

# Mini-Micro Systems

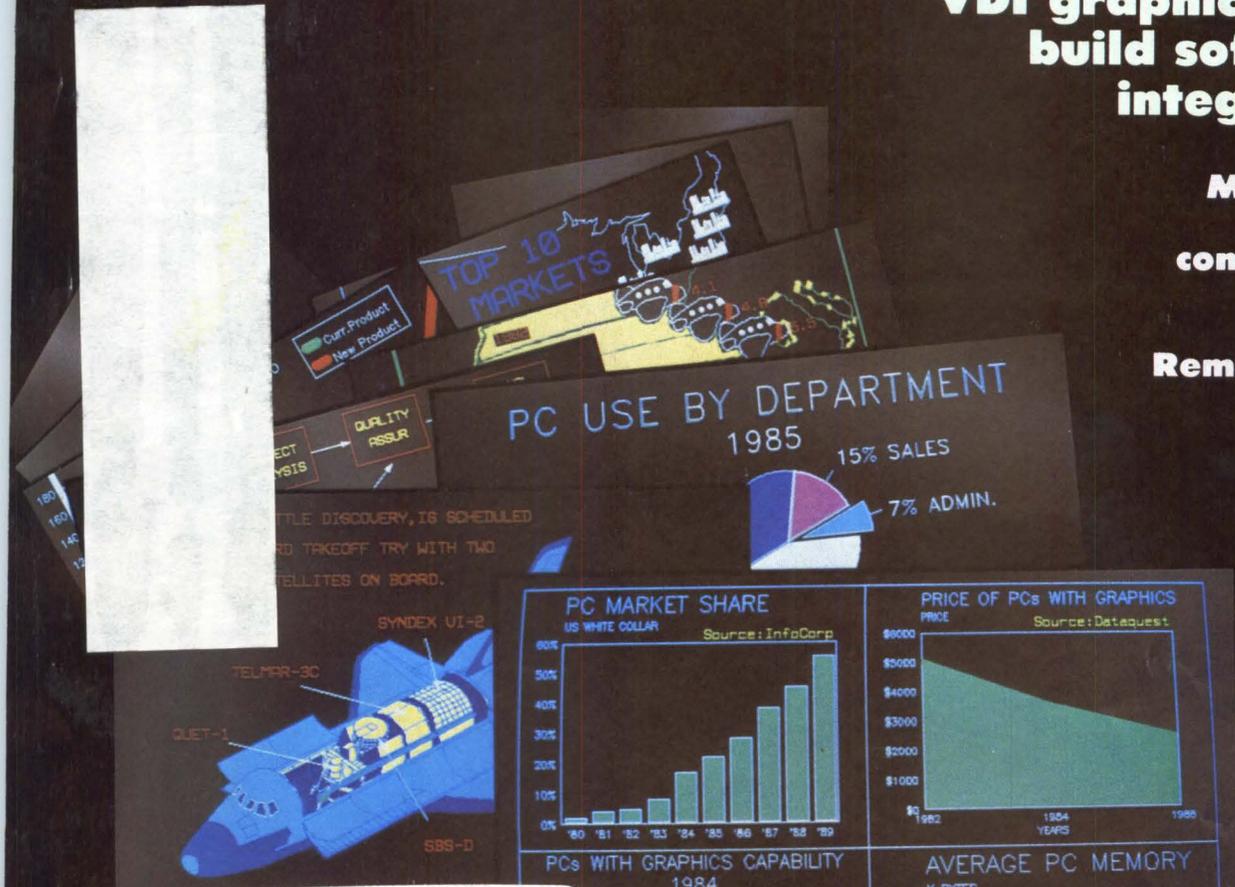
A CAHNERS PUBLICATION

JULY 1985

**VDI graphics tools  
build software  
integration**

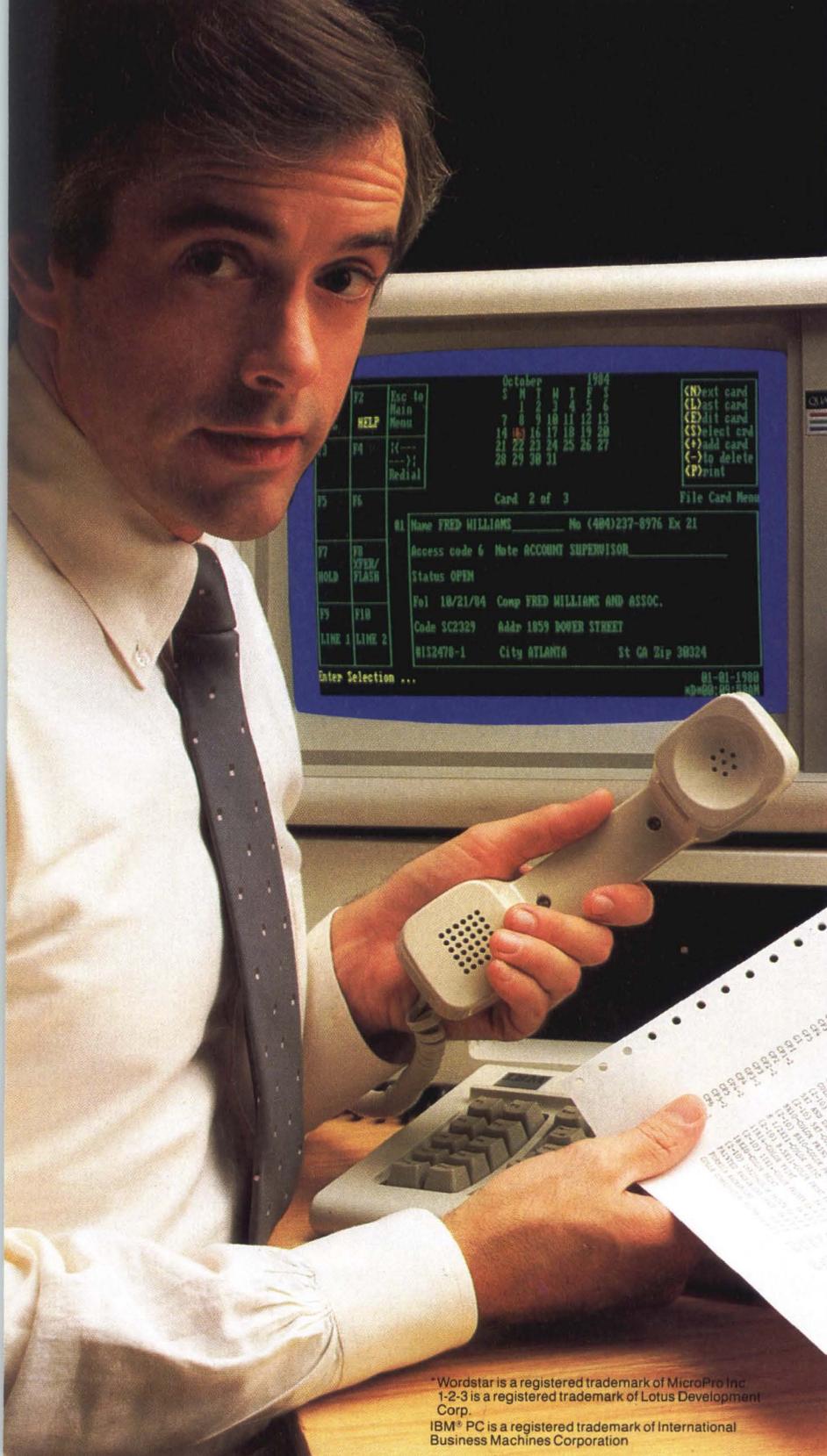
**Mini trims  
defense  
contractor's  
costs**

**Remarketing  
UNIX**



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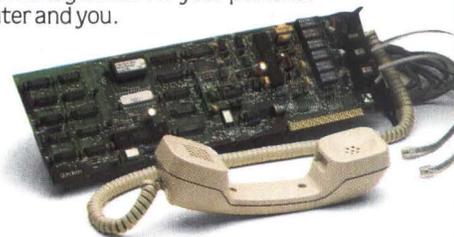
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p. 109 . Aiding software integration.  
 Art direction and design by Michael Satterwhite. Photography by Photo Tek. Courtesy of Graphic Software Systems Inc.



p. 65 . . . . . Servicing new markets

## MINI-MICRO WORLD

### NEWS

AT&T plays its 32-bit chip . . . . . 35

DECnet DOS challenges IBM to enhance SNA . . . . . 36

Integrated UNIX software package supports customized applications . . 38

Rockwell improves chip set for 2,400-bps modems . . . . . 39

Silicon Graphics, Tasvir gang up on Computervision . . . . . 45

CDC augments time-sharing with PC/XT software . . . . . 51

Heard on the Hill: Tough trade bills receive cool industry support . . . . 52

### INTERNATIONAL

Commodore moves with UNIX/graphics system . . . . . 57

Europe awakens to expert systems . . . . . 58

### INTERPRETER

UNIX vendors rearm for new markets . . . . . 65

### VERTICAL MARKET INTEGRATOR

Defense contractor cuts costs with mini . . . . . 77

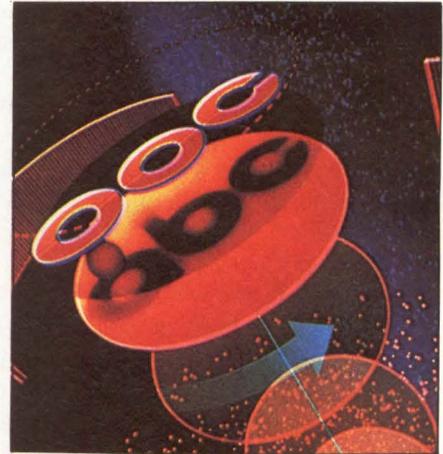
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## FEATURES

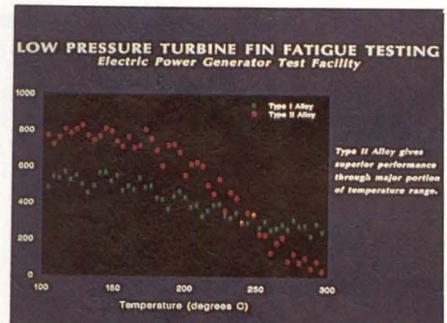
<b>Feature Highlights</b> .....	85
<b>3-D displays spur graphics market</b> .....	87
Mature graphics software meets demand for high-end, interactive-graphics terminals with improved 3-D shaded images	
<b>VDI graphics tools aid software integration (cover story)</b> .....	109
Use of the virtual device interface (VDI) could spell the difference between success and ruin for developers of integrated software	
<b>Graphics software brightens business look</b> .....	121
Software is painting better business graphics to meet increased demands for presentation-quality output	
<b>Optical 3½-inch drive introduces erasability</b> .....	133
To writing to and reading data from a 3½-inch optical-disk drive, thermo-magneto-optic technology adds erasability	
<b>Rethinking networks: A coordinated approach</b> .....	145
By employing virtual-path technology and decentralized control, networks can maximize transmission capacity and minimize protocol conversion	
<b>Business users ponder desktop pen plotters</b> .....	157
Technical users are happy with pen plotters, but emerging software and lower prices beckon business toward computer-image recorders and page printers	
<b>Desktop plotter table</b> .....	169

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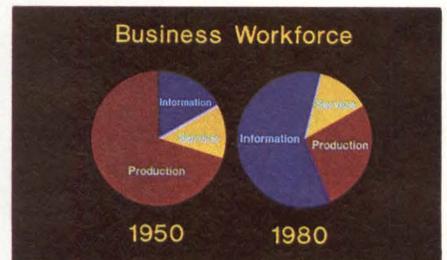
Editorial Staff .....	4
Editorial .....	11
Letters .....	16
Breakpoints .....	23
New Products .....	176
Calendar .....	194
Career Opportunities .....	196
Classified Advertising .....	198
System Integrators' Notebook .....	199
Index to Advertisers .....	200
Market Track .....	201
Artful Intelligence .....	202
Mini-Micro Marketplace .....	203



p. 87 ..... 3-D graphics terminals



p. 121 .... Painting better graphics



p. 157 .... Recorders battle plotters

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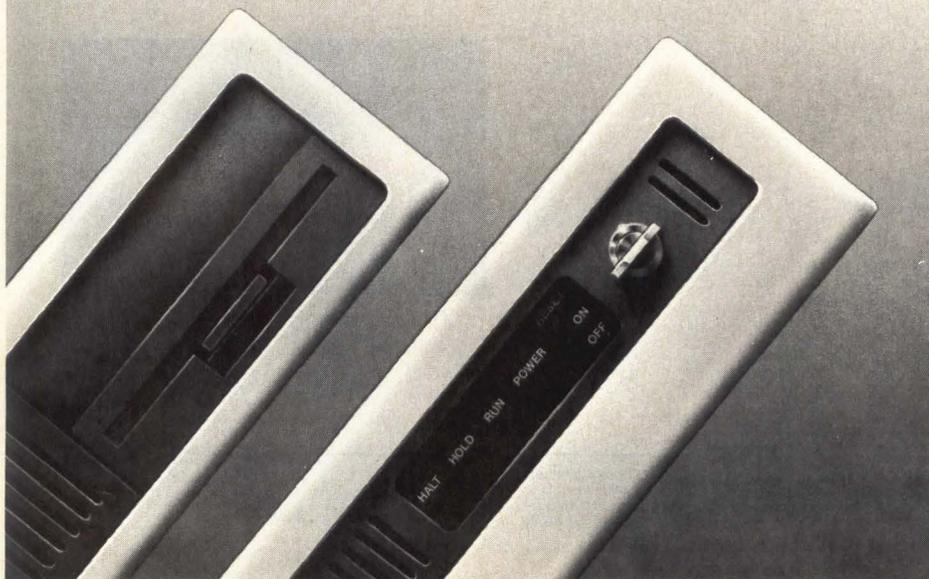
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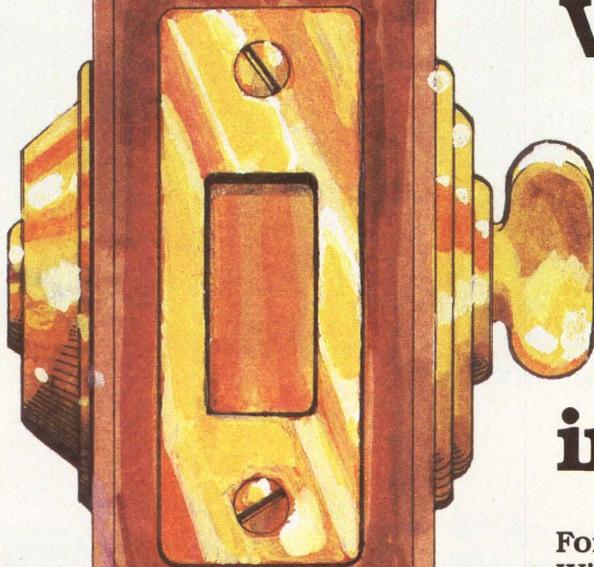
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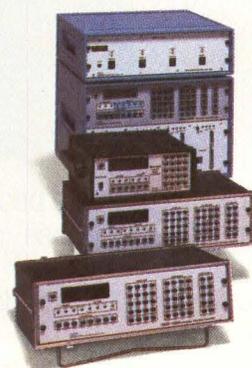
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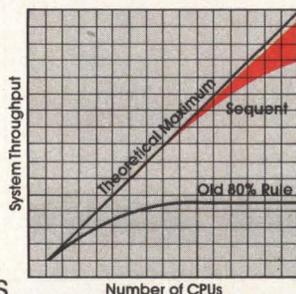
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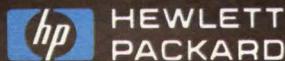
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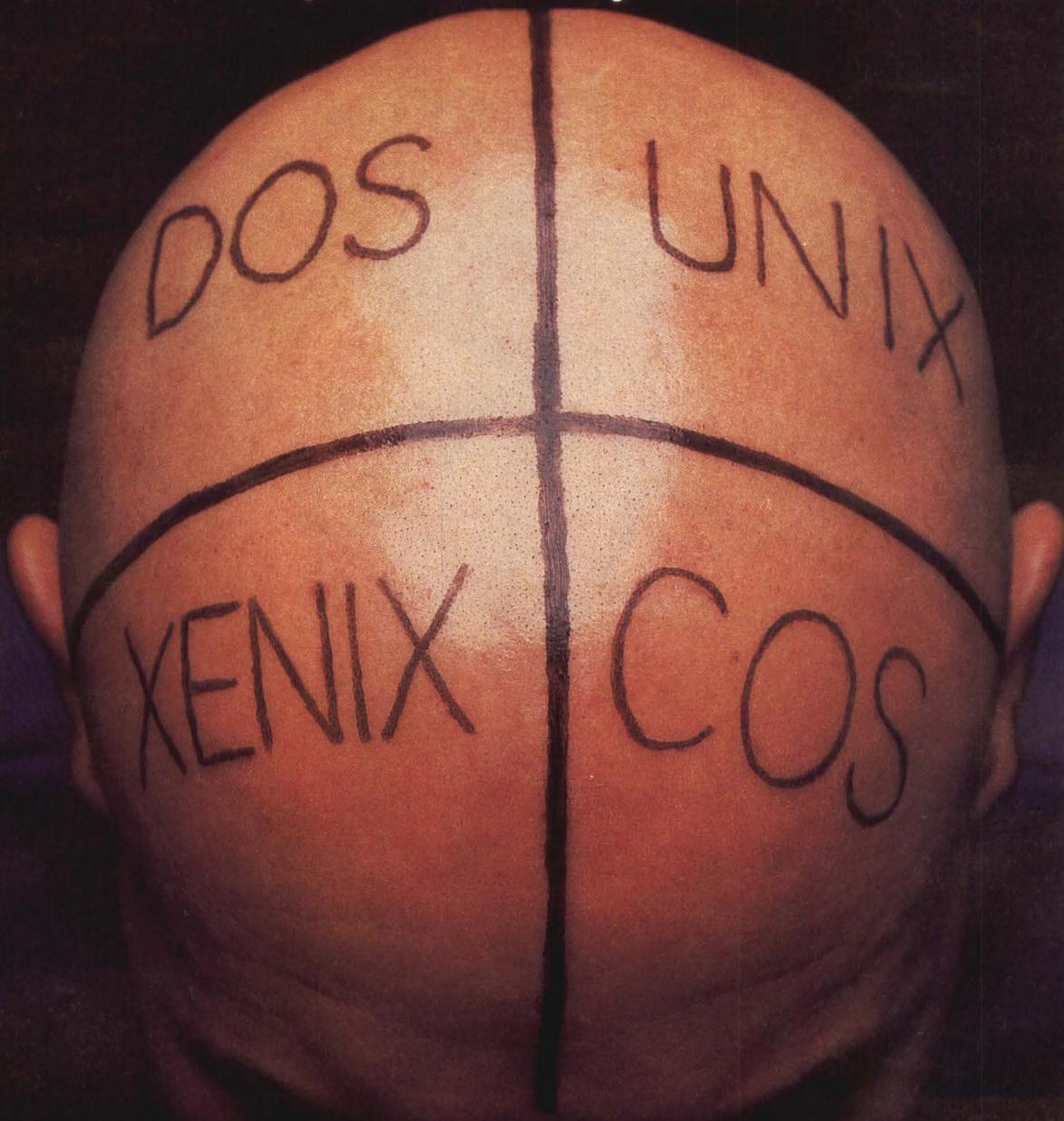
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**CIRCLE NO. 7 ON INQUIRY CARD**

## BUSINESS GRAPHICS PRESENT BRIGHT OUTLOOK



Graphics generated by today's microcomputers and software for business presentations produces detailed, high-quality and inexpensive charts. These charts come in a variety of styles, such as pie, bar and line. More important to users, though, they make charts, slides and layouts more effective, save preparation time, allow fast changes and permit close security. Of course, lower cost than that charged by outside or inside graphics departments helps too.

In fact, according to market research company, International Data Corp. (IDC), the number of business microcomputer users producing graphics should jump from 14 percent in 1984 to 21 percent in 1985. IDC also predicts that more than a million users will work with graphics on personal computers in 1985. And their number should zoom to 11 million in 1989. As for software, sales of specialized graphics packages will total more than 0.5 million this year and soar to 7 million in 1989, according to IDC.

Supporting that outlook is research company Frost & Sullivan Inc. In their "Computer Graphics in the Manufacturing Industries" forecast, they state that the U.S. market will expand approximately 14-fold from 1982 to 1992, or from \$1.7 billion to \$23.3 billion. And although computer-aided design will dominate this market, its share will shrink from 53 percent to 43 percent. On the other hand, the only segment to show dramatic growth over this time period will be business graphics. This segment will more than double, jumping from 17 percent to 35 percent.

Initially, business users lacked experience in applying microcomputers, software and graphics. But after a slow start, microcomputer-based graphics quickly attracted interest because of integrated software packages, high-resolution monitors and inexpensive hard-copy devices. These units provide a range of predefined chart types that can be customized as to color, layout and style.

Many business users discovered microcomputer graphics in Lotus Development Corp.'s 1-2-3 integrated software package. They easily transformed business data derived from spreadsheets and databases into pictorial representations. Indeed, users could now convert business data into a range of graphical forms for optimum display.

But they wanted more than relatively simple analytical graphics. As a result, graphics users generally manipulate several software packages to gain the desired advantages of each one. The next market breakthrough, therefore, will probably center on a single package that incorporates all of the most wanted graphics techniques.

Unfortunately, all is not what it appears. For one thing, presentation quality remains highly subjective to the observer. What seems attractive to some, proves disappointing to others. For another thing, graphics standards lack universal implementation. Business users want to tie into varied applications with diverse peripherals. Fortunately, the proposed graphical kernel system standard and its virtual device interface have found favor with most graphics manufacturers.

Yet another problem stems from the variety of available output devices. Many display and hard-copy peripherals contain incompatible interfaces and, therefore, require special software-driver routines. Consequently, graphics-package developers must incorporate several device-specific drivers to handle common peripherals, thus adding cost and complexity. Joining device drivers to specific applications also proves difficult.

In summary, although beset with obstacles, the microcomputer graphics market holds the potential for rapid and lucrative expansion. What's needed, though, is a concentrated effort by system integrators. They must help business users solve their graphics problems by configuring, integrating and implementing small systems.

A handwritten signature in cursive script that reads "George V. Kotelly".

George V. Kotelly  
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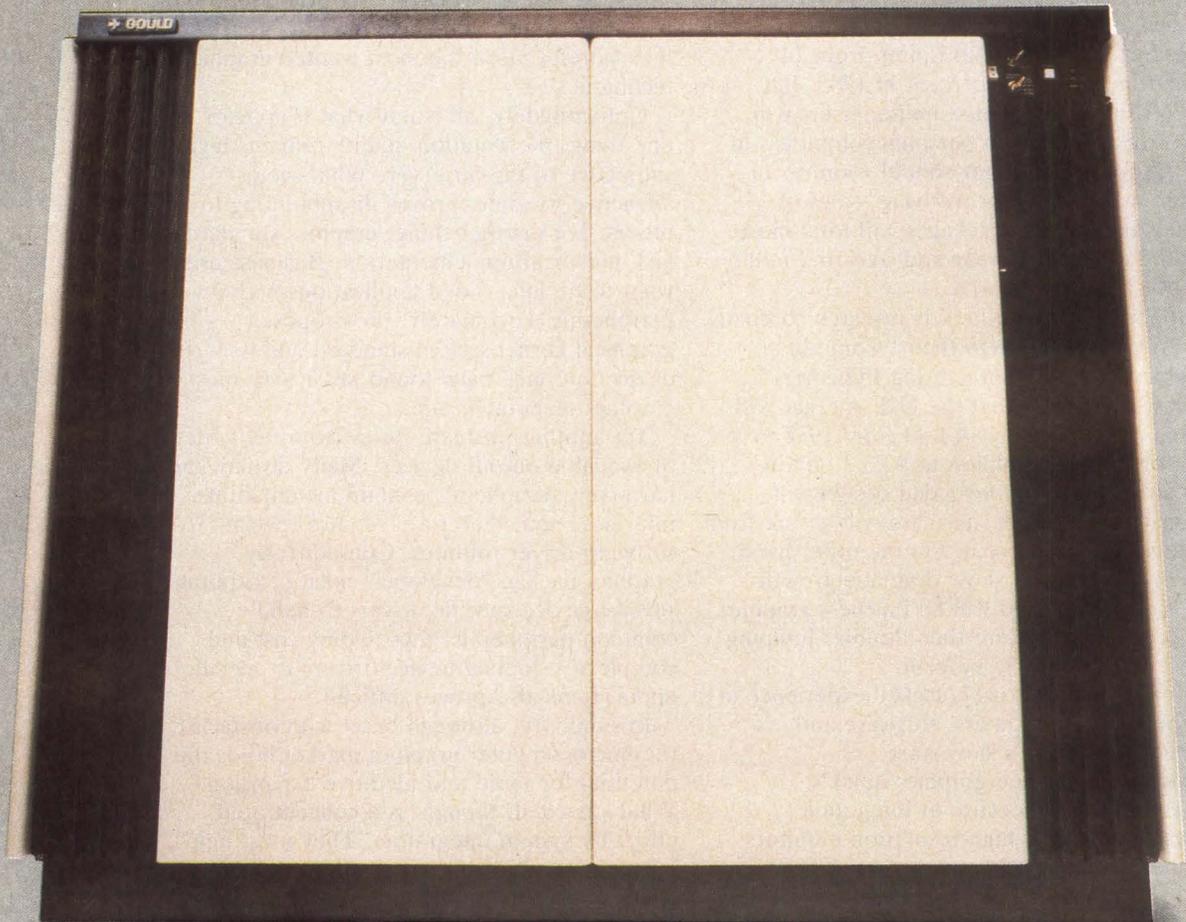
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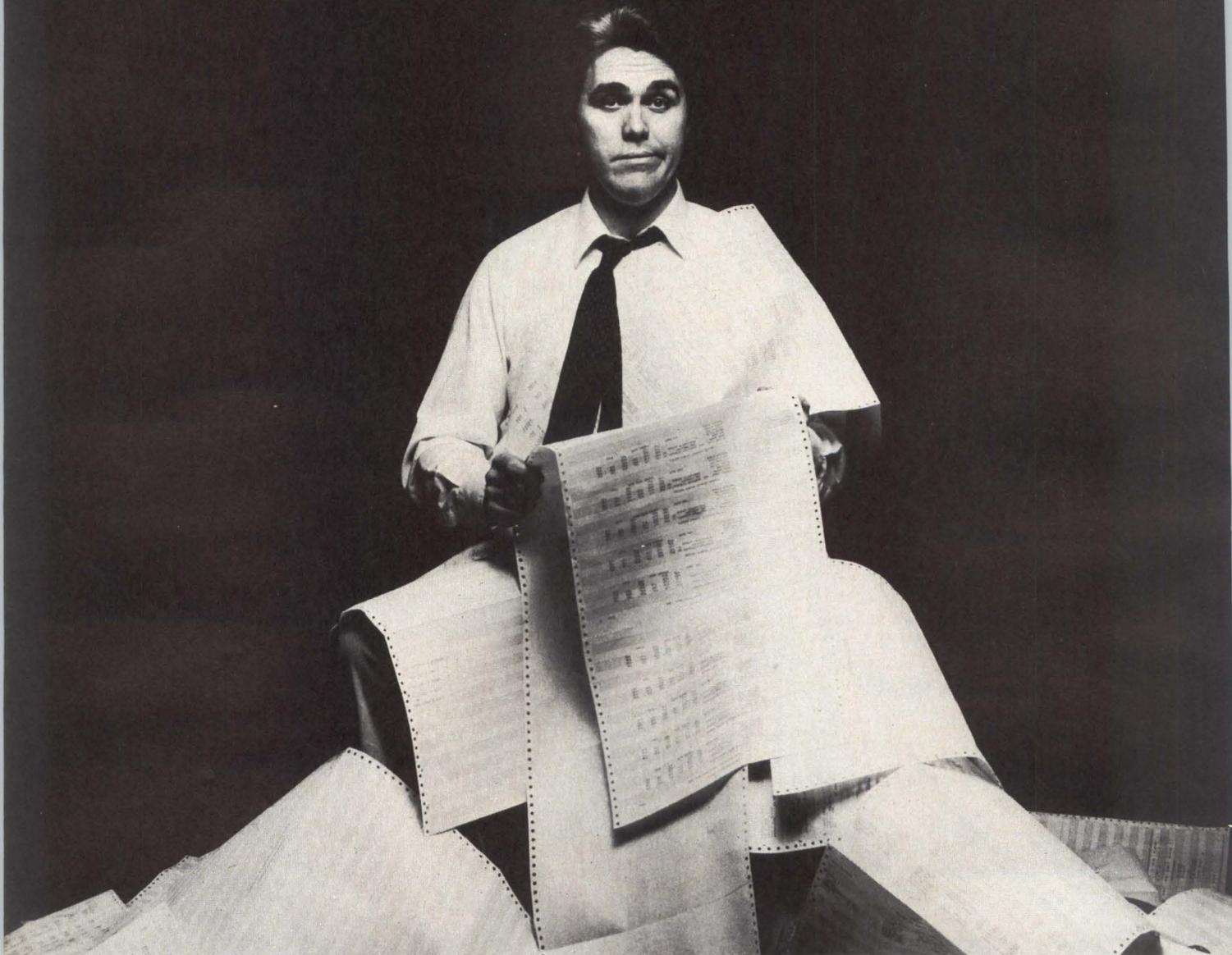
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CIRCLE NO. 103 ON INQUIRY CARD

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CIRCLE NO. 9 ON INQUIRY CARD

# LETTERS

## OPTIONS OMITTED

### To the editor:

Compiling a complete operating systems directory is an insurmountable challenge, but the effort in your February 1985 issue is commendable (MMS, February, Page 164). Nonetheless, I noticed a few omissions regarding the offerings of Digital Equipment Corp. Most notably, DEC offers ULTRIX-11, a native implementation of UNIX Version 7, for the PDP-11 family.

Contrary to the directory, the RT-11 operating system supports a variety of hard disk and magnetic tape options.

Items omitted from the RSX-11M entry include support of overlays, swapping and dynamic relocation. RSX also supports checkpointing. The system supports magnetic tape drives offered both by DEC and third-party vendors and performs I/O multibuffering, meaning that numerous I/O operations to the same device can be queued or active simultaneously.

**Warren Lewis**  
Software Specialist  
Digital Equipment Corp.  
Spokane, Wash.

## MISSING SYSTEMS

### To the editor:

The directory of operating systems in your February issue (MMS, February, Page 164) left out Data General's proprietary operating systems: AOS/VS virtual storage operating system and the AOS/RT32 real-time operating system.

In addition, Data General offers two UNIX operating systems: MV/UX, a UNIX System V environment integrated with AOS/VS, and DG/UX, a native UNIX implementation of the fourth Berkeley Software Distribution.

**Stephanie Haack**  
Marketing Communications  
Data General Corp.  
Technical Products Division  
Westboro, Mass.

### Editor's response

Ironically, the problem here was a lack

of a "lingua franca." I did not include MV/UX in my article because I was led to believe—erroneously—that MV/UX was a native, standalone, true UNIX, rather than a coresident operating system pair.

The fault was in our terms. The whole idea of coresidency is so new that the computer industry has yet to establish a common vocabulary. When I asked my informant if MV/UX was a native or a coresident system, I was told that it was native. Unfortunately, we meant different things by "native." I meant "solitary" while she meant that MV/UX made UNIX "native" to the machine, rather than simply emulating it for the user.

I hope that some day the UNIX community's drive to standardize the language of UNIX will similarly standardize language about UNIX.

—M. Tucker

## DISPUTES STANDARDS SET

### To the editor:

The article by James F. Ready in the December issue (MMS, December 1984, Page 137) presents an incomplete and misleading view of operating system interfaces and related standards.

The article suggests that a set of system calls, for example, deserves to be considered a "standard" merely because it has been defined by its developer for a single operating system, such as PC-DOS or VRTX. At the same time it fails to even mention broader-based standards development projects being undertaken by the IEEE and other organizations that have made progress in developing standards applicable to diverse operating systems in a uniform way.

As an example with which I am familiar, the P-855 working group of the IEEE Computer Society Microprocessor Standards Committee has worked for several years to develop such a standard for microprocessor operating system interfaces (MOSI). This effort has resulted in a standard (IEEE 855-1985), recently approved for trial use, that defines system calls in various categories. These system calls are designed to be implemented in a consistent way on various, underlying operating systems. By select-

ing the appropriate categories, the functions of many types of operating systems (single-user, multiuser, real-time, etc.) are supported, and application programs following the MOSI conventions could be easily transportable between different operating systems at the source level.

A number of problems discussed by Mr. Ready, such as lack of support for random file access, interprocess communication and device control, are addressed by the MOSI standard or are under consideration as future extensions.

**James D. Mooney**  
Associate Professor  
Computer Science  
West Virginia University  
Morgantown, W.Va.

## WANTS GOOD RELATIONS

### To the editor:

In the interest of good Anglo American relations I'd like to clarify a statement made in "Breakpoints" (MMS December 1984, Page 23).

In your news flash about British company Newbury Data [Recording Ltd.'s] 3½-inch disk drive, called Penny, you stated that the drives were designed by the American company Cambrian Consultants Inc. In fact, Newbury Data developed the specifications for this product over 18 months ago. They then commissioned Cambrian to help with the design of various major subassemblies.

The development of Penny has been firmly under the control of Newbury Data, using Cambrian Consultants as an extension to its own design team where necessary.

Manufacture of the Penny is due to start in the UK in April and a number of disk manufacturers have been in touch because they would like to license this product from us. Interestingly enough, Cambrian, quite independently, has announced tentative plans to design and license its own low-performance 3½-inch disk drive.

**Dave Muir**  
International  
Marketing Manager  
Newbury Data Recording Ltd.  
Staines, England

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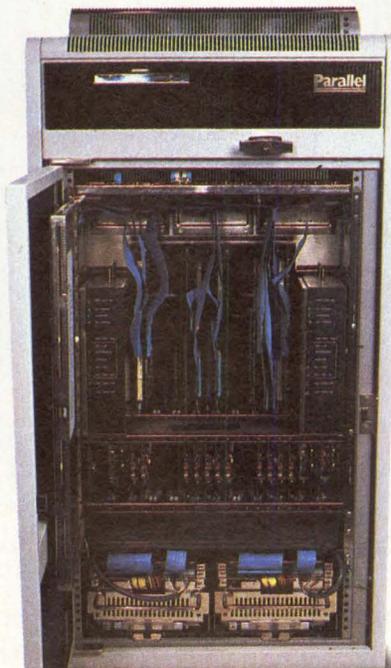
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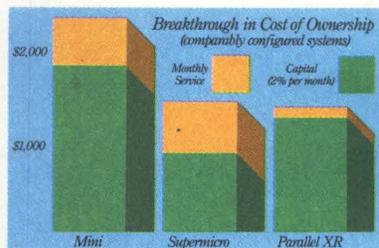


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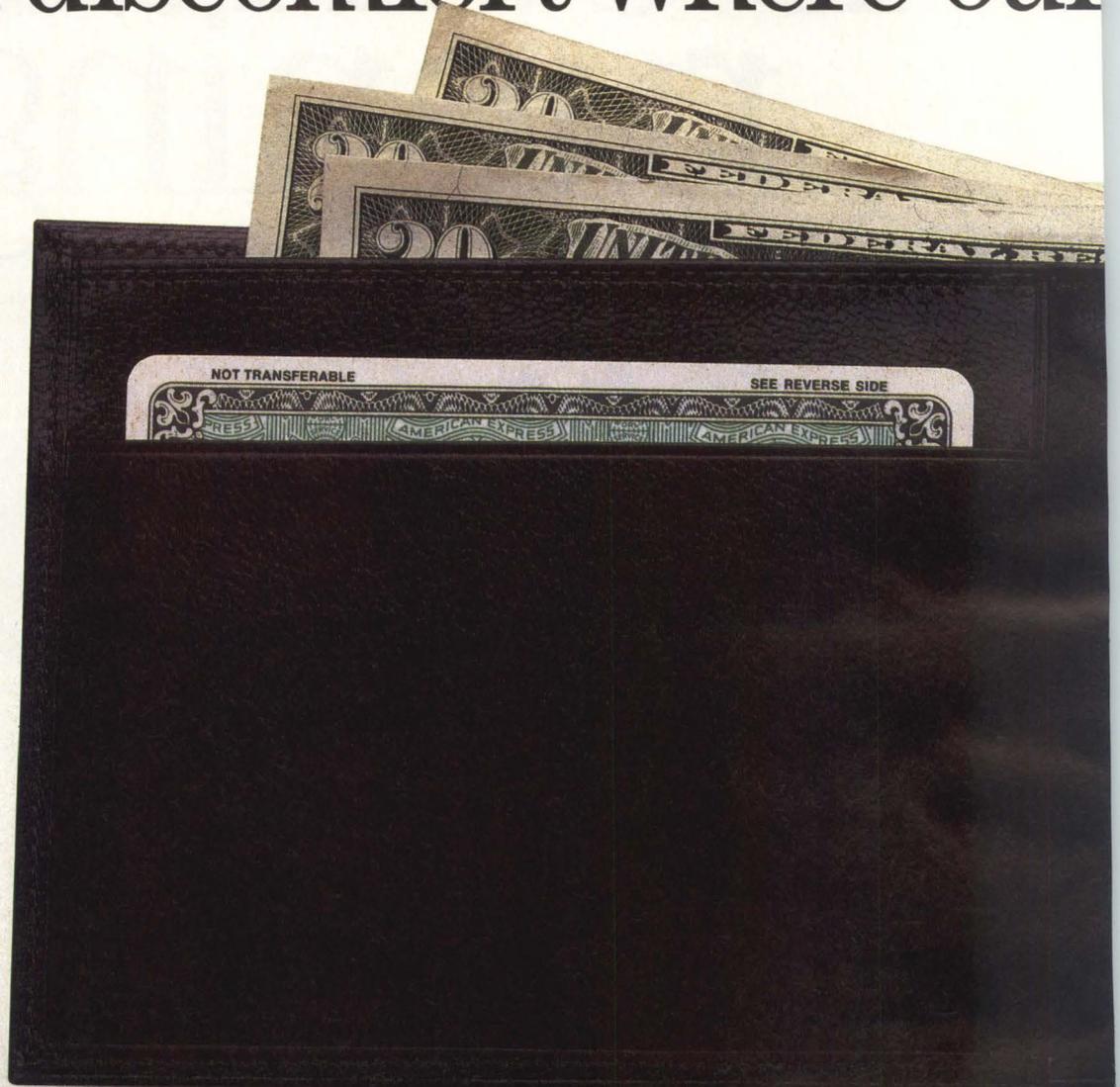
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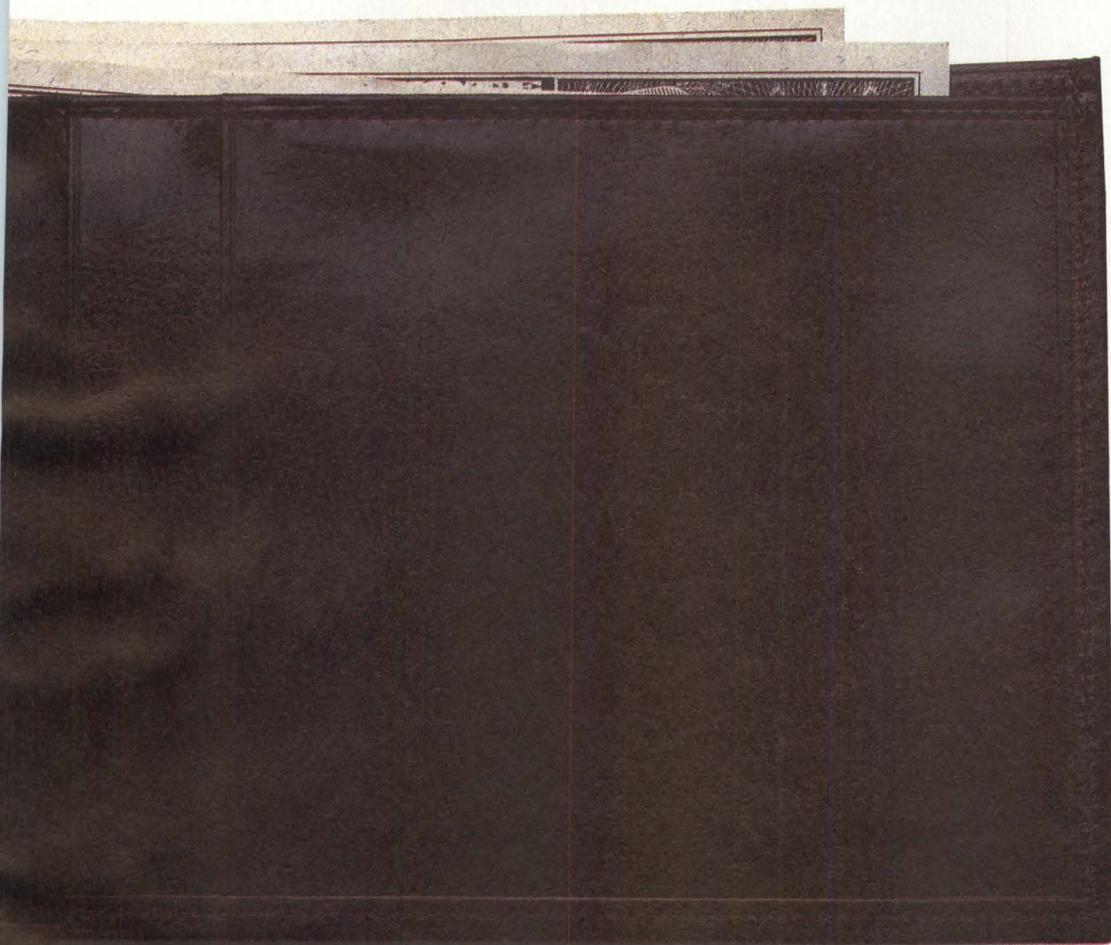
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Its price tag.

Fact is, for the money, the Ampex 230 offers quite a few features you won't find on terminals it emulates: Wyse 50, TeleVideo's 914, 924, 925 and 950\*.

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offer a standard second page of memory or non-embedded attributes. And neither one offers amber.

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What's more, we back our whole Ampex terminal family with worldwide service. A one-year warranty. Reliability above industry standards. Plus something else the competition can't match—our 30 years of video,



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Controls 4 DMA channels for disk, tape, floppy, and parallel printer port; overlapped seeks on up to 3 disks.

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32-bit MC68020 microprocessor running at 1.5 MIPS with no wait states; 8 Kb high speed cache memory; up to 16 MB virtual address space per program; optional floating point processor.

## RAM BOARD

Can be configured to OEM needs, up to 16MB using 1MB, 2MB, & 4MB boards.

## BREAKTHROUGH PRICE/PERFORMANCE

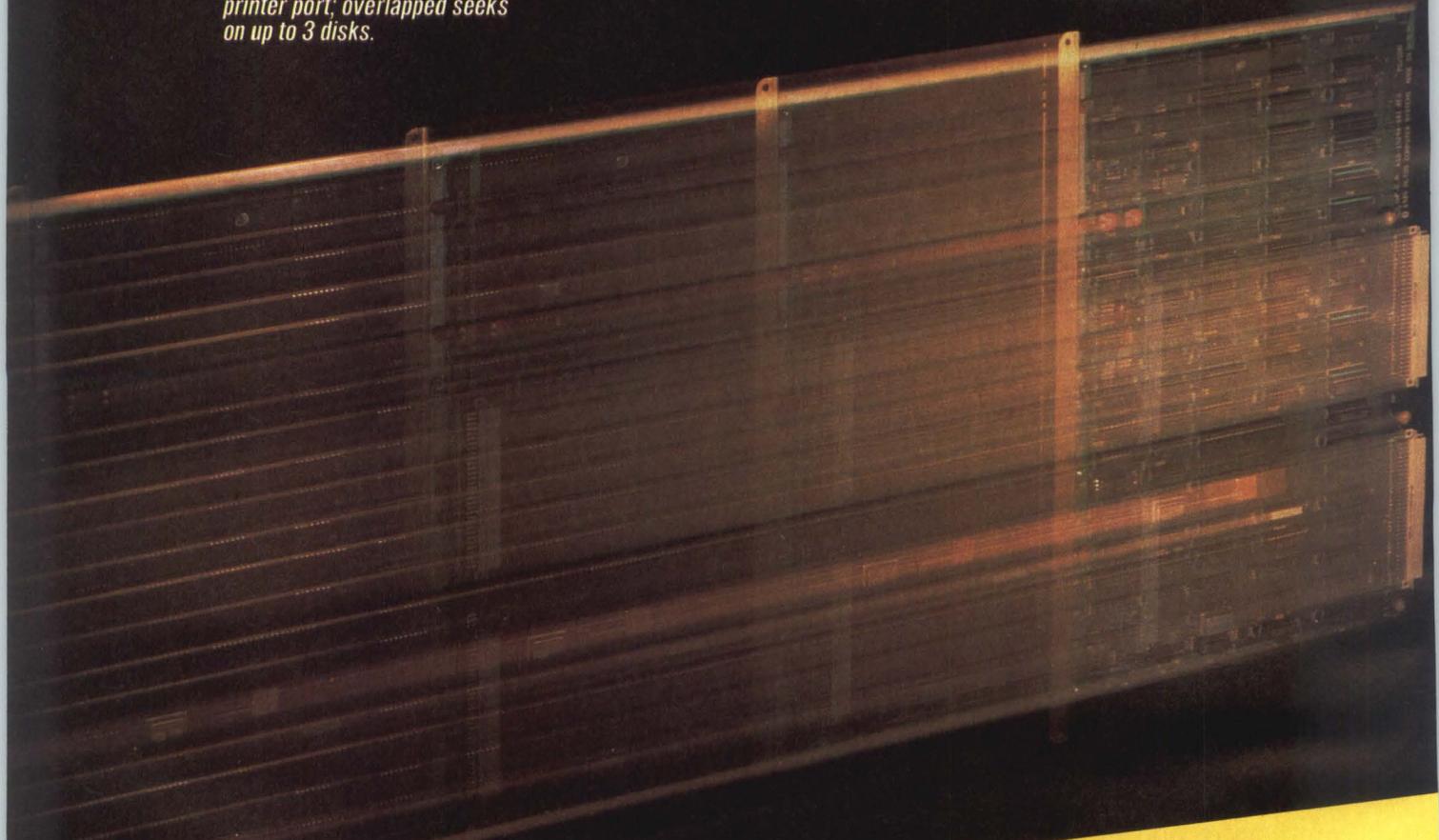
Combining the 32-bit MC68020, multiple auxiliary processors, and a tuned version of UNIX™ System V, the 30-user 3068 "is capable of a performance that rivals large mini-computers." (Computerworld, April 1985). And it does it for a micro computer price - from \$7,000 for OEM quantities.

## BREAKTHROUGH MODULARITY

"Using plug-in boards the way a personal computer does really sets Altos apart." (research firm Creative Strategies, Computerworld, April 1985). OEM's can choose from a wide range of modules: 10 to 40 serial ports; 1 to 16 MB of memory; 17 to 200 MB (formatted) hard disk storage.

## BREAKTHROUGH HARDWARE DESIGN

"Altos is way ahead of everybody else." (Creative Strategies, Computerworld, April 1985): high speed 8 KB cache maximizes CPU speed, with no wait states; cache is simultaneously shared between many processors; high performance memory management supports demand paged virtual memory; on-board microprocessors handle all I/O processing.



## SERIAL COMMUNICATION BOARD

8 MHz 8086 with 10 serial ports; 32 KB RAM on standard board supports Async. and LAN; 128 KB of additional RAM to support X.25, SNA or custom protocols.

## STREAMING TAPE

60 MB, 90 IPS cartridge tape drive.

## 1.2 MB FLOPPY DISK DRIVE

## EXPANSION BOARD SLOTS

Up to three field installable boards can be added for more users or memory.

## BREAKTHROUGH UNIX™ SUPPORT

To meet the most rigorous applications requirements, the 3068 incorporates demand paged virtual memory, record locking, and sophisticated interprocess communication. An optimizing C compiler, symbolic debugger, and a full set of development tools and languages form a complete development environment. Productivity tools include an integrated package of word processing, spreadsheet, DBM, graphics, and electronic mail.

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## BREAKTHROUGH DIAGNOSTICS

Remote diagnostics minimize downtime by isolating problems to an easily exchanged Field Replaceable Unit.

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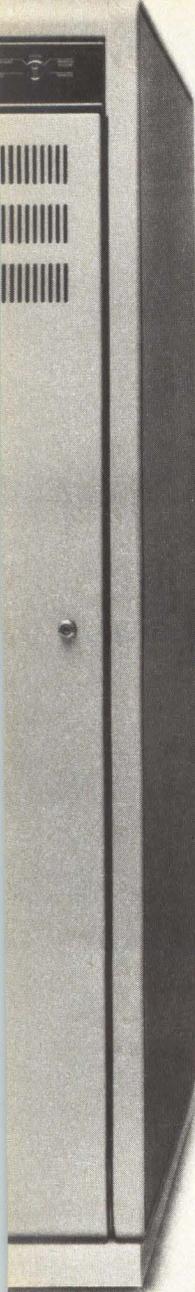
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# BREAKPOINTS

## **AT&T TECHNOLOGIES TO LICENSE ALCYON'S REGULUS**

Alcyon Corp., San Diego, announced recently that AT&T Technologies Inc. will license Alcyon's Regulus, a real-time, UNIX System V-compatible operating system. Regulus runs on Motorola Inc.'s MC68000 family of microprocessors. According to an AT&T spokesman, AT&T is working on a specialized product that requires the real-time attributes of Regulus.—*L. Haber*

## **SCSI CONTROLLER RUNS FOUR DRIVES**

Fujitsu America Inc., San Jose, Calif., plans to begin shipments this month of an intelligent controller that allows up to four Winchester disk drives to operate from a single bus connection on the small computer systems interface. The M1053A controller can be used only with Fujitsu's 168M- and 337M-byte drives and features full ANSI command sets and the extended storage module device interface for data-transfer rates of up to 2.46M bytes per second. The OEM price is \$895 in quantities of 100.—*M. Seither*

## **INTERFACE TIES MINIS INTO IBM'S DISOSS**

Motorola Inc./Four Phase Systems, Cupertino, Calif., this month will begin shipping software that will allow its series 4000 and 5000 minicomputers to become active nodes on an IBM Corp. Distributed Office Support System (DISOSS) network. The TransText programs enable users of small Four Phase systems to write and change files and distribute documents over any IBM network whose host is running CICS/VS (customer information control system/virtual memory) and DISOSS 3.0 or higher. A program to let users exchange, edit and return documents to the originator in a form that's compatible with IBM's revisable form text document architecture will be available in November. Program prices are between \$800 and \$6,000.—*M. Seither*

## **WESTERN DIGITAL SHRINKS WINCHESTER CONTROLLER**

Using VLSI and surface-mount technology, Western Digital Corp., Irvine, Calif., has reduced a Winchester controller to one board that includes drive electronics, interface and controlling functions. The board features the WD2010 Winchester controller chip and the WD10C20 self-adjusting data separator. The board can be tailored to match any drive or host interface. Western Digital plans to deliver this fall a 20M-byte, 3½-inch drive with the new controller. Although the company expects to sell bundled drives and controllers, it will also offer controller and chip sets separately.—*C. Warren*

## **CALMA TO ADD MICROVAX II TO CAD LINE**

Calma Co., Milpitas, Calif., is bringing Digital Equipment Corp.'s new MicroVAX II supermicrocomputer under its wing and should announce

# BREAKPOINTS

price and configurations this month. Calma will offer the MicroVAX II in a network that operates with other VAX machines for computer-aided design, computer-aided manufacturing and computer-aided engineering. Calma, a subsidiary of General Electric Co., plans to begin shipments of the MicroVAX systems in the fourth quarter of this year.—*M. Seither*

## **ATTIS EXPANDS 3B LINE OF MINICOMPUTERS**

AT&T Information Systems was expected to announce late last month additions to the company's 3B line of minicomputers. The 3B2/400 is reportedly a full 32-bit machine based on Western Electric's 32100 chip set. According to a company spokesman, the 3B2/400, a successor to the 3B2/300, has a hard-disk storage capacity of up to 720M bytes, floppy-disk storage capacity of 720K bytes and 12 expansion slots. The 3B2/400 can support up to 25 concurrent users and up to 46 terminals. The 3B/15, an upgrade of the company's 3B5 computer, is also a 32-bit, 32100-based machine with 2.2G bytes of hard-disk storage and 16M bytes of RAM. The 3B/15 supports 16 to 40 users. Both machines run the UNIX System V operating system.—*L. Haber*

## **BRITISH PASCAL COMPILER MEETS U.S. GOVERNMENT STANDARD**

British compiler specialist Prospero Software Ltd., London, is seeking distributors throughout the United States for Pro Pascal, an ANSI-standard compiler for IBM Corp. PC/XT computers and any machine running MS-DOS and configured around the Intel Corp. 8086 microprocessor. Pro Pascal is said to be the world's first Pascal compiler for these machines to be validated by an extensive suite of programs running at the British Standards Institution. The same suite of validation programs is also being installed at the Federal Software Testing Center (FSTC), Falls Church, Va. The installation follows the adoption earlier this year of ANSI-standard Pascal as a Federal Information Processing Standard. Computer vendors will need to offer an FSTC-validated compiler when bidding for U.S. government contracts. The U.S. end-user price for the first copy of Pro Pascal is \$390.—*K. Jones*

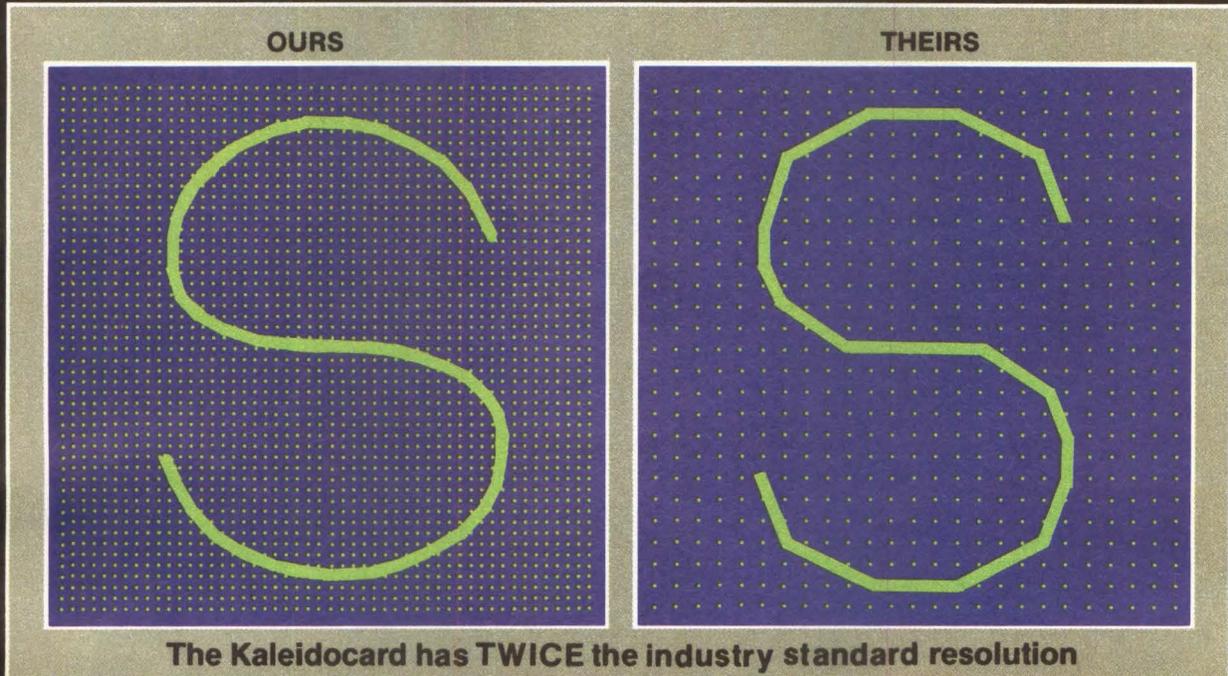
## **BELGIUM'S MA BELL CALLS FOR U.S. UNIX MACHINES**

Bell Telephone Manufacturing Co., Antwerp, Belgium, wants to sell its UNIX expertise in the United States in the form of technology-transfer deals with U.S. manufacturers of computers running any version of UNIX. Bell offers two technologies: Eurix, which involves the replacement of the ASCII character set in UNIX with European characters to make UNIX implementation more acceptable to the European marketplace, and Netix, which enables several machines running UNIX to share files across a local area network. Both technologies require changes to the UNIX kernel, but Bell will show users how to achieve them. Eurix technology is priced at

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MINI-MICRO SYSTEMS/July 1985

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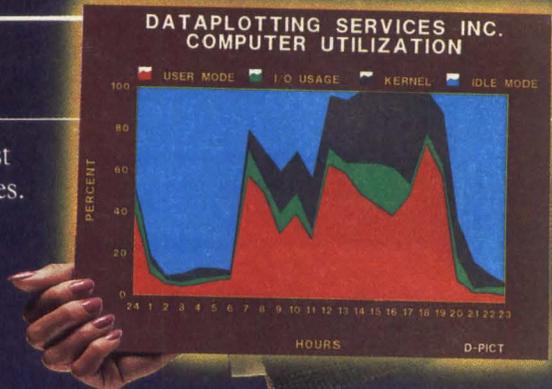
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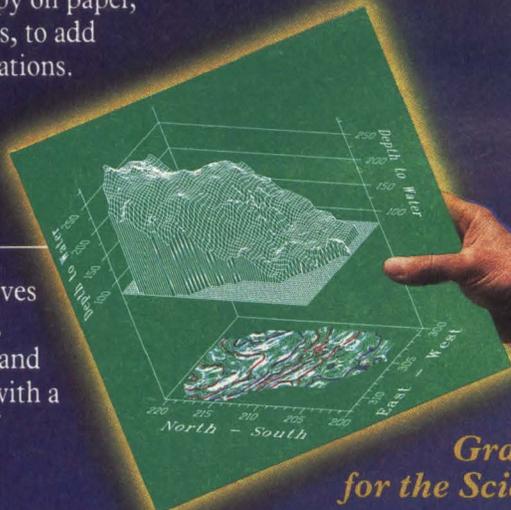
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# BREAKPOINTS

\$30,000, plus \$20,000 for each type of system to which it is ported. The Netix charge is \$50,000 for the technology transfer plus a royalty on each machine sold.—*K. Jones*

## **FASTER PC/XT ADD-ON BOARD BOOSTS CAD/CAE PERFORMANCE**

A 10-MHz version of the Intel Corp. 80286-based add-on board produced by Seattle Telecom & Data Inc., Redmond, Wash., for the IBM Corp. PC/XT is said to make the PC/XT run twice as fast as the PC-AT. Designed for computer-aided design/computer-aided engineering, scientific and UNIX applications requiring high computational speeds, the 10-MHz board upgrades the PC/XT to a high-end, single-user workstation, yet still allows the system to run programs such as AutoCad, VersaCad and Personal Cad. The PC 286 board can be configured with memory ranging from 128K bytes to 2.5M bytes. The board supports bank switching or can be used as a RAM disk. Quantity-one pricing starts at \$3,995.—*B. MacDonald*

## **EUROPE CRIES EUREKA IN REPLY TO AMERICAN TECHNOLOGY**

Eureka, the 3-month-old French proposal for high-technology collaboration in Europe intended to prevent the Continent from falling behind the United States in advanced technology, is gaining support from fellow members of the Common Market. The joint research is aimed at civilian uses of lasers, optical technology, microprocessors, supercomputers, composite materials and artificial intelligence. Eureka is now said to be moving into an "industrial phase," with European companies compiling lists of specific projects to be supported. The timing of France's Eureka proposals suggest that France intends to provide other European countries with a political and economic alternative to the anticipated U.S. "Star Wars" research program. Common Market countries are also discussing whether to invite non-Market members, such as Austria and Sweden, to participate.—*M. O'Gara*

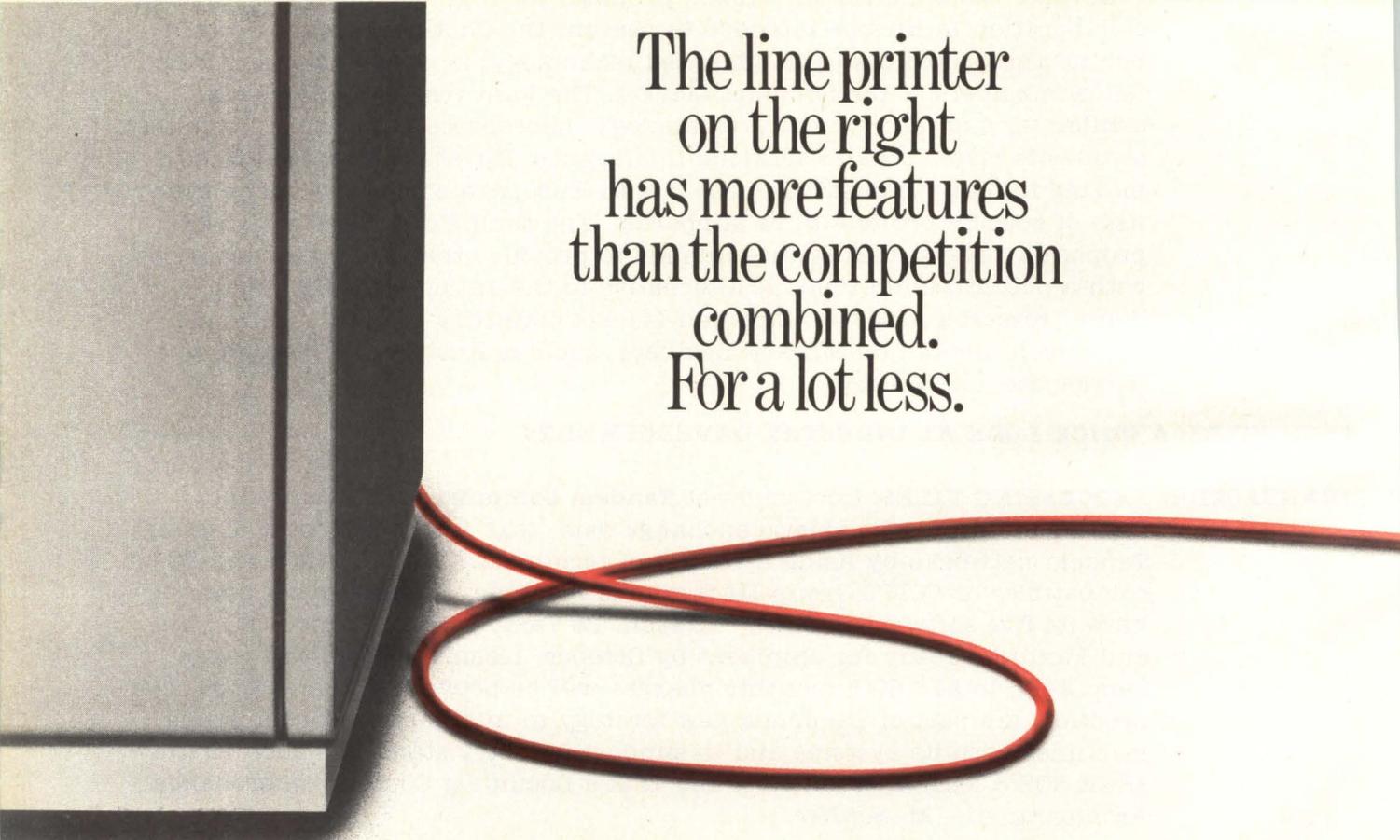
## **TECH FILES: A QUICK LOOK AT INDUSTRY DEVELOPMENTS**

**TRANSACTION PROCESSING FILES:** Customers of **Tandem Computers Inc.**, Cupertino, Calif., should soon be able to exchange data, text and images over existing Tandem networks by using a variety of terminals, IBM Corp. PCs and PC-compatibles or CCITT Group III facsimile machines. The company plans to have its five software utilities—PS Mail, PS Text, PS Text Format, PC Link and Faxlink—ready for shipment by October. Licensing costs will range from \$495 to \$12,500; monthly charges will be between \$50 and \$200. The products are part of Tandem's new strategy to interconnect incompatible machines with its systems and to support industry standards such as the IEEE 802.3 local area network and IBM's Document Content/Interchange Architectures.—*M. Seither*

# BREAKPOINTS

**SHOW FILES: Plus Development Corp.**, Milpitas, Calif., a new subsidiary of Quantum Corp., is showing at this month's National Computer Conference (NCC) in Chicago a 10M-byte hard disk in the form of an IBM Corp. PC plug-in board. The "Hardcard" measures 4 by 13 by 1 inches and includes a controller, electronics and a complete hard disk assembly with a 3½-inch platter. The 2-pound board plugs into an IBM PC expansion slot, consumes 10.9W, has an average access time of 65 msec and carries a retail price of \$1,095. Departing from Quantum's OEM marketing strategy, Plus Development plans to sell primarily through dealers and value-added resellers. To date, the product has been successfully tested on the PC, PC/XT, AT&T Co. 6300 and Compaq Computer Corp.'s Portable and Plus personal computers.—*D. Simpson*

Framingham, Mass.-based **Charles River Data Systems** expects to be the largest shipper of Motorola Inc. MC68020-based systems this year following the introduction of their 32-bit Universe 32 supermicrocomputer at NCC. Incorporating open system standards such as VERSAbus and a UNIX



The line printer  
on the right  
has more features  
than the competition  
combined.  
For a lot less.

