

APRIL 1987

# Mini-Micro Systems

THE MAGAZINE FOR COMPUTER SYSTEMS INTEGRATION

A CAHNERS PUBLICATION

**Conner Peripherals launches  
100M-byte  
3½-inch  
Winchester**



## **SPECIAL REPORTS:**

- **VMEbus boards**
- **Laser printers**
- **Portable computers**
- **80386 technology**

SMARTMODEM 2400



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We'd like to pass along some data on why you should insist on a Hayes Smartmodem 1200™ or Smartmodem 2400.™

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Second, Hayes has a long-standing and unwavering commitment to customer support, not just to service its products, but to serve as a resource for information, assistance, and technical advice for everyone from the home user to the corporate communications manager. Moreover, Hayes provides more than a warranty on the material and workmanship of its products. Hayes warrants they will perform as promised, as well.

Should you need further data to help you make up your mind, we offer this reassuring statistic: Year after year, more personal computer owners buy far more Hayes modems than any other kind.

And that may be because a Hayes modem is the only modem with the ability to transmit and receive data, and at the same time convey a feeling of peace of mind.

**Hayes**®

SAY YES TO THE FUTURE

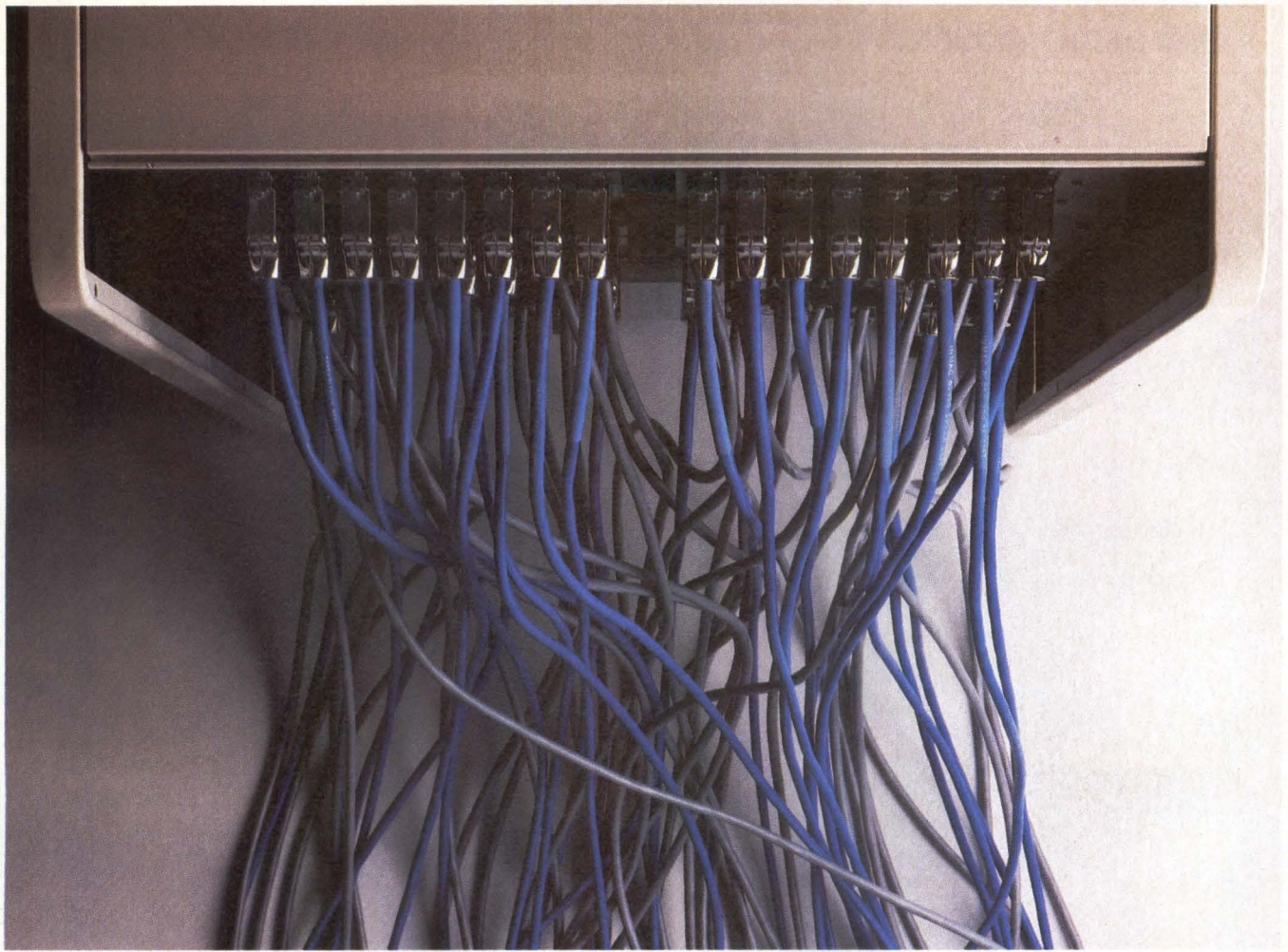
This offer involves an extension of the standard Hayes Two (2) Year Limited Warranty (making a total of 4 years) on Hayes 2400 and 1200 bps modems purchased between February 1, 1987 and April 30, 1987. The purchaser must return the warranty registration card to be registered for the free extended warranty. However, the Two Year Limited Warranty is not conditioned on the return of a warranty registration card. A complete statement of the Two Year Limited Warranty can be found on the product packaging or obtained from Hayes. The usual cost for the extended warranty is \$50 for 1200 bps modems and \$75 for 2400 bps modems.

This offer applies to Hayes Smartmodem 2400,™ Smartmodem 2400B,™ Smartmodem 1200,™ Smartmodem 1200A,™ Smartmodem 1200B,™ Smartmodem 1200C,™ including those modems bundled with Smartcom II™ software.

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CIRCLE NO. 1 ON INQUIRY CARD



## How many more reasons do you need to Unplug your computer?

Until now, connecting 128 terminals to your computer meant one thing. A myriad of cards taking up precious space on the backplane. And accomplishing nothing but communications. All of which could frustrate almost any self-respecting system designer into hanging up his calculator.

Well, at Systech, we understand the serial communications problems of a multi-user system. So we developed The Unplug™ asynchronous distributed multiplexer that can be used with any Multibus®, VMEbus or Multibus® II system.

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You see, what we did was move part of the computer's operating system—the part devoted to managing traffic to and from the terminals—out of the computer and into The Unplug. Giving the host computer the freedom to concentrate on more important tasks.

We know it sounds simple. And the truth is, it is. In fact, you might wonder why no one thought of it before. Then again, no one else has our commitment to make your job easier. And a lot more gratifying.

Just give us a call at Systech to hook up with The Unplug. Then you can start figuring out what you want to add on next.

Instead of trying to figure out how to untangle all those wires.

Systech Corporation, 6465 Nancy Ridge Drive, San Diego, CA 92121, (619) 453-8970.

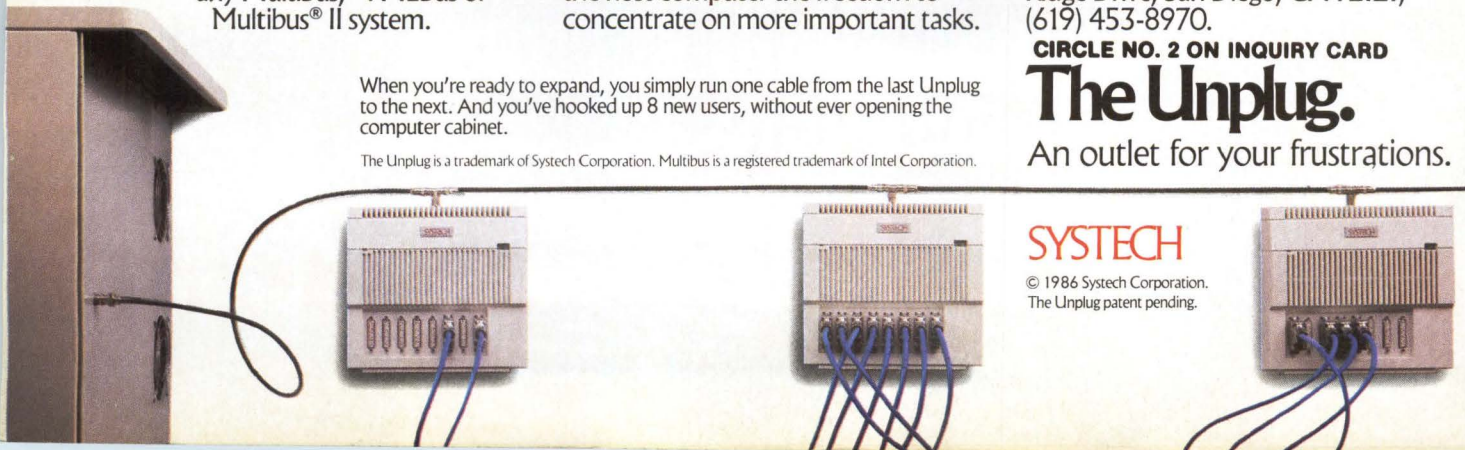
**CIRCLE NO. 2 ON INQUIRY CARD**

# The Unplug.

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When you're ready to expand, you simply run one cable from the last Unplug to the next. And you've hooked up 8 new users, without ever opening the computer cabinet.

The Unplug is a trademark of Systech Corporation. Multibus is a registered trademark of Intel Corporation.



**SYSTECH**

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The Unplug patent pending.



# Series 32000 makes VAX power more personal.

**NOW YOU CAN JOIN HEWLETT-PACKARD, FUTURENET, EATON, COMPUTERVISION, AND OVER 50 OTHER COMPANIES IN BRINGING 32-BIT POWER TO THE LARGEST INSTALLED BASE IN THE WORLD**

There are over 10.7 million\* IBM® personal computers and compatibles in use today. That's the largest "installed base" in the world — an enormous pre-existing market that represents an enormous marketing opportunity. And National Semiconductor is leading the way for OEMs, systems integrators, VARs and VADs to take full advantage of it.

Because it's now possible to put the power of a VAX™ 11/780 into the PC environment. At a mere fraction of the cost.

PC add-in boards, based on National's Series 32000® family, allow you to immediately upgrade almost any personal computer to true 32-bit performance.

Simply by plugging a Series 32000-based board into one of the computer's standard expansion slots,\*\* you can deliver the power and speed of a \$30,000 workstation for about \$3,000.

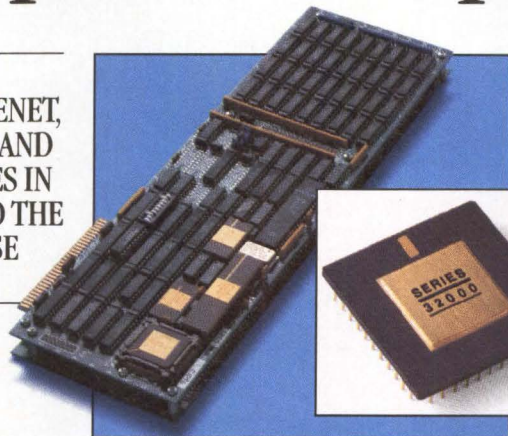
That means you can put high-performance CAE/CAD capabilities onto every engineer's desktop. You can distribute more computing power to more people at a lower cost in a multi-user, multitasking office environment.

\* Source: Infocorp 1987

\*\* For IBM PC/XTs, PC/ATs, and compatibles. Standard PCs need to be upgraded with a hard disk (10 Mbyte, minimum) and a larger power supply.

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You can capitalize on the hot new market in desktop publishing. The opportunities are endless.

## DELIVER TRUE 32-BIT POWER

Already more than 50 key systems integrators, VARs and VADs have realized the potential of this market by using PC add-in boards.

And more PC add-in board manufacturers are using the Series 32000 than all other 32-bit microprocessors combined.

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And, because the entire family was designed with the same highly symmetrical, orthogonal 32-bit architecture, the Series 32000 is fully software-compatible across all its CPU offerings. So your customers' software investment is completely protected even as they migrate to higher performance.

## BRIDGE THE UNIX-DOS GAP

A Series 32000-based add-in board gives your customers the best of both worlds in operating systems. Since the Series 32000 was the first 32-bit microprocessor to support full demand-paged virtual UNIX™, your customers can run high-performance engineering and business applications in the most cost-efficient multiuser, multi-

tasking environment in the industry. Yet they can still run important personal-productivity tools like spreadsheets, word processing, and project managers under DOS.

## PLUG INTO THE MARKET NOW

Obviously, the potential of the PC add-in market is enormous. And it's already being tapped with Series 32000-based boards being manufactured by a number of OEMs. If you're a systems integrator, VAR or VAD, contact one of these companies about their products.

Or if you're a board-level OEM yourself, follow their lead by contacting National Semiconductor about how you can design the Series 32000 into your own product.

### PC ADD-IN COMPANIES USING SERIES 32000

#### Selected OEMs

Aeon Technologies, Vail, CO (303) 986-3599  
 Cybertool Systems USA, San Jose, CA (408) 263-1700  
 Definicon Systems, CA (818) 889-1646  
 DFE Electronic Data Systems, CA (415) 829-3925  
 Hightec EDV Systems, Saarbrücken, Germany  
 Matrox Electronic Systems, Quebec, (514) 685-2630  
 Opus Systems, Cupertino, CA (408) 446-2110  
 Sritek, Cleveland, OH (216) 526-9433  
 Zaiaz, Huntsville, AL (205) 881-2200

#### Selected VARs

|                       |                        |
|-----------------------|------------------------|
| Analog Design Tools   | Lattice Logic USA      |
| Auto-Trol Technology  | Matrox Elec. Sys.      |
| Cambridge Graphics    | National Semiconductor |
| Computervision        | Oasys                  |
| Cybertool Systems USA | Olivetti               |
| Hightec EDV Systems   | Siemens AG             |

Either way, the PC add-in market represents one of the most significant business opportunities in years. With over 10,000,000 prospective customers. And the Series 32000 can help you reach every one of them.

Personally.

National Semiconductor  
 MS 23/200  
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 Santa Clara, CA 95052-8090

 **National Semiconductor**

CIRCLE NO. 3 ON INQUIRY CARD

## Discover the true potential of laser printing.

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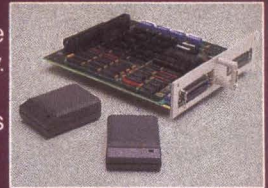
**Superior Handling.** When it comes to paper handling, the Genicom 5010 Laser is the printer to beat. It delivers double the standard input and 10 times the output capacity of other leading brands.

Handle big jobs easily with the 5010's automatic 200 sheet feeder. Shift into overdrive with a Genicom exclusive: an optional 50 sheet feeder cassette. There's even a manual feed slot, so you can print single sheets and transparencies without interrupting your work flow. And keep your work moving without a hitch, thanks to Genicom's efficient paper path.

But no matter what you feed the 5010, the result is laser perfect. Whether it's word processing that approaches typeset quality or high resolution graphics, the Genicom 5010 leaves nothing to the imagination.

**It's Convertible.** With Genicom's unique personality cartridges, the 5010 converts into multiple identities. Like a Diablo® 630, an IBM® Graphics Printer, or a Hewlett-Packard® LaserJet Plus for starters. Changing personalities is easy. Simply plug in a new cartridge. In seconds, the 5010 is up and running with any computer worth mentioning, plus the very latest laser software.

When it comes to print styles, the 5010 converts to your personality. Choose from a variety of fonts. Insert up to four font cartridges at once, and vary type styles within the same document.



**Take Command.** The 5010's prominent control panel is sophisticated simplicity. Just push a button to select fonts, input cassette, forms overlay, paper size, characters per inch, lines per inch and form feed. Even the 5010's diagnostic readout speaks your language, with a 32 character LCD that informs you of printer status in plain English.

**Pass The Limit.** Genicom designed the 5010 to surpass the standard limits for printer reliability. That's why the 5010's OPC drum and developer last 28,000 pages. And the toner cartridge has a 5000 page life, instead of just 3000 pages like other lasers.

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CIRCLE NO. 4 ON INQUIRY CARD

# Mini-Micro Systems

A CAHNERS PUBLICATION

VOL. XX NO. 4

APRIL 1987

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Innovative packaging, powerful processors, easy-to-use add-ins and wider software options all mark significant advances in portable computers

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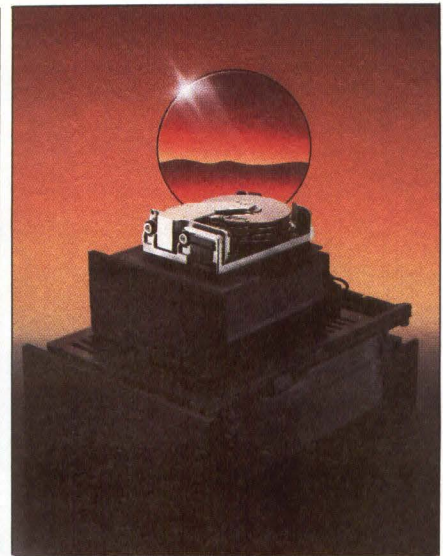
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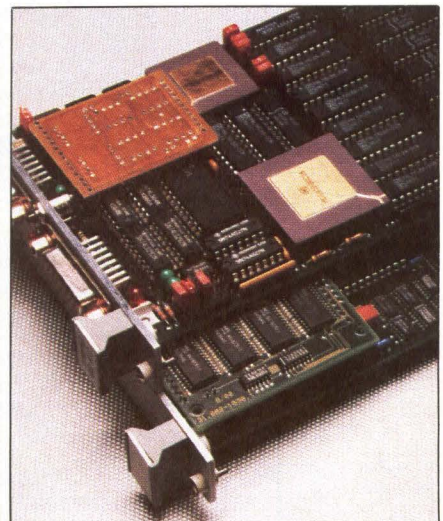
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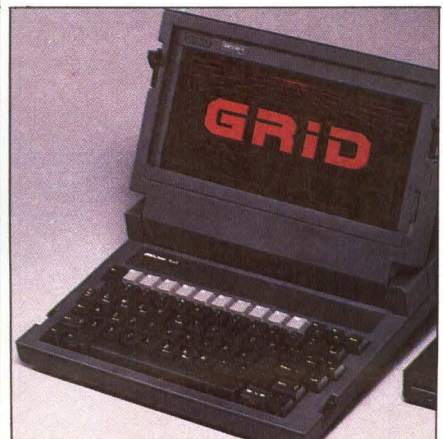
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p. 27 . . . . . Conner leapfrogs the competition. Art design by Lutat, Batty and Associates. Courtesy of Conner Peripherals Inc.



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**CIRCLE NO. 5 ON INQUIRY CARD**

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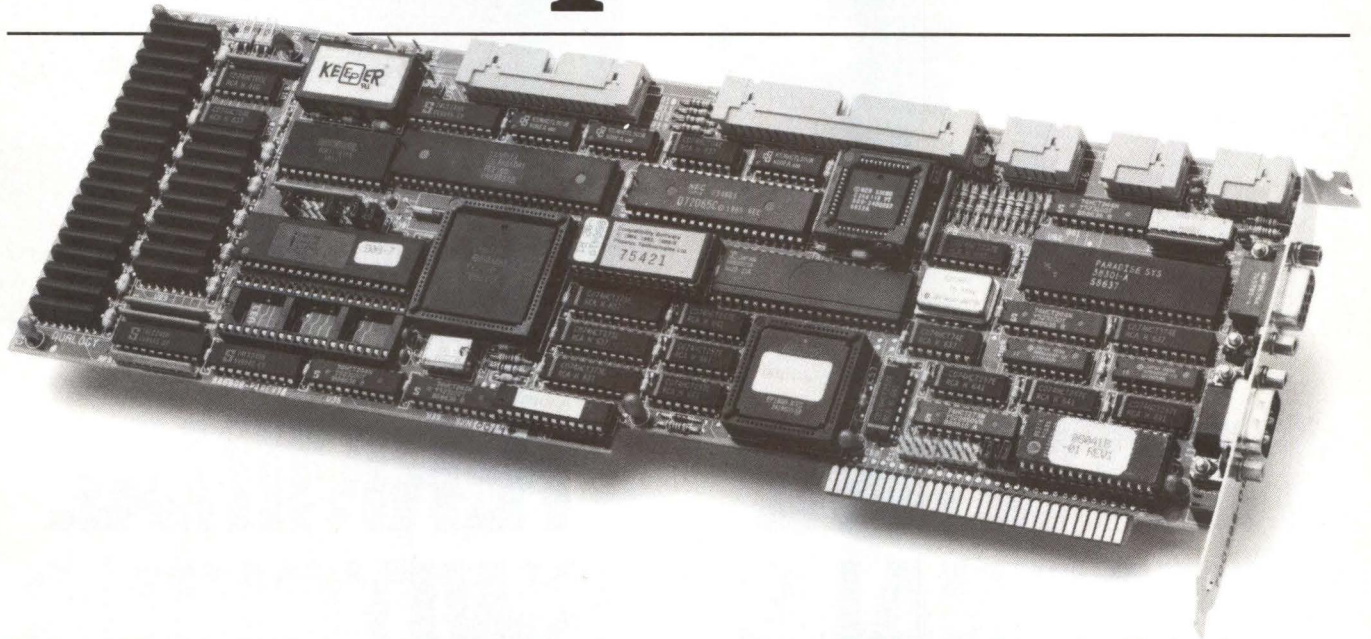
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**CIRCLE NO. 6 ON INQUIRY CARD**



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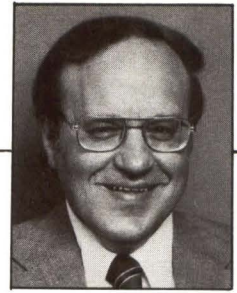


# EQUINOX

## Smart Connections For Dumb Terminals.

CIRCLE NO. 7 ON INQUIRY CARD

# EDITORIAL



## 80386-BASED COMPUTERS SHATTER INDUSTRY BASICS

In the short term—1987—the impact of 80386-based personal computers centers on blazing processing speed. In the long term—1988 and beyond—the impact of 80386-based personal computers holds the promise of a new era in computing power and an enormous marketing payoff.

This new generation of personal computers sits on a desktop, offers performance for about \$6,000 that just a few years ago called for a \$350,000 superminicomputer, and integrates easily into virtually every computing application. The unprecedented power and low price of 80386-based units will shake the computer industry to the core. It will also completely revamp the business practices of personal computer, minicomputer and mainframe manufacturers, vendors, resellers and users alike. But not all is positive, however. On the negative side, market pitfalls abound that could sidetrack widespread adoption.

The 80386 chip is evolutionary in that it represents an orderly performance progression from 8 bits, to 16 bits and now to 32 bits. It is revolutionary in that it can address a staggering 64 trillion bytes (terabytes) of physical and virtual memory. This seemingly unlimited memory access and a 20-MHz clock rate pave the way to true multiprocessing, multitasking, high-resolution graphics, engineering workstation, multiuser system and artificial intelligence applications. Consequently, 80386 computers can compete functionally with minicomputers and mainframes.

The 80386 burst on the scene in the second half of 1986 when Compaq Computer Corp. introduced the first IBM Corp. software-compatible desktop computer based on this chip. This bold maneuver rattled the marketplace, leapfrogged IBM's anticipated, but as yet unannounced, version and heralded the new age of desktop supermicrocomputers.

The reaction was immediate. Users bought and competitors scrambled. Industry experts estimate that Compaq probably sold more than 10,000 of their 80386 machines in 1986 and might sell around 150,000 in 1987. In

addition, the experts claim that all 80386-computer vendors could ship about 300,000 units in 1987, not counting an IBM entry.

But the first wave of buyers is an easy sell: engineers, scientists and developers simply want a newer, faster machine. These eager types always like to experiment with faster processing, denser memory and deeper number crunching. And they are willing to pay the high initial cost.

Selling to the second wave of buyers, though, is a different story. These business, manufacturing and commercial users prefer to play a waiting game. They're more interested in standards, operating systems, application packages and system integration. And they are more price sensitive.

What's more, the version of MS-DOS that will take full advantage of the power of the 80386 chip (386DOS) will not be available from Microsoft Corp. until 1988 or 1989.

Furthermore, Microsoft's 286DOS, an updated version of the IBM PC operating system and due in mid or late 1987, will fully support the 80286 but only partially support the 80386 chip. And finally, application software packages that can fully utilize the 80386 chip's advanced features must await system software availability.

But when system software does become available, the computer industry will undergo a radical transformation into an explosive marketing period. Computer makers, system integrators, resellers and users will be awash in new product choices, prices, and applications. Further complications in this scenario revolve around what products and strategies IBM will introduce.

It will be a nontrivial task, then, to study, investigate, and evaluate the 80386 arena. To meet the monumental challenges imposed by the onrushing 80386 cataclysm, therefore, system integrators must start planning their configuration strategies immediately.

*George V. Kotelly*

George V. Kotelly  
Chief Editor

# SCSI FORUM

A technology conference, featuring 2 days of business and technical sessions on the **Small Computer System Interface**, an optional one-day SCSI Tutorial, and a SCSI Exhibitors Program.

**WHERE** The Doubletree Hotel on Great America Parkway in Santa Clara, California

**WHEN** May 12-14, 1987

**WHO** Engineering, Planning, Marketing and Management Personnel of companies using SCSI, or considering its use, should not miss this conference.

## SCSI BUSINESS AND TECHNICAL PROGRAM

This two-day program (May 13-14) consists of the following sessions:

- A User's Perspective of SCSI
- SCSI Market Structure, Size and Trends
- Interface Alternatives: A Business Perspective
- Future SCSI Directions
- SCSI Performance Issues
- SCSI Test and Evaluation Issues
- SCSI Firmware and Software Issues
- SCSI Hardware Issues
- Storage Technology — The Driving Force Behind SCSI
- SCSI for Tape

## SCSI TUTORIAL

On Tuesday, May 12, 1987 an Introduction to SCSI and SCSI Protocol will be covered in the morning, and SCSI Commands and SCSI Variants will be covered in the afternoon. Attend the 1-day SCSI Tutorial, or with the SCSI Business and Technical Program as part of the 3-day SCSI Forum Program.

## SCSI EXHIBITORS PROGRAM

Exhibitors Workshops will be held on May 12-14. On the evening of May 13, an Exhibitors Reception will provide delegates and guests with the opportunity to see SCSI products.

## KEY ISSUES

- Is high performance SCSI an oxymoron?
- Should SCSI remain a configurable standard?
- Is the copy command useful or useless?
- Who really needs multihost support?
- Who's using search?

## FEATURED SPEAKERS

- **Norman Petersen**, Fujitsu America, President and General Manager
- **Roger Johnson**, Western Digital, President, Chairman and C.E.O.
- **Bill Frank**, InfoCorp, Senior Vice President, Director of Mass Storage Services

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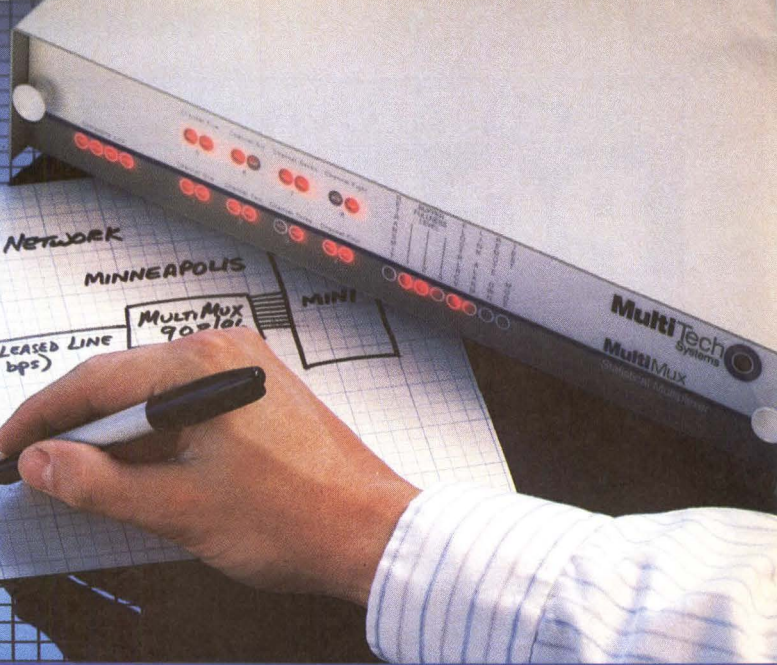
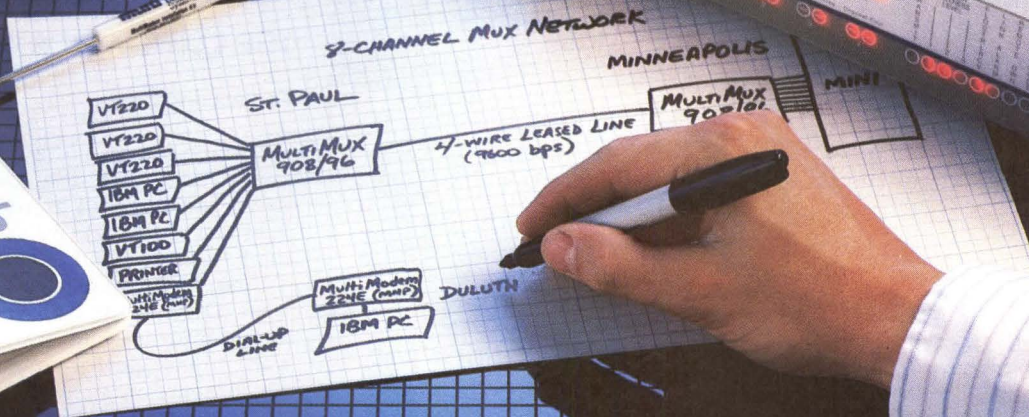
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- With that in mind, we'd like to introduce you to the new MultiMux™ from Multi-Tech Systems. The biggest difference between the MultiMux and other muxes is that you can easily install a pair of them yourself, without the excessive time, expense and frustration you've avoided in the past.

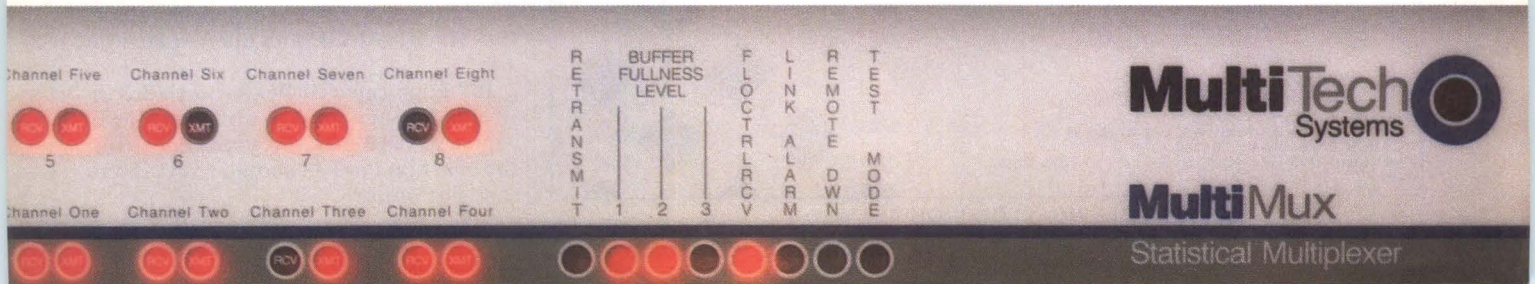
- You may know us best for our MultiModem™ line of 1200 and 2400 bps dial-up modems. The same simple approach we use for our modems is now used for our MultiMux. We even use similar "AT" type commands.
- The MultiMux is offered in four- and eight-channel versions, with or without an integral 9600 bps V.29 modem. Instead of paying for up to eight dial-up lines for your asynch terminals, PCs or printers, you can use a pair of MultiMuxes to combine them all into a single leased line, for much less money.
- Convinced? If not, consider that the MultiMux is completely command driven, with a supervisory port, help menus, downline loading, full LED display, statistical reporting, and an integral 1200 bps dial-up modem for remote configurations and diagnostics. Also, consider that the MultiMux (like all of our products) is manufactured and supported by us in Minnesota, and that we've been doing so since 1970. Finally, consider our price. You'll find that to be a pleasant surprise too.
- Please call us toll-free at **1-800-328-9717**, for additional information... get a multiplexer that's as simple as it is smart!

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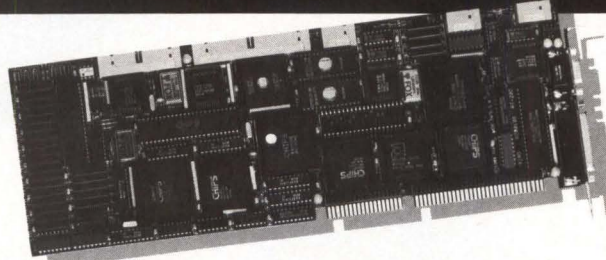
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**CIRCLE NO. 10 ON INQUIRY CARD**

# LETTERS

## THE CUSTOMER'S RIGHT

To the editor:

I would like to add a little "heat" to your article "SCSI test gear's here, but drive analysis still at issue," (MMS, February, Page 37). We at ACT believe the hard truth requires the light of day.

First, let us establish who says/wants what. Drive manufacturers want lower manufacturing and test costs. They want higher performance, capacities and production yields, all with greater product differentiation. System houses want lower prices and higher reliability, capacities, performance and shipment yields. Test equipment suppliers want more business, test specifications and product differentiation. They also want earlier participation in drive designs to insure testability.

Let us not forget that the customer is king—in Japan he is god. In this case, the customers are the system houses. They buy disk drives from the guys who buy test equipment from people like ACT. So, let us give the customer what he deserves: good product at reasonable prices with on-time deliveries.

How do you do that with SCSI drives when SCSI controllers do not provide signals at the connector or at special test points? In multiple steps:

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- Separately test SCSI PCBAs;
- Marry the two and exercise the final product.

In this fashion, the customer gets good product, the disk drive manufacturer ships good product without re-designing anything, and the test equipment people get to sell product today.

**Jose C. Elaydo**  
 President  
 Applied Circuit Technology  
 Anaheim, Calif. 92806

### Corrections:

The labels of Apple Computer Inc.'s two new personal computers were inadvertently swapped in "Apple opens Macintosh to system integrators," (MMS, March, Page 30). The Macintosh II is the more powerful of the machines and has six expansion slots; the Macintosh SE has one expansion slot.

In "High-capacity flexible disk drives invade low-end storage arena," (MMS, January, Page 34), the y-axis label for the chart on Page 43 should read "thousands of units."

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*Ted Odolecki*

Ted Odolecki, Business Manager — Terminals

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Charles Humphrey  
Computer & Software News  
11/24/86

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of growing  
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momentum."

"There was a  
level of electricity  
running through  
the show, stimulated  
by a wave  
of new products,  
that I haven't  
felt for several  
years."

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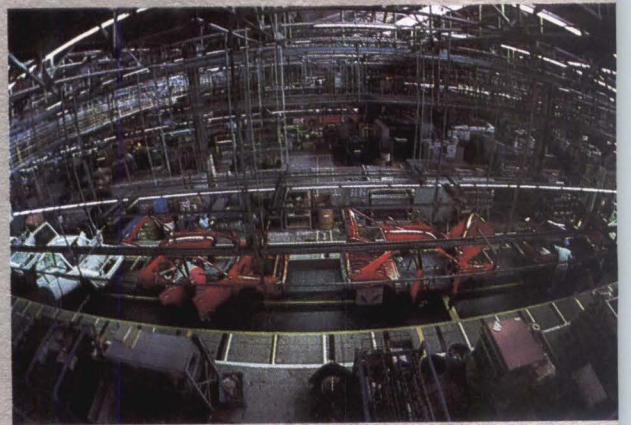
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CIRCLE NO. 13 ON INQUIRY CARD

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it  
now.



“As the world’s largest privately-owned software company, Cincom develops software for Digital and IBM systems in national and international markets,” states Stanley J. Sewall, vice president of R&D. “For the past four years, we’ve been designing all our business solutions on Digital equipment. Digital’s total systems approach – the interactiveness of its hardware and software – gives us tremendous business leverage.”

One significant advantage has been a dramatic drop in Cincom’s software development costs. “Until we started using Digital,” says Mr. Sewall, “the expense



**“Computing systems so cost-effective, Cincom uses them to develop its software products – even those for the IBM market.”**

of developing each line of code had soared. As a conservative estimate, now we have cut our costs in half.” Mr. Sewall is equally impressed with the time savings and productivity gains Cincom has made. “With Digital systems, our software development cycle is four times faster than before. As a result, we’re beating our competitors to market with our products. And that’s the kind of edge everyone can appreciate.”

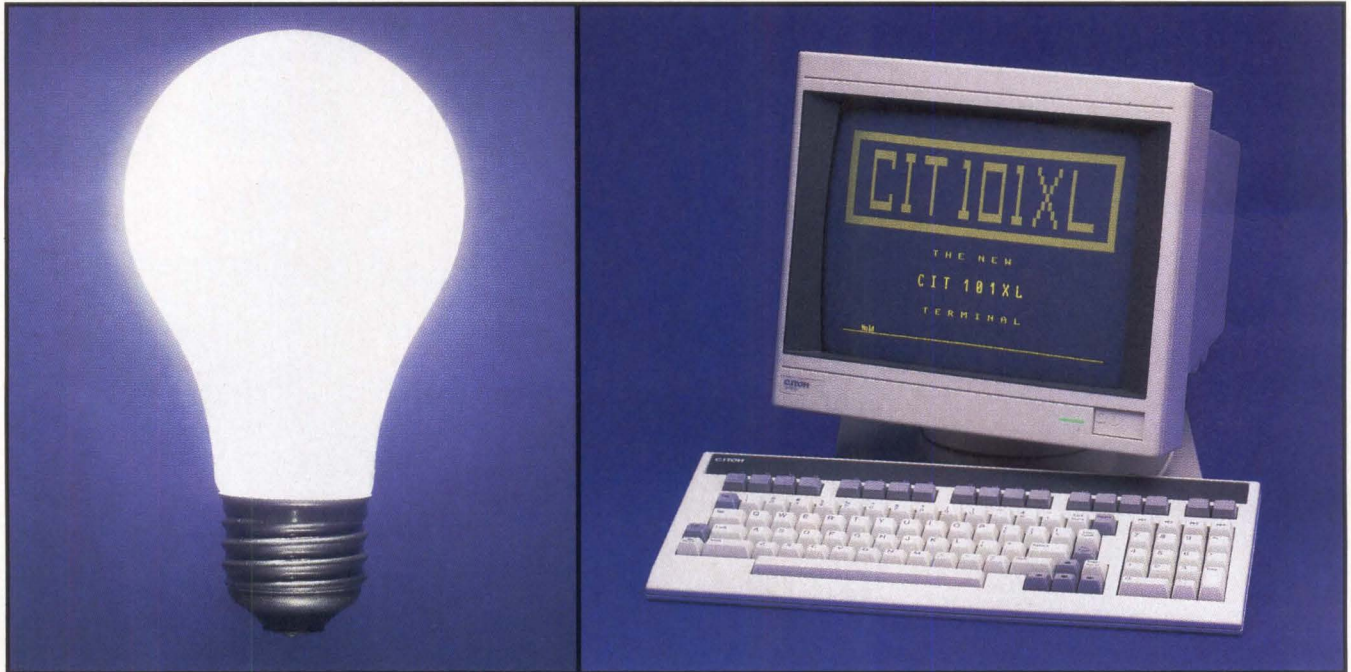
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**CIRCLE NO. 8 ON INQUIRY CARD**

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Replacing your aging VT100 terminal with our CIT 101XL is as easy as changing a 100 watt light bulb. Because from start to finish, the whole process takes only about 60 seconds.

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But don't think we re-invented the light bulb completely. While the CIT 101XL keyboard retains that comfortable VT100 layout and functionality, we improved it by arranging the cursor keys into an inverted "T" and adding 16 function keys.

The CIT 101XL. It's time to shed some new light on the old.

For more information on the CIT 101XL terminal, contact CIE Terminals, a C. Itoh company, 2505 McCabe Way, Irvine, CA 92714; or call (714) 660-1421 or our toll-free number (800) 624-2516.

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CIRCLE NO. 14 ON INQUIRY CARD

# BREAKPOINTS

## **LEADING COMPANIES ESTABLISH NETWORK COMPUTING FORUM**

The first meeting of the Network Computing Forum will be held this June in Boston. The Forum, a group of more than 25 corporations and research centers, was established in March to foster practical network computing applications in scientific and engineering environments. In such environments, computational and data-management tasks will be distributed across a network of diverse systems, allowing users to access information through their own workstations. Charter members of the Forum, led by Apollo Computer Inc., include Apple Computer Inc., Concurrent Computer Corp., Motorola Inc., Oracle Corp., Texas Instruments and Westinghouse Electric Corp. Membership is open to companies involved in developing applications and products for network computing.—*Megan Niels*

## **SOFTWARE RESALES NO LONGER AN ISSUE AT DEC**

Is it a response to the overwhelming criticism Digital Equipment Corp. has received from its users, or has the Maynard, Mass., company merely revised a statement it offhandedly made toward the end of last year that barred users from including their software licenses when reselling their computer? No one will ever know for sure, but DEC has reversed its decision to exclude operating system software from the sale of used computers. Previously, buyers of secondhand DEC equipment had to pay DEC a license fee for the software. Now, when the system is sold, so is the software, which means that thousands of users can breathe a sigh of relief that their computers are still marketable.—*Tim Scannell*

## **MARRIAGE OF CONVENIENCE: MS-DOS AND VMS VIA ETHERNET**

The place: DEXPO South '87, Nashville, Tenn. The time: April 28-30. Logi-craft Inc., Nashua, N.H., will be showing its 386WARE subsystem. Built around an Intel Corp. 80386 processor, the multitasking server—a combination of hardware and file-handling software—provides up to eight DOS sessions on Digital Equipment Corp. VT terminals. Routed to a VAX or VAX cluster over Ethernet, 386WARE gives each MS-DOS user 704K bytes of memory with a 64K-byte cache in addition to six 32M-byte virtual disks on the host. The system, with six expansion slots, supports up to 16M bytes of memory. A four-user version costs \$9,995; an eight-user version, \$12,995.—*Doug Pryor*

## **NEW COMPANY PUTS A TRACE ON SCSI**

Developers who are tacking things onto a system via the SCSI bus may be willing to spend \$3,995 with start-up instrument maker D-Designs of Palo Alto, Calif., for its model 341 DSC-202, a non-intrusive SCSI bus tracer. Designed to be controlled via an ASCII terminal or an IBM Corp. PC, the DSC-202 emulates any SCSI device. It delivers information about device and bus integri-

ty and about throughput, signal and CCS (Common Command Set) activity.

—*Carl Warren*

### **MAP 3.0 IS DUE OUT THIS MONTH, BUT VENDORS MAY BALK**

A draft set of specifications for version 3.0 of Manufacturing Automation Protocol (MAP), the factory-automation network scheme backed by General Motors Corp., is due out this month from the Corporation for Open Systems. Meanwhile, vendors of network equipment continue their campaign to delay implementation of MAP 3.0 until they get their money's worth out of investments in MAP 2.1 and 2.2 equipment. "It would not surprise me at all if we were to see a delay in [implementation of] 3.0," says Joseph P. Schoendorf, president of MAP-user Industrial Networking Inc., Santa Clara, Calif. "MAP 2.X is good enough. Let's not get carried away by trying to make it perfect."

—*Jim Donohue*

### **MERGER PROMISES FAULT-TOLERANT PICK SYSTEM**

With the acquisition of Parallel Computers Inc. by General Automation Inc. now signed, sealed and delivered, plans are in the making to add fault tolerance to GA's line of ZEBRA minicomputers, which run under the Pick operating system. Parallel, Santa Cruz, Calif., will continue to market its UNIX-based fault-tolerant supermicrocomputers as a wholly owned subsidiary of General Automation of Irvine, Calif. In exchange for its experience in designing fault-tolerant systems, Parallel will gain GA's manufacturing and marketing expertise and access to its distribution channels in the United States and Europe.

