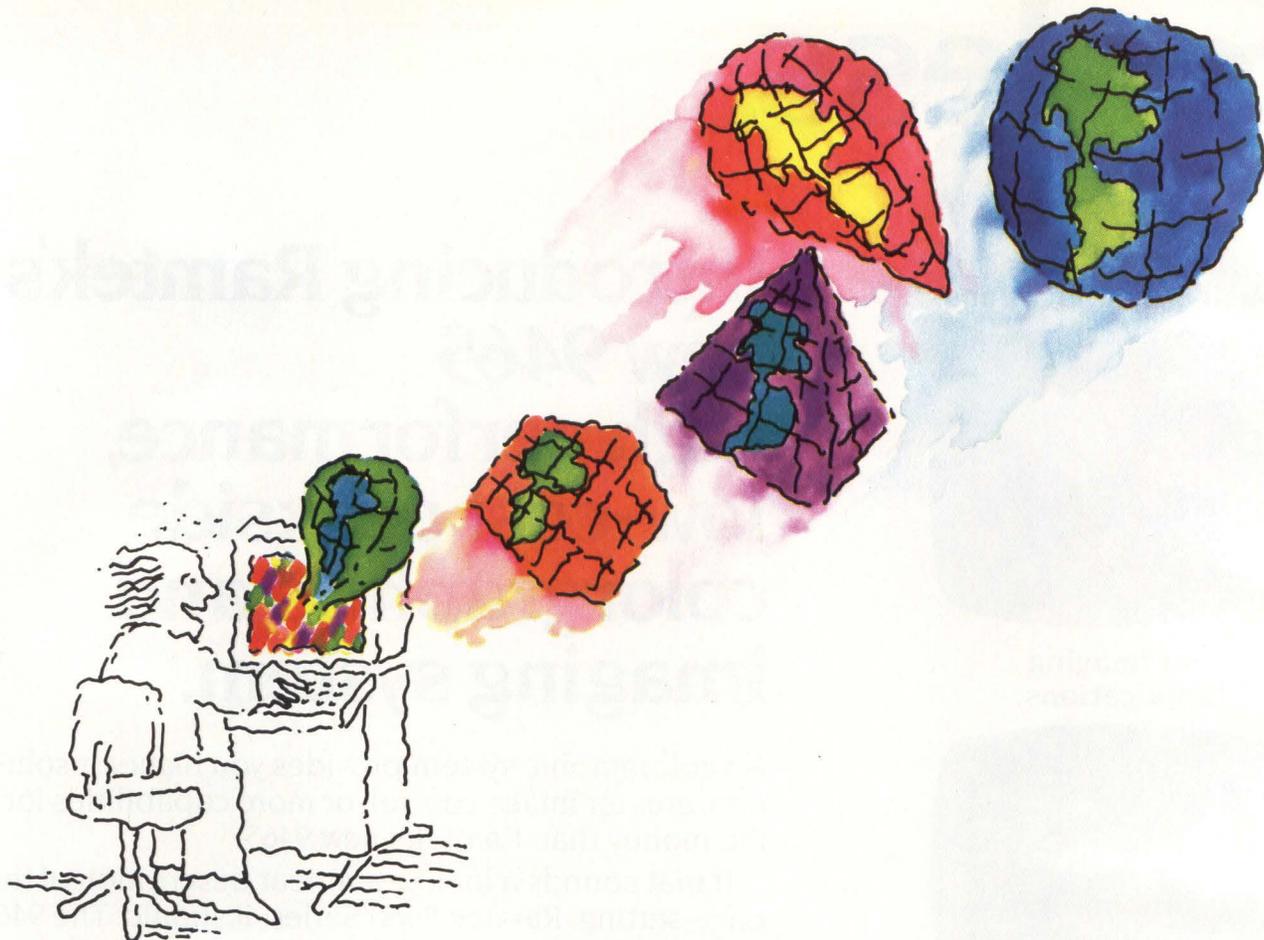


OUR EXPERIENCE SHOWS.

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774-2233; McLean, VA (703) 893-2020; Denver, CO (303) 694-0758;  
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(305) 645-0780; Boston, MA (617) 273-4590; Atlanta, GA (404) 446-3393.



# CHANGE THE WORLD.

Or anything else you can display. Easier and faster than you imagine. Because D-SCAN's new GR-2412 terminal is changing the cost/performance standards for raster scan graphics.

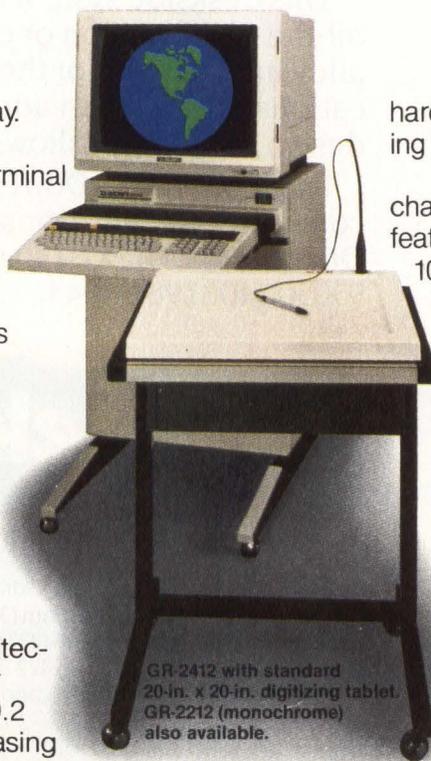
Its world address space, for example, is a full 32K by 32K. Large enough to handle the most ambitious project. Yet easily manageable with dynamic zoom, pan, window, and viewport commands.

Its zoom operation faithfully preserves resolution and detail, instead of simulating it with pixel replication.

And those aren't all the improvements we've made.

Our dual microprocessor architecture draws 12,500 short vectors per second while transferring data at 19.2 kilobaud. And our exclusive anti-aliasing

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GR-2412 with standard 20-in. x 20-in. digitizing tablet. GR-2212 (monochrome) also available.

hardware removes jaggies without affecting drawing speed.

About the only thing we didn't change is our long list of standard features. Like our high resolution 1024x780 display. Local transformations. Up to 768K bytes of local segment memory. 4014 emulation mode. And the 10 years of Daini Seikoshu (Seiko) craftsmanship in every D-SCAN product.

If you're ready to make some changes, contact us at Seiko Instruments U.S.A., Inc., 2620 Augustine Drive, Santa Clara, California 95051. Telephone (408) 727-0768.

We'll give you a terminal that can take on the world.

**D-SCAN**  
Seiko Instruments U.S.A., Inc.

Nobody offers you a wider variety of computer printers and printer experience than Facit/Dataroyal... all the way from low cost (\$695 list) matrix printers, to sophisticated graphics and color matrix printers, to models that print variable size characters and bar codes, to "daisy wheels" and a multimode near letter-quality printer. Industry standard parallel and RS232C serial interfaces are available in all printers.

Our products are built to perform day after day in the most rugged

environments. We achieve that kind of reliability by incorporating modern, trouble-free LSI circuitry, and fewer moving mechanical parts along with a high level of quality control.

Hundreds of computer systems manufacturers choose Facit/Dataroyal products with confidence, as do a great number of Fortune 500 companies who use Facit/Dataroyal peripherals with their systems.

If you want a trouble-free printer, contact your local computer

printer dealer or Facit/Dataroyal, 235 Main Dunstable Road, P.O. Box 828, Nashua, NH 03061, (603) 883-4157.



**FACIT  
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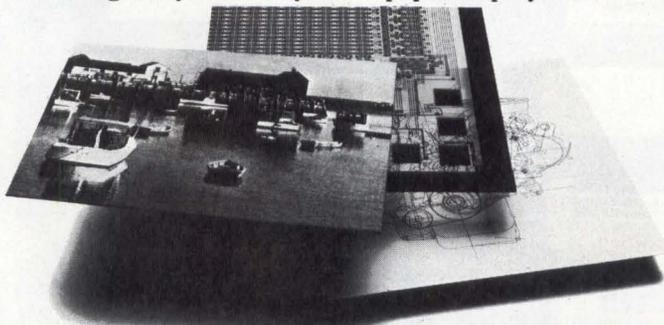


CIRCLE NO. 90 ON INQUIRY CARD

# No other printer or plotter does so much for so many.



Only V-80 does so much, so fast, for so many. V-80 is a multi-user printer that delivers drafts at 1000 lines per minute. V-80 is a plot server that draws graphics, maps, even halftone pictures, for a local network. V-80 is a workstation hard copy unit that makes copies direct from your favorite display terminal. It does all these jobs quickly and quietly. And at your option, it gives you those jobs on paper or polyester film.



Print reports, complete with graphics. Draw complex plots that would take hours on a pen plotter, in just seven seconds. Even produce transparent overlays, overheads, and photocopy masters direct from computer or display terminal.

164

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Share your V-80. Nobody waits long at seven seconds per page. And you can place V-80 nearby, because it works without nerve-racking clatter.

V-80 delivers output worth sharing. It prints with three times the character definition of comparably priced impact printers. And with 40,000 points per square inch resolution, it's the choice of leading CAD and graphics workstation suppliers for high speed graphics.

Versatec serial and parallel interfaces, intelligent controllers, and multiplexers link V-80 with a wide range of multi-terminal systems. Available with Ethernet interfacing, V-80 is the ideal plot server for local networks.

Discover how V-80 can help you get more out of your multi-user system or local network. Circle our readers' service number for a free full-color brochure.

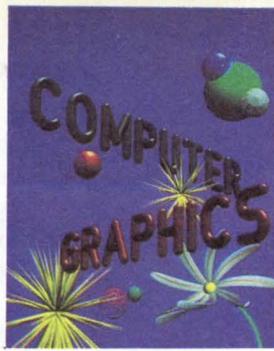
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CIRCLE NO. 91 ON INQUIRY CARD

MINI-MICRO SYSTEMS/July 1983



# Product profile: graphics workstations

PATRICK KENEALY, Senior Editor

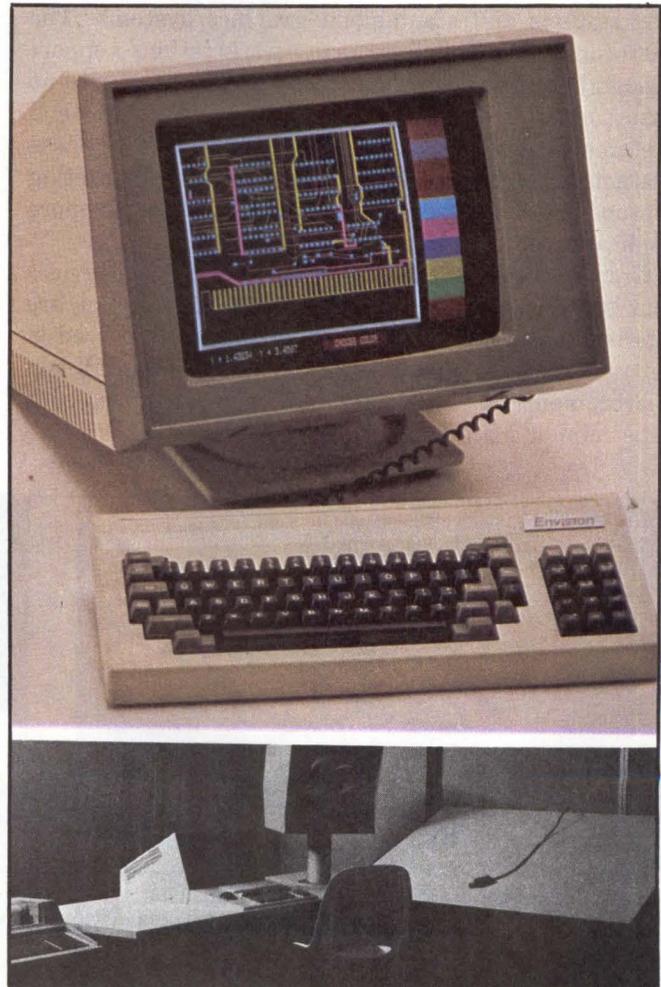
## *The excitement's in the mid-range*

The development of the computer graphics industry, like any other, is illustrated most easily by describing its most recent and dramatic new products. This usually means describing two kinds of products: the least expensive and the most capable. The graphics workstations in the news fit the pattern and are typified by \$2000 color terminals and full-blown \$100,000 CAD/CAM subsystems. This year, however, most of the significant graphics workstation development's involved mid-range units. The big news is in price/performance ratios rather than in absolute price or performance levels. "Workstation" is a misused word, but the homogeneity of recent hardware developments is redefining it.

### **What's a graphics workstation?**

In surveying 80 vendors and their products, *Mini-Micro Systems* found that "workstation" is used to describe diverse graphics displays, terminals, subsystems and turnkey systems (Fig. 1). It also found that a consistent definition that describes current products is possible.

**Fig. 1.** "Graphics workstation" is applied to a wide variety of products. The Envision 230 terminal (top) and the Aydin Controls AYCAD are both graphics workstations. As a general-purpose graphics device intended to work with pictures more than alphanumeric, the Envision unit is more a graphics workstation than a terminal with graphics capabilities. Although the AYCAD system is designed to work with pictures, it is not a workstation because it's a stand-alone system. The Envision unit falls into the low end of the workstation spectrum, and the AYCAD falls outside of the high end.



A graphics workstation is a hardware/software combination that gives a user local graphics input, graphics display and graphics processing. A stand-alone turnkey CAD/CAM system such as those offered by Computervision Corp. and Evans & Sutherland is more than a graphics workstation. A bare-bones graphics generator without keyboard or display (such as those offered by Aydin Controls, Raster Technologies, Ramtek Corp. and others) is a great OEM component but it's not a workstation. Many desk-top personal computers have impressive graphics capabilities, but their primary application is working with letters and numbers, not with pictures. A graphics workstation gives a user what he needs to create and interact with graphics information. In many ways, "graphics workstation" is the new way to say "graphics terminal."

Giving a user a graphics display and a keyboard, tablet or other graphics input device is giving him a terminal. Giving him that plus local graphics processing is giving him a workstation. The inexpensive availability of that local processing power, thanks to powerful microprocessors, custom graphics chips and inexpensive memory, blurs the distinction between graphics workstations and stand-alone graphics systems. The microcomputers built into many workstations support enough functions to perform many applications with no host support and, as a result, are sold as low-end systems rather than as workstations. Many of these systems sell for workstation prices and for marketing reasons are called workstations, but they are far more application specific than their workstation kin.

Graphics workstations are general-purpose devices that sometimes have significant local power but are intended as part of larger systems. A few are used in networks with other workstations, minicomputers and microcomputers. Most are intended for use with supermini or mainframe hosts.

Graphics workstations, especially mid-range units selling for between \$10,000 and \$40,000, are displaying bigger, more colorful, more detailed pictures than ever before. Display screens are almost universally raster units, although some direct-view-storage-tube models from Tektronix Inc. are still in use. Screens are offered in diagonal sizes of 11, 12, 13, 14, 15, 19, 20 and 25 in.

Resolutions range from 512 (horizontally)  $\times$  256 (vertically) pixels to 1536  $\times$  1024 for raster units and to 4096  $\times$  3120 for DVST (direct view storage tube) and vector displays. Lower-resolution units are no more common than they were last year, but 1000-  $\times$  1000-point multicolor units have come into their own (Fig. 2). Tektronix, Ramtek, Megatek Corp., Genisco Computers, Lundy Electronics & Systems, Advanced Electronic Design, Chromatics Inc., Lexidata Corp., Florida Computer Graphics and others offer 1000  $\times$  1000 units, and this summer's National Computer Graphics Association and SIGGRAPH conferences promise more introductions. Refresh rates have improved as well as with 60-Hz, noninterlaced rates the rule.

This year was the first that our survey found more color than black-and-white models. Color units account for two-thirds of workstations and far more than that if DVSTs are excluded. Raster units simultaneously display eight to 256 colors. Raster Technologies offers a display controller for its workstations that it claims can simultaneously display 16.8 million colors. The news is in the number and price of 16-, 64- and 256-color units available for less than \$50,000.

Running such dynamic screens requires substantial local processing power. Workstation vendors use a wide variety of microprocessors (often together) to provide it. Most established products use Intel 8080 series, Motorola 6800 or Zilog Z80 microprocessors. New units use Intel 80186, Motorola 68000, Zilog Z8000 and DEC LSI-11 microcomputers. Math chips such as the Intel 8087 and graphics chips such as the AMD 2901, the Intel 82720, the NEC 7220 and numerous proprietary processors have also improved local processing speed and functionality. The Tektronix 4115B writes 50,000 vector

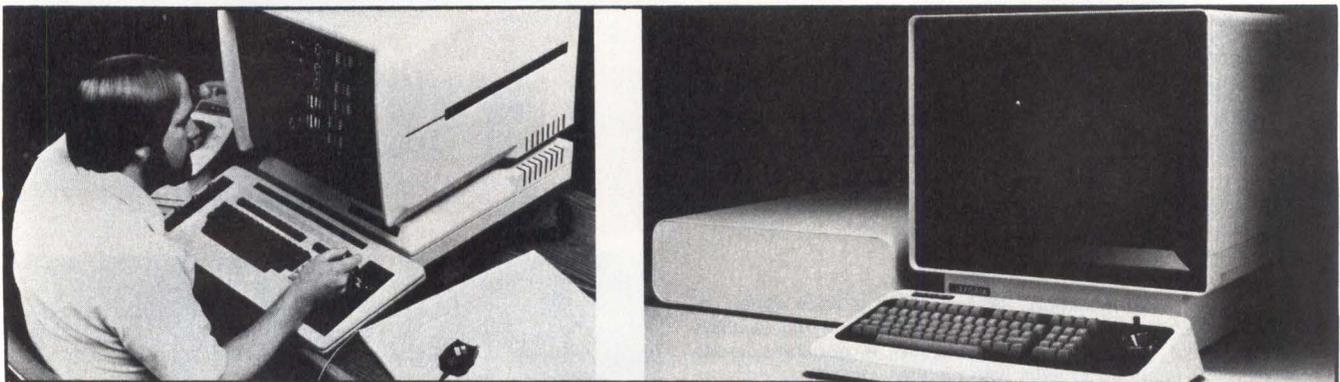


Fig. 2. Mid-range graphics workstations such as the Megatek Whizzard 1650 (left) and the Lexidata 2400 are offering better price/performance than ever. The Lexidata unit features a black-and-white 1280-  $\times$  1024-pixel screen and an MC68000 processor at prices starting at \$11,000. The Megatek unit displays 16 simultaneous colors of a possible 4096 on a 640  $\times$  480 pixel screen and sells for less than \$16,000 in single-unit quantities.

# Frankly, Tek, we're flattered.

When we heard that you folks at Tektronix will have a text/graphics color terminal like our Envision 220 available soon, we weren't really surprised.

We were flattered.

Because you've always had a reputation for doing things the right way.

That means providing all the features both OEMs and end-users want. Like text and graphics on the same screen. A convenient desktop size. Distributed graphics processing. High-resolution 640 x 480 color graphics. And a display of 16 colors from a palette of 4,096.

And it means designing your product to use the industry's most popular software. Our terminals are compatible with VT100 alphanumeric software, PLOT 10™, DISSPLA®, TELL-A-GRAF®, DI3000/

GRAFMAKER® and TEMPLATE™ among others.

To really do it right, you'll need a whole family of terminals that are both compatible and upgradable. Like our 210, 220 and 230.

And the innovations that people are clamoring for. Like our mouse, graphics tablet and optional 19-inch screen.

Then there's the matter of printer compatibility. Our color VectorPrinter™ prints letter-quality text and plotter-quality graphics, together.

So while we're flattered that you may be giving us a run for our money in the text/graphics color terminal market, we're not too worried.

Because it looks like the leader may be following us.

See us at Siggraph, Booth #911

## Envision

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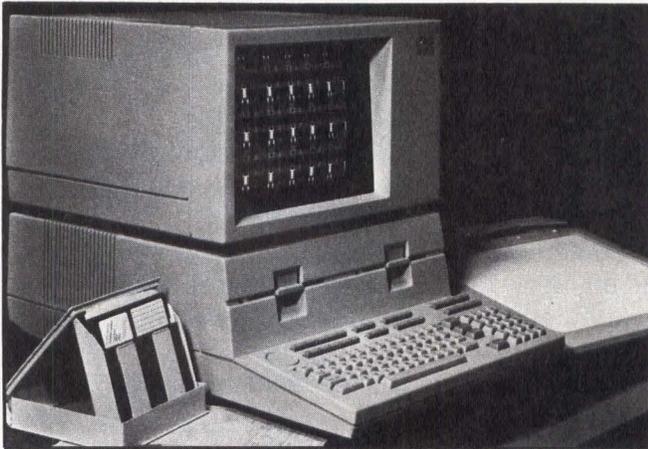


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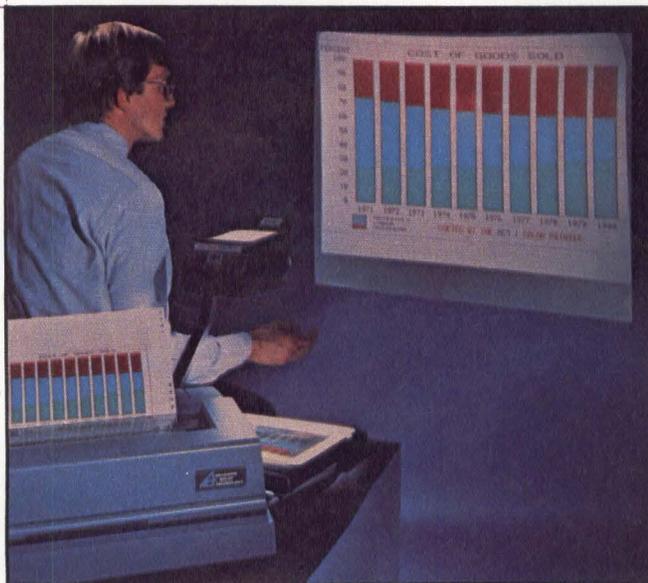
color images in less than 1 sec. and fills polygons as fast as 125 million pixels per sec.

Workstation memory has never been more plentiful. Eight planes of display memory for a resolution is common, and some units offer 24. More memory planes mean more gray shades, colors and display attributes. Many units use 64K RAMS, and many offer 128K-byte and larger program memories in addition to their display memories.

Off-line storage is another expanding capability.



**Fig. 3.** Hewlett-Packard's Series 200 technical computer is typical of many such units in that it doubles as a graphics workstation. The 16-color, 68000-based unit offers a resolution of 512 x 390 pixels and sells for \$17,660, roughly \$3000 more than the standard black-and-white model.



**Fig. 4.** Overhead transparencies are one of the media available from graphics hard-copy peripherals. The Advanced Color Technology Inc. ACT II ink-jet printer copies a color workstation image onto paper or transparent plastic in 90 sec. at a resolution of 140 x 85 dots per in. The \$6400 printer competes against impact matrix, electrostatic, thermal, xerographic, photographic, and other graphics hard copy units.

High-capacity floppy disk drives store images and programs, and new 5¼-in. Winchesters are as popular on graphics workstations as they are on microcomputers.

**Capabilities**

Workstation price/performance levels are the result not only of better displays, microprocessors and memory, but also of better graphics software, peripherals and system design. Graphics software is becoming standard. Most of the units surveyed are at least partially compatible with Tektronix's PLOT10 package, and many vendors support popular third-party packages such as Precision Visuals' DI-3000, SAS's SASGRAPH, PDA's PATRAN and ISSCO's DISSPLA and TEL-A-GRAPH. Large workstation memories and fast workstation processors are encouraging large local graphics command sets featuring commands for point, line, arc, circle, conic and rectangle generation and for solid and patterned polygon filling. Dynamic commands for zooming, scaling, clipping, panning, scrolling and rotating can often be handled locally, but most workstations leave complex image manipulation and number-crunching analysis to their hosts.

Workstations support a wide assortment of graphics input and output peripherals, and this ability often distinguishes from "terminals" in users' minds. The keyboard is still the most popular input peripheral, but most units support joysticks, light pens, digitizer tablets, trackballs, mice and valuator dials. On the output side, camera systems, impact matrix and ink-jet printers and pen and flatbed plotters give users hard copy for every budget and application (Fig. 3).

While workstations as *Mini-Micro Systems* defines them don't ordinarily function as stand-alone CAD/CAM systems, many do function as stand-alone microcomputer systems. Most models have the memory, off-line storage and processing power, and the ability to perform local graphics program development as well as general-purpose scientific and office computing, a powerful selling point. Tektronix and Hewlett-Packard Co. have sold their graphics workstations as desk-top computers for years, and more recent competitors are following suit (Fig. 4). UNIX is the most popular local operating system, and BASIC, FORTRAN, APL and Pascal are the most popular programming languages.

Compatibility and the ability to be upgraded are becoming even more important. Compatibility among vendors is improving due to government, academic, user group and professional society efforts, and to the high cost of developing complex, hardware-specific software. Upgrade paths are being carefully planned as new products facilitate switching vendors. Minicomputer, microcomputer and terminal manufacturers are competing more aggressively with mainframe and graphics-specific vendors that have dominated the workstation market over the past few years. They've kept technical and price/performance progress moving as fast as ever. □

# A Complete Graphics Department For Just \$2295



Realize day-in and day-out solid performance from a quiet and capable desktop plotter. It's true. For only \$2295\* the Houston Instrument HIPLØT™ DMP-29 will provide you with world-class multi-color hard copy graphics, and deliver a level of quality and performance that you would expect in a plotter costing three times as much.

It's a hard worker. The DMP-29 goes about its job with amazing speed and precision. Unbeatable resolution and repeatability are yours in both 8½" x 11" and 11" x 17" formats, and 8-pen capability assures you of fast attention-free flexibility when multi-color output is required. High pen speed combined with an addressable resolution of 0.001" assures fast, accurate and stepless traces.

It's friendly. You can call 21 different functions directly from the front-panel membrane keyboard. It's tolerant too. The DMP-29 will modestly protect itself from user errors, as when attempting to place a pen in an already occupied stall.

And it's smart. An extensive set of firmware routines makes life easier for the user. A small sampling of the built-in talent inherent in the DMP-29 includes character generation, circle, arc and ellipse synthesis, line type variations, viewport/windowing, clipping and scaling.

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# Finally, a single source for multi-processor, designed for OEMs and systems integrators. Now that's intelligent.



## Intelligent Systems introduces the Datavue multi-processor, multi- user computer system.

The Datavue system offers OEMs and system integrators a powerful solution for multi-user, multi-tasking, terminal-based environments—and all the advantages of single-sourcing.

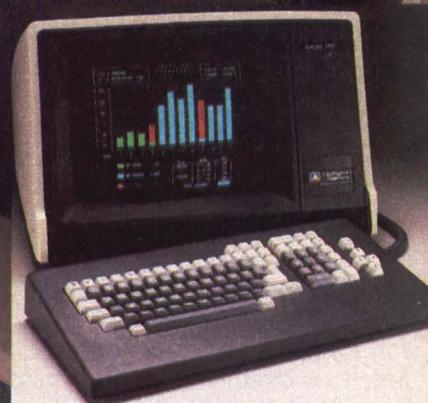
With Datavue you configure just the right amount of computer power for current needs and deliver to your customers a simple, economical growth path from one to eight users.

**Advanced systems architecture delivers stand-alone performance.** For advanced applications—decision support systems, office automation, management productivity,

and even process control, Datavue provides a simple computing environment with a dedicated computer for each user (or control application).

Up to eight computer cards can be inserted in the Datavue system which resource shares mass storage and common I/O. Each user gets a full microcomputer with a Z80A, 64Kb RAM, and CP/M\* 2.2. As a result, all users get stand-alone performance with the economies of a multi-user shared resource system.

Choose the precise amount of storage: 6Mb to 80Mb 5 1/4" Winchester hard disk, and either a 1Mb floppy or a 20Mb streaming tape for back-up.



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# multi-user computer systems



Advanced architecture gives each user a microcomputer card with a Z80A and 64Kb RAM, and lets you add up to eight terminals.

Common Centronics printer port.

In addition, you can add users for only \$450 each. Consequently, you can deliver precisely the computing power your applications need.

**Datavue's unique single-user home system is fully compatible and only \$1995!** To supplement your sales of Datavue's multi-user systems, you can offer a single-user home system that can be used as a stand-alone or with a modem to communicate with the base system.

The home system includes a Z80A, 64Kb RAM, 1 Mb floppy, two RS232-C ports and CP/M 2.2. And it's very competitive—in function and price—with personal computers.

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**More information.** Datavue is shipping now. OEM contract discounts are available. And a limited number of dealerships are open. For details, contact Marketing Communications at 404/449-5961, TWX 810 766 1581.

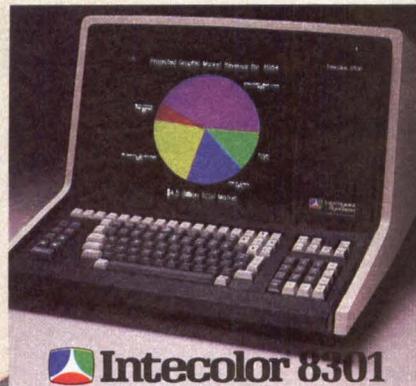


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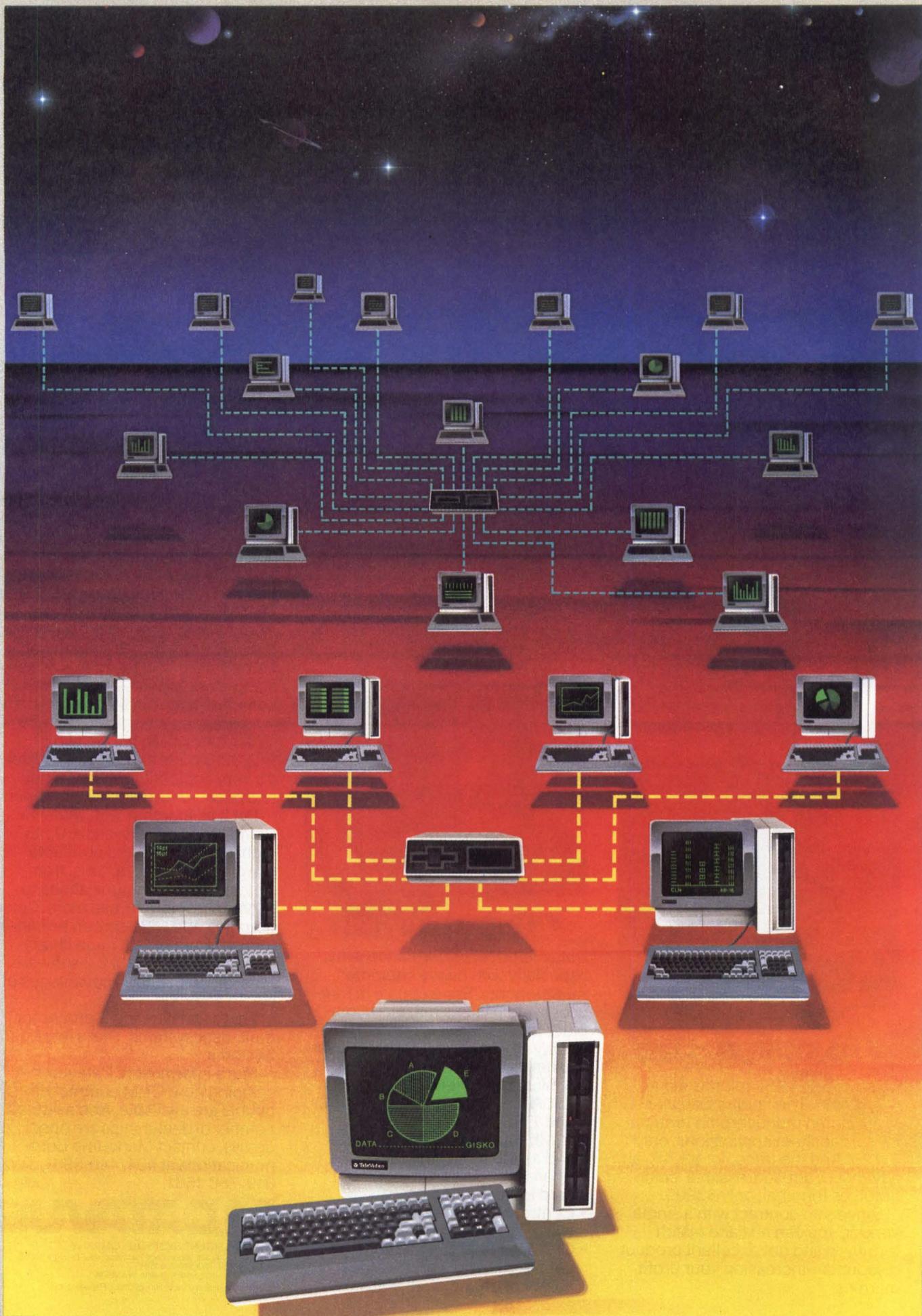
try standard ANSI color terminal; only \$1295. The unique Datavue 132-column monochrome terminal for spreadsheet applications; only \$1795. And the Intecolor 8301R, an advanced, dot-addressable, color graphics terminal; only \$3995.

Since you contract with a single vendor, you can mix and match terminals and get excellent product discounts—increasing your profit margins.



**Datavue price/performance wins, especially with heavy compute requirements.** For example, a four-user system with a full microcomputer for each user is only \$7045—or only \$1762 a user! This four-user system includes:

- 4 microcomputers, each with a Z80A, 64Kb RAM, 4Kb EPROM, and 2 RS232-C ports
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- Shared resource management card for mass storage
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# Of all the personal computers you can choose today, TeleVideo gives you more choices for tomorrow.

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## GRAPHICS WORKSTATION VENDORS

Company: model	Screen size (in.), resolution (horizontal x vertical)	Colors	Processor(s)	Memory (bytes)	Local functions
<b>Advanced Electronic Design Inc.</b>					
AEDS11	19 768 x 575	256 of 16.8 million	LSI-11/23	512K	Layout, ellipse and arc generation, polygon fill, Tektronix 4010 emulator, pattern fill, anti-aliasing
AED512	13 512 x 512	256	5502	256K	Tektronix 4010 emulation, zoom, pan, polygon fill
AED767	13 768 x 575, 640 x 480, 512 x 512, 512 x 483	256 of 16.8 million	6502	42K RAM/ROM	Tektronix 4010 emulation, continuous joystick panning, polygon fill, anti-aliasing, ellipse and arc generation
AED1024	19 1024 x 768	256 of 16.8 million	6402	Firmware, user RAM	Tektronix 4010 emulation, polygon fill, pattern fill, zoom, pan
<b>Aydin Controls</b>					
ICON 16	13, 19, 25 256 x 256	2 to 16 million	8086, AMD bit slice	32K RAM, 23K EPROM, 768K expansion RAM	Pan, zoom, vector generation scale, scroll, all primitives, auto circle correction, 2D and 3D transformation
<b>C. Itoh Electronics Inc.</b>					
CIT-414	12 640 x 480	Monochrome	6809		Tektronix 4010/4014 emulation; line, arc, circle, box generation; alpha mode
CIT-427	12 640 x 480	8 of 64	6809		Tektronix 4027 emulation; line, arc, circle, box generation
<b>Chromatics Inc.</b>					
CT4200	13 512 x 384 (CT 4300: 1025 x 768)	8	Z80, graphics display processor	64K	Programmable function keys, zoom, pan, graphics primitives
CGC 7900	19 1024 x 768	As many as 256 out of 16 million	MC68000	As much as 8M	Programmable function keys, zoom, pan
CT4300	13 1024 x 768	8	Z80, graphics display processor	64K	Programmable function keys, zoom, pan, graphics primitives
<b>Convergent Technologies Inc.</b>					
IWS	15 660 x 512		Dual 8086s	128K	
<b>Data General Corp.</b>					
G500	15 640 x 480	16 out of 4096	68000	0.5M	Downloaded graphics command interpreter, primitives
G300	13 640 x 240	Monochrome	Z80		Primitives
GDC/1000 color workstation	768 x 576, 1280 x 1024	256 out of 16.7 million	Bit-slice display controller, Z8000- based command processor	8 planes, each separately addressable	
<b>Data-Type Inc.</b>					
Autograph XK1	15 1024 x 780	Green monochrome	6809, 68000	256K	Tektronix 4014 emulation; circle, arc, ellipse generation; polygon fill; zoom; pan; bidirectional scroll; TVI 925 emulation
Autograph Series 100	12 512 x 250	Monochrome	6805	16K	Tektronix 4010 emulation
Autograph Color X5A	14 512 x 390	16 of 511	6809, 68000	256K	Tektronix 4010/4014/4027 emulation; circle, arc, ellipse generation; zoom; pan; bidirectional scroll; polygon fill; TVI 925 emulation
Quickview	12 512 x 250	Monochrome	6805	16K	Vector drawing
<b>Digital Equipment Corp.</b>					
VT125	12 768 x 248	4 of 64	8080, (8085 add- on optional)		Bidirectional, horizontal, vertical scroll; vector, circle, arc generation
<b>Envision</b>					
220	13 640 x 408 (640 x 480 optional)	16 of 4096	8088, NEC 7220	128K (256K optional)	Vector, circle, rectangle, polygon fill, pattern fill, zoom, pan

Standard peripherals	Optional peripherals	Host interface	Software	Price	Circle no.
Keyboard, joystick, 10M-byte Winchester disk drive, floppy disk drive	Data tables	RS232C, parallel (DMA channel)	RSX-11M, RT-11, RSTS-E, UNIX, VENIX, TSX +, PLOT10	\$19,995	837
Keyboard, joystick	19-in. color monitor, data tablet	RS232C, parallel (DMA channel)	Built-in command protocol instruction set (FORTRAN), ISSCO, Control Data, SAS (most third party)	\$5995, includes monitor	
Keyboard monitor	19-in. color monitor, data tablet	RS232C, parallel (DMA channel)	FORTRAN, Precision Visuals, SAS, ISSCO, Control Data (most third party)	\$7995	
Keyboard, monitor, mouse	Data tablet	DMA channel or RS232C	AED FORTRAN, protocol, ISSCO, Control Data, SAS	\$13,295	
Keyboard, pixel address devices, joystick, digitizer tablet, hard copy (photographic to ink jet)		HP, RS232C, dual DMA interfacing	ATP, I/O drives to most mainframes, high-level languages, control programs (for stand alone)	\$12,295	838
	Various printers	RS232C	PLOT10, ISSCO, GKS	\$1895	839
Keyboards, LA 120 with graphic interface		RS232C	PLOT10, ISSCO	\$3500	
64-key detachable keyboard	92-key keyboard with numeric keypad, light pen	RS232C, 11 interfaces (optional)	ISSCO, Precision Visuals, SAS	\$3995	840
Keyboard	Joystick	RS232C, RS449, parallel DMA (optional)	Edwards OS, C, Pascal, FORTRAN	\$11,995	
	92-key keyboard with numeric keypad, light pen		ISSCO, SAS, Precision Visuals	\$6995	
Keyboard	Winchester disk drive	X25, IBM 3270, 2780/3780	CTOS, COBOL, FORTRAN, BASIC, Pascal, Assembler	\$8350 to \$12,350	841
16-bit printer port, video output		RS232, 20-Ma current loop, 9600 baud	Graphical kernel software	\$9500	842
	Dot-matrix printer	RS232, 20-Ma current loop	Graphical kernel system, runs all DG graphics programs	\$3900	
2 Eclipse boards, data channel interface	Monitor		Graphical kernel software	\$19,000 to \$23,000	
Keyboard	Autograph 1001 graphics printer, digitizer	RS232C	PLOT10 compatible, ISSCO, Megatek, Precision Visuals	\$4495	843
	Dot director, cursor control, keypad, Autograph 1000 graphics printer	RS232C	PLOT10	\$1895 to \$2395	
Keyboard	Autograph 1200 color graphics printer, digitizer, mouse	RS232C	PLOT10, Tektronix 4027	\$4995	
Dot director keypad, Autograph 1000 printer	1200-baud modem	RS232C	PLOT10	\$3095 to \$4495	
None	LA50, LA100 printers	RS232C, (20-Ma current loop optional)	ReGIS	VT125 — \$3800, VT100 upgrade — \$1800	836
Keyboard	Mouse, graphics tablet, 2 optional input devices	RS232C	ISSCO, Megatek, Precision Visuals, PLOT10	\$4950	844

## GRAPHICS WORKSTATION VENDORS

Company: model	Screen size (in.) resolution (horizontal x vertical)	Colors	Processor(s)	Memory bytes	Local functions
230	13 640 x 408 (640 x 480 optional)	16 of 4096	8088, NEC 7220	128K (256K optional), 128K display list memory	Point vector, polygon, polyline, circle, arc, pre- segment generation; polygon fill; rotate; translate; pick; scale; zoom; pan
<b>Florida Computer Graphics Inc.</b> Beacon	13, 19 640 x 480	32 of 256	Multiprocessor architecture: AMD 2901 bit slice, two Z80s, two 8048s	256K	Vector, arc, circle, rectangle generation; polygon fill; pan; zoom
Intelligent Terminal	13, 19 640 x 480	32 out of 256	AMD 2901 bit slice, two 8048s	128K	Vector, arc, circle, rectangle generation; polygon fill
<b>Genisco Computers Corp.</b> G-1000	19 1024 x 792	White monochrome	Z8001	32K	Tektronix 4014-1 emulation, alpha mode
G-6100 Series (6120, 6110)	19 768 x 512 (1392 x 1024 color optional)	16 of 64	16-bit slices	512K (1M optional)	Tektronix 4014 emulation, alpha mode, zoom, scroll, blink
<b>Hewlett-Packard Co.</b> 2623A	12 512 x 390	White, green, amber		2 pages	
2627A	12 512 x 390	8	Z80	2 pages	
2647F	12 720 x 360	White	8085	6 pages	
2700	12 512 x 390	16	MC68000	1M display, 4 pages without enhance- ments 640K	Zoom, pan, multiple views
Series 200 model 36C	12 512 x 390	16 of 4096	MC68000	640K	Rectangle, polygon, circle generation; polygon fill; edge color
<b>ID Systems Corp.</b> 100	13 608 x 480	4	8088		Cursor reporting, scan, selectable windows, split screen
ID 200	12 (13, 14, 19 optional) 640 x 480, (1024 x 1024 optional)	8	8088		Cursor reporting, scan, selectable windows, split- screen programmable functions
<b>Intelligent Systems Corp.</b> 8001 R	19 480 x 384	4913 shades	8080A	8K	arc, circle, vector
8301 G	13 160 x 192	8	8080A	8K	Baud rate, editing

Standard peripherals	Optional peripherals	Host interface	Software	Price	Circle no.
Keyboard	Mouse, graphics tablet, 2 optional input devices	RS232C	ISSCO, Megatek, Precision Visuals, PLOT10	\$6950	
<b>845</b>					
Keyboard	Joystick, light pen, digitizer, printer, plotter	IBM 3270, 3780, 2780; SDLC/SNA, HASP; emulates VT100; Tektronix 4010, 4012, 4014	BASIC, FORTRAN, Pascal, Assembly, C, graphics application, kernel package, PLOT package, interfaced drives, ISSCO, Precision Visuals, Megatek, SAS, business graphics, drafting package, word-processing graphics package, financial analysis, graphics arts package	\$13,000 to \$30,000 (average \$20,000)	
Keyboard, CRT	Ink-jet printer, plotter	IBM 3270, 3780, 2780; SDLC/SNA, HASP; emulates VT100; Tektronix 4010, 4012, 4014	BASIC, FORTRAN, Pascal, Assembly, C, graphics application, kernel package, PLOT package, interfaced drives, ISSCO, Precision Visuals, Megatek, SAS, business graphics, drafting package, word-processing graphics package, financial analysis, graphics arts package	\$8500	
<b>846</b>					
Keyboard, joystick	Vector generator, Versatec and Okidata printers	RS232C	PLOT10	\$9950	
Keyboard, joystick	Tablet	RS232C, RS442/449, DEC, DG, Gould, P-E	GENCOR, FORTRAN	\$21,950	
<b>847</b>					
Keyboard	Internal printer	RS232C	HP software, Precision Visuals, ISSCO	\$3250	
Keyboard		RS232C, RS422	HP, major industry graphics, Tektronix 4010 emulation, Precision Visuals, ISSCO	\$5975	
Keyboard	Minifloppy disk	RS232C, RS422	Autoplot/47	\$9950	
Keyboard		RS232C, RS422	Autoplot/2700, Paintbrush/2700, ISSCO, Precision Visuals	\$19,900 to \$36,200	
Keyboard, dual minifloppy drives		HP-IB, RS232C, 16-bit parallel	Pascal, BASIC	\$17,660	
<b>848</b>					
CT100-compatible keyboard	Digitizer, plotter printer	VT100, VAX compatible, Tektronix compatible	PLOT10, ISSCO, Telautograph, DISSPLA	\$2895 to \$5895	
Keyboard, CT100 compatible	Digitizer, plotter printer, mouse, trackball	VT100, VAX compatible, Tektronix compatible	PLOT10, ISSCO, Telautograph, DISSPLA		
<b>849</b>					
Light pen, additional memory, expanded keyboard, printer		RS232C, parallel also available	FORTRAN, Business BASIC, Assembly, SAS, ISSCO	\$3975	
Light pen, additional memory, expanded keyboard, printers		RS232C, parallel	Programming languages	\$3045	

