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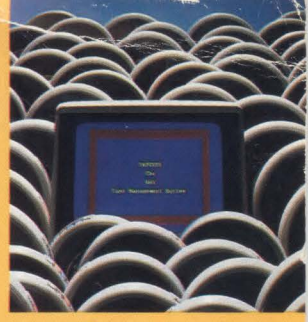

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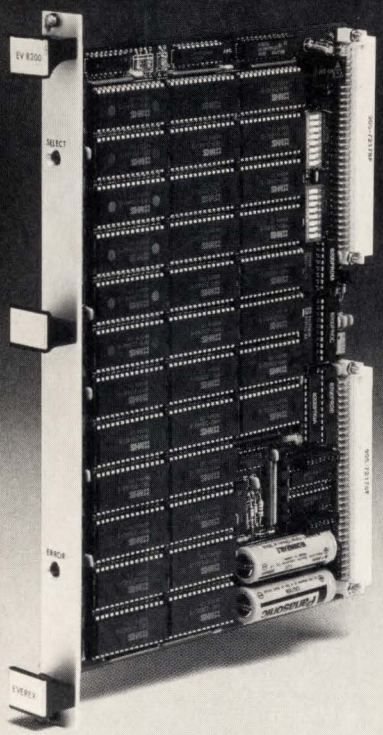

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FROM THE BLUE LINE

I recently picked up a copy of *U.S. News & World Report* and found an interesting article: "Computer Industry Hits the Wrong Button." The article cited massive layoffs: 1300 at Data General, Apple 1200, and so on and so on. The article went on to claim that companies were putting a clamp on expenditures for personal computers and larger computers, such as those made by DEC and IBM, weren't faring much better. I was starting to get worried and thought: "this is just like the summer of '85!" Well, it was the summer of '85. In fact, the issue date was July 1, 1985.

Taking a deep breath I thought, well that's in the past. Then I remembered saying the same thing in the spring of 1976—that was two years after the big semiconductor bust in 1974. That was the year a number of companies (Intel, Mostek, Motorola, and Texas Instruments) hit bottom with overproduction and no markets. Our nasty little war in Southeast Asia was over, Congress found it fitting to reduce the aerospace budgets, so there went the semiconductor business.

The computer business hadn't really taken off since there wasn't really any notion of a microprocessor except for the Intel 4004 and 8008. In 1976, we thought growth would never happen.

In 1985 we slipped—and slipped badly. I blame it on two things. First is inherent greed: "If you can make a bunch of money today, obviously there will be more to be made tomorrow." Second, market researchers tended to tout products and market segments without any foundation. One report issued in October of 1985 claimed, as the market was crashing about our feet, that all segments were expected to grow by an additional 30-40% by year's end. What occurred was a sliding back to pre-1983 levels. It appeared that the market researchers were more interested in protecting member client interests by creating a false market than by banking the fire against short markets, inflation, and just plain bad technology.

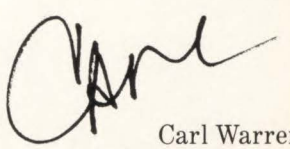
That brings us to January 1988. In case you haven't looked, again predictions are high. The market, however, is the same size.

The Fortune 5000, that group of companies everyone professes to sell to, is still just 5000 companies strong. And yes, they buy product. But as in 1985, corporate controllers have instituted tough requirements for the acquisition of capitol equipment. Now the rule is: Use what you got, make it work better, and upgrade the old. A perfectly good idea, and one, in fact, that represents a multibillion dollar business by itself—and a safe one.

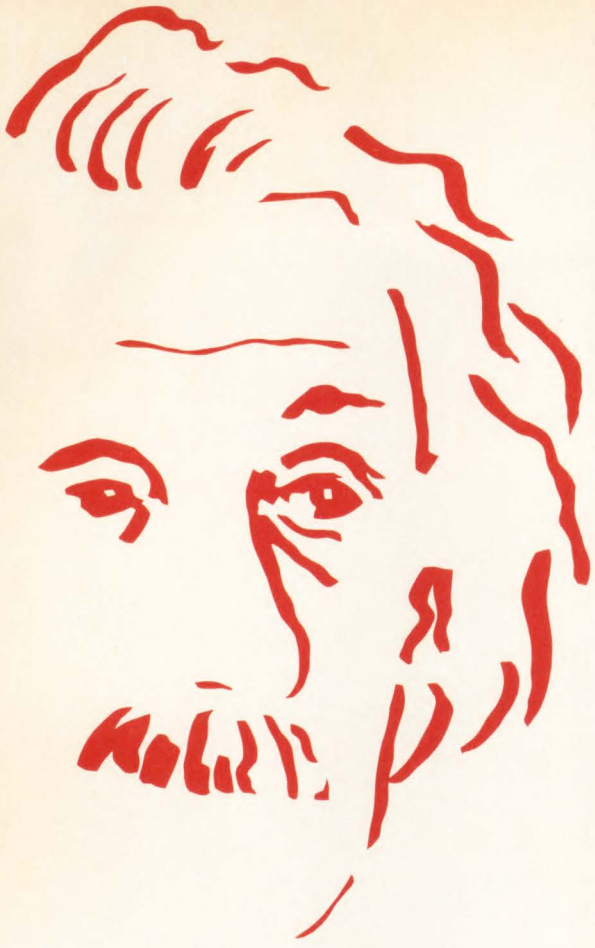
Consequently, for 1988 we are forecasting slow and safe growth for the more sophisticated companies and many peaks and valleys for the newcomers. More dollars will be spent in 1988 than ever before. Corporate mergers and strategic alliances, the word of the day in late '86 and throughout '87, will still be the way the game is played the rest of this decade.

Interestingly, there are some bulletproof companies and markets. We believe the most important to be the extended opportunities offered by DEC attachments. In 1988, the market will more than quadruple in this arena. For disk drives alone, the direct DEC attachment business will be in excess of $800 million, while storage attachments to workstations will be well into the $2 billion stratosphere. But these are aftermarket sales that have a continuation factor of at least 36 months. By integrating workstation devices, you directly expand the system storage required of the VAX host—as well as the additional I/O ports and software tools needed to manage the environment.

Despite these golden opportunities, we recommend a conservative and consistent approach to business. There are signs that 1988 could suffer the same mid-year corrections seen in 1985. We don't want to be the harbinger of bad news, or rain on anyone's parade, but a carefully planned market approach is far superior to fast, knee-jerk reactions based on someone else's numbers you can't verify.



Carl Warren
Editor In Chief



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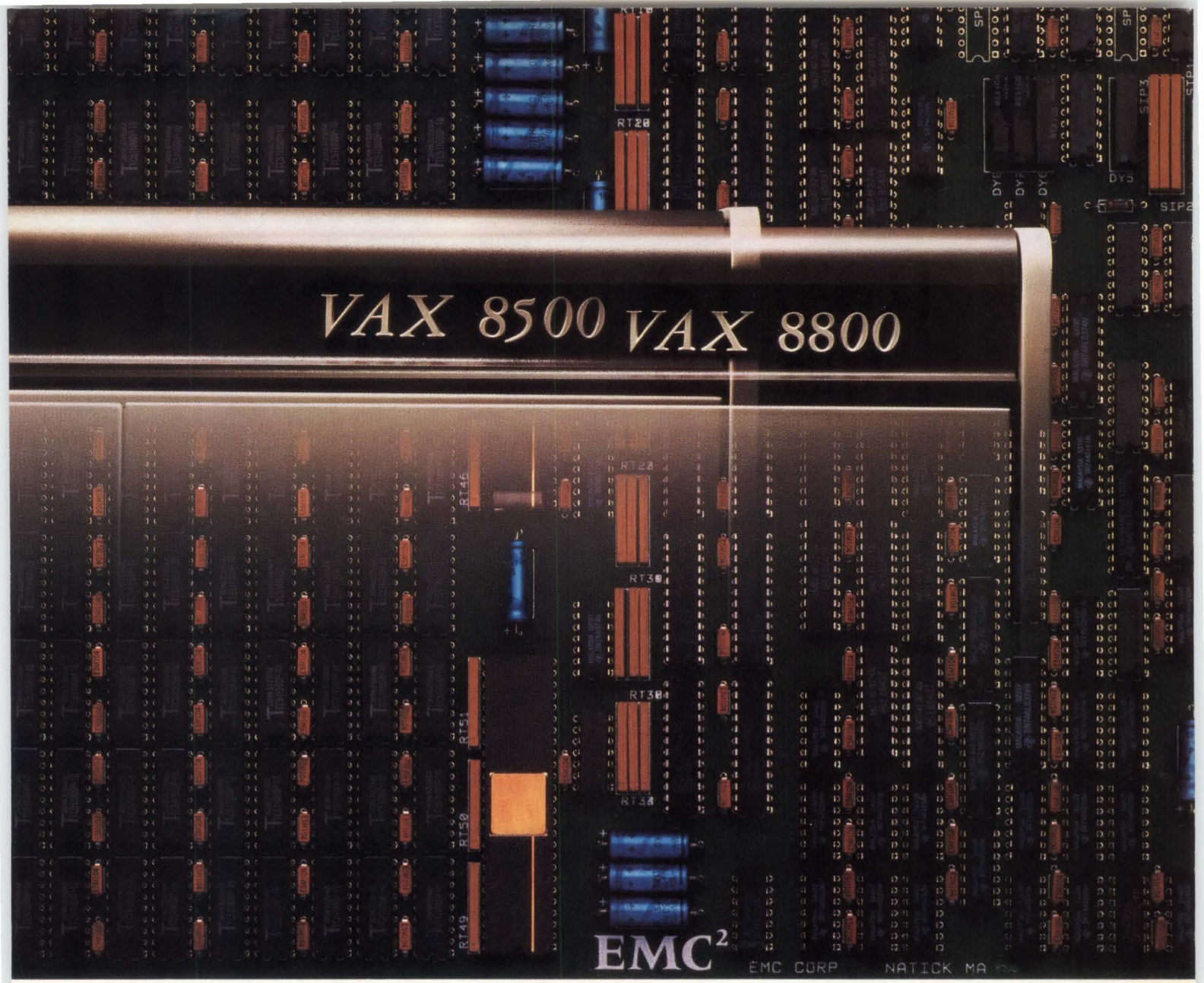

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POSTMASTER: Send address changes WITHIN USA to: Hardcopy magazine, P.O. Box 759, Brea, CA 92621-0759. Send changes of address OUTSIDE USA to: *Hardcopy*, Seldin Publishing Inc., c/o PDS, European Circulation Center, Radlett Rd., Colney St., St. Albans Herts, AL2 2EG, England. *Hardcopy* magazine ISSN 0279-8123 is published monthly by Seldin Publishing Inc., 1061 S. Melrose Ave., Ste. D, Placentia, CA 92670-7180. Subscriptions are complimentary to qualified sites in U.S. and Europe; Canada $25, Foreign air mail $50. All orders must be prepaid. *Hardcopy* magazine is an independent journal, not affiliated in any way with Digital Equipment Corp. HARDCOPY® is a registered trademark of Seldin Publishing Inc. DEC is a registered trademark of Digital Equipment Corp. The term "UNIX" is the trademark of AT&T.

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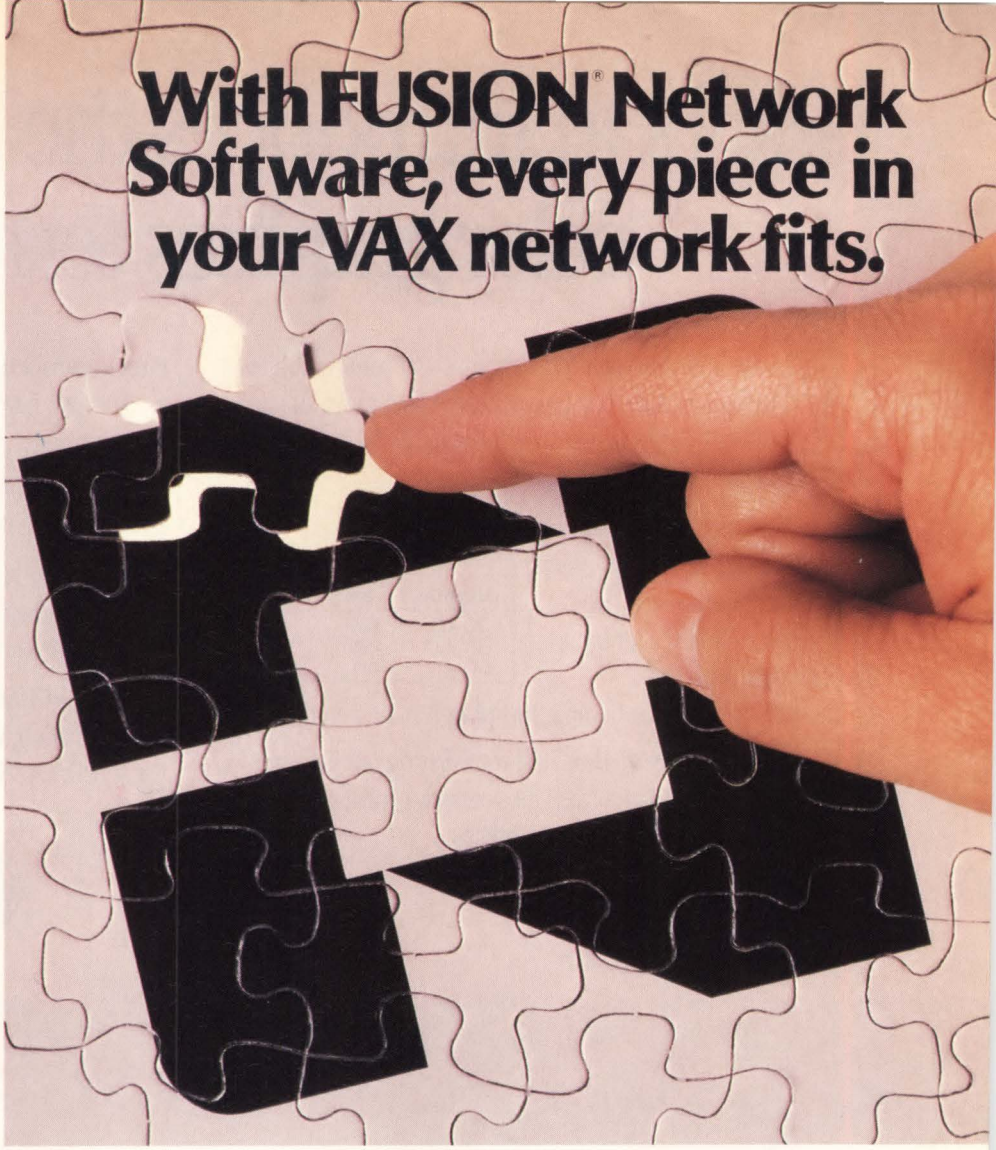

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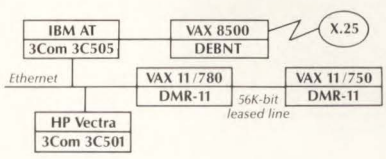

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JANUARY 1988, VOL.8, NO.1

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INTRODUCING

17 **Home Video Technology Entertains New Technologies**
It's more than a home movie . . . */by Brad Harrison*

19 **Newest Laser Printers Sport More for Less**
by Renee P. Brown

24 **Word Processing Software Bursts Vertical Application Barriers**/*by Renee P. Brown*

24 **Service Organizations Scurry to Keep Multi-Vendor Connections On-line**/*by Evan Birkhead*

LEE KARJALA

If your application requires permanent archiving, you need optical storage—page 18

FEATURES

Every color in the rainbow—page 98

32 **Tape Technologies Collide in Archive/Backup Race** Helical-scan technology and innovation in half-inch cartridges are already providing greater capacity at lower cost/*by Brad Harrison and Carl Warren*

45 **DEC-Compatible Tape Subsystems Vendors Directory**

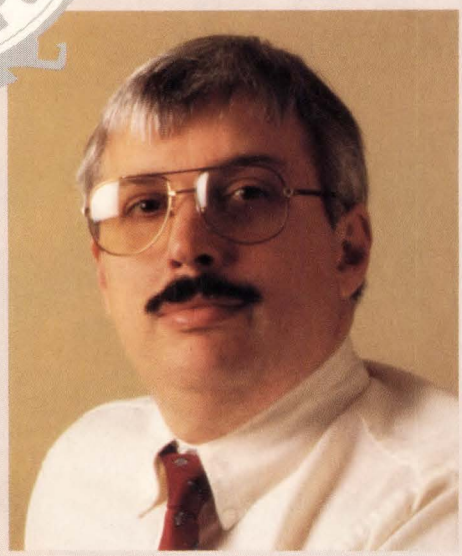
52 **WORM Technology Trying to Stay Alive** Has helical-scan tape obsoleted WORM technology in the data storage race?/*by Brad Harrison*

66 **Inside the HC/WG Labs** Find out how you can exploit *Hardcopy's* newly acquired HC/WG Labs *by Steve Bostwick*

94 **A New Twist for Helical-Scan** Achieve office copier convenience on oversize, color graphics output/*by John Potter*

CONTENTS CONTINUED ON PAGE 10

CONTENTS CONTINUED FROM PAGE 9


ROBBIE BELL

Introducing HC/WG Labs Senior Scientist, Steve Bostwick—page 66

INTRODUCING

HC/WG LABS HOW REPORTS

48 **HC/WG Labs Evaluates the Exabyte-8200** The Exabyte EXB-8200 is one of the first video storage devices for DEC systems and HC/WG Labs integrated it with the MicroVAX II for test evaluation/*by Jon Elson*

74 **Peace of Mind for MIS/DP Managers** Which data backup utility for the VAX best meets your needs?/*by David Spencer*

90 **Coefficient's Vterm/220 Links PCs to DEC** Vterm/220 emulation software for the PC is worth investigating/*by David J. Molta*

DIRECT FROM DEC

85 **Resource Management in Dynamic MIS Situations** Monitoring and managing system resources to achieve peak performance may be the greatest challenge/*by Sandra Gray and Del Prothero*

INTRODUCING

PRODUCT FOCUS

98 **Tektronix's 4300 Series Graphics Workstations** Can you imagine 16.7 million colors?

99 **MDB System Inc.'s Data Shuttle 2000** Removable-drive subsystem with shock isolation and configuration versatility

100 **Tara Computer Products Inc.'s Phoenix** Portable MicroVAX hits the road

DEPARTMENTS

From the Blue Line 4
Letters 12
Who to Contact at *Hardcopy* 12
Product News 102
Mini Mart 117
New/Used Equipment 118

COLUMNS

INTRODUCING

The Mass. Report 31
VAX/VMS Outlook *by Steve Davis and Matthew Owen* ..72
Graphics Notes *by Edward R. Teja* 89
PDP Perspective . . . RT-11 *by Milton Campbell* 116

INTRODUCING

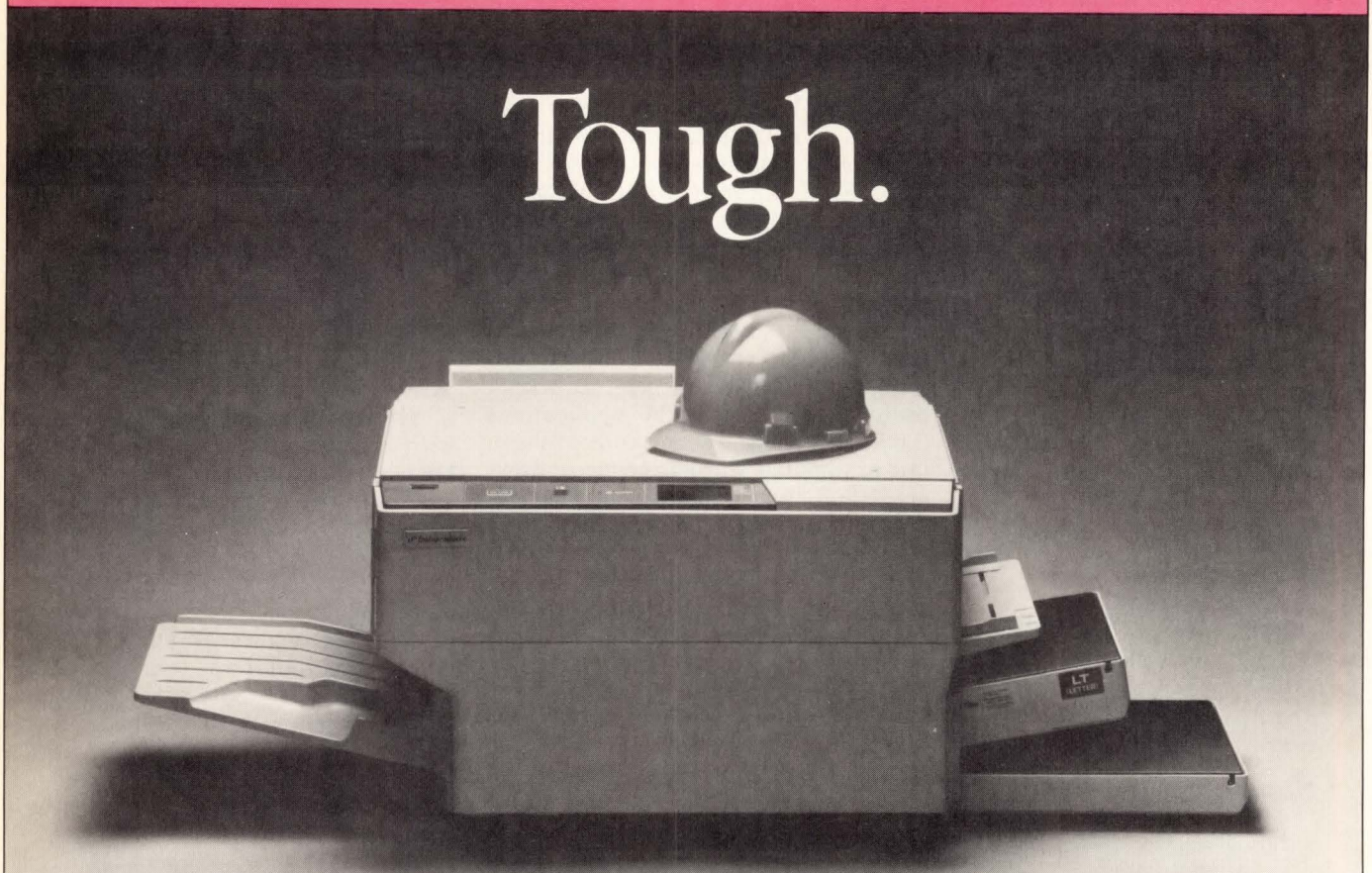
Bus Stop 129

8mm is more than a home movie—page 17

This month's cover, provided by Exabyte Corp., depicts the tremendous capacity of helical-scan technology media over traditional choices.

L A S E R P R I N T E R

Tough.



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LETTERS

PDP-11s ARE REAL WORLD

Although I enjoyed Mr. Miller's article, in your October issue ("VMS for Realtime"), I disagree as to how "suitable" VMS is for realtime. Although realtime applications can be performed using VMS, they cannot be cost-effective. PDP-11 based systems (often networked to a central VAX) are eminently more "suitable" for these operations. After 14 years or so of programming at the hardware level in what I prefer to call "real-world" applications (i.e., monitoring and/or controlling a lab, automated warehouse, or whatever), I find that zeroing in on the "response time" question leaves out more crucial issues.

As far as time is concerned, if I am programming in one of DEC's better realtime systems (IAS, RSX, RT11), I have direct access to the hardware on the Unibus or Q-bus from my program, or even from my terminal. Usually one instruction code or link command does all the work of setting up this access.

As far as money is concerned, if you compare costs for a total hardware and software package, a MicroVAX system typically costs two to three times as much as its PDP-11 equivalent. Enough said.

Frank R. Borger
Instrumentation Section Head
Michael Reese/University of Chicago
Chicago, IL

GREMLINS IN HC POWER FEATURE?

After reading the article "Power Conditioning Technologies" in the November 1987 issue of *Hardcopy*, I felt compelled to point out biases and errors.

The table comparing the four "leading types of power conditioning technologies" is so specific to certain manufacturers that it per se is comparing only four different manufacturers' 75 kVA systems and not generic technologies. The "tap switching system" is readily identifiable as the system that Digital Equipment Corp. sells. The "ferroresonant regulator" is recognized as the Datawave Magnetic Synthesizer product that our company manufactures. The comparison could have been made more generic by expressing footprint in square feet and giving ranges for other data using more than one vendor's information.

The efficiency comparisons in the article are obviously in error. How can the cost of operating a system at half load equal or exceed the cost at full load? The correct formula for calculating the five-year efficiency operating cost (ignoring the time value of money) is:

$$\text{COST} = \frac{(\text{KW LOAD} - \text{KW LOAD})}{\text{EFFICIENCY}} \times 8760\ \text{HRS} \times 5\ \text{YRS} \times \$0.08/\text{KWHR}$$

This cost can be multiplied by 1.33 to include an estimate for the additional air conditioning costs associated with removing the heat generated by the power conditioner.

According to the article, "the ferroresonant efficiency numbers in the table are based on measurements of kVA-in vs. kVA-out . . . the acceptable method is to measure true root-mean-square (RMS) power in and out; if the ferroresonant unit was evaluated using this method, it would yield less than 70% efficiency without being fully loaded." This is not true. The efficiency data in the table is correctly stated for the Datawave Magnetic Synthesizer product.

Thomas M. Gruzs
Technical Marketing Manager
Liebert
Columbus, OH

The purpose of the comparisons in the table was to show that cost of operation increases as the load decreases on power systems whose efficiency decreases with the load.
—Ed.

CORRECTION

"ESDI: High Performance Controllers for State-of-the-Art Winchesters," p. 83, November 1987, incorrectly stated all dwell times in milliseconds (msec). These measurements were actually made in microseconds (μsec).

We welcome your comments . . .

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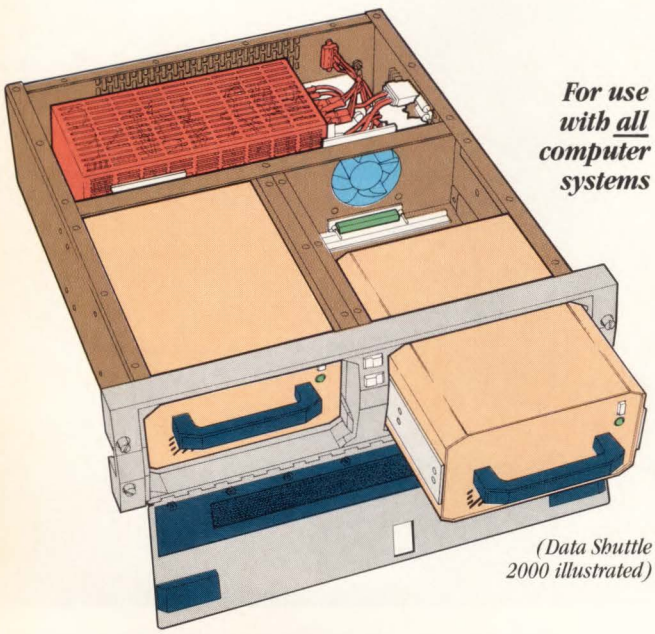

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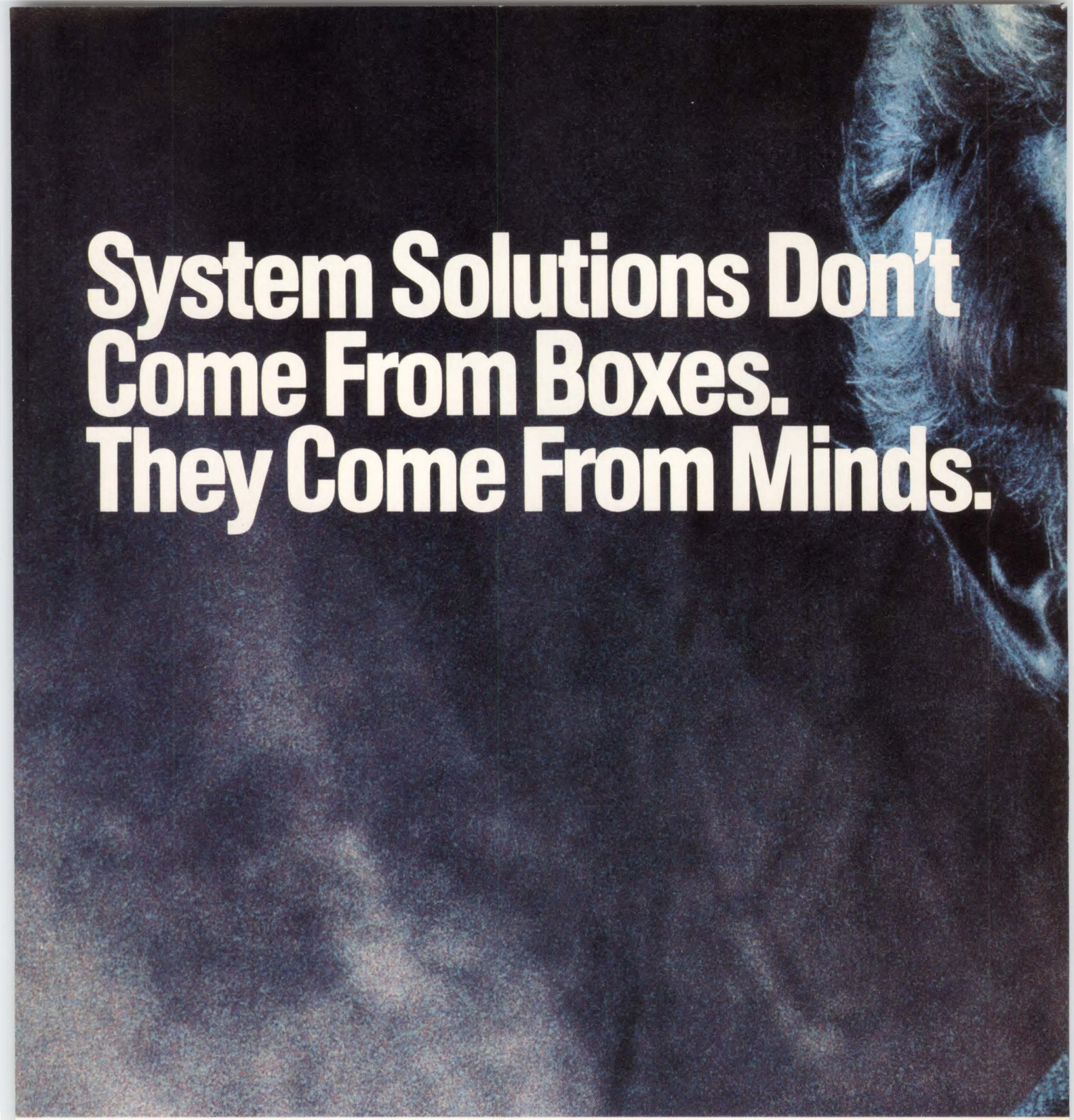

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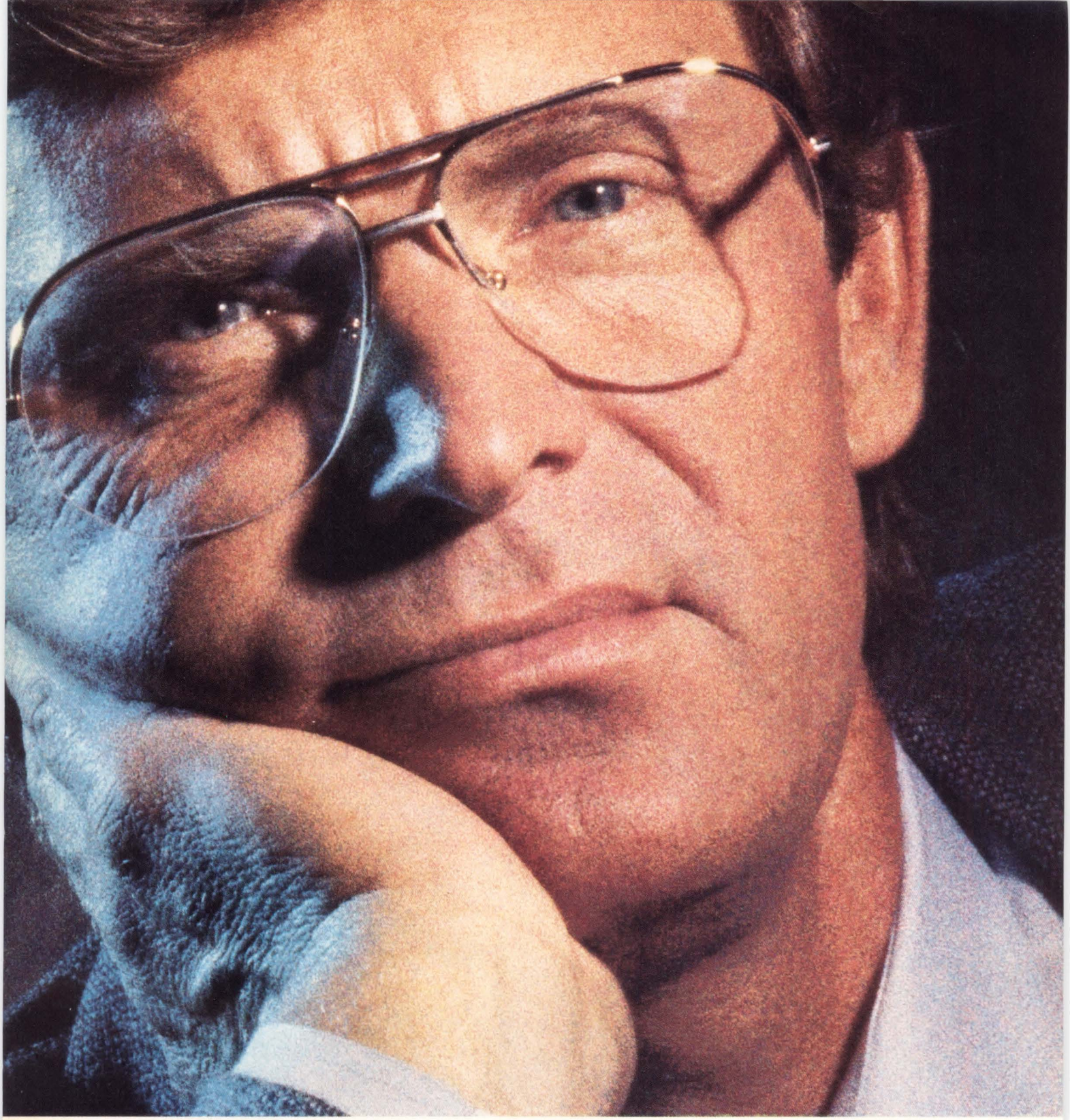

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CIRCLE 428 ON READER CARD

Home Video Technology Entertains Gigabytes of Storage

Packing gigabytes of information on tape as narrow as 4mm, helical-scan technology moves from home movies to storage of critical computer data

by Brad Harrison, *Senior Technical Editor*

In a market where just one year ago the DEC TK50 half-inch tape drive's 95-Mbyte capacity seemed adequate, gigabytes of storage are now becoming available at nose-diving costs.

The technology making this possible is helical-scan recording, borrowed from the home video industry. Add to this the use of industry-standard interfaces such as the Small-Computer-Systems interface (SCSI), and it quickly becomes obvious that a new kind of product—sophisticated, supported, and based on established technology—has arrived.

Industry analysts are optimistic: "Things look very good for helical-scan implementations," states Lee Elizer, president of Peripheral Strategies Inc. and co-author of *Helical Scan Tape Market Strategy Report.* "The main factor holding it up is the momentum of the entrenched tape technologies like QIC [Quarter-Inch Cartridge]."

Using the same basic mechanism used in this Sony 8mm home video camera, helical-scan tape drives are making it possible to store gigabytes of data for pennies per megabyte.

Pushed By Success

Helical-scan products supporting three form factors are available: Digital Audio Tape (DAT), 8mm (from the video camera industry), and standard VHS. DAT uses the smallest cartridges—supporting tape just 4mm wide—and has been very successful in Japan and Europe. But DAT is being restricted from U.S. markets by the lobbying efforts of compact disk manufacturers—a fact that in itself indicates how successful DAT will probably be once it finally becomes available in the United States.

The lobbying efforts are bound to fail, according to Louise Biggs of market research firm Dataquest (San Jose, CA): "It's not inevitable, but there's a very strong possibility that DAT will soon be a strong force in U.S. markets." Biggs points out that all that's required to establish DAT is a single large U.S. manufacturer to use it in a mass market product like car stereos.

Such products, in fact, have already been shown at U.S. trade shows. For example, at Comdex/Fall last November, a prototype 1-Gbyte DAT mass storage subsystem with a SCSI interface was shown by Hitachi Sales Corp. of America. The product, however, won't be available until sometime next year—but large supplies of the 4mm cassette probably won't be, either.

More Bytes Per Inch

Several companies are jumping on the helical-scan bandwagon and taking potshots at other media: "Traditional magnetic-tape technology is doomed," claims James Copenhaver, vice president of data storage operations for Honeywell's Test Instruments Division in Denver. "DAT will soon be the predominant low-end tape technology, and VHS will handle the rest."

Honeywell manufactures what Copenhaver calls a "high-value, high-end" 5.2-Gbyte tape storage subsystem that uses standard VHS cassettes and features a transfer rate of 4 Mbyte/second. The product was developed primarily for high-volume data acquisition applications, although it is also being used for heavy-duty data backup of VAXclusters. But the product's relatively slow SCSI interconnection to Q-bus and Unibus systems is currently limiting any kind of widespread application; the company, however, reports that it intends to have the product on the VAXBI bus soon.

"Honeywell's presence in the market legitimizes the technology," says Geoffrey Griffith, a senior engineer at Digi-Data Corp. "Helical-scan technology is here now and it's just a matter of getting the word out."

Like Honeywell's product, Digi-Data's DDC-71 helical-scan tape drive uses VHS cassettes. However, the DDC-71 is much less expensive and stores a maximum of 2.5 Gbytes at a sustained transfer rate of 120 Kbyte/second. The DDC-71 is basically a repackaged VCR. The necessary electronics and a Pertec interface were added, and the drive bundled with a Distributed Logic Corp. (DILOG) controller for use on the Q-bus and Unibus. According to Digi-Data, the equivalent of twenty 6250-bits-per-in. (bpi) tapes can be stored on a single six-hour cassette, and an end-to-end search for a file can be accomplished in six minutes.

Another helical-scan product comes from Exabyte Corp. Built around an 8mm drive and recording technology manufactured by Sony, the EXB-8200 stores up to 2.3 Gbytes and transfers data at a sustained rate of 256 Kbyte/second (see "HC/WG Labs Evaluates the Exabyte EXB-8200 on the MicroVAX II," p. 48 this issue). Ninety-five percent of the Exabyte product is assembled by Sony at a rate of 100,000–150,000 units per year. According to Dataquest's Biggs, this kind of mass production and the wide availability of media go a long way toward establishing helical-scan products even before they find mass appeal on computer systems. "And if DAT becomes as established in America as it is abroad, the low cost and wide availability of the product will give it a strong advantage," says Biggs.

All, However, Isn't Roses

Peripheral Strategies' Elizer warns that helical-scan tape products still face some tough challenges. Physical media standards have been established but the process of establishing format standards (see sidebar) is just beginning. And competing technologies—including optical—are entrenched. "The toughest part will be to convince system managers to switch," predicts Elizer.

With no format stan-

dards, there's no interchange capability between manufacturers of different products—a capability reel-to-reel and QIC products offer. This situation will be aggravated, Elizer points out, by the fact that manufacturers of computer products may conflict with manufacturers of consumer products. Industry standards aren't as important for consumer products as they are for commercial computer products, so the two groups may end up working at odds.

Marty McCoy, Exabyte's director of marketing and sales, doesn't agree that standards are or will be hard to come by. "The EXB-8200 already supports three standards—the 5.25-in. form factor, SCSI, and 8mm," McCoy defends. "And we've submitted an 8mm format standard to the ANSC [American National Standards Committee] X3B7 for tape format standards."

Exabyte, however, is being criticized for more than just standards problems. Complaints range from read electronics reliability (Exabyte has provided free "factory upgrades"), which McCoy dismisses as growing pains, to the fact that no second source exists for the product—a problem Exabyte is rectifying with a second source agreement with Kubota Ltd. in Osaka, Japan. "Besides, Sony makes most of the [tape] deck in its [manufacturing] plants—which is a sort of second source," enjoins McCoy.

Traditional Tape Still Sticking

And what do vendors of traditional tape products have to say in defense of their own products?

"There's a good chance that, as far the computer industry is concerned, magnetic tape will go the way of bubble memory, CD-ROM, and the Bernoulli box," says Charles Calisto, a market development manager for data cartridge products at 3M Co. "Watch the reliability—there's a lot of costly error correction going on there. And since the helical-scan head is always rotating, there's a tape wear problem."

Calisto points out that there's a psychology behind backup that causes customers to question the media if it's too cheap. "If you've ever picked up one of those DAT cartridges, you know how cheap they feel. You expect a mainframe system manager to trust all his data to those things?

"And besides," summarizes Calisto, "we'll be getting a full gigabyte on quarter-inch cartridges soon."

Despite the disparities, DEC sites are buying helical-scan products. The prospect, for example, of backing up four 627-Mbyte DEC RA81's without changing media is

Table—Comparison of Tape Media

	Helical Scan			Traditional Alternatives		
	DAT	8mm	VHS	1/2-in. reel-to-reel	1/2-in. cartridge	1/4-in. cartridge
Capacity	1.3 Gbytes	2.3 Gbytes	2.5–5.2 Gbytes	To 270 Mbytes	To 750 Mbytes	To 135 Mbytes
Minimum Cost/ Mbyte	Unknown	1/2¢	1/20¢	7¢	7.5¢	28¢
Drive Cost	$3,500 (expected)	$3,500	$4,500–$19,000	$3,000–$50,000	$1,000–$109,000	$275–$3,500
Common Interfaces	SCSI? IBM?	SCSI	SCSI, Pertec	Pertec, STC, SCSI	DEC, IBM, SCSI	QIC
Format Standards	None	Proposed ANSI	None	ANSI	IBM, HI/TC	QIC

Format Standards—Helical-Scan's Challenge

by Lee Elizer, *President, Peripheral Strategies Inc.*

A product can implement the greatest technology in the world and still fail if it's not supported by standards. Formation of widely accepted format standards for helical-scan tape is the challenge ahead that may determine whether the technology is successful in the computer marketplace.

Historically, three approaches have resulted in the establishment of standards for removable media products: volume power, volume shipments, and general agreement among manufacturers.

- Volume power—Tremendous market power has been exhibited by systems manufacturers within their own bases. Examples are IBM with the 3480 half-inch tape cartridge subsystem replacing half-inch reel tape products for all tape applications except data interchange, and DEC with the introduction of the TK50 and, later, TK70 half-inch tape cartridge subsystems used for software distribution and disk backup applications. Both of these products have become de facto standards for their targeted applications—at least temporarily—and in spite of some obvious performance deficiencies.
- Volume shipments—Volume shipments into the OEM marketplace can also result in de facto standardization. The most recent example is the QIC-24 quarter-inch tape cartridge selling into the IBM small systems base as a fixed backup device. This product wasn't supported by IBM until several years after initial product shipments. The technology currently ships in volume in multiple configurations, with several formats supported by several suppliers. The products have been extended to multiple applications (software distribution, transaction processing, network data backup, archiving, and transport of data among systems) with the prospect of data interchange within common system architectures becoming a reality.
- General agreement among manufacturers—This is the quickest method of ensuring interface and format standards for data storage products. Formal standards groups, such as American National Standards Institute (ANSI) or European Computer Manufacturers Assoc. (ECMA), provide a meaningful formulation of specific standards, often after volume shipments have occurred.

Ad-Hoc Ground Swells

An alternative to formal standardization is when a relatively small group of manufacturers meets on an informal basis to create development standards for spe-

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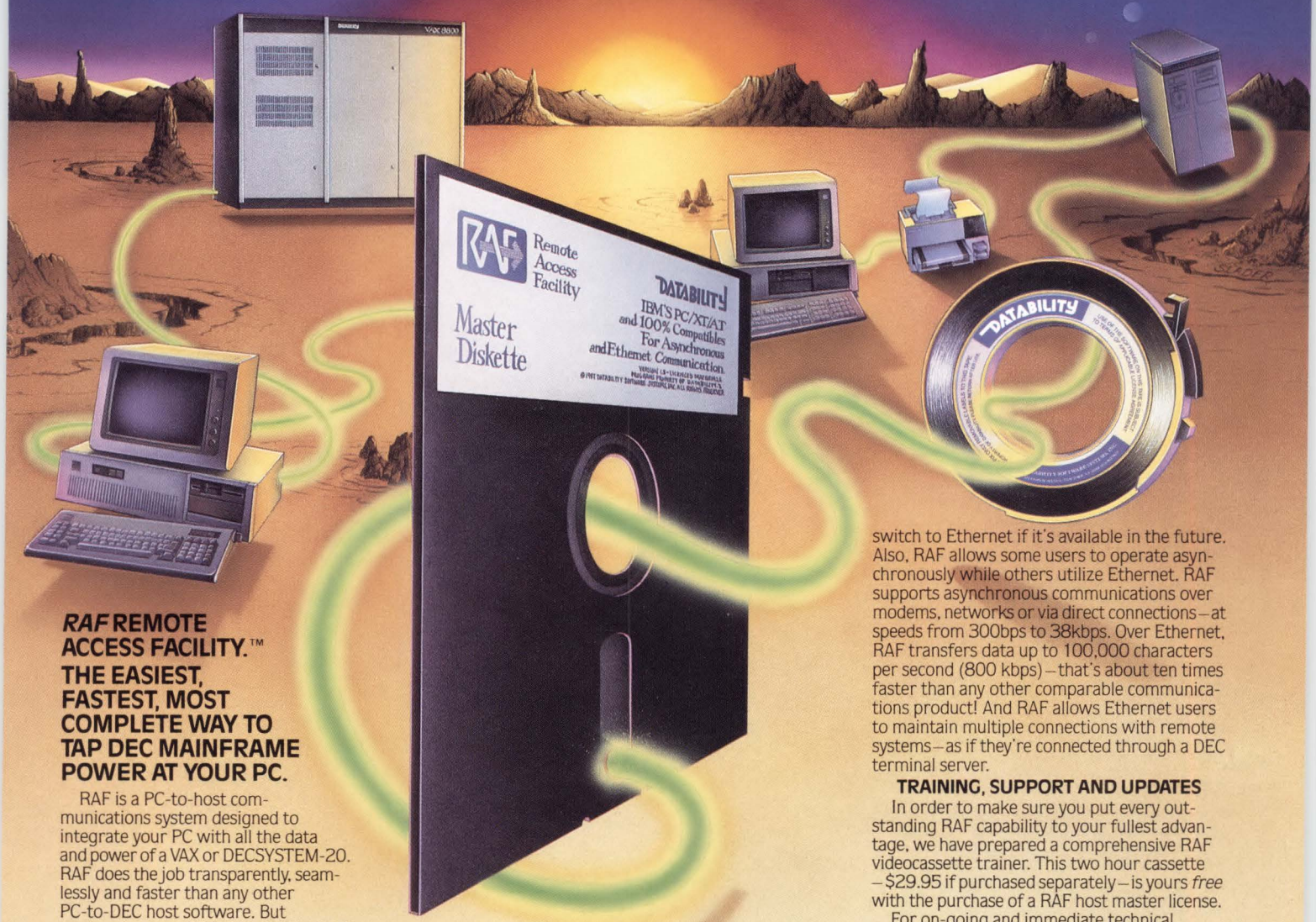

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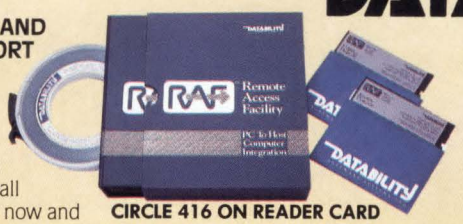

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EASE OF USE

Unlike other products which force PC users to become network gurus, RAF allows PC users to remain PC users. RAF acts as an extension to a PC, allowing users to directly access files stored on remote systems as quickly and easily as files stored on local floppy or hard disks. Users can, for example, use PC editors to edit VAX files or use PC spread sheet programs to manipulate information stored on the VAX.

And MS-DOS commands can manipulate remote files exactly as they normally access local files. Cumbersome file transfer programs are no longer needed—a simple COPY command will do.

ETHERNET MADE EASY

RAF communicates via a LAT compatible protocol allowing PC users to directly access remote systems as if connected through a terminal server. No special hardware is required on the VAX because RAF users appear as normal terminal connections to the host.

RAF also allows users to maintain multiple system connections simultaneously with the freedom to instantly switch from one connection to another. And RAF preserves each connection's screen, making the control of multiple simultaneous connections much easier.

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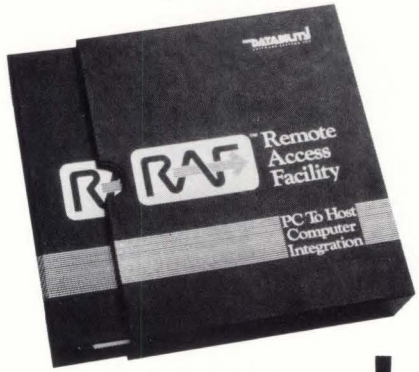

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too compelling to resist.

Taping Up the Market

To establish emerging helical-scan products, manufacturers are selecting very defined market niches in which to sell. The Honeywell product, for example, is finding its greatest use in medical and imaging applications, as well as publishing and other areas where great quantities of data are dealt with. The company markets the product primarily through OEMs.

Not so with Digi-Data—it sells direct. Digi-Data has been selling a lot of drives to customers that require transporting large quantities of data to be transported between VAX sites: the customer buys two or more DDC-71s—one for each installation. Digi-Data sells the DDC-71 with a custom driver for DEC systems. The driver is a functional equivalent of the TS-11 driver, but incorporates a patch that prevents driver time-outs from occurring. The customer can use a DILOG controller or attach the DDC-71 directly to an existing Pertec interface, but he must buy the driver from Digi-Data.

Exabyte's sales strategy, on the other hand, is to cultivate a growing force of subsystem integrators. Already they claim half a dozen for the DEC environment alone, and each is targeting its niche.

For instance, one of the first of these integrators is Transitional Technology Inc. This company packages the EXB-8200 with a custom Unibus or Q-bus controller and driver software.

Other DEC-compatible suppliers of the Exabyte product are Aviv Corp., U.S. Design Corp., and Summus Computer Systems. Summus packages the product with a custom TMSCP-to-SCSI Q-bus or Unibus host adapter and features a large on-board buffer. U.S. Design offers the Exabyte product as an option with its VIP 3000 product. The VIP accepts any combination of four SCSI or ESDI 5.25-in. form factor devices. Aviv offers it in a similar system, plus as an add-in or tabletop model.

Inside and Out Newest Laser Printers Sport More for Less

by Renee P. Brown,
Southern California Editor

With price tags less than $10,000, and in some cases sliding below $2,000 like QMS Inc.'s KISS for $1,995, the newest crop of laser printers offer you a number of features including:

- 8- to 26-page-per-minute (ppm) output,
- compatibility with Raster-Image Processor (RIP) products,
- 300- to 600-dots-per-inch (dpi) resolution, and
- emulations of most popular printer protocols.