System V-compatible operating system, the Universe 32 achieves computational speeds of 2.7 million instructions per second with its 12.5-MHz 68020 microprocessor. A typical OEM configuration, equipped with a 35M-byte Winchester, 45M-byte streaming tape unit, UN/System V operating system and UniverseNet software, is priced at \$28,500 in quantities of 25 or more. A \$6,500 upgrade package consisting of a 68020-based board, to replace the 68000 board of the the company's current Universe 68, is also available.—*B. MacDonald*

**Control Data Corp.**, Minneapolis, will show two new high-performance Winchester disk drives at NCC. An 8-inch model, code-named EMD, has a 368M-byte capacity and an enhanced storage module device interface that delivers data at 15 MHz. The company expects to offer both the small computer systems interface and the intelligent peripheral interface-2 for the EMD within six months. The drive will be priced at approximately \$4,000 in quantities of 5,000. Observers say Control Data's as-yet unnamed 14-inch model will offer over 1G byte of storage.—*C. Warren*

## That's priceless to the computer on the left.

The way it usually goes, you find a printer with all the features you need. Then you hold your breath and peek through your fingers at the price tag.

Or you just go for low price and learn to live with inconvenience.

The trade-off is over. With CIE Terminals CI-300+ and CI-600+ Matrix Line Printers.

While our so-called competitors offer you less features and costs as much as 300% higher, the 300+/600+ offer you more features.

Like data processing and letter-quality printing. Up to 200x 288DPI graphics resolution. Compressed print. Bar code generation. Serial, parallel and IBM interfacing.

Along with the highest quality in their class. More choices for more uses.

So when the time comes to choose line printers, go ahead and compare us. Feature for feature.

You'll pick the plus. Its value is priceless.

For more information on the CI-300+/CI-600+ Matrix Line Printers, contact CIE Terminals at 2505 McCabe Way, Irvine, CA 92714-6297 (800) 624-2516.



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A CITIZEN ELECTRONICS COMPANY

Because your computer is only as good as its peripherals.

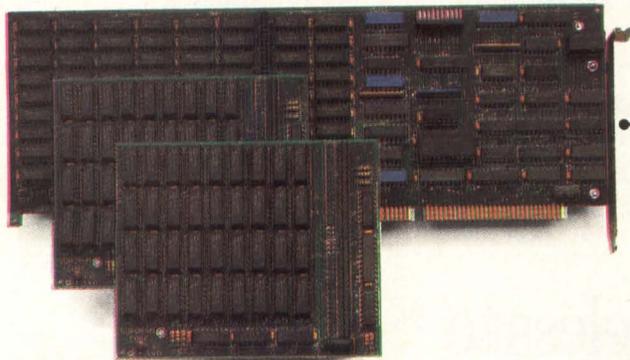
CIRCLE NO. 16 ON INQUIRY CARD

# COMBINE POWER AND ENHANCE YOUR PC-AT

Quadram introduces the smart way to enhance your IBM PC-AT. Quadmeg-AT and Quadport-AT. Smart because Quadmeg-AT and Quadport-AT make the most of your AT system today and expand to meet your system's growing needs in the future.

Quadmeg-AT comes socketed for memory expansion from 128K to 2 Megabytes. Harness this power to create megabyte-sized RAM drives, access

## QUADMEG-AT™



greater amounts of information, and process data faster and more efficiently than ever before. Plus, with "split memory mapping," Quadmeg-AT lets you expand the AT's base system memory to 640K without buying a space-wasting 128K card.

## Advance to 4 Megabytes

When you need more than 2Mbytes, Quadmeg-AT adapts with two Quadmeg-AT Expansion Cards. Each packs 512K or 1Mbyte extra RAM.

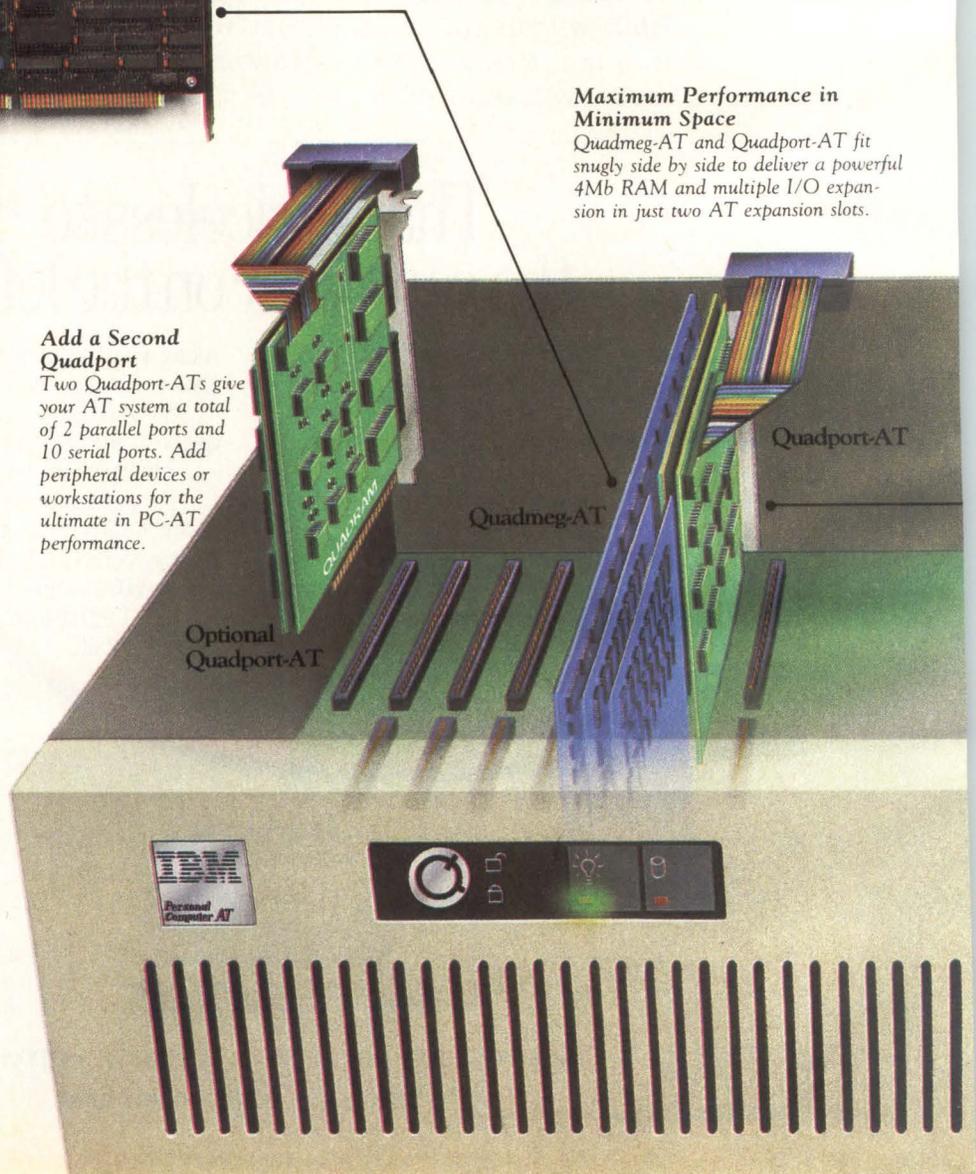
Both cards filled give Quadmeg-AT a powerful 4Mbyte capacity. Quadmeg-AT delivers the power you need to take full advantage of the AT's capabilities.

## Maximum Performance in Minimum Space

Quadmeg-AT and Quadport-AT fit snugly side by side to deliver a powerful 4Mb RAM and multiple I/O expansion in just two AT expansion slots.

## Add a Second Quadport

Two Quadport-ATs give your AT system a total of 2 parallel ports and 10 serial ports. Add peripheral devices or workstations for the ultimate in PC-AT performance.



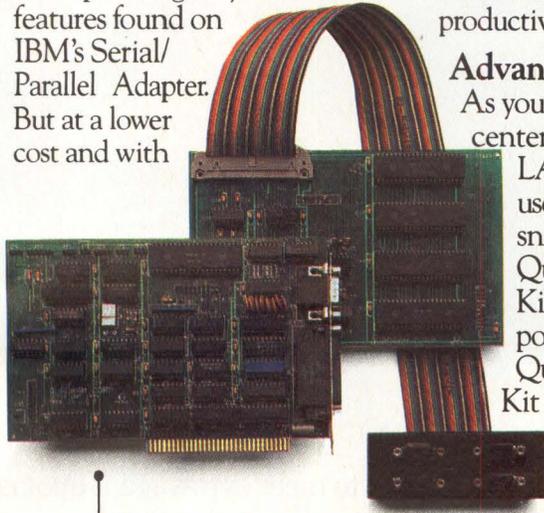
Look for this seal. It's the mark of dependability and performance from the leader in microcomputer enhancements.

IBM PC-AT is a registered trademark of International Business Machines Corporation.

# EXPANDABILITY TO THE SMART WAY.

## QUADPORT-AT™

Quadport-AT combines a parallel printer port and a serial port to give your AT the features found on IBM's Serial/Parallel Adapter. But at a lower cost and with



built-in expandability. Connect printers, plotters, modems, and other devices for increased productivity.

### Advanced Port Expansion

As your AT becomes the center of a high-performance LAN or growing multi-user, multi-tasking system, snap on the optional Quadport-AT Expansion Kit and add 4 more serial ports to your system. The Quadport-AT Expansion Kit comes with software to access these ports, making it easy to add shared peripherals or workstations.

### Enhance the smart way with Quadram.

For basic AT expansion, Quadmeg-AT and Quadport-AT work together to provide 128K memory expansion, a serial port, and a parallel port.

Then, as your system grows, Quadmeg-AT and Quadport-AT give you up to 4MB RAM, 1 parallel port, and up to 5 serial ports in just two PC AT expansion slots. Only Quadram combines so much power and expandability. That's PC AT enhancement the smart way.

### Features

**Quadmeg-AT:** RAM expansion from 128K to 2Mbytes. Expandable in 512K increments. Split memory mapping assigns 128K or 384K to base memory.

**Total RAM Capacity:** 4Mbytes.

**Quadport-AT:** Port expansion with 1 Centronics parallel port and 1 RS-232C serial port.

**Expansion Cards:** Two cards available. Each comes with 512K or 1Mbyte RAM installed.

**QuadMaster-AT Software:** RAM Drives and Spooling for extended memory.

**Quadport-AT Expansion Kit:** (optional) 4 RS-232C serial ports. Software to access ports.

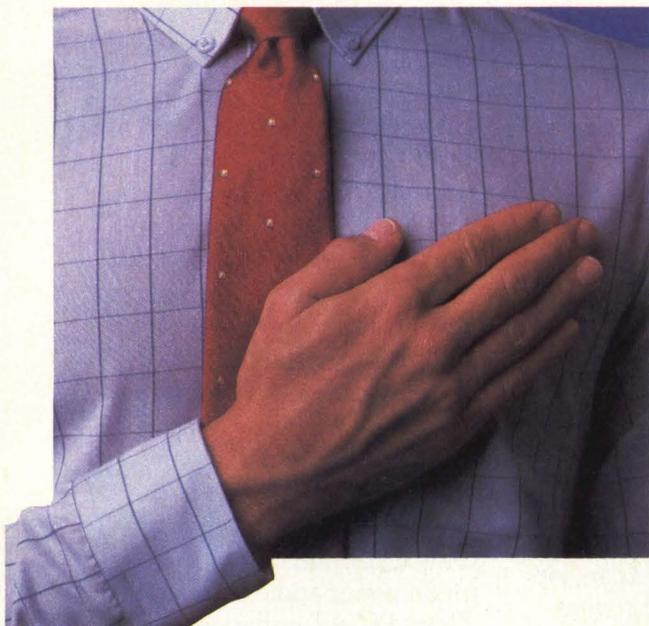
For a free demonstration visit the Quadram dealer nearest you. Or, for information, write us at 4355 International Blvd., Norcross, Georgia 30093 (404) 923-6666.

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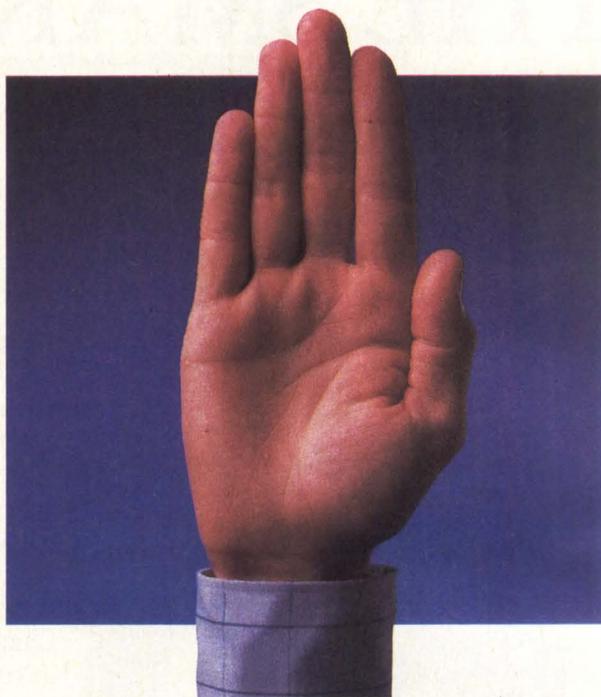


CIRCLE NO. 17 ON INQUIRY CARD

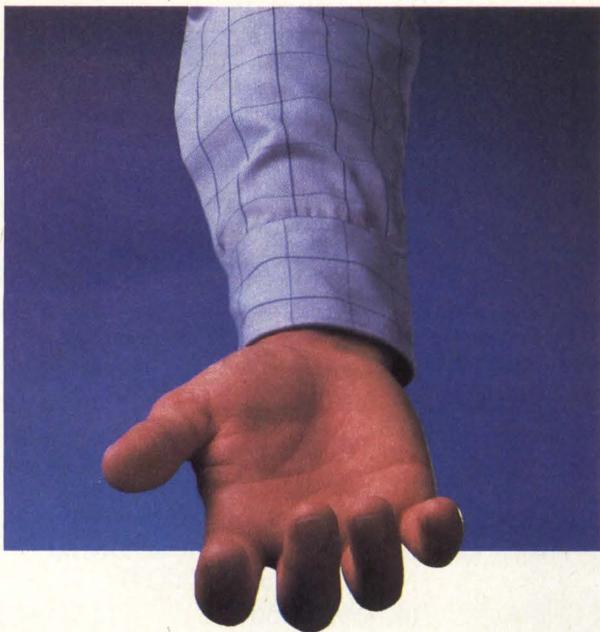
# **MOST COMPANIES ASK A LOT OF THEIR VARS.**



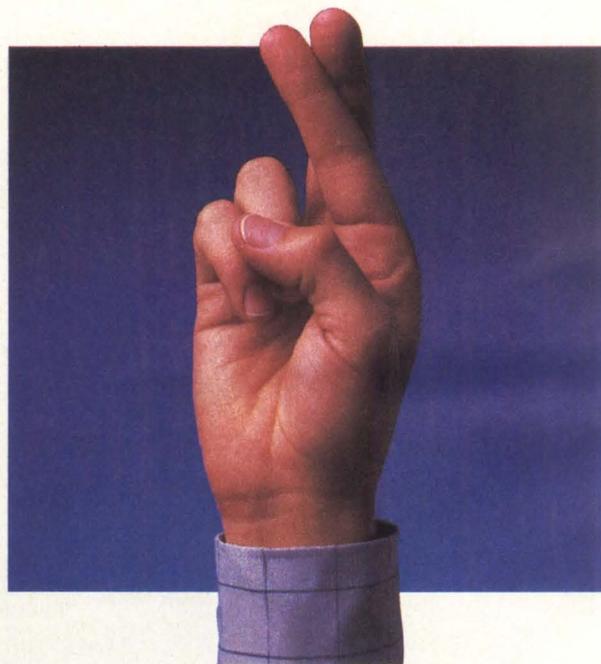
First, you have to pledge undying allegiance.



Then swear to meet extravagant quotas.



Beg for technical and ad support.



And hope they won't disappear.

# WE'RE A LOT LESS DEMANDING.



When most computer manufacturers offer to lend you a hand, they expect you to repay that loan with interest. A lot of interest.

Like putting up with unreasonable quotas. And stingy margins. And direct sales forces that skim off your most lucrative accounts. And so on.

At NCR, we do business a little differently.

For example, we offer you an aggressive discount schedule. Based on very reasonable sales goals and lenient milestones. With rebates for excess sales. And protection against price changes.

Then there's our Major Account Sales Program. You use NCR Direct Sales prices and discounts. And you get 10% of product list prices. Plus **100%** of all add-on revenues. **We** maintain the inventory, schedule shipments, invoice the customer, and accept responsibility for receivables.

If you want NCR service for your customers, they can get it from any of our 7,000 qualified service technicians in over 400 locations nationwide.

If you want to provide your own service, we can help you there, too. We'll even train your service techs tuition-free.

You won't have to beg us for support, either. We have a toll-free number for questions about NCR-supported operating systems or NCR-marketed software. And our co-op ad program features 100% payment of 5% of invoices. With the money paid up front, when you need it.

Our product line includes three IBM-compatible PCs. From the NCR PC4™ to the NCR PC8™. A retail PC. And a local area network that can connect up to 64 IBM-compatible PCs. Those are just some of the programs and products that are helping make NCR the partner of choice for more and more VARs.

But programs are only part of the story. What's winning most VARs over is our attitude.

You see, we think of our VARs as partners, not puppets. After all, the more successful you are, the more successful we are. So we work very hard indeed to make sure you're very successful.

Almost as hard as you do.

You can have our hand on that. Just by calling (513) 445-7478.

Then the next time another manufacturer offers to give you a hand, you can look them right in the eye and tell them to keep their hands to themselves.

## WE'RE GIVING VARs A HAND. AND VICE VERSA.

# NCR

Personal Computer Division

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**CIRCLE NO. 18 ON INQUIRY CARD**

# DECLARE YOUR DATA INDEPENDENCE.



**When In The Course Of Business Events . . .**  
OEMs designing business systems face two new

realities. One, data processing is becoming more distributed—more individualized work units, defined by job function and application, performed by more people in more places, demanding more independence.

The second reality? Winchester's. This prevailing storage technology is headed in a direction that's just the opposite of data independence—tying users to shared storage systems, large or desk-top.

## Slavery By Any Name . . .

The central issue is no longer just more data. It's *more data dynamics*. And Winchester's aren't really dynamic at all. Consider "wait your turn" access, or the need for lots of user "system savvy." Consider time-consuming backup and restore. And consider the ever-present risk of expensive head crashes. Now consider the IOMEGA alternative.

## IOMEGA's Distributed Data Storage: Freedom Of Information.

Our family of data management/storage systems matches the distributed data processing reality with a new reality: *distributed data storage*—with systems whose reliability and specs often exceed Winchester's, particularly in access times and transfer rates, and with cost-per-megabyte figures that Winchester's simply can't figure.



	IOMEGA BETA 5	IOMEGA ALPHA 10/10H	TYPICAL WINCHESTER
Formatted Capacity	5.0 Mbytes per cartridge	10.0 Mbytes per cartridge	10.0 Mbytes fixed
Data Transfer Rate	5.0 Mbits/Sec	9.0 Mbits/Sec	5.0 Mbits/Sec
Average Access Time	50 msec includes settling	35 msec includes settling	85 msec
Form Factor	5.25"	8"/8" Half Height	5.25"

The IOMEGA cartridge is the key. Now download data and software to a 5- or 10-megabyte cartridge, then manipulate, update, and upload conveniently and efficiently. The result is a total enterprise solution that can store applications, complex programs, or data sets—all of which can then be passed along to others without networking. And when you need more storage, you use more cartridges, not more hardware.

## Accept No Alternatives.

IOMEGA's distributed data storage solutions—full and half-height 8-inch 10-megabyte and a 5¼-inch 5-megabyte versions—give OEMs Winchester performance and reliability with floppy convenience and cost-efficiency. They are proven, risk-free solutions. And IOMEGA's cartridges are the only ones that are truly rugged, fully interchangeable, and inexpensive.

Now OEMs gain the *freedom of designed-in freedom*. The freedom today's customers require.

So take the liberty of calling an IOMEGA representative today. There's one in your area.

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CIRCLE NO. 19 ON INQUIRY CARD

IOMEGA HAS REMOVED CAPACITY AS THE MASS STORAGE ISSUE.

# MINI-MICRO WORLD

## NEWS

### AT&T plays its 32-bit chip

David Bright, Assistant Editor

In an effort to become a "serious player" in the semiconductor business, AT&T Co. has placed its 32-bit WE 32100 microprocessor chip set on the commercial market. The 32100, the first microprocessor marketed by the company, is an enhanced version of the 32000 microprocessor that forms the heart of AT&T's 3B series of mini-computers and microcomputers.

Although the new chip is not restricted to any one operating system, AT&T designed it specifically for UNIX System V, to which AT&T also has the rights. AT&T expects this UNIX connection to attract designers of UNIX 32-bit systems.

While AT&T waits for system designers to scoop up the WE 32100, which many observers consider to be of high quality, Motorola Inc.'s MC68020 appears to be emerging as the chip of choice for vendors building UNIX 32-bit systems. The reason is twofold: Motorola's 68000 family, with its 16/32-bit 68000 and 68010 microprocessors, has already become a de facto standard, and there is some skepticism about the amount of support that system designers can expect from AT&T.

At Cromemco Inc., a Mountain View, Calif., builder of 68000-based supermicrocomputers, director of engineering Curt Terwilliger says his company will stick with the 68000 family until the market tells them to do otherwise. Terwilliger feels it would be unwise to ignore the 68000 family's "widespread acceptance in the UNIX community and its momentum with software developers." Cromemco is working on a new system that incorpo-

rates the 68020. The WE 32100 may be an excellent chip, Terwilliger says, but a microprocessor's technological excellence alone does not always determine its success. As an example of that phenomenon, he cites the Intel Corp. 8088 used in the IBM Corp. PC. Although the 8088 wasn't the fastest chip available when IBM brought out the PC in 1981, it quickly became a standard.

#### Chalk up one for the 68020

Even some companies that use chips competing with the 68020 are switching to the Motorola camp. One such manufacturer—Flexible Computer Corp., Dallas—makes a multiprocessor system based on as many as 20 National Semiconductor Corp. 32032 chips, but will be replacing those with 68020s by this fall, a spokesman reveals. Flexible makes its decisions according to customer demand, he says, and right now the customers want the 68020. Although Flexible is not ruling out the 32100 for use in future systems, the company feels it would be "going out on a limb" by switching to the AT&T chip now.

Despite AT&T's enormous resources, many observers assert that the company is still new in the commercial electronics business and has a lot to learn, especially about marketing and support. "I'm not optimistic about their chances as a chip maker," says David Fiedler, president of InfoPro Systems, which publishes the *UNIQUE* UNIX newsletter in Denville, N.J. The problem? "It's the image." AT&T had poor marketing and inadequate support for its 3B computer systems, says Fiedler. It's his personal experience that you have to

#### COMPARING 32-BIT MICROPROCESSORS

	AT&T WE 32100	Motorola MC68020
Housing	132-pin, ceramic	114-pin, ceramic
Clock speeds (MHz)	10, 14	12, 16
Direct-memory addressing (G bytes)	4	4
On-chip instruction cache	64 word	64 word
32-bit registers	16	16
Floating point support	yes	yes

know someone just to get routine support from AT&T. AT&T needs to sell the industry on using its microprocessor, rather than just offering it for sale, Fiedler says. "The image right now is not that of a company that's prepared to do all these things like a traditional company."

But Linda Nardelli, an AT&T manager of microprocessor sales planning and technical product support in Holmdel, N.J., says the company is prepared to take on that challenge and has a full-time engineering support force. In addition to providing support, maintaining a second manufacturing source to keep up with demand is generally considered critical to a microprocessor's marketing success, but at press time AT&T had not announced any alternate sources.

Although interest in the 32100 is rather low at this point, Jan Rey, a research analyst at Dataquest Inc., a

San Jose, Calif., market research company, predicts that the chip will gain popularity as the 32-bit microprocessor market matures. "The 1990s is the 32-bit market, but you've got to start now," Rey explains. Microprocessor-market segments usually go through five-year growth cycles before they thrive, so the 32100's time will come, she says. She expects the 32100 to eventually show up in computer-aided engineering and computer-aided design systems.

Regardless of the marketing and support controversy, most observers rate the 32100 high on a technological level. The major enhancements over

the chip's AT&T predecessor are faster clock rates—either 10 MHz or 14 MHz, compared to 7.2 MHz on the 32000—the addition of a 64 word on-chip instruction cache and an enlarged instruction set. In addition to the 32100 CPU, the six-chip set comprises the 32106 math-acceleration unit, the 32101 memory-management unit, the 32103 dynamic RAM controller, the 32104 direct-memory access controller and the 32105 system-interface unit.

Production of the 32100, 32101 and 32105 has begun, with the other chips scheduled to be in production by the first quarter of 1986. Samples of the 10-MHz CPU are available for \$400;

14-MHz CPU samples cost \$480.

Along with the chip set, AT&T sells a development system that comprises UNIX V software development tools, microprocessor-emulation equipment and a single-board computer for evaluating system performance. "We've got a complete system now, to meet any designer's shopping list," says Al Hofmann, AT&T manager of microprocessor market planning at Holmdel.

Products planned by Hofmann's group for next year include a VMEbus board-level product running UNIX V and a 16-bit microprocessor that will be software-compatible with the 32100. □

## DECnet DOS challenges IBM to enhance SNA

**James F. Donohue**  
Managing Editor

Digital Equipment Corp. has come up with DECnet DOS, a \$500 software package that extends the full capabilities of its wide area network (WAN) environment, Digital Network Architecture (DNA), to IBM Corp. PC and PC/XT microcomputers. With DECnet DOS, scheduled for delivery in September, the IBM machines will join the DEC Professional Computer and Rainbow microcomputers in being able to function as nodes on DECnet, DEC's WAN that operates under DNA protocols.

DECnet DOS lets users communicate bidirectionally between applications running on IBM's Systems Network Architecture network and systems running on DECnet. Until now, the PC and PC/XT could tie into DECnet through SNA Gateway, a DEC product, but only in terminal emulation.

Many industry analysts say the PC and PC/XT can operate more efficiently on a DNA network with DECnet DOS than they can on SNA. The PC and PC/XT connect to IBM's SNA network environment in terminal emu-

lation. But, as nodes on DEC's WAN, they can swap files and communicate directly between applications running on other nodes. Thus, analysts say, the PCs can get greater power on a DEC network than they currently can on an IBM network.

When will IBM have something like DECnet DOS for its PC machines? Most computer and communications analysts contacted by *Mini-Micro Systems* say it will take IBM about a year to bring DECnet DOS-like communications functions to the PC and PC/XT.

### 'High-horsepower' networking

Eric H. Killorin, president of market research concern Hyatt Research Corp., Andover, Mass., praises DEC for bringing "high-horsepower networking functions down to the PC level," but he adds that DEC's motivation was probably to defend its own customer base.

"They have an installed base of DEC users who own a ton of IBM equipment, including PCs," Killorin says. "These users have been saying to them, 'Look, we have all these IBM PCs and we want to hook them to our DECnet network. If you can't do that,

then in a few years, we may trash all the DEC equipment and go IBM all the way.'"

### Five other products

At the same time it announced DECnet DOS, DEC introduced five other software products: three packages that help users communicate between DEC systems and SNA-based systems and two protocol emulators that provide communication links from DEC's Micro/RSX operating systems to IBM environments. All five products are available now.

DECnet/SNA VMS Advanced Program-to-Program Communications (APPC) programming interface enables VMS-based applications running on DEC VAX and MicroVAX systems to communicate with applications on an IBM host mainframe on a peer-to-peer basis by way of the DECnet/SNA gateway. "The major benefit of APPC," says Bob Murray, manager of networks and communications marketing at DEC's plant in Tewksbury, Mass., "is that all DECnet/SNA interconnect functions are transparent to the programmer." That means, he says, that programmers need to have little SNA knowledge and "can concentrate on application programming and not on SNA conversions." APPC carries a \$2,500 price tag.

A related product is DECnet/SNA VMS Application Programming Interface (API), which also permits ex-

## OSI fidelity gives DEC edge on IBM

Digital Equipment Corp.'s Digital Network Architecture (DNA), implemented in DECnet, is based on the International Standards Organization's seven-layer networking model, the open systems interconnection (OSI). IBM Corp.'s Systems Network Architecture is not, and it differs from OSI in two key areas:

- IBM combines OSI's network and transport layers into its path-control layer
- IBM divides OSI's session layer into two layers: data-flow control, which synchronizes the flow of data between end-points, and transmission control, which paces data exchange to match end point processing capacity.

### DEC IS CLOSER TO ISO THAN IBM

IBM'S SNA layers	ISO'S OSI layers	DEC'S DNA layers
application	application	user-level network applications, network management
presentation	presentation	network application
data flow control	session	session control
transmission control		
path control	transport	end communications
	network	routing
data link control	data link	data link
physical control	physical	physical link

Source: Mini-Micro Systems, DEC, Hyatt Research Corp.

According to many computer and communications industry analysts, DEC's closer adherence to OSI gives it a leg up on IBM among the increasing numbers of system integrators who support international standards for computer communications. And DEC's huge customer base of about 25,000 DECnet nodes gives it a leadership position among the other vendors of wide area network (WAN) products such as Data General Corp. (Xodiac), Hewlett-Packard Co. (AdvanceNet), Honeywell Inc. (Distributed Systems Architecture) and Wang Laboratories Inc. (Wang Systems Network).

"DEC has a significant lead in distributed-processing networks and is expected to direct the industry in supporting OSI multivendor communications under DECnet," says Hyatt Research Corp., Andover, Mass., in its book, *The Executive's Guide to PC Networks*. "DEC's lead should position their networking scheme as the open systems' alternative to SNA in the years ahead."

Some analysts think DEC's position in WAN technology will put the pioneer minicomputer vendor back in a head-to-head battle with IBM for industry leadership. Says Steven Dube, senior vice president at financial analyst Shearson Lehman/American Express, New York, "In terms of sheer transaction-processing power, modularity and networking, I think DEC's ahead of IBM...I look on DEC in the decade of the 1980s as the primary alternative systems vendor to IBM."

changes between IBM and DEC VMS applications. But, in the \$1,500 API, the SNA functions are not masked from the user. This feature lets the user write programs that incorporate SNA-based resources.

The third software package, DECnet/SNA VMS 3270 Data Stream Program Interface, is related to the others but is designed for 3270 emulation interfaces. Like APPC, the \$2,500 package insulates the user from SNA.

The protocol emulators are the Micro/R SX 2780/3780 and the Micro/R SX 3271. The Micro/R SX 2780/3780, which sells for \$1,200, emulates the communications protocol of an IBM 2780 or 3780 batch terminal. The \$900 Micro/R SX 3271, with a 3270 terminal emulator utility, allows users of DEC's VT100 and VT200 terminals on Micro/R SX systems to access an IBM host

system.

Both emulators give users the ability to communicate with IBM systems

using binary synchronous communications protocols in both batch and interactive manner. □

## PRICE CUTS PARE PC PRINTER PROFITS

The biggest story in personal computer printers is continuing price erosion and consequent smaller profits, according to a report from International Data Corp., a Framingham, Mass., market research concern. In 1984 the number of units shipped increased by 72 percent over 1983, while the value of those shipments rose by just 45 percent, says the report. The average price of dot-matrix printers fell by 14 percent last year, while the average price of character printers dropped by 20 percent. Although the popularity of non-impact printers is increasing, impact printers will continue to dominate the personal computer printer market at least through the end of the decade, says the report. It predicts that 90 percent of the nearly 6 million personal computer printers shipped in the United States this year will be impact printers.

# Integrated UNIX software package supports customized applications

David Bright, Assistant Editor

Until recently, integrated, multiple-function software packages like Lotus Development Corp.'s 1-2-3 and Ashton-Tate's Framework were the near-exclusive domain of personal computers. Despite the proven demand for such packages, few were available for larger systems running UNIX. But now that is changing.

With interest in UNIX at an all-time high, due largely to AT&T's entrance into that market last year, the UNIX-based, integrated-software movement in multiuser systems is gaining momentum. A few companies, such as Handle Technologies Inc. and Quadratron Systems Inc., have established a foothold in the fledgling market but are certain to have many new competitors in the near future.

One of the newest players—Inspiration Systems Inc., Sewickley, Pa.—has developed an open-ended, integrated-software package to which customized applications can be added. Called Prevail, the database-driven package comprises seven modules: spreadsheet, menu-driven word processor, database-management system (DBMS), telecommunications program, proprietary applications-development language (ADL), report writer/applica-

tion generator and user interface. Added applications access the common database and link to all other applications in the system.

Chairman Dennis Moyles of Inspiration Systems believes Prevail will appeal to a wide range of users, from the novice who can immediately use the ready-made applications to the data-processing manager and value-added reseller who will write specialized programs that can be merged with the off-the-shelf programs.

## Common command structure

Each Prevail module can run stand-alone or with the others. All modules use the same command structure, which features eight function keys. Those include WINDOW OPEN and REMEMBER for retaining data when switching from application to application and for cutting and pasting.

## Graphics program expected

The spreadsheet supports work sheets of unlimited size, links work sheets and performs automatic consolidation of data from several work sheets. By late in the second quarter of this year, when quantity shipments are scheduled to begin, the spreadsheet should include a graphics program that draws 10 types of charts, says Moyles.

The DBMS creates both relational and hierarchical models and has three levels of difficulty: novice, intermediate and advanced.

Prevail's ADL, which is said to be similar to Pascal, can also be used to insert customized messages into the HELP section. The report writer/application generator has three levels: generate (which automatically sets all parameters), one-screen form and multiple-screen form. The source code generated by this non-procedural language can be manually modified by the user.

Prevail currently runs under UNIX on AT&T's 3B series of computers, Digital Equipment Corp.'s VAX superminicomputers and systems from Masscomp, NCR Corp., Parallel Computers Inc. and Sun Microsystems Inc. For single-user systems, 1M byte of RAM is required; 2M bytes of RAM is required for multiuser systems. Prevail can be adapted to any version of UNIX running on any machine, says Carol Sledge, vice president of software development. She says an automated process is used to accomplish the porting quickly.

Inspiration Systems is implementing Prevail on an IBM Corp. 4381 mainframe for Manufacturers Hanover Trust. That system runs Amdahl

The screenshot shows a terminal window titled "Prevail" in "INSERT mode". It displays a memo with a header, a table of revenue figures, and a footer with function key shortcuts. Three arrows point from external text to specific elements: one to the memo header, one to the table, and one to the footer.

**MEMO TEXT ENTERED IN PREVAIL WORD PROCESSOR**

**NAMES SELECTED FROM PREVAIL DATABASE AND COPIES LIST GENERATED BY REPORT WRITER**

**REVENUE TABLE OBTAINED FROM PREVAIL SPREADSHEET**

Prevail INSERT mode

To: John Smith  
From: Tom Brown  
Subject: 2nd Quarter Actual Revenue

Here are the revenue figures you requested

Sales Rep	APR	MAY	JUN	TOTAL
Mary Jones	25100	26700	26900	78700
Bill Thomas	19800	17300	19400	56500
Todd Klein	29200	30900	27700	87800
	74100	74900	74000	223000

If you have further questions let me know

cc: Mary Jones  
Bill Thomas  
Todd Klein

k1 DBMS k2 Editor k3 Execute k4 SpreadSheet k5 WordProcessor k6 Comm k7 Menu

Prevail's user interface allows cutting and pasting of information from any of the package's components.

Corp.'s UTS version of UNIX System V. In addition, Moyles says, his company is giving high priority to tailoring the software to XENIX on the IBM PC-AT.

### Major drawbacks claimed

Laura Stuart, senior analyst at The Yankee Group, a research company in Boston, says Prevail has some major drawbacks. Since ADL is a proprietary language, any applications created by it cannot run on other machines without the Prevail environment. And files built from Prevail cannot link to those from other vendors' software. But four UNIX software vendors—Quadratron, The Software Express Inc., Access Technology Inc. and Unify Corp.—have addressed that problem on their software by establishing the independent software-interchange standard (ISIS).

ISIS allows UNIX file interchanges in much the same way as the data-interchange format (DIF) does in the MS-DOS world. Sledge says future versions of Prevail will conform to ISIS.

Stuart of The Yankee Group sees other problems with Prevail. She says Prevail's electronic-mail function is geared to programmers, and the package should have included IBM Systems Network Architecture support. However, "given the dearth of UNIX software in general," there may be a market for Prevail, Stuart concedes.

The list price of an entire Prevail system for an AT&T 3B2 supermicro-computer is \$4,125. Module prices range from \$375 for the user interface to \$1,350 for the DBMS. Prices for minicomputer, superminicomputer and mainframe versions are 50 percent, 100 percent and 150 percent higher, respectively.

A competing package, Quadratron's Q-Office, lists for \$1,960 on the 3B2 and comprises eight components: word processor, menu generator, electronic calendar, calculator, electronic-mail program, phone directory, forms generator and electronic notepad. Q-Office for VAX systems is \$9,200. The components can be purchased separately.

Moyles and six other software developers founded Inspiration Systems in 1983. All of them had developed DBMSs at On-Line Systems Inc., a remote-computer services company

based in Pittsburgh. Six private investors, including Prime Capital Management Inc. and Smith Barney Venture Corp., have put \$4.5 million into Inspiration Systems. □

## Rockwell improves chip set for 2,400-bps modems

Mike Seither  
Associate Western Editor

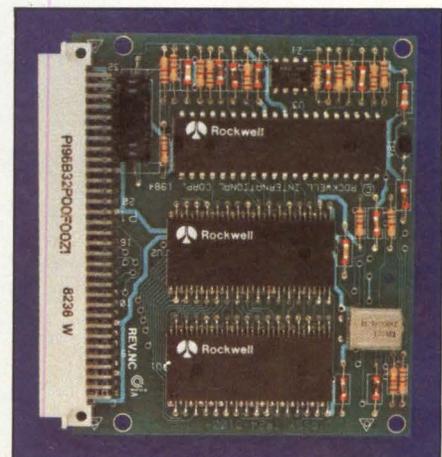
Volume shipments of full-duplex, dial-up modems that transmit at 2,400 bits per second (bps) are beginning to hit the market following improvements in a Rockwell International Corp. chip set used by a number of modem manufacturers.

According to industry sources, a defective Rockwell chip set—composed of two N-channel metal-oxide semiconductors for signal processing and one for filtering analog noise—occasionally would cause modems to go into a loopback test. This tendency would interrupt the flow of data during transmission.

Kim Maxwell, president of Racal-Vadic, Milpitas, Calif., says the chances of modems with the "E-level" Rockwell chips—so called because they are marked on top with the letter "E"—malfunctioning are one in 100,000. The problem has to do with a scrambler in the modem when it's used to transmit at a speed of only 1,200 bps. Under certain conditions, the scrambler would initiate a test pattern that would be looped back continuously from the modem at the other end until the line was disconnected or the call disabled.

"Once in 100,000 times is not a small number when you consider the amount of information we send today," says Maxwell. "If you have a thousand units in the field, the probability drops to one in 100. It could happen several times a day."

According to Maxwell, Racal-Vadic late last year decided that the faulty E-level versions of the Rockwell chips



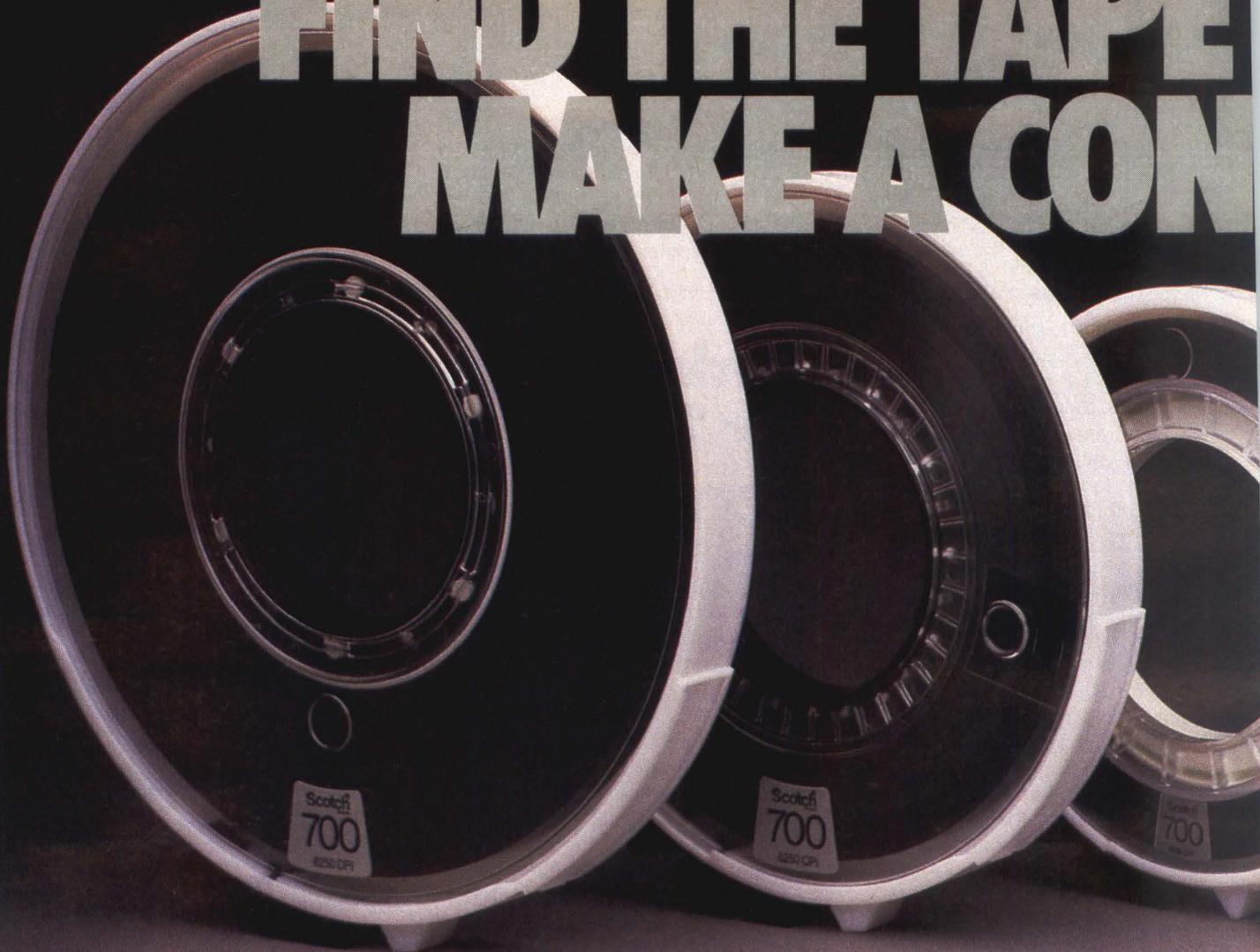
The signal processing and noise-filtering chips Rockwell uses in its R2424 modem are also used by such manufacturers as Hayes and Novation in their 2,400-bps devices.

were not acceptable and returned them to Rockwell's Semiconductor Products Division in Newport Beach, Calif.

"Rockwell is now supplying us with a new generation of F-level chips that we consider to be commercially suitable," Maxwell says. "They [the new chips] still have problems, but the bugs do not provide a sufficiently high level of user problems that we consider them unreliable." Maxwell says Rockwell will be selling Racal-Vadic "shipable" chip sets this month.

Racal-Vadic uses the F-level Rockwell chips in two modems: the 2400V, a standalone unit, and the 2400PC, a card for IBM Corp.'s PC. Both sell for \$795. The 2400V has been shipped in evaluation quantities since April, but the company does not plan to ship the 2400PC until this month. Maxwell says

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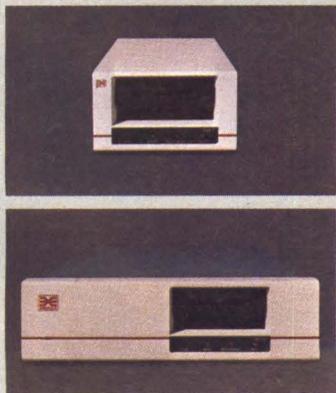
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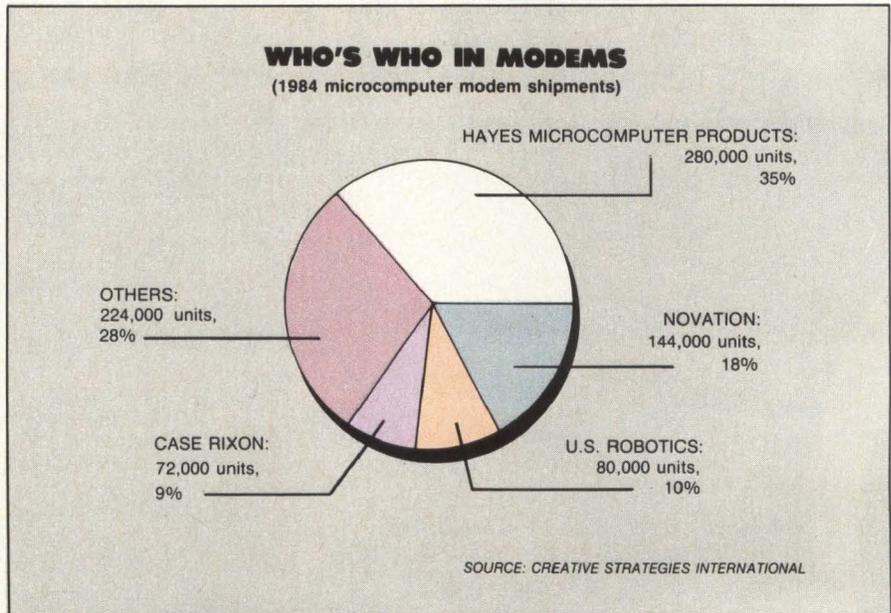
**The genuine alternative.**

the delay in getting out the 2400PC is due to in-house problems at Racal-Vadic, not chip supplies from Rockwell.

At least a dozen manufacturers plan to be shipping 2,400-bps full-duplex modems by midyear. Maxwell says 80 percent of all 2,400-bps units on the market will rely on Rockwell chip sets to perform signal processing. Besides Racal-Vadic, Rockwell supplies the three-chip set to a number of modem makers, including Hayes Microcomputer Products Inc., Norcross, Ga., and Novation Inc., Chatsworth, Calif.

Hayes, the leading microcomputer modem supplier with about 35 percent of the market, also had problems with Rockwell chips in its new \$899 Smartmodem 2400, which it began shipping in limited quantities last year. But Gary Betty, vice president of sales and marketing for Hayes, says the company now is using a Rockwell chip set that is different from the one used in an earlier version of the Smartmodem 2400.

He says the modem released last fall was incompatible with certain Rolm Corp. private branch exchanges



shipped before 1983. Customers could solve that problem, which involved dropping the digits 3 and 0, either by changing a switch on the PBX or trading their old unit for a newer Smartmodem 2400, Betty says.

"There have been on-going changes to the Rockwell chip set," Betty ad-

mits. "Rockwell has been very responsive. Any time you do anything as complicated as they did with signal-processing chips, you are going to make modifications."

Craig Ensley, director of business development and advanced product strategies for Rockwell, says his com-

### Handful go without Rockwell chips

Of the dozen or so manufacturers that plan to ship 2,400-bps full-duplex modems this year, a handful will use their own signal-processing chips rather than rely on Rockwell International Corp. for the devices.

"We looked at Rockwell chips early on in our development and decided we didn't want to limit ourselves to their design," says Hank Morgan, product-line manager for Gandalf Data Inc., Wheeling, Ill.

Gandalf began shipping its \$795 Sam 24 in February. In a marketing move that epitomizes the competition for the 2,400-bps market, Gandalf will rebate \$200 if buyers trade in a full-duplex 1,200-bps modem for a 2,400-bps Sam 24. "We've traditionally been a supplier of limited-distance modems," Morgan says. "But now we want to make a big splash in the dial-up market."

Other companies not relying on Rockwell are Cermetek Microelectronics Inc., Sunnyvale, Calif.; Concord Data Systems Inc., Waltham, Mass.; the CTS Datacomm division of CTS Fabri-Tek Inc., Eden Prairie, Minn.; Micom Systems Inc., Simi Valley, Calif.; and Chicago-based U.S. Robotics Inc.

Concord Data is recognized as the pioneer in the 2,400-bps market. The company originally introduced its CDS224 in 1982. Since then the price has dropped from \$1,695 to \$695.

Kim Myrhe, an analyst with International Data Corp., a Framingham, Mass., market research company, says manufacturers of 2,400-bps modems are going to find it difficult controlling the prices of their new products because of so much competition. "Wait six months and you'll see serious erosion," Myrhe says.

Gordon Stitt, director of personal computer products for Ven-Tel Inc., a Santa Clara, Calif., modem manufacturer, says his company does not intend to ship a 2,400-bps modem until this month. He would not say whether Ven-Tel will use the Rockwell chips in its modem, but he admits his company is aware of the competition. "We're concerned that so many people are shipping and apparently so few people buying [2,400-bps modems]," he says. "We want to see where prices are going and stick with a price once we introduce a product."

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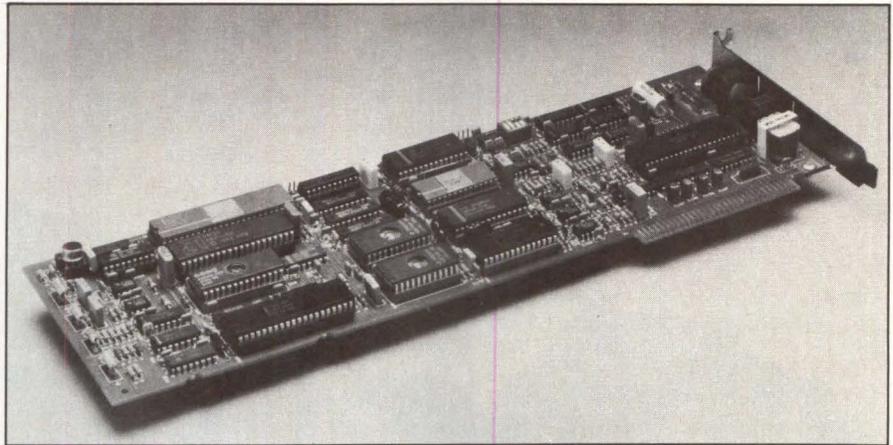
**CIRCLE NO. 22 ON INQUIRY CARD**

pany has been shipping the chip set in volume according to customers' specifications since December 1984.

He would not, however, discuss specific problems that modem vendors may be having in readying their products for production. "There are a host of possibilities not necessarily associated with Rockwell," Ensley says. "We're one component out of many in a complex system."

Several modem companies announced 2,400-bps full-duplex modems last fall at Comdex in Las Vegas, but most manufacturers have only recently started to ship the units in volume. Hayes did not begin volume shipments until March. Novation, the No. 2 modem supplier with about 18 percent of the market, didn't ship until April.

Analysts expect the market for 2,400-bps devices to grow substantially



**The Racal-Vadic 2400PC** modem, which uses a newer version of the Rockwell chip set, is expected to be shipped in volume this month.

in coming years as personal computer users switch from slower 300- and 1,200-bps modems to save on transmission costs. Since the AT&T Co. divest-

iture, private-line costs have been escalating and users are looking at dial-up switched service as an economical solution. □

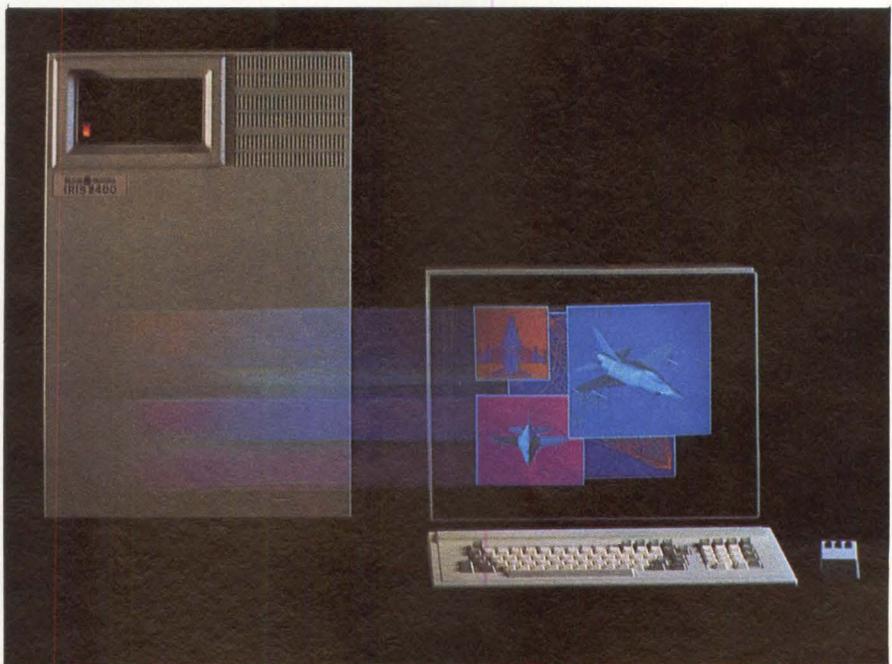
## Silicon Graphics, Tasvir gang up on Computervision

James F. Donohue, Managing Editor

Two Mountain View, Calif., companies have teamed up to battle Computervision Corp., Bedford, Mass., as a supplier of computer-aided-design and computer-aided-engineering systems for mechanical engineers. The two are Silicon Graphics Inc., a builder of high-performance CAD/CAE terminals and standalone workstations, and Tasvir Corp., which sells SuperCads 3-D, mechanical-design software.

SuperCads, run with Silicon Graphics' new IRIS 2000 series of UNIX-based workstations and terminals, emulates Computervision equipment at a far better price, says Robert Pearson, application marketing manager for Silicon Graphics. For example, he says, the IRIS 2400 standalone workstation sells for \$67,000 with SuperCads. He says a system with comparable performance from Computervision sells for about \$200,000.