## GRAPHICS WORKSTATION VENDORS

Company; model	Screen size (in.): resolution (horizontal x vertical)	Colors	Processor(s)	Memory (bytes)	Local functions
8301 R	13 480 x 384	4913 shades	8080A	8K	Arc, circle, vector
2405	13 160 x 96	8	8085	2K	Menu-driven setup mode
2427	13 640 x 288		8085	2K	Menu-driven setup mode
8001 G	19 160 x 192	8 foreground and background	8080A	8K	Baud rate, editing
VHR19	19 1024 x 1024	8 out of 4096	Z80		NEC GDR functions
Lexidata Corp.					
2400	19 1280 x 1024	Monochrome	MC68000	128K	Pan, zoom, window, graphics primitives
2410	19 1280 x 1024, 30 Hz	As many as 16 out of 4096	MC68000	128K	Scrollable text, pan, zoom, graphics primitives
Lundy Electronics & Systems, Inc.					
T5470 Series	15 1536 x 1024	Green monochrome	M68V09	64K	Tektronix 4010 emulation; line, circle, ellipse, arc generation; polygon fill, pattern fill, alpha mode, 120 total local commands
S5480 Series	20 1536 x 1024	16 out of 4096	6809	48K	Tektronix 4010/4014 emulation; vector, block circle, ellipse generation; pan; overview; zoom, polygon fill; alpha mode
T5680 Series	13 768 x 512	256 out of 4096	M68V09	64K	Tektronix 4010 emulation; line, circle, arc, ellipse generation; 120 local commands; alpha mode
Megatek Corp.					
Whizzard 1650	19 640 x 480	16 out of 4096	8086	256K	Vector generation; zoom, scale, clip, rotate, pick, polygon fill; VT100/VT52; alpha mode; sound generation
Whizzard 7600	19 1024 x 1024	16 out of 4096	8086	Display list: 192K, 512K RAM	Vector generation, zoom, scale, clip, rotate, pick, polygon fill, alpha mode
National Computer Communications Corp.					
Termgraphics	12 640 x 240	Green phosphor		128K	80 x 24 character, alpha mode
Orcatech Inc.					
Orca Series	19 1024 x 1024	256 out of 16.7 million	8086/87, AMD2900, MC68000	512K	Tektronix 4014/4114 emulation, zoom, pan
Prime Computer Inc.					
PW93	19 1280 x 1024	Monochrome	16 bit		Pan, zoom, selective erase, circles, polygon, conics, multiple line fill, algorithms
PW95	19 1280 x 1024	8 out of 4000	16 bit		Pan, zoom, selective erase, circles, polygons, conics, multiple line fill, algorithms
PW200 Series	19 1280 x 1024		32-bit virtual memory	1M main memory, 68M Winchester, 15M cartridge tape	Z-d drafting, 3D solid modeling
Ramtek Corp.					
6211	13 640 x 480 (640 x 512 optional)	16 out of 64	Z80A	RAM	Tektronix 4014 emulation, graphics primitives
6212 Colorgraphic Terminal	13 640 x 480 (640 x 512 optional)	16 out of 64 (256 of 4096 opt.)	Z80A	12K RAM	Tektronix 4014 emulation, graphics primitives

Standard peripherals	Optional peripherals	Host interface	Software	Price	Circle no.
Light pen, additional memory, expanded keyboard, printers		RS232C, parallel	ISSCO, SAS	\$4240	
Light pen, additional memory, expanded keyboard, printers		RS232C, parallel	DEC VT100	\$995 (100 units)	
Light pen, additional memory, expanded keyboard, printers		RS232C, parallel	Tektronix	\$995 (100 units)	
Light pen, additional memory, expanded keyboard, printers		RS232C, parallel	FORTRAN, Business BASIC, Assembly	Q: \$2745	
Light pen, additional memory, expanded keyboard, printers		RS232C, parallel	CAD software, printing, publishing	not available	
					<b>850</b>
Keyboard, joystick	Mouse, tablet	RS232C	PLOT10	\$9900	
Keyboard, joystick	Mouse, tablet	RS232C	PLOT10	2 plane: \$13,600 4 plane: \$14,950	
					<b>851</b>
96-key ASCII with programmable function	Numeric keypad, joystick, data tablet, output devices, monochrome electrostatic printers, photographic hand-copy devices	RS232C, 2-Ma loop	FORTRAN IV subroutines	\$10,000	
Keyboard, joystick	Hard-copy unit	RS232C, 20-Ma loop, RS422	UltraGraphics II	\$19,500	
Keyboard, joystick	Text store, light pen, touch pen	RS232C, 20-Ma loop	UltraGraphics II (SIGGRAPH compatible), Rapidata, DataVue by ISS, UNIRAS, seismic-analysis system	\$5000 to \$10,000	
					<b>852</b>
Keyboard	Joystick, dials, light pen, tablet	RS232C	FORTRAN subroutine packages	\$15,900	
Keyboard, joystick	Data tablet, Versatec hard copy	IEEE-488, RS232C	FORTRAN, Template, Precision Visuals	\$50,000 to \$75,000	
					<b>853</b>
Keyboard		Tektronix compatible	Tektronix compatible	\$1675	
					<b>854</b>
Keyboard, joystick	Tablet, printers, plotters, disk drives, diskette drives	Ethernet, RS232C, parallel	FORTRAN IV, UNIX, C, Pascal, Mainsail		
					<b>855</b>
Video processor, video display tube, data tablet, joystick, alphanumeric terminal		Prime 50 series	Medusa CAD	\$25,000	
Video processor, video display tube, data tablet, joystick, alphanumeric terminal		Prime 50 series	Medusa CAD	\$35,000	
Processor, disk drive, terminal data tablet, joystick, keyboard		Prime 50 series	Medusa	\$61,000 to \$95,000	
					<b>856</b>
Keyboard	Printer, light pen, graphics tablet	RS232C	DISSPLA, Tektronix 4014, TELL-A-GRAF, PATRAN, SAS/GRAPH, DI-3000 charts and graphs	\$4995	
Keyboard, joystick, digitizer tablet	Printer	RS232C	CGL, DISSPLA, Tektronix 4014, TELL-A-GRAF, PATRAN, SAS/GRAPH, DI-3000 charts and graphs	\$10,495	

## GRAPHICS WORKSTATION VENDORS

Company; model	Screen size (in.); resolution (horizontal x vertical)	Colors	Processor(s)	Memory (bytes)	Local functions
6412 Colorgraphic Terminal	19 1280 x 1024	16 out of 4096 (256 out of 16 million optional)	Z80A	12K	Zoom, pan, alpha mode, graphics primitives
<b>Raster Technologies</b>					
ONE/25	19 512 x 512	256 out of 16.7 million	Z8002	128K RAM	More than 150 local commands including integrated debugger, 2D display list, 4014 emulator, scrolling text windows, macro programming, graphics primitive VT100 format keyboard
ONE/25 (display station with 24 bit planes)	19 512 x 512	16 out of 16.7 million	Z8002	128K RAM	More than 150 local commands including integrated debugger, 2D display list, 4014 emulator, scrolling text windows, macro programming, graphics primitive
ONE/40	19 1024 x 1024	16 out of 16.7 million	Z8002	128K RAM	More than 150 local commands including integrated debuggers, 2D display list, 4014 emulator, scrolling text windows, macro programming, graphics primitive
ONE/60	19 768 x 576	16 out of 16.7 million	Z8002	128K RAM	More than 150 local commands including integrated debugger, 2D display list, 4014 emulator, scrolling text windows, macro programming, graphics primitive
<b>Spectragraphics Corp.</b>					
1250	Monochrome: 20, color: 19 1024 x 1024	Monochrome: 16 intensity levels, color: 16 out of 4096	Graphics processor: AMD 2901 16 bit slices, system supervisor: Intel 8086, channel processor: AMD 2901 8 bit slices	32K per workstation	Local diagnostics
1500	19 1024 x 1024	4096 simultaneously displayable colors	Workstation processor: Intel 8085, transformation processor with discrete components, graphics processor: AMD 2901, system: Intel 8086	128K display-list memory (expand- able to 1M), on-board 256K RAM for operating system	Local diagnostics, pan, zoom, translate, rotate, character generation
<b>Synercom Technology Inc.</b>					
GWS III	dial 19 1024 x 1024	8 out of 4096	16 bit	512K	Cursor tracking, grid generation, pan, zoom, diagnostics
<b>Tab Products Co.</b>					
132/15-G	15 512 x 384 (560 x 420 optional)	Green monochrome	8085, Z80	32K RAM	Tektronix 4010/4027 emulation; alpha mode; vector, arc generation; polygon fill; APL mode
<b>Tektronix Inc.</b>					
4109	19 640 x 480	16 out of 64	80186	256K	Zoom, pan, 2D transformation, segment manipulation
4107	13 640 x 480	16 out of 64	80186	128K	Zoom, pan, 2D transformation, segment manipulation
4105	13 480 x 360	16 out of 64	80186	32K	
4025A	12 640 x 480	Monochrome	8085A	Display: 16K (32K optional), graphics: 32K optional	Edit keys, user-definable keys

Standard peripherals	Optional peripherals	Host interface	Software	Price	Circle no.
Joystick, keyboard, digitizer tablet		RS232C	DISSPLA, TELL-A-GRAPH, PATRAN, SAS/GRAPH, DI-3000 charts and graphs	\$19,600	
					857
VT100 format keyboard	Tablet joystick, mouse	RS232C, IEEE-488, DMA-to-VAX Unibus, Q-bus, Multibus, P-E, DG	FORTTRAN subroutine library	\$15,350	
VT100 format keyboard	Tablet, joystick, mouse	RS232C, IEEE-488, DMA-to-VAX Unibus, Q-bus, Multibus, P-E, DG	FORTTRAN subroutine library	\$18,850	
VT100 format keyboard	Tablet, joystick, mouse	RS232C, IEEE-488, DMA-to VAX Unibus, Q-bus, Multibus, P-E, DG	FORTTRAN subroutine library	\$17,350	
VT100 format keyboard	Tablet, joystick, mouse	RS232C, IEEE-488, DMA-to-VAX Unibus, Q-bus, Multibus, P-E, DG	FORTTRAN subroutine library	\$17,350	
					858
Light pen; programmable 32-key function pad; backlitged, alpha numeric keyboard; monitor	Data tablet	IBM plus compatible (3030 series, 4200, 3080 series)	IBM-compatible graphics	mono: \$21,000 per workstation, color: \$42,000 per workstation	
	Monitor, keyboard, keyboard with integrated joystick, free-standing, joystick, light pen, digitizing tablet, evaluator dial, programmed function switcher	interfaces: IBM (4300, 3030, 3080), DEC VAX, P-E, ULI, IEEE-488, RS232C	FORTTRAN, GKS	\$19,900 without peripherals; typical 4-station configuration: \$25,000	
					859
Camera			Infomat, TRACE, TOPS		
					860
Keyboard	Printer	RS232C, 20-Ma loop	PLOT10, DISSPLA, TELL-A-GRAPH, IGP, DI3000, ILS, Template, Plotpak	\$3295	
					861
	Digitizing tablet, color ink-jet copier/printer, plotter, graphics processor for local programming	RS232C		\$9950	
	Digitizing tablet, color ink-jet copier/printer, plotter, graphics processor for local programming	RS232C		\$6950	
	Color ink-jet copier/printer, plotter, graphics processor for local programming	RS232C		\$3995	
	Hard copy, tape storage, plotter	RS232C full duplex, half duplex optional, current loop optional		\$5900	

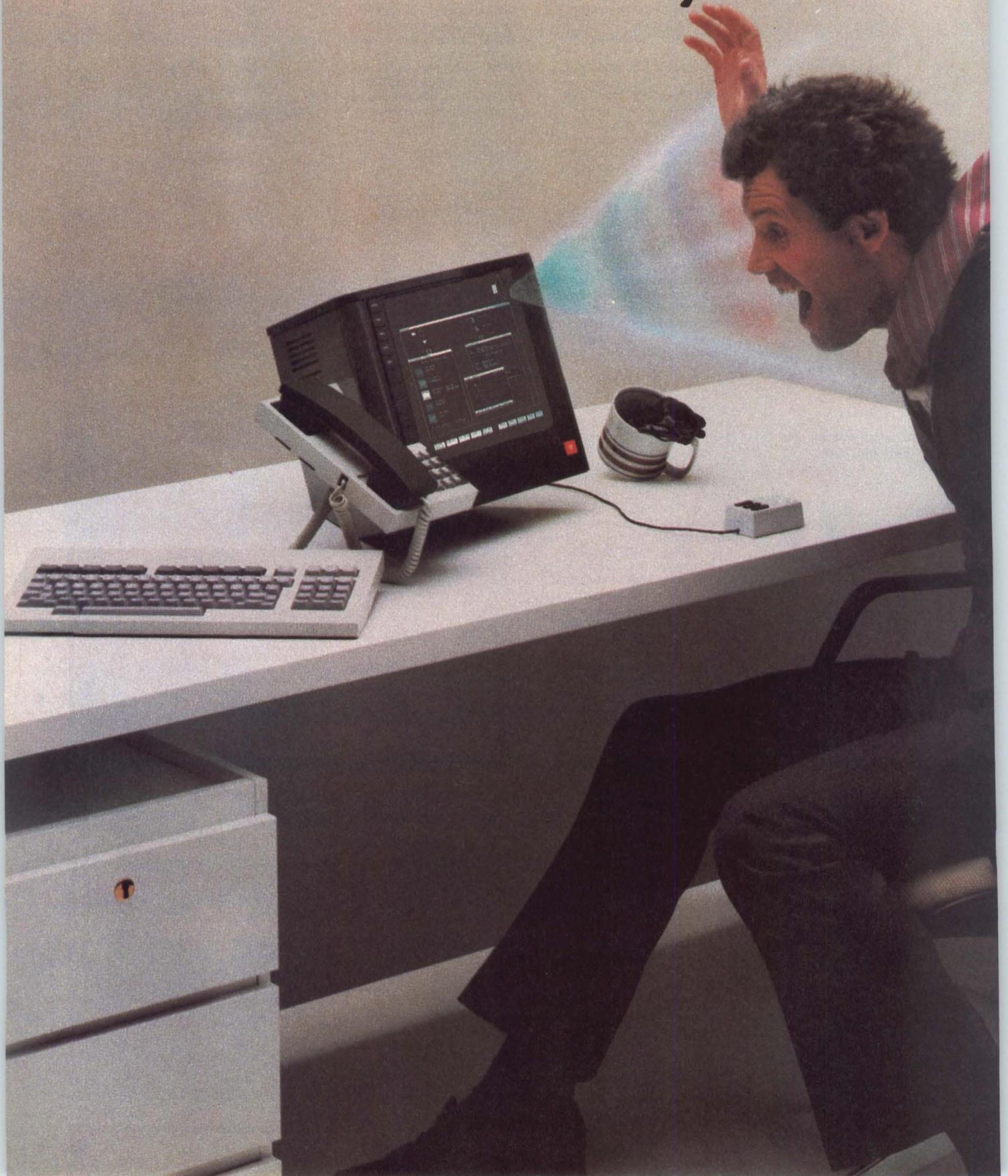
## GRAPHICS WORKSTATION VENDORS

Company; model	Screen size (in.), resolution (horizontal x vertical)	Colors	Processor(s)	Memory (bytes)	Local functions
4027A	13 640 x 480	8 out of 64	8085A	Display: 16K (32K optional), graphics: 48K, 192K optional	Edit keys, user-definable keys
4012	12 1024 x 780	Monochrome		Dust screen	
4006	12 1024 x 780	Monochrome		Dust screen	
4014	19 4096 x 3120	Monochrome	None standard	Dust screen	None standard
4016	25 4096 x 3120	Monochrome	None standard	Dust screen	None standard
4112A	15 640 x 480	Monochrome	8086/8087	32K (800K optional)	Zoom, pan, local programmability
4113A	19 640 x 480	8/16 out of 4096	8086/8087	32K (800K optional)	Zoom, pan, lo-pro
4114A	19 4096 x 3072	1	8086	80K user, 1M total address- ability	More than 150 including 2D transformations, segment user-definable scrollable refreshed dialog area, local picture storage
4115B (pedestal or modular package)	19 1280 x 1024	256 out of 16 million	8086/8087 and proprietary bit-slice graphics processor	As much as 800K RAM	Zoom, pan, segment scaling, rotating, repositioning, English language commands to set terminal parameters, dialog area to separate alphanumeric text from graphics
4116A and 4116A-30 (desk version)	25 4096 x 3120	Monochrome	8086 W/8087 co-processor	32K RAM (800K optional)	Segments; fast redraw; dialog area; user-definable; 2D transformations; write- through refresh support
4054A	19 4096 x 3120	Monochrome dust standard, two-color dust optional	16-bit bipolar bit-slice	32K (64K, 256K, 512K optional)	Programmable in high-level BASIC
4051	11 1024 x 780	Monochrome (DVST)	6800	16K (32K optional)	Programmable in extended BASIC with high level graphics commands
4052A	11 1024 x 780	Monochrome (DVST)	16-bit bipolar bit-slice	32K, 64K, 256K, 512K optional	Programmable in high-level BASIC
Terak Corp. 8600	13 640 x 480	64 out of 512	LSI-11, 8086		Rotate, zoom, zone
Transiac Corp. TR1024	15 1024 x 780 viewable, 1024 x 1024 addressable	Monochrome	TI9995	64K RAM	VT100 emulation, Tektronix 4010 emulation
Vectrix Corp. VX Series (model 128)	13 672 x 480	8 (512 out of 16.8 million optional)	8088, NEC 720	128K	Rotation; scaling; translation; clipping; polygon fill; line, arc, polygon generation, zoom

Standard peripherals	Optional peripherals	Host interface	Software	Price	Circle no.
	Hard copy, tape storage, plotter	RS232C full duplex, half duplex optional, current loop optional		\$10,900	
	Hard copy, plotter, tablet tape	RS232 full duplex, half duplex optional, flagged optional		\$6200	
	Hard copy, plotter, tape	RS232 full duplex, half duplex optional, flagged optional		\$3900	
	Hard copy, plotter, tape, tablet	RS232C full duplex, half duplex optional, flagged optional		\$15,750*	
	Hard copy, plotter, tape, tablet	RS232C full duplex, half duplex optional, flagged optional		\$20,500	
None	4662/63 plotter, 4632/34 HCU, option 13/14 tablets, printers	RS232C		\$5500	
None	4691 color HCU, 4662/63 plotters, 4632 HCU, option 13/14 tablets, printers	RS232C		\$16,500	
Keyboard with thumbwheel GIN input	Local computing software — CP/M-86 plus FORTRAN 86 plus graphics routines, single/dual floppy disk drive, Winchester disk drives, graphic tablets, plotters, hard-copy units	RS232C ASCII asynchronous, current loop optional		\$17,900	
None	4691 color graphics copier and I/F, 4634 monochrome graphics copier, 4926 Winchester disk drive, one or two integrated floppy disk drives, 11-x 11-in. and 30-x 40-in. graphics tablets, DMA I/F for DEC Unibus	RS232, DMA-to-DEC Unibus		\$19,950 includes 4 bit planes and 288K-byte RAM	
None	4611 hard copy, 4631 hard copy, 4662 plotter, 4663 plotter, 1 or 2 494K-byte floppy disk drives, 11-x 11-in. or 30-x 40-in. tablet	RS232C DC1/DC3 (Xon/Xoff) flagging, blockmode optional		4116A: \$22,400, 4116A-30: \$22,900	
Integrated tape cartridge drive (600K-byte capacity)	8-in., 1.8M-byte 4907 floppy disk drive, multi-user 4909 file-management system, 32M- to 96M-byte hard disk supporting as many as 10 users, 4662/4663 digital plotters, 4611/4631 hard-copy units, 4643 line printer, 4924 digital tape drive, 4952 joystick, 4956 graphics tablets	Asynch RS232C, programmable to 9600 baud, PLOT10 emulation		\$14,950	
Integrated tape cartridge drive (600K-byte capacity)	8-in., 1.8M-byte 4907 floppy disk drive, multi-user 4909 file-management system, 32M- to 96M-byte hard disk supporting as many as 10 users, 4662/4663 digital plotters, 4611/4631 hard-copy units, 4643 line printer, 4924 digital tape drive, 4952 joystick, 4956 graphics tablets	RS232C, PLOT10 emulation		\$6295	
Integrated tape cartridge drive (600-byte capacity)	8-in., 1.8M-byte 4907 floppy disk drive, multi-user 4909 file-management system, 32M- to 96M-byte hard disk supporting as many as 10 users, 4662/4663 digital plotters, 4611/4631 hard-copy units, 4643 line printer, 4924 digital tape drive, 4952 joystick, 4956 graphics tablets	RS232, PLOT10 emulation (4012)		\$9900	
	Floppy disk drives, Winchester disk drives, printers, plotters, digitizers	RS232C	VENIX, VENIX/2, Pascal, RT-11/85, FORTRAN		862
Interface to Tektronix, Versatec, CalComp plotters, digitizer		RS232C	PLOT10, ISSCO, Precision Visuals	1 plane: \$4500, 4 planes: \$9000	863
None	Light pen, keyboard, joystick, digitizing tablet	RS232C Centronics parallel	Paint program running off of the Apple, CAD program, VX series is language independent	\$2495	864

\*Includes enhanced graphics, previously option 34.

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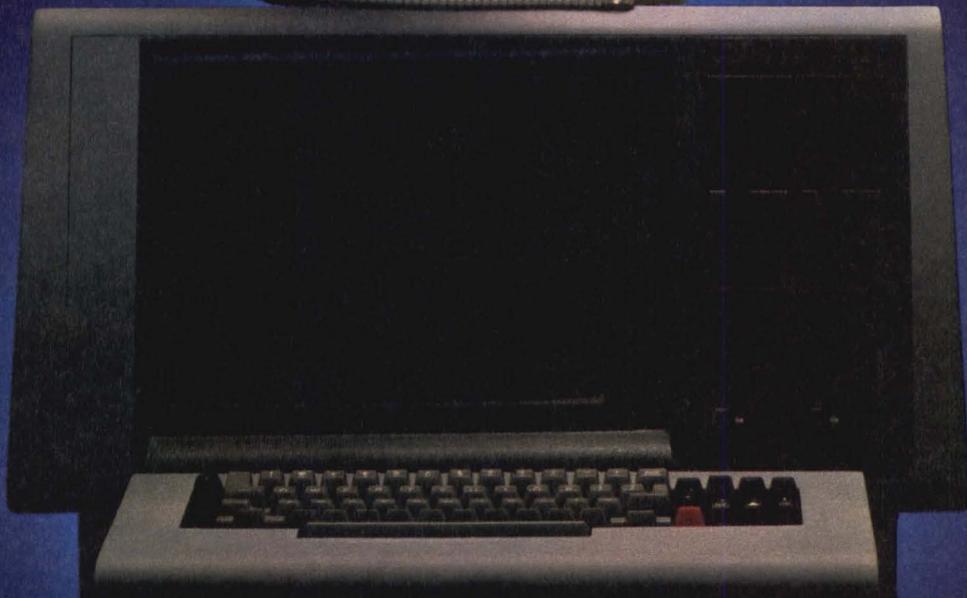
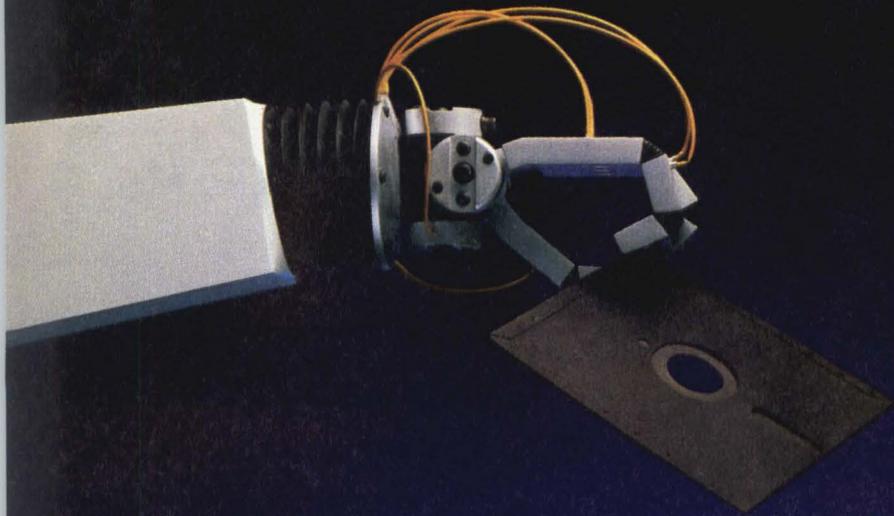
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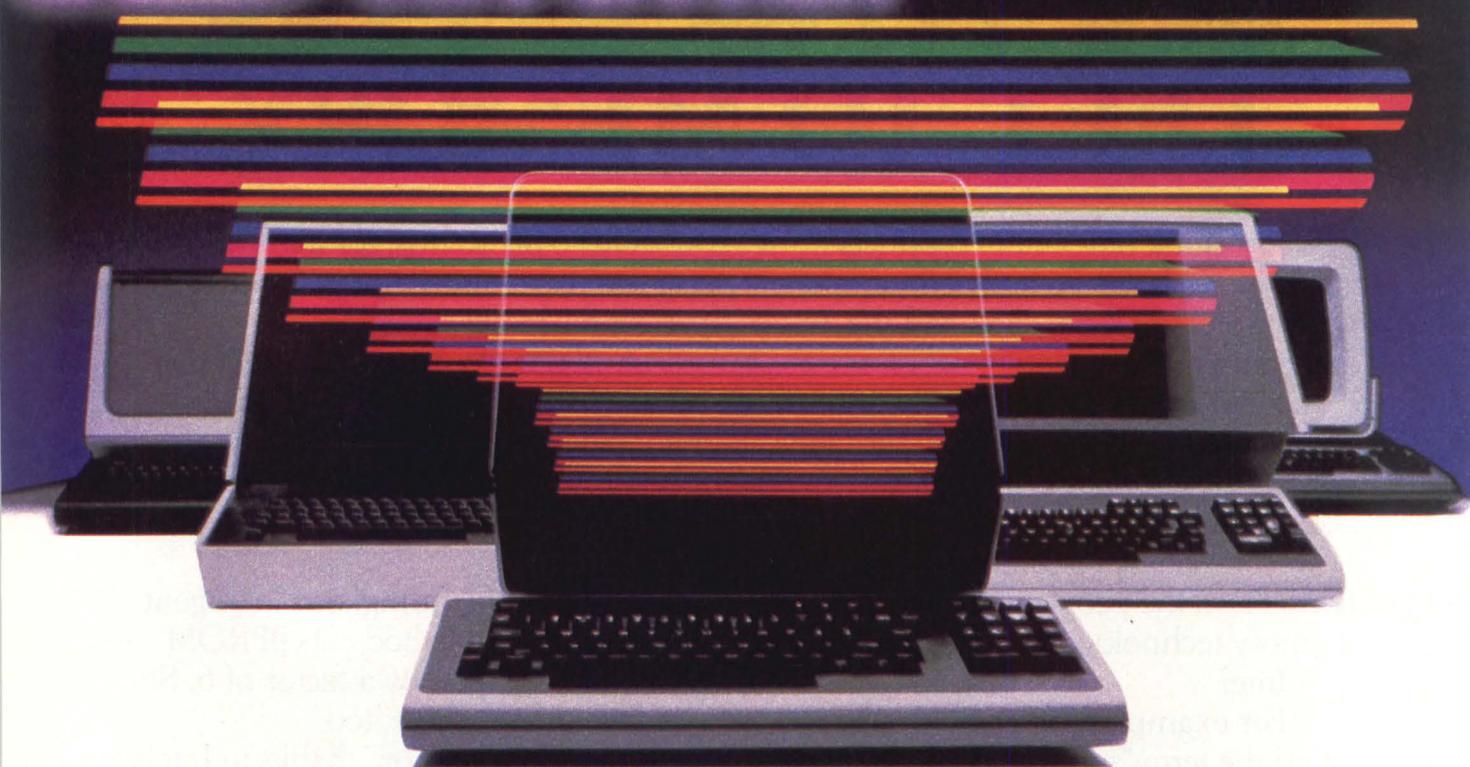
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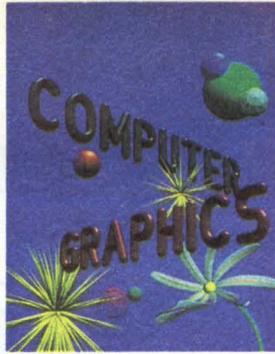
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RICHARD FICHERA, Raster Technologies Inc.

*Graphics compatibility is like computer compatibility, only trickier*

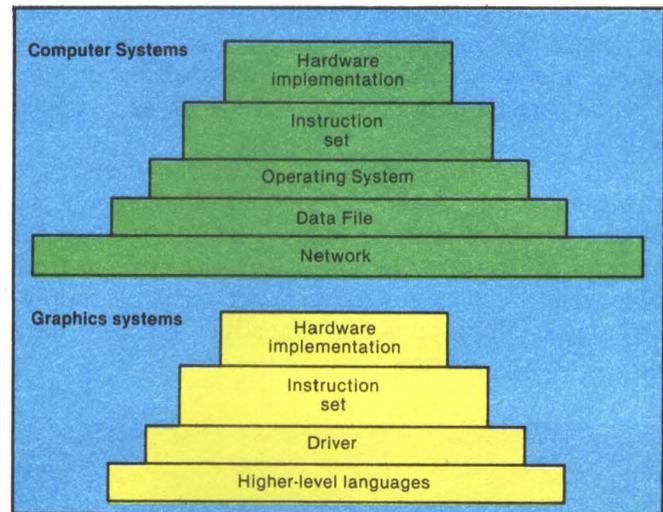
Reductions in the cost of memory, logic, video timing circuitry, and video monitors over the last few years have reduced overall graphics workstation costs by an average of 25 to 30 percent annually. Graphics hardware represents a much smaller percentage of system cost than it once did. Consequently, graphics users are paying increased attention to the cost of writing and maintaining software. Given the rapid rate of graphics hardware introductions, preserving software investments in graphics applications can be difficult. Software compatibility across product lines and into future products has become a prerequisite for graphics workstation success.

In its Model One family of raster display systems, Raster Technologies Inc. has applied a number of compatibility-promoting techniques first employed in large data-processing product lines. The Model One's "compatibility level" was a fundamental choice that dictated its overall design.

## Compatibility levels

Compatibility between graphics workstations is theoretically similar to compatibility between computer systems (Fig. 1).

At the highest level—hardware compatibility—systems are 100-percent compatible when their hardware implementations are essentially identical. Two hardware-compatible systems may differ in a few chips, perhaps using one chip to replace 20 in the latest



**Fig. 1. Levels of compatibility exist for both computer systems and graphics systems. The level of compatibility supported by a family of graphics systems is a crucial decision for graphics vendors. Raster Technologies uses instruction-set compatibility to control software development and redevelopment costs, to preserve software investments and to adapt to changing market requirements.**

design. But common backplanes and interconnection hardware allow what can be attached to one system to be attached to the other. A disadvantage is that rigid adherence to hardware compatibility can constrain the development of new products.

A second level is instruction-set compatibility, which allows computer systems with *different* hardware

implementations to run the same programs. An excellent example of instruction-set compatibility is found in Digital Equipment Corp.'s PDP-11 family of computers. Although PDP-11 models vary in size and configurations, many programs can run unchanged on all models.

Instruction-set compatibility can also make graphics devices compatible. Graphics instruction-set compatibility allows a vendor's graphics devices to use the same instruction set across all its products, despite different resolutions, bit-plane depths and price/performance levels.

Driver compatibility is the next level. Instruction sets can differ, but users can employ host-resident drivers to make graphics devices compatible with application programs.

Language-level compatibility allows a user to access graphics devices through a higher level language such as FORTRAN. A host library of compatible programs allows the same tasks to be performed despite the use of different drivers, instruction sets and hardware implementations.

Operating-system compatibility can apply when neither the hardware nor the instruction sets allows the programs to run unaltered. However, by using the same operating system utilities, file structures and compilers, the resulting operating-system compatibility allows application programs to run unchanged. Substantial sharing of data and programs gives an added benefit.

Data-file compatibility is the next level. It refers to two computer systems that have in common only the ability to share disk or tape files. Most computer systems are at least file compatible with systems from other vendors. Some standards initiatives have attempted to make all systems file compatible, but they have met with little success.

The final level, network compatibility, allows communication between machines that are otherwise incompatible. For instance, many vendors support IBM 2780 protocol, but this level of compatibility results in very limited functionality.



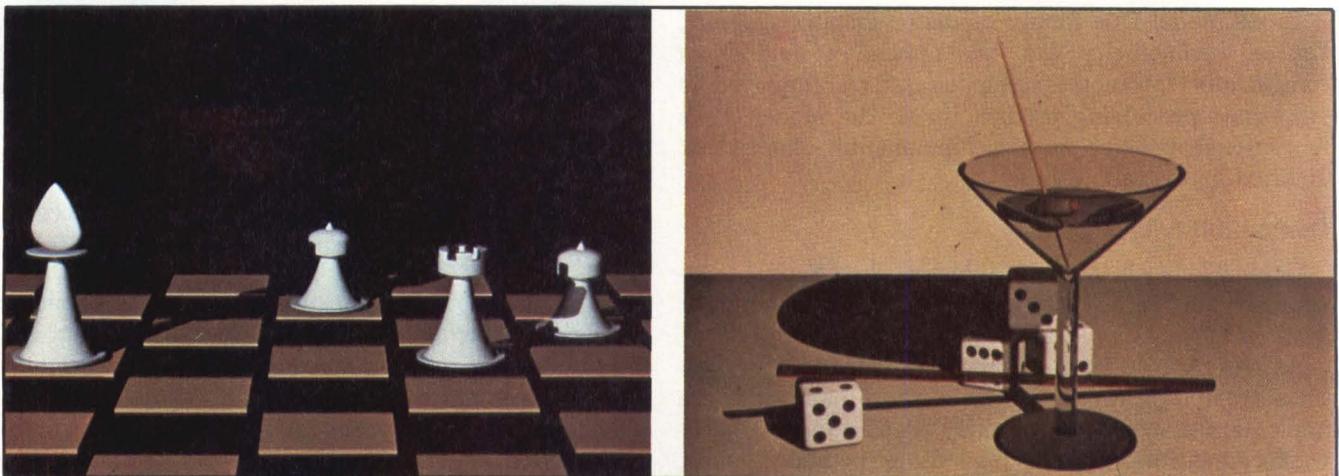
*Versions of the Model One graphics systems use different resolutions, bit plane depths and peripherals*

Most commercially successful computer system underscore the importance of compatibility. Much of a computer or graphics vendor's success results from its strategic choice of the right compatibility level. For example, both the DEC PDP-11 family and the IBM 360/370 product families use instruction-set compatibility. Less successful computer families have used lower levels of compatibility and have burdened users with substantial conversion problems and large software-development and redevelopment expenses.

### Designing for compatibility

In designing a multi-product compatibility strategy, a graphics vendor faces important technical trade-offs. The closer the vendor moves to hardware-implementation compatibility the more difficult the engineering of new products becomes. The closer the vendor moves towards host-library-level compatibility, the simpler hardware engineering becomes because new hardware need not be tied to the old. At this level, a user is limited to the use of a higher level language and a vendor-supplied library. Thus, system flexibility and overall performance are constrained.

Instruction-set compatibility provides the most bene-



**Two 1024 × 1024 pixel images** generated by the Raster Technologies Model One graphics subsystem. The Model One is available in a number of instruction sets compatible with differing resolutions and prices.

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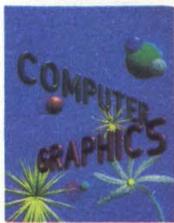
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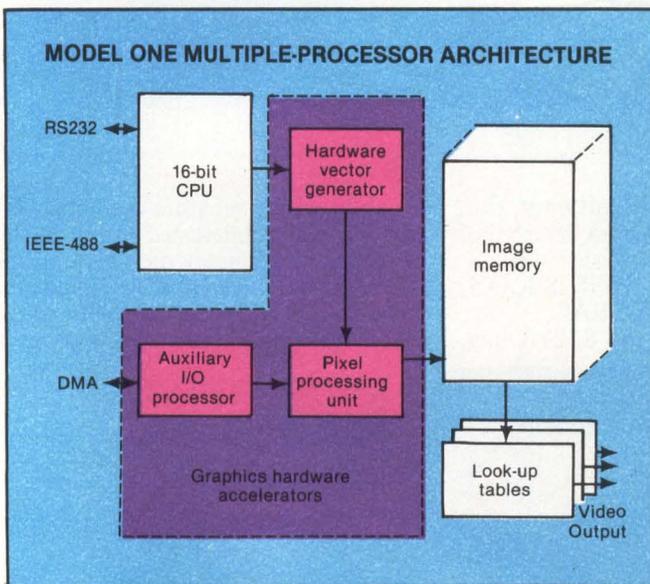
fit to both users and vendors. Hardware implementations can evolve with new technical advances, but users must also have the flexibility to use different languages, libraries and drivers.

Maintaining instruction-set compatibility places some stringent design restrictions on new products, but these can be overcome through development of an appropriate product architecture (Fig. 2).



*The instruction set is designed to support evolving graphics standards including CORE and GKS*

The foundation of the compatibility strategy in Raster Technologies Model One Graphics System design is the use of a high-performance, embedded 16-bit microprocessor. This 8-MHz Z8002 microprocessor is augmented by hardware accelerators for graphics processes such as vector computation and pixel arithmetic. This design gives the user a very broad, flexible instruction set and passes commands to hardware accelerators for direct execution. The microprocessor



**Fig. 2. Multiprocessor architecture** used in the Raster Technologies Model One is a useful approach to maintaining instruction-set compatibility across a graphics product line. A collection of hardware accelerators provides fast interactive graphics, while a high-speed multiprocessor insulates the user from the details of hardware implementation.

maintains the entire user interface. The programmer deals only with a basic instruction set and is isolated from the internal implementation details of the product; the use of hardware accelerators is transparent. More graphics vendors are introducing products based on microprocessors with hardware and bit-slice accelerators.

Versions of the Model One graphics systems use different resolutions, bit plane depths and peripherals (Fig. 3). All are compatible at the instruction-set level by appropriately programming the Z8002 microprocessor, which has 64K bytes of ROM and 128K bytes of RAM. The instruction set is designed to support evolving graphics standards including CORE and GKS.

THE MODEL ONE GRAPHICS SYSTEMS			
Feature	Model One/25	Model One/40	Model One/60
Picture resolutions	512 x 512, anti-aliased; or 1024 x 1024, dual mode	1024 x 1024	768 x 576 window into 1024 x 1024 image memory
Refresh rate	30 Hz interlaced	30 Hz, interlaced or 60 Hz, noninterlaced on a 512 x 512 window	60 Hz noninterlaced
Color support	As many as 16 million simultaneous displayable	As many as 64 simultaneous displayable	As many as 64 simultaneous displayable

**Fig. 3. Product compatibility via instruction-set compatibility** makes these diverse Raster Technologies graphics generators seem almost identical to the graphics programmer.

Graphics systems frequently include custom graphics instructions to define interactive routines to be executed locally in the graphics workstation. Local programming reduces host computer processing and improves response time. The second important design strategy that Raster Technologies adopted to maintain compatibility is graphics MACRO programming, or the ability to program the workstation locally in its own command set.

Writing local graphics routines for menu management, function buttons, cursor movement and other local interactive routines often requires user microcoding. Microcoding is expensive and contradicts the rationale for compatibility. Once a user is forced to microcode interactive routines and custom instructions in a graphics device, he has entered the realm of hardware implementation. Transportability of the microcode, even within one vendor's product line, can be very difficult, if not impossible. If the user upgrades to a different product of the vendor's same graphics family, he may be forced to rewrite that set of interactive routines. That's not compatibility.

Raster Technologies' systems offer MACRO program-

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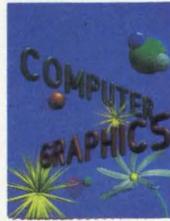
## GRAPHICS

ming capability that allows the user to produce custom graphics routines and interactive graphics functions.

MACDEF 10 (Define MACRO 10, As many as 255 macros can be active simultaneously)  
 VAL1 63 (Set color to white)  
 PIXFUN XOR (Set pixel function to exclusive or)  
 MOVABS 0, 0 (Position in center of screen)  
 RECREL 100, 100 (Draw enclosing rectangle)  
 MOVABS 20, 80 (Position for text)  
 TEXTC 16 (Set text size to 16 pixels. Text is vector font and can be smooth scaled and rotated in one degree increments)  
 TEXT1 BUTTON 1 to toggle menu (Write in text font 1. Font 2 is user definable)  
 MOVABS 20, 20  
 TEXT1 BUTTON 2 TO PAN SCREEN  
 MOVABS 20, 20  
 TEXT1 BUTTON 3 TO TRACK CURSOR  
 MACEND  
 BUTTBLE 1, 10 (assign button #1 to execute MACRO 10)  
 BUTTBLE 2, 12 (assign button #2 to execute MACRO 12, pan)  
 BUTTBLE 3, 15 (assign button #3 to execute MACRO 15, cursor)

Fig. 4. Raster Technologies MACROs handle menu-management tasks locally without host intervention. MACROs are written in the Model One graphics instruction set and not in assembler or microcode.

MACROs are written in the Model One graphics instruction set and not in microprocessor assembler or microcode. A convenient user interface is provided by the integration of MACROs with the button table. This allows groups of MACROs to be executed by a button on a digitizer or by the keys on a local keyboard (Fig. 4).



*Software compatibility has become a prerequisite for graphics workstation success*

With MACROs, the user is assured that interactive routines, such as menu management, tablet management and cursor management can be transported between any member of the Model One family. Furthermore, as Raster Technologies adopts new technologies, chips, RAMs and other circuitry, users' codes will run without modification. MACROs isolate users from the hardware-implementation level. □

Richard Fichera is product manager at Raster Technologies Inc., North Billerica, Mass.

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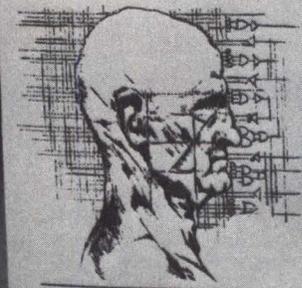
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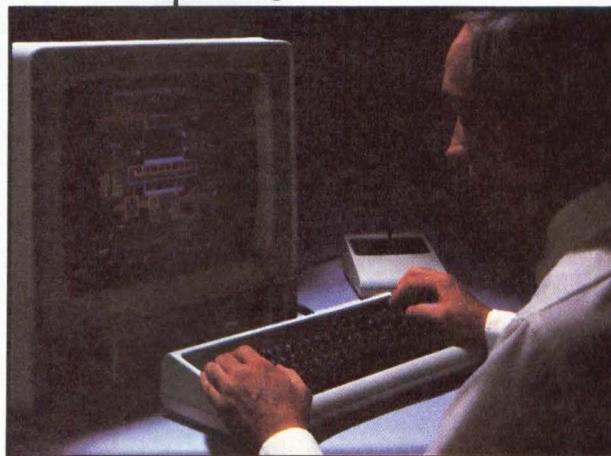
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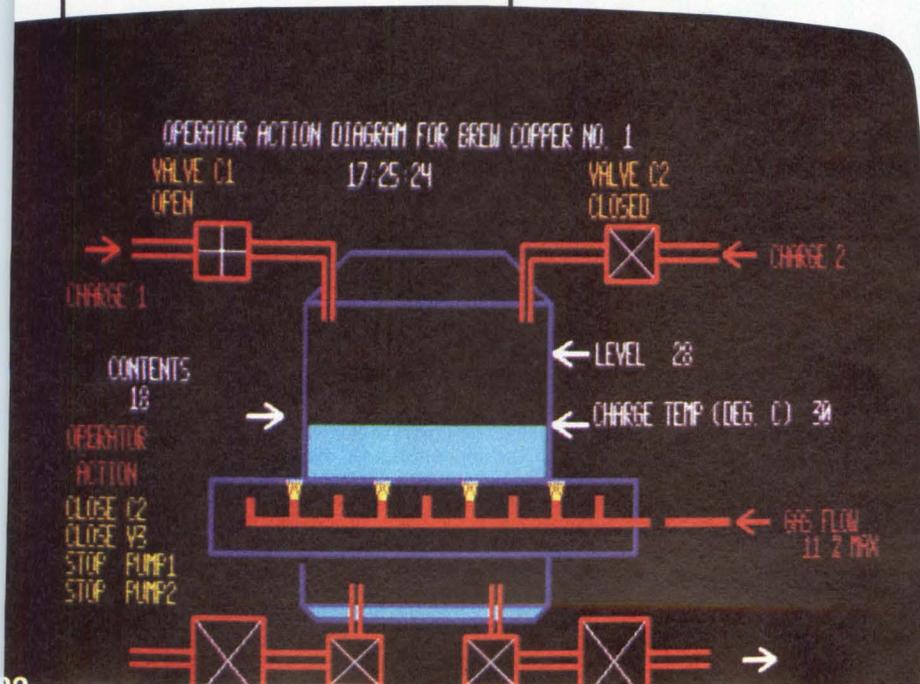
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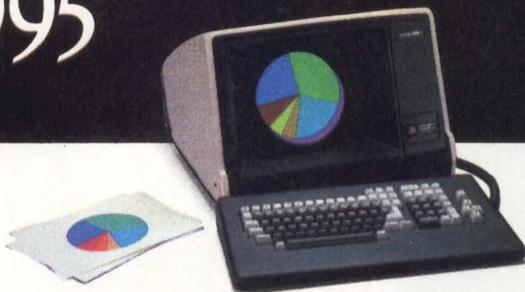
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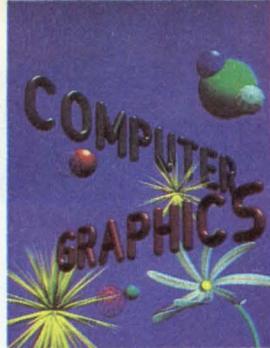
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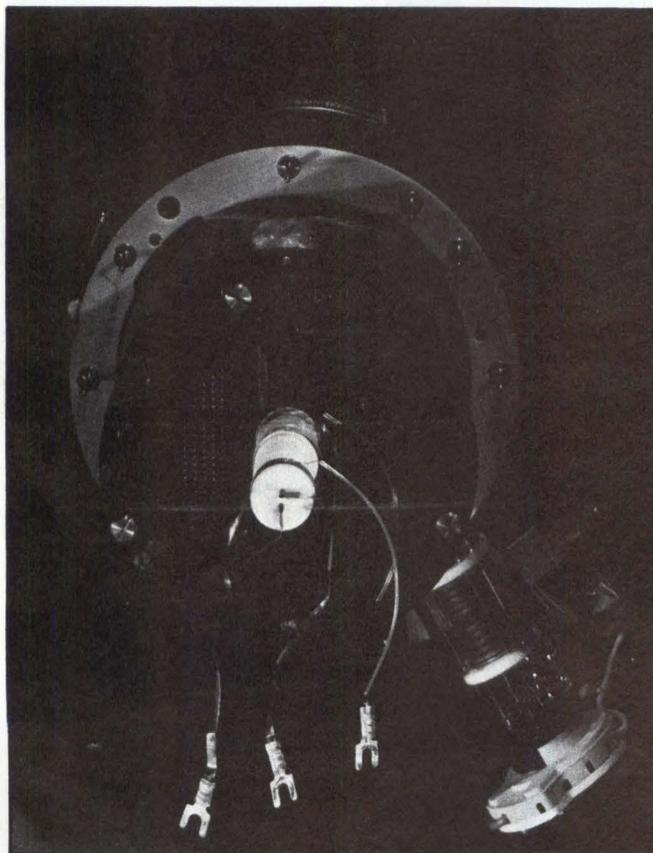
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# Light valve brightens large-screen displays

ROY FRIEDMAN and DAVID FREEDMAN, Associate Editors

*GE's single-gun projector generates 25-ft.-wide color images, rivaling those of a monitor*

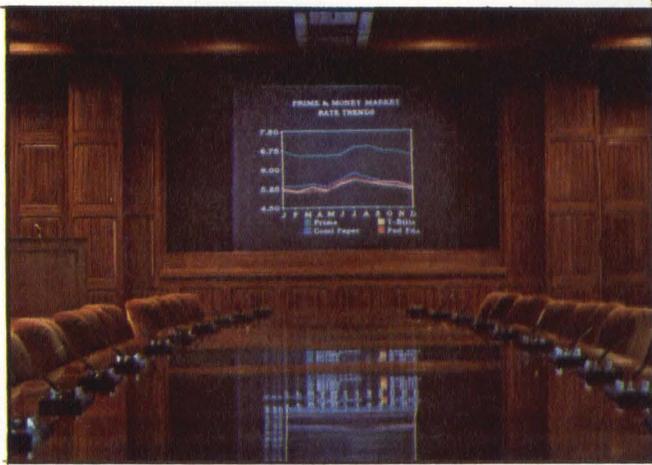


**General Electric's PJ 5055 color projector** houses a Xenon lamp, an electron gun, a light-valve chamber and a projection lens. The unit weighs only 140 lbs. and accepts RGB and NTSC color signals.