Some of these features such as 8-ppm output are standard fare along with one or two emulations. Boosting paper throughput, or adding advanced features (see sidebar "Duplexing Color and Printing") such as multiple emulations does increase the price, however. For example, Talaris Systems Inc.'s model 811/2, a $2,950 8-ppm printer, uses a Canon USA Inc. LBP-SX laser engine and sports an impressive array of features including five laser

cific technologies or classes of products, prior to volume shipments. The advantage of this approach—as demonstrated by the quarter-inch cartridge (QIC) and half-inch 3480 cartridge (HI/TC) products—is the speed with which technical issues can be resolved with the interface, media, and physical data format. This type of group allows early development of alternate sources, yielding volume shipments to OEMs and general acceptance of a new product technology. De facto standards are then submitted to the formal standardization organizations for implementation as specific standards.

The Process Begins

Media standards for VHS, 8mm, and DAT helical-scan tape drive products have been established due to their tie-in with associated consumer products.

Format standards for some of the helical-scan products are just beginning. An 8mm format proposal by Exabyte Corp. has been submitted and accepted by ANSI as a project. Agreement is expected due to the small number of manufacturers currently participating in this market. No activity is anticipated by VHS drive manufacturers toward format standardization.

An informal group of interested manufacturers met during last year's Comdex/Fall in Las Vegas to organize a standardization effort for the computer data storage versions of DAT. Eighty-six representatives of 42 companies attended the meeting, resulting in the scheduling of a formal meeting for January 19-20, 1988 in San Jose, CA. The agenda at this meeting will be to accept interface and format proposals leading, to the establishment of development standards in the areas of interface, physical format, and data interchange. Group membership information and registration for the meeting is through

Peripheral Strategies Inc.

5266 Hollister Ave., Ste. 123, Santa Barbara, CA 93111, 805-964-5441, or FAX to 805-964-5814.

Lee Elizer is president of Peripheral Strategies Inc., a firm specializing in tape storage and DAT format standards.

Additional information about the products or services described in this article can be obtained by contacting the company directly or circling the appropriate reader service number.

Aviv Corp.
26 Cummings Pk.
Woburn, MA 01801
617-933-1165
Circle No. 195

Digi-Data Corp.
8580 Dorsey Run Rd.
Jessup, MD 20794
301-498-0200
Circle No. 196

Distributed Logic Corp. (DILOG)
1555 S. Sinclair St.
Anaheim, CA 92806
714-937-5700
Circle No. 197

Exabyte Corp.
1745 38th St.
Boulder, CO 80301
303-442-4333
Circle No. 198

Hitachi Sales Corp. of America
401 W. Artesia Blvd.
Compton, CA 90220
213-537-8383
Circle No. 199

Honeywell Test Instruments Div.
P.O. Box 5227
Denver, CO 80217-5227
303-773-4491
Circle No. 200

Peripheral Strategies Inc.
5266 Hollister Ave., Ste. 123
Santa Barbara, CA 93111
805-964-5441
Circle No. 201

Summus Computer Systems
14925-A Memorial Dr.
Houston, TX 77079
713-589-9772
Circle No. 202

3M/Magnetic Media Div.
Building 223-5N-01,
3M Center
St. Paul, MN 55144-1000
612-736-5931
Circle No. 203

Transitional Technology Inc.
1401 N. Batavia St., Ste. 204
Orange, CA 92667
714-774-1030
Circle No. 204

U.S. Design Corp.
4311 Forbes Blvd.
Lanham, MD 20706
301-577-2880
Circle No. 205

and mechanical printer emulations: HP LaserJet Plus, IBM Proprinter, Epson FX-80, QUME Sprint, and Diablo 630 ECS. The latter two being the industry standards for fully formed daisywheel printing.

The DEC laser printer is built around the Ricoh Corp. engine and is priced from $3,495 to $4,995, depending on whether you want the LN03 with 325 Kbytes of memory, or the Plus model with 1 Mbyte. Neither version is particularly fast (8-ppm) if speed is what you're looking for. The advantage of the printer is that it does match DEC systems and is supported by DEC third-party maintenance agreements.

In contrast, the 12-ppm Printronix L1012, which emulates HP LaserJet Plus, Diablo 630, and Epson FX-80, rings the cash register bill at $3,495. Although it doesn't offer as many emulations as the Talaris product, the offset is apparently the output speed. Ricoh's low-cost printers range from its PC Laser 6000, a 300-ppm printer for $2,395, to the 15-ppm LP4150 priced from $5,000 to $8,000 depending on configuration.

At the very high-end of the scale, but still considered low-cost when compared to super speedy 100-ppm IBM printers, the 26-ppm 2600 Series from Dataproducts Corp. provides higher-level capabilities but for a higher price, ranging from $13,000 to $20,000. Designed for high-paper-rate environments of 1000 pages per month, the 300 dpi printers, available in five models, are equipped with several specialized capabilities including 11 x 17 printing, a feature not found on most laser printers.

According to Robert Murray, research analyst for market research firm CAP International Inc. (Marshfield, MA), choosing a laser printer is more a matter of features and capabilities rather than just price. "The printer purchased is dependent on the application. A user may be willing to pay a higher price for additional features and capabilities like Postscript emulation, ease of paper handling, and use of non-standard fonts," says Murray.

Kentek Information Systems Inc. takes the application approach with its laser printer offerings. The Model K-2+, a 15-ppm printer, has a resolution of 300 dpi, emulates a Diablo 630, HP LaserJet Plus, and Tektronix Plot 10. Additional options include the ability to use Graphic Software Systems' computer graphic interface adopted by IBM last year. The Kentek printer has a built-in Winchester disk drive to augment printer memory for managing up to 30 font sets, macros as well as forms. Surprisingly, Kentek puts a modest value on its efforts and charges $8,970 for the printer.

More Dots Per Inch

Indeed, one application that is clearly pushing laser printer advances is desktop publishing. To meet the actual, or perceived needs of vendors and users of desktop publishing systems, laser printer manufacturers are trying to put more dots per square inch to improve output. But, like speedier throughput, higher resolution also means a higher price; for example, Genicom Corp.'s 6000 Series of 8-ppm laser printers with 400 x 400 dpi resolution and a price tentatively scheduled at less than $5,000. On the higher end, for a $13,500 price tag, you can get Varityper's VT600, a 10-ppm printer with Apple Computer Inc. LaserWriter emulation and 600 x 600 dpi resolution.

LaserMaster Corp. is one company that's extending laser printing technology as a desktop publishing solution. Called the LM-TypeMaster, this laser imaging system provides 1200–2400 dpi resolution and can output up to 72-pica (12-in.) widths. The company says that the controller is designed to fit into an IBM PC/AT. Of course all of this doesn't come cheap. The suggested retail price is

Duplexing Color and Printing

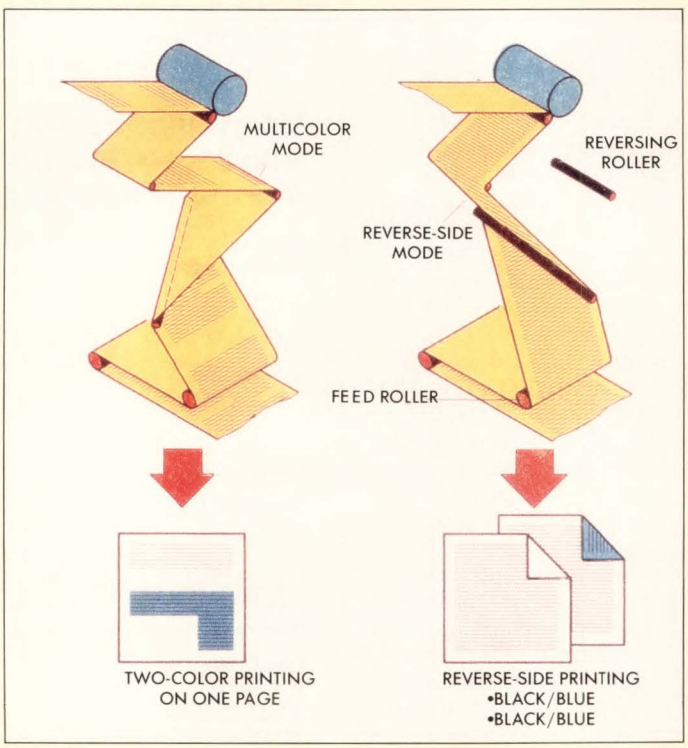
Providing duplex printing capability on laser printers is a function that doesn't come cheap and isn't often found on most laser imprinters. Indeed, desktop laser printers only print on one side. Double-sided printing is achieved by you flipping the pages over and restarting the print cycle.

But for applications where thousands of pages are printed per hour, manual manipulation is impossible. Therefore, Siemens Information Systems Inc.'s ND 3 uses a reversing roller to internally flip the paper before it reaches the next transfer drum.

This duplex printing feature, shown in the nearby figure, denotes a fairly complex internal system. But not as complex as the ability to manage two-color printing, also shown in the figure.

Adding a second color demands an additional toner, photosensitive drum, and scrubber system. Moreover, Siemens' engineers explained to us that complexity is compounded by the controller and software. Essentially, the controller has to be smart enough to recognize where the second color is to be and leave the space open for the next drum.

Currently, laser printers like the ND 3 that offer this capability are in the $100,000+ range. But don't be surprised if Hewlett-Packard Co. offers a less than $5,000 laser printer with duplex printing by this spring. —*R.P.B.*



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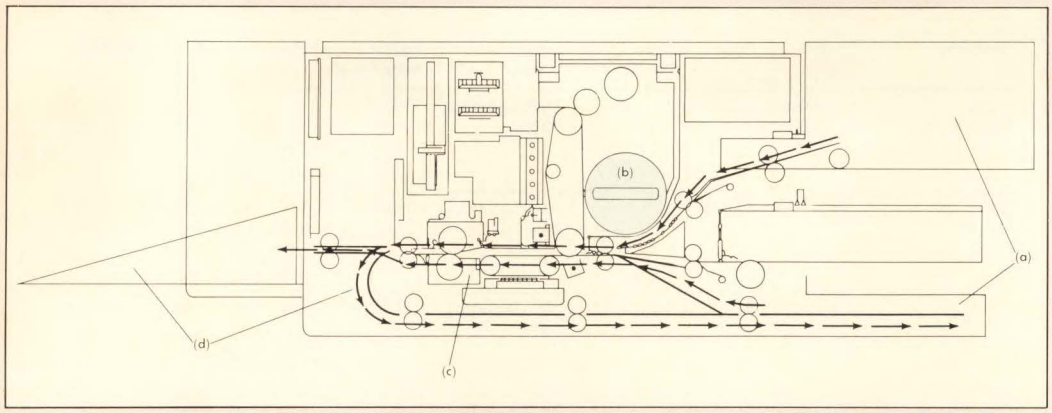


Figure 1—Looking like a complex transition on a Southern California freeway, the paper path inside an electrophotographic printer such as that made by Kentek, moves the paper from multiple sources *(a)* to the imaging drum *(b)*, past the fusing station *(c)*, and out via one of two paths *(d)*.

$29,995, which doesn't include the AT. What makes it notable, and a topic of conversation for an article on low-cost laser printing, is that it's about half the price of comparable dedicated products. Moreover, by using an AT as the controlling base, it can be attached to just about any system type either via RS-232, modem, or local area network.

Add-Ons Help Make Do

If you are already using an early model laser printer, and more than one million users are, you might want greater resolution and faster throughput. To this end, a number of add-on products, primarily for the PC market, like Tall Tree System's J-Laser card, Conographic Corp.'s ConoDesk 6000, and LaserMaster's CAPCARD, allow you to optimize the performance of your laser printer to its full engine rating. These RIP boards take over the tasks of managing printer commands and converting images to dots—rasters. The RIP technology is designed to "resolve the mismatch between the printer controllers and the sophisticated software available to the laser printer," says Joseph Meshi, vice president business planning for Conographic. He insists existing controllers aren't fast enough to handle commands, causing degradation in printer performance.

NEWS RELEASE

Conographic announces Desktop Publishing board for IBM AT/AT

Figure 2—Add-on raster-image processors (RIPs), such as those developed by Conographic, are making it possible to upgrade laser printers to produce quality output such as this with a variety of fonts.

The use of RIPs isn't really new. In fact, Imagen Corp. and Genicom have previously supplied imaging engines for laser printers. Both companies developed versions of page description languages (PDLs) that took advantage of their systems as well. Genicom's ASCII Coded Escapement (ACE) PDL was designed specifically for managing phototypesetting equipment and as such contains all the necessary verbs for handling fonts and dot placement. Similarly, Imagen's DDL (document description language) includes a rich set of command verbs that permit full rotations and expansion of fonts.

Neither Genicom's ACE nor Imagen's DDL have found overwhelming favor in the OEM or end-user markets. Both have been overshadowed by Adobe Systems Inc.'s PostScript. This language, adopted by Apple, provides full font manipulation and scaling. It is sluggish due to high overheads (about 1 ms per command),

Laser Printer Revenues Keep Getting Blacker

Laser printer revenues are clearly on the rise and are due to increase substantially in the next four years. That may not seem like a revelation, nor is it meant to be one. However, it does point out that laser printers are replacing wire-dot-matrix printers even though a few years ago some analysts felt the future of laser printers was limited—due mainly to their price. But Robert Murray, research analyst for CAP International Inc. (Marshfield, MA), a firm specializing in tracking printer markets, says that prices are coming down into the acceptable (less than

Laser Printer Operating Environment

Operating Environment	Printing Speed (Prints/Minute)	Typical End User Price Range	Typical Volume (Prints/Month)
Centralized	80+	$70,000–$300,000+	500,000–2,000,000+
Satellite	35–80	$15,000–$175,000	100,000–1,000,000
Office Cluster	10–35	$5,000–$35,000	5000–100,000
Workstation	Less than 10	$1,395–$8,000	500–5000

Source CAP International Inc.

but it does have the advantage of market impetus.

Networks Make Impact Lasers

Both IBM and Xerox Corp. have illusions of establishing the ideal PDL and are taking the communications approach. Xerox's Enterprise Printing Architecture is designed to create an electronic master that describes to a printer the detailed appearance of every page in a document. This includes fonts, graphic elements, halftones, line drawings, and scanned images. Additionally, it is designed to be compatible with the Xerox Network System (XNS). Thus, a uniform distributed printing environment is possible by sending multiple masters around the network.

Similarly, IBM's IPDS (intelligent printer data stream), used with the 4224 wire-dot-matrix printer product, describes the physical page to the printer. Like Interpress, IPDS is designed to work over networks such as the System Network Architecture (SNA) and X.25.

What is interesting is both IBM and Xerox have the most experience in developing printer network control software, but the least market acceptance at the desktop. But, "Networking," says Charles Reese, LaserMaster's regional sales manager, "that's the next printer advance." And companies like DEC are taking advantage of what has been learned by IBM and Xerox.

DEC already uses networked laser printers in its own in-house system, as does *Hardcopy* magazine. Clearly, networking of laser printers offers a number of advantages: Networks permit the sharing of expensive resources such as printers, thus reducing overall costs. If one printer in the network becomes inoperable, a job can be queued to a different printer. Finally, files from different systems can be sent to print at remote printers,

Printer Specifications

Company	Product	Price	Pages Printed Per Minute	Dimensions (in.)/ Weight	Engine Manufacturer	Special Features	Resolution	MFTB
Apple Computer Inc.	LaserWriter	$4,999	8	18.5x11.5x16.2 77 lbs.	Canon	8½ x 14; A4; B5; DWN; KB; SW; DB; PS	300 dpi	100,000 pages
Canon USA Inc.	LPB-8 A1	$3,000	8	18.7x16.3x11.5 70.5 lbs.	Canon	8½ x 14; A4; B5; DWN; ROM; SW; DB	300 dpi	100,000 pages
	LBP-8 A2	$4,300	8	18.7x16.3x12.5 75 lbs.	Canon	8½ x 14; A4; B5; DWN; ROM; SW; DB	300 dpi	100,000 pages
Dataproducts Corp.	2600 series 5 models (application-specific controllers)	$13,000–$20,000	26	26.7x23.4x16.1 176 lbs.	Toshiba	11 x 17; DWN; ROM; SW; PS; TEK; DB; P10; A4; A5; B5	300 dpi	N/A
Digital Equipment Corp.	LN03	$3,495	8	21x15x23.5 80 lbs.	Ricoh	ROM; DWN; KB; SW; TEK; ReG; SX	300 dpi	10,000
	LN03 Plus			21x15x23.5 80 lbs.	Ricoh	ROM; DWN; KB; SW; TEK; ReG; SX	300 dpi	10,000
Genicom Corp.	6000 series (3 models)	POR	8; 15–18; 20–30	18x19x9 35 lbs.	Canon	DB; IBM Graphics; HP; 8½ x 14; 7½ x 10½; A4; A5	400 dpi	100,000 pages
Hewlett-Packard Co.	LaserJet Series II Model 33440A	$2,995	8	18x24.5x8.5 50 lbs.	Canon	HP; 8½ x 14; 7½ x 10½; A4	300 dpi	N/A
Kentek Information Systems Inc.	K-2+	$8,970	15	26.6x18.3x14.2 132 lbs.	Kentek (company design)	HP; DB; P10	300 dpi	N/A
Printronix	L1012	$3,495	12	18.9x17.3x12.5 66 lbs.	Mita	HP; DB; EP; DWN; ROM; SW	300 dpi	N/A
QMS Inc.	KISS	$1,995	8	18.7x11.2x21 65 lbs.	Canon	A4; 8½ x 14; DWN; KB; SW; DB; EP; QU; XR	300 dpi	30,000
	Big KISS	$2,995	8	18.7x11.2x21 65 lbs.	Canon	8½ x 14; DWN; ROM; KB; SW; DB; EP; QU; XR	300 dpi	30,000
Ricoh Corp.	PC Laser 6000	$2,395	6	7.9x16.1x16.5 37 lbs.	Ricoh	EP; HP; DB; IBM; 8½ x 14; A4; A5	300 dpi	18,000
	LP 4150	$5,000–$8,000	15	16.5x21.5x18.5	Ricoh	Depending on configuration	300 dpi	60,000
Talaris Systems Inc.	811/2	$2,950	8	18x9.1x25 44 lbs.	Canon	HP; EP; QU; DB; ROM; SW	300 dpi	N/A
Varityper	VT600	$13,500	10	18.5x23x21 161 lbs.	Proprietary	DWN; PS; APL	600 dpi	N/A

KEY TO SPECIAL FEATURES COLUMN: 8½ x 14, 8½ x 17, 11 x 17, A4, A5, B4, B5—paper sizes supported in addition to 8½ x 11; **APL**—Apple LaserWriter compatible; **DB**—Diablo 630 compatible; **DWN**—down loadable fonts; **EP**—Epson FX/80 compatible; **HP**—Hewlett-Packard LaserJet compatible; **IBM**—IBM Proprinter compatible; **P10**—Plot-10 Compatible; **PS**—supports PostScript; **QU**—Qume compatible; **ReG**—supports ReGIS; **ROM**—fonts loadable through ROM cartridge; **SW**—options set through software; **SX**—supports Sixel; **TEK**—Tektronix 4010 compatible *POR—price on request; N/A—not applicable*

an important feature for long distance file sharing.

If you're expecting to add a unique variety of laser printers to a DECnet, you may get a surprise. DEC doesn't support any printers or software other than its own and doesn't feel it has to. "While other people derive compatibility by emulation," explains Pete Sanborn, DEC's marketing communications manager, Terminals Business Unit, "Digital gets compatibility through the network environment." DEC may have something, since a good portion of the industry does strive hard to emulate DEC products. Currently, though, no one is providing LN03 printer compatibility, and a survey of printer manufacturers seems to indicate that the majority of the market is Postscript capability.

Additional information about the products or services described in this article can be obtained by contacting the company directly or circling the appropriate reader service number.

Adobe Systems Inc.
1585 Charleston Rd.
P.O. Box 7900
Mountain View, CA
94039-7900
415-961-4400
Circle No. 171

Apple Computer Inc.
20525 Mariani Ave.
Cupertino, CA 95014
800-538-9696
Circle No. 172

Canon USA Inc.
One Canon Plaza
Lake Success,
NY 11042
516-488-6700
Circle No. 173

Conographic Corp.
16802 Ashton St.,
Ste. 101
Irvine, CA 92714
714-474-1188
Circle No. 174

Dataproducts Corp.
6200 Canoga Ave.
Woodland Hills, CA 91365
818-887-8000
Circle No. 175

Digital Equipment Corp.
P.O. Box CS2008
Nashua, NH 03061
800-258-1710
Circle No. 176

Genicom Corp.
23801 Calabasas Rd.
Calabasas, CA 91302
818-710-1682
Circle No. 177

Graphic Software Systems
9590 S.W. Gemini Dr.
Beaverton, OR 97005
503-641-2200
Circle No. 178

Hewlett-Packard Co.
Personal Computer Division
935 McLaughlin Ave.
San Jose, CA 95122
408-293-2444
Circle No. 179

IBM
Old Orchard Rd.
Armonk, NY 10504
914-765-1900
Circle No. 180

Imagen Corp.
2650 San Tomas Expwy.
Santa Clara, CA 95051
408-986-9400
Circle No. 181

Kentek Information Systems Inc.
Six Pearl Court, Box 78
Allendale, NJ 07401
201-825-8500
Circle No. 182

LaserMaster Corp.
4413 Roosevelt Rd.,
Ste. 111
Hillside, IL 60162
312-449-0900
Circle No. 183

Printronix
17500 Cartwright Rd.
Irvine, CA 92714
714-863-1900
Circle No. 184

QMS Inc.
P.O. Box 81250
Mobile, AL 36689
205-633-4300
Circle No. 185

Ricoh Corp.
2661 Gates Ave.
P.O. Box 16184
Irvine, CA 92714
714-863-0550
Circle No. 186

Siemens Information Systems Inc.
P.O. Box 5040
Cherry Hill, NJ 08034
609-751-7010
Circle No. 187

Talaris Systems Inc.
6059 Cornerstone Court W.
San Diego, CA 92126
619-587-0787
Circle No. 188

Tall Tree Systems
2585 E. Bayshore Rd.
P.O. Box 5690
Palo Alto, CA 94303
415-493-1980
Circle No. 189

Varityper
11 Mt. Pleasant Ave.
E. Hanover, NJ 07936
201-887-8000
Circle No. 190

Xerox Corp.
101 Continental Blvd.
El Segundo, CA 90245
213-333-2151
Circle No. 191

$2,000) range that makes laser printers good replacements even for so-called cheap wire-dot-matrix printers. "Originally, laser printers burned deeply into the daisywheel business. Now, with lower prices, wire-dot-matrix printers may soon feel the pinch," says Murray.

Multiple Environments

Like their early cousins, wire-dot-matrix, chain, and daisywheel, laser printers fall into a number of market segments as shown in the nearby table. Although the office cluster does represent a significant opportunity, especially in the DEC environment—about $37 million, CAP estimates—the workstation attachment may represent around $45 million in revenue when electronic publishing and word-processing applications—both of which are primarily used on single-user workstations.

—R.P.B.

Market Estimates

SUMMARY TOTALS BY ENVIRONMENT	1987	1988	1989	1990	1991	CAGR 84–86	CAGR 86–91
CENTRALIZED							
Total unit placements(K)	2.21	2.70	3.30	3.53	3.70	20%	16%
Segment revenue($M)	1080.36	1214.20	1310.59	1403.98	1477.11	14%	9%
Year end population(K)	9.40	11.57	14.11	16.67	18.79	21%	20%
SATELLITE							
Total unit placements(K)	4.25	6.22	7.57	8.88	9.53	8%	25%
Segment revenue($M)	514.55	611.18	728.62	854.10	968.50	30%	19%
Year end population(K)	16.61	21.96	27.78	33.92	40.52	29%	26%
OFFICE CLUSTER							
Total unit placements(K)	78.57	122.35	159.23	192.15	214.80	92%	41%
Segment revenue($M)	1333.14	1967.96	2702.33	3293.71	3903.41	80%	41%
Year end population(K)	144.63	263.87	414.94	581.63	756.98	95%	62%
WORKSTATION							
Total unit placements(K)	650.60	867.15	1035.30	1125.85	1195.30	262%	27%
Segment revenue($M)	2374.38	3187.69	3773.64	4144.19	4369.18	234%	27%
Year end population(K)	1234.04	2078.10	2999.51	3625.63	4153.90	353%	48%
GRAND TOTAL							
Total unit placements(K)	735.63	998.42	1205.40	1330.40	1423.33	211%	29%
Segment revenue($M)	5302.43	6981.03	8515.18	9695.99	10118.19	60%	26%
Year end population(K)	1404.67	2375.51	3456.34	4257.85	4970.19	237%	49%

SERVICE ORGANIZATIONS SCURRY TO KEEP MULTI-VENDOR CONNECTIONS ON-LINE

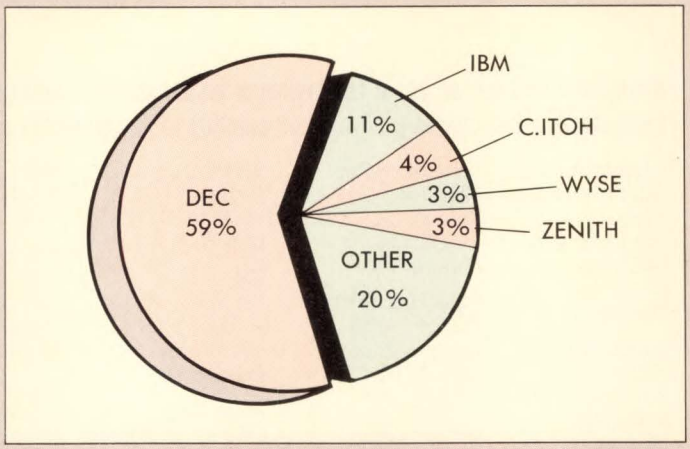
by Evan Birkhead,
East Coast Editor

Recent surveys reveal that the Fortune 500 is a multi-vendor environment tied together via DECnet or Ethernet to a variety of multi-vendor CPUs, workstations, and peripherals ranging from Apples to Crays.

This connectivity push, which is being carefully cultivated by DEC, has created not only a high-tech melting pot but an even bigger can of worms. Specifically, users raise the question(s) of what they are supposed to do when a non-DEC CPU fails or a workstation on the Ethernet no longer functions? Call Apple, DEC, IBM, Sun, the vendor responsible for the hardware and software, or a third-party service organization? There are no easy answers to these questions, nor to the technical issues of testing links.

Some independent sales organizations that cater to businesses buying personal computers claim their responsibility ends at the end of cable. Other organizations, however, believe they have full system responsibility. Microage Computer Stores Inc.'s (Tempe, AZ) Director of Technical Support, Bruce Grant states, "Our first job is to see that we aren't at fault, then we give the customer the benefit of our expertise in resolving the problem."

Jim Swanner, a senior technical consultant for American Technology Group (Tokyo, Japan) and former retailer, says he still has nightmares over systems that have lots of foreign devices. "It's really difficult to pinpoint the problem," complains Swanner, who specializes in communications.



Of the systems listed, 24% operate in the DEC environment as PCs; 26% operate as VT100s; 35% operate as VT200s, and 1% are VT52 emulators. DEC manufactures 19% of all the PCs on DEC networks; 74% of all VT100s; 89% of all VT200s; and 30% of the VT52s. SOURCE: Computer Intelligence, La Jolla, CA.

"Any time you create a system, you try to keep all the devices in the same family."

Swanner's point is well taken. Indeed, DEC has managed to keep its system configurations relatively clean. In fact, until recently, DEC refused to maintain systems with non-DEC equipment attached.

Homogeneity in Service

Heterogeneity of systems is here and non-DEC attachment is creating some chaos. When it comes to service and support, everyone is pointing their finger at someone else. Besides figuring out what broke, you also have the problem of deciding whose warranty covers you and for what, a process that is more difficult than it sounds. Because of this, top-level vendors, including DEC, have expanded their service coverage to include equipment from other vendors.

Sorbus, an independent service organization, is one company that provides full maintenance and service regardless of the equipment manufacture or host connection.

A comprehensive service package is also offered by TRW. Moreover, TRW offers a maintenance training program for your in-house technician with its Technical Training Center. The center is designed to provide training and experience on a broad range of equipment.

Similar maintenance programs are offered by Control Data Corp., Eaton Corp., GE Computer Services, McDonnell Douglas, and Unisys. Each of these companies provides service that ranges from simple preventive maintenance to complete maintenance and repair regardless of equipment type or manufacturer.

Analysts speculate that service will eventually be all-encompassing. Even IBM has been forced to service VAXes in some key Fortune 500 accounts. Likewise, DEC reports that it provides service to all attachments including IBM PCs and will, eventually, service Apple Computer Corp.'s equipment. (The latter hinges on a pending marketing agreement.) The fact that DEC is willing to service systems other than its own—albeit at a substantial price—is a remarkable about-face for the company. Indeed, its refusal to do so helped create the need for third-party service.

Warranty Incentives

Clearly the trend is toward comprehensive, multi-vendor service. Competition, however, is tough. To this end, several service organizations are offering special incentives—extended warranties and discounts, for example.

DEC's hardware warranty providing one year of on-site maintenance is considered to be the opening volley of a warranty war. Systems Industries, the only company to successfully battle DEC in court, has answered with a one-year plan of its own. The rest of the industry, say observers, is expected to follow suit by offering two- and three-year warranties before the end of the decade.

Warranties aren't the only things being tinkered with by DEC. Besides extending the warranty period, the company is dropping service prices as well. "A response not unforeseen," say industry analysts.

WORD PROCESSING SOFTWARE BUSTS VERTICAL APPLICATION BARRIERS

by Renee P. Brown,
Southern California Editor

Word processing software isn't used just for letter writing anymore. Vertical applications based on popular word processing packages such as Data Processing Design Inc.'s Word-11, Orion Information Systems' Organon, and WordPerfect Corp.'s WordPerfect package are now being used in the fields of law enforcement, publishing, and even architecture and engineering.

Automated Law Enforcement

Few workplaces demand and disseminate a more constant flow of information than your city police department. PoliceServer, a VMS-based software package from

AMAZING PDP-11 MIRACLE REVERSES THE AGING PROCESS.

Now your PDP-11/04, 24, and 34 can perform like kids again.

You can increase system performance by up to 300%, thanks to the miracle of the QED 11/90 CPU upgrade. It will improve your memory, too. The QED 11/90 can address 4 Mbytes of memory and comes standard with a 16K cache, so its J-11 processor can run flat out. That'll mean a real performance boost if your PDP is configured as a multi-user system.

Your software is safe, too. Our CPU upgrade is 100% compatible with your existing applications and peripherals. It even supports floating point operations.

Surprisingly, the QED 11/90 can be installed in any PDP-11 in just a couple of minutes, because it fits all existing CPU's with no backplane changes. All of this comes with a one year warranty and nationwide on-site service (overnight replacement available). Best of all, it's thousands less than the competition.

And you thought your PDP-11's were getting senile.

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CIRCLE 409 ON READER CARD

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Compudyne, is designed to assist in organizing and automating police department daily routines.

One key element of the PoliceServer application is the popular word processing package, Word-11, from Data Processing Design. Chosen for its powerful list processing capabilities and its "wild card" retrieval system, Word-11 performs a variety of departmental tasks ranging from multi-page incident reporting to storing confidential detective case notes.

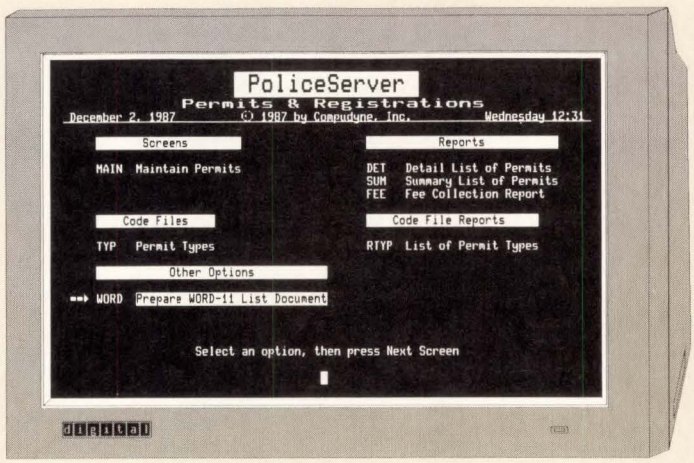
Automation of routine police tasks is the main purpose of PoliceServer. One particularly useful fact is the ability to create special reports and mailings by combining large amounts of police data with Word-11's list processing function. Other time-saving conveniences include: custom designed reports, faster processing of bookings, and automated general logistical operations.

PoliceServer provides the police dispatcher with an ongoing display of incidents and patrols. In the event of an emergency call, the software immediately displays any gun permits, outstanding warrants, "special need" persons, and other information pertinent to the given address.

The dispatcher then passes this information on to patrol cars flagged by the software as available and local to the scene. A single keystroke from the dispatcher notes the officer's arrival at the scene and automatically calculates and records the response time.

One-Person Office

The legal newspaper business provides another vertical vehicle for word processing software. Seven California-based legal newspapers have automated and simplified their workloads by incorporating the Organon Legal Publishing Application into their daily routines. The Organon software provides a complete system



Compudyne's menu-driven PoliceServer computerizes routine police tasks.

for monitoring, entering, and billing the publication of legal notices that are required by law.

The legal publishing program allows one operator to enter billing information, text, and number of times an advertisement is to run—all in a single operation. Using an 87,000-word dictionary, Organon's word processing software provides user-friendly data entry capabilities tied to a sophisticated phototypesetting system.

The publishing software can create a "snapshot" of any screen and print out a hardcopy for review prior to publication, which can be very important when legal information is involved. This application provides a tight integration of word processing, list processing, and data management for the legal publishing environment.

Good Application Timber

Special requirements within the architectural and engineering communities generated the need for SpecNet, an integrated system for developing design specifications. In use throughout the Omaha District of the U.S. Army Corps of Engineers, SpecNet automates specification development and editing procedures. Designed by the Construction Specifications Institute, a non-profit professional, technical organization of architects and engineers, SpecNet can reduce development time by as much as 60%.

As WordPerfect offers special features required by SpecNet—such as color change for bold print, underlining, a strike-over feature for editing, and automatic paragraphing capabilities—WordPerfect is the word processing software on which SpecNet is based.

WordPerfect also allows the creation of "macro" statements that combine several WordPerfect commands into two simple keystrokes. Macros can define an on-screen color change to indicate deletions and insertions to the guide specification, thus allowing for on-screen review of the edited guide. SpecNet uses WordPerfect's color capabilities to provide the word processing operator with white text on a blue background, red for deleted text, and green for inserted text.

When SpecNet is booted, master guide specifications that are used as guidelines for each project are loaded into the file server. A specially designed interface program initiates the project on the system and creates a subdirectory for that project, with required guide specifications copied into it. Designers access the system by reviewing the master list of specifications displayed on the screen and highlighting which specification they want. Pressing the Enter key places the desired specifications into the designer's project subdirectory.

To edit the specifications for his project, the designer again accesses the system and a list of active projects appears on the screen. He then highlights the project he wants and presses the enter key to select it. At this point, WordPerfect is activated and displays a listing of files in the subdirectory for that project. Using WordPerfect commands, the designer retrieves the specific specification and begins the editing process; when completed, the edited specification is again stored in the subdirectory.

Additional information about the products or services described in this article can be obtained by contacting the company directly or circling the appropriate reader service number.

Compudyne
898 Main St.
Acton, MA 01720
617-263-2060
Circle No. 207

Data Processing Design Inc.
1400 N. Brasher St.
Anaheim, CA 92807
714-970-1515
Circle No. 208

Orion Information Systems
13741 Foothill Blvd., Ste. 260
Sylmar, CA 91342
818-364-1692
Circle No. 209

WordPerfect Corp.
288 W. Center St.
Orem, UT 84057
801-227-4288
Circle No. 210

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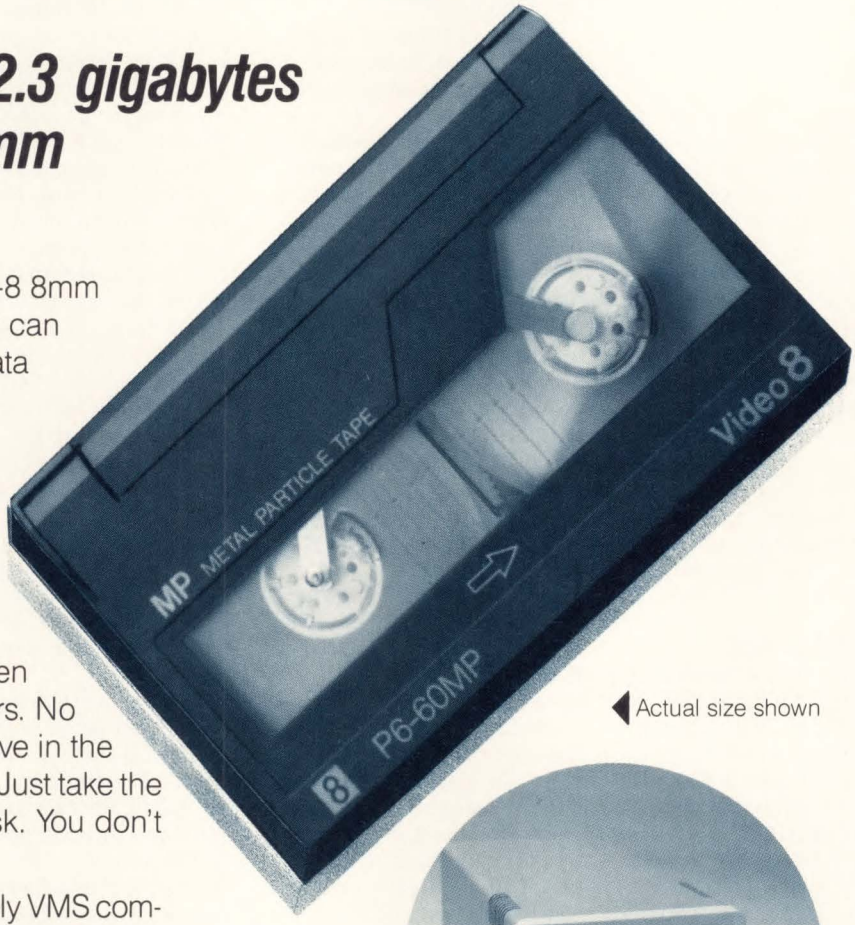


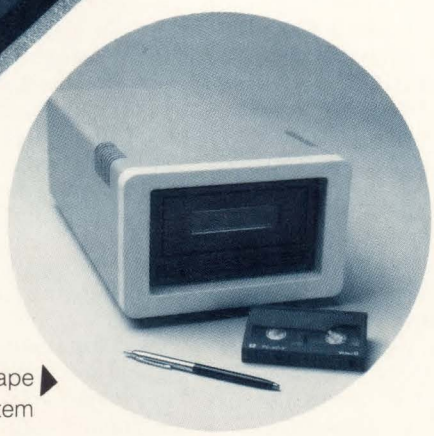
Actual size shown

Do your backups at night, when nobody's around. No operators. No tape swapping. When you arrive in the morning, your backup's done. Just take the tape out and put it in your desk. You don't even need a storage room.

And since the CTS-8 is completely VMS compatible, you can keep using the software and procedures you've always used. No hassles.

The CTS-8 is the breakthrough you've been waiting for. But you don't have to wait any longer. Because the CTS-8 is available *now* for DEC UNIBUS and Q-BUS VAX systems.

Let Transitional Technology show you what dense really means. Call TTI and ask for Sales.



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CIRCLE 410 ON READER CARD

AUTOMATED SOFTWARE DEVELOPMENT TOOLS SHOW PROMISE BUT LITTLE GROWTH

by **Evan Birkhead,** *East Coast Editor*

Computer-aided software engineering (CASE) made a great debut, but has achieved little impact. Originally viewed as a panacea to the woes associated with the management of large software projects—particularly projects being completed under government contracts—CASE is, unfortunately, recommended by few consultants and analysts.

It appears that suppliers of CASE products are providing a good idea rather than a working technology. "They were selling capabilities in technology that we knew weren't possible yet," says an information systems manager at Ford Aerospace. "CASE is a great approach, but the cost of implementing it is more than any real savings or headache-reduction."

No Overnight Success

A study by International Data Corp., a market research firm in Framingham, MA, predicts that 1987 will yield approximately $50 million in revenue to the companies offering CASE products. The study also predicts that the CASE market will top the billion dollar mark sometime in the early 1990s. But this seems to belie the activity that is, in fact, occurring.

Conceivably, CASE technology could transform how software development is accomplished. By encouraging the use of structured programming techniques and streamlining code development, less repetition of work occurs, there are fewer errors, and much of the tedious code-level work is automated.

But obstacles still remain. After a splashy, overpublicized entrance onto the market, CASE has encountered three primary stumbling blocks to success:

- it's immature—CASE is not yet capable of automating the entire software development life cycle,
- few coding and interface standards exist, and
- there's no integration between systems.

Once these problems have been addressed—a formidable task—CASE will stand a much better chance of widespread implementation.

Not Making the Grade

Contrary to what users were originally led to believe, none of the existing CASE systems truly automates the entire software development life cycle. The definitive model, agreed upon by most CASE analysts and producers, subdivides the life cycle into five phases:

- *Requirements analysis*—determining user objectives and building a data flow structure for the system;
- *Specification*—transforming the user requirements into system syntax and procedures;
- *Design*—tailoring system specifications to efficiently use the preferred operating system and programming language;
- *Implementation*—creating the system by coding, database definition and loading, debugging, and integration testing; and
- *Maintenance*—modifying and correcting the systems (sometimes new requirements require repeating the other four stages).

The maintenance phase requires the greatest amount of time, and is the area where vendors most frequently come up short. Most CASE packages perform analysis and design, but only a handful utilize fourth-generation languages (4GLs) or are capable of generating code.

The Force of Cooperation

Prospective CASE customers are fearful that the current lack of CASE standards will make it impossible to ever add to CASE systems. In effect, they fear that once they buy a CASE system, they're stuck with it.

Cadre Technologies Inc. is among several companies pushing for an IEEE standard based on the Electronic Data Interchange Format (EDIF) standard interface. Because it's a format used in both CASE and computer-aided engineering (CAE), EDIF shows potential.

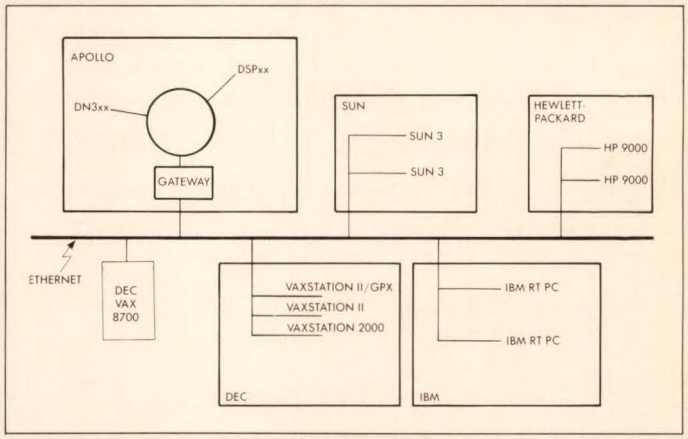
"Ultimately, shared data between CASE and CAE applications will bring new capabilities to both communities, and will, in fact, give birth to an entirely new community that will be total product engineering by computer," explains Lou Mazzucchelli, Cadre's co-founder. "The watchword for this new industry will be CAPE or computer-aided product engineering."

An important source of pressure toward standardization is the U.S. Government. Tektronix Inc.'s CASE Division, for example, is among a handful of developers that have released CASE software that adheres to government specs. TekCASE complies with the Department of Defense's STD-2167, which specifies formats for documentation and traceability procedures.

Another CASE solution that helps ease development confusion has already been implemented at large DEC sites by DuPont Information Engineering Assoc. (New York, NY). In its "120 Days" program, DuPont sends an evaluation team to your site to identify your software engineering needs. Using CASE methodology, customized prototypes are then installed and refined. After four months, a complete applications system goes on-line, completely documented and debugged.

Old Habits Are Hard to Change

In addition to requiring the establishment of standards, CASE systems need to follow one of several well-established methodologies. CASE methodology is based on the principles of structured analysis, which evolved from step-wise design and programming techniques. The best-known versions of structured analysis techniques are the Yourdon/DeMarco and Gane/Sarson methods. However, some designers are more accustomed to data-oriented methods, such as the Warnier/Orr, Holland/Martin, and Bachman methods, and real-time developers are at home with the Ward/Mellor or Hatley/Boeing methods. Too great a variety of methods, however,



CASE tools are supporting multi-vendor environments made up of workstations from many manufacturers.

confuses customers, and they'll delay their purchasing decisions.

Integration Woes

Another area of concern to customers is the lack of integration between the different hardware platforms on which CASE systems run.

CASE producers are taking different approaches to overcoming these barriers.

Cadre's Teamwork, for example, runs identically on workstations from Apollo Computer, DEC, Hewlett-Packard, IBM (the PC/RT), and Sun Microsystems; in an Ethernet environment, each can become a network node.

More and more CASE producers are recognizing VMS for its huge potential user base and flexibility as a networked design environment. Taking the lead from DEC's Applications Systems Development Environment (ASDE), many companies are releasing packages for the VAXstation 2000.

Other approaches focus on integrating CASE with varied computer-automated technologies. ProMod Inc. links its CASE environment with a family of computer-aided programming (CAP) tools.

Is CASE Right for You?

The key to knowing when CASE is right for you is to stay abreast of developments in the industry. According to Elliot Chikofsky at Index Technology, an ideal CASE environment should provide the analyst and systems developer with the facilities to draw architectural diagrams of an information system, describe and define functional and data objects of the system, identify relationships between systems components, and provide annotations to aid project management.

CASE will continue to search for its niche and will eventually uncover it's user base. The exact size of that user base, however, remains to be seen.

Table—CASE Products

Vendor	Product	Price	System Compatibility
Cadre Technologies Inc. 222 Richmond St. Providence, RI 02903 401-351-5950 **Circle No. 222**	Teamwork, consisting of five modules: • Access • Structured Analysis • Real Time • Information Modeling • Structured Design	$7,500–$15,900 per module	A workstation-based product compatible with MicroVAX, Sun, Apollo, Hewlett-Packard, and IBM RT
Cortex 138 Technology Dr. Waltham, MA 02154 617-894-7000 **Circle No. 223**	CorVision	$50–$150,000	MicroVAX through 8xxx Series; IBM PC/AT link to any VAX
Digital Equipment Corp. 146 Main St. Maynard, MA 01754 617-897-5111 **Circle No. 224**	VAXset option package, including: • Language-Sensitive Editor • Source Code Analyzer • DEC/Code Management System • DEC/Module Management System • Performance Coverage Analyzer • DEC/Test Manager	Dependent on CPU/OS/number of users	VAX
Index Technology One Main St. Cambridge, MA 02142 617-494-8200 **Circle No. 225**	Excelerator	$8,400 (single copy)	VAXstation
	Excelerator/RTS	$8,400 (single copy)	VAXstation
	XL/Design Integrator	$10,000 (2–5 users)	VAX host
ProMod Inc. 23685 Birtcher Dr. Lake Forest, CA 92630 800-255-2689 (outside CA) 800-255-4310 (CA only) **Circle No. 226**	ProMod/SA (Struct. Anal.)	$3,995–$23,950	VAXworkstation through 8xxx Series
	ProMod/RT (Real Time)	$4,995–$31,950	
	ProMod/MD (Mgmt. Design)	$4,495–$27,950	
	ProMod/DC (Design Charts)	$1,000	
	ProMod/TMS (Traceability Matrix Sys.)	$1,000–$4,000	
	ProMod/CM (Config. Mgmt.)	$1,000–$4,000	
	*Pro/Source Code Generation	$2,995–$4,995	
	*Pro/CAP Code and Design and Maintenance	$1,995–$7,995	
	*Pro/RE Source-Level Eng. *Avail. ADA, C, Pascal	$2,995–$11,999	
Tektronix Inc. CASE Div. Marketing P.O. Box 14752 Portland, OR 97214 800-TEK-WIDE (ext. 683) **Circle No. 227**	TekCASE Analyst	$5,400–$54,000	VAXstation through 8xxx Series; VMS/Ultrix
	TekCASE Designer	$3,600–$36,000	All VAX; VMS/Ultrix
	TekCASE Auditor	$12,000–$52,800	VAX/VMS (not including VAXstation)

When it's time to renew the service contract on your DEC® systems, will you be getting the best quality at the right price?

You could save up to 34% on what you may now be paying for comparable DEC service.

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Unfortunately, the plain and simple truth is that all too often, this is the case.

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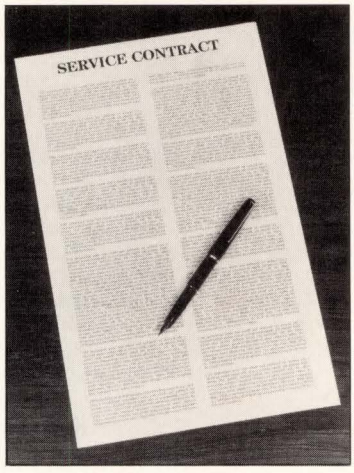
That's what you get with CUSTOMCARE® Service from Unisys. Here's why.



For starters, we offer some of the most dedicated and experienced people in the service industry. Customer Service Engineers who know your DEC systems and peripherals—even if they are of varied makes and models—because we place the highest priority on both pure technical and "hands on" training.

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All this results in more productivity for your organization. And more profit to your bottom line.

But what else should you expect from a $9 billion company with a 100-year commitment to excellence—the kind of commitment that guarantees cost-effective solutions to fit *your* requirements.

Now when you consider that we can do all this for you and also save you up to 34%, you'll want to give us a call before you sign that DEC service contract.

In fact, you may even qualify for Two FREE Months of CUSTOMCARE Service from Unisys. You can find out how when you send for your FREE CUSTOMCARE Information Kit today. Just complete and mail the coupon below or call us toll-free at **1-800-547-8362, Ext. 03,** now.

After all, there is no substitute for the right quality at the right price.

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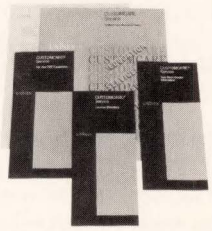

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○ I'm very interested. Please have a Unisys Representative contact me with the details on how to qualify for Two FREE Months of CUSTOMCARE Service from Unisys. And don't forget my FREE CUSTOMCARE Information Kit.

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BHAA88

CIRCLE 408 ON READER CARD

THE MASS. REPORT

Along the Boston corridor

Welcome to The Mass. Report, the most radical addition to Hardcopy's *editorial slate for 1988. This is where you'll be hit with a different, entertaining perspective of the Boston corridor in general and the DEC universe in specific. The purpose of this column is to dissect industry issues, expose potential policies, and present promising products. We'll go undercover within DEC's backyard—the software houses of Cambridge, the office parks along Route 128, and the Maynard mill. We'll report on the good, the bad, and the ugly, and leave the analysis up to you. And, in keeping with* Hardcopy's *philosophy, we'll present only hard facts, without sticky rumors.*

Ken Olsen, DEC's president, went in front of the company's stockholders to soothe their fears of the roller coaster market. He wasn't nervous, he wasn't shaken. In fact, quite the opposite. Olsen was calm and sure. He maintained that the plunge of Black Monday "will have no immediate or direct influence on Digital."