—*Mike Seither*

### **ROCKWELL UNVEILS 14.4K-BPS FAX-PC MODEM**

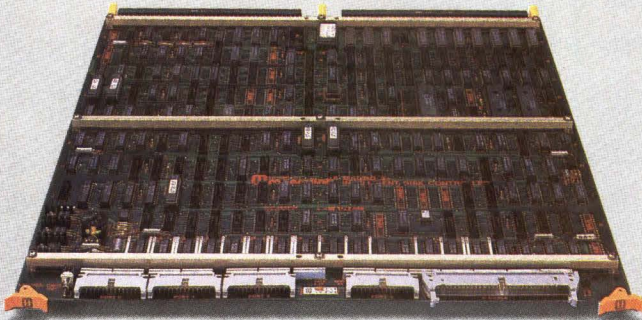
Rockwell International Corp., Newport Beach, Calif., will begin shipping samples this month of a modem board that can transmit at 14.4K bps over dial-up lines. The half-duplex modem is being marketed to facsimile OEMs and the growing number of vendors who make products that allow personal computers and fax machines to exchange data files. Another market is in telephone equipment that transmits still-frame video. The R144HD meets a number of CCITT standards allowing it to transmit down to 300 bps. Production units, scheduled for June, will cost \$140 in quantities of 1,000.—*Mike Seither*

### **STEREOSCOPIC SYSTEM BRINGS NEW DEPTH TO COLOR DISPLAYS**

If your color graphics display system doesn't give you enough perspective on complex molecular models, consider the IBM Corp. PC/AT-based stereoscopic graphics system (SGS) from Tektronix Inc., Beaverton, Ore. The unit uses a liquid crystal shutter affixed to a 16-inch color display to provide left circular polarization for the left eye and right circular polarization for the right eye. Glasses or clip-ons similar to flip-up sunglasses correctly decode for the 3-D effect. The \$9,800 SGS 420 comes with a stereographic adapter card for the 512-by-512-pixel display, the color monitor, graphics primitives (including 3-D transforms), a stereo modular driver and the glasses. Packages from Grafpoint and COMPRESS furnish Tektronix 4107 terminal-emulation and molecular-modeling functions, respectively.—*Jesse Victor*

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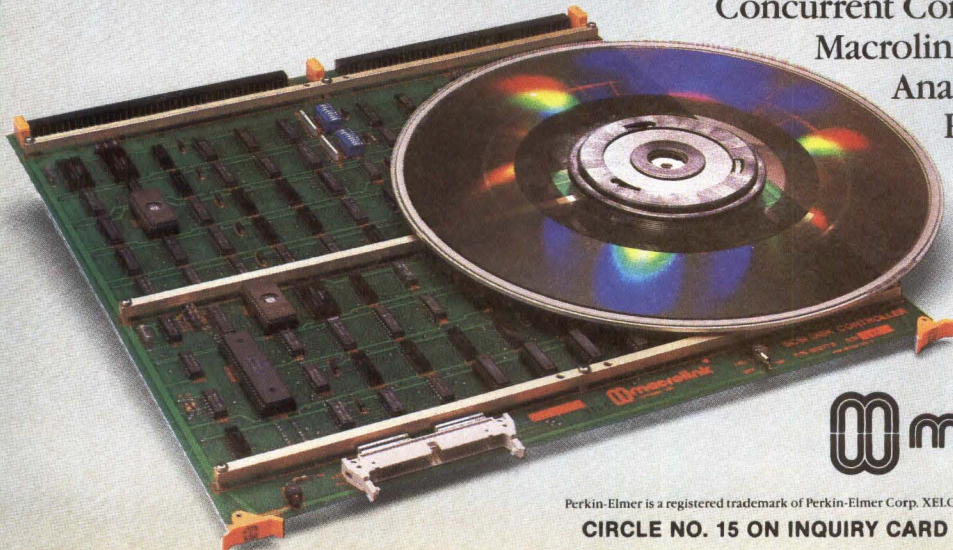
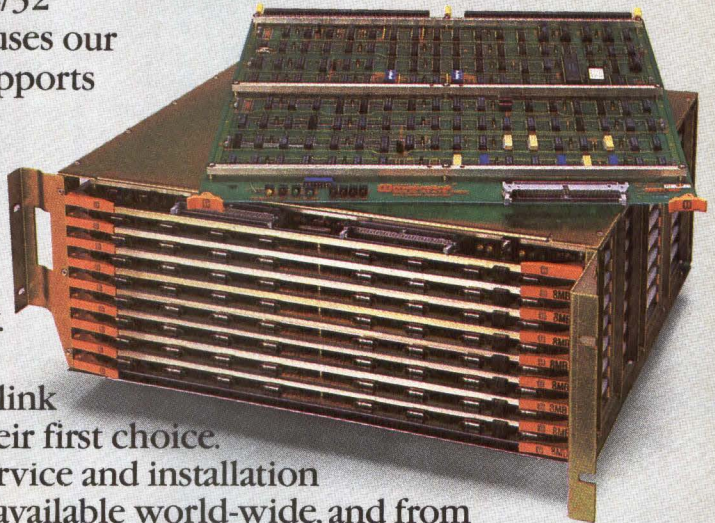
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**CIRCLE NO. 15 ON INQUIRY CARD**

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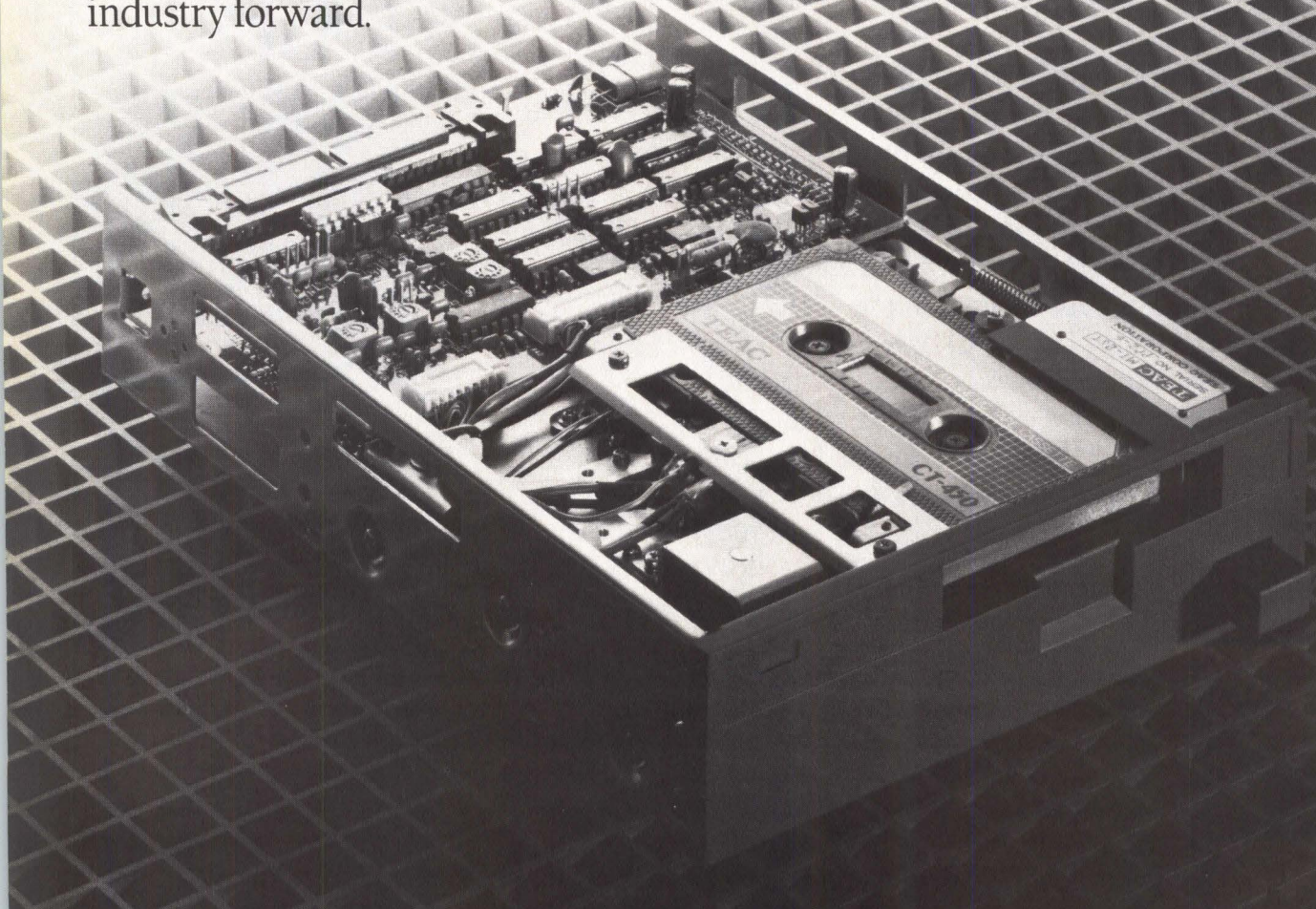
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CIRCLE NO. 18 ON INQUIRY CARD



## **FIBER OPTICS ADD DISTANCE TO TERMINAL-WIRING SCHEME**

System integrators who have latched onto Systech Corp.'s "Unplug" to unclutter cable connections on their computers now have further reason to smile. The San Diego company is broadening its terminal-cabling system to include SPURs—Systech Pluriaxial Unplug Repeaters. Through the use of fiber optics and a new star connection that allows coax to fan out in five directions, Systech has extended from 1,000 feet to three miles the distance terminals can be located from the host computer. The SPUR repeaters come with six coaxial ports and either one or two fiber-optic ports. Prices range from \$610 to \$2,205.—*Mike Seither*

## **PLEXUS JUMPS INTO SYSTEM INTEGRATION**

Plexus Computers Inc. has decided to build more than generic UNIX-based supermicrocomputers. With its latest announcement of the XDP Extended Data Processing System, the San Jose manufacturer has made a major move toward system integration. The XDP combines Plexus' MC68020 supermicrocomputers (including the new 128-user P/95) with an IBM Corp. PC/AT-compatible workstation, applications-development software and a wide variety of peripherals. These include single and "jukebox" optical disk drives, microfilm and microfiche scanners, image coprocessors, optical character readers and Ethernet controllers. Base systems begin around \$75,000. Plexus hopes to peddle the systems to military, telecommunications and government markets.

—*Mike Seither*

## **ADAPTEC BRINGING OUT NEW SCSI-DEVELOPMENT TOOLS**

Look in May for word from Adaptec Inc. on three new tools to design, test and debug SCSI equipment. Coming from the Milpitas, Calif., company—an IBM Corp. PC-based system to emulate the initiator and the target in host-adapter and controller designs (\$19,500); a menu-driven library of 50 preprogrammed SCSI test functions that access the bus through a special adapter (\$5,500); and a logic analyzer to monitor activity on the SCSI bus (\$3,750-\$4,500).

—*Mike Seither*

## **SEAGATE READIES SAMPLES OF 3½-INCH WINCHESTERS**

Beginning in April, system integrators can get their hands on evaluation units of Seagate Technology's new 3½-inch line of rigid disk drives. The drives are intended for OEMs of small IBM PC/AT-class personal computers specifically designed for the smaller form factor. The six drives from the Scotts Valley, Calif., company range in formatted capacity from 21.4M bytes to 49.1M bytes, feature access times under 30 msec and come with either the ST412 or the SCSI interface. Production models will be available in the fall. OEM prices: \$495 to \$695.—*Mike Seither*

## **HONEYWELL PACKS 5G BYTES ON DRIVE USING VHS TAPES**

Honeywell Inc. has been criss-crossing the country in the past weeks showing off a rack-mounted tape drive that uses VHS video cassettes to store up to 5G bytes. Called the Very Large Data Store (VLDS), the drive was developed by

Honeywell's test-instrument division in Denver. Two channels pump out a combined data-transfer rate of 4M bytes per second. The drive gets its capacity by packing 50,000 bpi on tracks .0025 inches wide. Honeywell is pitching the VLDS for data-acquisition, backup and archival applications. Initial interfaces will be for SCSI and VAX equipment. OEM pricing is expected to be about \$20,000. Look for evaluation sometime in July.—*Mike Seither*

### **INTERPHASE SHIPS 3-IN-1 CONTROLLER**

Interphase Corp., Dallas, this week begins shipping a peripheral controller for VMEbus-based systems that includes a SCSI port, a printer port and an electrostatic plotter port—combining on one board what typically requires multiple slots. The company claims the device reduces the number of interrupts the host is required to service. The multiport V/MIX 3210 costs \$995 in OEM quantities.—*Dave Simpson*

### **CONCORD PREDICTS THE PRICE OF MAP CONNECTIONS WILL PLUMMET**

Look for prices of products that link factory equipment like robots and controllers to the Manufacturing Automation Protocol (MAP) network to drop dramatically over the next few years. That comes from Michael Zak, vice president of Concord Communications Inc., Marlboro, Mass., a vendor of MAP gear. Concord's MAPware Series 1200, a bus-level connection to MAP for the IBM Corp. PC, carries a price tag of \$2,695 per node, and the company calls that a "price breakthrough." It's about 30 percent below the price of most MAP-connect gear, including Concord's earlier MAP products. Zak says the price of connections to MAP will continue to move lower: to below \$2,000 per node in 18 months and to around \$1,000 a node in 30 months.—*Jim Donohue*

### **MORE FUNCTIONALITY IN STORE FOR HENCO'S DBMS**

Henco Software Inc. of Waltham, Mass., targets May 1 as the release date for a full-function version of its Info-DB+ relational DBMS for Digital Equipment Corp. VAX computers. The final version will have all of the previously announced features of the software, such as a jump in the number of relatable files from 10 to 50 and increased support for a variety of different file types. It will also provide advanced text retrieval capabilities including intelligent text searching, wild-card and proximity searches and phrase matching. The company is also working on a version of Info-DB+ for Prime Computer Inc. of Natick, Mass., and is trying to strike a deal with Harris Computer Systems, Fort Lauderdale, Fla., to provide porting of the software to its systems.

—*Tim Scannell*

### **MINISCRIBE INTRODUCES 5¼-INCH WINCHESTER**

Look this month for a new half-height 5¼-inch Winchester disk drive from MiniScribe of Longmont, Colo. The unit stores 53.5M bytes and features a 25-msec access time and five read/write heads. According to the company, MTBF is 30,000 hours. Pricing in small OEM quantities will be \$650.

—*Megan Nields*

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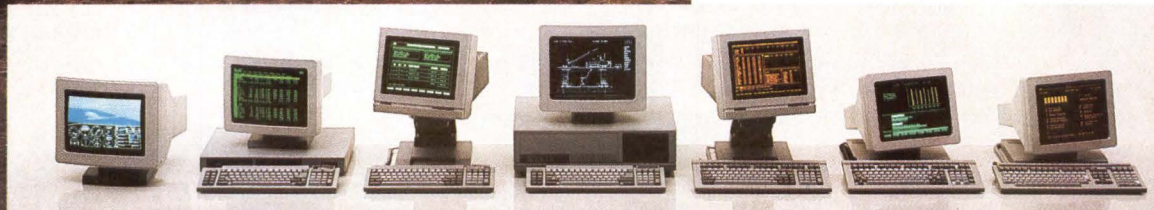
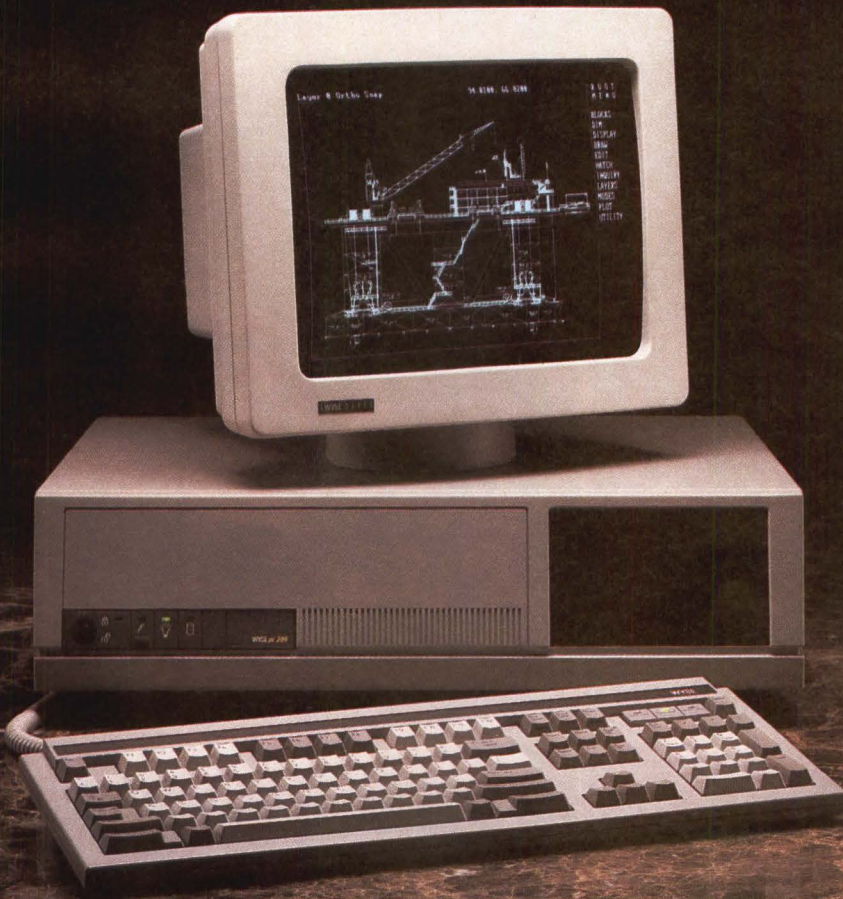
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# MINI-MICRO SYSTEMS PRODUCT SPOTLIGHT

## Conner vaults competitors with 100M-byte 3½-inch Winchester

Mike Seither, Senior Editor

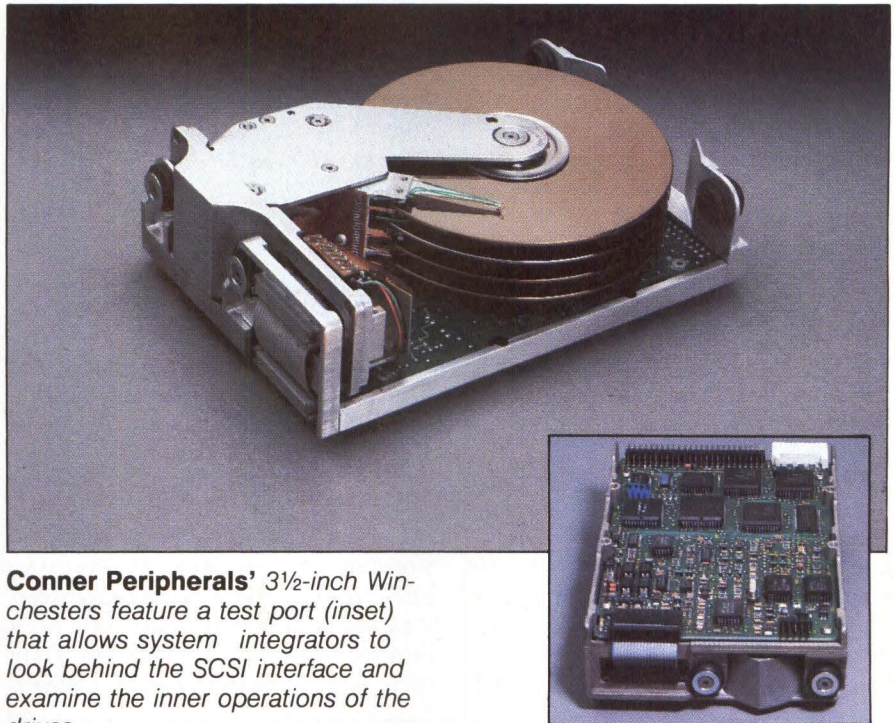
In an attempt to leapfrog its competitors, Conner Peripherals Inc. this month introduces a 3½-inch rigid disk drive with a formatted capacity of 100M bytes and an average access time of less than 29 msec. The company's goal: to become a leading supplier of 3½-inch rigid disk drives for OEMs and system integrators, especially those building the next generation of scaled-down desktop workstations using the 32-bit Intel Corp. 80386 microprocessor.

The CP3100, a four-platter drive with an embedded small computer systems interface (SCSI) that consumes less than 7W, positions Conner with the most powerful 3½-inch Winchester yet announced. The company plans to begin shipping evaluation units this month and start full production during the fourth quarter of 1987. Volume pricing for the CP3100 will be in the \$995 range.

Conner Peripherals, a San Jose company barely two years old, is the brainchild of Finis Conner, a disk drive industry veteran who has held key management positions with Seagate Technology and Shugart Associates. The CP3100 is Conner's second offering. Last fall the company brought out the CP340, a two-platter 3½-inch drive with a formatted capacity of 40M bytes. Like its newer sibling, the CP340 is a 7W device with an average seek time of 29 msec.

### The Compaq connection

Conner's venture is something of an ambitious gamble, considering the recent shakeout in the disk drive industry. "Most of the companies that failed in the last few years did so



Conner Peripherals' 3½-inch Winchesters feature a test port (inset) that allows system integrators to look behind the SCSI interface and examine the inner operations of the drives.

because they failed to execute well," says industry observer Bob Katzive of Disk/Trend Inc., the Los Altos, Calif., research firm specializing in the mass storage business. "They were either undercapitalized or unable to sustain an efficient manufacturing operation."

Conner hopes to avoid both those problems. The privately held company is backed by a number of venture capitalists. One important investor—and one expected to become a major customer as well—is Compaq Computer Corp. of Houston.

"I didn't want to get back into this business [after leaving Seagate] unless I had some kind of alliance with a major computer manufacturer," says Conner. "It's essential to know strate-

gic needs. You can't develop 10 products and throw them like darts at a wall to see which one sticks. No one is interested in funding that kind of effort."

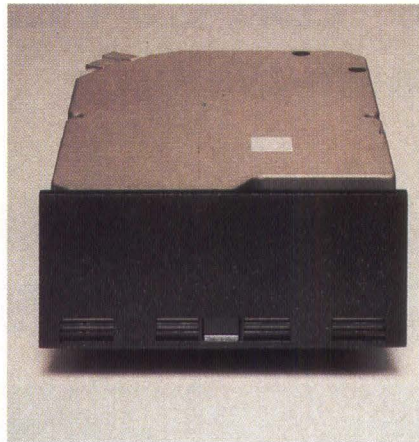
Although Conner says that Compaq is "an extremely valuable asset in attracting our customer base," Conner's business relationship with the \$625 million computer manufacturer is conducted strictly at arms-length. In order to become a supplier to the likes of Compaq, Conner knows only too well that his company will have to deliver on price, reliability and volume.

Conner hopes to compete on price by offering drives that use tighter electronics to compensate for looser tolerances in what he calls "less-than-

premium-grade mechanical components." For example, Conner says he can use disks with two to three times the number of defects per surface than tolerated by competing designs. Conner is able to do that by putting a servo pattern in each data sector, rather than dedicating an entire surface of a platter to the storage of servo information. A rotary voice-coil actuator moves the read/write heads, which are kept on track by the servo data. Not only does that kind of system save on the price of media, it also requires fewer heads and disks.

Conner has gotten rid of other components as well. Most spindle motors use "Hall-effect," or analog transducers to sense the mechanical motion of the spindle. Such transducers have become a reliability issue because they are prone to failure. Conner has designed a spindle motor that eliminates the need for those transducers. Instead, the company relies on micro-code and digital transducers to control spindle speed. That results in a double payoff: better reliability and fewer parts.

Eliminating other common drive features has increased reliability, the company claims. Conner's CP340 and CP3100 use plated thin-film media with a sputtered overcoat. A major concern of the company has been the susceptibility of thin-film media to corrosion by outside con-



**Fujitsu America** plans to boost the unformatted capacity of its M2227D 3 1/2-inch Winchester to 60M bytes by midyear through the use of run-length limited encoding.

taminants and moisture. To get around that, Conner designed out the breather filter found on most Winchesters and hermetically sealed the head/disk assembly. The only air that enters the HDA is what gets in during assembly in a clean room.

#### The marketeer's work

Conner is avoiding large capitalization costs by purchasing subassemblies from third-party vendors overseas, something that would have been impossible four or five years ago. Then there weren't the number of indepen-

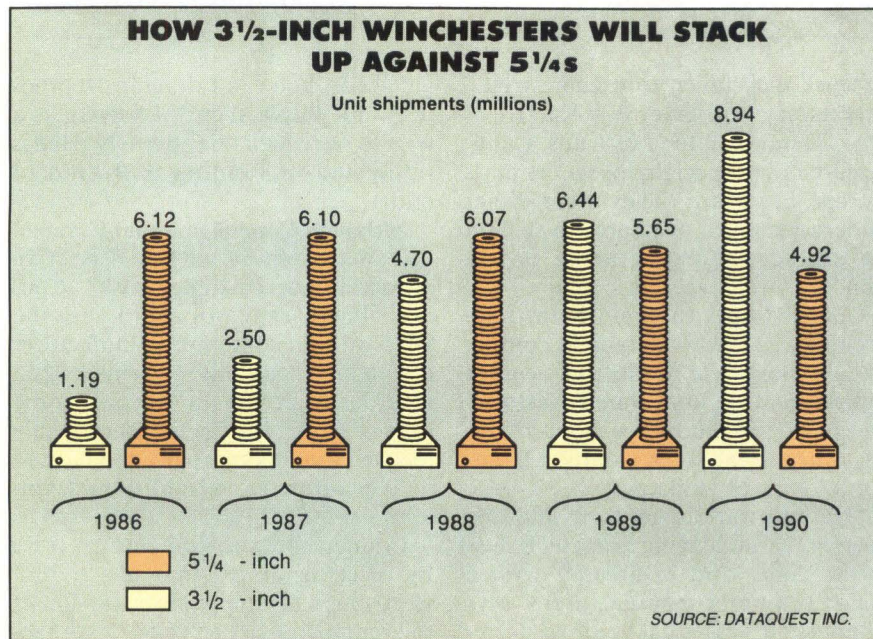
dent head, disk, motor and printed-circuit board vendors that there are today. Conner operates in sharp contrast to vertically integrated drive manufacturers like Seagate Technology, Scotts Valley, Calif., which makes it own everything, from motors to disks. However, final assembly and testing take place in Conner's U.S. facilities.

Industry analysts say that one of the biggest challenges facing a startup like Conner is having adequate manufacturing capacity. "Large OEMs want to see a vendor's ability to produce before they commit," says Phil Devin, a data storage analyst with Dataquest Inc., the San Jose market research outfit. "Conner has a good reputation and is one of the best marketeers in the industry. If anyone can make a convincing case, he can."

The case Conner is making is this. Capacity is now in place to manufacture 3,000 disk drives a day at the San Jose plant. Before winter the company will have the capacity to build 6,000 per day. "This whole team comes from a high-volume background," Conner says. "We believe we can build a million units a year."

One of the lingering questions is, when will the market for drives like Conner's 100M-byte 3 1/2-inch Winchesters materialize? Compared with their 5 1/4-inch brethren, 3 1/2-inch rigid disk drives have received only limited attention from system integrators. The majority of 3 1/2-inch drives—usually with 10M bytes or 20M bytes of capacity and access times above of 50 msec—have been patched together with a controller and sold as add-in boards for personal computers, says Dataquest's Devin. Others have been used in subsystems, and some have wound up in portable computers. A scant few have been designed into desktop systems.

But that situation is changing. Industry analysts say that system designers are seriously considering the 3 1/2-inch slot as the form factor of the future. In fact, Dataquest expects 3 1/2-inch drives to become the form factor of choice by 1989 when 6.4 million units will be shipped as opposed to 5.6 million 5 1/4-inch drives (see Chart).

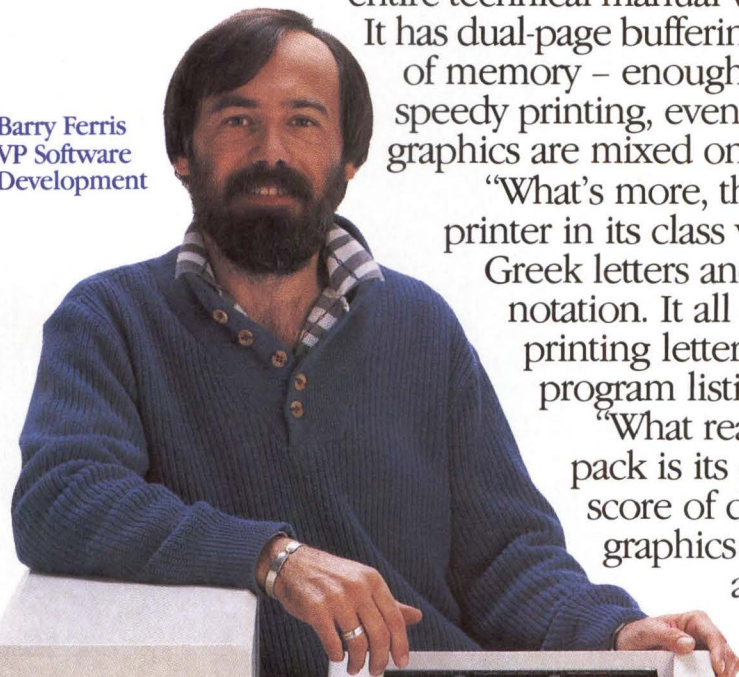


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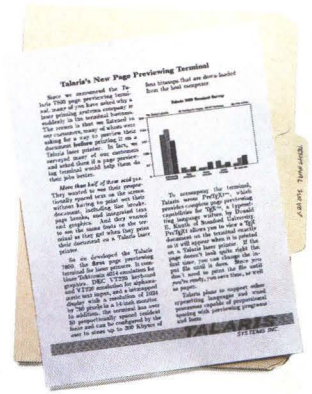
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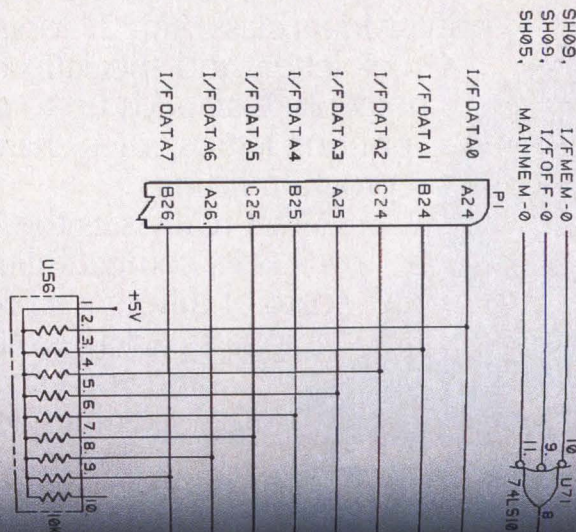
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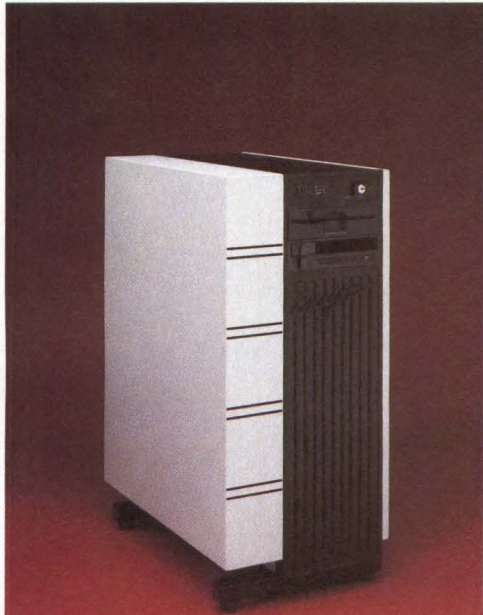
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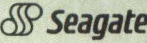
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| <br><b>FUJITSU</b>   | M2227D   | 40.3                         | 40                 | ST506/412 | 4     | 500(O)                         |
| <br><b>LAPINE</b><br><small>TECHNOLOGY</small>                               | Titan 40 | 45.3                         | 35                 | SCSI      | 2     | 575(O)                         |
| <br><small>WE'VE GOT THE DRIVE.</small><br><b>PERIPHERAL TECHNOLOGY INC.</b> | PT357R   | 47                           | 40                 | ST506/412 | 3     | 440(O)                         |
| <br><b>RODIME</b>   | RO3055   | 42.8                         | 28                 | ST506/412 | 4     | 995(L)                         |
|   | RO3057S  | 45.2                         | 28                 | SCSI      | 3     | 1,295(L)                       |
|   | RO3070S  | 58.0                         | 28                 | SCSI      | 3     | 1,395(L)                       |
|   | RO3085S  | 69.6                         | 28                 | SCSI      | 4     | 1,495(L)                       |
| <br><b>Seagate</b>   | ST157R   | 49.1                         | >30                | ST506/412 | 3     | 600(O)                         |
|   | ST157N   | 48.6                         | >30                | SCSI      | 3     | 695(O)                         |

One immediate indicator of increasing demand for the smaller drives comes from Apple Computer Inc., which in March began to integrate 3 1/2-inch Winchester into its new Macintosh II. Add to that rumors that IBM Corp. will move away from the 5 1/4-inch standard it uses for mass-storage devices in its PC line. At its Fujisawa, Japan, plant, Big Blue is reported to be gearing up to produce 100,000 of the 3 1/2-inch drives a month for internal consumption. Analysts say that IBM's drives offer a nominal performance of 20M bytes and an average seek time of 65 msec. Other vendors are anticipating the market for 3 1/2-inch drives by offering faster, higher capacity devices.

No company has yet announced a drive with a capacity and performance like Conner's. If anyone does in the near term, it's likely to be

Maxtor Corp. of San Jose, which is said to have a 170M-byte 3 1/2-inch Winchester under development. Meanwhile, others are matching Conner on speed. In February, Seagate introduced its first 3 1/2-inch Winches-

ter family. Those drives, ranging in formatted capacity from 21M bytes to 49M bytes, have access times of less than 30 msec. Rodime Inc., Boca Raton, Fla., also has a line of sub-30-msec 3 1/2-inch Winchesters with capacities from 42M bytes to 69M bytes (see Table).

Before summer MiniScribe Corp., Longmont Colo.; Peripheral Technology Inc., Simi Valley, Calif.; and Fujitsu America Inc., San Jose, are expected to unveil higher capacity drives. MiniScribe is said to be working on a 47M-byte drive, while Peripheral Technology is expected to bring out an 85M-byte product. Both companies are looking at sub-30-msec performance. And Fujitsu America plans to use run-length-limited encoding to boost the formatted capacity of its present MD2227D drive from 40M to 60M bytes. □

**FACT FILE**

CP3100

**Conner Peripherals Inc.**  
 2221 Old Oakland Road  
 San Jose, Calif. 95131  
 (408) 433-3340  
**Circle 473**

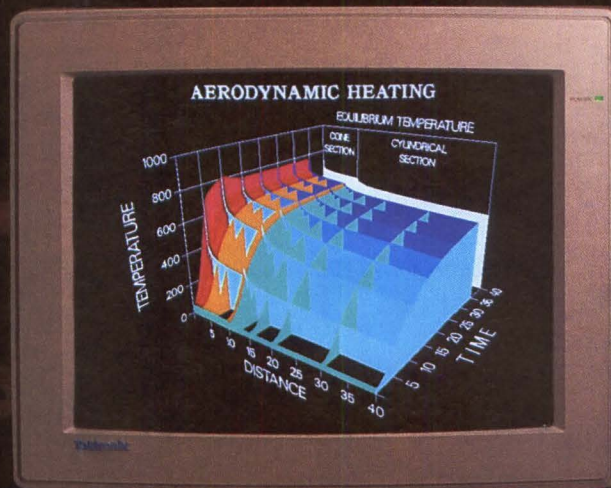
\*A 3 1/2-inch SCSI rigid disk drive with a formatted capacity of 100M bytes and an average access time of 29 msec

\*Shock-mounted system rated at 70Gs in non-operational mode

\*Four platters with thin-film plated media and sputtered overcoat

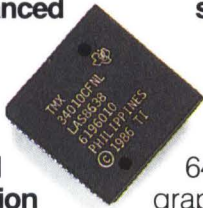
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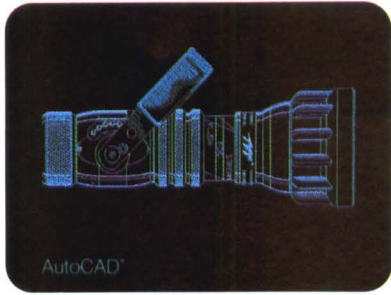


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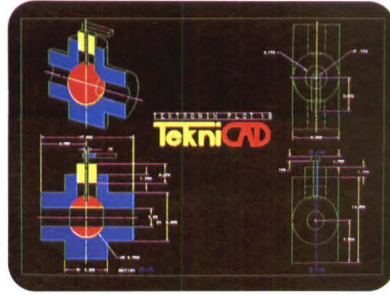
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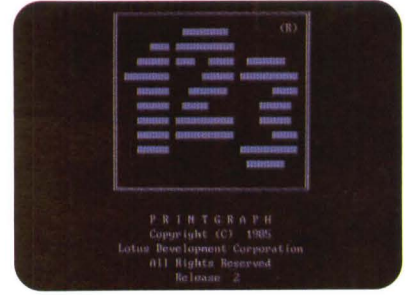
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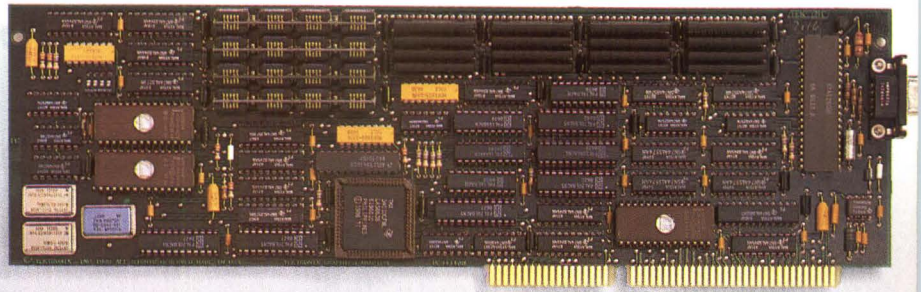


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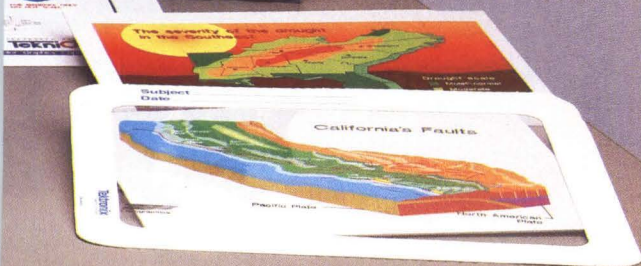
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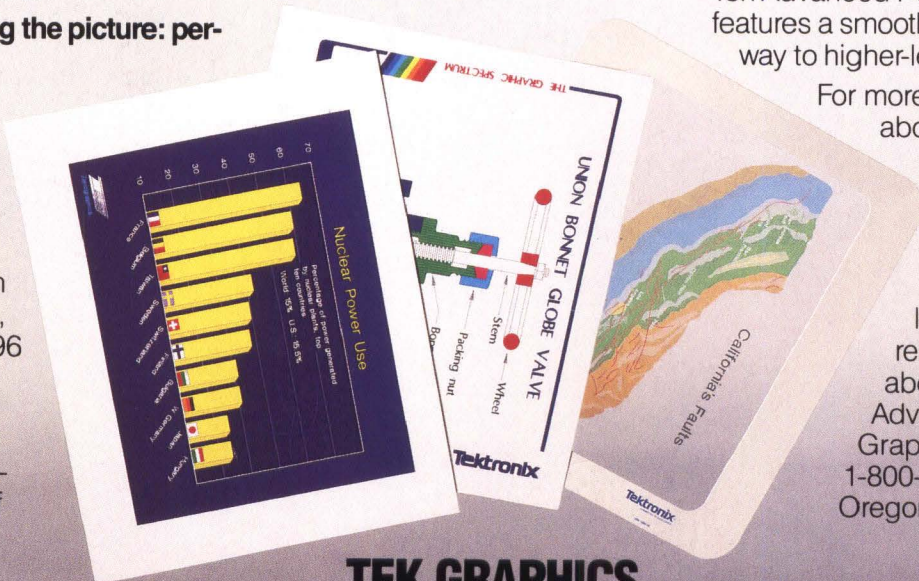
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# INTERPRETER

## WORKSTATIONS

# New DEC VAX desktop, workstation target third-parties and VARs

Tim Scannell, Senior Editor

Although Digital Equipment Corp., Maynard, Mass., has been the focus of some criticism lately over how the company treats third-party developers and OEMs, it is apparently working hard to iron out any misconceptions.

For example, in the past few months the company has unveiled a number of hardware and software products and services that extend both the high- and low-ends of its systems spectrum. In doing so, DEC appears to target nearly every major industry and work group up and down the corporate ladder. That includes the fast-evolving technical workstation market, which will reach \$4.5 billion annually and have a 37 percent annual growth rate by 1990, according to Dataquest Inc., a San Jose market researcher.

DEC offers four new hardware entries:

- Two clustered VAX systems, the 8974 and 8978, that cost up to \$4.7 million each and compete not only with IBM Corp.'s largest mainframes but, quite possibly, also with entry-level supercomputers offered by such manufacturers as Cray Research Inc. The two systems are DEC's largest yet.

- Two desktop computers systems, the MicroVAX 2000, which is aimed at office and traditional business applications, and the VAXstation 2000, designed to be a technical workstation. Both systems measure about 1 foot square and pack processing speeds of up to 1 million instructions per second, a fact that prompted at least one analyst to dub them "Apple IIs with an 11/780 inside." More important, however, is that they are



The VAXstation 2000 (left) extends DEC's workstation line. Other members include the monochrome VAXstation II, the four-plane VAXstation II/GPX and the eight-plane VAXstation II/GPX.

priced at about \$10,000—or about half the cost of DEC's previous low-end system, the MicroVAX II—and offer a new and highly competitive engine for value-added resellers and system integrators looking to develop a powerful technical workstation.

Finally, DEC also unveiled a VAX Solution Systems Program, which brings together DEC systems and software with third-party developers and their products to tackle specific system-integration problems such as networking, shared resources and mechanical design and analysis. The company also took the wraps off an innovative warranty and Work Group Services Program that reportedly provides total system support for one year at no extra charge.

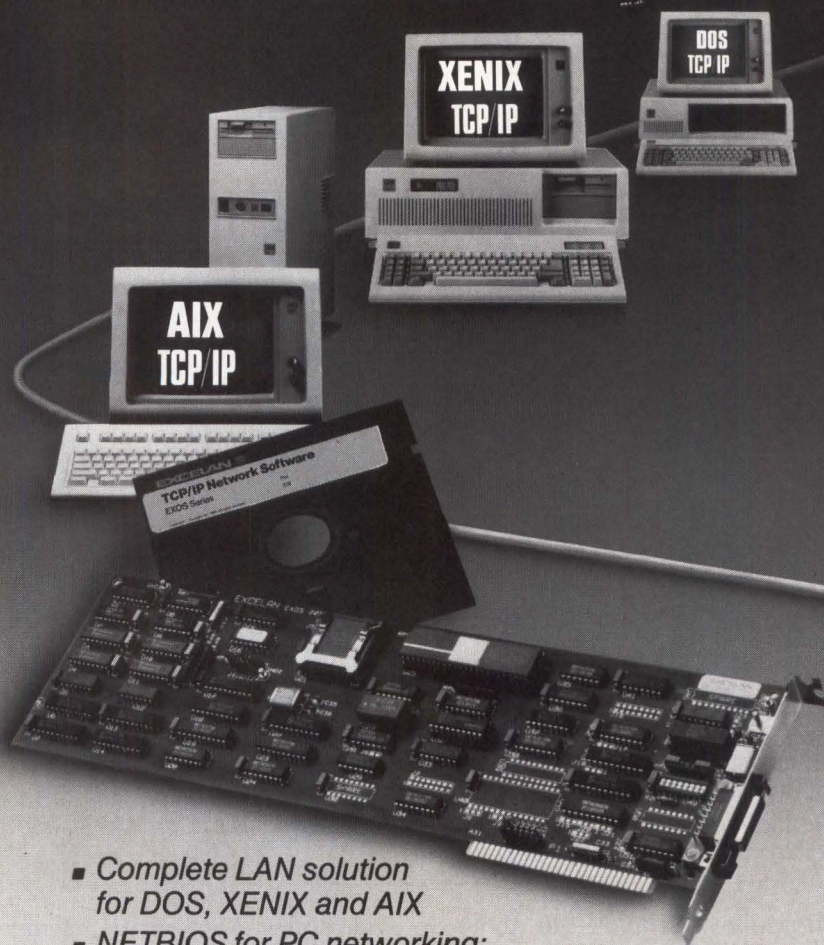
"The goal is to help customers attain a competitive advantage and to

provide access to information across the organization, while protecting the investment in equipment and data," says DEC vice president of product marketing Peter Smith.

### Market questions arise

However, despite DEC's rapid-fire approach to product introductions and highly aggressive efforts to expand into new and present markets, there are some questions that arise. For example, what impact will these new products—especially the smaller MicroVAX 2000 and VAXstation 2000—have not only on the general marketplace but also on DEC's own product line. There is also the question of how successful DEC's smaller systems will be in light of the heavy market inroads already made by such technical workstation firms as Apollo

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## INTERPRETER

### WORKSTATIONS

Computer Inc. and Sun Microsystems Inc. Also, will the MicroVAX 2000 and VAXstation 2000 be as successful as DEC hopes as the technical-workstation market becomes flooded and, in 1988, dominated by Intel Corp. 80386-based systems, as predicted by Dataquest.