Most video projection systems for large-audience viewing of computer graphics provide images vastly inferior to those of a color monitor. Large-screen projection systems such as those used for home television do not have sufficient brightness and resolution for most business and professional applications.



**Sealed light-valve chamber** reduces maintenance requirements of GE color projector. Maximum voltage of 7.2 KV eliminates x-ray hazard.



But one type of projection system, using a light valve instead of a CRT, throws monitor-sharp color images, bright enough to be viewed in an undarkened room, onto 25-ft.-wide screens. Color projectors using light-valve technology are available at prices of \$65,000 to \$90,000. These devices are the precursors of professional-quality, large-screen display systems that could be available within a few years at a small fraction of today's prices.

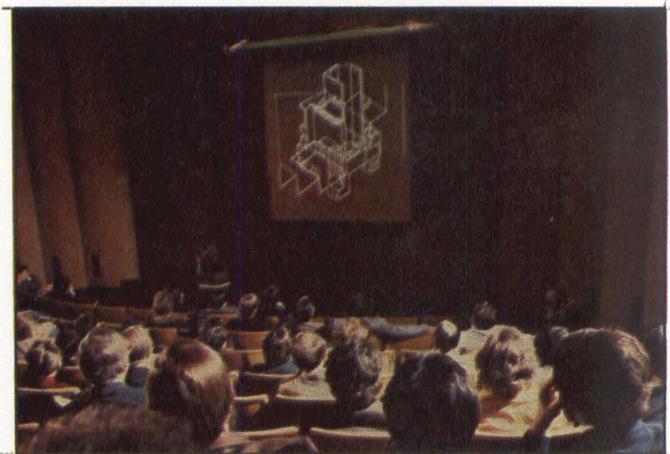
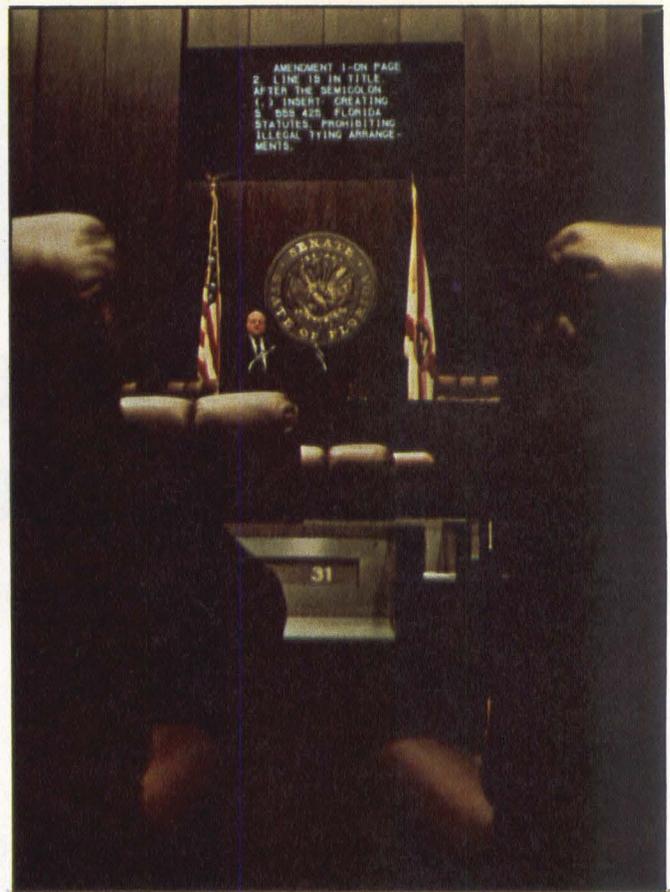
**Light valve instead of CRT**

Conventional large-screen projection systems use one or more CRTs. The simplest such systems, using a color CRT, have prices as low as \$500 each, but images tend to be blurred, and viewers must see them in completely dark rooms.

More sophisticated systems employ three monochrome CRTs that each accept a separate color signal. The three beams pass through color filters, and a lens converges the beams for viewing on a screen. The best of these systems have prices of \$15,000 to \$20,000 each and project 6-ft.-wide images readable in rooms with low ambient light. Because of the need to converge beams from three CRTs, these systems must be precisely aligned for a given screen position; if either the screen or projector is moved, the system must be realigned.

Light valve projectors do not use CRTs. Instead, an electron gun writes images on the oily surface of a transparent disk, which produces color by diffracting white light from a 650W Xenon lamp (see, "How the light valve works," p.200). Because the Xenon lamp is much more luminous than the phosphor used in CRTs, light-valve images are twice as sharp and 10 times as bright as those of CRT systems.

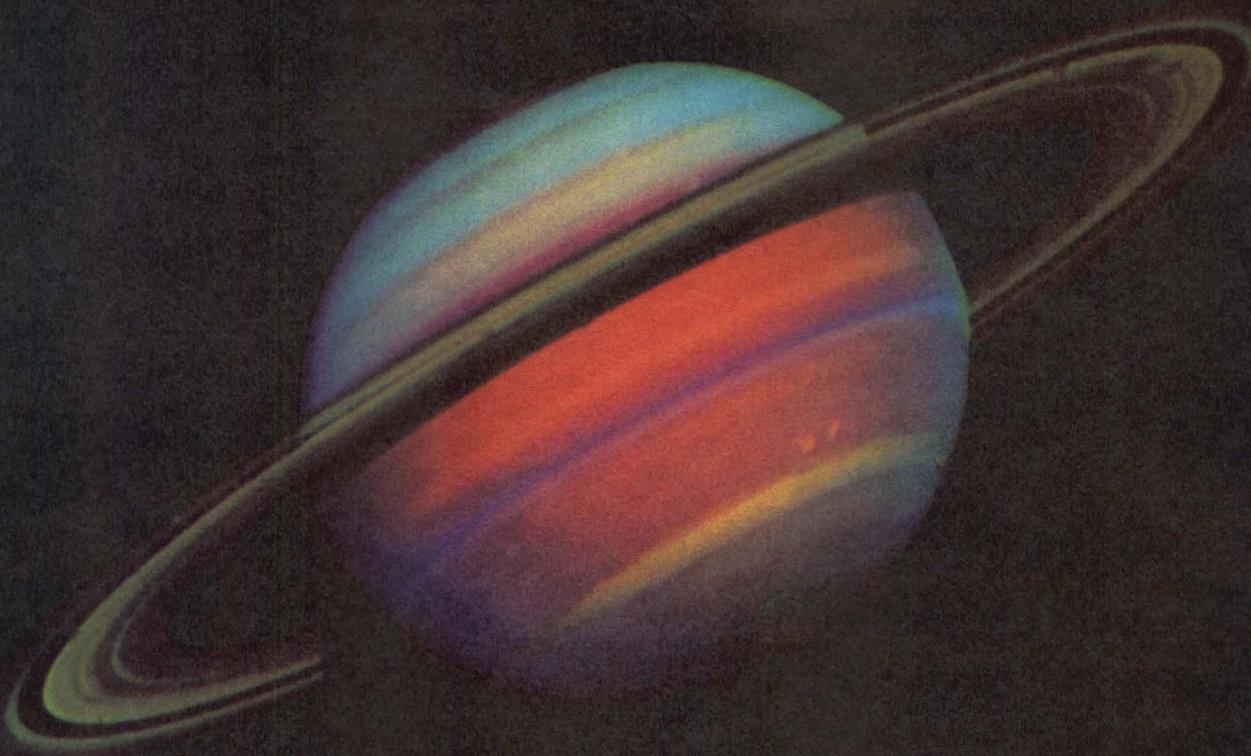
The two major suppliers of light-valve projection systems are General Electric Co. and Eidaphor, in Switzerland. Eidaphor's system produces color images sharp enough to be viewed on a 60-ft.-wide screen in



**Applications of the light-valve projector include computer-generated charts at the Mellon Bank of Pittsburgh, legislative text at the Florida Senate and computer-aided-design at the Engineering Society of Detroit.**

bright surroundings. But at \$600,000 per unit, the Eidaphor projector generally is limited to large sports and entertainment complexes. Moreover, the Eidaphor system uses a separate light valve for each of three colors, resulting in the same requirement for precise color alignment as many CRT systems.

GE's projector uses a single light valve to provide inherent color alignment. With no alignment requirement, the GE projector need not have a fixed location relative to the viewing screen. Other features of the GE projector are its suitability for front or rear projection, its absence of x-ray hazard and its sealed maintenance-



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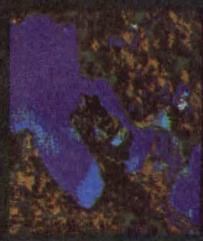
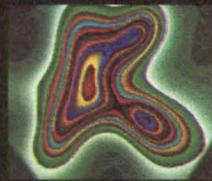
Our modular design approach with the architecture of the Vision Ten 24 gives you flexibility along with easier system upgrades. You can increase video paths, memory size or processing power by simply adding modules. Making the Vision Ten 24

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# COMTAL

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See Comtal at Siggraph Booth #235

free light-valve chamber.

**Trade shows to war rooms**

The GE light-valve projector accepts RGB and NTSC (TV) color signals at various scan rates and can be used with 2- to 25-ft.-wide screens. The system provides clear graphics and alphanumeric, making it suitable for lecture hall illustrations and corporate meetings. Several system and software vendors have leased light-valve projectors to display wares at trade shows. The projectors also are popular for military applica-

tions, which account for 20 percent of GE's light-valve sales. Countries whose armed forces use light-valve projectors include the U.S., Canada, Venezuela, Morocco, Spain, Italy and Germany. Teleconferencing, which often includes graphics presentations, likely will become a significant market for light-valve systems.

GE ships 200 light-valve projectors a year at prices of \$65,000 to \$90,000 per unit, and video-display marketing manager J.P. Gundersen doesn't expect shipments ever to exceed 300 to 400 units per year. But Gundersen says that in less than two years the company will market a light-valve color projector expected to sell for about \$20,000. Such a device would have tremendous impact on the video-display market and could lead to the replacement of monitors by projection screens in many applications. □

**HOW THE LIGHT VALVE WORKS**

General Electric Co.'s light-valve projector includes more than 150 patented inventions in optics, electronics and fluid mechanics. Major components of the projector are a Xenon lamp, an elliptical reflector, an electron gun, slotted input and output plates and an oil-coated, transparent glass disk (A).

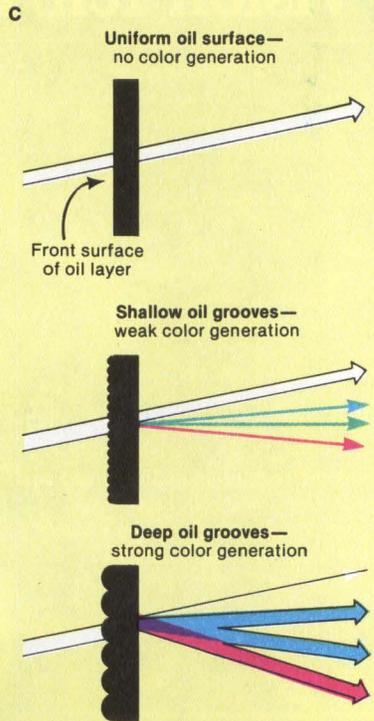
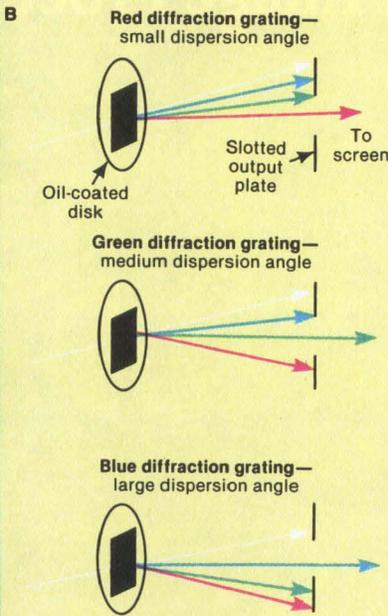
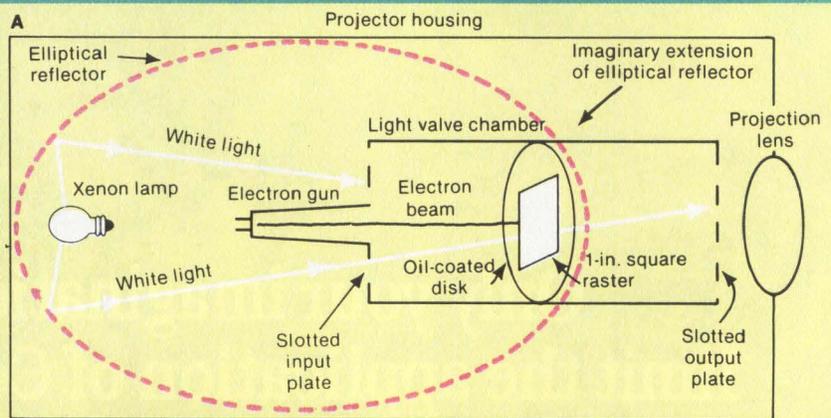
Light rays from the Xenon lamp at one focus of the elliptical reflector strike the slotted input plate, which blocks some of the rays. The remaining light rays enter the light-valve chamber and impinge on the oil-coated disk at the second focus of the reflector. The electron gun performs a raster scan of a 1-sq.-in. area on the disk.

When no video signal is present, oil on the disk is unaffected by the electron beam. Light rays pass through the disk without modification and are blocked by bars in the slotted output plate. No light reaches the screen.

When a red, green or blue video signal is present, the electron beam deforms the surface of the oil into a pattern of closely spaced grooves that acts as a diffraction grating. Red, green and blue video signals each produce a unique type of grating.

The diffraction grating causes a prism-like dispersion of colors and each of the three types of gratings generates a different angle of dispersion (B). Pixel color is determined by the position of output plate slots relative to the dispersion angle. Light that passes through the output plate is magnified by a lens and projected onto the viewing screen.

Pixel brightness is determined by the amplitude of the video signal and the consequent depth of the oil



grooves (C). The deeper the oil grooves, the greater the amount of color generation and the brighter the pixel image on the screen.

# In the world of emulating terminals... **VISUAL** is a world apart.



## VISUAL EMULATION CAPABILITY

**VISUAL 50/55** are low cost smart terminals. The VISUAL 50 emulates DEC VT52<sup>®</sup>, Lear Siegler ADM3A<sup>™</sup>, Hazeltine Esprit<sup>™</sup> and ADDS Viewpoint<sup>®</sup>. VISUAL 55 emulates the same plus Hazeltine 1500/1510 and VISUAL 200/210.

**VISUAL 100** is 100% compatible with the DEC VT100<sup>®</sup> and also emulates the VT52.

**VISUAL 300/330** are versatile terminals that can be easily customized. The VISUAL 300 emulates the DEC VT100 and VT52. VISUAL 330 emulates the DEC VT52, ADM3A, Hazeltine 1500 and Data General D200.

**VISUAL 500/550** are low cost, high resolution graphic terminals with powerful alphanumeric capabilities. The VISUAL 500 emulates the VT52, ADM3A, Hazeltine 1500, D200 and Tektronix<sup>®</sup> 4010/4014. The VISUAL 550 emulates the VT100, VT52 and Tektronix 4010/4014.

VISUAL terminals feature extended ergonomics including tilt and swivel non-glare 12" or 14" screens, detached keyboard, large character size, menu-style setup, sculptured key caps and more.

VISUAL has earned for itself an exclusive place . . . a solitary niche . . . in the arena of emulating terminals. Four great terminal series offer a combination of advanced features found on no other terminals anywhere in the world. Each series delivers higher performance at lower cost for its particular market segment. And nobody else gives such a wide choice of emulations as VISUAL . . . the pioneer in the field.

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Service available in principal cities through Sorbus Service, Division of Management Assistance, Inc.

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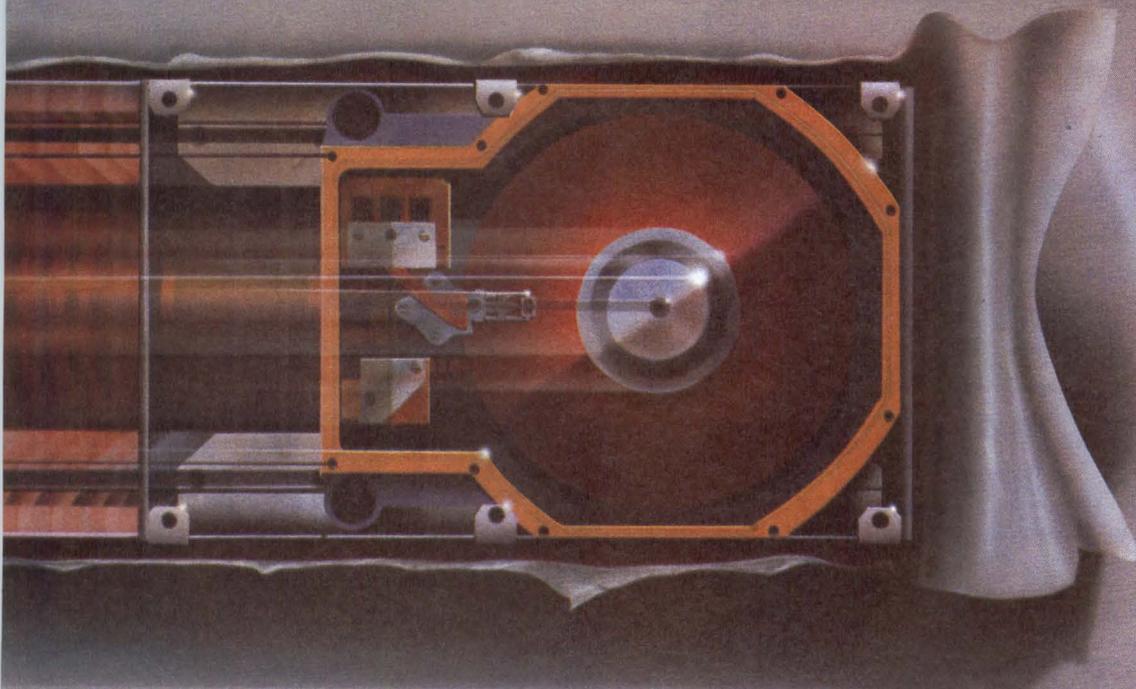
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14"	3350	34	46ms
	6650	68	46ms
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8"	3450	35	42ms
	7050	70	42ms
	804	105	42ms
5¼"	502	55	32ms
	503	71	32ms
	504	86	32ms
	505	111	32ms

**SMART Interfaces.** PRIAM gives you the finest in interfacing flexibility. Our intelligent interfaces can control up to four drives in any mix, plus tape and floppy backup. They're the fastest and easiest route to putting a Winchester database in your system.

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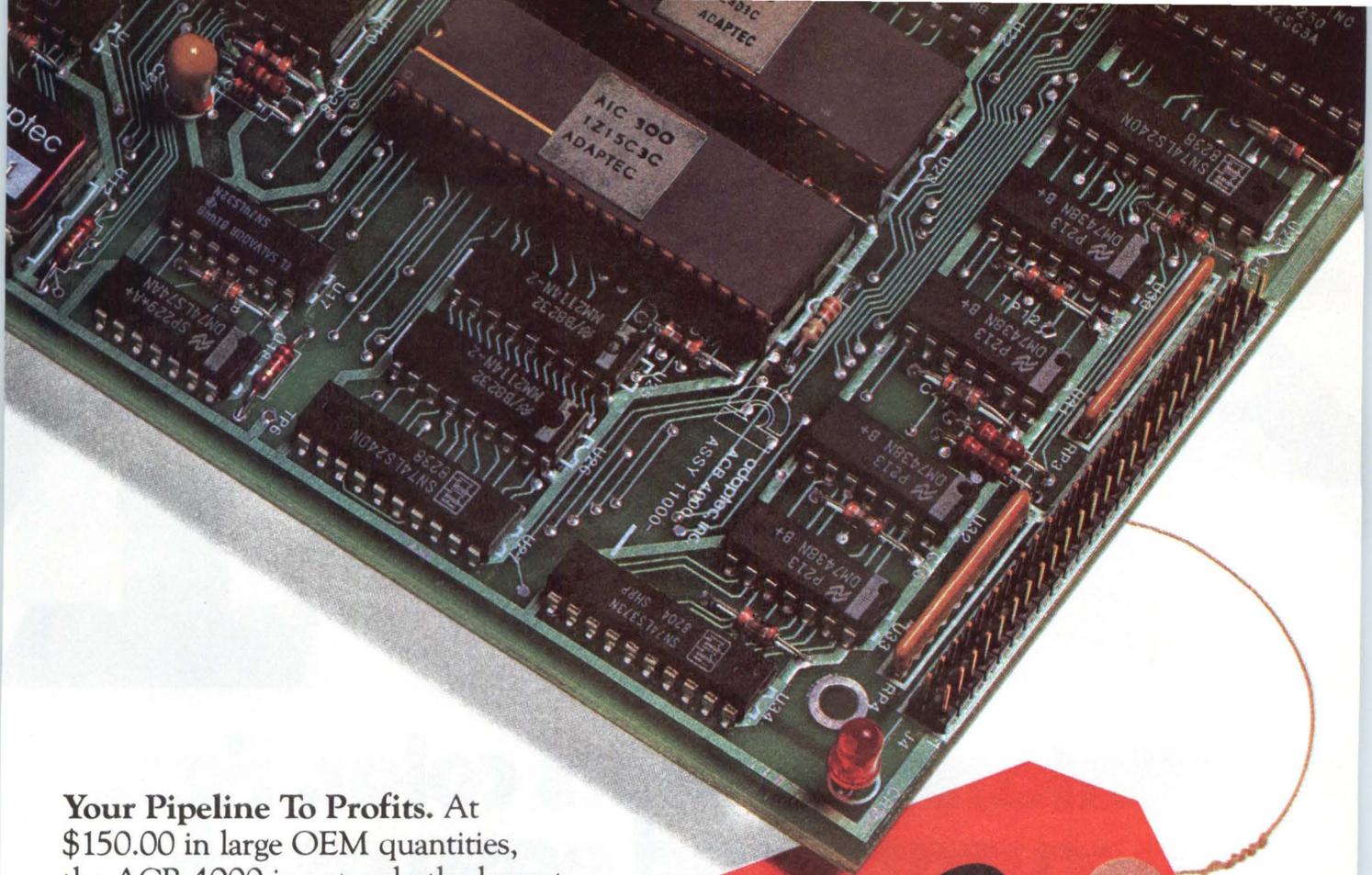
Break the I/O Bottleneck With High Performance Winchester Controllers for \$150.00. Or Less.

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since Adaptec controllers offer extended SASI/ANSI SCSI compatibility, they are more flexible and easy to integrate. So getting your 8/16-bit system to market fast is more than a pipe dream.





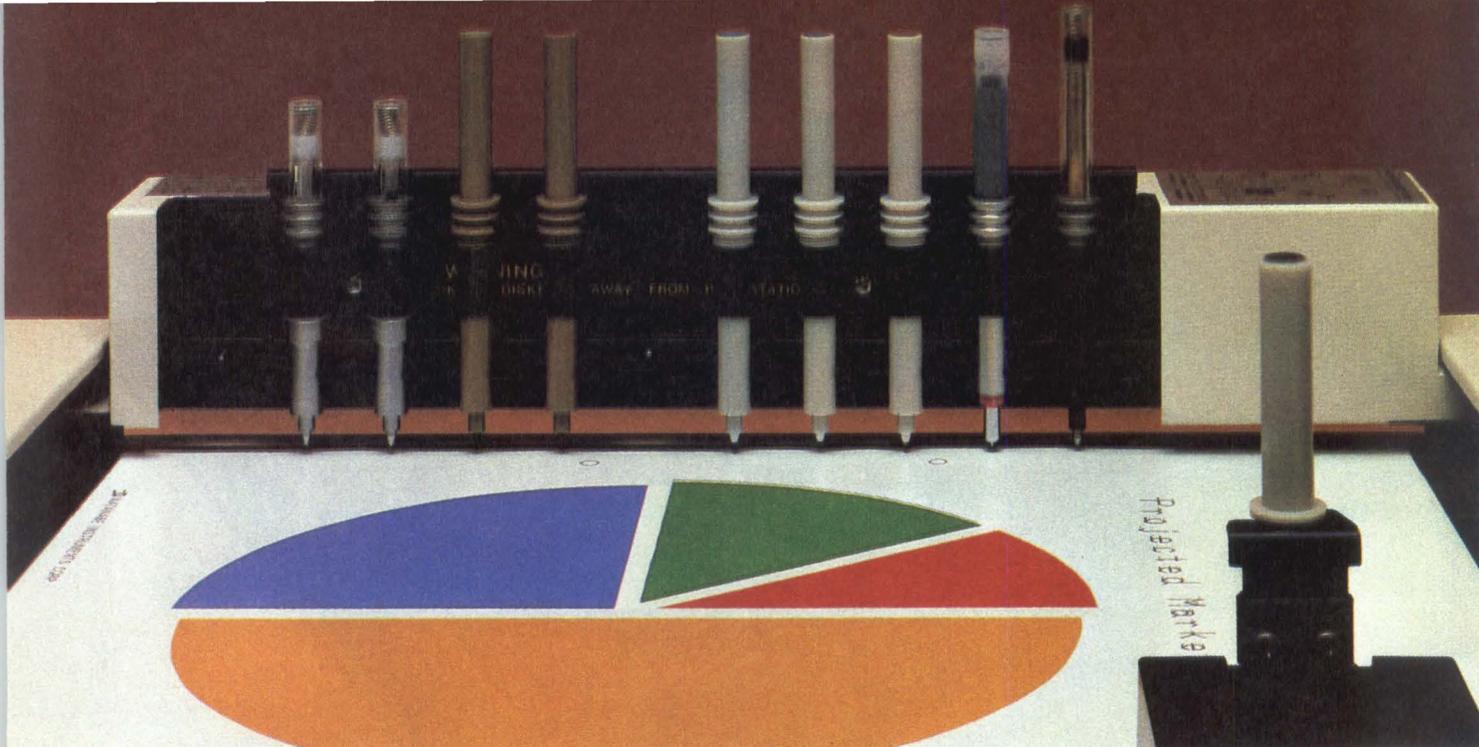
**Your Pipeline To Profits.** At \$150.00 in large OEM quantities, the ACB-4000 is not only the lowest cost, but also the most cost effective complete controller solution available today. SASI/ANSI SCSI compatibility provides a number of important benefits like reduced system design time, and device independent operation. ACB-4000 power consumption is only about half of competitive controllers', further saving you time and money. But just as important, the ACB-4000 provides a direct, easy upgrade path to our multi-user system controller, the ACB-5000. So your present system is also your pipeline to the future.

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you can make ... or buy**



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**Easy to program and use.** You don't have to be an engineer to use a Watanabe plotter. Yet it can produce complex engineering drawings. Intelligence is built into the plotter through our unique microprocessor controllers.

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**Choose the model that's right for you.** Why pay for features you don't need? Watanabe plotters are available in a variety of models. One will be best for your budget and graphics needs. Choose from our low cost, single-pen plotter, through a range of multi-pen configurations, to our high-speed, intelligent plotters. Or select a machine that

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Use water or oil-based pens, or ink pens. Choose from sheet-feed or roll-feed models, or produce drawings on acetate for overhead projection. In addition to programmable graphics and function commands, the complete ASCII character set is standard. Each plotter can interface to any computer with an RS-232-C serial interface, IEEE-488 interface, or parallel port.

**Designed for long use.** Just one example of Watanabe's built-in reliability is the ingeniously simple, automatic mechanical pen pickup used on the multi-pen models.

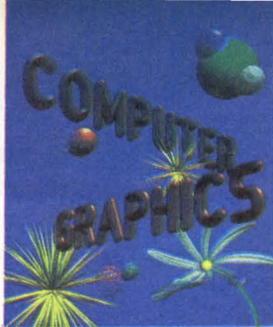
When your plotter does need maintenance or repair, one of our many locations worldwide will provide prompt service. We design, manufacture, and service our plotters ourselves. So we know we can stand behind them with confidence.

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# Desk-top design station features multimode graphics

JAY GLASER, Motorola Inc.

*MC68010-based micro provides seven-color displays, graphics hardware for efficient pixel manipulation*

Designers of microcomputer application systems increasingly use special-purpose graphics in addition to traditional character displays. This trend emphasizes the need for development systems with flexible, low-cost graphics capabilities. An example of such a development system is Motorola Inc.'s VME/10, a desk-top microcomputer for OEMs in the industrial and scientific markets. The VME/10 has multimode graphics, a modular design and many hardware- and software-development tools.

## Multimode graphics

To produce displays for a variety of applications, a development system should offer flexibility in features such as resolution, color and character set. The VME/10 provides a number of such choices: two graphics-resolution modes, seven colors and intensity levels, two ways to access pixels and user-definable characters and character attributes. Graphics- and character-handling are separate in memory. The contents of the two are logically "OR"ed to allow composite displays of graphics and characters.

The two graphics-resolution modes are  $800 \times 300$  pixels (low-resolution mode) and  $800 \times 600$  pixels (medium-resolution mode). The ability to select the resolution mode is useful because the low-resolution mode requires less graphics RAM (96K versus 192K bytes) and provides faster operation than the medium-resolution mode. In low-resolution mode, unused RAM is

available for general system use.

Graphics RAM is divided into three contiguous banks. Each bank represents one of the system's three primary colors: blue, green and red. Each pixel is controlled by 1 bit in each of the three memory banks. Since bank 1 represents blue, bank 2 green and bank 3



**VME/10 expansion modules** available from Motorola and other suppliers provide flexibility for many OEM industrial and scientific applications. The basic system includes an MC68010 microprocessor, 384K bytes of RAM, a 15-in. display and 20M bytes of unformatted mass storage.

red, it follows that a "1" bit in banks 1 and 2 generates blue-green, a "1" bit in banks 1 and 3 generates purple, a "1" bit in banks 2 and 3 generates yellow, and a "1" bit in all three banks generates white. In monochrome applications, the three banks of graphics RAM are used to produce multiple intensity levels for each pixel.

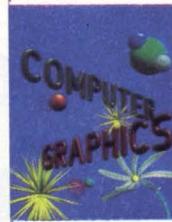
To draw a bar graph, fill an object with color or blank the screen, it is useful to access several adjacent pixels at once. The VME/10 can access 8 or 16 pixels at once by byte- or word-length read and write instructions. But these instructions are inefficient for drawing lines and curves or making small modifications to displays. For these functions, it is desirable to access pixels individually. The VME/10 can access the 3 memory-bank bits that control a pixel by using a single hardware instruction (Fig. 1).

Character displays on the VME/10 are 25 rows × 80 columns. Users can define characters and fonts using any 7-bit code to provide 128 symbols. Characters are stored in RAM in 16-bit words containing 7 bits for a character and 9 bits for character attributes. The character attributes are color, intensity and special effects such as blinking, underlining and inverse video. Users can define additional special effects that are implemented by software.

VMEbus and I/O channel provide flexibility

The VME/10 has a modular design consisting of a control unit, a keyboard and a CRT. The control unit houses the system control card (Fig. 2), the disk drives, the VMEbus and the I/O channel.

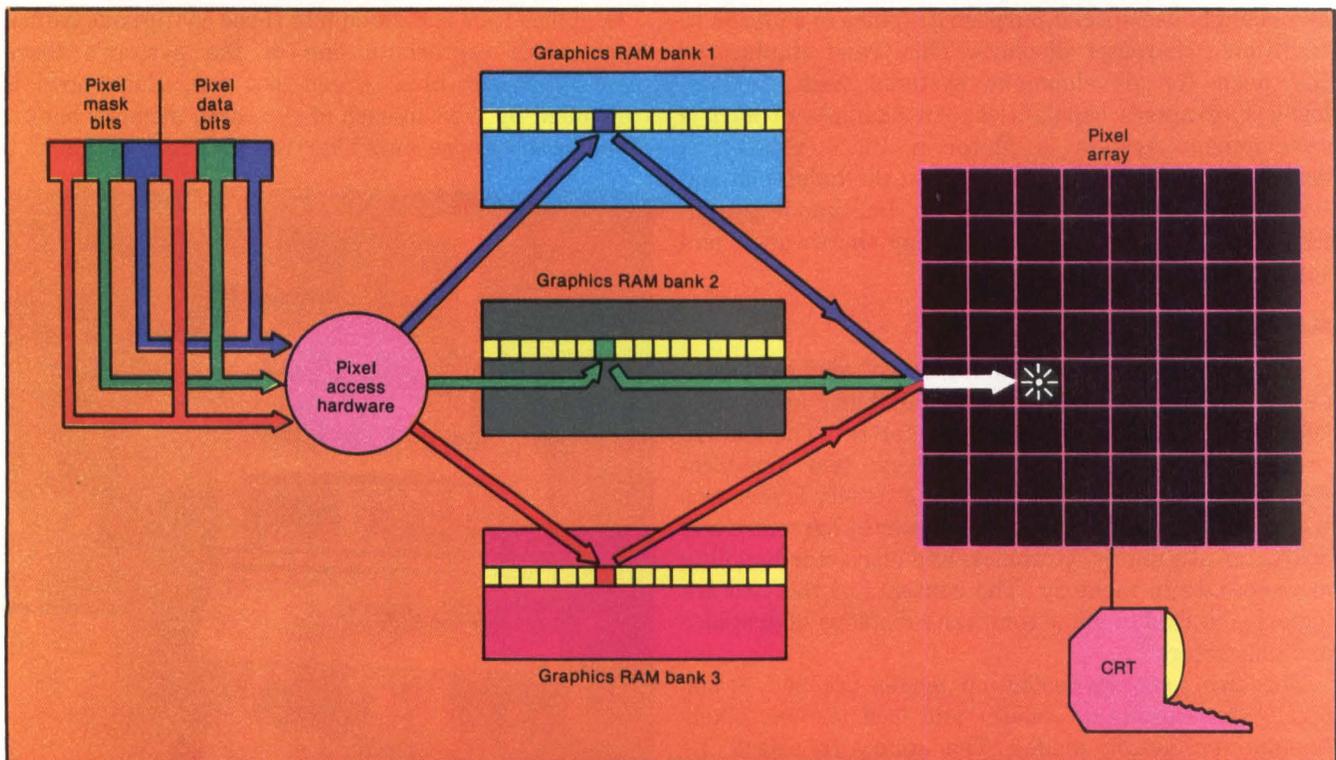
VME/10 mass storage consists of a 19M-byte, 5¼-in.



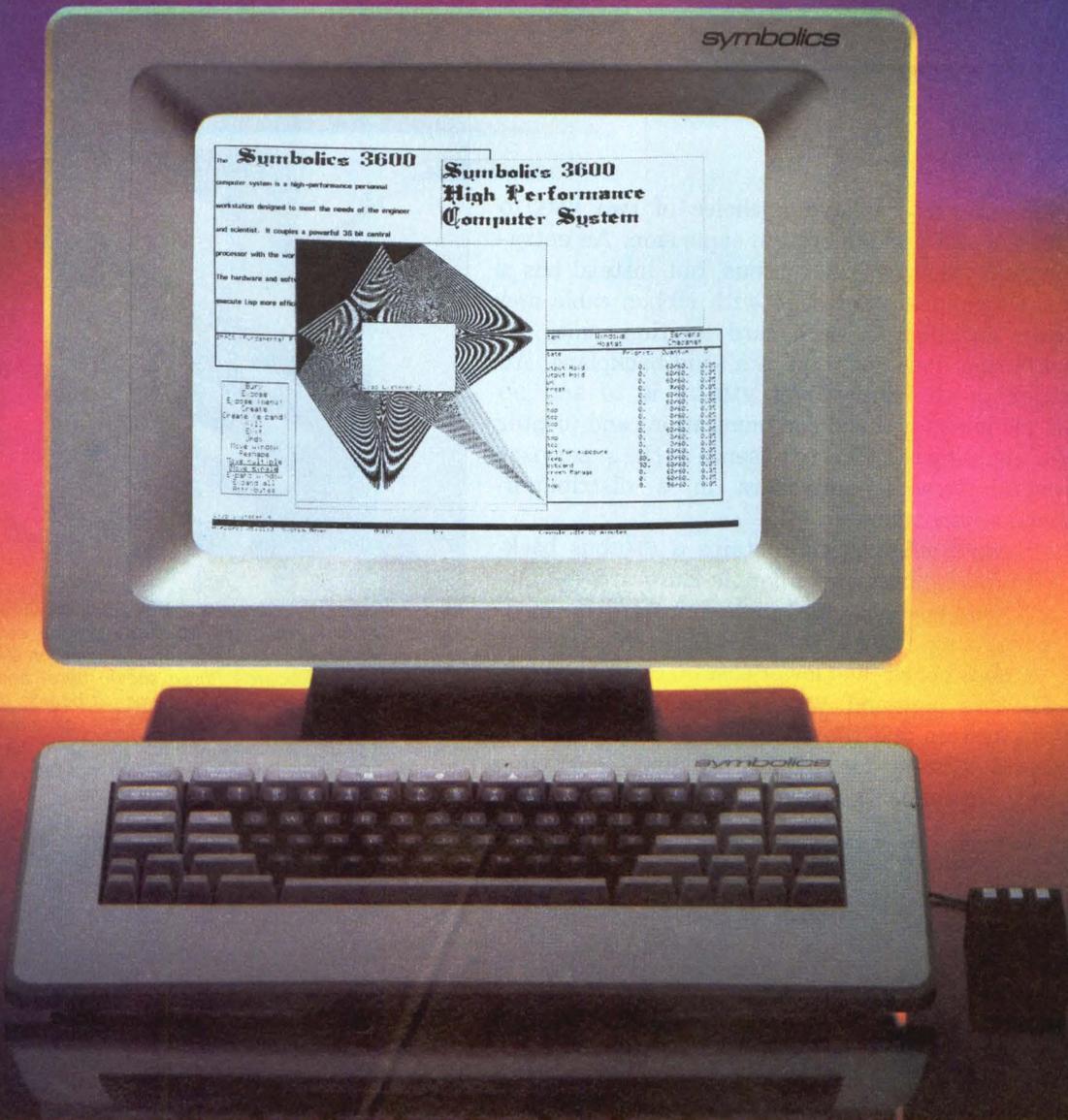
*To draw a bar graph, fill an object with color or blank the screen, it is useful to access several adjacent pixels at a time.*

Winchester and a 1M-byte, 5¼-in. dual-sided, dual-density floppy disk drive. The disk controller, which is FIFO buffered, allows continuous sector transfers to facilitate movement of large data blocks.

The VMEbus offers 16-/32-bit asynchronous, bidirectional operation and supports additional system capabilities such as direct memory access and multiprocessor operation. In multiprocessor operation, any designated VMEbus master device, including the main system processor, can issue a bus request and become the temporary bus master to perform a VMEbus-related activity.



**Fig. 1. Pixel access hardware** empowers a single CPU instruction to write 3 bits of pixel data into three separate bit positions in graphics RAM. Mask bits can disable the data transfer to any of the three banks, allowing one or more banks to remain unchanged while the others are modified. The pixel color displayed on the CRT is a combination of the three primary colors in which each primary is used if the pixel bit in the corresponding memory bank is on. Since each of three bits controlling a pixel can be on or off, there are 2<sup>3</sup>, or eight, possibilities: a blank screen location or one of seven colors.



## Introducing the sophisticated professional workstation.

The Symbolics 3600 Lisp-based system puts unlimited computing at your fingertips

### Unlimited computing power

The Symbolics 3600 puts the level of computer power associated with supermini class computers in your hands at a fraction of the usual cost. It has a 36-bit tagged architecture and executes programs at an average of one million high-level instructions per second. Our standard 3600 system software, a powerful and proven Lisp-based operating and program development environment, also supports FORTRAN, PASCAL, C, Interlisp compatibility and Flavors object-oriented programming.

Symbolics' innovations in symbolic computing extend the limits of solutions in traditional applications. For example, large-scale software system development and VLSI circuit design are massive undertakings. The Symbolics 3600 software environment takes care of many of the

routine tasks a programmer or designer is now required to perform, dramatically reducing programming and design time while significantly in-

creasing productivity. These benefits apply to emerging application areas such as development of expert systems, symbolic mathematics, robotics, CAD/CAM, genetic engineering, training simulators, and a broad range of research activities. Each user in a typical workstation environment has access to all other computing facilities on the network.

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The Symbolics 3600 brings to you today a new age of computing—symbolic processing systems that are being used by a growing number of 3600 customers as the sophisticated means for problem-solving. Join them in this new age of computing.

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### Symbolics 3600 Capsule Specifications

<b>System CPU</b>	50 KHz sample rate audio output	Autodial/Autoanswer 1200 baud modem (optional)
36-bit tagged, stack oriented architecture	Color: 1280 x 1024 with 8 to 32 bits/pixel, 10 bits/color RGB (optional)	<b>Operating System</b>
2.3 megabyte RAM with ECC, expandable to 34 megabytes	<b>Mass Storage</b>	Enhanced Zetalisp with on-line edit, compile, inspect, debug, network file system, electronic mail
1.125 gigabytes virtual memory	Built-in 169 megabyte Winchester	Totally interactive with sophisticated display system
20 million byte/second memory bus	Optional disk memory up to 1.8 gigabytes	<b>Languages</b>
Floating point accelerator (optional)	Optional cartridge or 9-track tape drives	Lisp, Fortran-77, C, Pascal, Interlisp
<b>Console and Keyboard</b>	<b>Communications</b>	Flavors object-oriented programming
Bit-mapped raster display	10 megabit/second Ethernet local area network	<b>Printer</b>
B&W 17-inch, landscape format, 1100 x 800 pixel	One parallel and three standard serial ports	Laser Graphics Printer LGP-1 (optional)
88 keys with n-key rollover		
3-button mouse		

**symbolics inc.**

9600 De Soto Avenue, Chatsworth, CA 91311 (213) 998-3600.

System integrators have a choice of two VME/10 configurations to provide system expansion. An entry-level configuration has no VMEbus, but instead has a five-slot I/O channel card cage with ribbon cable and connectors installed in each card location, since I/O channel busing does not require a solid backplane. An application of the entry-level VME/10 is to add I/O channel modules for serial communications and printer support, enabling the VME/10 to serve as the supervisor for several remote controllers in a distributed-processing environment.

A high-end configuration contains a VMEbus backplane with five connectors for double-Eurocard VME modules and four positions for single-Eurocard I/O modules, permitting users to add both high-performance VMEbus boards and lower cost I/O channel boards (Fig. 3). The high-end VME/10 with the VERSADOS operating system and the VME module GPIB controller comprise a system for monitoring and controlling laboratory instruments, performing complex calcula-

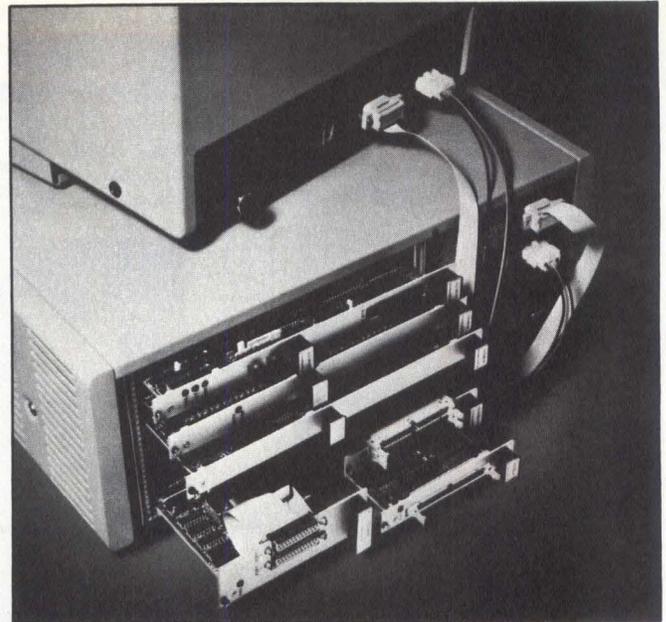


Fig. 3. The VME/10 high-end configuration has a "combination" card cage offering five slots at the top for VMEbus-compatible double-Eurocard boards (three shown here) and four slots at the bottom for I/O channel single-Eurocard boards (three shown here: one left, two right). The top (VME module) slots normally are used for additional processors, memory and intelligent peripheral controllers. Bottom (I/O module) slots are used for interfaces to devices such as modems, printers and analog converters.