After all, no one took a bigger bath that day than Olsen. But he was clearly taking it in stride, and keeping his sense of humor. He claimed he was more worried about how his VAXes performed during the crash. "As far as I could tell, our equipment did very well," said Olsen, feigning concern. "The communications links got overloaded before the computers."

The primary setback, according to Olsen, is half of DEC's stockholders will suffer with a lower index. He is also preparing for a recession, though not predicting one. His plan for a head start on the recession, he said, is to temporarily slow down capital expenditures and cut back on hiring.

As for a stock split, which appeared inevitable before the crash, Olsen said they are not currently considering one. His tone on that subject suggested that DEC won't split.

In case you're curious, Olsen owns 2,581,416 shares of DEC stock—more than 50% of the 4,750,507 shares owned by the corporation's 47 officers and directors and 2% of the company's total issued, outstanding stock. The Stratford Foundation, a private charitable organization founded by Olsen, owns another 2,108,745 shares.

Olsen's aggregate cash compensation was $905,706 for the fiscal year ending June. He also earned 30,000 shares of stock options during the year. His estimated annual retirement benefit will be $90,000 when Olsen, now 61, reaches 65.

Bids on the Burner

DEC is still feeling the effects of a drawn-out lawsuit with the government over the way in which a UNIX system was selected by the Air Force. The government chose AT&T's System V as a measuring stick for the other candidates, so naturally System V tested strongest.

"The government picked a proprietary system, which they said they wouldn't do," was Ken Olsen's explanation. In any event, DEC feels it won the decision since it will change the way UNIX is specified in an RFP. The contract was large, worth more than $3 billion, but won't be a backbreaker since DEC has several other potential contracts pending, many with other government agencies.

One major RFP, unrevealed until now, is with the NASA/Lockheed space shuttle program. DEC is competing head-to-head with IBM, Honeywell, and others for the opportunity to monitor all of the operations of the shuttle flight, from launching to landing. Lockheed wants the system to maintain a huge checklist of every minute operation to be performed—both manually and automatically—on board the shuttle and at the space center in Florida.

Lockheed hopes to develop a system that can double-check each operation to see if it's been completed. The system will go one step further than previous systems, which merely functioned as databases and didn't follow through on the execution of operations. They reportedly want a system that will determine what went wrong—why checklist items were missed and who was responsible.

Since the Challenger tragedy, Lockheed went back to the drawing board for its entire automation process. Its shuttle design facility now has a totally new look, and other areas will be redesigned before the next flight. The installation DEC is bidding for, however, is not expected to be in place until a subsequent launch.

Insiders feel that IBM has the edge because NASA is calling for a scheme that perfectly suits mainframes equipped with huge databases, a longtime IBM computing strategy.

Back on the Tube

It's been some time since DEC ran a commercial on the tube. That was a few Super Bowls ago.

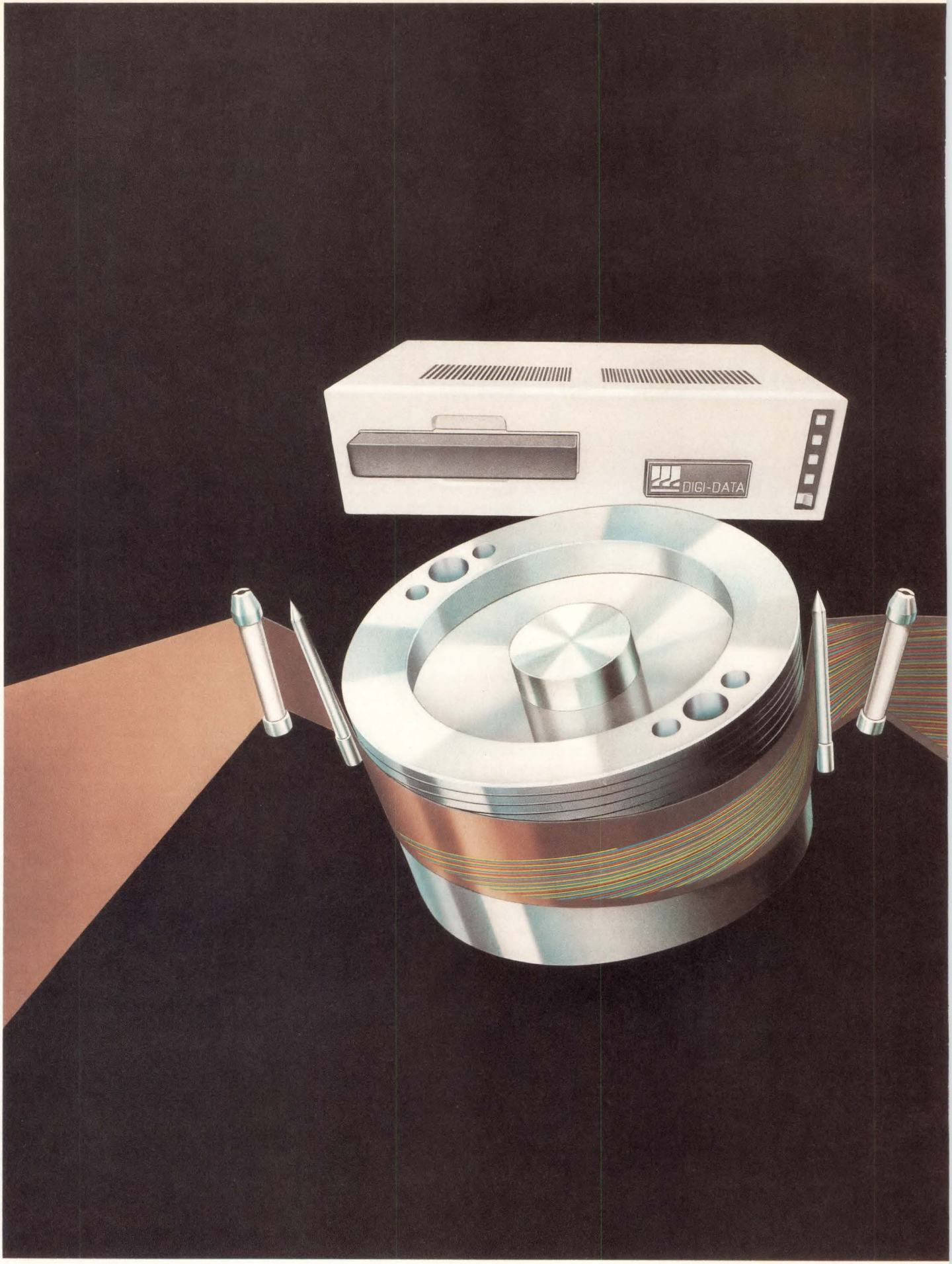
But the company has been back in the studio, and this time the effort could prove profitable. DEC's new television spots, produced specifically for the television series "The Infinite Voyage," are outstanding. "Infinite Voyage," which was funded by a grant from DEC, is a Sagan-esque documentary airing on PBS that explores science and natural history.

Olsen says that commercials on public television are more "efficient" because its audience overlaps heavily with DEC's target audience, and because PBS viewers are more attentive.

The new ads juxtapose comments from CEOs of corporations that use DEC equipment (Kodak, etc.) with comments from prominent figures in sports and the arts. Head and shoulders shots of the speakers are laid over film of, for instance, ballet dancers rehearsing in a segment with choreographer Twyla Tharp, and basketball players scrimmaging in an ad with Olympic coach John Thompson. These sequences are followed by the DEC logo and a voice-over statement that summarizes DEC's one architecture, one networking strategy.

The point is to draw a parallel between successful distributed data solutions and the logistics of teamwork. The photography is textured beautifully, and the message comes across smoothly. The result is just as powerful as IBM's M*A*S*H reunion, and infinitely stronger than technical approaches taken by Wang and Tandy.

In fact, if the lifeless clips we saw from "Infinite Voyage" are any indication, the ads will outshine the show.


DIGI-DATA

REPORT 81

QUARTER-INCH TAPE TECHNOLOGY IS JUST NOW STARTING TO CATCH WINCHESTER DISK DRIVE CAPACITIES WITH MANUFACTURERS PROMISING GIGABYTE CAPABILITY, BUT HELICAL-SCAN TECHNOLOGY AND INNOVATIONS IN HALF-INCH CARTRIDGES ARE ALREADY PROVIDING GREATER CAPACITY AT LOWER-COST

TAPE TECHNOLOGIES COLLIDE IN ARCHIVE/BACKUP RACE

BY BRAD HARRISON, Senior Technical Editor and **CARL WARREN,** Editor-in-Chief

Winchester disk drives are leapfrogging to higher and higher capacities. These capacity jumps are as great as 100 Mbytes on 3.5-in. drives, to the gigabyte range for high-end, 8-in. spindles. But as disk storage gets greater, so does the need for low-cost, reliable archival and backup systems. And manufacturers of half-inch, quarter-inch, and emerging helical-scan tape (Figure 1) products

Figure 1—Just like taking *a home movie with your video tape camera, Digi-Data's Gigastore helical-scan tape drive employs a cylinder that rotates at 1800 rpm. This cylinder serves as the mount for diametrically opposed video heads that read and write the tape in a horizontal plane. The tape is skewed at an angle to provide the proper striping bands.*

are all setting sights on being the chosen solution. Even though the majority of corporate America's databases are still predominately paper files (Figure 2), storage manufacturers, especially those who make tape and optical products (see "Write-Once Optical WORMS its Way Into Application Arenas," p. 52, this issue), are expecting a major shift to electronic storage.

The leading tape technologies expected to serve as the media of choice, at least for the next few years, are half-inch and quarter-inch tape. Helical-scan drives, however, are making themselves felt and may quickly push half-inch drives such as DEC's TK50 and TK70 out of most subsystem boxes—that is, if they are generally accepted as reliable backup devices. Something that helical-scan drive makers Digi-Data Corp. and Exabyte Corp. are betting on.

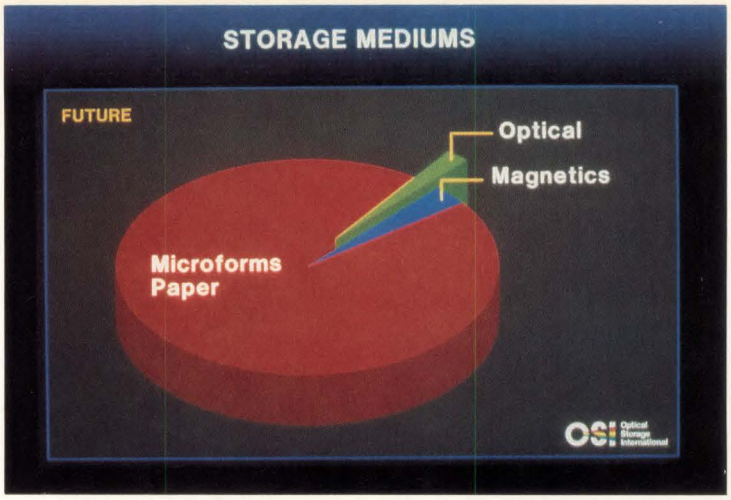


Figure 2—The data storage industry foresees *extensive growth based on the need to convert paper files to some form of electronic storage. Optical storage vendors are expecting to enjoy a significant portion of the growing market, but tape, at least half-inch reel-to-reel and 3480 cartridge, appears to be winning for the moment.*

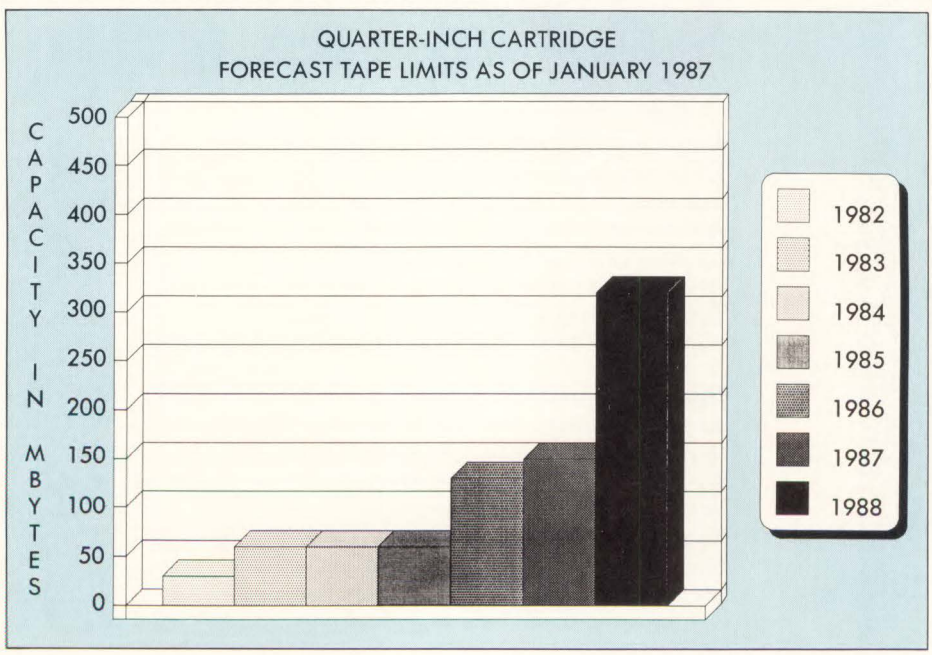
Quarter-Inch Staying Alive . . .

Don't discount quarter-inch drive and cartridge manufacturers either. These manufacturers are starting to feel real pressure not only from emerging 8mm helical-scan products, but from 4mm digital audio tape (DAT) when it becomes generally accepted into the consumer market place.

The quarter-inch tape makers have indeed realized that there are disparities in matching tape to Winchester drive capacity. Indeed, there is some concern as to whether quarter-inch tape has reached the limit that it can be reliably supported by the technology. As shown in Figure 3, the general consensus of the industry at the beginning of 1987 was that the maximum was approximately 150 Mbytes. Drive and cartridge vendors are bending to the needs of storage users and most now claim to be able to support 320 Mbytes on a single cartridge and expect to provide 1 Gbyte capability in just a few months. And, recently, DEI introduced an extended-length cartridge with 1000 feet of tape that can store as much as 500 Mbytes of data in the quarter-inch cartridge (QIC) 320 format. Additionally, the QIC industry committee is studying the possibility of boosting capacities to 1 Gbyte and defining an acceptable format.

Backup and archival applications for personal computers are being handled with quarter-inch and cassette-style drives in the 40- to 150-Mbyte range. This technology is claimed by many manufacturers to be overwhelmingly successful with OEM system integrators. The opposite seems to be true since few system manufacturers and no operating system developers are providing direct support for the drives. A clear sign of underwhelming interest.

Figure 3—Quarter-inch cartridge tape has barely kept pace *with the increasing capacity of Winchester disk drives. However, 1987 has shown a major trend toward matching backup capacities to primary storage with a jump from 150 to 320 Mbytes and indications are that capacities of 1 Gbyte will be standard in the next few months.* (Source Hardcopy)



"The leading tape technologies expected to serve as the media of choice, at least for the next few years, are half-inch and quarter-inch tape."

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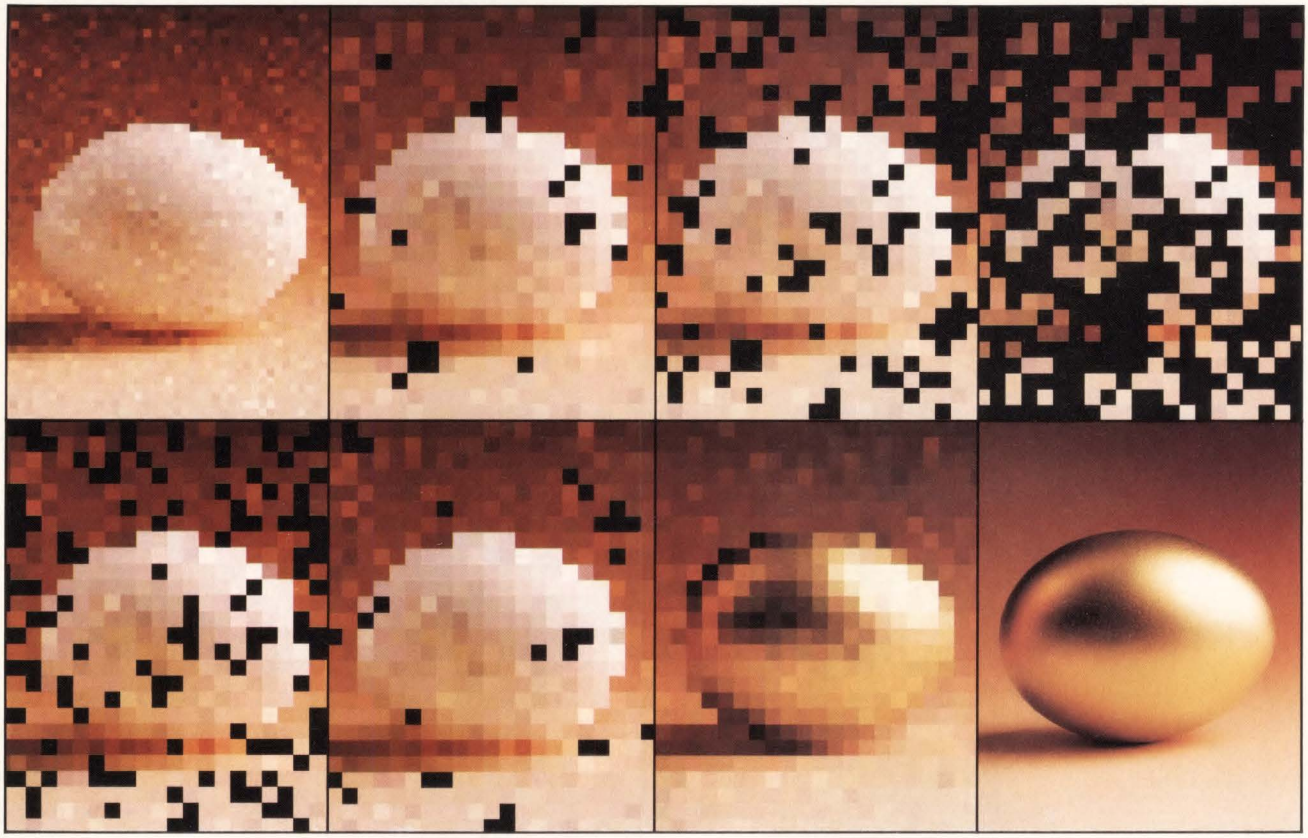

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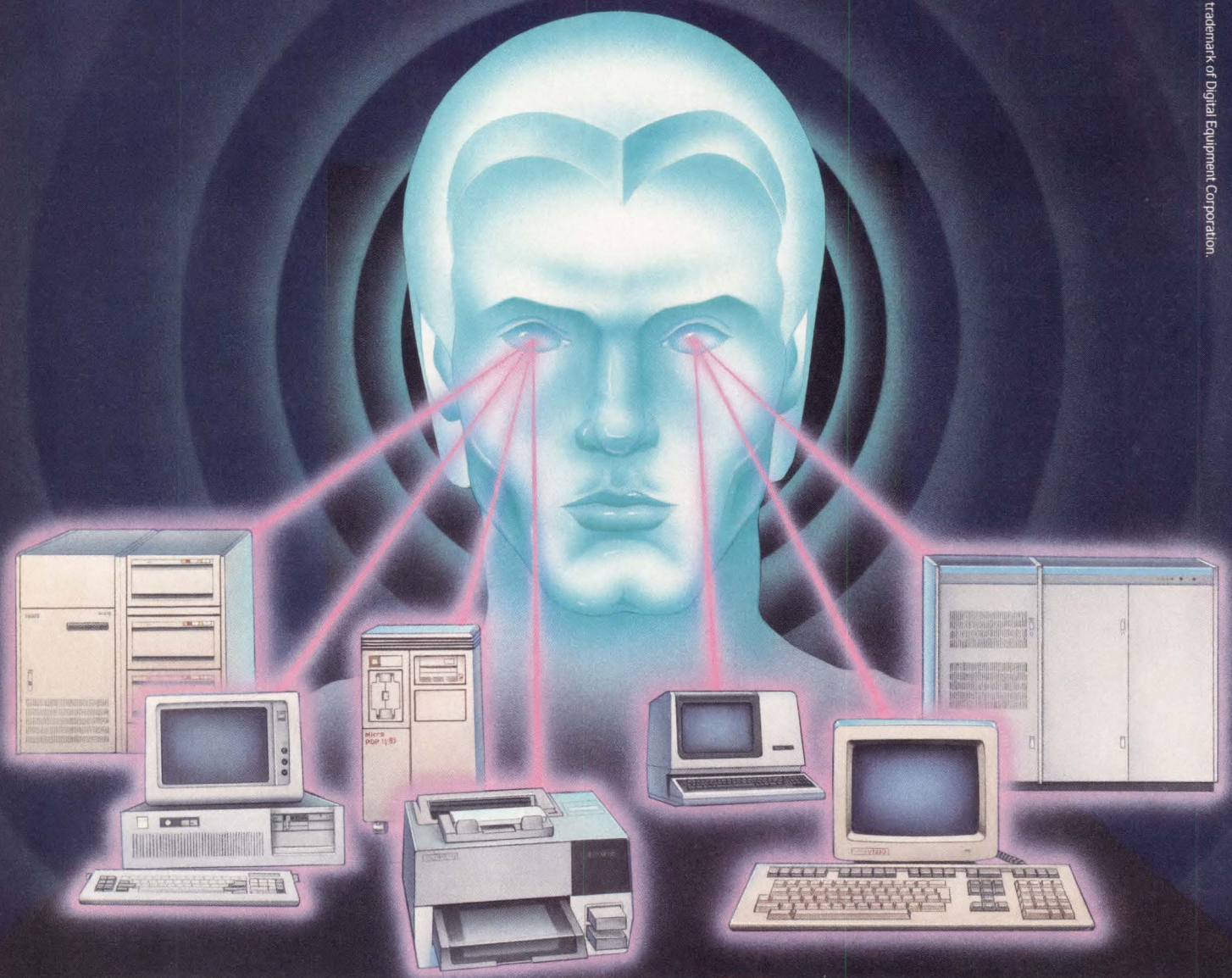

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Supported or Burdened by Standards

Currently, the QIC format standards that define the physical file layout include:

STANDARD	CAPACITY/MBYTES
QIC-24	60
QIC-120	120
QIC-150	150
Q1C-320	320

Quarter-inch drive and media manufacturers are quick to point out that there have been, and are many, stumbling blocks causing frustration. For instance, the QIC committee is still trying to create a fair verification process for determining whether a product conforms to a particular QIC standard. This test verification process, however, isn't simple and involves multiple tests that are still in the definition stage.

For example, one of the problems the QIC committee has is determining the test jig—the base drive and tape. Tests are expected to include: recording signal, amplitude stability, output, and bit shift. Additionally, the stability of the tracks and positioning plus conformance to a QIC standard are all to be measured.

No Interchange in Sight

Besides test verification, there is no definite interchange compatibility among quarter-inch cartridge vendors at the file level. Currently, the only company that is developing file-level compatibility for IBM PCs is Sytron Corp., with SY-TOS, a tape operating utility for QIC-40 type drives.

Interchangability between drives supporting different versions of QIC has been a problem, but QIC drives continue to sell well in the DEC market. Most DEC-compatible, quarter-inch subsystems support QIC-02 and run under the TS driver. Companies like Micro Technology Inc. have been successful selling QIC-02-compatible controllers for the MicroVAX, challenging DEC's TK50 and TK70 half-inch products. In fact, quarter-inch products have been so successful in the DEC environment that some industry analysts are skeptical that any half-inch cartridge products besides DEC's will have much of a future.

On the other hand, storage industry observers such as I. Dal Allan, president of ENDL Consulting (Saratoga, CA), don't seem to be overly encouraged by quarter-inch tape advances. Rather, Allan, like many observers, seems to be in favor of half-inch magnetic and emerging helical scan—the latter seeming to be the best buy when cost per Mbyte is considered.

Observers like Allan cite many of the limitations of quarter-inch cartridges such as: media coercivity, instantaneous speed variation (ISV), mechanical stability of the cartridge, and use of elastic bands in the cartridge that change characteristics with use.

Interestingly, 3M Company (Minneapolis, MN), who established the quarter-inch cartridge, is also the company many claim is smothering the business. Until recently, 3M has kept cartridge prices high (approximately $30 for a DC-600) and has been unwilling to make technical changes. However, 3M claims a 22.5% market penetration for quarter-inch tape—a number that most analysts are unwilling to live with.

Sony Corp. (Tokyo) is expected to add a new element to the quarter-inch wars with very low-cost cartridges.

Niche Solutions Stay on Track

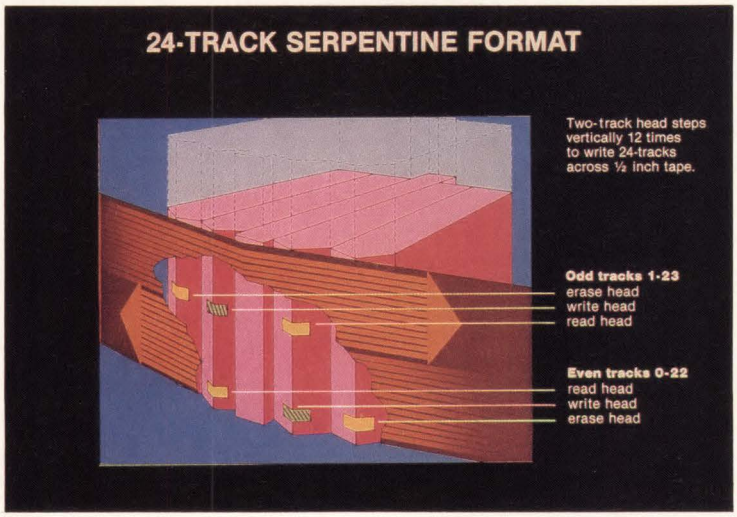
Not all the archive and backup solutions you have to consider are quarter-inch or even standard half-inch tape. MegaTape Corp., for one, offers a half-inch cartridge solution that definitely flies in the face of existing standards and methodology. MegaTape sells the MT-750, a 750-Mbyte, half-inch tape backup product that has sold well despite the fact that its Pertec interface is the only standard it supports. "There aren't any standards in the tape industry," says Clyde Cornwell, marketing communications manager of MegaTape. "The QIC stuff is the closest, but we all know about its compatibility problems."

The MegaTape drive isn't really all that different from the IBM 3480 or even helical-scan when viewed from a technology point of view. The cartridge uses standard half-inch tape, and the read/write mechanism (Figure 4) reads or writes 24 tracks by vertically stepping 12 times. A similar approach is used by IBM on the 3480 and helical scan.

Reeling in the Reels

Although MegaTape can be credited with creating a solid base for half-inch tape, most of the industry is headed for IBM 3480-style cartridges. Raymond C. Freeman, president of Freeman Assoc. (Santa Barbara, CA), predicts that by the end of 1988, shipments of cartridge

Figure 4—Using a 24-track, *vertically stepping head, the MegaTape half-inch drive uses 12 increments to step across the width of the tape. Read-after-write capability of the head design ensures the data integrity.*



"Drive and cartridge vendors are bending to the needs of storage users and most now claim to be able to support 320 Mbytes on a single cartridge and expect to provide 1 Gbyte capability in just a few months."

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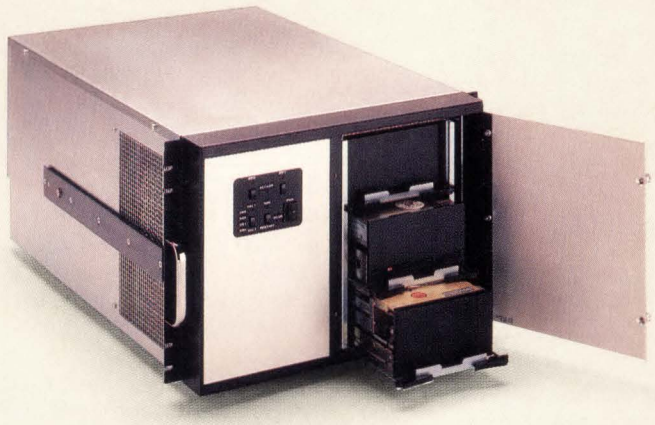

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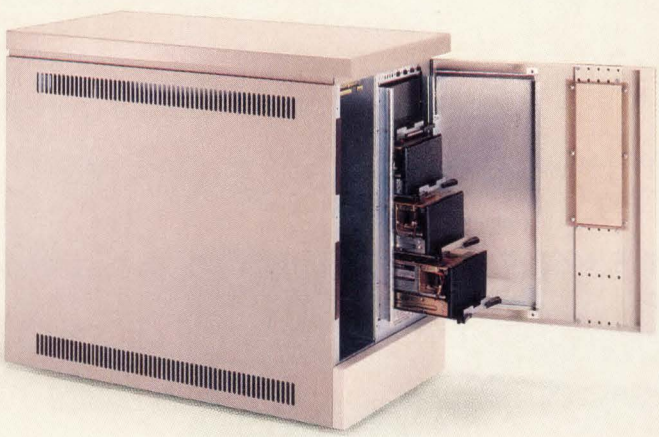

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CIRCLE 459 ON READER CARD

drives will surpass deliveries of reel drives. "Right now, interchange is limited to high-end cartridge systems, but soon interchange will be a reality through the spectrum of half-inch cartridge systems," says Freeman.

Traditional reel-to-reel tape, however, may not give up so easily, leaving it uncertain where half-inch cartridge fits. Standard fare at most DEC sites, ANSI-standard magnetic tape has a solid history of use and is completely interchangeable among systems. "If anything, we're seeing an increase in the demand for our reel-to-reel systems," says Haim Brill, president of Aviv Corp., a supplier of a wide array of DEC-compatible tape subsystems. "Reel-to-reel is as popular as ever."

Nevertheless, Aviv offers a complete line of quarter-inch systems, as well as the Exabyte helical-scan technology and drives that use the IBM 3480 cartridges. Brill says that he's covering the whole spectrum of applications—that the Exabyte product is for the really high-volume backup and data-acquisition applications and the 3480 product is "really expensive" and justified mostly on the basis that it is interchangeable with IBM's drives.

Scanning the Data

The excitement in tape backup, however, is clearly settling in on the helical-scan technology. Not really new (see sidebar, "Helical Scan Not New to Data Backup,"), the use of 8mm video cartridges is making itself felt throughout the industry. Two companies, Digi-Data and Exabyte, are lining up an impressive array of OEMs (see "Tape Subsystems Vendors Directory"). The helical-scan technology (Figure 5) is impressive because it provides

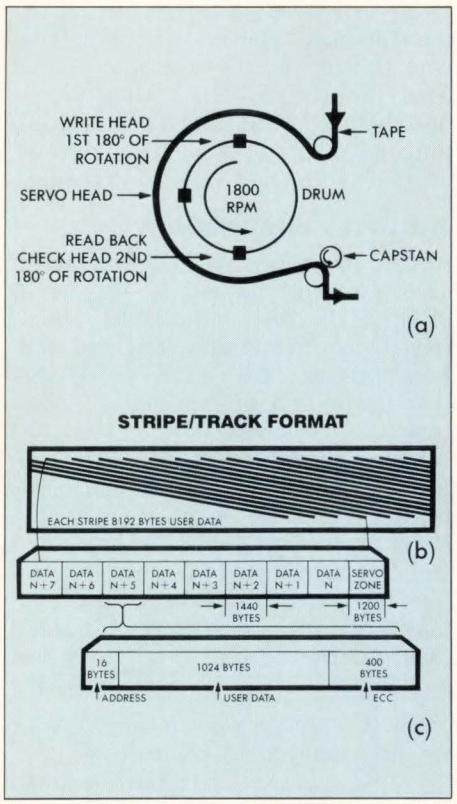
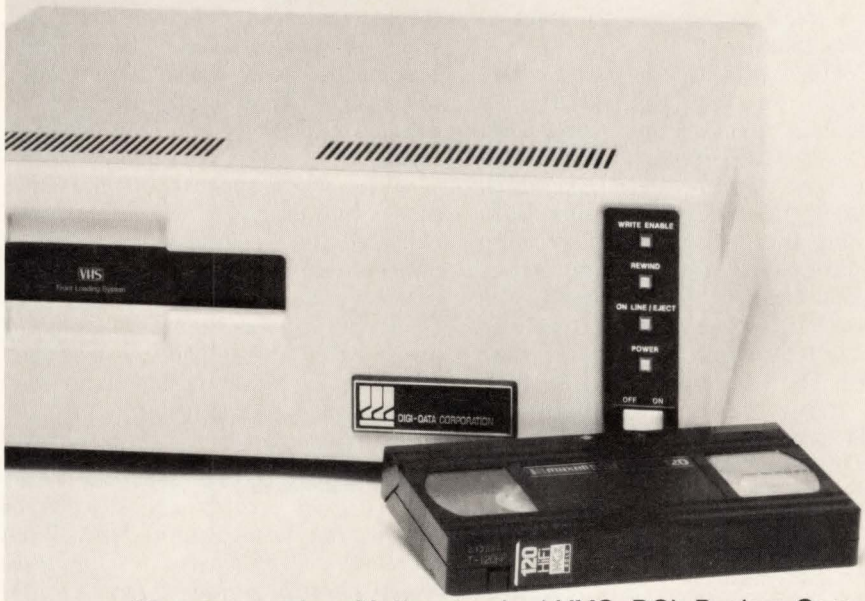


Figure 5—The technology used *in helical-scan drives isn't relying on anything as esoteric as lasers or rare-earth media. Rather, the devices are based on magnetic recording, but using an innovative approach to put the data on the tape. Unlike conventional tape drives that located a fixed set of heads that the tape runs by, helical-scan uses three heads mounted on a drum* (a) *that rotates at 1800 rpm. The tape is wrapped around the drum in the shape of a distorted C at an angle of approximately 5°.*
The idea behind the head/media relationship is to write stripes (b) *of data rather than long tracks. Each of the stripes is 3.037-in. in length and contains a maximum of 8182 bytes of formatted user data. Each stripe—track—is composed of 8 data blocks each with 1024 user bytes* (c). *The drives typically exhibit a track density of 820 tracks per inch (tpi).*

2.5 Gigabytes VAX Backup



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the ability to store as much as 2.5 Gbytes of data on a cartridge that fits in the palm of your hand.

Helical scan literally uses off-the-consumer-shelf devices—the same heads and basic electronics used in your cam-corder and media that costs pennies. In fact, a quick call to local retailers of videotape found prices ranging from $1.99 to $5.75. With media prices that low, the cost per megabyte is negligible.

Additionally, if you're planning on integrating a helical-scan drive, or buying one ready to plug in, there is an extra benefit. The drives use the small-computer systems interface (SCSI), thus making the interconnect easy for a variety of systems.

One of the companies that is providing TU driver capability for the Exabyte drive is Distributed Logic Corp (DILOG). Their Model TSS2 subsystem consists of the Exabyte drive, cable, and a SCSI interface and adapter for the Q-bus. The single-ended SCSI implementation provides for 64 Kbytes of buffer memory and delivers a 1.5-Mbaud data transfer rate. The price tag for the entire subsystem, including the

HELICAL SCAN NOT NEW TO DATA BACKUP

Although it would appear from the hoopla surrounding helical-scan tape technology that it is the newest and brightest backup technology on the market, "Not so," say computer old-timers. Indeed, RCA Corp. was experimenting with storing data as video frames as early as 1959.

Serious efforts for using video methods, particularly helical-scan heads, laid dormant until 1980. That year, a start-up company called Data-Dyne Inc., (Sunnyvale, CA), which would be later called Pragma Data Systems Inc., was founded by John Harman, John Lynolt, and Bruce Manildi. The goal of the company was to develop low-cost, efficient backup for high-capacity Winchester disk drives. The result was the DAC 2080 tape drive that used helical-scan heads and standard half-inch magnetic tape that was housed in a 4.87- x 4.87- x 1-in. cartridge. "This was really the first attempt at a direct-access cartridge tape system. It preceded IBM's 3480 half-inch cartridge tape drive, which was introduced March 22, 1984, by four years," remembers Freeman Assoc. (Santa Barbara, CA.) President Ray Freeman.

Besides using a relatively standard media approach, although the cartridge represented a new problem, the DAC 2080 had other compelling features:

- use of proven, helical-scan video heads, thus improving reliability and cost;
- ability to back up 80 Mbytes of formatted data in 7.4 minutes;
- matched 8-in. Winchester disk drive form factor of: 4.5- x 8.55- x 14.5-in.;
- low cost—about $10 to $15 per M byte with a goal to reach the $5 level at the OEM level; and
- easily matched to most standard interfaces.

Conceptually a 32-Head Disk Drive

In operation, the DAC 2080 appeared to operate as a 32-head Winchester disk drive with 615 cylinders. On each read/write pass, the two diametrically opposed heads, offset by 16 tracks each, would read or write one track on each rotation of the helical-scan head. The tape was incremented to a read/write zone, stopped, and the heads would rotate and read or write the data.

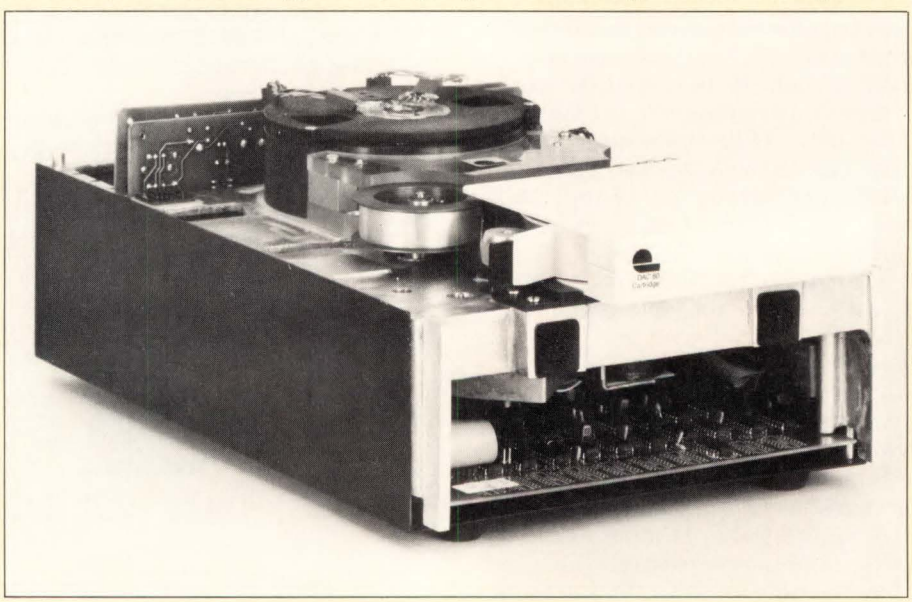
With what appeared to be more pluses than minuses, you might have expected the Pragma drive to set a new storage standard. The company, however, had to face a few facts. First, the technology, as they were using it, was untried and difficult to manage. Second, the quarter-inch cartridge (QIC) standards had begun to provide solutions to problems frustrating quarter-inch tape makers, and IBM was waiting in the wings with the 3480 tape drive, which they introduced March 22, 1984 and began shipping in January of 1985. "They ran out of time and money," claims Freeman.

A Better Foundation

The Pragma drive clearly showed an innovative approach, was well ahead of its time, and may have succeeded if a firm technology bed had been present. The latter being the case for 8mm and 4mm digital audio tape (DAT) systems.

Since the R&D costs for DAT have been absorbed by the consumer electronics industry, costs are already lower than for standard backup storage. But developers of DAT drives, unlike the Pragma pioneers, also can take advantage of advances in interface, microprocessor, and software technologies. *—B.H. and C.W.*

The Pragma drive represented *the first attempt at using helical-scan head technology for recording backup data on half-inch standard tape. The drive matched the form-factor of 8-inch Winchesters and was, as claimed the company, able to back up 80 Mbytes in 7.4 minutes. Unfortunately, the company was never able to make the technology work properly and ran out of time and money.*



mounting skid plate, is $5,395.

The bandwagon effect isn't the reason DILOG is providing an Exabyte system, claims product marketing manager, John Frassel. "It may sound like a hackneyed phase, but our goal is to provide solutions. And we see helical scan as one."

Summus Computer Systems is another company that is taking a speculative leap with the Exabyte drive. Summus does offer the drive as a system add-in, but recommends you should probably buy the fully integrated package in the GigaBox, which is designed for any host system—not just DEC.

Creating a bigger sale is part of the motivation for Summus to recommend buying the GigaBox. "You can buy an 8mm helical-scan tape drive and plug it in, but that's only the electrical portion (see sidebar, "TMSCP Driver Makes DEC Attachments Standard"). The software issues, especially for DEC systems, can be difficult and overly cumbersome," says Summus president Don Harmeier. To this end, Summus takes the approach of making the GigaTape operate transparently to both you and the system.

Similarly, Emerald Systems Corp.'s Virtual Archive Storage Technology (VAST) device uses helical-scan technology to achieve the high-capacity. Indeed, the company, which has been creating tape subsystems based on half-inch tape for the last several years, views helical-scan tape as an ideal distribution vehicle. Agreeing are Lee Elizer, president of Peripheral Strategies Inc., (Santa Barbara, CA) and Freeman Assoc.'s Ray Freeman. Both analysts see the 8mm cartridges providing a cartridge interchange format that can cut across a number of systems. "It's been established by Sony, and I don't see anyone meddling with it," says Freeman.

Even though 8mm may come through unscathed in a standardization effort, DAT most likely won't. Already Elizer has established an ad-hoc industry group DATA-DAT to investigate the type of standards that need to be imposed on the 4mm tape. The IEEE is taking a big interest as well. Dave Allen, president of Prairie Technologies Inc. (Aubry, KS), has petitioned the Microcomputer Standards Com-

TMSCP DRIVER MAKES DEC ATTACHMENTS STANDARD

Tape drives on DEC systems have been supported by a variety of different drivers. Now, however, DEC is standardizing tape drivers with TMSCP in the same way that it standardized magnetic disk drivers with MSCP. Both TMSCP and MSCP are components of DEC's Digital Storage Architecture (DSA) whereby operating systems view storage in logical rather than physical terms, reducing operating system overhead.

The TS11/TSV05 has been DEC's most popular tape driver, supporting DEC's TSV05 reel-to-reel tape subsystem and a variety of third-party products. In fact, it is often ported to MicroVAX systems to support drives other than the TK50/70.

But with the TMSCP compatibility of the TK50 on MicroVAX systems, the TMSCP driver is quickly becoming the DEC industry standard and will soon be the protocol supported by all DEC and third-party tape controllers in the same way that MSCP has become the standard for disk.

—B.H. and C.W.

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mittee (MSC), the governing body of standards working groups in the computer society, to establish a study group for 8mm and 4mm tape. Allen says that the issues range from the "mom and pop" stuff of reliability and performance to data rates and the style of heads. "The azimuth on the video style helical-scan head isn't correct to permit block update capability—that's the biggest question in my mind. The A/B head arrangement with crossed azimuths makes it difficult to do a block update," complains Allen. The MSC agreed to start a study group that may develop into a full standards working group by mid-1988.

DEC Tries Again

With third-party vendors moving toward helical scan, DEC is still underwriting half-inch cartridge formats. The TK50 half-inch tape product for the MicroVAX II hasn't been very successful. Problems range from the TK's generation of too much heat (resulting in failures both within the drive itself and in other electronics housed in the MicroVAX chassis) to extremely low quantities of data fitting onto the tape as the result of a poor method of writing data while the tape is streaming.

But the sheer quantity of sales, as well as the fact that the TK50 cartridge has become the standard method of program distribution on MicroVAX, has made the drive an industry standard. And now DEC has tried to remedy the problems with its new TK70 product, which uses advanced recording techniques and handles cartridges from both DEC and 3M. Previously, all TK50 cartridges were single-sourced from DEC.

It seems, however, that DEC can't help but win with its half-inch tape cartridge products. The competition is making strides, but DEC keeps pumping out MicroVAXes, and the TK drives continue to be the primary method of distributing software for these systems. Additionally, the TMSCP driver, originally only available with MicroVMS and developed to support the TK50, is now available across the range of DEC operating systems, encouraging users to buy DEC TMSCP products. More and more third-party manufacturers, however, are reverse engineering the TMSCP protocol and offering products compatible with it; the challenge, in fact, may be just beginning.

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Distributed Logic Corp.
1555 S.Sinclair St.
P.O. Box 6270
Anaheim, CA 92806
714-937-5700
Circle No. 231

Emerald Systems Corp.
4757 Morena Blvd.
San Diego, CA 92117
619-270-1994
Circle No. 232

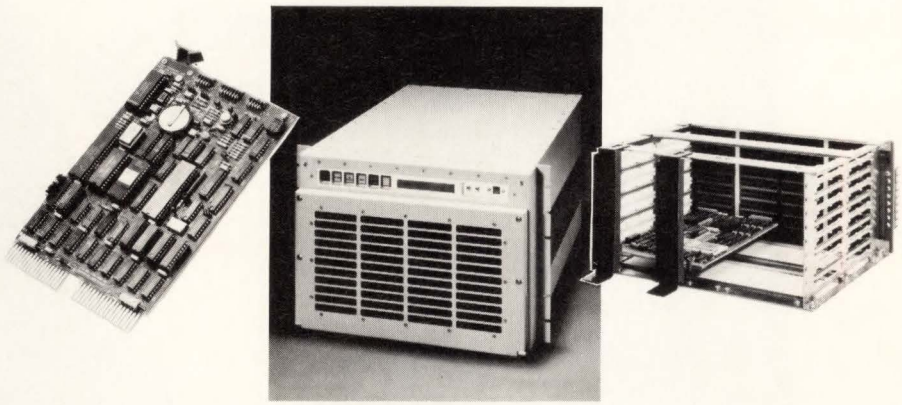
Exabyte Corp.
1745 385th St.
Boulder, CO 80301
303-442-4333
Circle No. 233

MegaTape Corp.
1041 Hamilton Rd.
Duarte, CA 91010-0317
818-357-9921
Circle No. 234

Micro Technology Inc.
1620 Miraloma Ave.
Placentia, CA 92670
714-632-7580
Circle No. 235

Summus Computer Systems
P.O. Box 820549
Houston, TX 77282-0549
713-589-9772
Circle No. 236

Sytron Corp.
135 Maple St.
Marlboro, MA 01752
617-460-0106
Circle No. 237



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Quality Designs You Can Count On

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- **Ruggedized MicroVAX II**
  Meets MIL-STDS 810D & 461B
  Holds four 380 Mbyte Disks
  TEMPEST/EMI Design & Filters
  Authorized MicroVAX CPU OEM
- **Q-Bus & MicroVAX Backplanes**
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  0.6" Spacing for Better Cooling
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  Fifteen 16-Bit Counter/Timers
  19 Distinct Counting Modes
  Replaces 15 DEC KWV11's
- **CMOS Calendar Clocks**
  Stand-Alone or Multi-Function
  CMOS RAM, LTC & Watchdog
  EPROM Boot for Disk & Tape
- **Q-Bus System Monitors**
  Measures Temp. & Voltages
  Time Stamped Error Logging
  DLV11 Serial Port
- **Watchdog Timers**
  Separate Boot & Run Delays
  Relay & Logic Alarm Outputs
  Auto Re-boot on System Crash

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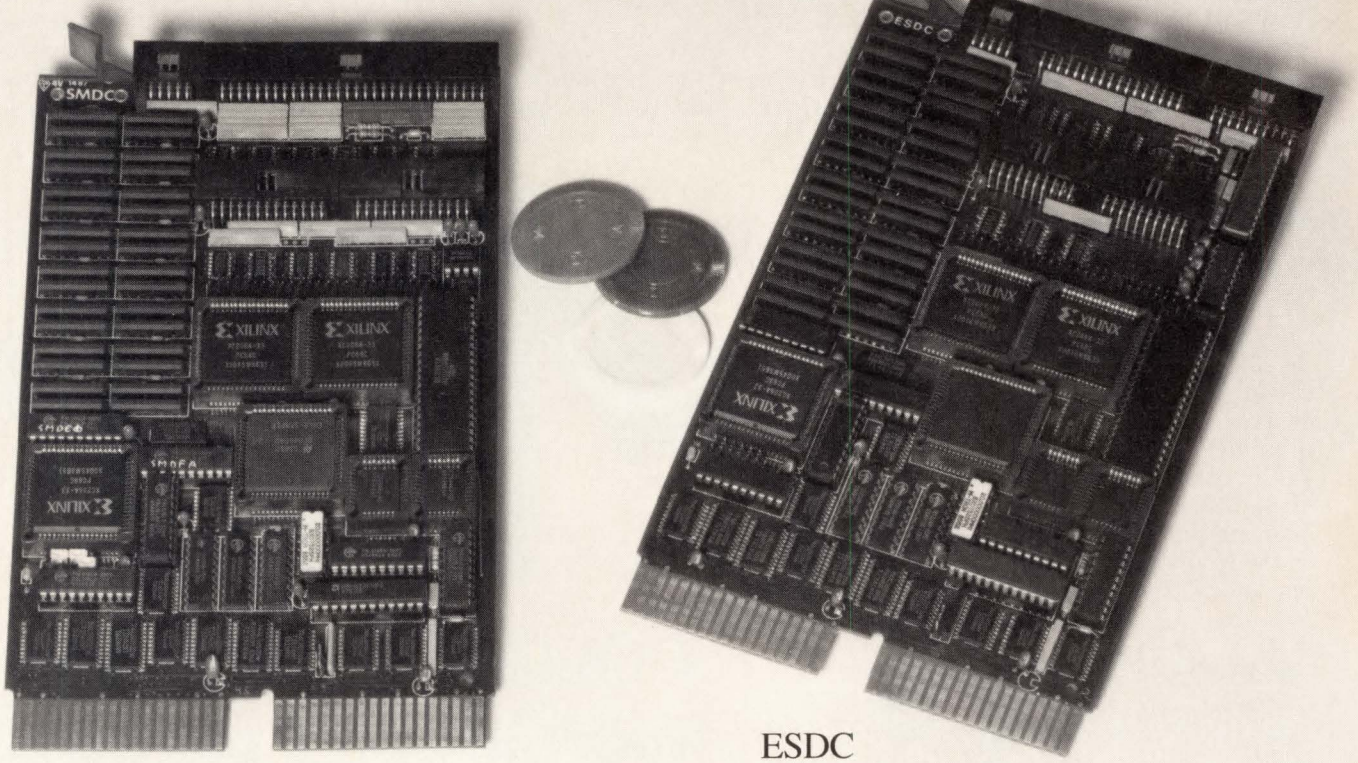
CODAR TECHNOLOGY INC.