"Our strategy is not to try to get a



**Silicon Graphics** says its IRIS 2400 standalone workstation is the first to offer an interactive window manager that permits users to run multiple 3-D application programs on a single screen.



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## BUS COMPARISON

	ISSUE	VMEsystem	MULTIBUS® II	COMMENTARY
Commercial Issues	<b>Specification Quality, Stability, Standardization</b>	VMEbus spec. available since 1981. Rev. C is a standard of clarity for the industry, very stable, and available now. VMXbus Rev. B available now; VMSbus completely specified, with Rev. B available in July '85. IEEE P1014 and IEC 47B committees have completed their work. Final approval expected later this year. VMXbus and VMSbus have been proposed to the IEC for standardization.	Various bus specifications available in draft form since late 1983. Complete draft has never been published for serial bus, iSSB™. IEEE Committee began work on Multibus® II in 1984. No known submission yet to IEC.	VMEbus IEEE activity represents the <i>first time</i> that the IEEE requested a committee be formed to standardize a microcomputer bus structure.
	<b>Proprietary Constraints</b>	None!	Intel trademarks: iLBX, iPSB, iSBX, iSSB, Multibus®, Multichannel. Intel patents: pending on Multibus® II. Copyrights: entire Multibus® II spec document. Licensing: by Intel, with fee required.	VMEsystem totally free of patent, trademark, copyright, and trade secret restrictions. It is truly an open system, with unimpeded public access.
	<b>Number of Vendors and Compatible Products</b>	Over 150 announced VME vendors with over 700 compatible products, encompassing boards, systems, packaging, and software.	Less than 10 vendors with announced products. Intel is the only major vendor with board-level products. (Three Intel board designs announced.)	VMEbus supported worldwide by Motorola, Mostek, Signetics/Philips, Thomson, Plessey, and many, many others. AT&T has selected VMEbus for its first line of board-level products.
Technical Issues	<b>Bus Timing</b>	All VMEsystem buses are asynchronous, except for VMSbus (which by its very nature must be synchronous). Asynchronous timing allows bus performance improvements as chip technology improves.	iPSB™ is <i>synchronous</i> , fixed at 10 MHz clock. Performance cannot be improved without increasing this clock rate, instantly obsoleting all pre-existing product.	VMEsystem architecture allows smooth growth as technology improves. Today's technology exceeds 10 MHz clock of Multibus® II. (E.g., 32.5 MHz and 16.0 MHz parts in M68000 Family.)
	<b>Interrupt Protocol</b>	VMEbus interrupt handling may be either centralized or distributed. Direct interrupts are provided to handle on up to 7 prioritized levels, with location monitors allowing any number of virtual interrupts.	iPSB™ interrupt latency is unbounded, and no priority override is allowed.	VMEbus interrupt protocol provides much greater flexibility and performance and is better suited for real-time applications.
	<b>Multiplexing</b>	Completely non-multiplexed VMEbus address and data lines, along with separate address and data strobes, allow data transfer rates in single transfers to approach block transfer rates. This also supports performance improvements with address pipelining features of modern processors.	iPSB™ single cycle data transfer rate is only half that of block transfer rate, since address and data lines multiplexed. Address pipelining not supported.	Clear performance advantage for VMEbus.
	<b>Serial Bus Protocol</b>	• Sender Self-Check for VMSbus • Collision-Tolerant	• CRC ERROR checking • CSMA/CD protocol. (Complete iSSB™ specification has never been published.)	VMSbus message rate stabilizes under heavy usage. CSMA/CD declines under heavy usage.
	<b>Bus Support Chips</b>	Nine defined, six presently available, with samples for additional three in 3Q 85. Presently sole-sourced from either Motorola or Signetics/Philips (depending on chip).	iPSB™ design requires LSI support. Two chips presently defined, sole-sourced from Japanese vendor. The chip implementing the complex message-passing protocol is not yet available.	VMEsystem is far ahead with available support LSI.

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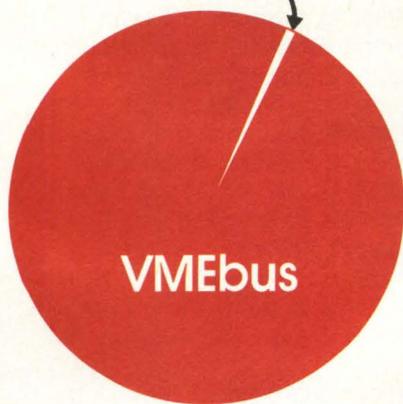
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user to throw out his existing Computervision system," he says. "But when he comes to add workstations, we point out the price advantage of adding one of our workstations over a Computervision machine."

### Claims faster throughput

Pearson claims a substantial performance advantage for the IRIS system. "Based on benchmark tests they have run," he says, "Tasvir claims SuperCads delivers two to five times faster throughput vs. Computervision."

Computervision declines to comment on the partners' claims, but consultant Richard N. Stover, president of CADD/CAM Advisors Inc., Lanham, Md., thinks the Silicon Graphics/Tasvir product could be competition for Computervision.

Silicon Graphics has given the 2000 series with SuperCads "an extremely competitive price," Stover says, adding: "I've seen SuperCads run. It's a Computervision-emulation package, and it's very nice."

Pearson says Computervision has such a strong position in the CAD/CAE market for mechanical design

engineers that just going after its machines in add-on situations "represents \$15 million to \$20 million in sales for us this year."

Pearson says, "When you add one of our machines to a Computervision system, you have essentially the same interface as the existing system. So the training effort is relatively low." Ease of training is important, he says, because "about half of all mechanical design engineers in the world have been trained to use Computervision systems."

Two OEM companies in Cambridge, Mass., have signed on to sell the Silicon Graphics/Tasvir machines as part of their systems. They are Skok Systems Inc., which sells to architects and building designers, and Lisp Machines Inc., which plans to use the product to design computers for movie animation.

Industry observers say the tie-in with Tasvir represents a positive step by Silicon Graphics to correct the lack of software that plagued sales of the 3-year-old company's first product, the IRIS 1000 series. It turned out with the 1000, says consultant Stover, that existing CAD/CAE software had to be

rewritten to take advantage of the IRIS features. "With Tasvir," he says, "they have something tailored to fit their system."

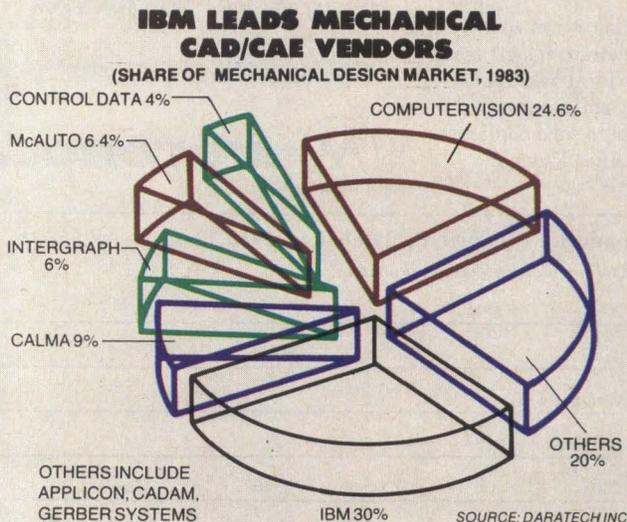
The 1000 series, which began in price at \$63,000, also was considered too expensive for the market it was in: CAD/CAE for electrical engineers. That is a market largely for 2-D applications which is dominated by two industry giants, Sun Microsystems Inc., Mountain View, Calif., and Apollo Computer Inc., Chelmsford, Mass.

Even the competition concedes the excellence of the IRIS hardware. "If a customer had no price sensitivity," says John Hime, director of product marketing for Sun Microsystems, he would choose Silicon Graphics. The problem Silicon Graphics faces, he explains, is that, while system integrators "would very much like to have the graphics functionality and performance of a Silicon Graphics [product], they've got to buy things for resale, and they know very well what their customers will and will not spend."

The price of the IRIS 2000 series without SuperCads begins at \$27,500.

## IBM has not been forgotten

Silicon Graphics Inc. has targeted Computervision Corp.'s 24.6 percent share of the computer-aided-design and computer-aided-engineering market for



mechanical engineers because Tasvir Corp.'s SuperCads software was available. Silicon Graphics describes SuperCads as a Computervision "knockoff" product.

But Silicon Graphics has not forgotten the No. 1 vendor in the field, IBM Corp., and its 30 percent market share.

Randy Nickel, a marketing manager at Silicon Graphics, says the company is working with Automation Technology Products, Campbell, Calif., on software and communication links that will allow the IRIS machines to tie into IBM mainframes and run high-speed, high-performance, 3-D design applications.

IBM's position in CAD/CAE, Nickel says, is based on its terminals, such as the 3279, which run off its mainframe with third-party software.

As with its strategy against Computervision, Nickel says, Silicon Graphics plans to attempt to coexist with IBM, selling IRIS as add-on products to existing IBM systems.

"I like to call us IBM-complementary," Nickel says. "We exist in an IBM environment very nicely."

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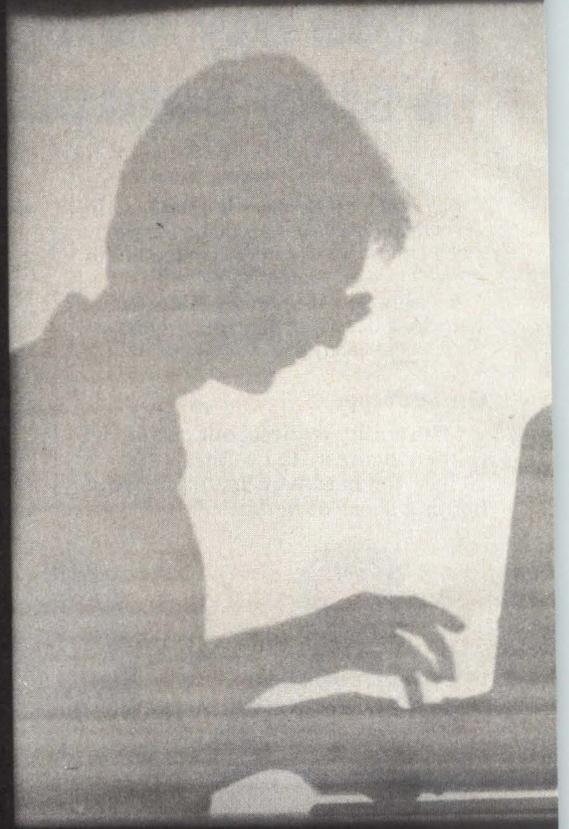
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Silicon Graphics says a unique feature of the 2000 series is the CAD/CAE industry's first interactive 3-D window manager. This feature allows users to work on several designs simultaneously, run multiple 3-D application programs and connect to several host computers through Ethernet.

The IRIS 2000 machines are based

on proprietary VLSI circuits developed at Stanford University by James H. Clark, Silicon Graphics' chairman.

The four models in the series are the 2000 (\$27,500) and 2200 (\$37,500), both terminals, and the 2400 (\$49,500) and 2500 (\$76,500), both standalone workstations. The prices are for the equipment without SuperCads.

The 2400 features 1.5M bytes of memory, expandable to 15M bytes, a 72M-byte Winchester disk drive, the UNIX System V operating system and 1,024-by-1,024, 60-Hz display. The 2500's main memory goes to 2M bytes, and the Winchester capacity, to 440M bytes. The 2000 series supports Ethernet local area networks. □

## CDC augments time-sharing with PC/XT software

Mike Seither

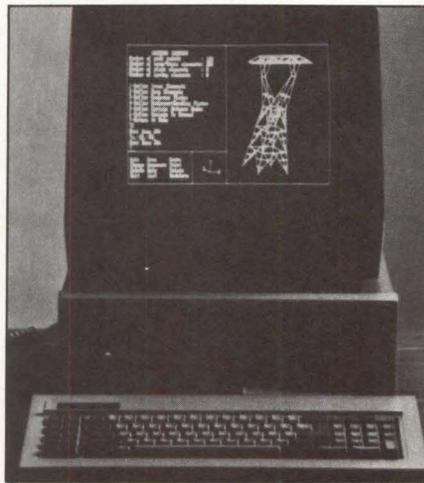
Associate Western Editor

Time-sharing companies like Control Data Corp.'s (CDC) Cybernet Services Division have taken a drubbing as more and more engineers switch from using remote mainframes to local personal computers for design and analysis. The Minneapolis company has decided to fight back by introducing a line of engineering software packages called Cybernet Express for the IBM Corp. PC/XT and compatibles.

Engineers can use the software on standalone workstations or in conjunction with Cybernet Service's time-sharing network whenever more computing muscle is necessary.

Cybernet Express will be marketed for engineers working on structures, power systems, piping, electronic design and petroleum reservoir simulation. For now CDC will concentrate its sales effort on Cybernet Services' existing customer base of electric utilities, petrochemical companies and others involved in large-scale engineering, says Harold Hahn, Cybernet Service's vice president of engineering applications.

Hahn admits that Cybernet Services has not been immune from the radical changes taking place in the time-sharing industry, which a decade ago saw annual growth rates in excess of 20 percent but is now leveling off. According to International Data Corp. (IDC), a Framingham, Mass., market



**The Cybernet Express Structures System** allows civil, aerospace and structural engineers to perform 3-D static and dynamic analysis.

research company, the segment of the time-sharing market that provides access only to mainframe computing time is expected to decline 1 percent between now and 1989.

Besides Cybernet Services, CDC also sells turnkey computer-aided design/computer-aided manufacturing systems made by its Computer Integrated Manufacturing Division. According to market research company Daratech Inc., Cambridge, Mass., CDC ended 1984 with \$95 million in CAD/CAM revenues and a 4 percent share of the market.

"Overall, CDC's time-sharing revenues are shrinking and may ultimately impact negatively on its [CAD/CAM]

market share," says Bruce Jenkins, a Daratech analyst. "However, certain segments of engineering time-sharing, such as large-scale structural engineering, appear to be growing." And it is at that market the new IBM PC software products are aimed, Jenkins notes.

The new software, which can be purchased separately or bundled with Zenith Data Systems' 150 IBM PC look-alike in a variety of configurations, includes the following:

- Power Systems, priced at \$8,300, for design, analysis and retrofit of industrial, commercial and institutional electrical-power systems
- Structures System, priced at \$4,500, is aimed at civil, aerospace and structural engineers. It allows 3-D static and dynamic analysis of structures, from packaging and mechanical design to space-frame analysis
- Electronic Designer System, priced at \$5,700, provides interfaces to host computer simulations and features schematic entry, pan and zoom, simulation analysis for logic and timing and multiple windows.

When bundled with CDC-supplied hardware, the highest priced workstation would cost about \$20,000, Hahn says. For that price, a purchaser gets a Zenith 150; MS-DOS 2.0; the 8087 math coprocessor; 512K bytes of RAM; a color-graphics adapter board; color monitor; a 132-column, dot-matrix printer; a 10M-byte Winchester disk drive and a 360K-byte floppy drive plus the Power Systems software. □

## HEARD ON THE HILL

# Tough trade bills receive cool industry support

**Stephen J. Shaw**  
Washington Editor

Industry reaction is surprisingly lukewarm to legislation recently introduced in the Senate intended to open foreign markets to U.S. telecommunications and other microprocessor-based equipment.

S.728, introduced by Sen. John Chafee, D-R.I., and the similar S.942, sponsored by Sen. John Danforth, R-Mo., would inhibit the entry of foreign telecommunication products into the United States if foreign governments restricted access of American products of like kind. The legislation adopts a broad definition of telecommunications products. It includes private branch exchanges and digital switching systems—minicomputers by another name.

Chafee's bill would prohibit the entry of Japanese telecommunication products until Japanese markets are opened to U.S. telecommunication goods. Unless the U.S. secretary of commerce and the U.S. trade representative (USTR) certify that U.S. telecommunication products had equal access to Japanese markets, no telecommunication products produced or manufactured in Japan would be allowed into the United States.

Danforth's bill is more broadly written. Under its provisions, the USTR would identify countries that engage in trade practices that discriminate against U.S. telecommunications goods and services. If such a country is determined not to offer "substantially equivalent competitive opportunities," the president would be directed to enter into trade negotiations to gain access to its markets.

If an agreement is not reached within two years, the president would be authorized to levy immediately a tariff surcharge of 35 percent on telecommunications goods or services exported by that country to the United

States. The president could also prohibit the federal government from purchasing the telecommunications products of a foreign country and prevent federal funds or credits from being used by private companies or individuals to purchase telecommunications goods from that country.

So, after years of listening to complaints from computer, telecommunications and other high-technology industries that the U.S. market offers far more access to foreign companies than foreign markets offer to them, Capitol Hill is finally responding with a legislative lever. The message from Capitol Hill to foreign governments is clear: Open your markets or we close ours, the largest in the world.

Nonetheless, U.S. high-tech industry reaction to the two bills has been lukewarm—at best. When the International Trade Subcommittee of the Senate Finance Committee held hearings on the issue in May, witness after witness offered either muted support or unqualified opposition to major provisions of the legislation.

Edwin Spievack, president of the North American Telecommunications Association, told the subcommittee: "While the legislation addresses one non-tariff barrier to increased U.S. exports—restrictive standards and the like—it fails altogether to address three other non-tariff barriers of equal, if not greater, importance. That is, the bloated dollar; the absence of independent marketing networks in foreign countries; and Defense Department restrictions on the licensing of American high-tech exports."

At best, Spievack said, Danforth's bill might open foreign markets to increased sales of products made overseas by American-owned corporations. At worst, it could trigger a trade war that would harm American consumers, devastate America's own independent distribution network and

leave the U.S. market vulnerable to large companies—most notably AT&T Co.—that dominate "what little American-based [manufacturing] capacity there is."

Blaine Davis, vice president for strategic, business and market planning for AT&T, testified on behalf of the Computer and Business Equipment Manufacturers Association. U.S. companies suffer from an international double standard, he said. The U.S. market for advanced telephone equipment, PBXes and digital-network switching equipment is wide open to foreign companies. But, he explained, when U.S. companies try to sell U.S. equipment and services overseas, they are faced with a variety of restrictive standards, certification and registration systems, or find national procurement controlled strictly by government agencies that do not allow foreign competition.

According to the AT&T executive, the Senate proposals are not versatile enough to handle the variety of tariff and non-tariff barriers imposed by U.S. trading partners. Davis urged that more flexibility be incorporated into Danforth's provision for an automatic 35 percent tariff surcharge if negotiations fail to produce an agreement within two years. Canada, for instance, maintains a 17.8 percent tariff on U.S. telecommunications imports. Under Danforth's proposal, the president would not be able to implement a commensurate tariff. He would be forced to levy the higher charge. "That's not achieving a balance of competitive opportunity," Davis said.

Edmund Fitzgerald, chairman of Northern Telecom Inc., Richardson, Texas, told the subcommittee that his company has been able to sell sophisticated network-switching equipment to the Japanese. It does not take any longer to sell to Nippon Telegraph & Telephone than it does to sell similar equipment to AT&T, he explained.

Without strong industry support, which does not appear to be forthcoming, S.942 and S.728 are given slim chances of passing.

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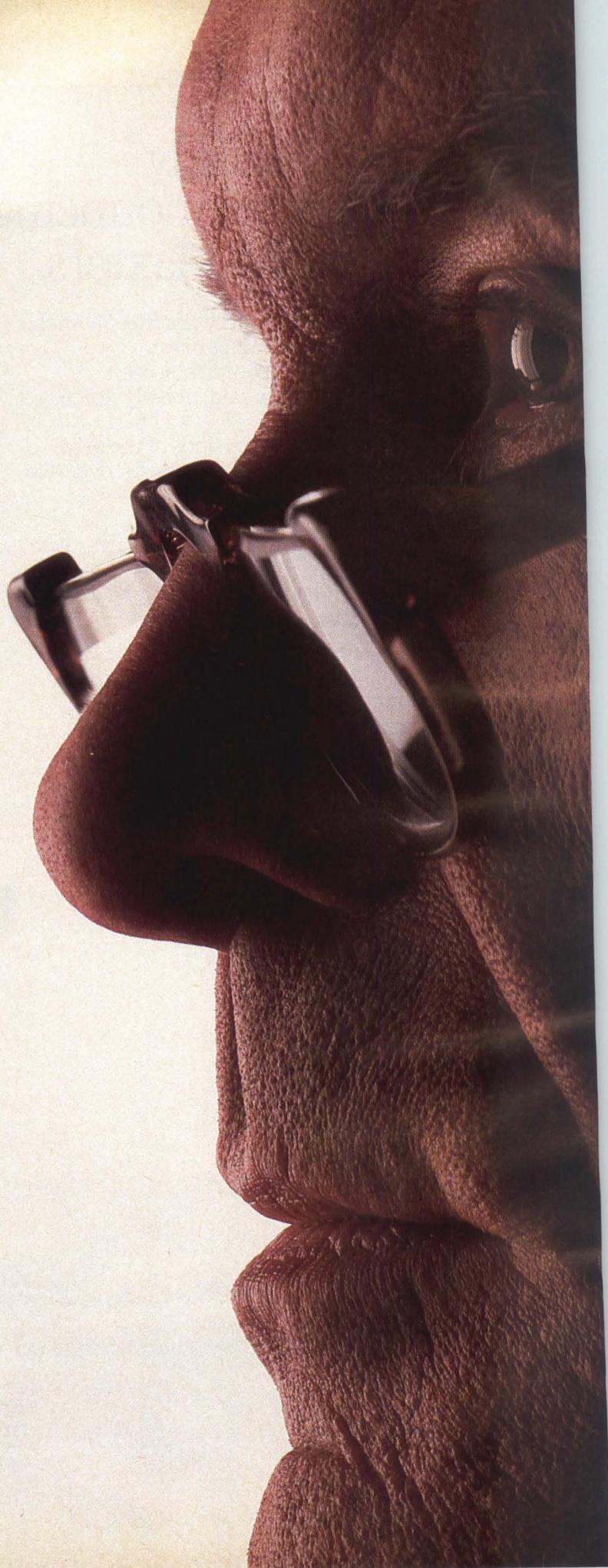
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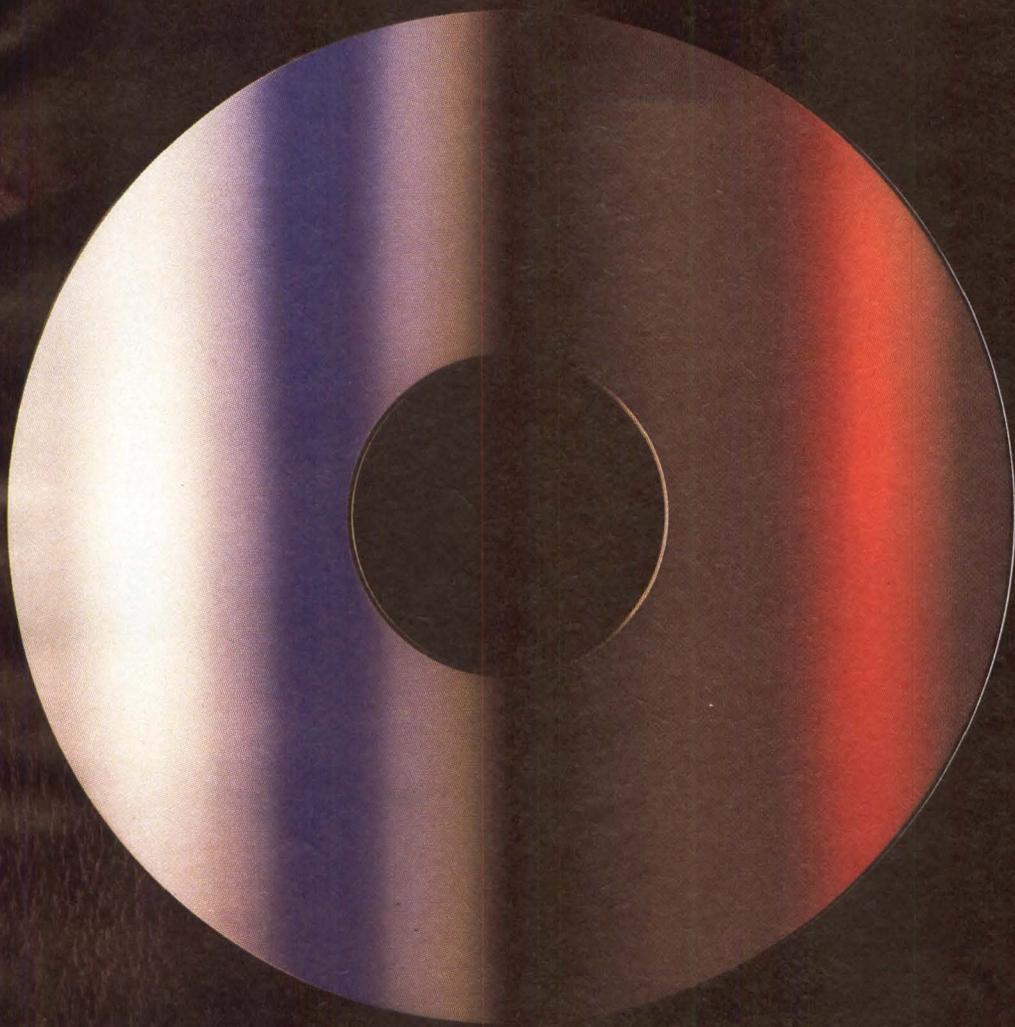
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# PERKIN-ELMER

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# MINI-MICRO WORLD

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## INTERNATIONAL

# Commodore moves with UNIX/graphics system

Lori Valigra, Senior Editor

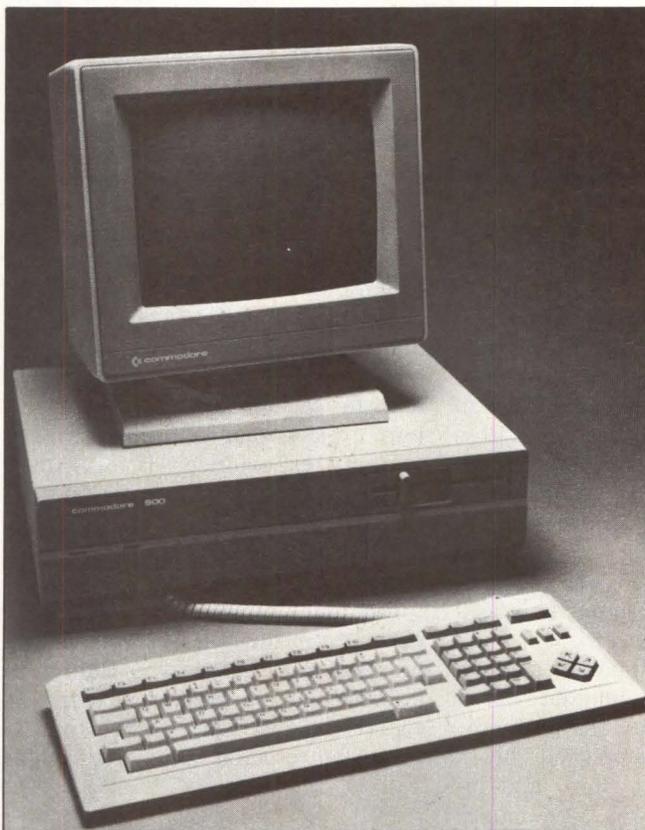
Commodore International Ltd., Westchester, Pa., one of the few manufacturers successfully bucking the economic slowdown in the home computer market, nevertheless joined some less fortunate competitors by introducing a business microcomputer at the Hannover Fair in West Germany.

The Commodore 900 business computer, which runs the UNIX-like Coherent operating system, was scheduled to be exhibited last month in a special international technology section at the Consumer Electronics Show in Chicago.

Commodore rival Atari Inc. already had introduced a business computer at the January Consumer Electronics Show in Las Vegas. The Atari ST has been described as a lookalike to the Apple Computer Inc. Macintosh (MMS, March, Page 47).

Commodore's introduction is the culmination of a two-year effort by the company to establish a foothold in the high-end microcomputer markets. "The company is actively entering new areas of the small-business and corporate markets and opening new channels of distribution," says Commodore president Marshall F. Smith.

The 900 will be marketed first in Europe, where the company has dealer channels established. Commodore has not specified when the unit will be introduced in the United States. A company source says this is partly because Commodore sells its computers domestically through mass merchan-



Commodore's card to play in the business market is the 900, a Z8001-based, UNIX-compatible microcomputer.

disers, such as K-Mart, which are not equipped to handle support for the 900's more sophisticated architecture. Worldwide, the computer should be available to dealers in the fourth quarter of this year, but software developers can now obtain it.

### Breaks new ground

According to Commodore software engineer Pete Bowman, the 900 will not only compete with midrange to

high-end general-business microcomputers, but, by virtue of enhanced graphics support, will also take Commodore into the low end of the graphics workstation market. Commodore's primary competition in that market will come from such companies as Sun Microsystems Inc., notes Bowman.

The 900 system incorporates a 16-bit Zilog Inc. Z8001 CPU with a 16M-byte address space. It also features 512K bytes of RAM, using 254K-bit memo-

ry chips, and is expandable to 2M bytes, with as much as 1M byte on the main memory board. Also included are one 20M-byte hard disk drive, a 1.2M-byte, half-height floppy disk drive, four expansion slots, one parallel interface, one IEEE-488 interface and two RS232 interfaces. The system can support drives housing 67M bytes of information, and a second floppy disk or streaming-tape drive can be added in an empty slot. While the model shown at Hannover was UNIX Version 7-compatible, a UNIX System V-compatible model is planned, the company says.

Support for the virtual device interface and Graphical Kernel System graphics standards is optional, as are COBOL, a Pascal compiler and a C compiler. The system can generate object code for the Intel Corp. 8086, 8088 and 80286; Zilog Z8000; Motorola Inc. MC68000; and Digital Equipment Corp. PDP-11.

Two versions of the 900, the model I and the model II, are available. The high-resolution model I competes with computer-aided design workstations produced by such companies as Sun Microsystems. It includes a 1,024-by-800-dot, bit-mapped, monochrome monitor; a three-button, mouse cursor controller to create and move windows on the 15-inch screen; and a video-controller card with 128K bytes of memory. This system should be priced at \$3,000 to \$3,500.

The model II can support as many as eight terminals, has a multiuser card with eight RS232 ports, is multiuser and multitasking (supported by a memory management chip) and includes an 80-character-by-25-line monochrome monitor. Its price should be slightly less than the model I's. Prices had not been firmly set at the Hannover Fair.

#### Windows slide

The model I includes a proprietary windowing package developed by Commodore for the 900. When a user changes the size of a window, the font in that window is automatically scaled down to fit into an 80-character-by-25-line matrix. Two types of windows can

be viewed: a VT100-like text window and a graphics window.

The company hoped to ready by introduction time a proprietary bit-block-transfer semiconductor that it will manufacture in Valley Forge, Pa. The chip, nicknamed the BITBLT, moves characters onto the screen and makes the screen scroll. So, for exam-

ple, tasks now done in software, such as moving a rectangle filled with information, will be done faster by using the chip. Commodore's Bowman says chip samples should have been available in May.

The computer is programmed in C, and Commodore offers a C compiler for software writers. □

## Europe awakens to expert systems

Keith Jones, European Editor

A burgeoning European market for expert systems is predicted in a report from Frost and Sullivan Inc., New York, a research group with offices in Paris, Frankfurt and London.

The report highlights differences between Europe and the more developed expert-system industry in the United States, where commercial companies are now selling large, expensive systems for specific applications. The report explains that in Europe, expert-system experience is confined primarily to a few universities and research institutes, adding that European systems tend to be small, inexpensive and generalized.

But the Japanese Fifth Generation computer project is seen as having provoked an awareness in Europe of artificial intelligence, particularly in expert systems. The report points to European research initiatives, such as

the European Community-backed ESPRIT program and to some national research programs.

The Frost and Sullivan report discusses in some detail more than 30 suppliers, including Bull-Transac, Paris; Nixdorf Computer AG, Paderborn, West Germany; and ICL Plc., London.

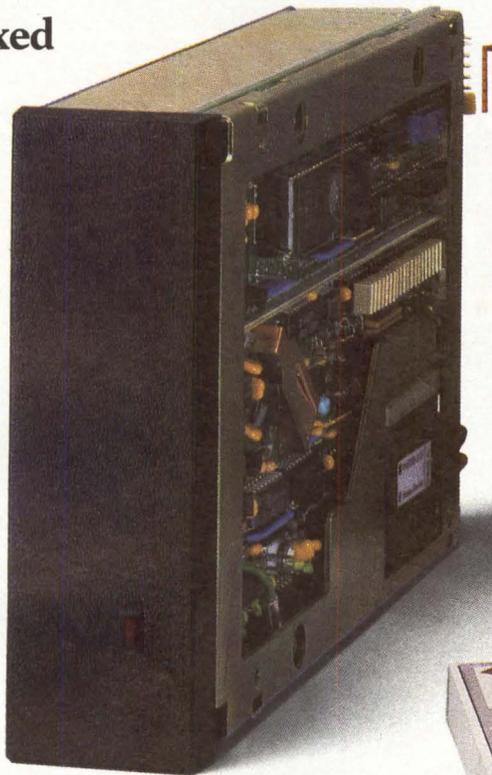
Five major categories of suppliers are identified. One category is of companies set up to sell expert-system hardware; another identifies new expert-system software companies. The other three categories comprise organizations active in the computer industry. They are established hardware manufacturers diversifying into expert systems, software product vendors doing likewise, or traditional computer-service companies and consultancies exploiting their expertise in areas such as banking and insurance to construct expert systems for those industries. □

### IBM WORKS TOWARD 16M-BIT RAM

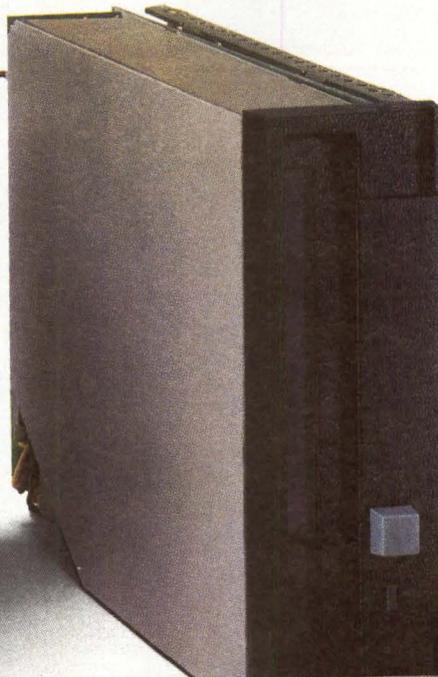
IBM Corp. scientists at Yorktown Heights, N.Y., say they have made the world's densest integrated circuits, with an eye to the development of 16M-bit RAM chips and chips with over 100,000 logic elements. Using a proprietary fabrication process, the scientists have shrunk circuits into an area 16 times smaller than that permitted by current semiconductor technology. One experimental chip they've developed includes a memory array with a one-transistor memory cell one quarter the size of those used in the 1M-bit chips currently being developed at IBM. The chip's power requirement was reduced from 5V to just over 1V.

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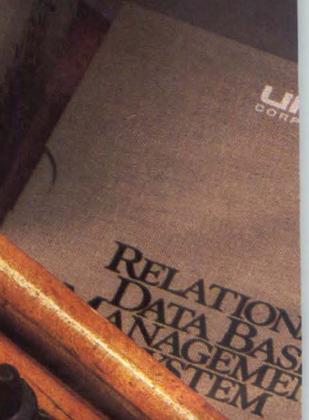
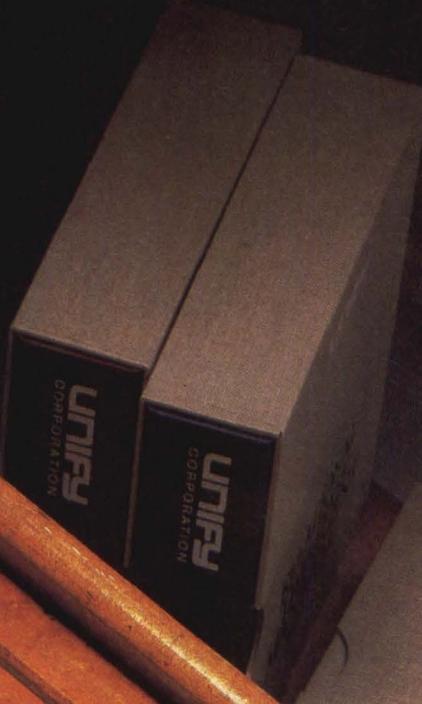
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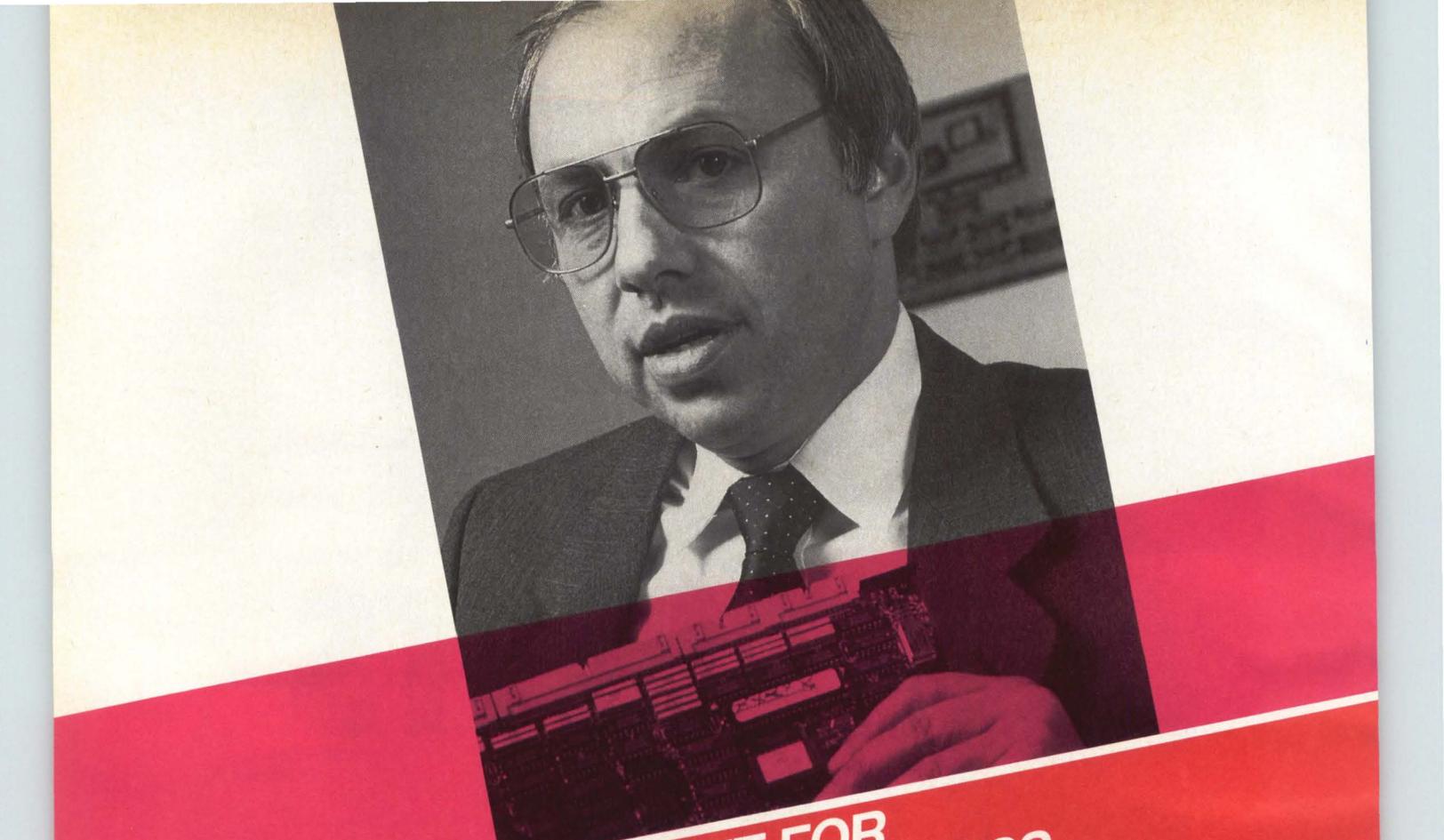
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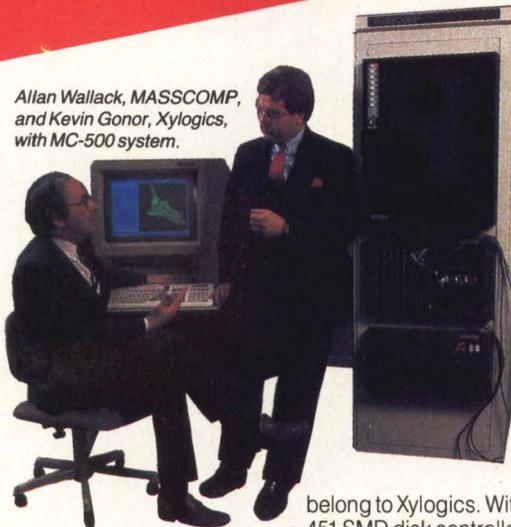
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**THE SECRET'S OUT.** CIRCLE NO. 31 ON INQUIRY CARD

Four years ago, MASSCOMP was a small company with one big idea: to build the fastest, most complete super micro-computer workstation ever made. A multi-tasking, performance oriented product that would bring new meaning to the term "real-time" for scientific and technical users. The MC-500.

Trouble was, after combing the marketplace, MASSCOMP couldn't find a peripheral controller with the kind of high performance necessary to fully support the MC-500's Fujitsu Eagle—the fastest disk on the market. Perform data acquisition—continuous to disk—at a rate of 1/2 million samples per second. And support a 924,000 whetstone benchmark rate.

Then in April, 1982, MASSCOMP met Xylogics.

*"From the beginning, Xylogics approached the relationship with a systems-level perspective,"* says MASSCOMP vice president Allan Wallack. *"That was very unusual for a board-level company. They understood that disk I/O—not how fast the CPU goes—is the critical ingredient for high performance. Because the quicker more information can be transferred, the more bus bandwidth is available to handle demanding applications like imaging, CAD and graphics."*

But that's not all.

*"Xylogics became part of our team. A MASSCOMP partner. Their engineers worked with our design experts to build the perfect high performance controller for the MC-500: the Xylogics 450. A product family that can use the Fujitsu Eagle to its maximum potential—2.4 megabytes per second—without disk swapping or switching."*

*"It's a much larger perspective."*

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# INTERPRETER

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

## UNIX VENDORS REARM FOR NEW MARKETS

They borrow personal computer industry techniques to bring products directly to business users

**Michael Tucker**, Associate Editor

To date, the UNIX operating system has failed to catch on with the business community. For office-automation applications, systems based on AT&T Bell Laboratories' UNIX have consistently lost out to IBM Corp.'s PC, a PC-DOS-based machine.

In short, despite the de facto standardization of UNIX elsewhere, primarily in the scientific and technical communities, Bell Labs' star has simply not risen over the office-automation marketplace.

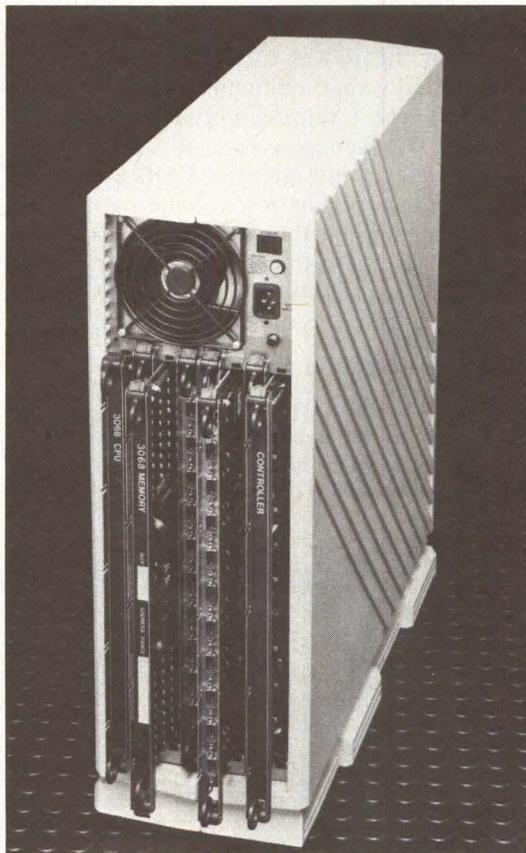
Now, UNIX vendors are confronting the fact that UNIX has never really been intelligently sold—at least not to the office-systems-integration market, which was targeted as its long-term niche. They are responding by opening new channels of distribution, specifically by directly marketing to value-added resellers and end-users, using techniques borrowed from consumer advertising. They are also developing UNIX products that exploit—rather than compete with—the vast installed base of MS-DOS personal computers already in the business marketplace.

"The only possible salvation of UNIX is the VAR," says Robert M. Lefkowitz, director of software services at InfoCorp, a market research company in Cupertino, Calif.

### Industry unto itself

Traditionally, UNIX has been an industry for, by and of itself, with its vendors attempting to sell to one another rather than to the end-user.

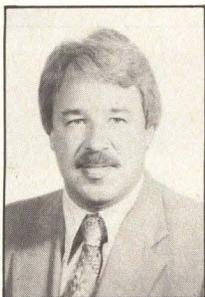
Dr. Brian Boyle, director of research at Novon Research Group, San Francisco, quotes a point made in the book, *In Search of Excellence*: "stay close to your customers." "The problem with UNIX," Boyle says, "is that nobody is



**The Altos 3068** is a UNIX box with a PC-DOS twist. With a board called "PC Path," an IBM PC or compatible can act as a node in a 3068-served network.

doing that. Vendors are like what Dylan Thomas said about the people on the Isle of Wight, who make a living taking in each other's laundry...everyone wants to be the manufacturer and let somebody else sell the product."

Unfortunately, Boyle notes, no one could depend solely on direct sales of UNIX-based systems and survive, much less make a profit. Established computer vendors often offer pro-



**UNIX vendors "are like what Dylan Thomas said about the people on the Isle of Wight, who make a living taking in each other's laundry,"** says Dr. Brian Boyle, director of research with the Novon Research Group.

proprietary systems through their own established distribution channels. Personal computer manufacturers commonly take advantage of retail channels already in place, such as hobbyists' electronic shops, mail-order operations and department stores, for the distribution of consumer goods.

But, as a new product, UNIX has been sold by companies that often don't have any investment in, nor experience at, the direct marketing of computer goods. Worse, unlike MS-DOS-based products, UNIX was simply far too expensive for storefront operations. "The only way you could take it to the consumer was to have a marketing arm bigger than the rest of your body," comments Boyle.

Peter Marvit, manager of laboratory services for Yates Ventures Inc., a market research company in Los Altos, Calif., argues that, because they limit themselves to single markets, small VARs can do what multimillion dollar corporations like AT&T Information Systems (ATTIS) have so far been powerless to achieve—take their products to the streets. "VARs are an easy channel...they can be low-volume or high-volume depending on the situation, and they can penetrate markets that producers can't enter because those markets are so small or specialized that a large company can't squeeze into them."

**Wherefore art thou, MS-DOS?**

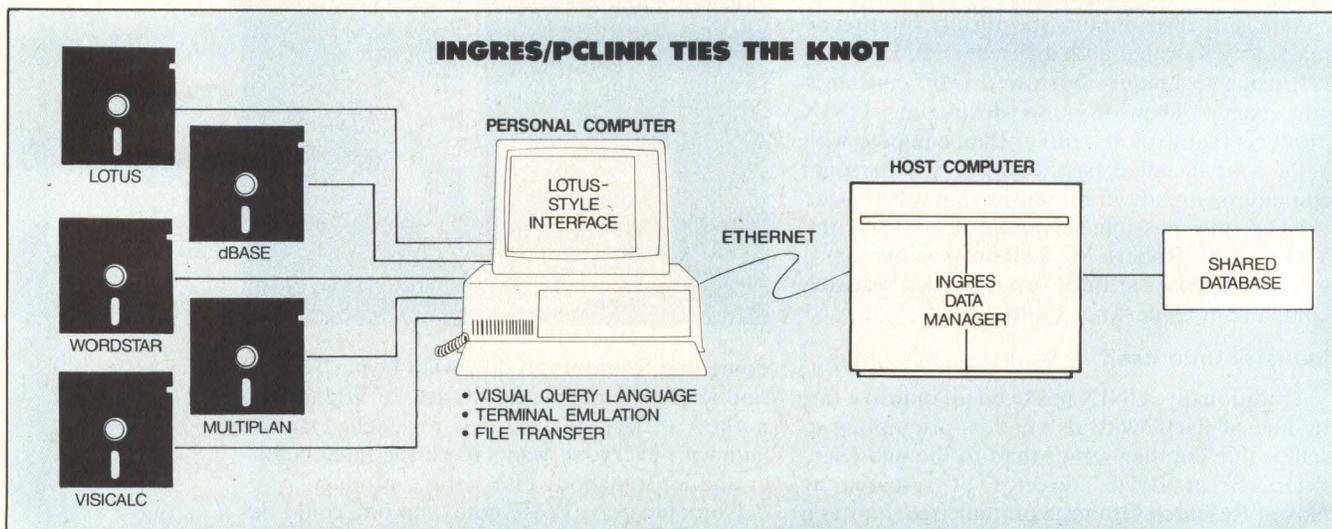
UNIX's assorted parents, godparents, vendors and supporters have recently been proud to announce the wedding of UNIX to that child of IBM and Microsoft Corp.—PC/MS-DOS. Sud-

denly, UNIX vendors are touting the compatibility of their products with the IBM PC.

The gossip columnists and society page editors of the computer industry were stunned—a 20th century Romeo and Juliet with a happy ending. Right up until the day of the ceremony, UNIX partisans had been saying the closest AT&T's kid would ever get to MS-DOS would be to dance on its grave after driving it into extinction.

What happened instead was that UNIX supporters received a healthy dose of reality. Manufacturers realized that the solution UNIX offered to office-automation problems—namely, multiuser machines running dumb terminals—was exactly 180 degrees opposed to what the office wanted. "Very few corporations are without personal computers," explains Jon Holtzman, research analyst with the Gartner Group Inc., a Stamford, Conn., research company. "They already own desktop machines and they want to link those machines [in a local area network], not scrap them in favor of a single multiuser computer."

Well, then, if UNIX could not replace MS-DOS, it could exploit it. On the hardware side, for example, Altos Computer Systems Inc. recently announced a new UNIX-based supermicrocomputer, the Altos 3068. As a multiuser microcomputer, it is a powerful and sophisticated box boasting a Motorola Corp. MC68020, a 12-MHz microprocessor, 16M bytes of memory and support for up to 40 dumb terminals. In a recent newsletter, International Data Corp., a market research outfit in Framingham, Mass., called the Altos 3068 "far and away the most



**Ingres/PCLink** allows the Ingres database manager to connect via an RS232 port, or Ethernet, to software running on the IBM

PC. It even reformats the host computer's output so that it can be slipped into such PC workhorses as Lotus' 1-2-3.

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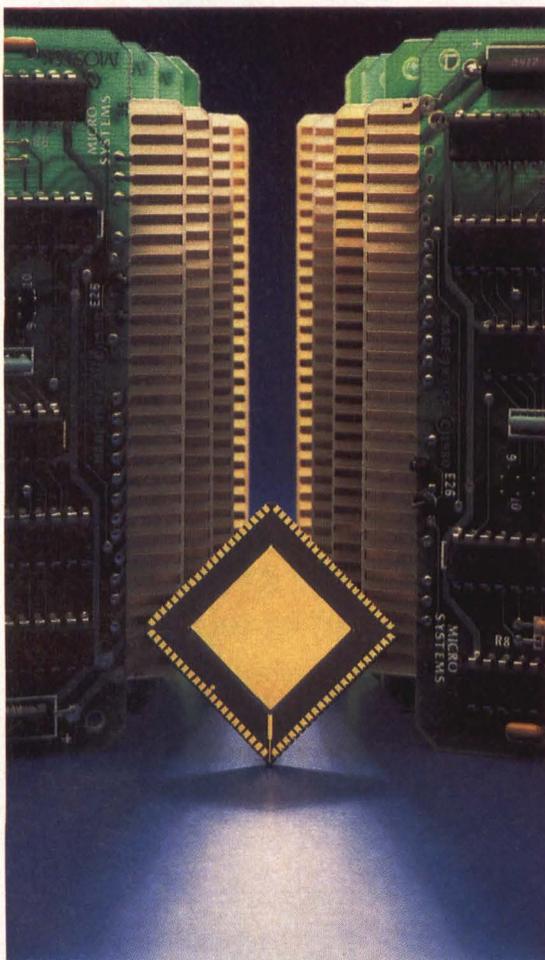


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For example, we've got intelligent serial boards for short (250 feet) and long (1 mile) communication distances. We have another that implements the IEEE 488 General Purpose Interface Bus standard with speeds up to 300 Kbytes/second. And an IPIO with 32-bits of parallel I/O, suitable for high-speed control and data transfer.

The point is, Mostek designed these to be the most sophisticated STD BUS boards available today. Which is one more way in which we show our continuing commitment to STD BUS.

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Z80 is a registered trademark of Zilog, Inc.





**Cognetic Systems** personifies its integrated software product in "Higgins," a bewhiskered manservant, ever ready to spring to the rescue of middle managers.

exciting multiuser, microprocessor-based system announced this year."

But the Altos 3068 is a UNIX-box with a PC-DOS twist. When it announced the 3068, Altos also announced a series of communications products—in particular, a board called PC Path, which, when installed in a PC or compatible machine, allows that personal computer to act as a node in a network that uses the 3068 as a server.

As a result of this type of product planning, Altos provided its VARs with a marketing advantage when they try to sell their wares to offices already bulging with IBM PCs.

On the software side of the fence, very similar strategic planning is going on. For example, Relation Technology Inc. (RTI) has been marketing the Ingres relational database for UNIX-based machines since the early 1970s. Last April, at the UNIX Systems Expo in San Francisco, RTI introduced Ingres/PCLink, software that allows Ingres to connect via an RS232 port or Ethernet to software running on the PC. Ingres/PCLink even automatically reformats the host computer's output so that it can be neatly slipped into such PC workhorses as Lotus Development Corp.'s 1-2-3.

### UNIX courts the consumer

Finally, UNIX manufacturers are learning to advertise. Whereas a few years ago UNIX was sold almost entirely to programmers as an operating system and programmer's tool or to high-level managers as a means of providing software and programmer staffs with a standard environment, UNIX vendors are now setting out with consumer-merchandising techniques to seduce end-users and middle management.

Leading the pack in the merchandizing of

UNIX is ATTIS itself, armed with fairly simple goals—to strip UNIX of its academic image and make it as respectable a part of the business professional's life as the three-martini lunch and the button-down collar. To this end, ATTIS has put together an advertising campaign that relies heavily on such intangibles as status and professionalism.

ATTIS' sales literature on UNIX, for example, is extraordinarily slick. Gone are the appeals to technical excellence. Instead, product booklets are thick with pages showing male and female models in tailored business suits poised before their executive workstations, performing what are clearly managerial rather than programming tasks.

### UNIX goes through the looking glass

To give their products a reason to be remembered, UNIX application vendors have taken cues from the personal computer marketers and are adopting whimsey, humor and comedy in their advertising.

Cognetic Systems Inc., for example, markets a small integrated software package for UNIX-based machines. The product includes such functions as a limited word processor, a small database manager and an expense-report generator.

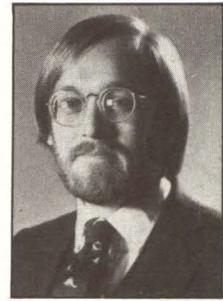
The product's technology is nothing revolutionary—it was, in fact, originally sold as a product for the IBM PC—but its marketing is truly ingenious. The company personifies the product as "Higgins," a bewhiskered, ever-ready manservant. Higgins, a stately British butler, is a sort of high-tech older brother to Mary Poppins, who springs to the rescue of middle managers about to vanish under a sea of note papers and administrative trivia.

Applix Inc., meanwhile, markets Alis, a much larger UNIX-based office-automation package. The company says Alis is designed to bring the advantages of personal computers—strong graphics, user-friendliness, and so on—to multi-user machines.

Where Higgins is a butler, Alis is like Alice of *Alice in Wonderland*. Applix's advertising literature shows Lewis Carroll's familiar heroine as a Victorian yuppie. She carries a briefcase while confronting the hookah-smoking caterpillar, or she sits before a terminal at the Mad Hatter's board meeting. The trademark for the product is the name "Alis" with the "i" dotted by the Cheshire Cat's levitating grin and nose whiskers.

### Tyme after tyme

But the ultimate in product recognition may have been reached by Tyme Computing. Tyme,



**Peter Marvitt**, manager of laboratory services for market research company Yates Ventures, argues that small VARs can often do what multimillion dollar corporations cannot—take the product to the streets.

**Applix's advertising literature shows Lewis Carroll's familiar heroine as a Victorian yuppie.**

a company that recently began marketing software development tools, primarily teaches other people how to be successful UNIX remarketers. It is a small company, selling something which cannot be seen, felt, smelled, tasted or run on a computer: expertise. And they must do it all with only limited resources expended on advertising. They are, therefore, outrageous.

At trade shows, Tyme staff members appear in snow-white jump suits. They wear electric purple buttons that read, "Drugs, Sex, and UNIX!" They may carry toy guns and proclaim that VARs are the exploited working class of the computer world—a working class to be liberated by revolutionary "VAR Wars." The Toronto company holds its training seminars in Florida at an institution they refer to as (what else?) the "uniVARsity." If you meet them socially, they may invite you to attend their "VARmitzvah."

And it works. For a relatively low advertising investment, they create a lasting impression. They are hard to forget.

Indeed, Tyme forms a weird counterpart to ATTIS, particularly at trade shows. On one

hand, show-goers have one of the largest companies in the world, its people attired in comforting banker's pinstripes, its entire operation calculated to sooth, inspire confidence and reassure. On the other hand, there is Tyme, its corporate culture openly modeled on punk rock, its appearance calculated to shock, to force recognition and to be remembered.

Each is the perfect and absolute antithesis of the other—and yet they are very much alike in that both have seen the need to bring UNIX directly to the buyer. Moreover, they have analyzed their respective clients and selected merchandizing techniques appropriately.

The presence of both in the market should be a comfort to UNIX partisans. At long last, the UNIX industry feels mature enough to have niche markets with individual marketing styles. □

Interest Quotient (Circle One)  
High 477 Medium 478 Low 479

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And for do-it-yourself savings, prices for a PCI-20000 system start at only \$854; the complete Logic Analyzer System is a low \$2750! Everything is ready off-the-shelf to begin your ATE project. Contact us today for complete information and specifications on these exciting new ATE products.

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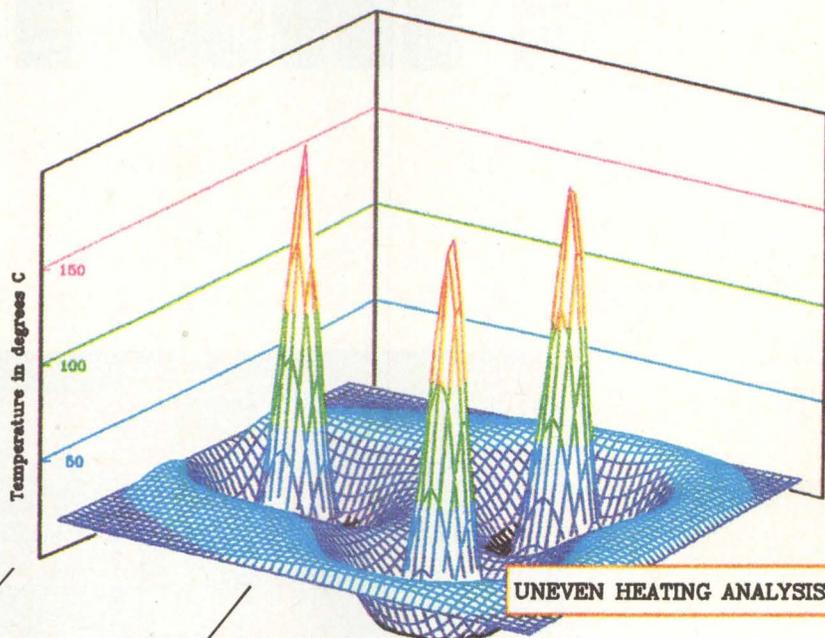
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CIRCLE NO. 34 ON INQUIRY CARD

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For more product and distribution information, write to Don Lawrence, V.P. Sales and Marketing, Advanced Matrix Technology Inc., 1157 Tourmaline Drive, Newbury Park, CA 91320. Or call (805) 499-8744.