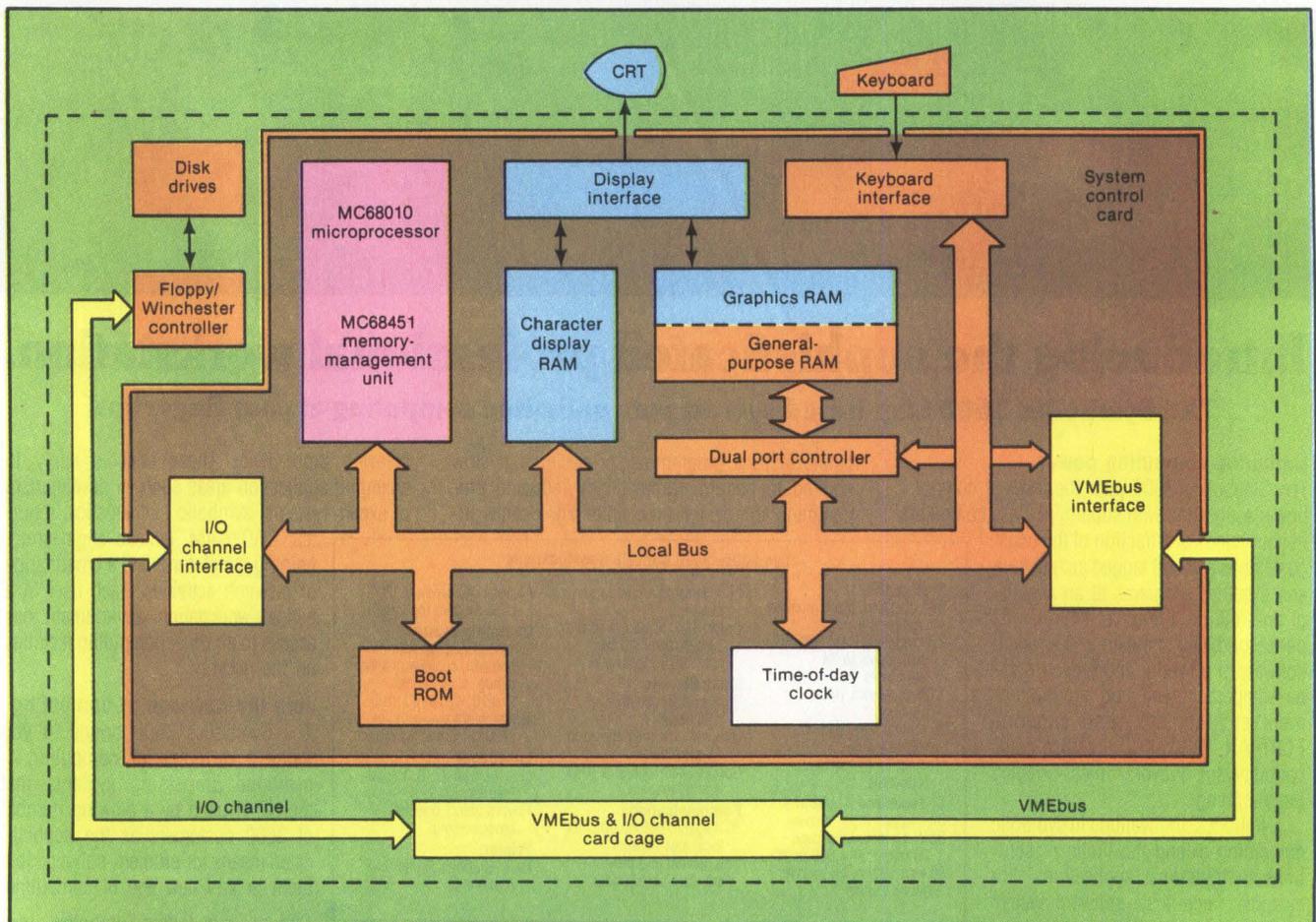


Fig. 2. The system control card contains the microprocessor and a memory-management unit that permits multitasking with full memory protection for each task. A dual-port controller allows shared access from the local bus and VMEbus. A battery-backed clock using an MC146818 CMOS chip provides the time of day, generates time-related interrupts to the microprocessor and stores 50 bytes of RAM for configuration parameters.

# Announcing Retro-Graphics for \$749.



## You can now update your ADDS, TeleVideo, or Lear Siegler terminal with the most economical Tektronix graphics around!

With our invention, the RG512 Retro-Graphics terminal enhancement, we introduced more than 25,000 operators to the standard of value in Tektronix®-compatible graphics.

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The 512-Series. A *user-installed* PCB assembly that converts your TeleVideo®, ADDS, or Lear Siegler® terminal into a powerful bit-map graphmaker. With Tek™ 4010/4014 features. And compatible with Tek's *PLOT 10™* or your RG512-based program.

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With the RG512, we led the way to affordable graphics. Now, at \$749, 512-Series sets the new standard for low-cost graphics.

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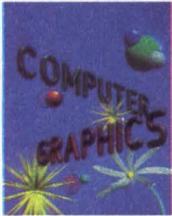
Retro-Graphics is a registered trademark of Digital Engineering, Inc. © 1983 Digital Engineering, Inc.

## GRAPHICS

tions on experimental data and displaying results graphically.

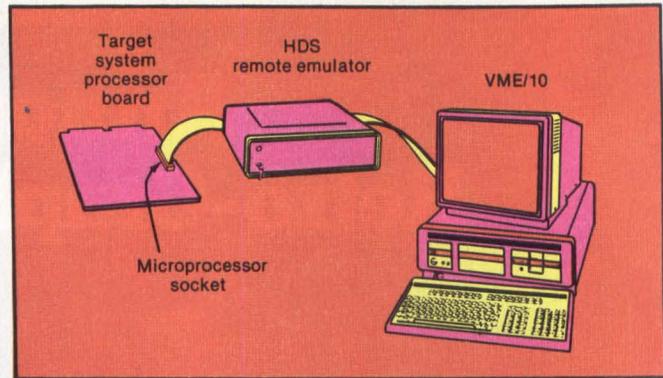
### Hardware and software tools

The VME/10 comes with a large set of development tools including the VERSADOS operating system; the



*The high-end VME/10 comprises a system for monitoring and controlling laboratory instruments, performing complex calculations and displaying results graphically.*

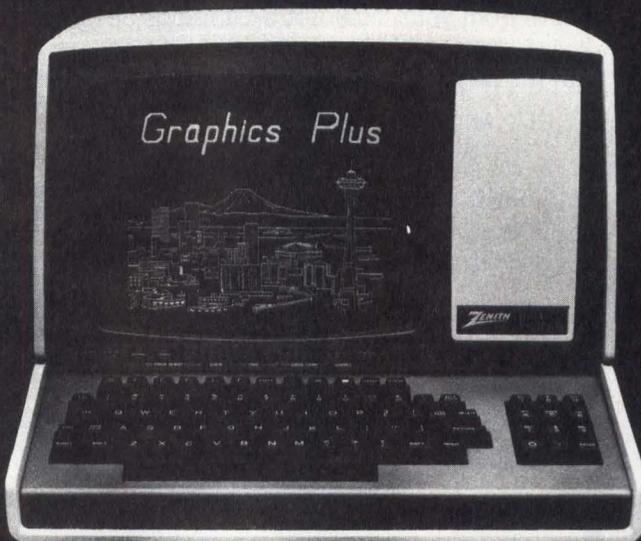
UNIX System V operating system (planned for late 1983); Pascal, FORTRAN, and C compilers; a macro assembler; a symbolic debugger; and a bus analyzer. These tools enable the VME/10 to be a stand-alone development system or a component of an application



**Fig. 4.** Target system emulation can make the difference between streamlined or plodding passage through hardware and software integration. The VME/10 can host Motorola's HDS-400 (MC68000 family) or HDS-200 (MC6800 family) remote emulators. Software is edited, compiled and linked on the VME/10 and then down-loaded to the HDS station, which emulates the target system by plugging into the microprocessor chip socket in the target system processor board.

system. A third possibility is to incorporate the VME/10 into a development and testing system that performs target system emulation (Fig. 4). Development tools and target system emulation are available for both MC68000 family (16-bit) and MC6800 family (8-bit) target systems. □

**Jay Glaser** is a product planning manager for Motorola Inc., Tempe, Ariz.



GRAPHICS-PLUS is a field installable enhancement board for the popular Zenith<sup>1</sup> Z19 video terminal adding many powerful features found only on terminals costing much more. GRAPHICS-PLUS provides Tektronix<sup>2</sup> 4010 compatible vector drawing graphics, VT100<sup>3</sup> compatible 80 and 132 column display formats, off-screen scrolling memory, programmable function keys, "Plain English" menu-driven Set-up mode, and a host of other enhancements. Installation can be accomplished within 15 minutes using only a screwdriver.

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- Optional Hardcopy Port
- Simple Field Installation

1 TM Zenith  
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GP-19 Upgrade for Z19 Terminal	\$ 849
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**Outmaneuvers Lines and Daisies at 350 cps.** Okidata's new multifunction Pacemark 2410 combines three printers in one remarkable machine. At 350 cps, it pumps out data at line speeds up to 420 lpm. Delivers drafts with extra-dense characters at 175 cps. Its 85 cps correspondence quality is three times faster than most daisywheels.

But that's just the opening salvo. This high powered dot matrix printer has an arsenal of extra features. Two-color printing. Dot addressable graphics. 96-character ASCII set, plus resident and alternate 96-character downline loadable sets. Column capabilities range from 136 to 233.

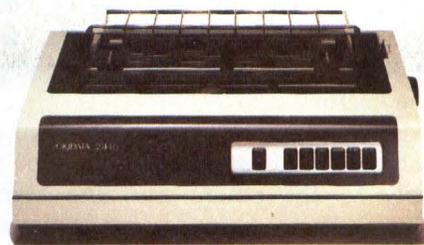
**Tough As Nails.** The 2410 won't suffer from battle fatigue or duty cycle

limitations. It's armed with our long-life, stored-energy print head with 9 tungsten pins to crank out up to 500 million characters with ruthless precision. Add laser-welded, precision-controlled construction and a rugged, stamped steel frame, and this machine's virtually invincible.

**Compatibility Plus.** Teams up with all the big guns in high performance desktops and small business computers, plus most low-end minis. Available with standard parallel or RS 232C serial interface with current loop. Additional interfaces on the way.

**Mean Machine. Nice Price.** It's capable. It's tough. It should cost a bundle. But it doesn't. Suggested retail is \$2995; \$2695 for its data-processing-only part-

ner, the Pacemark 2350. For more information, phone 1-800-OKIDATA. In New Jersey, (609) 235-2600.

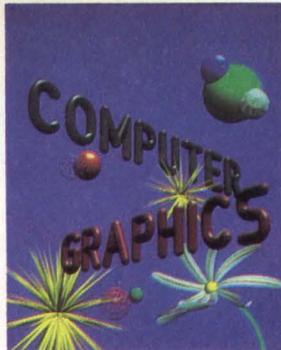


# OKIDATA

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A subsidiary of Oki Electric Industry Company, Ltd.

CIRCLE NO. 113 ON INQUIRY CARD



# Terminal measures 3D objects

*Stereo photographs provide 3D image for  
microprocessor-controlled measurement*

Whether dealing with a large mountain or a miniature model of a power plant, obtaining precise measurements can be a problem. Photographs provide one solution because they enable the precise indirect measurement of complex objects while an operator sits at a desk. But photographs present 2D images, and many applications require 3D measurements. A new microprocessor-based system provides 3D measurement using stereo photographs and polarized light.

## **How the system works**

The Traster stereo satellite terminal from Matra Technology, Los Gatos, Calif., integrates parallax data from separate and differently polarized binocular images into apparent 3D images that can be viewed through eyeglasses with correspondingly polarized lenses.

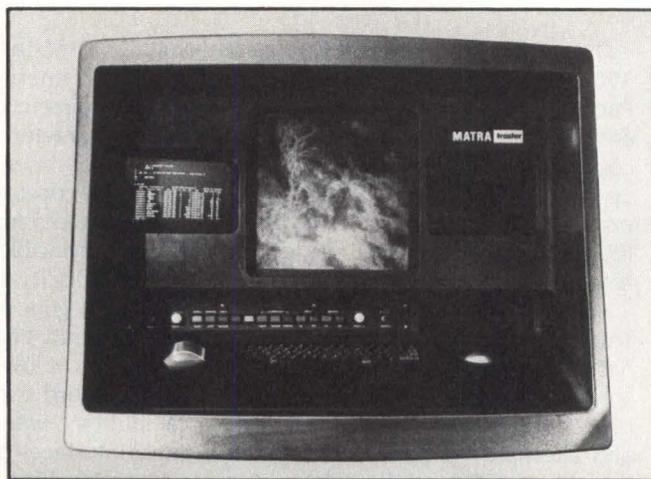
The technique starts by placing a pair of stereo photographs taken by a dual-lens camera on servo-controlled film carriages. Using positional data from high-precision optical encoders, an 8086 CPU and attached 8087 co-processor align the carriages to within one micron.

Images from the two photos are projected through polarizing filters—each of which polarizes perpendicularly to the other—onto the stereo photo display screen. The combined image is viewed through glasses in which the left lens is polarized perpendicularly to the right lens, so that each eye sees only one image. Thus, the image is perceived as 3D.

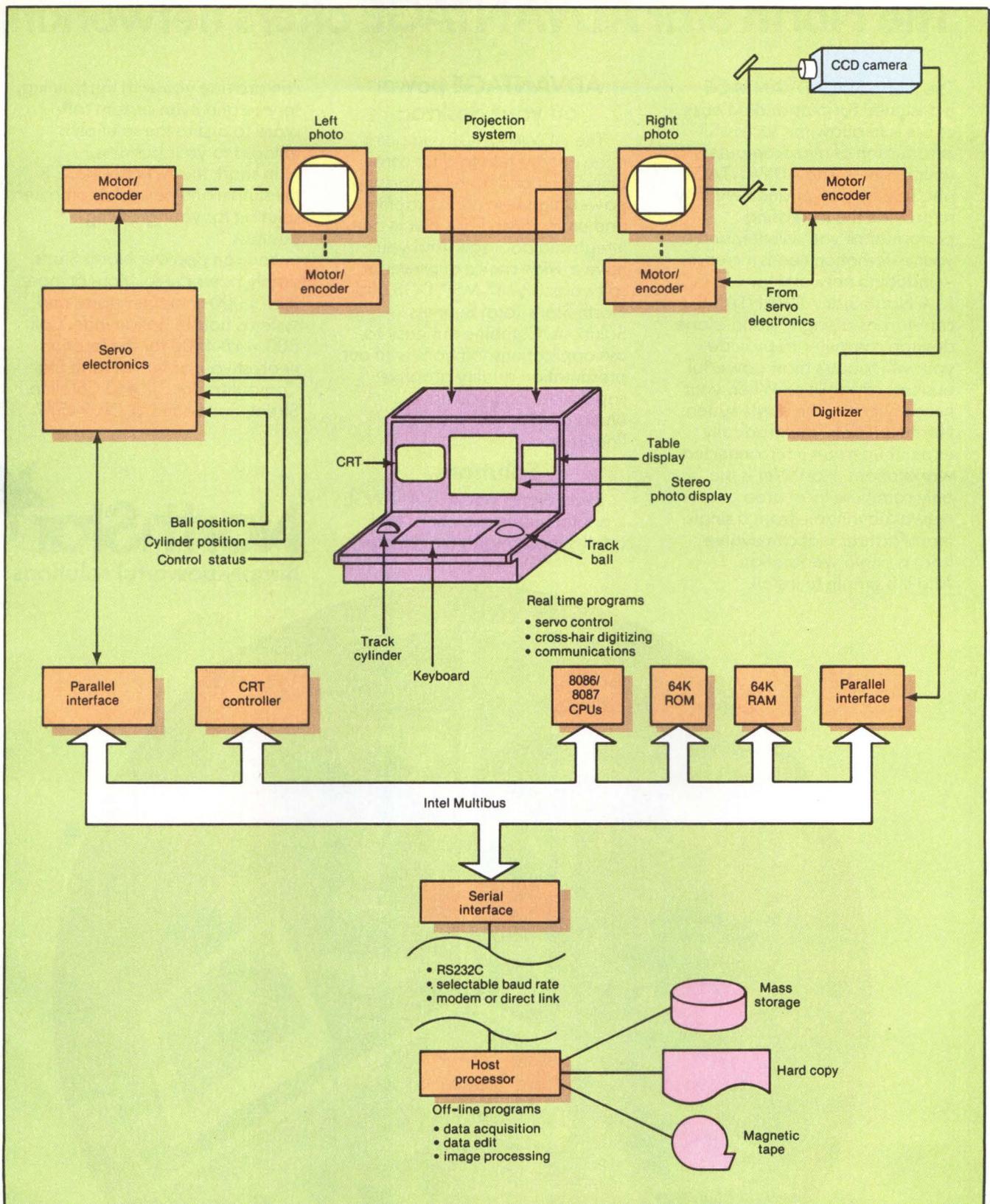
To take 3D measurements, an operator moves a cross hair through the image. A trackball controls the motion of the cross hair parallel to the plane of the screen.

A track cylinder controls apparent motion perpendicular to the screen. As the cylinder is rotated, the cross hair appears to move toward and away from viewer. The operator presses a key to record the point's x, y and z coordinates when a cross hair is aligned with a desired point in the stereo image.

A keyboard and CRT screen on the left of the console are used to communicate with the microprocessor. A TV monitor on the right of the console is connected to a CCD camera focused through a beam splitter on either of the stereo photos. This allows the operator to overlay compiled information directly on an image of the photo.



**Traster 3D measurement terminal** provides three displays—a CRT (left) for data, a stereo display screen (center) for 3D viewing with polarized glasses and a screen for overlaying data on one of the two stereo photographs. Trackball (right) and track cylinder control cross-hair movement on 3D screen.



**Traster system design** consists of 8086-8087-based console, stereo projection system and host interface. Projection system uses an optical encoder to position the photos. Communications, servo positioning and cross-hair position digitizing are microprocessor-controlled.

The console can pass digitized coordinates through a serial interface to a host processor for storage or applications processing, or to a hard-copy device. Results of computations, such as distances between pairs of points and areas enclosed by polygons, can be

passed back through the interface to the CRT screen.

Applications for the system include aerial surveying and mapping, civil engineering and complex structural analysis. The Traster SST terminal sells for \$150,000, with a plotter available for \$25,000. □

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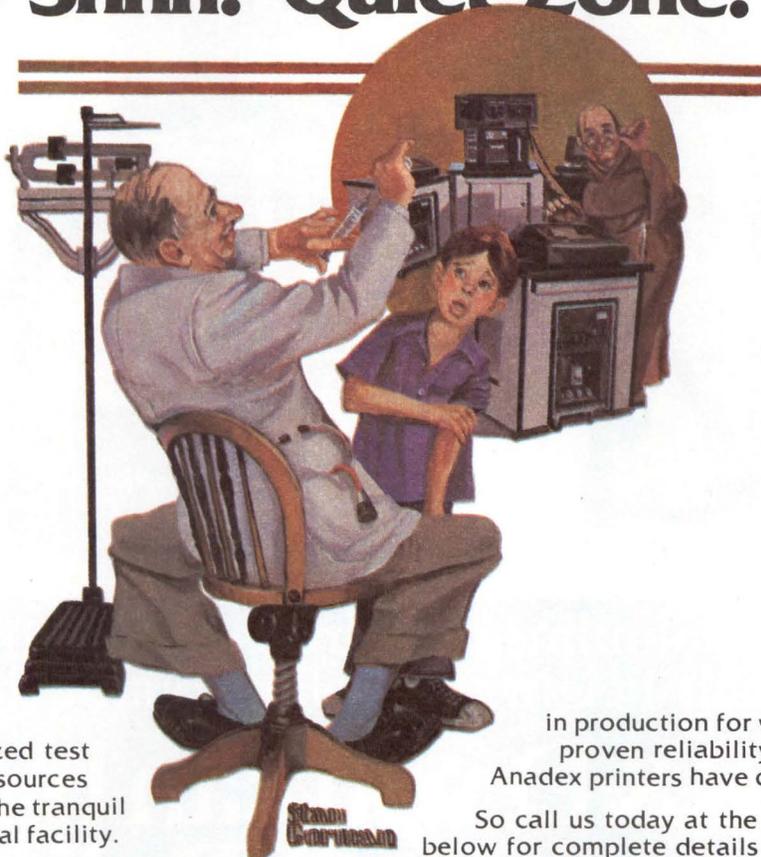
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# Half-height minifloppy stores 3.3M bytes

HERB THOMPSON, Drivetec Inc.

## *Mechanical design innovations ensure high-precision read/write accuracy*

System integrators have greeted half-height minifloppy disk drives with open arms, but until recently, they haven't been able to store more than 1M byte or 2M bytes in these streamlined packages. Drivetec Inc.'s 320 "SuperMinifloppy," however, packs 3.3M bytes into a half-height, 5¼-in. drive that can also operate as a lower capacity industry-standard drive. Even in high-capacity mode, the 320 offers a 500K-bit-per-sec. transfer rate and a 160M-sec. average access time.

The 320's impressive capacity-to-size ratio is largely the result of innovative mechanical engineering. The combination of a high-precision track-following servo system, media-friendly "gumball" heads, vertical media clamping and a patented anti-backlash positioning system allows the drive to read and write high-density, 192-track-per-in. diskettes and standard media. A low-profile DC motor assembly and a reduced electronic parts count allow the drive to fit into the standard half-height minifloppy form factor, and a Shugart-compatible interface lets it use industry-standard controllers.

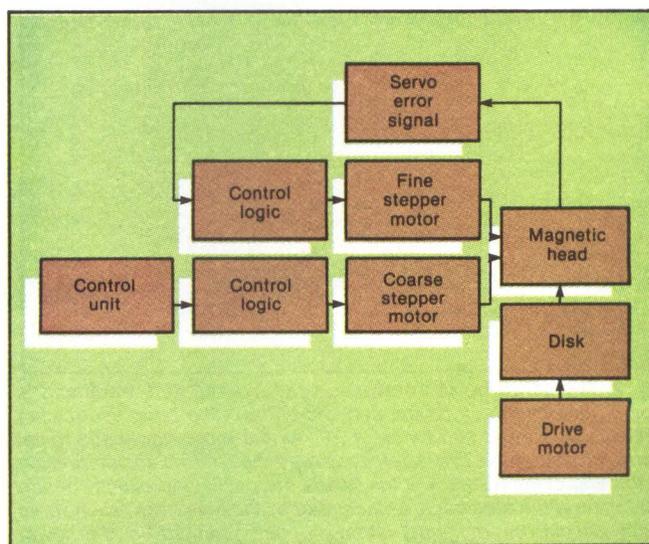
### **Dual-stepper positioning system**

The key to both the accuracy and reliability of the drive is the dual-stepper, track-following servo positioning system (Fig. 1). A coarse-stepper motor and a fine-stepper motor under microprocessor control position the read/write heads. The heads read pre-written servo information from the disk, and the control logic adjusts the stepper motors accordingly. Both motors step in 15-degree increments and a 5:1 lever is used to provide the coarse/fine resolution.

In a track-seek operation, the coarse stepper positions the heads to a track as a result of a command from the control unit. The fine stepper then responds to the servo burst information and positions the head to within 100 µin. of the track centerline. The servo

information is located at the end of each diskette sector (Fig. 2). The servo ID and the servo burst information (2 bytes of FF) are written exactly one-half track off-center from the data track. This means that when the read/write head is following the centerline of the data track, the signal strength of the servo burst on alternate tracks should be equal. If the head is off-center, either too far in or too far out, one of the servo signals will be stronger than the other. In this case, the appropriate fine-step corrections are made. This system ensures track-following accuracy regardless of the changes in the diskette itself due to thermal and humidity variations. It also guarantees diskette interchangeability from one drive to another.

Under worst-case conditions in which the data track

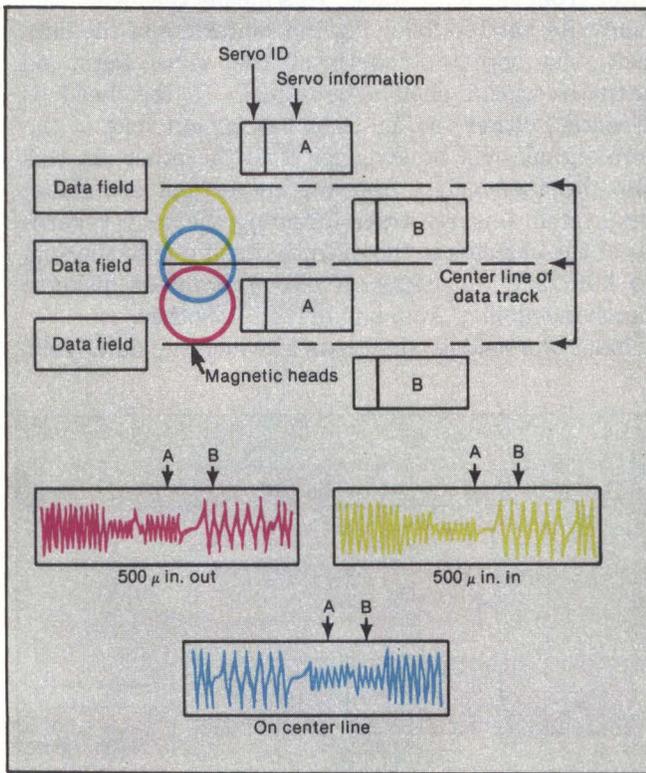


**Fig. 1. The dual-stepper servo-positioning system's microprocessor-based control logic monitors the servo error signal read from the diskette through the read head and controls coarse- and fine-stepper motors that position the read/write heads.**

centerline is not at a constant radius because of thermal, humidity or media-clamping variations, the head approaches the data track centerline at the rate of one step per sector until it crosses the centerline. At that point, it proceeds to track the data line within the 100- $\mu$ in. accuracy of the system (Fig. 3).

The media used in the drive is a standard minifloppy 0.0003-in. substrate, coated with a lubricated, 50- $\mu$ in. magnetic oxide. While the first minifloppy diskettes used 100- $\mu$ in. oxide, many media vendors are now moving to the thinner oxide-coated diskettes in response to the need for higher density. BASF Systems Corp., Brown Disc Manufacturing Inc., Dysan Corp., Maxell Corp. of America, Memorex Corp., 3M Co., Verbatim Corp. and Xidex Corp. produce higher density diskettes.

Unformatted track capacity is 10,416 bytes, and formatted capacity is 7680 bytes, divided into 30 sectors of 256 bytes. Each sector is defined by the pre-written ID field, followed by the user-written data in the data

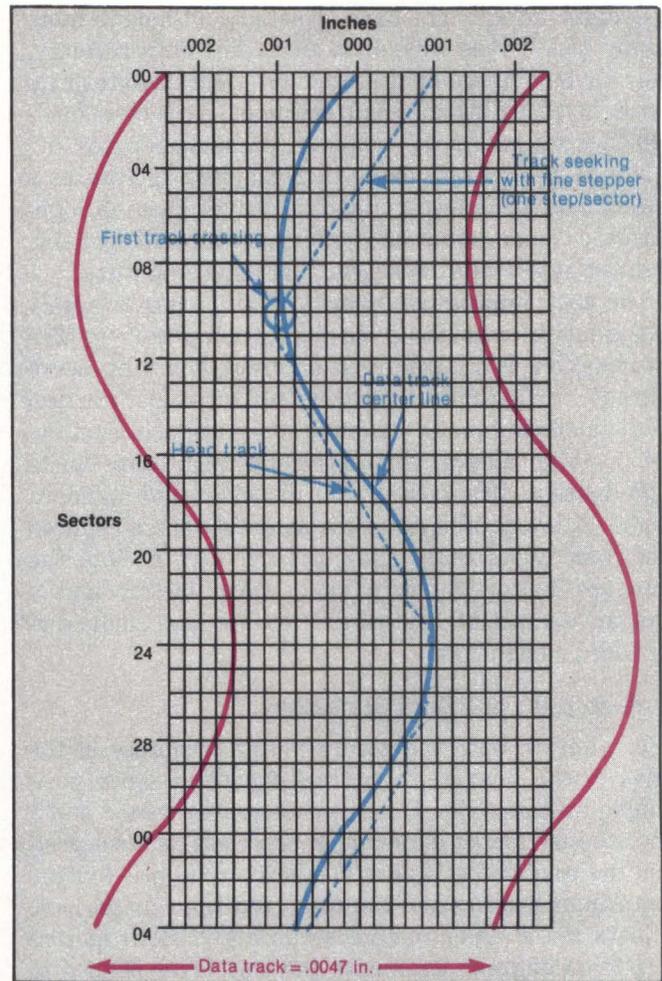


**Fig. 2.** The servo burst information follows the data track and is located one-half track off the centerline (top). The burst information contains an ID and two bytes of FF. As the magnetic heads travel along the data track, they alternately read the servo burst information at the end of each sector. If the heads are positioned exactly on the centerline of the data track, as indicated by the blue head, each servo burst should be of equal strength, as indicated in the lower oscilloscope trace. If the heads are off-center, one or the other signal is stronger, indicating that the heads are too close to or too far from the centerline. The fine-stepper control logic then repositions the heads until the two signals match.

field. There are cyclic redundancy checks for both the ID field and the data field and several gaps for timing and signal synchronization.

**Media/head registration**

Drivetec uses spherical "gumball" heads that capitalize on the elastic properties of the diskette substrate. The two magnetic heads are opposing and identical (Fig. 4). The standard head centerline offset is 0.0833 in. Because of this offset and because each of the heads can be rotated through an angle, the centerline distance between the two spherical heads self-adjusts to match the elasticity of the media. One of the heads is mounted rigidly, and the other is mounted on an arm to allow only enough translation so that the diskette can be inserted. The translating head is loaded with a force that exactly opposes the spring force of the diskette. The heads are then held apart by the reaction force of the diskette. An elliptical zone is formed between each head and the diskette, and the head-to-disk spacing is very small, stable and uniform. In addition, unlike



**Fig. 3.** A worst-case condition is indicated by a solid line (the data track) when it is not at a constant radius from the spindle. The dotted line is the track of the head position. If the head is positioned off the data track centerline (top of the grid), it approaches the data centerline at a rate of one step per sector. When it crosses the centerline, the head proceeds to track it to within 0.0001 in., regardless of how the data track centerline fluctuates.



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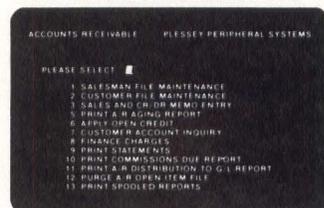
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Total Sales	1,200,000	1,280,000	1,360,000	3,840,000	10,980,000
Cost of Goods Sold	424,000	435,000	446,000	1,305,000	3,850,000
Operating Profit	176,000	185,000	194,000	555,000	1,610,000
Operating Expenses	140,000	145,000	150,000	435,000	1,270,000
Marketing Expense	40,000	42,000	44,000	126,000	350,000
Admin Expense	30,000	31,000	32,000	93,000	260,000
Total Operating Exp.	170,000	177,000	186,000	533,000	1,480,000
Interest Expense	20,000	21,000	22,000	63,000	170,000
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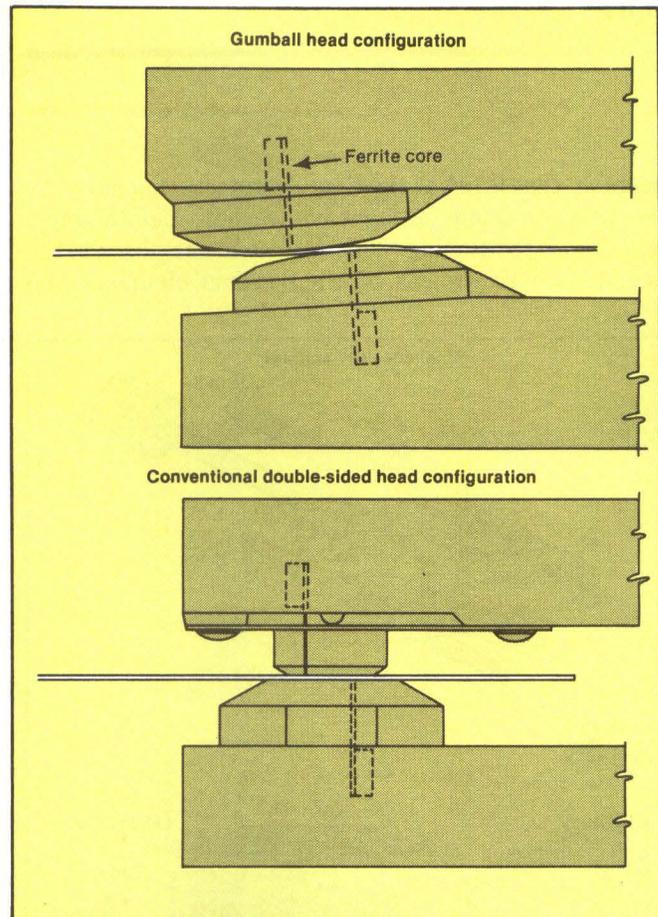


## FLOPPY DISKS

conventional squarish heads, which can rub the media, slowly destroying the surface coating, the rounded gumball heads ease the passage of the media and cause less surface wear.

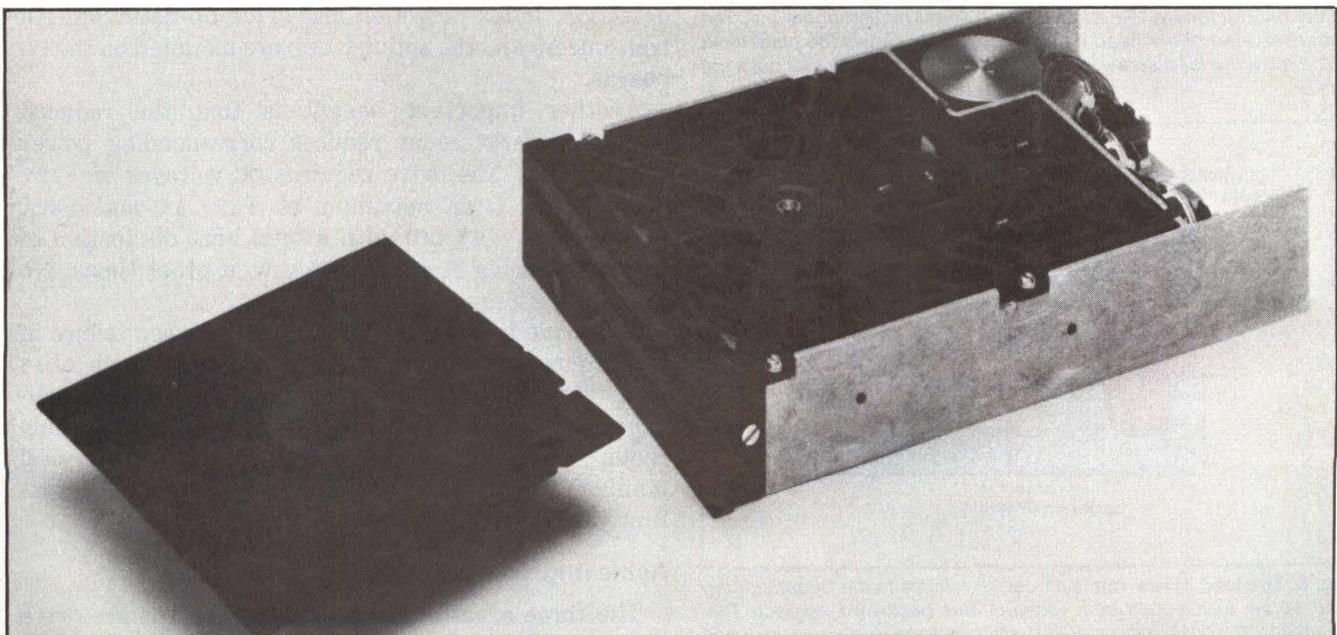
The head carriage assembly has a number of features that provide precise alignment. The head carriage is registered to the guide rod by the spring forces of the load rod (Fig. 5), which effectively holds the carriage in place, eliminating any need for field realignments. Further, an anti-backlash spring attached to the lead screw nut absorbs rotational and linear forces caused by the carriage movement along the lead screw. Thus, possible off-centering caused by movement in any direction is accounted for and corrected by the various spring attachments. The connection between the lead screw and the lead screw nut is also prone to possible mispositioning. As the nut is pushed forward and back, a gap between the two elements can cause a slight positioning error. This is eliminated by canting the lead screw nut at a slight angle relative to the threads in the screw (Fig. 6). When moving forward, the top edges of the screw move the nut forward; in reverse, the bottom edges move the nut backward. Meanwhile, a tight mechanical fit is maintained. This intentional cocking eliminates the tolerances of the connecting assembly and another source of potential positioning error.

The Drivetec 320 employs a modified acme thread to provide vertical clamping of the media (Fig. 7). Previous designs bring the media clamp down onto the media at a slight angle that can sometimes cause the media to be misclamped. In the Drivetec 320, the clamp



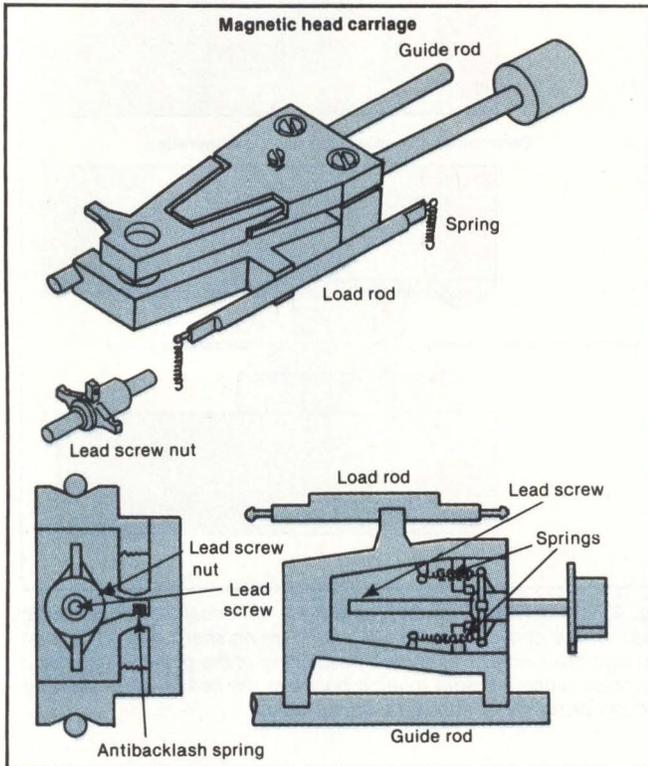
**Fig. 4. The Drivetec gumball heads are spherical to reduce media wear. Unlike conventional heads, there are no sharp edges that can damage the media. The angled positioning of the gumball approach promotes smooth media rotation between the heads while allowing enough proximity to achieve a strong signal.**

is at the same centerline as the spindle. This is accomplished by using a self-centering shaft/bearing

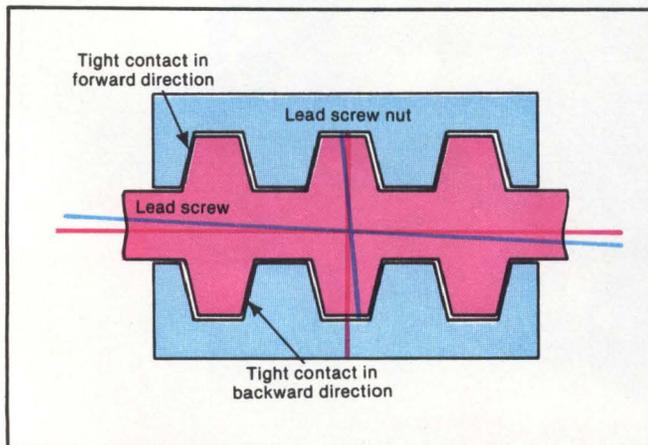


**The Drivetec 320 "SuperMinifloppy" drive offers 3.3M bytes of storage in a half-height, 1.62- × 5.75- × 8.48-in. package. The new drive is priced at \$333 in large OEM quantities.**

assembly that is set at the final manufacturing stage by inserting the clamp onto a wave washer, maintaining a true center positioning. This wave washer absorbs the accumulated tolerances of the various elements and



**Fig. 5.** The head carriage assembly (top) has a spring attached to the load rod to align the assembly into the proper orientation for precise head/media alignment. An anti-backlash spring on the lead screw nut decreases the rotational and linear motion of the nut. The underside view of the head carriage assembly shows the placement of the rods, the lead screw, the nut and the two springs that cock the nut.



**Fig. 6.** The lead screw nut is off-center relative to the threads of the lead screw to maintain both forward and backward contact. This eliminates mispositioning caused by tolerance problems in these parts. The overlapping centerlines show the center position of the lead screw versus the center position of the nut.

assures that spindle/clamp centering is accurate. The tapered clamp grabs the media as it begins to rotate and centers it before clamping it into place. No center ring media reinforcement is necessary.

**Down-sizing techniques**

To pack the drive into the space of a half-height package, Drivetec employs a low-profile DC motor assembly and an integrated electronics design that uses four custom LSI chips and an 8-bit 6805 microprocessor. The motor assembly is a belt-driven, brushless DC motor rated for a five-year life within the defined specifications. Although some half-height drives use direct-drive DC motors, Drivetec finds that this type of motor mounted directly under the read/write heads causes unacceptable EMI radiation. Therefore, a belt-

*An anti-backlash spring absorbs rotational and linear forces caused by the carriage movement along the lead screw.*

driven, brushless motor is used. Belt-and-pulley systems previously had tolerance problems resulting from wear and thermal changes. Recently, however, belt materials that eliminate these problems have been developed.

Reducing the control electronics to a few custom LSI chips and the 6805 microcontroller enables the resulting printed-circuit board to fit into the space of a half-height drive. The electronic circuitry handles track-positioning control, drive motor speed control, read/write circuits, track zero detection, write protect detection, index detection and drive I/O selection. All transducers and the activity LED are mounted on the PC boards.

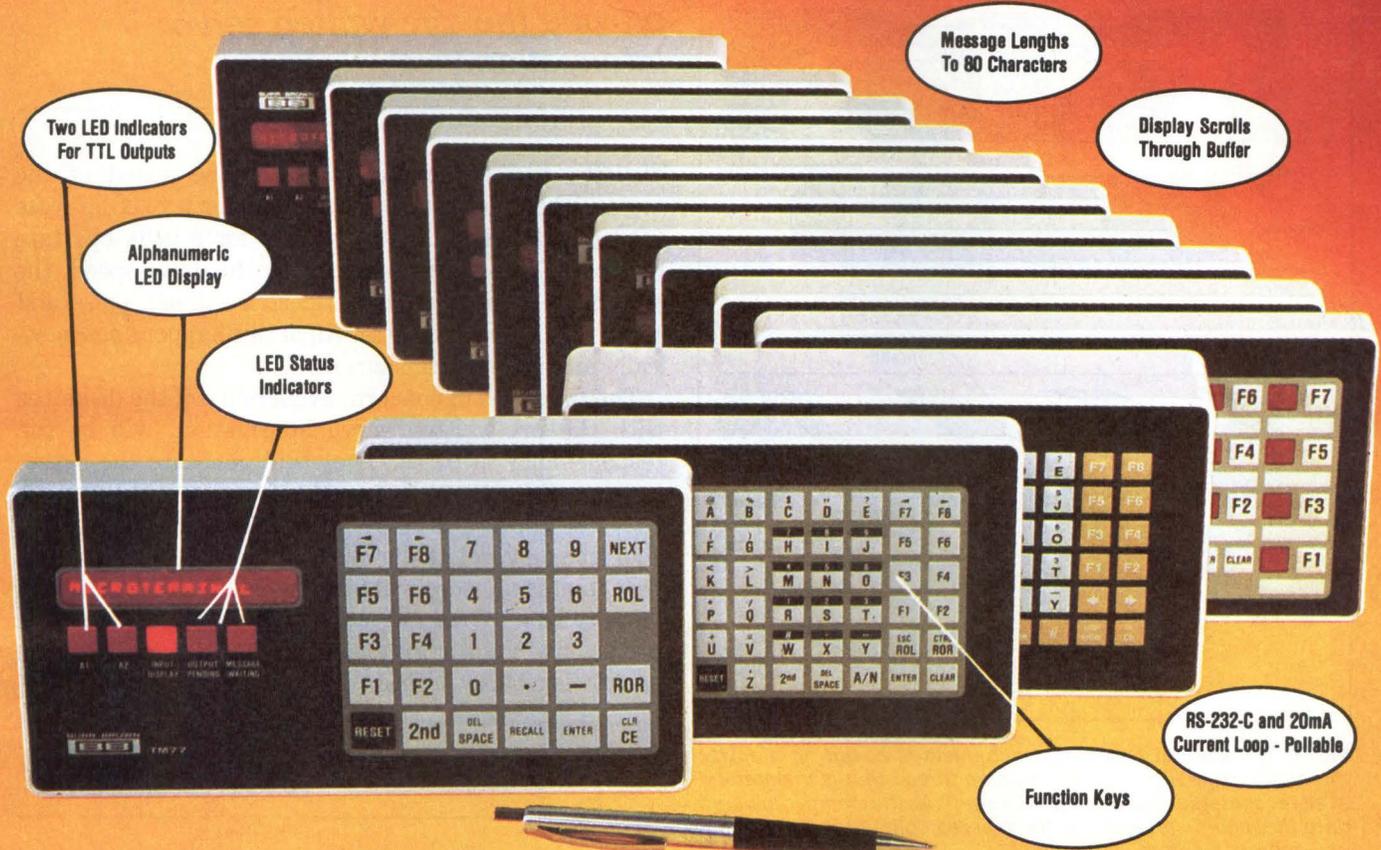
Another important benefit is that the reduced electronic parts count reduces corresponding power consumption. The drive requires DC voltages of +12V and +5V DC (1.2A maximum at +12V DC and 0.42A maximum at +5V DC) with a total heat dissipation of only 20W during stepping and 13W at other times. No AC power is required.

The drive is rated for mean time between failure of 10,000 power-on hours and a mean time to repair of 15 min. The embedded-servo information scheme, self-aligning head carriage and sealed DC motor assembly require no field alignments. By comparison, a typical minifloppy requires six or more alignments during its first year of use.

**Achieving compatibility**

The three areas of compatibility concerns are drive size, electrical interface and media availability. The 320 drive is designed to be exactly one-half the height of a

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TM71-I/O	16	110-19200	320 <sup>(1)</sup>	Alpha	14	TTL I/O	+5VDC
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TM71B	16	110-19200	320 <sup>(1)</sup>	Alpha	16	Bar Code Wand Mag Stripe Reader	+24VAC/ DC
TM71MS			5 x 50 <sup>(2)</sup>				
TM77B	16	110-19200	320 <sup>(1)</sup>	Numeric	16	Mag Stripe Reader	+24VAC/ DC
TM77MS			5 x 50 <sup>(2)</sup>				
TM71M	16	110-9600	320	Alpha	14	Military	+5VDC
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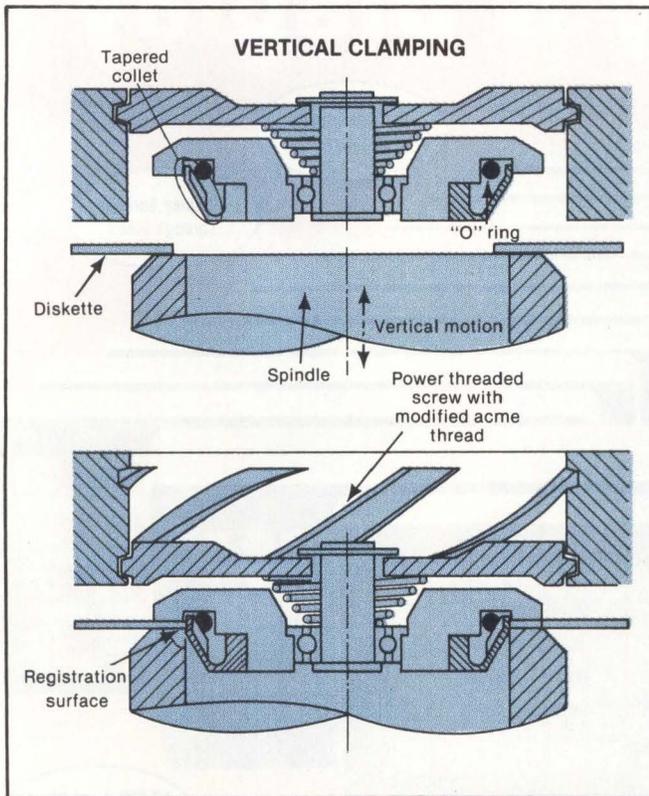


Fig. 7. The vertical clamping mechanism is based on a power threaded screw with a modified acme thread that is maintained at exact centerline over the spindle shaft. As the clamp is lowered onto the media and spindle, the tapered collet grabs the media and centers it before clamping.

standard 5¼-in. minifloppy drive, allowing two 320 drives to be mounted in the space typically occupied by a single standard minifloppy or an ST-506-type 5¼-in. Winchester. The 320 has four mounting holes on the bottom and two on each side. It must be mounted in a position that allows horizontal diskette entry.