Although successors to the aging VAX processor, the MicroVAX and VAXstation 2000 systems are technologically innovative and sport a number of advances that resulted in each system's small size. Among these are a reduction in the number of processing boards from four in the MicroVAX II to one, due to double-sided surface-mount techniques; the inclusion of 14 custom chips, designed and manufactured by DEC, that control disk, graphics and other I/O activities; and a 50 percent drop in power consumption to 160W.

Despite their size, however, the 2000's are not computing lightweights. In fact, their processing power, 6M-byte maximum memory and extended communications capabilities—including support for IBM's Systems Network Architecture (SNA)—make them as powerful as DEC's first VAX, introduced nearly a decade ago and competitive with midrange systems from IBM (see Table).

DEC's entry into the workstation area is "going to create a whole new level of competition in the low end," observes Bob Randolph, director of the DEC Advisory Service at International Data Corp. in Framingham, Mass.

Priced at \$10,500, the entry-level, diskless VAXstation 2000 with a monochrome display provides a MicroVAX chip and floating-point processor; 4M bytes of memory, expandable to 6M bytes; a built-in Ethernet adapter; a three-button mouse; a keyboard; and software licenses. Fully configured, the system has an expander system box, a model RD53 71M-byte disk drive, a 95M-byte TK50 streaming tape drive, and a 19-inch monochrome monitor. (A color version of the VAXstation 2000 system is not yet available but was demonstrated at the press announcement.)

At \$11,100, a typical entry-level



## WORKSTATIONS

MicroVAX 2000 has the same memory and processing power, as well as a 1.2M-byte half-height flexible disk drive, a 42M-byte RD32 Winchester disk, a tape-drive interface, four serial communications lines, onboard diagnostics and either a VMS or ULTRIX software license.

While the MicroVAX 2000 and VAXstation 2000 systems will overlap the same market as the MicroVAX II—particularly when used in conjunction with DEC's expander system box—DEC apparently has no plans to discontinue the earlier system. However, whether or not these plans will change remains to be seen. Even before the two new systems were announced, DEC had received about 5,000 orders for the desktop device. DEC officials see this as an indication that, even if the newer systems slice into the MicroVAX II market, the company will make up for any losses with greater sales volume.

"They'll continue to sell MicroVAX II's, but they won't sell as many," maintains IDC's Randolph.

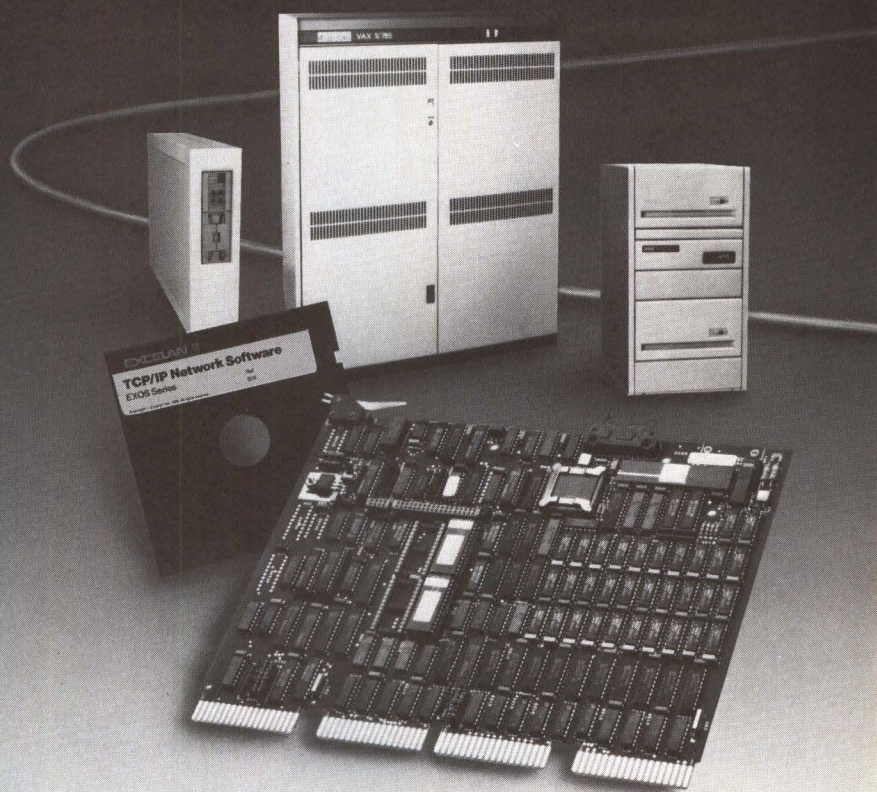
MicroVAX II reseller McDonnell Douglas, however, does not view the products as competitors. "The new VAXes fill a gap in our platform spectrum," says Richard Rothfuss, director of marketing for the Manufacturing and Engineering Systems Co., a McDonnell Douglas division. According to Rothfuss, the engineering market is divided into the haves and have nots. Ten percent or so of users have access to high-performance, high-cost systems and approximately 15 percent use IBM PC/AT and look-alike platforms. In the middle, roughly 70 percent, are the technology have nots and likely candidates for the VAXstation 2000 and the MicroVAX 2000.

### DEC signal stirs response

By offering a low-cost, VAX-compatible system, DEC is sending out a clear signal that it does not intend to slight third-party developers and will aggressively compete for the same system integrators and VARS that IBM is targeting with its 9370 system series. At present, DEC claims about 30 percent of its overall business is made up of VARs, roughly 80 percent

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## WORKSTATIONS

of whom purchase the company's MicroVAX II as a systems kernel, according to IDC.

That signal has been heard by CASE Technology Inc., Mountain View, Calif. "One architecture with multiple price points of entry will broaden DEC's market up and down the line," says Donald Ritzman, CASE's director of marketing. Ac-

ording to CASE, which sells design tools—bundled with IBM PCs and DEC equipment—to printed-circuit board and integrated-circuit engineers, DEC's migration path strategy will capture more users for the VAX environment and could even boost sales of the MicroVAX II.

DEC, however, has had its problems with third-party vendors who charge that the company was restricting its bus structure to eliminate non-

DEC products. In fact, at press time, DEC was still embroiled in a legal battle with Emulex Corp., the Costa Mesa, Calif., storage peripherals and controller manufacturer. DEC maintained Emulex had violated trade secrets and patents by manufacturing a storage subsystem that connected to DEC processors.

### Assures third parties

But, although DEC has put some restrictions on some of its bus structures, like its high-speed VAXBI, IDC's Randolph claims "the winds are blowing in the reverse direction." And small systems like the MicroVAX 2000 or VAXstation 2000—which can be placed at the center of a variety of scientific and desktop applications—can very well be a solid hook DEC can hang its hat on to prove it is not clamping down on the third-party development community. DEC also plans to offer incentives above the normal third-party discount structure to encourage development in vertical applications.

"Basically, it says DEC is really not going to walk away from its OEM business," Randolph says. "With all the problems they're having with OEMs, they're still going to produce something that has a great deal of appeal to them."

Since providing a total hardware/software solution has become a DEC credo, the company did not stop with just offering an impressive piece of hardware. It simultaneously announced the VAX Solution Systems in an apparent effort to showcase the flexibility of its pint-size VAX. Vice-president of product marketing Peter Smith described VAX Solutions as a group of nearly turnkey systems that are "tailored for applications, but easily tailored for specific applications."

The Solution Systems, 12 in all, target at such applications as desktop publishing, financial planning, computer-aided engineering and mechanical design. Basically, the program allows a third-party vendor to select Solution Systems from DEC's MicroVAX 2000 repertoire and easily tailor it to a highly specific application. For example, at the DEC announcement Sierra Geophysics, based in Houston, unveiled a seismic modeling system based on its software and the Micro-

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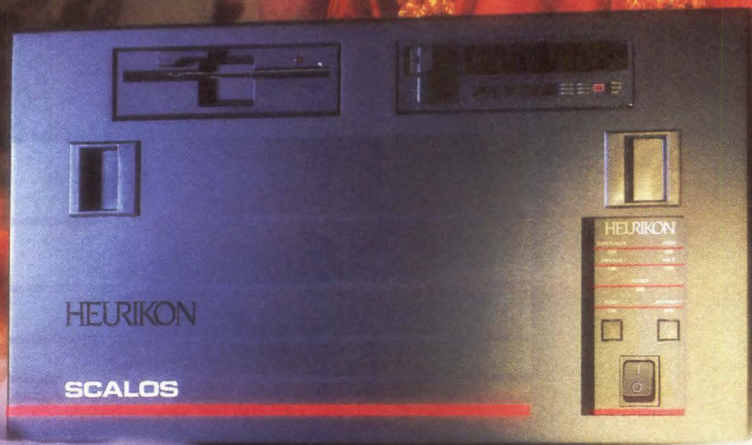
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WORKSTATIONS

VAX 2000. Likewise, BBN Software Products Corp. in Cambridge, Mass., revealed a system that's similar but aimed at data-analysis applications.

On the technical side, companies such as Tektronix Inc., Santa Clara, Calif.; Auto-trol Technology Corp., Denver, Colo.; and Data Translation Inc., Marlboro, Mass., announced

software that bends the VAXstation 2000 toward CAD/CAM and process-control applications.

In line with this total systems approach, DEC is also offering a Work Group Services Program that provides end users with systems support, hardware/software installation, start-up consultation, customer training, documentation and maintenance. The company has also initiated a war-

ranty program that provides total system support for one year at no extra charge.

But, while analysts see DEC's systems expansion as a positive move, some question whether DEC is spreading itself too thin by trying to serve every segment of computing. Randolph suspects this may be the case, especially in terms of the company's sales force, which may be trained to sell into one segment of the industry but not into all segments. He also thinks that one way around this is to push the single-network concept and sell everything from the MicroVAX 2000 to the 8974 and 8978 processors as parts of that network.

"I think that, at least, will be their opening shot," Randolph said, adding, "It's an interesting issue for them." □

**DEC'S MicroVAX 2000 VS. IBM'S 9370**

|                             | MicroVAX 2000 | IBM 9370/20 | IBM 9370/40  |
|-----------------------------|---------------|-------------|--------------|
| MIPS                        | 1             | 5           | .6           |
| Memory (M bytes)            | 4-6           | 4-16        | 8-16         |
| SNA support                 | full          | subset      | subset       |
| Entry-level price (\$)      | 11,100        | 80,000 plus | 110,000 plus |
| Cost per user (office) (\$) | 6,246         | 11,974      | 14,000       |
| Shared files/applications   | yes           | no          | no           |

SOURCE: DIGITAL EQUIPMENT CORP.

CONTROLLERS

# Xylogics boosts VMEbus throughput with H-SMD controller

Jesse Victor Associate Editor

High-performance open buses such as VMEbus and Multibus II offer OEMs and system integrators the promise of 40M-byte-per-second maximum data-transfer rates with 32-bit addressing over 32-bit data paths. In practice, however, disk/tape

I/O proves a serious bottleneck to system performance.

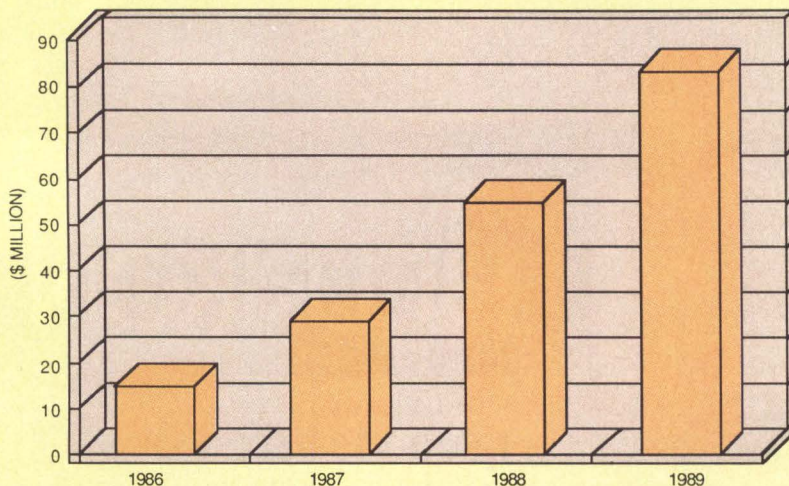
For the VMEbus, vendors of high-performance storage module device (H-SMD) disk controllers are attacking this problem with products that incorporate 32-bit-wide interfaces and fast direct-memory access (DMA). For example, Interphase

Corp., Dallas, claims burst DMA rates of 30M bytes per second for its V/SMD 4200 controller—very close to the maximum effective 33M-byte-per-second data-transfer rate on the bus. Ciprico Inc., Plymouth, Minn., offers 32-bit data and address support on its Rimfire 3200, and Dual Systems Corp., Berkeley, Calif., offers 32-bit addressing on its Optimatrack 32.

But the overhead involved in getting data to DMA to send out on the bus also can be a significant barrier to higher controller throughput. To solve this problem, Xylogics Inc., Burlington, Mass., is concentrating its efforts on using dual pipelines, a first-in, first-out (FIFO) buffer 16 times larger than those of its competitors and high-speed static RAMs in its new model 752 H-SMD controller. DMA rate is a fast, 18M bytes per second.

Significant features of the 752 include Dynathrottle, which provides a continuous flow of data on and off the disks and over the bus, and Read Ahead, a form of caching that keeps the FIFO full. The company claims these features boost VMEbus system

**VMEBUS CONTROLLER SHIPMENTS**



SOURCE: PERIPHERAL CONCEPTS INC.

## CONTROLLERS

throughput by as much as 100 percent, compared with competitors' products and alternative designs.

Disk/tape I/O is a critical path for high-speed system performance. "The 752 controller," asserts Xylogics' vice president for R&D, Chap Corey, "opens up VMEbus bandwidth to other applications by allowing peripherals to get on and off the bus quickly."

### Board the bus for fast I/O

VMEbus is becoming the I/O bus of choice for many OEMs and system integrators. Consequently Xylogics is targeting workstation, supermicro-computer, parallel processing and multiprocessing computer vendors and OEMs who now use the bus for I/O channels or plan to switch from the 16-bit Multibus. Touting the 752's performance gains, the company hopes it will capture a large chunk of the fast-growing VMEbus controller market.

Market researcher, Peripheral Concepts Inc., Garden Grove, Calif., estimates a phenomenal compound annual growth rate of 86.1 percent for all VMEbus peripheral controller shipments (on revenue growth of 74.8 percent per year) through 1989. And Joseph Jaworski, Peripheral Concepts president, says that VME leader Motorola Inc., Phoenix, Ariz., will face stiff competition from controller

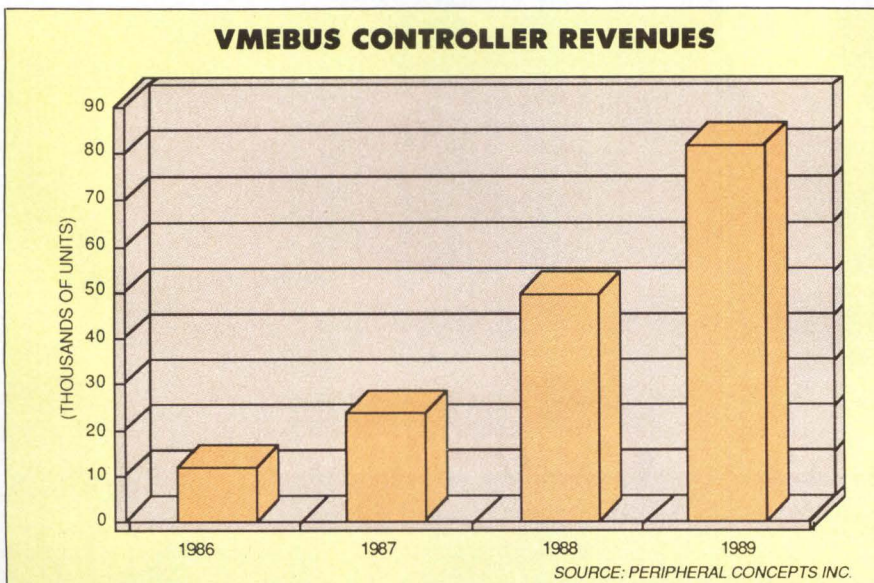
makers such as Xylogics, Interphase and Ciprico.

Anyone who wants very fast throughput on his I/O channel and plans to migrate to VMEbus is a target for the 752. Sun Microsystems Inc. is a customer for the 752's predecessor, the 751, and according to Corey, will design the 752 into future products. Apollo Computer Inc. also uses the VMEbus and is talking to Xylogics.

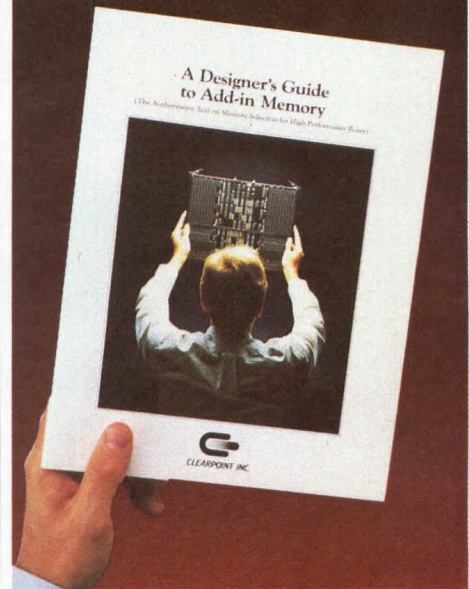
Xylogics does not want its performance claims for the 752 to be seen as just another empty boast in a fiercely competitive market. Sun Microsystems, it says, tested Xylogics' 752 on its benchmark for controller performance. Operating under Berkeley UNIX Version 4.2, the 752 ran the series of reads and writes twice as fast as previous controllers.

Although declining to comment on Sun's future controller purchases, John Hime, Sun's director of product marketing, affirmed the importance of fast I/O and the VMEbus for its workstations. "A big part of the performance of our workstations is based on how quickly they can locate and transfer data from mass storage," says Hime. "For high-speed disk I/O, VMEbus is the way to go."

The 752's design, Xylogics contends, eliminates the interpacket and microcomputer overhead incurred by competing controllers, which use dynamic RAM (DRAM) chips and small, typically 32- to 512-byte,



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## CONTROLLERS

FIFOs. Transferring small blocks of data (typically 256 or 512 bytes) in a two-step process from DRAM to a small FIFO buffer slows the transfer process.

According to Xylogics, using consecutive seeks, many DRAM and small FIFO-based controllers spend much time deciding when to do the next sector. "It may take time to refill the FIFO," contends Corey. "You may need several 100-nsec calculations after each packet of data. As a result, you can't start up the DMA to transfer data, even though you have data to transmit."

The overhead can be considerable. With a 10M-byte-per-second DMA, 512 bytes per packet and 100 nsec on the bus, the overhead between sectors can be 300 or 400 nsec, Xylogics claims. Transferring six sectors, the overhead can be more than the data-transfer time.

### Read Ahead keeps FIFO full

Optimized for the file capabilities of UNIX based systems, the Read Ahead process enables the 752 controller to keep the FIFO buffer full by reading data blocks stored on a cylinder past those requested by a given read command.

It boosts throughput with UNIX systems, especially those using data blocks greater than the usual 512 bytes, Corey notes. The controller anticipates the sectors the operating system is going to ask for next—without having to go out to the disk for data.

"Most UNIX implementations ask for just one block of data at a time," Corey stresses, "but after the system has been running for some length of time, the blocks tend to cluster in groups. The odds are that the operating system is going to ask next for the next sequential block. We can thus read ahead all the sectors that fit in the buffer."

As a result, Xylogics claims an effective "cache" hit rate for the 752 of close to 87 percent—and a 50 percent increase in overall response time—when a 1K-byte-block UNIX file system requests a number of sequential sectors.

John Black, developer of the

VMEbus specifications, member of the IEEE P1014 Committee, consultant to VME Laboratories and president of Micrology PBT, Tempe Ariz., also stresses the importance of a very large FIFO buffer able to hold consecutive disk data sectors and fast static RAMs for VMEbus controller performance. "UNIX and other operating systems like to assign disk sectors in clusters, that is where the advantage come from. If you need the first one, you probably need the next seven. Any operating system would benefit from being able to capture consecutive sectors," says Black.

Working with the bus-watcher feature, the 752's throttle burst control regulates the number of bytes transmitted to prevent the 752 from monopolizing the bus when other peripherals request access. A fourth-generation software interface enhances UNIX performance, Xylogics says, by allowing system integrators to implement features such as command chaining and sophisticated driver functions.

Xylogics plans to extend its Dynathrottle feature throughout its VMEbus controller line, which includes SMD, ESDI, tape controllers and its new 780 communications controller. It will also support SCSI inter-

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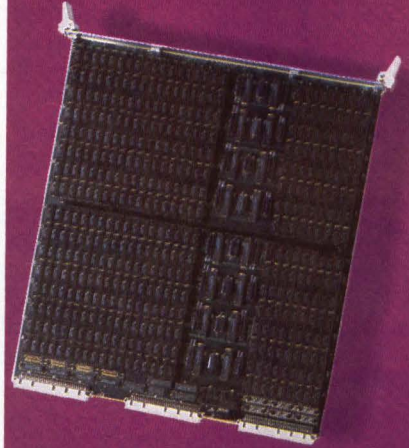
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\*UNIX drivers, fourth-generation interface, bad-block detection utilities

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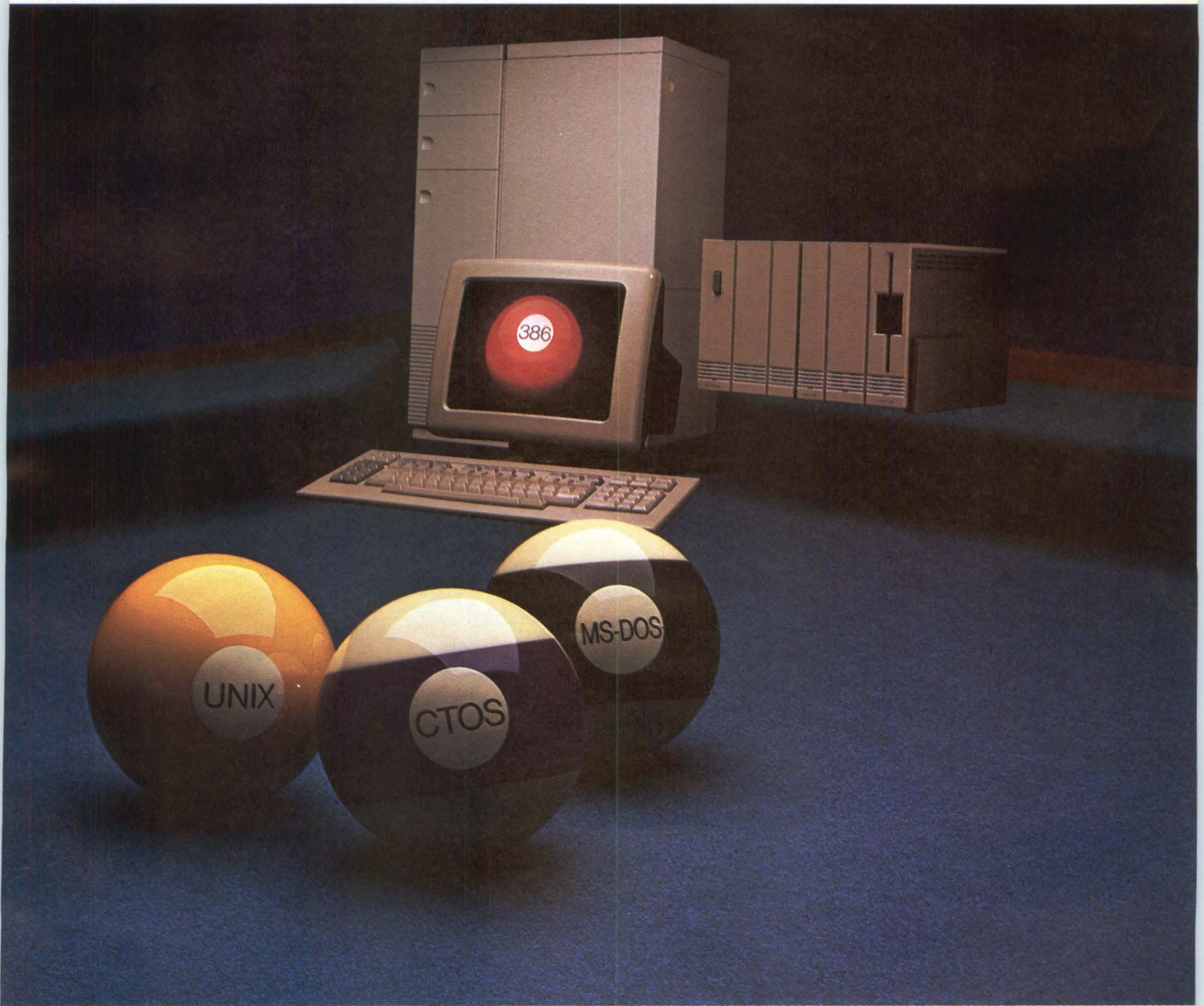
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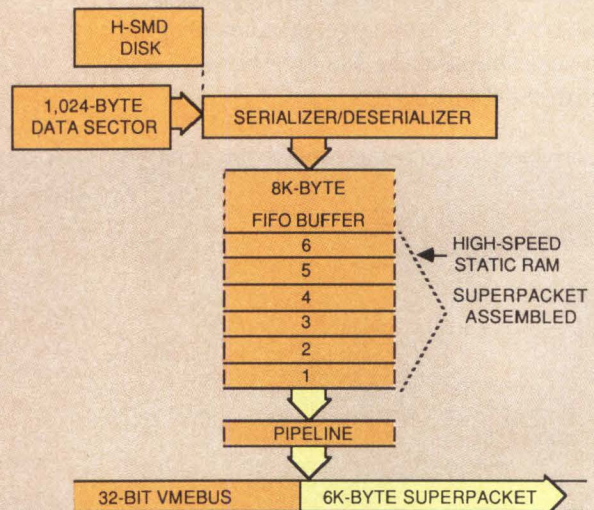
## How Dynathrottle boosts throughput

Implemented in microcode and hardware, the Dynathrottle feature of Xylogics Inc.'s 752 H-SMD (high-performance storage module device) disk controller assembles two to six 1K-byte sectors of data in the 8K-byte FIFO (first in, first out) into large "superpackets." The controller sends them via pipeline over the VMEbus at DMA (direct memory-access) speeds of up to 18M bytes per second, without microprocessor intervention.

Because the FIFO uses 45-nsec static RAMs instead of slower DRAMs, there is no data-transfer speed penalty, Chap Corey, vice president of R&D for Xylogics argues. And, because the whole process occurs without microprocessor intervention, there is no microprocessor overhead involved.

"With Dynathrottle on the 752, we reduce interpacket deadtime by as much as 50 percent," contends Corey. "Data can move continuously from disk for any number of bytes. You can transfer an entire 2.4M-byte SMD disk, a whole cylinder, without losing a revolution."

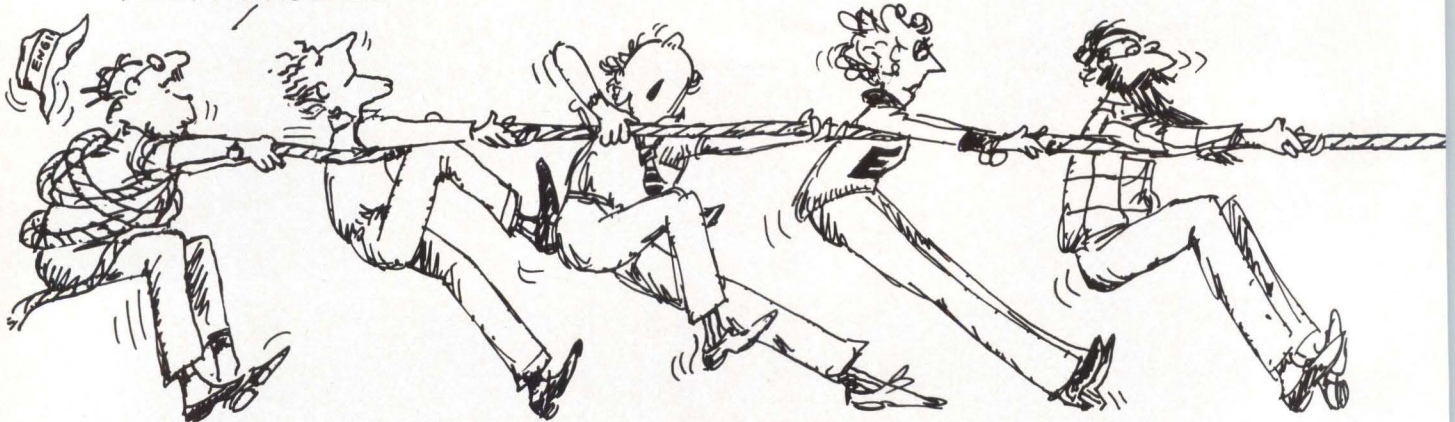
### LARGE FIFO BUFFER SPEEDS DATA TO VMEBUS



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for SMD interfaces.

Q.A. and Test counter that with a Pioneer Research Qualifier, they can format as drives come in, emulating their controller and saving a production step, can test up to four

drives and up to 50 drive formats, restore error maps, save time with up to 50 preprogrammed routines, and perform complete testing with go/no-go indications. And with Pioneer's portability,

## The Great Pioneer Disk Drive Tester Challenge.

CONTROLLERS

faces and optical disk on the bus.

Although the company has a strong presence in the Multibus controller market—Peripheral Concepts gives Xylogics a 26.1 percent market share, compared to 18.8 for Ciprico and 11.2 for Interphase—it entered the VMEbus controller arena late in 1985. Xylogics hopes to pick up market share by supporting the migration of its customers from the 16-bit Multibus I to the 32-bit VMEbus.

“A majority of our Multibus I customers are moving up to VMEbus, because they need the performance,” comments Dave Padley, Xylogics vice president for sales. “And a lot of new customers are using VMEbus who until recently had proprietary controllers.”

“We think VMEbus and high-performance disks is the place to be in the controller market,” adds Padley. “We hope to be as dominant with VMEbus controllers as we are with Multibus.” □

COMMUNICATIONS

## Shakeout coming among T-1 vendors

**James F. Donohue**  
Managing Editor

If the number of new product offerings is the criteria, the hottest items in computer communications these days are multiplexers for T-1, the service that provides 1.544M-bits-per-second (bps) transmission over leased telephone lines. Why? Money. With T-1 you can save it, and multiplexers permit you to tap into the service.

“Cost advantages are what it’s all about,” says Jim Michaels, product manager at Avanti Communications Corp., Newport, R.I., a vendor of T-1 products.

Says John Gantz, executive vice president, Technology Financial Services Inc., Chelmsford, Mass., “In gen-

eral, a single T-1 line operating over distances of under 200 miles is cheaper than the 24 analog channels it replaces, although the cost advantage varies with circuit tariffs. Savings on the data side are also impressive. One T-1 link might handle up to 140 9.6K-bps data circuits at substantial savings over equivalent Bell 3002 conditioned lines.”

About 50 concerns sell multiplexers for T-1, many of them start-ups like MegaRing Corp., Hauppauge, N.Y., and Newbridge Communications Networks Inc., Herndon, Va., led by Terry Matthews, the flamboyant founder of Mitel Inc. So far, the competition is based on the capabilities of the products, but industry seers expect price wars to break out soon as

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CIRCLE NO. 32 ON INQUIRY CARD

# The TeleVideo 955. Seeing is believing.

WYSE WY-50  
(Unretouched photo)

TELEVIDEO 955  
(Unretouched photo)

SALES ANALYSIS

LATEX SPECIALITY PRODUCTS INC.

PERIOD: Q3, 1985

| PERSON | ID NUMBER | TERRITORY | CUSTOMER | CUST. NUMBER | PART NUMBER | ITEM | SHIPDATE | WAREHOUSE  | SHIPDEST | CARRIER  | CUST |
|--------|-----------|-----------|----------|--------------|-------------|------|----------|------------|----------|----------|------|
| T      | 101000000 | NEW YORK  | APEXINC  | 33333088899  | KL23487654  | 200  | 10/02/85 | NWPHILIDE  | NEW YORK | ACMETRS  |      |
| SON    | 102277754 | BOSTON    | ZINCINC  | 33388990044  | KL23450987  | 007  | 12/01/85 | CENTRALLA  | BOSTON   | AJAXAIR  |      |
|        | 100000456 | CHICAGO   | AASEWER  | 98750372378  | KL23090867  | 999  | ONHOLD   | WOODLAWN   | CHICAGO  | DUMAIR   |      |
| IN     | 109057363 | ATLANTA   | TUSINC   | 77493087549  | KL23999999  | 808  | 11/19/85 | ATLANTANI  | AUGUSTA  | EWFR     |      |
| Y      | 107584948 | MINNIAP   | XYZCORP  |              |             |      | 11/07/85 | MINNSTPAUL | MINNIAP  | TRUCKER  |      |
| T      | 108958488 | SANFRAN   | JAKINC   |              |             |      | 11/28/86 | SANJOSESE  | SANMATED | SHORTAIR |      |
| ITT    | 108674637 | SANJOSE   | ACDCORP  |              |             |      | 11/08/85 | SACRAMENTO | SANJOSE  | EZHAULER |      |
| GOLD   | 107563848 | LOSANGEL  | LYNINC   |              |             |      | 11/18/87 | IRVINECA   | WESTLAWN | LATRUCK  |      |

| TELEVIDEO 955 VS. WYSE WY-50                           |                |            |
|--|----------------|------------|
| FEATURES   | TVI 955        | WY-50      |
| Screen Color   | Green or Amber | Green Only |
| Optional Graphics model                                | Yes            | No         |
| Dynamically allocated non-volatile function key memory | 512            | 128        |
| Maximum non-volatile bytes per function key            | 256            | 4          |
| High contrast super dark Matsushita screen             | Yes            | No         |
| List price   | \$549          | \$499      |

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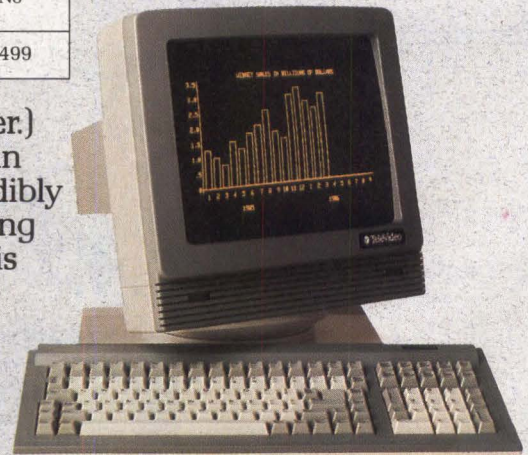
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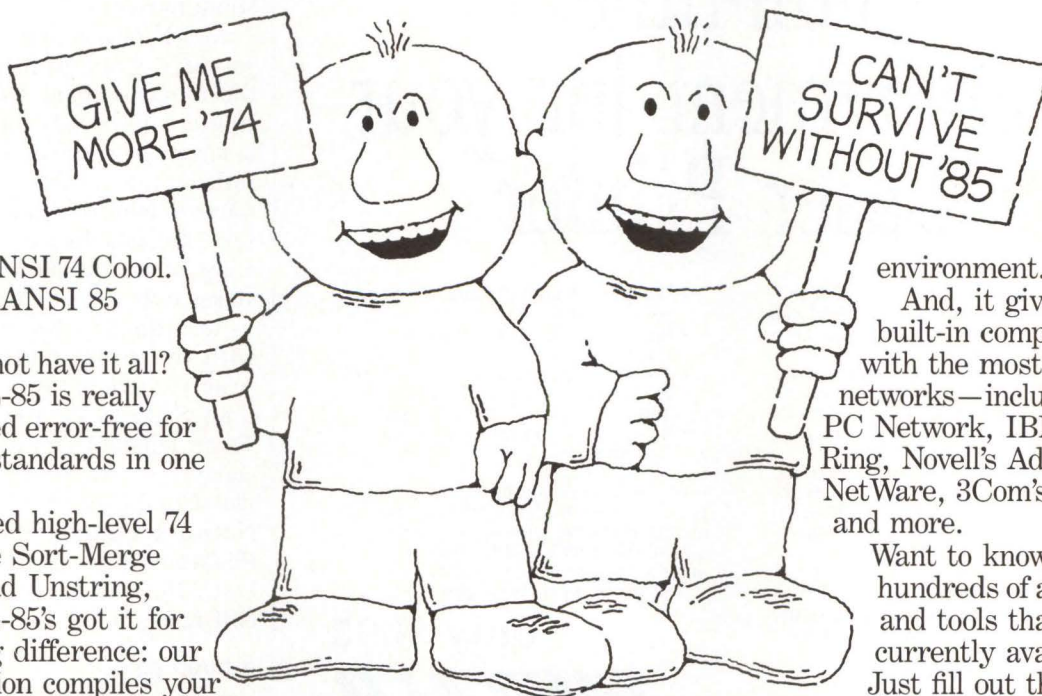
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COMMUNICATIONS

the competitors jockey for position in an overcrowded market.

For the time being, however, T-1 products are not cheap. The Integrated Services Digital Exchange (ISDX) from another start-up, Spectrum Digital Corp., Herndon, is a multiplexer capable, with compres-

sion techniques, of squeezing the equivalent of up to 508 voice/data channels over eight T-1 lines. Price tags range from \$12,000 (eight channels on one T-1 line) to \$450,000.

However, multiplexers can squeeze so many additional bits onto T-1 lines —boosting data throughput so much —that some vendors claim a payback on their hardware in about six

months, just from savings on line charges.

Hot and heavy competition, especially if price cutting takes hold, will winnow out a lot of companies. "I can't believe that all the vendors that have come out can usefully play a roll," says Dr. T. Doane Perry III, senior telecommunications consultant in market researcher International Data Corp.'s (IDC) Communications Group, Framingham, Mass. "There are some combinations and mergers going on, and I would expect some shakeout."

Alex Brown & Sons Inc., a financial services concern in Baltimore, predicts that companies selling T-1 multiplexers have only until next year to assure their survival by achieving significant market share. Because of this narrow window, the Brown report says, the established companies have a leg up in the survivability sweepstakes over the start-ups.

According to Brown, the vendors with the greatest market share are Avanti, Amdahl Corp.'s Communications Systems Division, Richardson, Texas; Digital Communications Associates Inc., Alpharetta, Ga.; General DataComm Inc., Middlebury, Conn.; Network Equipment Technologies, Redwood City, Calif.; Tellabs Inc., Lisle, Ill.; and Timeplex Inc., Woodcliff Lake, N.J.

**A huge pipe**

T-1 is a high-speed, digital-transmission service over telephone lines (copper wire and some microwave for the time being, fiber in not too many years). A good metaphor for T-1 is a huge pipe capable of carrying any data that can be digitized (including voice, video and facsimile). There are the equivalent of 24 channels on the line, each moving data at about 64.3K bps. If you multiply 64.3K bps by 24 lines, you get 1.544M bps, the rated capacity of the line.

Because of loss to overhead, however, the actual capacity of the line is really 1.344M bps, according to Avanti's Michaels.

Work continues in the United States and in Europe to boost the speed of T-1. In America, the Exchange Carriers Standards Associa-

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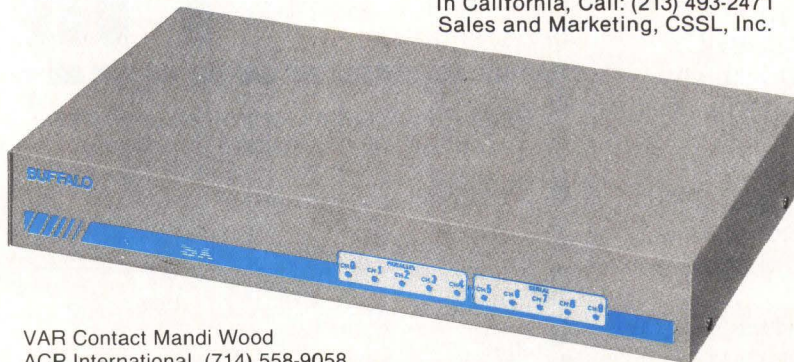
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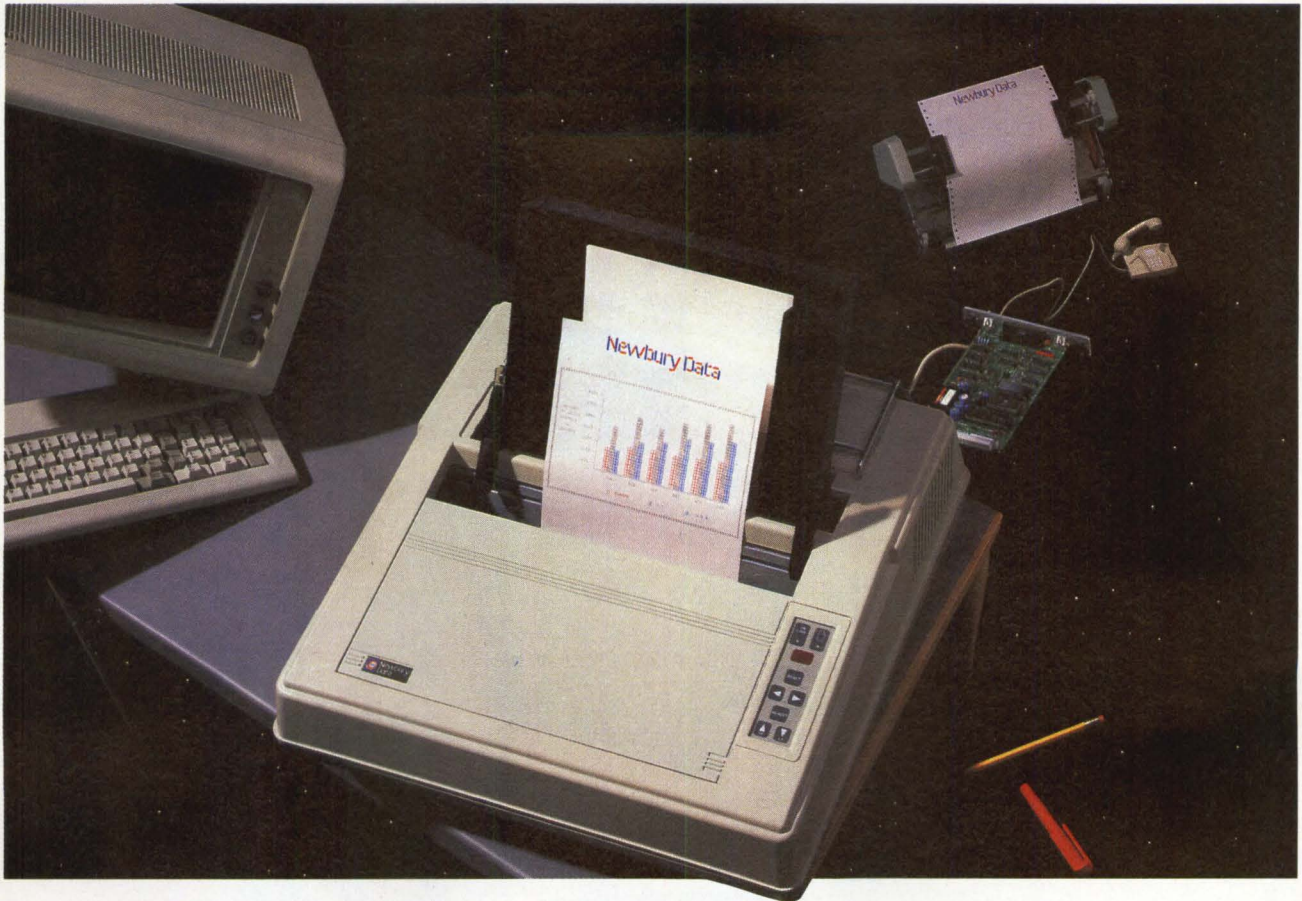
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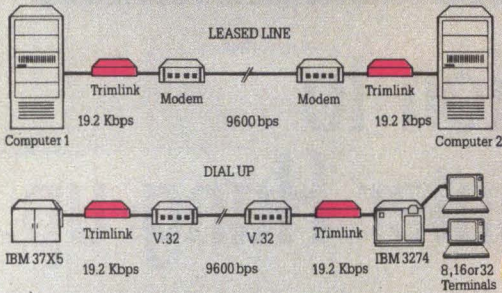
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CIRCLE NO. 252 ON INQUIRY CARD



COMMUNICATIONS

tion is working on standards for T-1C (3.152M bps), T2 (6.312M bps) and T3 (44.736M bps).

A lot of people think T-1 was invented in 1983 when AT&T Co. cut prices on the service and the local telephone companies (then called telcos, now called regional Bell operating companies) first saw an opportunity to make serious money with it. But AT&T first offered T-1 to business in 1977, and the telcos had been using it since the early 1960s.

Although T-1, as a technology, is a quarter century old, it was the price cuts just five years ago that spurred the business. There were 10,000 leased circuits in service in 1983; there are more than 50,000 today.