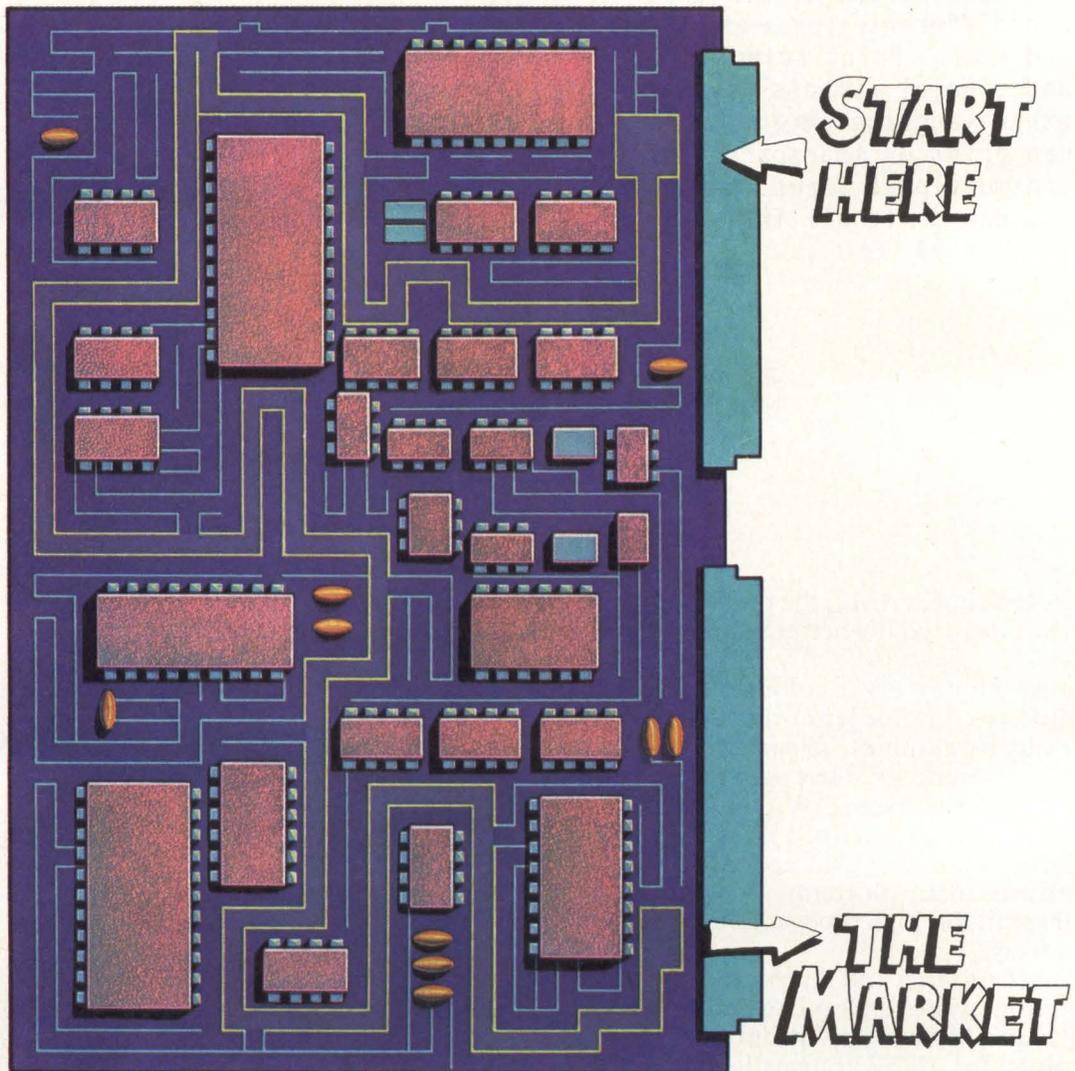
**Advanced Matrix Technology Inc.**

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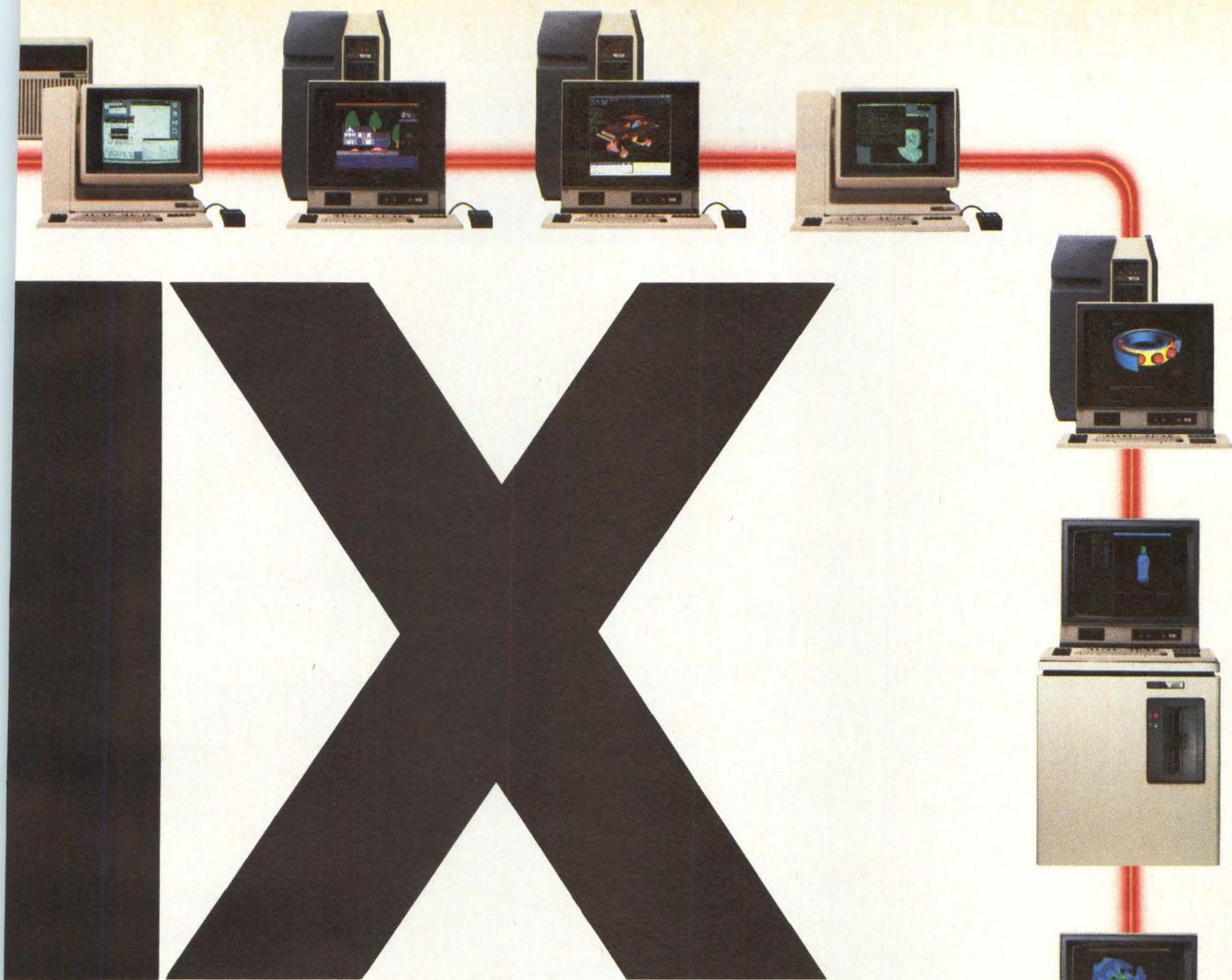
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We're the first major computer company to implement both AT&T System V and Berkeley 4.2 on a professional worksta-

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CIRCLE NO. 37 ON INQUIRY CARD

# What do these popular micro printers have in common?

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Atari  
Burroughs  
C.Itoh  
Commodore  
Coleco  
CPT  
Cromemco  
Digital  
Epson  
Hewlett Packard  
IBM  
Integral Data  
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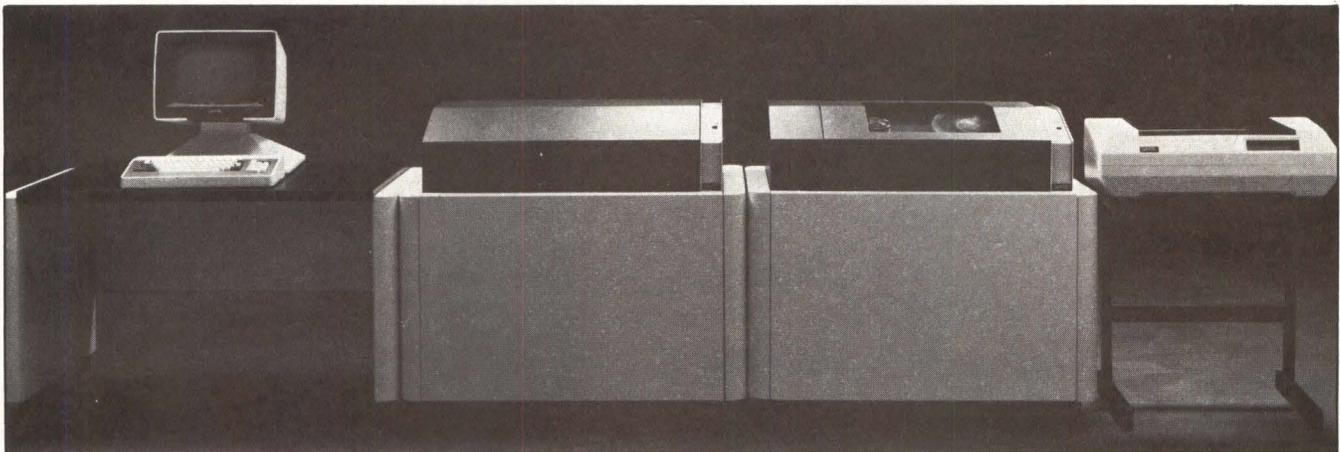
**CIRCLE NO. 38 ON INQUIRY CARD**

# VERTICAL MARKET INTEGRATOR

*Applying integrated systems  
in industry, engineering and commerce*

## DEFENSE CONTRACTOR CUTS COSTS WITH MINI

Aeroflex uses Qantel minicomputer and MRP software to track work progress and development costs, save money and increase productivity



**Charles W. McCasland**, MDS Qantel Inc.

In an age of skyrocketing military costs, a \$1 bolt might go for \$50, and a screwdriver might sell for as much as a good used car. However, as the government applies stricter contract controls, defense contractors might be well-advised to operate more cost-efficiently.

One company taking this advice is Aeroflex Laboratories, Plainview, N.Y., a defense subcontractor that supplies electromechanical, electronic and electro-optical components; stabilized platforms; and thick-film hybrid circuits to such prime contractors as General Dynamics Corp., Grumman Corp., IBM Corp., Rockwell International Corp. and Xerox Corp. Aeroflex's products include brushless DC motors for cryogenic engines, structural support systems, heavy-duty isolators, electro-optical scanners and electronic-

warfare subsystems.

Aeroflex is trying to minimize cost overruns by using the System 40 minicomputer from MDS Qantel Inc., Hayward, Calif., and Qantel manufacturing-resource-planning (QMRP) software along with a database-oriented management-information system (MIS). The System 40 has 256K bytes of main memory, expandable to 1,024K bytes, and supports as many as 64 intelligent video workstations and as many as six disk drives with capacities of 18M, 36M, 75M or 150M bytes. The Aeroflex configuration provides 4M bytes of storage and supports 11 terminals and five printers. "This system gives us access to an overall bank of company data on a real-time basis," says Aeroflex president Milton Brenner.

According to Jack Tusinski, vice president of finance at Aeroflex, many companies won't do

**Aeroflex uses Qantel's System 40 minicomputer and QMRP software to provide expenditure forecasting and accrued cost vs. original contract bids.**

business with the government because it requires them to provide detailed cost reporting and documentation to prove their equipment's fault tolerance and dependability. Tusinski says the Qantel system helped Aeroflex streamline these tasks.

### Seeks a turnkey solution

Aeroflex had been using a service bureau for its computerization needs. But, in 1978, the company switched to a time-sharing service, primarily for the cost-control software the service offered. But the time-sharing service allowed Aeroflex only limited flexibility, charged \$150,000 a year—a fee that was growing 20 percent annually—and could not always provide Aeroflex with necessary information when the company needed it. What's more, "Every time we wanted new capabilities, we had to pay software-development costs," says Tusinski. So, in 1982, with sales approaching \$28.7 million, up from \$3 million in 1973, Aeroflex began looking for an in-house solution.

Aeroflex hired a team of financial experts, accountants and consultants, who analyzed the company's operations for six months. Aeroflex then evaluated systems from IBM, Digital Equipment Corp. and Sperry Corp. Aeroflex wanted a turnkey system, but its top concern was integrating the company's MIS with general-ledger and cost-control software, according to Tusinski. Aeroflex chose the Qantel System 40 because of the QMRP software. Says Tusinski, "We're saving \$100,000 a year on what we paid the time-sharing service, and we purchased a system that allows us to develop our own database. The initial price for the System 40 was \$125,000—less than a year's fee from the time-sharing service."

### Software tracks cost overruns

To customize the QMRP software to their needs, Aeroflex personnel had to document—and, in some cases, change—the manual procedures they had previously been using. However, the on-line, database-oriented QMRP software tracks development costs and work in progress faster than manual methods. "We turned to MRP to get a more clearly defined picture of the shop floor," states Tusinski. "We can identify cost overruns while they're happening and take corrective action before a lot of money is lost. We get reports from the line immediately."

Using the QMRP software, Aeroflex personnel assign a budget to each project before its release to the factory floor. This allows the company to monitor accrued costs as the job progresses vs. the original bid the company

made. "With the QMRP's cost-control module, we can pinpoint trends virtually from their inception because each man-hour and every [product] part is immediately billed to a specific job," Tusinski says. As a project incurs charges, personnel enter those charges into the system so that the company can keep close supervision of expenses. "We're able to do things with the system that we weren't doing before—like forecasting," says Tusinski. "We can look at 'what-if' scenarios in much greater depth now, allowing for a more efficient allocation of resources and greater productivity."

System 40 runs under Qantel's business executive system for timesharing (BEST) operating system, BEST/AOS. The priority-driven, multi-user BEST/AOS provides dynamic memory allocation among users, a disk file-management system, print spooling, I/O device handlers, execution support for all program languages and password-access control. The QMRP software package supports manufacturing management and forecasting, fixed assets, customer-order processing and billing, accounts receivable/accounts payable, general ledger/payroll/sales analysis, master scheduling and inventory control. It also provides manufacturing routings/shop-floor control, bill of materials/product costs, material-requirements planning, manufacturing history, work-in-progress status and capacity planning/priority dispatch.

### Upgrade ups speeds

Aeroflex recently upgraded to a Qantel System 64 to boost processing speeds. The System 64 multiuser, multiprogramming system offers 1M to 4M bytes of main memory, a 64-bit storage word, a 16-bit transfer word, the ability to perform 0.7 million to 1 million instructions per second, support of 100 users, mapped memory and the COBOL programming language. Qantel's QicBASIC programming language is optional. Price of the System 64 ranges from \$105,000 to \$220,000. A typical system, including 1M byte of RAM, a CRT, a 600-line-per-minute printer, a 400M-byte disk and a 1/2-inch streaming-tape drive, sells for \$180,050.

Aeroflex is now planning to integrate some of its other equipment into the QMRP. The other equipment includes standalone word processors, computer-aided-design/computer-aided-manufacturing equipment, and DEC VAX minicomputers and personal computers. □

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**Charles W. McCasland** is a consultant to MDS Qantel Inc., Hayward, Calif. Formerly, he was vice president and general manager of the manufacturing and distribution systems division of the company.

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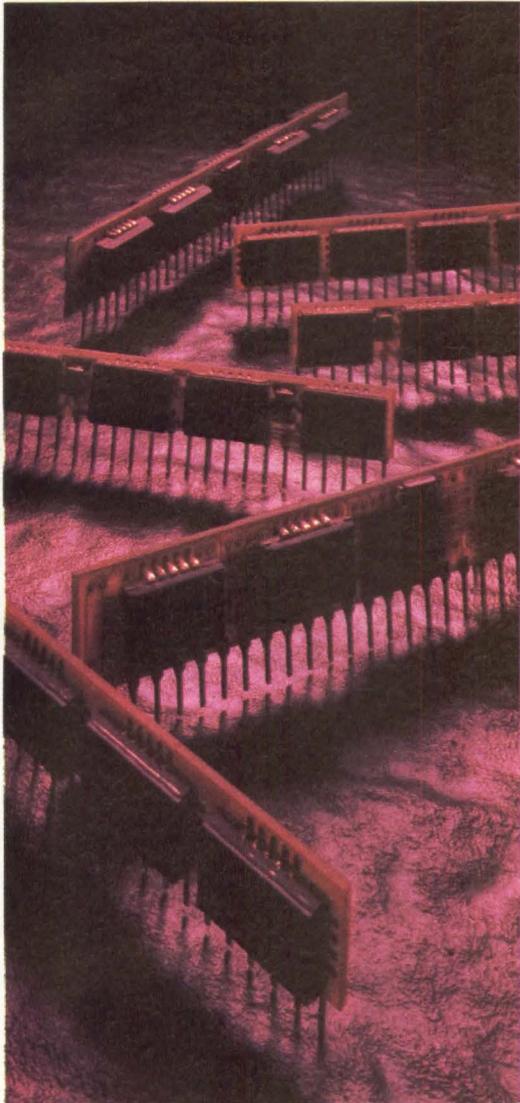


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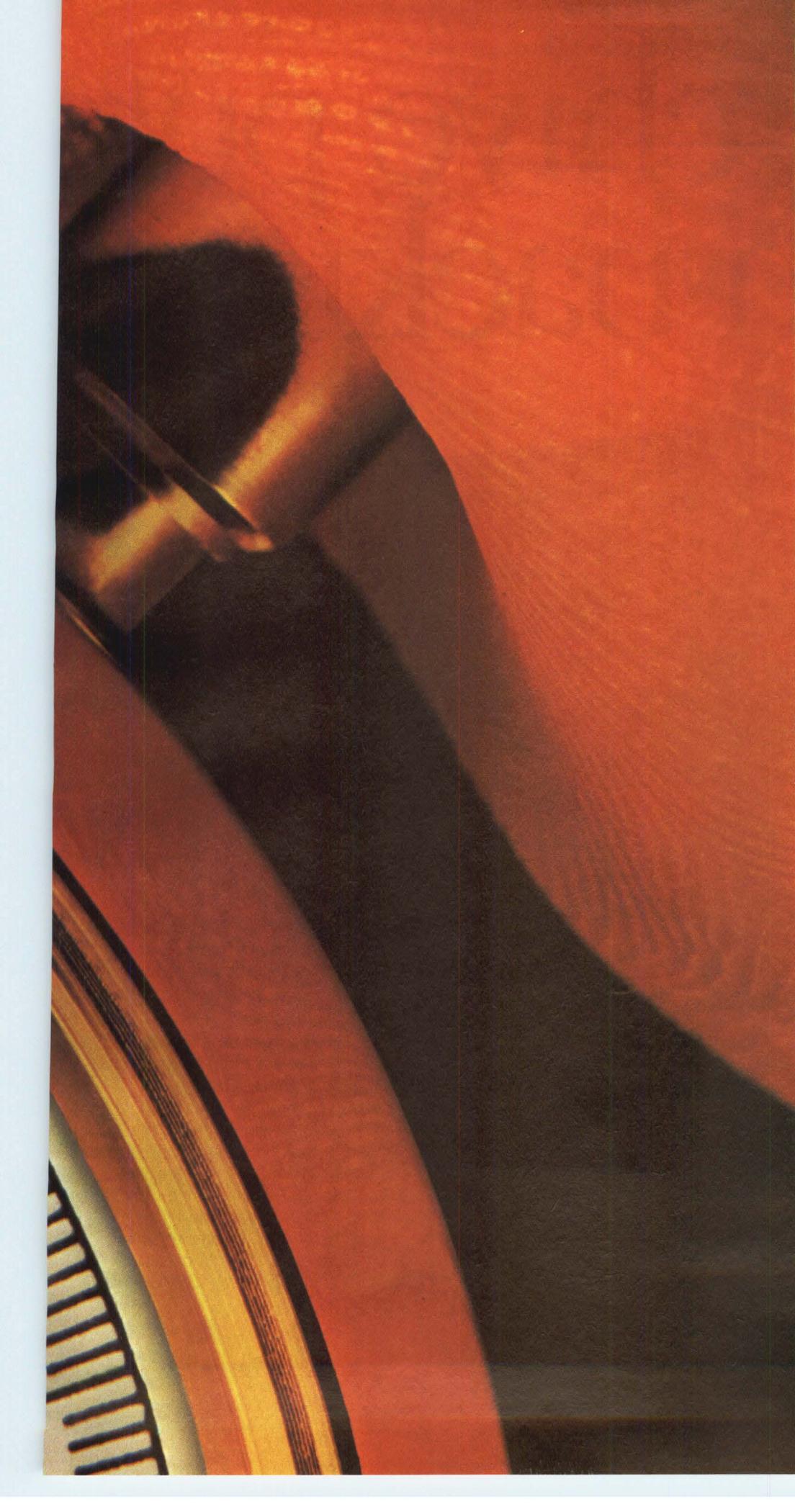
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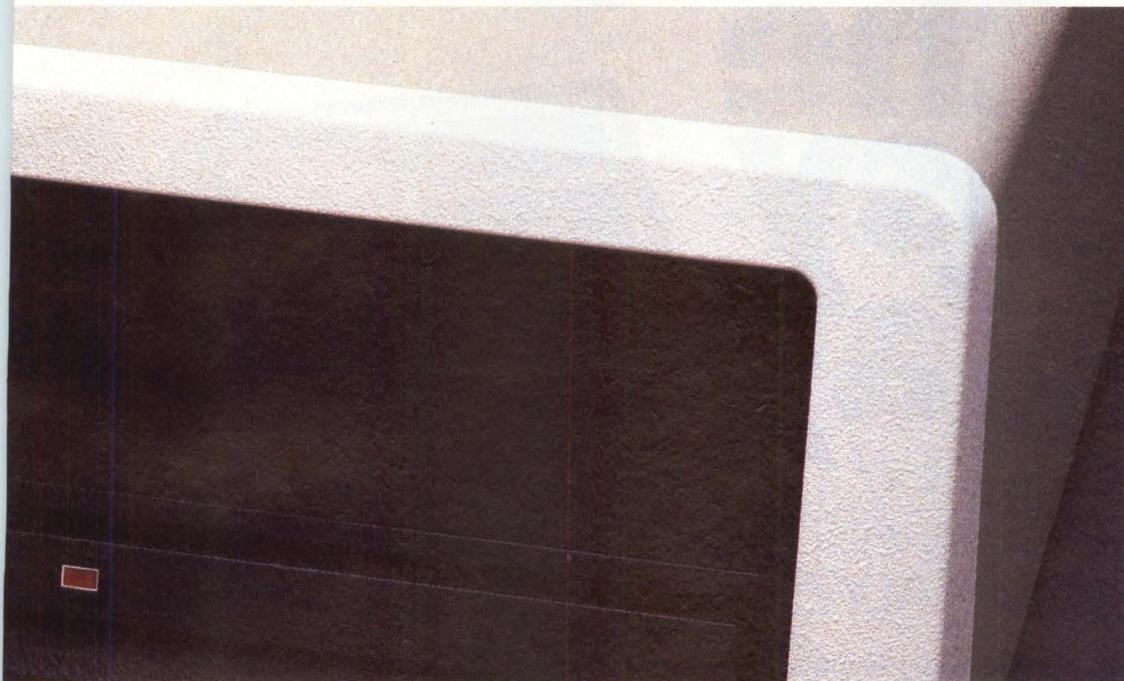
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# FEATURE HIGHLIGHTS



p. 87 . . . . . 3-D graphics terminals

## **GRAPHICS TERMINALS: 3-D DISPLAYS SPUR GRAPHICS MARKET . . . . . 87**

Until recently, high-performance graphics terminals have been products looking for a market. Now, however, those terminals are meeting the demands of users who work with sophisticated applications such as solids modeling, simulation and analysis. Improved features include hidden surface removal, shaded models and faster interaction.



p. 121. . . Business graphics software

## **GRAPHICS/INTEGRATED SOFTWARE: VDI GRAPHICS TOOLS AID SOFTWARE INTEGRATION (Cover story) . . . . . 109**

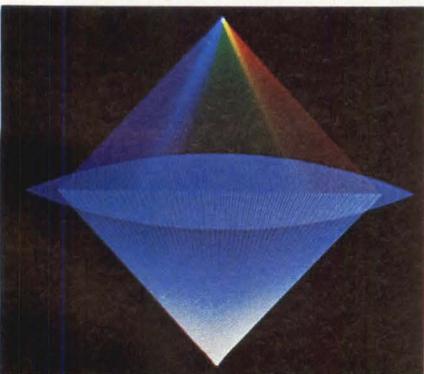
The ANSI-proposed virtual device interface (VDI) standard was developed to achieve device independence in graphics applications. The VDI also provides a powerful tool for software integration by allowing developers to work at a level between the operating system and the applications.

## **GRAPHICS SOFTWARE: GRAPHICS SOFTWARE BRIGHTENS BUSINESS LOOK . . . . . 121**

The business community is placing more and more emphasis on transforming data derived from spreadsheets and databases into presentation-quality graphics. As a result, software vendors are pumping out better products, including standalone packages, "paint programs" and enhancement packages.

## **OPTICAL STORAGE: OPTICAL 3½-INCH DRIVE ADDS ERASABILITY . . . . . 133**

Thermo-magneto-optic technology promises to eliminate a major drawback to optical disks; nonerasability. The only working example of this new technology is a 3½-inch, 47M-byte laboratory demonstration model from Verbatim Corp.



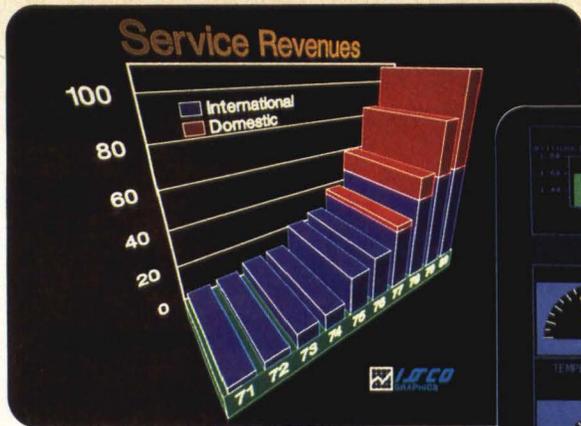
p. 157 . . . Film recorders vs. plotters

## **LOCAL AREA NETWORKS: RETHINKING NETWORKS: A COORDINATED APPROACH . . . . . 145**

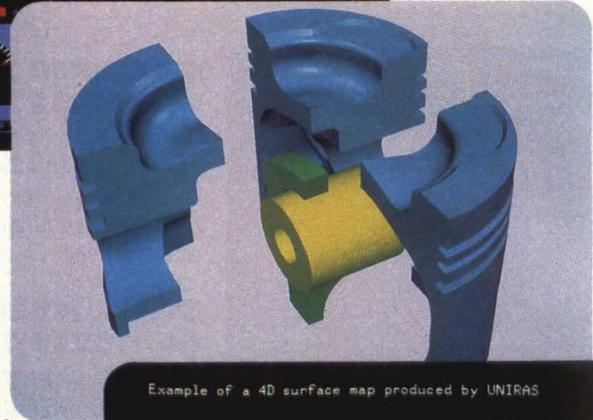
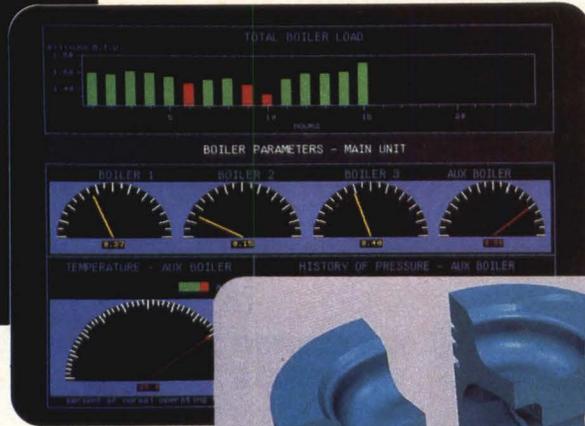
By employing virtual-path technology and decentralized control, networks can maximize transmission capacity and minimize protocol conversion.

## **DESKTOP PLOTTERS: BUSINESS USERS PONDER DESKTOP PEN PLOTTERS . . . . . 157**

Plotters are great for technical users, but how do they stack up against other technologies—such as image recorders and page printers—in the business environment? Our analysis includes a product table listing desktop plotter manufacturers and key plotter features, starting on p. 169.



Screen images courtesy of ISSCO® Visual Intelligence Corp., PDA Engineering, and UNIRAS® Inc.



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# 3-D DISPLAYS SPUR GRAPHICS MARKET

Mature graphics software meets demand for high-end, interactive-graphics terminals with improved 3-D shaded images

**Jerry Borrell**, Senior Western Editor

Until recently, high-performance graphics terminals have been products looking for a market. Finally, however, increasingly sophisticated software for 3-D applications such as computer-aided design and improved VLSI have combined with greater user demand to establish a thriving market for graphics terminals. As a result, system integrators and experienced users are now actively evaluating available terminals for high-performance applications.

## Applications expand

CAD applications currently account for nearly 80 percent of graphics-terminal sales. A growing number of engineers work with solids modeling, simulation and analytic packages. These users, as well as integrators of graphics systems, need high-performance features, such as hidden surface removal, shaded models and fast interaction.

The entry of VLSI design into the high-performance-terminal arena is contributing to the emergence of these capabilities, as well as to new application areas. Bill Weir, director of marketing at Metheus Corp., Hillsboro, Ore., says that, "To date, we think of high-performance terminals as applying primarily to CAD. The lowering cost of semiconductor memory and increasing VLSI performance, however, will bring new markets to the fore," including those for medical, geographic and graphic-arts imaging applications. This convergence in hardware of graphics and imaging should occur over the next year.



Graphics terminals that meet these needs incorporate such sophisticated hardware and firmware that they are referred to as "display systems." The term "intelligent" is a misnomer when applied to today's high-performance graphics terminals, which contain several micro-processor-based subsystems.

One dilemma facing system integrators is whether to provide standalone operation or to focus on performance characteristics while retaining external host dependence. The distinction between a host-dependent "graphics display system" and a standalone "graphics workstation" appears straightforward in theory. The

**The Evans and Sutherland CT-5 simulator generated this real-time scene for Daimler Benz of Germany. The simulator provides automobile operators with the ability to test vehicles.**



**The IMI Inc. Megaflop** display system generated this ABC logo. The system uses a real-time vector, shadow-mask monitor technology.

distinction becomes blurred, however, as more powerful personal computers emerge that offer standalone or host-dependent graphics applications (see "PCs enter high-end graphics market," Page 95).

Although most CAD software and systems are made for 2-D drafting applications, 3-D application software is starting to become more popular and more sophisticated. Peter Pally, industry marketing manager for Lexidata Corp., Billerica, Mass., nevertheless cautions that "despite recent growth in the perceived need for 3-D, much of the efficiency and the justification for CAD remains in editing graphics databases," which doesn't demand 3-D capability.

Most designers using CAD systems have been confined to 2-D representations on their terminals because of the difficulty and high cost of translating data into 3-D format. However, Arnie Karush, director of firmware engineering at Tektronix Inc.'s Information Display Group, downplays the importance of 3-D terminals. He maintains that, "The host will continue to do the 3-D modeling for terminals, handling information such as specific gravity and momentum because of these applications' enormous computational demands," whereas terminals will specialize in techniques for interactive modeling and visualization, which are the real needs of design engineers.

Application packages such as Evans and Sutherland's Romulus, Matra Datavision Inc.'s Euclid, MCS's Anvil, PDA Engineering's Patran and SDRC's Geomod have supported 3-D applications since the late 1970s. However, the packages' drawbacks include lack of color, inadequate surface representation and slow

interaction relative to 2-D software.

The algorithms for translating 3-D data to a 3-D format on a 2-D CRT have existed since the late 1960s. Until recently, though, only a few companies—such as Evans and Sutherland—have implemented them due to the algorithms' demanding computational requirements and high cost.

One problem centers on the matrix multiplications required to translate 3-D data to a 2-D format. But two VLSI advances have facilitated this operation: more powerful, low-cost processors capable of managing large databases, and specialized chips that handle basic math operations. For example, multiplier and floating-point chips assist in 3-D-to-2-D conversion; bipolar and semicustom chips draw lines; "palette chips" replace color-lookup functions performed in software; and integrated digital-to-analog converters (DACs) speed transmission of data to the monitor.

More specifically, VLSI-based devices include the Geometry Engine from Silicon Graphics Inc., Mountain View, Calif.; and the WLU Floating Point, WLU Multiplier and Tiling Engines from Weitek Inc., Sunnyvale, Calif. By offering a range of products, Weitek has become a leading supplier to graphics-terminal integrators.

#### Measurements prove difficult

Despite their advantages, VLSI chips pose an inherent problem—how to measure their speed of operation. Measurements include: pixel write times—the time required for the display processor to write a single picture element on the screen; vector write speeds—the time required to write a given pixel length; and transform speeds—the time needed to convert 3-D data to 3-D coordinates. Some industry critics point out, however, that these time measurements lack practicality. Increasingly, graphics manufacturers cite application-processing as the only real test of device performance.

Jim Moreland, director of marketing at Spectragraphics Corp., San Diego, Calif., claims that response time is the vital performance measurement and all else should be transparent to the user. "IBM [Corp.] studies have shown that 0.3- to 0.75-second response times are ideal," Moreland says.

Elliott Rech, vice president of marketing at VG Systems Inc., Woodland Hills, Calif., believes that, "The ability to write 50,000 vectors a second provides a performance benchmark." He points to the IBM 5080 graphics terminal as an example. The 5080 uses IBM's 3-D software package—CATIA—to shade images, but a host



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is required to perform dynamics, thus degrading designer efficiency.

For most graphics users, speed of interaction and object manipulation (dynamics) are critical. A graphics terminal must store a mathematical description of objects locally for fast manipulation. This storage is known as the "display list."

The physical size of the list and its organization are important to system integrators and users. The number of bytes determine the complexity of the object that can be stored, and the organization of the data determines whether different portions of an object can be manipulated. Hierarchical lists are required for independent motions of complex objects such as jointed robot arms or automobile suspensions. In these cases, the display list becomes a group of high-order primitives.

To access and edit the display list, graphics devices must manipulate the object database. "The process of data manipulation occurs in a series of matrix multiplications performed on the display-list segments, or primitives," explains Brad Powell, application engineer at Tektronix Inc., Beaverton, Ore. These transforms consist



**A Cray X-MP computer** generated this transparent skull via Cray's "Scene Simulation" techniques. Frames such as this can require over 300M bytes of image memory.

of two types: model transforms that move objects on the screen, and view transforms that adjust the model to obtain a particular viewpoint.

### Data must be converted

Transform operations include rotation, translation, scaling, clipping and perspective. Respectively, these operations allow the graphics terminal to revolve or concatenate objects, redraw an object in a different position, redraw an object

## Pros and cons of graphics workstations

Companies making exemplary graphics workstations are Apollo Computer Inc. and Sun Microsystems Inc. Other graphics workstations come from IMI Inc., Metheus Corp., Saber Laboratories and Silicon Graphics Inc. Vendors of high-performance terminals that have decided to concentrate on graphics capabilities include Adage Inc., Chromatics Inc., Evans and Sutherland, Megatek Corp., Ramtek Corp., Raster Technologies Inc. and Tektronix Inc.

"Mechanical engineers need these devices," says Michael Kondrat, production marketing manager for the Information Display Group at Tektronix. "However, the cost of capitalization-per-engineer remains a sensitive issue." Raster Technologies' Jay Torborg, vice president of engineering and co-founder, characterizes this cost as "the percentage increase of productivity for one engineer with a workstation vs. the cost of hiring and training another engineer or giving low-cost terminals to two engineers." This puts the critical price range between \$70,000 and \$120,000.

Industry arguments continue over the relative merits of terminals and workstations. "A large group of users out there do not need all the functions of a high-performance graphics terminal," comments William Waller, president of Vectrix Inc., Greensboro, N.C. "For instance, users in manufacturing environments, financial and managerial positions want to review a high-quality 3-D image but do not need to interact

with it."

David Scott, vice president of research and development for Chromatics, Tucker, Ga., maintains that another large group of users—those with minicomputers and superminicomputers—must offload their host of graphics processing to support several terminals. Scott stresses that existing workstation products such as those from Apollo do not have sufficient graphics-processing capabilities for all needs. "When one of our users wants a graphics workstation, we sell a Sun Microsystems version to act as a host to our terminal. In the range of graphics performance [that] we serve, it's simply not possible to design in all the needed hardware." He points to the 32-bit, floating-point coordinate data used in the Chromatics CX1500 series products. "The designer using this terminal," states Scott, "can access enormous databases, such as those dealing with an entire battleship or just with one of its bolts."

"One basic argument driving terminal vendors toward workstation products," says Randy Nichols, marketing manager for Silicon Graphics Inc., Mountain View, Calif., derives from the difficulty of getting two separate processors (terminal CPU and host) to work together efficiently. "The problem worsens as the application code becomes more complex"—almost necessitating a third computer to translate between the two processors, he says.

**The Chromatics 1500 CX display terminal** can draw as many as 400,000 line segments per second. Uniquely, the terminal is capable of both wire-frame and shaded images.

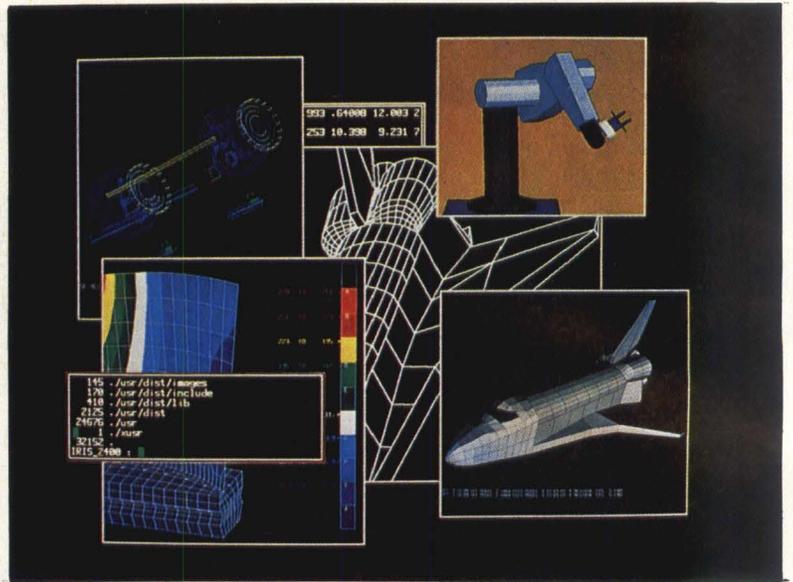


closer or farther away from a viewpoint, edit the model of an object as though the viewpoint lay within the boundaries of the object and give objects a realistic perspective.

Having performed such operations, the 3-D data must then be converted into 2-D coordinates. In other words, floating-point numbers from the database must be converted to integer numbers that relate to the coordinate system of the display list. These numbers are then translated into the terminal's screen coordinates.

The complexity of these operations varies with the 3-D database type. The majority of graphics terminals employ polygonal databases. However, some databases work with surfaces that can be defined by curves or splines. "At present," contends Mark Reiss, product marketing manager at Megatek Corp., San Diego, "No one uses hardware storage of patches (surfaces defined by several curves), although a few products use firmware for spline storage."

Light models are typically included for 3-D applications to let the viewer see the interior or back of the models. Terminals that allow only universal light of a single intensity hide certain information. For example, the viewer would not see lines representing the back surface of a wire-frame cube. Megatek's Reiss believes that, "The light source must be mobile like a flashlight and not merely programmable at a fixed number of points. This mobility allows the viewer to



**Silicon Graphics Inc.'s Iris 2400 workstation** can display several viewpoints. Running under the Berkeley UNIX Version 4.2 operating system, the 2400 can run concurrent application programs.

present all the features of an object."

Depth-cuing, another technique used in high-performance terminals, provides visual cues to the viewer that a portion of the model is close or far away. Although several methods exist that accomplish this technique, they all make objects or lines appear dimmer the farther away they are from the established viewpoint.

### Algorithms solve 3-D problems

A common complaint in working with 3-D systems in the past was that displays of the lines or surfaces associated with a 3-D object presented an ambiguous, confusing and sometimes illusionary appearance. "Three primary methods are used in high-performance terminals to resolve this problem: painter algorithms, scanline algorithms and Z-buffer algorithms," explains Nick England, vice president of graphics terminals at Adage Inc., Billerica, Mass.

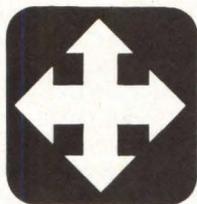
Algorithms basically determine in what order objects are stored in the terminal's memory and remove those that are obliterated by overlapping objects. Painter algorithms imitate painting on a canvas in which each object on the display is rendered from front to back. Popular in 2-D displays for its ease of use, this approach is often insufficient when applied to many objects or to three dimensions.

Scanline algorithms work by comparing all the polygons that appear on a scan line. This algo-

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rithm saves calculation time where there are not large numbers of edges. It best serves such stringent applications as flight simulation.

The Z-buffer technique has gained in popularity for most 3-D graphics terminals due to a dramatic drop in its memory cost. In this technique, every picture element on the screen has a "Z"—or depth value—associated with it. These values make the process of determining which objects are in front or in back relatively simple. Z-buffer is also particularly flexible; it allows layers of objects—polygons, text, vectors—to be mixed, added to, or sorted quickly. The trade-off, concedes England, "comes in the cost of the extra 16 to 24 planes of Z memory required."

### Rendering techniques improve

After processing 3-D object information, system integrators and users often want to shade models' surfaces. "Local shading is vital," insists Jay Tørborg, vice president of engineering and co-founder of Raster Technologies Inc., Chelmsford, Mass. "Shading and light models must be local, if the user needs to interactively manipulate a model."

Harris Hunt, engineering and software specialist at PDA Inc., Irvine, Calif., points to "the growing interest in supplying design engineers with shading capability, which increases efficiency by allowing engineers to review such subtle information as the shape of a curve." A turbine-blade design, for example, can easily be reviewed before analysis.

The three basic shading techniques used in today's graphics terminals include polygonal or facet shading (flat shading), smooth shading, and ray tracing—in ascending order of their computational requirements. All three depend



**Ramtek's 2020 display generator**—shown here with an IBM PC-AT—has a 1,280-by-1,024-pixel resolution and interfaces to Apollo, DG, DEC and Control Data computers.

on the number of available colors. Raster Technologies' Torborg claims that 256 colors is the minimum number needed for smooth shading and that 8 bits of pixel memory are needed for red, green and blue if "true color" or photographic quality images are to be displayed.

Other less used hardware approaches to rendering include "texture mapping," pioneered by James Blinn of the California Institute of Technology, Pasadena, Calif., and translucency/transparency pioneered in hardware by Lexidata. According to Megatek's Reiss, "Only Megatek's Merlin product offers pattern mapping, in which 2-D patterns stored in RAM are matched against polygons defining a surface."

Of the three approaches, flat shading requires the least computation. It suffers, however, from lack of realism, even when light sources are added.

Smooth-shading approaches that have become dominant in graphics terminals include Gouraud and Phong. Gouraud and Phong shadings are preferred for curved surfaces because they fill polygons with colors that are interpolated over their area. Gouraud shading, for example, inter-

## PCs enter high-end graphics market

The competition for high-performance graphics in the IBM Corp. PC market is heating up. Long-standing suppliers of graphics card sets for the PC include Number Nine Inc., Cambridge, Mass.; Scion Inc., Reston, Va.; Vectrix Corp., Greensboro, N.C.; and Vermont Micro Systems Inc., Winooski, Vt. For over a year, some of these companies have offered 640-by-480-pixel resolution products with up to 24 bit planes.

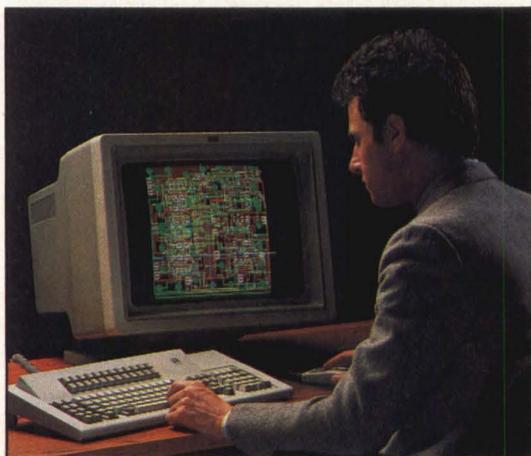
Another group of manufacturers builds graphics controllers that are external to the PC. Lead by Cubicomp Corp., Berkeley, Calif., those companies include Aydin Inc., Fort Washington, Pa.; and Ramtek Corp., Santa Clara, Calif. In addition, competing with IBM's "underwhelming" graphics cards are products from such companies as Emulex Corp., Costa Mesa,

Calif.; Frontier Inc., Minneapolis, Minn.; Hercules Inc., Berkeley, Calif.; Paradise Inc., Sunnyvale, Calif.; Quadram Corp., Norcross, Ga.; and Sigma Designs Ltd., Milpitas, Calif.

Finally, a new group of card manufacturers are building high-performance PC cards for display controllers with 1024-by-1024-pixel or 1024-by-780-pixel display resolutions. These vendors include BNW Inc., Los Gatos; TAT Graphics Inc., Milpitas; and Verticom Inc., Sunnyvale.

Robert Bruce, vice president of engineering at Metheus, observes that the market is a natural evolution for "controller vendors with several years of equity invested in graphics microcode."

**IBM's 5080 graphics terminal** is the company's first entry into 3-D terminals.



polates the color intensity across a given polygon, giving a curved appearance.

Phong shading is similar, except that it involves applying interpolation calculations to each picture element that lies within the polygon. It also provides smooth shading and reflections of light, often called highlighting. Demands are made of the terminal, however, because each polygon must be related to the color values of its

neighbor, that is, the color must be interpolated over the surface made up of polygons, if a realistic object is to be rendered.

Ray-tracing techniques were among the first to be implemented for shading images. These seemingly simple techniques produce complex and realistic images. However, because they involve calculations for each pixel, or for groups of pixels, they are computationally demanding.

"Application-software vendors are the key to the 3-D market," contends Tektronix's Kondrat. VG Systems' Rech agrees, but cautions that hardware and software are intertwined. "CATIA and other IBM software packages are very powerful, but we have yet to see whether the 5080's graphics primitives will work well with IBM's software." Rech adds that, "Almost two years after the 5080's release, CADAM [IBM's 2-D drafting package] is still not available for the terminal." □

Interest Quotient (Circle One)  
High 483 Medium 484 Low 485

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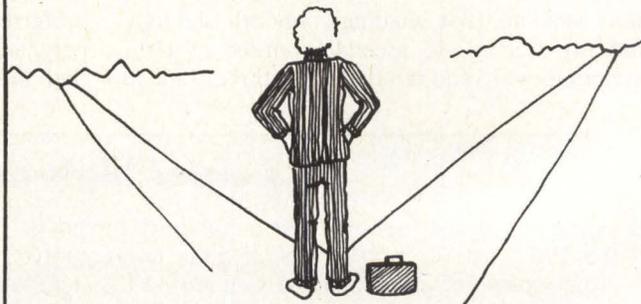
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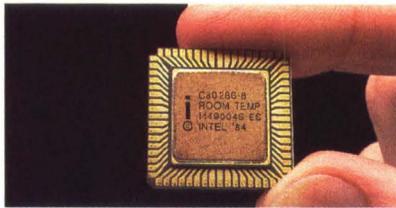


# Presenting the most capable

No other computer company has ever grown as fast as COMPAQ, because no computer company makes computers as powerful, as complete and as useful as COMPAQ. That's why the original COMPAQ Portable, COMPAQ PLUS,<sup>™</sup> and COMPAQ DESKPRO<sup>™</sup> became worldwide best sellers overnight. Now COMPAQ is introducing two new computers that advance the state of the art even further. While the original COMPAQ products remain cost-efficient cornerstones of business and professional use, especially for first-time buyers, the new products represent the utmost in performance for second-time buyers, or anyone who needs exceptional power and speed.

## Triumphs of advanced technology

The new COMPAQ PORTABLE 286<sup>™</sup> and COMPAQ DESKPRO 286<sup>™</sup>. Advanced technology puts them in a class all their own. With power, performance, speed, and expandability that exceed even the IBM<sup>®</sup> Personal Computer-AT<sup>™</sup>. They represent a new standard that makes others look



The new 80286 "chip" in COMPAQ 286 Computers processes data faster.

like what they are—the products of compromise. In fact, the new COMPAQ 286 Personal Computers can be considered the most useful in the world.

## Power with a bonus—portability

The COMPAQ PORTABLE 286 redefines portable computers. We gave it power to match IBM's most powerful desktop computer, the IBM PC-AT. Then we designed it to run all the popular programs and hardware designed for the IBM PC-AT. But we didn't stop there. COMPAQ pushed the technology further.

The COMPAQ PORTABLE 286

runs 30% faster. It can give you up to 20 Megabytes of internal fixed disk drive storage. And can come with features to make it even more useful. Like our *internal* fixed disk drive back-up system that protects 10 Megabytes of information on a single, pocket-sized tape cartridge.

But the most amazing thing about the COMPAQ PORTABLE 286 is that all these features come attached to a handle.

## Our most advanced desktop computer

Like the COMPAQ PORTABLE 286, the new COMPAQ DESKPRO 286 runs all the popular programs designed for the IBM PC-AT, 30% faster. And it can also come with our convenient *internal* fixed disk drive back-up system for added data protection.

But we didn't stop there. We weren't content to compromise. We wanted to make the new COMPAQ DESKPRO 286 a more powerful, more efficient stand-alone personal



# personal computers in the world.

computer, as well as a faster, more powerful, more useful file server. So we gave the COMPAQ DESKPRO 286 far more memory and storage capacity—over 8 Megabytes of RAM and 70 Megabytes of high-performance fixed disk storage.

## The legends continue

Not everyone will need the extra performance of the newest COMPAQ Computers. That's why we built our original line to last a long time.

These workhorses—the COMPAQ Portable, COMPAQ PLUS and COMPAQ DESKPRO Computers—are essential to many professional and business users. They run thousands of industry-standard programs developed for the IBM PC and PC/XT.™ They're indispensable tools in use on all seven continents (yes, even the South Pole!).

## Above all, no compromises

The unprecedented success of COMPAQ came as no accident. While

others built limited computers, COMPAQ built expandable computers.

While others took two screens to display high-resolution text and graphics, COMPAQ was the first to do it on one.

While others were looking for ways to cut corners, COMPAQ looked for ways to eliminate downtime by building the most rugged, reliable computers in the world.

The COMPAQ commitment to a philosophy of "no compromise" made the COMPAQ Portable and COMPAQ PLUS the world's best-selling 16-bit portable personal computers. In 1983 COMPAQ sold \$111 million worth of computers to achieve the most successful first-year sales of any company in American business history.

In 1984, we introduced the COMPAQ DESKPRO. In only four months, it became the second-best-selling 16-bit desktop business system in U.S. retail computer stores. And as a result, we've concluded the most successful second year of any computer company, with sales of \$329 million.

The reason for this success is simple.

COMPAQ computers have been recognized worldwide. Awards include:

- COMPAQ PLUS selected and voted Europe's 1984 Computer of the Year in the portable category.
- COMPAQ PLUS voted by readers of *PC WORLD* as their favorite product in its category in the "1984 World Class PC Contest."
- COMPAQ PLUS selected as the first-place winner in its category in the *Creative Computing Top 12 Computers of 1984 Awards*.
- COMPAQ Portable rated best personal business computer in overall user satisfaction by the *Yankee Group* market research firm opinion poll.
- COMPAQ DESKPRO named by *PC Week* magazine as one of the top ten products of 1984.

We offer people personal computers that simply work better. And make no compromises doing so.



# Introducing the new COMPAQ PORTABLE computer helps you

*Anyone can make a portable computer. But to make one that runs all the popular programs designed for the IBM PC-AT, 30% faster—in a package almost half the size—was no small challenge. But one COMPAQ welcomed.*

## **Go faster, go further**

The COMPAQ PORTABLE 286 is paced by the advanced technology of the 8-MHz, Intel 80286 microprocessor. This advanced technology has numerous advantages. One advantage is the flexibility to work with several different operating systems so you're not forced to choose a personal computer solely on that basis.

The advanced capabilities of this microprocessor become even more

apparent when you run complex programs. You can operate as part of a network. Or you can operate more than one program at the same time using multi-tasking software like IBM TopView.™ And you can handle the most difficult problems with breathtaking speed.

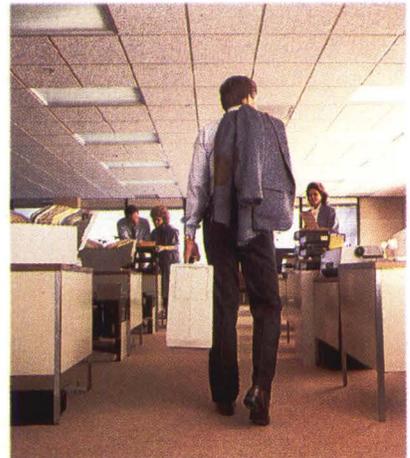
For many scientific and engineering programs you have the ability to add an 80287 coprocessor, which offers even more speed.

Both offer dramatic speed increases over earlier microprocessors. The faster response time means less waiting, and more productivity.

## **Power in a package**

The COMPAQ PORTABLE 286 has the power of the IBM PC-AT. But the IBM PC-AT doesn't have a handle. Ours does. So it goes where you go. Works where you work. Whenever and wherever necessary. And it's easy to share with co-workers.

That's full-function portability, pure and simple.



*A COMPAQ PORTABLE 286 can leave the office when you do. Take your work wherever you go.*

## **Expandability without getting bigger**

All the devices that increase the capabilities of the COMPAQ PORTABLE 286 go on the inside—not the outside—of the computer.

You can get it with one or two half-



# 286. Our fastest, most powerful portable do more - anywhere.

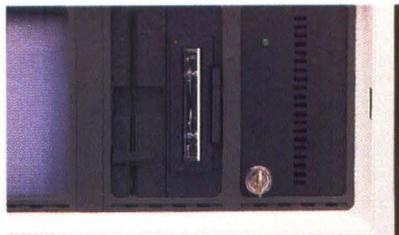
height 1.2-Megabyte diskette drives. Although they can "read" diskettes formatted for 360-K byte diskette drives, they cannot "write" to them. Therefore, as an option, COMPAQ offers a 360-K byte diskette drive to let you exchange data with other industry-standard personal computers.

There's an additional slot for a 20-Megabyte fixed disk drive. All COMPAQ Portable Computers offer fixed disk drive systems that fit *inside* the computer.

Another of our options: An *internal* fixed disk drive back-up system keeps a safety copy of your work, reducing the chance of losing your data. COMPAQ pioneered the system first in desktop computers, and now in portables.

The COMPAQ PORTABLE 286 even comes with a security lock feature that locks "on" to prevent interruption of a file transfer, or "off" to deny access to confidential information.

Because it's a portable, self-contained unit, the computer can be easily stored away after use.



*Two data protection features from COMPAQ: an internal fixed disk back-up system that stores data on tape cartridges, and a security lock for locking keyboard access to your system on or off.*

## Who can use it?

If you're an experienced user, you may be ready to upgrade your current equipment. The COMPAQ PORTABLE 286 gives you the latest technology.

For some, power is all-important: Speed, performance, and the ability to handle the most powerful software. All are leading qualities of the COMPAQ PORTABLE 286.

Starting a business? The COMPAQ PORTABLE 286 has tremendous data base capabilities to help you keep track of your inventory, your customers, your employees, your finances. Its exceptional storage capabilities make it ideal for the complexities of accounting. Its exceptional speed means greater networking ability. Its tremendous power enables you to get the edge on the competition.

In addition, large corporations can place several of these computers with field representatives to provide clients immediate information on current prices, product availability, even shipping dates and routing. So delivery shortages can be anticipated and avoided.

The COMPAQ PORTABLE 286 can also travel within the company. From office to office. Desk to desk. From accounting, to marketing, to research.

It's powerful and versatile enough to do almost any job. Light enough to carry. And tough enough to survive lots of users.

## Established reliability

Despite its newness, the COMPAQ PORTABLE 286 is in many respects a proven product. It's based on the rugged, reliable design of the original COMPAQ Portable and COMPAQ PLUS. Many of the construction techniques like cross-bracing components and shock-mounting disk drives are identical. All of which goes to prove our point: No other portable computer can measure up to the advanced power and potential of the uncompromising COMPAQ PORTABLE 286.

### The COMPAQ PORTABLE 286 Specifications

**Processor:** 16-bit 80286; 6 or 8 MHz clock speed. **Software:** Fully compatible with all major software applications written for the IBM PC-AT. **Expansion Slots:** 3 available slots in base configuration. **Memory:** 256-K bytes RAM, expandable to 2.6 Megabytes. **Storage Devices:** 360-K byte or 1.2-Megabyte diskette drives, 20-Megabyte fixed disk drive, fixed disk drive back-up (10 Megabytes per tape). **Interfaces:** RGB color monitor, RF modulator, composite video, parallel printer, and asynchronous communications interfaces. **Keyboard:** Standard IBM PC-AT layout (84-key). **Display:** 9-inch diagonal green monochrome dual-mode monitor, high-resolution text characters, high-resolution graphics. **Security:** Locks in operating and non-operating mode to prevent unauthorized keyboard access. **Physical Specifications:** 20"W x 8 1/2"H x 16"D. **Options:** Technical reference guide, MS-DOS™/BASIC Version 3, 512/2048-K byte memory board.

# Introducing the new COMPAQ DESKPRO 286. offers more expansion,

*The capabilities of the new COMPAQ DESKPRO 286 represent a personal desktop computer as practical as it is technically advanced. Plus, it maintains compatibility with the IBM PC-AT.*

## **Utmost expandability**

That's no exaggeration. The COMPAQ DESKPRO 286 can expand to give you massive storage and memory.

Without clutter. Expansion is *internal*.

It comes with a single, half-height, 1.2-Megabyte diskette drive. You

can add a second drive of the same capacity, or a 360-K byte diskette drive so you can exchange information with other personal computers.

For fixed disk storage, an internal 20-Megabyte system is available. You can also choose a 30- or 70-Megabyte high-performance internal fixed disk drive system. The storage capacity of each is equivalent to 10,240, 15,360, or 35,840 pages of double-spaced data.