The electrical interface is similar to the standard minifloppy drive interface. The IN USE and MOTOR ON signals are not needed because the activity LED is activated from the drive select lines and the DC motor runs continuously. The other significant change is that the DRIVE STATUS line has been changed to a ready signal that indicates that a seek operation is complete and the head is centered on the data track. These changes are easily handled in the microcode of most controllers.

The 320 has a data-transfer rate of 500K bits per sec., a disk rotation speed of 360 rotations per min. and a track density of 192 tpi. A speed adjustment must be made to enable the drive to read conventional 48- or 96-tpi diskettes. The position of the write protect cutout on the diskette jacket was changed to enable the drive to detect when a conventional diskette is inserted. In typical minifloppy diskettes, the cutout is

on the lower left corner. In the 320, the cutout is on the upper right corner. The microprocessor logic of the drive electronics detects the presence of a 48- or 96-tpi

*It is the responsibility of the OEM to provide the pre-written servo information.*

diskette and automatically alters the speed of the motor. The drive rotates at 300 rpm for a 125K-bps rate (48-tpi diskettes) and at 600 rpm for a 250K-bps rate (96-tpi diskettes). After changing the drive speed, the control electronics seek the electrical index pulse and begin reading the diskette. All of this happens automatically and is user transparent.

The final area of concern, availability of the diskettes with the pre-written servo information, will be the responsibility of OEMs. They will generate the servo-written diskettes and provide them to end users. A Drivetec servo-writer system will probably be available from several media manufacturers as well as from Drivetec. End users will be able to obtain the diskettes initially from OEMs and later from general suppliers at prices only slightly greater than those of double-sided, 96-tpi diskettes. □

Herb Thompson is president of Drivetec Inc., San Jose, Calif.

CORRECTION		
The following companies were omitted from our April survey of 32-bit mini-computers.		
Vendor	BTI Computer Systems	Ridge Computers
Product line	BTI 8000	Ridge 32
Line announced	1980	1982
Smallest model	BTI 8000	Ridge 32
Model announced	1980	1982
Packaging	19-in. rack mounted in 6-in. cabinet	34-in. cabinet
Performance		8 MIPS; 1500 single-precision Whetstones (FORTRAN)
Main memory (bytes)	512K-4M	1M-8M
Mass storage (M bytes)	67-254 (formatted)	60-985
Maximum workstations	as many as 200	8: 4 for high resolution graphics, 4 for alpha
Software	demand paging, time sharing, transaction processing, data-base management	demand paging, time sharing, word processing, database management, electronic mail
Networking		LAN
Languages	ANS, COBOL 74, ANS FORTRAN 77, Pascal 8000, BASIC 8000	Pascal, FORTRAN, C, assembly
Purchase price	\$105,000	\$54,500
Comments:	CPU includes 32- or 64-bit integer arithmetic, virtual memory; as many as 8 CPUs can be connected	Designed for CAD, scientific, engineering applications

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

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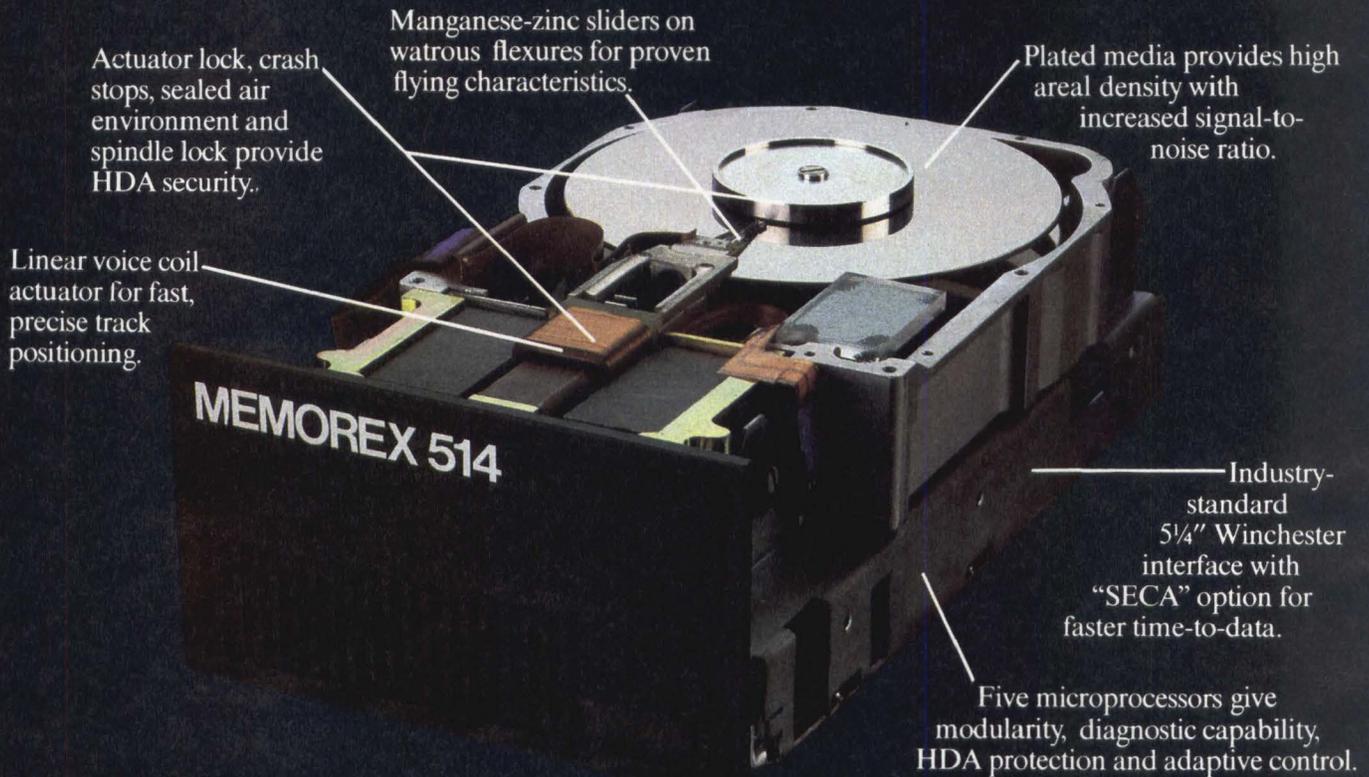
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LAW

# Law: the ultimate high-tech battleground

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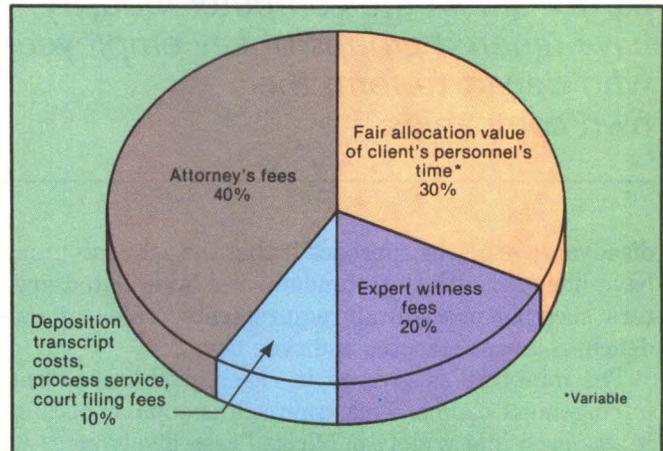
*Complex legal and technical issues are leading to lengthy trials and dubious decisions*

The 1980s have seen a significant increase in lawsuits to protect the intellectual property of high-technology firms. In many cases, these companies are trying to preserve their competitive edge in the face of economic stagnation and threats from spin-off companies. They can claim protection rights based on patents, trade secrets and general laws against "unfair competition." Yet the guarantor of these rights, the legal system, has not proved effective in dealing with most high-technology cases. Neither traditional judges and juries nor recently introduced alternatives such as arbitration, "mini-trials" and court-appointed technical advisors has been able to avoid expense, delay and uninformed decisions.

## Legal challenges to spin-offs

Historically, large corporations, particularly in the computer industry, have ignored groups of key employees who depart to form their own companies; an "unfair competition" lawsuit against a fledgling enterprise was perceived as lending more credibility to the spin-off than the potential legal relief was worth. But recession-hit corporations can no longer afford to ignore the infringements of former employees and so have turned to the courts as a recovery mechanism.

Recent high-technology litigation has illustrated this increased acceptance of legal action. For example, within the last year, Intel Corp. obtained a preliminary injunction against Seeq, a company formed by key technical personnel from Intel. National Semiconductor



**High-technology litigation's costs.** An average high-technology case costs \$650,000 to litigate. While attorney's fees account for the largest share of overall cost, expert witnesses, at \$100 to \$250 per hour, may be the most expensive personnel. The "value" of the client's personnel is the most variable factor in a cost breakdown, since a chief executive officer's litigation time can be worth more than that of a dozen junior engineers.

Corp. has twice sought protection from the courts when groups of former employees gravitated to a new place of business. IBM Corp. sued Bridge Technology before Bridge's alleged "founders" even left IBM, and Atari sued a group of former programmers who created Activision. Several video-game manufacturers and software houses have recently pioneered legal activity, demanding copyright protection for programs that they claim have been substantially copied by competitors. To

these companies, a "dot gobbler" by any other name is still a Pacman.

That more and more companies are invoking legal protection does not mean that the court system is better prepared to deal with technology. Most technology lawsuits stagger to inconclusive results or remain pending. Nevertheless, a number of vehicles have been developed by high-technology litigants to cope with the judicial system's lack of technical sophistication. These include arbitration by a mutually designated expert, the mini-trial and appointment by the court of technical advisors to assist trial judges in wading through the morass of high-technology litigation.

**Arbitration and mini-trials**

A number of recent disputes such as the litigation between National Semiconductor and Zilog Inc. have been turned over to arbitrators. Through this arrangement, the parties avoid committing large amounts of time and money to "educate" the judge and jury. The

*Historically, large corporations, particularly in the computer industry, have ignored groups of key employees who depart to form their own companies.*

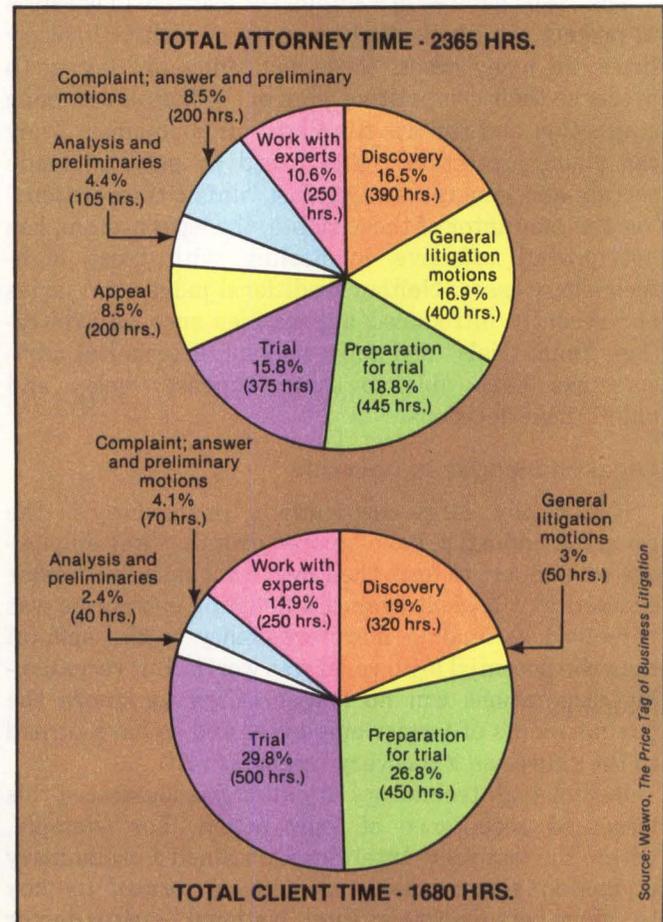
disadvantage of this approach is that the arbitrator may have little sensitivity to fundamental law-related matters such as procedural requirements, rules of evidence, relevant statutes and case law.

The mini-trial is favored in cases involving patent-infringement claims. This approach is popular because it was used in a widely publicized case involving TRW. The mini-trial involves selecting an expert moderator with legal and practical experience to serve as "judge." In the TRW case, a former judge of the Patent Appeals Court was selected. The decision of the judge is not binding on the parties.

What distinguishes the mini-trial from nonbinding arbitration is that key business personnel of the involved parties actively participate. While parties may agree upon different procedural ground rules for mini-trials, in general, there is minimal involvement of counsel. Business personnel present the reasons why litigation is being pursued. The mini-trial is only as good as the cooperation of the participants. Parties could come to the mini-trial without business representatives authorized to make substantive decisions, reducing the exercise to a replication of the pre-trial

Litigation step	Activities involved
1. Analysis and preliminaries	Client-attorney interview; review documents; legal research; inspection of physical items; strategic discussions
2. Complaint/answer and preliminary motions	Drafting preliminary documents; prepare preliminary briefs
3. Work with experts	Educate and prepare impartial experts to testify favorably about evidence that is unavailable to the client's own personnel because of confidentiality orders
4. Discovery	Prepare demands to get proper evidence; present evidence; take depositions
5. General litigation motions	Deal with disputes regarding discovery and procedure; examine the viability of legal theories
6. Preparation for trial	Conduct witness interviews; prepare documentation; issue subpoenas; draft pretrial statements
7. Trial	An average of three weeks, with two lawyers in court daily; prepare for the next day's testimony
8. Appeal	Organize, record and prepare briefs; present oral argument

**Steps in litigation, breakdown of time.** While the courtroom scene is the most public part of the litigation process and involves the largest portion (about 30 percent) of a client's litigation time, the trial is only one of several steps in which counsel must approach the bench. Complex motion procedures require that counsel spend a significant amount of time on pre-trial motions, while the client has a limited involvement.



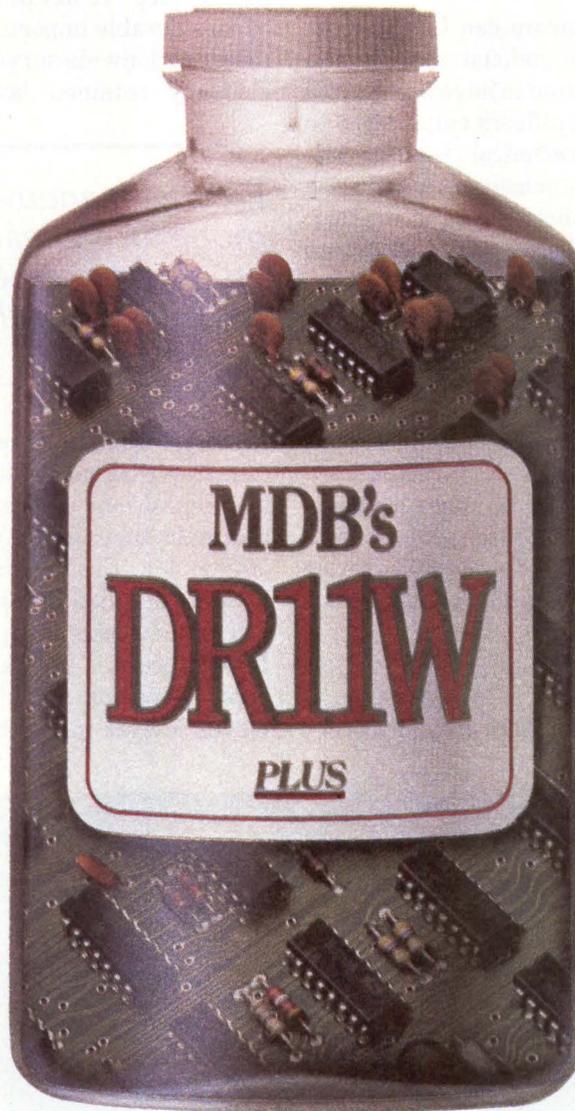
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### Technical advisors

Court-appointed technical advisors can be the most effective interface between the judicial system and technology issues. Some federal courts have designated such experts as temporary court officers empowered to hear evidence and rule on technical issues. The technical-advisor approach is as unbiased as arbitration and is within the context of judicial decision making. The court can direct its technical advisor to investigate the facts and present a written opinion. After submitting a report, the advisor testifies under cross-examination and monitors and assesses the testimony of partisan technical witnesses.

The technical-advisor approach differs from arbitration and mini-trials in that it is selected at the discretion of the court, not the parties. Moreover, the court need not follow the recommendations of its advisor. Many judges do not appoint technical advisors, preferring to go it alone rather than deal with the administrative difficulties of appointing, monitoring and assessing the reports of court-appointed experts.

### Wasting time and money

Large expense and delay are found in virtually every

method of resolving high-technology issues. Pre-trial maneuvering makes lots of money for litigation counsel but does little to decrease the inherent uncertainty of the legal process.

The willingness of some parties to incur vast expense was demonstrated by the IBM litigation against Greyhound Corp. To define the "relevant market" (a matter of considerable importance in antitrust litigations), IBM took a nationwide survey of the computer industry. The company retained lawyers in each section of the

---

*Pre-trial maneuvering makes lots of money for litigation counsel but does little to decrease the inherent uncertainty of the legal process.*

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country, issued subpoenas to virtually every U.S. company that made data-processing devices and took live depositions of principals of all these companies to ascertain their activity in the computer market. The outlay for this exercise exceeded the cumulative budgets of a half dozen small states.

The inevitable companion of expense is delay. The legal process is painfully slow in comparison with the rapid development of sophisticated technologies. A clever lawyer in the high-technology arena has more

## RECENT SIGNIFICANT HIGH-TECHNOLOGY CASES

- **Microcomputer Systems Corp. versus Data Technology:** Data Technology, a spin-off of Microcomputer Systems Corp. (now called Xelsec), was found to have misappropriated the architecture for the Microcomputer Systems disk-controller design. Microcomputer Systems was awarded a preliminary judgment of \$1.4 million to \$2 million. The case was settled as a final judgment was about to be entered.

- **IBM Corp. versus Hitachi America Ltd.:** This trade-secrets civil suit arose from "Computerscam." IBM's case was set back when one of its principal law firms was disqualified because of a conflict of interest. This case demonstrates that major corporations are no longer nonchalant about trade-secret violations.

- **State of California versus Magnuson:** The District Attorney of Santa Clara, Calif., issued a criminal complaint against Paul H. Magnuson, co-founder of Magnuson Computer Systems. After leaving Magnuson

Computer Systems to found Prodigy Corp., Magnuson allegedly offered financial inducement to other Magnuson Computer Systems employees to join Prodigy and to bring sensitive information about the older company. This case shows the public prosecutor's interest in trade-secret violations.

- **Fairchild versus Data General Corp.:** Fairchild is appealing the court's reversal of a favorable jury verdict. The jury ruled that DG violated the federal antitrust laws by "tying" its operating systems to the purchase of its computers. The federal judge reversed the decision by issuing a "judgment-notwithstanding verdict," a legal way of imposing his opinion that the jury could not possibly have reached the proper conclusion.

- **Tandy Corp. versus Personal Computer Systems:** This case extended copyright protection to programs recorded in a PROM, rather than limiting protection to printed software listings. This case set a

precedent.

- **The Bally-Midway and Warner Communications "Pacman" litigations:** Bally-Midway obtained sealed orders for federal marshals to seize alleged counterfeit "dot-eater" games. The alleged counterfeiters were not informed that Bally-Midway sought these seizure orders, so that the evidence would not be destroyed. These cases have broadened the copyright protections, ruling that, although the copyright itself might specify only a few visual displays in a video game, it covered all of the possible ways in which the game could be made playable.

- **Intersil Inc. mask litigation:** Intersil has claimed that the 1979 copyright law extends protection beyond the traditional integrated-circuit design as written on paper and that the laws protect the design as it is embodied in the mask from which the circuit is made. A favorable decision in this vanguard case could significantly expand the copyright's domain.



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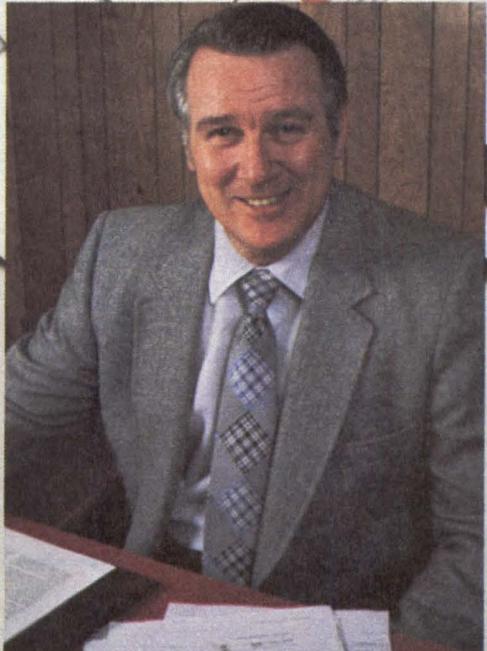
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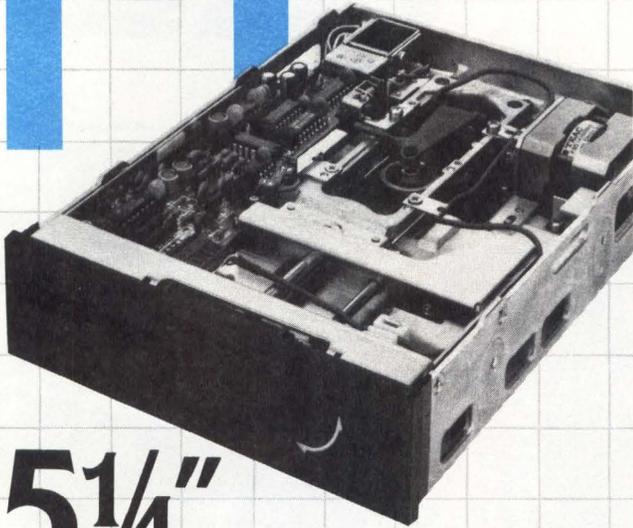
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## LAW

opportunities to slow litigation than he would in any other commercial dispute.

The confidentiality protective order is the principal delay mechanism used in high-technology litigation. In theory, this order prevents a party from accessing the sensitive business information of its adversaries. The order clashes, however, with the constitutional right of a party to confront the evidence introduced against it. The classifying of documents can force a party into employing the "Seeing Eye dog" approach to litigation. In such a situation, counsel must retain independent experts (the Seeing Eye dogs). These experts are educated in the relevant technology and business considerations, and must sift through mounds of documentation that could be examined much more expeditiously by the parties' own engineers. At least one of the camps involved in the dispute, desires the resultant slowdown, and it is generally the party that would lose if there were a speedy and focused resolution of the technical issues.

An example of the effect of delay is Digital Equipment Corp.'s litigation against Computer Operations involving DECTAPE. Computer Operations accused DEC of committing fraud in connection with applying for and obtaining a patent on a tape-memory technology. After conducting hearings, the U.S. Patent Office concluded that DEC had suppressed information that would have precluded the viability of its patent application. To

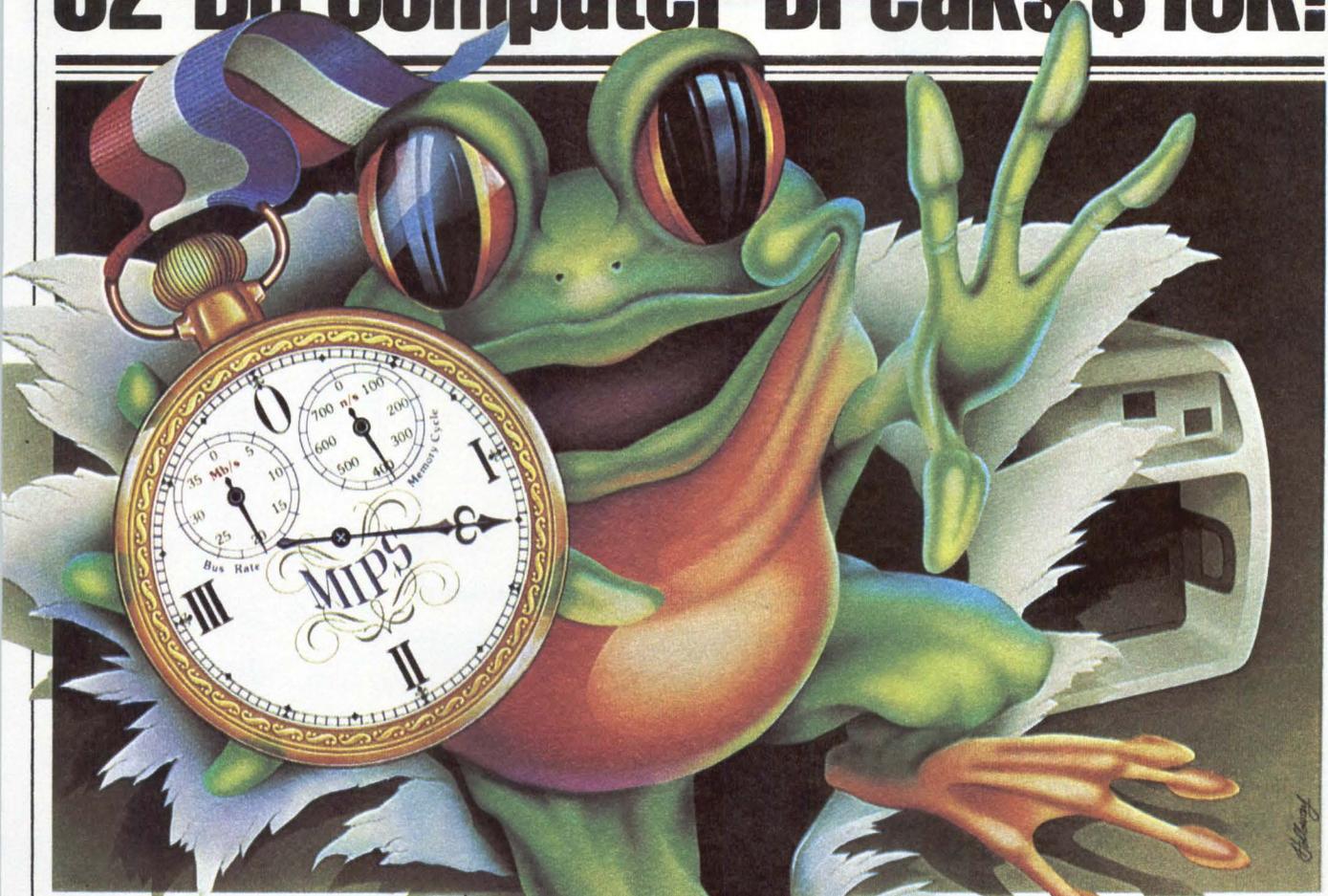
*The mini-trial is favored in cases involving patent-infringement claims.*

obtain compensation for these grievances, however, Computer Operations was forced to commence an antitrust lawsuit. It simultaneously had to appeal the Patent Office's determination through the federal courts. According to the federal court of appeals that ruled on this matter, the Patent Office had committed a number of procedural violations that invalidated its determination. The case was remanded to the Patent Office for further proceedings. But, by then, the parties had moved to other endeavors, and the invocation of the legal process had become irrelevant. □

**David J. Goss** is a lawyer who specializes in high technology counseling and heads litigation activities of the Rubin, Eagan and Feder law offices in San Francisco.

★ ★ ★ E X T R A ★ ★

# 32-Bit Computer Breaks \$10K!

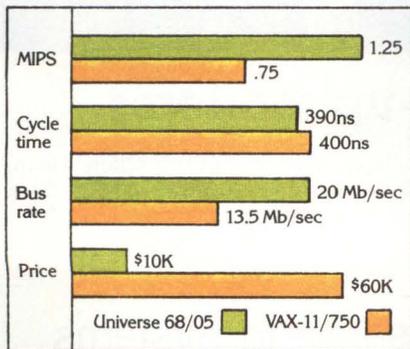


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performance versus that of 32-bit "superminis" several times more expensive, like the VAX-11/750.

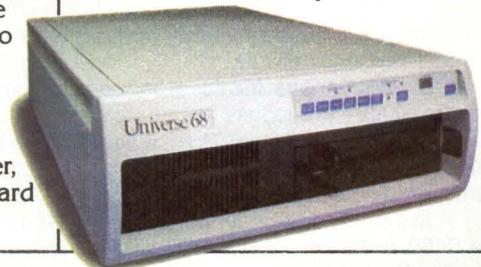
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The key to that performance is a 4Kb cache that eliminates processor wait-states and takes full advantage of a 12.5MHz 68000 processor. Also included are a separate 68000 I/O processor, four serial I/O ports (expandable to 64), 256Kb RAM (expandable to 3Mb), 20Mb/sec, 32-bit VERSAbus, 10Mb Winchester, 1.25Mb floppy disk, and 5-slot card cage. All in a 7-inch enclosure.

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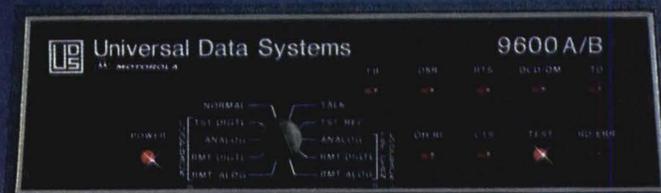
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# Cellular radio gives rise to portable data communications

DAVID H. FREEDMAN, Associate Editor

*New radio technologies promise to put computers on-line in cars and briefcases*

The market for portable computer equipment is growing almost as quickly as machines are shrinking. Executives, salesmen, service technicians and others can be seen in airports and on highways with angular plastic briefcases containing printers, keyboards and even entire systems. Many applications involving such equipment depend on remote communications via telephone. But telephones are often the most difficult to find when they are most needed by field personnel: in cars and vans, at outdoor sites or in a client's busy office. In addition, on-the-road data communications is often a one-way street, as a home office must wait for a traveling computer user to phone in before downloading data.

These problems may be solved by a new mobile-phone scheme that is expected to put telephones under the dashboards—and perhaps in the briefcases, tool boxes and even pockets—of millions of people who work away from their desks. This scheme, called cellular radio, as well as other developments in radio communications, should add new momentum to the portable computer-equipment market.

## Cellular radio takes over

Mobile phone service in the U.S. has been based on radio communications between weak car-based transceivers and powerful base transceivers connected to telephone land lines. Connections to the land lines are automatic, so calling to or from a mobile phone is no

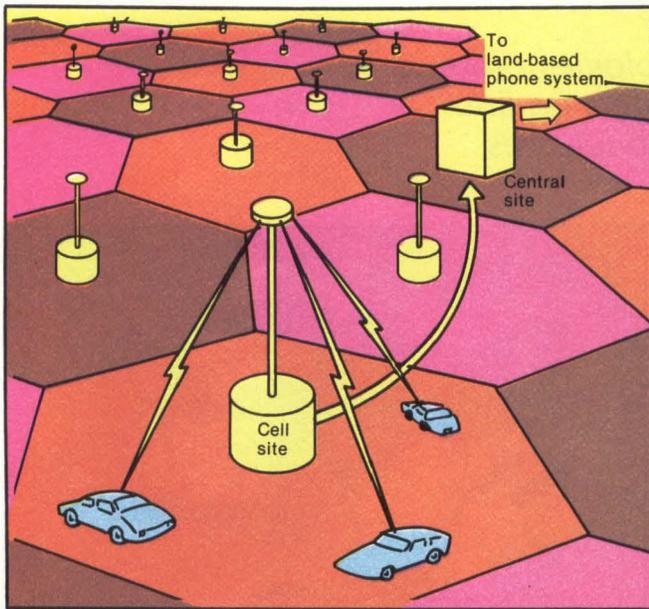


Mobile phone unit from Oki includes a handset, usually mounted within reach of a driver, and a box mounted in the trunk handling transceiver and control functions. Most mobile units are used with two antennas for optimum reception.

different from using a desk phone. The major problem with the current mobile service lies with the Federal Communications Commission's allocation of channels: only 23 duplex channels are available for use with this type of service, of which only 12 can be used within a given area. Thus, even in major metropolitan areas, only 12—and sometimes fewer—conversations can be supported simultaneously. Base transceivers can carry conversations of acceptable quality for only 25 miles,

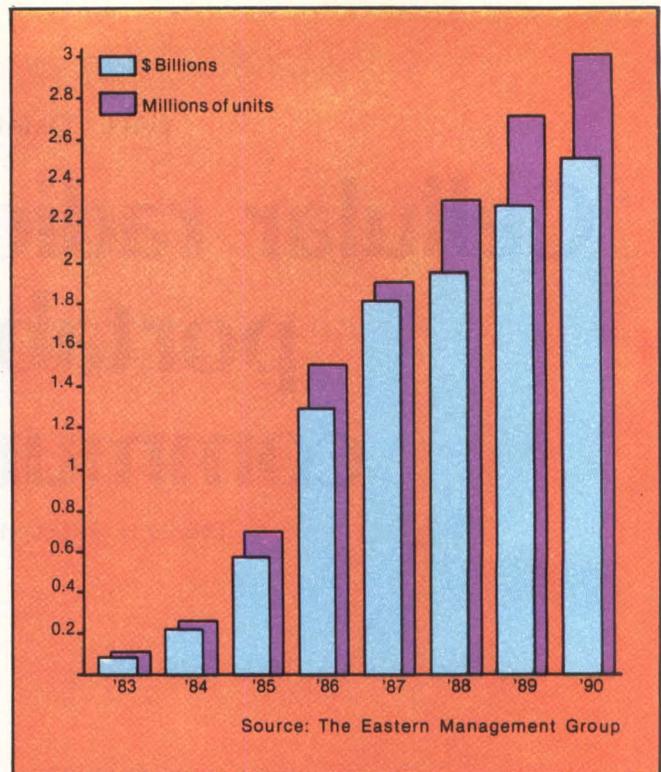
and channels cannot be reused within a 100-mile radius without risking interference, even further stretching limited channel resources. As a result, the demand for mobile phone service grossly exceeds its availability.

To limit channel clogging, telephone companies have offered mobile service to only a small percentage of those people requesting it. The Eastern Management Group, a consulting firm in Morris Plains, N.J., is preparing a market study on cellular radio. EMG president John Malone estimates that 100,000 people in New York alone are on mobile-phone waiting lists. "Their grandchildren wouldn't get phones under the current system," says Malone. "It's worse than waiting for Giants tickets." But even the small number of customers who do get mobile phones are not assured of adequate service. Finding an open channel in urban areas can range from difficult to impossible in the early morning and late afternoon.



**Fig. 1. Cellular radio scheme** divides an area into cells, each with its own transceiver. A mobile unit in a given cell communicates with the transceiver in that cell, which relays the transmission through a dedicated land line to a central site. The central site connects the cellular system with the land-based phone system. When a mobile unit passes into a new cell, the call is "handed off" from the transceiver in the old cell to that in the new cell. Because cell transceivers broadcast within the boundaries of the cell, channels can be shared by several nonadjacent cells without interference.

The FCC seized on cellular radio in the early 1970s as a solution to the mobile-channel availability problem. Under cellular radio schemes, a geographic area is divided into smaller areas, or cells. Each cell has its own base transceiver (or set of transceivers) and communicates only to those mobile phones within the cell (Fig. 1). The signals are weak enough so interference need be

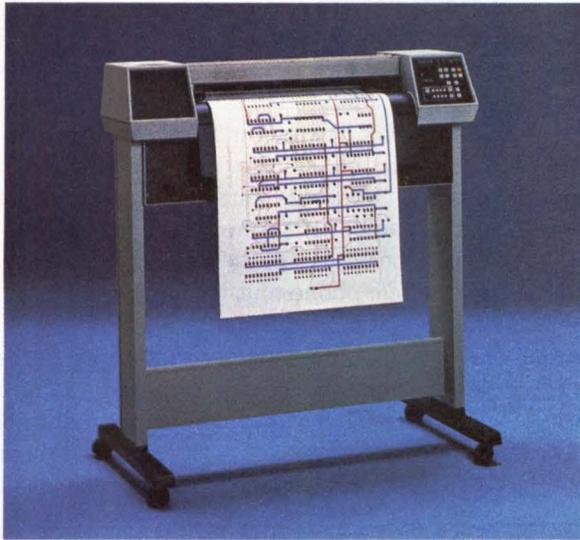


**Fig. 2. Predicted revenues and unit sales in cellular radio** should climb into the billions of dollars and millions of units over the next seven years.

considered only in nearby cells. Thus, several cells within an area can use the same channel simultaneously, as long as no proximate cells use the same channel. When an active mobile phone moves from one cell to an adjacent cell, the call is transferred to a new channel under control of the new cell, with no perceptible disruption in service. Because channels can be shared by several cells within the area, a cellular radio mobile phone system can provide service to many more callers than can a conventional system using the same number of channels. In addition, the number of serviceable mobile users can be increased by redividing an area into smaller cells, without increasing the number of channels. "In one fell swoop," says Malone, "all the applicants on waiting lists will be offered service."

The FCC is currently examining applications from wire-line and non-wire-line carriers for licenses to provide cellular mobile phone service in 30 large U.S. cities. The Bell System's Advanced Mobile Phone Service will typically receive one of the two licenses that will be granted in each city. With mobile phone service revenues expected to exceed \$2 billion by 1988 (Fig. 2), competition is fierce for the remaining licenses. Cellular mobile phone services have been implemented on a trial basis in Chicago with AMPS and in the Baltimore-Washington area with American Radio Telephone Service using Motorola's cellular system. Both experiments are working, and many major cities can expect to have cellular mobile phone service within two years.

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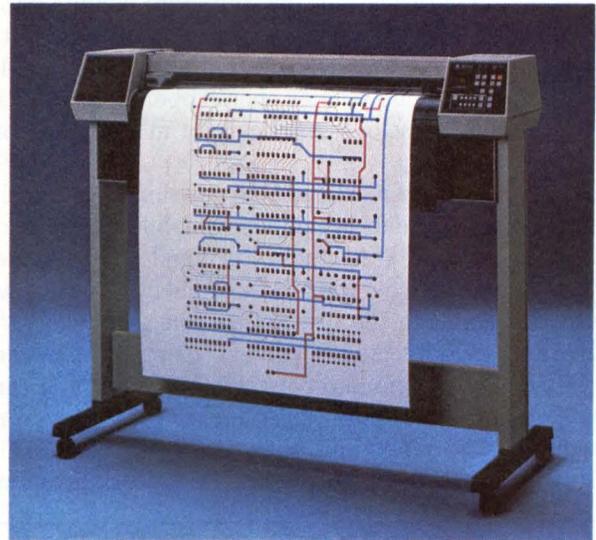
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**Computer applications**

The major application for the new mobile-phone service will be voice communication, just as it is for the regular land-based phone system. But the sudden availability of mobile phones should open opportunities in data communications, particularly in portable computer equipment.

Mobile phones will allow field personnel to receive and transmit data over a car-based mobile phone linked via a modem to a portable terminal or computer. Salespeople with changing lists of clients to visit will probably be among the first to use this technology. "A real estate agent could receive a printout of names, addresses and phone numbers while driving in a car," says Peter Erb, president of Millicom Inc., New York, which offers a mobile unit with an RS232C port.

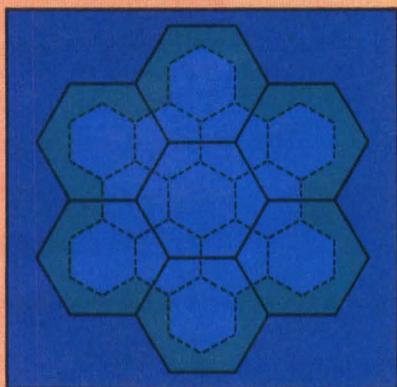
In addition to field sales, mobile phone data commu-

nications should prove useful for on-the-road executives keeping up with developments at their offices and with related markets, and for hospital-based medical personnel who must monitor ambulance patients over a wide area. Taxi companies are also considered prime targets by many mobile phone vendors, and many fleet operators are considering installing meter systems based on a central computer to calculate fares and route drives. But Douglas Turner, general manager of the People's Cab Co., Pittsburgh, points out that his company already operates such a system reliably without cellular radio. "It's a new technology, and I'll be taking a good look at it," says Turner, "but the \$1500 to \$2500 for a mobile phone unit is ludicrous next to the \$350 to \$800 for a standard radio."

As mobile phone equipment becomes more portable than the bulky units currently required, additional markets will arise. "There are many applications above and beyond the automobile," says the Eastern Management Group's Malone. "Service people who used to

**HOW CELLULAR RADIO WORKS**

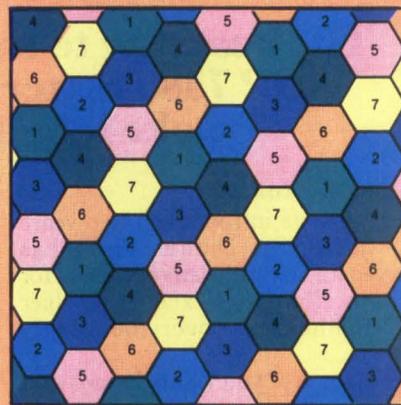
Despite the sudden attention recently accorded cellular radio, it is not a new concept. Bell Laboratories scientist D.H. Ring first proposed a cellular scheme in 1947 as an alternative to increasingly overworked conventional mobile radio systems. Although recognized as good, the idea languished for want of cost-effective switching technology fast enough to "hand off" a moving car from one cell to another. Since the technology became available in the late 1960s, the FCC has been wrestling with licensing and frequency-allocation schemes.



**Cell splitting** involves reconfiguring an area into smaller hexagons, usually one-half the width of the original. Each cell then covers one-quarter the area, but can handle the same number of mobile units, so that the entire system can then support four times as many units. Most systems start with 8-mile-wide cells, supporting as many as three splits for resultant 1-mile-wide cells. Such a system could service millions of units.

The basic elements of a cellular system are a mobile transceiver, a cell transceiver and a central control site. The mobile and cell transceivers communicate via radio, while the central control site is linked to each cell site through land lines to oversee mobile-unit location, channel selection and hand-offs. The central control site also links the cellular system and the land-based telephone system. The FCC has allocated 40 MHz (825 to 845 MHz and 870 to 890 MHz) of the radio spectrum to cellular radio, with 20 MHz going to each of the two systems in an area. Channel spacing is 30 KHz, leaving any one cellular system with as many as 666 channels.

An active mobile unit constantly monitors a 20,000-baud data channel used by each cell to transmit control information; the mobile unit chooses the channel of the cell transmitting the strongest signal, switching to another cell if the first signal fades. When a call for the mobile unit is received by the central site, all cells transmit the unit's name over the data channel. The mobile unit recognizes its name and sends an acknowledgement to the cell site, which then receives a voice channel assignment from the central site. Channels are assigned on a random basis from the pool of 666, with one restriction: a channel is not assigned if it is being used at that moment by a cell within interfering distance, typically about three cell-widths. The mobile unit is instructed to tune to the chosen frequency, and a user is alerted—that is, the phone

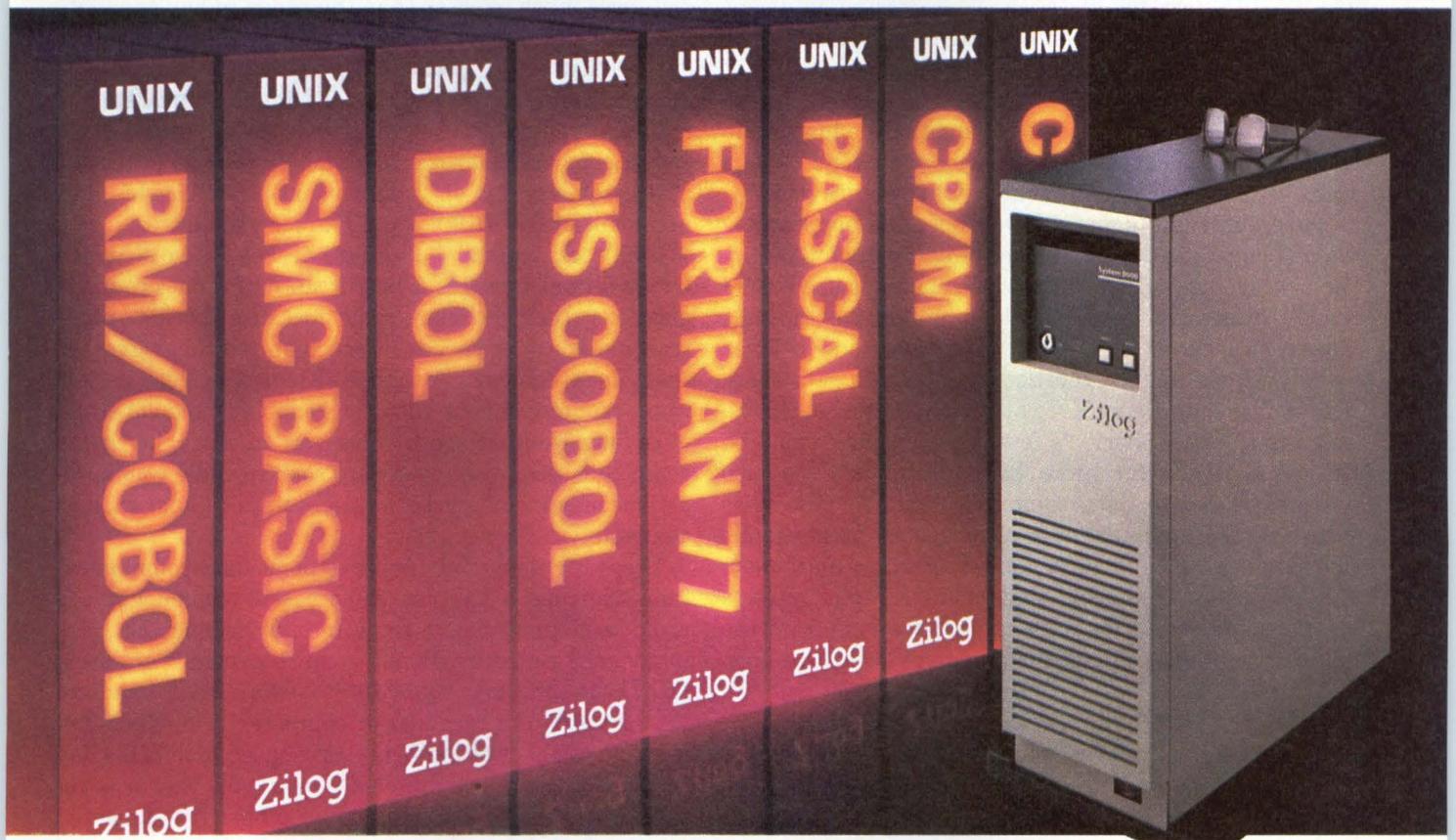


**A frequency-reuse pattern** shows how several cells separated by a sufficient distance can simultaneously use the same channel without interference. The number assigned to each cell represents a frequency; cells with the same number could use the same channel at the same time. Frequency reuse is not bound to a pattern or assignment; in practice, a cell would have as many as 666 channels to choose from, each of which can be shared by non-neighboring cells.

rings (some mobile phones allow the user to enable a horn alert when leaving a car).