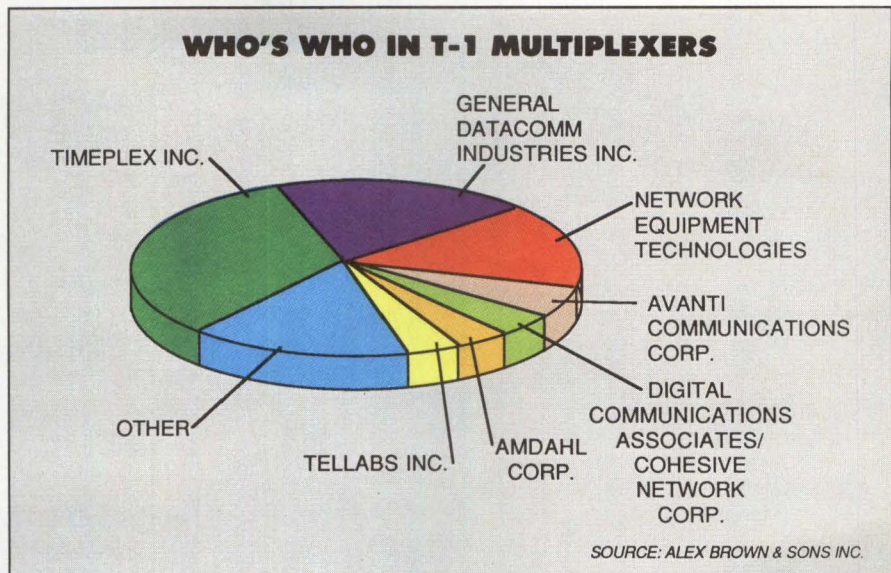
For a time, T-1 was little more than a point-to-point broadband link (usually city to city or building to building) for voice and digital communications, and only communications specialists had much to do with it. System integrators began to get involved with T-1 in 1985 when AT&T standardized protocols for packetizing information, enabling data to be efficiently managed: moved around, stored, broken apart and reformed in blocks of data on and off T-1 lines.

Now, vendors push T-1 as huge pipelines to connect computer networks, bringing the technology into the world of system integrators. Michaels, for example, sees T-1 acting as gateways in local area networks (LANs). Such a product is made by Vitalink Communications Corp., Mountain View, Calif., for Digital Equipment Corp. networks.

"T-1 is bandwidth, lots of it," Michaels says. "Anytime that you want to use a lot of bandwidth, such as LAN gateways, that's a T-1 application."

**The service and its products**

There are two kinds of T-1. First, there's the service itself, sold by AT&T, MCI Communications Corp. and, most recently, by US Sprint Communications Co. Second, there are the products, like multiplexers, that add intelligence, efficiency or



speed to the line—it's among these vendors that the shakeout is expected.

However, AT&T, MCI and US Sprint are engaged in a T-1 price war at the moment, and it's not even clear that all three of these communications giants will continue in the business.

In the product area, the newer companies are pumping out new hardware, many of them at the leading edge of telephone technology. One is General Communications Corp., Farmingdale, N.J. The company claims its T100V is the first T-1 communications controller fully compatible with AT&T's integrated Services Digital Network (ISDN).

Anyone familiar with ISDN recognizes the similarity between T-1 and the "primary" service of ISDN, also called 23B+D. The service provides 23 64K-bps "B," or bearer, channels for voice and data, and one 64K-bps "D," or Delta, channel for signalling and supervision. Despite the similarity in transmission speed and number of channels, T-1 and ISDN are not compatible. (Also, ISDN, although under test, does not yet exist commercially.)

Says Michaels, "Think of T-1 as an ISDN environment with existing technology." Adds IDC's Perry, "It's what ISDN might aim to be one day." Other T-1 vendors are working toward compatibility with ISDN. Tench

Coxe, product manager at Digital Communications Associates, says that one of the selling points for T-1 products is that "ISDN can build on T-1."

A principal job of the multiplexers is to squeeze even more data onto the T-1 line. Aydin Monitor Systems, Fort Washington, Pa., has introduced a multiplexer that takes advantage of the natural pauses and gaps in voice communications to compress conversations at a ratio of 4-to-1, effectively giving the user 96 voice lines on a single T-1 circuit (24 lines times 4).

Another vendor is StrataCom Inc., Campbell, Calif., which claims 2-to-1 compression of voice and up to 4-to-1 compression of data. Richard E. Moley, president of StrataCom, says an ability to compress data will become increasingly important for T-1 lines. "Right now," he says, "there's more voice communication than data transmission over T-1. But the amount of voice communication is growing only 5 percent a year, while the amount of data communication is growing at a rate of 30 percent a year."

Analysts forecast similar rates of growth for the value of the entire T-1 industry. Says the Alex Brown report, "We estimate that the T-1 marketplace totalled \$175 million in 1985, \$270 million in 1986 and will grow to \$665 million in 1989." □

12100

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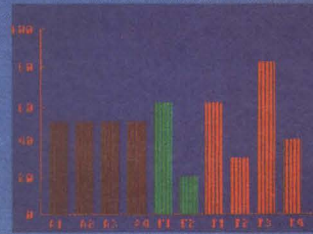
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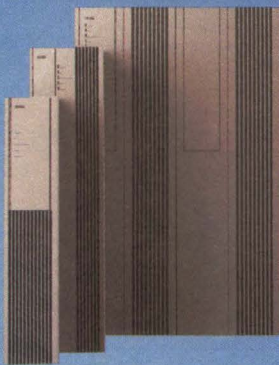
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CIRCLE NO. 37 ON INQUIRY CARD

DATA STORAGE

# QIC standards stimulate tape drive markets

**Raymond C. Freeman, Jr.**  
Contributing Editor

The QIC Working Group has been a textbook example of the power of standardization to stimulate markets. Worldwide shipments of quarter-inch streaming tape drives in 1982, the year the QIC (Quarter-Inch Compatibility) Working Group was formed, totaled 29,000 drives. Four years later, 560,000 such drives were delivered, most conforming to the QIC-24 recording-format standard.

Known formally as the Working Group for Quarter-Inch Cartridge Drive Compatibility, the QIC group creates and adopts "development standards." These documents represent consensus definitions of products that will be compatible when developed and brought to market by individual manufacturers. Many of these development standards are submitted to ANSI committees and to the European Computer Manufacturers Association for consideration as formal product standards, after development experience has been gained and revision status of the documents has stabilized.

The QIC group has adopted some 13 active development standards during a 4½-year period (Table 1). These standards define four product classes: two full-size cartridge classes and two minicartridge classes (Table 2).

Each product class is commonly identified by the number of the development standard for its recording format. For example, "QIC-24" connotes a full-size cartridge class with formatted storage capacity of 60M bytes on nine tracks, using 600 feet of tape. QIC-24 drives come with either an intelligent interface—such as QIC-02 or the small computer systems interface (SCSI)—or a basic QIC-36 interface. The newer QIC-120 class provides 125M bytes on 15 tracks with the same choice of intelligent interfaces. Both of these full-size cartridge classes have gravitated to-



**Raymond C. Freeman, Jr.** is president of Freeman Associates Inc., a Santa Barbara, Calif., market research and consulting company specializing in the tape-drive and optical-disk industries.

**TABLE 1**  
**DEVELOPMENT STANDARDS ADOPTED BY QIC**

|         |   |
|---------|---|
| QIC-02  | intelligent drive interface                 |
| QIC-24  | recording format (60M bytes)                |
| QIC-36  | basic drive interface                       |
| QIC-40  | recording format (40M bytes)                |
| QIC-100 | recording format (40M bytes)                |
| QIC-102 | magnetic head for QIC-100 drives            |
| QIC-103 | basic drive interface                       |
| QIC-104 | SCSI interface implementation               |
| QIC-105 | magnetic head for QIC-120 drives            |
| QIC-106 | magnetic head for QIC-40 drives             |
| QIC-107 | basic drive interface                       |
| QIC-108 | SCSI command set for "random-access" drives |
| QIC-120 | recording format (125M bytes)               |

Source: Freeman Associates Inc.

**TABLE 2**  
**QIC PRODUCT FAMILIES**

| Recording format            | Formatted capacity (M bytes) | Cartridge type     | Corrected bit error rate | Intelligent interface    | Basic interface    | Magnetic head |
|-----------------------------|------------------------------|--------------------|--------------------------|--------------------------|--------------------|---------------|
| <b>Cartridge drives</b>     |                              |                    |                          |                          |                    |               |
| QIC-24                      | 60                           | DC600A<br>DC600XTD | 10 <sup>-10</sup>        | QIC-02<br>QIC-104 (SCSI) | QIC-36             |               |
| QIC-120                     | 125                          | DC600A<br>DC600XTD | 10 <sup>-10</sup>        | QIC-02<br>QIC-104 (SCSI) |                    | QIC-105       |
| <b>Minicartridge drives</b> |                              |                    |                          |                          |                    |               |
| QIC-40                      | 40                           | DC2000             | 10 <sup>-14</sup>        | QIC-108 (SCSI)           | QIC-107 (flexible) | QIC-106       |
| QIC-100                     | 20 or 40                     | DC2000             | 10 <sup>-12</sup>        | QIC-108 (SCSI)           | QIC-103            | QIC-102       |

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CIRCLE NO. 39 ON INQUIRY CARD

**TABLE 3**  
**QIC DRIVE SUPPLIERS**

| Manufacturer           | Minicartridge |         | Data cartridge |         |
|------------------------|---------------|---------|----------------|---------|
|                        | QIC-40        | QIC-100 | QIC-24         | QIC-120 |
| Alloy                  | ✓             |         |                |         |
| Archive                | ✓             |         |                |         |
| Braemar                |               | ✓       |                |         |
| California Peripherals |               |         | ✓              | ✓       |
| Cipher                 |               |         | ✓              | ✓       |
| Conpart                |               |         | ✓              | ✓       |
| Kennedy                |               |         | ✓              | ✓       |
| Mountain               | ✓             |         |                |         |
| North Atlantic         |               |         | ✓              | ✓       |
| Northern Telecom       |               |         | ✓              | ✓       |
| Perex                  |               |         | ✓              | ✓       |
| Shinwa                 |               |         | ✓              | ✓       |
| TAF                    |               |         | ✓              | ✓       |
| Tallgrass              |               | ✓       |                |         |
| Tandberg               |               |         | ✓              | ✓       |
| 3M                     |               | ✓       |                |         |
| Wangtek                | ✓             |         | ✓              | ✓       |

Source: Freeman Associates Inc.

107) or a SCSI port (QIC-108), depending on the version selected. QIC-100 minicartridge drives record 20M bytes on 12 tracks or 40M bytes on 24 tracks. The interface choices for QIC-100 products include the basic QIC-103 and the QIC-108 SCSI.

The QIC group has also created development standards for the magnetic heads required by three of the product classes. These head standards are intended to enhance market acceptance of the drives by reducing cost and improving product availability.

More than 17 tape-drive manufacturers now offer QIC-compatible devices (Table 3). This critical mass of suppliers is expected to stimulate further market acceptance of already-popular quarter-inch cartridge tape drives. Meanwhile, QIC is at work defining 300M-byte and 600M-byte tape-cartridge drives and 100M-byte and 200M-byte minicartridge drives. □

ward half-height 5¼-inch form factors.

Buyers interested in smaller form factors are candidates for minicartridge drives. These products are

moving into 3½-inch packages. QIC-40 products record 40M bytes on 20 tracks, using 200 feet of quarter-inch tape. These devices can plug into a flexible disk controller (QIC-

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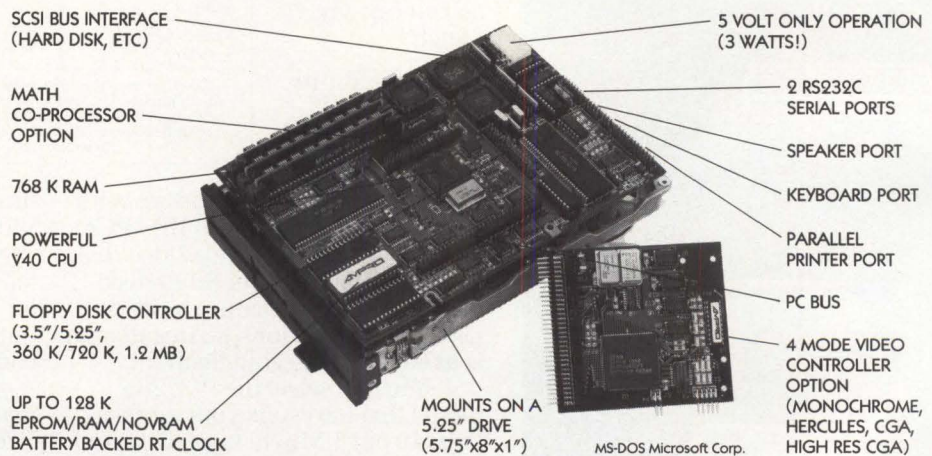
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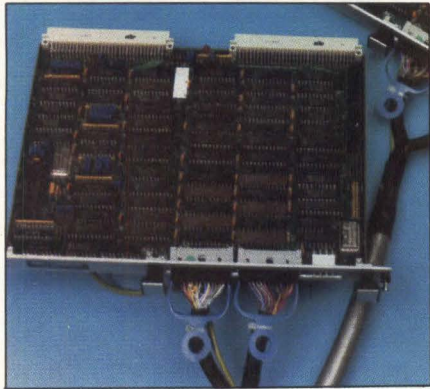
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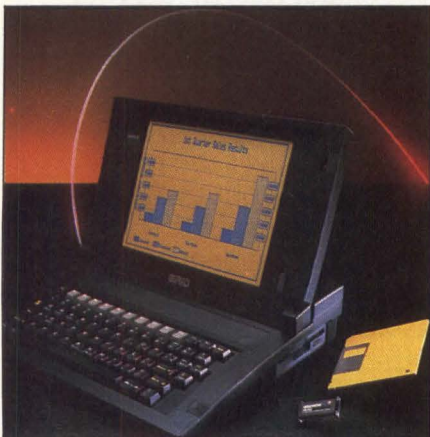
# FEATURE HIGHLIGHTS



p. 71 . . . . . Powerful VMEbus

## **VMEBUS PACKS MULTIPROCESSING POWER . . . . .71**

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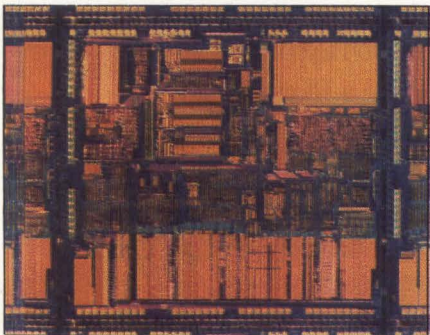
p. 97 . . . . . Here come the portables

## **BOARDS, SOFTWARE ENRICH LASER PRINTERS . . . . .83**

Because more than 45 companies now offer laser printers, it's getting harder and harder to differentiate among them. Buying plain vanilla laser printers in volume and reselling thus becomes increasingly difficult. For system integrators and resellers, the goal is to add value via faster interfaces, add-in memories and powerful page-description languages. Our survey covers those add-in/add-on products. It also includes a table of available laser printers, with key specs such as type of engine, speed, emulation and price.

## **MATURING LAPTOPS LURE USERS . . . . .97**

The portable computer market has been slow in developing, but this year's crop ushers in a handful of light, yet powerful, laptops that might unlock the market's potential. MMS takes a look at eleven of the leading units and outlines what's required in the "ultimate laptop".



p. 113 . . . . . Uniting UNIX and DOS

## **INTEL'S 386 UNITES UNIX AND DOS SOFTWARE . . . .113**

Running UNIX and DOS software on the same machine enables system integrators and software developers to tap the best of both worlds and to potentially double their customer bases. Products like the VP/ix, UNIX-DOS, integration—developed jointly by Interactive Systems Corp. and Phoenix Technologies Ltd.—and Locus Computing Corp.'s Merge software are leading the way. In this exclusive feature, Intel Corp. shows you how to use its powerful 80386 microprocessor to create virtual 8086 machines on top of UNIX and run DOS and UNIX applications concurrently.

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Dr. Chester L. Karrass

"Kaiser Aluminum & Chemical, which spent about \$15,000 over several years on Karrass Seminars, asked employees to identify specific savings they had made through better company negotiating. The total ran into millions of dollars. A Boeing sales executive says the same about a single Mideast negotiation. At General Electric, renowned for its own in-house training programs, 90 per cent of the employees called the Karrass course their most significant career training ever. The seminars are even regarded as a fringe benefit. 'You wouldn't believe how many of our employees have told me what a good deal they got on a boat or a car because they adopted Karrass' strategies,' says the head of training at a major oil company." (*Forbes* Feb. 15, 1982)

Since that article appeared in *Forbes*, February 15, 1982, the number of Fortune 500 companies sending executives, managers and other key staff members through the Karrass Seminar has risen to

↳ Continued next page

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See back page for two-day seminar schedule and fees

Continued from previous page

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# Effective N



**Dr. Chester L. Karrass**

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After earning an Engineering degree from the University of Colorado and a Masters in Business from Columbia University, he became a negotiator for the Hughes organization. There he won the first Howard Hughes Doctoral Fellowship Award and spent three years conducting advanced research and experiments in negotiation techniques before earning his Doctorate from the University of Southern California. He then returned to Hughes as a negotiation consultant.

In 1969 Dr. Karrass used his research and experience in his pioneering EFFECTIVE NEGOTIATING® seminar, assisting other business people to master the strategies, tactics and psychological insights of negotiating.

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CIRCLE NO. 44 ON INQUIRY CARD



# VMEBUS PACKS MULTIPROCESSING POWER

High-speed central, signal and math processors; MMUs; fast intelligent I/O; and abundant software rev up VMEbus for demanding multiprocessing and real-time industrial applications

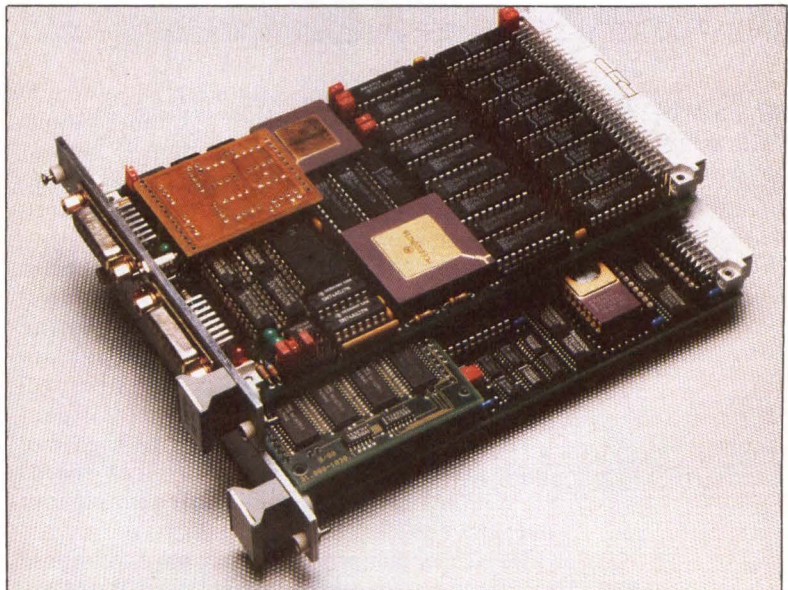
**Jesse Victor**, Associate Editor

VMEbus is on the move. With support from more than 300 board vendors, the bus continues to add a formidable array of powerful products aimed at high-throughput, fast-I/O, multiprocessing and real-time industrial-control tasks. In fact, the capabilities of these integrated boards and software center on certain key areas:

- A slew of 32-bit-processor-based boards with clock speeds up to 25 MHz;
- Zero wait-state access up to 4M bytes of on-board, dual-ported RAM;
- Multiple high-speed intelligent I/O channels;
- A variety of multitasking, multiuser and real-time operating systems;
- Data and/or instruction caches and high-speed local buses for fast memory access;
- Integrated math coprocessors and memory-management chips;
- Fast signal-processing boards.

Moreover, this is becoming the year of Motorola Inc.'s 32-bit MC68020 processor on the VMEbus. A score of companies base high-clock-speed processor boards on that chip. For example, the MVME133A-20 from flagship VMEbus vendor, Motorola Semiconductor Products Inc., packs a 20-MHz MC68020 and an integrated MC68881 floating-point math coprocessor with 1M byte of dual-access, 32-bit-wide dynamic RAM (DRAM). Also included are three 8-bit timers, two multiprotocol serial ports and a real-time clock.

The math coprocessor complements the power of the 68020 chip. It fully implements the IEEE P754 binary floating-point standard and supports a full set of transcendental and trigonometric functions. The 32-bit-wide (ad-



dress and data) VMEbus interface furnishes such system-controller functions as a time-out generator, a SYSCLK (system clock) driver, an IACK (interrupt acknowledge) daisy-chain driver and a level-three priority arbiter for bus control.

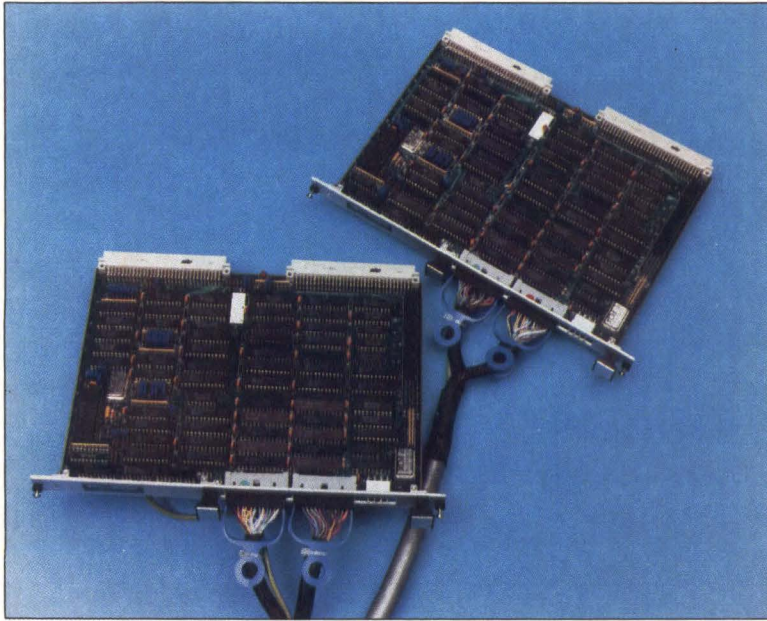
If you need even higher clock speeds, consider the VMPS-4M processor board from Dual Systems Corp. It blazes along at 25 MHz. In addition to its MC68881 coprocessor, it sports an MC68851 memory-management unit (MMU) to take full advantage of the on-board 68020's 4G bytes of virtual memory. Software support includes UNIX System V Version 2 as well as the real-time OS-9 operating system. The company plans to offer Version 3.0 support by the end of year.

Integrated Solutions Inc. also offers a 25-MHz 68020 on its no-wait-state VME-

---

**A megabyte of fast-access static RAM on the memory module (top) is tightly coupled to PEP Modular's VMPM68KC 68020-based VMEbus processor board via a high-speed 32-bit bus.**

---



**Bit 3's VME-to-VME adapter** performs data transfers between separate VMEbus card cages.

68K20C board. Running both UNIX System V and Berkeley UNIX Version 4.3, the VMEbus card boasts a 16K-byte cache with a 95 percent hit rate, an MMU, a 68881 chip and access to 56M bytes of memory over its proprietary high-speed memory bus.

Because VMEbus is asynchronous, processor clock speeds don't have to slow down to a maximum data-transfer rate imposed by the system bus. And with a theoretical maximum data-transfer rate of nearly 40M bytes per second, VMEbus leaves plenty of room for expansion. As important as they are in high-end applications, however, processor clock speeds are not the only factor in increasing throughput over the bus.

Because a fast processor may have to impose wait states to match relatively slow RAM access times, zero-wait-state access to memory—as well as to on-board data and/or instruction caches—can be crucial in boosting throughput. Dual System's 68020 board, for example, offers zero-wait-state access to as much as 4M bytes of parity-protected memory for 70 to 90 percent of the 68020's bus cycles via a 2K-byte data and/or instruction cache. To pack that much 115-nsec-access memory on the board, the chips are stacked on their sides using a "zip-pack" technique.

Force Computers Inc. also claims zero-wait-state performance for its 20-MHz 68020-based processor board. The SYS68K/CPU21A, rather than incorporating onboard DRAM as do most other VMEbus processors, uses, faster, static RAM—up to 512K bytes. Additional memory, on companion boards, is accessed via the proprietary Force local memory extension (FLME) 96-pin DIN connector. FLME can connect up

to 1M byte of RAM with 55-nsec access.

The Force board has a variety of software support, including kernels for embedded control functions plus real-time operating systems. Contained in electrically programmable ROM, the pSOS operating system provides real-time, multitasking support for time-critical applications. The concurrent MTOS-UK kernel has run-time interfaces for Pascal, C and assembly language as well as UNIX links.

Combining support for real-time task control, plus flexibility for user applications, the PDOS Version 3.1 operating system layers a real-time, multitasking kernel with file-management, floating-point and user-monitor modules. Semaphores and events provide intertask communication and synchronization. The operating system supports enhanced BASIC as well as Pascal, FORTRAN 77 and C compilers. Alternatively, versions of UniFLEX are optimized for real-time, process-control, multiuser and multitasking, RAM-disk-based applications.

#### Enhancements ease multiprocessing

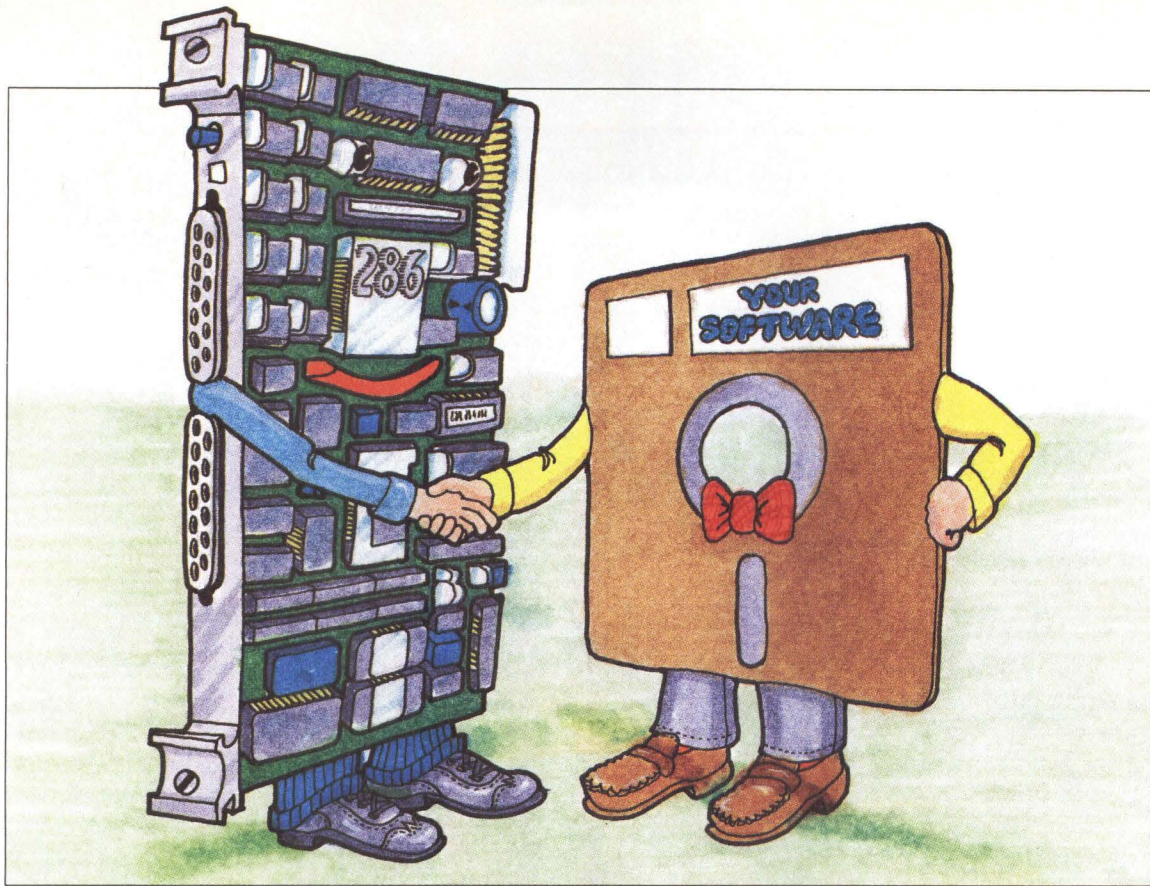
Processor boards from Heurikon Corp., Ironics Inc., Plessey Microsystems, PEP Modular Computers Inc. and ISKRA VME Technologies are specially enhanced for multiprocessor environments.

Heurikon's HK68/V20 sports a 24-MHz 68020 processor with up to 4M bytes of dual parity-checked RAM plus 128K bytes of non-volatile static RAM for user-developed functions. With a full 32-bit master/slave VMEbus interface, it has an optional 68851 MMU and 68881 math chip. Up to 976M bytes of VME subsystem bus (VSB)-compatible off-board memory is supported as is the OS-9 operating system.

A busLink utility of the LINK/X real-time development system allows a Heurikon processor board running UNIX to interactively communicate with up to 16 processor boards on the VMEbus running Hunter and Ready's VRTX real-time executive.

Ironics' 20-MHz, 68020-based IV-3201 board can access up to 4M bytes of dual-ported DRAM without wait states, with 1M byte on board. The new IV-3204 board has a full 4M bytes on the card. Either board can form the basis of a multiprocessing system by adding the IV-3273 system-control module, the IV-01624 eight-port intelligent serial I/O controller and several other of the company's processor boards—such as the IV-1602, which run UNIX kernels.

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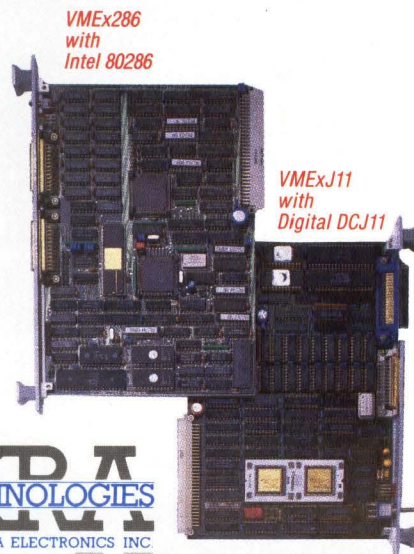
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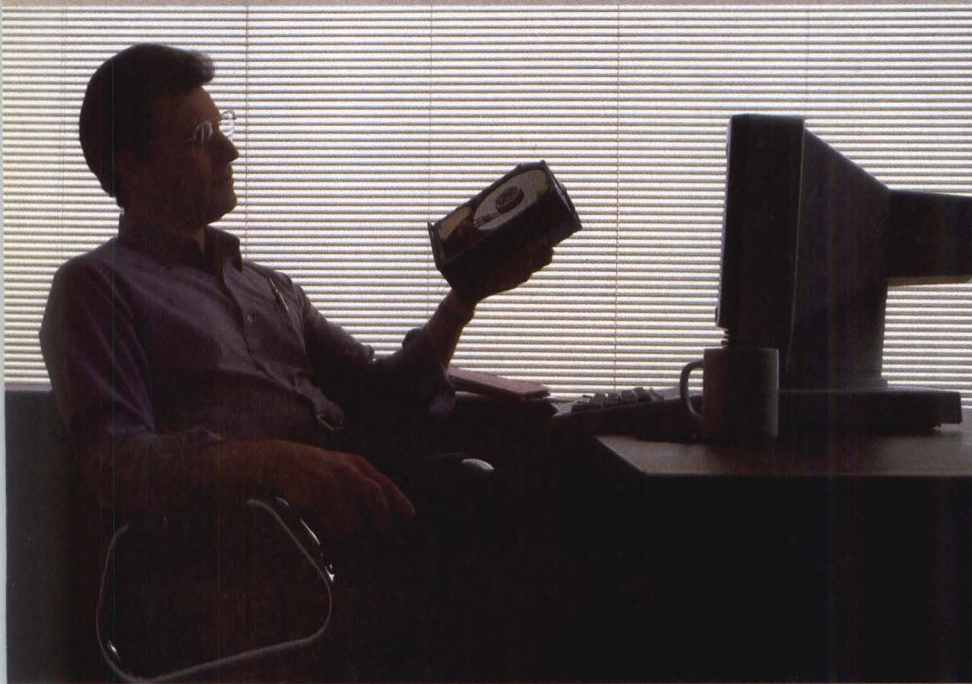


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Software support includes UNIX V.2 and Software Components Group's pSOS multitasking kernel, along with pHILE-68K for disk-based file management and pROBE-68K for resident debugging.

If you need fast throughput for demanding applications, consider Plessey's PME 68-21 two-board set: the 68-21C processor plus the 68-21A accelerator. With a 25-MHz 68020, the processor board furnishes a 68881 floating-point chip, two RS232C serial ports, a 16-bit command-status register and a 32-bit VMEbus interface.

The interface provides full VMEbus system-control functions. It has a four-level bus arbiter and a seven-level interrupt handler. An interrupt module allows the 68020 processor to raise VMEbus interrupts in multiprocessor configurations.

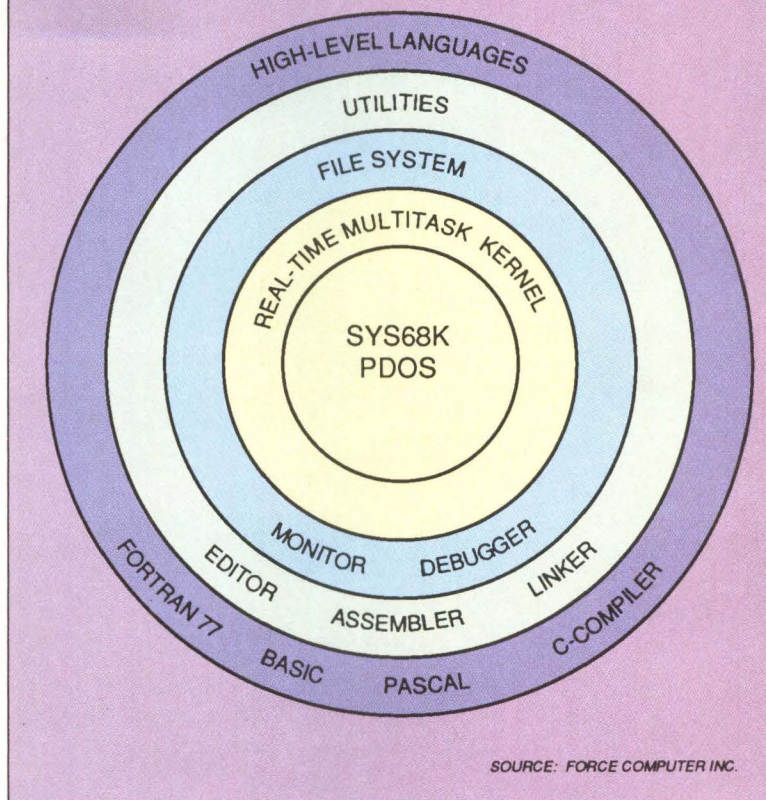
But the accelerator board is the heart of the system. It improves performance by way of a VSB bus interface, dual-ported RAM and 1K-byte prefetch cache. The asynchronous VSB speeds data transfers between a board acting as a master and slave memory boards, peripheral control devices or coprocessors. The cache preloads memory with the next series of instructions while the 68020 performs data fetches; instructions for loading into the cache come over the VSB.

With a 16.7-MHz 68020 processor plus 68881 unit, PEP's VMPM68KC loads 1M byte of fast-access static RAM (without wait states) and up to 512K bytes of 32-bit-wide ROM (for embedded applications) on one single-high VMEbus board. The memory module is tightly coupled to the processor via a high-speed, non-multiplexed 32-bit address and data bus, reducing the need to access the VMEbus. Piggyback modules provide RS232, RS422 and 20-mA current loop interfaces. OS-9 operating system support is standard.

#### MC68020 alternatives exist

ISKRA VME Technologies offers alternatives to the ubiquitous 68020. If you want to utilize your MS-DOS-based applications on the VMEbus, there is ISKRA's VMEx 286 processor board. Optimized for XENIX multiuser environments, real-time iRMX 286 applications and MS-DOS (or CP/M 86), it furnishes an Intel Corp. 80286 processor and 80287 math coprocessor. It also has 512K bytes of dual-ported RAM with zero-wait-state access, a real-time clock, two bootstrap sockets for up to 64K bytes of EPROM and two RS232C ports.

#### PDOS AIDS REAL-TIME TASK CONTROL



SOURCE: FORCE COMPUTER INC.

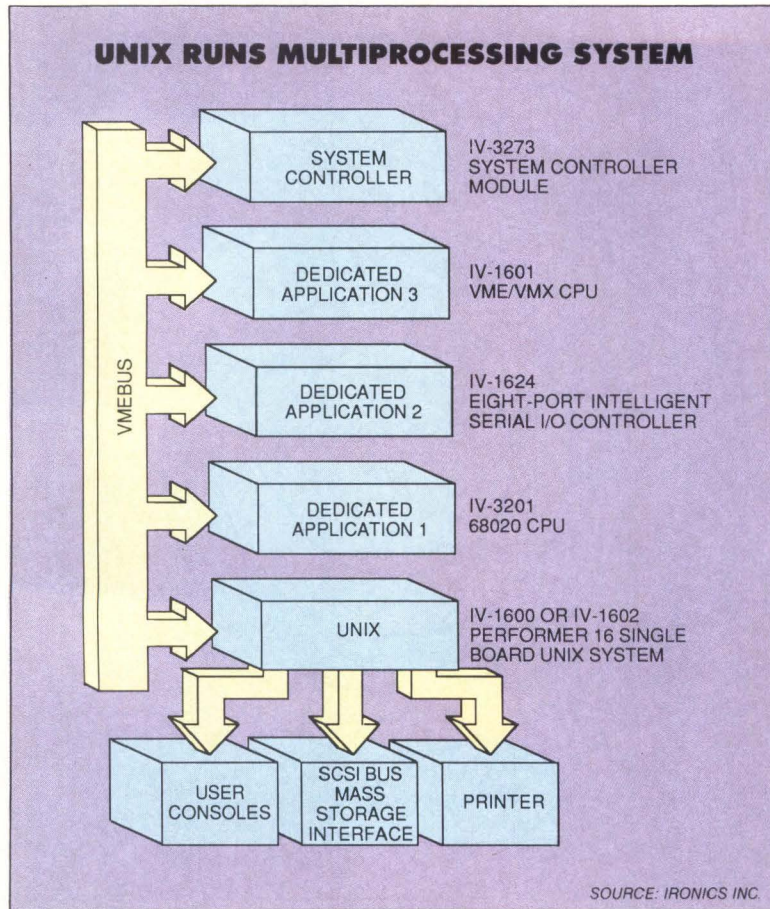
Bus-lock support aids multiprocessor configurations, especially for real-time applications, explains Keith Cribbin, ISKRA area sales manager: "For critical applications, if one processor holds the VMEbus, it puts out a lock signal that holds the bus until it finishes operation. For real-time operations, you don't want a machine to crash because a processor with a higher priority (for bus access) steals the bus."

ISKRA's VMEx J11 board is for "people with a large base of Digital Equipment Corp. PDP-11 applications who want to migrate to a VMEbus environment," says Cribbin. Supplying a 15-MHz J11 processor, 512K bytes of 120-nsec access DRAM with parity, real-time clock, serial and parallel ports and three programmable timers, it supports the extended RSX-11M operating system.

Cribbin continues: "We have run multiple versions of RSX on two J11 boards where each has its own kernel. You can have more-than-two-processor configurations if, for example, the other boards are running an assembler program or microcoded program or acting as an intelligent controller and bus master."

AT&T Technologies Systems offers another alternative to the 68020 on the VMEbus. It has upgraded its 14-MHz, 32-bit WE 32100 proces-

**Supported by Force Computer's SYS68K/CPU21A VMEbus processor board, SYS68K PDOS operating system supplies a real-time multitasking kernel, layered by a file-management system, utilities and high-level-language support.**



**The 20-MHz 68020-based IV-3201 board from Ironics forms the core of a multi-processing system under UNIX, with the addition of a system-control module, serial I/O controller and other VMEbus processor boards.**

processor on its WE 321SB VMEbus board to 18 MHz. Combining the WE 32101 MMU and WE 3210C math accelerator chips, 1M byte of parity DRAM and up to 256K bytes of EPROM and three user-programmable counter/timers, the board can run the company's UNIX System V/VME version of UNIX System V Release 2.1. Enhancements include demand paging and record and file locking.

But the big news about the 321SB board is that it can also run the first available version of UNIX System V Release 3.1 (due for introduction in the second quarter of this year). UNIX System V/VME Release 3.1 implements the company's Streams networking interface with a driver running under Ethernet and media-independent networking support.

"Release 3.0 supports AT&T's Streams interface under the Starlan local area network and twisted-pair wiring. With V/VME Release 3.1, you can develop software to interface to any kind of network," explains Marc Harrison, technical consultant for microprocessors with AT&T. "The Remote File Sharing capability of 3.1 is a very high-level implementation that sits on top of Streams. It allows transparent access to data on a remote UNIX machine, which appears to the first computer as a different

directory under UNIX."

A score of VMEbus manufacturers, Harrison says, have announced they will write device drivers that allow their products to talk to the WE 321SB and UNIX System V/VME.

"This is the first time the VMEbus community has agreed to a software standard analogous to the VMEbus hardware standard," Harrison asserts. "It is a real step forward."

**Exchange data between card cages**

Products from Performance Technologies Inc., Bit 3 Computer Corp. and VME Microsystems International Corp. meet the need for more-demanding or extensive interfaces between multiple VMEbus processor boards.

Totally transparent to the system and requiring no special software, Performance Technologies' PT-VME902 32-bit VMEbus Expander/Repeater ties two or more VMEbus chassis together with full 32-bit data, address and interrupt capability in both standard daisy-chain and star configurations.

Aiding multiprocessing configurations, the software-controlled disconnect/isolate capability allows two VMEbus systems to be operated concurrently under software control and then be connected via registers mapped into VMEbus I/O space for message passing between the systems.

Bit 3's VME-VME adapter links two VMEbus card cages together via three methods and also allows interrupts to be passed between the systems. Address mapping permits a VMEbus master in one chassis to directly address VMEbus memory in the other, as though it were local memory, without having to pass data through intermediate software drivers.

Paging uses a 65K-byte window in the host VME address space linked with an 8-bit programmable register. The host can scan through 16M bytes of memory in the destination system. Finally, via optional dual-ported RAM on a piggyback card, each system can read and write to the other.

VME Microsystems International Corp. offers a full line of interfaces from the VMEbus to DEC, Prime Computer Inc., Data General Corp., Gould/Sel and other companies' host computers. VMIVME-DMAL boards support 32-bit transfers between VMEbus systems at a maximum burst-mode rate of 6.25M bytes per second via direct-memory access (DMA). VMEnet master controller supports up to 16 slave boards with 32-bit transfers at 8M bytes per second over a parallel network and can operate in multidrop configurations.

HVE Engineering Inc. has its VMEbus-to-VMEbus Syner-System real-time interfaces plus VMEbus-to-VERSAbus or Multibus-to-

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## Companies mentioned in this article

**AT&T Technologies Systems**  
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(612) 881-6955  
Circle 324

**Dual Systems Corp.**  
2530 San Pablo Ave.  
Berkeley, Calif. 94702  
(415) 549-3854  
Circle 325

**Force Computers Inc.**  
727 University Ave.  
Los Gatos, Calif. 95030  
(408) 354-3410  
Circle 326

**Heurikon Corp.**  
3201 Latham Drive  
Madison, Wis. 53713  
(608) 271-8700  
Circle 327

**HVE Engineering Inc.**  
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Campbell, Calif. 95008  
(408) 370-4666  
Circle 328

**Integrated Solutions Inc.**  
1140 Ringwood Court  
San Jose, Calif. 95131  
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Circle 329

**Ironics Inc.**  
Computer Systems Div.  
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**Motorola Semiconductor Products Inc.**  
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**Sky Computers Inc.**  
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**VME Microsystems International Inc.**  
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Huntersville, Ala. 34803  
(205) 880-0444  
Circle 338

VMEbus products. The former enables multiple systems to operate independently or in one real-time link and has user-selectable VMEbus priority.

Array processors on the VMEbus can boost throughput considerably in computation-intensive applications such as signal or image analysis, vision inspection, seismic analysis or lab data analysis.

For example, providing a 24-bit address and 16/32-bit data VMEbus interface, Sky Computers Inc.'s Sky Warrior array processor board offers 15-MFLOP, 32-bit performance. Sitting in a VMEbus system as a bus master or slave board, it responds to programmed I/O commands from the host processor board, performing DMA transfers in and out of system memory. Microcoded instructions synchronize internal computations with the host.