One expansion board works with all the fixed disk drives. When you upgrade to a larger fixed disk storage system, a new board is not required.

To back up data, use the COMPAQ internal fixed disk drive back-up system. It's also a safe and convenient way to store information for record keeping.

## **Hardworking, networking**

Alone, the COMPAQ DESKPRO 286 is a tremendously useful computer. It doesn't limit you to using software under any one operating system. It runs all the popular programs designed for the IBM PC-AT. It can be configured for advanced color graphics display using a color monitor and the IBM Enhanced Graphics Adapter.



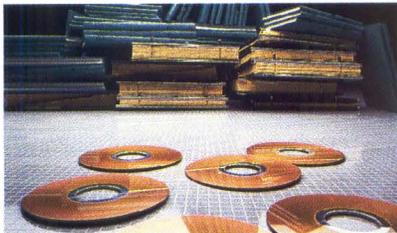
# Our most powerful desktop personal computer more speed and more flexibility.



An enhanced keyboard layout, with shift keys in easy reach for touch typists, is standard on the COMPAQ PORTABLE 286 and COMPAQ DESKPRO 286.

The modular design of the computer also lets you configure RAM and storage to the exact needs of any individual. So you never have to buy more computer than you need. Or worry about obsoleting your investment because you bought less computer than you need.

The COMPAQ DESKPRO 286 also makes the ideal hub of a local area network. Using networking packages, your computers (and your people) can share information and software, and can communicate with one another. With 70 Megabytes, the COMPAQ DESKPRO 286 becomes a powerful, high-performance file server. You



A fixed disk can store enough programs and data to handle all the accounting for most businesses.

can store lots of data, as well as store several programs you can run simultaneously when using software programs like IBM TopView. Your computer will perform at lightning speeds. And other configurations can make economical "nodes" of the network.

## Where to start

The flexibility of the COMPAQ DESKPRO 286 allows you to begin at any level of computing power and reach beyond the IBM PC-AT.

You can use your computer for writing extensive documents, preparing professional graphics for presentations, and for doing complicated financial studies. Chances are, however, you'll not want to stop there. You'll discover new ways for streamlining your work. You'll want to do customer lists, accounting tasks and business taxes, product inventory, annual sales projections on spreadsheets. You have the option of adding a second diskette drive, a fixed disk drive, more memory, even a

fixed disk drive back-up system. All are available and can be added to the inside of your COMPAQ DESKPRO 286—easily, affordably, without losing your initial investment in hardware, software, or training.

## A proven heritage

The COMPAQ DESKPRO 286 is of tested lineage. It has many of the reliable construction and design qualities of the COMPAQ DESKPRO. It has further conveniences like a dual-function security lock to prevent unauthorized access. As well as greater performance, power, and speed. The COMPAQ DESKPRO 286 stretches the limits of personal computing—with no compromises.

## The COMPAQ DESKPRO 286 Specifications

**Processor:** 16-bit 80286; 6 or 8 MHz clock speed. **Software:** Fully compatible with all major software applications written for the IBM PC-AT. **Expansion Slots:** 5 slots available in base configuration. **Memory:** 256-K bytes RAM, expandable to 8.2 Megabytes. **Storage Devices:** 360-K byte or 1.2-Megabyte diskette drives; 20-(half-height), 30-, or 70-Megabyte fixed disk drives; fixed disk drive back-up (10 Megabytes per tape). **Interfaces:** RGB color monitor, RF modulator, composite video, parallel printer, and asynchronous communications interfaces. **Keyboard:** Standard IBM PC-AT layout (84-key). **Display:** 12-inch diagonal green or amber dual-mode monitor, high-resolution text characters, high-resolution graphics. **Security:** Locks in operating and non-operating mode to prevent unauthorized access; cover lock to protect internal components. **Physical Specifications:** System unit—19.8"W x 6.4"H x 16.5"D, Keyboard unit—18.0"W x 1.5"H x 7.0"D, Display unit—14.75"W x 10.25"H x 13.75"D, Weight—57–64 lbs., depending on configuration. **Options:** MS-DOS/BASIC Version 3, Tilt & Swivel Monitor Stand, Desk-Saver, Technical Reference Guide, 512/2048-K byte memory board.

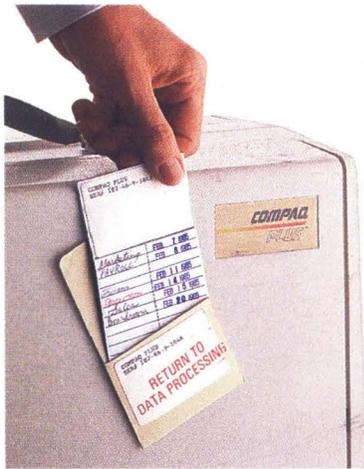
# COMPAQ makes full-function portability a full-fledged reality.

*If you're anxious to put a computer to work for you, but don't need the extra power and added performance of our most advanced portable computer, we have the answer.*

## Lots of software, lots of uses

The COMPAQ Portable and COMPAQ PLUS are based on the 8088 microprocessor, one of the most popular computer technologies, so software is abundant. Integrated business programs, personal productivity, learning tools, even educational thoughtware to sharpen your business skills. Literally thousands of programs, compatible with the IBM PC and IBM PC/XT, will run on the COMPAQ Portable and COMPAQ PLUS.

Many businesses put the COMPAQ Portable or COMPAQ PLUS to work as a full-time computer for part-time users. Carry it from desk to desk. Office to office. Let several people use it for one or more hours a day. Or one person use it a few days a week.



*Many companies use a COMPAQ Portable as a full-time computer for part-time users.*



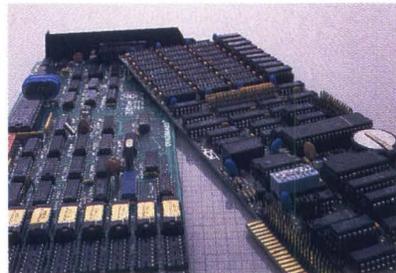
For heavy users, a COMPAQ Portable or COMPAQ PLUS can become a "second computer" for computing power away from the office.

With their rugged, uncompromising construction, they're built tough enough to pass around—something that's impractical to do with desktop computers. And because you stretch its use, you stretch your budget as well.

## If you need more, it does more

How can one computer be so versatile?

One reason is the ability of the COMPAQ Portable to become a COMPAQ PLUS with the addition of a 10-Megabyte fixed disk drive. This expands storage capacity to the equivalent of 5,120 double-spaced pages of information.



*Expansion boards let you add memory and extra functions inside, not out.*

There are other ways to improve on your COMPAQ. Hundreds of industry-standard expansion boards are available. They fit neatly inside your COMPAQ. So you can run more advanced programs. Communicate over telephone lines. Network with other computers.

It's this kind of versatility and ease of use that makes COMPAQ Personal Computers second to none.

## SPECIFICATIONS

### The COMPAQ Portable

**Processor:** 16-bit 8088, 4.77 MHz clock speed.  
**Software:** Fully compatible with all major software applications written for the IBM PC/XT.  
**Storage Devices:** One or two 320-K byte diskette drives. **Expansion Slots:** 3 available slots.  
**Memory:** 128-K bytes RAM expandable to 640-K bytes. **Display:** 9-inch green diagonal monochrome dual-mode monitor, high-resolution text characters, high-resolution graphics. **Interfaces:** RGB color monitor, RF modulator, composite video, and parallel printer.  
**Keyboard:** Standard IBM PC layout (83-key).  
**Physical Specifications:** 20"W x 8½"H x 16"D.

### The COMPAQ PLUS

Specifications the same with the exception of: One 360-K byte diskette drive, one 10-Megabyte fixed disk drive, 2 available expansion slots, and full compatibility with all major software applications written for the IBM PC and PC/XT.

# Lasting value led to instant success for the COMPAQ DESKPRO.

*If you don't need all the extra performance of the COMPAQ DESKPRO 286, you can buy the popularly priced COMPAQ DESKPRO and still get many advanced features.*

## A command performance at every level

The COMPAQ DESKPRO Series allows you to buy as *much* computer as you need—not *more* computer than you need.

It's a polished performer, from entry level to advanced computing, in one totally expandable unit. Its plug-in, modular design accepts up to four separate storage devices. You select almost any combination of diskette or fixed disk drives you desire. And there's the practical, internal fixed disk drive back-up system to protect and store your data. So as your needs grow, the DESKPRO grows.

In fact it will grow from an IBM PC to far beyond the IBM PC/XT level of functionality. The COMPAQ



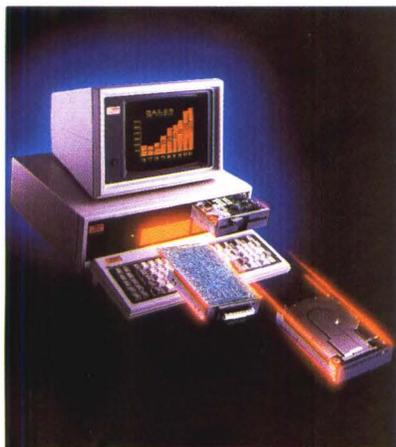
DESKPRO will run all the popular programs written for both the IBM PC and PC/XT, two to three times *faster*, without sacrificing compatibility.

## Power? It's got what it takes.

The COMPAQ DESKPRO can be easily configured for scientific, engineering, and advanced business applications.

A high-performance, 30-Megabyte fixed disk drive provides added storage capacity.

The ability to add a high-speed 8087-2 coprocessor lets you deal with complex scientific calculations and economic models.



*Internal expandability saves desk space.*

## SPECIFICATIONS

### The COMPAQ DESKPRO

**Processor:** 16-bit 8086; 4.77 or 7.14 MHz clock speed. **Software:** Fully compatible with all major software applications written for the IBM PC and PC/XT. **Expansion Slots:** 6 slots available in base configuration. **Memory:** 128-K bytes RAM, expandable to 640-K bytes. **Storage Devices:** One or two 360-K byte diskette drives, 10-(half-height) or 30-Megabyte fixed disk drives, fixed disk drive back-up (10 Megabytes per tape). **Interfaces:** RGB color monitor, RF modulator, composite video, parallel printer, and asynchronous communications interfaces. **Keyboard:** Standard IBM PC layout (83-key). **Display:** 12-inch diagonal green or amber dual-mode monitor, high-resolution text characters, high-resolution graphics. **Physical Specifications:** System unit—19.8"W x 5.8"H x 16.5"D, Keyboard unit—18.0"W x 1.5"H x 7.0"D.

# Features common to COMPAQ in most other

*It's been easy for COMPAQ to recognize the compromises other personal computer makers have been making.*

*It's been just as easy to avoid them.*

*That's why performance, expandability, compatibility, durability, and versatility are features you'll find in the entire COMPAQ family of computers.*

## How advanced technology affects the choice you make

There's an ever-growing library of fast, powerful programs designed for the IBM PC-AT and compatible with the COMPAQ PORTABLE 286 and COMPAQ DESKPRO 286. These programs will utilize the full potential of the computer "nerve center"—the Intel 80286 microprocessor.

If you own a COMPAQ Portable, COMPAQ PLUS, or COMPAQ DESKPRO, you may discover that

these newer programs are simply too big to run on your computer.

Therefore you have a choice: the extra power and speed of the 80286 or the popular COMPAQ Personal Computers that use the 8088 and 8086 microprocessors. Remember that the COMPAQ PORTABLE 286 and COMPAQ DESKPRO 286 offer more power, speed and performance than any other personal computer. If your needs don't require the advanced technology, or you need a second computer to complement the one you have now, consider the COMPAQ Portable, COMPAQ PLUS, or COMPAQ DESKPRO. All three are hardware and software compatible with the IBM PC and PC/XT. Our intention is to give you a choice without forcing you to invest in more, or less, computing power than you think you need.

Of course, COMPAQ Personal Computers maintain compatibility with the add-on devices and expansion boards available for industry-standard personal computers, without any alteration or modification.

## Increased power without increased size

All COMPAQ Personal Computers can take on more memory and storage without taking up more space. The COMPAQ Portable becomes a



*Internal add-on devices add greatly to the capabilities of a COMPAQ Computer.*

COMPAQ PLUS when you add a 10-Megabyte fixed disk drive. The COMPAQ PORTABLE 286 can accept a 20-Megabyte fixed disk drive. The fixed disk drive fits neatly beside the diskette drive inside the unit.

With the COMPAQ DESKPRO and COMPAQ DESKPRO 286, you can install almost any available combination of diskette or fixed disk drives you desire to achieve the level of performance you need. The COMPAQ DESKPRO and COMPAQ DESKPRO 286, along with the COMPAQ PORTABLE 286, can accept the fixed disk drive back-up system as one of the internal storage devices.

There are slots inside each COMPAQ Computer for optional expansion boards. These boards greatly enhance the functionality and versatility of your computer. Literally hundreds are available to plug right in. Each lets you do something different. Like expanding the amount of memory in your computer. Or communicating with other personal computers. Or



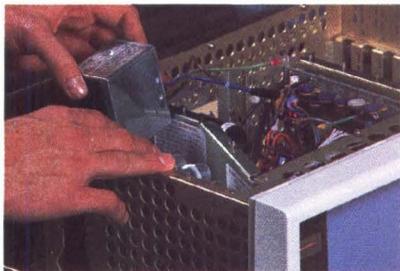
# Computers are features uncommon personal computers.

even communicating with mainframe computers.

## Built tough to take it

COMPAQ Portable Computers are expected to take some hard knocks. A specially designed shock isolation system protects the diskette drives from jolts and vibration.

Their inner components are surrounded by a cross-braced aluminum frame. Those equipped with fixed disk drives are protected by a triple shock mount system. Plus, the outer case is molded from high-impact plastic, the same kind used to make bulletproof windows and space helmet faceplates. COMPAQ Portable Computers are tough, protecting your data from every angle.



COMPAQ DESKPRO Computers are no pushovers, either. They're surrounded by a protective steel shell.

They're the only desktop computers made with protective shock mounts, isolating the disk drive compartments from those unexpected but inevitable bumps and knocks that can cause downtime.

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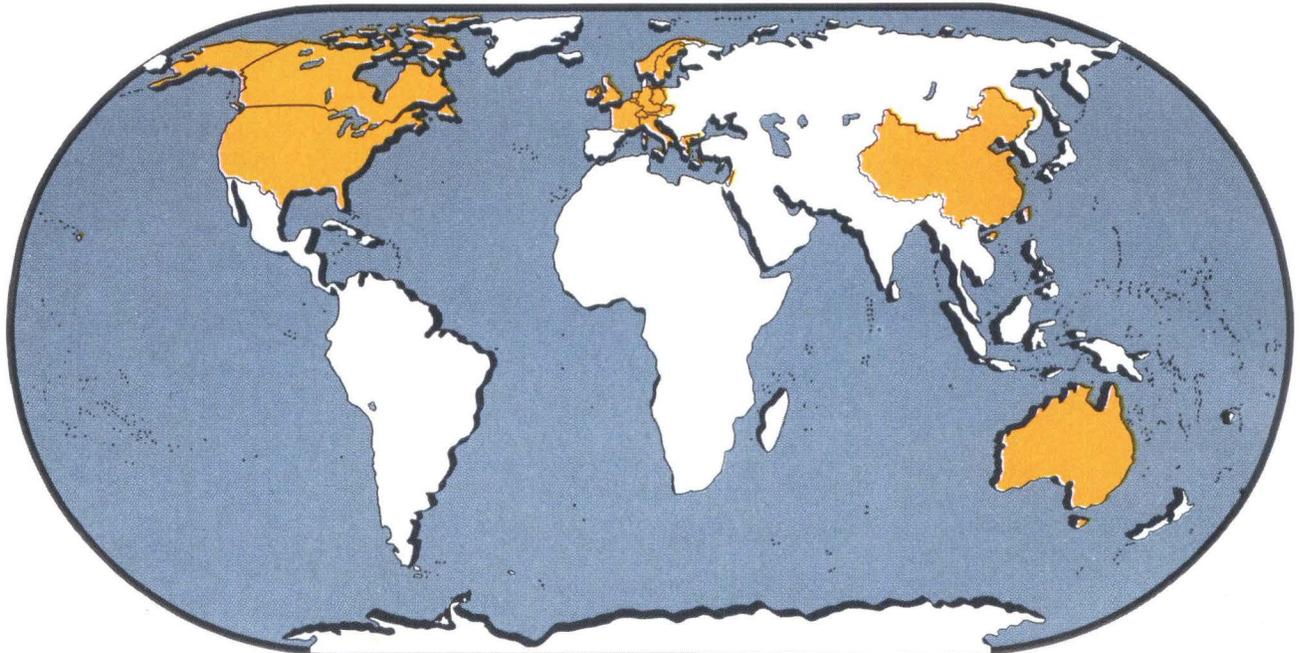
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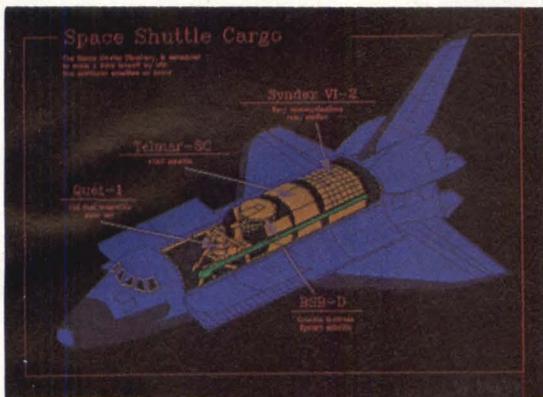
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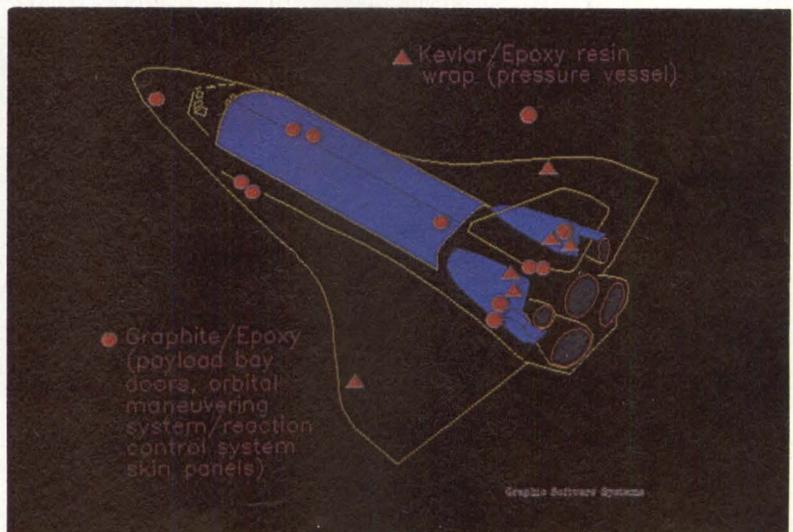
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# VDI GRAPHICS TOOLS AID SOFTWARE INTEGRATION

Use of the virtual device interface (VDI) could spell the difference between success and ruin for developers of integrated software



**Thomas B. Clarkson III**  
Graphic Software Systems Inc.



Integrated software has been the hot topic in the computer industry recently. Ever since 1-2-3 and Symphony from Lotus Development Corp. and Framework from Ashton-Tate popularized the concept of integrated software in the microcomputer environment, big-name hardware and software vendors have been rushing to grab a piece of the rapidly growing integrated-software market. For example, Apple Computer Inc.'s Macintosh, Digital Research Inc.'s Graphics Environment Manager, IBM Corp.'s TopView and Microsoft Corp.'s MS-Windows, all offer different approaches to integration.

Given the large number of contenders and approaches in the integrated-software market, software developers are understandably confused. As a result, three fundamental questions need to be resolved:

- Should the integration of applications take

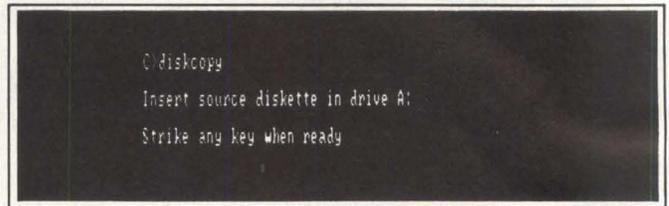
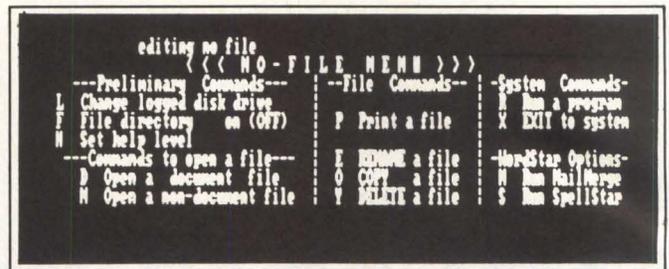
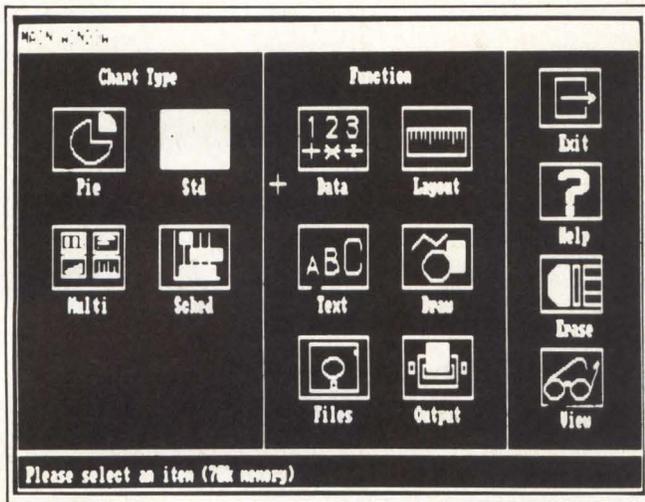
**These images of a space shuttle** were generated by the VDI-based *Sound Presentations* package from *Communication Dynamics Inc.* Written for microcomputers, *Sound Presentations* combines a graphics editor with a library of predefined graphics templates.

place at the operating system-level or at the application level?

- Should the user interface be defined by the operating system or be created by the application developer?

- How should the integrated package meet the increasing demand for graphics in the modern office?

How developers choose to answer these questions can determine their product's uniqueness,



**The three basic types** of user interfaces are graphics-driven (left), menu-driven (top right) and command-driven (bottom right).

portability, usability and ultimate commercial success. And, developers are now discovering that the answers are related and may come from a surprising quarter—the virtual-device-interface (VDI) standard for graphics.

Proposed by ANSI, the VDI standard was developed to achieve device independence in graphics applications. Basically, the VDI sits between an application and the operating system of a host computer. It translates graphics commands from the application into arrays of command parameters that can be relayed to drivers for printers, plotters and virtually any other standard graphics-output device.

As an unexpected bonus, the VDI also provides powerful tools for software integration by allowing developers to work at a level between the operating system and the application.

**Integration becomes an issue**

To understand VDI's role in software integration, it's important to remember that there's only one reason to integrate software at all: to make it easier to use.

Integrated software is easier for end users because it enables them to access multiple, diverse application packages through a single, uncomplicated interface. Integrated software also provides a common environment for creating and accessing data, thus providing consistency among all integrated functions.

For developers, there are two distinct types of integration: integration of the data itself and integration of user-interface functions.

Data integration is the attempt to make data common to several functions—such as spreadsheets, graphics packages, database management systems and word processors—so it can be passed back and forth and be processed by all functions.

Integrating the user interface, meanwhile, provides a consistent methodology for the user's interactions with the various functions in the package.

While the idea of offering a single user interface to several diverse functions is appealing, vendors must use extreme caution in creating that single model. It will, to a large degree, define how each user perceives the product and decides whether it is useful. Hence, the user interface has a direct effect on the commercial acceptance of the applications.

There are three primary types of user interface designs: command-driven, menu-driven and graphics-driven (visual). Each has a particular user appeal, depending on a user's experience.

Command-driven systems appeal to experienced users. Since the systems offer very few prompts or choices, the user is expected to know which programs are available and how they're used. If the system doesn't immediately recognize a command the user enters, it responds with an error message.

The biggest advantage of a straight command-driven interface is speed. Very few keystrokes are required to initiate any action and it eliminates wading through multiple levels of menus. The system's biggest drawback, however, is its "unfriendliness." The novice facing a screen with nothing but a prompt has no guide to what to do next.

Menu-driven interfaces were incorporated into some of the first integrated software packages. With this interface, every possible choice the user can make is in a menu that is frequently arranged in a hierarchical manner. These menus typically impose a temporal order, in which one choice or action must be taken before another. The selection of one menu item brings up another menu, which brings up yet another until a final



Benjamin West. *The Death of General Wolfe*, 1770. Courtesy The Bettmann Archive.

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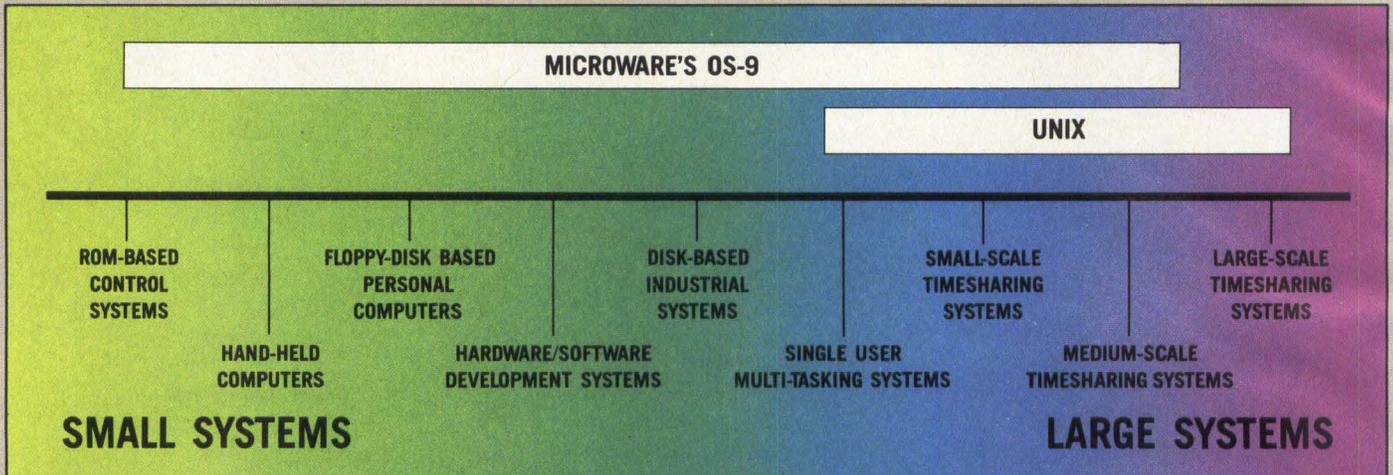
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selection allows work to be done. As a result, the user never has to remember the name of any command or program. These interfaces are easy for the novice but frustrating for the accomplished user who must endure screen after screen of prompts before reaching the desired function.

Graphics-driven interfaces, pioneered by Xerox Corp. in its Smalltalk programming language, are a fairly recent development and usually provide an interface that is both friendly and non-restrictive. Rather than a temporal order, the user is presented with a spatial order of possible actions that are represented by "icons"—pictorial representations of actions. The user positions a graphics pointer over an icon to select an action. The visual interface's "object orientation" rather than "procedural orientation" is expedient in moving the user to a point in an application at which he can perform useful work.

The most popular example of a visual interface is the window-based variety. Window-based interfaces create "windows" into data, giving the user immediate visual feedback for each action. A user can even juxtapose windows of data from different applications or, in some systems, transfer data from one window to another, and therefore, one application to another.

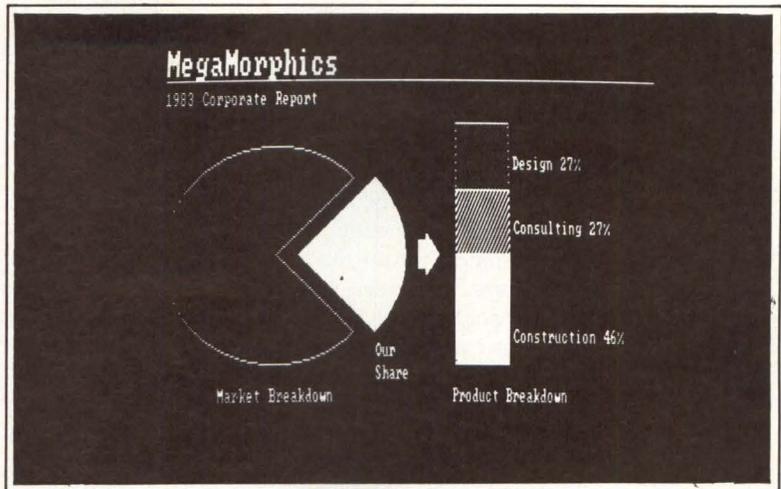
**Application meets operating system**

There are two fundamental levels at which integration can take place: the application level and the operating-system level. Integration at the application level involves integrating multiple functions and creating a common user interface within a single, executable program provided by one vendor. Symphony and Framework integrated-software packages take this approach.

The second approach is to provide an operating-system-level environment for integrating multiple executable programs or functions. In this approach, the user interface is effectively embedded in the operating system. TopView from IBM and MS-Windows from Microsoft employ this method of integration.

Operating-system-level integration generally provides facilities for data integration as well as a user-interface component. The operating system fulfills the user-interface function by providing a common run-time environment for the applications (as in the Apple Macintosh, for example).

The primary distinction (and disadvantage) of the operating-system approach is that the system integrator cannot change the user interface to suit the specialized needs of the various application packages he is creating. Several of the new integrated packages offer this kind of embedded user interface by extending the capabilities of the



**GSS-Chart is a graphics application built according to the VDI standard using the GSS Toolkit. It provides microcomputers with the graphics capabilities of many host packages without the overhead of large mainframe use.**

operating system. However, the user-interface model that results from such an extended operating system forces the software developer to choose between application portability and user-interface flexibility.

With many of the embedded user-interface systems, the big gain is portability. The product will run on any machine that is using the same operating system.

However, what is gained in portability, is lost in flexibility. Product differentiation is one of the most difficult challenges faced by a software developer in today's fiercely competitive software market; the perpetual challenge is to create unique features. The embedded user interface can greatly restrict the software developer's ability to provide such uniqueness. An application-based user interface gives the developer that flexibility but historically has severely limited the environments in which the product can run.

There is also the related question of whether to allow the operating system to define the user interface. How well can it manage the user-interface function? The role of an operating system is device control, not user-interface management. Major benefits result from standardizing device control, but major problems may result from standardizing the user-interface function.

Another question is whether a system-software vendor can produce a user interface that works for all end-user market needs. Application vendors are the best group to define user inter-

**There's only one reason to integrate software at all: to make it easier to use.**

faces, because they know best their specific markets.

In short, even with all its drawbacks, software integration and user-interface definition is best done at the application level. Making that integration possible, and easy, is the greatest challenge facing the software developer today.

The third issue software integrators face is graphics. Given the ever-increasing demand for charts, drawings and even photographs in the modern office, the integrated-software package that can't manage graphic processing is becoming obsolete. Moreover, as local area networks become more common, integrated software must be able to output to many different kinds of graphics devices, such as page printers, laser printers and plotters.

**Enter the VDI**

Here is where the VDI, in its final stages before formal adoption by ANSI, comes into the picture. Device-independent VDI presents a single standard for relaying input to an application and graphics output to peripheral devices. VDI specifies capabilities of input and output devices including joysticks, mice, keyboards, printers, plotters and cameras.

VDI provides device independence for the development and use of graphics-based application software. This is achieved through a virtual graphics-device interface—often called the “perfect peripheral.” The interface allows an applica-

tion to control any graphics peripheral supported by VDI's library of device drivers. Device peculiarities present no obstacles to VDI-based applications.

For input devices, VDI supervises such actions as pointing or string input. For output devices, VDI controls high-level graphics capabilities such as drawing lines and circles.

The proposed VDI standard exists today in product form and is available to software developers and hardware manufacturers. Graphic Software Systems Inc.'s (GSS) implementation of VDI is included in GSS-Driver. VDI is also available from IBM in the Personal Computer Graphics Development Toolkit. It provides device independence through device-driver management, coordinate transformation, text models, character I/O, emulation of graphics primitives, device inquiry and error reporting.

GSS also markets a collection of software tools, GSS Toolkit, for programmers working with the VDI. The toolkit includes the international standard graphical kernel system (GKS), a plotting system for the graphic representation of data, a metafile interpreter that reads back files stored in virtual device metafile format, and a window manager that allows the developer to build user interfaces from icons, windows and visual menus.

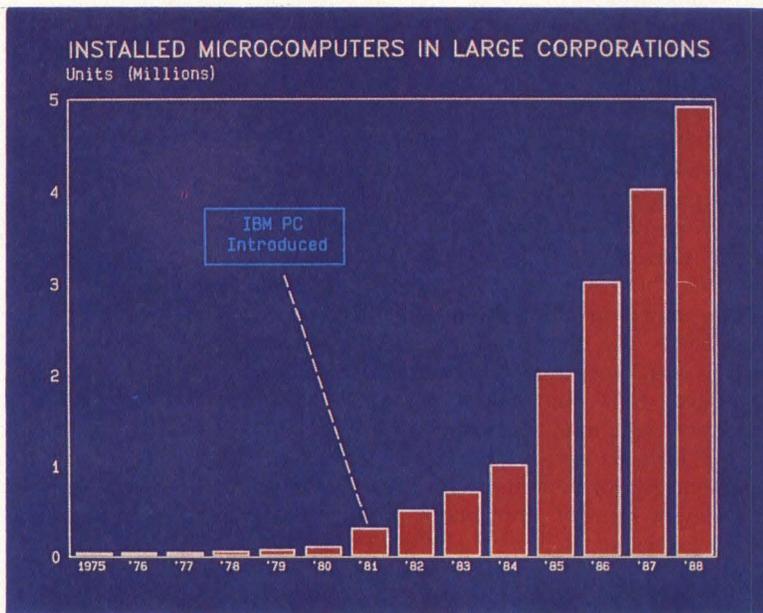
The GSS implementation of VDI is divided into two parts: a device-independent VDI controller and a library of drivers for specific peripheral devices. The VDI controller handles device-driver management, coordinate transformations and emulation of graphics primitives. The device drivers handle all graphics tasks. This division is transparent to the application developer and end user.

What is important to the developer and end user is that the VDI is a standardized interface between specific device drivers, the application and the operating system. This means VDI-based applications are easier to develop and will support a wide variety of computers and I/O devices.

**VDI sidesteps the question**

In addition to graphics, the VDI plays a role in the development of the user interface of an integrated package. Since the GSS Toolkit contains a window manager that developers can use to build graphics-based user interfaces, they can also use the VDI to define that interface.

If the developer chooses a non-embedded user interface, integration can take place at the application level using VDI to provide device control while application vendors provide the user interface and data integration. However, if the devel-



*GSS-Plottalk, based on VDI, is meant to give the novice user the ability to create quality graphics.*

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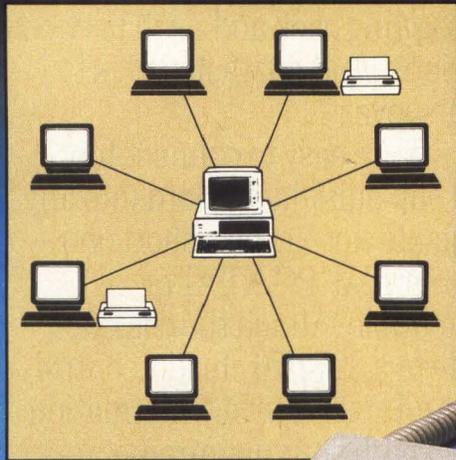
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oper wants an embedded interface, software can still be integrated at the operating-system level, using an environment manager based on a VDI. In either case, the VDI will enable the software developer to create unique user interfaces.

Moreover, the VDI enables the developer to customize the user interface to the application without worrying about portability. Since the user interface is defined via the VDI rather than the operating system, developers have the freedom to configure the user interface as they wish, without limiting it to only a handful of computers. In an integrated package, developers can even have a different user interface for each application function.

Finally, the VDI allows greater product differentiation. The software developer is able to maintain the distinctness of individual functions; uniqueness isn't lost or blurred in an integrated environment. A VDI-based interface allows software developers to maximize and spotlight their product's unique features in a crowded marketplace.

With the market acceptance of visual inter-

faces, demonstrated by Apple's Macintosh and given impetus by the entrance of IBM's Top-View, the increased development of integrated software with window-based user interfaces is inevitable.

However, integration is not enough to make a product commercially successful. The product must also be easily distinguished as different and superior in the marketplace. It must be easy to use and, it must be portable to an ever-increasing supply of sophisticated hardware.

A VDI-based user interface places all these criteria for success in the developer's hands. As such, the VDI is an important method of ensuring product differentiation and ease of use in integrated, window-based environments. The software developer doesn't have to use the VDI and create unique user interfaces for each application but at least he will be able to, should the software market demand it. □

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**Thomas B. Clarkson III** is president and co-founder of Graphic Software Systems Inc., Wilsonville, Ore. Before starting GSS, Clarkson was a consultant at Tektronix Inc. and was a software project leader and computer analyst at the Jet Propulsion Laboratory in Pasadena, Calif.

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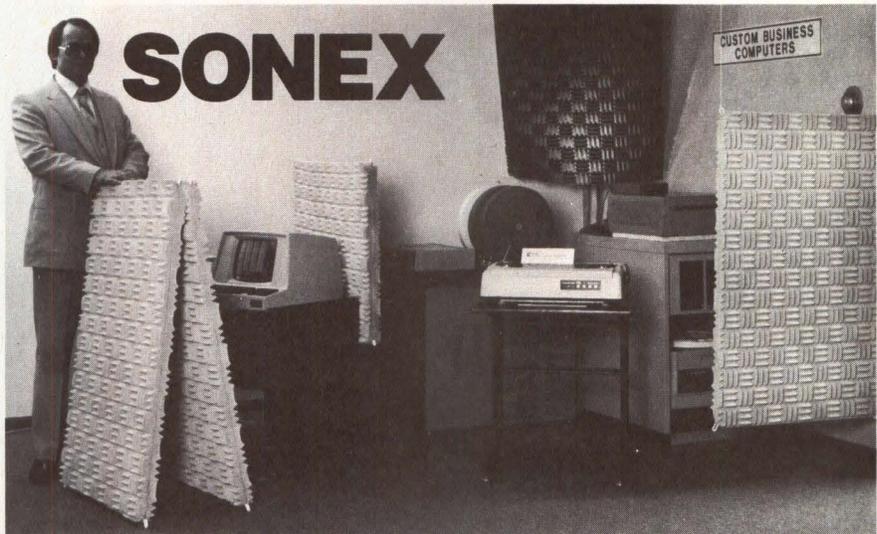


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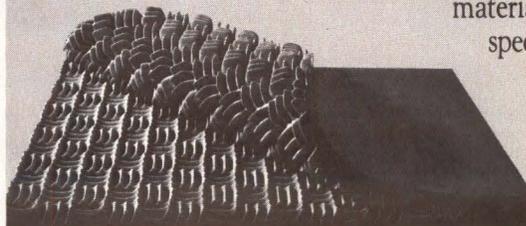
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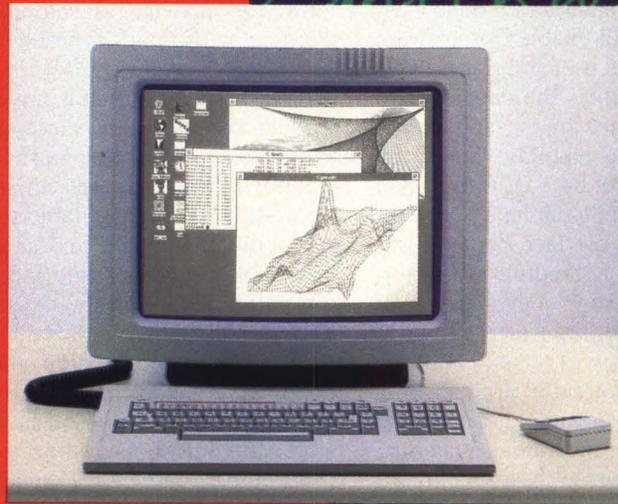
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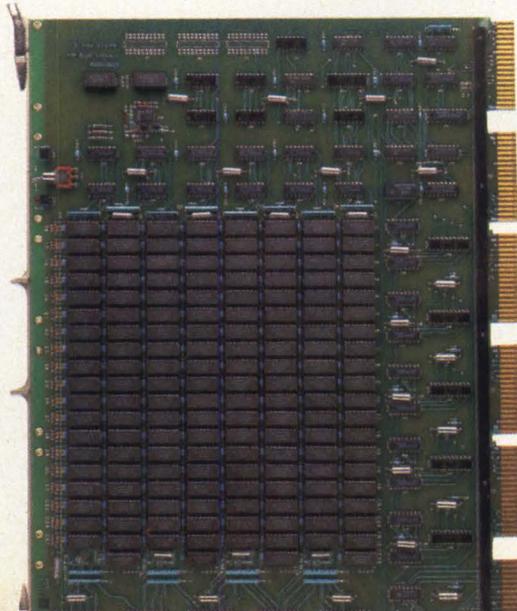
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# GRAPHICS SOFTWARE BRIGHTENS BUSINESS LOOK

Software is painting better business graphics to meet increased demands for presentation-quality output

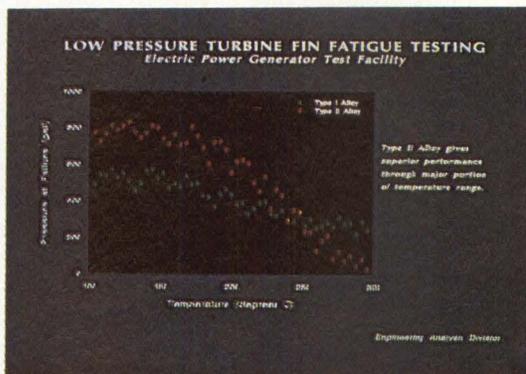
Carl Warren, Western Editor

The business community has discovered the truth in the old cliché that a picture is worth a thousand words. Accordingly, it is placing more and more emphasis on transforming business data derived from spreadsheets and databases into pictorial representations.

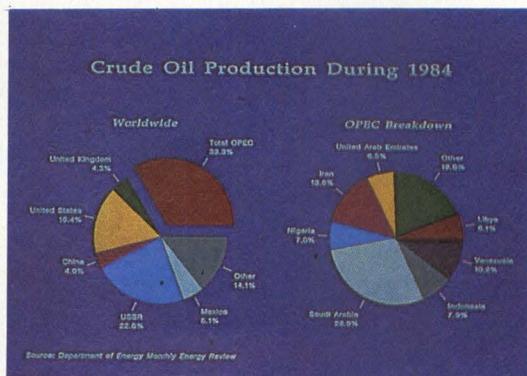
The growing interest in business graphics has gone hand in hand with the increased use of integrated software packages, such as Lotus Development Corp.'s 1-2-3, which allow users to make data-to-graphic transformations quickly. Also, a new phenomenon, paint programs—which are spin-offs on Apple Computer Corp.'s MacPaint—replicate freehand drawing on a CRT screen. Kathleen Lane, manager of software services at Dataquest Inc., San Jose, Calif., says paint programs are “basically to play with,” but speculates they are sometimes used for business presentations.

In addition, standalone graphics packages have proved successful as powerful business-graphics tools. These packages allow users to efficiently manipulate business data. “That’s the beauty of business graphics,” says Steve Ediger, product acquisitions manager for software distributor Softeam Inc., Compton, Calif. “Being able to look at data in a variety of forms appears to be critical to most business people.”

Ediger, too, sees potential for business applications of paint programs, but thinks the next market breakthrough will be statistical packages that combine several graphics techniques. One such package, Decision Resources Inc.'s \$245 Sign-Master, combines a text and color capabili-



**A major benefit of computer-generated graphics is the ability to represent data in a variety of forms. For example, Precision Visuals Inc.'s PicSure presentation graphics package allows transformation of data into pie charts (a) or scattergrams (b).**



ty in acceptable output quality for many purposes. What constitutes acceptable—or presentation—quality is not rigidly defined, but generally, the closer machine graphics can come to those created by a graphic artist, the better they are considered to be.

Whether in standalone applications or complex development tools, end users and value-

added resellers (VARs) are basically looking for three things: ease of use, ease of integration and low cost. In general, there's great divergency in how various packages meet those criteria.

General-purpose programs, normally offering basic graphics such as bar, line and pie charts,

are usually machine-specific and often cost under \$200. They constitute by far the largest portion of the market. Dataquest reports that 350,000 copies of MacPaint, alone, have been sold. Software Publishing Corp.'s PFS Graph, at \$140, is one of these inexpensive packages. It has

### Drivers link up output

Although business graphics software provides the tools necessary to produce the graphical representation of numbers, displaying it on the CRT screen or printing it on a hard-copy device is another matter.

The most difficult part of a graphics package to create is the device interface, because each peripheral device is different and requires a special driver. Consequently, developers of graphics packages are forced to build in multiple device-specific drivers to accommodate various peripherals.

Steve Brightbill, president of Brightbill-Roberts and Co. Ltd., Syracuse, N.Y., notes that the diversity among such raster-style devices as dot-matrix printers creates a need for a large library of drivers. "Not all dot-matrix printers use the same command sequences, so you have to provide a driver for each brand you choose to support," explains Brightbill.

Besides the diverse devices software developers must contend with, there is the problem of combining device drivers with the application. Usually, software

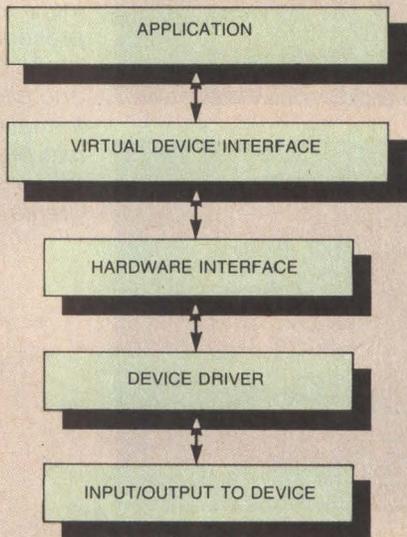
packages tightly couple device drivers to the application. Although this does make the driver part of the software, it makes it difficult to alter. Therefore, upgrading the software to accommodate enhancements to peripheral devices can be difficult, and usually require the developer to completely rewrite the application.

Graphics applications developed within the last year, however, are taking advantage of the graphical kernel system (GKS) and virtual device interface (VDI) implementation of that standard. This proposed standard, adopted by IBM Corp., provides device independence and language binding—a way of hooking into any development language with common code. Therefore, unlike tightly coupled device drivers, VDI device drivers, which are standalone library modules, are loosely coupled to the application. Changing the device driver doesn't require any alteration of the application code.

The VDI language bindings serve the purpose of translating the graphics request into code for the device driver in a common format. Thus, a keystroke command to draw a circle on a plotter, for example, would send the Circle command and the appropriate dimensions to the device interface. The device driver, which receives the command from the interface, then translates the command—now in the form of the proper operation code—to the proper command sequence for the device. This information is in turn sent to the device, which then creates the image.

Because VDI provides a common interface, a library of portable device drivers can be created. To this end, Graphic Software Systems Inc., Wilsonville, Ore., has developed the GSS Driver Library, which supports a wide range of devices, including graphics display boards, mouse input pointers, a full range of printers (dot-matrix, ink-jet, laser and daisywheel) and virtually all plotter command languages.

Incorporating drivers into a system such as the IBM PC can be as easy as including them as an extension to the operating system by creating a system configuration file. Assigning the PC DOS device driver to the GSS device driver HI29.SYS, for example, would establish a Houston Instrument plotter as the graphics output device. Thus, graphics output commands from the application are translated into a syntax that is compatible with the plotter.



**The VDI implementation of the GKS standard provides a common link to device interfaces and drivers. The VDI translates graphics commands from the application to code in the form of arrays of command parameters. These arrays then pass to the device-specific interface, which then passes the commands to the device driver.**

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sold an estimated 20,000 copies since its introduction almost two years ago. For \$200, Sound Presentations from Graphic Software Systems Inc. adds a few more features: freehand drawing with a mouse or cursor, pre-drawn templates and the ability to create other templates.

For more than \$200, users can supply the raw data for graphics from afar. For instance, Micro-Systems Software Inc., Boca Raton, Fla., offers a combined spreadsheet, graphics and communications package for \$299. This package, called Miracle, is built around communications. It allows users to take, manipulate and ship main-frame data by telephone. Company president Larry Stoddard is quick to maintain that Miracle produces graphics similar in quality to those of 1-2-3.

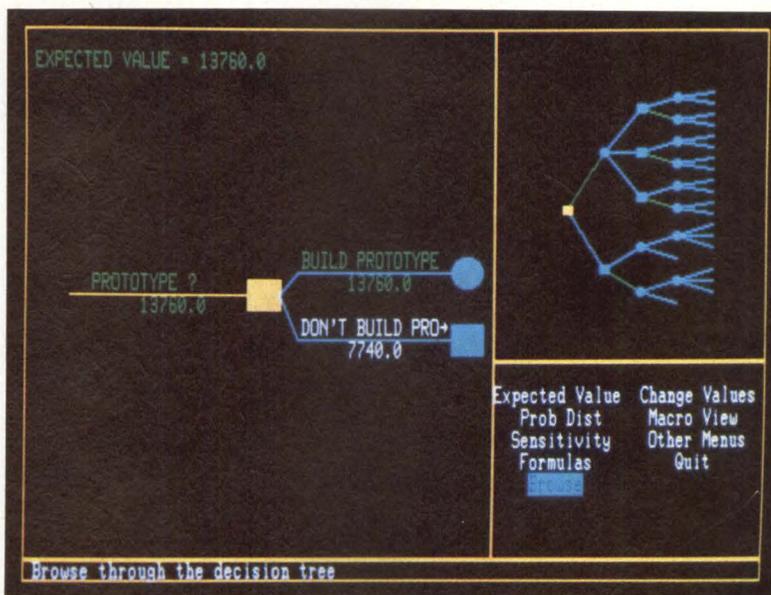
There is a considerable jump—in price and performance—from low-cost packages to full-feature, integrated graphics tools, such as those from Applix Inc. Its \$1,495 Alis package provides business graphics but adds presentation-quality capabilities as well. Operators can, for instance, create organizational charts and combine them with word-processed documents, using windows.

One advantage of more expensive packages such as Visual Engineering Corp.'s ProChart (\$1,000 to \$36,000, depending upon the machine) is that they can support a wide range of system architectures and not just a single machine. And, unlike lower priced programs, the more costly applications provide better handling of the display and hard-copy devices. Visual Engineering's Visual: GKS (graphical kernel system) also runs on VAX microcomputers or supermicrocomputers. It costs \$36,000, but provides charting, ANSI-based performance graphics, device independence, portability of software and of data to all UNIX-based machines, and 2-D and 3-D capability.

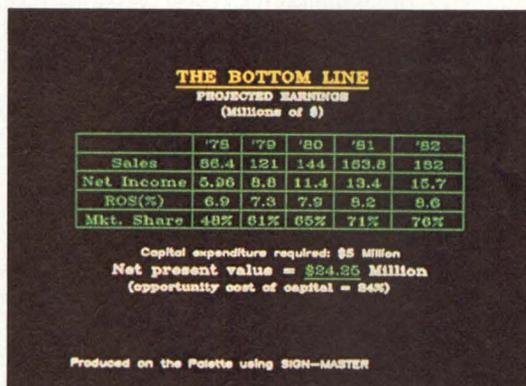
## Paint pictures by number

The actual transformation of raw data into graphics has been a major challenge to software developers because a number of elements in the system architecture must be addressed to create pictures. The hardware, of course, must have graphics capability, and the application and system software must be able to translate graphic data.

Except for a few packages, programs employ raster-style (as opposed to vector-style) graphics. Therefore, drawing pictures on a CRT screen makes use of the individual dots or bits stored in screen memory. These dots are grouped into picture elements (pixels), which make up a displayable graphics element. Thus,



**Creating the complex graphic representation of a tree-structure hierarchy is simple using Texas Instruments' Arborist software, which requires a software screen manager to keep track of the displayed information, and a graphics code that translates detailed data into viewable graphics structures.**



**This 35mm slide shows how presentation graphics can take business graphics beyond bar charts and graphs by combining high-quality output with typeset-like lettering. This example was created with Decision Resources Inc.'s Sign-Master.**

as the image is drawn, the pixels are illuminated at specific locations to define a given picture.

But that is only part of the graphics process. The most difficult task is the actual transformation from data to pixel, which is accomplished by scaling the range of the data to be represented, mapping the device surface—be it printer, plot-

**CRT technology keeps pace** with graphics technology. The Princeton Graphic Systems SR-12, priced at \$999, is a marked improvement over color monitors of just two years ago, at about half the price. Offering a small



ter or graphics screen—and, finally, transforming the data to specific X-Y coordinates. This process has to take place for each point in the data to create a graph. Conversely, paint programs create new data rather than scale and map existing data, usually with a mouse or a light pen.

**Standards trigger debate**

In order to improve the portability and marketability of graphics packages, vendors take advantage of emerging ANSI standards, especially the proposed graphical kernel system (GKS) standard and its virtual device interface (VDI) implementation. GKS provides the necessary common links to the hardware and operating systems.

Many companies view standard implementations as a route to developing graphics. Stanley Klein, publisher of the *S. Klein Newsletter on Computer Graphics*, Sudbury, Mass., believes that standardization is the single most important aspect of the whole graphics field. He believes that GKS, already widely employed and for all practical purposes a de facto standard, will become codified and reach final formulation this year.

Klein contends that business-graphics standards are extremely important. "People want to tie into applications without worrying about devices," says Klein. "The developer has no idea what's out there. Standards facilitate the tie-in between the output devices and the program (see "Drivers link up output," Page 122 ). What the standards do is free up software vendors to do program development. It puts them in harmony."

Not everyone is as convinced that standards are helpful. Steve Oaks, director of OEM sales for Time Arts Inc., Santa Rosa, Calif., the

developers of the Lumena graphic-arts package, vents the traditional complaint against standards: "They tend to inhibit creativity. By their very nature standards set up guidelines that everyone has to follow," argues Oaks.

Oaks holds that GKS is especially good for defining graphics in the more costly vector-type environment. (GKS was originally only for vector devices but now encompasses raster devices as well.) Oaks asserts that consequently, GKS doesn't lend itself well to a raster-based package like Lumena, which is essentially a freehand drawing product, primarily because "We do a lot of reading and writing of pixels," though Oaks adds, "We have developed our own graphics primitives to do it efficiently."

Even with standards establishing some common working ground, there remains the question of who's responsible for integrating machine-specific software with the machine's hardware. Time Arts, for one, takes responsibility for porting their product to a specific system. Currently, Lumena is for the IBM Corp. PC and compatibles and costs \$249 to \$9,600, depending upon the machine and desired capabilities. Time Arts prefers to sell a bundled system that handles output to digital film recorders. The company is planning to offer Lumena on UNIX 68000-based machines and suggests that buyers come to them rather than to a VAR. "It's the hardware manufacturer's responsibility to offer a selection of software," says Oaks. He thinks VARs should only have to use tools, not bear the responsibility of adding them to systems. Not so surprising, most of the software companies building graphics around standards feel the same way.

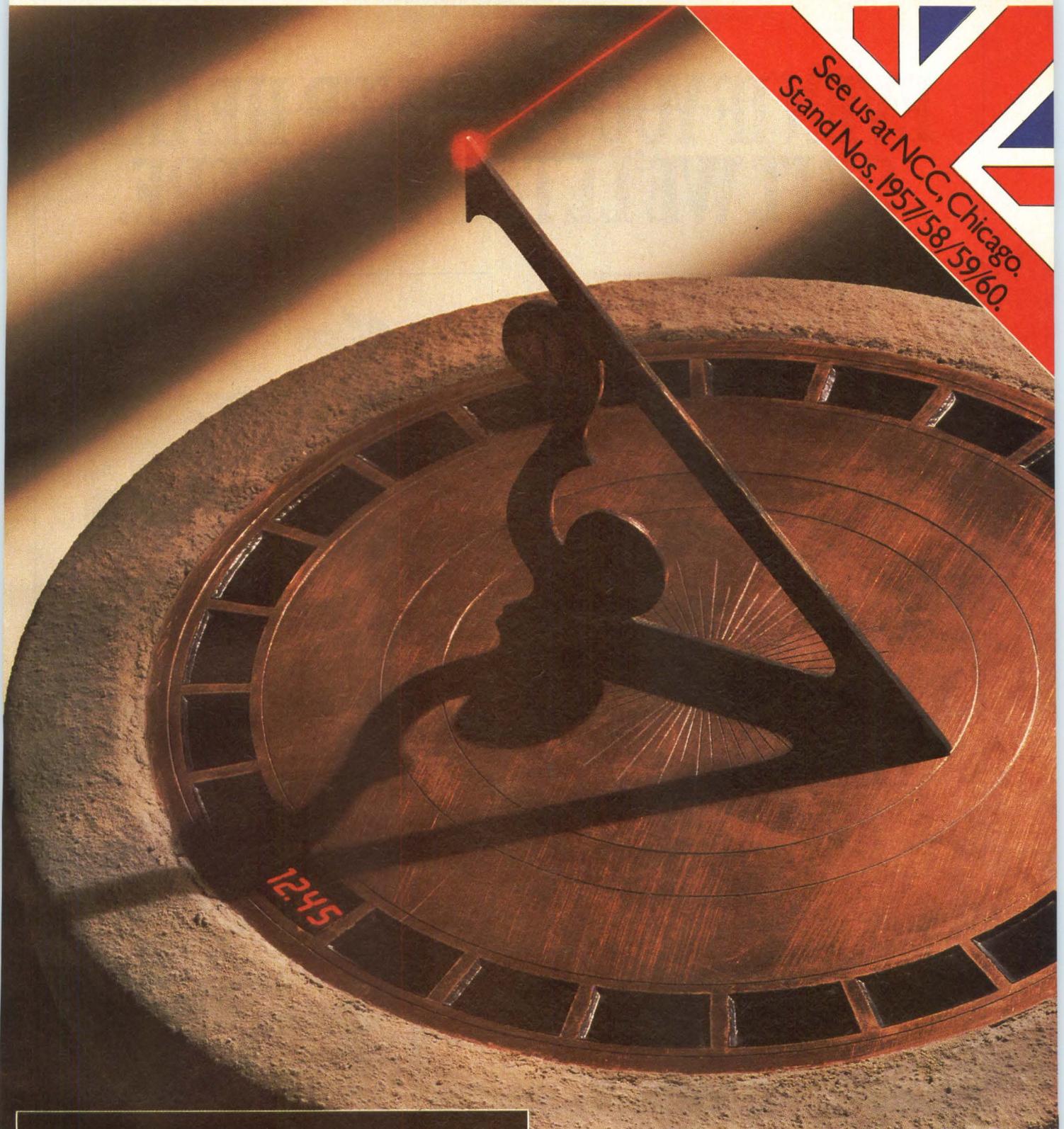
Standards may be a boon to developing so-called presentation-quality graphics. "Presentation graphics software makes it possible to create slides and view graphs that are of highly acceptable quality," says Edward Washington, senior industry analyst at Dataquest.

Graphics-image enhancers have emerged to complement the most popular packages. Even with sophisticated graphics packages available, users seek improvements in the appearance of graphics generated by such popular packages as Ashton-Tate's Framework, Lotus' 1-2-3, and Sorcim/I.U.S. Microsoft's SuperCalc3.