While the phone is being used, the mobile unit monitors the signal strength. If the signal is fading, usually because the car is leaving the cell, the mobile unit determines which new cell has the strongest signal and alerts the central site through the data channel. A new channel is selected in the new cell, and the call is transferred, or handed off, to the new cell and channel without interrupting the call. Calls made from the mobile unit are handled in similar fashion.

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carry pagers will soon carry small dot-matrix printers on their belts."

Many computer users will use mobile phones with equipment that remains in their homes or offices, as well as with portable units, to avoid missing data sent to wrong locations. Anyone wishing to contact a mobile phone user would simply dial his number, regardless of where the unit might be located at that moment—as long as it was within range of a compatible cellular radio system. "The great advantage to mobile phones," says Erb, "is that your phone number travels with you."

Some observers point out that data communications via mobile phone will be at least temporarily limited by the narrow bandwidth of the voice channels used. Saul Sherr, director of market planning for North Hills Electronics, Glen Cove, N.Y., thinks that some cellular radio systems might eventually implement data channels similar to those used for system operations. "In the meantime," says Sherr, "a few voice channels could be thrown together for more bandwidth." Malone also downplays mobile data communications for the near future, estimating that less than 5 percent of mobile phone use will be for data communications until 1990. But Millicom's Erb feels that cellular radio systems should be designed for data communications from the outset. "It will be difficult to implement later," he says.

### Other radio schemes

While cellular radio is one of the most visible new communications schemes, other technologies also offer opportunities to link radio with data transmission. Two such approaches are packet-switching radio for completely portable networks and radio modems for simple point-to-point communications.

Packet switching radio differs from cellular radio in two important ways: packet-switching radio does not require fixed cellular areas with base transceivers connected to land-line systems, and packet-switching radio uses wide-band bursts of digital data, in contrast

to cellular radio's narrow-bandwidth analog transmissions.

Each mobile unit in a packet-switching radio network can act as a repeater, receiving transmissions and rebroadcasting them if it does not recognize its own name code as the intended receiver. Thus, a given message can be transmitted and retransmitted over distances much greater than the range of any one unit. Because a packet-switching radio network does not depend on fixed transceiver stations, major uses include military and public safety applications. "Packet radio is well-suited for rural, hostile environments," says Leonard Kleinrock, a computer science professor at the University of California at Los Angeles and president of the Technology Transfer Institute.

Kleinrock points out that packet radio's wider bandwidth also makes it better suited for data communications than cellular radio because packet radio transmits data at speeds as much as 100 times greater than does cellular. Although Kleinrock feels packet radio cannot compete with the reliability and coverage of cellular radio's fixed transceivers in cities, he claims companies that want to switch soon to radio communications may install packet systems until cellular radio is available.

Users requiring only point-to-point data communications can use a simpler radio-based technology: the radio modem. Gandalf Data Inc., Wheeling, Ill., has introduced the RadioModem, which provides an interface between any VHF/UHF two-way radio and an RS232C port of a terminal or computer. The RadioModem, an offshoot of the firm's taxi-based mobile display terminal system, communicates synchronously or asynchronously at rates as high as 3600 bps. It is targeted for remote mining, forestry and oil exploration.

Cellular, packet and point-to-point radio schemes have not yet been widely implemented for data communications. But the increasing demand for computer access in virtually every application and environment should ensure the radio schemes' popularity, which is fueling and being fueled by the market for specialized portable terminals. □

### WHO'S WHO IN CELLULAR RADIO

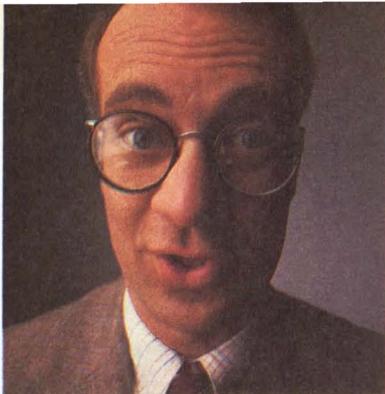
The enormous revenues predicted for cellular radio have attracted a host of contenders for licenses to operate cellular systems and for potentially lucrative equipment contracts.

Bell's Advanced Mobile Phone Service can hardly avoid becoming a leader in cellular radio, given the FCC decision that effectively allots it one license in almost every major city. Most of AMPS's equipment will probably come from Western Electric Corp. and will establish the company as a major mobile-phone equipment supplier.

Some companies vying for licenses are relatively old hands at cellular radio, by virtue of the fact that they operate systems in other countries. NEC Information Systems Inc. had provided cellular radio service to Japan since 1977 and currently services more than 17,000 mobile units there; additional systems are operating or are being implemented in Australia, Mexico City and Hong Kong. Millicom Inc. holds a cellular license in the U.K. in conjunction with Racal Electronics, and is expected to play an active role in U.S. systems as

well. Other companies hoping to get into cellular radio include Time Inc., Metromedia and General Electric Co.

A number of companies hope to grab a share of cellular radio's profits through equipment sales to licensees, or even to users. These include Motorola Inc. (said to have spent four times the \$2.5 million it received from the American Radio Telephone Service in the Washington-Baltimore trial system), Oki, E.F. Johnson, Harris Corp. and Fujitsu America Inc.



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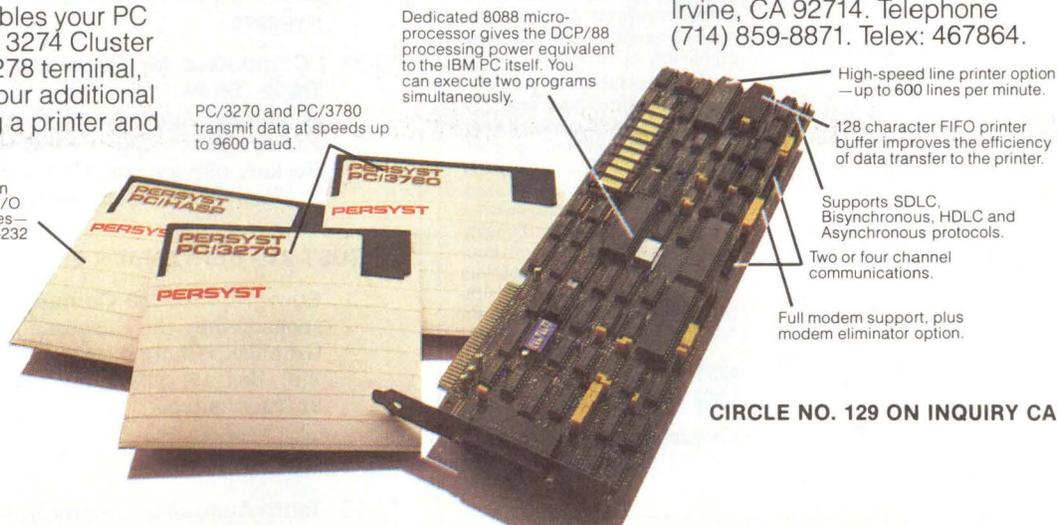
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CIRCLE NO. 131 ON INQUIRY CARD

## Calendar

### JULY

- 25-29 SIGGRAPH '83, 10th Annual Conference on Computer Graphics and Interactive Techniques**, Detroit, sponsored by the Association for Computing Machinery's Special Interest Group on Computer Graphics. Contact: SIGGRAPH '83 Conference Office, 111 E. Wacker Dr., Chicago, Ill. 60601, (312) 644-6610.
- 25-29 "Fundamentals of Control" Course**, Calgary, Canada, sponsored by The Foxboro Co. Contact: Registrar, Educational Services, The Foxboro Co., Foxboro, Mass. 02035, (617) 543-8750. Also to be held Aug. 1-5, and Nov. 14-18, Foxboro, Mass., Oct. 17-21, Toronto, Canada, Nov. 28- Dec. 2 Calgary, Canada.

### AUGUST

- 1-5 "Introduction to Process Computers" Course**, Foxboro, Mass., sponsored by The Foxboro Co. Contact: Registrar, Educational Services, The Foxboro Co., Foxboro, Mass. 02035, (617) 543-8750. Also to be held Aug. 15-19, Calgary, Canada and Oct. 24-28, Houston.
- 6-10 International Federation of Operational Research Societies Triennial Meeting**, Washington, D.C., hosted by the Operations Research Society of America. Contact: Richard M. Soland, George Washington University, Washington, D.C. 20052, (202) 676-7531.
- 8-12 "Advanced Computer Process Control" Course**, Foxboro, Mass., sponsored by The Foxboro Co. Contact: Registrar, Educational Services, The Foxboro Co., Foxboro, Mass. 02035, (617) 543-8750. Also to be held Nov 28 - Dec. 2.

### AUGUST

- 8-12 Eighth International Joint Conference on Artificial Intelligence**, Karlsruhe, West Germany, hosted by the Federal Republic of Germany. Contact: Institut für Informatik I, Universität Karlsruhe, Postfach 6380, D-7500 Karlsruhe, West Germany, (0721) 608-3975.
- 26-28 "Computers for Farm and Family" Seminar and Trade Show**, St. Paul, Minn., organized by the Minnesota Agricultural Extension Service and *The Farmer/Dakota Farmer* magazine. Contact: Sandra J. Becker, OSP-XY, 405 Coffey Hall, 1420 Eckles Ave., St. Paul, Minn. 55108, (612) 373-0725.

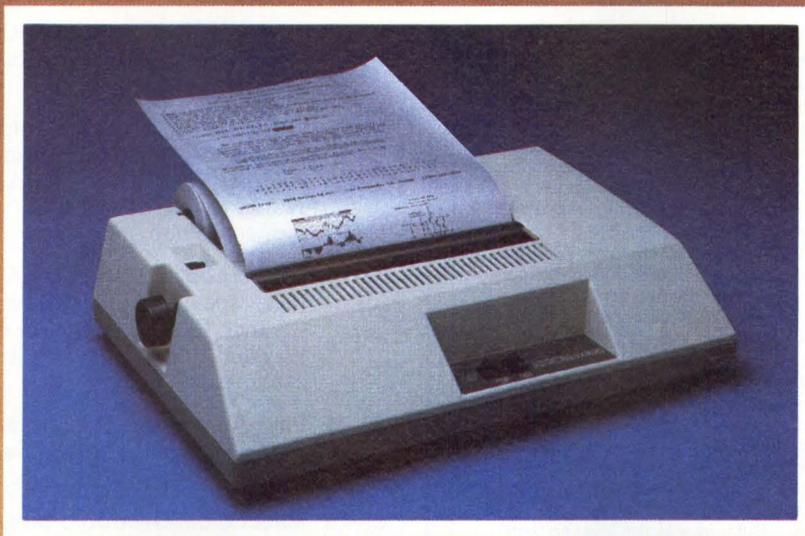
### AUGUST 31 - SEPTEMBER 2

**Eurographics '83 Conference**, Zagreb, Yugoslavia, sponsored by the European Association for Computer Graphics. Contact: ATLAS, Congress Department, P.O. Box 17, YU-41001, Zagreb, Yugoslavia, Telex: 22413 yu alcon.

### SEPTEMBER

- 12-15 Tenth Australian Computer Conference**, Melbourne,

# Q. WHAT DO YOU CALL A \$795 PRINTER THAT'S 10-TIMES FASTER AND REQUIRES 1/10 THE MAINTENANCE OF AN IMPACT?



## A. AN AXIOM EX-1620!

### Virtually Maintenance-free

For speed and reliability you can't beat our new EX-1620 electrosensitive printer. It's tough, simple, low-cost and virtually maintenance-free. There are no adjustments to make. No inky ribbons to change. Other benefits: the printout (formed by passing a high current from printhead to paper for a few microseconds) is permanent, shelf-life is no problem unlike thermal paper, print quality is unaffected by sunlight, moisture, or age, and the high contrast makes excellent photo copies.

### 960 Character-Per-Second

Our EX-1620 can knock out 960 alphanumeric characters per second in the exclusive "Quick-Print" mode. That's 10-times faster than a comparably priced impact printer. And 20% faster than a 300 LPM line printer! A 3500 line program could be finished in 10 minutes compared to over an hour using an impact printer. Even in the NLQ mode, the EX-1620 is faster than impacts, printing near-letter quality at 240 cps.

### Built-in 8K Buffer

Another benefit is the built-in 8K buffer which allows the contents of a VisiCalc screen, or many pages of word processing, to be transferred from the computer, freeing it for other tasks.

### High Resolution Graphics

The EX-1620 has a genuinely readable resolution of 144 dots per inch both horizontally and vertically. This is perfect for CAD/CAM, data logging, and instrumentation systems, and for screen dumping from a high resolution CRT. Some impact printers claim this resolution, but the size of the pins in the printhead itself results in dot pile up and a blurred printout.

### Four Models To Choose From

The EX-1620 is the top of our printer line. We do, however, have others that may better fit your needs.

Model	Paper Width	Speed	Hi Res Graphics	Price
EX-1620	8-1/2-inch	960 cps (Quick-Print) 240 cps (NLQ mode)	Yes	\$795
EX-1601	8-1/2-inch	240 cps	No	589
EX-420	5-inch	550 cps (Quick-Print) 138 cps (NLQ mode)	Yes	745
EX-401	5-inch	192 cps	No	395

Don't settle for an impact when our printers give you 10-times the speed with 1/10th the maintenance.

# AXIOM

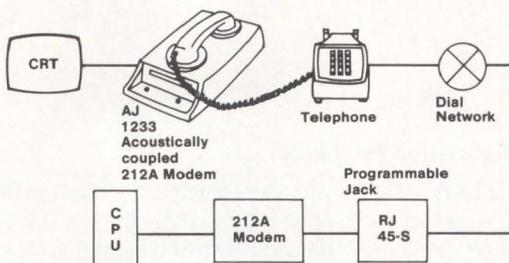
AXIOM CORPORATION

1014 Griswold Avenue, San Fernando, CA 91340 • Telephone: (213) 365-9521 • TWX: 910-496-1746

CIRCLE NO. 132 ON INQUIRY CARD

# The Case of the Modem Operandi

One of our best customers with a large network of hard wired 1200 baud terminals and 212 modems felt it would be convenient to use a portable Anderson-Jacobson 1233 acoustically coupled 212 compatible modem for sales demonstrations and to work on programs from an office at home. Unfortunately, after delivery he found that whenever he called his own computer using the coupler, the computer received his transmissions perfectly, but the computer's replies were hopelessly garbled. The other clues seemed to make the case even more confusing. A hard wired 212 worked just fine in both the send and receive directions, but the acoustic coupler also worked just fine in both directions when the A.J. test center, or a time sharing service, was called. Since nothing untoward was to be observed at the coupler end, the investigation moved to the computer site where it was observed that the modems interfaced to the switched network via RJ45S programmable jacks. This jack contains a resistor which interacts with components inside the 212 modem to set the transmit level to approximately -9 dbm. However, a quick check with a meter showed that the transmit level was close to 0 dbm., and it was clear that such a high signal level must be generating severe distortion in the remote telephone earphone. This caused the AJ 1233 receiver to garble the data. But why was the level so high?



Inspection of the cable going from the modem to the jack revealed a jumper shorting the programming resistor thus raising the transmit level. It turned out that the 212 modems were of a type that could be used alternately on 2 wire private lines at a higher voltage merely by switching line cables. The wrong cables had been used at installation putting the modem into the wrong mode of operation. Clipping the short set the proper transmit level, eliminating the distortion and the garble.

—R.G.

## NEXT MONTH: The Case of the Prejudiced BERT

Call or write for a free Glasgal catalog to solve your data communications problems. Over thirty leading brands of modems, multiplexers, testers, data converters, switches, cabinets, cables and lots, lots more stocked for same day shipment. On-site service and installation available many locations. Overseas orders invited!

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Just out: "Techniques in Data Communications" — 209 pages \$35.00.

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CIRCLE NO. 133 ON INQUIRY CARD

# Calendar

Australia. Contact: Susan Coleman, Publicity Chairperson, P.O. Box 4063 Mail Exchange Melbourne, 3001, (03) 41 6220.

**13-15 "Automating Technical Information from Design to Support" Symposium**, San Diego, Calif., sponsored by Aerospace Industries Association. Contact: John W. Stahl Jr., 1725 De Sales St. N.W., Washington, D.C. 20036, (202) 429-4635.

**13-15 1983 Federal Computer Conference**, Washington, D.C., sponsored by Federal Education Programs. Contact: Federal Computer Conference, P.O. Box 368, Wayland, Mass. 01778, (800) 225-5926 or (617) 358-5181.

**23-24 First Annual Dakota Computer Fair**, Bismarck, N.D. Contact: Stephen Cobb, Dakota Computer Fair '83, P.O. Box 7036, Bismarck, N.D. 58502, (701) 224-0166.

**26-28 Maecon/83 Electronic Show and Convention**, Kansas City, Mo., sponsored by Kansas City and St. Louis Sections of the IEEE and the Heart of America and Spirit of St. Louis Chapters of the ERA. Contact: Maecon/83 Professional Program Committee, c/o Dale Litherland, Director of Education, 8110 Airport Blvd., Los Angeles, Calif. 90045.

**26-28 Sixth European Conference on Electrotechnics**, Brighton, England, organized by the Institution of Electrical Engineers, sponsored by the Convention of National Societies of Electrical Engineers of Western Europe and Region 8 of the IEEE. Contact: The Manager, Conference Services, Institution of Electrical Engineers, Savoy Place, London WC2R 0BL, U.K. (01) 240-1871, ext. 222.

**28-29 Ottawa Computer & Office Automation Show**, Ottawa, Canada, presented by Industrial Trade Shows of Canada. Contact: Industrial Trade Shows of Canada, 20 Butterick Rd., Toronto, Ontario M8W 3Z8, (416) 252-7791.

## OCTOBER

**10-12 Online '83 Conference**, Chicago, sponsored by Online Inc. Contact: Jean-Paul Emard, Conference Chairman, 11 Tannery Lane, Weston, Conn. 06883, (203) 227-8466.

**10-14 Seventh International Fiber Optics & Communications Exposition**, Atlantic City, N.J., sponsored by Information Gatekeepers Inc. Contact: Paul W. Fitzgerald, Exposition Marketing Manager, Information Gatekeepers Inc., 167 Corey Rd., Suite 111, Brookline, Mass. 02146, (617) 739-2022.

**18-19 Sixth Annual Newport Conference on Fiber-Optic Markets**, Newport, R.I., produced by Kessler Marketing Intelligence. Contact: Conference Coordinator, Kessler Marketing Intelligence, 22 Farewell St., Newport R.I. 02840, (401) 849-6771.

# ONE COMPUTER CAN'T RUN ALL THIS SOFTWARE.



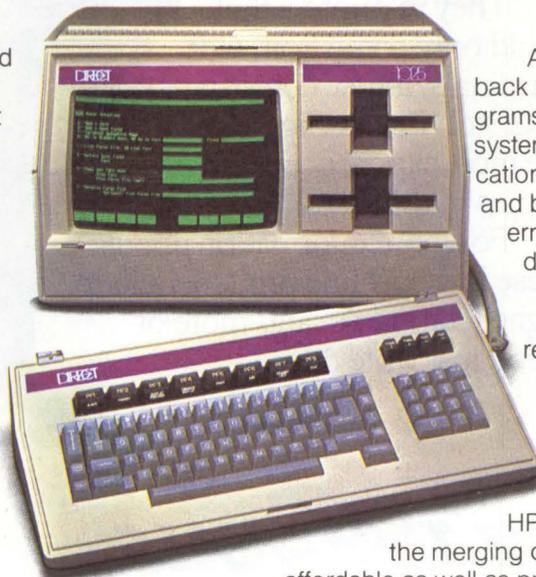
## ONE TERMINAL CAN.

From the beginning, we designed the 1025 to meet the demand for both host and personal processing at HP3000 sites. With the touch of a key, you select either the flexibility of our HP-compatible 825 terminal or the problem solving power of a personal computer. All from one integrated, transportable unit.

As a terminal, the 1025 delivers everything you need for true interaction with your host programs. Like a selectable 80 or 132 column display. Programmable function keys. On-screen, programmable labels. And enough display memory (32K minimum) to handle all HP3000 block mode software.

As a personal computer, the 1025's dual Z-80 architecture, 128K of memory, and up to 1.2 Mbytes of disk storage let you run the vast array of CP/M compatible software. Without running up a tab for additional hardware.

CP/M is a registered trademark of Digital Research, Inc. WordStar is a trademark of MicroPro International Corporation. VisiCalc is a trademark of VisiCorp. SuperCalc is a trademark of Sorcim Corporation. MBASIC is a registered trademark of Microsoft Corporation.



And for the first time you can store, back up, and distribute all your programs and data under the HP3000 file system. Our Direct-Link 1025 communications package lets you transfer ASCII and binary files to and from the HP3000, error free, for increased security and data integrity.

(For applications needing only host processing, like data entry or retrieval, you'll find that installing an 825 makes excellent operational and economic sense.

Especially since it's upgradeable to a 1025 at your option.)

Best of all, our unique line of HP3000 compatible terminals makes

the merging of host and personal processing affordable as well as practical. For information contact Direct, Incorporated, 1279 Lawrence Station Road, Sunnyvale, California 94086. Or call (408) 734-5504. Ask for a demonstration of our 1025 and 825.

And in no time you'll be off and running.



When you compare CIE matrix line printers with others, you'll find others either do a lot less. Or cost a lot more. Or both.

Our CI-300 gives you 300 LPM for data processing and 85 LPM of letter quality. Our CI-600 increases DP to 600 LPM and letter quality to 170 LPM.

Both are plug-in compatible with virtually every type of computer system, including IBM.

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Both give you hundreds of unique character fonts. And you have broad customization potential with RAM and EAROM.

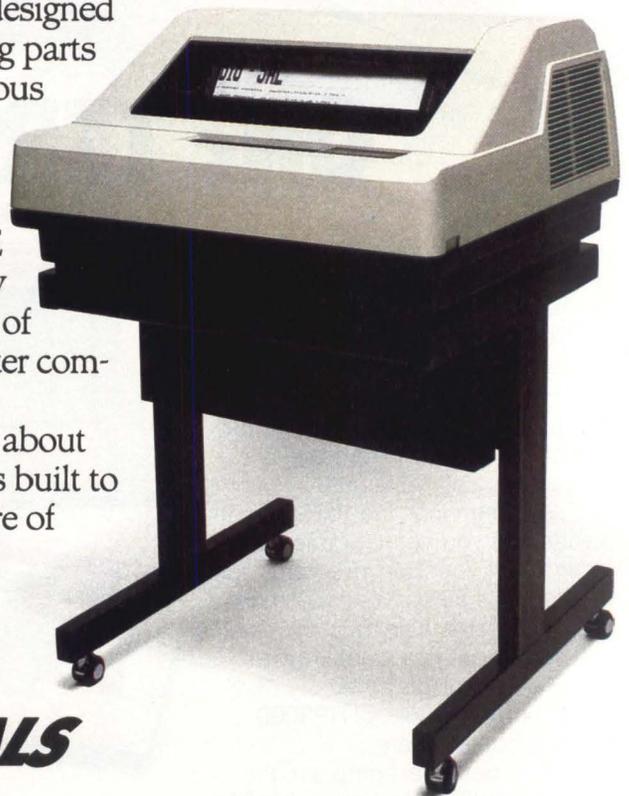
Both come with three built-in interfaces, two parallel and one serial.

Both give you flexible line spacing, line feed speed and three paper-loading points—front, bottom and back.

And because they're designed with a minimum of moving parts and have undergone rigorous testing, both give you unmatched reliability.

They're printers that could only come from CIE Terminals, a new company of C. Itoh Electronics, one of the most experienced printer companies in the world.

For more information about these low-cost line printers built to higher standards, and more of them, just write or call.



## ***CIE TERMINALS***

A new company of  
C. ITOH ELECTRONICS, INC.

New headquarters and Southern California sales office: 2505 McCabe Way, Irvine, CA 92714-6297. (714) 660-1421. Or call toll-free, 1 800 854-3322. Other regional sales offices: San Jose, CA (408) 977-1146; Cherry Hill, NJ (609) 983-5075; Chicago, Ill (312) 992-2346; Houston, TX (713) 777-1640; Atlanta, GA (404) 257-1814.

# New Products

## SYSTEMS

### Business computers feature high performance, expandability

Higher performance characterizes three new business computer systems in Hewlett-Packard Co.'s HP 3000 family, the Series 68, 48 and 42. Improvements in the HP 3000 Multi-Programming Executive Operating System and disk caching are the keys to the systems' capabilities.

Depending on the application, the Series 68 provides a 30- to 100-percent performance improvement over the Series 64 that it replaces. The Series 68 supports as many as 400 terminals, 336 of which are point-to-point terminals. It also supports 24 disk drives with a total storage capacity of 9.5G bytes and 24 intelligent network processors for data communications. Maximum main memory is 8M bytes. The system is available in configurations with one or two I/O bays.

The Series 48 provides a 20- to 30-percent increase in performance over the HP 3000 Series 44 that it replaces. The Series 48 supports as many as 152 terminals, 104 of which are point to point. It accommodates as many as 16 disk drives with a total storage capacity of 4.2G bytes, as much as 4M bytes of main memory and as many as seven intelligent network processors for data communications.

The Series 42 features a 20- to 30-percent performance improvement over the HP 3000 Series 40 that it replaces. The Series 42 supports as many as 92 terminals, as much as 3M bytes of main memory, as many as eight disk drives with a total storage capacity of 3.2G bytes and as many as three intelligent network processors for data communications.

HP 3000 Series 68 prices begin at \$245,614 for a configuration consisting of a Series 68 processor, 3M bytes of main memory, a system console, 12 terminal ports, a 404M-byte disk drive and a 1600-bpi magnetic-tape drive.

HP Series 3000 Series 48 prices begin at \$109,500 for a configuration consisting of a Series 48 processor, 2M bytes of main memory, a system console, four terminal ports, a 132M-byte disk drive and a 1600-bpi magnetic-tape drive.

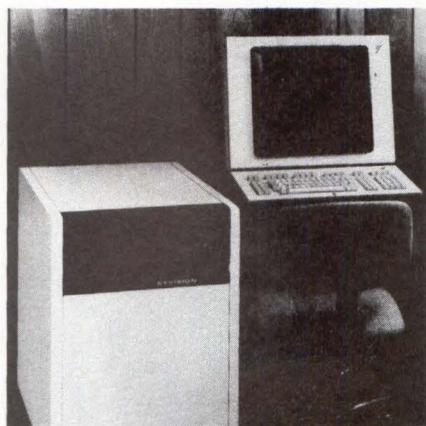
HP 3000 Series 42 prices begin at \$72,400 for a configuration consisting of



**Hewlett-Packard Co.'s HP 3000 Series 68 business computer system features performance enhancements such as disk caching and an improved MPE operating system.**

a Series 42 processor, 1M byte of main memory, a system console, four terminal ports, a 132M-byte disk drive and a 1600-bpi magnetic-tape drive. **Hewlett-Packard Co., 3000 Hanover St., Palo Alto, Calif. 94304.**

**Circle No 300**



### Computerized publishing merges text and graphics

The Xyvision modular, Motorola MC68000-based composition/pagination system can integrate text and graphics, including line art, halftones and charts, into fully composed and paginated documents. The system provides inter-

active on-screen page makeup in addition to background, algorithmic pagination processing. The system is built around three hardware components: the Xyview text/graphics display terminal on which operators can edit, manipulate and reformat pages or parts of pages interactively; the Xytext input/editing terminal that accepts input from local or remote word processors, scanners and computers; and the Xycomp system control unit that contains a Motorola MC68000 32-bit microprocessor for I/O control, file-management functions and background composition processing. The system control unit also contains Winchester and floppy disk drives and an optional 1/4-in. cartridge-tape drive for on-line database storage, archiving and disk backup purposes. A typical configuration consisting of a 70M-byte Winchester disk drive, two editing terminals, a text/graphics terminal, an interface to an on-line phototypesetter, software and documentation is priced at \$78,000. **Xyvision Inc., 52 Cummings Park, Woburn, Mass. 01801. Circle No 301**

### Single-board computer features no wait state

The model IV-1600 VMEbus single-board computer includes a 68000 CPU, 256K bytes of RAM with a dual port option, 10 universal 28-pin memory sockets, as many as four serial I/O ports, a SASI bus mass-storage interface and a buffered parallel printer port. A VMEbus interface with all system controller functions is available on board for expansion. Other features include a three-channel programmable counter/timer, a vectored interrupt controller and an optional real-time clock/calendar with battery backup. The IV-1600 can be configured with an 8-, 10- or 12-MHz 68000 CPU and executes from its local RAM with no wait states. Prices for the IV-1600 vary depending on configuration and options. The 8-MHz version is priced at \$2995 in single-unit quantities. **Ironics Inc., 117 Eastern Heights Dr., P.O. Box 356, Ithaca, N.Y. 14850.**

**Circle No 302**

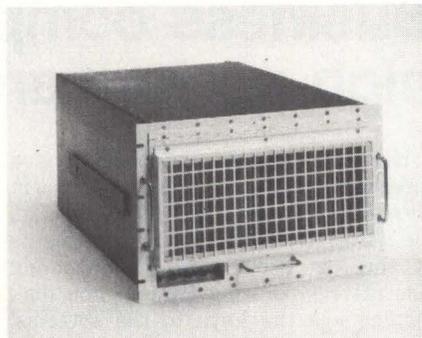
# New Products

## SYSTEMS

### Ruggedized DEC system is Winchester based

The Trilobite II ruggedized Winchester-based PDP-11/LSI-11 system is housed in a 12¼-in. rack-mount package that provides cooling and protection from dust, shock and vibration. These

features allow the use of commercial Unibus/Q-bus processors, memories, interfaces and disks in adverse environments. The rugged aluminum rack-mount chassis is designed to withstand the abuse of field, mobile and factory applications. The single-chassis design reduces space requirements and elimi-



nates interconnect cables, yet accommodates two full-height or four half-height, 8-in. Winchester or floppy disk drives. The Trilobite II accepts the standard DEC Hex-by-9 backplane format allowing full PDP-11 Unibus and 4M-byte LSI-11/23-Plus systems. Other backplane configurations include dual Q-bus (nine and 18 dual slots) and split Q-bus/Unibus. The Trilobite II runs RT-11, TSX+, RSX-11/M-Plus, RSTS/E and UNIX operating systems. To handle marginal utility power, the Trilobite II uses Kepco switching supplies with full-line isolation for 120V/240V AC and 12V/24V/48V DC input. A Trilobite II with an LSI-11/23 processor, 0.5M bytes of main memory, a 36M-byte Winchester disk drive, a 1.2M-byte floppy disk drive and an RT100 terminal is priced at \$27,044 in single-unit quantities. **Trilobite Computer Corp.**, 780 W. Grand Ave., Oakland, Calif. 94612.

Circle No 303

## Home Sweet Home for Your Multibus\*

Finally there's a system chassis that is designed and manufactured with the thoroughness and care you expect in your Multibus system. It's Electronic Solutions' new Multichassis™.

- 9 slots, 0.6" spacing—or 7 slots, 0.75" spacing
- Hefty 4-output 300W power supply— 40A at +5V
- Cool operation even with high-density boards

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cage and backplane, plus full RFI filtering, locking front panel function switch, power fail detection, and quiet dual cooling fans with quick-change filters.

And best of all, the removable front panel lets you easily customize the Multichassis to match your company color and logo.

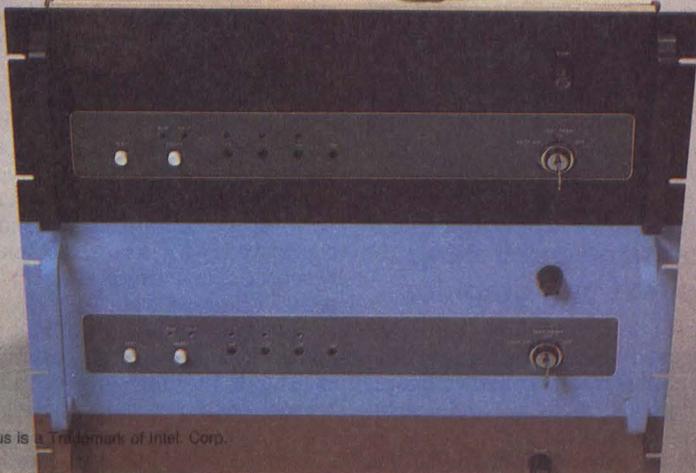
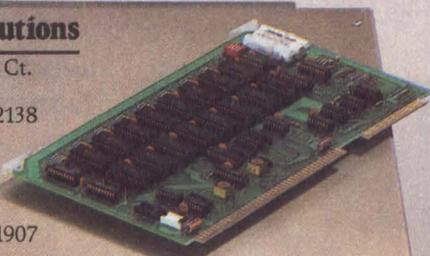
So treat your Multibus system to an elegant but affordable new home—the Multichassis by Electronic Solutions. Call us today for full specifications and prices.



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Transduction Ltd. (416) 625-1907



\*Multibus is a trademark of Intel Corp.

CIRCLE NO. 136 ON INQUIRY CARD

### STD-bus-compatibles offer on-board options

The Series 8800 family of STD-bus-compatible microcomputers boards is designed for computation and control applications such as inertial navigation, vibration analysis and robotics. The models ZT8810/8811 and ZT8812/8813 feature direct addressing of as much as 1M byte of main memory, a choice of 5- or 8-MHz, 16-bit 8088 CPUs, wait states for compatibility with slower memories and I/O, 16K bytes of ROM capacity and an optional development/debug monitor PROM. The model ZT8810 also features an on-board serial I/O port. An 8087 math co-processor and RMX-86 or CP/M-86 silicon operating systems are also available on the models ZT8812/8813. Prices range from \$425 to \$499. **Ziatech Corp.**, 3433 Roberto Court, San Luis Obispo, Calif. 94301.

Circle No 304



## Some of our VARs' best ideas began on the backs of envelopes.

Great ideas, plus hard work, business sense and commitment to customer satisfaction. That's what it takes to be a Value Added Remarketer for IBM.

IBM is looking for business people with specialized industry experience. For companies that can successfully merge our systems with applications software. For those to whom quality is fundamental.

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MMS-7-83

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# What makes the HiNet™ local area network a star performer in OEM sales?



With HiNet, you sell a complete system: unique microcomputer work stations, peripherals, system software, and central or distributed disk drives. All from one supplier. All turnkey. All backed by

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Thousands of installations worldwide are proving HiNet's reliability right now (and providing you with solid reference accounts.) Digital Microsystems is the leader in Local Area Network technology, backed by international financial, technical and marketing resources.

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RG11 2PQ, Tel. (0734) 793131, Telex 849925 DMSLTD.

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# New Products

## SYSTEMS



### Computer includes application generator

The Unidata 3000 self-programmable small business computer is designed for ease of use. Unified software, including an application generator and a database manager, is at the heart of the system. The application generator allows users without computer expertise to create customized application programs based on routine business forms. Using an interpretive language called Unisyn, novices enter a sample of every line in a form and provide directions for filling in each blank by answering the computer's questions. Unidata 300 hardware consists of a computer module, a letter-quality daisy-wheel printer, a detachable keyboard with numeric keypad, cursor control, function and editing keys and a 12-in., tilt-and-swivel display screen. The computer module contains a real-time clock, an 8-bit Z80 microprocessor, 128K bytes of memory, two 8-in. floppy disk drives with a combined capacity of 2.5M bytes and two communications ports. Single-unit price is \$15,000. **Unidata Systems Inc.**, Newington Park, Portsmouth, N.H. 03801. **Circle No 305**

### Workstation emulates IBM 3278 terminal, IBM PC

The model 9010 modular, multifunctional workstation emulates IBM 3278-2 terminals and IBM Personal Computers. The model 9010 includes a computer system unit, a disk storage unit, a display monitor unit, a display logic unit and a keyboard unit. Major features include a 16-bit 8088 microprocessor, 128K bytes of RAM, five system expansion slots that are compatible with

IBM PC option boards and two 320K-byte, 5¼-in. floppy disk drives. The P9010 supports the CP/M-86 and MS-DOS operating systems. A companion product, the model P9002 information-processing facility, adds P9010 capability to an IBM 3278 terminal or the vendor's P3278 terminal. The P9002

includes the computer system unit and the floppy disk drives. Prices are \$4990 and \$3195 for the models P9010 and P9002, respectively, in single-unit quantities. **Phaze Information Machines Corp.**, 7650 E. Redfield, Scottsdale, Ariz. 85260.

**Circle No 306**

## Meet The Infoscribe Family.



Whether your computer system is large or small, simple or complex, Infoscribe multifunction matrix printers match your real needs.

### Family Characteristics

All Infoscribe models share certain advanced features. These include microprocessor-controlled electronics in bi-directional, logic seeking designs; standard or double-width upper and lower case characters; double density printing; up to 136 columns at 10 cps; true descenders, underlining, subscripts, and superscripts; rugged, full-duty-cycle performance; unique integrated, structural-foam chassis; and many more.

### Model Variations

Each Infoscribe model offers features and benefits ideal for particular applications:

FEATURE	MODEL				
	500	1000	1100	1200	1500
DATA PROCESSING (CPS)	150	200	200	200	400
CORRESPONDENCE (CPS)	75	100	100	100	200
NEAR LETTER QUALITY (CPS)			40	40	100
GRAPHICS (72 x 72)	♦	♦	♦	♦	♦
GRAPHICS (144 x 144)			♦	♦	♦
PROGRAMMABLE FONTS		♦	♦	♦	♦
FOUR COLOR RIBBON				♦	

### Something For Everyone

To top it off, Infoscribe delivers the most user-friendly printers on the market. They're extremely quiet (approximately 54 dBA), easy to learn, easy to use, easy to maintain, and easy on the eyes. Whether you're a computer expert, or don't know a volt from a bolt, Infoscribe will make you a friend of the family.

Manufactured in the U.S.A. and sold and serviced internationally by Infoscribe, Inc., 2720 South Croddy Way, Santa Ana, California 92704, U.S.A.

Phones (714) 641-8595, (800) 222-8595, In California (800) 223-8595, Telex 692422.

# PRINT WITH INFOSCRIBE

CIRCLE NO. 139 ON INQUIRY CARD

# New Products

## DISK/TAPE

### Floppy disk drives for use with Ace 1000 computers

The ACE 1100 add-on disk drive assembly for the ACE 1000 personal computer includes a controller and one or two ACE 10 5¼-in. floppy disk drives. The unit replaces the cover of the ACE 1000 computer and slips in place. The ACE 10 floppy disk drives used in the ACE 1100 read and write any Apple II-compatible diskette. The controller, which accommodates two drives, can be used with DOS 3.2 and DOS 3.3 and includes a built-in disk drive exerciser. The controller plugs into one of the eight peripheral connectors. There is no



external cabling. The single-sided ACE 10 drives store as much as 143K bytes and feature an 18-msec. track-to-track access time and a 250K-bit-per-sec. transfer rate. The single-drive ACE 1100 is priced at \$699 including the controller. A second drive adds \$399. **Franklin Computer Corp.** 2138 Route 38, Cherry Hill, N.J. 08002.

Circle No 307



### Tape drive features cache buffer

The CacheTape 75 ½-in. reel-to-reel tape drive features a 64K-byte cache buffer. The nine-track drive accommodates 7-, 8½- and 10½-in. reel sizes and is available in two versions. One version operates at 100 ips and stores 46M bytes (unformatted) using a 1600-bpi recording density, while a second version operates at 50 ips and stores 92M bytes

(unformatted) using a 3200-bpi recording density. Both versions feature a 225-ips rewind speed and user-selectable transfer rates from 20K to 120K bytes per sec. to match the performance of the drive to multiple host system needs. In OEM quantities, CacheTape 75 is priced at \$2820. **Cipher Data Products Inc.**, 10225 Willow Creek Rd., P.O. Box 85170, San Diego, Calif. 92138.

Circle No 308



### Winchester drives feature technical advances

The Cogitator Series I, models 906 and 912 5¼-in., half-height Winchester disk drives store 6.38M bytes (unformatted) on one platter and 12.76M bytes (unformatted) on two platters, respectively. Both drives are compatible with the Seagate ST-506/412 interface, and both have an average access time of 85 msec. and a data-transfer rate of 5 MHz. The drives feature thin-film-plated media, a dynamic braking system, manganese/zinc composite read/write heads mounted on an IBM 3370-type suspension and single-PC-board construction for high reliability. In OEM quantities of 500, price of the Cogitator Series I, model 906 is \$725, and price of the model 912 is \$825. **Cogito Systems Corp.**, 118 Charcot Ave., San Jose, Calif. 95131.

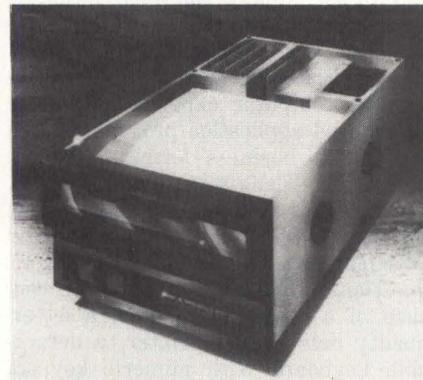
Circle No 309

### Tape subsystems work with Onyx computers

The models TD-1050 and TD-1012 are ½-in., nine-track, 800-/1600-cpi, IBM-, ANSI-, ECMA- and ISO-compatible mag-

netic-tape systems for Onyx 16-bit UNIX-based computer systems. The tape drives store approximately 40M bytes per 7-, 8½- or 10-in. reel and can generate or read tapes in ASCII, binary or IBM EBCDIC code. They feature a data-transfer rate of 40K bytes per sec. The tape subsystems use an intelligent microprocessor-based controller providing an 8-bit bidirectional parallel interface. A UNIX System III software application driver is supplied as part of the software operating system furnished by Onyx. The TD-1050/Onyx system is priced at \$9175 and supports dual-mode, 800- and 1600-cpi recording at 45 ips start/stop, while the TD-1012/Onyx system is priced at \$6995 and supports only 1600-cpi recording at 12.5 ips. **Innovative Data Technology**, 4060 Morena Blvd., San Diego, Calif. 92117.

Circle No 310



### Disk drives feature removable dual media

The Cardiff family of 5¼-in. Winchester disk drives includes fixed-only, removable-only and fixed/removable models with unformatted data storage capacities ranging from 20M to 80M bytes. The Cardiff drives are compatible in size, power requirements, interface and data-transfer rate with available microcomputers and controllers. Measuring 3¼ × 5¼ × 8¼ in., they require +5V DC or +12V DC, use the ST-506 interface (modified to accommodate removable-media status information for the removable-media models) and have a data-transfer rate of 5M bits per sec. Average seek time is 25 msec. Price for a 40M-byte fixed/removable drive is \$2250. **Innovative Data Technology**, 4060 Morena Blvd., San Diego, Calif. 92117.

Circle No 311

# ACHIEVE THE STANDARD IN WINCHESTER, FLOPPY AND TAPE DEVICE TEST!

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Westlake Village, CA (805) 496-8778  
San Jose, CA (408) 287-8720

# New Products

## PRINTERS

### Low-cost, dot-matrix printers feature high-resolution, multi-mode printing

Available in three models that are priced from \$799 to \$1250 in single-unit quantities, the Pinwriter series of multimode, dot-matrix printers offers 180-cps printing for high-volume printing, near-letter-quality output at lower speeds and nearly unlimited font flexibility for graphics. The latter is made possible by the 18-pin,  $2 \times 9$  staggered structure of the Pinwriter's print head.

The 80-column model P1 prints at 180 cps in a high-speed mode and 90 cps in a high-density mode. It offers a Centronics-type interface. In addition to 180-cps, high-speed printing and 90-cps, high-density printing, the 80-column model P2 offers program- or operator-selectable dual-pass printing at 35 cps to



NEC Information Systems Inc.'s Pinwriter series of low-cost, dot-matrix printers features 18 printing pins to form high-density characters.

produce near-letter-quality output. The model P2 features an IBM PC interface that recognizes the IBM command set as well as an optional RS232 interface. The 136-column model P3 offers the same three print modes and interfaces as the model P2.

All three models of the Pinwriter family feature proportional spacing, boldface printing, elongated characters and continuous underline. Standard character sets stored within the printers include high-speed pica ( $7 \times 9$  matrix), high-density pica ( $13 \times 9$  matrix), high-density elite ( $13 \times 7$  matrix) and a condensed character set for printing 17 cpi ( $7 \times 9$  matrix). The models P2 and P3 also feature dual-pass pica ( $26 \times 18$  matrix) and elite ( $26 \times 14$  matrix). Optional character sets can be

downloaded from the host computer to the models P2 and P3.

Using friction paper feed, the models P1 and P2 accommodate forms from  $4\frac{1}{2}$  to 10 in. wide, while the model P3 handles forms as wide as  $14\frac{3}{4}$  in. Optional forms handlers include a

tractor feed and cut-sheet guide that are available on all models and a cut-sheet feeder option for the models P2 and P3. NEC Information Systems Inc., 5 Militia Dr., Lexington, Mass. 02173.