Computer Products Division
1500 Kansas Avenue, Bldg. 2E
Longmont, Colorado 80501
(303) 776-0472 TELEX 4947090

CIRCLE 456 ON READER CARD

Andromeda's Winning Pair

SMDC
- Controls 2 SMD Drives
- 25 Mbit/sec Data Rate



ESDC
- Controls 7 EDSI Drives
- Controls 3 RX50/33 Drives
- 25 Mbit/sec Data Rate

- 1 MB Cache
- Adaptive Readahead
- User Service Port
- Field Upgradable Microcode
- 16 MB Cache Expansion Board

If sheer, flat-out performance is what you are looking for? Have we got a deal for you! Under typical system conditions Andromeda's cache controllers experience hit rates of over 80 percent. This means that, using either the ESDC or the SMDC, seek time and rotational latency are reduced to *ZERO* over 80 percent of the time. Thus typical disk accesses are up to *FOUR TIMES* faster.

Caching technology isn't the only area where Andromeda is setting new standards. The on board access port provides extensive disk diagnostics, a real time cache performance monitor and allows customer to upgrade controller microcode via modem. Thus, more advanced cache algorithms as they are developed by Andromeda's engineers are only a phone call away.

ANDROMEDA® SYSTEMS

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CIRCLE 441 ON READER CARD

TAPE STORAGE SUBSYSTEMS

Company	Product Name	Price	Drive Type: Reel-To-Reel	Drive Type: ¼-in. Cartridge	Drive Type: ½-in. Cartridge	Drive Type: Helical Scan	Drive Type: Other	Host Bus Compatibility	Controller: Mfg./Model	Controller: Emulation	Drive Manufacturer/ Model
A/G SYSTEMS INC. 1919 14th St. Boulder, CO 80301 303-444-6157 **Circle No. 129**	CDS-2000 ¼-in. 9-Track Cartridge Duplicator	$17,500		•				Multibus I	Proprietary		¼-in. Archive SDD
	Echo ½-in. 9-Track Tape Duplicator	$41,623	•		•			Multibus I	Proprietary		½-in. Pertec FS 1000/2000
AMERICAN DATA SYS. MKTG. INC. 53 Elderwood Dr. Stoughton, MA 02072 617-341-0171 **Circle No. 130**	MXM 2442/2444	$10,000-$12,000	•					Multibus I	Xylogic 4472		Fujitsu MXM 2442/2444
	MXS 2442/2444	$10,000-$12,000	•					Multibus I	Xylogic 472		Fujitsu MXM 2442/44AC
	MXA 2442/2444	$10,000-$12,000	•					Multibus I	Xylogic 472		Fujitsu MXM 2442/44AC
	VXS 2442/2444	$10,000-$13,000	•					VME	Xylogic 772		Fujitsu MXM 244
	TDQ 2442/2444	$9,800-$11,500	•					Q-bus	Wespercorp TDQ	TS11, TSV05	Fujitsu M 2442
	TDU 2442/2444	$10,000-$12,000	•					Unibus	Wespercorp TD IV, Emulex TC 13	TS11	Fujitsu M 2442 AC
	TDU 2435	$23,900	•					Unibus	Wespercorp TD IV	TS11	Fujitsu M 2335 L1
	TDU 2436	$28,500	•					Unibus	Wespercorp TD IV	TS11	Fujitsu M 2436 L1
	TDQ 2435	$23,900	•					Q-bus	Wespercorp TDQ IV	TS11	Fujitsu M 2335 L1
	TDQ 2436	$28,500	•					Q-bus	Wespercorp TDQ IV	TS11	Fujitsu M 2336 L1
AMERICAN DIGITAL SYSTEMS INC. 75 Union Ave. Sudbury, MA 01776 617-443-7711 **Circle No. 131**	Master Tape	$3,400		•				Q-bus	Micro Technology MSV05	TSV05	Archive Viper
APPLIED DIGITAL SYSTEMS 30 State St. Fairport, NY 14450 716-377-7000 **Circle No. 219**	ADS 880/990	$4,400-$9,700	•					Q-bus	Emulex TC02/ TC03	TS11, TSV05	Cipher
	ADS 882/992	$5,500-$9,900	•					VME	Xylogics 772		Cipher
	ADS 884/ADS 2472	$4,900-$9,000	•					Multibus I	Xylogics 472		Cipher/Pertec
ARCHIVE CORP. 1650 Sunflower Ave. Costa Mesa, CA 92626 714-641-1230 **Circle No. 292**	Viper Series/2060, 2125, 2150	$1,895+		•				Unibus, Q-bus	Emulex, DILOG, Microtech	TS11, TSV05	Archive Viper
ARTECON INC. 2431 Impala Palomar Tech. Cir. Carlsbad, CA 92008-3864 619-931-5500 **Circle No. 220**	½-in. Reel Tape Subsystem	POR	•					VME	Ciprico Tape Master 3000		Kennedy 9600A, 9610
	8mm Video Tape Subsystem	POR				•		VME	Ciprico 2F3500	SCSI	Exabyte EXB-8200
	QIC Tape Subsystem	POR		•				VME	Ciprico, Emulex	SCSI	Wangtek
AVIV CORP. 26 Cummings Pk. Woburn, MA 01801 617-933-1165 **Circle No. 132**	TFS 835-8200	POR				•		Unibus	Aviv TFC 835	TS11	Exabyte EXA-8200
	TFS 835-3480	POR			•			Unibus	Aviv TFC 835	TS11	Aspen 3480
	TFS 825-2436	POR	•					Unibus	Aviv TFC 825	TS11	Fujitsu 2436
	TFS 935-8200	POR				•		Q-bus	Aviv TFC 935	TSV05	Exabyte EXA-8200
	TFS 935-3480	POR			•			Q-bus	Aviv TFC 935	TSV05	Aspen 3480
	TFS 925-2436	POR	•					Q-bus	Aviv TFC 925	TSV05	Fujitsu 2436
BROOKVALE (COMPUTER) ASSOCIATES INC. 265 Oser Ave. Hauppauge, NY 11788 516-273-7777 **Circle No. 133**	9 Track Tape Subsystems	POR	•					Unibus, Q-bus	All DEC	All	All DEC
DIGITAL BASICS INC. 689 S. Canterbury Rd. Shakopee, MN 55379 612-496-2550 **Circle No. 291**	DB82A	$5,995				•		Unibus, Q-bus, VME	DILOG SQ/ SU703	TU81, TK50, TMSCP	Exabyte EXB-8200
	TU81E-DBI	POR	•					Unibus, Q-bus	DILOG DQ/ DU153	TU81, TMSCP	LMSI 92185-02h

The vendors listed in this buyers guide responded to a survey conducted by Hardcopy. *To be included in the* Hardcopy *database, please contact Cindy Grant-Thurman at 714-632-6924.*

POR—price on request

TAPE STORAGE SUBSYSTEMS

Company	Product Name	Price	Drive Type: Reel-To-Reel	Drive Type: ¼-in. Cartridge	Drive Type: ½-in. Cartridge	Drive Type: Helical Scan	Drive Type: Other	Controller: Host Bus Compatibility	Controller: Mfg./Model	Controller: Emulation	Drive Manufacturer/ Model
DIGITAL COMPUTER EXCHANGE INC. 27773 Industrial Blvd. Hayward, CA 94545 415-887-3100 **Circle No. 134**	K9400	POR	•		•			Unibus, Q-bus	Emulex TC13/ TC03		Kennedy 9400
	M990	POR	•		•			Unibus, Q-bus	Emulex TC13/ TC03		Cipher M990
	F880	POR	•		•			Unibus, Q-bus	Emulex TC12/ TC02	TS11	Cipher F880
	M891	POR	•		•			Unibus, Q-bus	Emulex TC12/ TC02	TS11	Cipher M891
DILOG COMPUTER PRODUCTS GROUP 17466 Daimler Ave. Irvine, CA 92714 714-261-9945 **Circle No. 135**	TSV12A	POR	•					Q-bus	DILOG DQ132	TS11, TSV05	Cipher M890-1
	606/2	POR	•					Q-bus	DILOG TCV21	TMSCP	Cipher F880-1
	605/2	POR	•					Q-bus	DILOG DQ132	TS11, TSV05	Cipher F880-1.
	TS14	POR	•					Unibus	DILOG DU142	TS11, TU80	Kennedy 9401
	TS13C	POR	•					Unibus	DILOG DU142	TS11, TU80	Control Data Keystone III
	TS13A	POR	•					Unibus	DILOG DU132	TS11, TU80	Control Data Keystone II
	TS12D	POR	•					Unibus	DILOG DU132	TS11, TU80	Cipher M891-2
	TS12B	POR	•					Unibus	DILOG DU132	TS11, TU80	Cipher M890-2
	TS12A	POR	•					Unibus	DILOG DU132	TS11, TU80	Cipher M890-1
	TMSV12A	POR	•					Q-bus	DILOG TCV21	TMSCP	Cipher M890-1
EAKINS ASSOCIATES INC. 67 E. Evelyn Ave. Mountain View, CA 94041 415-969-5109 **Circle No. 136**	Mini Max Model 10	$6,000				•		Unibus	TD Systems UTO	TMSCP	Exabyte 8200
	Mini Max Model 11	$6,000				•		Q-bus	TD Systems QTO	TMSCP	Exabyte 8200
	Mini Max Model 12	$6,000				•		VME	Ciprico 3500		Exabyte 8200
	Mini Max Model 20	$4,000			•			Unibus	TD Systems UTO	TMSCP	Pertec 240
	Mini Max Model 21	$4,000			•			Q-bus	TD Systems QTO	TMSCP	Pertec 240
	Mini Max Model 22	$4,000			•			VME	Ciprico 3500		Pertec 240
EXABYTE CORP. 1745 38th St. Boulder, CO 80301 303-442-4333 **Circle No. 137**	EXB-8200 8mm Cartridge Tape Subsystem	POR				•		Unibus, Q-bus, VME	Any DEC-compatible SCSI host adapter	TMSCP, TS11	Exabyte EXB-8200
FINTEC SERVICES 15520 Rockfield, Unit 1 Irvine, CA 92718 714-768-8219 **Circle No. 138**		POR	•					Unibus, Q-bus, VME, Multibus I	DILOG, Emulex, Micro Technology	All	Cipher, Kennedy
GROUP THREE ELECTRONICS 21041 Western Ave., Ste. 300 Torrance, CA 90501 213-781-9222 **Circle No. 139**	Guardian 4489	POR	•					Q-bus	DILOG DQ142	TS11, TSV05	Cipher M891
	Guardian 4490	POR	•					Q-bus	DILOG DQ142	TS11, TSV05	Cipher M990
	Guardian 4290	POR	•					Multibus I	Xylogics 472		Cipher M990
	Guardian 4289	POR	•					Multibus I	Xylogics 472		Cipher M891
	Guardian 4689	POR	•					VME	Xylogics 772		Cipher M891
	Guardian 4690	POR	•					VME	Xylogics 772		Cipher M990
HONEYWELL P.O. Box 5227 Denver, CO 80217-5227 303-773-4491 **Circle No. 140**	Very Large Data Store (VLDS)	POR				•		Unibus, Q-bus, VME	Any DEC-compatible SCSI host adapter	TS11, TMSCP	Honeywell VLDS
INNOVATIVE DATA TECHNOLOGY 5340 Eastgate Mall San Diego, CA 92121 619-587-0555 **Circle No. 221**	MTS Series/130	POR	•					Unibus	DILOG	TS11, TM11	IDT
	MTS Series/150	POR	•					Q-bus	DILOG	TS11, TSV05, TM11	IDT
	MTS Series/150MVL	POR	•					MicroVAX	DILOG MV132	MicroVMS	IDT
	TD Series/VME	POR	•					VME	I/O Inc. VME 403	VersaDOS	IDT
	TD Series/INTL	POR	•					Multibus I	Ciprico		IDT
KENNEDY CO. DIVISION OF SHUGART CORP. 1600 Shamrock Ave. Monrovia, CA 91016-4247 818-357-8831 **Circle No. 141**		POR	•	•				Unibus, Q-bus, VME, Multibus I	DILOG, Emulex, and others		Kenndey

TAPE STORAGE SUBSYSTEMS

Company	Product Name	Price	Drive Type: Reel-To-Reel	Drive Type: ¼-in. Cartridge	Drive Type: ½-in. Cartridge	Drive Type: Helical Scan	Drive Type: Other	Host Bus Compatibility	Controller: Mfg./Model	Controller: Emulation	Drive Manufacturer/ Model
MEGATAPE CORP. 1041 Hamilton Rd. P.O. Box 317 Duarte, CA 91010-0317 818-357-9921 **Circle No. 142**	MT-500	$13,500			•			Unibus, Q-bus, VME, Multibus I	Emulex TC-03, TC-13	TS11	MegaTape MT-500
	MT-750 Plug & Play Tape Subsystem	$15,250			•			Unibus, Q-bus, VME, Multibus I	Emulex TC-03, TC-13	TS11	MegaTape MT-750
MICRO TECHNOLOGY INC. 1620 Miraloma Ave. Placentia, CA 92670 714-632-7580 **Circle No. 143**	MU 600	$9,000				•		Q-bus	Micro Technology QTS	TMSCP	Exabyte EXB-8200
	MS 400	$3,095		•				Q-bus	Micro Technology MSV05	TS11, TSV05	Archive Viper
	Microsafe	$3,445		•				Q-bus	Micro Technology MSV05	TS11, TSV05	Archive Viper
	MD 4650	$10,500				•		Q-bus	Micro Technology QTS	TMSCP	Exabyte EXB-8200
MINI COMPUTER TECHNOLOGY 696 E. Trimble Rd. San Jose, CA 95131 408-435-161 **Circle No. 144**	Ruggedized Tape Drive Subsystem	$12,000		•				VME, Multibus I	Mini Computer Technology MCT4700		Mini Computer Technology RUTS
	Removable Disk Drive System	$4,780					•	VME, Multibus I	Mini Computer Technology MCT4700,		Mini Computer Technology RDS
PSI INC. 18 Tait Rd. Saratoga Springs, NY 12866 518-587-5886 **Circle No. 218**	XT-880, XT-890, XT-990	$9,995-$17,995	•					VME, Multibus I	Xylogics 472		Cipher 890, 990
QUALSTAR CORP. 9621 Irondale Ave. Chatsworth, CA 91311 818-882-5822 **Circle No. 145**	9 Track ½-in. Tape Drive	POR	•					Q-bus	Micro Technology MSV15	TSV05	Qualstar 701, 1052, 1054
SUMMUS COMPUTER SYSTEMS 14925-A Memorial Dr. Houston, TX 77079 713-589-9772 **Circle No. 146**	Masstape Model 2460	$1,900+		•				Unibus, Q-bus, VME, Multibus I	Summus 2460U, 2460Q, 2460V, 2460M	TS11, TMSCP	Archive Viper
	Datatape Model 2470	$4,700+	•					Unibus, Q-bus, VME, Multibus I	Summus 2470U, 2470Q, 2470V, 2470M	TS11, TMSCP	Cipher 890, StorageTek 2900
	Gigatape Model 2480	$4,200+				•		Unibus, Q-bus, VME, Multibus I	Summus 2480U, 2480Q, 2480V, 2480M	TS11, TMSCP	Exabyte 2480
THE 11 CONNEXTION 1105 Pamplona Ave. Davis, CA 95616 916-758-2943 **Circle No. 147**	11X-MSV05-5T/60	$2,500-$3,400		•				Q-bus	Micro Technology MSV05	TSV05	Archive 9045L
TOTAL TEC SYSTEMS INC. 2 Gourmet Ln. Edison, NJ 08837 201-906-6500 **Circle No. 148**	TT96003	POR	•					Q-bus	Emulex TC03	TS11, TSV05	kenndey 9600A
	TT96013	POR	•					Unibus	Emulex TC13	TS11, TSV05	Kenndey 9600A
	TT75013	POR			•			Unibus	Emulex TC13	TS11	MegaTape MT-750
	TT75003	POR			•			Q-bus	Emulex TC03	TS11	MegaTape MT-750
TRANSITIONAL TECHNOLOGY INC. 1401 N. Batavia St., Ste. 204 Orange, CA 92667 714-744-1030 **Circle No. 149**	CTS-8	$6,995				•		Unibus	Transitional Technology	TMSCP/ Proprietary	Exabyte EXB-8200
	CTS-8	$5,995				•		Q-bus	Transitional Technology	TMSCP/ Proprietary	Exabyte EXB-8200
	CTS-8	$7,995				•		VME	Transitional Technology		Exabyte EXB-8200
	CTS-8	$7,995				•		Multibus I	Transitional Technology		Exabyte EXB-8200
TRIMARCHI & ASSOCIATES INC. 139 N. Gill St. State College, PA 16801 814-234-5659 **Circle No. 150**		POR		•				Q-bus	Micro Technology MSV05	MS-type, TS11	Archive
ZOLTECH CORP. 7023 Valjean Ave. Van Nuys, CA 91406 818-780-1800 **Circle No. 151**	F0X-U1	$2,635		•				Q-bus	Zoltech TCC-TSV05-QIC2	TSV05	Kenndey 9500
	F0X-U2	$5,725	•					Q-bus	Zoltech TCR-TS11-P-M	TSV05	Kenndey 9600

REPORT 1

HC/WG LABS HOW REPORT

HC/WG Labs Evaluates the Exabyte EXB-8200 on the MicroVAX II

No bigger than a TK50 tape drive, the Exabyte EXB-8200 is one of the first video storage devices for DEC systems and HC/WG Labs integrated it with the MicroVAX II for test evaluation

The Exabyte 8mm product stores *2048 Mbytes of data, as compared to the much smaller capacities of traditional tape media.*

by Jon Elson,
President Pico Systems

The Exabyte EXB-8200 is a high-capacity (2.3 Gbytes) magnetic tape drive that uses standard 8mm video cartridge tapes as media. This cartridge is smaller than an ordinary audio cassette, but slightly thicker. It is used in several video cam-corders and with the emerging Digital Audio Tape (DAT). These cartridges are available for about $9.95 (quantity 10) and 2.3 Gbytes is the equivalent of more than 14 full-sized 6250-bpi, nine-track tapes or fifty-one 1600-bpi tapes.

The drive has the same form factor (8.5-H x 5.8- W x 3.3-in. D) as a standard, full-height 5.25-in. floppy or hard disk, or DEC TK50 tape drive. The power required is +5 V (at 4 amps) and +12 V (at 1.2 amps), somewhat greater than a 5.25-in. hard disk. The power connector is the same four-pin Molex 8981 used on all 5.25-in. drives, thus, the drive is compatible with all system cabinets that house and power 5.25-in disk drives.

HARD FACTS:

EXB-8200

Price: $3,500 (Qty. 1)
$2,830 (Qty. 100)
Sold only to OEMs/no end-user price.

- Integrated SCSI controller and formatter
- On-board Error Correction Code (ECC) and Error Recovery Procedures (ERP)
- 256-Kbyte speed-matching buffer
- Recording format: 8mm helical-scan digital computer tape
- Transfer rate (peak): 1.5 Mbyte/second
- Transfer rate (sustained): 246 Kbyte/second
- Buffer size: 256 Kbytes
- Standard 8mm tape cartridge (3.7 x 2.5 x 0.6 in.)

EXABYTE CORP.
1745 38th St.
Boulder, CO 80301
303-442-4333
Circle No. 192

Striping the Data

The data is recorded in diagonal stripes onto the tape, similar to the way a frame is recorded on video tape. Firmware in the drive seeks the center of the data track for the strongest data recovery signal. Each track of data includes 8 Kbytes of user data per rotation, broken into 1K blocks. Each 1K block contains 400 bytes of error-correcting code, plus a housekeeping preamble that identifies the structure of the blocks of user data packed into the physical 1K data blocks. The drive handles user data blocks from 1 to 65,536 bytes. The user data is packed into the physical blocks, so that if you use data blocks shorter than 1 Kbyte, there is no loss of density or speed, as there would be on a nine-track tape drive.

The drum that rotates against the slowly moving (½-in./second) tape carries three heads: servo, write, and read. The tape flies past the rotating head at 150 in./second, providing a strong data signal to the read preamplifier. The read head picks up the just-written data while the write head is still writing the track and checks for errors that will degrade the error-correction system. If an excessive number of errors are detected, then the block is re-written in the next available location on tape. This occurs without any backspacing of the tape. Upon readback, the replacement block is read instead of the original. The error-correction code can correct a burst of up to 264 bytes as well as 80 additional random errors in each 1K data block! This is the most advanced error-correction capability ever available on an off-the-shelf computer peripheral—capable of correcting more than 25% of the data in each block. Data density is 43,200 data bits/in. and track density is 819 tracks/in. for a bit density of 35.4 Mbit/sq. in.

Operational Characteristics

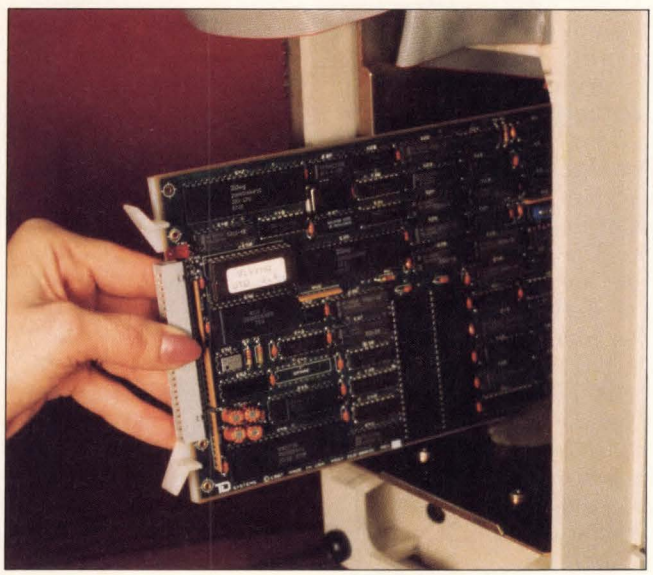
The head drum rotates at 1800 rpm (30 revolutions/second). Each rotation covers one track that contains 8 Kbytes, providing a maximum data rate of 240 Kbyte/second. Additionally, the drive has a 256-Kbyte buffer, used for both read and write operations. This buffer smooths the irregular data transfer rate between the computer and the drive, thereby enabling the drive to remain in streaming mode (the only other mode is stopped). If the computer cannot keep the data flowing when writing and the buffer completely empties, the drive writes blank tape for 1/30 second (one track), and stops tape motion. During reads, the tape backs up slightly, then rolls forward to regain sync with the data once the computer resumes reading. This repositioning takes less than 1 second.

At 240 Kbyte/second, 1 Mbyte transfers in 4.3 seconds; therefore, 14 Mbyte/minute are processed, which works out to reading or writing 2 Gbytes in 145.7 minutes—if your computer can handle it that fast. A big 6250 bpi, 125 inches-per-second (ips) tape drive can move data faster, but you have to allow 14 rewinds plus manual intervention for the equivalent 14 nine-track tapes.

The cartridge can be unloaded by either manual or computer control and loading is accomplished by simply pushing the cartridge into the drive and closing the door. Motors whir, solenoids click, and after about 1 minute, the green LED lights indicate that the cartridge is loaded and ready.

Table—Summary of Exabyte Performance

Command	Time (min:sec)	Number of 8K Blocks	Transfer Rate (Kbyte/second)
BACKUP WITH CRC	22:39	6254	37.7
BACKUP WITHOUT CRC	12:41	6254	89
DIRECTORY OF MUA0:	0:88	6254	582
COPY MUA0: NL:	5:10	6254	165
DIRECT I/O	6:25	10,000	211



***TD Systems' QTO is** a dual-wide board for 22-bit Q-bus systems like the MicroVAX. It uses the standard DEC TMSCP driver to support up to eight devices on a single SCSI bus.*

Storage By Inches

Comparing archival storage volume in cubic inches is another interesting exercise. A 2400-foot, nine-track tape is 10 in. in diameter, and standard tape racks hold these tapes on 1-in. (center-to-center) spacing. This occupies 100 cu. in. for every tape, since the corners of the square around the tape are empty. The 8mm cassette is approximately 4 x 2.5 x 1 in. in its plastic storage case. This works out to 10 cu. in., and it stores 14 times as much data as the single 2400-foot tape, therefore increasing data density in the tape storage area by a whopping factor of 140 to 1! I have not tried fitting these tapes into a "Wright-Line" type storage rack system for data cassettes or DC-300 data cartridges, but they should fit one or the

other. The IBM 3480 format stores, at most, 300 Mbytes in a cartridge about twice the size of an 8mm cassette, so it is still at a disadvantage of about seven to one in density.

In modest quantities, 2400-foot ½-in. tapes cost $12–$15 each, so the 8mm format costs up to 21 times less to acquire the media. The cost savings are almost as great when compared to the IBM 3480 format.

The MicroVAX II Connection

In order to connect the Exabyte drive to the MicroVAX, we used the TD Systems Inc. QTO (Q-bus, tape only) SCSI tape interface. The QTO sells for $1,395 in single quantity, and the Exabyte EXB-8200 is priced at $3,500 in single quantity, so the whole system can be obtained for only $4,895. This is less than any high-performance magnetic tape system, and is a spectacular deal, considering the advantages of this system. The QTO controller uses a Z-80 and 64 Kbytes of firmware to make several different models of SCSI tape drives compatible with TMSCP protocols. The interface is a dual-wide Q-bus module with a 50-pin connector on the handle end. A self-test LED on the board blinks when SCSI data transfers are occurring to give you an idea when the SCSI path is busy as it might become a bottleneck if more than two drives are in use simultaneously. The controller supports up to four drives.

The drive can transfer 1.5 Mbyte/second in a burst to the buffer, and the interface can transfer at the same rate, so that all four drives can be transferring simultaneously without interfering on the SCSI. We only have one drive so we couldn't verify this. The drive's buffers allow the computer to make one transfer at the burst rate and then release SCSI to perform transfers on another drive. Most nine-track systems don't buffer a whole tape block, thus tying up the computer interface during the transfer. If a skip file operation is specified on a nine-track drive, the whole tape system (all drives) is locked up until the operation is completed. The method used by the QTO interface, however, allows other drives to continue operating while one drive performs a long operation.

The TD Systems' interface handles emulation of TMSCP protocols and all details of the tape drive's activity so that the drive autoconfigures into VMS. INIT, MOUNT (both ANSI and foreign) BACKUP, and COPY commands performed flawlessly. File searching and directory operations are performed at accelerated speed because the Exabyte drive does record skip and file skip operations at search speed—10 times normal data transfer speed. The drive counts the number of blocks skipped before it hit the tape mark, and reports this back to the interface. Thus, a directory search runs almost 10 times faster than the comparable copy command: MUA0:*.* NL:, which involves a wild card search of every file.

Installation Ease Defined

The Exabyte drive can be mounted on a standard DEC disk drive mounting slide (DEC part number 74-25652-02), permitting easy installation into existing system configurations. The (+5, +12) power cord is plugged into the drive and a 50-conductor ribbon cable is run from the controller to the drive. This is a rather nasty procedure because of the prewiring of the system modules on an H9642 system (KA630-Q5), but is fairly easy on the BA23—internal processor module—and BA123. Any of the four slots on the 9642 can be used for the tape drive. It may be necessary for you to place the tape controller card before the disk controller. For example, you might consider placing it between the CPU and disk controller, because some DEC Q-bus disk controllers do not pass the grant for DMA.

TD Systems provides a junction panel that splits the SCSI signals and the RS-232 signals for the configurations console. This junction panel mounts on the rear bulkhead of the system cabinet if you remove a blank filler panel. However, when internally mounting the tape drive, these panels can be ignored.

We didn't have to use the configuration console because the unit was already configured properly for our use. But should you need to change any configuration setup data, this data is stored in a non-volatile on-board EEPROM and can be altered interactively by use of the on-board diagnostic monitor program, which runs on the QTO's Z-80.

The diagnostic monitor is accessed through any 9600 baud CRT terminal. You can ask for a report on what devices the QTO sees on the SCSI bus, enable or disable parity checking on the SCSI bus, or enable/disable SCSI Disconnect, which allows the controller to read and write from other drives while one drive is tied up with a long operation like a MOUNT, INIT, or file skip. You can also remap MUxx: devices to specific unit addresses on the SCSI bus, and select DMA burst size, from two to 16 words in even number steps. This will be most useful on the MicroVAX 3000 series since the Buffered Data Path is back with this new model. The Buffered Data Path, if used, will greatly ease the data bottlenecks on the Q-bus.

The QTO interface can be set up for seven different addresses on the Q-bus by jumper selection. Vectors are assigned automatically, at boot time, by the VMS system's auto-configuration software.

The Test Environment

The test environment we established included a MicroVAX II, running VMS 4.3, with a 2-Mbyte memory and an Andromeda Systems Inc. UDC-11 disk controller attached to a Maxtor 85-Mbyte (unformatted) hard disk. This drive served as the data source for most of the transfers we measured. To ensure a true test of the tape in a home environment, the files on the disk were fragmented and no special precautions were taken to ensure contiguous file throughput.

To begin the test, the INIT command is issued to write the first physical block on the tape. This is a slow operation for the Exabyte, regardless of tape status. We measured 2 minutes, 13 seconds per block. MOUNT takes 52–56 seconds, whether ANSI or foreign. If the tape drive has not been accessed in more than 3 minutes, the head drum is stopped by the drive, and it takes about 1 minute to complete drive recalibration and place the tape back at the point where it was when the drum was stopped. This reduces tape and head wear.

The BACKUP DUA0:/ignore=interlock mua0:dua0.bck/save function, took 22 minutes and 39 seconds to write a block of 6254 files each of which are composed of 8,192 bytes, with a save set to tape, which yields a 37.7 Kbyte/second overall throughput. If you subtract the time it takes the tape drive to get going initially (approximately one minute), the

throughput is 39.4 Kbyte/second. This isn't stunning, but remember that the source disk was fragmented and not a particularly fast disk subsystem either.

In another test that involved setting up the environment as: BACKUP DUA0:/image/ignore=interlock mua0:dua0/save/block=8192/ buffer=5 /nocrc the backup process took 12 minutes and 41 seconds to write the same disk files that we used in the first test. Actual writing took 9 minutes 35 seconds, yielding an 89 Kbyte/second throughput. This time we observed that the tape was rarely moving and that the disk was almost constantly not-ready.

Obviously, VMS BACKUP isn't the utility to make the Exabyte shine.

Issuing DIR/SIZE MUA0: showed the high-speed search mode of the Exabyte; it gave a directory list of the backup save sets on the EXB-8200 created in the previous tests in 88 seconds, scanning over the data at 582 Kbyte/second, while it took COPY MUA0: NL: 5 minutes and 10 seconds to actually read the blocks at 165 Kbyte/second. The DIR command uses read commands to pick up the file header and trailer labels, and skip commands to speed past the data blocks.

Finally, we wrote a simple FORTRAN program to write data at the maximum rate with a QIO call. A total of 10,000 blocks—files—each composed of 8192 bytes were written in 6 minutes and 25 seconds, a throughput of 211 Kbyte/second. This we believe to be significant since it demonstrates that you can make the drive perform better without operating system software overheads.

The Andromeda disk controller, as well as the DEC RQDX2 (disk controller for RD52, RD53) requires two revolutions of the disk to transfer a whole 17-sector track of 8704 user data bytes, which equals 265 Kbyte/second, so this tape drive can provide measured performance nearly equal to the theoretical maximum transfer rate of the disk subsystem.

The DEC RQDX3 (RD53, RD54 drive controller) can transfer a whole track in one revolution, doubling the transfer rate, but if the disk has to do much seeking, transfers will drop to a lower rate (below 100 Kbyte/second) and the Exabyte will have no trouble keeping up.

Jon Elson is president of Pico Systems (Webster Grove, MO), an image system development firm. Elson earned a B.T.E.E. from Washington University, St. Louis, MO and has 10 years experience developing software and hardware for DEC systems. For further information, contact Elson at 314-962-6103

For additional information about the products described in this evaluation, either contact the companies directly or circle the reader service number.

Andromeda Systems Inc.
9000 Eton Ave.
Canoga Park, CA 91304
818-709-7600
Circle No. 193

TD Systems Inc.
24 Payton St.
Lowell, MA 01853
617-937-9465
Circle No. 194

Accounting Software

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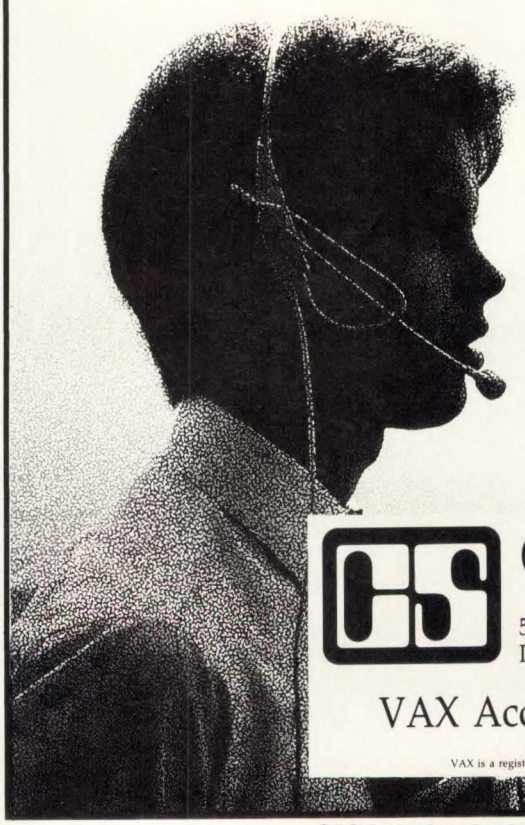

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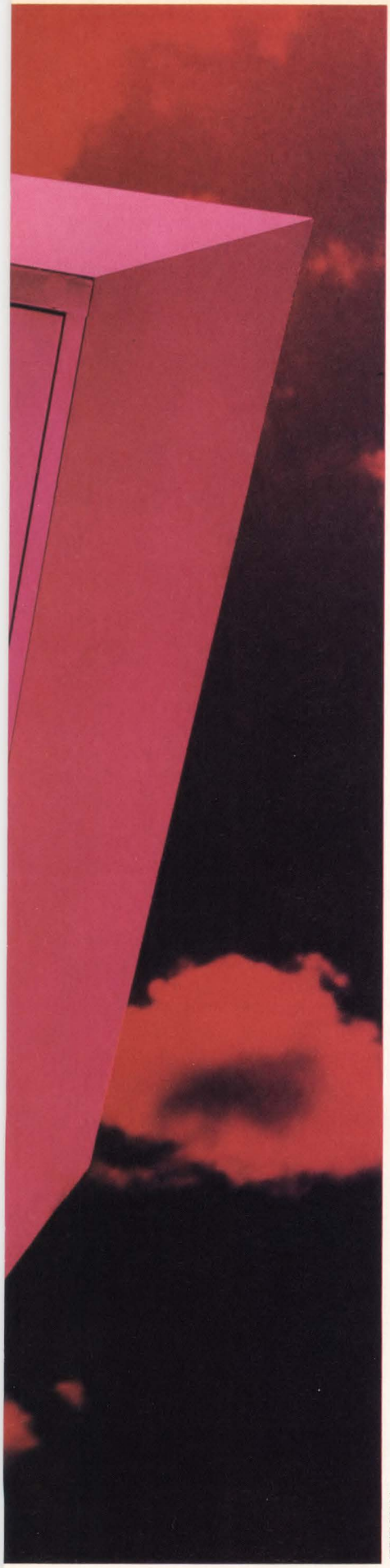
CIRCLE 411 ON READER CARD



LEE KARJALA

WRITE-ONCE OPTICAL WORMS ITS WAY INTO APPLICATION ARENAS

FACING STIFF COMPETITION FROM HELICAL-SCAN TAPE AND ERASABLE MAGNETO-OPTICAL STORAGE, WRITE-ONCE OPTICAL-STORAGE TECHNOLOGY SEEKS OUT NEW APPLICATIONS TO MOVE PRODUCT INTO THE MAINSTREAM

BY BRAD HARRISON, Senior Technical Editor

Write-once read-many (WORM) optical-disk technology has and is having a tough time of it. Relatively new—the first products introduced only three years ago—WORM has had trouble finding its niche, especially for 5.25-in. products.

The write-once technology may prove to be an ideal substitute for both magnetic Winchester disk drives and tape when capacity is at issue. Early developers, such as the French company Alcatel Thompson Gigadisk and Optimem (now part of Cipher Data), both pioneers in optical storage, ran into financial and technical problems. Storage media, especially that using ablative technology, suffered from poor error rates and small yields. Additionally, problems with positioning systems and reliability of the laser proved troublesome.

Despite these early stumbling blocks, WORM drives—especially 12-in. models—are finding extensive use for large document storage and retrieval systems. Because the read-only nature of WORM allows many users simultaneous access to files, these applications of WORM technology are particularly compelling when many users require access to the documents—a factor FileNet Corp. is betting on.

A Suitable Technology

Although WORM technology isn't easily updated, or erasable, "WORM technology is the only suitable media for certain types of document storage," says Otto Reichardt, FileNet's director of OEM marketing.

Specifically, FileNet manufactures systems that improve normal paper-

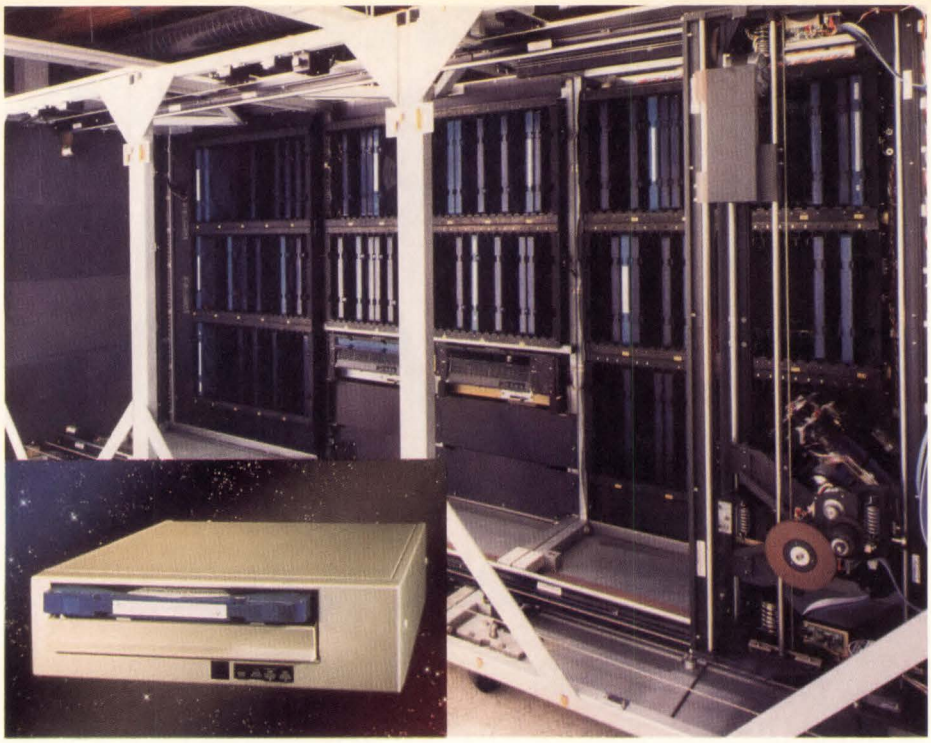


Figure 1—FileNet's OSAR-200 optical storage library puts *204 disks on-line for 530 Gbytes storage capacity. Up to eight 204-disk units may be configured in a single FileNet system, providing more than 4 terabytes of on-line storage capacity. This is equal to storing the text in approximately five million issues of* Hardcopy.

The robotic mechanism on the right removes the selected platters from the shelves and inserts them into the optical drives in the center of the arrangement, permitting any record to be accessed in less than 10 seconds.

LMSI's 12-in. drive (inset) *is used in the OSAR-200 jukebox because of its single-insertion capability.*

WHAT'S YOUR APPLICATION?

Write-once optical drives are finding many new applications for image and data storage, as well as in areas where the inherent physical property of an unalterable medium is of significant value.

In conjunction with jukebox technology, WORM optical disk drive applications are growing fast. If you require access to a large body of information that is infrequently updated—if updated at all—then consider WORM. Or if you just need a permanent, secure method of storing and accessing data, WORM might be the answer. *—B.H.*

Table 1—Key Applications For WORM Optical Disk Drives By Industry

Vertical Markets:	Office Automation	Medical	CAD/CAM	Banking	Natural Resources	Government (Federal/Local)
Key Applications:	Word processing Accounting Billing Directories Usage Filing Electronic mail Records	X-ray images CAT scan images Patient records Hospital administration Archiving	Engineering drawings Catalogs Documentation	Demand deposits Credit cards Journaling POS Customer accounts	Seismic Oceanographic Weather Mapping	IRS Patents Office Library of Congress Welfare records Statistics Fingerprints Intelligence

Courtesy Freeman Assoc.

Table 2—Key Applications For WORM Optical Disk Drives By Application

Generic Applications:	Office Information	Reference Information	Transaction Processing	Image Processing	Data Collection
Key Examples:	Electronic mail Word processing Order processing Document filing Manuals Directories File server	Medical records Patents Catalogs Legal records Marketing statistics Libraries	Accounting Billing Insurance claims Demand deposit Point of sales Credit card processing Equipment usage	X-ray Engineering drawings Insurance documents Fingerprints Maps	Seismic Journaling Weather Oceanic research Utilities usage

Courtesy Freeman Assoc.

work activity (Figure 1). The systems are sold to businesses such as banks and insurance companies that need to transfer original paperwork onto a computer-readable, permanent media. The paperwork is then easily accessible in a read-only form to everyone on the system. "A fact that ensures document security," claims Reichardt.

Industry analysts claim this read-only security is especially important for credit card and retirement fund applications where transaction histories need to be referenced by several people but stability—unalterability—of the document is permanent. Moreover, these machine-readable documents are considered original documents where veracity and authenticity are solid, even if challenged in court—or so-claim vendors.

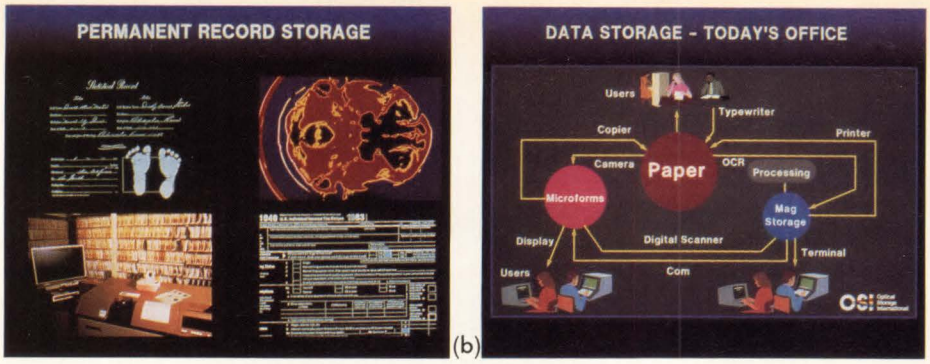
WORM's read-only nature makes it a unique media. "An investment in WORM is permanent," points out Philip Shires, vice president of sales and marketing for Laser Magnetic Storage International (LMSI), the manufacturer of the OSI brand name optical products, "and that won't change no matter what technical developments occur in other media."

Putting the Platters on Play

Surprisingly, support technology—jukeboxes—are helping bring write-once technology into the mainstream. Originally developed for the record industry, these mechanical marvels locate, mount, and even flip the platters.

Jukeboxes are available from several companies including FileNet, Cygnet Systems Inc., and Hitachi America Ltd. Because the jukebox allows terabytes of data to be readily available, markets that were traditionally served by micromedia—microfiche and microfilm (Figure 2)—are expected to be serviced by optical.

Although the multi-platter, rapid



(a) (b)

Figure 2—As the information age progresses, *new means of storing data are sought. Traditional repositories* (a) *have included human memory, file cabinets, and micromedia. But the demand for more efficient methods is growing as today's office* (b) *accumulates an ever-greater amount of data that must be dealt with in a timely manner. Currently, most of the data resides on magnetic storage and micromedia, but optical storage is rapidly dropping in price and increasing in functionality to become the media of choice for these applications.*

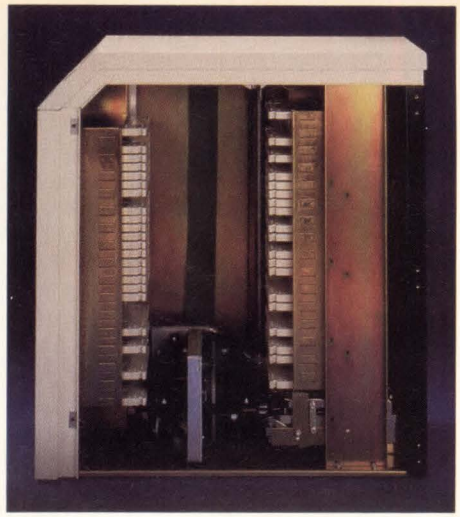


Figure 3—Optotech's Optofile offers *26.4 Gbytes of user capacity. Its small footprint allows users to store the unit under a desk for space efficiency. Optofile can hold up to sixty-six 400-Mbyte write-once disks and up to four drives.*

retrieval jukeboxes are in general use with 12-in. technology, they have only recently become available for 5.25-in. optical drives. Optotech introduced a 50-platter, 26-Gbyte jukebox at Comdex in Las Vegas this past November (Figure 3). Though jukeboxes do make more data available, they truly can't be considered as on-line. Therefore, they are being referred to as "near-line." The notion here is that the locality of the data, not necessarily the speed of access, is improved by jukeboxes.

MO's Challenge to WORM

Even with a reasonably bright, but conservative future ahead for WORM products, technology advances are on the horizon that many expect to limit interest in WORM. Specifically, erasable drives using magneto-optical (MO)

INSIDE MO

Though several different types of erasable laser disk technology are under development, the most promising appears to be magneto-optical (MO), which uses a combination of magnetic recording techniques along with established optical technology.

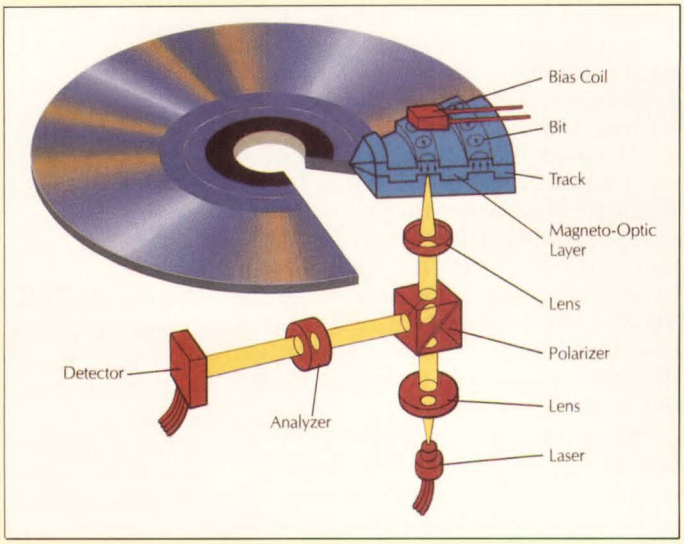
In MO recording, a spot on the sensitive layer of the disk is first heated by a laser beam, then a magnetic coil applies a magnetic field to the spot, resulting in a magnetic flux reversal in the laser-heated spot. This spot is equal to a logical "1"; a logical "0" is where no flux reversal occurs.

Reading is accomplished by detecting the effect of the magnetization differences on the reflected beam.

Data is erased in MO systems by applying an external bias field in the direction opposite to the magnetic flux reversal, while focusing the write laser beam on the area to be erased.

This technique allows for resolutions not obtainable by magnetic means alone. Specifications for an MO are similar to those of a standard magnetic disk such as Olympus Optical Co. Ltd.'s (Tokyo, Japan) MO drives, marketed by Olympus Corp. T.D.C. (see Table), except transfer rates are much lower. Also, a separate erase cycle is required, further decreasing performance. —*B.H.*

When the temperature of a magneto-optic recording layer is raised *to about 200°C, the high coercivity is temporarily lowered, and a small magnetic field is then able to reverse the direction of magnetization. It is this property that allows the media to be recorded and erased.*



Table—Specifications For Olympus Optical Co. Ltd. Magnetic Optical Drives*

MO DISK DRIVE (MODEL ME-D5010E)	
Access time:	
Average	130ms
Track to track	2ms
Average latency	16.6ms
Data transfer rate	5 Mbit/second
Disk rotation speed	1800 rpm
Interface	Modified ESDI
Weight	2.8kg
Power requirements	+12 VDC, +5 VDC
Dimensions (mm)	145Wx82.5Hx203L
MO SUB-SYSTEM (MODEL ME-S5010E) (INCLUDING CONTROLLER AND POWER SUPPLY)	
Data transfer rate	1 Mbyte/second
Corrected bit error rate	10^{-12}
Host interface	SCSI
Power requirements	100–120 VAC
Dimensions (mm)	245Wx203Hx310L
MO DISK (MODEL ME-M5011ME)	
Disk diameter	5.25 in.
Cartridge dimensions (mm)	135Wx11Hx153L
Sector size	512 bytes
Capacity per side:	
Formatted	240 Mbytes

*Available 3rd quarter, 1988

techniques are already showing up as technology introductions that will challenge WORM.

Currently, Eastman Kodak has the lead with an MO drive first shown in a primitive version three years ago by Verbatim Inc. (before it was purchased by Kodak), then again in November of '87. But don't expect to run out and buy huge quantities of the new device—it's still in the "wonderment" stage and most likely won't see the light of day until sometime in 1999.

This case seems to be representative of MO technology in general. In fact, Raymond Freeman, president of Freeman Assoc. (Santa Barbara, CA), predicts that it will still be quite some time before usable MO drives in the 1-Gbyte range are available. "They're still in the laboratory stage right now," he says. Once they're available, erasability and fairly high-storage capacity may be for a time the only compelling reason to consider the MO drives, speculates Ken Cross, vice president of systems at Perceptics, a leading DEC-compatible optical subsystem manufacturer. "Basically, MO drives will be slow, low capacity, and expensive—eventually they may fit into the PC world."

Right off the bat, there will be at least one major limitation to MO—you'll only be able to write to the media a million times. In an average lifetime, a magnetic disk—particularly the sectors where directories are stored—may be written to billions of times.

And since the first models to receive widespread use will hold just 500—600 Mbytes of data, MO probably will—at least at first—be restricted to the PC world. As for cost, the first drives available in large quantities will reportedly cost between $1,500 and $2,000, and platters will run about $75 each.

"MO will threaten 5.25-in. WORM," says LMSI's Shires. "Not 12-in."

Tape Up the Loose Ends

Making a bid for what could be optical disk's market is helical-scan tape technology and high-capacity ¼-in. and ½-in. magnetic tape. Helical-scan tape is making gigabytes of capacity available on a single cartridge, and traditional tape options are reaching into the hundreds of megabytes.

Interestingly, WORM manufacturers acknowledge tape as an ideal backup medium. "If backup is what you want, use tape," says Jeff Dulude, vice president of marketing for Optotech. "But if the data was costly to develop, and you want to keep it around for a long time, WORM, we believe, is the ideal choice. You have to compare the cost of acquiring and managing the data against the cost of storing it," he says.

Because there is still some question on the reliability of 5.25-in. WORM media, and standards are slow to emerge, tape may prove to be the appropriate solution—at least for the short term.