Creating high-quality presentation graphics doesn't come cheaply. To achieve acceptable resolutions of 80 to 120 dots per inch requires a 35mm slide-film recorder or a hard-copy device capable of printing at high dot densities. Washington explains that there are two levels of acceptability in presentation graphics. "The screen image is primarily for review, so jaggies [non-smooth curves] are acceptable. At the final

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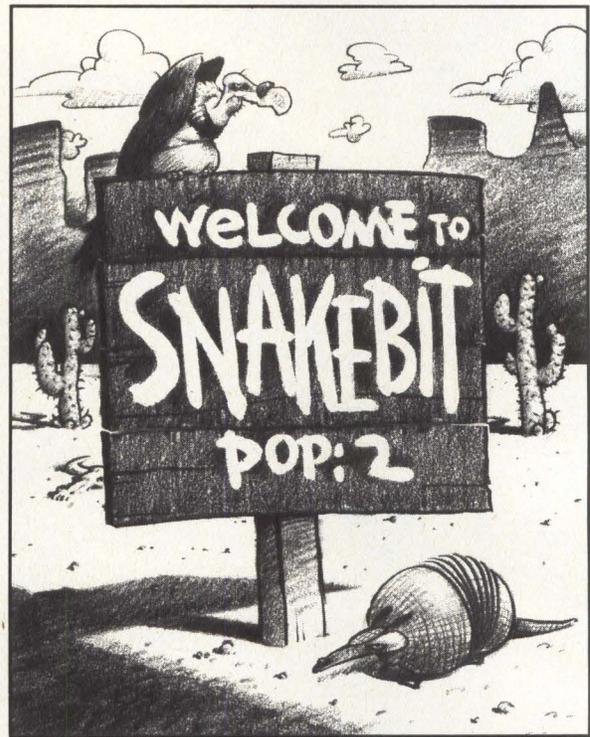
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stage, the presentation level, you want as much resolution as possible. That's where you spend the money—on the output device."

Klein agrees but contends that, even with more graphic-arts departments using computer-generated graphics, the cost of outputting must be reduced if the market is to surge. "Right now, film recorders cost a few thousand dollars and only laser printers in the \$10,000 range can provide the quality output that is desired," says Klein.

**Enhance the picture**

Enhancement programs use the base graphics drawn by another package as a work slate, which becomes the palette. These packages can then be used to highlight specific areas on the graph by drawing in predefined templates—representing objects, colors or text fonts—from a template library.

Although most enhancement packages are implemented entirely in software, Personal Computer Graphics Corp., Los Angeles, uses firmware on the \$695 IBM PC add-in board called the 123 Master. The 123 Master, designed to enhance 1-2-3-style graphics, employs an NEC 7220 graphics-display processor from NEC Corp. It achieves resolutions of up to 1,024 by 1,024 dots, and non-flickering smooth scrolling.

The 123 Master doesn't replace any display boards in the system, but serves to enhance their capabilities. Thus, a standard PC with color adapter and the 123 Master is capable of displaying enhanced Lotus graphics. The 123 Master provides the capability of adding text fonts, colors and shading without requiring the user to learn a programming language.

But screen presentation is only one part of the total picture. Currently, the 123 Master works with the IBM graphics printer and Epson America Inc.'s printers.

Other companies are solving the problems through software, touting the ease of use and avoiding complex programming codes to achieve enhancements. Brightbill-Roberts and Co. Ltd., Syracuse, N.Y., for example, offers the GraFix Partner for \$149. This package is billed as a coresident graphics processor. A user can invoke GraFix Partner by tapping a key; the keyboard cursor-positioning arrows define the area to be enhanced. Besides providing a number of text fonts, this package also includes a series of templates that can be plucked from the template library and placed into the graph, allowing the user to represent certain things graphically without having to create them. The GraFix Partner provides support for most dot-matrix printers and plotters and the Polaroid Corp. Palette film

recorder as well.

Similarly, PC Draw (\$395) from Micrografix Inc., Richardson, Texas, is an object-based package that provides templates and multiple fonts. The \$155 Fontrix package from the Data Transforms division of Solarstatics Inc., Denver, serves as an enhancement to business graphics and word processing. This package gives users a graphics writer for typing in a specific choice of fonts, a font editor for changing or creating a font and 50 VDI-compatible printer drivers. The display screen's resolution cannot match the printer's, but Fontrix uses disk space as virtual memory to increase the resolution of the font.

Greg Harvey of Palo Alto, Calif., market researcher Yates Ventures Inc. believes that enhancement packages add value to integrated-package style graphics. "Users tend to like Lotus-type graphics. When they can enhance them for a presentation, the entire system becomes that much more valuable to them." □

**Many companies view standard implementations as a route to developing graphics.**

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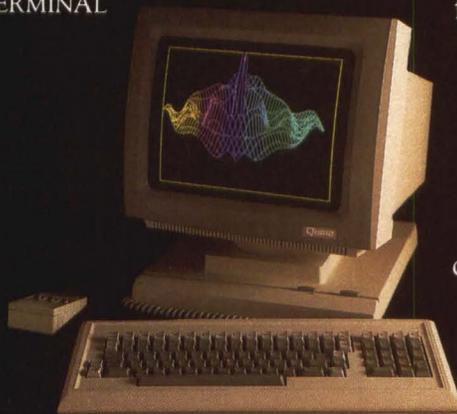
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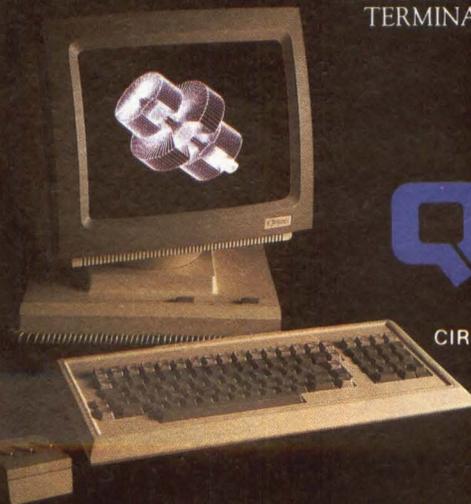


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**CIRCLE NO. 62 ON INQUIRY CARD**

# OPTICAL 3½-INCH DRIVE ADDS ERASABILITY

Thermo-magneto-optic technology  
incorporates erasability into optical-disk drives

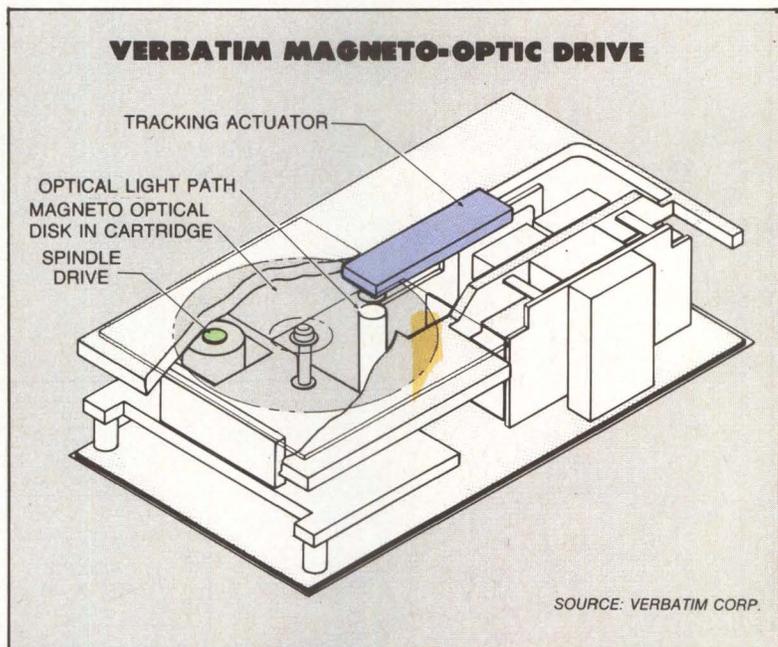
Carl Warren, Western Editor

Optical technology is taking all classes of disk drives a quantum leap forward in capacity. The latest drive, a 3½-inch prototype developed as a laboratory demonstration model by Verbatim Corp., Sunnyvale, Calif., features erasability and an unformatted capacity of 47M bytes (44M bytes formatted). The drive records at 15,875 bits per inch (bpi) and has 6,350 tracks per inch (tpi) on a removable cartridge disk.

Unlike other optical recording methods—such as optical read-only memory (OROM), write-once-read-many (WORM) and phase change—the Verbatim approach uses a combination of laser and magnetic technologies to achieve writing, reading and erasability.

The OROM method is employed in the production of inexpensive laser-read disks (e.g., digital audio disks) that are pressed in a batch process. It uses a master disk in the manner of phonograph record production. Information is embossed on the disk surface in a pattern of pits. Then, laser light reflected off the pits is translated into digital information. Although this type of optical storage can't be rewritten or erased, it is inexpensive (usually, \$6 per disk in OEM quantities) and stores up to 780M bytes on a 4.72-inch diameter platter.

The WORM technique is similar to OROM, except that the data isn't premastered (embossed) but is written in a serial fashion by the drive's laser, which also serves to read the data. However, information written on WORM disks is also unchangeable.



**The low-cost subassemblies used in the Verbatim magneto-optic drive include a tracking actuator, an optical light path, a focusing mechanism, an erasable 3½-inch disk in a protective cartridge and a spindle drive.**

To write the data on a WORM drive, the laser either burns holes in a very thin metal film or raises bubbles in the material. To burn the holes requires a relatively high-powered laser, above 10 mW, and a lower power laser to read the

data. In some cases, one diode laser can serve both purposes. This method yields capacities as high as 100M bytes to 250M bytes on 5¼-inch drives.

### WORM requires pointers

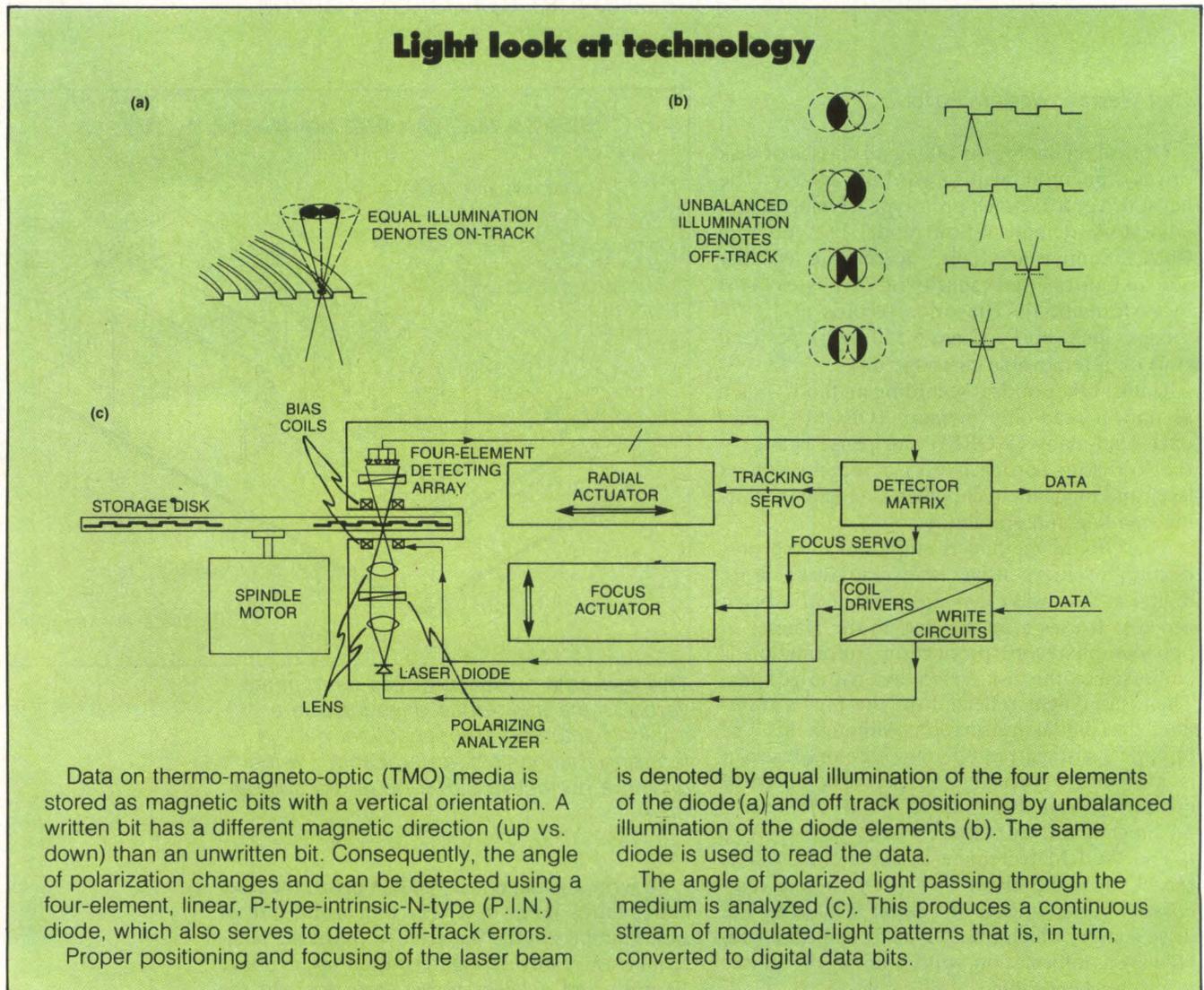
Although the WORM method does offer advantages over OROM for writing and storing data, there are some operational problems associated with it. For example, writing a new bit over an old bit destroys the data area. Therefore, a read-before-write mechanism is required to prevent destruction of a data region. And because the data can't be erased, updating a record requires a pointer system to retrieve new records, thereby increasing the complexity of the operating system software.

The need for phase-change techniques arises in direct response to the drawbacks of noneras-

ability. With phase-change media, the recording surface is composed of a film of tellurium-suboxide alloyed with germanium, indium and lead for stabilization. Heat generated by the drive's laser beam converts the highly reflective crystalline surface to the less-reflective amorphous state, and vice versa. The difference in state is represented by the presence or absence of data bits.

Although phase-change technology allows for erasing and overwriting data, there are accompanying difficulties. In fact, the medium isn't yet proven. Its raw bit-error rate (e.g. rate before error-correction), is high, typically  $10^{-4}$ . Its sensitivity to ambient temperature also is high, calling for special storage considerations.

Thermo-magneto-optic (TMO) technology employs both laser and vertical magnetic recording methods. Three processes are involved in





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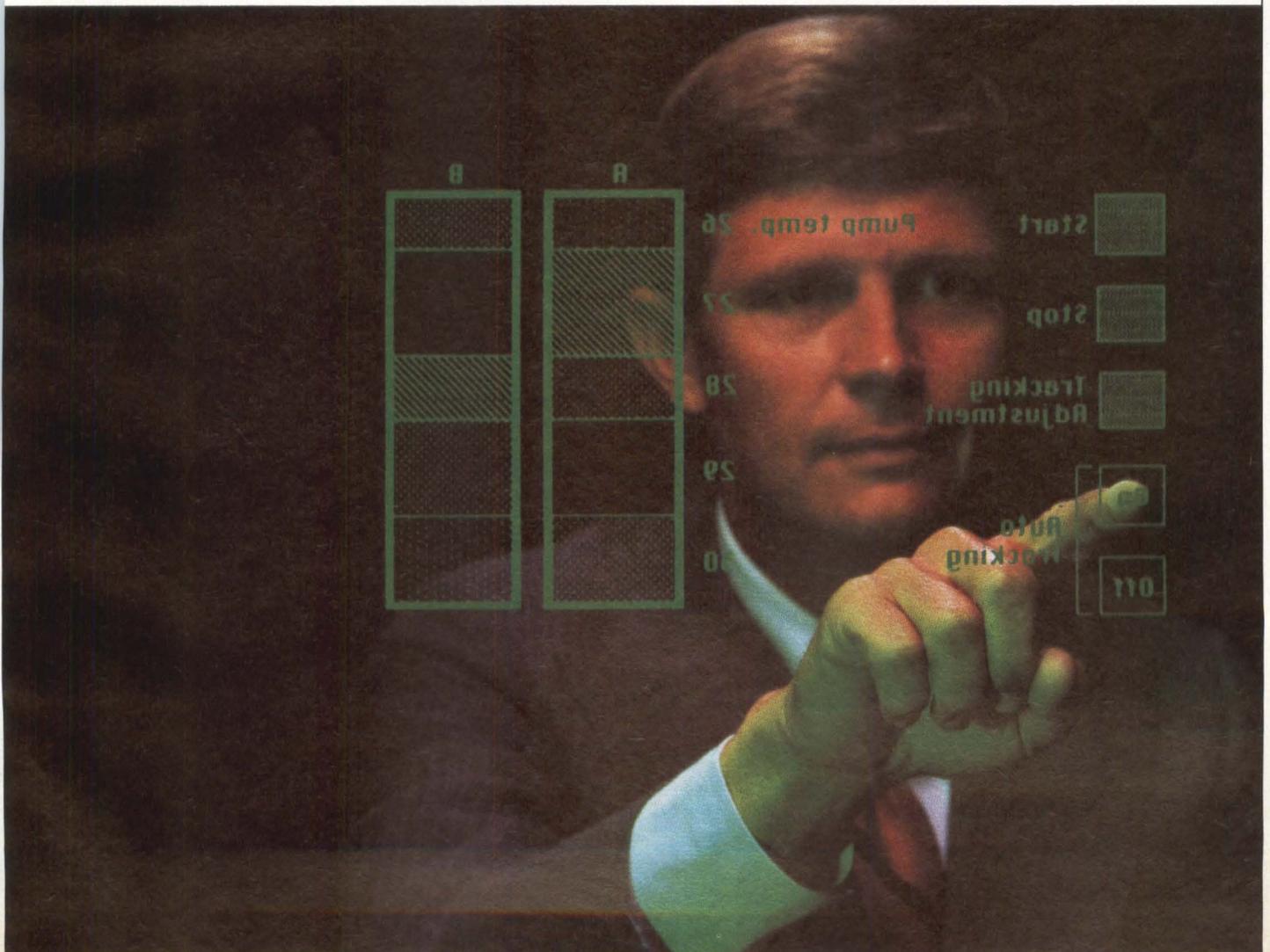
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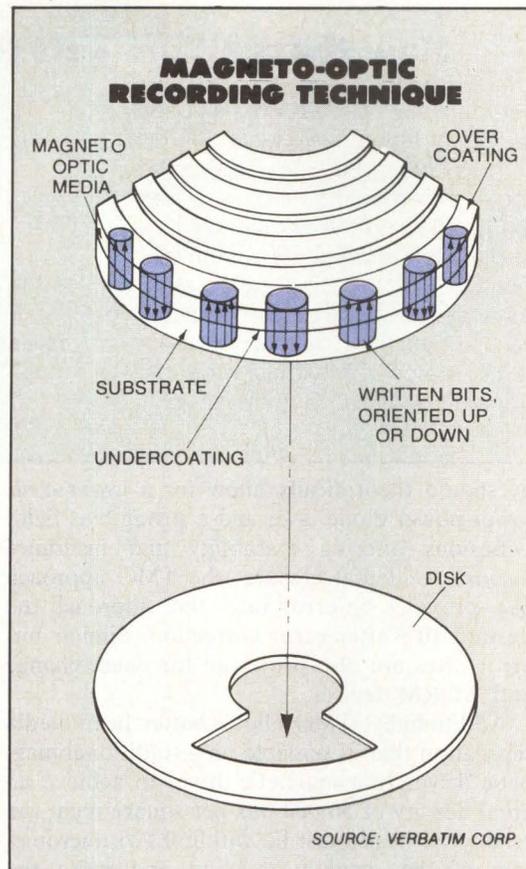
**TMO:** magneto-thermal for writing and erasing, magnetic for storing written bits and magneto-optic for reading the bits. Like phase change, TMO permits overwriting of data bit cells.

The medium used in the Verbatim drive consists of a terbium, iron and cobalt surface layer in which all the bits are vertically, rather than horizontally, magnetized, as in standard magnetic media.

A written bit is created by reversing the magnetic direction of a portion of the disk's surface. This reversal is accomplished by heating the desired spot with a 10-mW laser. The sensitive layer of the medium itself has a coercivity of 2,500 Oe at room temperature (70 F). Therefore, it's highly resistant to magnetic change. When the laser beam hits the spot, its temperature rises, thus lowering the coercivity of that spot to 100 Oe. Consequently, that spot is susceptible to magnetic reversal by the steady bias field of 200 Oe in which it resides, while adjacent areas within the field remain unaffected.

The bits are read by detecting the difference in polarization of light transmitted through the medium (the magneto-optic process). Because a written bit has a different magnetization than that of an unwritten region, unpolarized light passing through a sheet of polarizing material detects the presence or absence of a bit. An analyzer determines the angle of the laser light as it emerges from a region on the media, and a photodetector sees a continuous stream of changing or modulated light patterns. This modulated analog information can then be translated into digital bits.

TMO media isn't as temperature-sensitive as phase-change media. Unlike phase-change media, which may change state at a temperature



**In magneto-optic recording, a diode laser is used to raise the temperature of the media to a level where the magnetic domains can be oriented either up or down perpendicularly by an externally applied field.**

of 100 C, TMO media requires a higher temperature—220 C—and a surrounding bias field to cause a magnetic reorientation. Consequently, TMO media is less susceptible to accidental erasure due to temperature variations. Verbatim uses a high-power laser in the 10-mW range and a low bias field, even though the TMO technolo-

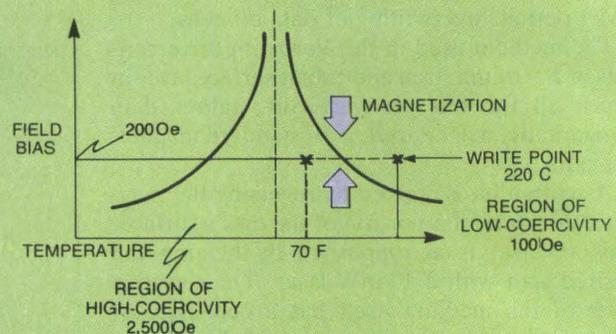
### Spec summary

- **Product:** Thermo-magneto-optic disk drive (prototype stage)
- **Manufacturer:** Verbatim Corp., 323 Soquel Way, Sunnyvale, Calif. 94086
- **Capacity:** 44M bytes (formatted) 47M bytes (unformatted)
- **Disk diameter:** 3½ inches (8.9 cm)
- **Cartridge:** 3.9 by 3.9 by 0.24 inches (100 by 100 by 6 mm)
- **Substrate:** glass
- **Sensitive film layer:** sputtered terbium, iron and cobalt
- **Recording sides:** one
- **Tracks:** 4,000, pre-grooved
- **Sectors per track:** 20
- **Capacity per sector:** 512 bytes (10,240 bytes per track)
- **Bits per inch (bpi):** 15,875 (625 bits per mm)
- **Tracks per inch (tpi):** 6,350 (250 tracks per mm)
- **Access time:** track-to-track, 1 msec; average, 50 msec
- **Transfer rate:** 1M bps
- **Rotation speed:** 600 per minute
- **Laser type:** 10-mW laser diode
- **Interface:** presently undefined
- **Power dissipation:** Less than 10W
- **Prototype size:** 2 by 4.2 by 7 inches (50.8 by 106.8 by 177.8 mm) Note: Production models will be same size as Sony 3½-inch flexible drives, measuring 2 inches by 4.2 inches by 5½ inches.

## How the medium gets the message

To write data on an optically assisted magnetic disk drive requires a medium of high coercivity (2,500 Oe) and a low magnetic bias field of 200 Oe. Raising the temperature of a spot—region on the media—lowers its coercivity to 100 Oe, allowing the vertical bit in that spot to change direction to denote a written bit.

To avoid accidental erasure, the temperature at which a magnetic change can occur in combination with the bias field is well past the coercivity curve. In the Verbatim prototype, the coercivity must drop to 100 Oe with the temperature at 220 C to cause a change.



gy should theoretically allow for a lower cost, lower power diode laser and a strong bias field.

Besides offering erasability and insurance against accidental erasure, the TMO approach also provides bit-error rates that approach the desired  $10^{-12}$  after error correction. Similar bit-error rates are also projected for phase-change and WORM devices.

Additionally, TMO allows better head/media separation than is possible on a traditional magnetic drive. In a magnetic drive, to achieve an areal density of 50,000 bits per square inch, the read/write head must be within 0.125 micrometers of the medium to read and write the crowded bit cells. In contrast, an optically assisted drive allows the laser lens to be a millimeter or more away from the medium and still achieve high linear densities. Therefore, increasing the linear density can be easier in an optically assisted drive.

The Verbatim prototype uses an optical, closed-loop servo mechanism to reduce off-track errors to a maximum of  $[+/-] 0.1$  micrometers. The servo mechanism uses a four-element, linear, P-type-intrinsic-N-type (P.I.N.) photodetector, placed opposite the laser on the other side of medium. Strong illumination of any element denotes off-track error, which causes the positioning mechanism to adjust the location of the laser beam. When the transmitted laser light, passing through the medium, illuminates all four elements equally, the laser is properly positioned and focused on the track. Writing, reading or erasure can then take place. Because the Verbatim drive operates at 600 rpm with 10,240 bytes per track, the servo is spec'd at 120 kHz to provide sufficient time for the laser to adjust.

The Verbatim thermo-magneto-optic prototype, which is scheduled to be unveiled at the National Computer Conference (NCC) this month, uses a 3½-inch-diameter glass substrate medium with a sputtered terbium-, iron- and

cobalt-sensitive layer. The medium is encased in a 3.9-by-3.9-by-.24-inch plastic cartridge.

The glass medium has 4,000 pre-grooved, 4-micrometer-pitch concentric tracks that yield 6,350 tpi. Although the track density can be doubled in the mastering process, ensuring accuracy in the production process can be difficult with current technology. However, 5¼-inch WORM drives, which use a 4.72-inch diameter disk, can support track densities of 12,000 to 15,000 tpi, due to the large physical area of the platter. Each track on the Verbatim medium contains address information for guiding the laser. The medium is designed so that each track can be divided (formatted) into 20 512-byte sectors—the standard sector size used on most magnetic drives. Therefore, a one-to-one relationship can be drawn between translating data from a magnetic Winchester drive to the Verbatim drive.

Although the Verbatim prototype uses a glass substrate, evaluation models—planned for early 1986, with production models due in 1987—will use a more durable and less expensive substitute. Verbatim is exploring a number of alternatives, including polymethyl methacrylate (PMMA), a rigid, transparent acrylic plastic currently used in videodisks; and polycarbonate, which is a rigid, transparent thermosetting plastic used in OROM compact disks.

The PMMA substrate exhibits acceptable optical properties, but absorbs water, which changes the optical- and data-retention properties of the sensitive film layer. Polycarbonate, while it's water resistant, tends to have poor optical properties; laser light passes through the substrate at two different speeds, resulting in two separate rays which partially obscure the change in polarization of light passing through a bit. As a result, the polycarbonate substrate, in its present form, is unusable in a TMO-type drive.

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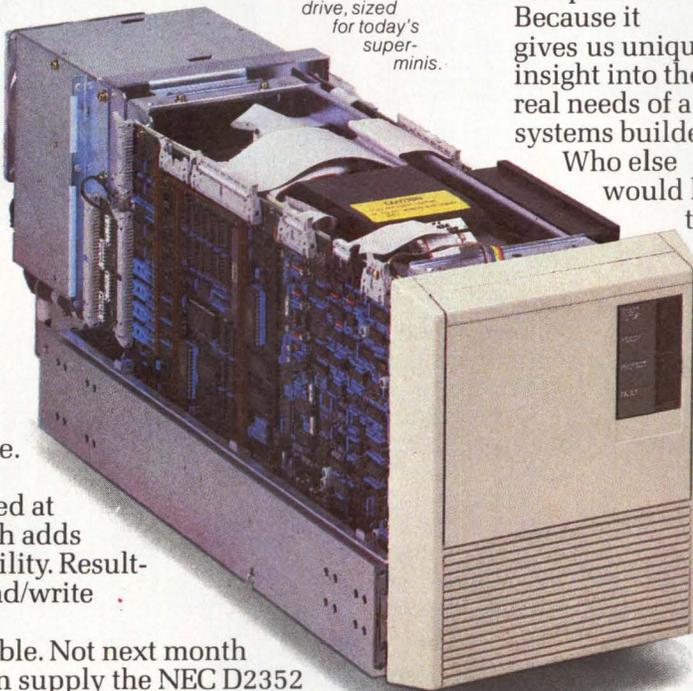
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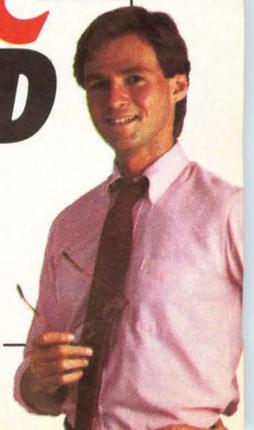
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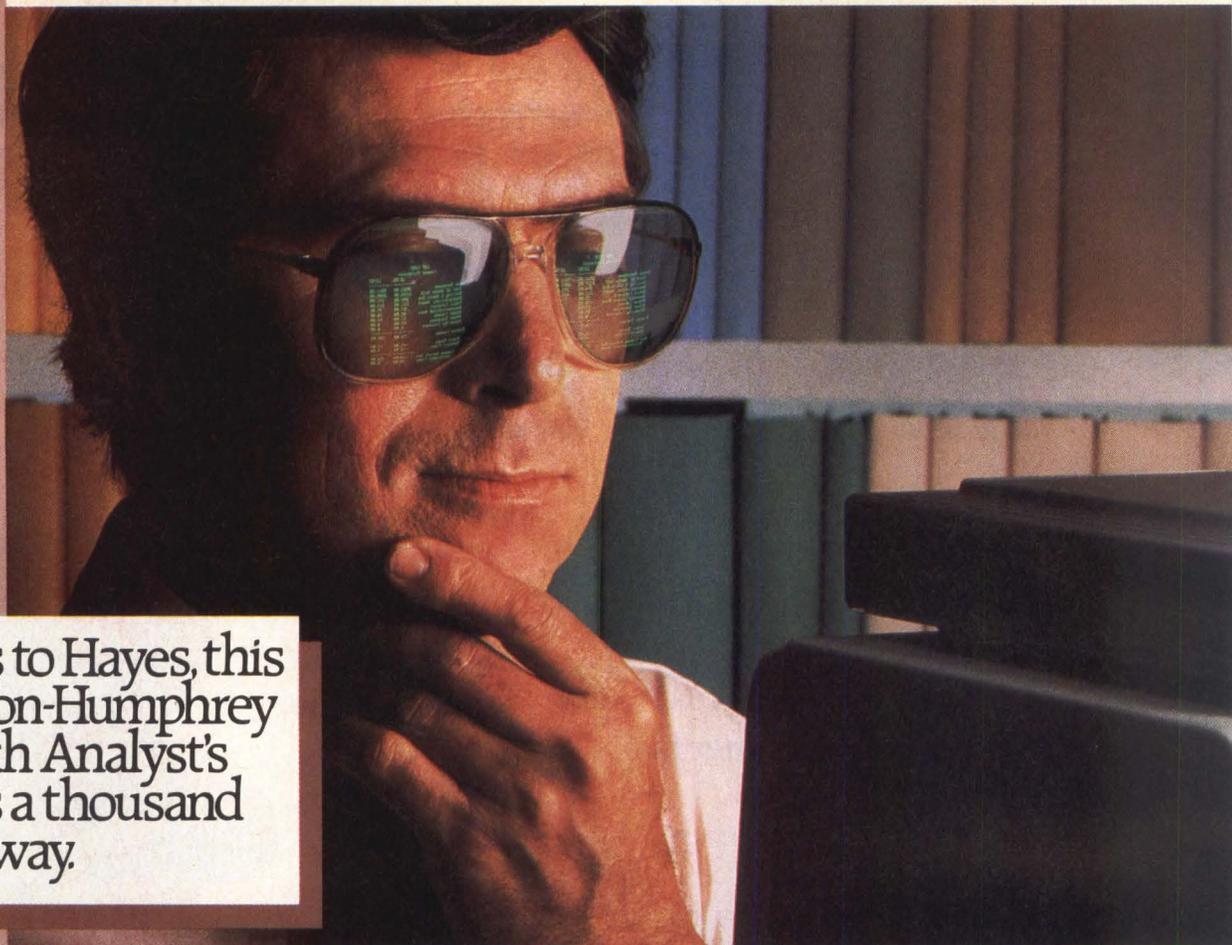
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medium is a substrate that provides the optical properties and water resistance of glass and the durability and cost-effectiveness of a polycarbonate or PMMA. Under consideration is a fiberglass-type base acrylic with a pre-defined angle of polarization.

**Interfaces remain a challenge**

The emergence of optical drives raises the question of what type of interface best exploits the attributes of the disk drive and, yet, can be easily attached to a host computer.

Verbatim and others are exploring the possibility of using the enhanced small disk interface (ESDI), which is currently being refined for optical drives. Using ESDI would offer drive manufacturers and system integrators certain advantages. Specifically, semiconductor manufacturers are beginning to develop ESDI chip sets and controller manufacturers are designing ESDI-compatible controllers. Optical-drive manufacturers expect to take advantage of these controllers to obviate the necessity of expensive, special optical-disk controllers. Additionally, ESDI provides the specifications for error-cor-

rection needed to raise raw error rates from  $10^{-4}$  to  $10^{-12}$ , using Reed-Solomon polynomials and sufficient control lines for handling the laser portion of the drive.

Because ESDI is defined primarily as a device interface, it can be coupled to the small computer systems interface (SCSI) to add intelligence and provide the necessary host-bus independence. Moreover, although the Verbatim prototype has a 1M-bps transfer rate—and evaluation and production models are expected to offer twice this rate, which is still five to 10 times slower than a Winchester—a cache-buffering mechanism can be implemented on the interface to provide data rates consistent with the rest of the system architecture. Furthermore, by combining ESDI and SCSI, the attributes of the drive become transparent to the host computer system. Consequently, little or no modification of the operating system software will be required. □

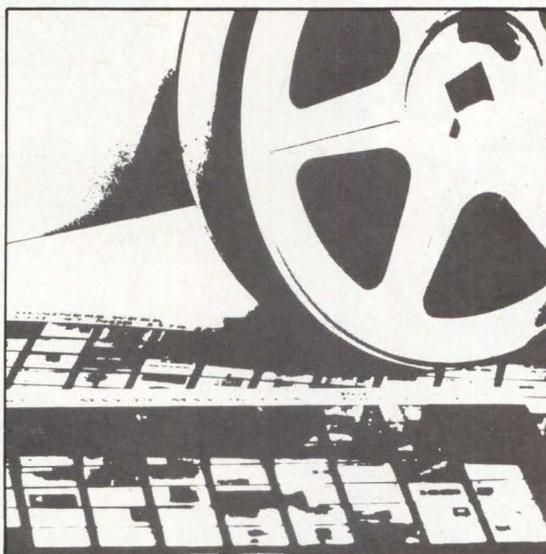
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**TMO allows better head/media separation than is possible on a traditional magnetic drive.**

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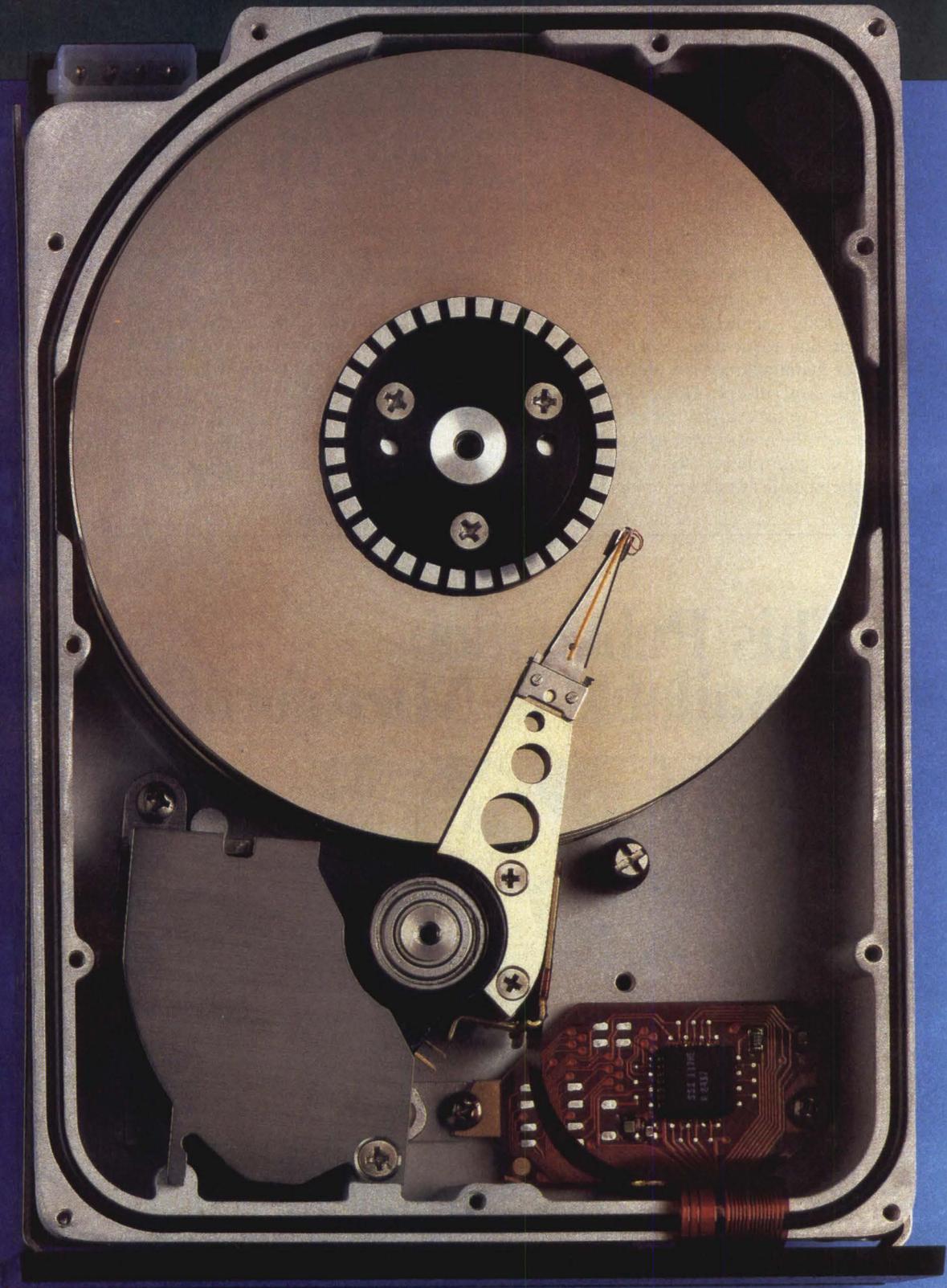
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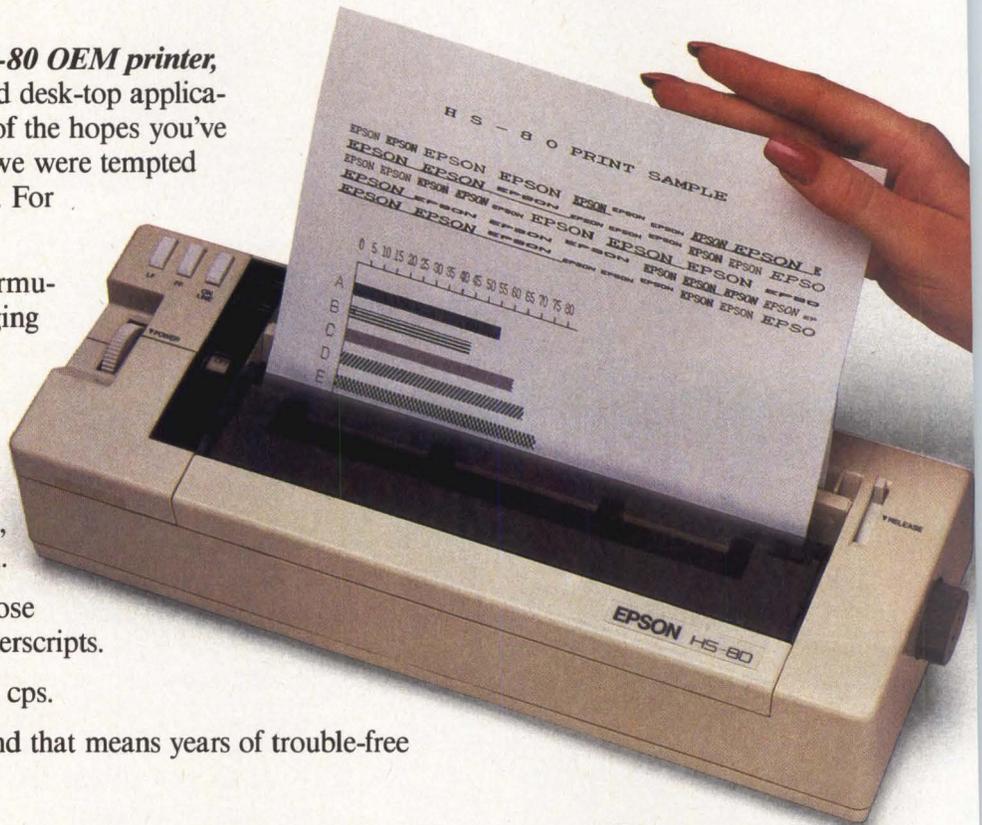
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# RETHINKING NETWORKS: A COORDINATED APPROACH

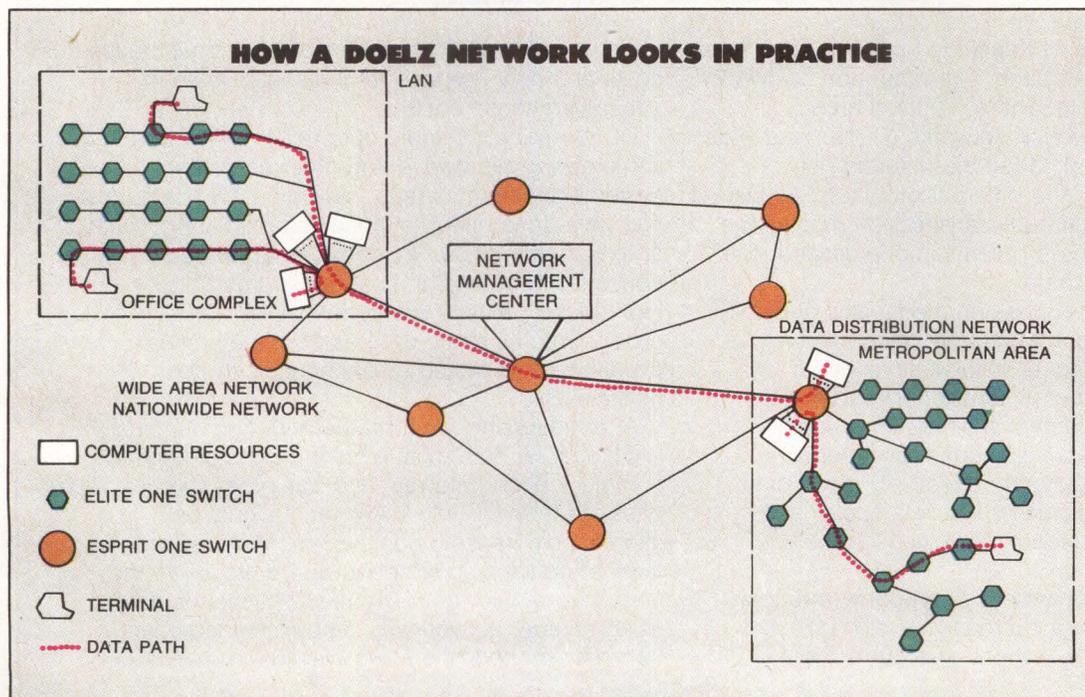
By employing virtual-path technology and decentralized control, networks can maximize transmission capacity and minimize protocol conversion

**Richard D. Haney**, Doelz Networks Inc.

Data networks should ideally resemble an efficient postal service. Data senders insert information into one end of the network, and data recipients remove it from the other without either party's being concerned about the mechanics of route transmission.

As a practical matter, this scenario doesn't

exist. Frequently, data must pass through multiple, dissimilar independent networks and network jurisdictions, requiring constant or frequent user or system intervention. Each network deals with data communications on a specific level, but none eases the passage of data among them. (see "Networks suffer from disunity," Page 146.) What's needed is a coherent, coordinated approach to the movement of data from



**A data-transmission network built with the Elite One and Esprit One switches places data in "sealed" packets and sends them unchanged along virtual paths to individual users.**

one point to another, regardless of speed, protocol, media, or equipment type.

One attempt at such an approach uses Elite One switching concentrators and/or Esprit One switches, both from Doelz Networks Inc., Irvine, Calif. These devices multiplex incoming data into data packets that can be separately routed to their destinations over third-party transmission lines. This setup closely matches

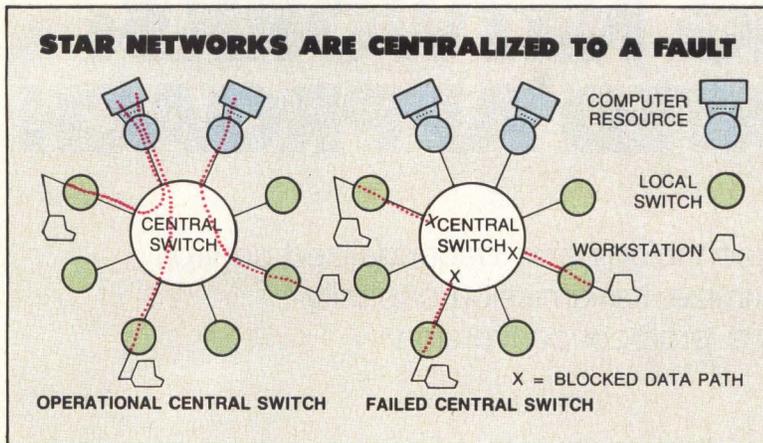
the post office ideal. For example, concentrator switches treat data packets like envelopes. They are addressed, sealed and sent unopened along a virtual path to the addressee—independent of the transmission media.

**Intelligence put where needed**

Most traditional data networks place switching intelligence in central locations to maintain tighter system control. But, unfortunately, highly centralized systems can cause some operational problems and are vulnerable to others.

Centralized intelligence routes data to a middle location and then switches the data to its destination. The gateways through which the data must pass can be numerous, requiring considerable formatting and handling. The processing ensures error-free routing, but data formatting consumes transmission capacity and costs time.

Decentralized, or local control, on the other hand, formats data for network transmission directly at the user's location. This setup improves network performance by reducing the amount of control and error correction needed in each data packet. Local control also improves transmission capacity by reducing transmission to, and retransmission from, a central controlling switch. It even improves system flexibility and reliability—all the intelligence and control are not put into one all-important switch. If a concentrator switch malfunctions, the rest of the



**The highly centralized intelligence of a traditional star network has several drawbacks. For example, a failure in the central switch will stop traffic throughout the system, and thus a single equipment fault becomes a network-wide disaster.**

**Networks suffer from disunity**

Many of the problems besetting networks stem from a lack of common approach. Even the term "network" itself is open to debate. There are local area networks, data distribution networks (DDNs) and wide area networks (WANs). Often the different networks use different speeds and different protocols. Almost invariably they use different transmission media. The result? Solutions to the problems in one network may create problems in others.

LANs use proven transmission media and generally support data rates to 10M bits per second (bps). LANs effectively distribute data within a single building or limited campus location. Unfortunately, many LANs are product- or manufacturer-specific. And most LANs operate with specific protocols. Therefore, although they can effectively move data within a location, their numerous data-speed and protocol limitations present difficulties to other networks.

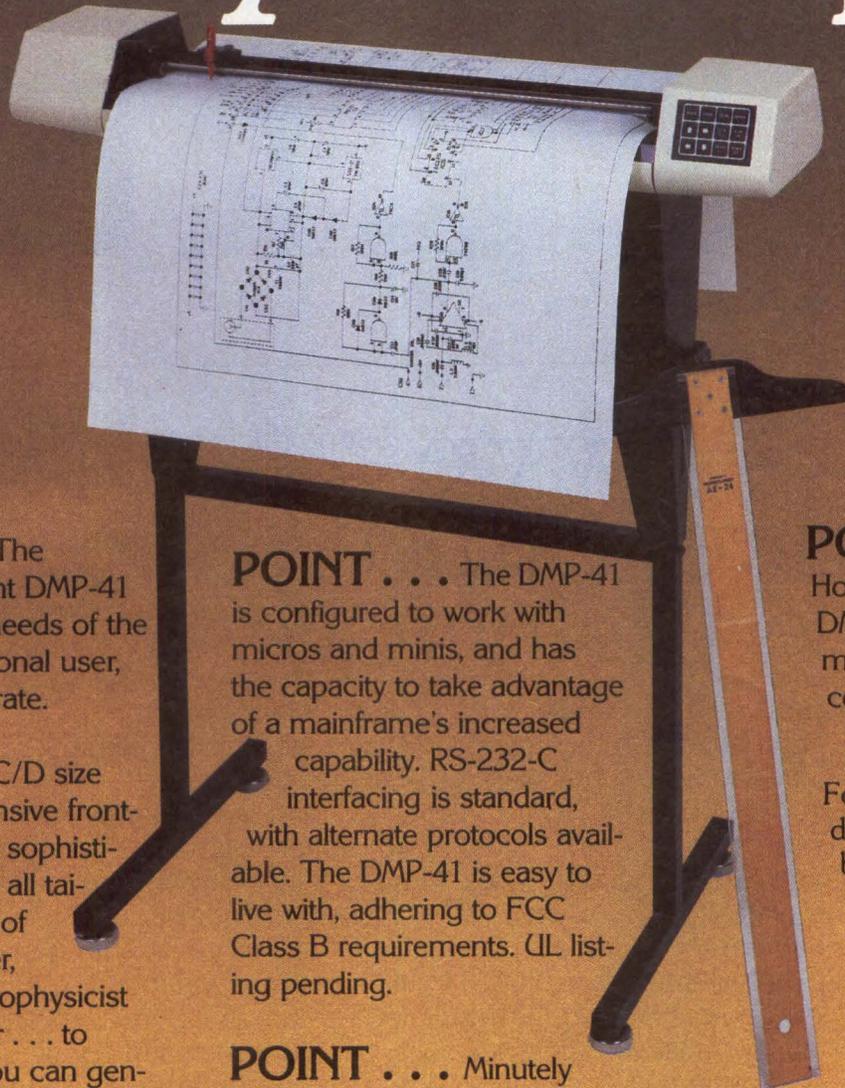
A DDN can be a local phone company, a regional cable system or even a microwave system. These intra-city and regional networks are currently

undergoing rapid change as deregulation increases costs and new "bypass" technologies arise to circumvent those costs.

DDNs typically handle data rates to 64K bps, but some newer microwave and other cable-bypass systems accommodate 1.54M bps. LAN users must find ways to connect to these intermediate networks at reasonable costs. So, speed and protocol conversion equipment must boost data from high-speed LANs to low-speed DDNs and concentrate as much data as possible across expensive and limited DDN channels through multiplexers.

After traversing the tortuous path from terminal to LAN to DDN, data must pass through yet another communication gateway, and again pay the cost. The passage from DDN to WAN, the national or international transmission system, often requires another conversion of speed and protocol. At the least, the transfer from DDN to WAN means data is using another network with its own management, transmission and operating systems.

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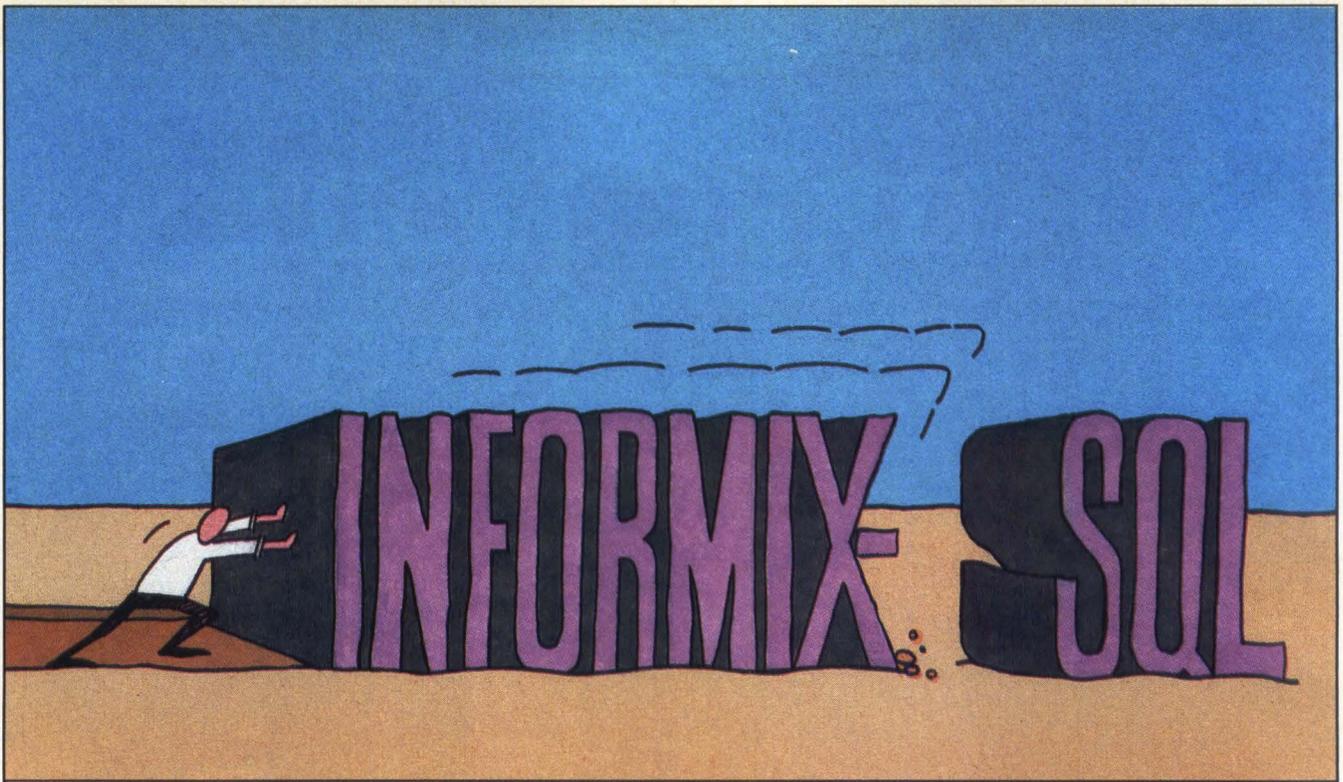
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network remains in operation.

The Motorola Inc. MC68000 microprocessor and custom VLSI architecture and software provide intelligent control at the local-switch level via the Elite One concentrator switch. Elite One can independently control as many as 16 ports and six data links. What's more, as many as 60 concentrator switches can form a network link with distributed intelligence.

Network links are connected with Esprit One switch nodes. Each node can handle 109 connections. They can be trunks to other Esprit One switches, Elite One network links, clusters of as many as 16 local ports or network processors. The total addressing capability of the network exceeds 500,000 users.

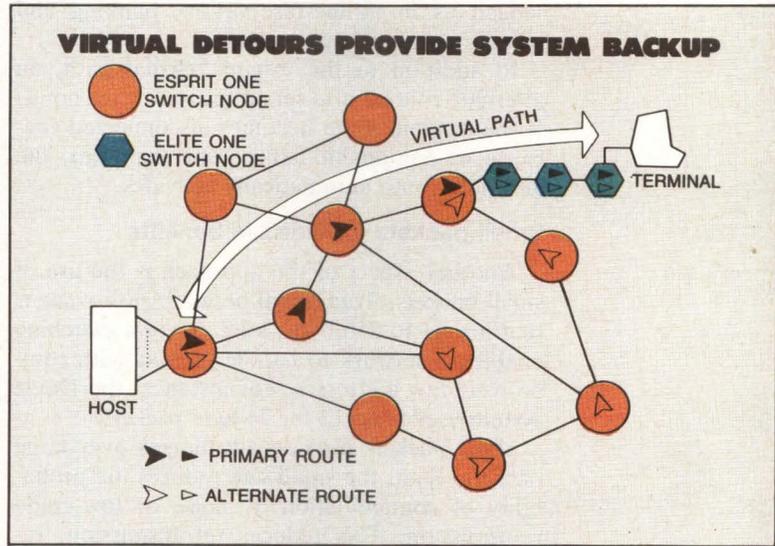
**Virtual paths unite network**

The key to network unity lies in the "virtual path." When a transmission begins, the Elite One switching concentrator establishes a "virtual connection" between sender and recipient in much the same way that a phone call establishes a virtual connection between terminals. The connection, established by the virtual circuit, exists for the duration of the transmission. This situation eliminates the need for long "to" address codes because the recipient is already established. The network identifies the source of each packet and points it toward its destination.

Most modern network nodes stop each packet and "open" it to determine whether it is destined for that node. If isn't, the node repackages the packet and sends it to the next node. The packet travels from node to node until it finds its prescribed destination. All this activity uses system capacity unnecessarily. By identifying only the sender and establishing virtual connections with the recipient, the "post office" approach

eliminates the wasteful packet assembly/disassembly process.

Because each recipient switch acts as one end of an exclusive virtual path, it determines whether an arriving packet is from an address to which it is currently talking. Packets from other addresses are ignored. Each node determines the destination at a glance by checking the first two bytes in each data packet for a match to one of its destination addresses. This real-time check, done in parallel with ongoing processing, does not impose additional throughput delay and



*As a backup to a virtual path, the Doelz network prepares an alternate path at each switch point. Should the first path become unworkable for any reason, data is rerouted to the second.*

**Spec summary:  
Elite One**

- **Company:** Doelz Networks Inc., 18581 Teller Ave., Irvine, Calif. 92715
- **Model:** Elite One switching concentrator
- **Interfaces:** RS232C, V.35 or internal modem
- **User ports:** user-specified four to 32 ports per unit
- **Protocols:** X.25, asynchronous, bisynchronous and synchronous data-link control
- **Protocol rates:** to 9,600 bps
- **Codes:** 5, 6, 7 or 8 data bits
- **Parity:** odd, even or none
- **Price:** starts at \$5,640

**Spec summary:  
Esprit One**

- **Company:** Doelz Networks Inc., 18581 Teller Ave., Irvine, Calif., 92715
- **Model:** Esprit One switch
- **Interfaces:** V.35, RS232C or internal modem
- **Protocols:** X.25 asynchronous, bisynchronous and synchronous data-link control
- **Protocol rates:** to 19.2K bps
- **Network capacity:** 99 Esprit One units, 500,000 users
- **Switching capacity:** 67 link ends, 4,096 user addresses
- **Trunk speed:** 72K bps
- **Parity:** odd, even or none
- **Price:** starts at \$50,000

eliminates the need for every byte in a packet to be read by every node.

The system can thus set up virtual circuits among multiple ports, which reduces modem and line costs. It also eliminates line redundancy, protocol adapters and telephone company intervention whenever new "drops" are added to or deleted from the network.

One or more virtual, multipoint circuits provide a single shared path among the network ports. This approach proves useful within asynchronous or synchronous environments that tie several terminals to a central processing facility—such as in airline-reservation, banking and inventory-control applications.

In addition to the original virtual path, an alternate route is also set up at each switch point. If the original route becomes disconnected (because of equipment failure, for example), the alternate route automatically activates.

**Small packets provide big benefits**

Another aspect of the approach is the use of small packets. Traditional networks use packets that are 64 to 256 bytes long. Virtual switching enables a network to handle packets with comparatively few addresses. For instance, the Doelz system uses fixed 12- or 24-byte packets.