Employing vector-function chaining and run-time buffer control, the ZIP 3232 20-MFLOP array processor from Mercury Computer Systems Inc., can perform a complex, 1,024-point FFT (Fast Fourier transform) in 2.2 msec and matrix multiply a 100-by-100 data set in 109 msec. Packaged as double-high Eurocards, the board set is loosely coupled to the host VMEbus computer via DMA. Up to 16M bytes of main memory, storing data and program code, allows the processor to run complex algorithms with minimal host intervention, according to the company.

System integrators who need more raw processing power on the VMEbus than afforded by the MC68020 will have to wait until Motorola rolls out its 16.67-MHz MC68030 in October. With an 80-MHz-per-second bus bandwidth and highly parallel Harvard-style architecture, the new chip will give the VMEbus twice the

performance of the 68020 at the same clock speed and still preserve software compatibility with the 68000 family. On-chip MMU, twin 32-bit data and address buses and 256-byte data and instruction caches will boost throughput as will the companion MC68882 floating-point unit.

A powerful alternative is Force Computer's 80386 VMEbus board. The CPU-386 has 2M bytes of zero-wait-state, parity-checked dynamic interleaved RAM. Look-ahead logic can minimize wait states for consecutive address to the same bank of memory. The board also supplies a full-featured, serial communications controller, a real-time clock, five programmable counter-timers and vector-oriented interrupt support over the VMEbus. The FORCEbug/386 debugging package (in EPROM) furnishes test facilities, a line assembler/disassembler and a macro facility.

The VMEbus will continue to add even more powerful 32-bit processors such as the 68030 and the 80386 to support faster and more computation-intensive real-time and multiprocessing applications. Advanced intelligent communications and disk-drive controllers compensate to some extent for the lack of full 32-bit data paths in most peripherals. But new versions of today's real-time and multiuser-multitasking software will have to be developed for VMEbus systems in order to take full advantage of the capabilities of the more powerful processors now beginning to appear on the bus. □

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Interest Quotient (Circle One)  
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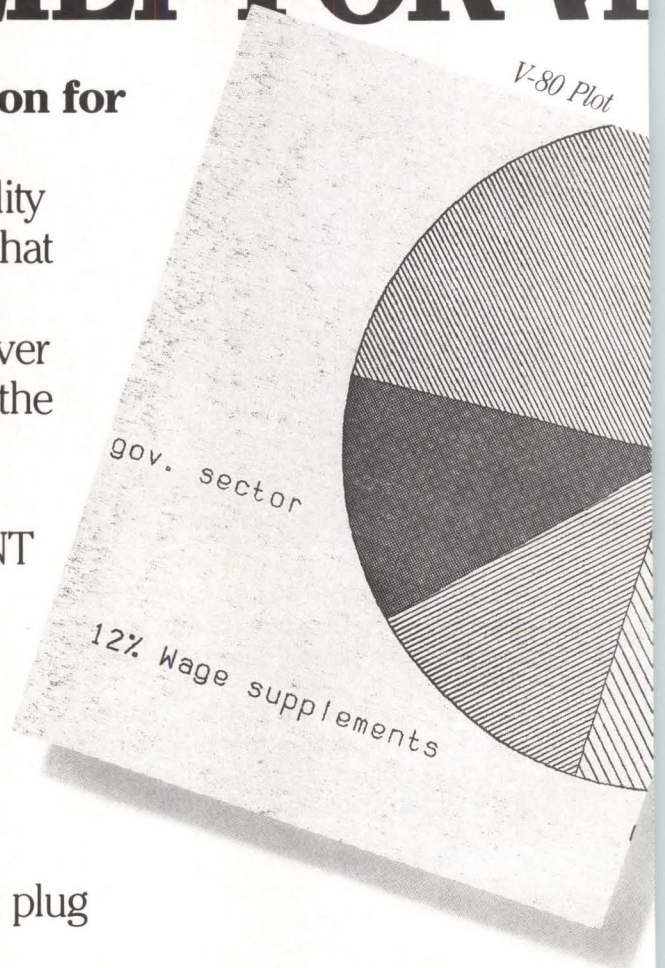
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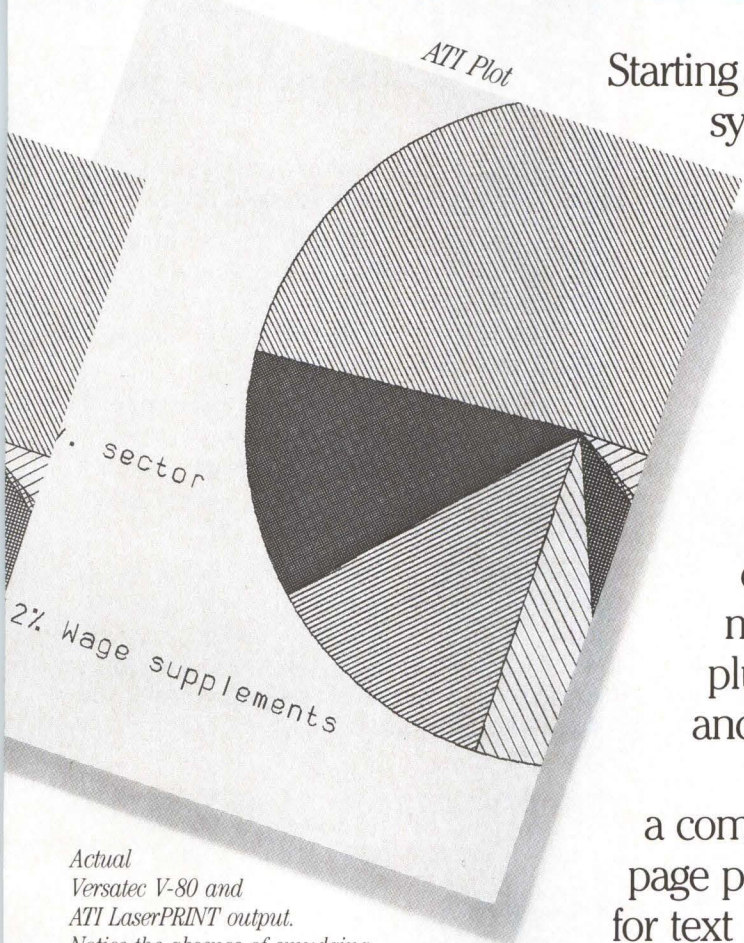
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# BOARDS, SOFTWARE ENRICH LASER PRINTERS

Add-in boards, fast interfaces, more memory and powerful page description languages advance the speed and output of low-cost laser printers

Carl Warren, Senior Editor

There seems to be no end to new entrants in the laser printer parade. Last fall there were 30 manufacturers (MMS, October 1986, Page 87). Since then at least 12 more companies have entered the market (see Table). And, of course, prices keep dropping and speeds keep increasing.

However, for system integrators and value-added resellers, the real news isn't in the number of printers available or in their price reductions. Although these factors are important, most industry watchers agree that faster interfaces, add-in memory and powerful page and document description languages are more important. New laser printer enhancements, designed to improve off-the-shelf products, are being spurred by a growing appetite for faster output and greater resolutions in applications such as desktop publishing, CAD and complex business graphics.

"Last year the demand was for low-cost laser printers. That hasn't changed, but now users are realizing the need for increased capabilities in such applications as desktop publishing," says Tony Bove, publisher of the *Desktop Publishing Newsletter*, Woodside, Calif. Even though desktop publishing is just entering its second year, users already want more fonts, greater resolution—400 to 600 dots per inch (dpi)—and speedier output.

Printer manufacturers are rising to the challenge by improving throughput speeds (the rate data travels through the interface and controller to produce a printed image) and by pushing toward 600-dpi resolutions. Ricoh Corp. is just one company with an as yet unreleased 600-dpi laser printer.

Hewlett-Packard Co. still owns the lion's



**Conographic provides** a complete library of fonts to complement its Cono-Vision 2800 controller system, which drives displays at resolutions as high as 4,096 by 1,024 pixels and links to the company's raster image processor (RIP) increases the resolution of Canon-based print engines to 600 by 300 dots per inch.

share of the desktop laser printer market. But even HP is adding improvements. For example, in concert with Imagen Corp., HP will soon add the powerful document description language (DDL) to its LaserJet and LaserJet Plus series of printers. The company also offers extra memory. Adding a 2M-byte memory upgrade to an HP LaserJet costs \$995; a DDL-equipped upgrade kit consisting of an add-in board for the host computer and a board for the printer will cost about \$2,500.

Kentek Information Systems Inc., primarily an OEM supplier, builds in features that are advantageous to system integrators. For example, its model K-3 prints at a blazing 24 pages per minute (ppm) and has 7M bytes of internal memory to support duplex operation (two-sided printing). But fast speed and duplex operation costs; system integrators can expect to

## REPRESENTATIVE LASER PRINTERS

| Company                  | Model             | Engine                 | Speed (ppm) | Emulation                                | Price (\$)     | Comments  |
|--------------------------|-------------------|------------------------|-------------|--|----------------|---|
| Acom Computer            | LX 528            | Canon                  | 8           | Epson, HP                                | 3,995          | 2 built-in fonts  |
|                          | LQ8219            | Canon                  | 8           | Diablo                                   | 4,995; 6,995   | 4; 14 built-in fonts  |
| Advanced Technologies    | 0870/80           | Canon                  | 8           | Diablo, Epson, Qume, NEC 3550            | 4,990          | exact pricing depends on controller                         |
|                          | 1570              | Ricoh                  | 15          | DEC LN03, ANSI 3.64                      | 7,990          | exact pricing depends on controller                         |
|                          | 2670              | Dataproducts           | 26          |  | 15,000         |   |
| Apple                    | Laserwriter; Plus | Canon                  | 8           | Postscript                               | 5,999-6,798    | 1.5M bytes; Plus model supports extra fonts                 |
| AST Research             | Turbolaser        | Ricoh                  | 8           | Epson, HP Plotter                        | 4,995          | max. 2M bytes   |
| Blaser                   | Blaser series     | Canon                  | 8           | IBM graphics                             | 2,395-2,995    | 64K bytes, one to five users                                |
| Canon                    | LB-P 8A-1/2       | Canon                  | 8           | Epson, Diablo                            | 3,000/4,000    | 128K/1.25M bytes  |
|                          | LB-P 20           | Canon                  | 8-12        | Epson, Diablo                            |                | OEM model   |
| Centronics               | Pageprinter 8     | Sharp                  | 8           | Centronics, Epson                        | 2,495          | memory expansion option                                     |
| CIE Terminals            | LIPS-10           | Konica                 | 10          | HP LaserJet Plus                         | 2,995          | dual input cartridges                                       |
| Citizen America          | Overture 110      | Mita                   | 10          | downloadable fonts                       | 2,395          | 512K bytes standard   |
| CMS                      | Laserpower series | Sharp, Konica, Hitachi | 8-10        | downloadable fonts                       | 2,795-3,795    | 256K-512K bytes standard                                    |
| Colorocs                 | FC 3010           | proprietary            | 30          |  | 15,000         | 4-color, 4Q '87   |
| Cordata                  | LP-300, X         | Canon                  | 8           | Epson                                    | 2,995; 3,895   | .PC-compatible interface; 1.25M bytes and 32 fonts          |
| Dataproducts             | LZR-1230          | Toshiba                | 12          | Epson, Diablo, HP LaserJet, line printer | 3,495          | uses plug-in profile cards                                  |
|                          | LZR-2600 series   | Toshiba                | 26          |  | 12,900-14,900  | line printer replacement, bar code printer, dual paper bins |
|                          | LZR-2655, 65      | Toshiba                | 26          | Diablo, line printer                     | 19,900; 22,900 | 3M bytes, supports Postscript for System/36; has 15 fonts   |
| Decision Data            | 6408              | Ricoh                  | 10          | IBM                                      | 5,495          |   |
| Digital Equipment        | LN03; Plus        | Ricoh                  | 8           |  | 3,495; 4,995   | Plus version has 1M byte, downloadable fonts                |
| Electronic Forms Systems | Formwriter series | Canon, Ricoh, Xerox    | 8, 10, 20   | Epson                                    | 4,995-24,995   | software available for electronic forms management          |
| Epson America            | GQ-3500           | Ricoh                  | 6           | HP, Diablo, Epson                        | 2,495          | includes 640K bytes   |
|                          | Opus-1            | Ricoh                  | 12          | line printer                             | 9,500          | bar code rotation   |
| GBT                      | GBT 6635XP        | Canon                  | 8           |  | 6,995          | forms overlay buffer  |
| Genicom                  | 5010              | Hitachi                | 10          | Epson, Diablo, HP LaserJet, IBM          | 5,000          | up to 1,500 fonts   |
| Hanzon Data              | LP-3000           | Ricoh                  | 8           | Diablo, Epson, HP                        | 3,995          | 12 embedded fonts   |
| Hewlett Packard          | LaserJet series   | Canon                  | 8           |  | 2,995-4,995    | 128K-512K bytes, dual paper handling system                 |
| Imagen                   | 2308              | Canon                  | 8           | Epson, Tektronix                         | 8,950          | auto collation  |
|                          | 3320              | Canon                  | 20          | Epson, Tektronix                         | 21,875         | two bins  |
|                          | 4324              | Xerox                  | 24          | Epson, Tektronix                         | 29,950         | 6M bytes  |
|                          | 7320              | Canon                  | 20          | Epson, Tektronix                         | 32,950         | duplex 11x17  |

pay \$7,990 for an evaluation model of the K-3.

Also targeting system integrators, Okidata's Laserline 6 printers tout flexible paper handling, HP emulation and printer sharing by having a microprocessor poll the serial interfaces of up to three users. Qume Corp., which traditionally sells to OEMs and VARs, packages its LaserTEN and LaserTEN PLUS printers with bundled software. The software includes word processing, graphics, utilities and a desktop publishing package. Prices range from \$2,795 to \$3,395.

Some companies have developed add-in products to meet the demand for improved speed and resolution. For example, Pacific Rim Data Sciences' \$995 SCRAMJET board uses a

Texas Instruments 32010 digital-signal processor coupled with up to 2M bytes of memory to manage bit-mapped graphics at 300 dpi on 11-by-17-inch paper. The SCRAMJET accelerates processing of complex pages (text plus graphics) to the specified speed of the printer. The board fits inside the printer and can control either an 8-ppm Canon U.S.A. Inc. LBP-CX engine or an 18-ppm Fujitsu America Ltd. M3722 engine.

The SCRAMJET emulates the Diablo 630, Epson FX-80 and HP LaserJet. To achieve maximum flexibility, the SCRAMJET uses downloading firmware that accepts emulation software and permits fonts on disk to be sent to the printer. This allows system integrators to

## REPRESENTATIVE LASER PRINTERS

| Company             | Model              | Engine              | Speed (ppm) | Emulation   | Price (\$)                   | Comments   |
|---------------------|--------------------|---------------------|-------------|---|------------------------------|--|
| ITT Qume            | LaserTEN; Plus     | Hitachi             | 10          | HP, Qume, Diablo, NEC                                 | 2,795; 5,695 with Postscript | supports 33 fonts internal   |
| Kentek              | K-2; K-3           | proprietary         | 12; 24      | Diablo 630; supports all                              | 7,995                        | LED technology; duplex double-sided printing                         |
| Konica              | LP-310             | proprietary         | 10          | OEM engine  |                              | helium neon laser  |
| Kyocera             | FBP-01             | proprietary         | 10          | Epson, Diablo 630, IBM, HP LaserJet, NEC, Qume Sprint | 3,495                        | 1M byte, own page description language, 60 fonts                     |
| Lexi Computer       | M5311              | Xerox               | 20          | IBM 52XX, Diablo 630                                  |                              | SNA compatible   |
| Mannesmann Tally    | MT910              | Toshiba             | 10          | Epson, Diablo, HP LaserJet, IBM                       | 3,695                        | up to 4 users  |
| Matsushita Electric | MEI                | proprietary         | 20          |   | <2,500                       | 400 dpi, dithering   |
| Mita                | LP-XI              | proprietary         | 10          | OEM model   |                              | video interface  |
| Mitek Systems       | 110T               | Canon               | 8           | HP LaserJet   | 5,680                        | Tempest model HP   |
| NCR                 | 6416               | Canon               | 8           | all   | 2,795                        | planning SCSI model  |
| OASYS               | Laserpro Express   | Mita                | 8           | Epson, Diablo, HP LaserJet, Qume                      | 1,895                        | may change engine  |
|                     | 805-R; 805-C       | Ricoh; Canon        | 8           | Epson, Diablo, HP LaserJet, Qume                      | 3,795                        | may change engine  |
|                     | Laserpro series    | Canon, Ricoh        | 8-15        | Epson, Diablo, HP LaserJet, Qume                      | 4,995-7,815                  | 368K bytes   |
| Okidata             | Laserline 6 Basic  | Ricoh               | 6           | Epson, HP   | 2,195                        | planned as replacement printer                                       |
|                     | Laserline 6A       | Ricoh               | 6           | all   | 2,395                        | supports 3 users   |
| Philips             | Laserprinter       | Canon               | 8           | Epson, Diablo   | 3,995                        | 400 fonts  |
| Printronix          | L1012              | Mita                | 12          | Epson, Diablo, HP LaserJet Plus                       | 2,995                        |  |
| Quadram             | Quadlaser          | Ricoh               | 8           | Epson, Diablo, Qume                                   | 3,795; 4,295                 | 1.5M bytes; 2M-byte version  |
| QMS                 | PS 800             | Canon               | 8           | Tex, Troff, Scribe                                    | 5,895                        | 2.5M bytes   |
|                     | KISS; BIG KISS     | Canon               | 8           | Diablo, Epson, HP                                     | 1,995; 2,995                 | 12 fonts; 17 fonts   |
|                     | Smartwriter series | Canon, Ricoh        | 8-15        | Epson, Diablo, HP                                     | 4,595; 6,995                 | 17 fonts; 19 fonts; 2.5M bytes                                       |
| Ricoh               | 4080 series        | proprietary         | 8           | Diablo 630  | 3,495 and up                 | retail and OEM models available                                      |
|                     | 4150               | proprietary         | 15          | OEM model   |                              | 300 dpi  |
|                     | 3400-5400          | proprietary         | 40          | OEM model   |                              | 240-400 dpi  |
| Talaris Systems     | 800; 1200; 2400    | Canon, Xerox, Xerox | 8; 12; 24   | Calcomp, Tektronix, IBM Selectric, Versatec plotters  |                              | primarily graphics system with special firmware, FORTRAN subroutines |
|                     | 610; 810           | Canon               | 6; 8        | Diablo, Epson, HP                                     | 2,850; 3,450                 | 384K bytes; 512K bytes   |
| Texas Instruments   | 2108               | Ricoh               | 8           | HP LaserJet, plotter                                  | 3,995                        | 2M bytes   |
|                     | 2015               | Ricoh               | 15          | HP LaserJet, T1855                                    | 5,995                        |  |
|                     | 2115               | Ricoh               | 15          | HP LaserJet, plotter                                  | 7,995                        | 3M bytes   |
| Toshiba America     | PageLaser          | proprietary         | 12          | P35, HP LaserJet                                      | 3,499                        | 512K bytes   |
| Xerox               | 4045               | proprietary         | 10          | Epson, HP LaserJet                                    | 4,995                        |  |

create their own fonts and emulation software.

Having more fonts is sometimes more important than raw speed. Consequently, a variety of companies are developing font libraries. For example, Conographic Corp. offers a complete library of fonts to complement its ConoVision 2800 controller system. The \$1,325 controller manages video-display resolutions as high as 4,096 by 1,024 pixels. The controller also interfaces to the company's \$660 add-on raster image processor (RIP), which boosts the horizontal resolution of Canon-based print engines from 300 to 600 dpi for a resulting matrix of 600 by 300 dpi. Using the Conographic fonts doesn't require the controller and RIP, but without them you sometimes can't distinguish

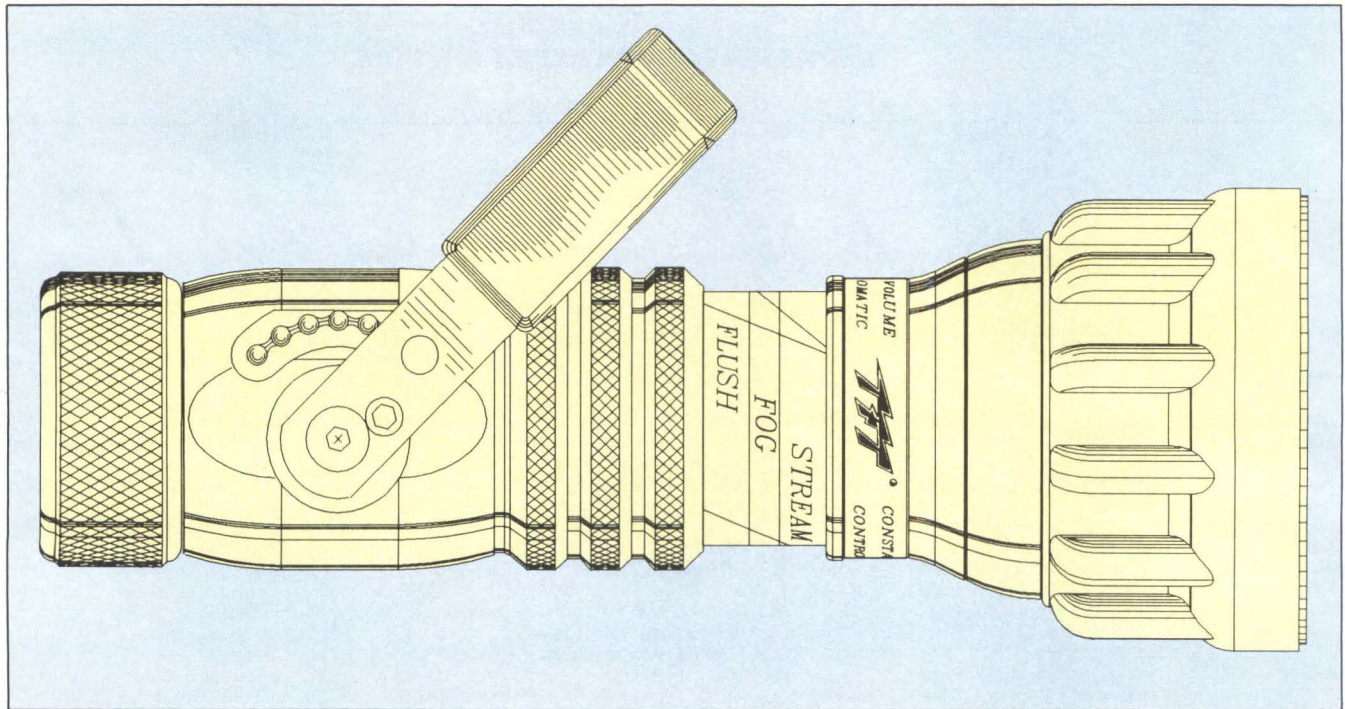
fonts on the screen.

#### PDLs provide power

Another way to add value to laser printers is via boards that add page description languages (PDLs). For example, The Laser Connection's \$2,995 PSJET controller board adds Adobe Systems Inc.'s PostScript PDL to Canon CX-based laser printers.

Although the PSJET is relatively expensive, company marketing analyst Liz Reed says that the cost is justified because of the strong industry support for PostScript. "There are more than 276 software vendors supporting PostScript," she says.

But widespread support of a PDL by applica-



**This image of a hose nozzle,** originally 8 by 3.5 inches, was produced in approximately 18 seconds on a Cordata LP-300X laser printer. The software was Autodesk's AutoCAD graphics package.

tion vendors doesn't necessarily ensure the language's success. PostScript does provide users with the ability to rotate and manipulate text and images, but it slows speed by forcing the output device to be a slave of the front end. In other words, PostScript requires that all command processing be done by the host. The problem is language overhead. Typically, with PostScript, there is a latency of about 1 msec per command; thus, complex pages take a relatively long time to create. "Even for locally attached printers, you still have to be concerned about the amount of time it takes for a command to take place," says Steve Bostwick, group manager at Local Data Corp., Torrance, Calif.

Bostwick says that the command bottleneck imposed by a language is frequently overlooked by developers, who then end up frustrated by slow performance. Genicom Corp.'s director of marketing, Rob Oster, agrees with Bostwick and explains that improvements in performance come from careful hardware and software integration.

To maximize the performance of its laser printer, Genicom obtained the ASCII Coded Escapement (ACE) PDL from Chelgraph Ltd., a British company that specializes in raster image processors for typesetting equipment. The ACE PDL and attendant RIP work on the basis that the front-end application software (such as for desktop publishing or CAD) makes all decisions regarding kerning (proper spacing of adjacent characters), image drawing and justification. ACE manages command transla-

tion and printer-operation sequences. Genicom expects to ship the products later this year.

Even though Adobe is the early leader among PDL developers, Imagen Corp. has also succeeded on other fronts. First, Imagen provides a RIP-printer combination capable of doing intricate graphics combined with text using its Impress PDL. Second, the company developed DDL, a high-level printer-control language. HP, which adopted DDL, claims that it most closely matches HP's printer-control language (PCL), the original language for LaserJets. PCL consists of a series of escape commands that tell the printer where marks should be made.

John Nairn, vice president for R&D with Imagen, explains that a RIP is responsible for taking a representation of an image, expressed in a high-level language, compiling the image and converting it into a set of primitive objects, such as text characters, lines, filled areas and shades of gray. The primitive objects are then converted to a bit-map for a given printer resolution and transmitted over a link. Thus the RIP offloads processing from the printer, using a high-level language such as DDL.

Typical DDL code might look like this:

```
LOCATE 44,55
DRAW LINE, 6,7,4
CIRCLE, 55,5.9
```

This example locates the print mechanism at x, y coordinates 44 and 55; then it instructs the print mechanism to draw a line that is 6 inches down from the top of the page and 7 inches across, with a thickness of four predefined units of measure. It then instructs the print



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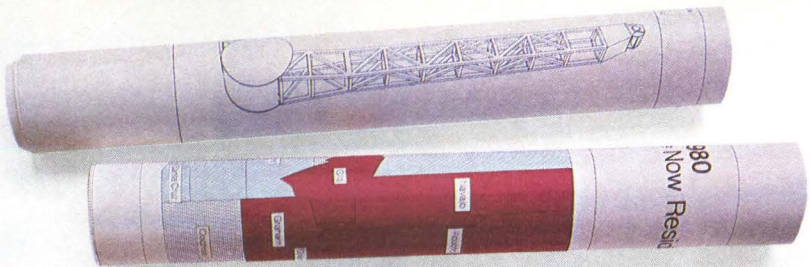
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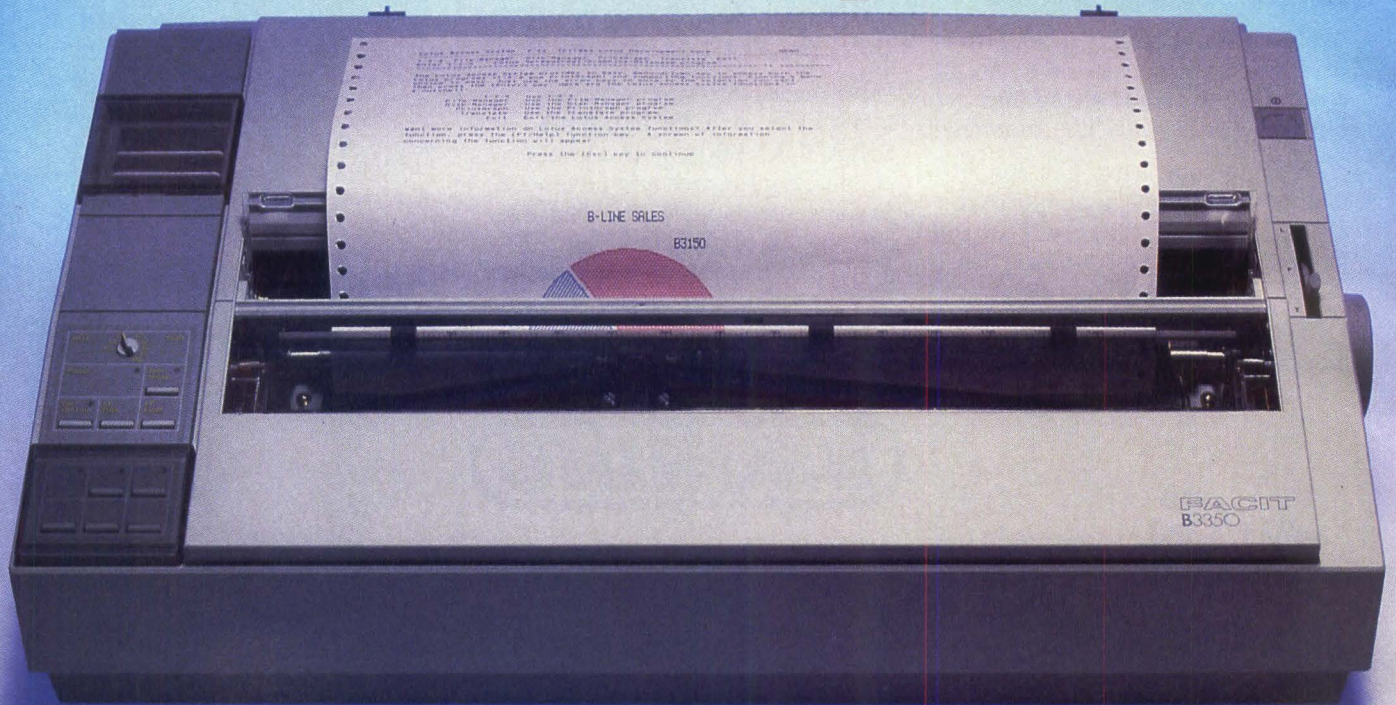
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mechanism to draw a circle with a center point at 55 and a radius of 5.9 inches. This results in an image of a line bisecting a circle.

Currently, no printers implement DDL or ACE, but software companies, like Insight Development Corp., are working with Imagen to add DDL functionality. Insight will add DDL to its LaserControl PC printer-control software package. DDL should be available on HP's printers within the next two months, according to Imagen. And Microsoft Corp. is supporting DDL by supplying a Windows device-driver library.

Of course, not every application has to match up with a sophisticated PDL to manage the image-creation process. For example, Prosoft's \$69.95 Fantasy package supports multiple fonts (a disk of 10 fonts costs \$24.95) and

virtually any image you can create or pull from a disk-based library. The company provides device drivers for a wide range of printers, including wire dot-matrix units. The drawbacks in not using a PDL, however, include lower resolution, slower speed and a lack of graphics-manipulation such as rotating.

Incorporating a PDL usually entails adding additional memory. But not all printer problems are solved by adding a new board with a PDL and extra memory. Okidata's product manager Frank Lodge explains that adding memory slows down the printer. He explains that a printer with half a megabyte of memory may take up to 3 minutes to load. "Increasing the memory just means that there is more time required to do the job. What's needed is proper matching of the controller with a low-overhead

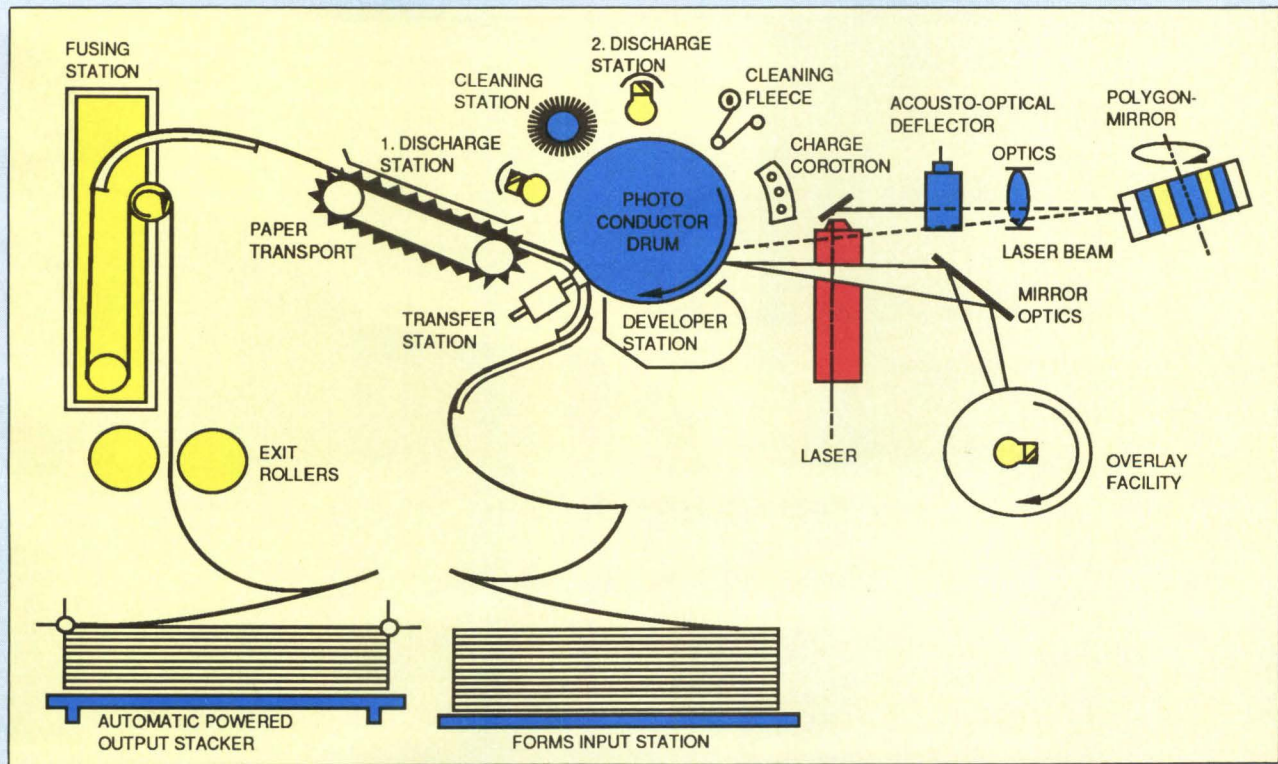
## Siemens goes duplex, two-color

Desktop laser printers aren't the only level of printer receiving attention. The 200-page-per-minute, large-scale printers used with mainframes and superminicomputers are also receiving their share of enhancements. Although 200-ppm printers are fixed at 210 dots per inch to accommodate the driving software, companies like Siemens AG, Munich, West Germany, add value by providing high-speed duplex (double-sided), two-color printing.

Siemens' 200-ppm, IBM Corp.-compatible ND 3 laser printer uses a charged photoconductor drum

onto which positively charged toners are applied at a developer station. The toner is attracted to a negatively charged paper at a transfer station and is fused to the paper in a cold fusing station (see Diagram).

The ND 3 performs high-speed duplex operation and two-color printing via a reversing roller and a second print station (not shown). However, operation-control software must be modified to accommodate the extra passes, because most IBM printer software expects to see only a single printer.



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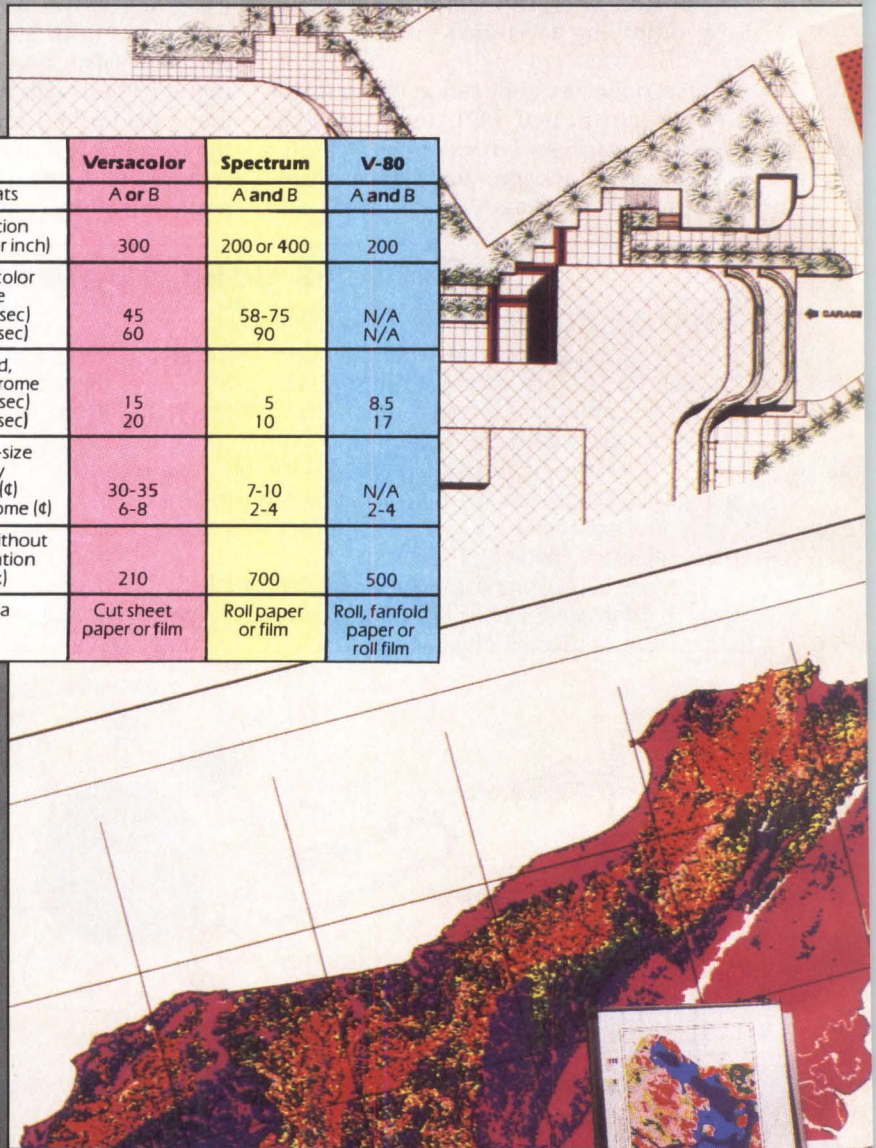
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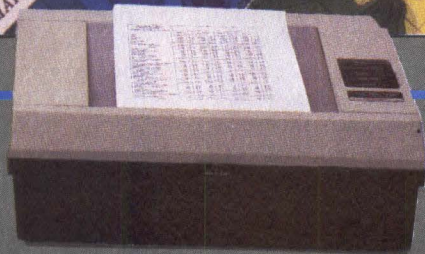
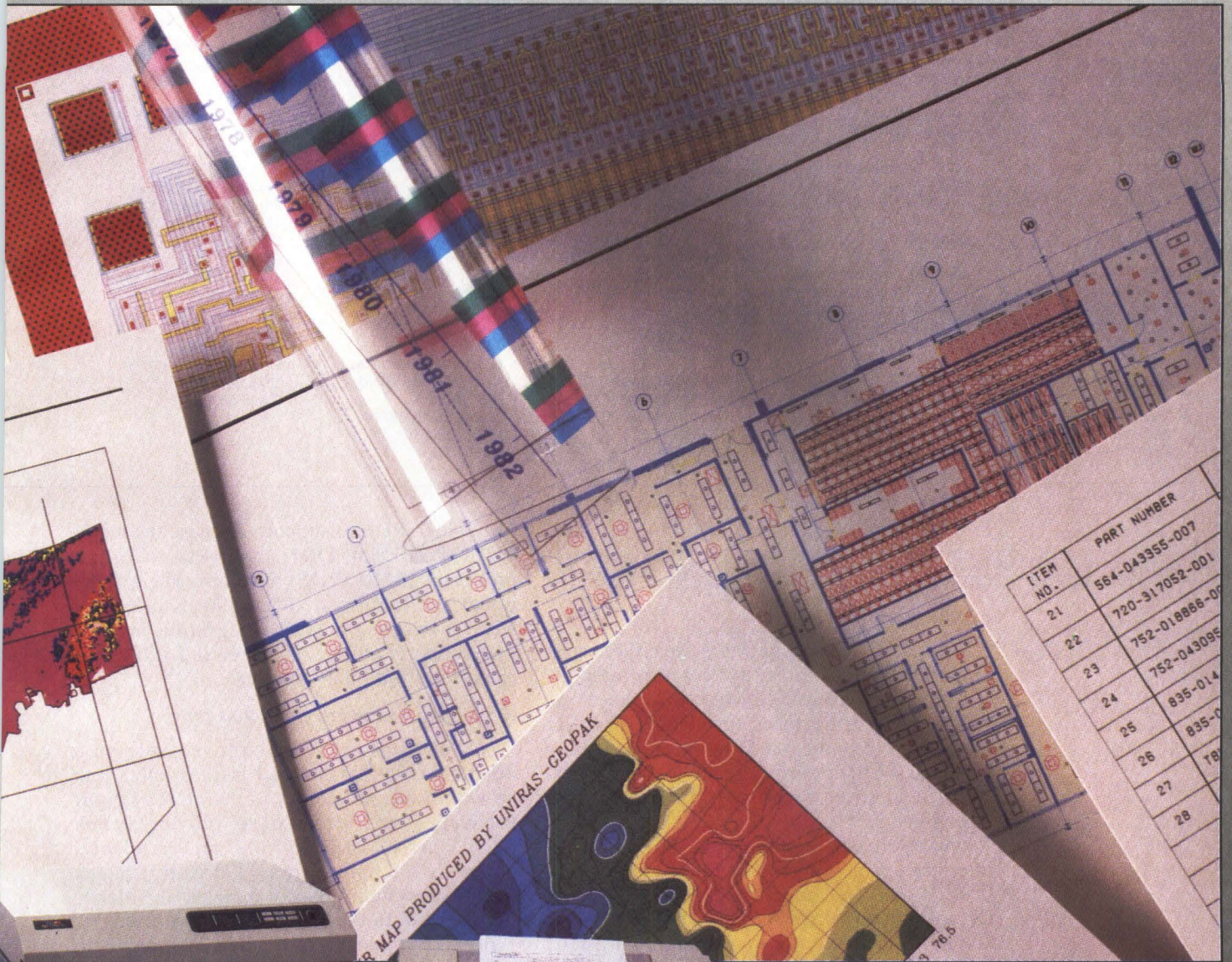
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| Speed, color page                 |                         |                    |                                  |
| A-size (sec)                      | 45                      | 58-75              | N/A                              |
| B-size (sec)                      | 60                      | 90                 | N/A                              |
| Speed, monochrome                 |                         |                    |                                  |
| A-size (sec)                      | 15                      | 5                  | 8.5                              |
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PDL, or a very sophisticated printer-control language and a fast interface," Lodge maintains.

### SCSI enters printer arena

Most laser printer interfaces use either serial or parallel ports, direct system-to-printer direct-memory access (DMA) interfaces, or RS722 video interfaces (used by HP in its LaserJets). But the small computer systems interface (SCSI) promises to solve many printer cost and speed problems (MMS, February, Page 49).

One approach to solving the SCSI printer-interface problem facing line printers is NCR Corp.'s ADP-60 interface. Linking SCSI to Dataproducts Corp.'s line printers, the ADP-60 allows up to two hosts to talk to a high-speed line printer at rates as fast as 1.67M bytes per second. However, this approach doesn't account for the bit-mapped requirements of laser printers. But help is on the way: the ANSI X3T9.2 committee on low-level interfaces, the group responsible for formal SCSI definitions, is in the process of developing a working document for laser printers and other raster-type output devices.

One problem that ANSI members have is

over which PDL to support. Because the major PDLs (PostScript, DDL, Interpress, ACE, Impress and IBM's IPDS) have only slight functional similarities, ANSI architects are faced with developing a SCSI integration method that supports all the languages and still leaves room for additional functions.

### High-speed printers push 200 ppm

Not all laser printers fit conveniently on a desktop. Large, high-speed laser printers link up with minicomputers and mainframes. Spur Products Corp., for example, provides a link from Harris Corp. H-1000 superminicomputers to 200-ppm Xerox 9700 laser printers. Spur's subsystem adapter matches the Harris I/O protocol to the Xerox Corp. protocol.

BGL Technology Corp.'s BGL graphics controller for 26-ppm Dataproducts' printers provides graphics emulation of Tektronix Inc. 4010 and 4014 plotting commands. In addition, the controller emulates Versatec Inc. plotters by providing vector-to-raster conversion.

Wespercop has solved the interconnect problems for HP-3000 minicomputers with its DLP-3000 printer-protocol converter. The \$900 DLP-3000 emulates the HP2631B or 293X on the host side and connects to the

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printer via an RS232C connection. The DLP-3000 converts the complex series of HP escape sequences to the sequences expected by the printer.

Hooking laser printers into large system environments often entails negotiating networks. To meet these needs, Xerox's printing system division developed the Interpress PDL, designed around the requirements of the Xerox Network Systems (XNS) architecture—thus taking into account communication needs and printing requirements at the same time.