Helical-scan drives are making a dramatic entry into the market from companies such as Exabyte Corp. and Digi-Data Corp., and are expected to quickly acquire some of the DEC TK50/70 market due to their low cost per Mbyte per cubic in.—a new means of gauging cost/performance based on recording density.

"You as a DEC user aren't out in the cold but can enjoy the bright light of optical storage as well."

Although tape is pressing optical for market dominance, don't forget magnetic Winchester for primary storage. Several companies including Control Data Corp. (CDC) and Maxtor Corp. are offering 5.25-in. drives in the 300–780 Mbyte range with access times less than 30ms at a cost/Mbyte of less than $5. And this cost is moving toward less than $2.

But even with an emphasis on improved magnetics, both CDC and Maxtor are aggressively pursuing the optical world as well. Maxtor's 800-Mbyte, 5.25-in. WORM drive is manufactured by Ricoh Corp., and CDC owns a portion of LMSI, manufacturer of the OSI line of optical products.

Who Needs Standards Anyway?

Standards for optical disk packaging and disk formatting have been slow in arriving, but that hasn't necessarily been bad. Sales of WORM drives in the 12-in. form factor have been as brisk as can be expected regardless of the total lack of standardization. This, however, may not hold true for the next generation.

"Twelve-inch WORM drive manufacturers would like a standard for later generations," says Robert Katzive, vice president of research firm Disk/Trend (Mountain View, CA), "and a 12-in. media standard has already been proposed to ANSI [American National Standards Institute]."

Standards activity for 5.25-in. WORM is, however, much further along. The proposed ANSI X3B11 committee for 5.25-in. drives has already developed standards that define items such as media cartridges and disk labeling, but not physical or logical file formats, which are still in dispute. ANSI has submitted the proposed standard to the International Standards Organization (ISO) for worldwide approval.

More Than Physical

Defining a cartridge is only part of the problem facing standards makers. Still to be resolved are issues regarding physical and logical file formats, along with which servo method—continuous or sampled—will prevail.

In the meantime, each company has custom offerings. Optotech, for example, has complied with the X3B11 standard but has eschewed proposed physical and logical file format standards—at least for the moment—in favor of its own software solution. This solution permits platters to be interchanged among DOS, VMS, and some UNIX machines. Optotech does admit it runs the risk of interchange problems down the line when file formats finally emerge, but the company is pushing ahead anyway.

Making DEC Wormy

You as a DEC user aren't out in the cold but can enjoy the bright light of optical storage as well. Though DEC hasn't announced any products yet, you have a number of third-party 5.25-in and 12-in. models to choose from (Table 1), and connection is simplified by use

continued on page 58

TABLE 1—OPTICAL SUBSYSTEMS

Company	Product	Price (Quantity One)	Controller			Drive	Capacity
			Host Bus	Model	DEC Emulation		
ADEPT DIGITAL SYSTEMS INC. 2381 Zanker Rd. #150 San Jose, CA 95131 408-435-9151 **Circle No. 102**	Optical Disk Subsystem	$19,000	Q-bus, Unibus	Custom	Custom driver for VMS, RSX, or RT-11	LMS/OSI	1-2 Gbytes
AQUIDNECK SYSTEMS 650 Tenrod Rd. N. Kingstown, RI 02852 401-295-2691 **Circle No. 103**	OAS-100 Optical Archiving System	$23,300+	Q-bus, Unibus	Aquidneck OAS-100 (Pertec interface)	TSV05, TS11	Any SCSI	200 Mbytes to 6.8 Gbytes
	OAS-150 Optical Archiving System	$28,300+	Q-bus, Unibus	Aquidneck OAS-150 (Pertec interface)	TSV05, TS11	Any SCSI	200 Mbytes to 6.8 Gbytes
	OAS-2000 Optical Archiving System	$95,000+	Q-bus, Unibus	Aquidneck OAS-2000 (Pertec interface)	TSV05, TS11	Any SCSI	30-300 Gbytes
	OAS-3420 Optical Archiving System	$34,500+	Q-bus, Unibus	Aquidneck OAS-3420 (Pertec interface)	TSV05, TS11	Any SCSI	800 Mbytes to 6.8 Gbytes
AVIV CORP. 26 Cummings Pk., Woburn, MA 01801 617-933-11**Circle No. 104**	OSS 2000/925 (Q-bus), OSS 2000/625 (Unibus)	$32,000	Q-bus, Unibus	OSS 2000 (Pertec interface)	TSV05, TS11	Optimem	1-2 Gbytes
C.ITOH & CO. (AMERICA) INC. 1 Maritime Plaza San Francisco, CA 94111 415-391-2510 **Circle No. 105**	OPCA-11	$24,000	Q-bus, Unibus	SSVA-11, SSV-11	Custom driver for VMS	C.Itoh	1.3-2.6 Gbytes
COMPUTER UPGRADE CORP. 2910 E. La Palma, Ste. A Anaheim, CA 92806 714-630-3457 **Circle No. 106**	OSR-VAX/U1, OSR-VAX/Q1	$19,995 (U1), $10,500 (Q1)	Q-bus, Unibus	KOM OSR-U/HA, OSR-Q/HA	INP	LMS/OSI, Sony, Optimem, Kodak, Optotech	2-40 Gbytes
CYGNET SYSTEMS INC. 601 W. California Ave. Sunnyvale, CA 94086 408-773-0770 **Circle No. 107**	Series0 Optical Disk Jukebox	POR	Q-bus, Unibus	INP	N/A	ATG, Hitachi, LMS/OSI, Optimem	30-366 Gbytes
DIGITAL BASICS INC. 689 S. Canterbury Rd. Shakopee, MN 55379 612-496-2550 **Circle No. 108**	DB59A/B Optical Disk Subsystems	$11,250	Q-bus, Unibus	DILOG SQ703 or SU703	MSCP	LMS/OSI Model 1200	1-2 Gbytes
	DB81A/B Optical Disk Subsystems	$6,800	Q-bus, Unibus	DILOG SQ703 or SU703	MSCP	Laserdrive Model A10	408-810 Mbytes
EMC CORP. 171 South St. Hopkinton, MA 01748 617-435-2541 **Circle No. 109**	Archeion 1000	POR	Q-bus, Unibus	EMC Corp Archeion 1000	INP	Optimem 1000 (12-in. removable platter)	56 Gbytes
EMULEX CORP. 3545 Harbor Blvd. Costa Mesa, CA 92626 714-385-1685 **Circle No. 110**	LX400	$17,000	Q-bus, Unibus	UC04, UC14	MSCP	Optimem, LMS/OSI	1-2 Gbytes
IPS TECHNOLOGY INC. 11201 Richmond Ave., Ste. A102 Houston, TX 77082 713-870-0880 **Circle No. 111**	Model 2000	$24,495	Q-bus, Unibus	Models 3350, 2250	Custom drivers	Any SCSI	1-6 Gbytes
ISI 2768 Janitell Rd. Colorado Springs, CO 80906 303-579-0460 **Circle No. 112**	525WC	$2,995-$3,250	Q-bus, Unibus	ISI SCSI 525	Std. SCSI Command Set	ISI 525000-550	115-230 Mbytes
	525GB	$3,995	Q-bus, Unibus	ISI SCSI 525	Std. SCSI Command Set	ISI 525000-550	500-1000 Mbytes
KOM INC. 145 Spruce St. Ottawa, Ontario Canada K1R 6P1 800-267-0443 **Circle No. 113**	Optifile II Kit	$5,000-$13,500	Q-bus, Unibus	TD Systems TDL12, UHA-11	VMS RM Series	Optotech, Toshiba, Maxtor	400-800 Mbytes
MCS COMPUTER PRODUCTS INC. 2785 White Bear Ave. St. Paul, MN 55109 612-770-5232 **Circle No. 114**	Laser Databank	$6,900	Q-bus	Optotech	INP	Optotech 5984	400 Mbytes to 3.2 Gbytes
	OAS 100/150	$38,500-$39,500	Q-bus, Unibus	Aquidneck OAS 1004150 (std. Pertec)	INP	LMS/OSI LD1200	2 Gbytes to 2 Tbytes
NISSHO ELECTRONICS (USA) CORP. Inwood Pk. #200 17310 Redhill Irvine, CA 92714 714-261-8811 **Circle No. 115**	Nissho N1505	$9,950	Q-bus, Unibus	Emulex UC04	VMs MSCP	Toshiba	800 Mbytes

TABLE 1—OPTICAL SUBSYSTEMS

Company	Product	Price (Quantity One)	Host Bus	Controller		Drive	Capacity
				Model	DEC Emulation		
OPTOTECH 740 Wooten Rd. Colorado Springs, CO80915 303-570-7500 **Circle No. 116**	VAX Laser Databank	$6,950	Q-bus	TD Systems Viking QDO	Custom driver	Optotech 5984	400 Mbytes
PERCEPTICS 725 Pelissippi Ctr. P.O. Box 22991 Knoxville, TN 37932 615-966-9200 **Circle No. 117**	LD1200	POR	Q-bus, Unibus	TD Systems Viking	MSCP	LMS/OSI	2+ Gbytes
	Optimem 1000	POR	Q-bus, Unibus	TD Systems Viking	MSCP	Optimem 1000	2+ Gbytes
	LaserStar Jukebox	POR	Q-bus, Unibus	TD Systems Viking	MSCP	LMS LD1250, Optimem 1000	200+ Gbytes
TECEX 1061 S. Melrose Ave. Placentia, CA 92670 714-632-6672 **Circle No. 118**	TX-2200	$14,500	Q-bus, Unibus	TX-1500 Interface (CDC, Cipher, Pertec protocol)	TS11, TM11, TU	OSI	1-2 Gbytes
	TEC-OAS/1	$17,500	Q-bus, Unibus	TX-QB01 (Q-bus), TX-UB01 (Unibus)	MSCP	OSI	1-2 Gbytes
U.S. DESIGN CORP. 4311 Forbes Blvd. Lanham, MD 20706 301-577-2880 **Circle No. 119**	VOS (Virtual Optical Storage) Series	$10,000	Q-bus, Unibus	SCSI 1108, 1158; 4190 Cache Controller	MSCP, TS11	LMS/OSI, Maxtor, Sony	800 Mbytes to 1.148 Gbytes
	VOX II Series	$4,000+	Q-bus, Unibus	SCSI 1108, 1158; 4190 Cache Controller	MSCP, TS11	LMS/OSI, Maxtor, Sony	800 Mbytes to 2.36 Gbytes
	JukeVOS	$3,500	Q-bus, Unibus	SCSI 1108, 1158; 4190 Cache Controller	MSCP, TS11	LMS/OSI, Maxtor, Sony	164-1148 Gbytes
	VIP 3000 Series	$2,000	Q-bus, Unibus, SCSI bus, Mac	SCSI 1108, 1158; 4200 Cache Controller	MSCP, TS11	Maxtor, Exabyte	175 Mbytes to 3.2 Gbytes
UNBOUND INC. 15239 Springdale Huntington Beach, CA 92649 714-895-6205 **Circle No. 120**	OPTO-5020 QUBE Add-on Optical System	$4,500-$10,000	Unibus	Custom	MSCP, TMSCP	Maxtor, LMS/OSI	400-800 Mbytes (unformatted)

The vendors listed in this buyers guide responded to a survey conducted by Hardcopy. *To be included in the* Hardcopy *optical subsystems database, please contact Cindy Grant-Thurman at 714-632-6924. INP—information not provided, POR—price on request, N/A—not applicable.*

of the Small Computer Systems Interface (SCSI) that allows attachment to a number of host adapters (Table 2).

Attaching an optical disk isn't an easy decision. "You have to consider data life, how often it changes, and whether on-line storage is important," counsels Optotech's Dulude. "WORM offers long data life, some change, and immediate access," he claims. However, others warn that WORM might only be a short-term solution.

Some of this concern stems from lack of standards, and whether optical should be treated as a random access or sequential device—a not-so-subtle decision when system needs are considered. Perceptics' Cross claims that the access decision is determined by the application need: "Using optical as a primary storage device dictates a random access optical drive. Backup or archiving denotes sequential." When handled sequentially, files are usually transferred to a magnetic disk before being used.

Moreover, using write-once drives instead of magnetic poses several problems to the operating system. Specifically, all operating systems are expecting to see alterable devices that permit writing over existing tracks—something that could damage the data stored on a WORM device. Consequently, special device handlers are required to properly manage the device.

"Using optical as a primary storage device dictates a random access optical drive. Backup or archival denotes sequential."

To support WORM devices under VMS, a number of companies including Perceptics, KOM Inc., and Optotech offer special software. This software allows the operating system to view WORM drives as random access devices by transparently performing operations that handle the drives as though they were, in fact, random access.

The software can handle the WORM drive at either a very low level (with direct SCSI commands), or via DEC's standard Mass Storage Control Protocol (MSCP). Some SCSI host adapters allow only MSCP-level control, restricting the driver software to use of MSCP message packets, while others also support a SCSI pass-through command. This command allows the operating system software to directly control the adapter at the SCSI level.

continued on page 63

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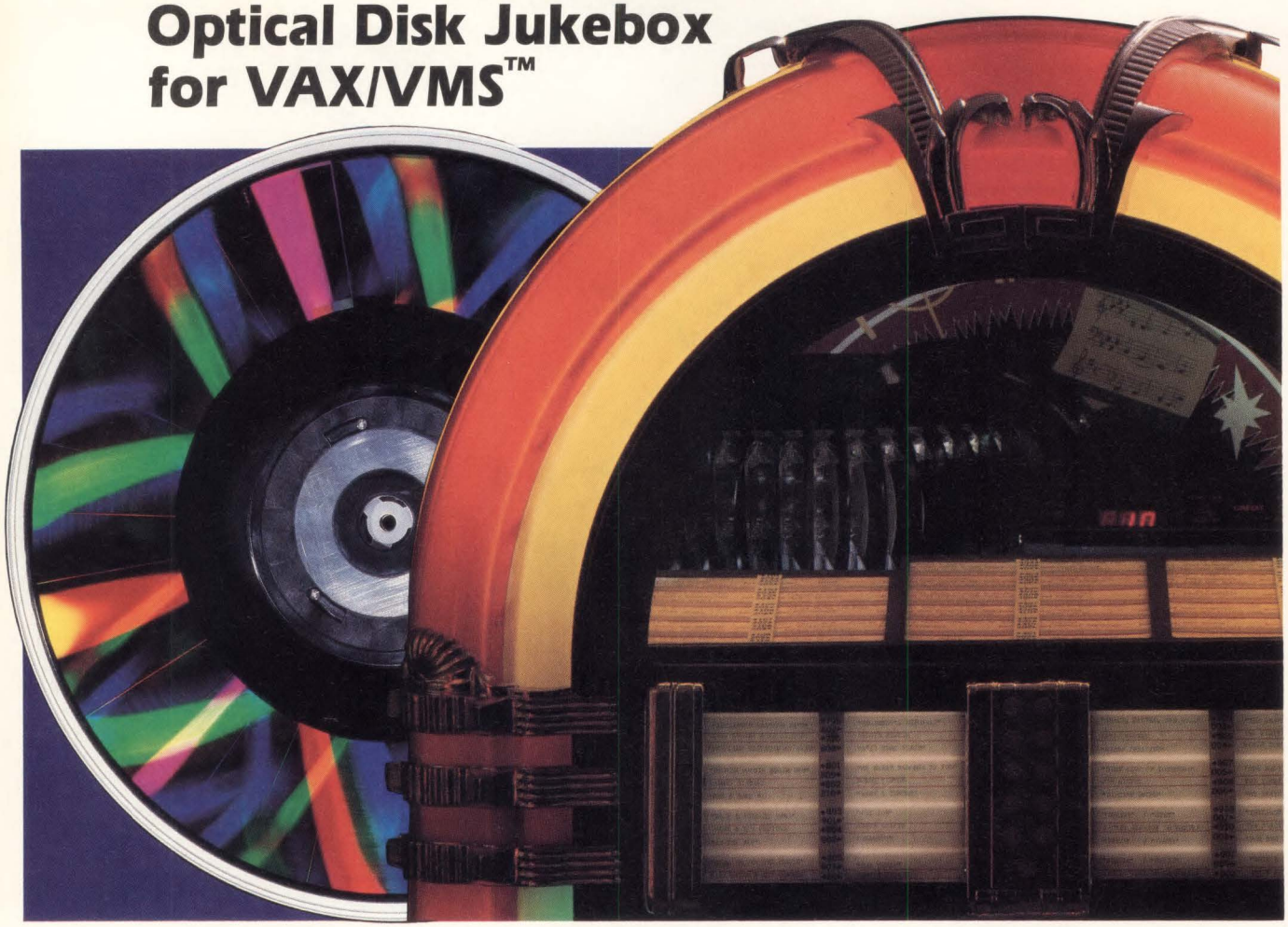

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CIRCLE 436 ON READER CARD

TABLE 2—SCSI HOST ADAPTERS

Company	Product	Price	Bus	DEC Compatibility	Width	SCSI Transfer Rate	Interrupt Priority Level	Disconnect/Reconnect	Seek Optimization	Block Mode DMA	Board Test Capability	Other Features
ADEPT DIGITAL SYSTEMS INC. 2381 Zanker Rd., Ste. 150 San Jose, CA 95131 408-435-9195 **Circle No. 121**	SCSI I/F Package	$4,000	Q-bus, Unibus	Custom driver to direct SCSI	Dual (Q-bus), hex (Unibus)	Max. SCSI	Selectable	•		•	•	Custom driver enables applications software to pass SCSI command definition blocks to SCSI bus and receive returned SCSI status to allow easy interfacing of any SCSI-compatible device to any Q-bus or Unibus host
CMD TECHNOLOGY INC. 3851 S. Main St. Santa Ana, CA 92707 714-549-4422 **Circle No. 122**	CDU700/M	$1,850	Unibus	MSCP	Hex	2 Mbyte/second	4, 5	•	•		•	On-board utility to format, qualify drive, and replace bad blocks; on-board NOVRAM; on-board auto bootstrap and utility bootstrap
	CDU700/OM	$2,350	Unibus	MSCP	Hex	2 Mbyte/second	4, 5	•	•		•	On-board utility to format, qualify drive, and replace bad blocks; on-board NOVRAM; on-board auto bootstrap and utility bootstrap
	CDU700/T	$2,050	Unibus	TMSCP	Hex	2 Mbyte/second	4, 5	•	•		•	On-board utility; on-board NOVRAM; on-board auto bootstrap and utility bootstrap
	CQD200/M	$1,250	Q-bus	MSCP	Dual	2 Mbyte/second	4, 5	•	•	•	•	On-board utility to format, qualify drive, and replace bad blocks; on-board NOVRAM; on-board auto bootstrap and utility bootstrap
	CQD200/T	$1,450	Q-bus	TMSCP	Dual	2 Mbyte/second	4, 5	•	•	•	•	On-board utility; on-board NOVRAM; on-board auto bootstrap and utility bootstrap
	CQD200/OM	$1,750	Q-bus	MSCP	Dual	2 Mbyte/second	4, 5	•	•	•	•	On-board utility to format, qualify drive, and replace bad blocks; on-board NOVRAM; on-board auto bootstrap and utility bootstrap
COMPUTER EXTENSION SYSTEMS INC. 16850 Titan Dr. Houston, TX 77058 713-488-8830 **Circle No. 123**	MDC8	$1,250	Omnibus (PDP-8)	Custom driver from supplier	Hex	6 Mbyte/second	N/A			•		Includes second port (40-pin parallel) that supports 3M 75-Mbyte block-oriented tape drive with random access capability
DISTRIBUTED LOGIC CORP. (DILOG) 1555 S. Sinclair St. Anaheim, CA 92806 714-937-5700 **Circle No. 124**	SQ703	$1,500	Q-bus	TU driver compatible	Dual	1.5 Mbyte/second	4-7			•	•	Common command set; on-board bootstrap support; 256-Kbyte data buffer; 16 entry command queue; 22-bit addressing; user-selectable address selection; on-board serial diagnostic/utility port
	SQ706	$1,500	Q-bus	DU driver compatible	Dual	1.5 Mbyte/second	4-7		•	•	•	Pass-through mode; common command set; on-board bootstrap support; 256-Kbyte data buffer; 16 entry command queue; 22-bit addressing; user-selectable address selection; on-board serial/diagnostic/utility port
EMULEX CORP. 3545 Harbor Blvd. Costa Mesa, CA 92626 714-662-5600 **Circle No. 125**	UC04	$1,800-$2,300	Q-bus	MSCP	Dual	INP*	4, 5	•	•	•	•	Optical support; large data buffers (20-Kbyte); 22-bit addressing; NOVRAM; SCSI protocol controller
	UC14	$2,200-$2,950	Unibus	MSCP	Quad	INP*	5	•	•		•	Adaptive DMA; optical support; large data buffer (20-Kbyte); 18-bit addressing; NOVRAM; SCSI protocol controller
QUALOGY INC. 2241 Lundy Ave. San Jose, CA 95131 408-434-5200 **Circle No. 126**	QLC-1000	$1,995	Q-bus	TMSCP	Dual	0.75 Mbyte/second	4-7			•	•	No software modifications required; runs under all current DEC operating systems; user-defined logical tape volumes (partitioning); fast transfers of backup/archive data

The vendors listed in this buyers guide responded to a survey conducted by Hardcopy. *To be included in the* Hardcopy *SCSI host adapters database, please contact Cindy Grant-Thurman at 714-632-6924.*

TABLE 2—SCSI HOST ADAPTERS

Company	Product	Price	Bus	DEC Compatibility	Width	SCSI Transfer Rate	Interrupt Priority Level	Disconnect/Reconnect	Seek Optimization	Block Mode DMA	Board Test Capability	Other Features
TD SYSTEMS INC. 24 Payton St. Lowell, MA 01853 617-937-9465 **Circle No. 127**	Viking/QDA	$1,395	Q-bus (22-bit)	MSCP	Dual	1.5 Mbyte/second	4	•	•	•	•	• Available from stock; on-board serial diagnostic/utility port; optional front panel; on-board boot for MicroPDP processors
	Viking/QDO	$1,395	Q-bus (22-bit)	MSCP	Dual	1.5 Mbyte/second	4	•	•	•	•	• Available from stock; on-board serial diagnostic/utility port; optional front panel; direct SCSI mode included on standard product for attaching non-emulating devices such as optical drives
	Viking/QDD	$1,995	Q-bus (22-bit)	MSCP, direct SCSI	Dual	1.5 Mbyte/second	4	•	•	•	•	• Available from stock; on-board serial diagnostic/utility port; optional front panel
	Viking/QTO	$1,395	Q-bus (22-bit)	TMSCP	Dual	1.5 Mbyte/second	4	•	•	•	•	• Available from stock; on-board serial diagnostic/utility port; optional front panel
	Viking/QDT	$1,995	Q-bus (22-bit)	MSCP/TMSCP	Dual	1.5 Mbyte/second	4	•	•	•	•	• Available from stock; on-board serial diagnostic/utility port; optional front panel; direct SCSI mode included in standard product for attaching non-emulating devices such as optical disks
	Viking/UDO	$1,595	Unibus	MSCP	Quad	1.5 Mbyte/second	4-7	•	•		•	• Available from stock; on-board serial diagnostic/utility port; optional front panel; direct SCSI mode included in standard product for attaching non-emulating devices such as optical disks
	Viking/UDD	$2,195	Unibus	MSCP, direct SCSI	Quad	1.5 Mbyte/second	4-7	•	•		•	• Available from stock; on-board serial diagnostic/utility port; optional front panel
	Viking/UTO	$1,595	Unibus	TMSCP	Quad	1.5 Mbyte/second	4-7	•	•		•	• Available from stock; on-board serial diagnostic/utility port; optional front panel
	Viking/UDT	$2,195	Unibus	MSCP/TMSCP	Quad	1.5 Mbyte/second	4-7	•	•		•	• Available from stock; on-board serial diagnostic/utility port; optional front panel; direct SCSI mode included in standard product for non-emulating devices such as optical drives
	TDL-12	$695	Q-bus	RLV-12	Dual	8 Mbyte/second	4				•	• Available from stock; direct SCSI mode included in standard product such as optical drives
	UHA-11	$895	Unibus	RL-11	Quad	6 Mbyte/second	4-7				•	• Available from stock; direct SCSI mode included in standard product such as optical drives
U.S. DESIGN CORP. 5100 Philadelphia Way Lanham, MD 20706 301-577-2880 **Circle No. 128**	1108-01	$1,250	Q-bus	MSCP (disk); TS-11 (tape)	Quad	1 Mbyte/second burst; 650 Kbyte/second typical	4		•		•	• Command queueing and seek optimization for up to 24 commands; 1108-01 married with Maxtor 250-Mbyte drive is the 280-Q add-in expansion kit for MicroVAX-11 BA-123; SCSI pass-through mode supported for both MSCP and non-MSCP programming suitable for all operating systems; dual-port capability with other U.S. Design adapters
	1108-03	$1,750	Q-bus	MSCP (disk); TS-11 (tape)	Quad	1 Mbyte/second burst; 650 Kbyte/second typical	4		•		•	• Tailored for support of optical drives; switch-selectable options for all major optical manufacturers using one set of firmware; switch-selectable to form 2500-Mbyte logicals on a 1-Gbyte platter; optical utility software available for optical backup/restore functions; both MSCP and non-MSCP SCSI pass-through supported

TABLE 2—SCSI HOST ADAPTERS

Company	Product	Price	Bus	DEC Compatibility	Width	SCSI Transfer Rate	Interrupt Priority Level	Disconnect/Reconnect	Seek Optimization	Block Mode DMA	Board Test Capability	Other Features
U.S. DESIGN CORP. *continued*	1108-10	$1,750	Q-bus	MSCP (disk); TS-11 (tape)	Quad	1 Mbyte/ second burst; 650 Kbyte/ second typical	4		•		•	• 1108-10 is the heart of the virtual optical storage (VOS) optical system; directory and file structure accesses are re-vectored to companion magnetic disk for full Files-11 compatibility without OS patches; all features of 1108-01 and 1108-03 adapters supported (major optical vendors via switches, 24 command queue, etc.); VOS supports VMS and MicroVMS
	1158-01	$1,750	Unibus	MSCP (disk); TS-11 (tape)	Hex	1 Mbyte/ second burst; 650 Kbyte/ second typical	4		•		•	• SCSI pass-through mode supported for both MSCP and non-MSCP programming available for all OS; command queueing and seek optimization for up to 24 commands; compatible SCSI devices are being qualified as they become available
	1158-03	$2,250	Unibus	MSCP (disk); TS-11 (tape)	Hex	1 Mbyte/ second burst; 650 Kbyte/ second typical	4		•		•	• Tailored for support of optical disks; switch-selectable options for all major optical manufacturers using one set of firmware; switch-selectable to form 2500-Mbyte logicals on a 1-Gbyte platter; optical utility software available for optical backup/restore functions; both MSCP and non-MSCP SCSI pass-through supported
	1158-10	$1,250	Unibus	MSCP (disk); TS-11 (tape)	Hex	1 Mbyte/ second burst; 650 Kbyte/ second typical	4		•		•	• 1158-10 is the heart of the virtual optical storage (VOS) optical system; directory and file structure accesses are re-vectored to companion magnetic disk for full Files-11 compatibility without OS patches; all features of 1158-01 and 1158-03 adapters supported (major optical vendors via switches, 24 command queue, etc.); VOS supports VMS and MicroVMS

continued from page 58

Directory Dilemmas

Managing directories can be difficult since WORM drives aren't capable of being updated. Some companies—most notably, U.S. Design—have experimented with maintaining directories on a separate magnetic disk, but this can pose severe problems if the magnetic disk crashes. You may be unable to access several gigabytes of data. "We looked at putting the directories on a magnetic drive when we were first considering writing the software," says Perceptics' Cross, "but decided the directory and data should stay together."

Similarly, Mike Johnson of Tecex, an optical subsystem integration company, considers using magnetic disk with WORM as a bandage that masks the real problem. "It's not a viable solution—you need the special system software."

U.S. Design defends maintaining the directories on magnetic disk by pointing out that its system is completely compatible with DEC's Files-11 system software—no "fix" is necessary. The company does plan, however, to support periodic writing of directories to the optical disk in later product versions.

Scientific Micro Systems Inc. (SMS) offers a solution that provides complete compatibility with DEC's directory software. The company's Optical Development Kit requires the user to specify the approximate number of files that will be written to the WORM disk, then formats it via the SMS 0109 optical controller. The 0109 can format 5.25- or 12-in. SCSI optical drives, and additionally supports magnetic disks on the same controller.

Another approach developed by Optical Storage Solutions Inc. (OSS), a supplier of operating system software to support optical on a variety of machines, uses the magnetic disk as a cache to contain both directories and the most recently used files in addition to storing them on the optical drive. "This allows us to search the directories faster," says Jerry Myers, market-

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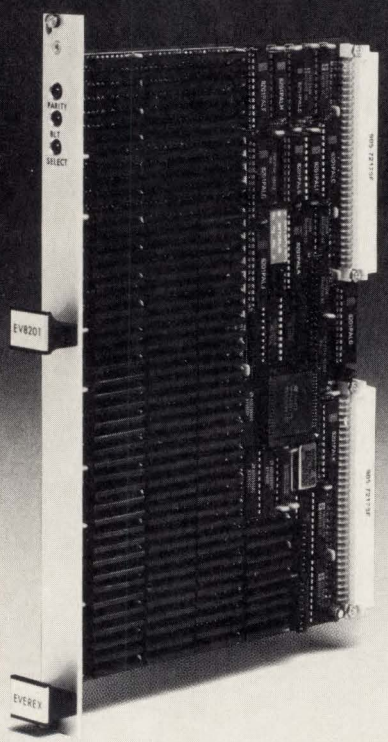

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CIRCLE 439 ON READER CARD

ing manager for the company. OSS also provides special software for searching the directories, which can be lengthy because of the great number of files on a WORM platter.

But magneto-optical technology, when and if it finally becomes widely available, may obsolete special system software for WORM. "Using the standard MSCP driver will be the accepted way of handling random-access optical applications, and TMSCP will be used for handling the sequential applications," says Tecex's Johnson. "WORM will still have a good market for sequential applications, and we intend to offer both WORM and magneto-optical."

TMSCP Provides a Perfect Fit

And DEC is right there with the right sequential device handler protocol—TMSCP. The third party is quickly bringing products to market that make use of it.

For example, Qualogy Inc., a DEC-compatible subsystem supplier, just announced a TMSCP-to-SCSI host adapter for Q-bus systems, which it intends for optical subsystems. Until recently, all DEC-compatible SCSI host adapters supported MSCP, so Qualogy's product represents a distinctively different direction. Why did the company do it?

According to Bill Castle, a senior staff engineer for the company: "We're trying to address one area of the market and do a really good job of just that. Optical is replacing a lot of tape applications, so all the software is already in place."

Additionally, Qualogy is adding some capabilities to the board that allow a user to partition the optical disk to speed seek times for a single file. Currently, the drive must sequentially search the disk like a tape.

Johnson is working on a similar technique. "We're developing some technology that will provide an index to a sequential optical disk to reduce the amount of time required to find a file under TMSCP."

TD Systems Inc. is another company that provides TMSCP emulation in DEC-compatible SCSI host adapters, but the company has, in addition, recently developed products that support both MSCP and TMSCP. A combination of random access and sequential access optical disks can be combined on the same controller, plus standard magnetic disk and tape drives.

Additional information about the products or services described in this article can be obtained by contacting the company directly or circling the appropriate reader service number.

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Bloomington,
MN 55420-1478
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Circle No. 152

Cygnet Systems Inc.
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Sunnyvale, CA 94086
408-773-0770
Circle No. 153

Digi-Data Corp.
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Jessup, MD 20794
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Circle No. 154

Eastman Kodak Co.
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Rochester, NY 14650
716-724-4000
Circle No. 155

Exabyte Corp.
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Circle No. 156

FileNet Corp.
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Lowell, MA 01853
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Tecex
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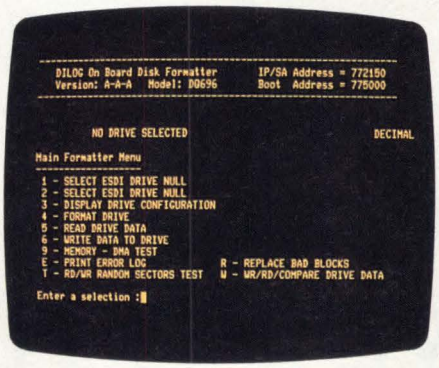

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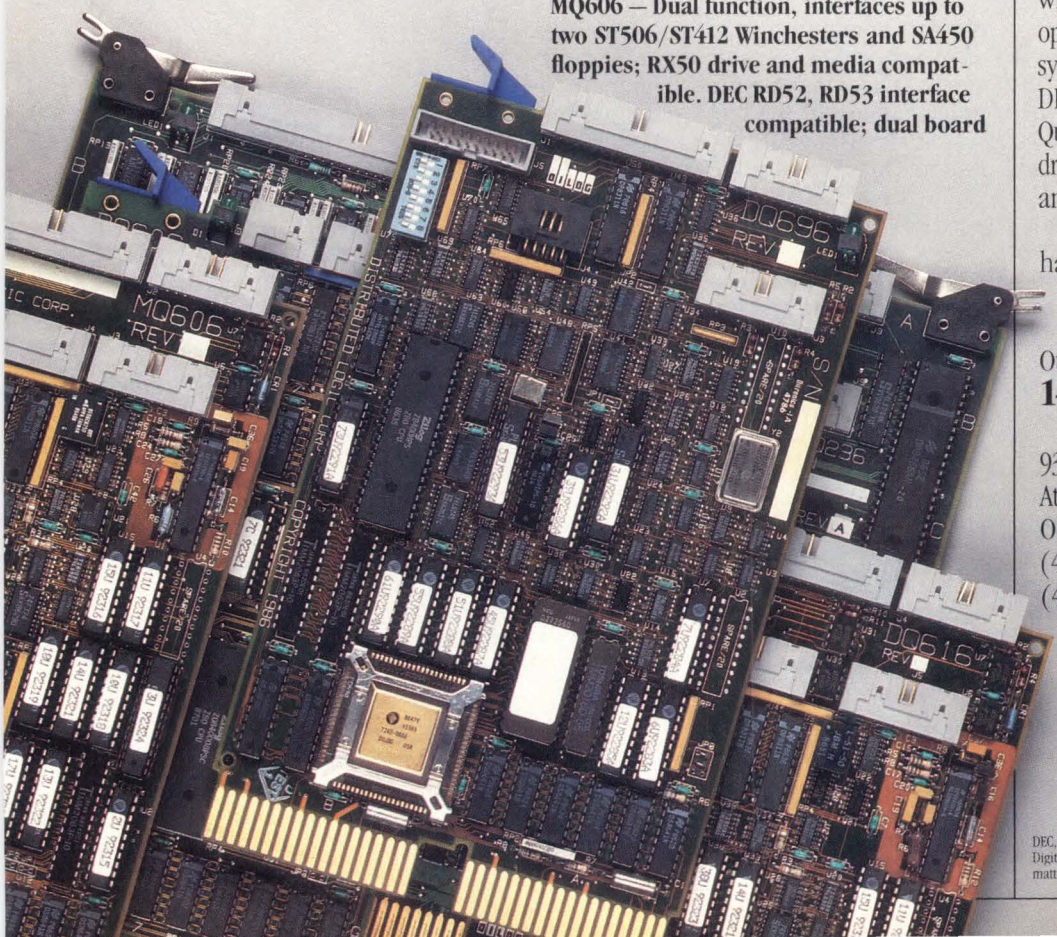
DQ616 — interfaces up to four ST506/ST412 and DEC RD52, RD53 Winchester disk drives; dual board

DQ696 — interfaces up to two ESDI Winchester drives; dual board

MQ606 — Dual function, interfaces up to two ST506/ST412 Winchesters and SA450 floppies; RX50 drive and media compatible. DEC RD52, RD53 interface compatible; dual board



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CIRCLE 440 ON READER CARD

HARDCOPY MAGAZINE RECENTLY ACQUIRED WARREN GROUP LABORATORIES AND THIS INSIDE LOOK AT THE LAB EXPLAINS HOW WE OPERATE AND WHAT YOU AS A *HARDCOPY* READER CAN EXPECT TO SEE THROUGHOUT 1988.

INSIDE THE HC/WG LABS: HOW WE DO IT

BY STEVE BOSTWICK, Senior Scientist and Laboratory Manager

The world of the minicomputer system builder is becoming increasingly complicated. There was a time when the DEC system builder needed to know only the DEC equipment and perhaps a few peripheral manufacturers. Now, with DEC expanding into every nook and cranny of the computer world, from number crunching to the automated office, the successful system builder needs to know many technologies that were previously foreign to him. *Hardcopy*/Warren Group Laboratories (HC/WG Labs) are instituting a new evaluation-program philosophy to trade magazines, to make life easier for you as an OEM, system integrator, or sophisticated DEC equipment end user.

This new evaluation program shouldn't be confused with the simple reviews of new products that you may be used to. Don't worry, we aren't dropping reviews. Indeed, we consider reviews to be a valuable information tool. They provide early warning and feature lists, along with quick, subjective impressions of the reviewer. Such reviews are important, and this magazine will continue to carry them.

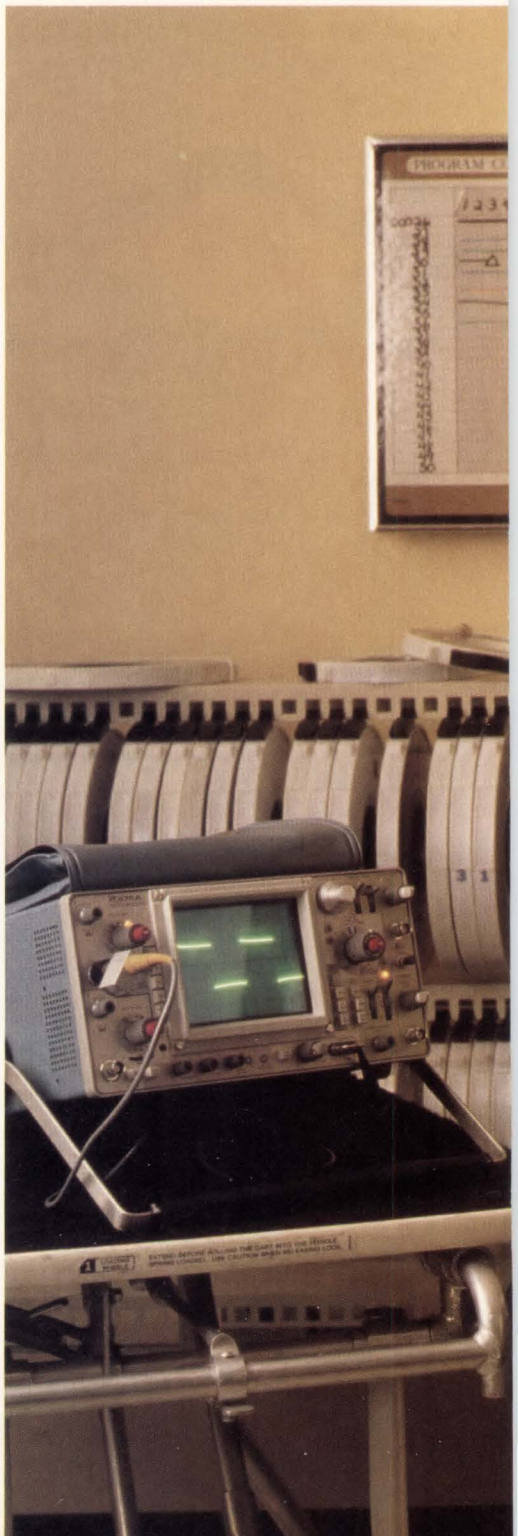
The new test and evaluation program offers, instead, an in-depth laboratory analyses of the product along with thorough human factors and user-interface studies. The tests and analysis applied will be of the same type that would be used by you as an OEM or specifier when selecting components to be integrated into a system. For that reason, we are calling the new test system the HC/WG OEM Evaluation Program, or HOW for short.

The key to success in such an undertaking as the HOW Program is INDEPENDENCE. The people who perform the evaluations must be either employees of HC/WG Labs or leading consultants in certain specialized areas. The identities of these people are a closely guarded secret. These technicians, engineers, and scientists communicate with the technical community only through me as the Senior Scientist, who in turn directs the testing activities of the lab.

We request manufacturers to submit equipment for evaluation. The tests only proceed after the manufacturer signs a document acknowledging the independence of the tests and agreeing to abide by their results. As Machiavellian as this may seem, our goal isn't to grade products. Rather, as you will see, our HOW process puts products in perspective relative to the manufacturer's published specifications. We don't issue a grade (such as good, better, best, or worst). Rather, we present all of the measured data so that the reader does not have to accept our evaluation—he or she can draw his or her own conclusions.

Moreover, we recognize that in normal OEM evaluations, multiple samples are provided. In most cases HOW studies are performed on single samples, in which case, we will make due note of the sample size. Where we believe that measured samples can vary over 'n' samplings, we will make that notation as well.

Although we do demand independence and insist that manufacturers agree to abide by the results, they aren't left in the cold. Once our report is finished, the manufacturer is provided



ROBERT BELL

with a copy in sufficient time to respond to any discrepancies from the published specifications. This response will be published along with the report. But this is part of the overall procedure which I'll be discussing later.

Inside the Lab

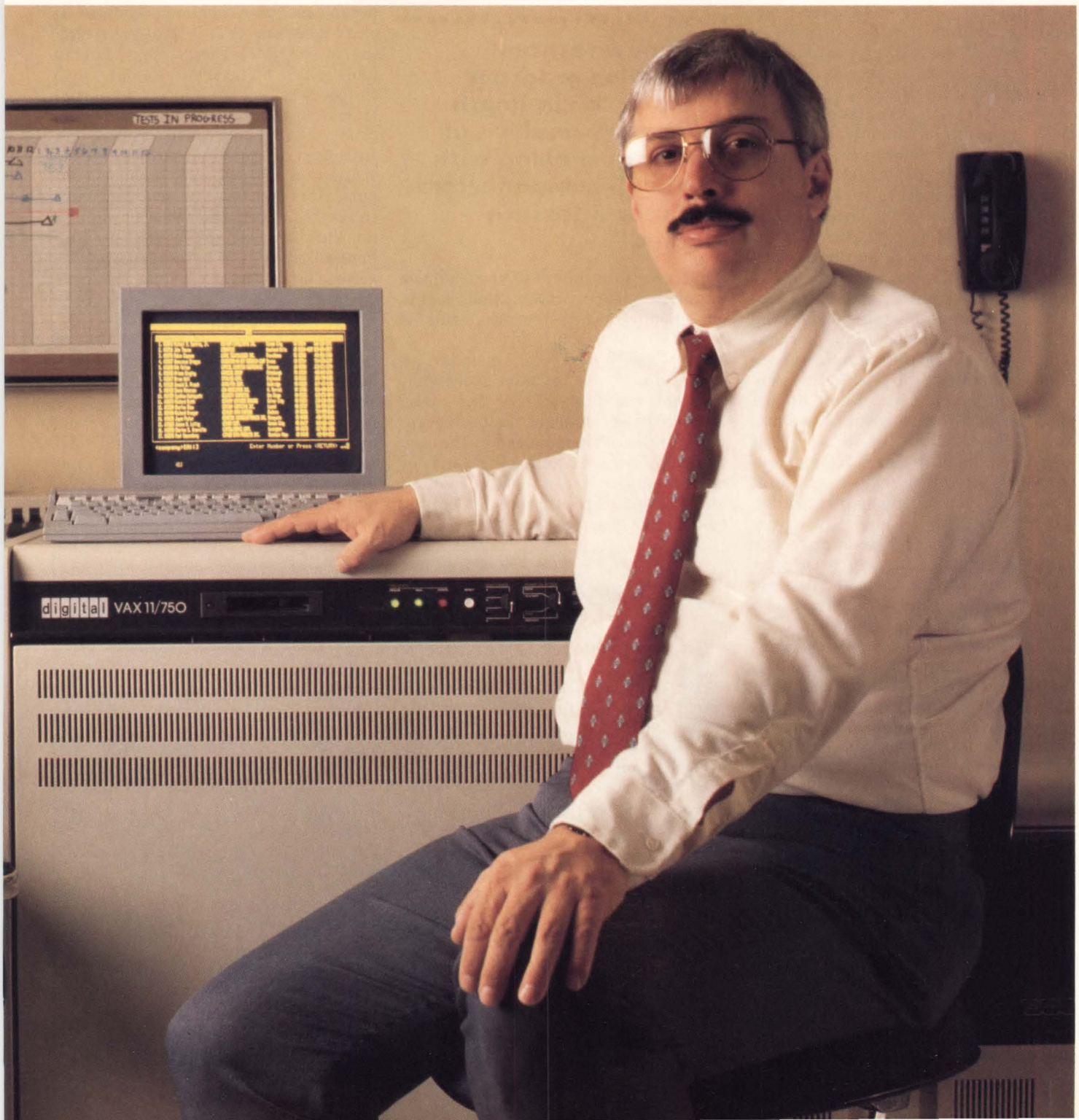
Physically, the HC/WG main laboratory (we have other sites as well) is located at the Seldin Publishing site in Placentia, CA. This site is used to house the bigger equipment such as the PDP-11's; MicroVAXes; and various PC-, Apple-, VME-, and Multibus-based systems. Our other locations have specialized equipment for doing EMI, vibration, and harsh environment testing.

Although the laboratory inventory changes from week-to-week, we do maintain certain equipment. Specifically, we use PDP-11/70's and MicroVAX CPUs. Various other systems including Multibus, Q-Bus, and VME are moved in and out as needed.

As with any testing facility, our tools range from standard, off-the-shelf software utilities and hardware to ad-hoc tool kits that we create or adjust to meet a specific need—willy-nilly testing or recreating the wheel isn't our goal. We go to great lengths to use standardized methods wherever possible. Products such as printers and storage devices are tested using a standard approach; thus, realistic comparisons can be made.

The HOW Test Plan

The evaluation of a new product at HC/WG Labs involves several steps. The most important step is the design of a test plan. Notice the use of the word "design"—the creation of a test plan is an engineering procedure not much different from designing a computer program or a piece of hardware. Each test



plan is different and must be tailored to the product being evaluated. As with all engineering activities, however, there are certain rules and disciplines that must be followed when building a test plan and conducting tests. The test plans are all based on minimum test criteria that are customized to reflect the current state of the industry and the products being tested.

The test criteria are categorized as:

- *engineering evaluation*—mechanical and electronic tests of hardware,
- *software evaluation*—tests the functionality and quality of software,
- *human factors*—evaluates practicability of product, and
- *general*—overall product evaluation to assess performance and fitness for intended application.

The engineering evaluation always looks at the product functionality first. Does the product do what it's supposed to do? Another important test performed on all hardware products is parametric verification. The manufacturer makes certain parametric claims about the product (weight, volume, current consumption, etc.). We will verify that these parameters are stated correctly; a common mistake made when integrating equipment into a new system is to believe the manufacturer's numbers, only to find that the published numbers are out of date or just plain wrong. We also look at less obvious items that are important, but might be difficult to learn from manufacturer's literature. One example of this is the level of agency certification (UL, CSA, FCC, VDE, etc.). If you were selecting a product based on price, you might get an unpleasant surprise after you've bought 200 of them and find you have to pay $8,000 for an FCC certification before you can use the product.

We also test some less obvious engineering aspects of a product—items that are definitely not in the manufacturer's sales literature. We examine the quality of the workmanship, for example. This includes evaluating the selection of components and raw materials and the quality of the finish, both internal and external.

Finally, we will perform reliability testing and evaluation. The evaluation of reliability is done in conjunction with the assessment of component and raw material selection. We also perform environmental reliability testing appropriate to the level of the product being tested.

The HOW testing of hardware is tailored to fit the product. For a summary of the minimum tests, see the chart at the end of this article.

HOW is Equally Rigorous on Software

The testing of software is very much like the testing of hardware. However, one prime area of the software test plan is also functionality. The operator's manual and literature from the manufacturer are used to build the functional portion of the test plan. As with hardware, this part of the test is designed to ensure the product does what it is supposed to.

The software is also subjected to parametric verification of its limits and capacities as specified by the manufacturer. If the manufacturer claims a database can support a million records on a floppy disk system, that will be tested.

"The new test and evaluation program offers . . . an in-depth laboratory analysis of the product along with thorough human factors and user-interface studies."

Any HOW test plan includes an evaluation of the software workmanship and reliability. These two areas are related and some of the tests overlap. Workmanship is judged by the care taken with screen layouts, the clarity of error messages, the absence of spelling and grammar errors in screen prompts, and similar observations.

Reliability and workmanship are also evaluated by stress testing. Software that can be run at or beyond the limits suggested by the manufacturer (or by common sense) would be deemed more reliable and of better workmanship than software that fails by destroying every fifth file on the hard disk.

Evaluating the man/machine interface is a more subjective task. In order to help quantify this evaluation, we have chosen to call these criteria by their older name—human factors. This was a term used in the '60s and '70s before the much vaguer "ergonometric" became popular. "Human factors" is clearer because that is what we are going to evaluate—everything a human must touch or use. We evaluate such things as ease of use, placement of controls (both hardware and software), clarity of controls, consistency of controls used in similar situations, and resistance of the system to erroneous inputs. (It is amazing how many systems can be brought to their knees by applying the gorilla piano player test—rolling the knuckles of both hands rapidly across the keyboard.)

Shaping Up for Finals

That brings us to the final type of criteria—general. These tests deal with factors that are common to all systems. The quality of the documentation, for instance, is an evaluation that should be made for both hardware and software systems. For products that combine hardware and software, the level and quality of the integration will be evaluated.

ARE YOU READY TO CHALLENGE HOW?

If, as a manufacturer, you are interested in submitting your product for a HOW Report, the following procedure must be followed:

Send *Hardcopy* a letter that describes your product, along with any manuals and/or applications notes. Do *not* send the product.

Once your request is received, the HC/WG Labs staff will determine if your product fits our evaluation profile. Based on the manuals, a Test Implementation Plan (TIP) will be created. A copy of the TIP, along with the HOW test agreement and a Purchase Order to cover the equipment during transit, will be sent to you.

Manufacturers submitting equipment for test are responsible for all transportation costs. *Hardcopy* assumes no liabilities associated with the transportation or operation of the equipment. We assume only those liabilities associated with loss or theft while the equipment remains on our premises.