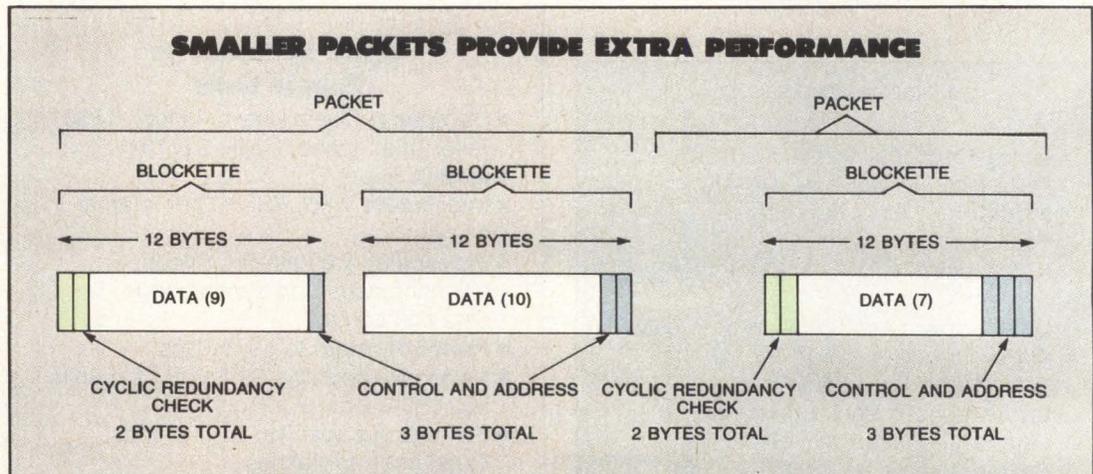
Short packets provide advantages over large packets. First, the small size reduces the probability of contamination by noise or low-grade transmission. This reduces retransmission, resulting in higher throughput. In addition, the small-packet approach increases responsiveness to user demands over large-packet approaches. Because short packets require less transmission capacity, they can be easily manipulated. In

addition, short packets can get through the "pipeline" faster, increasing the number that can be handled in a given time.

Second, short packets eliminate the waste often contained in the variable packet sizes carried by traditional networks. Packets with a minimum of 64 bytes often produce wasted transmission space because of the lack of meaningful material. That is, a 64-byte packet might contain only 12 or 16 bytes of data. A packet of 12 to 24 bytes accommodates small amounts of data, increasing the economy of the entire network.

Doelz packets, on the other hand, contain one or two "blockettes." If a user's data is only a few characters in length, such as generated by a keyboard entry, the network system demands a blockette of 12 bytes, made up of 7 bytes of data plus 2 bytes of a cyclic redundancy check (CRC) to test overall network performance and 3 bytes of address and packet-control information. For longer transmissions, two blockettes can be combined for 24 bytes, of which 19 bytes can carry data because packet-control and network checks are still handled by only 5 bytes of information.

Third, short packet size relates closely to the virtual-path concept. Traditional long packets contain data from many users. When such a packet reaches its destination, the individual parts must be separated and redirected to appropriate terminals. This division uses up switching capacity in the local loop. In the virtual-path approach, however, individually addressed packets can go directly to their recipients, thereby increasing the speed of communications in the local loop. Furthermore, because each packet is dedicated to one user, error control can be



**Doelz packets** consist of one or two blockettes. If a user's data is only a few characters in length, the system uses a blockette of 7 bytes of data plus 5 bytes of

system test and control information. For larger transmissions, two blockettes can be combined for 19 data bytes.

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switched in or out on a per-path basis—an essential feature when dealing with mixed synchronous and asynchronous data. Such switching is impossible in the traditional multiuser packet.

### Networks escape protocol problems

Transmitting data enclosed in different protocols over the same network is difficult. The traditional approach centers on protocol conversion: turning equipment-specific languages into a network-specific language. This approach, of course, wastes switching capacity. Less obvious is the fact that protocol conversion is also wasteful of network-transmission capacity.

Traditional networks using the X.25 interface standard convert the incoming bytes of various protocols, such as asynchronous or synchronous data-link control, into the X.25 protocol. That includes the incoming protocols' start bit, CRC bits and stop bits. Once the now-X.25 packet reaches the output port, the entire packet is converted back into its original protocol.

In contrast, the post office approach leaves the majority of the bytes untouched. Instead, it strips the existing protocol's start bit, CRC bits and stop bits from each data byte and replaces them with control bits. This substitution eliminates both the need to convert the entire packet from one protocol to another and also the time wasted in converting and transmitting useless protocol-specific control bits. The result? Transmissions are not affected by protocols, because there is no protocol conversion, saving switching and transmission capacity.

### Method provides 'self-healing'

Transmission integrity on the packet level is relatively easy to address: It requires an effective packet format and an error-correction scheme. But system integrity is difficult to ensure.

Deregulation has affected the vendors that control network transmission links from end to end. Until January 1984 the only vendor was AT&T Co. Now, however, in addition to the AT&T long-distance network, there are regional and local operating companies across the country. Even satellite or private carriers have been considered. When a network problem occurs, getting the responsible vendor to remedy the situation is often as difficult as discovering the fault's location.

Today's private networks must provide high-quality diagnostics in order to discover transmission faults and, if possible, route around them. The Doelz system does these things with local intelligence that provides distributed-diagnostic capabilities, redundant-switching facilities, a multiple-priority scheme and integral network

management for flexible routing and control.

The Esprit One switch and the Elite One switching concentrator utilize four priority levels for data transfers. The highest level is reserved for network-management-control messages, which transmit and collect information on the network's operational status. The other three priority levels allow the data-communications manager to control the transmission precedence of user data through a network. By giving the user several levels of access priority, data of differing importance can be handled concurrently and efficiently.

Although each switch has management capabilities, overall network supervision is assigned to a specific node as network manager. This node directs the flow of traffic along the virtual paths and polls the network periodically with an "all call" signal. With the other nodes' responses to the all-call, the network manager has a complete picture of the entire network every 30 seconds in terms of user statistics, alarms, network structure, modem operation and line quality. This supervision tests the integrity of the network and collects data on network performance and current structure in order to analyze system effectiveness.

Any node in the system through the network manager is capable of identifying and isolating system faults. In fact, nodes can test themselves, their transmission lines and their transmission elements. When a fault is identified in a nodal or transmission element, internal functions maintain network integrity. When a fault is identified in a line segment, the network manager instigates a self-healing process, which—by means of a redundant leased line (or dual dial-up)—automatically restores service. This architecture avoids the problem found in traditional star networks in which a line failure can isolate an entire network segment from the controlling capabilities of the central switch, as well as from the transmission links of the rest of the network. □

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**Richard D. Haney** is manager of product planning for Doelz Networks Inc., Irvine, Calif. He previously managed his own company, Group 1000, a data-communications concern in the San Francisco Bay area and was a co-founder of Network Resource Corp., now a wholly owned subsidiary of Sytek Inc., Mountain View, Calif. He holds bachelor's and master's degrees in computer science from San Jose State University.

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Interest Quotient (Circle One)  
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**Because each packet is dedicated to a single user, error control can be switched in or out on a per-path basis.**

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# BUSINESS USERS PONDER DESKTOP PEN PLOTTERS

Technical users are happy with pen plotters, but emerging software and lower prices beckon business toward computer-image recorders and page printers

**Rick Dalrymple**, Senior Editor

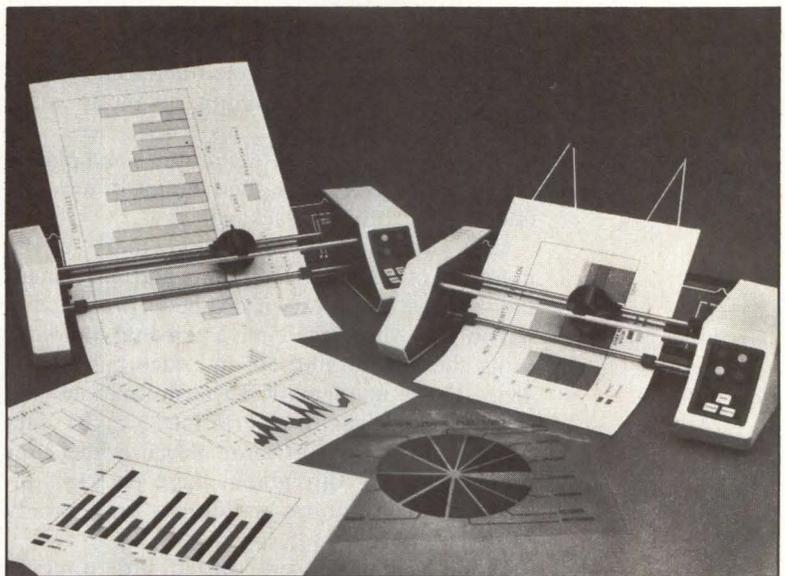
By dramatically dropping prices, desktop plotter manufacturers have made their products more affordable. But look at who's buying them: engineers, scientists, architects, draftsmen, medical technicians, college professors and, oh yes, a sprinkling of businessmen.

Shouldn't businessmen be in the majority? After all, don't personal computer market statistics show business and professional applications outnumbering the scientific and technical by at least three to one? The answer is "yes." But, nevertheless, the desktop plotter manufacturer's best customer so far is the technical user.

The reasons lie in market timing. Business personal computer users are just entering the market for graphic-output devices at a time when computer-image recorders and page printers are being introduced at prices low enough to be considered by personal computer users. But, even more important is the development of interactive-graphics software aimed at the business user. These products are making computer-image recorders and page printers easier to use and together they offer the business user two items the desktop plotter cannot—35mm slides and the combination of text and graphics on paper.

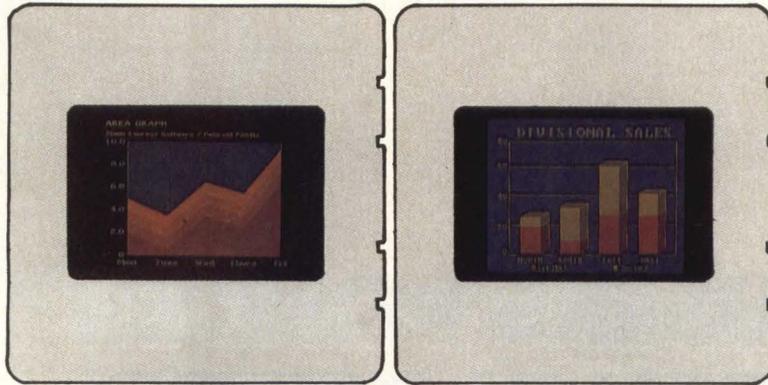
To understand the evolving niche of the desktop plotter, it is worthwhile to compare and contrast the requirements and motivations of both technical and business users.

The love affair between technical users and their computers has been going on for a long



**A low-cost, six-pen plotter, the Houston Instruments PC Plotter 695 (left), produces both 8½-by-11-inch and 11-by-17-inch plots. The PC Plotter 595 (right) produces 8½-by-11-inch plots only. The plotters cost \$695 and \$595, respectively.**

time. Never keen on the idea of sharing a computer, technical users were quick to adopt the personal computer. And, because they had had a favorable experience with the clean continuous lines drawn by a pen plotter, technical users were in the market for a plotter to go with their new computer.



**35mm slides** are produced by the Polaroid Palette using instant Polaroid Polarochrome CS 35mm color transparency film. Resolution is 640 by 400 pixels.

Although many technical users are expert programmers, few are interested in spending their time writing programs, software interfaces and graphing routines. Also, most could ill afford to spend more on a plotter than they had spent on a computer.

To meet their needs, pen plotter manufacturers introduced small, inexpensive desktop plotters featuring firmware that responds to high-level control sequences. Meanwhile, developers of software packages targeted at technical personal computer users picked up the plotter manufacturer's high-level control sequences and used them to create plotting routines and plotter interfaces, which were then bundled into the developer's software package.

One example of the results enters in the marriage of personal computers and instrumentation. Most laboratory instruments provide digital output, which is fed into a personal computer using the general-purpose interface bus (IEEE 488). Then, mathematical transformations and statistical routines are performed on the data using third-party software. Because the user requires a hard-copy graph, these packages include plotting routines and drivers for a variety of pen plotters.

While technical users wasted little time in getting their personal computers up and running, the same cannot be said for most business users. For many, using a personal computer was their first direct contact with computers and, accordingly, the first order of business was to learn how to use word-processing and spreadsheet software.

Although spreadsheet programs are usually considered businessmen's tools, scientists and engineers, along with market researchers and economists, were the first to appreciate the graphics routines found in Ashton-Tate's Framework, Lotus Development Corp.'s 1-2-3, Sorcim IUS Microsoftware's SuperCalc3 and other integrated software packages.

Because spreadsheet packages can be used as a kernel, allowing the user to add applications-specific templates, spreadsheets have been used to create mathematical simulations. And the best way to view the results of these "what if" simulations is to examine a collection of graphs created by the software package's graphing routines drawn on a desktop plotter.

Although individuals working with statistics often think in graphics ("If I can figure out a way to dampen this curve it should reduce the number of outliers in the scatter plot"), most businessmen are more comfortable with words and numbers. And this leads us to the big difference in the use of graphics between the technical and business communities.

Consider the scientist and his pen-plotter graphs. For each change in experimental conditions there are corresponding graphs. Each is studied and reviewed with changes in the shape of the graph noted and recorded. Although the process may require hundreds of graphs, only a few might be shown to other scientists.

Consider a typical businessman. Instead of collecting graphs, he acquires his analytical insight by "pushing the numbers." When the businessman uses a graph, it functions as a visual aid to communicate information to others. Each graph attempts to make a point: "Sales are up, but profits are down. Contributing to the problem are unfavorable currency-exchange rates, high interest and increased shipping charges."

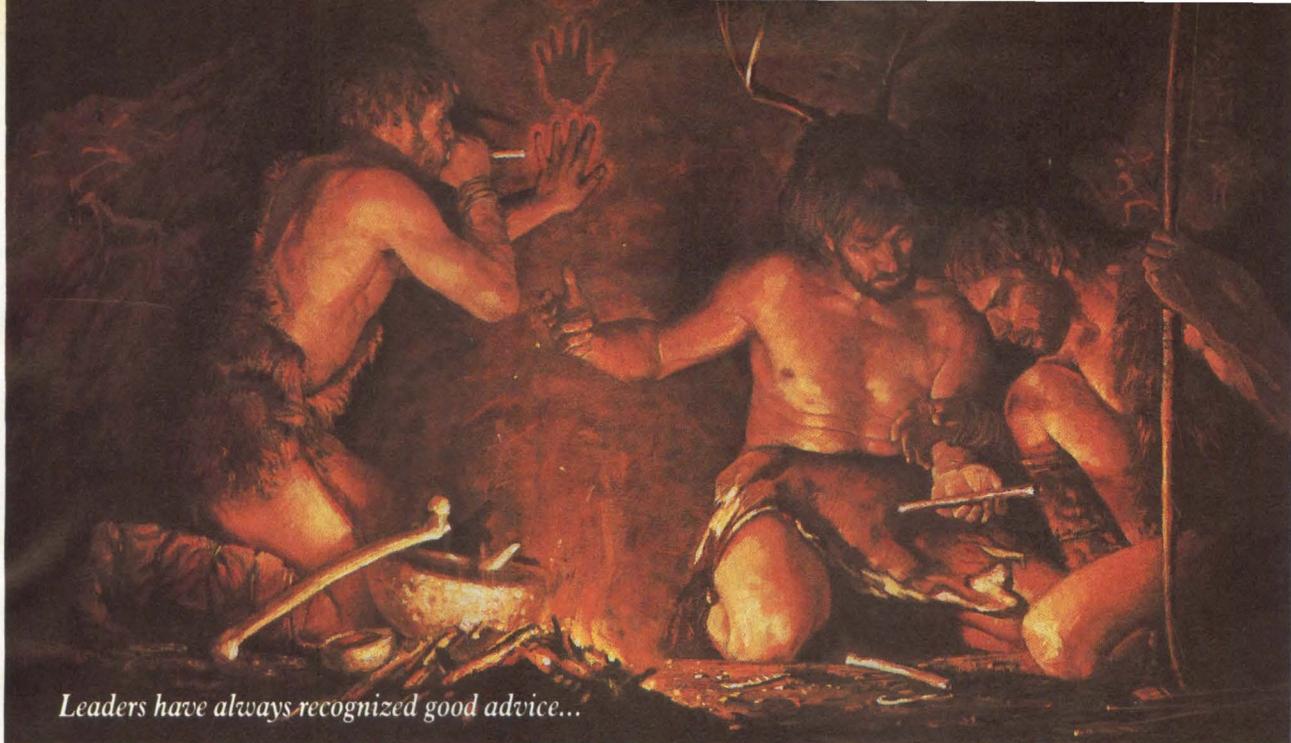
Businessmen don't merely share information, they present information, and, for them, creating the right impression is often more important than the data contained in the graph. That's why, when advertising to business users, vendors of graphics software and output devices tout "presentation graphics."

**Create useful presentation graphics**

Most businessmen are not happy with the graphing capability of their spreadsheet software. Even when the graphs are drawn with a pen plotter, the result lacks pizzazz. To improve the appearance of these graphs, businessmen are turning to software programs that interactively enhance the graph drawn by the spreadsheet program. However, to take advantage of this software, the user needs to add a graphics card to the computer.

Businessmen learned that, in shopping for word-processing software, it is wise to select the software first and then buy a compatible printer. Extending that wisdom to presentation graphics, businessmen are buying graphics software before selecting an output device.

The first software program to offer graphics-



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Combine our brilliant color capability, precise line quality, and proven reliability—and HP becomes the obvious choice for your presentation graphics needs. When it comes to plotters, it's easy to see why HP has become the world's Number One recommendation.

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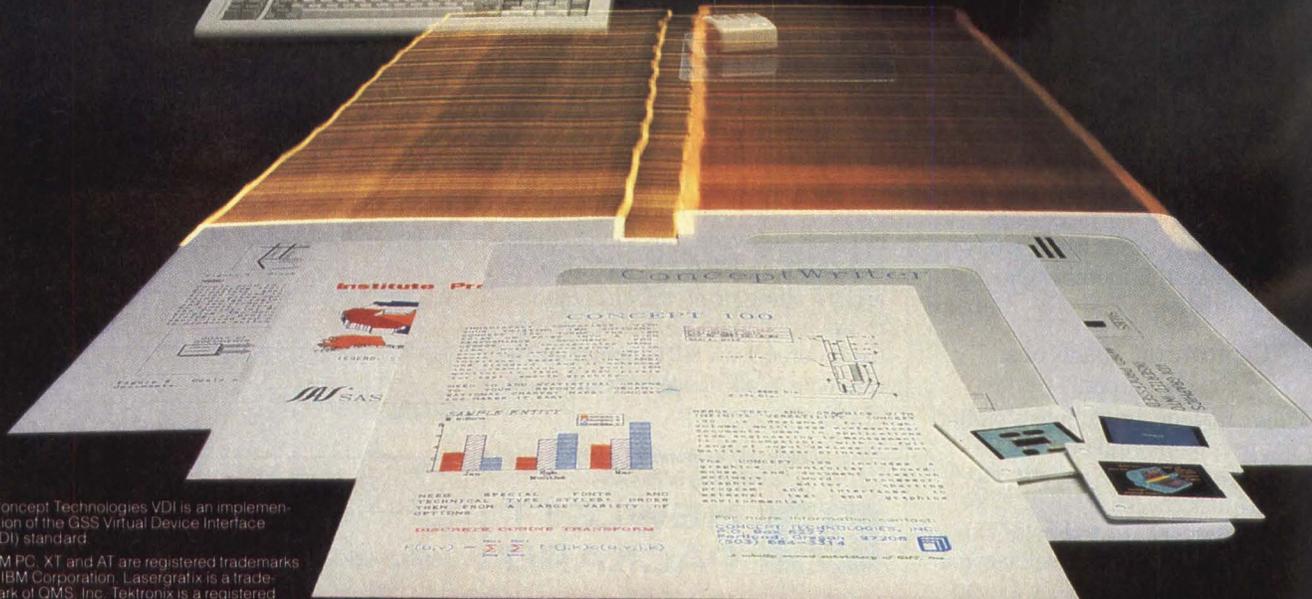
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CIRCLE NO. 77 ON INQUIRY CARD

enhancement capability was the Grafix Partner from Brightbill-Roberts and Co. Ltd., Syracuse, N.Y. Grafix Partner is a member of the new breed of "background" software packages (MMS, January, Page 107). The program is

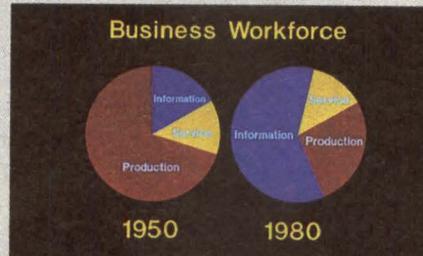
loaded into the computer's main memory along with any other application package the user may wish to run. Grafix Partner remains "invisible" until called. When activated, the Grafix Partner makes an electronic copy on a disk of whatever is

## HP introduces vector-technology computer-image recorder

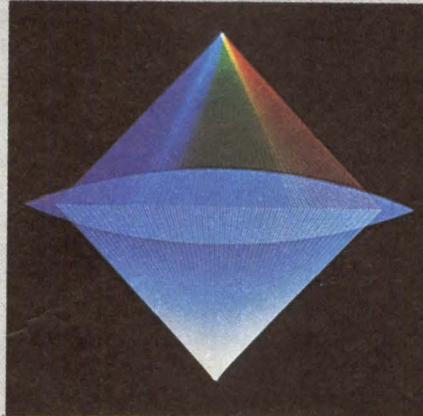
Two items make the introduction of the HP 7510 Color film recorder interesting. First, the product uses vector technology instead of raster technology and second, it comes from the leading manufacturer of pen plotters, the San Diego Division of Hewlett-Packard Co., San Diego.

The HP 7510 uses the same vector technology as HP plotters but instead of drawing on paper with ink, the HP 7510 draws on film with light. Like the Polaroid Corp. Palette, the HP 7510 passes the computer generated image through three color filters (red, green and blue). Unlike the Polaroid Palette, the HP 7510 draws each image on a direct-view storage tube instead of a raster CRT. The resulting specifications are impressive: 16,344 by 10,896 addressable points per frame with over 16 million available colors. By contrast, the Palette offers a resolution of 640 by 400 pixels.

Although the HP specifications are way above those of the Palette, unfortunately so is the price—\$13,900 compared to \$1,499. As the specs and prices indicate, the Palette and the HP 7510 are in different leagues. According to Peter Testan, director of Marshfield, Mass., research company C.A. Pesko



**Vector-drawn pie charts** from the HP 7510 do not have the jagged lines usually found in raster-CRT-based computer-image recorders. Prism-like cones show the color range of the product—over 16 million colors are available.



**Using vector technology,** the HP 7510 Color Film Recorder offers a resolution of 16,344 by 10,896 addressable points per 35mm frame. Camera (circled) shown mounted on the HP 7510 is optional.

and Associates Inc.'s Color Hardcopy Market Requirements Service, the HP 7510 will compete with computer-image recorders priced from \$10,000 to \$50,000. A likely competitor for the HP product is the CalComp Samurai from CalComp Sanders, Anaheim, Calif. Priced at around \$10,000, the CalComp Samurai uses raster technology to produce slides with a resolution of approximately 4,096 by 2,732 pixels.

Because the HP 7510 uses vector technology, it accepts the vector output produced by most graphics software directly—increasing speed and eliminating the need for special vector-to-raster conversion cards. Therefore, plotter drivers that support the HP 7550 plotter will produce immediate results on the HP 7510.

Of course, the programs that support the HP 7550 plotter do not take advantage of the unique capabilities of the HP 7510. HP has already placed HP 7510 in the hands of many graphics software vendors. There is little doubt that the product will create a stir in the technical community. The question yet to be answered is, will the developers of business-presentation graphics software consider the product exciting enough to work with HP to exploit its potential?

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**Most businessmen are not happy with the graphing capability of their spreadsheet software.**

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on the computer's display screen. The user can then take advantage of the program's graphics-editing features to rearrange elements in the image, change colors, change type fonts or superimpose one image on top of another.

The Grafix Partner also allows the user to load in other graphics-enhancement software packages so that additional type fonts, border designs, icons, logos and other graphic elements not included in the Grafix Partner may also be used.

Although the Grafix Partner offers support for a variety of graphic-output devices, including pen plotters, it has clearly been promoting a relatively new computer-image recorder—the Polaroid Palette from Polaroid Corp., Cambridge, Mass.

#### **Recorders permit direct transfers**

Computer-image recorders allow users to directly transfer computer images onto 35mm slides, a capability not offered by pen plotters, which produce images on either paper or overhead transparencies. Before the introduction of the Polaroid Palette, computer-image recorders were so expensive that their use was limited to a few large corporations and service bureaus catering to graphic artists. Recently, however, the cost of these devices has been coming down.

The Polaroid Palette offers an attractive alternative to pen plotters. Besides enjoying compatibility with almost all business, graphics-enhancement software, the product is compact (8 inches wide, 6 inches high and 14 inches deep without a camera) and affordable—\$1,499 (without the camera).

Having to wait for slides to come back from a processing lab has long been an inconvenience in the use of computer-image recorders. Polaroid has attacked the problem with its Instant Slide System based on the proprietary AutoProcessor and instant film. Users can produce 35mm slides right at their desks in broad daylight.

To make the slides, programs adapted for the Polaroid Palette present images to the camera one color at a time on a CRT inside the unit. A rotating assembly in the unit has red, green and blue color filters. The unit also allows the CRT display—320 by 200 pixels—to shift one scan line. It produces a 640-by-400-pixel color image by exposing the film six times, once for each color and again for each scan line shift.

The fact that businessmen employ 35mm slides as premier visual aids has not been lost on the leading manufacturer of pen plotters. This month Hewlett-Packard Co., San Diego Division, San Diego, is introducing its first computer image recording product. Called the HP 7510

Color Film Recorder, the product uses the same instant 35mm slide film employed by the Polaroid Palette. However, the products differ in the method used to create the computer-generated image. Instead of using raster technology, the HP 7510 uses vector technology. (see "HP introduces vector-technology computer-image recorder," Page 161).

#### **Take care of pen plotters**

Although it takes time to shoot and mount 35mm slides, the process is more convenient and less time-consuming than producing overhead transparencies with a pen plotter. Most plotters require the operator to manually feed transparency film one sheet at a time and to tell the computer when to begin plotting. It is also necessary for the operator to change pens when they become dull, or run out of ink. If the plot requires more colors than pens in the plotter, the operator will have to change pens and restart the plotter.

Pen plotters are not fast and must operate at even slower speeds to draw images on transparency film. Plotting times for overhead transparencies on low-cost plotters can take from 10 to 15 minutes per plot and sometimes longer if pen changes are required. Higher priced desktop plotters can cut transparency plotting times, without pen changes, to between 5 and 7 minutes.

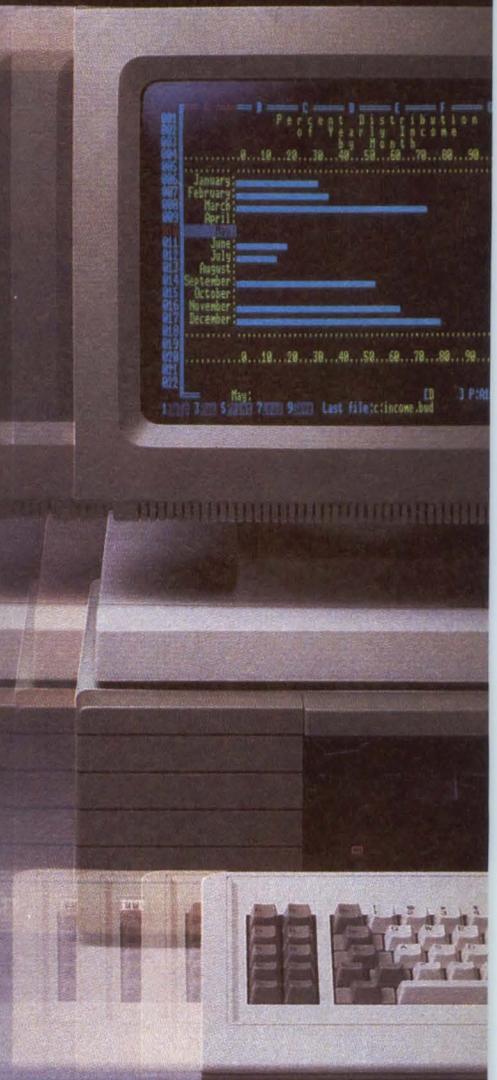
Plotting on paper is faster, by about 3 to 5 minutes, but still painfully slow if a number of copies is required. Eight sets of 10 plots each can easily tie up a plotter and an operator for an entire day. One solution is to make a set of plots using black only and then copy them with a photocopier. For presentations, this means creating two sets of plots, one in color on overhead transparencies and another in black only to provide originals for the photocopier.

#### **Color printers gain favor**

There are other ways to produce color hard copy. The problem, of course, is cost. The lowest priced color photocopier still costs more than \$20,000, and getting color photocopies through quick-print services is expensive and introduces the same turn-around problems encountered with photo labs.

There are color computer printers. However, the time it takes to print a plot is still measured in minutes, not seconds, and users must trade off alphanumeric printing speed for color-graphics capability. Some printers are optimized for graphics and only print a few characters per second; others offer faster printing speeds but with lower resolution graphics. Unlike most plot-

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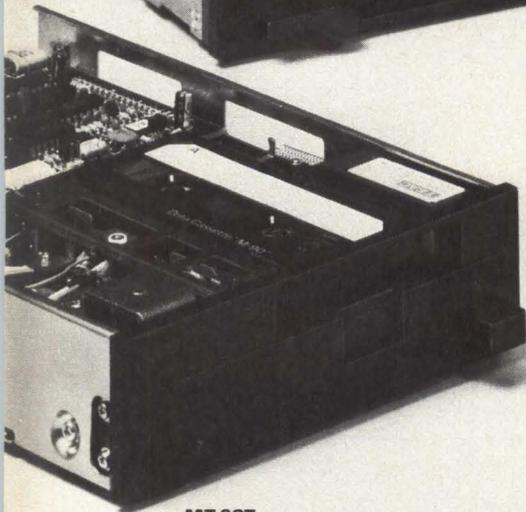
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ters, printers can print unattended for long periods of time and the price of color printers using both ink-jet and impact matrix technologies is now falling below \$5,000.

But the best printer compromise for the office is probably the monochrome page printer (MMS *Spring Peripherals Digest*, April 19, Page 55). No longer limited to the data-processing center by price or size, page printers allow users to combine "near-typeset-quality text" with graphics. The most important advantage of the page printer is that it will be viewed by most businesses as a daisywheel printer replacement. Its cost is justified by its alphanumeric printing capability; page printers supply high-resolution graphics without the agony of justifying a printer purchased to print graphics exclusively.

Even low-cost page printers, priced below \$5,000, offer the same high-resolution graphics found on the higher priced units—typically 300 by 300 dots per inch. The rub, of course, is the lack of color. Businessmen who have never seen page-printer graphics will probably be pleasantly surprised by its reproduction quality. Because

page printers use a different fill technique, pie charts and bar charts printed with a page printer look better than those drawn by a pen plotter using only one color. Page printers can use shades of gray to differentiate sectors, while pen plotters are limited to cross-hatching techniques.

Businessmen will prefer to use the same graphics in both slides and hard copy. And chances are that vendors of graphics-enhancement software will offer screen aids to allow users to build slide images in color and hard-copy images in page-printer shades of gray. Vendors of page-printer software, on their part, already offer features that allow users to pick up bit-mapped images so that they can be further manipulated by page-layout utilities.

Should business users buy desktop plotters? If their objectives closely match those of the technical user the answer is decidedly yes. If not, the marketplace offers a variety of alternatives. □

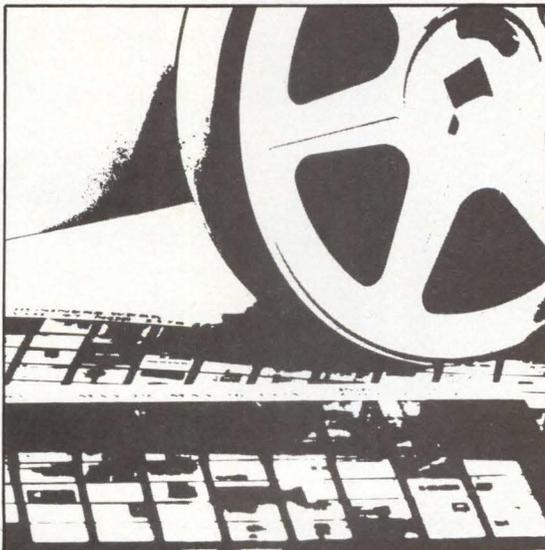
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**Businessmen are shopping for graphics software first and then selecting an output device.**

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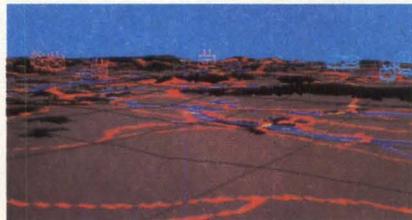
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Computer-driven command and control battle simulators are using Lexidata graphics systems to display 3-D terrain appreciation maps. (Courtesy of The Singer Company, Link Simulation Systems Division)



Students at the Royal College of Art in Kensington, England, use Lexidata's SOLIDVIEW to create designs such as these first-class passenger train seats.



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Company Model	Plotter type	Type	Pens		Type	Media				Compatible software	Hardware interface	Price (\$)
			No. of colors	Plotting speed (ips)		Size (inches)	No. of character sets available	Mechanical resolution (inches)	Repeatability (inches)			
<b>ALPHA MERICS CORP.</b> 20931 Nordhoff St. Chatsworth, Calif. 91311 (818) 709-1155 Circle 427												
Alphaplot I	pen plotter, open-bed, flatbed	fiber tip, felt tip, wet ink, nylon tip, ballpoint, steep tip, plastic nib	6	7	paper, transparency, film, mylar, vellum, bond	18 x 30, 30-inch roll	2	0.001	0.001	Auto Cad, Cadplan, Lotus 1-2-3, Spring Cad, 4-D Cad	RS232C	4,590
Alphaplot II	pen plotter, open-bed, flatbed	fiber tip, felt tip, wet ink, liquid ink, nylon tip, ballpoint, steel tip, plastic nib	6	7	paper, transparency, film, mylar, vellum, bond	24 x 36, 36-inch roll	2	0.001	0.001	Auto Cad, Cadplan, Lotus 1-2-3, Spring Cad, 4-D Cad	RS232C	5,590
<b>AMDEK CORP.</b> 2201 Lively Blvd. Elk Grove Village, Il. 60007 (312) 595-6890 Circle 428												
Amplot II	flatbed	fiber tip, plastic nib	6	8	paper, transparency, mylar	10 x 15	4	0.002-0.004	0.012	IBM, Apple	RS232C, Centronics	799
<b>ADVANCED COLOR TECHNOLOGY INC.</b> 21 Alpha Road Chelmsford, Mass. 01824 (617) 256-1222 Circle 429												
Chromajet II	printer/plotter, platen	ink jet	125		paper, transparency, film, bond	12-inch roll	1	0.011		Lotus 1-2-3, Chart-Master, Autumn, Mirage, Dr. Halo	RS232C, Centronics, video	6,150
<b>APPLE COMPUTER INC.</b> 20525 Mariani Ave. Cupertino, Calif. 95014 (408) 996-1010 Circle 430												
Apple Color Plotter Model 410	pen plotter	plastic tip, fiber tip	4-8	3.94	paper, transparency	11 x 17	7	0.004	0.008-0.016	Apple Business Graphics, PFS-Graph, Graph 'n Calc	RS232C	779
<b>BENSON INC.</b> 2690 Orchard Park Way San Jose, Calif. 95152-2059 (408) 945-1000 Circle 431												
B90	printer/plotter	thermal transfer	1	.65	paper, film, fan fold, bond	11-inch roll	1	240		Benson/ISAP	Benson parallel, Versatec emulation	6,995
<b>DATA GENERAL CORP.</b> 4400 Computer Drive Westboro, Mass. 01580 (617) 366-8911 Circle 432												
4435	pen plotter		up to 10	15	paper, transparency	8½ x 11		0.001	0.004-0.008	DG Graphical Kernel System	RS232C	
<b>DATAPOINT CORP.</b> 9725 Datapoint Drive San Antonio, Texas 78284 (512) 699-7542 Circle 433												
9656	pen plotter		15-20		paper, transparency	8½ x 11, 11 x 17	19	0.00098	0.004		RS232C, CCITT V.24	
<b>DIGITAL EQUIPMENT CORP.</b> 129 Parker St. Maynard, Mass. 01754 (617) 493-5111 Circle 434												
LVP 16	pen plotter, flatbed	fiber tip	10	15	paper, transparency	8½ x 11, 11 x 17	19	0.0098	0.004	BASIC, HPGL, AGL	RS232C, CCITT V.24	

## DESKTOP PLOTTERS

Company Model	Plotter type	Type	Pens		Media					Compatible software	Hardware interface	Price (\$)
			No. of colors	Plotting speed (ips)	Type	Size (inches)	No. of character sets available	Mechanical resolution (inches)	Repeatability (inches)			

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Circle 435

Sweet-P Model 100	pen plotter, grit wheel	fiber tip, felt tip, wet ink, liquid ink, nylon tip, ballpoint, plastic nib	12	6	paper, transparency, film, mylar, vellum, bond	8½ x 11, 8½ x 120	1	0.004	0.012	IBM, Apple Business Graphics, Lotus 1-2-3, Auto Cad, Chart-Master, Energraphics, PFS-Graph, Chartstar	Centronics, parallel	395
Sweet-P Model 600	pen plotter, grit wheel	fiber tip, felt tip, wet ink, liquid ink, nylon tip, ballpoint, plastic nib	10	14	paper, transparency, film, mylar, vellum, bond	8½ x 11, 11 x 17	18	0.004	0.012	HP-7475 device-driver	Centronics, parallel, RS232C, serial	1,095

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4550	pen plotter, roller grip	fiber tip, ballpoint, ceramic tip	up to 12	6	paper, transparency	8½ x 11	16	0.004	0.008	IBM PC, HPGL	RS232C, Centronics	
4551	pen plotter, roller grip	fiber tip, ballpoint, ceramic tip	up to 12	9	paper, transparency	11 x 17	16	0.004	0.008	IBM PC, HPGL	RS232C, Centronics	

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(401) 884-6800

Circle 437

Microplot 80	printer/plotter	dot matrix, thermal	1		roll chart		1				RS232C, IEEE-488	2,000
Superplot 80	printer/plotter	dot matrix, thermal	1		fan fold, roll chart	8½ x 11	1				RS232C, IEEE-488, Centronics, TTL	2,000

### HETRA COMPUTER AND COMMUNICATIONS INDUSTRIES INC.

1151 S. Eddie Allen Road  
P.O. Box 970  
Melbourne, Fla. 32901  
(305) 723-7731

Circle 438

9911	pen plotter	ballpoint	6	300	paper, transparency	8½ x 11, 11 x 17, 11-inch roll		0.005		IBM, Apple, Morrow, NBI, Tandy	serial loop	
9912	pen plotter	ballpoint	8	300	paper, transparency	8½ x 11, 11 x 17, 11-inch roll			0.005	IBM, Apple, Morrow, NBI, Tandy	serial loop	

### HEWLETT-PACKARD CO.

16399 W. Bernardo Drive  
San Diego, Calif. 92127  
(619) 487-4100

Circle 439

7470A	pen plotter, grit wheel	fiber tip	10	15	paper, transparency	8½ x 11	5	0.001	0.004	over 200 packages supported	RS232C, IEEE-488, HP-IL	1,095
7475A	pen plotter, grit wheel	fiber tip, liquid ink	10	15	paper, transparency, mylar	8½ x 11, 11 x 17	19	0.001	0.004	over 200 packages supported	RS232C, IEEE-488	1,895

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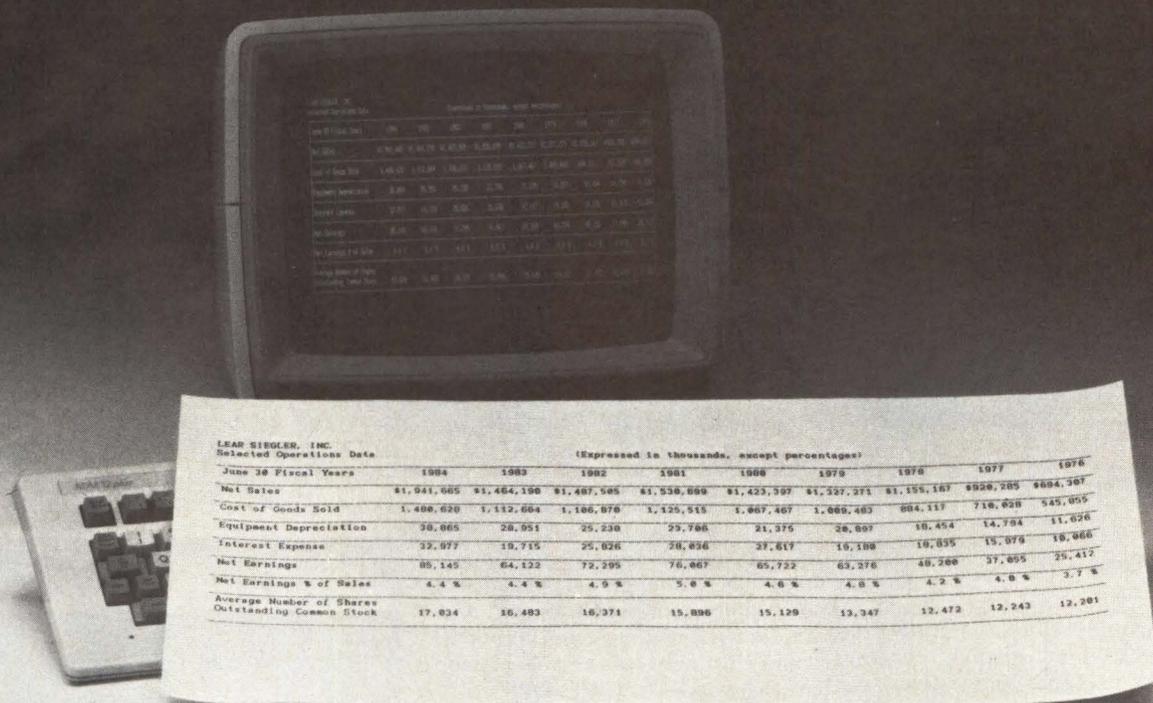
## DESKTOP PLOTTERS

Company Model	Plotter type		Pens		Media					Compatible software	Hardware interface	Price (\$)
			Type	No. of colors	Type	Size (inches)	No. of character sets available	Mechanical resolution (inches)	Repeatability (inches)			
7550A	pen plotter, grit wheel	fiber tip, liquid ink, roller ball	10	31.5	paper, transparency, mylar, vellum	8½ x 11, 11 x 17	20	0.0002	0.004	over 200 packages supported	RS232C, IEEE-488	3,900
<b>HOUSTON INSTRUMENT</b>												
8500 Cameron Road Austin, Texas 78753 (512) 835-0900 Circle 440												
DMP-29	pen plotter, flatbed	fiber tip, felt tip, liquid ink, steel tip, plastic nib	8	22	paper, transparency, mylar, vellum, bond	11 x 17	8	0.005	0.005	Lotus 1-2-3, IBM	RS232C	2,295
DMP-29-3	pen plotter, flatbed	fiber tip, felt tip, liquid ink, steel tip, plastic nib	8	22	paper, transparency, mylar, vellum, bond	11 x 17	8	0.005	0.005	Lotus 1-2-3, IBM	RS232C	2,790
DMP-40	pen plotter, grit wheel	fiber tip, felt tip, liquid ink, steel tip, plastic nib	8	4.2	paper, transparency, film, mylar, vellum, bond	8½ x 11, 11 x 17	8	0.005	0.005	Lotus 1-2-3, IBM	RS232C	995
PC Plotter 595	pen plotter, grit wheel	liquid ink	8	4.2	paper, transparency, mylar, bond	8½ x 11	8	0.004	0.004	Lotus 1-2-3, IBM	RS232C	595
PC Plotter 695	pen plotter, grit wheel	liquid ink	8	4.2	paper, transparency, mylar, bond	8½ x 11, 11 x 17	8	0.004	0.004	Lotus 1-2-3, IBM	RS232C	695
<b>IBM INSTRUMENTS INC.</b>												
Orchard Park P.O. Box 332 Danbury, Conn. 06810 (203) 796-2500 Circle 441												
XY/749 Digital Plotter	flatbed	fiber tip, liquid ink, nylon tip, steel tip, ceramic tip	8	13-18	paper, transparency, vellum	8½ x 11	6	0.05	0.1-0.3		RS232C, current loop, 8-bit parallel, IEEE-488	1,995
XY/750 Series Digital Plotters	flatbed	fiber tip, liquid ink	8	13	paper, transparency	11 x 17	5	0.04	0.004		RS232C, IEEE-488, 8-bit parallel	4,500-5,500
<b>MANNESMANN TALLY CORP.</b>												
8301 S. 180th St. Kent, Wash. 98032 (206) 251-5524 Circle 442												
Pixy III	pen plotter	water-, oil-based fiber tip	3	8	paper, transparency	8½ x 11	9	0.004	0.012	IBM, Apple Business Graphics, Lotus 1-2-3	RS232C, Centronics	595
<b>NEC INFORMATION SYSTEMS INC.</b>												
1414 Massachusetts Ave. Boxborough, Mass. 01719 (617) 264-8000 Circle 443												
Britewriter	pen plotter	felt tip	4	2.4-4.48	paper, transparency, bond				0.004	Lotus 1-2-3, PFS-Graph, GraphWriter, HP 74-75	serial, parallel	599
<b>NICOLET'S COMPUTER GRAPHICS DIV.</b>												
777 Arnold Drive Martinez, Calif. 94553 (415) 372-7568 Circle 444												
ZETA 8	pen plotter, drum, roller grip	fiber tip, felt tip, liquid ink, nylon tip, ballpoint	10	25	paper, transparency, film, mylar, fan fold, vellum, bond	11 x 17	20	0.001	0.004	all major software packages	RS232C, IEEE-488	5,950
ZETA 887	pen plotter, drum, roller grip	fiber tip, felt tip, liquid ink, nylon tip, ballpoint	10	25	paper, transparency, film, mylar, fan fold, vellum, bond	11 x 17	20	0.001	0.004	all major software packages	RS232C, IEEE-488	7,950

## DESKTOP PLOTTERS

Company Model	Plotter type	Type	Pens		Type	Media			Compatible software	Hardware interface	Price (est.)	
			No. of colors	Plotting speed (ips)		Size (inches)	No. of character sets available	Mechanical resolution (inches)				Repeatability (inches)
ZETA Sprint	pen plotter, flatbed	fiber tip	8	14	paper, transparency, mylar, vellum, bond	8½ x 11, 11 x 17	19	0.004	0.004	all major software packages	RS232C, Centronics	
<b>NUMONICS CORP.</b>												
418 Pierce St. Landsdale, Pa. 19446 (215) 362-2766 Circle 445												
5412	pen plotter, grit roller	felt tip, liquid ink, ballpoint	3	5-6	paper, transparency, film, mylar, vellum, bond	11 x 17	2	0.005		Auto Cad, BG Graphics, Versacad, LL Plot, Starplot	RS232C, IEEE-488, 8-bit parallel	1,275
6412	pen plotter, grit roller	fiber tip, liquid ink, ballpoint, plastic nib	8	17.7	paper, transparency, film, mylar, vellum, bond; opt. roll chart	11 x 17	11	0.002-0.004	0.004	Auto Cad, BG Graphics, Versacad, LL Plot, Starplot	RS232C, IEEE-488, 8-bit parallel	2,795
<b>PRINTRONIX INC.</b>												
17500 Cartright Road Irvine, Calif. 92713 (714) 863-1900 Circle 446												
Graphicprint 4160	printer/plotter				paper, mylar, fan fold, roll chart	16-inch roll	1	160 x 168			Centronics, many host computers	5,380
<b>SHARP ELECTRONICS CORP.</b>												
10 Sharp Plaza, Box C Paramus, N.J. 07652 (201) 265-5600 Circle 447												
CE-515P	printer/plotter, pen plotter, grit wheel	fiber tip, felt tip, ballpoint	4	2.5-3.5	paper, transparency	8½ x 11, 4-inch roll	1	0.008	0.008	IBM, Apple II, Texas Instruments, Epson, Kaypro, Osborne	RS232C, Centronics	399
<b>SOLTEC DISTRIBUTION</b>												
P.O. Box 818 Sun Valley, Calif. 91353-0818 (800) 525-5544 Circle 448												
SPL-400	pen plotter, flatbed, platen	fiber tip, wet ink, nylon tip, ballpoint	6	16.5	paper, transparency, film, mylar, vellum, bond	11 x 17	3	0.001	0.015	HPGL	RS232C, Centronics	1,195-1,395
<b>VERSATEC (A XEROX CO.)</b>												
2710 Walsh Ave. Santa Clara, Calif. 95051 (408) 988-2800 Circle 449												
V-80	printer/plotter	electrostatic	1		paper, transparency, film, mylar, fan fold, roll chart, vellum, bond	8½ x 11	un-limited	200	0.002		RS232C, IEEE-488, Versatec parallel	8,999
<b>WESTERN GRAPHTEC INC.</b>												
12 Chrysler St. Irvine, Calif. 92718 (714) 770-6010 Circle 450												
DA 8400	pen plotter, flatbed	fiber tip, felt tip, ballpoint	6	18	paper, transparency, film, vellum, bond			0.004	0.004	IBM, Apple Business Graphics, Hewlett-Packard, Lotus 1-2-3, BASIC	RS232C, IEEE-488, Centronics, current loop	1,790-1,850
FP 5301	pen plotter, flatbed	fiber tip, felt tip, ballpoint	10	18	paper, transparency, film, vellum, bond			0.004	0.004	IBM, Apple Business Graphics, Hewlett-Packard, Lotus 1-2-3, BASIC	RS232C, IEEE-488, parallel	3,290
MP 1000	pen plotter, flatbed	fiber tip, felt tip, ballpoint	6	6	paper, transparency, film, vellum, bond			0.004	0.004	IBM, Apple Business Graphics, Hewlett-Packard, Lotus 1-2-3, BASIC	RS232C, IEEE-488, parallel	1,190
WX 4731	printer/plotter, pen plotter, drum	ballpoint	4	8	paper, transparency, roll chart	12½		0.004	0.004	IBM, Apple Business Graphics, Hewlett-Packard, Lotus 1-2-3, BASIC	RS232C, IEEE-488, parallel	2,490

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# NEW PRODUCTS

## SYSTEMS

Eileen Milauskas, Assistant Editor



### Business system offers three functions

- 80286 CPU
- 512K-byte memory
- 13-inch display

Software-compatible with the proprietary Professional Computer Family, the TI Business Pro computer system serves as a single-user workstation, a network server or a clustered multiuser system. Based on a 16-bit, 80286 CPU, the system achieves a 150-nsec RAM speed and comes with a color or monochrome, bit-mapped, 13-inch display; 512K bytes of main memory, expandable to 3.5M bytes and serial and parallel interfaces. It handles four of six possible data-storage options: a 360K-byte or 1.2M-byte, flexible disk drive; a 21M-, 40M- or 72M-byte Winchester disk drive and/or a 60M-byte cartridge-tape backup. The unit runs the MS-DOS 3.0 or XENIX operating system and supports eight users. It accommodates MS-BASIC, MS-FORTRAN, MS-Pascal, MS-COBOL, RM/COBOL, LISP, Assembler and C. \$3,995. **Texas Instruments Inc.**, Data Systems Group, P.O. Box 809063, Dallas, Texas 75380-9063. **Circle 300**

### Minis serve data, transaction processing

- 32, 64 users
- Instruction processors
- 2M-, 4M-byte memory

The DPS/42, a 16-bit minicomputer

supporting 32 users, integrates data and word processing with communications. It includes a commercial instruction processor (CIP), memory-management unit, disk controller, two multiline communications processors and 2M bytes of memory. Maximum fixed disk capacity is 3G bytes. The DPS/85, a 32-bit minicomputer accommodating 64 users, comes with 4M bytes of memory and 3G bytes of mass storage and serves transaction-processing requirements. Features include a memory-management unit with a 4K-byte cache, CIP and scientific instruction processor (SIP). The CIP executes COBOL programs at 80,000 statements per second; the SIP adds floating-point arithmetic capability for FORTRAN, BASIC, and Pascal programs. Both models run the proprietary GCOS 6 MOD 400 operating system and support concurrent synchronous and asynchronous communications in proprietary and IBM networks as well as public-data networks. \$19,300, DPS 6/42; \$57,000, DPS 6/85. **Honeywell Information Systems Inc.**, 300 Concord Road, Billerica, Mass. 01821, (617) 671-6000. **Circle 301**

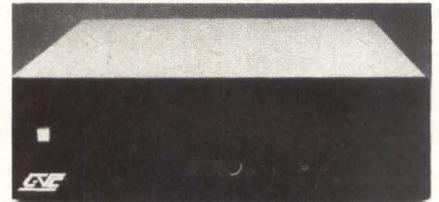


### Transportable aids business requirements

- 9-inch screen
- 8088 CPU
- Bundled software

The Corona PPC400 series of transportable personal computers generates a resolution of 640 horizontal dots by 400 lines on a 9-inch, green screen for graphics and text-processing applications. The 16-bit, 8088-based series comes in three

configurations. The PPC400-12 offers one 360K-byte, half-height floppy disk drive and a 256K-byte RAM. The PPC400-22, also providing 256K bytes of RAM, comes with two half-height floppy disk drives. The PPC400-XT has a single half-height floppy drive, a 10M-byte hard disk and 256K bytes of RAM. Memory is expandable to 512K bytes. Each system comes with bundled software that includes MS-DOS 2.11, GW BASIC 1.12 graphics language and Comprehensive Software's PC TUTOR and CORONA-PAL. \$2,640, PPC400-12; \$2,795, PPC400-22; \$4,295, PPC400-XT. **Corona Data Systems Inc.**, 275 E. Hillcrest Drive, Thousand Oaks, Calif. 91360, (805) 495-5800. **Circle 302**



### Multiuser systems use 32016 processor

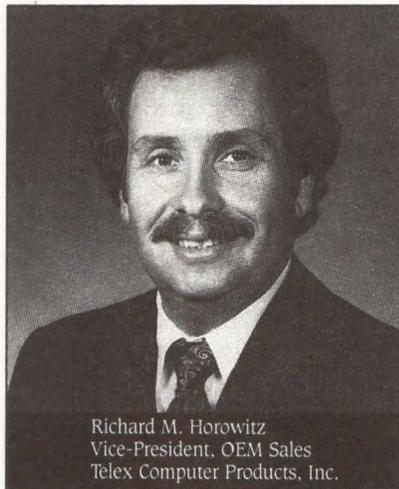
- C compiler
- 45M-byte Winchester
- 1M-byte RAM

Running the GENIX operating system, an enhancement of Berkeley UNIX Version 4.1, the GS1 and GS2 multiuser systems support four users. Incorporating National Semiconductor's 10-MHz NS32016 CPU, the systems incorporate the proprietary GVC-16 Multibus board. Both models include a C language compiler, demand-paged virtual memory, a 45M-byte Winchester disk drive, floating-point hardware, four RS232 ports, 1M byte of RAM and an 800K-byte floppy disk drive. The single-board GS1 is expandable to 2M bytes of memory; the GS2 adds a four-slot Multibus card cage for memory cards, analog-to-digital converters, Ethernet controllers or bit-mapped graphics cards. \$8,900, GS-1; \$9,900, GS-2. **GVC Inc.**, 222 Third St., Cambridge, Mass. 02142, (617) 576-1804. **Circle 303**

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Jan. 9, 1986	Irvine, CA
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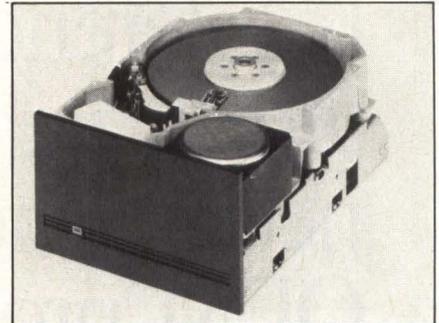
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Phone: (714) 957-0171 Telex: 5101002189 BJ JOHN

## Drives access data in less than 40 msec

- ST506/412 interface
- 20M, 41.9M bytes
- Four, eight heads

Employing a linear, closed-loop servo positioning system, the models CM4426 and CM6853 disk drives from Computer Memories Inc. achieve respective average access times of 40 and 39 msec. Transferring data at 5M bits per second (bps), the half-height model CM4426 stores 20M bytes of formatted data; the full-height model CM6853, 41.9M bytes. Both drives are compatible with the ST506/412 interface.

Suiting desktop and portable applications, the CM4426 achieves reliability through an isolated, shock-mounted head/disk assembly. Read preamplifiers within the head/disk assembly reduce electromagnetic interference and radio-frequency interference noise susceptibility. A dynamic spindle brake minimizes head-to-media contact, and heads are parked in a dedicated shipping zone. Thermal tracking and a positioner car-



**Compatible with the ST506/412 interface, the models CM4426 half-height and CM6853 full-height disk drives serve desktop and portable applications.**

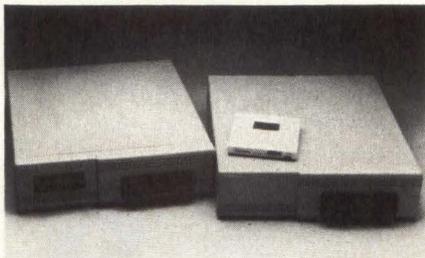
riage lock prevent head movement during shipping or power-down periods to assure data integrity. The CM4426, using two oxide-media disks and four monolithic read/write heads, reaches a 9,687-bpi recording density and a 695-tracks-per-inch (tpi) track density. Track-to-track access time is 10 msec.

The CM6853 offers four oxide-media disks and eight read/write heads. It attains a recording density of 9,275 bpi and a track density of 750 tpi, achieving a

track-to-track access time of 9 msec. Rotational speed for both disk drives is 3,573 revolutions per minute.

The mean time between failures (MTBF) for the CM4426 is 20,000 power-on hours (POHs); MTBF for the CM6853 is 17,000 POHs. Q1000 price for the CM4426 is \$750; \$890 for the CM6853. **Computer Memories Inc.**, 9216 Eton Ave., Chatsworth, Calif. 91311, (213) 709-6445.

Circle 304



### Subsystems employ IEEE-488 interface

- 10M-byte hard disk
- 3½-inch floppy disk
- HP compatible

Software- and hardware-compatible with Hewlett-Packard technical, business and personal-computing systems, the TopSecret-1 and -2 Winchester cartridge disk drive subsystems use the HP-IB/IEEE-488 interface. The subsystems suit high-speed data logging and hard-disk backup applications. The TopSecret-1 consists of a 5¼-inch, 10.4M-byte Winchester disk cartridge drive with an 85-msec average access time. Data-transfer rate runs 174K bytes per second. The TopSecret-2 includes a 3½-inch, double-sided floppy disk drive in addition to the

cartridge hard disk. Formatted capacities of the floppy drive are 630K, 710K and 788K bytes under the HP microdisk formats of 256, 512 and 1,024 bytes per sector, respectively. The average access time is 185 msec; data-transfer rate is 13K bytes per second. TopSecret-1, \$3,890; TopSecret-2, \$4,190. **Bering Industries Inc.**, 1400 Fulton Place, Fremont, Calif. 94539, (415) 651-3300. Circle 305

### Removable drive suits personal computers

- 10M-byte storage
- Sputtered media
- 5M-bps transfer rate

A 5¼-inch, removable, half-height, cartridge disk drive with 10M bytes of formatted storage, the MS212 uses carbon-coated, thin-film, sputtered media and a closed-loop servo system. Aimed at personal microcomputers, the drive loads from the front and employs the ST506/412 interface. Its MTBF is 10,000 power-on hours. An on-board microprocessor accepts either single or multiple buffered seeks. Average access time is 98 msec; track-to-track, 25 msec.