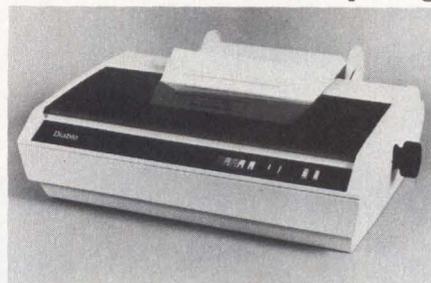
Circle No 312

### Diablo expands products with new technologies

Seeking to become the industry's leading single-source supplier of printers, Diablo Systems Inc., a Xerox subsidiary known for its 11-year development and production of daisy-wheel printers, has introduced a series of printer products based on other technologies. The new products include two impact dot-matrix printers, a non-impact, thermal-transfer, plain-paper printer and a color ink-jet printer.

The models 11A and 31A 80- and 132-column, 100-cps printers use a  $16 \times 35$  dot-matrix pattern to create near-letter-quality text and line and block graphics. They print at 30 cps in correspondence-quality mode. They feature front-feed cut-sheet capability, a 2K-byte print buffer and Xon/Xoff and ETX/ACK line protocols. They will be available in the third quarter of this year, with expected end-user, single-unit prices of \$750 and \$1099, respectively, for the models 11A and 31A.

The Series 200 electronic printing



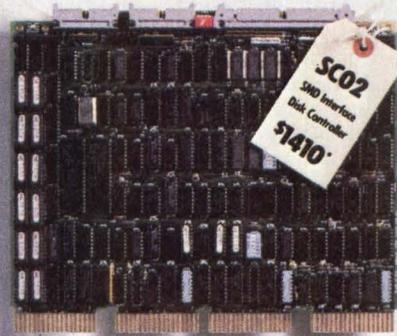
Diablo Systems Inc.'s Series C seven-color ink-jet printer integrates text and graphics on plain or clay-coated paper at 20 cps.

machine non-impact, thermal-transfer printer uses plain paper and generates as many as six pages of text and graphics per min. It generates its image by energizing the thermal head elements that in turn cause the transfer of black ink from an ink-donor film roll onto plain paper via a pressure roller. Each ink-donor film roll can produce as many as 1300 pages. With its  $200 \times 200$ -dpi resolution, the printer can be programmed to generate a virtually unlimited array of text and graphic characters and symbols. Many of the more popular fonts designed for the company's daisy-wheel printers are available via software license to EPM users. Single-unit price is \$4995, with volume discounts available.

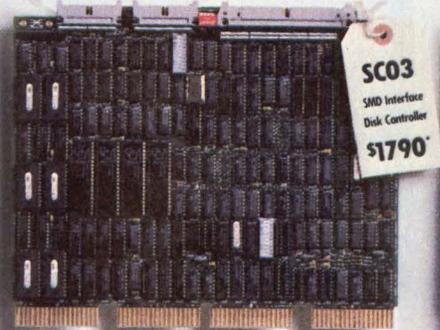
The Series C non-impact ink-jet printer uses drop-on-demand color ink-jet technology to address the image-processing and color-graphics requirements of personal-computer, professional-workstation and business-system users. This four- and five-pass, 20-cps printer features switch-selectable unidirectional and bidirectional printing and integrates text and graphics on cut-sheet or roll paper in seven colors including cyan, magenta, yellow, black, violet, green and red. The printer features  $1024 \times 1024$ -dot-per-page resolution, a 96-character U.S. or European ASCII set and an additional set of 64 mosaic graphics characters. The printer will be available in the third quarter of this year with an expected end-user, single-unit price of \$1250. Diablo Systems Inc., 24500 Industrial Blvd., Hayward, Calif. 94545.

Circle No 313

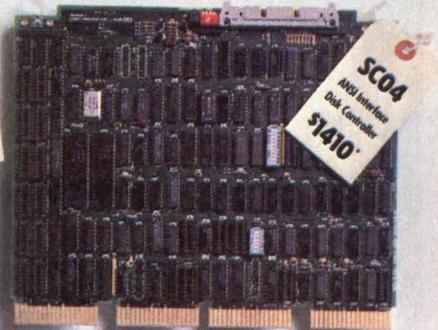
# The LSI-11 controllers with features comptrollers love.



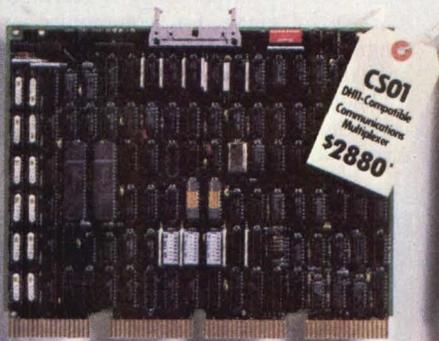
Handles small 12-80MB disks, emulates RP02/03, RK06/07 and RL01/02.



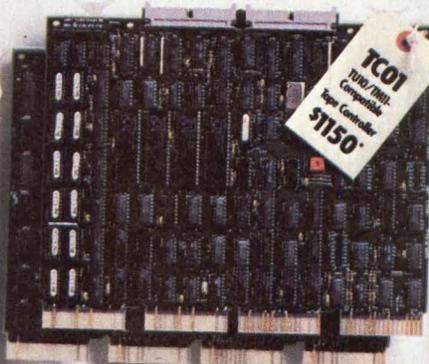
Operates with new high-performance 80MB and larger disks on LSI-11/23.



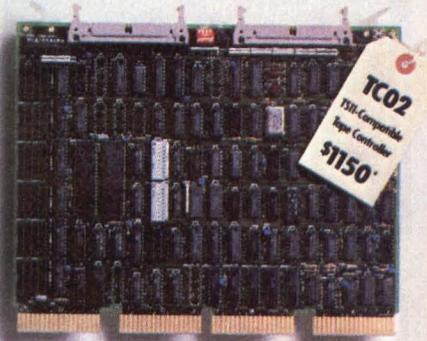
Handles up to eight ANSI 8" Winchesters, emulates RK06/07 and RL01/02.



Handles 8-64 channels, 16-bit word transfers (DMA), 22-bit addressing. (16-channel price)



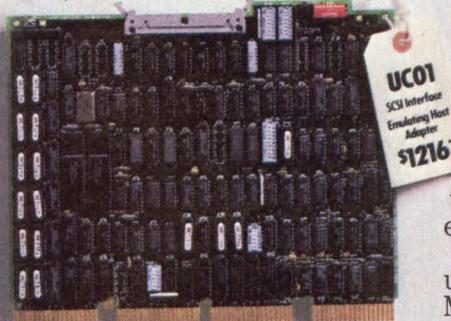
Dual density at up to 75 ips, handles up to four 1/2" transports.



Coupler works with all NRZI, PE, GCR formatters at speeds from 12.5 to 125 ips.

Handles new cartridge Winchester disk drives, emulates RLV11/12.

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comptrollers with sharp pencils. With Emulex you can mix and match across a very broad product line of Q-Bus, Unibus & VAX controllers so it doesn't take long to bring prices down even further.

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are pleased to know that nationwide applications assistance, training, and technical support is only a quick phone call away.

Great figures?

Write or call Emulex Corporation, 3545 Harbor Blvd., P.O. Box 6725, Costa Mesa, CA 92626. Telephone (800) 854-7112 toll-free. In California call (714) 662-5600.

Flinty-eyed finance types are push-overs for Emulex controllers.

And why not? Emulex controllers have great figures.

DEC LSI-11 users simply don't pay extra for higher Emulex quality, performance and reliability. In fact, Emulex controllers are priced to be highly competitive with the lower quality brands. And that's just the beginning.

There's no up-front investment because Emulex controllers are totally software transparent to LSI-11 CPUs. No special software drivers, handlers or tweaks required.

Smart comptrollers don't tie up cash in needless inventory. With Emulex's remarkably fast delivery, inventories can be kept economically small.

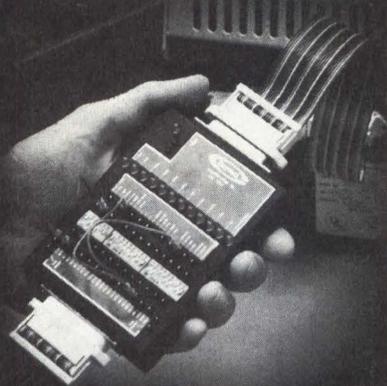
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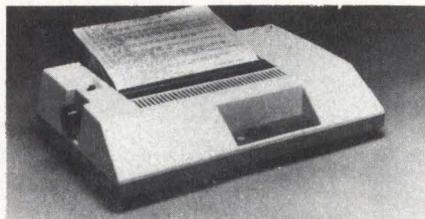
### University Microfilms International

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# New Products

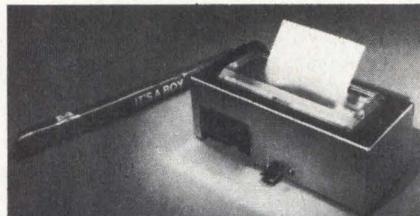
## PRINTERS



### High-speed OEM printer prints on full-sized paper

The model EX1601 non-impact, electrosensitive printer prints at 240 cps. Its speed and low maintenance make it suitable for applications in communications, instrumentation, medical data logging and other data-gathering systems. The model EX1601 prints the full 96-character ASCII set on standard 8½-in.-wide paper and features 128 additional symbols and foreign-language characters. The printout is software selectable for an 80-, 40- or 27-column format. Print sizes can be mixed on a line. A choice of parallel, RS232C and 20-mA serial or IEEE-488 interfaces is available. Single-unit price is \$699, with quantity discounts available. **Axiom Corp.**, 1014 Griswold Ave., San Fernando, Calif. 93140.

Circle No 314



### Minaturized printer fills industrial requirements

Designed for a variety of industrial and commercial applications, the model EUY-3T miniaturized thermal printer measures 4.69 × 1.79 × 2.64 in. It features ⅛-in.-high characters on a 40-character line, bidirectional printing, a printing speed of 1.2 lines per sec., dot-addressable graphics and use of 3.15-in.-wide paper. In OEM quantities, the EUY-3T is priced at less than \$100 each. **Panasonic Industrial Co.**, One Panasonic Way, Secaucus, N.J. 07094.

Circle No 315

### Demand printer delivers labels, tickets, tags

The Zebra demand printer can print and dispense labels, tickets or tags. It

can print on pressure-sensitive, heat-sensitive and gummed labels; card-stock tickets and tags; multiple-part forms; and various other paper stocks as thick as 0.016 in. Labels can be dispensed singly or in strips that can be torn off. A backing rewriter option takes up pressure-sensitive backing paper as labels are dispensed. This impact, dot-matrix printer produces approximately 250 lpm when operating with a normal print-line width of 2.3 in. It offers OCR-M fonts as well as four alphanumeric fonts. It can also print eight popular bar codes of various heights and densities that are readable by hand-held and moving-beam scanners. The printer uses a standard RS232C interface for communication. Single-unit price is \$3650 with the backing rewriter option or \$3470 without the backing rewriter option. **Data Specialties Inc.**, 3455 Commercial Ave., Northbrook, Ill. 60062.

Circle No 316



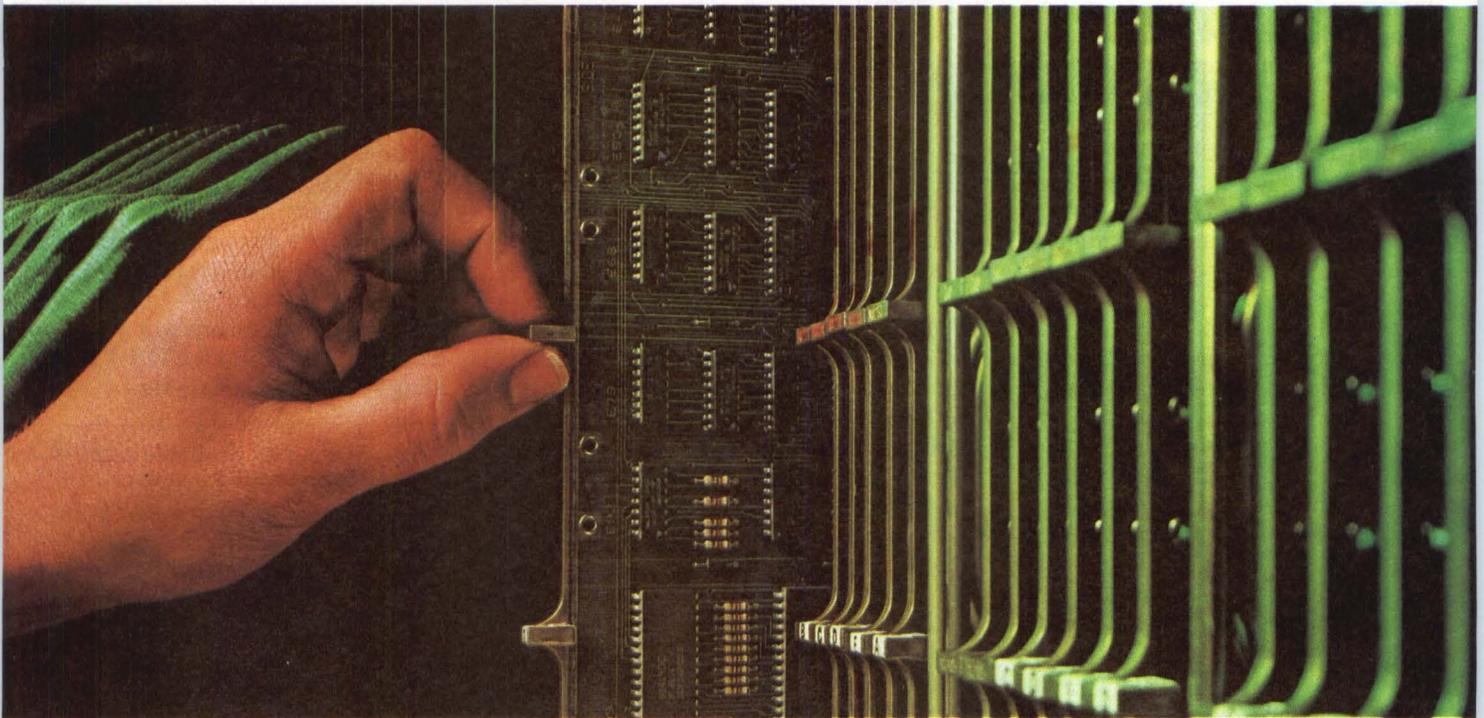
### Desk-top plotter has high resolution

The model 84 eight-pen desk-top plotter produces high-resolution charts, graphs and drawings on paper or overhead transparency film. It has a plot speed of 16.5 ips and a resolution of 0.004 in. It plots on 8½ × 11-in. or 287 × 200-mm. paper in as many as 10 colors using liquid ink or nylon- or ceramic-tipped pens. Based on a Z80 microprocessor, this intelligent plotter has firmware commands including five line styles, selectable character rotations, special symbols, six character sets, viewporting/windowing, scaling and circle/arc generation. The plotter features an RS232C, IEEE 488 or Centronics parallel interface. With the RS232C interface, baud rates from 110 to 9.6K baud are switch selectable as is parity. Single-unit price is \$1995, with quantity discounts available. **California Computer Products Inc.**, 2411 W. La Palma Ave., Anaheim, Calif. 92801.

Circle No 317

The things we hear about General Electric service.

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It will be called the UNIX operating system.

But the breakthrough features of this operating system are going to make stringent demands on the computer.

The microcomputer developed specifically for the UNIX operating system more than two years before its commercial distribution is called ONYX.™

ONYX will live up to every demand and expectation.

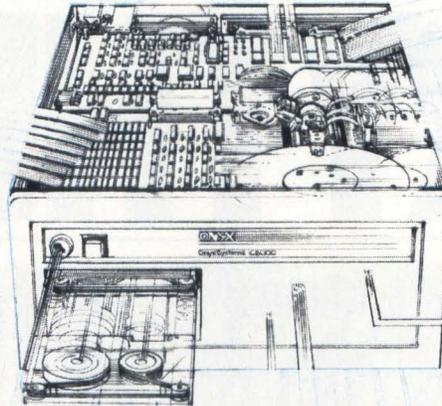
To achieve the ultimate flexibility, simplicity, efficiency and productivity, the UNIX operating system will incorporate a file system of highly uniform sets and sub-sets of directories, arranged in a tree-like hierarchical structure.

And flexible directory and file protection modes, allowing all combinations of "read," "write," and "execute" access, independently for each file or directory, for a group of users.

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

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

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



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

So, obviously the ONYX C8002 will do.

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

In the UNIX operating system environment, the disk becomes an extension of main memory. "Swapping" programs between the disk and main memory



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

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

ONYX has installed over 1500 UNIX systems.

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

## System III available now for immediate delivery.

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- "Term Cap" capability that supports a wide variety of terminal interfaces;
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\*UNIX is a trademark of Bell Laboratories.

Make the Connection

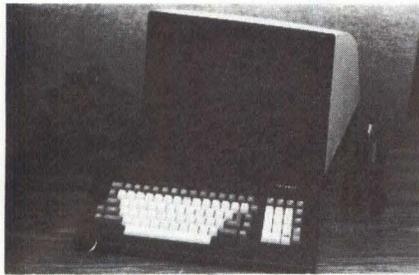
# ONYX-UNIX

OPERATING SYSTEM

Onyx Systems Inc., 25 East Trimble Road, San Jose, CA 95131  
CIRCLE NO. 144 ON INQUIRY CARD

# New Products

## TERMINALS



### APL editing terminal features instant replay

The ANSI X3.64-compatible model 16-APL user-definable, multi-page APL editing terminal features true character overstriking and instant replay by which a user can view the separate elements of previously overstruck characters. The model 16-APL's 385 displayable characters include 96 APL, 128 ASCII, 64 mosaic, 32 line-drawing and 32 subscript/superscript characters plus 33 special symbols and math notations. The terminal's standard four-page display memory can optionally be expanded to eight volatile or nonvolatile pages. The model 16-APL displays a standard 24-line  $\times$  80-column page, but its four- or eight-page memory can be organized by the user into any number of pages by redefining logical line lengths and page lengths. The 25th information line is used to display terminal status, feature selection and computer messages. The unit's built-in calculator and real-time clock also use the 25th line for displaying calculations and time of day/elapsed time. The model 16-APL has two fully buffered, bidirectional RS232 ports. It is available in four enclosure styles and three (9-, 12- or 15-in.) CRT sizes. The standard 12-in. version is priced at \$1695. **Teleray Division of Research Inc.**, Box 24064, Minneapolis, Minn. 55424. **Circle No 318**

### Display station from IBM is low cost, lightweight

The IBM 3178 display station incorporates many of the features of the IBM 3278 model 2 display station in a compact, lightweight, low-cost unit. The 3178 includes a 12-in., non-glare screen and a choice of 75-key data-entry or 87-key typewriter keyboards. The screen displays as many as 1920 characters and swivels 90 degrees to the left or right. The detached, low-profile keyboard can be adjusted to a 6- or

12-degree slope to suit the operator. Among the standard 3278 model 2 features offered in the 3178 are an audible alarm, a numeric keyboard lock and a security key lock whose key can be removed with the power on. Prices are \$1660 or \$1720, depending on the keyboard selected, and volume discounts are available. **IBM Corp., Information Systems Group**, 900 King St., Rye Brook, N.Y. 10573.

**Circle No 319**

### Ergonomic terminal is user friendly

The model Z-29 terminal features a menu-driven setup procedure, a detached keyboard, power-up diagnostics and a screen saver. It is compatible with ANSI protocol units and the DEC VT52. In addition, it emulates many of the DEC VT100's functions (in the 80-column mode), the Lear Siegler ADM-3A and the Hazeltine 1500. The keyboard has 77 typewriter-style keys, a separate 14-key numeric keypad, four LED



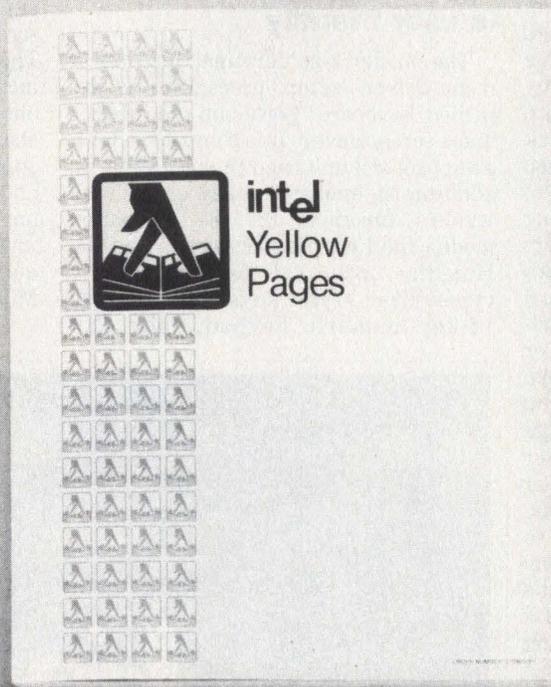
indicator lights, an optional palm-rest extension and user-selectable audible key click. The tiltable 12-in. green screen displays 25 rows of 80 characters. The terminal can display 256 characters including the 95 ASCII set, 33 graphics characters and an alternate 128-character set that includes subscripts, superscripts, VT100 graphics characters and special shapes. For OEMs, there is an expansion socket for 32K bytes of RAM or ROM. Price is \$849 in single-unit quantities. **Zenith Data Systems**, 100 Milwaukee Ave., Glenview, Ill. 60025.

**Circle No 320**

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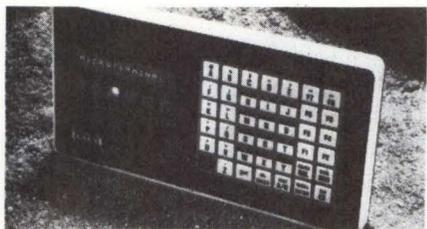
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# New Products

## TERMINALS



### Self-contained data-entry terminal meets MIL specs

The TM71M, a militarized model of the vendor's Microterminal control panel, conforms to MIL-E-16400, MIL-STD-454, MIL-S-901 (shock) and MIL-STD-167-1 (vibration) specifications. Measuring 8.5 × 4.5 × 0.85 in., the unit mounts on a flat surface. It has a 42-key, sealed keyboard with tactile feedback and contoured key tops that generates 80 alphanumeric characters. A 16-character LED alphanumeric display with scroll-left/scroll-right keyboard controls permits review and editing of data entered before transmission. Two 80-character buffers are provided for keyboard-generated data, and two 80-character buffers are available for CPU-generated messages. The TM71M's display includes CPU control of flashing, scrolling or blanking features. In addition to data-input and control keys, the TM71M keyboard includes 14 programmable function keys. Other features include RS232C and 20-mA serial communications at baud rates from 110 to 9.6K baud, remote reset and two TTL-compatible digital outputs to control external equipment. The TM71M sells for \$3000 in quantities of 100. **Burr-Brown, Industrial Systems Products Division**, P.O. Box 11400, Tucson, Ariz. 85734. **Circle No 321**

### Color graphics terminal features anti-aliasing

The AED512 and AED767 are color graphics terminals designed for control of industrial processes, display of charts and other types of business graphs and CAD/CAM. The AED512 is a raster-refresh display that features 256 colors and a resolution of 512 × 512 pixels. The AED512 contains a small computer and a bit-map memory and emulates Tektronix 4010-4015 terminals. Standard interactive devices include a keyboard, function keys and a joystick. The terminal also features pixel-replication zoom, pan, polygon fill and Superoam. Superoam allows the display of a

software- or keyboard-selectable portion of an image that is larger than the full screen size. All video outputs drive external monitors and video tape equipment. The AED767 uses the same architecture as the AED512 but features a 1K × 1K × 8 virtual-address space with a 768- × 575-pixel viewing window. The AED767 also incorporates anti-aliasing. The AED512 and AED767 are priced at \$5995 and \$10,995, respectively, including eight memory planes and a 13-in., standard-persistence monitor. **Advanced Electronics Design Inc.**, 440 Potrero Ave., Sunnyvale, Calif. 94086. **Circle No 322**

### Large-screen display uses gas-panel technology

The IBM 3290 gas-panel display station is designed for program development, report retrieval and database/data-communications applications. It can display as many as 9920 alphanumeric characters and a wide range of graphics including line draw-



ings, charts and sketches. The 10.7- × 13.4-in. flat screen can be divided into windows to provide an operator with access to as many as four applications or databases in one or more computers. The screen is a sealed sandwich of two glass plates less than 1/70 in. apart. The space between the plates is filled with neon/argon gas that glows as electrical charges are selectively applied onto 737,280 intersections of a wire grid to create high-resolution orange-on-black images. Single-unit price is \$7100, with quantity discounts available. **IBM Corp., Information Systems Group**, 900 King St., Rye Brook, N.Y. 10573. **Circle No 323**

# MBA's for under \$2,000.

See our ad on Page 267.

# New Products

## CAD/CAM



### CAD system permits automatic PC-board routing

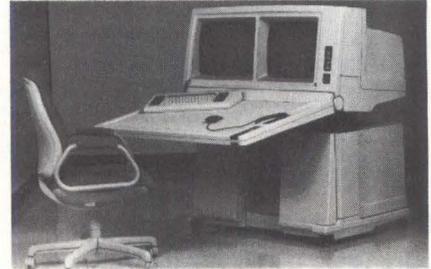
The Calay V03 CAD system features automatic routing of PC boards without a designer's presence or assistance. Hardware highlights of the system include a Digital Equipment Corp. LSI-11/23 computer with 256K bytes of RAM, a 512K-byte floppy disk drive, an 8M-byte Winchester disk drive, an alphanumeric terminal, a raster-scan screen with a graphics processor, a plotter interface and a digitizer. Calay V03 software includes an interactive multi-user graphic system with real-time data checking and user-friendly

input, a statistical program for analyzing PC-board data, the automatic routing program and a post processor for controlling output to various types of plotters. Price is \$169,000. **Calay Systems Inc.**, 3901 MacArthur Blvd., Suite 104, Newport Beach, Calif. 92660.

Circle No 324

### Engineering workstation has local processing

The Interact graphics workstation includes three internal processors and more than 0.75M bytes of memory. Two 19-in. monochrome raster screens display drawings with 1280- × 1024-pixel addressability and resolution. The workstation performs dynamic panning, continuous zooming and real-time rotation of 3D elements without relying on the host data-processing system. Other display functions, including grid generation, cursor tracking, menu-command decoding, dynamic dragging and selective erasing, are also off-loaded. The host computer maintains and updates

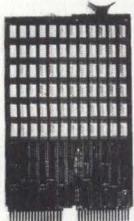


data files. The workstation incorporates an electronically active digitized surface large enough to accommodate a standard D-sized (22- × 34-in.) drawing. A movable keyboard for command input and text is also included. The workstation can communicate with a host data-processing system over a dedicated, polled access line using SDLC protocol. A second contention-access line enables the workstation to function as a node with Internet, the vendor's local-area communications network. Single-unit price is \$44,000. **Intergraph Corp.**, One Madison Industrial Park, Huntsville, Ala. 35807. Circle No 325

## Q-Bus MEMORY from CLEARPOINT

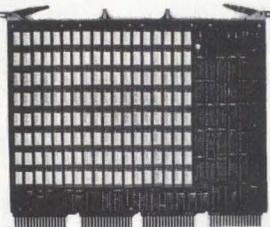
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- 1/2 MB on a dual-height card
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CIRCLE NO. 164 ON INQUIRY CARD

MINI-MICRO SYSTEMS/July 1983

# CalComp introduces the MBA.

Every computer system has the business basics—accounting, finance, administration.

But when end users or OEMs add CalComp's M-84 plotter, their system becomes an MBA (Master of Business Art) that produces presentation-quality graphics for less than \$2,000.

The M-84 actually makes your system a little smarter. It's based on the Z80 microprocessor and has built-in firmware for five line styles, selectable character rotation, six different character sets and circle, arc and sector generation. It can also work as a printer and digitizer.

M-84 is fast, precise and quiet. It plots at speeds up to 177 inches per second with resolution of .004 inches on paper or film for overhead projection.

M-84 is analytical and easy to maintain. Diagnostics test and report on interface and plotting functions on your command.

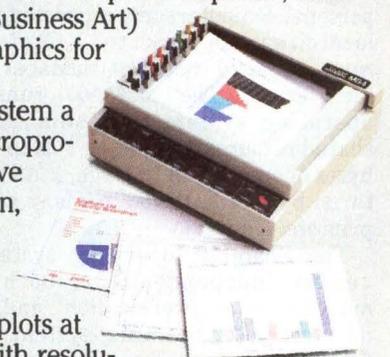
The M-84 is versatile. There are three standard interface models—Centronics, IEEE and RS-232, and most popular applications software packages, including ISSCO's DISSPLA and TELL-A-GRAF, SAS/GRAF and Digital Research CP/M-based Graphic System Extension.

Our M-84 is colorful—8 pens, 8 colors. The high number of pens means faster plots and easier operation because users won't have to switch pens to get more colors.

Don't wait to get your M-84. Call your CalComp representative today.

California Computer Products, Inc., M/S3, 2411 West La Palma Ave., Anaheim, California 92801. In continental U.S. except California, call (800) 556-1234, ext. 156. In California (800) 441-2345, ext. 156.

**CALCOMP**  
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# New Products

## DATACOMM

### Local-area network supports multiple microcomputers, operating systems

The ShareNet Networking System includes hardware and software for networking as many as 24 personal computers. In the ShareNet System, personal computers are connected via a local-area network to a Motorola MC68000-based network manager and file server. The MC68000 runs an operating system that administers shared resources, including 20M to 120M bytes of on-line disk storage, 256K bytes to 1M byte of RAM and as many as five printers.

The ShareNet operating system is vendor independent for both the microcomputer workstation and the microcomputer operating system. As a file server, the ShareNet operating system allows different operating systems running on networked microcomputers to share the same directory areas and data files concurrently. For example, an IBM Personal Computer running under PC-DOS and a Z80-based microcomputer running under CP/M-80 can view the same directories and access the same file structures. The ShareNet directories appear as logical drives under the respective operating systems. Security for the data on the network disk is imposed at the file, user, user group and directory levels. ShareNet software manages as many as five network printers in a spooled

fashion. Pipes are provided for direct station-to-station communications.

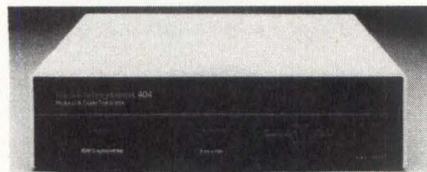
The basic topology of the ShareNet System is a Star network. Each workstation has its own cable connected to the network processor, with the network processor as the center. Personal computers connect to the network through a network interface card. Data-communications rate is 300K to 500K baud for each station. The Star topology allows each workstation to send and receive packets at its own rate without data path contention with other workstations.

A six-port network processor is priced at \$7995 in single-unit quantities. A node processor that converts a dumb CP/M terminal into an intelligent workstation and interfaces the terminal to the network processor is priced at \$1721. A network interface card for an IBM Personal Computer is priced at \$250. Network shared disk drives are priced from \$5000 to \$9000. **Novell Data Systems Inc.**, 1170 N. Industrial Park Dr., Orem, Utah 84057. **Circle No 326**

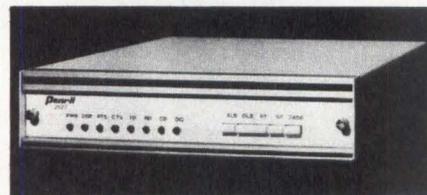
#### Protocol translators allow communications

The models 101, 202 and 404 protocol translators allow normally incompatible word-processing systems to communicate with each other, thus eliminating the need for physical transfer and manual rekeying of documents. The model 101 is designed for business applications in which text conversion is required between two word processors. Complete translation of text is handled internally by the fixed protocol software located in the model 101 EPROM. The user selects two protocols to match those of both end word processors when ordering the model 101. The model 202 provides on-line network capabilities among different word processors. A private communications network is formed by installing a model 202 at each site and connecting them over hard-wire circuits or voice-grade telephone lines. The model 202 uses a plug-in cartridge system offering a selection of 17 protocols. The model 404 protocol translator allows a wide variety of word

processors at separate locations to communicate with a central word-processing system. All protocol translation in receive or send operation is



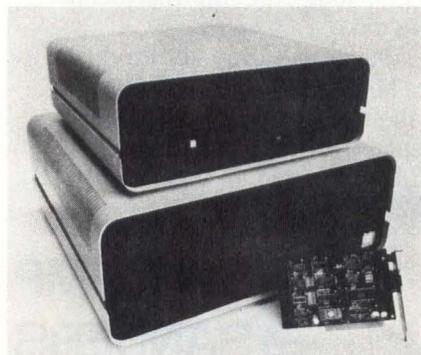
handled by the model 404 located at the central site. A dual, plug-in cartridge system for protocol translation eliminates the need for a protocol translator at both ends. All three models operate at data rates from 50 to 9.6K baud and feature built-in self-diagnostics, error reporting and inclusion of error codes on received documents. In addition, the models 202 and 404 feature a user-selectable direction of translation and automatic sequence initialization. Prices are \$3995, \$3195 and \$4995 for the models 101, 202 and 404, respectively, in single-unit quantities. **Racal-Telesystems Inc.**, 410 N. Michigan Ave., Chicago, Ill. 60611. **Circle No 327**



#### LSI modem features low error rate

Operating at 4800 or 2400 bits per sec., the model 2027 LSI modem can be used on two- or four-wire leased lines in point-to-point or multi-point applications. The CCITT V.27 bus-compatible modem includes an automatic adaptive equalizer that adjusts for variations in line properties. Other features include a selectable data quality alarm that alerts the operator if the error rate exceeds one error in  $10^5$  bits. The 2027 stand-alone model has a single-quantity price of \$1595. Rack-mount and single-card OEM versions are also available. **Penril Corp.**, 5520 Randolph Rd., Rockville, Md. 20852.

**Circle No 328**



**Novell Data Systems' ShareNet networking system** is built around an MC68000-based network processor, a central disk subsystem shared by all nodes on the network and individual network interface cards for each workstation. Software for electronic mail and database management is optional.

NEW...

from DATARAM

# MOTOROLA VERSAbus 1.0 MB ADD-IN

## Not just more capacity; more capability

Motorola's 68000 is a winner, and using this popular microprocessor in a VERSAbus/VERSAbord configuration is a smart move. Dataram's new single-board 1.0 MB DR-680 can make it even smarter. Increased single-board memory capacity means lower power, less space, higher reliability, and lower cost...and the DR-680 provides a lot more!

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**Advanced error handling:** The DR-680 provides an on-board control and status register (CSR) which allows program control of ECC functions and contains the diagnostic information required for error analysis. The CSR can be read or written via the VERSAbus. Additionally, the DR-680 greatly increases reliability by performing error "sniffing" and error "scrubbing" during refresh operations.

**Availability:** Best of all, the 1.0 MB DR-680 is available now. And it comes with Dataram's standard one-year warranty.

For more information, send in the adjacent coupon or, for faster response, call Dataram today at (609) 799-0071.

VERSAbus and VERSAbord are registered trademarks of Motorola, Inc.

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# DATARAM

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# Before you buy a printer look at the fine print.

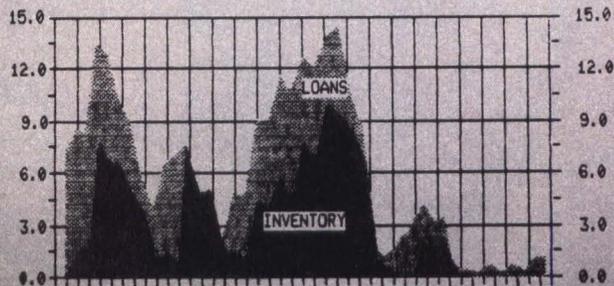
There's a big difference in printers, and the proof is right before your eyes.

This is an actual printout from Digital's Letterprinter 100. As you can see, it's good enough to send out to customers.

But that's not all the Letterprinter 100 can do. Suppose, for instance, you're in a hurry.

JUST PUSH A BUTTON AND YOU CAN PRINT OUT A WHOLE PAGE OF DRAFT COPY IN LESS THAN TEN SECONDS.

There are other fine points. You can see how the Letterprinter 100 can print multiple typefaces. It can also print in **BOLD**, **double-width** and *condensed*. And do all these styles automatically, without stopping. And with its wide range of graphics capabilities, you can even draw your own conclusions.



You simply can't find a more versatile printer than the Letterprinter 100. And it's just one of a family of printers we offer for Digital's personal computers and video terminals. Including a daisy-wheel printer, the LQP02, and a low-cost Personal Printer, the LA50, that still make you look good on paper.

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Or write Digital Equipment Corporation, Terminals Product Group, 2 Mt. Royal Avenue, UP01-5, Marlboro, Ma. 01752.

digital

# New Products

## SOFTWARE

### KBASIC has file-management capabilities

KBASIC integrates Microsoft's MBASIC interpreter with keyed indexed-sequential search routines that provide multi-key indexed-sequential and direct-access record management using 14 file-handling verbs. The file managers maintain deleted-record buffer tools and space-allocation checkpoints, eliminating the need for user file-maintenance operations. A single program can have as many as four ISAM files and 16 DAFM files open simultaneously. Direct-access files accept record sizes from 64 to 512 bytes long. KBASIC runs on 8080/8085- and Z80-based microcomputers under the CP/M or TurboDOS operating system. Price is \$475. **Eidos Systems Corp.**, P.O. Box 3216, Nashville, Tenn. 37219.

Circle No 329

### Performance analyzer measures data-processing

Series/1 Performance Analyzer runs on IBM Series/1 computers under the EDX operating system to measure data-processing activity. A single program can be analyzed iteratively to determine which source statements are using excessive computer resources. During successive iterations, the analyzer observes progressively narrower ranges of statements until the problem is pinpointed. The analyzer can also be used to examine system behavior when several programs are competing for resources. Disk-file and central-processor usage are tracked for each program to identify wait time and contention problems. A corporate license is priced at \$3500. **H&A Computer Systems Inc.**, 30 Hoteling Place, San Francisco, Calif. 94111.

Circle No 330

### Program aids multidrop-network design

Optinet, running on Apple II microcomputers, is intended to design and predict line charges for intercity multidrop data networks. The package incorporates AT&T interstate tariffs and location information for 212 cities and uses the Esau-Williams algorithm in cost computation. A user can add tariffs and data for other cities. The analyst specifies the central site and other nodes of the planned network. Optional entries

include amount of traffic expected at each node and maximum number of drops and maximum traffic permitted in each network segment. Optinet then defines a network said to minimize monthly charges and satisfy the entered constraints. Price is \$599. **Le Roux International Inc.**, 3090 Acushnet Ave., New Bedford, Mass. 02745.

Circle No 331

### Software simulators test application programs

A line of software simulators that runs on DEC PDP-11 computers helps programmers test application software for Intel 8080/8085 and 8086/8088 and Zilog Z80 microprocessors. Each simulator provides major functions and features of a microprocessor including instruction execution, hardware registers, input/output and interrupts. Intel hex files can be loaded into simulated memory. Programs execute under breakpoint control; trace mode provides execution history. Contents of registers and memory can be displayed and modified. Assembly, disassembly, symbolic debugging and relocatable values are provided. A count of executed cycles is kept. Prices start at \$1400. **Virtual Systems Inc.**, 1500 Newell Ave., Walnut Creek, Calif. 94596.

Circle No 332

### Mainframe development supports Displaywriter, PC

VM-86, a multitasking, multi-user supervisor with virtual memory for both the IBM Displaywriter and the IBM Personal Computer, and V1.4, a virtual COBOL Host compiler for OS/VS, permit users of IBM's most popular small computers to develop and maintain interactive COBOL applications centrally using mainframe-development tools and communications. The Virtual COBOL Host compiler can be used in batch and interactive mainframe environments to develop and maintain interactive COBOL applications for VM-86. The output of the compiler can also be used with the IBM Virtual COBOL System Executive for the Series/1. VM-86 provides a multitasking, multi-user virtual-memory system equal to the IBM Virtual COBOL System Executive including dynamic JCL, logical resource sharing, device-independent I/O, indexed data files, sort, timer support and communications

facilities. The system features time-slicing, priority dispatching and paging support for Virtual COBOL applications developed using the Virtual COBOL System Executive on an IBM Series/1. Perpetual license fees for the Virtual COBOL Host compiler and VM-86 are priced at \$5000 and \$1000, respectively, per system. **Advanced Software Products Inc.**, 100 E. Linton Blvd., Tower B, Delray Beach, Fla. 33444.

Circle No 333

### Cross-reference facility runs on 6809 computers

XRF, a cross-reference facility for Motorola 6809-based microcomputers using the OS9 operating system, simulates the abilities of a full database system without the related overhead in CPU time and disk usage. Using Boolean logic, XRF routines maintain a separate ISAM file containing the information to link logically associated records. The primary data ISAM file can be considered a multiple-key file when used with XRF. XRF must be used with the vendor's ISAM software. The ISAM software features sequential and random access in any combination for keyed and unkeyed records. XRF is priced at \$100 if purchased at the same time as ISAM (priced at \$350). If purchased separately, XRF is priced at \$200. **JBM Group Inc.**, Department 11C, 332 W. Church Rd., King of Prussia, Pa. 19406.

Circle No 334

### Interface package links Displaywriter to IBM hosts

With this interface package, an IBM Displaywriter word-processing station can be used as an interactive terminal to communicate with an IBM System/34, System/38 or 370 host via the SDLC or BSC protocols. The package operates with the vendor's Gateway software, running in an IBM Series/1 computer that acts as a front end to the host. The Displaywriter connects to the Gateway computer via direct-connect, direct-dial, leased-line or X.25 packet networks and communicates with it at speeds as high as 9600 bps. The Displaywriter appears to the host as a 5251 or 3270 terminal on a multidrop line. The Displaywriter-resident software is priced at \$300. **Systar Corp.**, 1762 Technology Dr., San Jose, Calif. 95110.

Circle No 335

# New Products

## LITERATURE



### Guidebook on using data-conversion products

The 32-page Designers' Guide and Handbook for data-conversion products details formulas, definitions and application considerations for building signal-processing systems that meet a user's real-world requirements. The book also includes condensed specifications and selection criteria for a broad range of A/D and D/A converters, sample-and-hold circuits and ancillary devices useful in creating precision signal-handling circuits and systems. **Analogic Corp.**, Audubon Rd., Wakefield, Mass. 01880. **Circle No 336**

### Reference helps locate software for DEC computers

This 228-page software-referral catalog lists and describes more than 600 engineering-application software packages that are compatible with Digital Equipment Corp.'s computer systems. It covers chemical, civil/architectural, CAD/CAM, earth-resource, electronic, mechanical, optical, power-systems and structural engineering. General engineering tools and management and administration packages are also covered. A companion volume, the 69-page graphics-referral catalog, lists and describes more than 175 graphics hardware devices and software tools that are compatible with DEC computer systems. It covers display, hard-copy and input devices. **Digital Equipment Corp., Engineering Systems Group**, Two Iron Way, Box 1003, Marlboro, Mass. 01752. **Circle No 337**

### Resale telephone networks described

A three-panel, color brochure describes the field of resale telephone networks with emphasis on required switching equipment. It details how deregulation in the telecommunications

industry permits entrepreneurs, inter-connect companies, hotels and others to resell the services of common carriers, satellite networks, AT&T and others. The publication explains how features of the vendor's tandem switching systems, such as automatic route selection and detailed station-message accounting, increase profits by routing calls through the optimal calling path and ensure accurate customer billing. **Harris Corp., Digital Telephone Systems Division**, Novato, Calif. 94948. **Circle No 338**

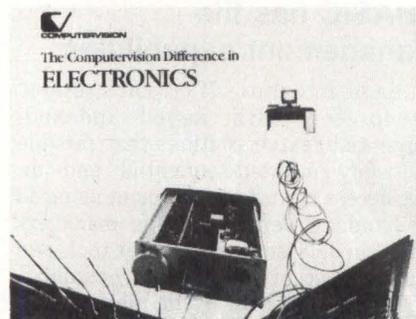


### Power sources catalog explains power problems

A six-page product catalog describes the potential electric-power problems confronting users of high-technology equipment and details the vendor's line of motor-generator-based load-isolation computer power conditioners, rotary uninterruptible power supplies and frequency converters. The brochure also provides product warranty information and service provisions. **Computer Power Products**, 227 E. Compton Blvd., Gardena, Calif. 90248. **Circle No 339**

### Magnetic-tape drives for DEC, DG computers

A family of magnetic tape drives for DEC and DG computers is described in an illustrated, color brochure. The brochure provides details, features and specifications of the company's DMT3000 series rack-mountable digital magnetic-tape drives. These drives connect directly to the DEC PDP-11, LSI-11, VAX-11 and DG Nova and Eclipse computers without program changes. **Unitronix Corp.**, 197 Meister Ave., Somerville, N.J. 08876. **Circle No 340**



### Brochure describes use of CAD/CAM in electronics

A 12-page color brochure describes how the vendor's Designer CAD/CAM system can increase productivity in electronic design and manufacture. The brochure describes how the Designer system can be used for the design and manufacture of integrated circuits, hybrid circuits, PC boards, wiring diagrams and electromechanical packaging. **Computervision Corp., Marketing Communications Department**, 3 Oak Park, Bedford, Mass. 01730. **Circle No 341**

### Card badge reader is used in industrial applications

The vendor's line of serial and static punched-card and badge readers for industrial applications in warehousing, assembly lines, process controls and security systems is described in an 18-page catalog. The illustrated catalog details the series HT manual badge-/card-reader terminals, motorized serial readers and microprocessor-controlled card readers. The catalog also includes information on static or parallel readers. **Taurus Corp.**, Box 278, Lambertville, N.J. 08530. **Circle No 342**

### Computer-based instructional aids listed

Offerings in the vendor's Microcourse series in reading and language arts for grades three to eight are listed in a four-page brochure. These software-based curriculum materials cover more than 350 skills on 114 diskettes in reading and more than 440 skills on 136 diskettes in language arts. The brochure groups the diskettes into grade levels and lists the diskettes by title within each grade level. **Houghton Mifflin Co.**, One Beacon St., Boston, Mass. 02108. **Circle No 343**



# Take your data places it's never been before.

Fiber optics technology can not only dramatically increase your data transmission capabilities, it can also simplify all the practical problems associated with linking computer systems and peripherals in local networks. It provides data security and freedom from interference unattainable with traditional wire-only systems.

As a major step towards making fiber optics available for every plant or office application, Hewlett-Packard is pleased to announce the HP 39301A multiplexer. It accommodates up to 16 peripherals and allows you to send data at distances up to one kilometre at speeds up to 19.2 kbps per channel simultaneously with a bit error rate of less than  $10^{-9}$ . It is

completely compatible with your existing RS-232-C (V.24) I/O ports.

The information you need to evaluate the potential of fiber optics for your application has been put into a new brochure, "The Hewlett-Packard Fiber Optic Multiplexer," that is available free for the asking.