As a *Hardcopy* reader, there may be products that you would like to see evaluated or reviewed; if so, let us (or the manufacturer) know of your interest by contacting:

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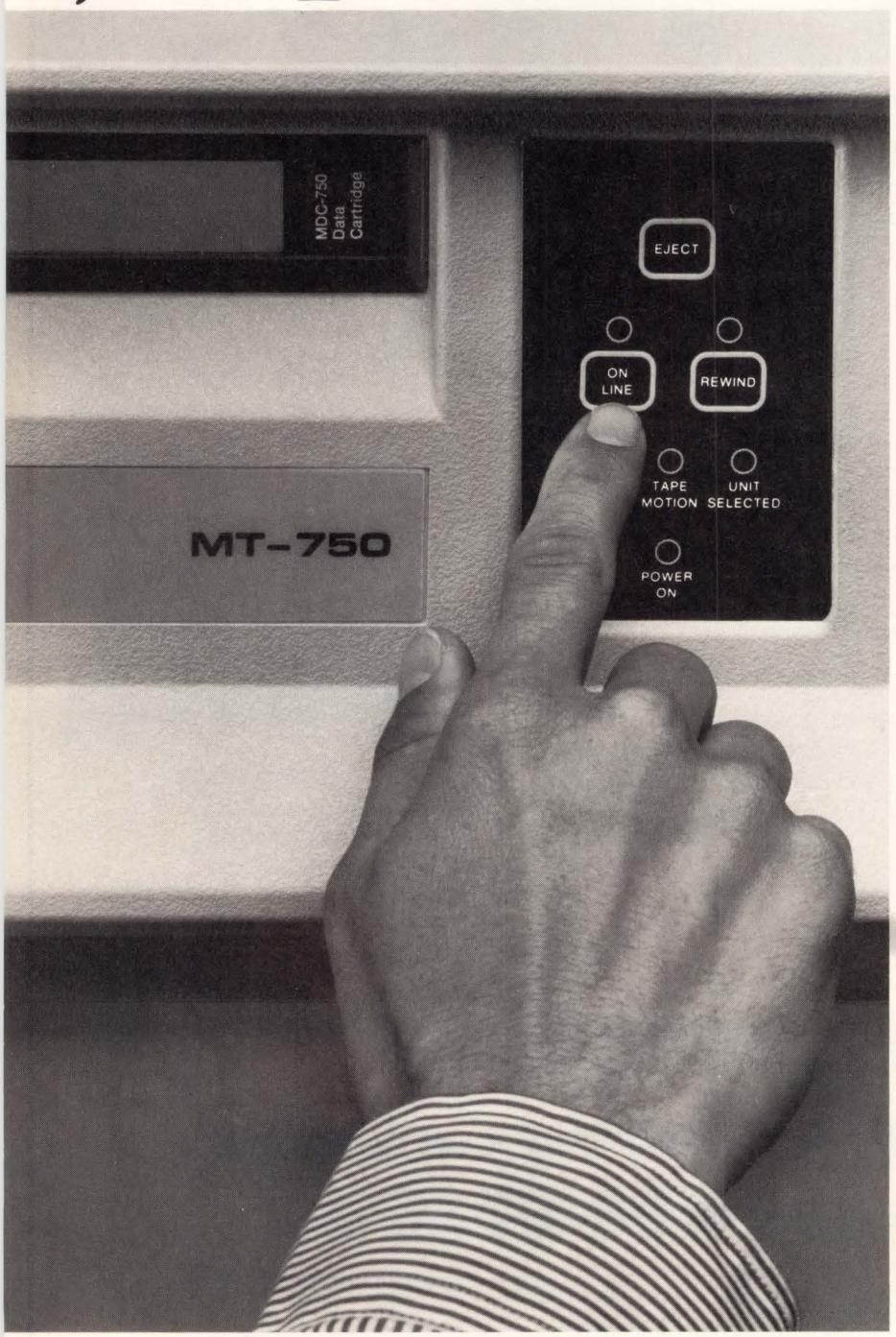

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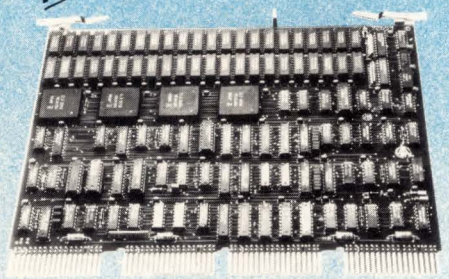

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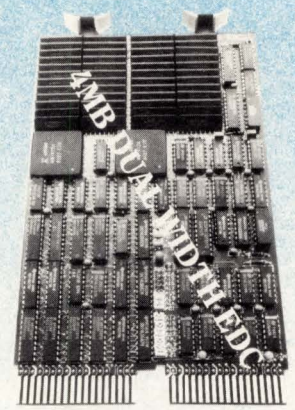
- Block mode DMA



CI-QBUS-EDC
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- CI-1173-EDC: 2 megabyte error detecting and correcting w/block-mode
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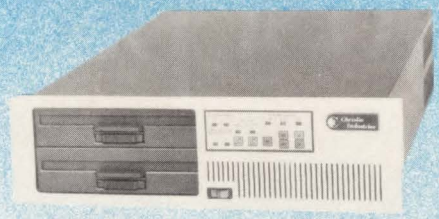

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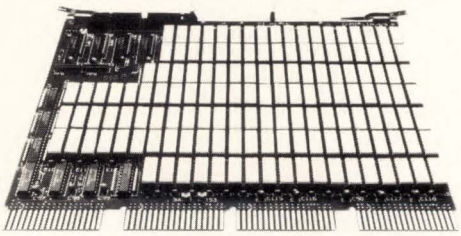

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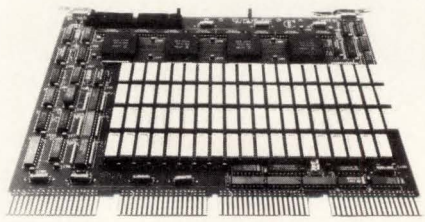

CI-MIV8-EDC

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Putting HOW to Work

Creating the test plan is only part of the job; the actual testing is most important, of course, and is usually straightforward. The tests are run at one of the HC/WG Labs sites, unless special facilities are required. Technicians and engineers running the tests maintain careful records of both the test results and their subjective observations.

As can be seen from the test plan outline, the planned tests aren't done overnight. For this reason, don't expect to see a full-blown HOW Report on products the day they are announced. Product reviews can serve this purpose with a snapshot overview. Developing a HOW Report on a product takes several months. Because of the extensive nature of the tests, not all products can be tested. We only test products of particular interest to the DEC community.

Summary of Minimum Test Plan

Engineering Evaluation

- Functionality
- Parametric verification
- Reliability testing and evaluation
- Quality of workmanship
- Selection of components and raw material
- Quality of external finish
- UL/CSA/FCC certification

Software Evaluation

- Functionality
- Parametric verification
- Quality of workmanship
- Reliability and stress testing

Human Factors

- Ease of use
- Placement of controls (hardware and software)
- Legibility of controls
- Clarity of controls and functions
- Resistance to erroneous inputs

General

- System considerations such as hardware/software integration
- Quality of documentation
- Security provisions

Publishing the Results

The organization of the published test results varies from test to test, but all reports will contain four major areas:

- test plan,
- test results,
- observations and opinions of the evaluator, and
- manufacturer's response to test report.

It is important, we believe, to publish all the test results. This allows you to reach your own conclusions on the suitability of a product for a particular application. The subjective observations and opinions of the evaluators are also important because of their hands-on use of the product.

The final area may surprise you. Most reviewers and testers don't permit the manufacturer to comment on the test results before they are published. We do. If the manufacturer is willing to correct some shortcoming in a future version, the user community should be made aware of this. We also allow the manufacturer to comment on and challenge our test procedures. This makes the tests fair to all parties.

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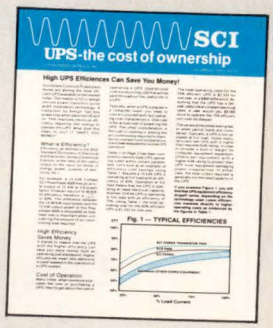

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CIRCLE 430 ON READER CARD

VAX/VMS OUTLOOK *by Steve Davis and Matthew Owen*

New outlook for software pricing

It's time for VMS software vendors to rethink their pricing strategy. The MicroVAX has the clear-cut advantage of the 10-year-old VMS operating system that no other micro can match.

Hardware is less and less expensive every day; a multiuser VAX, complete with terminals, printer, and VMS, costs less than $15,000. But many VMS account packages cost more than the VAX. Moreover, VMS itself makes up 20% of the cost of an entry-level VAX system.

VMS has the backing of the second largest computer manufacturer in the world. It is largely up to third-party software vendors to take advantage of this. Some decisions must be made soon, as a whole new generation of VMS software looms on the horizon.

Historically, VAX software has been developed by medium-to-large-sized companies having the resources to own this expensive hardware.

Now, even programmers and consultants can afford VAXes. The new, low-priced VAXes have caused some PC software vendors to eye the VMS software market as well.

When VMS software starts at hundreds of dollars instead of thousands, traditional DEC software houses will have to bend—or break. Many developers have already seen the handwriting on the wall and are experimenting with new pricing alternatives.

One scheme involves monitoring the use of software and then charging accordingly—similar to resource accounting in the time-share environment. But it's difficult to sell a customer on something when you can't tell them what it will cost. Then, too, this approach creates an additional support requirement of every sale.

Some VMS software vendors are charging by the number of users; this offers some advantages over charging by CPU size, but presents some interesting new twists. (VMS V. 5 will offer support for this approach to software licensing.) For example, the *maximum* number of users may be so much higher than the *average* number of users that the price is prohibitive. A combination of the charge-by-CPU-size and charge-by-user schemes is probably what will emerge as the standard for VMS software.

VAX technology is constantly evolving and marketing strategies must evolve with it. The VAX needs a greater variety of reasonably priced software to really compete on the low end and in smaller companies using the larger VAXes.

Steve Davis is a senior systems analyst whose credits include: extensively modifying operating systems for various new hardware devices, writing the original RSTS/E Disk Structuring Utility, as well as creating and implementing a directory structure for the new generation of write-once laser disk drives. Matthew Owen is a programmer who has worked with Davis since 1978.

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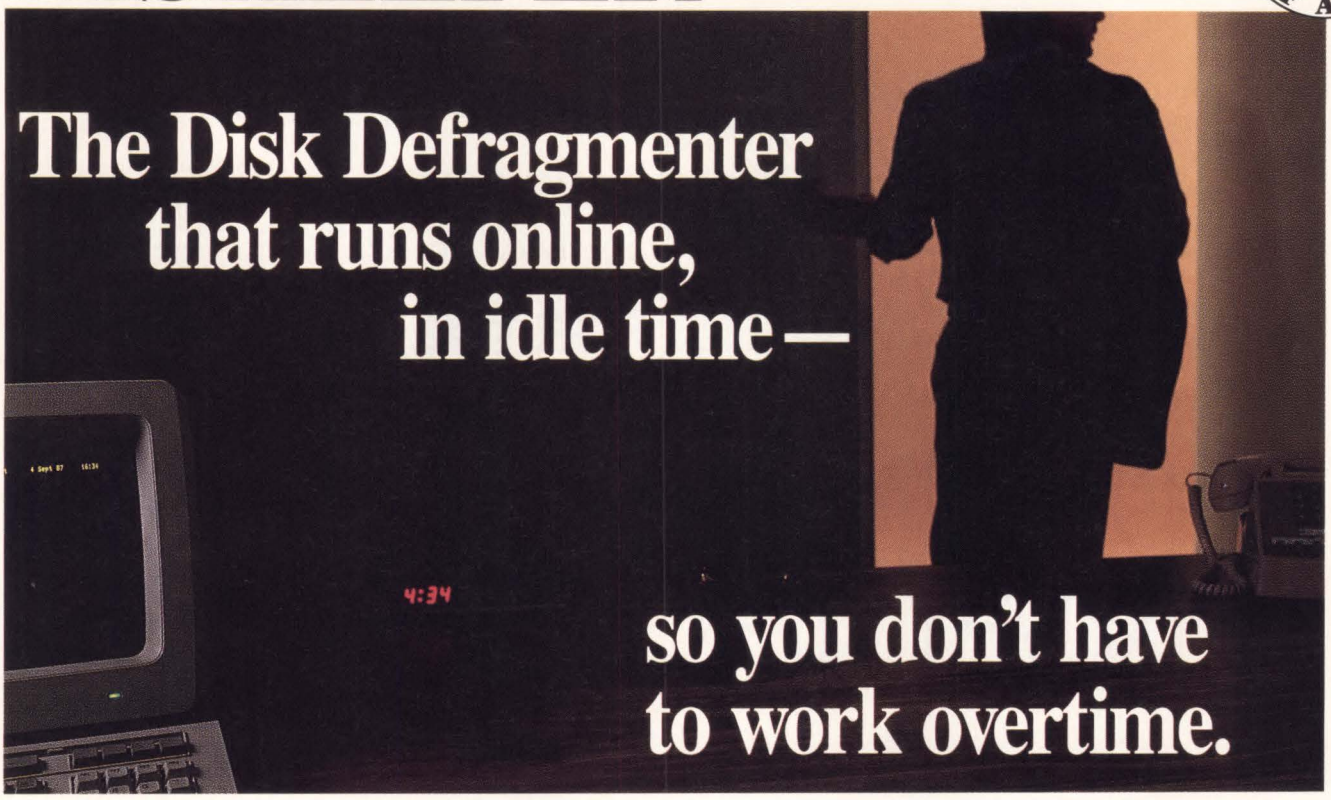

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CIRCLE 381 ON READER CARD FOR EUROPEAN INQUIRIES

HC/WG LABS HOW REPORT

AUTOMATIC DATA BACKUP ON YOUR VAX IS AN IMPORTANT UTILITY THAT HELPS YOUR PEACE OF MIND. HC/WG LABS REVIEWS THREE PACKAGES FOR THE VAX THAT MAY BE JUST THE TICKET

ARCHIVAL SOFTWARE FOR THE VAX KEEPS

DATA SAFE AND MANAGEABLE

BY DAVID SPENCER, Contributing Author

One of the most important functions of your data center is protecting the information on your VAX system from flood, fire, head crashes, and all other forms of disaster. Typically, this data, stored on the system disk, is regularly scheduled for full and incremental disk backups to tape. HC/WG Labs reports on three systems written for the VAX that perform data backup and access management functions. These specific packages are: Raxco's Rabbit-5, Software Techniques Inc.'s Media/Schedule/Vault, and Software Partners/32 Inc.'s Tapesys.

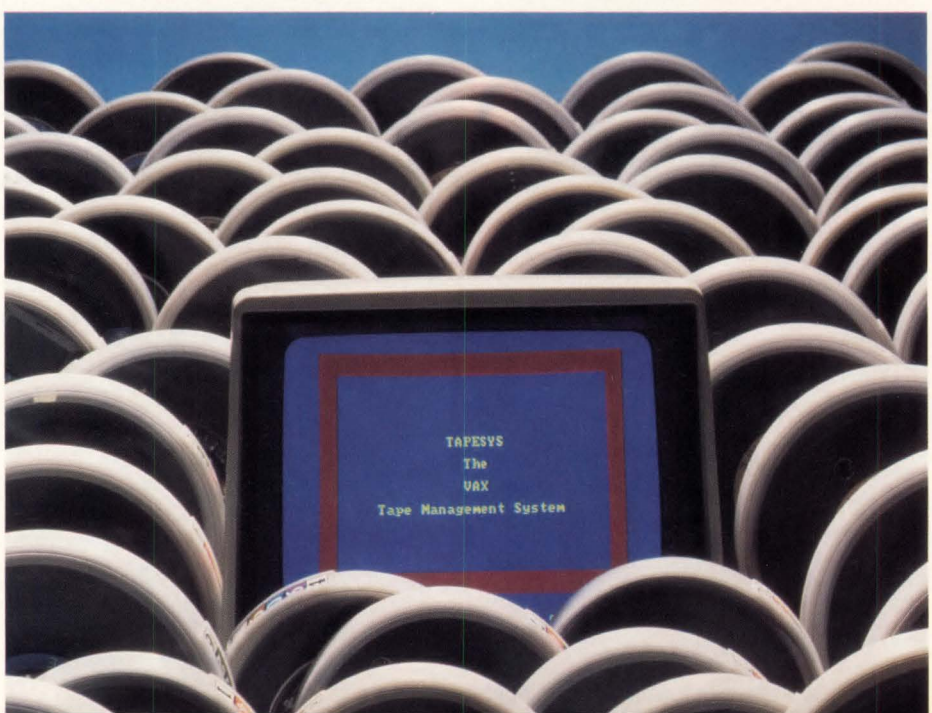
The Packaged Solutions

To get a proper feel for these packages, HC/WG Labs requested an evaluation copy from each manufacturer. The packages all included documentation, software, and the various utilities necessary to install the program.

Raxco's Rabbit-5 consists of two programs: R5 and R5Q. R5 is used for either backup or restore; R5Q allows you to query the backup journal database for files on tape. R5 uses a multi-command line interface to enter action or qualifier commands. Action commands such as MOUNT are used to mount a mag tape; an example qualifier command would be DEFAULT to set the device to be backed up. To save or restore files, the operator enters a series of qualifier and action commands to control Rabbit-5. All commands, such as tape initialization, mounting of tapes on a drive, and tape librarian management, go through the R5 interface interactively or via a command file run in batch.

The R5Q uses a video screen to let you try various queries for finding files saved on tape. Once a volume number and save-set name are determined, you can run R5 to request the file be restored.

Media/Schedule/Vault, from Software Techniques, comes as a series of three separate, loosely coupled programs. The Media program is a general-purpose program for managing access to both disks and tapes—thus the name Media. Schedule manages the scheduling of repetitive jobs—backup or otherwise. Vault is the user interface



to the files placed on the tapes. To perform a backup, a job is defined using Schedule, which, in turn, uses Media to allocate tapes and Vault to process the journal. All processing of backups with Media/Schedule/Vault is done through batch, with operator tape-mounting requests handled through the DCL REPLY command. Once your backups are complete, you can use the VAULT utility to create directories of offline files. Also, Media/Schedule/Vault comes with a utility called FORMAT to do foreign tape translations for you.

Partners/32, on the other hand, takes the long way around with Tapesys. This program consists of a series of programs that you access through a few DCL commands: TAPE and STORE for users and TOPER for the system operator. Tapesys requires the Forms Management System (FMS) for building the screens from which users select files for backup and restore, as well as screens for use by the system operator. When using Tapesys, however, the majority of commands are issued through the DCL TAPE command.

Tapesys also has an All-In-1 interface that allows you to save, archive, and retrieve files. The actual selection of tapes and mounting is managed using the DCL REPLY command. Tapesys also includes a queuing package called E-Z-Queue for scheduling periodic backup jobs.

Putting the Utilities to Work

With the software in hand, HC/WG Labs set about installing them for purposes of this review. We used a VAXcluster with two 11/750s and a TA81 1600/6250 tape drive attached to an HSC50 controller. Installation was quick and easy. Of course that is subjective and really depends on how you define quick and easy.

Installing the Rabbit-5 software involved restoring a VMS backup save-set from the distribution tape to a created directory. Following the restore, installation was completed by running a command file (that links the R5 image) and adding a foreign—undefined VMS command—DCL command to the system-wide log-in file. After installation was complete, R5 was run and the tape librarian files were created. This process can be thought of as priming the backup pump by establishing a base image.

Media/Schedule/Vault lets VMS do most of the work. You install it by using the standard VMSINSTAL installation procedure. The installation is completed by adding foreign DCL commands to the system-wide log-in file—an easily accomplished process.

Based on the ease of installation of the other two packages, we thought, upon inspection, that Tapesys was going to be very complicated. Our fears were due primarily to the wide variety of options available for network access. Fortunately, many of the options included defaults for simple installation and can be modified once you are experienced with the product—something we heartily recommend doing at a later time.

The actual installation of Tapesys consists of restoring a VMS backup save-set and executing a command procedure that links the product. Following the link, we authorized two usernames for use by the package and a server process was activated (the command procedure to start the server was also added to the system start files.) Finally, the DCLTABLES file must be updated by adding the DCL Tape com-

"Software vendors tend to defend their manuals more vigorously than the products."

mand; and then, using the INSTALL utility, you replace the previous DCLTABLES file with the newly revised version.

The Workbook Tools

Any critique of documentation is always difficult. Software vendors tend to defend their manuals more vigorously than the product.

Generally, the documents were legible. They did give sufficient information to get things working and that is generally all that is necessary. However, if you have a number of PC-type manuals in your library, and most likely you do, don't compare them with these manuals. The PC manuals will win hands down. With that aside, a quick review of what the manufacturers did supply is in order.

The 150 pages of Rabbit-5 documentation, divided into eight chapters and five appendices, is bundled into a single three-ring binder. Don't look for an index, however.

The manual is a combination of instructional, reference, and technical material, and has an introduction and a getting-started section on how to start running backups of files. However, that's as far as it goes. To begin using the file management program and the tapes recorded via the tapes librarian, you must thoroughly read the reference portion of the manual—there's no orderly, step-by-step procedure for you to follow. Fortunately, there are several examples to review and the R5 interface is fairly simple.

We strongly recommend that Raxco take the time to review this manual; we think it tends to spoil the product.

The Media/Schedule/Vault manual is slightly better but could also use some revision, in our opinion. Like the Raxco manual, it is supplied in a three-ring binder. This manual is divided into two sections: the installation guide and the reference manual. The reference section is quite extensive—15 chapters, seven appendices, and an index, for a total of almost 400 pages. The first four chapters describe the product, its use, and includes a getting-started section. The remainder of the book consists of descriptive and reference chapter pairs. As with Rabbit-5, the getting-started section is good but leaves a lot unsaid and requires considerable reading of the reference material before you can effectively use the program.

The Tapesys documentation consists of five separate manuals: an Installation Guide, Instruction Guide, User Guide, Manager's Guide, and Error Guide. All five were typeset on an Apple Macintosh (the fonts and graphs were a dead giveaway). The manual uses an instructional format, which makes it easy to get started, but leaves you hungry for more substantial reference material—especially when you're trying to find an elusive command or option.

Making the Label Stick

Each of these packages relies on having a pool of labeled tapes available to record files in the library. To get tapes into the library, each vendor's package has its own method of entry and labeling. Although this implies no standards exist for backup (and none do), that really doesn't become an issue as it is likely you will choose only one of the products for your site.

The Rabbit-5 software, for instance, depends on each tape being mounted with a Rabbit-5 label written to it prior to use. This is done interactively with the R5 program (Figure 1). Although time consuming, this method ensures that the correct tape is always mounted. Once new tapes are entered into the system, they are placed in the free pool for allocation by the NEXT command. If the tape contents are not for permanent retention, a relative life in days, or an absolute expiration date can be set. But remember, the label is unique to the Rabbit product and can't be used by similar utility programs.

Software Techniques' strategy with Media/Schedule/Vault allows single or multiple entry of consecutively numbered tapes with the Media ADD command. All newly added tapes are assigned to the pool of tapes available and are labeled the first time they are mounted. Again, the label is unique to the product and can't be used universally.

At the same time, other useful library information can be assigned to the tape's label as well, such as manufacturer, length, density, relative or absolute expiration date, and shadow media.

Similarly, the Tapesys utility permits either single or multiple tape entries with an FMS entry form. The first tape is entered along with defaults for purchase date, manufacturer, length, density, etc. (Figure 2). Following the first tape, subsequent tapes use the defaults from the previous tape, with individual changes possible, if required. As the tapes are entered, they go into the scratch pool.

Tapesys also has the ability to print labels to a file or printer so physical labels can be affixed to the reels for visible identification. We applaud this

The Rabbit-5 command screen, *required to enter a tape into the library, asks for each tape to be mounted and labeled as entered.*

```
$ RUN R5
R5:ALLOCATE MUA0:
R5:LOCAL
R5:TLIB ENTER 1000
R5:TLIB ENTER 1001
R5:TLIB ENTER 1002
R5:TLIB ENTER 1003
R5:TLIB ENTER 1004
R5:TLIB ENTER 1005
```

The Tapesys Master File Access Screen gives *you a wealth of useful library/tape information.*

TAPESYS MASTER FILE ACCESS SCREEN

Entering range of tapes

Reel number		Allocated date	17-MAR-1987 08:46
Purchase date	17-MAR-1987 08:46	Init date	17-NOV-1858 00:00
Cleaned date	17-MAR-1987 08:46	Next reel	
Reel length	2400	Block factor	0
Brand		Record length	0
Location	HEADQUARTERS	Job name	
Slot name		Off-site date	17-NOV-1858 00:00
Pool name		On-site date	17-NOV-1858 00:00
Status flag	Free	Clean count	0
		Slot name	
Owner Username		Mount count	0
Owner Nodename	MRVAX	Labelled?	No
Owner UIC	[0,0]	Last Access	17-NOV-1858 00:00
Account		Freed date	17-MAR-1987 08:46
Protection	S:RW,O:RW,G:R,W	I/O error count	0
Format		Prev reel	
Density	1600		
Scratch date	1-JAN-2000 00:00		
Notes			

Specify starting reel id

feature since it basically comes for free and ensures proper visible labeling of the tapes.

Making the Backup Grade

Specifications and marketing hyperbole aside, the real test is product performance. As you can expect, each of these packages performs differently.

The Rabbit-5 system relies entirely on interactive or command file-based backup procedures. To perform an incremental, archival, or full disk backup, you enter the command at a terminal through R5 or submit a batch job that invokes R5 and issues the commands from a file. Automated scheduling of backup jobs is left to whomever is responsible for managing system resources, since Rabbit-5 makes no provisions to interface the system batch queues. Rabbit-5 does make it easy for you to write generalized command files, however. This is achieved with the tape librarian command that manages the returns and requests for mounting of the next available tape from the available tape pool. And another appealing feature of Rabbit-5 is that it is noticeably faster than VMS Backup, which is used by Media/Schedule/Vault and Tapesys.

Media/Schedule/Vault, on the other hand, defines a special queue—SYS$TAPE—at installation time expressly for scheduling of Media program jobs. The Schedule program is a sophisticated system allowing management of other jobs besides those for backups, as well as allowing definition of pre- and post-processing batch streams. Jobs from Schedule can be defined to start on specific days, the beginning of the month, or the end of the month. Like Rabbit-5, when a Scheduled backup is executing, the operator is directed to mount tapes picked from the scratch pool as needed.

Tapesys tackles the scheduling of repetitive jobs with E-Z-Queue. Each night, E-Z-Queue is run to check its directory for jobs that are needed the next day. Jobs can be defined to run on certain days, holidays, beginning or end of month, etc., in a manner similar to Media/Schedule/Vault. Unlike Media/Schedule/Vault, however, there is no integrated hook for the creation of jobs into the scheduling system. To define a job that runs periodically, you must create a special format command file in the E-Z-Queue directory to run the job. The queuing mechanism conve-

Table—Product Features

Company	**Raxco Inc.** 1370 Piccard Dr. Rockville, MD 20850 301-258-2620 **Circle No. 211**	**Software Techniques Inc.** 6600 Katella Ave. Cypress, CA 90630 800-332-8650 **Circle No. 212**	**Software Partners/ 32 Inc.** 447 Old Boston Rd. Topsfield, MA 01983 617-887-6409 **Circle No. 213**
Product	Rabbit-5	Media/Schedule/Vault	Tapesys
Price	$995 MicroVAX II; $9,995 VAX 8800	$220 MicroVAX II; $8,250 VAX 8800	$3,000 MicroVAX II; $7,600 VAX 8800
Number of Users	600	400	150
Warranty	90 days	90 days	One year
User Support	15% of purchase price annually gets telephone support and updates	One year telephone support during business hours, contract available afterward; free updates	One year telephone support during business hours, contract available afterward; free updates
Training	One day free at Raxco; on-site available on time and materials basis	One day of training available at Software Techniques; on-site available on time and materials basis	One day on-site at $650 plus expenses
Target Market	Business, education, government, industry	Business, education, government, industry	Business, education, government, industry
Full Disk Backups	Yes	Yes	Yes
Incremental Backups	Yes	Yes	Yes
Shadow Sets	No	Yes	Yes
VAXcluster Support	Yes	Yes	Yes
Network Support	No, each node is treated separately	Yes, but each node keeps a database	Yes, a central database is supported
Bulk Tape Entry	No	Yes	Yes
Facility to Integrate Existing Tapes	Yes, but only for tapes in Rabbit-5 format	Yes, but requires tape listing files from user	Yes
Facility to Print Tape Labels	No	No	Yes
Reports on Tape Status/Location	Yes, but only by pool	Yes, and files are Datatrieve compatible	Yes, and files are Datatrieve compatible
Tape Usage History Kept	No	Yes	Yes
Sub-Pools of Tapes Possible	No	Yes, if tracked by owning user	Yes
Can Average Users View and Recover Files	Yes	Yes	Yes
Format Used for Backup	Rabbit-5	VMS Backup	VMS Backup
Tuning of Backup Parameters Available	Yes	No	No
Documentation Details How to Get Started	Partially, with many examples throughout	Yes, but very brief and requiring extensive reading later	Yes, includes a separate Instruction Guide

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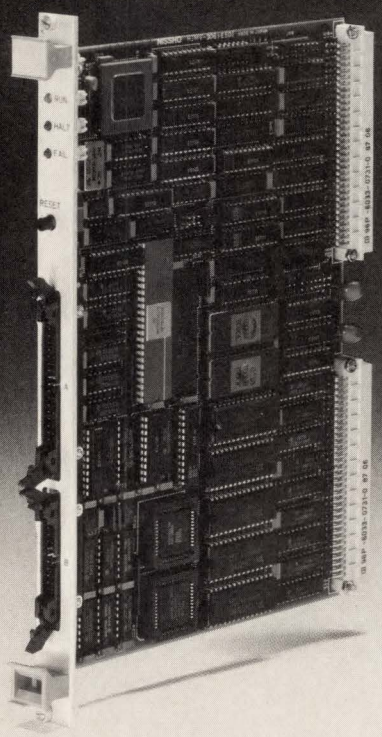

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niently allows an optional chain of jobs to be performed before and/or after the backup, again similar to Media/Schedule/Vault.

Bringing Back Lost Files

Complementary to copying files to tape is getting them back. Depending on privileges, you may be able to restore just your own files or files for other users. To perform the actual recovery, each package performs the retrieval process in different ways.

Rabbit-5, when doing a backup, copies the disk files into a container file on the tape called a save-set. When the journaling option is selected, R5 writes a record of each file copied into the journal database. To recover a file, the user runs R5Q to query the journal database. R5Q is an interactive, video-based utility. To locate a file, the user first specifies the disk name where the file was originally recorded, followed by a full or wild-card filename specification. R5Q then identifies the tape and save-set where the entered filename(s) can be found. With this information, you can then run R5, defining the tape volume ID, save-set name, and files to be restored. The files to be restored can be read to either their original location or to any other directory desired.

Media/Schedule/Vault uses the Vault utility to let you list files stored on the offline tape media. Vault works very simply and is like the VMS DIRECTORY utility—you just enter VAULT, the device, and the files to find. Vault returns a DIRECTORY-like list of matching files.

To restore any files, the user adds the /RESTORE qualifier to the VAULT directory command. The Vault utility advises you, as the system operator, to mount the tape containing the file(s) and restores them. You never need to know the save-set name or tape number to get a listing or a file back. We like that feature since it lets the computer do what it does best—remember complex information.

To restore a file using Tapesys, you enter a DCL TAPE REPORT command to list offline files and then either enter a DCL TAPE RESTORE command or start an FMS restore screen. The REPORT command works like the VMS DIRECTORY command by accepting a device, directory, and file specification. What is returned is a list of matching files, the reel number, and the save-set name.

To restore the files, you then enter either the RESTORE or RETRIEVE command to bring up the FMS form. In either case, the files, save-set name, and reel number is entered. Tapesys then requests the system operator to mount the tape, and the files are restored.

Although Tapesys does supply you with all the needed information, it isn't totally interactive. We think that rather than requiring you to input an actual entry, the cursor should be placed over the desired tape and file and the process should be automatic.

Keeping Humans Employed

If you're expecting that any of these packages will put you, as the system operator, on the bread line, don't worry. All three demand that you have an active, critical role in the backup and restore process.

For example, whenever a tape is to be mounted, a message will appear on your console that includes a reel number and text indicating whether the tape should be mounted with or without a write-ring. Once the tape is mounted on the required drive, you use the DCL REPLY/TO=<request #> command to inform the program that the tape is mounted and to continue. If for some reason the request cannot be satisfied (the tape can't be found, is offsite, the database wasn't modified yet, was eaten by a dog, etc.), you can abort the request by entering a REPLY/ABORT=<request #> command.

Besides the mount/dismount commands, two additional commands, /BLANK or /INIT (which are treated as synonyms), allow you to specify that the tape you just mounted is new or has no label and shouldn't be verified but should just be labeled and processed.

Smart Tracking of Non-backup Tapes

You naturally expect a fully featured tape librarian system to be able to keep track of tapes not created by the backup/archive system. Examples of such tapes are system software distributions, tapes received from other parties such as the government or post office, and tapes transferred from a previous archive system. Without this ability, confusion can and does arise over the status of a tape, possibly resulting in a tape being incorrectly erased.

The Rabbit-5 utility keeps track of its own tapes, but provides no facility in its tape librarian to manage tapes other than the ones created with R5. Media/Schedule/Vault, however, has the ability to enter and allocate tapes so they may not be inadvertently used for backups. In some cases, the contents of the tape can be stored in the Vault database if the tape was written in VMS Backup, PDP-11 DOS, IBM stan-

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dard, or FILES-11 format. Tapesys can, similarly, hold tapes in its database. If the tape was written using VMS Backup, there is an automated procedure to load its directory of contents into the file journal database.

And We Conclude . . .

Each package described in this article is targeted, we feel, to slightly different needs, yet they all provide the same standard backup and restore functions. Each program performs incremental or full disk backup, file archiving, directories of files on tape, and file retrieval.

The product emphasis for Rabbit-5 appears to be sites that have a lot of disks to be backed up and want it done fast. Media/Schedule/Vault appears to be more suited for large-operation shops with lots of tapes in rotation to an off-site vault, regular tape cleaning, and a staff of professional operators. Tapesys is, surprisingly, more oriented to individual users that back up and archive their own files.

Regardless of these solution niches, we felt each package fulfilled the basic requirements of saving disk data to off-line media and, thus, protecting the valuable data at a site.

What surprised us was the lack of emphasis placed on hands-off file backup management. We thought that some of the automatic system management concepts would have crept into the design of these packages. Moreover, it is unclear whether these utilities are capable of managing new technology in the VAX environment. Specifically, IBM 3480-style cartridges that are just now being attached to the VAX and emerging helical-scan drives (see "Home Video Technology Entertains Gigabytes of Storage," page 17 in this issue).

It comes down to the needs and requirements of each data processing shop and choosing the right package for themselves. Any of the products reviewed here can do the job. And yes, we recommend you do backup.

David Spencer, a regular review contributor to Hardcopy, *is a VAX systems consultant with more than 10 years experience using DEC equipment. He has designed and implemented several systems for networking, process control, financial accounting, video games, inventory management, health care, and publishing. Besides authoring numerous technical articles and writing for* Hardcopy, *he contributes to the DECUS library with such utilities as DIRECTORY SCAN.*

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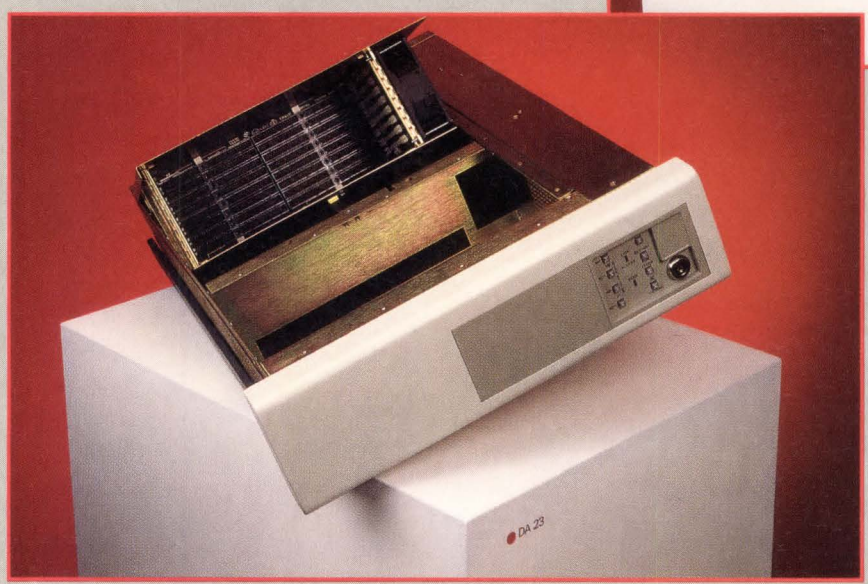

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Monitoring and managing system resources to achieve peak performance may be the greatest challenge

by Sandra Gray and Del Prothero, *Digital Equipment Corp.*

How many new users have you added in the past 12 months? How many new applications? What impact has growing user demand had on the performance of your computing resources? How can you assess the effects of future demands on resources?

The management of change may be the greatest challenge facing MIS managers today. In your responses to research interviews conducted by DEC, you describe change as a "moving target." Not only are you embracing technology more rapidly, you're demanding more sophisticated applications to meet new business objectives. And, while acceptance of new technology is "good news," meeting these demands can strain current resources.

How can MIS management meet the technical requirements for changing business goals while maintaining a consistent and predictable level of performance for all applications? The answer is "proactive performance management."

What is Proactive Performance Management?

Proactive performance management monitors system performance according to established standards—criteria set up to meet business objectives. With this procedure, you reduce the need for "fire fighting" and acquire trend data to assist you in forecasting and justifying future requirements. In short, it's one way to manage change within your MIS environment.

Think of proactive performance management as comprising the following four steps:

- understanding supply and demand—assess the rate and manner in which your computing resource demands are changing,
- establishing a service-level objective (SLO) by which you monitor system performance during peak processing periods,
- monitoring critical system resources (CPU, I/O, and memory) to identify first and second limiting resources, and
- gathering performance trend data for establishing near-term capacity needs.

Knowledge of change in your user community and how it affects your system usage during a period of time puts you ahead of "crisis mode" in your MIS environment.

Step One: Understanding Supply and Demand

After reviewing user requests during a 6 to 12-month period, you should have a good indication of the growth and change that has taken place in your computing environment.

To establish your rate of demands, answer the questions "how much?" and "what kind?"

Your answers to these questions help you develop a profile of new users and applications that have been added to the system. Every change impacts system performance and user productivity; you now have to determine how new demands impact you and your system.

On the supply side, when you meet growing user demand with a fixed supply of available resources, system performance is first impacted during peak periods. The acceptable quality of service may be diminished for all system users or groups of critical users only.

The supply and demand cycle of computing resource utilization can be illustrated as alternating periods of surpluses and deficits of system resources (Figure 1).

Step Two: Establishing Your Service-Level Objective (SLO)

To manage the peaks and valleys of resource demand, you need standards against which to monitor on-going performance. SLOs are often defined as part of a company's purchase specification. If your application and user mix has continued to grow and change, now is the time to re-establish SLOs for your system.

What is an SLO?

An SLO is a computing performance standard established to meet a defined business objective—the number of transactions per second, the time to process a specific number of payroll records, or the interactive keyboard response time. In every case, it is your agreed-upon level of performance below which you cannot drop without impacting user productivity or business goals. Many MIS environments require multiple SLOs, one for each critical computing function (Figure 2).

How is a Service-Level Objective Established?

- *Key Activity*—your priority processing function(s) on a particular system. Select activities that are critical business and/or user functions.
- *Critical Processing Period*—that time period when business goals

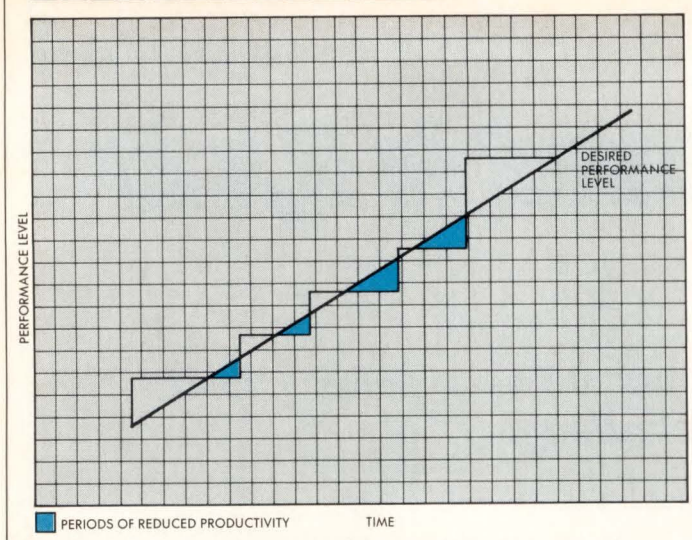

Figure 1—The growing demand for services at acceptable performance levels is represented *by the diagonal line. As demand increases over time, system resources are consumed until demand exceeds supply and performance drops to an acceptable level, at which time further system resources must be added to again meet acceptable performance levels.*

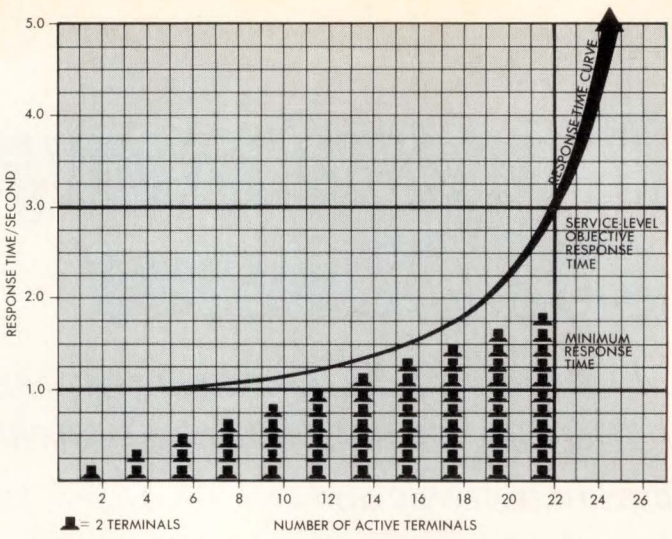

Figure 2—The system response time of a typical office configuration is charted *as the number of active terminals is increased. A response time of 3.0 seconds was established as the service-level objective (SLO); note how quickly the response time curve accelerates once this time is exceeded.*

or user behavior dictate these activities normally occur. This is also known as the peak processing period and could be as diverse as the last week of every fiscal quarter, the hours between 10 and 12 o'clock, or the time during which a major project must be completed.

If, for example, you manage a software development team, the SLO should include all processing time for representative program edit, compilation, and linking processes with all software developers logged onto the system.

Create an SLO benchmark by choosing a representative processing task, including all steps as they are actually executed, and clock the time required to complete all processing. This "script" then becomes your benchmark for monitoring future performance activity.

Routinely repeat the benchmark script during your peak processing period(s); after several months, this data should reveal useful trends. (You can either collect the data manually or write a small program to automate this function.) With this information, you now have the basis for managing and modifying the application workload mix during your peak period(s) as well as a performance record relating to your SLO. Whether you consistently meet or fall short of the SLO benchmark as defined by your business goal can aid you in managing critical MIS resources.

Step Three: Monitoring Your Critical System Resource(s)

Your systems have both a primary and a secondary limiting resource—be it memory, disk I/O, or CPU cycles.

As your application and user workloads grow and change, it's a good idea for you to monitor and observe the utilization patterns of each system resource separately and as they interrelate. Identifying system resources that point to impending bottlenecks helps you to:

- avoid critical performance degradation during peak processing times,
- establish contingency plans to avoid critical overload, and
- determine additional growth within limits of existing resources.

Step Four: Gathering Performance Trend Data

Taking snapshots of resource utilization and comparing the data trends gives you the best indication of your changing requirements.

Your goal for every resource is optimization; resource utilization trends are your way of gauging impending performance bottlenecks or underutilization of resources. Trend data gathered relative to system performance helps you make informed decisions regarding:

- performance management,
- resource allocation,
- load balancing, and
- introduction of productivity tools.

Optimize Performance And Productivity

As an MIS manager, you're faced with a dual role: 1) maintaining system performance on current applications, and 2) introducing new tools to increase the productivity of your user environment.

These goals are not mutually exclusive. Proactive monitoring and management give you the trend data to make informed decisions on how and when to introduce productivity enhancements. What impact these enhancements have on current resources can be established as well as how to plan for and justify the need for added capacity. Proactive performance management is the first step of a well-formulated system growth plan and is flexible to your changing MIS environment.

Sandra Gray, a marketing communications manager at DEC, has authored many technical papers for DEC's product development, industry, and application groups. Del Prothero is currently systems growth planning manager at DEC. His 30-year career in the computer industry has included software programming, technical training and curricula design, and field and customer service implementation.

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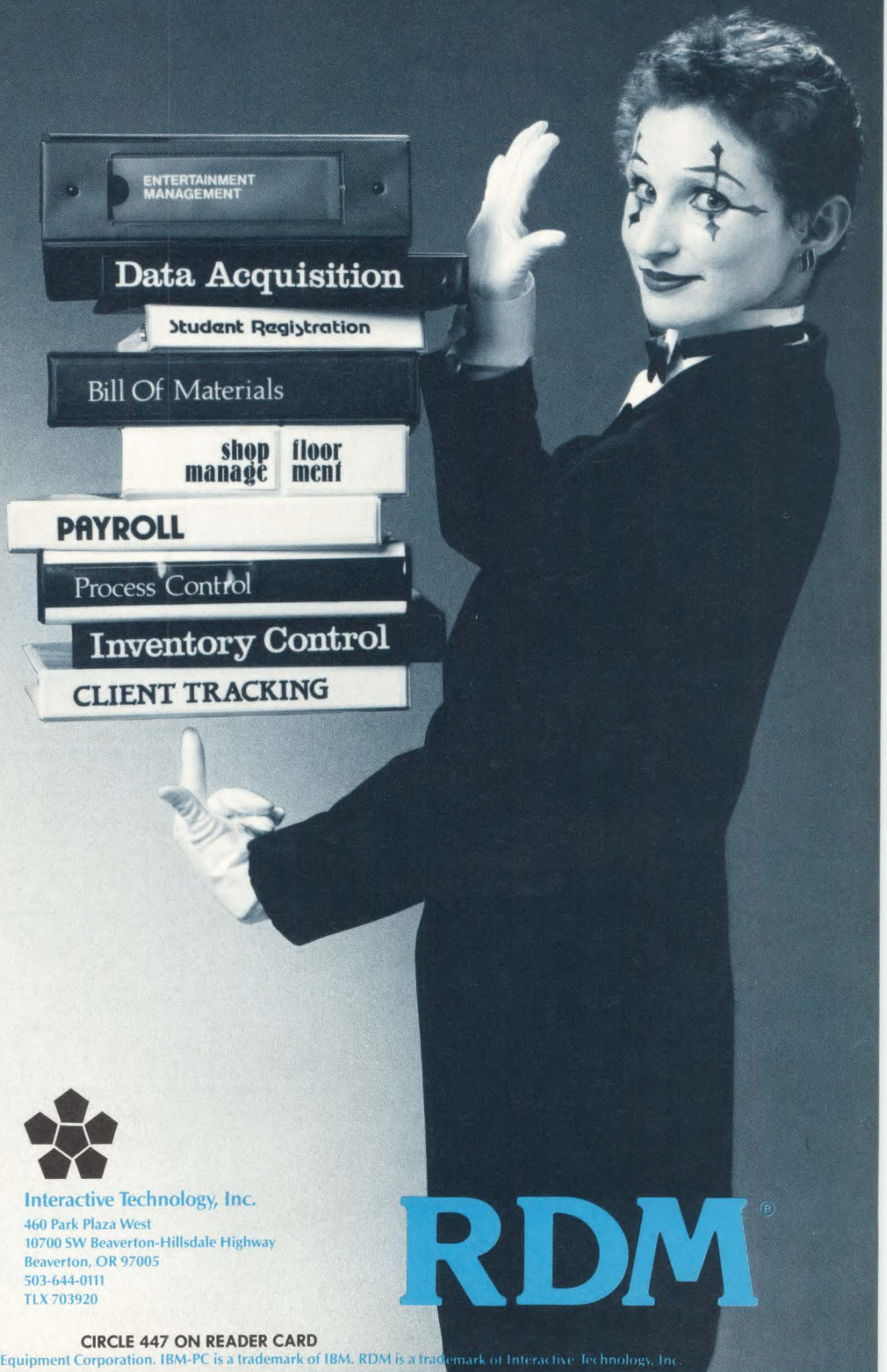

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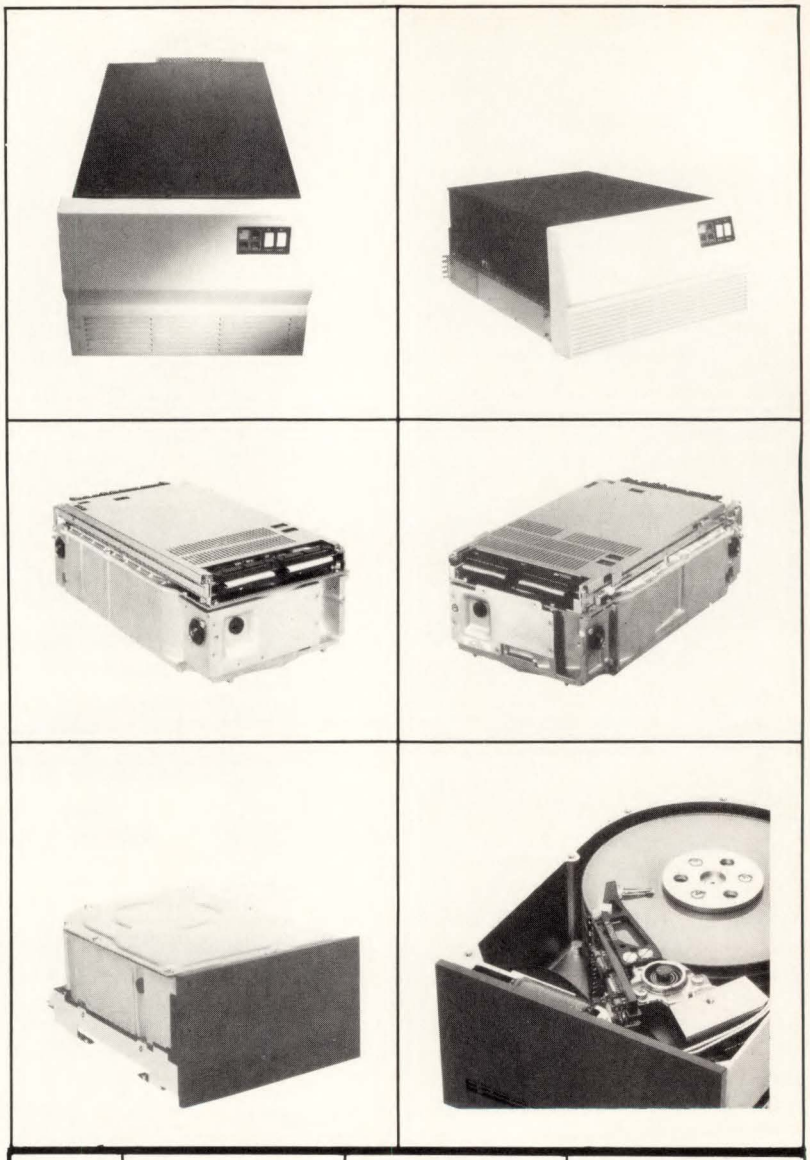

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TRANSFER RATE (K Bytes/s)	9295 12288	2458	1860	2458	2458	1229	1250	1250	625
INTERFACE	PTD	MSMD	HSMD	HSMD	HSMD	SMD	ESDI	ESDI	ST506
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GRAPHICS NOTES *by Edward R. Teja*

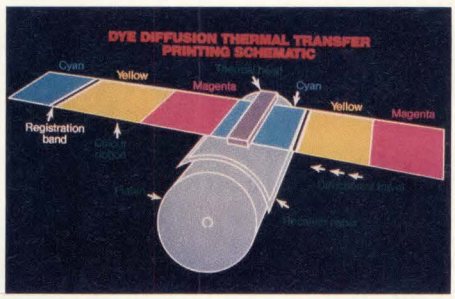
Thermal printing heats up

You don't refer to high-end color graphics applications as graphics at all these days . . . these are the stratospheric systems that transcend graphics to become "imaging systems." And imaging systems, quite naturally, must meet your application requirements: photographic-quality *Hardcopy* output with low per-copy costs and the ability to capture images from cameras, video tape, or computer screen without losing resolution.