Transferring data at 5M bps, the unit records at 10,700 bpi. Track density is 556 tpi. \$1,075. **Micro Storage Corp.**, 2986 Oakmead Village Court, Santa Clara, Calif. 95051, (408) 986-0770.

Circle 306

### Disk controller supports SMD drives

- Multibus-compatible
- 2.5M bytes per second
- Disk interrogate command

Achieving a 2.5M-byte-per-second transfer rate, the Rimfire 1200 caching disk controller supports SMD disk drives and suits UNIX-based systems. Up to 32K bytes of cache can be segmented into 512 bytes each. Capabilities include overlapped seeks, zero latency track read, sector skewing and sector slipping. Features include scatter/gather commands, 48-bit error-correction coding, Tag 4/5 SMD features, 11th-cylinder bit or SMD-E bits in Tag 2, pick and hold, dual-ported drive support and disk interrogate command. \$2,195, OEM quantity. **Ciprico Inc.**, 2955 Xenium Lane, Plymouth, Minn. 55441, (612) 559-2034.

Circle 307



# Big Memories Come in Small Packages!

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Our C2476, an 8-inch Winchester disk memory with an ESMD interface, has 476 megabytes of storage and an average head positioning time of 15 milliseconds. Thin film technology and simplicity of design provide OEM's with the ideal disk memory for multi-user, multi-task environments.

These factors along with a high data transfer rate of 1.859 megabytes per second, fast track-to-track positioning time of 3.5 milliseconds and average rotational latency of 7.5 milliseconds make the C2476 a key element in computer systems requiring a responsive and reliable disk memory.

AND.....you get all these features in a compact 8-inch package. The reduced size of the C2476

allows our disk memory to occupy half the space of the competitor's equivalent capacity drive. In fact, the C2476 offers higher performance than any 8-inch drive currently available. And you get Century Data Systems' reliability in the same compact package.

The C2476 is the compact solution for high capacity, high performance, reliable storage. For more information contact: Century Data Systems, Product Marketing, 1270 N. Kraemer Blvd., Anaheim, CA 92806, (714) 632-7500.



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CIRCLE NO. 87 ON INQUIRY CARD

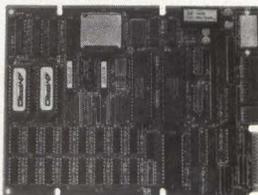
## Available, Reliable, Affordable Solutions for Computerization

### Little Board™/186 . . . \$499 <sup>with</sup> (128K)

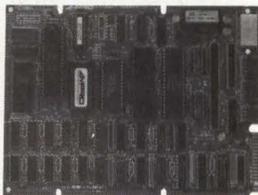
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Same as Little Board/186 except:

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CIRCLE NO. 88 ON INQUIRY CARD

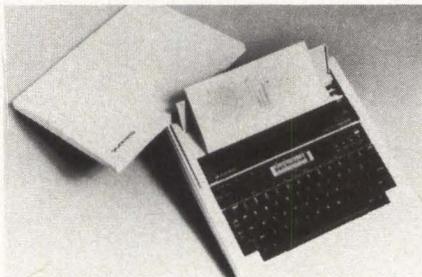
## NEW PRODUCTS

## PRINTERS

### Plotter/printer provides four graph formats

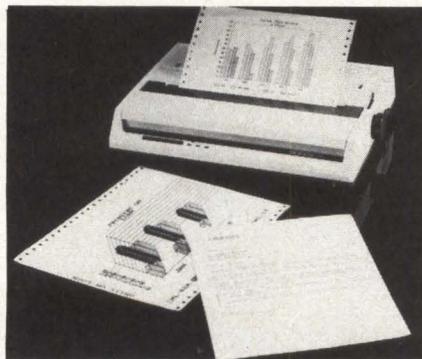
- 40 to 160 cpl
- Three size settings
- Two type styles

A combination printer, typewriter and graph plotter, the portable model EB50 Colour PenGraph incorporates a rotating, ball-pen writing head to produce charts and graphs in four colors. The unit outputs four graph formats, consisting of



layout charts for tables, pie charts including concentric, bar graphs and line graphs, in three print sizes: 40 cpl at 4 cps, 80 cpl at 7 cps and 160 cpl at 14 cps. The two type styles are Courier and Italic. Features include a 44-key keyboard; 16-character, LCD display generating a 5-by-7-dpi matrix; one-line correction memory; 10-key buffer; and a Centronics interface. \$299. Silver-Reed America Inc., 19600 S. Vermont Ave., Torrance, Calif. 90502, (213) 516-7008.

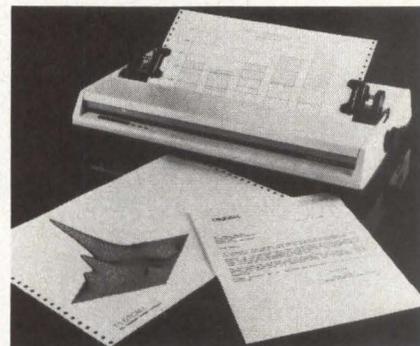
Circle 308



### Dot-matrix printers emulate IBM 5152

- Re-inking cartridge
- 160 cps, utility mode
- 40 to 233 cpl

The standard-carriage ML192 and the wide-carriage ML193 dot-matrix printers achieve a 58-dB(a) noise level and an MTBF of 4,000 hours. Emulating the IBM 5152 graphics printer, the models also provide bidirectional utility printing



with short-line seeking logic at 160 cps; enhanced mode, 80 cps; and correspondence-quality mode, 33 cps. Seven- or 8-bit graphics resolution ranges from 60 by 144 dpi to 288 by 144 dpi. At 5 to 17.1 cpi, the ML192 prints from 40 to 132 cpl; the ML193, 68 to 233 cpl. Features include a re-inking ribbon cartridge, menu-select mode, self-test, downline-loadable character set, unidirectional print mode, an 8K-byte buffer, superscripts and subscripts, underlining, proportional spacing, horizontal tabs, 6 and 8 lpi and a printhead with a life of 200 million characters. \$499, ML192; \$699, ML193. Oki-data, an Oki America Company, 532 Fellowship Road, Mt. Laurel, N.J. 08054, (609) 235-2600. Circle 309

### Dot-matrix printer targets word processing

- 220 cps
- 72, 144 dpi
- Diablo interface

Used specifically for word-processing applications, the model 354 of the Printstation 350 series of dot-matrix printers achieves 220 cps. Employing a Diablo model 630 interface, the unit's printing capabilities include bold and emphasized print with an optional 64K-byte CPU with loadable character sets. Graphics input is available in dot densities of 72 or 144 dpi. Features include proportional printing, right justification, automatic centering and three-way paper handling for cut-sheet, unfold and multipart demand documents. \$2,895. Centronics Data Computer Corp., 1 Wall St., Hudson, N.H. 03051, (603) 883-0111.

Circle 310

### Dot-matrix printer generates 140 cps

- 80 columns
- ASCII character set
- Three pitches

# HITACHI ANNOUNCES OUR 39TH DISK DRIVE TRIUMPH.

Our new DK512-17 squeezes 171 MBytes of unformatted storage—the most ever—onto 5¼" coated media. That puts it at the top of our 5¼" Winchester line along with 36, 51, 86 and 120 MByte capacities.

The past 21 years have been full of triumphs like this. It began with our 14" products in the 60's and 70's.

Ten years ago, we introduced Winchester technology to our 14" drives. In 1980, we brought out a complete line of 8" Winchesters. In 1982, a 5¼" Winchester. Then, in 1984, our 2.6 gigabyte optical disk.

And this promises to be our best year yet.

## AND OUR 40TH.

Our DK815-5 packs 525 MBytes onto an 8.8" drive. It's so compact, you can put two side-by-side in a 19" rack for more than a gigabyte of storage.

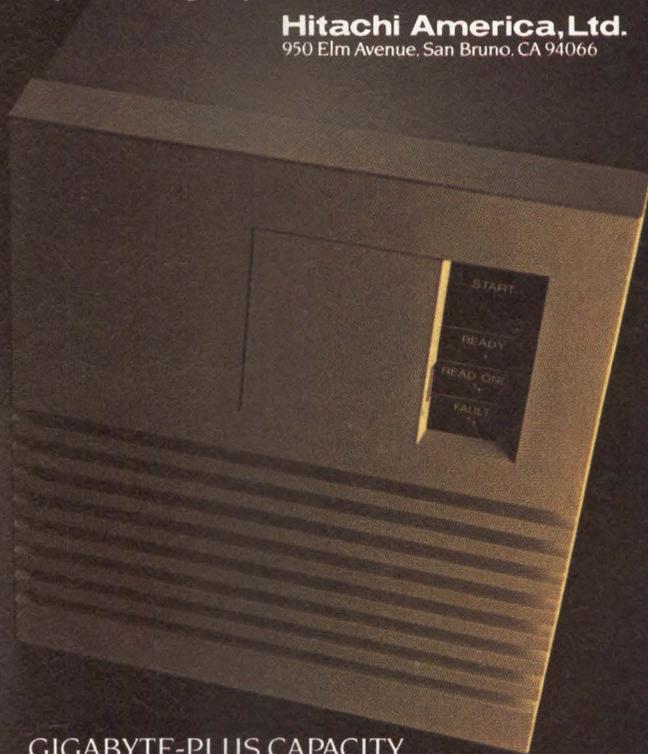
With 18 millisecond average access time, it's ideal for faster, larger systems.

So, if you want some reasons why we're the largest OEM supplier of disk drives in Japan, we'll give you 40 of them.

**Hitachi America, Ltd.**  
950 Elm Avenue, San Bruno, CA 94066



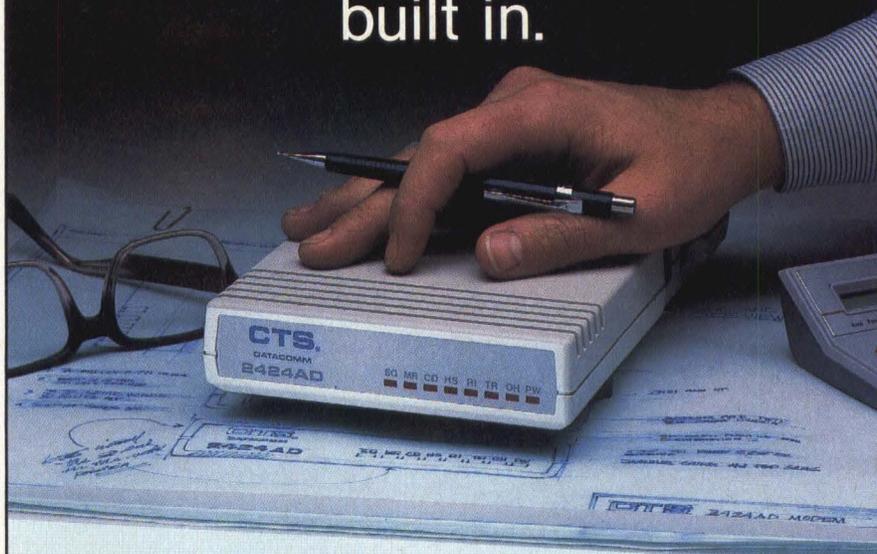
171 MB AND  
RELIABLE COATED MEDIA  
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GIGABYTE-PLUS CAPACITY  
IN A 19" RACK.

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check the one with  
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Our 2424AD meets CCITT V.22bis requirements and operates both synchronously and asynchronously at 2400 and 1200 bits per second. Other features include autodial with memory storage of up to ten telephone numbers (40 characters per number).

The CTS 2424AD offers **field reliability** with its two year warranty. And we demand our distributors provide you with the service you deserve.

**Brand reliability** is important at CTS, because it's important to you. That's why we suggest you check out our 2424AD before you buy a 2400 baud modem. You'll find what's built in to a CTS DATACOMM product is what you're looking for.

# CTS®

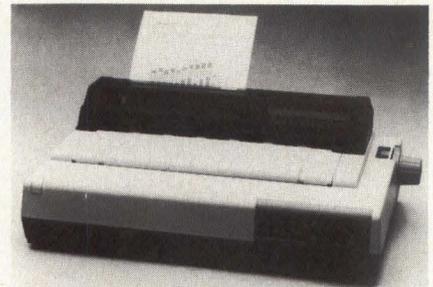
DATACOMM Products Division  
6900 Shady Oak Road  
Eden Prairie, MN 55344

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NEW TO THE INDUSTRY SINCE 1896.

## NEW PRODUCTS PRINTERS

An 80-column, 140-cps, dot-matrix printer, the Westrex 1 offers a 96-character ASCII and a 12-international-character set with true descenders. Printing in pica, elite or condensed pitches, the unit achieves superscript, subscript, underline and short-line seeking capabilities. Features include serial or parallel interface; 2K-byte buffer; auto sync; eight selectable baud rates; 120 variations of pitches, fonts and styles; 8-bit, dot-addressable graphics; a ribbon cartridge lasting up to 8 million characters; and self-test and diagnostics. The printer handles cut-sheet and roll-fed paper up to 9 inches wide, pin-fed fanfold paper up to 9½ inches wide and the original plus two copies. \$499. **Westrex OEM Products**, 51 Penn St., Fall River, Mass. 02724, (617) 676-1011. **Circle 311**



### Printer offers three modes

- Letter-quality text
- Color graphics
- Data processing

A serial-matrix impact printer, the model 750 executes letter-quality printing at 100 cps, data processing at 180 cps and color-graphics printing at 10 ips. Resolution for letter-quality is 180 by 360 dpi; draft-quality, 180 by 180 dpi. Graphics resolution varies from 60 by 60 to 180 by 180 dpi. Using a 24-wire printhead, the unit holds six resident fonts plus four downloadable fonts. RAM is expandable to 64K for downloaded fonts or transfer buffer. Capable of four-part printing, the model is compatible with Fujitsu DPL24 graphics and the Diablo 630 protocol for word processing. Friction feed and a 16K-byte buffer are standard. With an optional IBM PC and PC-compatible software package, the printer emulates the IBM color graphics printer and the Toshiba P1351 dot-matrix printer. \$1,990; \$95, emulation software. **JDL Inc.**, Suite 104, 2801 Townsgate Road, Westlake Village, Calif. 91361, (805) 495-3451. **Circle 312**

# We're not just talking about fifth generation parallel computers, we're delivering them.

We're Flexible Computer Corporation and we've developed the Flex/32 Multicomputer. The fifth generation massively parallel computer. The computer that everyone predicted would be the next major step for the computer industry. The Flex/32 provides the only multi-computing environment; parallel hardware with concurrent software.

The Flex/32 offers you a whole new generation of capabilities. And that's not just a lot of talk.

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#### **PARALLEL HARDWARE**

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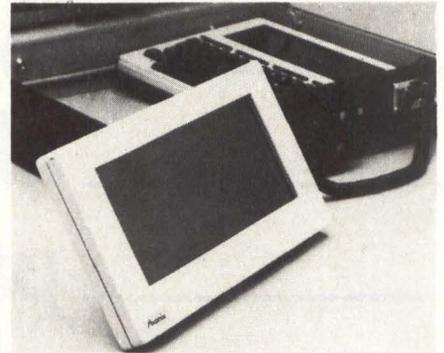
## TERMINALS

**Display system enhances portable computers**

- 25 lines by 80 characters
- 128K addressable dots
- 640-by-200-dot matrix

A 6½-by-11¾-inch, self-contained display system for augmenting the performance of portable and desktop computer

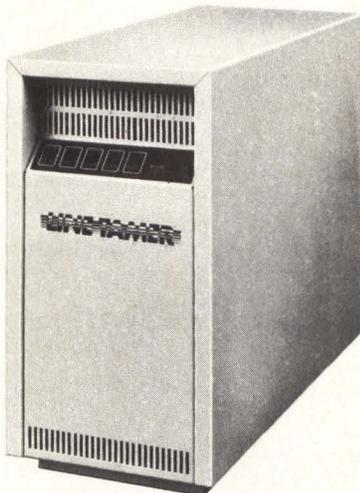
systems, the ThinView 25 displays 25 lines by 80 columns of text. For graphics display, the unit achieves 128K addressable dots, arranged in a 640-by-200-dot matrix, and separates data and graphics in split-screen mode. Picture elements are updated in 200 msec with a 70-Hz refresh rate. The internal, rechargeable battery system allows 16 hours of use. The sys-



tem is interfaced via optional serial or parallel ports. \$749. **Axonix Corp.**, 417 Wakara Way, Salt Lake City, Utah 84108, (800) 821-7093. **Circle 313**

## The Line Tamer™ UPS speaks for itself.

Its on-board micro and RS-232 port let it talk with your computer for power system monitoring and control. And its energy-efficient design slashes your operating cost.



See us at NCC Booth #5003

A conventional UPS calls for the battery and inverter to run constantly, wasting up to 40% of the power used. The Line Tamer Uninterruptible Power System for microcomputers is up to 80% efficient because it bypasses the battery and inverter during normal operation. Its unique design will save you money without sacrificing the performance of an on-line UPS.

The built-in Line Tamer Power Conditioner cleans and regulates AC power, removing spikes, transients, noise, overvoltages and undervoltages. When a blackout occurs, or line frequency varies beyond specified tolerances, the battery and inverter activate in phase, with no break in the sine wave output to your equipment.

The on-board microprocessor and RS-232 port let the Line Tamer UPS alert you automatically in the event of a power emergency, so you can begin an orderly shutdown. Among the user-defined warning and alarm parameters are High or Low Battery Voltage, Over or Undervoltage, Over-temperature and Battery Capacity.

It also keeps you informed of System Status, including Number of Power Outages, Number of Minutes on Inverter, Number of Hours on System, Number of Overloads, and Battery Time Remaining.

The Line Tamer UPS also features five front panel LED's for System Ready, Inverter On, Charger On, AC Present and Alarm. An audible alarm backs up the LED and automatic interrupts.

The complete specifications for the Line Tamer UPS for microcomputers speak well, too. For your copy, call or write Shape Magnetronics today.

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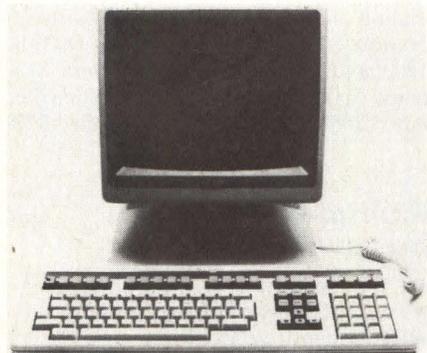
### Terminals include graphics, APL Set

- 15-inch screen
- 107-key keyboard
- 132 columns

The HDS-200 series of video display terminals consists of four models, the HDS-200 display terminal, HDS-200G graphics display terminal, HDS-201 APL display terminal and the HDS-201G APL/graphics display terminal. All models conform to ANSI X3.64 standards, are compatible with DEC software and offer a 107-key keyboard with 55 programmable function keys, two RS232C interfaces and a 15-inch, amber monitor. The model HDS-200 features an 80- or 132-column display, smooth scroll, four pages of memory, windows, viewports and text- and form-editing functions. Providing Tektronix 4010 and 4014, Retrographics VT640/DQ640 and Visual 500 terminal emulation, the HDS-200G supports local printing and offers a printer buffer. Resolution is 720 by 350 dpi



with 1,024-by-1,024, 4,096-by-4,096 or 320-by-720-pixel addressing in vector mode. In alpha mode, the unit displays a 96-ASCII character set in 35 lines by 72 columns. The HDS-201 and HDS-201G offer the capabilities of the HDS-200 and HDS-200G, adding an APL character set, APL keyboard with APL legends and the ability to create APL overstrike characters with 96 predefined APL overstrike characters and 32 user-defined overstrikes. \$995, HDS-200; \$1,295, HDS-200G; \$1,295, HDS-201; \$1,595, HDS-201G. **Human Designed Systems Inc.**, 3440 Market St., Philadelphia, Pa. 19104, (215) 922-2353. **Circle 314**



### Terminal combines graphics, alphanumerics

- 20 function keys
- 14-inch screen
- Tektronix emulation

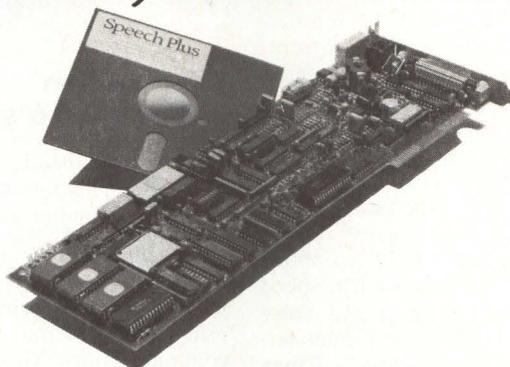
Compatible with DEC VT100, VT220 and VT240 terminals as well as Tektronix 4010 and 4014 terminals, the CIT-420 monochrome terminal supports both graphics and data- or word-processing applications. In interlace operating mode, resolution is 632 by 574 pixels; in non-interlace operating mode, 632 by 287 pixels. Addressable plot area is 4,096

by 3,120 pixels. Graphics mode includes line, arc, circle and box graphics. Tektronix emulation functions include variable line types, four character sizes and vector, point and incremental plotting. The terminal's 105-key, low-profile keyboard offers 20 programmable function keys with a 10-key, DEC editor-type keypad. Features include a set-up mode for

87 user-selectable operating features; RS232C and 20-mA loop printer ports; 14-inch, green, amber or white screen; APL character set; variable-speed, smooth scroll; and selectable static and blinking cursor control. \$1,295, Q100. **CIE Terminals Inc.**, 2505 McCabe Way, Irvine, Calif. 92714, (714) 660-1421.

**Circle 315**

## One board speaks over 450,000 words.



### CallText™ Voice Synthesizers have an Unlimited Vocabulary

With CallText Voice Synthesizers, your computer can *speak* electronic mail, stock quotations, sales status, weather reports or any vital information. And CallText products include a telephone interface, so people can call in and listen as any ASCII text file is converted to speech in real time.

Advanced technology gives CallText Voice Synthesizers full command of the entire English language — nearly a half million words.

For a live, interactive demonstration of how data can be delivered in voice, call (415) 969-6257.

#### Features

- High quality text-to-speech conversion.
- FCC-registered telephone interface with Touch-Tone decoding and generation.
- Speaker amplifier for local monitoring.
- Two models now available:
  - CallText 5000, IBM PC / XT compatible card. Includes I/O drivers; BASIC, C, Assembly languages.
  - CallText 5050, RS-232C computer peripheral.



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INCORPORATED

461 NORTH BERNARDO AVENUE, MOUNTAIN VIEW, CA 94039-7461  
TELEPHONE (415) 964-7023

CIRCLE NO. 93 ON INQUIRY CARD



**Calling unit operates with any modem**

- Bell-, CCITT-compatible
- 19.2K bps
- RS232C interface

Compatible with Bell 801C, CCITT V.25 and CCITT V.25bis standards, the ACE Universal autocall unit works with modems on the domestic or international circuit. Accepting asynchronous or synchronous dialing commands from a personal computer, terminal, CPU or front-end processor, the unit accepts input speeds of 19.2K bps. Non-volatile soft-strapping is accomplished via an external keypad or from a terminal connected to the serial interface. Features include RS232C and RS366 interfaces, error-message reporting, call-progress reporting, memory storage for 50 telephone numbers with 20 characters each, speed dialing, automatic redialing and automatic call initiation via synchronous terminal power-on. \$975. **Nokia-Kinex Corp.**, 6950 Bryan Dairy Road, Largo, Fla. 33543, (813) 541-6404. **Circle 316**



**Modem transmits over PSTN**

- 2,400 bps
- Dual autodial
- Bell-, CCITT-compatible

Offering full diagnostics and dual autodial capability, the 2,400-bps Datalinx 224 modem transmits data over the Public Switched Telephone Network (PSTN) or over two-wire, leased lines with fall-back data rates of 1,200 and 300 bps. The unit is CCITT V.22bis-compatible at

2,400 bps and Bell 212A- and 103-compatible at 1,200 and 300 bps, respectively. Capable of synchronous and asynchronous operation, the DLX 224 incorporates an automatic adaptive equalizer at 1,200 and 2,400 bps. Features include a pattern generator, an error detector and an integral auto dialer. \$895. **Penril DataComm**, 207 Perry Parkway, Gaithersburg, Md. 20877-2197, (301) 921-8600. **Circle 317**



**Data switch networks 16 systems**

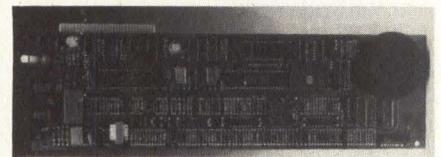
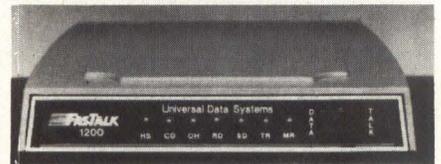
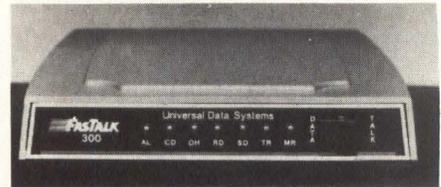
- 150 to 9,600 baud
- Peripheral-sharing support
- RS232 communications

Dynalink, a 16-port, microprocessor-controlled serial data switch, links together systems, printers and modems using RS232 serial asynchronous data communications. Up to eight communication channels can be active at any time. Achieving data rates of 150 to 9,600 baud, the unit requires commands from the attached devices to establish and break data links. Each of the 16 interfaces supports transmit, receive and signal ground and can be configured for data terminal equipment or data circuit-terminating equipment. \$1,575. **Dynapro Systems Inc.**, Suite 400, 177 W. Seventh Ave., Vancouver, B.C., V5Y 1L8, Canada, (604) 872-8631. **Circle 318**

**Modem series bundles software**

- 300, 1,200 bps
- Talk/data toggle
- Auto-dial/auto-answer

Operating with the Hayes Smartcom II software, the Hayes-compatible series of FasTalk modems comes with SignOn software. The FasTalk 300 and 1200 standalone models run at 0 to 300 bps and 0 to 300 or 1,200 bps, respectively.



The FasTalk 1200PC, a plug-in card compatible with the IBM PC, achieves 0-to-300 or 1,200-bps data rates. Modem capabilities include auto-dial/auto-answer, automatic selection of pulse or tone-dialing modes, talk/data toggle for switching between voice and data without redial, call-progress detection and a speaker for monitoring call progress. Supporting the XModem protocol, the software offers a learning mode, auto-start, phone directory, single-keystroke dialing and password-protected host operation. \$345, FasTalk 300; \$525, FasTalk 1200 and 1200PC. **Universal Data Systems**, 5000 Bradford Drive, Huntsville, Ala. (205) 837-8100. **Circle 319**

**Multiplexer acts as bus switch**

- 120 addresses
- IEEE 488 bus-compatible
- Redundant resource control

In bus-switch operating mode, the 4840 bus switch/multiplexer enables a single controller to address up to 120 primary addresses on up to four independent IEEE-488 buses. In multiplexer operating mode, it allows a single resource to be shared by up to four GPIB controllers, offering redundant control of the resource. Providing optical isolation of each IEEE-488 bus, the unit prevents ground loops and reduces system noise. Devices on any of the buses request service through an SRQ interrupt. \$2,895. **ICS Electronics Corp.**, 2185 Old Oakland Road, San Jose, Calif. 95131, (408) 263-4844. **Circle 320**

# Take a fast step forward in backup.

Introducing FasTape, the fully assembled subsystem from Archive. Now systems integrators, VARs, VADs and OEMs can add streaming tape to their Winchester disk-based systems almost as fast as you can say "backup."

## Get Serious.

You can't turn a PC into an effective engineering workstation, office automation file server, small business accounting system or any sort of "serious" computer without backup.

Today's advanced personal computers have more power than yesterday's minis, and with 20MB to 100MB Winchesters, they have backup needs to match.

FasTape is the answer. It's the serious solution for serious data.

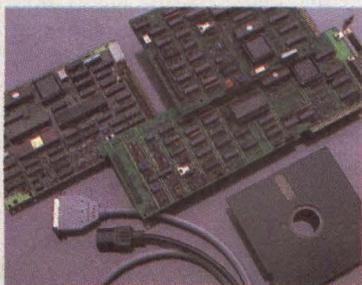


## It's About Time.

Until now if you wanted to add tape backup to your system, you had two choices. You could take the time, invest the money and put up with the aggravation of selecting a drive,

bending metal, specifying a power supply, adding a fan, building a controller and developing software. Or you could pay a small fortune to have a sub-system house do it for you.

Now just call Archive. We've done all the work for you. So you save time. And money.



*FasTape is a complete solution, including 1/4" streaming tape drive, power supply, switch selectable 115/230VAC, enclosure, cables, and utility software, with controllers available to interface FasTape to your system.*

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As the industry's leading manufacturer of 1/4" streaming tape drives we're able to offer 20MB, 45MB and 60MB backup systems at low OEM pricing.

As a tried and true OEM supplier we also understand what it takes to make you successful. Like controller/formatter boards—

IBM PC, SCSI and QIC-02 — technical support, fast delivery, volume pricing and a very reliable product.

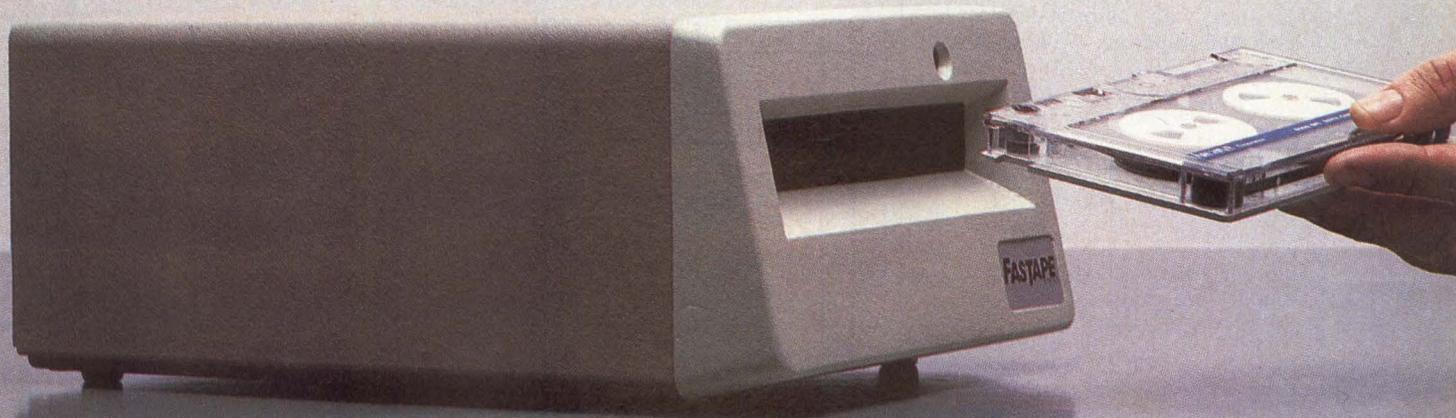
## You've Got Our Number.

Take the first step. Call Archive today at (714) 641-0279 and you can have a FasTape system up, running and fully integrated in less than a megasecond. Or write for more information. Archive Corporation, 3540 Cadillac Ave., Costa Mesa, CA 92626.

# ARCHIVE

Out front with backup.

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CIRCLE NO. 94 ON INQUIRY CARD



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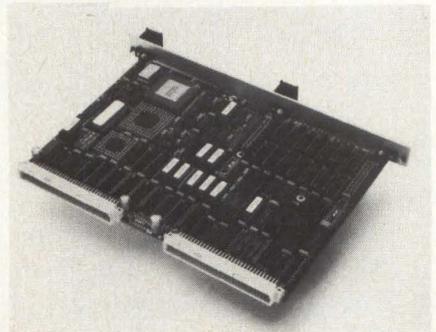
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IBM PC-compatible, the VocaLink CSRB240 voice-recognition board incorporates a connected-speech-recognition feature which allows input of data in a natural-speaking style. A command vocabulary of 15 to 20 words may be structured, including the digits and control words, to be spoken without unnatural pauses. This command/digit connected-speech vocabulary is used in conjunction with a 240-word vocabulary of discretely spoken words. The board uses an 80186 microprocessor and holds 128K bytes of RAM. \$1,650. **Interstate Voice Products**, 1849 W. Sequoia Ave., Orange, Calif. 92668, (714) 937-9010. Circle 326



**Catalog represents 100 manufacturers**

The summer edition of the Glasgal catalog contains specifications of data-communication products represented by over 100 manufacturers. Illustrated with photos, schematics, charts and diagrams, the catalog includes indexes and cross-referencing. The edition covers 68 product categories, including modems, multiplexers, multiplexing systems, protocol converters, channel-sharing units, tail-circuit adapters, LANs, fiber-optic equipment, buffers and network-management systems. **Glasgal Communications Inc.**, 207 Washington St., Northvale, N.J. 07647, (201) 768-8082.

Circle 327

**Catalog describes communications products**

The 1985 edition of the *Modem Mart Catalog* offers 98 pages of data-communications products from 30 manufacturers, including Gandalf Data, Hayes Microcomputer, Micom Systems and Racal-Vadic. The product listings include modems, multiplexers and protocol converters. **Modem Mart**, 905 Bassett Road, Cleveland, Ohio 44145, outside Ohio, (800) 321-2510; inside Ohio, (800) 362-6883.

Circle 328

**Directory presents 120 project-planning packages**

*Project Management Software Directory*, compiled by Jack Gido, lists companies that supply computer programs for

project planning, scheduling and control and the programs' application features. Specific "yes" or "no" designations are given for application features such as network format, capacity, time bases, duration estimates and graphics output. The directory also provides information

on computer hardware configuration and software operating systems required for over 120 project-planning software packages. \$21.95. **Industrial Press Inc.**, 200 Madison Ave., New York, N.Y. 10016, (212) 889-6330.

Circle 329

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## NEW PRODUCTS LITERATURE

### Directory accesses computer consultants

Providing 2,500 listings of reference-qualified professional computer consultants, the third edition of *The Directory of Consultants in Computer Systems* contains a keyword index of hardware and software expertise. Listings are arranged alphabetically within states and include computer languages most often used, machine-language expertise, number of client references, years of experience and number of consultants on the staff. \$75. **Research Publications**, 12 Lunar Drive, Drawer AB, Woodbridge, Conn. 06525, (203) 397-2600. **Circle 330**

### Catalog lists 150 software titles

Listing over 150 software titles for the Data General/One portable personal computer, the full-color Data General/One software catalog contains 80 pages. All of the software listed is available on 3½-inch media and runs under the MS-DOS operating system. Detailed summaries are provided for the packages, which are organized into 10 application types. The catalog lists over 250 IBM PC-compatible software packages, which run when used with the optional 5¼-inch disk drive. **Data General Corp.**, 4400 Computer Drive, Westboro, Mass. 01580, (617) 366-8911.

**Circle 331**

### Document forecasts export trade trends

The "Export Statistics Profile" for the computer and peripheral-equipment industry provides information on international competition, the U.S. share of foreign markets and export trends. Examining the U.S. industry's export performance over the last five years, the document forecasts 1985 U.S. exports by product and by country. It assesses the global market and identifies the best prospects for American suppliers. A user guide answers the questions most often asked by U.S. exporters on their products' potential and main foreign competitors. \$70. **Office of Trade Information Services**, U.S. Department of Commerce, P.O. Box 14207, Washington, D.C. 20044, (202) 377-2432.

**Circle 332**

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# CALENDAR

## AUGUST

- 5-8 "Digital Communications And Computer Network Systems" Course**, Washington, offered by the George Washington Continuing Engineering Education Program. Contact: Shirley Forlenzo, The George Washington University, Washington, D.C. 20052, (202) 676-8530.
- 7-9 National Computer Training and Education Conference and Exposition (COMTRED '85)**, Philadelphia Civic Center, Philadelphia, sponsored by National Computer Education Expositions Inc. (NCEE). Contact: NCEE, Suite 200, 1411 Walnut St., Philadelphia, Pa. 19102, (215) 972-8792.
- 12-16 "Fiber and Integrated Optics" Course**, San Diego, offered by The George Washington University Continuing Engineering Education Program. Contact: J.W. Perkins, The George Washington University, Washington, D.C. 20052, (800) 424-9773.
- 13-15 Computer Graphics '85 East**, Bayside Exposition Center, Boston, sponsored by the National Computer Graphics Association (NCGA). Contact: Chris Radiske, NCGA, Suite 601, 8401 Arlington Blvd., Fairfax, Va. 22031, (703) 698-9600.
- 14-16 The Second International Forum on Micro-Based CAD**, Colorado State University, Fort Collins, Colo., sponsored by Autodesk Inc. Contact: Colorado State University, Department of Industrial Sciences, Fort Collins, Colo. 80523, (303) 491-7240.
- 15-16 "Micro/Personal Computer Operating Systems" Seminar**, Washington, held by Digital Consulting Associates Inc. Contact: Software Institute of America, 8 Windsor St., Andover, Mass. 01810, (617) 470-3870.
- 20-23 "16-Bit Microprocessors" Course**, Toronto, offered by Integrated Computer Systems. Contact: Integrated Computer Systems, 6305 Arizona Place, P.O. Box 45405, Los Angeles, Calif. 90045, (213) 417-8888.
- 21-23 Macworld Exposition**, Bayside Exposition Center, Boston, produced by World Expo Co. Contact: Macworld Exposition, Mitch Hall Associates, P.O. Box 155, Westwood, Mass. 02090, (617) 329-7466.
- 21-23 Seventh Annual Conference on Interactive Video-disc in Education and Training**, J.W. Marriott Hotel, Washington, sponsored by the Society for Applied Learning Technology. Contact: Society for Applied Learning Technology, 50 Culpeper St., Warrenton, Va. 22186, (703) 347-0055.
- 26-29 Integrated Information Technology Conference and Exposition (INTECH '85)**, Moscone Center, San Francisco. Contact: Jill Nieman, National Trade Pro-

ductions Inc., Suite 400, 2111 Eisenhower Ave., Alexandria, Va. 22314, (703) 683-8500 or (800) 638-8510.

## SEPTEMBER

- 9-11 The Eighth Annual Federal Computer Conference**, Washington, Convention Center, sponsored by the National Council for Education on Information Strategies. Contact: Dallas Kinney, Conference Communications, P.O. Box N, Wayland, Mass. 01778, (617) 358-5356.
- 10-12 Midcon/85 High-Technology Electronics Exhibition and Convention**, O'Hare Exposition Center, Rosemont, Ill., sponsored by Electronic Conventions Management. Contact: Jerry Fossler or Nancy Hogan, Electronic Conventions Management, 8110 Airport Blvd., Los Angeles, Calif. 90045, (213) 772-2965.
- 10-13 "Teleconferencing" Seminar**, Selfridge Hotel, London, sponsored by Frost & Sullivan Inc. Contact: Carol Every, Industry Representative, Frost & Sullivan Inc., 106 Fulton St., New York, N.Y. 10038, (212) 233-1080.
- 10-13 "Packet-Switching Networks For Modern Data Communications" Course**, Washington, offered by The George Washington University Continuing Engineering Education Program. Contact: Ron Donais, The George Washington University, Washington, D.C. 20052, (202) 676-8523.
- 16-18 Data Storage 85 International Forum**, Red Lion Inn, San Jose, Calif., sponsored by Disk/Trend Inc. Contact: Cartlidge & Associates Inc., Suite M-259, 1101 S. Winchester Blvd., San Jose, Calif. 95128, (408) 554-6644.
- 16-20 FOC/LAN '85, The Ninth International Fiber Optic Communications and Local Area Networks Exposition**, Brooks Hall/Civic Auditorium, San Francisco, organized by Information Gatekeepers Inc. Contact: Information Gatekeepers Inc., 214 Harvard Ave., Boston, Mass. 02134, (617) 787-1776.
- 18-20 The UNIX Operating System Exposition and Conference**, the New York Hilton and Sheraton Hotels, New York, sponsored by Unigroup of New York. Contact: Don Berey or Robert P. Birkfeld, National Expositions Co. Inc., 14 W. 40th St., New York, N.Y. 10018, (212) 391-9111.
- 30 "Digital Switching" Seminar**, Logan Airport Hilton, Boston, sponsored by Communications and Information Institute. Contact: Danae Fasano, Conference Assistant, Information Gatekeepers Inc., 214 Harvard Ave., Boston, Mass. 02134, (617) 232-3111.

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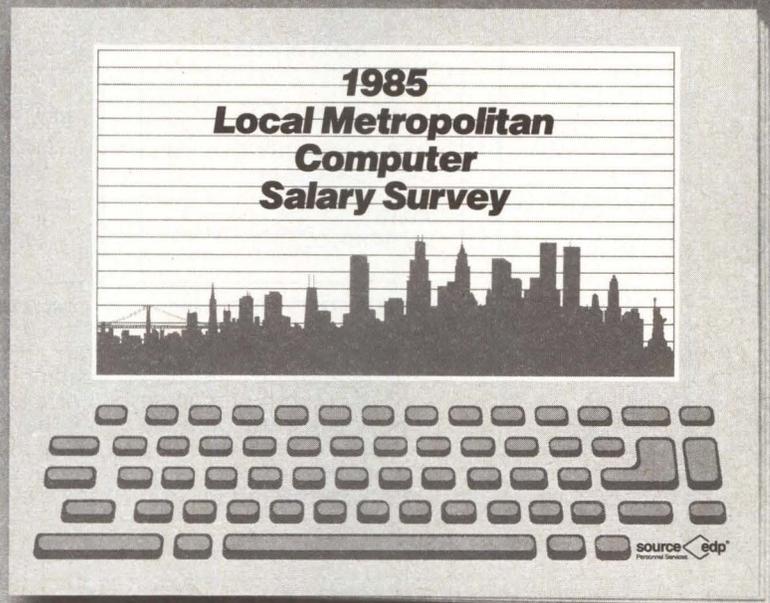
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# SYSTEM INTEGRATORS' NOTEBOOK

*Tips that make dollars and sense*

## SOFTWARE COMBINATIONS SOLVE BACKUP PROBLEMS

**Carl Warren**, Western Editor

By combining commercial software with your own programs and batch files, you can more easily back up large volumes of data stored on a Winchester disk drive.

Possibly the simplest method of backing up data in the IBM Corp. PC environment is to use its built-in COPY command. This command allows you to copy single files by entering COPY [file name] and destination. You can back up complete directories of files by using the "wildcard" capability—which essentially says "copy everything"—by entering: COPY \*.\* and destination.

Although COPY is useful, it can be slow if done manually, especially if you're trying to back up as much as 10M bytes. But you can automate the process of copying and switching directories by using batch command files or by writing a simple program in a high-level language. For example, you can create and back up a batch file by entering:

```
COPY CON: AUTOCOP.BAT :this copies all console input to
                        the file AUTOCOP.BAT
CD \                   :go to the root directory
COPY *.* A:           :copy all the files to drive A
```

The next lines would change the directories. For example, "CD tools" would change the directory from the root to the subdirectory "tools."

Although this method works, it doesn't take into account the target disk eventually getting full. Moreover, it also requires detailed knowledge of all the subdirectories being used.

An alternative to writing code is to use either the BACKUP utility provided with MS-DOS and PC-DOS, or to rely on a commercial product.

The DOS BACKUP utility provides a number of switches that allow you to back up files in subdirectories, files that have been modified, and to choose files created on or after a specific date. In addition, BACKUP checks available space on the target disk and issues a prompt indicating when to switch disks. Moreover, you can append files to existing disks, thus maximizing available media.

Taking a similar tack as BACKUP is a product called JET, published by Talltree Systems. JET handles the same functions as BACKUP faster.

Interestingly, JET can be used in combination with Cipher Data Products Inc.'s FloppyTape ¼-inch tape cartridge drive. FloppyTape emulates a standard floppy disk and therefore allows for directories. However, using a drive not being expected by the system requires that you reassign the drive by using the DOS function verb ASSIGN. Thus ASSIGN A»C means that all inquiries to drive A are directed to drive C. Typically, the drive assignment for Cipher's FloppyTape is D. Because JET expects to read and write to and from drive A, the assignment would be: ASSIGN A»D.

Major subsystem manufacturers incorporate sophisticated backup utilities into their disk/tape products. Examples include Sysgen Inc. and Tallgrass Technologies Corp.

A backup solution that is cloaked as a file-by-file backup utility is BAKUP, from Infotools Inc. BAKUP is actually a full-file management system with management audit trails and reports.

Backup utilities aren't limited to MS-DOS/PC-DOS environments. Systems that operate under UNIX or Microsoft Corp.'s XENIX can also employ batch techniques to solve the backup problem. □

Solved a hardware or software integration problem lately? If so, other *Mini-Micro Systems* readers would like to know about it. Please send your integration notes to Carl Warren, Western Editor, Mini-Micro Systems, Suite 236, 12233 W. Olympic Blvd., Los Angeles, Calif. 90064. Phone (213) 826-5818 Ext 307.

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# ADVERTISERS INDEX

Advanced Matrix Technology Inc. . . . .	71	Kimtron . . . . .	116
Altos Computer Systems . . . . .	20-21	Lear Siegler Inc. . . . .	175
Ampex Corp., Computer Products Div. . . . .	18-19	Lexidata Corp. . . . .	168
Ampro . . . . .	180	Lockheed Getex . . . . .	50
Apollo Computers . . . . .	74-75	Maxtor Corp. . . . .	53
Archive Corp. . . . .	82-83, 187	Megatek Corp. . . . .	44
AT & T Electronic Photography and Imaging Center. . . . .	123	Memory Products . . . . .	54-55
AT & T Information Systems . . . . .	94, 171	Microplot Systems . . . . .	129
Auscom. . . . .	93	Microware . . . . .	112
Burr-Brown Corp. . . . .	70	Mini-Micro Systems. . . . .	14, 96, 117, 141, 165, 193, 195
Carroll Touch Technology . . . . .	135	Mostek Corp. . . . .	68, 72-73, 79
Century Data Systems (a Xerox Co.) . . . . .	179	Motorola Semiconductor Products . . . . .	46-47
Charles River Data Systems . . . . .	132	Multi-Tech . . . . .	90
CIE Terminals . . . . .	22, 28-29	NCR Corp. . . . .	32-33
Compaq Computer Corp. . . . .	97-108	NEC Peripherals . . . . .	139, 154-155
Concept Technologies . . . . .	160	Newbury Data . . . . .	127
Concord Data Systems. . . . .	111	Onyx & IMI Inc. . . . .	189
CTS Corp.—Datacomm Products . . . . .	182	Output Technology . . . . .	156
CXI . . . . .	115	Parallel Computer . . . . .	17
Datamedia. . . . .	67	Pelikan . . . . .	76
Data Plotting Services Inc. . . . .	26	Perkin-Elmer Corp. . . . .	56
Datapoint. . . . .	172	Pertec Peripherals Corp. . . . .	151
Dataram . . . . .	120	Quadram Corp. . . . .	30-31, C2
Delta Airlines . . . . .	128	Quantum Corp. . . . .	142-143
Digital Equipment Corp. . . . .	80-81	Qume . . . . .	130-131
Dranetz Technologies. . . . .	84	R-Systems. . . . .	10
Dual Systems . . . . .	4	Radio Shack (Tandy Corp.) . . . . .	49
Emulex Corp. . . . .	40-41	Raster Technologies. . . . .	86
Epson America, Inc. . . . .	144	RDS-Relational Database Systems . . . . .	148
Facit Inc. . . . .	152	Seiko Instruments USA. . . . .	89
Flexible Computer . . . . .	183	Sequent Computer Systems . . . . .	6-7
Genicom. . . . .	60-61	Shape Magnetronics Inc. . . . .	184
Gould Inc., Computer Systems Div. . . . .	12-13	Sony Corp. . . . .	166-167
Hayes Microcomputer Products . . . . .	140	Speech Plus . . . . .	185
Heurikon Corp. . . . .	190	SyQuest Technology . . . . .	59
Hewlett-Packard . . . . .	8-9, 159	Talaris . . . . .	136
Hitachi America Ltd. . . . .	181, 191	TEAC Corp. of America . . . . .	164
Houston Instrument Div. of Bausch & Lomb . . . . .	147	Texas Instruments Inc. . . . .	C3
Human Designed Systems Inc. (HDS). . . . .	43	Unify Corp. . . . .	62-63
Ibex Computers Corp. . . . .	96	Universal Data Systems Inc. . . . .	C4
Illbruck/USA. . . . .	117	Vectrix. . . . .	192
IMS International . . . . .	25	Wilson Laboratories . . . . .	5
Infotron Systems Corp. . . . .	1	Wyse Technology. . . . .	124
Integrated Solutions Inc. . . . .	118-119	Xylogics, Inc. . . . .	64
Invitational Computer Conferences . . . . .	177		
Iomega Corp. . . . .	34	See P. 198 for Classified Advertisers	
ITT Information Systems . . . . .	163	See P. 196-197 for Career Opportunity Advertisers	
Keytronic. . . . .	15	See P. 203-204 for Mini-Micro Marketplace	

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# MARKET TRACK

**Sharon Hassell**  
Assistant Editor

## CAE companies invade electronic CAD market

Companies specializing in computer-aided design will lose a large portion of the electronic CAD market to companies making their mark specializing in computer-aided engineering for electronics, according to a recent research letter from The Technology Research Group, Boston.

The electronic-design, market-research company estimates that within three years the majority of board-design tools will be sold by CAE companies. These companies, including Daisy Systems Corp., Mentor Graphics Corp. and Valid Logic Systems Inc., are expected to introduce board-layout systems this year.

According to Technology Research figures, unit shipments of board-design tools from CAE companies are expected to reach 1.6 thousand by 1987.

This would equal CAD companies' predicted shipment figures, giving CAE companies 50 percent of all shipments.

The layout systems from CAE companies will offer two major advantages over products from CAD companies, says Technology Research. First, engineers will be able to purchase all major engineering-oriented tools from one company, and second, board-layout systems will allow tight coupling of circuit design and implementation. This will alleviate problems with data-exchange and back-annotation problems that have plagued the integration of CAE and CAD systems in the past.

Another advantage CAE companies have over CAD companies is greater experience in serving engineers. Technology Research says CAE companies were the first to recognize and offer solutions to the problems engineers face in designing complex circuits. Alternately, CAD companies such as Applicon, Calma Co. and Computer-

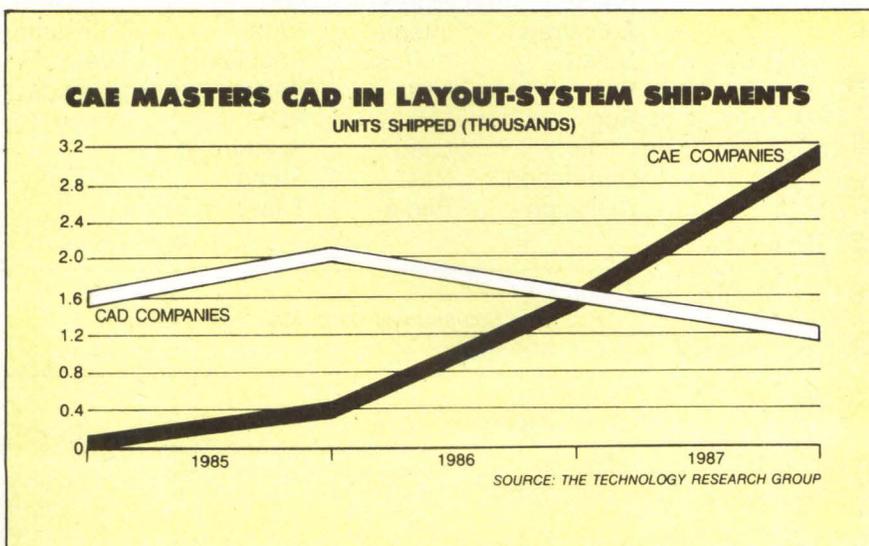
vision Corp. merely sell tools for draftsmen to use in laying out electronic circuits on printed circuit boards after engineers have already designed them.

## Bit-mapped in, non-graphics out in software

This will be the last year that non-graphics software will have any significance in the personal computer market, according to a report from International Resource Development Inc. (IRD), Norwalk, Conn. The research company says bit-mapped, integrated software will become so popular that it could lead to an IBM Corp. introduction of a proprietary 8086-based chip family that will include an embedded graphics instruction set.

By graphics, IRD means the capability to mix font-creation graphics with word processing to create a typesetting system for personal computers or the ability to run a picture-oriented database management system. Although these products already exist for the Apple Computer Inc. Macintosh, they will begin to be available for the IBM PC family by the year-end, says IRD.

The report also states that the software market is expected to change in structure several times in the next decade, starting with sharp price reductions and a switch to cooperative programs between now-competing software houses. IRD says software houses, making use of the cooperative environments, will find ways to unbundle their products, thus increasing variety in available software. □



Shipments of CAE board-layout systems are expected to soar, leaving CAD products far behind. By 1987, CAE companies will claim 50 percent of the units shipped; reflecting a 100 percent increase from their 1985 shipments.

Interest Quotient (Circle One)  
High 471 Medium 472 Low 473

# ARTFUL INTELLIGENCE

By John K. Young

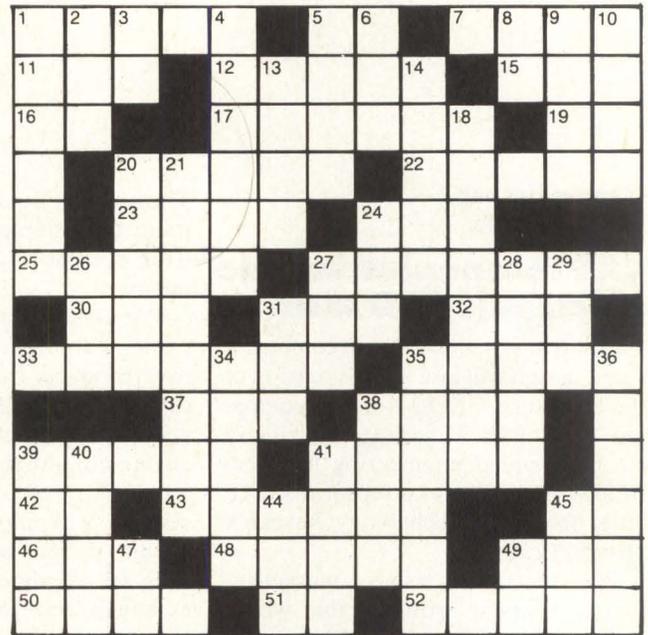
A C R O S S

- 1 Power anomaly
- 5 Logical operation
- 7 Information going in or out of computer
- 11 Teaspoonful (Abb.)
- 12 Man's name
- 15 Another 1-Across
- 16 Its capital is Little Rock (Abb.)
- 17 South American Indian
- 19 Musical note
- 20 Craftier
- 22 Symbol in scale of 10
- 23 Turns brown
- 24 Are in poor health
- 25 Computer lookalike
- 27 Program that stores characters for later printing
- 30 Units of energy
- 31 Indicated airspeed (Abb.)
- 32 Computer problem
- 33 Lining up to be served
- 35 System operator (Abb.)
- 37 Do something
- 38 Deck post to wind cable around
- 39 Reclaimed wool
- 41 Old-fashioned guy
- 42 Sure of success
- 43 Commissioned Navy officer of lowest rank
- 45 Yours truly

- 46 Money for the waiter
- 48 Latin American dance music
- 49 Sweetheart
- 50 Computer games' way out
- 51 You and I
- 52 Repetitions of instructions

D O W N

- 1 Pipeline condition when each pass always references the same global section
- 2 Kind of a group
- 3 Regius Professor (Abb.)
- 4 Sir Lancelot's Astolat love
- 5 Persian poet and mathematician
- 6 Unedited
- 8 Aluminum (Chem.)
- 9 Ankles
- 10 Soviet knockoff of Apple II
- 13 Greek god of war
- 14 Science of converting sounds into electromagnetic waves
- 18 1,024 characters
- 20 Remember information
- 21 Programming
- 24 American Physical Society (Abb.)
- 26 Monetary unit of Romania
- 27 Temporary decrease in voltage
- 28 Full of vigor
- 29 Individual as aware of himself



- 31 Function
- 34 Graphic function keys
- 35 Transmission entity
- 36 Dots composing characters
- 38 Becomes stuck in
- 39 Mighty \_\_\_\_\_
- 40 Popular operating system
- 41 Information stored on disks
- 44 Witnessed
- 45 Graphic tablet drawing
- 47 3.1417
- 49 Operate

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*Solution will be printed next month.*

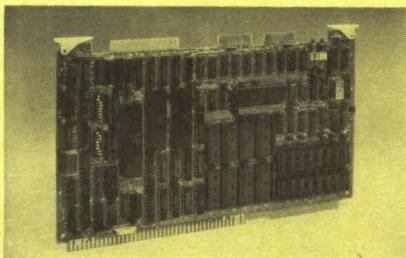
Answers to June's puzzles can be found on Page 188.

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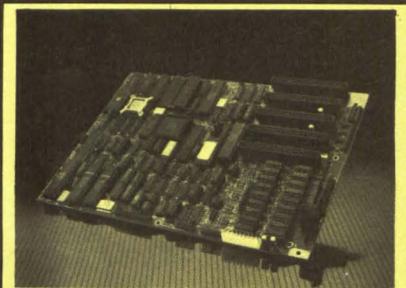
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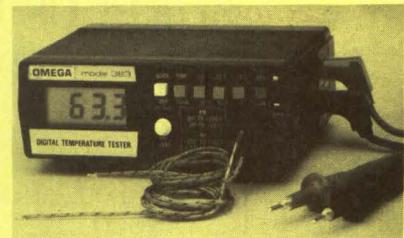
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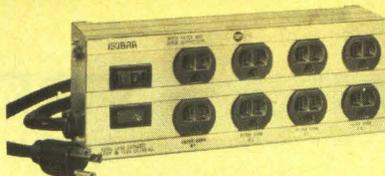
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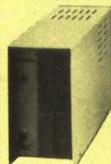
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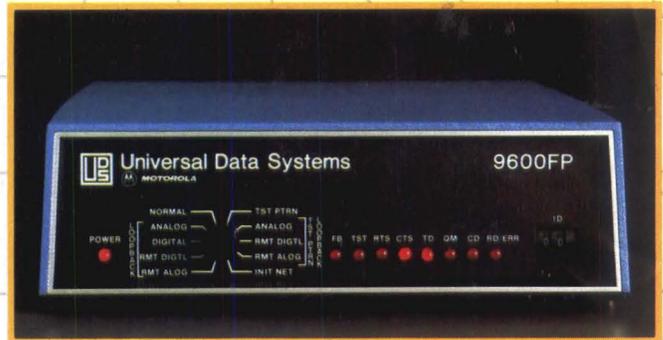
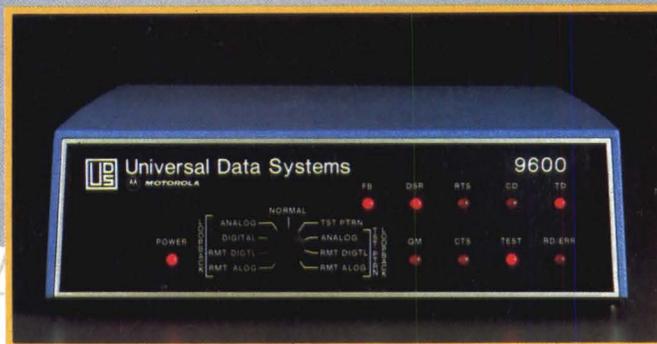
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