Interpress, like all major PDLs, is more than just a printer-control language. It permits a computer to create an electronic master, which describes to a printer the detailed appearance of every page in a document, including its type fonts and graphics elements—such as line drawings, halftones and scanned images. It also enables most word processing packages to make use of image-scanning devices and any type of raster printer. Proponents of Interpress insist that it is virtually overhead-free and makes use of compact code. Software vendors are lining up behind Interpress but, interestingly enough, they are the same vendors who also support DDL and PostScript.

The big question in the laser printer and PDL

arenas is what IBM will do. The bets are on that a low-end (8- to 12-ppm) desktop printer will show up this year. IBM has discussed DDL support with Imagen and PostScript support with Adobe, but many analysts are guessing that the printer will have more than one language.

Those consultants also believe that IBM will include the IPDS (intelligent printer data stream) PDL, which grew out of the Systems Network Architecture Control Stream (SCS) communications protocols. IBM, like Xerox, has a pressing need to support devices that operate over wide communications areas, and it's likely that the company will develop languages that match that need.

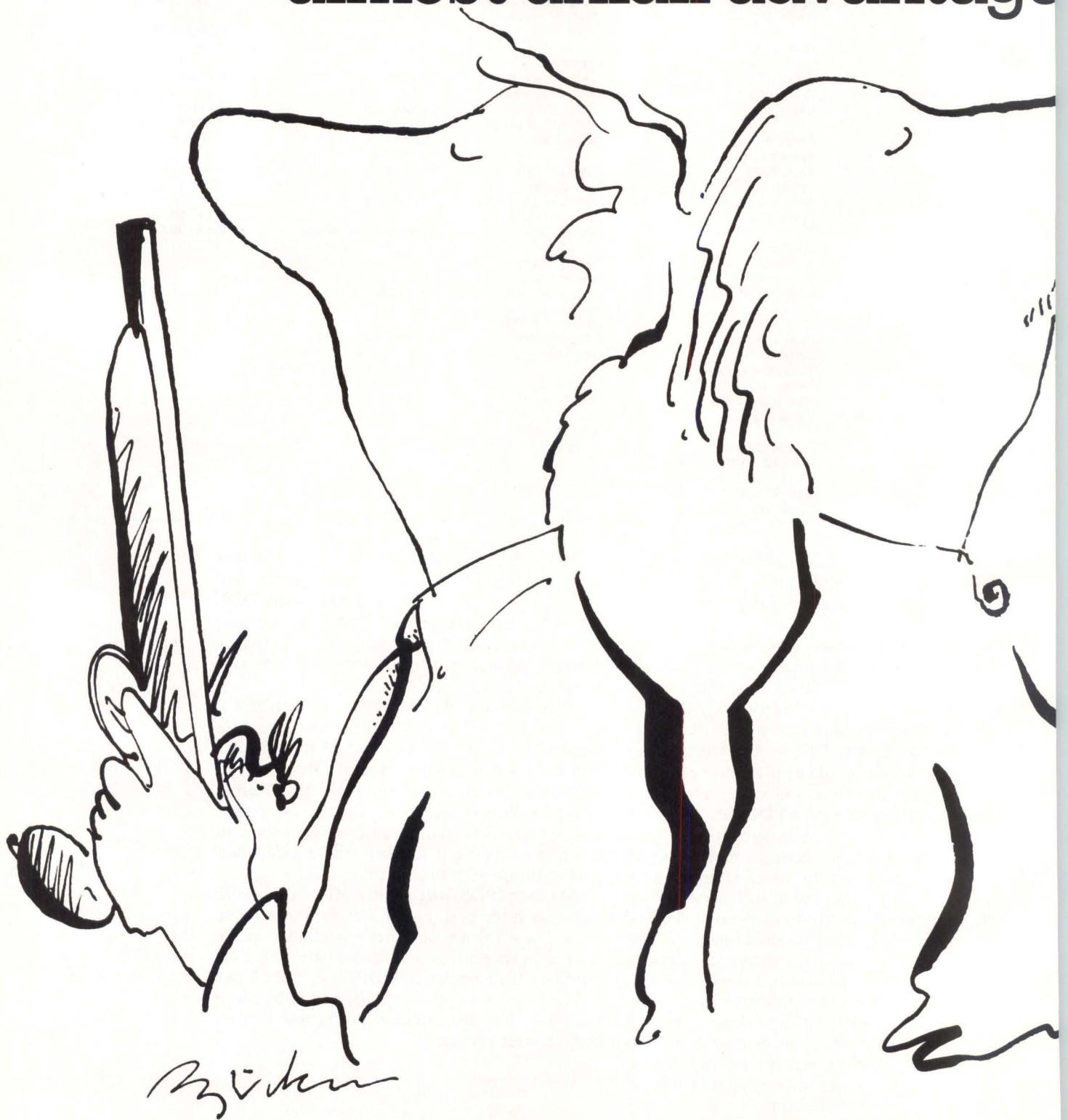
Whether IPDS will greatly affect the entire low-end laser printer market remains to be seen. Local Data's Bostwick says that it really isn't a matter of one standard winning over another. "Remember EBCDIC?" he asks. "The entire world was going ASCII, and IBM chose their own encoding method. And guess what—they're both standards." □

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**Respect for the bottom line.** To meet the requirements of cost-critical applications, LaPine Spartan™ series drives reflect a refinement of contemporary drive technology—without cutting corners. For example, a single screw and plate assembly distributes mounting torque evenly across the oxide-media disks—eliminating the problem of disk warpage. And by integrating components with flex circuitry, eliminating connectors, and utilizing a two-layer PC board, LaPine has effectively simplified the drive while increasing inherent reliability.

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CIRCLE NO. 54 ON INQUIRY CARD

# MATURING LAPTOPS LURE USERS

Innovative packaging, powerful processors, easy-to-use add-ins and add-ons and wider software options all mark significant advances in portable computers

**Gene R. Talsky**, Contributing Editor

A handful of laptop systems are finally unlocking the commercial potential for portable computers. Research studies since 1982 have consistently identified strong prospective markets for portables and have projected substantial unit shipments and revenues. However, the market never fulfilled those projections because the technology and packaging of the portables did not satisfy users' demands. Other than for a few pioneers in special niches, together with some federal agencies and data-intensive sales organizations, the market has consistently failed to meet expectations.

Except for the Tandy/Radio Shack model 100, users have not purchased large quantities of portable computers, primarily because the systems do not offer general desktop-computer capabilities. Now that advanced systems are appearing, however, the market can be expected to respond. Of the dozen or so laptops in the market, none yet offer full desktop capability, speed and flexibility. Nevertheless, they offer enough power and capability to appeal to a growing number of mobile computer users.

### Three types of users emerge

There are three broad types of portable computer users:

**Multiple-system users:** Corporate executives, managers and support staff who take work home represent a growing body of portable computer users. These users have full-blown desktop IBM Corp. PC/ATs in their offices but also need equivalent power, capability and flexibility in the system they take home. They also do not want to strain their backs carrying the system and its related software, documentation and accessories—in addition to the files and



other office material they need to work on. These users are spoiled by high-speed Intel Corp. 80286 processors operating at 8 MHz or better; 640K bytes or more memory; math coprocessors that speed and enhance their work; and by 20M-byte rigid disk drives that contain their operating system, word processor, spreadsheet, database management system and voluminous data.

Another use for portables in the corporate environment is as backup systems for broken-down desktop systems. Lower costs, coupled with increased capabilities make a few of the current portables attractive as backup units for departments with many desktop PCs.

**Incorporating a 12-MHz 80286,** Compaq's Portable III weighs 18 pounds. The system includes a gas plasma display, a 5¼-inch flexible disk drive and an optional 20M- or 40M-byte rigid disk drive. Prices range from \$3,999 to \$5,999.

**Users have not purchased large quantities of portable computers, primarily because the systems do not offer general desktop computer capabilities.**

**Single-system users:** Small and mid-sized business owners and managers who need desktop capabilities at their offices, and who frequently take the same system home with them at night, represent one of the largest potential markets for easily transported, full-capacity portables. These users need lightweight systems with large, high-quality displays that are easy enough on the eyes to allow them to operate comfortably for hours. The units must have sufficient internal rigid disk storage to hold accounting records at the transactional level. They must have comprehensive accounting software modules to handle ledgers, payrolls, inventories and accounts receivable and payable. And they must be capable of word-processing, spreadsheet and database applications needed for vendor, customer and personnel records and for credit profiles.

**Triple-decker users:** Some corporate executives, along with accountants, attorneys, financial advisors, consultants, real estate agents, investment brokers and other professionals, have a three-pronged need for computers. First, there's the office computer for day-to-day business. Second, there's a home computer for further administrative functions, catching up on correspondence, developing sales proposals and performing financial analysis. Third, these users need a computer to take on the road for face-to-face meetings with clients.

This type of user is best served by a single system that minimizes the need for extensive software and data transfer. The modest space requirements and ease-of-use of a cableless, self-contained, full-function, battery-operated portable appeals strongly to this market.

Of all users, perhaps the most conspicuous

are sales representatives working onsite with customers and prospects. Insurance agents, producing proposals with accurate premium payments and related equity values, exemplify this usage. Sales prospecting, follow-up letters, appointments, proposal generation and customer tracking are applications that have top priority, because they increase sales productivity and help reduce selling costs.

#### **Which portables meet these needs?**

One of the more advanced portable computers is the new Spirit, from Remote Equipment Corp. At a starting price of \$1,995—which includes a 10-MHz 80286, a 3½-inch flexible disk drive and a supertwist liquid crystal display—it arguably offers the most power per dollar on the market. On the other hand, the success of Toshiba America Inc.'s \$2,399 T1100 Plus and \$4,499 T3100 proves that users will pay the price for products that meet their needs. The reception of the Zenith Data Systems Z-181 by both dealers and users, and GRiD Systems Corp.'s growing success, are other examples of market acceptance.

NEC Home Electronics (U.S.A.) Inc.'s Multi-Speed is well-positioned at its entry price point \$1,995. The unit comes with dual 3½-inch flexible disk drives, but the absence of an internal rigid disk drive may prove to be a costly omission.

Datavue, with its Spark portable, targets low-end buyers looking for more IBM PC compatibility and greater capability than offered by the Tandy 100 or 200. Datavue's Snap 1+1 expands upon the concept the company introduced with the Keystyle 80, an intelligent keyboard-based computer that is enhanced by

### **The Compaq III: too big, too late, too much (\$)?**

Compaq Computer Corp.'s recent portable computer entries may jeopardize the lead that the king of compatibles established with its initial Compaq Portable and Portable 286 models. The Compaq Portable II, which is only slightly smaller and lighter than earlier Compaq Portables, has not received broad market acceptance. Unfortunately, the packaging of the new Compaq Portable III, which does offer advanced capabilities, trails competitive products by almost a year. The Portable III packaging more closely resembles the Sharp Electronics Corp. PC, which is more than a year old, than it does more recent laptops.

The Portable III includes a high-resolution, 640-by-400-pixel gas plasma screen and 640K bytes of RAM, expandable to 6.6M bytes. But, in spite of the growing impact of 3½-inch flexible disk drives, the company included a single 1.2M-byte, 5¼-inch disk

drive (a 360K alternative is optional) and a 20M-byte or 40M-byte rigid disk drive. The Compaq Portable III's 80286 processor runs at 12 MHz, automatically slowing to 8 MHz when it senses software that requires the slower speed. It measures 9.8 by 16 by 7.8 inches.

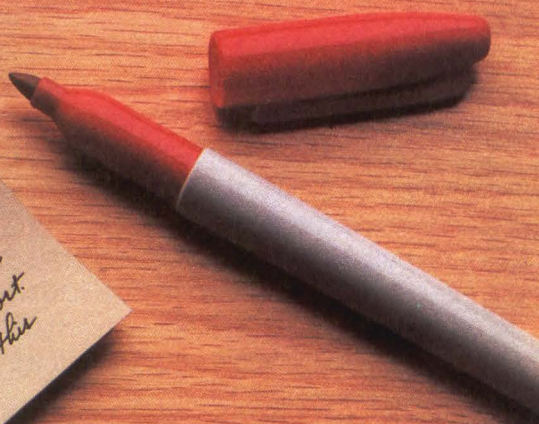
However, starting at 18 pounds and a base price of \$3,999 (\$5,999 with the 40M-byte disk drive), Compaq may have underestimated the demand for lighter, smaller, less expensive battery-operated portables. The company's conservative approach with its portable line may prove costly. In fact, Compaq may be surrendering its lead in the portable market by dipping its toe in too slowly and ignoring the market's increasing acceptance of advanced laptops, exemplified by the success of Toshiba America Inc.'s T1100 Plus and T3100, Zenith Data Systems' Z-181 and other advanced portables.

**MEMO**

TO: J. Brennan  
 FROM: J. L. Sanders  
 RE: Our "Ideal" Laptop

Jack, we need a laptop that doesn't compromise on performance. Include as many of these key features as possible. J.L.

- ① Full featured "desktop" power - must do everything a standard PC can do with full IBM software compatibility.
- ② 20MB hard drive - Max storage for our big jobs. Shock-resistant with auto bleed park, too!
- ③ Expansion slot - Network work station for Novell, 3COM, token ring.
- ④ Bright screen - Use latest flat panel technology. And RGB port.
- ⑤ Lightweight - Can you do all this and keep it under 10 lbs.?



640K MEMORY STANDARD IN EXPANSION MODULE.

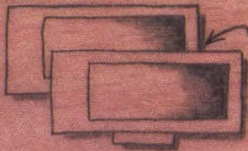
80X25 FLAT PANEL DISPLAY - FOLDS DOWN, POPS IN AND OUT (SEE BELOW)

INTERNAL 20MB HARD DRIVE OR DUAL 720K 3 1/2" DRIVES - SHOCK MOUNTED - RUGGED

4.2 LBS

3 1/2" MICROFLOPPIES HOLD TWICE THE DATA OF CONVENTIONAL 5 1/4" FLOPPIES

J.L. - TECHNOLOGICAL INNOVATION - REAR "EXPANSION" MODULE DOCKS WITH FRONT "LAP" MODULE - INCREASED PORTABILITY!



POP IN/OUT DISPLAY OPTIONS - SUPER-TWISTED CRYSTAL LCD, AMBER GASLIT OR LONG LIFE "BLUE" BACK LIGHT

512K ROM/RAM CARD ALLOWS LAP MODULE TO FUNCTION AS "DISKLESS" SIB. PC.

BACK VIEW

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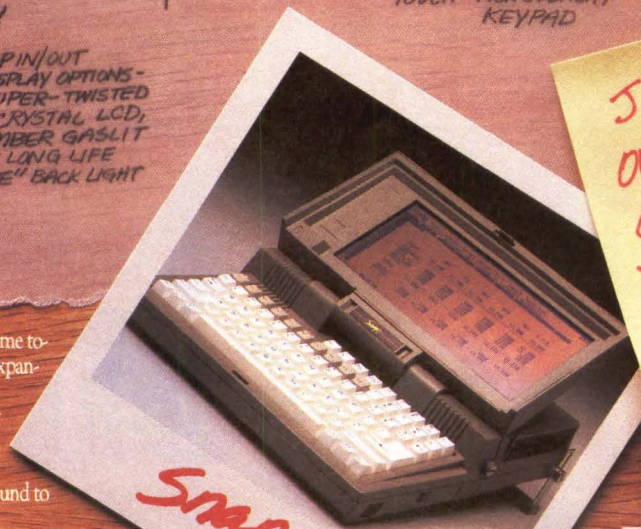
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4.8 LBS.

PC COMPATIBLE EXPANSION SLOT - IBM STANDARD HALF-CARD SIZE - FOR EGA, NETWORK, TERMINAL EMULATION, ETC.

FULL SIZE KEYBOARD - (83 KEYS) MECHANICAL TOUCH - NON-OVERLAY KEYPAD



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For more information, contact us at One Meca Way, Norcross, Georgia 30093, (404) 564-5555.

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# For security reasons, we're



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CIRCLE NO. 56 ON INQUIRY CARD

plugging into an expansion chassis. The company provides full desktop-computer functionality by combining the two units, which makes such a handy 10-pound package that many users find it unnecessary to "unsnap" the units.

Data General Corp. entered the market early with an advanced laptop—the DG/One. However, its initial hard-to-read display precluded wide market acceptance. However, the updated DG/One model 2, with an optional 10M-byte internal rigid disk drive and an optional electroluminescent display, provides a more competitive product.

Wang Laboratories Inc.'s LapTop portable is a relatively late market entry. The unit incorporates a 10M-byte rigid disk drive and a thermal printer. However, the company has sacrificed

internal flexible disk drive capability, forcing users to load software and data onto the rigid disk via optional external 3½-inch or 5¼-inch drives.

#### Add-ons lure buyers

Manufacturers and resellers are offering a growing body of products that make it easier to use portable systems. For example, some companies provide tools for conversion from 5¼-inch to 3½-inch disk formats, increasingly popular in portables. Manzana Microsystems Inc.'s internal and standalone 3½-inch flexible disk drives come with software that enables conversion from and to most common formats. Similarly, White Crane Systems' Brooklyn Bridge, consisting of a cable and two disks, allows

## GRiD pushes packaging, technology

GRiD Systems Corp., starting in 1982, was one of the earliest laptop portable computer manufacturers and is the only pioneer to have survived. Although the company made its share of mistakes in initial product and marketing strategies, the basic design of its Compass laptops was not among them. The initial Compass models were based on the Intel Corp. 8086, with an 8087 coprocessor and a ROM-based operating system. It included a high-resolution plasma display that set a standard unmatched for years. However, the advanced technology, superior packaging and proprietary operating system and application software forced original prices into the \$7,000-to-\$10,000 range.

Over the years, GRiD has enhanced and repackaged the Compass. The company released GRiDCase and GRiDCase Plus models, which brought its prices out of the stratosphere without sacrificing critical capabilities or quality. Its new GRiDLite line, with base prices starting at \$1,750, offers the same internal power and quality in a plastic case with a supertwist liquid crystal display. But, because all the base models come with only 128K

bytes of RAM and incorporate fewer features than other portables, options required for greater functionality result in prices at the high end.

However, GRiD continues to offer advanced technology. The GRiDLite, at only 9.3 pounds with batteries, offers up to 1M byte of EMS (expanded memory specification) memory above the standard 640K-byte RAM and 1M-byte ROM. Miniature EMS boards are available for both GRiDLite and GRiDCase Plus models. Optional internal 10M-byte rigid disk drives are available for the GRiDCase Plus models. These drives can be supplemented by a 10M-byte rigid disk drive that attaches to the GRiDCase Plus units, bringing total storage to 20M bytes.

---

**Weighing in at 9.3 pounds,** *GRiD's GRiDLite portable (left) includes a 128K-byte RAM, a 3½-inch flexible disk drive and a supertwist LCD display. The GRiDCase 3 Plus (right) offers a plasma display, an optional 10M-byte internal rigid disk drive and a 10M-byte detachable rigid disk drive.*

---



| SELECTED PORTABLE COMPUTERS |                 |           |                   |                    |                          |  |   |
|-----------------------------|-----------------|-----------|-------------------|--------------------|--------------------------|--|---|
| Company                     | Model           | Processor | Clock speed (MHz) | MS-DOS version     | RAM (std./max., bytes)   | Storage (flexible/fixed)                         | Display type                                  |
| Data General                | DG/One Model 2  | 80C88     | 4                 | 2.11, 3.1*         | 256K, 640K*              | 1 3½-in., 3½-in. int.*; 5¼-in. ext.*; 10MB int.* | LCD enhanced, EL*                             |
| DataVue                     | Spark           | 80C88     | 4.77, 9.54        | 2.11               | 284K, 640K*              | 1 3½-in., 2 3½-in.*                              | supertwist LCD, EL backlit*                   |
|                             | Snap 1+1        | 80C88     | 4.77              | 2.11               | 512K, 640K*              | 1 3½-in. with 20MB or 2 3½-in.                   | supertwist LCD, fluorescent backlit gaslight* |
| GRiD                        | GRiDCase 3 Plus | 80C86     | 4.77              | 3.2, 2.11, GRiD OS | 128K, 640K*; 0.5-1M EMS* | 1 3½-in., 10MB int.*; 10MB ext.*                 | light-emitting plasma                         |
|                             | GRiDLite        | 80C86     | 4.77              | 3.2                | 128K, 640K*; 0.5-1M EMS* | 1 3½-in., ext. 3½-in.*                           | supertwist LCD                                |
| NEC                         | MultiSpeed      | NEC V-30  | 4.77, 9.54        | 3.2                | 640K                     | 2 3½-in.   | supertwist LCD                                |
| Remote Equipment            | Spirit          | 80286     | 10                | 3.2                | 730K, 8M EMS*            | 1 3½-in., 20MB*                                  | supertwist LCD; EL*; plasma*                  |
| Toshiba                     | T3100           | 80286     | 4, 8              | 2.11               | 640K, 2.6M*              | 1 3½-in./10MB, ext. 5¼-in.*                      | gas plasma                                    |
|                             | T1100 Plus      | 80C86     | 4.77, 7.16        | 2.11               | 256K, 640K*              | 2 3½-in.   | LCD   |
| Wang                        | LapTop          | 8086      | 8                 | 3.2                | 512K, 1M*                | 10MB, 3½-in. ext.*; 5¼-in. ext.*                 | supertwist LCD                                |
| Zenith                      | Z-181           | 80C88     | 4.77              | 3.2                | 640K                     | 2 3½-in.   | supertwist LCD backlit                        |

## The Remote Spirit . . .



After Adam Osborne's introduction of the portable computer concept in 1981, two of the most significant developments in the CP/M-based portable computer market were the introduction of the Otrona Corp. Attaché and the Teleram Communications Corp. 3000. The Teleram 3000, introduced in 1982, was the first true laptop system, but it never really got off the ground. In contrast, the Otrona Attaché, offering significantly improved capabilities and performance

**The 14.7-pound Spirit**, from Remote Equipment, includes a 10-MHz 80286, a 3½-inch flexible disk drive, a 1,200/300-baud modem, an optional 20M-byte Winchester, and either a supertwist LCD, electroluminescent or plasma display.



## SELECTED PORTABLE COMPUTERS

| Resolution/<br>display size (inches)/<br>Aspect ratio | Interfaces   | Modem support<br>(baud) | Expansion slots                           | Battery hours  | Size (W×D×H,<br>inches) | Weight with<br>battery (lbs)                         | Base price (\$)<br><br>* Optional                       |
|---|--|-------------------------|---|--|-------------------------|--|---|
| 640×256/<br>8.5×6.75;<br>640×200/<br>4.8×7.6/<br>2:1  | RS232, parallel,<br>exp. bus                       | 1200/300*               | 2: RAM,<br>modem,<br>monitor or<br>serial | 7  | 14.51×11.79×3.07        | LCD: 10.5, EL:<br>11.5                               | 2,995: LCD/hard<br>disk; 3,995:<br>EL/hard disk         |
| 640×200/<br>9.5×4.5/<br>1.6:1                         | RGB composite,<br>RS232, parallel                  | 1200/300*               | 0   | 8  | 13.2×13×2.3             | 10.5   | 995; 1,925 with<br>640K, 2 3½-in.<br>diskettes, modem   |
| 640×200/<br>9.5×4.5/<br>1.6:1                         | RGB, RS232, parallel,<br>exp. module,<br>composite | 1200/300*               | 1 in exp.<br>chassis,<br>½ card           | 4  | 13×13×3                 | 5, 5   | 2,095; 3,820 with<br>640K, 20MB,<br>modem               |
| 640×200/<br>9.5×4.25/<br>1:1.14                       | RGB*, RS232,<br>parallel, exp. bus*,<br>ext. disk* | 1200/300*               | 1MB ROM,<br>cartridge                     | LCD: 4-6; hard<br>disk: 1.5-2;<br>plasma: 1.5,<br>with hard<br>disk: 1 | 15×11.5×2.25            | 11.5, 12 with hard<br>disk, ext. hard<br>disk adds 3 | 3,280; 3,880 with<br>640K; 4,855 with<br>int. hard disk |
| 640×200/<br>8.5×6.5/<br>2:1                           | RGB, RS232, parallel,<br>exp. bus*, ext. disk      | 1200/300*               | 1MB ROM,<br>cartridge                     | 3-4, 10-12*  | 13×11×1.75              | 9.3  | 1,750; 2,350 with<br>640K                               |
| 640×200/<br>9.1×4.7/<br>1.6:1                         | RGB, RS232, parallel,<br>ext. PC*                  | 1200/300*               | 0   | 4-6  | 13.6×12×3               | 12   | 1,995   |
| LCD: 640×400/<br>11.1×8.6; EL:<br>7.6×4.79/2:1        | RGB, RS232   | 1200/300<br>cellular    | 1 int., ½ board                           | 0  | 16×16×3.95              | 14.7   | 1,995; 3,900 with<br>EL and 20MB<br>hard disk           |
| 640×400/<br>5.9×7.7/<br>N/A                           | RGB, RS232, parallel,<br>ext. disk, exp. chassis   | 1200/300*               | 1 short                                   | 0  | 12.2×14.2×3.1           | 15   | 4,499   |
| 640×200/<br>9.1×4.7/<br>N/A                           | RGB, RS232, parallel,<br>ext. disk, exp. chassis   | 1200/300*               | 1 int., modem                             | 7  | 12.1×12×2.6             | 10   | 2,399   |
| 640×200/9.5-in.<br>diameter/N/A                       | RGB, RS232, SCSI,<br>numeric key pad               | 2400/1200,<br>300*      | RAM, modem                                | 4  | 13.9×11.9×4             | 14.25  | 3,530   |
| 640×200/6×8/<br>N/A                                   | RGB, RS232, parallel,<br>ext. disk                 | 1200/300*               | 0   | 3-5  | 13.5×11.75×3            | 11.8   | 2,399   |

## Otrona legend lives on

over the Osborne I in an innovative package, developed a loyal cult following among both dealers and users.

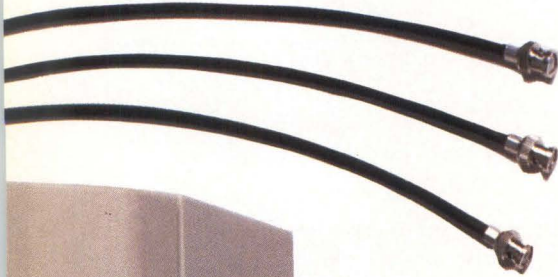
Ron Lingemann, founder of the now-defunct Otrona and the primary designer of the Attaché, has now joined forces with Remote Equipment Corp. The Spirit, the company's initial product, is scheduled for beta test in the second quarter of this year and for production shipments in the third quarter. The Spirit arguably comes closer to fulfilling the requirements for the ultimate 1987 portable than any other system now offered or announced.

From its 10-MHz Intel Corp. 80286 processor, 3½-inch flexible disk drive and optional 20M-byte internal rigid disk drive to its 640-by-400-pixel supertwist electroluminescent, gas plasma or liquid crystal display, the Spirit represents advanced

portable computer design. A secondary 1-line-by-80-character display provides a dynamic label mask for the function keys. The mask changes for each type of bundled software, which includes an icon-based environment and productivity applications. A half-card slot accepts boards with up to 8M bytes of expanded memory. Its standard 1,200/300-baud modem can also be used for cellular transmission. And an integrated dot-matrix printer incorporates an internal fanfold paper supply.

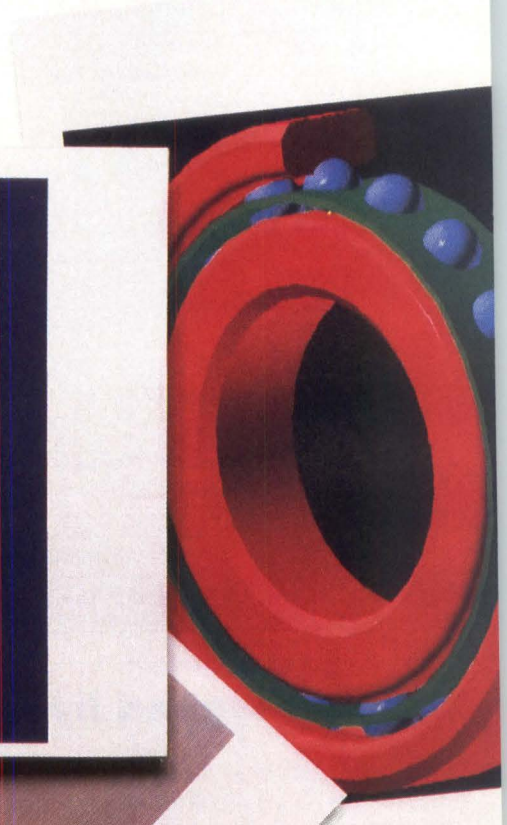
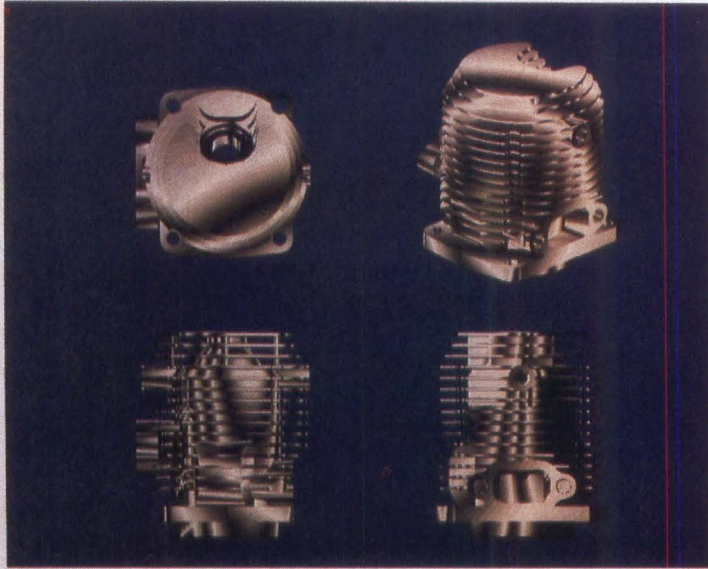
Aggressively priced at \$1,995 for the flexible disk drive model with an LCD and \$3,900 for the 20M-byte rigid disk drive model with an electroluminescent display, the Spirit should make a major impact on the market. Remote Equipment plans to OEM the unit, giving other companies the opportunity to enter the portable arena with a powerful, competitive offering.

- Both parallel and RS-232 interfaces are supported by a wide selection of software.



- Easy video interfacing—over 150 interfaces are supported. No need to write software.

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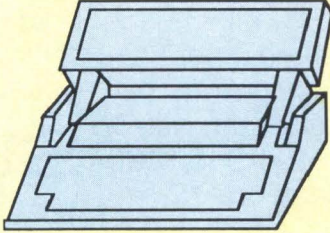
CIRCLE NO. 57 ON INQUIRY CARD

© 1987 Seiko Instruments USA, Inc.  
Visuals courtesy of Ramtek Corporation, Matra Datavision, Computer Design Equipment Incorporated.

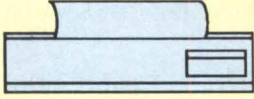
The ultimate portable computer would draw upon the strengths of a variety of existing technologies. To date, no one company has put them all together.

### WHAT COMPRISES THE ULTIMATE PORTABLE?

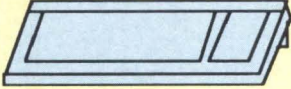
**DISPLAY**  
SUPERTWIST LCD, EL OR PLASMA  
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640 BY 400 PIXELS  
2:1 ASPECT RATIO  
FULLY ARTICULATING



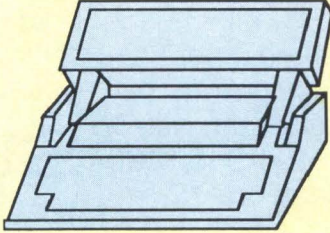
**PRINTER**  
DRAFT QUALITY  
ATTACHABLE  
3 POUNDS



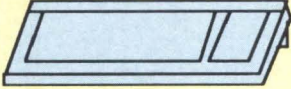
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3 1/2-INCH,  
720K-BYTE FLEXIBLE DISK DRIVE  
5 1/4-INCH,  
20M-BYTE REMOVABLE CARTRIDGE



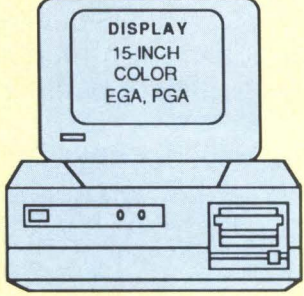
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### Two Macs to go

Apple Computer Inc. has finally authorized the marketing of a portable Macintosh. Under license, Dynamac Computer Products Inc. re-ships Macs in an 18-pound package with a 640-by-400-pixel electroluminescent display.

Colby Computer Inc. also repackages Macs into portable formats. These portables tend to be expensive due to the necessity of cannibalizing standard Macs and adding electronics and

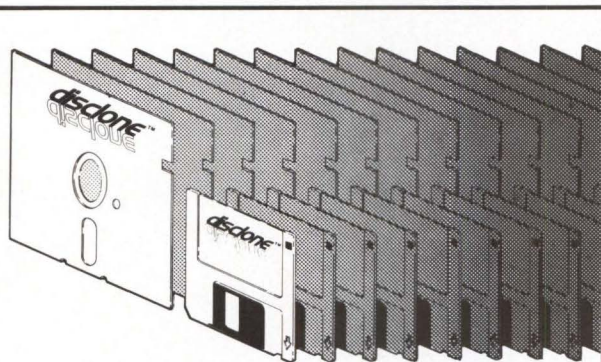
other components to transform the units into reliable machines. Colby operates independently but is trying to establish a direct relationship with Apple.

### Ultimate laptop is still to come

Supertwist LCD, EL and plasma displays, 3½-inch flexible disk drives and 20M-byte Winchester, stronger batteries, high-speed processors, ROM-based DOS, clever keyboard design, sophisticated packaging—they are all available today. Most of the leading portable units include enough capability to ensure market share. However, the first vendor to deliver the total portable package will dominate the desktop-user market. These are the users who want all the capabilities, without cables but with minimal "deskprint" and maximum portability. Each of the current systems requires some compromise. And neither IBM nor Compaq Computer Corp., the two most likely market leaders, appear to be planning to offer the ultimate portable in the near future. □

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**Gene R. Talsky** is president of Professional Marketing Management Inc. (PROMARK), Old Lyme, Conn., a computer industry business-development and marketing consultancy.



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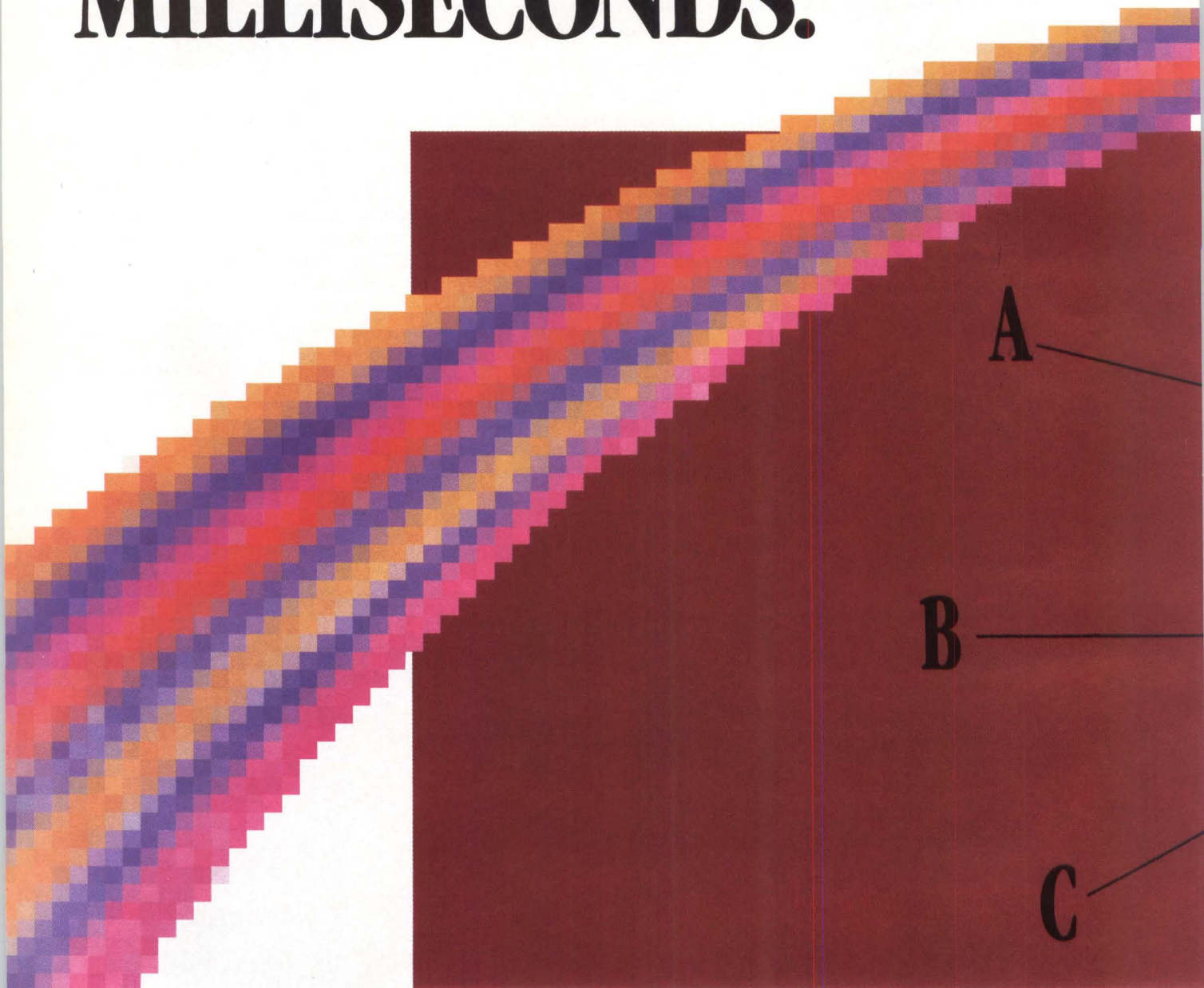
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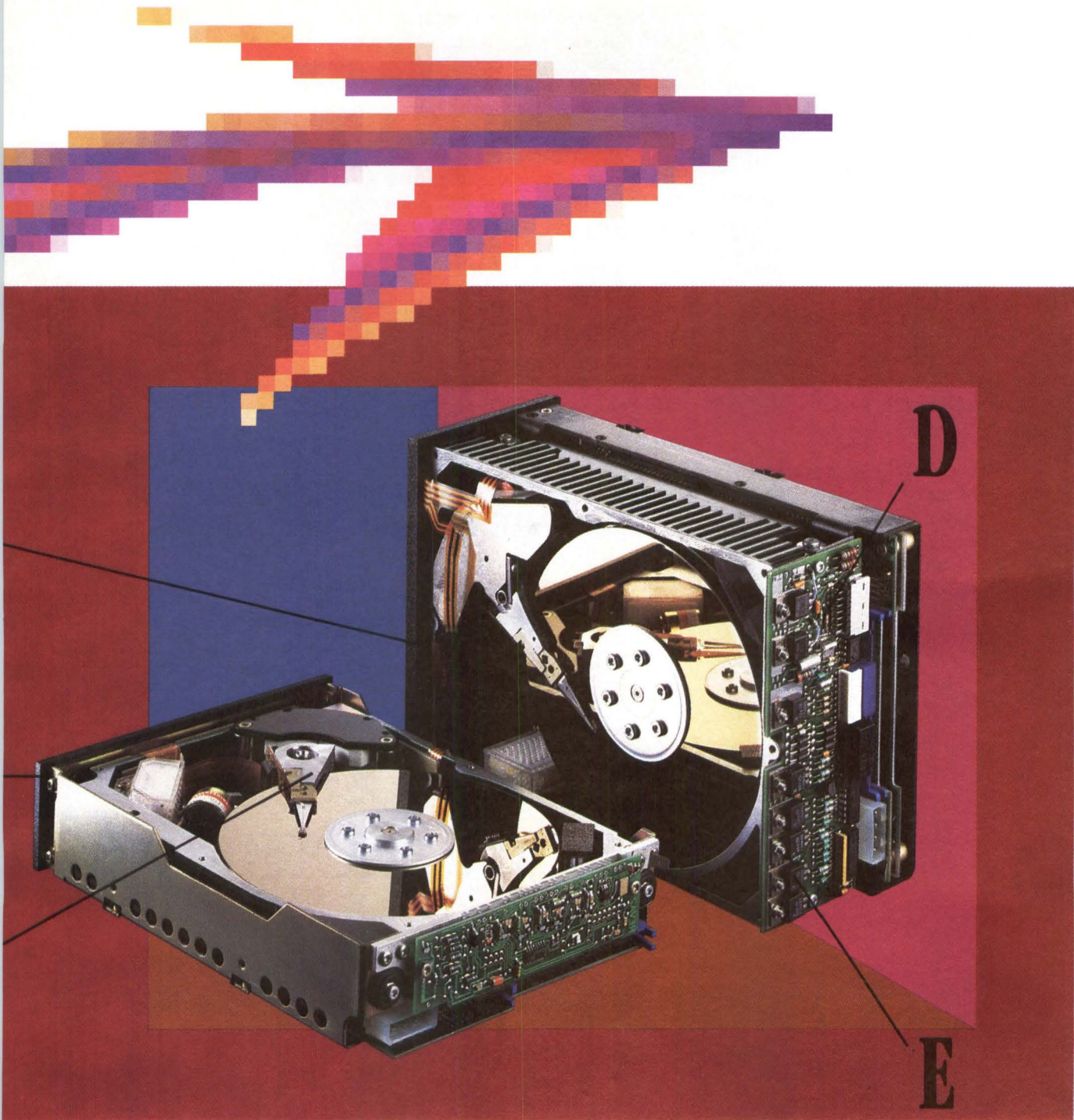
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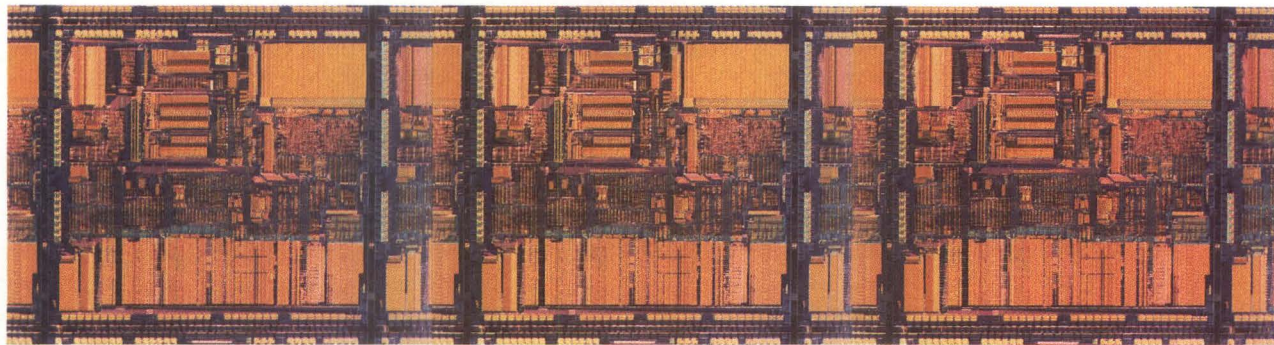
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# INTEL'S 386 UNITES UNIX AND DOS SOFTWARE

Intel's 80386 chip creates virtual 8086 machines on top of UNIX to merge UNIX and DOS software bases, speed execution and make DOS multitasking

**Clif Purkiser**, Intel Corp.

UNIX workstation manufacturers, having recognized the importance of providing access to both UNIX technical and MS-DOS commercial software, have tried various ways to merge the system utilities and applications of the two operating systems. One popular approach has been to develop an add-in board that allows MS-DOS software to run on the UNIX workstation. Although better than buying two microcomputers for each user, this approach has several disadvantages—particularly in the areas of price, performance and compatibility.

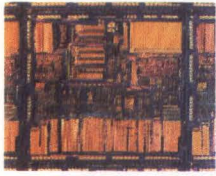
The addition of a separate CPU board complicates the hardware and operating-system designs in such a dual-processor system. This added complexity increases both design and production costs while compromising performance. For example, such add-in boards typically perform at less than 80 percent of the speed of a 6-MHz IBM Corp. PC/AT and add several hundred dollars to the manufacturing cost and over \$1,000 to the end-user price. Often, these add-in boards are only MS-DOS (not PC-DOS) compatible and, therefore, are unable to run the most popular PC-DOS applications. In addition, DOS coprocessor cards based on the Intel Corp. 80286 microprocessor

run past and present DOS software but will not allow access to future 32-bit DOS applications.

The Intel 80386 microprocessor offers a simpler method for workstation vendors and system integrators to merge technical UNIX applications with PC-DOS applications. It provides an upwardly compatible hardware architecture and a UNIX operating system (Intel's System V/386) with hooks that allow software developers to construct virtual 8086 machines on top of UNIX. The virtual 8086 machine supports the execution of existing 8086 applications as System V/386 processes. This eliminates the need for cumbersome, performance-degrading multiprocessor solutions and provides multitasking capabilities for PC-DOS or MS-DOS.