Why all the fuss? Because you wouldn't use computers at all if the only output you could get came from the complicated pen plotters or laser printers that provide printout from most systems. Computer mavens now think of 300 dpi as the acme of print quality, whereas in many corporations this is accepted as barely readable.

Consider that a typical application of imaging systems is what Eastman Kodak Co. (Rochester, NY) calls desktop presentations. The object is to produce computer-generated overhead transparencies for presentations. Kodak's director of marketing, Jim Parker, assures us that audiences retain as much as 50% more information from a presentation that uses transparencies as opposed to the standard lecture with handouts. But, to sell in this market, a system must make slides that surpass the quality of pie charts created by your PC—even if upgraded with an enhanced graphics adapter (EGA).

Despite these demands, or perhaps because of them, there are almost as many contenders for market share in the imaging-systems arena as there are ideas for new computer applications. The most interesting progress we have seen recently is in *Hardcopy* output devices. They are, in a word, impressive. Unfortunately, technology is following three different tacks; and if you want to buy *Hardcopy* imaging devices, you must know each technology and what it offers. Problem one: You'll have to choose from three unique printing technologies: photographic, thermal, or ink jet. These three clearly compete—if not head to head, at least dot to dot.



D2T2 thermal printing technology provides *high-resolution* Hardcopy *color output, including transparencies.*

Photographic and ink jet peripherals should be at least somewhat familiar to you by now—photographic is Polaroid instant print quality (typically) and ink jet represents the current ultimate in dot-matrix printing. However, thermal printing has improved dramatically and now promises even greater potential as the technology of choice for industrial-strength printing, but thermal printing encompasses more than one technology. Because of this, problem two arises: If thermal is your choice in problem one, you'll have to choose the appropriate thermal technology.

The viability of thermal printing, especially color printing, depends to a large extent on what the printer prints on (print media). For instance, Seiko Instruments USA (San Jose, CA) achieves an exceptional color print quality using a wax-based thermal paper. The problem with this process is not in its quality, but rather, that wax reflects light—you can't make transparencies with it. Of course, this is just a market restriction, not the death knell for a fine *Hardcopy* technology. If transparencies aren't part of your system's requirement, this process is available and demonstrable.

Another thermal technology is a chemical process called Dye Diffusion Thermal Transfer (referred to as D2T2, believe it or not). Rather than using heat to bring out a color, D2T2 diffuses a dye into the paper at up to 400 dpi (currently); the amount of dye depends on the energy present in your heating element. Superimposing yellow, magenta, and cyan dyes produces a full-color and continuous tone image. This technology works for both color prints and overhead transparencies.

The first-generation products using the D2T2 process are just beginning to appear on the market from printer vendors such as Hitachi (Sunnyvale, CA). Current models provide a beautiful 3 x 4-in. print, and promised models (now being shown; delivery promised for 1988) offer 8.5 x 11-in. output.

This technology affords you *Hardcopy* output with the look and feel of a photograph. Currently, D2T2 printing is a bit expensive—about $3 per print—but British paper and chemical process manufacturer ICI Electronics (Cheshire, UK) expects image prices of less than $1 per print during the next five years. ICI, which makes a ribbon/white paper receiver set that's compatible with D2T2 printers, predicts several vendors will enter the market with D2T2 technology printers in 1988.

With a quality approaching that of photographic processes, continuous tone reproduction might prove the miracle that the business graphics market needs to achieve its long-promised breakthrough. Maybe. The determining factor will, of course, be acceptance by OEMs (first) and (then) end users. The primary question centers on how many systems manufacturers are willing to give thermal printing a go. If you are building systems for the corporate environment, therefore, it might be a good idea to investigate imaging output systems.

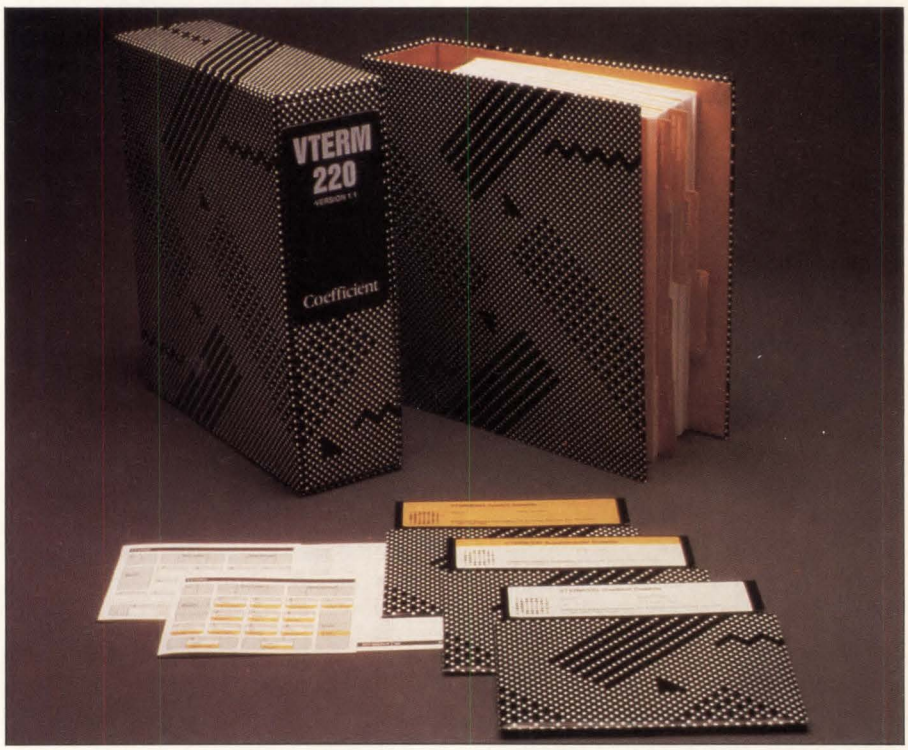
Edward R. Teja is a Hardcopy *columnist.*

Reader Interest Level	
High	**Circle No. 257**
Medium	**Circle No. 259**
Low	**Circle No. 261**

HC WG LABS HOW REPORT

Coefficient's Vterm/220 Links PCs to DEC Via Multiple Protocols

Excelling in the quality of its VT220 emulation and the scope of its documentation, Vterm/220 emulation software for the PC is worth investigating



Vterm 220 allows you to emulate *DEC VT220 terminals as well as older VT52 and VT100 series. The VT220 emulation supports the full range of VT220 features, including national language character sets and 7- or 8-bit controls.*

by ***David J. Molta***

Vterm/220 is powerful, easy to use, and warrants your serious consideration if you are looking for a VT220 emulation package. With Vterm/220, your IBM PCs and compatible systems can be asynchronously linked to DEC's VAX or other host systems. Vterm/220 also offers you the facilities for converting host files into several popular PC spreadsheet and database software file formats, in addition to the standard terminal emulation, file transfer, and general asynchronous communications facilities found in similar products.

Vterm/220 is not copy-protected and requires 320 Kbytes of RAM, minimum. It sells for $245 with volume purchase discounts and site licenses available.

Terminal Emulation

With Vterm/220 you can emulate DEC VT220 terminals as well as the older VT52 and VT100 series. The VT220 emulation supports the full range of VT220 features including na-

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- Full emulation of a variety of DEC-compatible terminals; supports two most commonly used file transfer protocols—Kermit and Xmodem.
- IBM PCs and clones can be asynchronously linked to DEC VAX and other host systems.
- Permits full-screen operations such as EDT and allows total control over keyboard mapping.

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tional language character sets and 7- or 8-bit controls. When using Vterm/220, you operate with full-screen applications such as EDT as easily as with an actual VT terminal.

The Vterm/220 emulator is easily invoked using a hot-key toggle and is compatible with other memory-resident applications. In its simplest configuration, the program occupies approximately 175 Kbytes of RAM, leaving enough free memory on a typical 640-Kbyte system to run most word processors or a reasonably large spreadsheet. In those cases where other memory-resident software is also being used, Vterm/220 can be easily removed from memory. However, unlike other memory-resident applications, it's not possible to hot-key (single key execution) to Vterm/220 from within the application—a limitation of the product; the hot-key will only work from the DOS command prompt. According to Coefficient Systems, a soon-to-be-released version of Vterm/220 will enable you to hot-key without exiting to DOS.

Vterm/220 is invoked by typing 220 at the DOS prompt. You can run the package from any DOS directory, provided a DOS path to the Vterm/220 directory has been defined. Once the program is loaded, a blank screen appears with status information on the 25th line of the display screen. The status information changes according to the operation being performed so that, for example, indicators of file transfer status are displayed while performing a file transfer.

Help screens, which are generally well laid out and easy to use, are available for your use at any time by pressing ALT-H. Vterm/220's four setup screens are available by pressing ALT-S a corresponding number of times. The first setup screen allows for an extremely flexible configuration of the terminal, communication, and printer options. The other setup screens allow you to configure file transfer options, softkey macros, and VT-series function keys. The softkey macros are particularly flexible, allowing fairly sophisticated script programs to be assigned to keystrokes. You can obtain help in using the setup screens by pressing ALT-H. Custom configurations can be saved in different files if you communicate with multiple hosts requiring differing setups.

One problem common to most VT-series terminal emulators is mapping the PC keyboard to emulate dedicated VT function keys. This problem has been complicated by IBM's frequent changes in keyboard layout. Vterm/220's solution to this problem is to give the user total control over mapping the keyboard. While this can be accomplished with other communications software using third-party keyboard macro utilities, Coefficient's approach stands out for ease of use among its competitors.

Vterm/220 includes several nice features that greatly enhance micro-to-host communications. The scrollback buffer allows you to maintain a buffer of up to 64 Kbytes (approximately 80 screens) of incoming information that has scrolled off the screen. This information can be reviewed at any time by pressing ALT-V and the PC's cursor movement keys. The contents of the scrollback buffer can be easily stored in a file or printed, if desired.

File Transfer

The documentation describes a powerful file transfer capability. Indeed, Vterm/220's file transfer capabilities are both flexible and consistent in use and operation. Included with Vterm/220 are an ASCII file transfer implementation, two highly efficient proprietary protocols, VTRANS8 and VTRANS7 (with full host source code), and the two most widely used file transfer protocols, Kermit from Columbia University and Ward Christenson's Xmodem.

The ASCII file transfer function allows for character and line control as well as management of the up and down loading process. This capability makes Vterm/220 suitable for transferring text files to non-DEC host editors where special requirements might be imposed.

The usefulness of the Kermit file transfer protocol is also available to you from Vterm/220's Kermit options setup. Thus, you avoid having to issue numerous Kermit SET commands to customize the file transfer environment. In terms of flexibility and ease of use, Vterm/220's implementation of Kermit is certainly among the best available.

The Xmodem protocol within Vterm/220 includes the CRC option, but none of the recent extensions, i.e., larger block sizes, multiple file transfers, and sliding windows. While this may not be a problem for most of you, these extensions are highly desirable for users of computer bulletin boards—not necessarily Coefficient's market.

Coefficient includes two proprietary protocols, VTRANS7 and VTRANS8, together with host source code in several languages for multiple operating systems. Both protocols allow for unattended single- and multiple-file transfers under host computer control. VTRANS7 and VTRANS8 are similar except that VTRANS7 converts all control characters to printable ASCII characters before transmitting them and reconverts them when received. Although this imposes additional overhead on file transfers, ASCII data conversion is required in some communications environments.

OneShot

The OneShot utility program included with Vterm/220 allows you to extract information from reports, files, and queries and convert it into a format recognizable by most popular PC spreadsheet and database management programs. The only restriction is that data to be converted by OneShot must exist as an ASCII text file with a maximum record length of 254 characters—easily accomplished by redirecting an application's reports to a file rather than a printer. Another method is to output directly to the screen and capture it to a file with Vterm/220.

OneShot is not an integral part of Vterm/220 but a PC application that is executed from the DOS command prompt. Thus, in addition to serving as a host-to-PC file translator, OneShot may prove useful for applications having little to do with PC-to-host communications, such as data extraction from PC files for storage in a PC DBMS. To use OneShot, you must first set up a template defining the structure of the text file—including headers, footers, and field locations. The product is relatively easy to use and includes a tutorial and complete reference guide to assist you.

Installation

Initially, you will find it helpful to create a Vterm/220 configuration by running the V2CONFIG utility. This

program allows you to configure the program's video operation, terminal characteristics, disk and printer options, and foreign language capabilities. V2CONFIG is menu driven and quite easy to use. Options are changed by moving the cursor to highlight the desired choice and then pressing RETURN or by pressing the first letter of the desired choice. Useful help screens are included with each option.

The video operation option allows you to select colors for color monitors, suppress screen snow, and indicate whether you have a 132-column video card installed. The terminal operation option is used to enable or disable the margin bell, warning bell, and status line; set the default numeric keypad state (numbers or cursor control); determine the hot-key combination; and allocate memory for the scroll buffer. The disk and printer operation option allows you to determine whether or not an XOFF will be transmitted during disk access and instructs the software to translate or pass graphics characters directly to the printer. A foreign language operation option allows you to select among 11 foreign character sets.

Documentation

The documentation included with Vterm/220 is comprehensive, including details of recent program enhancements. Moreover, the manual serves as a reference source for file transfer protocols.

Recommendations

Vterm/220 provides full emulation of a variety of DEC-compatible terminals and supports the two most commonly used file transfer protocols, Kermit and Xmodem, in addition to the proprietary but efficient VTRANS. The implementation of Kermit is particularly well done. Its hot-key operation is particularly if you frequently move between communications and DOS.

Like any product, however, there are a few shortcomings. Specifically, we would like to see the addition of an integrated text editor or at least the ability to access one from within the program. The Vterm/220's hot-key exit to DOS does permit invoking an editor and returning to Vterm/220, but is less state-of-the-art than we like. Additionally, we'd like a search capability of the capture buffer. Since Vterm/220 allows more than 64 Kbytes of data to be buffered, this feature would be invaluable if you access large amounts of data. Finally, our wish list calls for an integrated dialing directory (preferably disk-based so it's not limited) and a script language for developing user-specific interfaces. ■

David J. Molta, a data communications analyst at North Texas State University (Denton, TX), holds an M.A. from the university, and is completing work on his Ph.D. He's responsible for integration of all PCs into a campuswide broadband communications network with DEC computers at the hub.

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CIRCLE 413 ON READER CARD

Helical-Scan Technology: A New Twist To Graphic Output

Large-sized color graphics output devices use helical-scan technology to achieve office copier convenience

by John Potter, *Product Marketing Engineer/Precision Image Corp.*

The office copier is a solid example of successful industrial design. Having had adequate time to evolve, the design—and operational simplicity—of xerography can be used almost everywhere. Refinements in design and production have reduced copier price/performance ratios to present levels, while increasing the copier's everyday utility and accessibility.

When attempting to bring copier convenience to the widespread computerized community of engineers, architects, draftsmen, etc.—users with a need for quick-turnaround, high-quality production of large (D- and E-sized) multicolor hardcopy outputs—you might first consider the essential qualities already present in the modern office copier.

Office Copier Qualities

One of the most significant (and certainly among the least obvious) aspects of the contemporary office copier is that it's an automatic single-sheet mechanism. Regardless of whether the source documents are fed manually or mechanically, or whether the copy blanks are hand-fed singly or automatically, the output of the copier is a stack of single sheets. Copies can be returned, examined, and disseminated quickly.

This is also a significant characteristic for plotters. A plotting device should be as user-convenient as possible. Single-sheet feeding, common in the copier world, enables image processing devices to act as productivity tools in real time, with individual pieces duplicated and returned to their originators quickly.

In contrast, the web-feed (continuous-roll) paper transport commonly used by electrostatic plotting devices requires that all drawings on a roll be generated and printed before each individual image can be cut and removed. This creates a batched flow of operation with a corresponding loss in productivity.

Helical-scan technology brings many of the characteristics of the common office copier to plotters.

Other characteristics of your common office copier—its print speed, high-quality imaging, and low operational and maintenance costs—are also important parts of its basic feature set. And each characteristic poses its own unique set of engineering and manufacturing challenges for the designer of state-of-the-art hardcopy output devices.

The foundation of helical-scan technology is based on attempts to combine solutions to these design challenges with the practical realities of device manufacture. Helical-scan methodology is a new approach to the design and manufacture of cost-effective, high-speed/high-resolution, multicolor electrostatic plotting devices.

Start With a Drum

A drum transport mechanism (cylinder) handily addresses the single-feed sheet issue and, at the same time, provides a stable base transport from which to develop an extremely high degree of registration accuracy. Paper can be fed from a cassette-stack on the side of the machine, guided onto the drum with a simple finger mechanism, and then held firmly to the drum by vacuum. A drum 12 in. in diameter and 54 in. long can handle media of up to 36x48 in. (Figure 1).

With the paper (or film) copy surface held firmly in place by tons of force (approximately 5000–10,000 lbs. over an E-sized 36x48-in. plot), one of the long-time difficulties inherent to multicolor electrostatic copying—precise color-layer registration—is neatly eliminated. Simply put, the paper can't move at all. Paper movement as a result of environmental changes (drying of the paper, for example) is also inhibited by the paper's direct contact with the drum surface.

Very tight registration is extremely

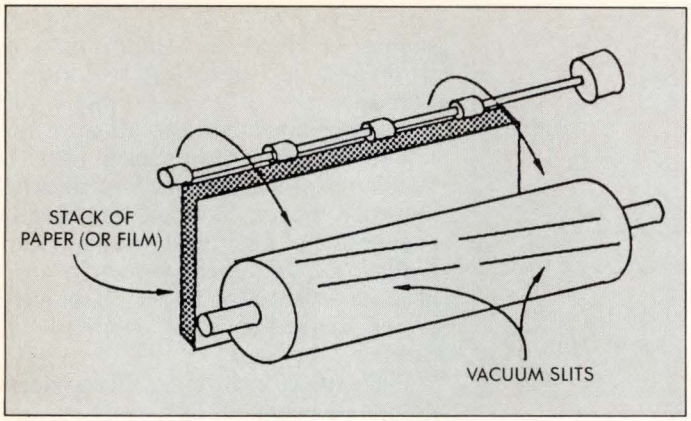


Figure 1—The drum mechanism functions *as a rigid transport mechanism for single D- and E-sized sheets of paper or film, holding the sheet firmly in place to provide registration accuracy within tolerances of 0.001 in.*

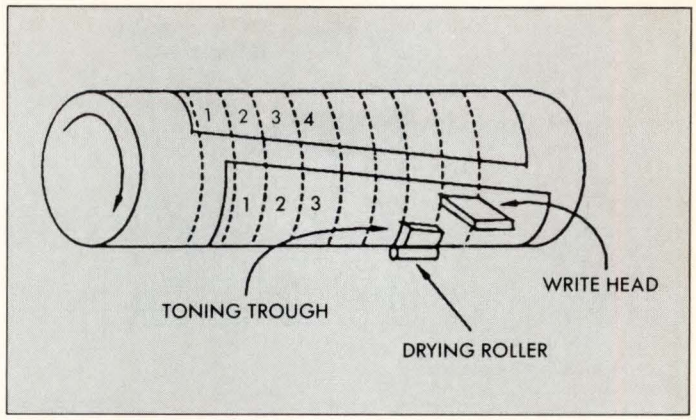


Figure 2—A skew of 4° permits *a horizontally driven writing head to describe a helical path across the full surface of the plotting medium.*

BLACK	70 SEC.
clean and reposition head	20 SEC.
CYAN	70 SEC.
clean and reposition head	20 SEC.
MAGENTA	70 SEC.
clean and reposition head	20 SEC.
YELLOW	70 SEC.
clean and reposition head	20 SEC.

6 MIN.

Figure 3—The toner common volume is *that portion of the toner feed mechanism common to all four toner paths (and the isopar cleaning fluid). Its total volume (less than 2 cm³) is flushed with a net loss in toner solids of less than 0.010 gram. Toner cleaning fluid is recycled with zero loss.*

important in multicolor plotting, since it's the precise positioning of the small dots, one upon the other, that permits consistency of color to be developed over the entire plot. (These tolerance requirements are similar to those necessary for the multi-pass cutting of threads on a precision lathe.) By holding the plot medium firmly to the drum surface, it becomes more feasible to precisely position the successive layers of colored dots. This has the additional advantage of eliminating the costly and relatively inaccurate electromechanical registration techniques used in nonfixed-media plotting devices.

Big Drum, Small Head

A conventional writing head covering a 35.2-in. writing track at 400 dots per in. (dpi) would require a complement of 14,080 writing styli. Since styli (and the electronics required to drive them) contribute substantially to the ultimate cost of any electrostatic plotter, reducing the width of the head is an obvious way to produce a less costly device. However, since a smaller head still has to cover a (proportionately) larger area, the issues of precisely controllable lateral movement and overall throughput must be addressed.

Though stepper-motor mechanisms present their own set of electromechanical and cost disadvantages, all are neatly circumvented if the narrow (less than 2½ in. long) recording head is attached to a lead-screw mechanism. As the drum rotates and the lead screw advances, the electrostatic writing head and the toner trough (following one track behind) trace a helical path around the cylinder's axis. By tilting the writing head at a slight angle (approximately 4°), and also skewing the plotting media at the same angle, the plot eventually covers the entire surface in a single smooth sweep that is 54 ft. long for E-sized media (Figure 2). With this approach, your color registration accuracy depends only on lead-screw and encoder precision and accuracy of ±0.001 in. is easily obtainable.

Small-Head Bonuses

In addition to the cost advantages of a small head mechanism, the narrow writing head used in electrostatic helical plotting technology permits additional usability, plotting speed, and reliability.

Foremost among these is the reduction in size of the electrostatic writing head permitting a corresponding reduction in the size of the plotter's moving toner trough. This, in turn, permits a reduction in the size of the toner common volume (Figure 3), and promotes the design of a toner-efficient, self-cleaning mechanism.

The automatic self-cleaning operation occurs between each of the four passes of a multicolor plot. At the end of each pass, the small common volume is drained and cleaned by rinsing it with clear isopar (cleaning fluid). The result is that a full-color, individually printed, E-sized electrostatic plot can be produced within a total elapsed time of six minutes, including cleaning cycle time (Figure 4).

The helical plotter's toner common volume includes the internal volume of the toner head (shoe) itself, plus the additional volume of a small flow concentrator to control the individual flow of the four colored toners (cyan, magenta, yellow, and black) and the self-contained cleaning fluid. The cleaning fluid is simple toner base fluid, without the coloration particulates.

With a total common volume of less than 2cm³, the toner common volume is flushed by 10 times its volume during its 20-second cleaning cycle. The toner base fluid is filtered each time it's used, then recycled for subsequent use in later cleanings.

The small common volume, coupled with the recycling of the toner cleaning

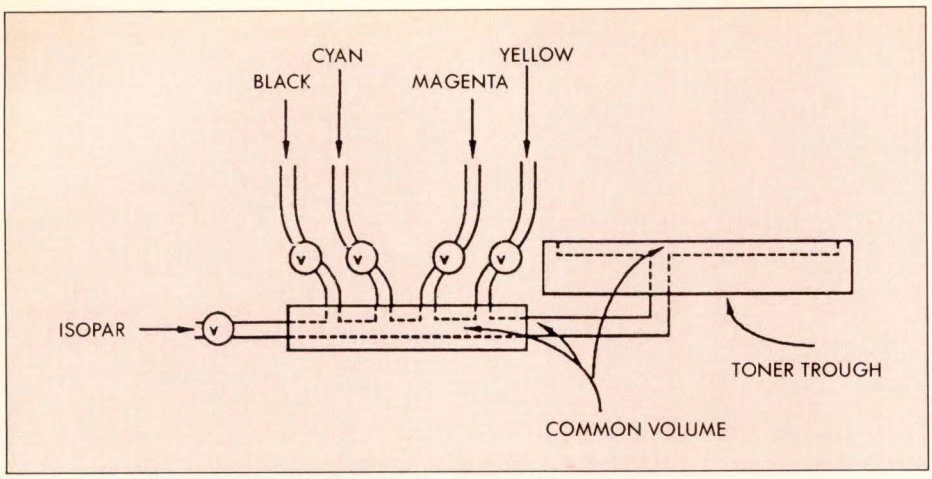


Figure 4—An E-sized electrostatics plot can be produced *within a total elapsed time of six minutes, including cleaning cycle time.*

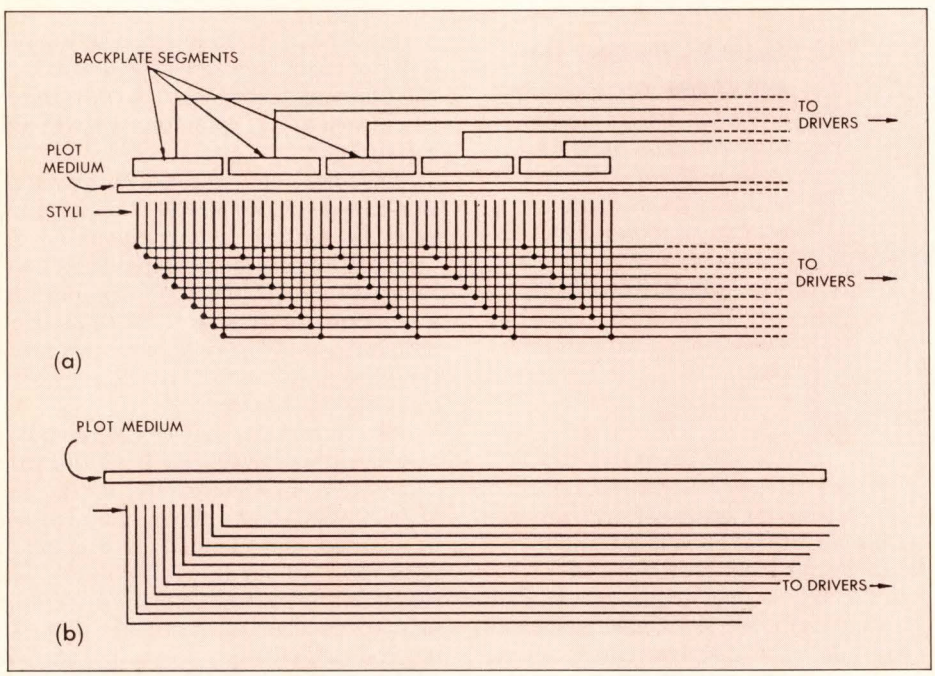


Figure 5—Multiplexed styli (a) are driven *by the differential between the charge applied to the stylus and the voltage applied to the electrical plate behind the medium, allowing full-width heads to be operated with a manageable number of stylus drivers; direct-drive styli* (b) *are driven individually.*

fluid, results in an extremely small amount of toner loss per pass. Less than 0.010 gram of solids is filtered out and lost per flushing cycle—typically, less than 1% of the toner consumed during the previous color pass. The filter is disposable and can be replaced as needed (usually one filter throughout the operational life of the four containers of toner color).

Non-Multiplexed Styli

The design of the electrostatic writing head calls for 1024 styli positioned across the 2½-in. head width. This low stylus-count (compared to the 14,080 styli that would be required for any full-width head) permits affordable implementation of one high-voltage driver per stylus. This is an alternative to conventional wide-head multiplexing techniques in which styli are grouped into sections and individually selected for printing/nonprinting. This is accomplished by means of electrical differentials between the styli themselves and electrical plates (backplane segments) that are positioned on the other side of the media (Figure 5).

The smaller, 1024-styli head, with each nib under direct control of its own driver, permits far quicker response to electrical stimuli than do wide-head multiplexing techniques. Printing rates of up to 5 million dots per second have been obtained, which allows the paper to be moved past the heads at speeds that greatly increase printing clarity. Further, because the production of a dot is so precisely controlled, the actual time to write is 70 μsec, substantially faster than write times available using multiplexed heads.

This faster write time allows charge dots to be swept out as required, avoiding the "doughnuts" often found in web plots. Also, the elimination of the backplates simplifies the entire electrical mechanism, increases electrical operating margins, and further eliminates problems that arise from nonuniform charge density (extraneous dots and multiplexing striations) due to uncontrolled voltage variations in the paper.

Cost Savings

The impact of the smaller writing head on manufacturing and operating costs of the plotting device is substantial. The lowered number of writing styli, together with the simpler electronics required to drive them (compared to multiplexed approaches), reduce the cost of producing the electrostatic head and its supporting electronics by almost 80%. Additionally, because the 1024 pins in the narrow head correspond to the 1024 raster standard currently supported by commercially available rasterizing chips developed for CRT displays, further cost savings in device design and manufacture can be realized. Other savings occur as a result of being able to easily integrate these high-speed off-the-shelf components into the plotter electronics for the vector-to-raster conversion process.

Day-to-day operational savings are derived from the mechanical simplicity of the helical plotter's lead-screw drive mechanism, consisting of fewer moving parts and generally requiring lower maintenance and repair expenses. Of equal or greater importance, however, is the reduction in toner and paper costs arising from elimination of unnecessary waste. In multicolor plotting, the minimal amount of toner lost (0.015 gram) between each color pass results in more than 99% of the toner being used to produce plots. Paper and film costs are likewise minimized, since plots are produced individually and

need not be cut from longer rolls.

The self-cleaning capabilities of the helical plotter eliminate the need for a human operator to manually clean the device and change toner colors between passes. Since cleaning a conventional plotter is akin to cleaning a printing press, this eliminates a difficult, messy, and costly part of plotter operation. As with the office copier, the self-cleaning nature of the helical electrostatic plotter makes it similarly suitable for the office environment.

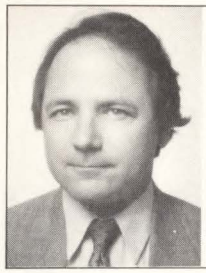
Interfaces

Since multicolor electrostatic plotting applications exist in mainframe, minicomputer, and microcomputer environments, a variety of hardware and software interface requirements must be satisfied to provide true device accessibility. Furthermore, the user interface (operator console) of any peripheral should permit convenient control of device function and behavior characteristics, including provisions for the ability to easily switch system- and application-specific compatibility/emulation modes as required.

Contemporary board-level hardware and software technologies permit the cost-effective construction of a built-in operator console/interface unit that allows device hardware interfacing to be accomplished with industry-standard, off-the-shelf components, providing operator-switchable parallel, serial, and Ethernet connectivity to most computer hosts.

Although the proposed computer graphics interface (CGI) standard holds the eventuality of a unified computer graphics language, the present real-world situation is one in which a number of de facto graphics output standards dominate and must be supported. To that end, console-selectable Hewlett-Packard Graphics Language (HPGL) and CalComp 906-907 settings must be available for 100% plug compatibility with the widely used HP and CalComp pen plotters. Also, host-resident subroutine libraries providing full American National Standards Institute (ANSI) CGI and Versaplot compatibility are required for VAXes (VMS and UNIX) and other mini, micro, and mainframe computers.

High-speed, multicolor helical plotting—due to its self-cleaning operation and automatic single-sheet feed mechanism—is a particularly appropriate technology for CAD/CAM/CAE; IC and PCB design; solids modeling; seismic/geological mapping; architecture, engineering, and construction (AEC); and graphic arts applications. Future manufacturing and design refinements promise still lower product cost, broadening the application potential for these peripherals. While currently available only for the production of large (D- and E-sized) plots, smaller output sizes can be accommodated using the identical design approach, eventually bringing high-quality color plotting capability to other application areas requiring the quick turnaround of full-color hardcopy output.



John Potter, product marketing engineer for Precision Image Corp. (Redwood City, CA), has more than 17 years of experience in computer graphics hardware and software.

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CIRCLE 458 ON READER CARD

Can You Imagine 16.7 Million Colors?

You can certainly match any color and pattern of any fabric in the "rag" business if you have a Tektronix 4300 Series graphics workstation. This high-end workstation can produce vivid, accurate shaded solids using the simultaneous display of its full palette of (yes!) 16.7 million colors.

For reliability and compatibility, the 4300 Series workstations incorporate industry standards, including Motorola's 68020 processor, UTek—Tektronix implementation of BSD 4.2 UNIX, with System V extensions—X Windows, Network File System, Ethernet local area network with TCP/IP protocol, and PLOT 10 graphics software. These standards are balanced with Tektronix proprietary, pipelined graphics architecture, featuring custom gate arrays and a separate display list memory, to maximize total graphics application performance.

All standard configurations for the workstations include 86-Mbyte hard disks, 4 Mbytes RAM, C, LAN support, X Windows, and IBM PC emulation. Optional features include additional RAM, larger disks (150 Mbytes and 300 Mbytes), FORTRAN, Pascal, LISP, Prolog, and a variety of I/O options.

For 3D products ranging from true-color graphics workstations to wire-frame graphics systems, the 4330 Series is the fastest of any standalone graphics workstation—450,000 2D vectors per second; 340,000 3D vectors per second; and 20,000 Gouraud shaded polygons per second. Targeted at graphics-intensive applications such as: molecular modeling, medical imaging, visual simulation, and engineering design. Prices range from $37,500 to $51,500.

All standard configurations of Tektronix's 4300 Series workstations include 86-Mbyte hard disks, 48-Mbyte RAM, C, LAN support, X Windows, and IBM PC emulation.

If your graphics needs require only 2D applications such as drafting, cartography, and electronic design engineering, the 4320 Series workstation with dedicated graphics hardware performs at 90,000 2D vectors per second. Tek's 4310 Series workstations offer monochrome, grayscale, or color bit-mapped displays and provide you a low-cost, entry-level graphics workstation with prices starting at $9,995.

With Tek's strong ties to leading software suppliers, you always have a choice of compatible graphics software programs from the leaders in the graphics software industry.

HARD FACTS:

Tektronix 4300 Series Graphics Workstations

Price: $9,995–$51,500

- All standard configurations include 86-Mbyte hard disk, 4-Mbyte RAM, C, LAN support, X Windows, and IBM PC emulation
- Incorporate Motorola 68020 processor graphics engine, UTek (Tektronix's implementation of BSD 4.2 UNIX, with System V extensions), X Windows, Network File System, Ethernet with TCP/IP protocol, PLOT 10
- Independent, 68020/68881-based, 2.5 MIPS compute engine

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503-685-3837
Circle No. 240

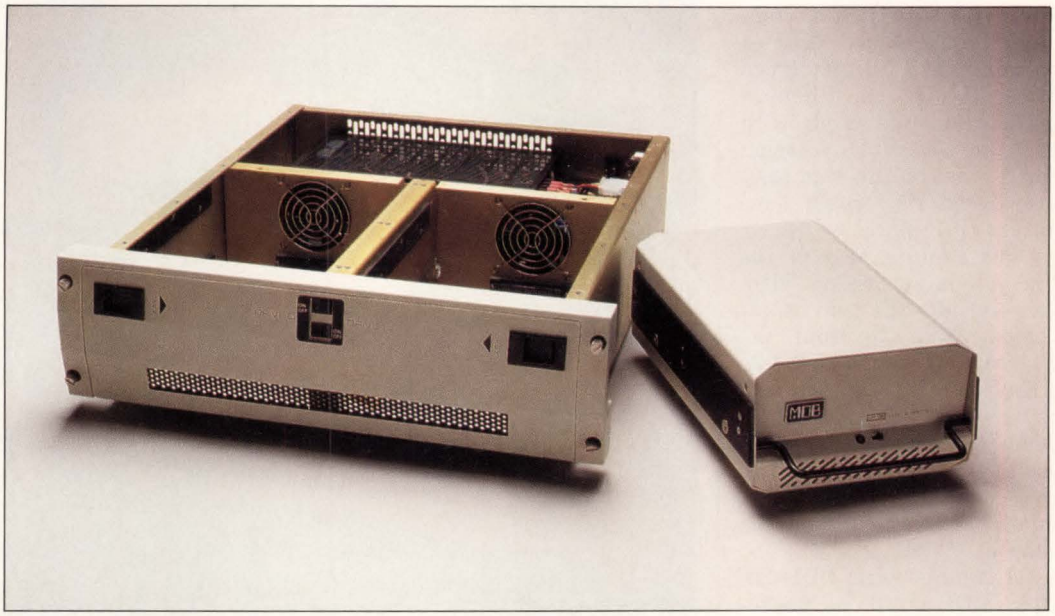
Removable-Drive Subsystem with Shock Isolation and Configuration Versatility

Have you ever wished that your disk subsystem had just a little more speed or a little more storage? Most computer users have faced this dilemma at least once or twice. Well, with the Data Shuttle 2000 from MDB Systems Inc., users can create a shock-isolated, removable, 5.25-in. Winchester disk subsystem configured to their specific needs.

The Data Shuttle 2000 is a rack-mountable disk subsystem using one or two disk canisters that provide shock isolation for the disk drives mounted within. Shock isolation reduces any shock endured by the canister to less than the non-operating shock spec for the Head/Disk Assembly (HDA) of the disk drive manufacturer; for instance, a 100-G shock is reduced to 20 G's.

The subsystem can be used in a wide variety of applications where it is necessary to remove the disk for security, data backup, or transporting data. For a faster backup system, the removable disk can be used instead of a magnetic tape. Additionally, where many programmers are using a single computer, each can have their own containerized disk for development.

Available as a disk subsystem or as a disk chassis, Data Shuttle 2000 allows users to choose from a variety of controllers with either ESDI, ST506, or SCSI interfaces and a long list of compatible 5.25-in. disk drives. Each canister can house a disk with up to 760 Mbytes unformatted capacity, yielding a subsystem with more than 1.5 Gbytes of storage.



MDB's Data Shuttle 2000 provides removable Winchester storage with single drive capacities up to 760 Mbytes (unformatted).

When provided as a subsystem, Data Shuttle 2000 includes the disk controller and appropriate interconnection cables. Q-bus or MicroVAX controllers are available with RM or MSCP emulation. If RM emulation is required for MicroVAX II installation, the driver is supplied on either RX- or TX-compatible media.

As a disk chassis, Data Shuttle 2000 can be integrated with most computers if a disk controller with an ESDI, ST506, or SCSI interface is used. With appropriate controllers, the chassis is compatible with VME or Multibus systems, and IBM PCs and compatibles.

Jim Moore, vice president and director of research of the Computer Storage Industry Service for Dataquest, a market research firm in Santa Clara, CA, is "guardedly optimistic" about the future of the removable 5.25-in. market. "The market started out as very niche oriented, as in government applications," explains Moore. "I feel that the market will expand to include a more commercial market, using removable Winchester technology in shared environments such as in disk drive arrays."

HARD FACTS:

MDB Data Shuttle 2000 Subsystems

Price: $5,115–$15,950

- Shock-isolated, removable 5.25-in. disk subsystem with chassis
- Can house two 760-Mbyte drives; total storage of 1.5 Gbytes
- Automatic power-off upon removal of disk canister

MDB Systems Inc.
1995 N. Batavia St.
P.O. Box 5508
Orange, CA 92613-5508
714-998-6900
Circle No. 238

Transportable MicroVAX II Hits the Road

MicroVAX II computing capability has taken to the road with the availability of the Phoenix, a transportable MicroVAX II from Tara Computer Products Inc. Designed to operate as a fully equipped MicroVAX II, the Phoenix provides mobile users with the same powerful processing capabilities on the road that, previously, they could have only at their offices.

The compactness of the Phoenix is surprising when you consider all that is included. From the front, the 22-bit Q-bus system looks like a Kaypro PC. The only tip-off to the power inside comes when you look at the back and see the multiple output ports that connect to the eight-slot, quad backplane inside the chassis.

Available with PDP-11/23+, PDP-11/73, or MicroVAX CPUs, the Phoenix offers you a variety of configurations to address various markets. The system is equipped with 256 Kbytes of memory (expandable to 16 Mbytes); MSCP emulation; a built-in, 9-in., green phosphor CRT screen; and VT100-compatible keyboard with numeric keypad.

Storage options include a choice of disk drives with capacities ranging from 87 to 380 Mbytes, a 400/800 Kbyte RX50-compatible floppy drive, and a nine-track 1600/3200 bpi 60-Mbyte cartridge, thus allowing the user to configure a system to meet his needs.

Compatible with RT-11, RSX, RSTS, and MicroVMS operating systems, the Phoenix is suited to a variety of environments. As with other forms of removable media systems, it is popular in military applications where removable storage is very necessary for security reasons. Commercially, the system is a beneficial tool for software houses that need to perform customer demonstrations of their products at remote sites. Instead of dialing into the central office to the company mainframe, they simply carry the system with them.

ROBERT BELL

On land or sea, Tara Computer's Phoenix, a transportable MicroVAX II system, provides the same powerful functionality as its larger counterpart, but in a compact, portable package.

HARD FACTS:

Phoenix
Transportable VAX

Price: $19,500
- 21- x 9.5- x 17-in. metal carrying case; 35–40 lbs.
- MicroVAX II CPU (or PDP-11/23+ or PDP-11/73)
- Integral 87-Mbyte Winchester, 9-in. VT100 emulation CRT with keyboard, expandable 256-Kbyte memory
- Operating Systems: RT-11, RSX, RSTS, MicroVMS

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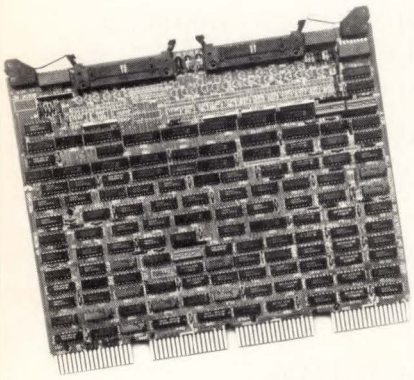
CIRCLE 434 ON READER CARD

PRODUCT FOCUS

Conserve the Unibus

There is a new high-speed, digital I/O device interface to the Q-bus on the market. The GEN/COMP Inc. 2142 interface and interprocessor link gives you hardware parity with 18- or 22-bit addressing and switch-adjustable DMA pacing so that you can connect your high-speed peripherals to the Q-bus or actually link two Q-bus computers.



Q-bus DMA interface emulates DEC's DR11-B, -W, and DA11-B with 18- or 22-bit addressing and complete software compatibility.

The Model 2142 provides two ways to access the Bus Address Extension Register and uses DIP switches rather than potentiometers for ease in setup. Burst lengths of 1–4 cycles improve system performance by conserving the Unibus bandwidth and the peak transfer rate can be selected through the range of 30–400 Kwords per second.

The interface is priced at $850 and includes a two-year warranty.

GEN/COMP Inc.
6 Algonquin Rd.
Canton, MA 02021
617-828-2008
Circle No. 283

The HDS3200 Image Leader terminal series from Human Designed Systems offers enhanced graphics terminal capabilities for less cost.

New Competition for DEC's VT320 and VT330 Terminals

Paying a lower terminal price doesn't necessarily mean you get less capabilities; that is, not if you're comparing terminal prices between DEC's VT320 and VT330 and Human Designed Systems Inc.'s HDS3200 Image Leaders.

The less expensive Image Leader models start at $699 for the basic HDS3200 Model 10 that includes integrated text and graphics capabilities and a 15-in. screen with resolution of 1056 x 400 pixels for better character formation.

Models 20 and 30 are enhanced versions of the basic Model 10. Model 20 adds higher screen resolution (1056 x 800 pixels) and a 50-line text display mode for $999. Model 30, for $1,299, is the most enhanced version of the terminal family, offering capabilities not available from DEC terminals. True pan and zoom graphics allow users to magnify a graphics image up to 16 times its original size without loss of resolution. Up to 512 Kbytes of memory are available for graphics storage; windows allow users to store four separate graphs in memory and display them on the screen simultaneously.

Human Designed
Systems Inc.
3440 Market St.
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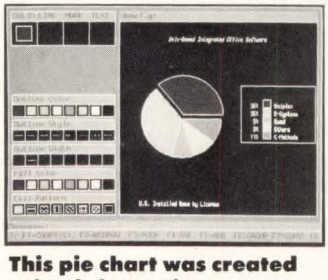
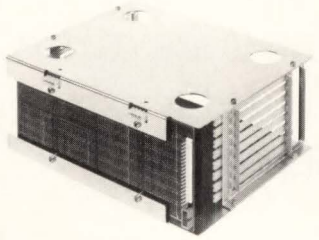
You can add the three primary office automation applications—word processing, spreadsheet, and database management—to your computer system with one phone call to Uniplex Integration Systems Inc. With the Uniplex II Plus integrated, multiuser system, you do not have to purchase three standalone software packages that require costly cross-training and take up valuable time flip-flopping from program to program.

If your business is a multinational corporation, you have a choice of several foreign languages. You can use the UNIX-based Uniplex II Plus with a variety of systems—from single-user PCs to high-performance mainframes. By implementing integration at source code level rather than menu level, you benefit from the common commands, menu structure, and other special features of Uniplex.

Uniplex Integration
Systems Inc.
Glen Lakes Tower, Ste. 1300
9400 N. Central Expwy.
Dallas, TX 75231
214-373-4971
Circle No. 285



This pie chart was created using information accumulated by the Uniplex II Plus database management facility. (The screen shown in the illustration is an example of Uniplex's new Advanced Graphics System.)



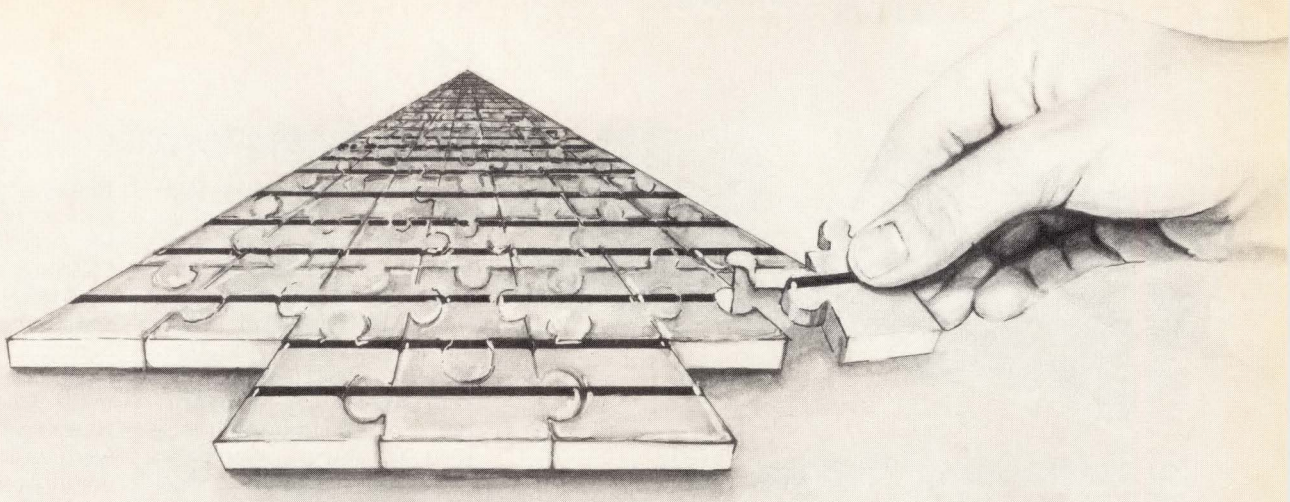
Addition of Interlogic's H9278-A8 extends the MicroVAX II backplane by eight slots.

Backplane Slots Grow

You can increase the size of your MicroVAX II backplane by eight slots when you connect it to the H9278-A8, a compatible interconnect system from Interlogic Industries. The H9278-A8 consists of a card file housing an eight-slot, quad-sized backplane that is wired for 22-bit addressing and comes complete with socketed termination resistors. The multilayered backplane can also be configured for 13 dual-sized boards, along with three CD slots.

This $225 add-on product for the MicroVAX II is mechanically and electrically compatible with DEC's backplane and can be used separately to provide eight slots of usable connectors in the DEC BA23 chassis.

Interlogic Industries
85 Marcus Dr.
Melville, NY 11747
516-420-8111
Circle No. 289



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Exorbus • BITbus • Fastbus
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FOR COMPLETE INFORMATION:
Write or telephone
Anne Weber, Project Manager
CMC • 222 Fashion Lane, #201
Tustin, CA 92680
Telephone (714) 669-1201
FAX: 714 669-9105

BUSCON will run concurrent with the Power Electronics Conference and NEPCON/West

TO: **BUSCON/88-West** c/o CMC 200 Connecticut Avenue, Norwalk, Connecticut 06856-4990

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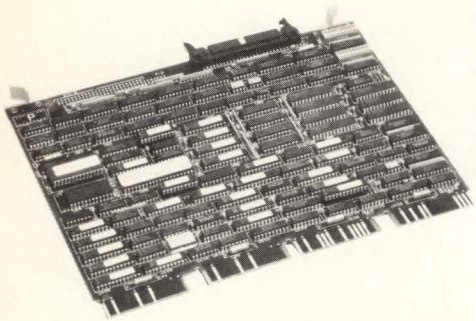
❑Conference Programs ❑Exhibiting ❑Presenting a Paper

Name _____ Title _____ Company _____ Address _____ Phone ( ) _____ M/S _____

HC

PRODUCT FOCUS



Aviv's TFC 935 achieves high data throughput by incorporating a 64-Kbyte fast buffer and distributed processing in high-speed PALs.

GCR Controller Looks to the Future

If you're in the market for a full-performance GCR tape controller, you might consider Aviv Corp.'s Model TFC 935, a high-performance universal controller for the DEC market. Offered in four versions, the TFC 935 is fully compatible with MicroVAX II and III, MicroPDP-11, and LSI-11/73-83 systems and comes with SCSI, StorageTek, and Pertec interfaces.

This controller is designed to answer your needs both today and in the future. It operates with any GCR tape drive, including Fujitsu's 200 ips drive as well as Aspen's and StorageTek's IBM 3480 18-track cartridge drives. Pertec and StorageTek interfaces offer compatibility with current tape drives while SCSI provides the way to future tape generations, like the IBM 3480 that requires transfer rates up to 3 Mbytes per second.

Aviv Corp.
26 Cummings Park
Woburn, MA 01801
617-933-1165
Circle No. 290

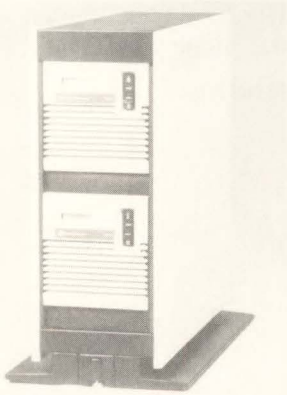
Billions of Bytes

You can now have 1.5 Gbytes of data storage (one and one-half *billion* characters of information) on your mini or microcomputer. In fact, two of Century Data Systems' new C21000 Series 8-in. drives can be mounted in a vertical, desk-side floor rack—providing multi-gigabyte data storage in a fraction of the floor space normally required by the more expensive, power-hungry, 14-in. fixed disk drives we're used to using.