**Show me!** I'd like the facts on how HP's fiber optic technology can make my data communications more productive. Please send me my free copy of "The Hewlett-Packard Fiber Optic Multiplexer" immediately.

NAME _____	TITLE _____
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YOUR COMPUTER _____	INTENDED CONFIGURATION _____

In the U.S., mail coupon to: Hewlett-Packard Company • 640 Page Mill Road • Palo Alto, CA 94304.  
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# New Products

## LITERATURE

### Brochure explains architected software

A 12-page, color brochure describes the "architected" software approach used on the vendor's new family of array processors. The brochure contains an overall description of how the software is architected into strictly defined functional layers that are fine-tuned to corresponding system components and application needs. Sections are included on software tools for application development including AP Linker, Assembler and Interactive Debugging Tools. In addition, the run-time system software and AP function libraries are described as well as the software services available. **Analogic Corp.**, Audubon Rd., Wakefield, Mass. 01880. **Circle No 344**

### Tektronix-compatible graphics featured

An updated, six-page brochure describes the second generation of

Retro-Graphics terminal enhancements. Called GEN.II Retro-Graphics, the low-cost, PCB kits convert standard alphanumeric displays into Tektronix-compatible, bit-map graphics terminals. The full-color brochure also details the company's history, product manuals, warranties, services and line of I/O interfaces used in interactive Retro-Graphics applications. **Digital Engineering Inc.**, 630 Bercut Dr., Sacramento, Calif. 95814. **Circle No 345**

### Ada style manual illustrates program structuring

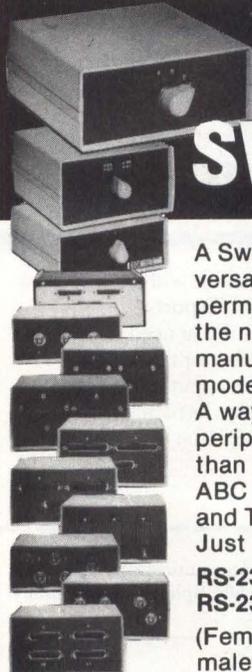
This six-page guide for Ada application programmers illustrates techniques for efficient program structuring. Numerous examples show preferred methods for in-house standardization of program syntax. The style recommendations are based on the examples in the *Reference Manual for the Ada Programming Language*, U.S. Department of Defense, July, 1982, with additions and changes made as a result of the

vendor's discoveries and usage experience. **Intellimac Inc.**, 6001 Montrose Rd., Rockville, Md. 20852.

**Circle No 346**

### Basic industrial-control described in brochure

The vendor's BASIC industrial-control packages as well as its line of industrial-grade microcomputer modules are illustrated and described in a brochure. Featured are the RacPac 8 and RacPac 12 industrial rack-mount enclosures and 1872+ Industrial BASIC module. The products are intended for control, data acquisition and similar applications and are designed, manufactured and tested to operate reliably in industrial and other harsh environments. The brochure also lists the vendor's industrial-software offerings and its customer-service capabilities. **Xycom Inc.**, 750 N. Maple Rd., Saline, Mich. 48176. **Circle No 347**



Make the most of your hardware

## SWITCH-IT

A Switch Box can add to the versatility of your equipment—permanent connections avoid the need to change cables manually to and from terminals, modems, CRT's, for example. A way to make CPU's or peripherals do extra duty. More than a dozen different kinds of ABC and ABCDE switch boxes, and Transfer Boxes in stock. Just for instance:

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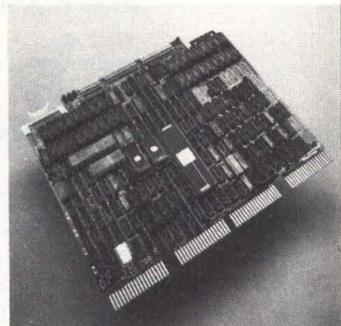
CIRCLE NO. 153 ON INQUIRY CARD

## 12MHz 68000 Based CPU On LSI-11\* Bus • Runs UNIX\*

You don't have to combine the high performance of a 12MHz 16/32 bit processor with the wide variety of peripherals available on the LSI-11 Q-bus and the versatility of the powerful UNIX operating system. We already have—with the IS-68K from Integrated Solutions.

### CPU Features

- Single board, quad form factor
- 256Kb on-board, dual ported parity memory
- Dual bus design permits expansion of on-board memory to 4Mb with 1Mb array cards (available now)
- On-board and expansion memory runs with **no wait states**
- Hardware Q-bus arbitration logic allows 68000 to execute while DMA transfers occur
- 2 serial ports—programmable baud rates
- MMU: segmentation, paging system optimized for UNIX
- CPU can also use memory on Q-bus
- 8, 10, 12MHz versions (10MHz version exceeds performance of VAX 11/750\*)



### UNIX Features

- Full System III UNIX with enhancements
- Supports full range of Q-bus peripherals

CPU prices start at \$2395. Shipping **now** (delivery 30 days ARO). OEM, rep., distributor inquiries welcomed. For more information write or call:

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**Integrated Solutions, Inc.**

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\*LSI-11, Q-bus, VAX 11/750 are registered trademarks of Digital Equipment Corp. UNIX is a trademark of Bell Labs.

CIRCLE NO. 112 ON INQUIRY CARD

# TOWER™ 1632.

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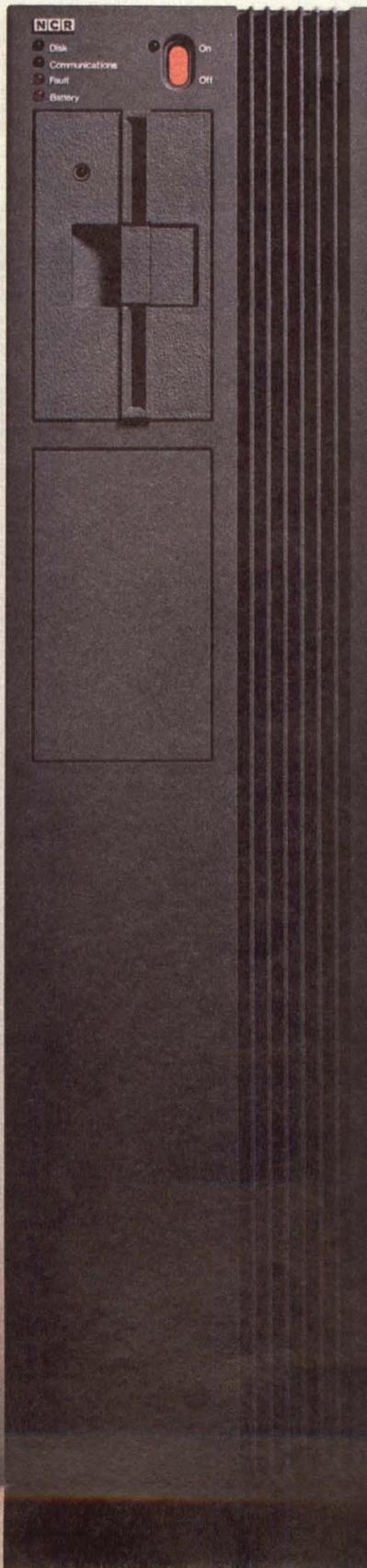
We call it "computer a la card."

Up to six microprocessor-based controller cards mounted into Tower™ 1632's Multibus\* give system builders a range of hardware options until now available only to those with the resources to design, develop and manufacture a totally new system from the ground up.

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It's the system builder's ideal foundation. Mass storage



options, for example, range from a megabyte to a gigabyte. From networking to peripherals, it's as ready for the future as it is right for today. And the operating system, derived from UNIX\*\*, delivers maximum software capability and portability.

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OEM Marketing Division

**CIRCLE NO. 154 ON INQUIRY CARD**

\*Multibus is a trademark of Intel.  
\*\*UNIX is a trademark of Bell Laboratories.

Products for delivery in U.S.A. will comply with appropriate FCC rules.

# New Products

## LITERATURE

### LITERATURE THAT COSTS

#### Reference discusses cryptographic systems

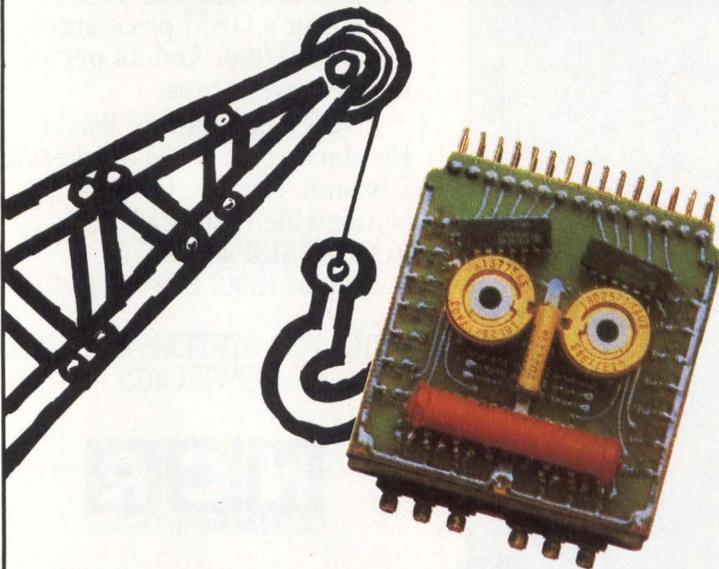
*Cryptography: A New Dimension in Computer Data Security* is an

application-oriented guide to planning, designing and implementing cryptographic systems for protecting information transmitted through large communications networks such as telephone lines, microwave or satellite. Written by Carl H. Meyer and

Stephen M. Matyas, the 755-page book is geared for non-experts confronted with problems of cryptographic design and implementation within a communications network or electronic data-processing system. The authors show what problems can be solved using cryptography, when cryptography is a solution to a data-security problem and when it is only a partial one. Single-copy price is \$39.95. **Wiley-Interscience**, 605 Third Ave., New York, N.Y. 10158.

Circle No 348

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### Research tool provides access to standards

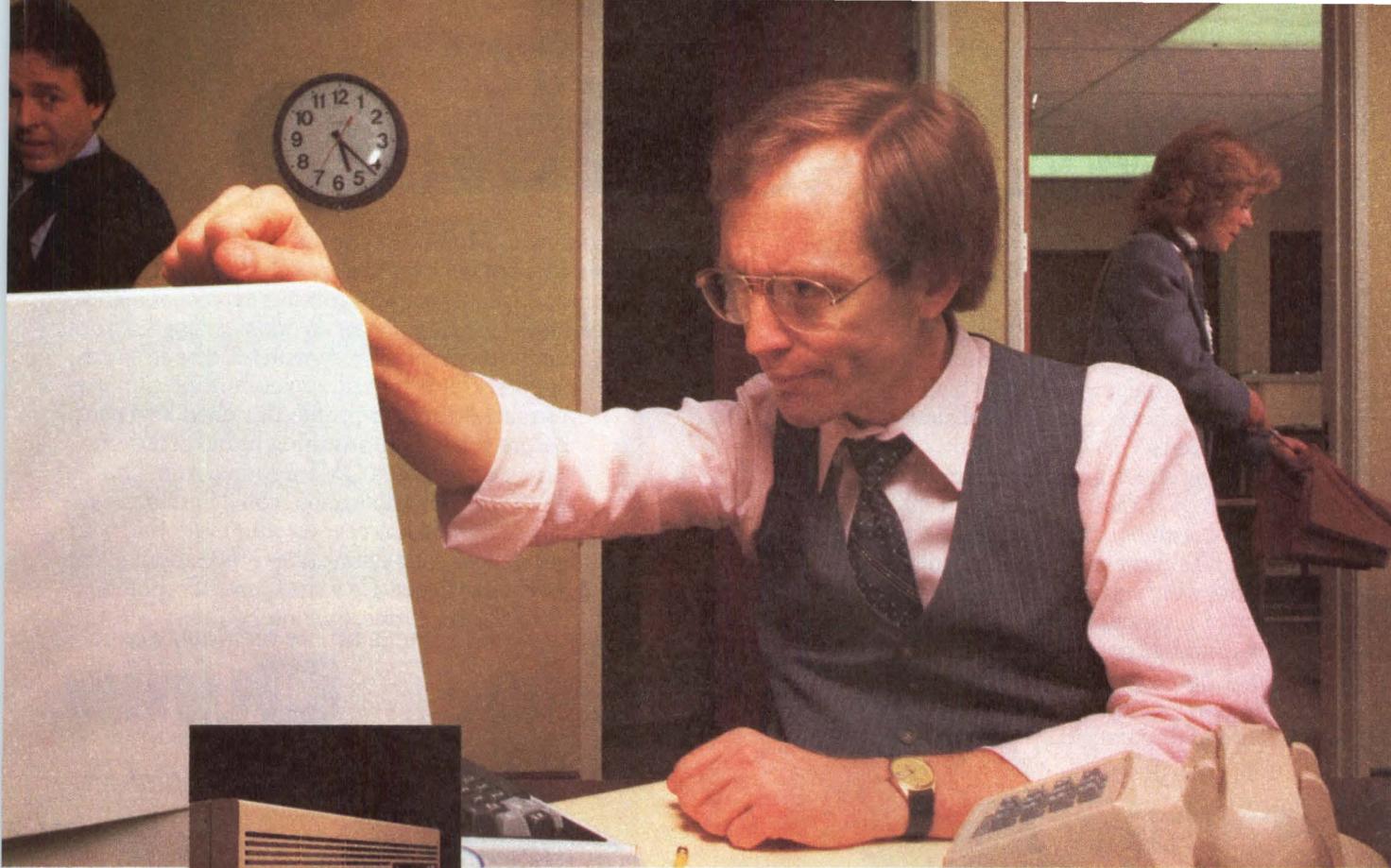
The 1983 edition of the *Catalog of American National Standards* lists all current ANSI-approved standards. The standards establish dimensions, ratings, terminology and symbols, test methods and performance and safety requirements for materials, equipment and products ranging from abrasives to zippers. The 192-page catalog is divided into two major sections. One section lists the titles of all standards under alphabetic subject headings. Each entry includes title, designation, price and discount information if applicable. The other section is a compilation of the designations of all standards listed. Each entry refers to the subject heading under which the complete listing appears and also gives price and discount information. Single-copy price is \$10. **American National Standards Institute Inc.**, 1430 Broadway, New York, N.Y. 10018.

Circle No 349

### Telecommunications reference manual

The 350-page *Executive Telecommunications Planning Guide*, which is updated monthly, contains a glossary of terms, a directory of common carriers with rates and descriptions of all their service offerings, a list, by area code and exchange, of all the U.S. rate centers, a chart showing the availability (by city) of each of the full-period and measured-use services, traffic tables, carrier interconnection specifications, a tariff directory and an intercity mileage chart. The guide also contains cost-of-service estimating guides, frequently used telecommunications formulas and conversion tables, operator position planning data,

CIRCLE NO. 155 ON INQUIRY CARD



## “What good is 9600 baud if your stat mux slows you down?”

Speed can be addictive, that's a fact. Once users get accustomed to fast feedback they just don't want to hear that your lines are overloaded or your mux just can't keep pace. They want their data and they want it now.

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Want more? How about local or remote echoplex, full field expansion, CRC error detection and ARQ retransmission, speed conversion—plus the same dependable service we've been giving the telecommunications industry for more than 15 years.

It's a combination that's really hard to beat, in a mux for people who'd rather be working than waiting. Call 1-800-227-3800 Ext. 2301 (in California 1-800-792-0990) or write Teltone Corp., PO Box 657, Kirkland, WA 98033. In Canada call (406) 475-0837 or write 91 Telson Road, Markham, Ontario L3R 1E4.

**TEL TONE**

CIRCLE NO. 156 ON INQUIRY CARD

# Our 14" screen option won't strain your eyes. Or your budget.

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readability to what is already the best CRT in its class. Screen size is only one reason why QVT terminals have the clear edge for operator comfort and convenience. There's also Qume's superior ergonomic design: a non-glare green or amber display, with full tilt and swivel. A big 9x12 character cell to even further minimize eyestrain. And a low-profile, detached keyboard.

Before you choose any other brand of terminal, size it up against a QVT terminal from Qume. Whatever your application, you'll find the QVT family of terminals is easy on your eyes. And your budget. Talk to your Qume sales office about filling all your terminal needs. Or write Qume Corporation, 2350 Qume Drive, San Jose, California 95131.  
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# New Products

## LITERATURE

modem interface specifications and strapping arrangements. Annual subscription fee is \$450. **Center for Communications Management Inc.**, P.O. Box 324, Ramsey, N.J. 07446. **Circle No 350**

### Book exposes TRSDOS 2.3 operating system

Authorized by the Tandy Corp., *TRSDOS 2.3 Decoded and Other Mysteries*, by James Favour, guides programmers through the internal operations of the TRSDOS operating systems of the Radio Shack model 1 computer. Although a knowledge of basic computer architecture and assembly language is assumed, the reader need not be familiar with the details of either on the model 1, as the significant features of both are presented in the text. The book details the components of the TRSDOS operating system including file-system modules, the command-line interpreter, the error-message processor and the debug module. The entire TRSDOS operating system code with detailed comments is included in an appendix. Single-copy price is \$29.95. **IJG Inc.**, 1953 W. 11th St., Upland, Calif. 91786. **Circle No 351**

### Standard specifies expanded keyboard

The ANSI X4.23-1982 standard provides recommendations on the arrangement of a 48-key, 96-character keyboard for typewriters, word processors and other alphanumeric-keyboard machines. The standard provides specifications for the keyboard arrangement of the 44 basic printing keys. It also provides for four additional keys and supplies users and manufacturers with recommended graphic characters and substitutions for extra keys. Graphics characters suggested for placement on the additional keys include the symbols for degree, plus/minus, left and right brackets, superscripts 2 and 3, paragraph, section, less than, greater than, the Greek  $\mu$  and product dot. Copies of the standard are priced at \$5 each. **American National Standards Institute Inc.**, 1430 Broadway, New York, N.Y. 10018. **Circle No 352**

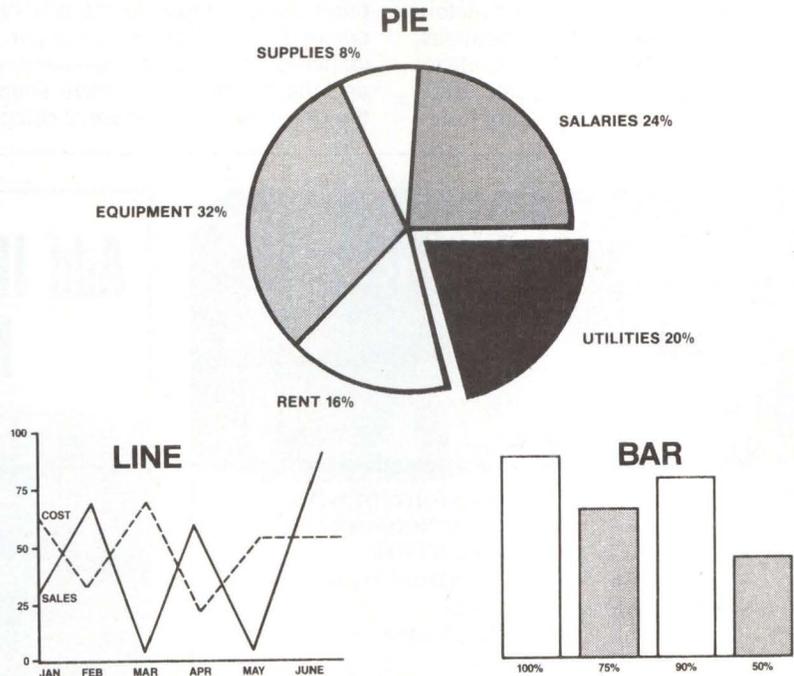
### Second volume on database systems

A sequel to the author's previous book on the same subject, the 383-page *Introduction to Database Sys-*

*tems, Volume II* provides an in-depth tutorial on a variety of topics that were excluded from the earlier book. Author C.J. Date describes the principles underlying recovery, concurrency and security of database systems with examples from implemented systems.

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CIRCLE NO. 158 ON INQUIRY CARD

# New Products

## LITERATURE

He also discusses semantic modeling, the treatment of missing information and distributed transaction management. Single-copy price is \$26.95. **Addison-Wesley Publishing Co.**, Reading, Mass. 01867.

Circle No 353

### Directory describes computer publications

Designed for information specialists and others interested in industry publications, *Select: A Guide to Computer and Software Publications*, is a directory of serial publications serving the computer and software industries. Scheduled for shipment in September, the directory describes more than 500 publications. *Select* serves as a reference guide for identifying industry periodicals. Each entry in the directory includes

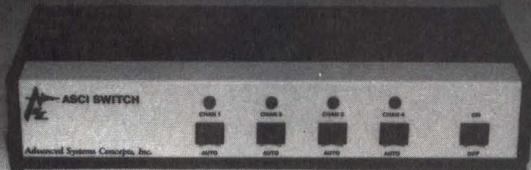
publication name, content description, cost, publisher and address, average number of pages, audience and advertising information. The directory also has an alphabetical list of publications and indexes to publishers and topics. The pre-publication price for *Select* is \$50. After Sept. 1, 1983, the directory will sell for \$65. **Data Courier Inc.**, 620 S. Fifth St., Louisville, Ky. 40202. Circle No 354

### Report explores Japanese personal computers

Volume 52 of the JIPDEC report, *RUN Personal Computers*, contains four articles that explore the sale and use of personal computers in Japan. The first article, "Trends in Personal Computer Usage," presents the history of personal computer use in Japan. It identifies the major manufacturers and the machines that have shaped the development of personal comput-

ers in Japan. The second article, "Distribution of Personal Computer Hardware/Software," outlines the distribution systems established in Japan for personal computer products and the various sales strategies employed by retailers. The third article, "Personal Computer Schools," deals with the educational and training applications of personal computers in Japan. The final article, "OMRON Tateishi Electronics Co.—An Example of Personal Computer Utilization," relates the experiences of a major Japanese company in its efforts to introduce personal computers into all phases of its operations. The JIPDEC report is published quarterly and is available for an annual subscription fee of \$85. **Japan Information Processing Development Center**, Kikai Shinko Kaikan Building, 5-8, Shibakoen 3-chome, Minato-ku, Tokyo, 105, Japan. Circle No 355

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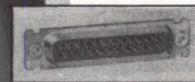
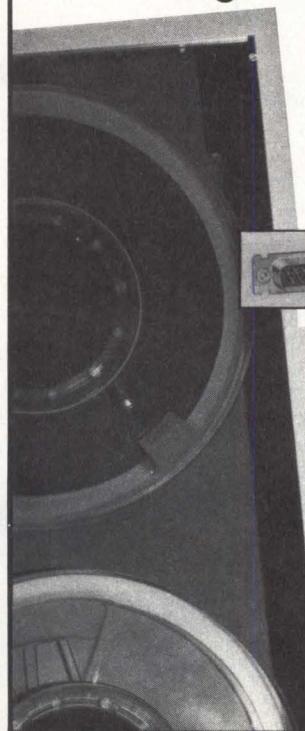
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MINI-MICRO SYSTEMS/July 1983

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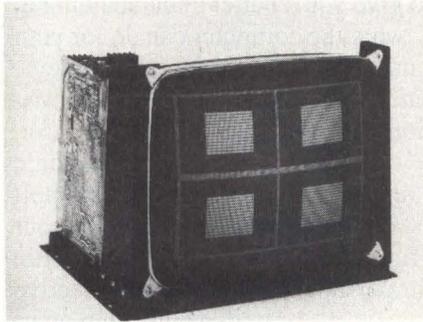
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708 Third Avenue, New York, NY 10017

# New Products

## SUBASSEMBLIES



### Monitors feature long-term reliability

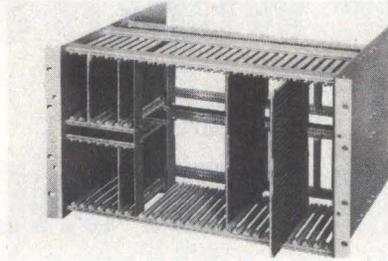
A family of high-resolution monochrome CRT monitors for graphics, workstation and composition system OEMs includes models with 15-, 17- or 19-in. diagonal CRTs. Monitors are available with as many as 1100 visible lines at a 60-Hz noninterlaced refresh rate and a choice of 70- or 120-MHz video amplifiers. The 70-MHz video amplifier accepts TTL, linear or ECL levels, while the 120-MHz video amplifier interfaces to differential ECL. Interlaced or noninterlaced 90-Hz vertical refresh rates and horizontal rates from 30 to 65 KHz are available. These CRT displays have been designed for long MTBF through conservative derating and low junction-temperature operation. Included on all monitors are a stator yoke, regulated high-voltage and dual-axis dynamic focus. For ease of maintenance, all electronics are on a single swing-out PC board. Diagnostic LEDs on all major circuit functions allow quick determination of status without test equipment. The monitors are available with any JEDEC phosphor, contrast-enhanced faceplates and anti-reflection coatings. Prices of the 70-MHz monitors range from \$685 to \$799 in OEM quantities. U.S. Pixel Corp., 125 Irving St., Framingham, Mass. 01701.

Circle No 356

### Eurocard rack for double-sized VME boards

The model CCKE2 high-capacity rack allows placing single- and double-sized VME-bus-compatible boards in one enclosure and has space in the rear for mounting large power supplies. The 19-in. EIA standard cage holds as many as 27 double-sized (6.3 × 9.19 in.) Eurocards or as many as 54 single-sized (6.3 × 3.94 in.) Eurocards. The CCKE2 can also be configured to accommodate a

combination of Eurocard sizes. Bus interconnections are made with one 96-position connector on the single card and two connectors on the double card. Card-guide and connector-mounting holes are spaced on 0.2-in. centers, so that cards with varying components and



lead heights can be installed in any position. As the rear of the rack, a 10.5 × 16.8 × 5.5-in. space is available for power supplies with 1-in. clearance for backplane wiring. The rack measures 10.5 × 19 × 14.25 in. and weighs 5.7 lbs. Price is \$56.82 for the unassembled version, model CCKE2U, and \$68.18 for the assembled version, model CCKE2, in single-unit quantities. Vector Electronic Co., 12460 Gladstone Ave., Sylmar, Calif. 91342.

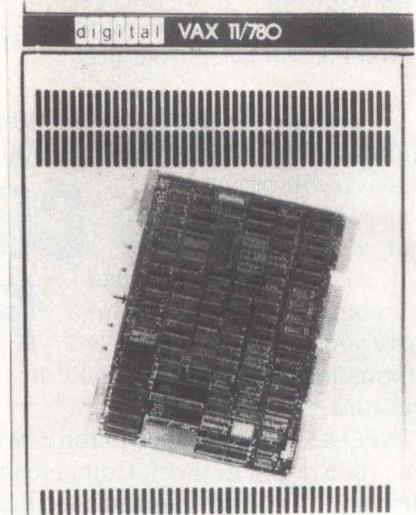
Circle No 357



### Test instrument combines emulator, logic analyzer

The model 4009 emulator/logic analyzer for Motorola microprocessors combines a microprocessor emulator and an optional independently operated, 20-MHz, 32-channel logic analyzer into one instrument. It also features special digital-test-equipment functions such as clock operation and standby monitors, memory and bus testing, target system power monitor and voltage measurement. A separate 2-MHz, 6809E-based computer serves as the 4009's system supervisor. Measuring 17½ × 15 × 5¾ in., the model 4009 includes an emulator card set and pod assembly that supports the 6809 and 6809E processors, emulator trace, supervisory controller and an RS232C port. It is priced at \$6495 in single-unit quantities. The 32-channel

logic analyzer is priced at \$3995. Advanced Digital Technology Inc., 13400 Northrup Way, Building 27, Bellevue, Wash. 98005. Circle No 358

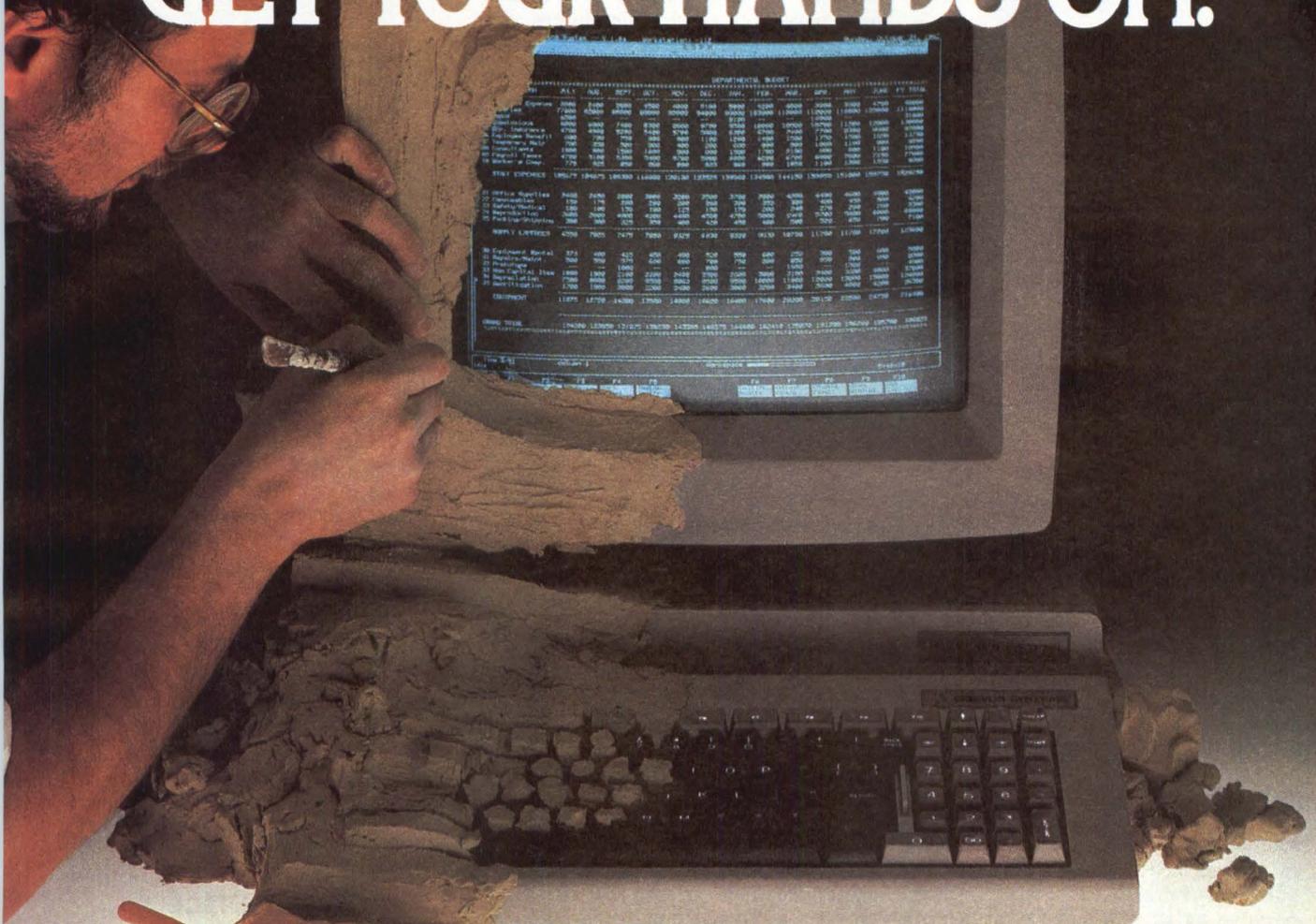


### Coupler interfaces tape drives to DEC superminis

The model DU132 tape coupler interface board provides streaming- and start/stop-tape backup for Digital Equipment Corp. PDP-11/34 through PDP-11/70 minicomputers as well as VAX-11/750, VAX-11/780 and VAX-11/782 superminicomputers. The device interfaces with ½-in., start/stop, formatted nine-track tape transports from all major manufacturers or streaming-tape transports with embedded formatters from Cipher Data Products, Control Data Corp., Kennedy Co. and System Engineering Labs. The coupler permits data-transfer rates as high as 200K bytes per sec., with tape speeds as fast as 125 ips. When used in start/stop mode, it is software compatible with DEC VMS, RSTS/E, RSX-11M and RT-11 operating systems. A stand-alone utility software package accommodates the streaming-tape transports. A pair of 50-conductor ribbon cables links the DU132 with as many as four tape transports in a daisy-chain interconnection at distances as far as 25 ft. The DU132 is implemented on a standard DEC quad-width module measuring 10.44 × 8.42 in. Single-unit price is \$2850, with quantity discounts available. Distributed Logic Corp., 12800 Garden Grove Blvd., Garden Grove, Calif. 92643.

Circle No 359

# THE SOFTEST PIECE OF HARDWARE YOU'LL EVER GET YOUR HANDS ON.



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The Corvus Concept has a real soft spot in its heart for OEMs and systems integrators. That's why we offer so many software tools—ISO Pascal, FORTRAN 77, and many more. Plus plenty of internal

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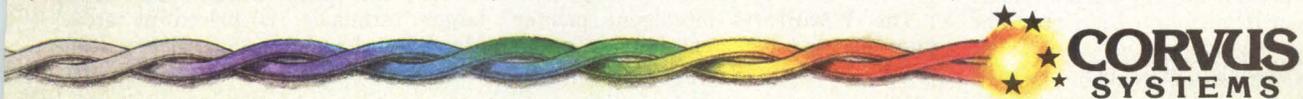
Our user interface is as soft a sell as you'll ever find, too. Take display formats, for example. With a fully bit-mapped screen—720 by 560 pixels—the Concept lets you mix any combination of graphics and text you want. Or create any character font your customer needs.

For display positions, the Concept is an equally soft touch. Horizontally, the screen can display 120 characters by 56 lines. Flip the screen vertically and you can display 80 characters by 72 lines. We've combined that flexibility with multiple

windows, finger-tip tilt and swivel adjustments, and 10 soft keys that define up to 40 displayed functions.

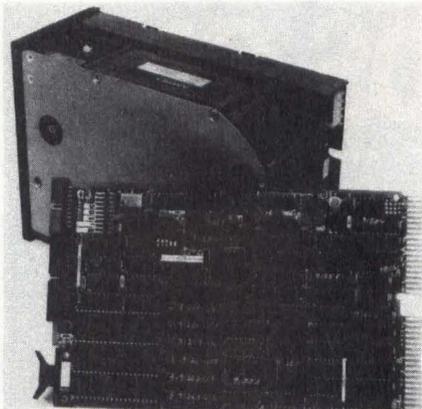
By the way, if you're wondering how hard it is to expand a Concept with peripheral add-ons, relax. It comes network ready via the Corvus OMNINET™ local area network. And its four expansion slots leave lots of room for growth.

So if you're trying to carve out a niche in the booming office automation market, start with a workstation that's like putty in your hands—the Corvus Concept. For full details, contact your Corvus Sales Representative today.



# New Products

## SUBASSEMBLIES



### Controller matches LSI-11s with 5¼-in. Winchester

The model DQ614 disk controller interfaces one or two 5¼-in. Winchester disk drives with Digital Equipment Corp. LSI-11, LSI-11/2, LSI-11/23 and LSI-11/23 Plus microcomputers. The controller operates directly from the Q-bus without additional boards and emulates as many as four RL01 or RL02 disk drives giving formatted capacities as large as 41.6M bytes. Occupying a single dual-width slot in any LSI-11 backplane, the DQ614 is transparent to RT-11, RSX-11 and RSTS operating systems. The controller operates with drives that incorporate an ST-506 interface. A microprocessor-based universal formatting system compensates for drives with different characteristics such as number of heads, data-transfer rates, surfaces and capacities. The DQ614 measures 8.62 × 5.19 in. and requires 5V at 3.5A and 12V at 300 mA from the computer power supply. Single-unit price is \$1695, with quantity discounts available. **Distributed Logic Corp.**, 12800 Garden Grove Blvd., Garden Grove, Calif. 92643.

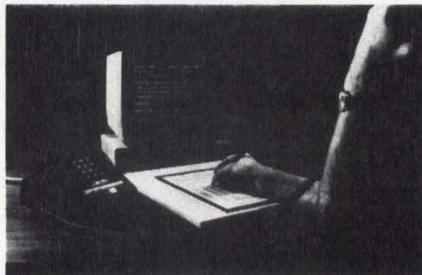
Circle No 360

### Printer buffer interfaces popular computers, printers

The Microfazer hardware buffer/spooler can be used with almost any make of printer or computer and contains 8K bytes of RAM, user-expandable to 512K bytes. It has front-panel LEDs to give copy, ready and error status confirmation. A reset switch is provided to set the Microfazer and to clear its memory. Data rates and handshake signals are user-selectable on serial models. Single-unit prices of

the parallel-to-parallel Microfazer models range from \$169 for the 8K-byte version to \$1395 for the 512K-byte version. Serial-to-parallel Microfazers and parallel-to-serial Microfazers are priced from \$199 for the 8K-byte version to \$330 for the 64K-byte version. Serial-to-serial Microfazers include the required power supply and are priced from \$229 for the 8K-byte version to \$330 for the 64K-byte version. **Quadram Corp.**, 4357 Park Dr., Norcross, Ga. 30093.

Circle No 361



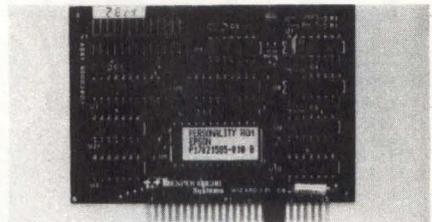
### Writing tablet recognizes 51 characters

Penpad products allow users to communicate with a computer by hand writing. Each unit consists of a writing tablet, a control unit and an electronically activated ballpoint pen. They can recognize block capitals A through Z, numeric characters 0 through 9 and 15 other characters such as dollar signs and punctuation marks. The product analyzes character shapes to build memory images as they are written on the tablet. Each character shape is approximately 2000 bits of data that is reduced to 7-bit ASCII code and displayed on the screen. Data are transmitted to the computer by character, line or block as pre-defined or specified by an operator. The product is available in two versions. Personal Penpad, priced at \$3500, can be used with most personal computers and attaches via an RS232 interface to the computer's serial port. Penpad, priced at \$3950, is a complete terminal that includes a 12-in. green display screen and can be attached to various minicomputers. **Pencept Inc.**, 39 Green St., Waltham, Mass. 02154.

Circle No 362

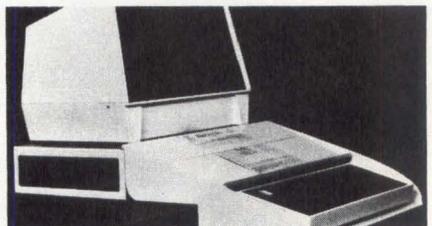
### Printer interface performs text-formatting functions

The Wizard IPI intelligent printer interface card mates parallel printers to the Apple II, Apple II Plus and Apple IIe



computers. It enables full implementation of a printer's text processing and graphics capabilities. By using control key commands, a user can set the left and right margins and line and page lengths, skip page perforations and select automatic or programmable line feeds. He can also print double-sized pictures, rotate pictures by 90 degrees, invert the video or do high-resolution screen dumps. The Wizard IPI can be run with most Apple II software including Applesoft BASIC, Apple Integer BASIC, the Apple Pascal system and CP/M. Graphics firmware for the unit is contained in an on-board personality ROM. Single-unit price is \$87.50. **Wesper Microsystems**, 14321 New Myford Rd., Tustin, Calif. 92680.

Circle No 363



### Video terminal workstation raises work surface

The Ergo-Mate models 1522 and 2022 convert 29- to 30-in.-high work surfaces into comfortable, ergonomically designed workstations. The Ergo-Mate includes a CRT platform that raises the video terminal 4¾ in. above the work surface to operator eye level. The CRT platform also tilts up at the rear, so that operators can adjust the screen angle for glare control. The Ergo-Mate accepts keyboards as wide as 22.125 in. and places them at the proper keying height. The Ergo-Mate places the document copy in line with the keyboard and the CRT and at a comfortable reading angle. The model 1522, which accepts terminals 15 in. deep, is priced at \$99; the model 2022, which holds larger terminals, is priced at \$109. **Mead-Hatcher Inc.**, 752 Military Rd., Buffalo, N.Y. 14216.

Circle No 364

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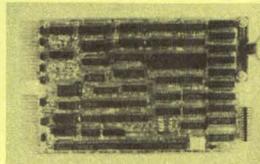
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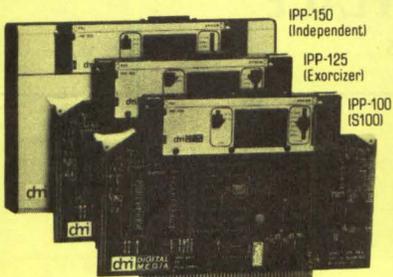
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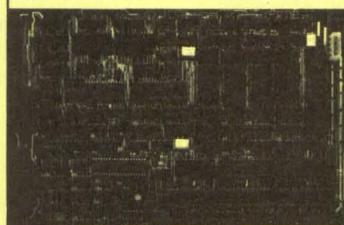
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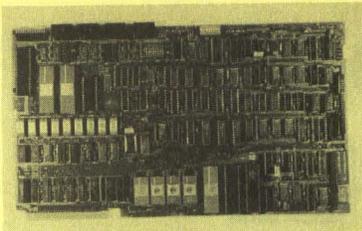
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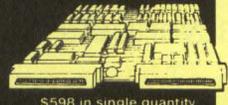
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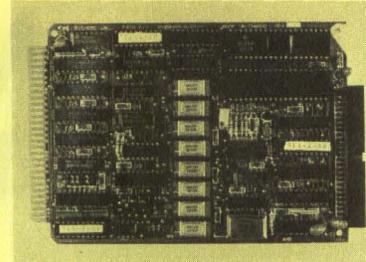


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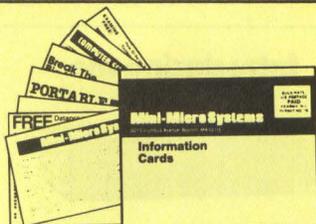
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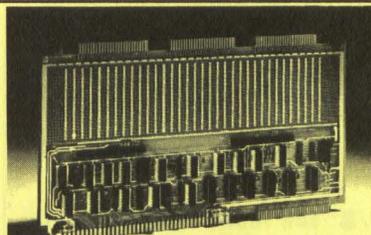
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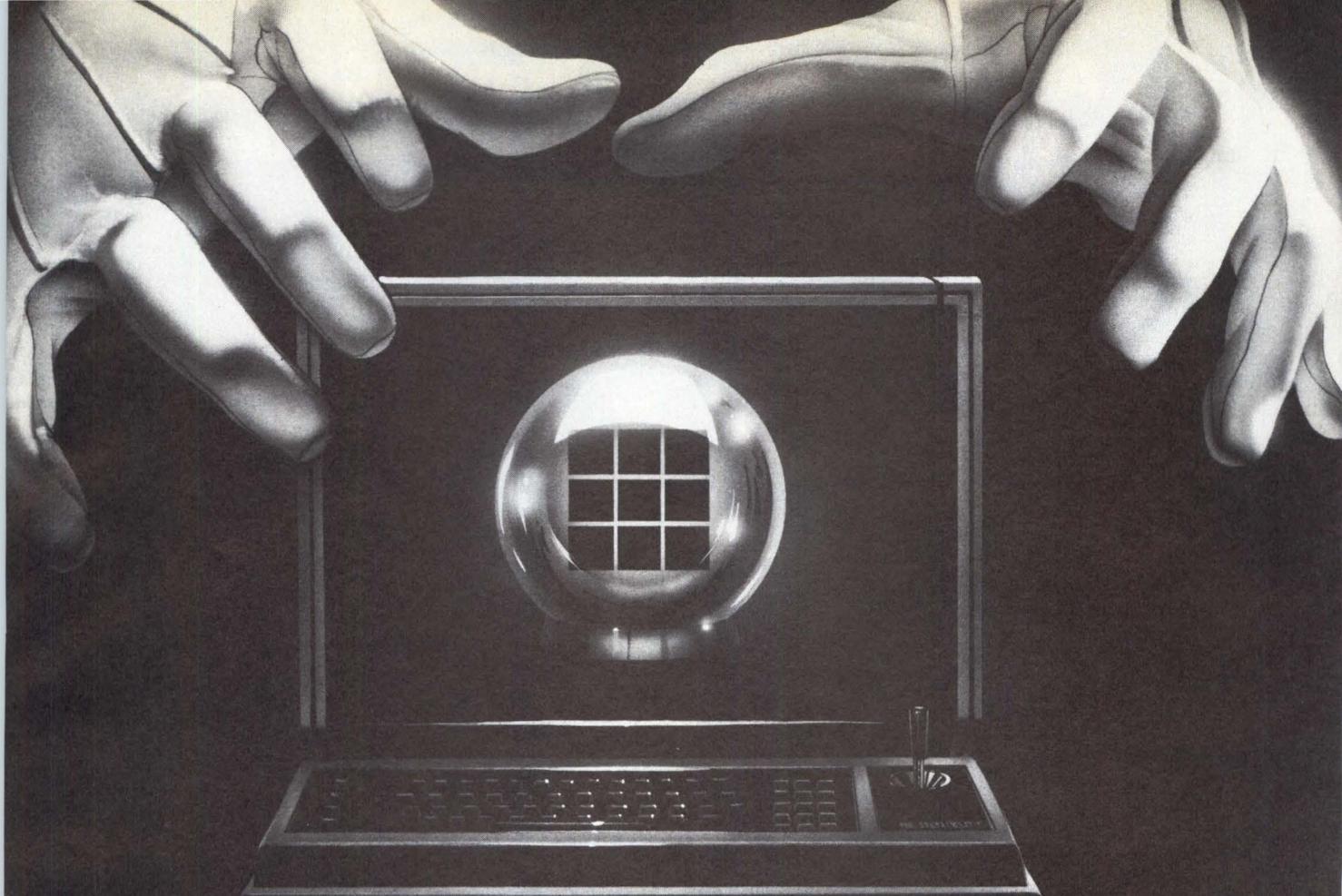
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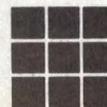
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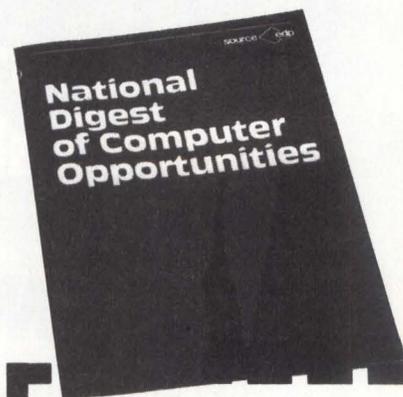
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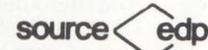


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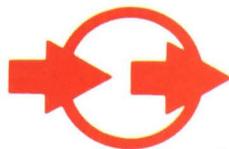
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