## Supports virtual machines

In general, a virtual machine provides an environment that allows operating systems and applications designed for one type of computer to be run on a different type of computer. It supports the different operating systems and applications because it acts exactly like the different computers' CPU and peripheral devices (disk drives, displays) via either direct execution or software emulation. Of these two techniques, software emulation is inherently slower.



Achieving an acceptable performance level is the biggest problem for a virtual machine. Unless the virtual machine runs at least as fast as the original machine, there is little reason to buy the new computer.

For this reason, the 80386 microprocessor is designed to support fast virtual 8086 machines. As a result, 80386 systems can create a virtual IBM PC that executes all PC-DOS software much faster than does the PC. This is true even if the 80386 system has peripherals that are totally incompatible with the PC.

To achieve this speed and compatibility, the 80386 directly executes the instructions of the 8088 and 8086 microprocessors. To achieve such direct execution, the 80386 is designed with what is known as a Virtual 8086 Mode (V86). The V86 Mode is a subset of the protected mode of the 80386 and is selectable on a per-task basis. When the 80386 operates in V86 Mode, it executes 8086 programs in the same manner as an 8086 would, as opposed to emulating the 8086.

#### V86 accelerates DOS execution

For example, in the V86 Mode, the 32-bit 80386 processor assumes that instructions, registers and data types are only 16 bits in length. But it generates a 20-bit linear address just like an 8086 does. However, because the V86 Mode is a subset of the 80386's protected mode, its tasks are run in a fully protected, demand-paged environment under a host 32-bit operating system, such as System V/386. In fact, there are only two major differences between the V86 and an 8086 or 8088: 90 percent of the instructions execute 15 to 20 times faster, and programmers and applications have control over the execution of privileged instructions.

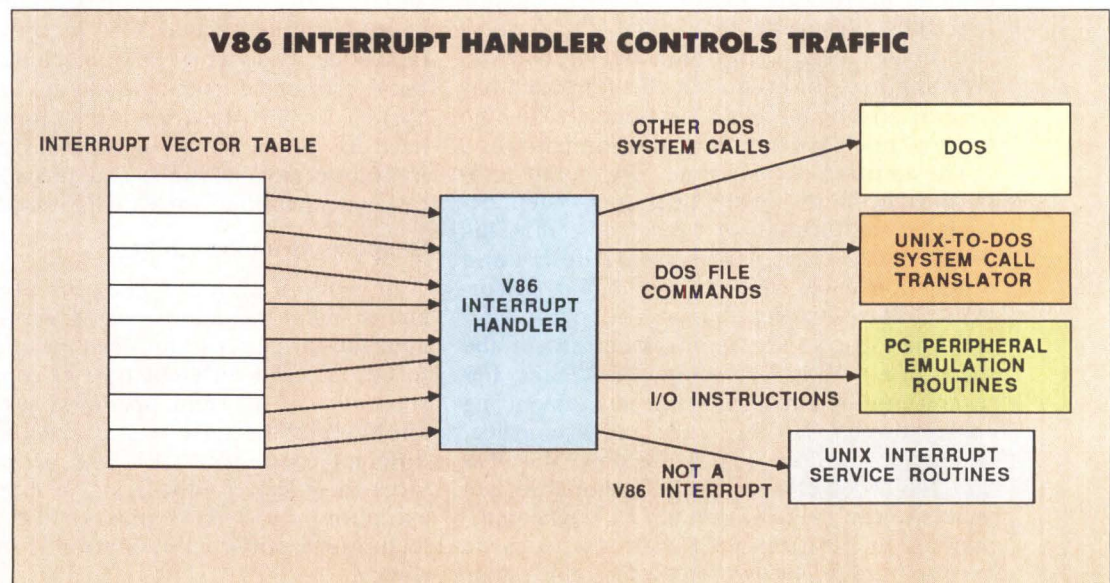
Privileged instructions are instructions used by the operating system. There are three main classes of privileged instructions: I/O, interrupt-related and operating system support. Control over all these instructions is important because a single-tasking application's privileged instructions are potentially disruptive in a multitasking environment.

The interrupt-related instructions are especially important to trap because almost all 8086 applications were written for single-tasking computers. Many 8086 applications disabled interrupts for relatively long periods of time. When these applications execute in the System V/386 multitasking environment, the disable interrupts prevent other processes from running until the V86 application re-enables the interrupts.

I/O instructions, also, can cause problems for a multitasking operating system. The problem is that typical 8086 applications think they own the disk. Although these 8086 applications are likely to be running side-by-side on the 80386, one of them may operate as though it were in a single-tasking, single-user environment and re-program the disk controllers accordingly. This would create a potentially disastrous situation if another application is waiting for data from the disk. Software is needed to control what the application can do.

However, the common solution of trapping instructions may not, by itself, solve the problem effectively. In many 8086 applications, which routinely manipulate time-sensitive peripherals (such as CRT controllers), trapping every I/O instruction would degrade performance. So, the 80386 provides a higher degree of protection via the I/O Permission Bit-Map.

The I/O Permission Bit-Map allows the



**Fig. 1. The Virtual 8086 Mode (V86) interrupt handler identifies V86 interrupts and then either reflects them back to DOS or redirects them to the appropriate routines.**

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32-bit operating system to specify exactly, on a per-task basis, which peripherals an MS-DOS application can access directly without causing an exception. System V/386 can use these maps to allow foreground processes to access the screen without trapping requests for a resource, while background processes would trap requests and write to a virtual screen. Page-based protection can be used in an analogous way to manage memory-mapped I/O.

Whenever a V86 application attempts to execute a privileged instruction, if trapping is enabled, an exception occurs. This causes control to pass from the V86 task to the 80386's operating system and also causes the processor to switch from V86 Mode to protected mode. After the System V/386 (or other host operating system) handles the exception, it returns from the exception handler and switches the processor back into V86 Mode.

#### VM monitor translates 8086 calls

The simple trapping of privileged instructions prevents a number of operating system problems, but it does not solve the V86 applications' need to execute these instructions. In order to execute privileged instructions, an optional piece of software, called a virtual 8086 monitor (VM monitor), can be added to System V/386. Two such monitors are VP/ix, developed jointly by Interactive Systems Corp., Santa Monica, Calif., and Phoenix Technologies Ltd., Norwood, Mass.; and OS/Merge 386, developed by Locus Computing Corp., Santa Monica (MMS, February, Page 81). The VM monitor translates 8086 operating system calls into 32-bit operating system calls and emulates hardware devices that are present on the 8086 computer but not on the 80386 computer.

With a VM monitor, users can execute UNIX applications and one or more 8086 operating systems and their applications. Any 8086 operating system can be run; MS-DOS, CP/M-86, and proprietary 8086 operating systems are examples. Users can also create virtual I/O devices, such as disk drives, graphic adapters and memory-expansion cards.

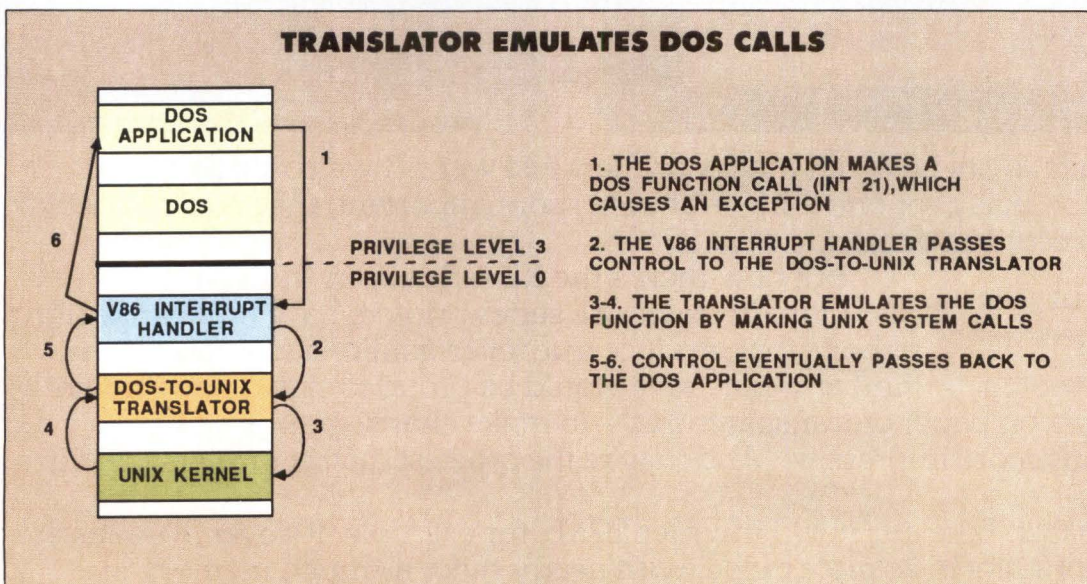
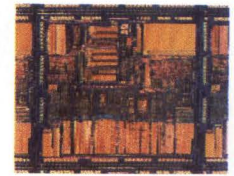
#### How to create a VM monitor

Each combination of a 32-bit operating system and an 8086 operating system needs its own VM monitor (even though much of the code is common between monitors). Because the greatest market demand is to merge the UNIX and PC-DOS software bases, consider what is needed to sketch out such a VM monitor.

A VM monitor usually consists of three logical partitions: V86 interrupt handler, a DOS-to-UNIX system-call translator and an optional peripheral emulator. The V86 interrupt handler is closely tailored to the base 32-bit operating system, and many of the handler's functions are built into System V/386. The DOS-to-UNIX system-call translator interprets DOS system and function calls and translates them to UNIX system calls. The peripheral emulator is a set of software routines that mimic all of the user-programmable peripheral devices on the IBM PC. It is used when the 80386-based computer contains peripherals that are different from an IBM PC's.

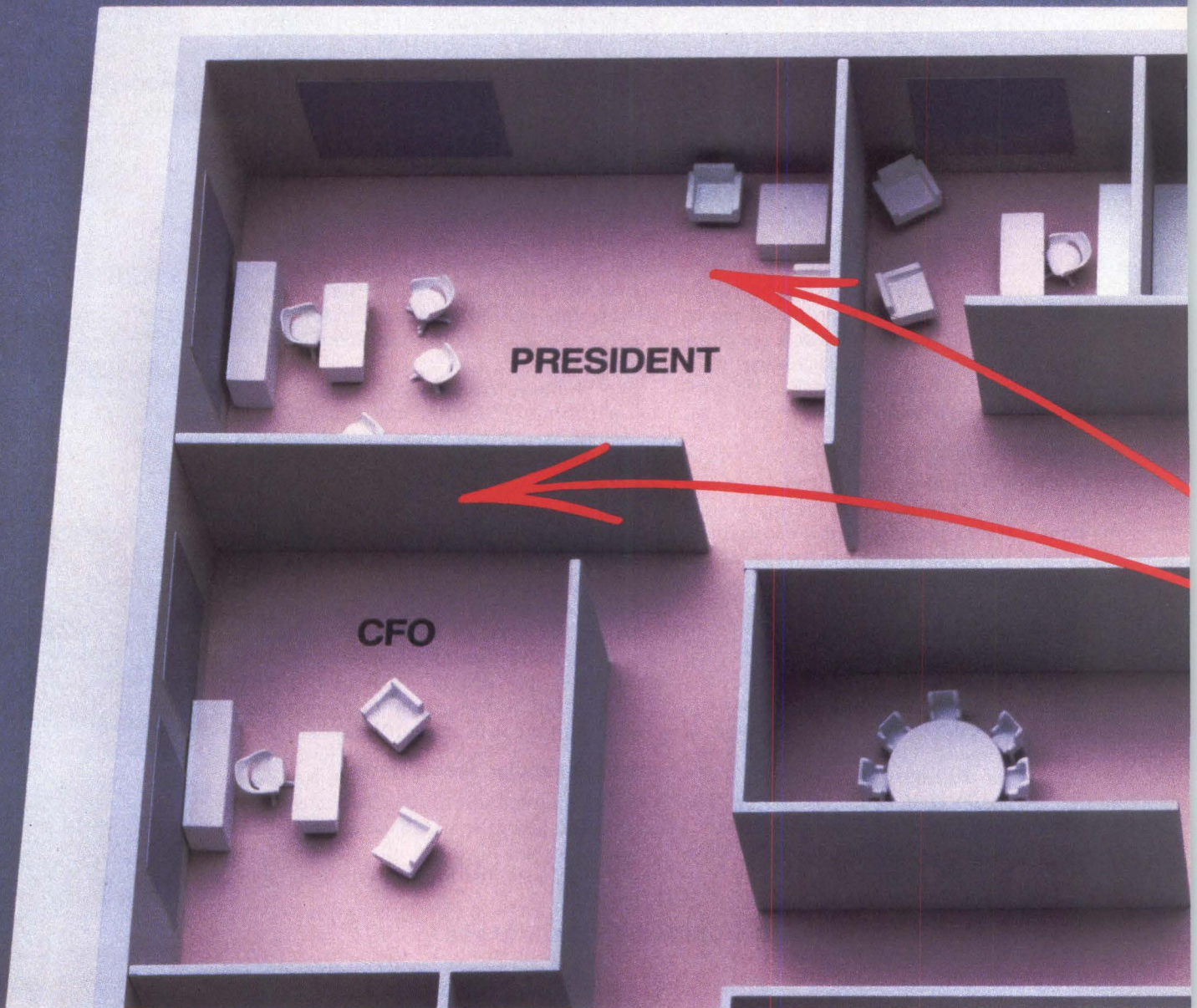
#### Interrupt handler directs traffic

The V86 interrupt handler serves as a "traffic cop" for all of the 80386 system's interrupts. It identifies a V86 interrupt, and then either reflects (returns) the interrupt back to DOS or



**Fig. 2.** For some DOS system calls, such as "Open File" or "Read File," it's necessary to map the DOS calls into corresponding UNIX System V/386 calls via emulation.

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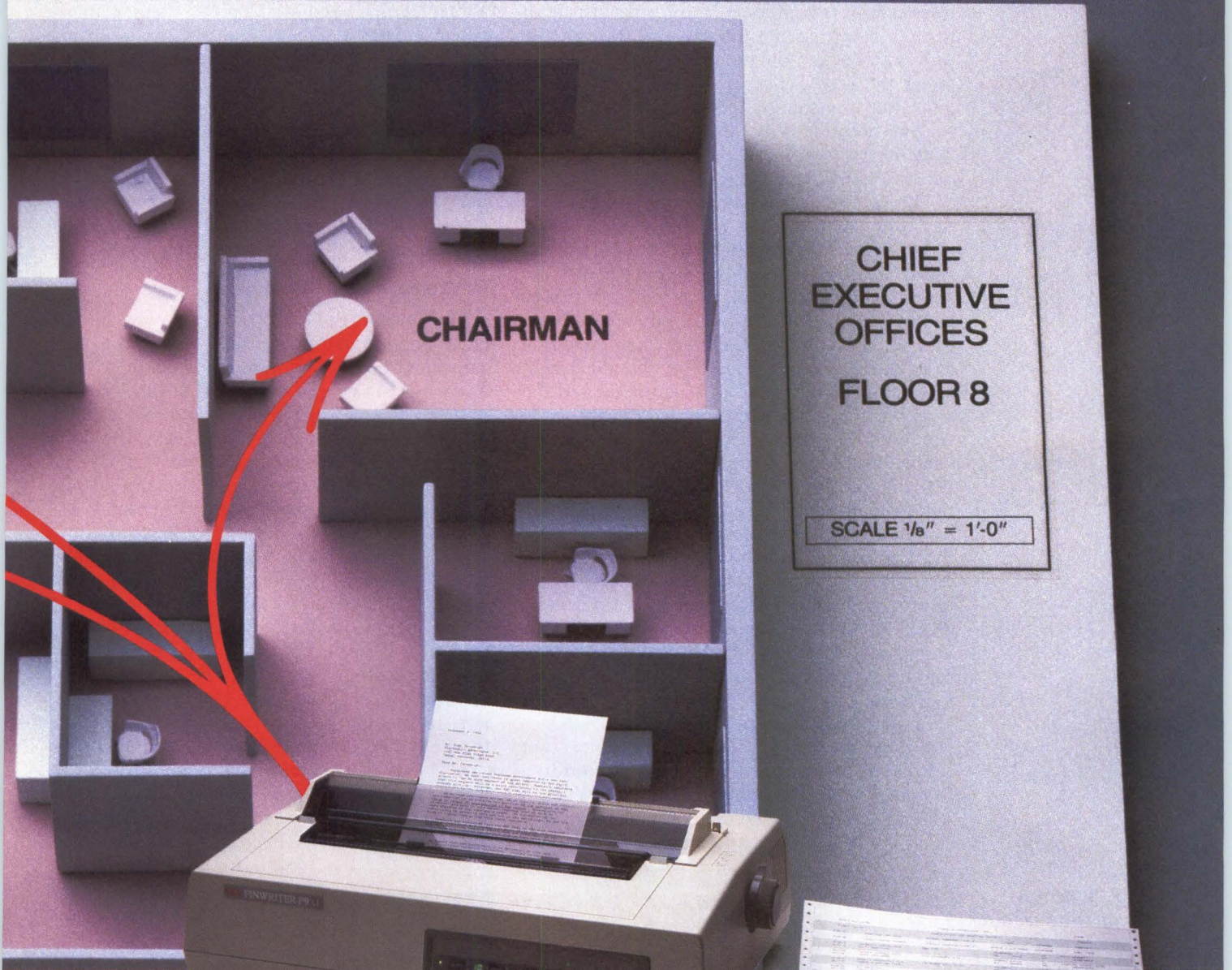
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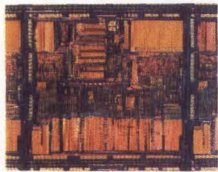
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redirects it to the appropriate routine (Fig. 1).

When a V86 task attempts to execute a privileged instruction, it causes a general protection fault (exception 13). Information about the faulting instruction and the state of the processor at the time the fault occurs is pushed on to the stack, (flag and instruction pointer and other registers) and control passes to the routine pointed to by the exception 13 vector. The interrupt service routines for exception 13 will call the V86 interrupt handler.

The V86 interrupt handler determines if the fault was generated by a V86 program by checking to see if the VM bit is set in the EFLAGS image on the stack. If the exception was not generated by a V86 task, then control is passed to the System V/386 exception handlers. However, if the fault was generated when executing a V86 task, the V86 interrupt handler must determine what type of instruction caused the interrupt: an I/O instruction, an explicitly stated "INT n" instruction or an interrupt enable/disable instruction.

If the faulting instruction is an I/O instruction from either a background task or from any task in a system with non-PC peripherals, then the appropriate emulator routine is called. Interrupt enables and disables can be ignored for most systems; UNIX systems do not normally allow user programs to disable interrupts. INT n instructions are used by DOS applications to initiate system calls and are handled in one of two ways: reflection or emulation.

Emulation is appropriate for some DOS system calls, like "Open File" or "Read File," that can easily be mapped into a corresponding System V/386 operating system call. When a V86 task requests DOS to open a file, for example, it generates an Interrupt 21 instruc-

tion and passes the function code for "Open File" in the AX (a general purpose) register. The Interrupt 21 vector switches control to the V86 interrupt handler. The V86 handler then calls the DOS-to-UNIX call translator. After the DOS call is translated, control passes back to the DOS application (Fig. 2).

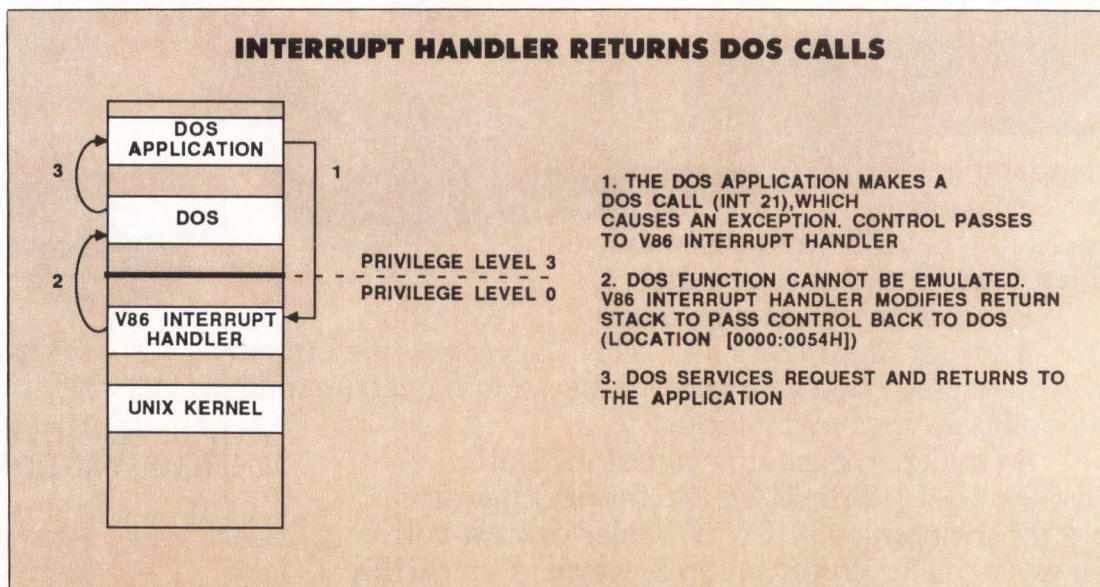
Reflection occurs for other DOS function calls, like "Terminate and Remain Resident," that are best handled by DOS. In this case, the V86 interrupt handler modifies the return stack so that control is passed backed to DOS. Then, DOS will service the request and pass control back to the application (Fig. 3).

### Translator operates functions

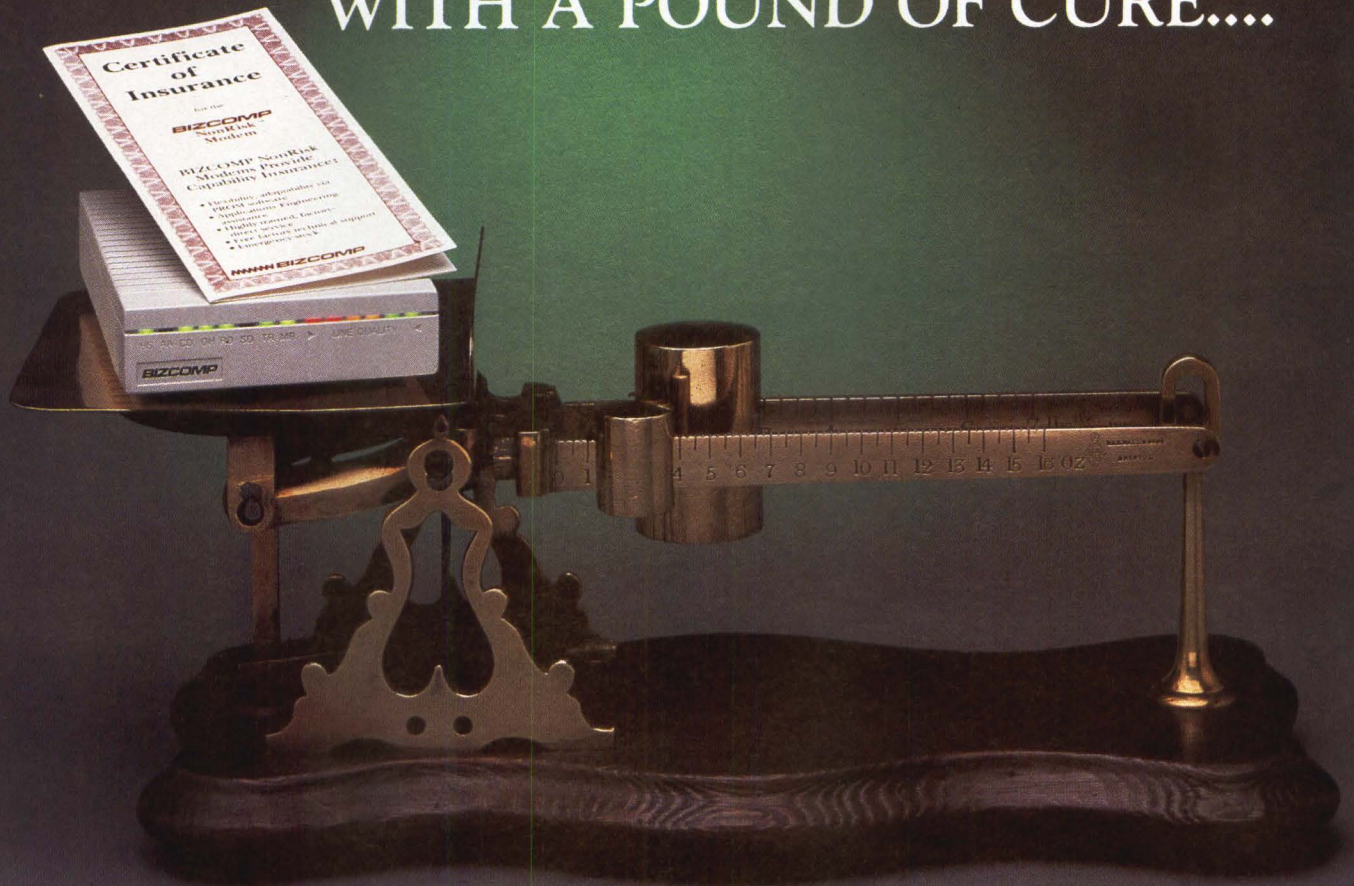
The DOS-to-UNIX translator maps most DOS functions and some BIOS functions to the equivalent UNIX function. The DOS-to-UNIX translator can be as large or as small as desired, or it can be nonexistent. If it is nonexistent, the V86 handler would redirect all DOS function calls back to the copy of DOS that is loaded with each application. All of the emulation would then be performed by the PC peripheral-emulator routines. Assuming that the translator exists, the only requirement for the DOS-to-UNIX translator routines is that they look identical to DOS at the system-call level.

The main advantage of the DOS-to-UNIX translator is performance. It is faster to translate the system call from the virtual 8086 application being run to the UNIX format than it is to execute the PC-DOS system call and then emulate the hardware devices that DOS expects. It is also relatively easy to directly translate many of the DOS functions, such as the file routines (open, close, read, write) into the equivalent UNIX operating system calls.

**Fig. 3. When emulation is not possible, it's necessary to return, or "reflect," DOS calls back to the DOS operating system, which then services the request and passes control back to the application. An example of a call that is best handled by this method is "Terminate and Remain Resident."**



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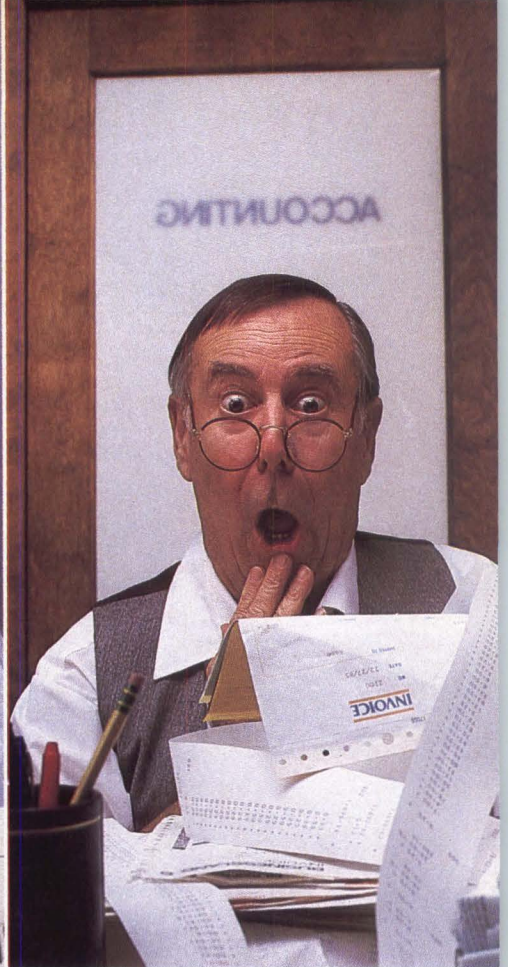
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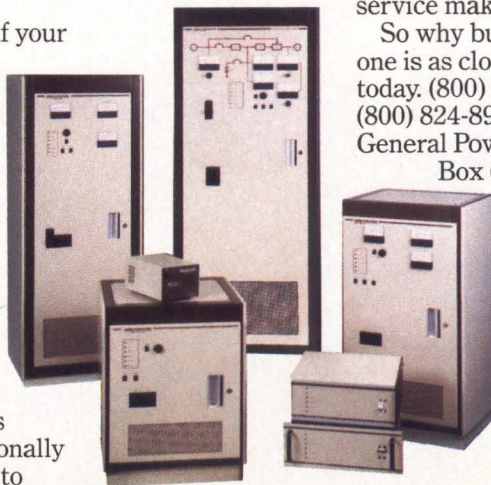
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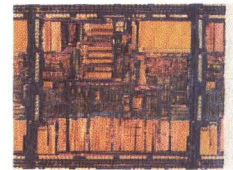
The IBM PC's ROM BIOS also contains many functions. Like the DOS functions, these too can either be emulated or reflected back to a copy of the BIOS that is loaded in RAM.

### Emulator simulates peripherals

The PC peripheral emulator provides software simulation of peripheral devices that exist on an IBM PC but do not exist on the 80386 system. The PC peripheral emulator routines would not need to exist if all DOS applications were well behaved. Unfortunately, many popular DOS applications bypass MS-DOS and call the ROM BIOS and/or write directly to the PC's peripherals.

The PC peripheral-emulator routines are unnecessary for two types of computers. With the one, MS-DOS, rather than PC-DOS, compatibility is sufficient. Here, there is no need to run software that works only with the IBM PC and compatibles. The second type is of those computers that contain peripherals identical to an IBM PC (i.e., an 80386 PC/AT clone).

The peripheral components most commonly manipulated directly on an IBM PC are the 6845 CRT controller, the 765 disk controller and the 8237 DMA (direct-memory access) controller. Most 80386 UNIX workstations tend to have higher resolution displays, higher performance disk controllers and higher band-



## The 80386 as a UNIX engine

Intel Corp.'s 80386 microprocessor is a true 32-bit microprocessor that can execute 3 to 4 million instructions per second. Its achievement of 6,000 to 7,000 Dhrystones per second at 16 MHz puts it in the performance class of the Digital Equipment Corp. VAX 8600. The 80386 can also address tremendous quantities of memory with its 4G-byte physical, 4G-byte linear, and 64-terabyte virtual, address spaces. Furthermore, its on-chip memory-management unit allows the full performance of the processor to be realized in demand-paged virtual-memory systems.

The 80386 is fully compatible with previous Intel microprocessors: the 8086, 8088 and 80286 real and protected modes. What's more, the 80386 can run 8086 operating systems and their applications concurrently with 80286 and 80386 applications in a fully protected multitasking environment under a 32-bit operating system like Intel's System V/386.

The 80386 architecture also supports the needs of the UNIX System V operating system—for example, the MMU's support of demand-paged virtual memory. The 80386's two-level paging scheme operates in a manner similar to that of a VAX, the most popular UNIX host.

Each System V/386 operating system process has its own set of page directories and page tables, giving every process 4G bytes of virtual address space. The 80386's paging mechanism supports the sharing of page tables and pages between processes, which simplifies code- and data-sharing between applications. (The UNIX operating system minimizes physical memory requirements by having only one copy of a program loaded into memory even though numerous users are running it.)

The MMU also reduces the performance penalty associated with paging schemes implemented with an external MMU. The translation of a virtual address to a physical address is overlapped (pipelined) with

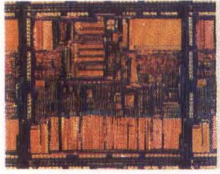
other operations. In addition, the 386 contains a 32-entry page-address translation cache. The large cache, coupled with an efficient 4K-byte page size, handles over 98 percent of all memory accesses.

The System V/386 operating system uses a combination of segment- and page-based protection to increase the system's integrity. The kernel's code and data are in separate segments, which are isolated from user processes. A page directory for each process provides protective isolation between user processes.

System V/386 also fully supports the high-performance numeric processing needs of 32-bit applications. The operating system supports two types of numeric coprocessors: the Intel 80287/387 and the Weitek Corp. 1167 chip set. The 80287 and 80387 are binary-compatible with the industry standard 8087 and offer a full implementation of the IEEE P754 standard for floating-point math. The Weitek 1167 is a high-performance floating-point coprocessor that can execute up to 4 million Whetstones per second when coupled with a 386.

In order to facilitate the development of 32-bit applications, a large number of independent software vendors are developing tools to run on the System V/386 operating system. These tools include highly optimized C, FORTRAN, Pascal, COBOL, Lisp, Prolog, RPG II and BASIC compilers developed by major UNIX software vendors.

The System V/386 operating system also provides powerful debugging tools such as SDB (a source-level debugger). Due to the 80386's hardware debug registers, SDB for the future versions of System V/386 operating system will allow breakpoints to be set not only on instructions but also on data reads or writes and in ROM. This allows an application programmer to easily determine why variables are being corrupted, normally a tedious task without hardware debug support.



width and addressability DMA devices than does a PC. Therefore, emulators will likely be needed for these devices.

**Virtual machine speeds execution**

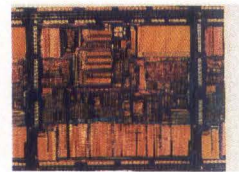
The speed of a virtual IBM PC on an 80386-based workstation running the System V/386 operating system should be between 3 to 12 times the speed of a PC. This increase is possible, in spite of the need to perform slow operations like emulating certain privileged instructions, because in typical PC-DOS applications (such as Lotus Development Corp.'s 1-2-3) only 5 percent to 10 percent of the instructions executed are V86 privileged instructions that need to be emulated. The remaining 90 percent to 95 percent of the instructions execute about 17 times faster than they would on the 8088-based PC, simply because they run at the 80386's 16-MHz clock speed (compared to 4.77 MHz for the 8088), and they take advantage of the improved implementation of the instruction set on the 80386.

The impact of privileged-instruction traps can be reduced by writing efficient DOS-to-UNIX translator routines. Additional perfor-

mance will also be gained because UNIX, unlike DOS, can run other processes while waiting for I/O operations like disk reads or writes. The faster peripheral devices of 80386-based advanced workstations will more than compensate for the slightly slower speed of I/O instructions. □

**Clif Purkiser**, a technical marketing engineer at Intel Corp., Santa Clara, Calif., supervises independent software vendor support for the 80386.

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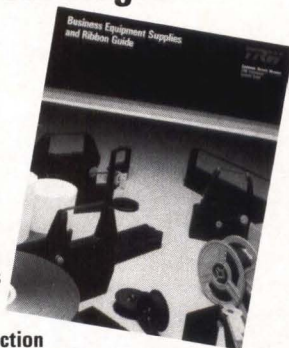
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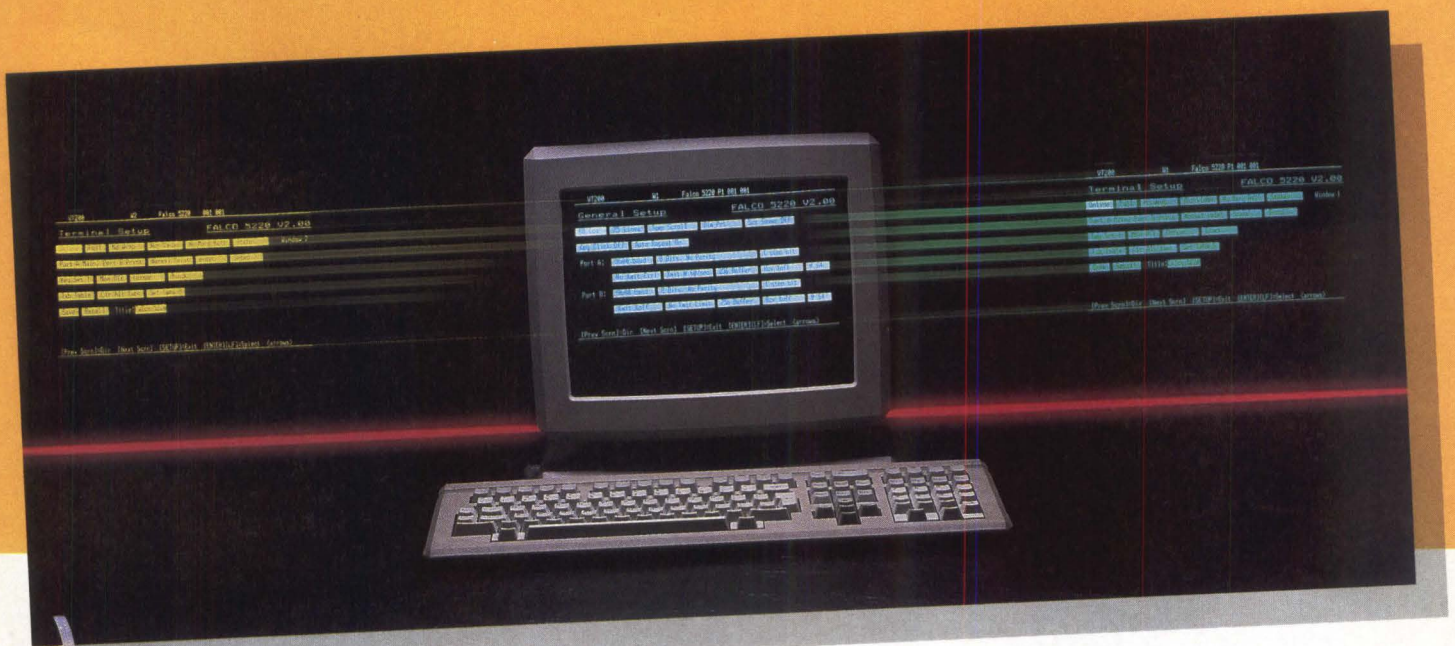
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# DEC DIRECTIONS

An editorial and advertising supplement for Mini-Micro Systems' readers who indicate that they buy, resell and/or use Digital Equipment Corp. computers.

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## DEXPO South stresses software

DEXPO South '87, a show for users and vendors of Digital Equipment Corp. products, will be held April 28 to 30 at the Nashville Convention Center in Nashville, Tennessee.

### SOFTWARE

**Speakeasy Computing**, booth 311, will demonstrate Epsilon, a new release of the Speakeasy IV language. Features include a proprietary graphics package, report writing and full-screen editing. The software runs on VAX/VMS systems. \$7,000. Speakeasy Computing Corp., 222 W. Adams St., Chicago, Ill. 60606, (312) 346-2745.

Circle 423

**Park Software**, booth 336, will exhibit the 3.1 version of the Xentis Information and Reporting system. The software selects and formats information from VAX/VMS applications. It includes change and delete capabilities. Park Software Inc., P.O. Box 31529, Seattle, Wash. 98103-1529, (206) 282-8886.

Circle 424

**IMSL**, booth 401, is showing Edition 1.0 of PDE/PROTRAN, a problem-defining language that supplies diagnostic error-checking. It suits VAX computers running under the Berkeley UNIX Version operating system. \$2,000 to \$2,900. IMSL, 2500 ParkWest Tower One, 2500 CityWest Blvd., Houston, Texas 77042-3020, (713) 782-6060.

Circle 425

**Stone Mountain Computing**, booth 407, will feature Release 4 of Graphic Outlook, a VAX/VMS spreadsheet program that reads and writes Lotus Development 1-2-3. The software prepares vertical and horizontal bar graphs and line plots and has more than 80 built-in functions. Stone Mountain Computing, 1096 Cambridge Drive, Santa Barbara, Calif. 93111, (805) 964-9101.

Circle 426

**Interlink Computer Sciences**, booth 425, is demonstrating the Full Screen Terminal Emulation package. The bi-directional software emulates DEC VT100 and VT220 units. Connectivity products will also be featured. Interlink Computer Sciences Inc., 39055 Hastings St., Fremont, Calif. 94538, (415) 792-6212.

Circle 427

**Access Technology**, booth 829, will show a new version of the 20/20 spreadsheet that supports DEC's All-In-1 Office and Information System. Features include graphics and database management. Prices range from \$3,300 to \$14,700. Access Technology Inc., 6 Pleasant St., South Natick, Mass. 01760, (617) 655-9191.

Circle 428

**WordPerfect**, booth 840, is unveiling WordPerfect Version 4.08 for VAX computers. The software supplies a speller and a thesaurus. License fees range from \$5,000 to \$29,000. WordPerfect Corp., 288 W. Center St., Orem, Utah 84057, (801) 227-4000.

Circle 429

**Applied Information Systems**, booth 905, will exhibit a new version of the EasyEntry forms management and data entry system for VAX, PDP-11 and Professional Rainbow Computers. The software supports file searches, windowing and color. Data is stored in indexed and sequential files. Applied Information Systems Inc., Suite 207, 500 Eastowne Drive, Chapel Hill, N.C. 27514, (919) 942-7801.

Circle 430

**EEC Systems**, booth 920, is demonstrating Turbo Disk/VMS virtual memory software. The package uses VAX or VMS main memory. Other products include spreadsheet and graphics packages. EEC Systems Inc., Millbrook Park, 327 E. Boston Post Road, Sudbury, Mass. 01776, (617) 443-5106.

Circle 431

**Uniras**, booth 1028, will introduce four VAX system software products. Raspak is a general purpose tool with 2D and 3D viewing, 30 text fonts and full color support; Raspak-CAD is a solids-modeling add-on package to CAD systems. The Geopak mapping package supplies multidimensional contour and grid maps. Gimage is for image processing of aerial or satellite images. Uniras Inc., Suite 650, 5429 LBJ Freeway, Dallas, Texas 75240, (214) 980-1600.

Circle 432

**Computer Information Systems**, booth 1032, is releasing Quantum RS 4.2, a VAX resource-management package. It offers accounting, capacity-planning and tracking features. New I/O routines interface directly with VAX Record Management Serv-

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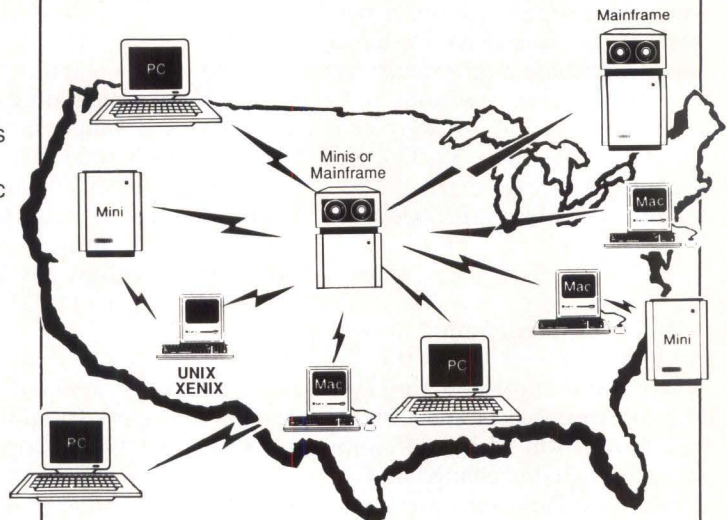
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ices. \$2,500 to \$12,000. Computer Information Systems, 165 Bay State Drive, Braintree, Mass. 02184, (617) 848-7515.

Circle 433

**Touch Technologies**, booth 2000, will demonstrate the Intouch fourth-generation language for VAX/VMS computers. It interfaces to all VAX data files. Debug functions include tracing program and recording execution, timing and statistics. Touch Technologies Inc., Suite 220, 9990 Mesa Rim Road, San Diego, Calif. 92121, (619) 455-7404.

Circle 434

## HARDWARE

**ADAC**, booth 504, is announcing the PX11/BASYS satellite data acquisition and control system. It provides LSI-11/23- or 11/73-based distributed control while interfacing with IBM PC, XT, AT and DEC VAX computers. The unit stores up to 4M bytes of battery-backed RAM. Software is included. \$5,500. ADAC Corp., 70 Tower Office Park, Woburn, Mass. 01801, (617) 935-6668.

Circle 435

**Sigma Information Systems**, booth 809, will display a range of products that include Q-bus enclosures and VAX-compatible controllers. Multiplexers with eight and 16 channels will also be shown. Sigma Information Systems, 3401 E. La Palma Ave., Anaheim, Calif. 92806, (714) 630-6553.

Circle 436

**Talaris**, booth 915, is featuring a new version of its DEC-compatible laser printer. Producing 8 ppm, the unit supplies a 250-sheet output tray and applications software. The 7800 terminal and other products will also be shown. Talaris Systems Inc., 5160 Carroll Canyon Road, P.O. Box 261580, San Diego, Calif. 92126, (619) 587-0787.

Circle 437

**Micro-Term**, booth 921, will unveil its Foresight Edition series of alphanumeric display and graphic terminals. The models 4520 and 4525 emulate the DEC VT220; model 4560

adds Tektronix graphics compatibility. They supply 500 scan lines, a 20-by-20-dot character cell and multiple pages of screen memory. 695, model 4520; \$795, model 4525; \$1,295, model 4650. Micro-Term Inc., 512 Rudder Road, Fenton, Mo. 63026, (314) 343-6515.

Circle 438

**International Software**, booth 1121,

is demonstrating the ViewMate windowing workstation for VMS or UNIX systems. The personal computer-based unit permits simultaneous virtual terminal sessions on a single RS232C port. Proprietary software is supplied. International Software Corp., P.O. Box 10648 Edgemont, Golden, Colo. 80401, (303) 526-0388.

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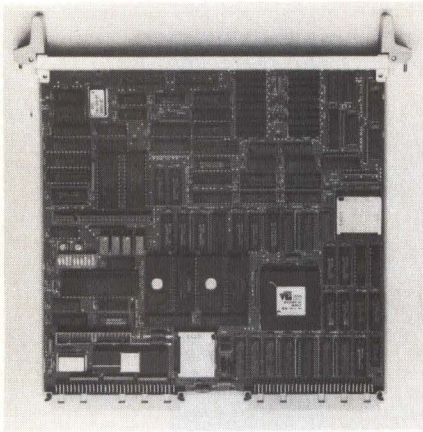
- T1, ISDN compatible
- Dual processor
- 1.544M bps

A UNibus-compatible communications controller for VAX and PDP-11 computers, the T100U accommodates

present and anticipated T1 data formats while conforming to ISDN standards. It furnishes a 1.544M-bps data transfer rate for applications such as VAX cluster-to-cluster wide area networking and VAX cluster to PBX interfacing. A UNIX System V driver is

available. \$4,950, T100U; \$1,350, UNIX driver. **General Communications Corp.**, Central Monmouth Business Park, 1433 Route 34 S., Farmingdale, N.J. 07727, (201) 938-6560.

Circle 440



## SCSI controller talks to 52 devices

- 1.5M bytes per second
- 2M bytes of RAM
- Internal self-test

The SCSI/Floppy Controller Board offloads data storage from the host CPU. A SCSI interface communicates with up to 56 devices. The 82258 Advanced DMA Controller delivers data

transfer rates of 1.5M bytes per second, asynchronous; 4M bytes per second, synchronous. Features include 2M bytes of on-board RAM, parity error detection and internal self test. \$2,465. **Central Data Corp.**, 1602 Newton Drive, Champaign, Ill. 61821-1098, (217) 359-8010.

Circle 441

## Software links VAX and Macintosh

- Text/graphics linkage
- DEC VT240 emulation
- Tektronix emulation

VMacS, Mac240 and Reggie software packages link VAX and Macintosh computers, providing two-way text/graphics communication. VMacS runs on the

VAX host and stores Macintosh files on VAX disk and tape drives. It uses the XMODEM MacBinary protocol for file transfers. Mac240 runs on the Macintosh and furnishes emulation of DEC VT240 and Tektronix 4010 and 4014 terminals. Reggie allows graphics communication from Macintosh to VAX

and other DEC peripherals. It converts MacDraw, MacPaint and Clipboard images for VAX storage and presentation. \$399, VMacS; \$199, Mac240; \$99, Reggie. **White Pine Software Inc.**, 75 Route 101A, P.O. Box 1108, Amherst, N.H. 03031, (603) 673-8151.

Circle 442

## Software joins IBM PC and MicroVAX

Multiplex software connects an IBM PC to a DEC MicroVAX. The package links programs such as Lotus 1-2-3, dBASE and WordStar to databases resident on multiuser computers. It sup-

ports VAX data-management tools, thus providing PC users with direct and transparent access to files. A Lotus-like interface displays results in row and column format. \$695 and higher. **Net-**

**work Innovations Corp.**, 20863 Stevens Creek Blvd., Cupertino, Calif. 95014, (408) 257-6800.

Circle 443

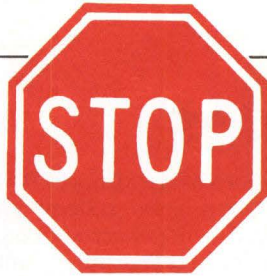
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*If you run*

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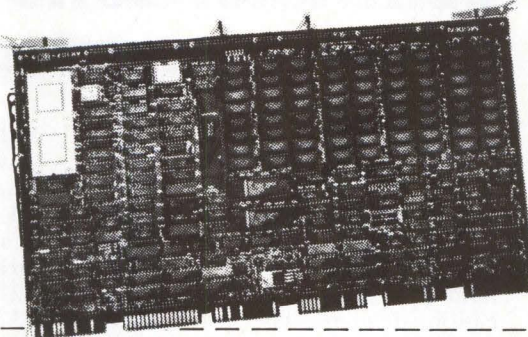


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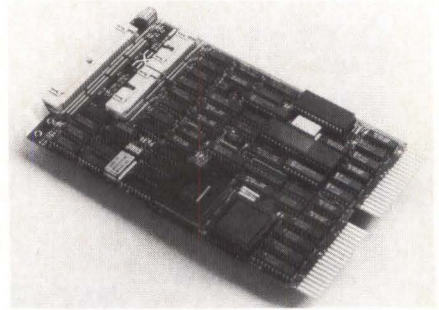
## Controller emulates DEC KDA50

- 3M bytes per second
- Q-bus compatible
- MicroVAX support

Emulating the DEC KDA50, the QD33 is a dual-wide, Q-bus-compatible SMD/SMD-E disk controller. It sup-

ports MicroVAX, MicroPDP-11 and LSI-11 Q-bus-based systems and provides a 3M-byte-per-second data-transfer rate. The unit features dynamic bad-block replacement, adaptive DMA, rotational position sensing and fast head select. \$2,700. **Emulex Corp.**, 3545 Harbor Blvd., P.O. Box 6725, Costa Mesa, Calif. 92626, (714) 662-5600.

Circle 444



## Software connects DEC and IBM computers

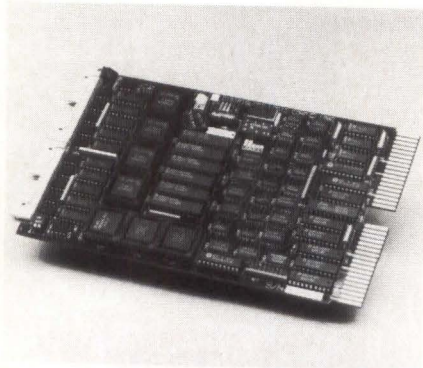
- Menu-driven
- Auto-dial capability
- X.25 compatible

The VAX-Link family of communications software enables VAX and MicroVAX computers to interconnect

with IBM SNA and BSC networks. They also exchange information over X.25 packet-switching networks. The software is downloaded in RAM on DEC processor boards. Features include menu-driven operation, auto-dial

capability and multiple protocol support. Modification to existing DEC or IBM software is not required. \$3,500 to \$10,000. **Systems Strategies Inc.**, 225 W. 34th St., New York, N.Y. 10001, (212) 279-8400.

Circle 445



## Controller suits Q-bus computers

- Eight channels
- Dual-size board
- 64-character buffer

Contained on a dual-sized board, the CQ1620 communications controller furnishes eight channels for attaching terminals and other remote communication devices. The product suits

LSI-11, MicroVAX and MicroPDP-11 systems. It runs standard DEC DHV11 driver and diagnostics software under MicroVMS, RSTS/E, RSX and ULTRIX-32m operating systems. A 64 character buffer is supplied. \$1,100. **DIALOG**, 1555 S. Sinclair St., P.O. Box 6270, Anaheim, Calif. 92806, (714) 937-5700.

Circle 446

## Board joins DEC, IBM computers

- VAX/VMS compatible
- 1M byte of RAM
- IBM PC/AT interface

The Q-bus version of the AT/Bridge allows MicroVAX computers to run

IBM PC/AT software and attach IBM PC hardware to VAX/VMS computers. The board includes an 8-MHz 80286 microprocessor, 1M byte of RAM, an IBM PC/AT interface and an optional

80287 floating-point processor. \$3,990. **Virtual Micro Systems Inc.**, Suite 300, 2150 Shattuck Ave., Berkeley, Calif. 94704, (415) 841-9594.

Circle 447

# NEW PRODUCTS

## SYSTEMS

Megan Nields, Staff Editor

### Workstation runs on 80286 processor

- IBM PC/AT compatible
- Two models
- Eight expansion slots

Based on the 80286 processor, the XTRA/286 Advanced Technology Workstation is available in two configurations. Model I features 640K bytes of RAM and a 1.2M-byte flexible disk; Model III includes a 30M-byte flexible disk with a 40-msec access time. Both IBM PC/AT-compatible units have eight expansion slots and run at 10 MHz. Proprietary disk caching software is provided. \$2,499, Model I; \$4,299, Model III. **ITT Information Systems**, 2350 Qume Drive, San Jose, Calif. 95131, (408) 945-8950.

Circle 392



### 386 computer runs at 16 MHz

- 1M byte of RAM
- Two serial ports
- MS-DOS, XENIX

The PC's Limited 386 is a 16-MHz personal computer based on the Intel Corp. 80386 microprocessor. A base configuration includes 1M byte of RAM, a 1.2M-byte flexible disk drive, an I/O interface card and two serial ports. The unit runs twice as fast as Compaq Computer Corp.'s system in conventional memory-read benchmarks. The computer operates under MS-DOS and XENIX and runs IBM-compatible software programs. \$4,000 and higher. **PC's Limited**, Building 3, 1611 Headway Circle, Austin, Texas 78754, (512) 339-6800.

Circle 394



### Portable computer weighs 39 ounces

- 320K bytes of memory
- 1,200-baud modem
- RS232C port

Weighing just 39 ounces, the ACCESS II portable computer furnishes 320K bytes of memory. The unit contains a 1,200-baud auto-dial/auto-answer internal modem that is compatible with Bell or CCITT standards. Features include a 40-character-by-8-line display, an RS232C port and communications options such as Digital Equipment Corp. VT100 emulation. Built-in software is supplied. \$799 to \$2,250. **Melard Technologies Inc.**, 5 Westchester Plaza, Elmsford, N.Y. 10523, (914) 592-3044.

Circle 393

### Portable computer uses 80286 microprocessor

- 6.6M bytes of RAM
- 5¼-inch disk drive
- Three configurations

Available in three configurations, the Compaq Portable III computer incorporates a 12-MHz 80286 microprocessor. The unit weighs 18 pounds and measures 9.78 by 16 by 7.83 inches. It supplies up to 6.6M bytes of RAM, 20M or 40M bytes of 3½-inch rigid disk storage, a 1.2M-byte 5¼-inch flexible disk drive and an 84-key detachable keyboard. Options include an expansion unit for two expansion slots. Graphics resolution is up to 640 by 400 pixels. \$3,999, model 1; \$4,999, model 20; \$5,799, model 40. **Compaq Computer Corp.**, 20555 FM 149, Houston, Texas 77070, (713) 370-0670.

Circle 395

### Workstation accesses IBM minicomputers

- 80286 processor
- 1.2M-byte disk drive
- Display adapter

The 5250-Premium/286 workstation, based on Intel's 10-MHz 80286 microprocessor stands alone or accesses IBM System 34, 36 and 38 minicomputers. Available in nine configurations, the product supplies a 1.2M-byte flexible disk drive, a 101-key keyboard and a proprietary display adapter with Hercules bit-mapped graphics capability. Bidirectional file-transfer software is included. \$3,095. **AST Research Inc.**, 2121 Alton Ave., Irvine, Calif. 92714, (714) 863-1333.

Circle 396



### Portable computer weighs less than 1 pound

- Eight-bit processor
- 64K bytes of RAM
- 2-by-16 display

Measuring 5.6 by 3.1 by 1.1 inches, the Advanced Pocket Computer weighs only 10 ounces. Utilizing an 8-bit processor, it supplies 64K bytes of internal RAM and ROM, a 2-line, 16-character display and 256K bytes of storage in modular RAM and EPROM. Asynchronous serial communication is provided through RS232C links at baud rates ranging from 50 to 9,600. \$295. **Hand Held Products Inc.**, P.O. Box 2388, Charlotte, N.C. 28211, (704) 541-1380.

Circle 397

## DISK/TAPE



### Flexible disk drive stores 720K bytes

- 3½-inch unit
- IBM PC compatible
- MS-DOS 2.0

Offering compatibility with the IBM PC, PC/XT and PC/AT, the MDQ is a host-powered, external 3½-inch flexible disk drive. It furnishes 720K bytes of storage and works with MS-DOS 2.0 and higher. Proprietary software is included. A multiplexer adapter card is optional. \$355. **Manzana Microsystems Inc.**, P.O. Box 2117, Goleta, Calif. 93118, (805) 968-1387.

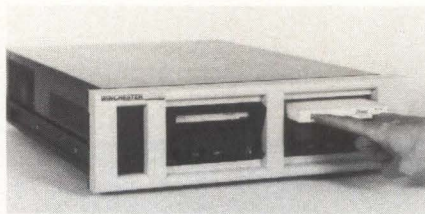
Circle 398

### Disk controllers work with IBM PC/XT, /AT

- Two models
- On-board sector buffering
- UNIX, XENIX compatible

Suiting the IBM PC, PC/XT and PC/AT, the 200 series disk controllers supply four-port address, on-board sector buffering and 15-head drive support. The PS180 and PS200HP work with existing ST506 and ST412 disk drives. They are compatible with CP/M, PC-DOS, UNIX and XENIX. Automatic retry and error correction are supplied. \$495, PS180; \$595, PS200HP. **Perstor Systems and Software Inc.**, 7825 E. Redfield Road, Scottsdale, Ariz. 85260, (602) 948-7313.

Circle 399

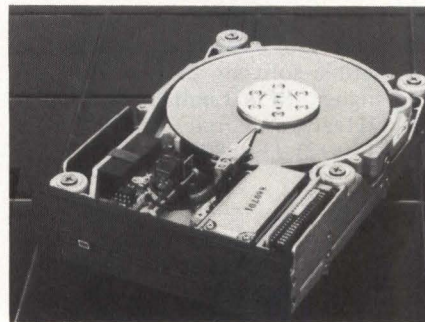


### Disk subsystems run on Q-bus

- 80M to 226M bytes
- DEC compatible
- Five models

Available in five configurations, the DataSafe family of Winchester disk subsystems is compatible with Digital Equipment Corp. Q-bus-based computers. They supply storage capacities of 80, 110, 165 and 226M bytes. LSI-11 and MicroVAX software-support is provided. \$4,995 and higher. **Winchester Systems**, 400 W. Cummings Park, Woburn, Mass. 01801, (617) 933-8500.

Circle 400

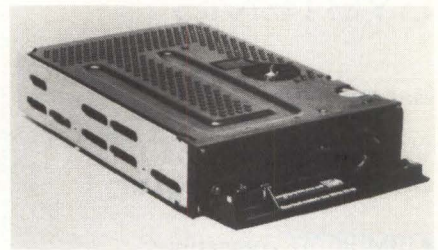


### Winchester boasts ESDI interface

- Half-height unit
- 28-msec access time
- 106M-byte capacity

A half-height Winchester disk drive, the HH-2085 furnishes an ESDI interface. The unit transfers data at a rate of 10M bps and provides formatted and unformatted capacities of 89M bytes and 106M bytes, respectively. Average access time is 28 msec; track-to-track access time, 5 msec. The drive includes three platters and five read/write heads. \$995. **Microscience International**, 575 E. Middlefield Road, Mountain View, Calif. 94043, (415) 961-2212.

Circle 401



### Tape drive boasts 300M-byte capacity

- Quarter-inch unit
- 64K-byte buffer
- SCSI, QIC-2 interfaces

The Siemens 300M-byte streaming cartridge tape drive is a quarter-inch, half-height unit boasting a formatted storage capacity of 300M bytes. Features include a 64K-byte buffer, 24-track recording density and 240K-byte data rate. SCSI and QIC-2 interfaces are offered. Tape speed is 120 ips. \$1,000. **Siemens Information Systems Inc.**, 5500 Broken Sound Blvd., Boca Raton, Fla. 33431, (305) 994-8800.

Circle 402



### Rigid disk drives store 45M bytes

- 3½-inch unit
- Minus 30-msec access
- SCSI controller

The six-configuration ST series of 3½-inch rigid disk drives provides up to 45M bytes of formatted storage capacity. The devices feature thin-film media and embedded SCSI controllers. Average access time is less than 30 msec. \$495 to \$695. **Seagate Technology**, 920 Disc Drive, Scotts Valley, Calif. 95066-4544, (408) 438-6550.

Circle 403



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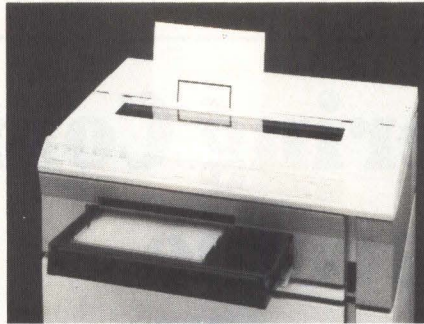
CIRCLE NO. 74 ON INQUIRY CARD

PRINTERS

**Ink-jet printer achieves 400 cps**

- 480 dpi
- 8K-byte line buffer
- 55-dB(a) noise level

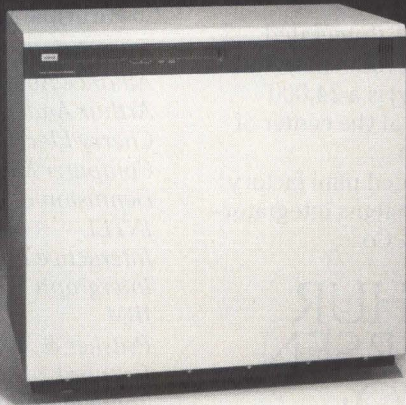
The SI 480 Solid Ink printer achieves letter-quality printing at 200 and 400 cps. It provides a horizontal resolution of 480 dpi and supports RS232C serial and Centronics parallel interfaces.



Paper handling includes automatic feed of cut-sheet and tractor feed. The unit supplies two font styles and an 8K-byte line buffer and has a 55-dB(a) noise level. MBTF is 1,000 printing hours. \$2,795. **Dataproducts Corp.**, 6200 Canoga Ave., P.O. Box 746, Woodland Hills, Calif. 91365-0746, (818) 887-8000.

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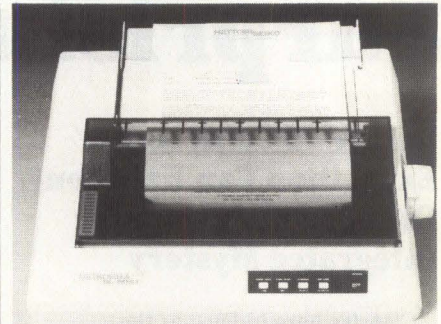
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**Dot-matrix printer handles 135 cps**

- 24-pin unit
- 55-dB(a) noise level
- Epson, IBM emulation

A dot-matrix printer, the SL-80AI generates 45 cps, draft, and 135 cps, letter quality. The 24-pin unit has a noise level of 55 dB(a), an adjustable tractor feed and automatic single-sheet loading. It emulates Epson LQ-1500 and IBM graphics printers and supports IBM character sets 1 and 2. \$549. **Hattori Seiko Computer Peripherals**, 1111 Macarthur Blvd., Mahwah, N.J. 07430, (201) 529-4655.

Circle 405

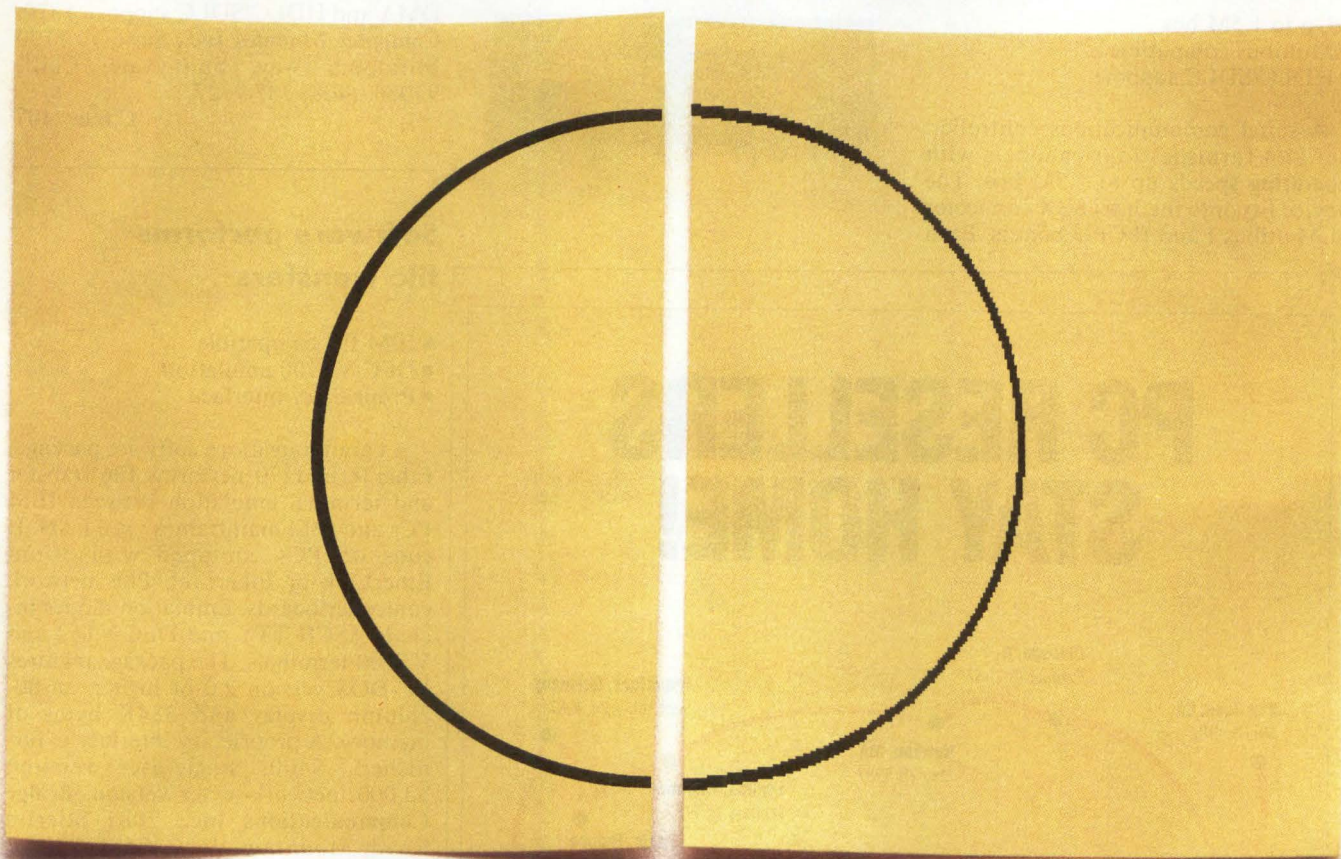
**Plotter produces 14 ppm**

- 2 inches per second
- 200 points per inch
- Color or monochrome

Plotting at a 2-inch-per-second rate on 11-inch wide paper, the Spectrum plotter produces either full-color or monochrome copy. The device generates 14 ppm and offers a 200-point-per-inch resolution. Features include proprietary software and a choice of interfaces and controllers. \$11,950. **Versatec**, 2710 Walsh Ave., Santa Clara, Calif. 95051, (408) 988-2800.

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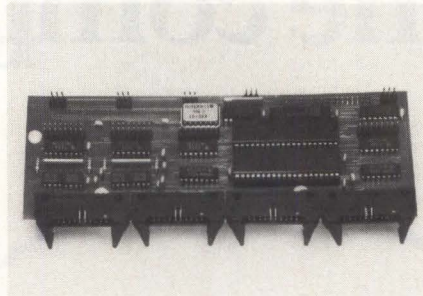
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DATA COM

**Controller supplies four channels**

- Up to 1.5M bps
- Multibus compatible
- HDLC/SDLC support

A serial communications controller, Serial/4 furnishes four channels with operating speeds up to 1.5M bps. The device fits onto the Intel SBX connector of Multibus I and II CPU boards. Each



channel meets RS232/423, RS499 or RS422/485 specifications. Features include a built-in baud rate generator and DMA and HDLC/SDLC support. \$370. **Computer Modules Inc.**, Suite Y, 1190 Miraloma Way, Sunnyvale, Calif. 94086, (408) 737-7727.

Circle 407

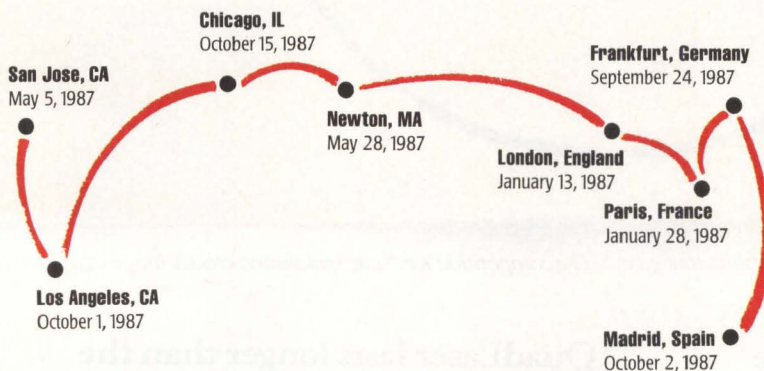
**Software performs file transfers**

- IBM PC compatible
- DEC VT100 emulation
- Proprietary interface

A communications software package, EtherTerm/3270 performs file transfer and terminal emulation between IBM PCs and IBM mainframes via a LAN. It runs on PCs equipped with 3Com EtherLink or EtherLink Plus network controller boards. Emulation modes include ASCII TTY and DEC VT52 and VT100 terminals. The package requires PC-DOS version 2.0 or higher, an 80-column display and 384K bytes of memory. A proprietary interface is furnished. \$400, single-user version; \$2,000, network-server version. **Bridge Communications Inc.**, 2081 Stierlin Road, Mountain View, Calif. 94043, (415) 969-4400.

Circle 408

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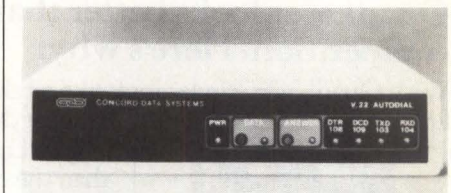
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CIRCLE NO. 75 ON INQUIRY CARD



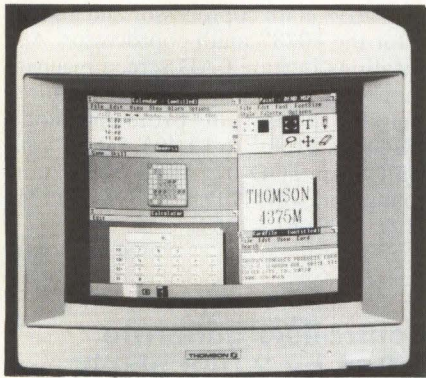
**Modem operates at 300, 1,200 bps**

- Auto-dial
- Bell 103, 212 compatible
- Hayes command set

The CDS 212/V.22 provides auto-dialing and full-duplex operation at 300 and 1,200 bps in both asynchronous and synchronous modes. It is compatible with Bell 103 and 212 and CCITT V.21 and V.22 standards. Hayes and proprietary commands sets are included. \$350. **Concord Data Systems Inc.**, 397 Williams St., Marlborough, Mass. 01752, (617) 460-0808.

Circle 409

TERMINALS



**Monitor displays up to 64 colors**

- 13-inch screen
- 800 by 560 dpi
- IBM compatible

The 4375M UltraScan monitor supports CGA, EGA and PGC standards for the IBM PC and compatibles. It furnishes a 13-inch screen, 0.31-mm dot pitch and an 800-by-560-dpi resolution. The unit displays up to 64 colors and conforms to IBM monochrome and Hercules standards. It adjusts to horizontal scan frequencies between 15.7 kHz and 35 kHz and vertical scan frequencies between 45 Hz and 75 Hz. \$895. **Thomson Computer Products Corp.**, Suite 111, 5731 W. Slauson Ave., Culver City, Calif. 90230, (213) 568-1002.

Circle 410

**Terminal emulates TeleVideo, Wyse units**

- 80, 132 columns
- 14-inch screen
- 128 ASCII characters

Offering 128 ASCII characters, the Freedom One terminal supplies a 14-inch amber screen, 80- and 132-column display formats and a 60-Hz refresh rate. The unit emulates ADDS Viewpoint A2, Lear-Siegler ADM 31, TeleVideo 950 and Wyse WY-50 terminals. Features include 44 non-volatile function keys, X-on/X-off protocols and smooth or jump scrolling. Baud rates range from 50 to 38.4K. Up to 256K bytes of non-volatile memory are available for programming. \$549. **Liberty Electronics**, 332 Harbor Way, South San Francisco, Calif. 94080, (415) 742-7040.

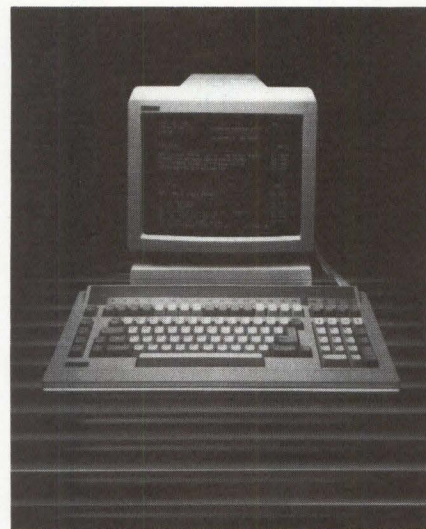
Circle 411

**Terminal furnishes DEC VT220 emulation**

- 14-inch screen
- Two RS232C ports
- 15 programmable keys

A multiple-window display terminal, the KT-22/PC supplies DEC VT52, VT100 and VT220 emulation modes. It furnishes a 14-inch green or amber screen, 15 programmable function keys and two bidirectional RS232C ports. The unit can display either two or three pages of 25-line-by-80-column memory. \$749. **Kimtron Corp.**, Bldg. 380, 1709 Junction Court, San Jose, Calif. 95112-1090, (408) 436-6550.

Circle 412

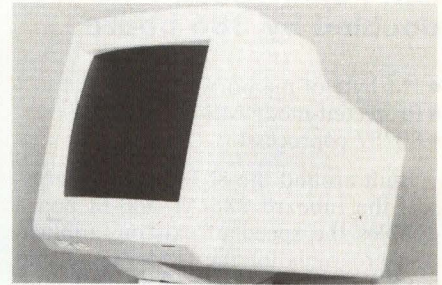


**ASCII terminal runs at 70-Hz refresh rate**

- 14-inch screen
- 32 function keys
- 80 or 132 columns

An ASCII terminal, the 2020 displays 80 or 132 columns by 24 lines on a 14-inch screen. Emulation modes include ADDS Viewpoint, Hazeltine 1500, TeleVideo 910, 920 and 925 and Wyse WY-50 devices. It includes 32 programmable function keys, parallel and serial ports, presents four speeds of smooth scroll and runs at a 70-Hz refresh rate. \$695. **Applied Digital Data Systems Inc.**, 100 Marcus Blvd., Hauppauge, N.Y. 11788, (9516) 231-5400.

Circle 413



**Color monitor offers IBM compatibility**

- 800 by 560 dpi
- 0.31-mm dot pitch
- 45 to 75 Hz

A multi-application color monitor, the AUM-1371A supplies horizontal frequencies from 15.6 kHz to 35 kHz and vertical frequencies from 45 Hz to 75 Hz. The unit is compatible with IBM MDA, CGA, EGA, PGC and monochrome Hercules graphics boards. It furnishes up to 800 by 560 dpi and 0.31-mm dot pitch. \$889. **Mitsubishi Electronics America Inc.**, Computer Peripherals Division, 991 Knox St., Torrance, Calif. 90502, (213) 515-3993.

Circle 414

**Color terminals emulate DEC, Tektronix units**

- Three models
- 68000 processor
- 57.6K bytes per second

Available in three models, the GO-400 series of color composite terminals uses a 16-bit 68000 microprocessor running at 10 MHz and supports DEC and Tektronix interfaces. All models supply communication speeds of up to 57.6K bytes per second, a 0.26-mm dot pitch and a 14-inch screen. Model GO-405 boasts a 480-by-360-pixel resolution, 16 pages of storage, a 4,096-color palette and one parallel and three serial ports. Model GO-407 supplies an 800-by-520-pixel resolution and 32 pages of storage. Model GO-411 accommodates 1,024 by 768 pixels and a 16-million color palette. Options include a current loop interface and a 1M-byte RAM upgrade. \$2,995, GO-405; \$3,795, GO-407; \$5,995, GO-411. **GraphOn Corp.**, 1901 S. Bascom Ave., Campbell, Calif. 95008, (408) 371-8500.

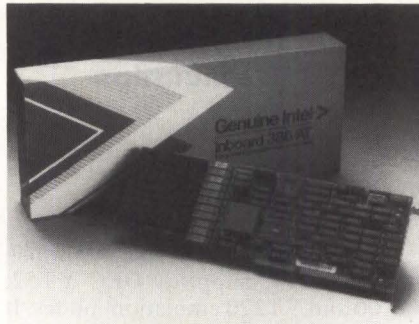
Circle 415

SUBASSEMBLIES

**IBM PC/AT speed doubled by 386 board**

- 1M byte of memory
- Protected-mode MS-DOS
- 80287 coprocessor

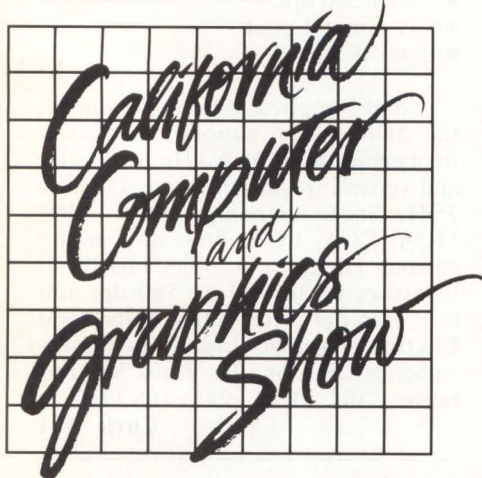
Built around the 80386 microprocessor, the Inboard 386/AT add-in board doubles the speed of existing application programs for the IBM PC/AT and handles 80386 software. The device of-



fers up to 1M-byte of optional memory, a 10-MHz math coprocessor and a socket for the 80287 math coprocessor. Applications include CAD screen regeneration and statistical analysis. Features include support of protected-mode MS-DOS. \$1,995 to \$2,495. **Intel Corp.**, Mail Stop TOD-07, 5200 N.E. Elam Young Parkway, Hillsboro, Ore. 97124-6497, (503) 629-7354.

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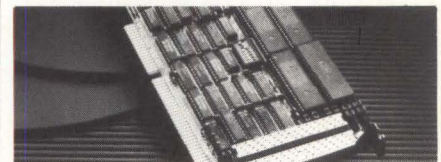
CIRCLE NO. 76 ON INQUIRY CARD

**Controllers generate 2,048 by 2,048 pixels**

- 256 colors
- Double buffering
- 262,144-color palette

The models 3710 and 3720 graphics controllers generate a 2,048-by-2,048-pixel resolution on an RGB color monitor. They supply up to 256 colors from a 262,144-color palette and a double-buffering option for real-time or dynamic applications. Pixel writing rates range from 6 million pixels per second to 160 million pixels per second. \$29,950, model 3710; \$35,000 to \$40,000, model 3720. **Metheus Corp.**, 5510 N.E. Elam Young Parkway, Hillsboro, Ore. 97124, (503) 640-8000.

Circle 417



**Controller provides 512K bytes of RAM**

- 128K bytes of EPROM
- 16-bit memory transfer
- 80186 processor

An intelligent communications controller, the Smart Hostess supplies 512K bytes of RAM, up to 128K bytes of EPROM and an 80186 processor. It is compatible with the IBM PC, PC/XT and PC/AT. The unit acts as a front-end processor for serial communications under DOS, XENIX and other operating systems. It utilizes PC/AT I/O channel signals, allowing 16-bit memory transfers. Features include two-way interrupt capability, two independent full-duplex channels and full modem control. \$1,495. **Control Systems Inc.**, 2675 Patton Road, St. Paul, Minn. 55113, (800) 826-4281.

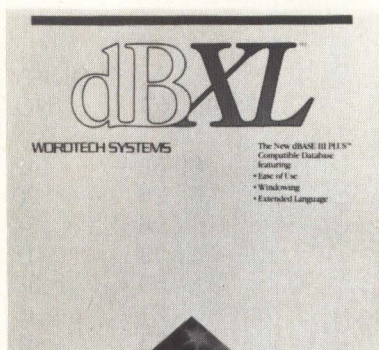
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## SOFTWARE



### DBMS suits dBASE III Plus

A database management system, dBXL is fully compatible with Ashton Tate's dBASE III Plus. The software supplies a menu-driven assist feature and several levels of on-line context-sensitive help. It is not copy protected. Features include windowing and MS-DOS compatibility. \$169. **WordTech Systems Inc.**, P.O. Box 1747, Orinda, Calif. 94563, (415) 254-0900.

**Circle 419**

### Text software works with Lotus 1-2-3

The 4WORD Add-In-Word Processor installs directly into Lotus 1-2-3. It furnishes capabilities such as word wrap, text justification, move and copy commands and centered text. Users can create, edit and print documents without leaving 1-2-3. The software runs on the IBM PC, PC/XT, PC/AT and compatibles and requires minimal RAM. \$99.95. **Turner Hall Publishing**, 10201 Torre Ave., Cupertino, Calif. 95014, (408) 253-9607.

**Circle 420**

### Operating system supports 25 users

The PC-MOS/386 multiuser operating system aids the Intel 80386 chip while maintaining DOS compatibility. The product runs multiple applications in virtual and 32-bit protected modes. It is written in assembler and occupies 40K bytes of RAM-overhead. Features

include support for record- and file-locking, intertask communication through the NETBIOS protocol, print spooling and remote modem access. It supports up to 25 users. \$165 to \$995. **The Software Link Inc.**, Suite 632, 8601 Dunwoody Place, N.E., Atlanta, Ga. 30338, (404) 998-0700.

**Circle 421**

### Operating system runs on IBM PC

A multitasking operating system for the IBM PC, PC/XT and PC/AT; chronOS uses standard DOS programming tools to write real-time applications. The software, written in assembler language, includes a demonstration program, device drivers and an on-line symbolic debugger to modify tasks at runtime. \$1,995. **Dynapro Systems Inc.**, 1000-1200 W. 73rd Ave., Vancouver, British Columbia, V6P 6G5, Canada, (604) 263-2638.

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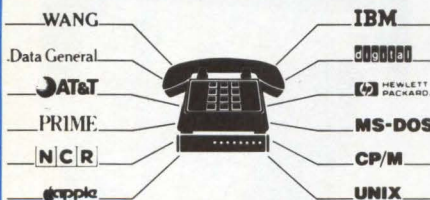


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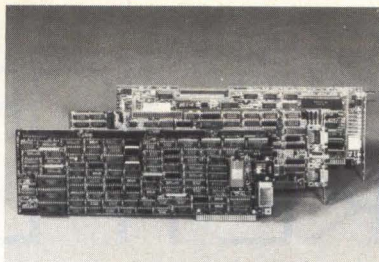
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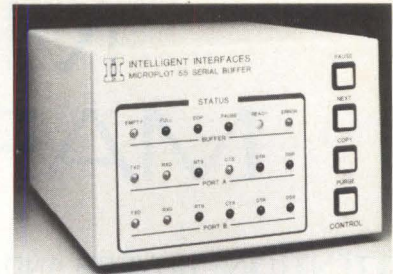
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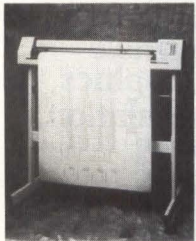
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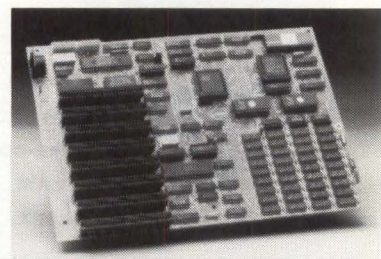
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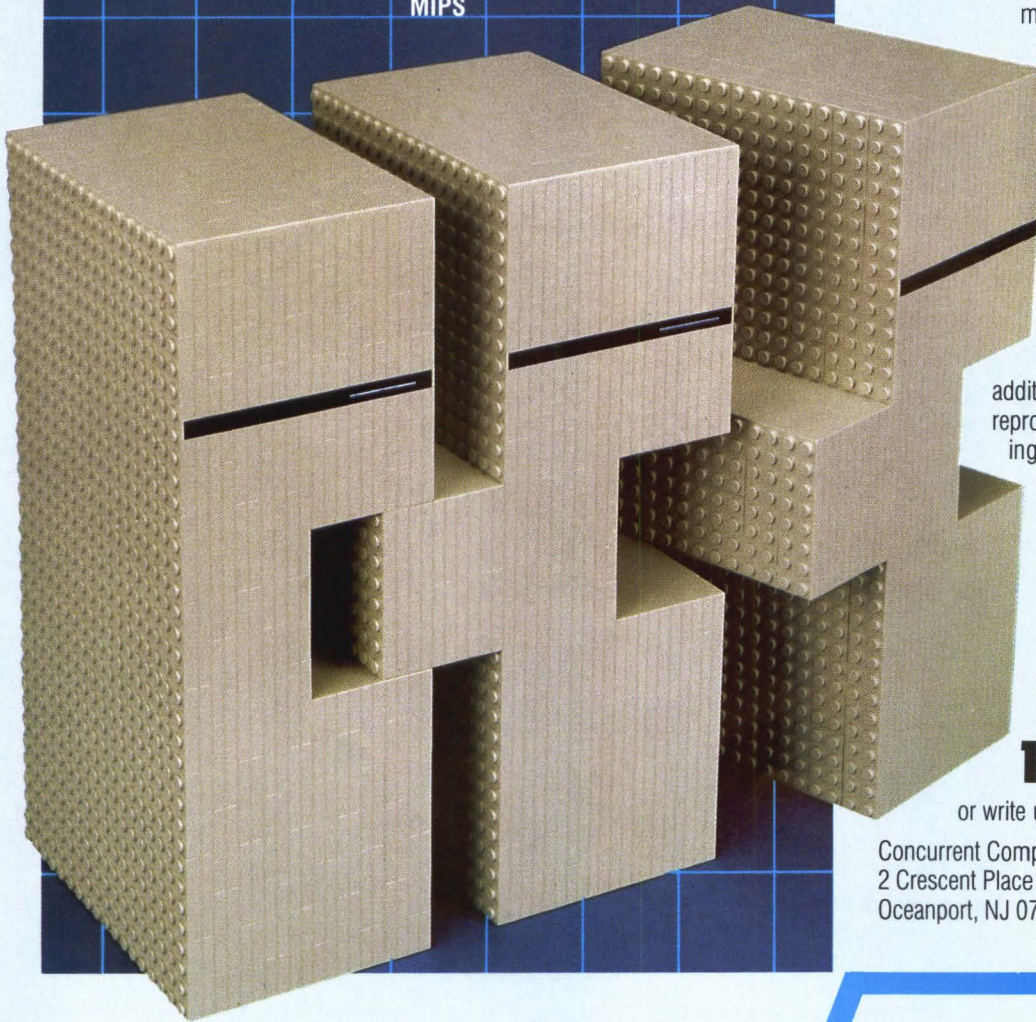
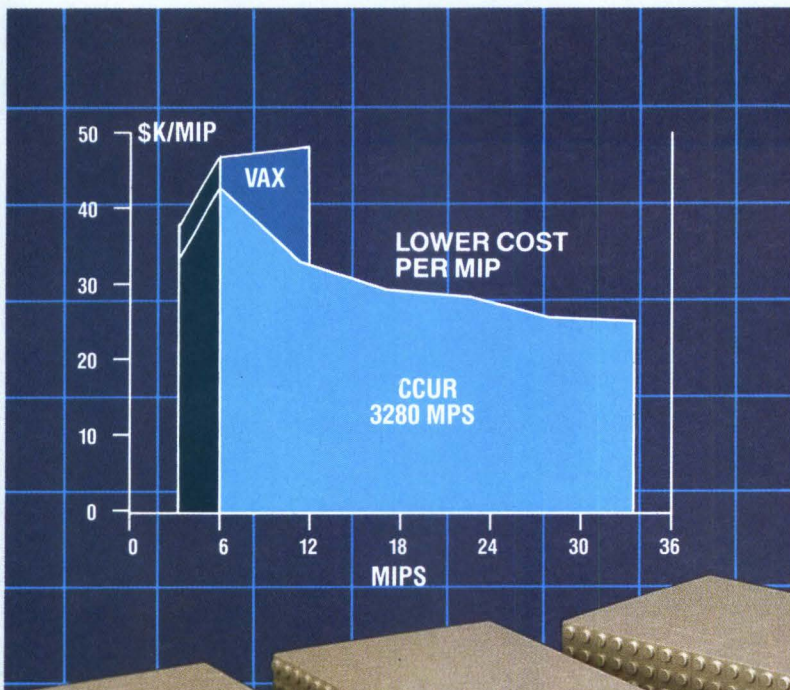
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