The large-quantity storage space, as well as the fast access times and high transfer rates, are essential to your large, number-crunching systems such as array processors and supermicrocomputers, or data-intensive graphics' systems.

Prices for the C21000 Series start at $12,000 in single-unit quantities.

Century Data Systems
2055 Gateway Place
San Jose, CA 95110
408-298-5756
Circle No. 293



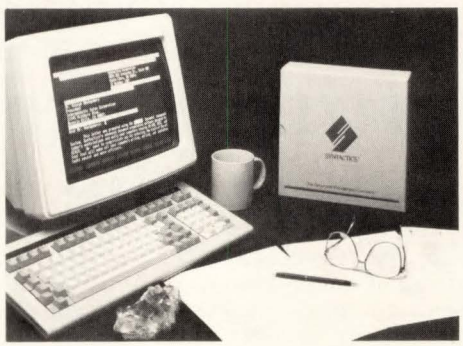
By using a track recording density of 93.3 Mbytes per surface, and 10 surfaces per drive, the Century Data C21000 Series Winchester drives allow data storage of more than 1 Gbyte in each 8-in. drive.

You, Too, Can Be a Typesetter

If you have one of the popular, multifont laser printers on your system, you can have "desktop publishing" at your fingertips by using Syntactics Corp.'s Crystal Document Management System. This product combines advanced document preparation, a document layout database, and integral automatic typesetting capabilities that can be your ticket to "one-step" camera-ready document creation. Or output mass mailings that have the look of quality—directly from your laser printers—since the open architecture of this system interfaces to databases, spreadsheets, graphics, and other applications software.

Almost any business office needs and can enjoy the benefits of an easy-to-use, high-volume, high-quality, multi-page document production facilities—from basic word processing to typeset-quality output—provided by the UNIX-based Crystal Document Management System.

Syntactics Corp.
46555 Old Ironsides Dr.,
Ste. 400
Santa Clara, CA 95054
408-727-6400 **Circle No. 295**



You can easily create professional, typeset-quality page layouts when you use the document layout database of the Crystal Document Management System.

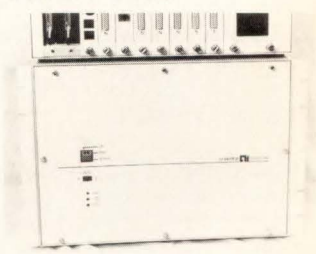
Resource Sharing Acts as Data PBX

In order to maximize the use of your costly but high-powered computer network, Applied Innovation Inc. offers the AISwitch Series 180 to act as a switchbox connecting a large number of users and/or devices to a limited number of computer host ports. This device performs in much the same way as the old-time telephone PBX that was used to connect and transfer a large number of telephone users to a limited number of outside common-carrier lines.

Likewise, you can use the Series 180 as a port selector or contender and, optionally, as an X.25 PAD, to connect and transfer your computer users to the host resources of your system. You can store two complete configurations in firmware for backup to a standby host or network.

Prices range from $5,480 to $26,230.

Applied Innovation Inc.
651 Lakeview Plaza Blvd.
Ste. C.
Columbus, OH 43085
614-846-9000
Circle No. 296



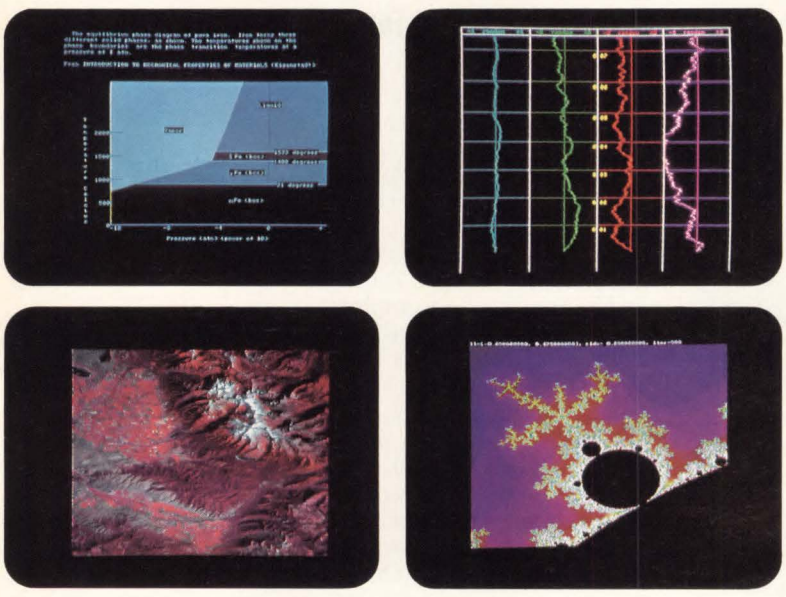
A 16-port interface card from Applied Innovation reduces the list price of the 256-port Series 180 by 40% and the physical space requirement by 400%.

Call it the computergraphics freedom machine

Take the load off your host CPU in both Q-bus and Unibus DEC computers with our new VCK-Q/U tightly coupled combined graphics controller and single board computer. Our new quad height board gives you a stand-alone 68010-based computer and an advanced CRT controller to do graphics primitives, zoom, pan and scroll. On board to lend power to the 68010 are 1-megabyte of system RAM, fast DMA circuitry, serial I/O ports and a SCSI port for a hard disk.

Our new VCK-Q/U board systems liberate DEC Q-bus and Unibus machines. In your VAX or Microvax, a formidable combination indeed.

One VCK-Q/U provides 1024 × 1024 × 8 to display 256 colors out of 16 million. Multiple VCK-Q/U's can be used together to extend bit plane depth to 1024 × 1024 × 16, 24, 32, and up for fine color control. Advanced applications include animation and high resolution imaging.



Use the SCSI/DMA link to quickly input and output images, display lists, commands, and programs. The DMA controller lets you rapidly move data between the SCSI port, CRT controller, computer bus, and all on-board memory.

Our microcomputer has a 9.8 MHz 68010 CPU and a 68881 FPU with access to all other on-board devices including 1 MB each of system and video RAM, two video overlay memories, and up to 128 KB of EPROM and 16 KB RAM.

For the rest of the story, phone (415) 531-6500. TWX: 910-366-2029. Or write Peritek Corporation, 5550 Redwood Road, Oakland, CA 94619.

Peritek

DEC, Q-bus, Unibus are trademarks of Digital Equipment Corporation.

CIRCLE 449 ON READER CARD

PRODUCT FOCUS

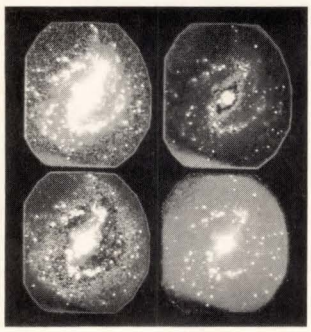
User-Programmable Image Processing

Unlike collections of application programs (or subroutine libraries), Data Translation Inc.'s new DT/IDL is entirely interactive, including an interactive data language. English-language commands and syntax eliminate the need for you to know advanced mathematics, algorithm development, and programming. You have access to 250 frame-grabbing, image analysis, filtering, and plotting functions for use in medical diagnosis, science, or engineering image processing.

You can group these commands into short, powerful programs to tailor your procedures for acquiring, processing, and displaying images—or create entirely new commands in any language supported by the VAX Calling Standard.

DT/IDL lists at $3,750 and requires a MicroVAX II, an analog RGB display monitor, and Data Translation's DT2651 Frame Grabber.

Data Translation Inc.
100 Locke Dr.
Marlboro, MA 01752
617-481-3700
Circle No. 299



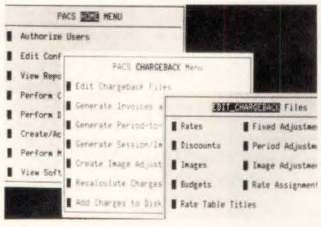
Gray-scale transformation using DT/IDL. Clockwise from top left: original image of galaxy; histogram equalized; elements less than 50% of transformed image's maximum; logarithmically transformed image.

Commercial DP Requires Resource Accounting

Do you need help computing resource accounting and figuring job chargebacks for your VAX/VMS system? Signal Technology Inc. (STI) now offers you V. 5.0 of its PACS Plus software that incorporates the newest 4GL features. By employing the cursor and simple keypad commands, you can perform resource accounting functions directly from a screen's form displays. A new screen editor allows you to visually edit any data collected in the summary file about your system usage. You can enter, modify, retrieve, or delete data; create customized formats for specialized reports on system usage; and, with only a few keystrokes, select the system statistics on which you want to base the report.

PACS Plus operates on any VAX or MicroVAX configuration, from a single CPU to a complex network/cluster combination. You can collect and report on data from a central node or from distributed nodes when optimum performance is required.

Signal Technology Inc.
5951 Encina Rd.
Goleta, CA 93117-2274
800-235-5787 **Circle No. 301**



System managers can create customized menus that may be used to access specialized sequences of PACS Plus operations or any DCL-based VMS facility (such as electronic mail or Monitor) without leaving the menu environment.

The desktop-sized MicroVAX 2000 (6- x 12- x 13-in.), weighing less than 30 lbs., provides a space- saving solution for today's high-technology analytical and chemistry laboratories.

MicroVAX 2000 in The Chromatography Lab

All the features and benefits of the MicroVAX 2000 are now available to scientific laboratories that use stored chromatograms in their analyses. Nelson Analytical Inc. recently announced a new multitasking, multiuser chromatography data system that performs acquisition as well as post-processing of data from chromatographs using the MicroVAX 2000 from DEC with the Access*Chrom software from Nelson Analytical.

The chromatography software supports the latest in high-resolution DEC terminals such as the VT340/330, as well as Tektronix's TK4205/4207 color graphics terminals. Graphics editing allows you to optimize your data collection parameters and routines to graphically compare, add, subtract, and ratio chromatograms. The data acquisition system uses special 20-bit, precision analog-to-digital converters that communicate through thin-wire Ethernet; therefore, instruments throughout an entire building can be connected to the computer.

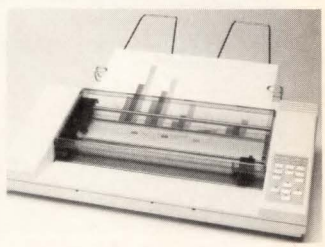
The complete system is priced at less than $50,000.

Nelson Analytical Inc.
10040 Bubb Rd.
Cupertino, CA 95014
408-725-1107 **Circle No. 303**

High-Quality Output For Less Money

Just because your color plotter has a low-cost price tag doesn't mean you have to produce second-rate output. For example, Fujitsu Component of America Inc.'s (FCA) ImageGraph, a 6-pen, desktop color plotter, provides high-quality output for A- and B-sized business graphics and technical applications. Fully compatible with Hewlett-Packard's (HP) 7475A model, the ImageGraph uses one-half the desktop space and, at a price of $1,200, costs 35% less than the HP version.

Designed for business presentations and small-scale engineering or architectural design, the ImageGraph can use several types of media including paper, coated paper, transparency, or polyester drafting film. Furthermore, free-sized media as small as a postcard, up to and including A3/B-sized formats (11.7- x 32-in. maximum), are automatically accommodated.



FCA's ImageGraph features both a Centronics parallel port and an RS-232C serial port.

Fujitsu Component of America Inc.
3320 Scott Blvd.
Santa Clara, CA 95054-3197
408-562-1000 **Circle No. 305**

Too many people have been led to believe only DEC™ is experienced enough to service their computers.

For years, you've believed that only DEC has the expertise to service your computer. But that's just not true.

Because at Control Data, we've been in the computer maintenance business for over 25 years. And we fix everything from PCs to mainframes, even mixed peripherals.

So before you're led into signing another one of their service contracts, call us instead. **1-800-828-8001, ext. 58B.** In Minnesota, 612-921-4400, ext. 58B.

CONTROL DATA

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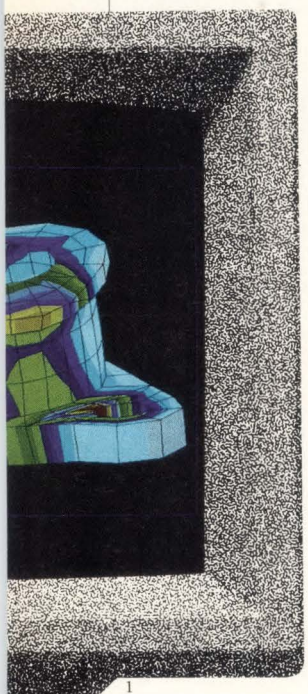
CIRCLE 450 ON READER CARD

FULL TEKTRONIX™ CAPABILITY ON PCs

Introducing a New Image for DECnet DOS™

Mainframe Graphics Through Your PC.



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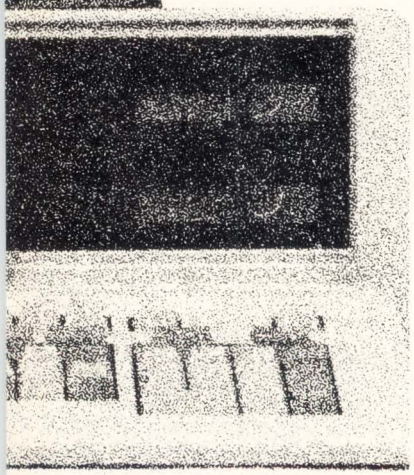


Grafpoint™, the leader in Tektronix terminal emulation software, announces support for DECnet DOS. With Grafpoint's TNET™ your PC can now be networked with host-based graphics programs.

Look To Grafpoint For The Widest Selection In Terminal Emulation Software

Grafpoint has a wide range of high-performance graphics terminal emulators, giving you a choice of Tektronix's 4105, 4107, 4109, or 4115 Terminals in asynchronous or local area network environments. Grafpoint's software transforms your PC and graphics card combination into a powerful graphics terminal, capable of supporting hundreds of mainframe graphics applications.

Discover The Latent Graphics Terminal In Every PC

With TNET, your networked PC will provide full Tektronix compatibility, plus the advantage of network communications speeds. PCs become powerful and versatile workstations for both stand-alone and host-dependant applications. Grafpoint's TNET offers graphics terminal emulation capability over networks such as Ungermann-Bass Net One™, Bridge EtherTerm™, and now, DECnet.

You Can't Afford To Use Less Than The Best

Grafpoint's commitment to quality in products and customer support is second to none. Free updates and technical support for one year are just part of Grafpoint's comprehensive effort in providing support to you the customer, making Grafpoint the industry leader in high-performance terminal emulation.

Free 30-day Trial

To learn more about TNET, or to arrange for a no-risk 30-day trial, call **1-800-426-2230,** (408-446-1919 in CA).

Yes, please send me your free terminal emulation guide on Grafpoint's high-performance Tektronix graphics terminal emulation software for PCs.

Name _____

Title _____ Company _____

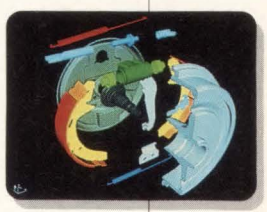
Address _____

City _____ State _____ Zip _____

Telephone _____

GRAFPOINT

1485 Saratoga Avenue, San Jose, California 95129
(800) 426-2230 In CA (408) 446-1919



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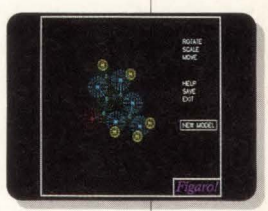

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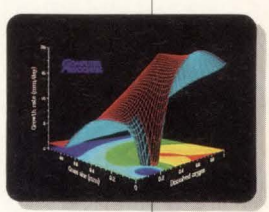

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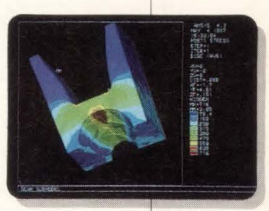

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1 Courtesy of PDA Engineering
2 Courtesy of SDRC
3 Courtesy of TEMPLATE
4 Courtesy of Computer Associates International, Inc.
5 Courtesy of Swanson Anylsis Systems, Inc.

CIRCLE 420 ON READER CARD

DECnet DOS is a registered trademark of Digital Equipment Corporation. EtherTerm is a registered trademark of Bridge Communications. Grafpoint & TNET are registered trademarks of Grafpoint. NET-1 is a registered trademark of Ungermann-Bass, Inc. Tektronix is a registered trademark of Tektronix, Inc.

Storage Devices

4-Gbyte 12-In. Optical Disk Drive

WM-S500; a 4-Gbyte, 12-in., write-once optical disk drive designed to provide archival applications with increased storage capacity and high performance; provides a 4–8 Mbit/second data transfer rate; operates in a modified-constant-angular-velocity (MCAV) mode; operates at a 615 rpm rotation speed, providing an average latency of 49ms; provides a SCSI interface; one controller can support up to four WM-S500 drives.

The WM-S500 is mountable in a standard 19-in. RETMA rack; functions as a standalone unit with a built-in power supply; offers a mean-time-between-failure (MTBF) rate of 10,000 power-on hours; front-loading cartridge design permits ease of loading; $11,495+; available April 1988.

Toshiba America, Disk Products Division, 9740 Irvine Blvd., Irvine, CA 92718, 714-583-3108. **Circle No. 262**

Interchangeable, Plug-and-Play Optical Drives for VAX

Laser DataBank; plug-and-play 5.25-in. write-once read-many (WORM) optical drive subsystems; available for the DEC MicroVAX II, the Sun Microsystems Sun-3, the IBM PC/XT and 286/386-based computers including the PS/2 and compatibles, and the Apple Computer Inc. Macintosh SE and Macintosh II computers; built around the Optotech Model 5984 Optical Disk Drive that provides 400 Mbytes of storage per 5.25-in. optical disk.

The Laser DataBank includes Optotech's Write-Once File Management System and various utility routines; interfaces allow programmers to access the optical drives directly; VAX interface allows direct access in FORTRAN, Pascal, or C; VAX subsystem includes a Q-bus host adaptor; all subsystems include Optotech's PC controller or high-performance SCSI controller; $2,995–$6,950; available now.

Optotech Inc., 740-770 Wooten Rd., Colorado Springs, CO 80915-3518, 303-570-7500. **Circle No. 263**

High-Performance, Second-Generation Optical Drive

LaserDrive 510; an intelligent optical disk drive; offers 327 Mbytes of storage per side of a double-sided removable disk, a 600 Kbyte sustained transfer rate, an average access time of 75ms, and a maximum track-to-track seek time of 1.5ms.

Interfacing for the LaserDrive 510 is handled through an embedded SCSI, supporting single-ended drivers to permit daisy-chaining of up to eight SCSI devices; internal sustained data transfer rate between the controller portion and the disk is 600 Kbyte/second; LaserDrive 510 $2,880; media $95.

Laser Magnetic Storage International Co., 4425 Arrows West Dr., Colorado Springs, CO 80907-3489, 303-593-7900. **Circle No. 264**

High-Performance Disk System

High-Speed ImageDisk; a high-performance disk system designed specifically for imaging and graphics display applications; capable of storing 560 Mbytes to 16 Gbytes of information and transferring burst data at a rate of up to 8 Mbyte/second; with multiple interface capability, it can communicate with a host CPU and single or multiple Ramtek imaging display systems to provide a link for high-speed image and data transfers.

The ImageDisk design is based on a smart disk controller and 4–16 standard disk drives connected in parallel; designed to be used with the Ramtek 4660 high-resolution, high-performance imaging display system; $65,999.

Ramtek Corp., 2211 Lawson Ln., Santa Clara, CA 95054, 408-988-2211. **Circle No. 265**

Optical Disk Drive

Optifile, Optifile II; Optifile is a software/hardware package that effectively handles the write-once nature of the optical drive by still allowing files to be indexed, updated, and deleted in exactly the same manner as magnetic; Optifile II is an implementation of this technique with DEC's series of VAX computers; Optifile II now supports a fourth 5.25-in. optical disk drive.

Optifile II currently provides support for four 12-in. optical drives and four 5.25-in. drives; the latest 5.25-in. drive offers 800 Mbytes of storage; it is available as a standalone unit, a 19-in. rack-mount unit, or a pedestal unit with either single or dual drives; Optifile is available without drives.

KOM Inc., 145 Spruce St., Ottawa, Ontario, Canada K1R 6P1, 613-238-7766. **Circle No. 266**

2.88-Gbyte Disk System

MasterDisk Series 8; a disk storage system that offers capacities from 721 Mbytes to 2.88 Gbytes; is based on Control Data Corp.'s Sabre 850 8-in. disk drives, combined with American Digital Systems' optimized controller, which includes a full megabyte of cache; average disk access times as low as 6ms have been measured and typical MasterDisk access times are less than 10ms.

MasterDisk Series 8 is available as an internal rack-mount or floor-stand configuration; is fully hardware and software compatible with all DEC Q-bus and Unibus computers and all standard operating systems; the disk controller emulates DEC's MSCP interface (DU: device); $16,750–$57,550.

American Digital Systems Inc., 75 Union Ave., Sudbury, MA 01776, 617-443-7711. **Circle No. 267**

Tape Duplication System

CD-2500; a high-speed tape duplication system that now includes additional ¼-in. and ½-in. tape formats and any SCSI-compatible tape or optical drive; can make as many as 960 copies per hour of a 5-Mbyte tape or 80 copies of a 60-Mbyte tape; two to 16 individual tape drives in any combination of formats can be interfaced to each CD-2500 CPU; copies and verifies information in a single operation using simultaneous bit-map verification techniques.

The CD-2500 can be expanded to 1.5 Gbytes of hard disk storage; optional post-amble recording writes a frame after the last data block to identify the drive, machine, and date; housed in a standalone cabinet; $39,950 including a monitor and four QIC-11 or QIC-24 drives.

Applied Data Communications, 14272 Chambers Rd., Tustin, CA 92680-6998, 714-731-9000. **Circle No. 268**

Controllers and Host Adapters

Bus-to-Bus Interface for Multibus I to VMEbus

422 Multibus I-VME Adaptor; a Multibus I to VMEbus Adaptor that permits the interconnection of a Multibus system and a VME system; consists of one Multibus I card and one 6U VME card; the two systems connect together with a round EMI shielded cable to distances of 25 feet; address mapping enables a bus master in one chassis to directly address memory or I/O in the other chassis as though it were local memory or I/O; communication between the two systems is via random access reads and writes.

Direct addressing mode enables 65 Kbytes to 16 Mbytes of destination chassis memory to appear as local memory; page mode addressing enables a processor on a host system access to 16 Mbytes of destination memory in pages; page sizes from 65 Kbytes to 1 Mbyte are available on the Multibus and page size is 65 Kbytes on the VMEbus; optional dual-port RAM memory can be added to the adaptor; $1,580.

Bit 3 Computer Corp., 8120 Penn Ave. S., Minneapolis, MN 55431, 612-881-6955.
Circle No. 269

Data Input and Display Devices

High-Speed Printers

4470, 4490; two shuttle matrix line printers with print speeds of 1200 and 1400 lines per minute (lpm), respectively; enhanced with a cartridge ribbon that will print up to 1.25 million lines or 50 million characters before replacement.

4285; a band printer with a minimum print speed of 2000 lines per minute (lpm) with a 48-character set, or 1850 lpm with a 64-character set in typical field-duty applications; has a proven performance level of 2000 hours mean time between failure; comes standard with a Dataproducts parallel interface, a swing-out gate, a power paper stacker, and an integral vacuum system; features an easy-to-use, intelligent control panel with a 16-position alphanumeric display.

Genicom Corp., Waynesboro, VA 22980, 703-949-1828.
Circle No. 270

Data Communications And Interconnects

PC Interface for UNIX

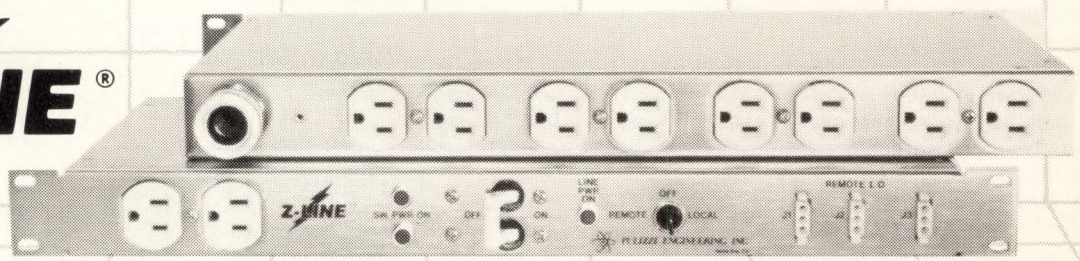
PC-Interface; a PC interface for UNIX that provides

PROBLEM: High Inrush Current
SOLUTION: Multiple Time Delay™

POWER UP WITH

Z-LINE®

TPC 115-10 MTD™



The Smallest Power Distribution & Control System

MTD™: Sequence your computers power-up with a controlled time delay between switched 1 and switched 2.

REMOTE: On/off & emergency shutdown, sequence power-up additional equipment downline.

LINE PROTECTION: EMI/RFI, Spike & Surge.

PATENT PENDING

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FAX# 714-641-9062

CIRCLE 421 ON READER CARD

connectivity and functionality between PCs and a UNIX host by integrating UNIX and DOS into a transparent, distributed processing system; provides access to the complete UNIX file system with a DOS interface even if the user is not familiar with UNIX.

PC-Interface file service is provided by software implemented on both the PC and the UNIX host server; features transparent file access, processor services, network security, and VT100 terminal emulation; available now.

Locus Computing Corp., 3330 Ocean Park Blvd., Santa Monica, CA 90405, 213-452-2435. **Circle No. 271**

High-Performance VAX/VMS Networking Package

EXOS 10624; a high-performance networking package for the VAX; uses Excelan's EXOS 304 intelligent controller board, which is based on Intel's 80286 microprocessor and Excelan's TCP/IP software.

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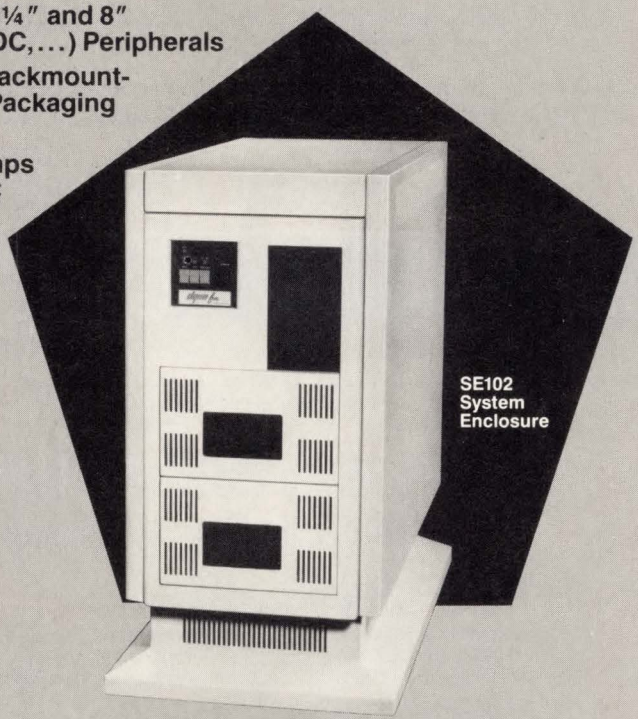

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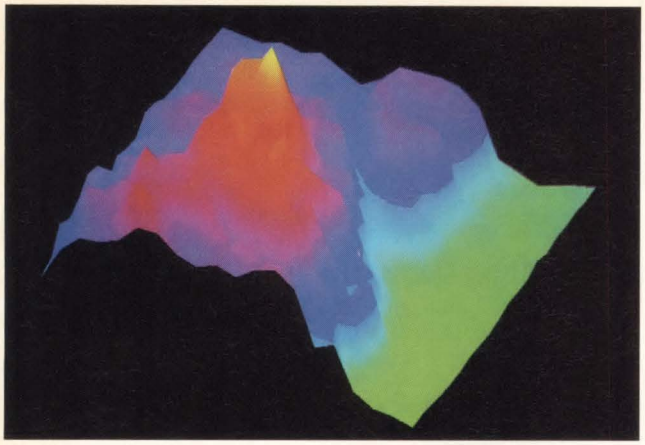
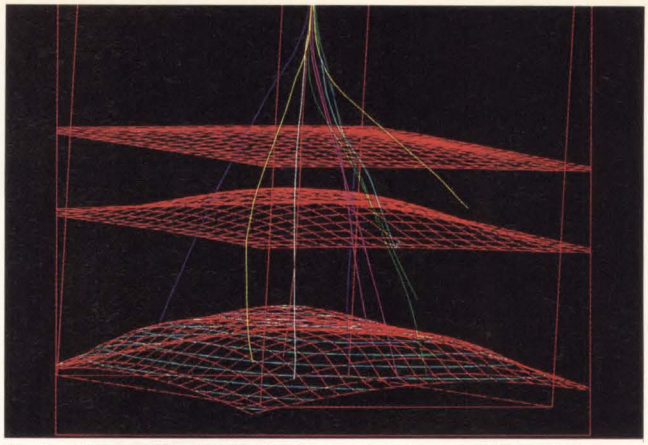


Local, interactive 3D manipulation of mapping data captured on a Tektronix 4129.



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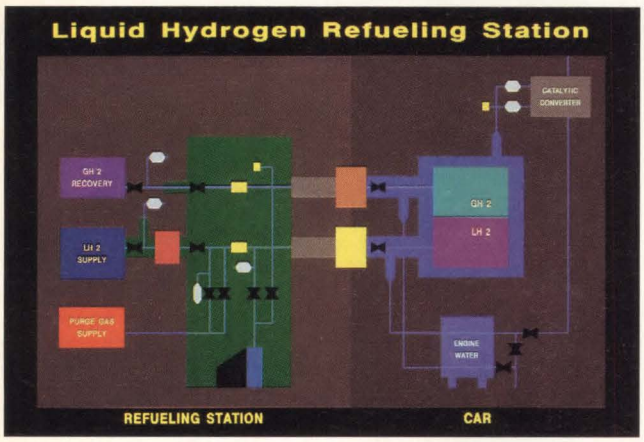

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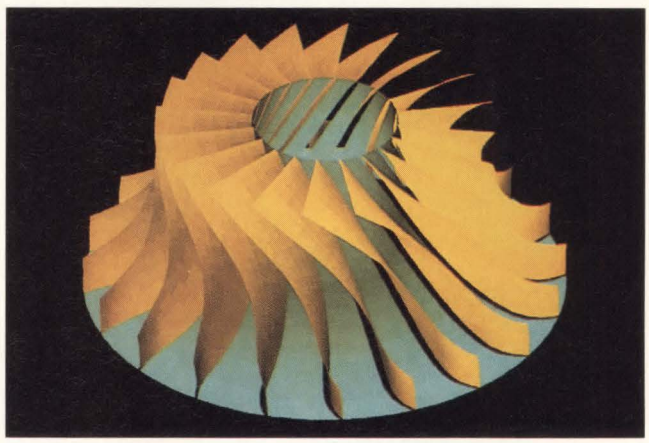

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The Story

To get the full story on DI-3000 XPM, including technical information and a complete list of supported systems and users,

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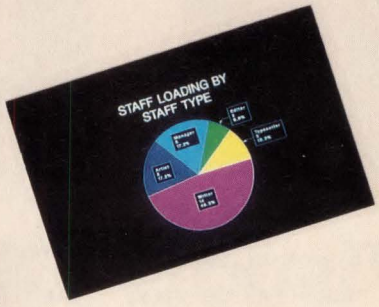

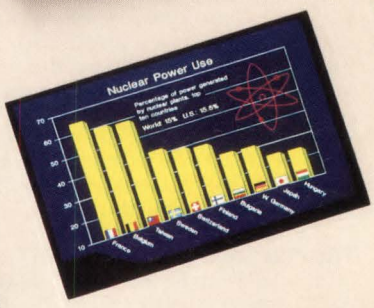

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12 times per year	12	$32.00

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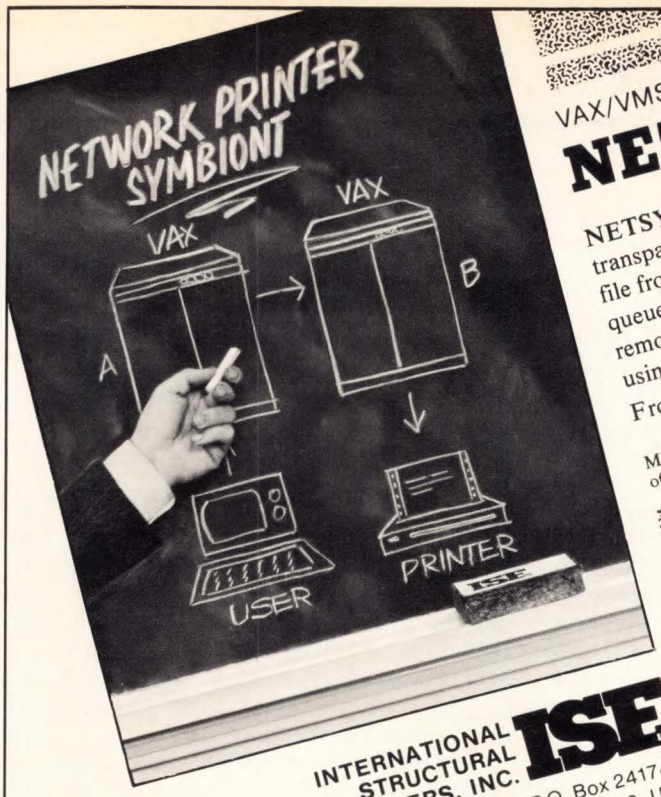

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PDP PERSPECTIVE . . . RT-11 *by Milton Campbell*

Considered by many to be obsolete and a thing of the past, RT-11 continues to evolve with TSX-Plus V. 6.3 and a proposed TSX-32 for the VAX

A new version (V. 6.3) of TSX-Plus should be hitting the dealers as you read this. Speed improvements in several of the memory management emulation traps (EMTs or system calls) are the most significant changes in the new V. 6.3 release. S&H Computer Systems has implemented an additional, faster method of mapping shared runtime systems to a program. Shared runtime systems are a shared memory mechanism somewhat similar to, but older than, the shared global regions available in RT-11. While TSX-Plus also supports shared global regions, shared runtime systems are used to reduce memory demands of programs written in COBOL-Plus (from S&H) and DBL (from DISC) languages.

With TSX-Plus V. 6.3, your program can predefine a number of different map descriptions into shared runtime systems using a new EMT. Error checking and necessary mapping computations are performed by TSX-Plus when processing this definition EMT, rather than each time the actual mapping of the program's address space to the runtime system occurs. Actual mapping occurs when the program executes a TRAP 1 instruction with the map description number in R0. The claim is that the resulting map change is 10 times faster than previous methods.

New versions of COBOL-Plus and DBL are required if they are to take advantage of this fast-map capability. COBOL-Plus V. 6.3 and DBL V. 4.17 will support the new map change procedure. Programs not using the predefinition EMT could use the TRAP instruction for other purposes. Since the TRAP is used by both FORTRAN-IV and FORTRAN-77 for internal error processing, this new directive cannot easily be used with FORTRAN programs.

Also, the standard EMT used to map a shared runtime system to a job has been substantially speeded up in V. 6.3 of TSX-Plus. The increased speed is more than 20% greater in EMT processing and provides a performance improvement to any program using shared runtime systems without requiring program changes. Thus, COBOL-Plus and DBL users will see some performance improvement with V. 6.3 of TSX-Plus even before upgrading to new versions of the languages.

In addition to more efficient shared runtime systems, S&H has speeded up the processing of the .MAP directive that is used to change the mapping of program address space to physical memory. The processing time of the predefinition EMT in V. 6.3 has been cut in half, so programs using RT-11XM-compatible memory management directives should see a substantial speed improvement. These EMTs are used extensively by both FORTRAN-V and -77 in virtual array processing. The remap time is a major overhead component when using virtual arrays, so the remap speed improvement should be evident to all with programs using virtual arrays.

Another common use of the .MAP EMT is in programs using virtual overlays. Virtual overlays are already substantially faster to use than disk overlays because it is necessary only to change your program's memory map, rather than read the overlay from disk. The improved speed of the .MAP directive will make the difference between overlay types even greater.

The new V. 6.3 of TSX-Plus provides a number of other improvements, as well as the usual problem fixes. The most noticeable improvement is the provision of a large recall buffer for the single line editor. In the previous V. 6.2, the single line editor retained the last three commands, which could be accessed by using the up-arrow key. V. 6.3 has a recall buffer of 300 bytes so, for most commands, the number of stored commands will at least double. A new keyboard command, RECALL, has been added to allow recall of previous commands—by number or beginning string match. All commands in the recall buffer can also be displayed. Of course, the up-arrow key can still be used to access previous commands.

On the subject of a real-time operating system for the VAX (other than VMS), there is one bright spot. As previously reported, DEC has made it clear that VAX/VMS and VAXELN are its answer to the real-time market. Several third-party software companies have, in the past, considered producing an RT-11-flavored system for the VAX. It appears that the only surviving effort is that of S&H to produce TSX-32. The October 1987 issue of the *S&H Support Bulletin* discussed some of the features that S&H is considering for TSX-32. It is by no means a product announcement, but the description in the *Bulletin* is a good sign that TSX-32 is a real possibility. While not exactly what those who are pushing for a VAX/RT desire, TSX-32 may fill in a big part of the real-time operating system gap.

TSX-32 may well be more of a competitor to UNIX and its clones than to VMS. While TSX-32 is not intended to be a UNIX clone (thank goodness), it is likely that TSX-32 will also impact the UNIX market. With sufficient application products available, TSX-32 could do well in the UNIX arena. Currently, TSX-Plus enables the PDP-11 to perform admirably; a similar efficiency in the 32-bit arena would be a strong selling point. A less complex operating system with resultant lower learning curve will also be a marketing advantage against UNIX.

Assuming TSX-32 comes to fruition (which seems likely), it will provide an option to those needing a small real-time system for the VAX. Support of other 32-bit processors would be an added bonus. TSX-32 appears to have a future as a reasonable choice.

Milton Campbell is a Hardcopy *columnist.*

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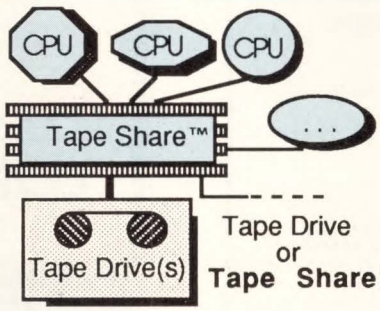

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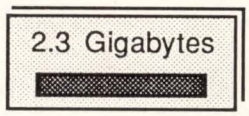

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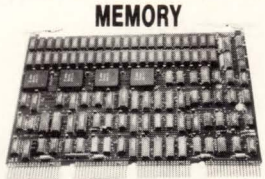

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ADVERTISERS INDEX

Reader Inquiry Number	Page Number
383 ACS Equipment Corp. 713-363-9126	118
441 Andromeda Systems 818-709-7600	44
374 Best Power Technology 608-565-7200	72
384 Boston Boards & Systems Inc. 617-747-6222	118
380 Brookvale Associates West Coast 800-252-6200 East Coast 800-645-1167	117
— Buscon 88-West 714-669-1201	103
399 California Boards 213-542-3000	124
429 Chrislin Industries Caribe Inc.	70
418 Chrislin Industries Caribe Inc. 818-991-2254	117
414 Clearpoint 800-CLEARPT	Cover IV
433 CMD Technology Inc. 714-549-4422	Cover III
456 Codar Technology 303-776-0472	43
407 Cognos	5
411 Compu-Share 806-794-1400	51
450 Control Data 800-828-1400 In MN 612-921-4400	107
386 Data 3 Computer Corp. 612-896-1400	119
416,417 Datability Software 800-DIAL-DSS	18a,18b
413 Datalease	93
434 Datalease	101
388 Datalease	120
397 Datalease	122
398 Datalease 714-632-6986	124
403 Dataproducts 818-888-4488 ext. 650	126
384 Dataware Inc. 305-771-7600	118
375 DEX 714-632-1841	88
419 Digi-Data Corp. 301-498-0200	39
394 Digital Dealers Association 313-475-8333	122
404 Digital Solutions 916-638-5606	127
440 DILOG Corp. 714-937-5700	65
393 Diversified Computer Systems 303-447-9251	122
422 Dyna Five Corp. 714-751-0133	111
377 Eakins Associates	117
378 Eakins Associates 415-969-5109	117
395 Electronic Service Specialist Ltd. 414-255-4634	123
387 Eli Heffron & Sons Inc. 617-547-4005	120
442 EMC Corp. 800-222-EMC2	6
428 Emulex Corp. 800-EMULEX 3 In CA 714-662-5600	16
435 Exabyte 303-442-4333	59
381,382 Executive Software 818-249-4707	73
— ExpoConsul International 800-433-0880	82,83
405 Federated Consultants 214-278-4031	127
420 Grafpoint	108
454 Graph On 800-GRAPHON	8
438 Horizon Data Products 804-740-9244	79
437 Ibimaint 714-850-0390	114
447 Interactive Technology 800-362-6203 In OR 503-644-0111	87
426 ISE Inc. 213-837-8339	115
427 KEA Systems 800-663-8702	115
391 Kimberly Electronics 800-843-4009 In NJ 201-387-0872	121
448 MDB Systems 714-998-6900	13
379 Meadowlark Enterprises 617-777-4666	117
431 MegaTape Corp. 818-357-9921	69
452 Micro Technology Inc. 714-632-7580	42
402 Minnecomputer Inc. 612-884-6601	126
412 Monolithic Systems Corp. 800-525-7661	92
396 MRI Corp.	122
400 MRI Corp. 305-587-7464	125
453 MTI Systems Corp. 800-645-6530	11
389 National Data Systems 201-843-5300	120
443 Network Research 805-485-2700	7
458 Networking Dynamics 213-668-0077	97
406 Nissho Electronics Corp.	4
439 Nissho Electronics Corp.	64
432 Nissho Electronics Corp. 800-233-1837 ext. 420 In CA 714-261-8811 ext. 420	78
436 Perceptics 615-966-9200	60
449 Peritek 415-531-6500	105
425 Precision Visuals 303-530-9000	113
424 Process Software 413-549-6994	112
423 Promod Inc. 714-855-3046	112
421 Pulizzi Engineering Inc. 714-540-4229	116
401 QEI Inc. 617-275-6800	126
409 Quickware Eng. & Design 800-237-1185 In MA 617-782-8330	25
444 Raxco 301-258-2620	80
429 Sigma Info. Systems 714-630-6553	38
430 Solid State Controls 614-846-7500	71
445 Sorbus 296-6284	81
372 Strategic Information 800-227-1209 In MA 617-273-5500	3
457 Summus Computer Systems 713-589-9772	41
373 System Industries 408-432-1212	14,15
415 Talaris Systems 619-587-0787	Cover II
455 Tektronix 800-225-5434 In OR 235-7202	35
410 Transitional Technology 714-744-1030	27
446 Trimm Industries 818-983-1833	84
408 Unisys 800-547-8362	30
390 U.S. Leasing 415-627-9000	120
451 Volt Delta Resources, Maintech Div. 800-426-TECH	36
376 William A. Pedersen & Associates 408-734-9511	117
421 Z Line 714-540-4229	116

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Bus Stop

COMPUTERS REACH OUT AND 'TOUCH' SOMEONE

If you harbor a fear of George Orwell's 1984, it may be well-founded. It appears that several credit card firms, banks, and, we are told, the IRS are beginning to use computers to automatically call you if your account is in arrears. The computer searches your file for the phone number(s) and makes the call. It keeps trying until someone is reached, at which time a synthesized voice puts the touch on you. Now we at *Hardcopy* are reasonably sure these computers are probably big and blue, since Ken Olsen would never let his computers take on a Simon Legree attitude.

DISK STORAGE GETS SMALLER AND MORE PORTABLE

While some companies are making disk drives that pack gigabytes of data onto 5.25- and 8-in. spindles, others are looking at the other end of the spectrum. For example, Brier Technology (San Jose, CA) and Irwin Magnetics Inc. (Ann Arbor, MI) are developing a 20-Mbyte, 3.5-in. flexible disk drive that uses standard 600 Oe media, with prewritten servo, and has a 35 ms average access time. This drive is a compelling add-in for portable systems. Similarly, start-up Prairie Tech (Longmont, CO), founded by Terry Johnson, the founder and former president of Miniscribe Corp. (Longmont, CO), is expected to introduce a 2.8-in. Winchester in the 20- to 40-Mbyte range some time in the second quarter of this year. However, James Moorehouse, acting president and head of Engineering at Prairie Tech, isn't that anxious to talk about the product: "If we were developing a product like that," he said, "we probably would only announce it after it was used in a product."

NEWEST SERVER WHIPS WOES AND MAKES SLOTS PAYOFF

The troubles you're having with your DECserver 500 may soon be over. Owners of networked VAXes and VAXclusters will appreciate a multifunctional communications server developed by Xyplex Inc. (Concord, MA). The MAXserver 5000, planned for introduction later this month, connects VAXes to VMS, Ultrix, and TCP/IP Telnet devices, and supports connections to wide-area satellite and T1 networks. Unlike the DECserver 500 with eight add-in slots, Xyplex adds an extra payoff with 16 slots that allow cards to be removed or added without a system shutdown. Moreover, the company claims that the MAXserver can support 480 sessions as opposed to DEC's 256 for about two thirds the price.

UNIX—IT MAY BE REAL, JUST LOOK AT THE VERSIONS

DEC and Apple Computer Inc. (Cupertino, CA) are preparing to ship new versions of AT&T's UNIX System V operating system. That may not sound like news since every day brings a new version of Ma Bell's O/S. But, apparently, Apple's AU/X UNIX operating system for the Macintosh is reportedly not close to completion. You can probably expect this version to be an interim offering with the "real thing" coming later. Similarly, DEC's boss, Ken Olsen, announced that they have a top team working on Ultrix System V. Naturally Olsen claims DEC's software will be better than AT&T's, and DEC insiders say it is the foundation of DEC's bid for a huge U.S. Air Force contract. This contract, however, may end up being a real shoot-out. IBM and Microsoft are also readying a bid and the operating system is expected to be the next generation of OS/2. It will be interesting to see who emerges as Top Gun.

MAC AND VAX TALK SQL

In cooperation with Gnosis n.v. (Brussels, Belgium), Alisa Systems (Pasadena, CA) has developed the capability to access Oracle databases on the VAX from a Macintosh. Sequelink uses standard Structured Query Language (SQL) to permit programs on the Macintosh to remotely query, update, create, and manage Oracle database tables on the VAX.

continued on page 130

Bus Stop

continued from page 129

SPEEDY UTILITY ACCELERATES VAX THROUGHPUT, BUT DEVELOPER IS TRYING TO PUT ON THE BRAKES

Raxco Inc. (Rockville, MD), the people who have made a name for themselves with VAX disk utilities, have developed a new VMS utility called VAST (VAX acceleration software technology) that constantly adjusts system and per-process parameters with dynamic tuning bursts. The notion behind the utility is to accelerate system throughput on the mighty VAXes, which the company claims can be boosted by as much as 100%. Apparently the utility must be good, since the company has reason to believe the controlling algorithms that use heuristic artificial intelligence techniques are at risk. Therefore, they are seeking patent protection—a real first for VMS-based software.

NEWEST SCSI HOST ADAPTER PUTS RANDOM LINKS WITH SEQUENTIAL EASE ON Q-BUS AND UNIBUS ARCHITECTURES

Taking advantage of the ability of SCSI to handle multiple and diverse devices, TD Systems Inc.'s (Lowell, MA) Viking/QDT and UDT for Q-bus and Unibus systems supports both MSCP and TMSCP for approximately $2,000. The adapters are the first to support both random and sequential devices on the same string. The adapters caught TD's competitors, DILOG and Emulex, slightly off guard, the latter having made significant contributions to SCSI development in general. At *Hardcopy* we believe this clearly shows that there is a market for combining magnetic disks, tape, and optical disks all in the same configuration.

QUIT USING WHIPS

WordPerfect's (Provo, UT) announcement that it has Data Set Access Block (DSAB)-level integration with DEC's All-In-1 should be good news for users of both products. No longer locked into using WPS Plus, users get the benefit of multiple editors and don't need to learn two word processing packages in order to do their jobs.

Integration of All-In-1 with WordPerfect is accomplished by relinking All-In-1, a procedure that makes WordPerfect part of the package and allows it to replace WPS Plus or other editors in All-In-1. System managers can set and change the default editor used by All-In-1 at will, allowing WordPerfect and WPS Plus to be used on the same All-In-1 system at the same time.

Users already familiar with WordPerfect will have a shorter learning curve for All-In-1. They only need learn one set of software commands, and document conversion is handled automatically by the system.

VAXING AROUND WITH A MOUSE

Apple Computer Inc. (Cupertino, CA) tells us that technical and nontechnical users alike will be up and running on a Macintosh within minutes of opening the packing box. And now, Eurosoft International Inc. (Saratoga, CA) tells us that the same is true for VAX—if you use a Mac.

The company's MacNIX/Net for UNIX-based VAXes and the soon-to-be-available Makeasy for VMS systems put all the operating system commands and functions on the Mac desk top. The company claims that any VAX user, by mousing around with pull-down menus and icons, can be an ace on DEC's wonder-child machine in less time than it takes to say "Macintosh-to-DEC."

CPU-BOUND PDP-11/70s SET FREE

From Digital Data Systems Inc. (Plantation, FL) and Setasi Research and Development (Hollywood, FL) comes yet another PDP upgrade that nearly doubles the performance of PDP-11/70 systems. Unibus and Massbus throughput is increased, and the companies claim that CPU throughput is improved a whopping 40%. The PEP70 is basically an extremely high-speed memory board that achieves its startling performance gains via an algorithm that anticipates what memory locations will be requested next, and has them ready.

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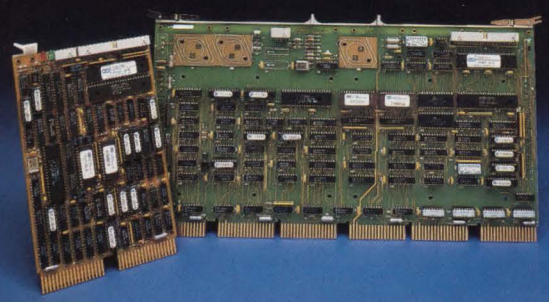

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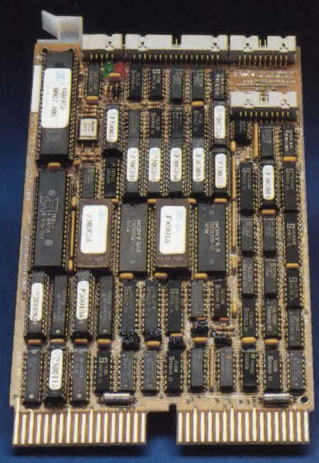

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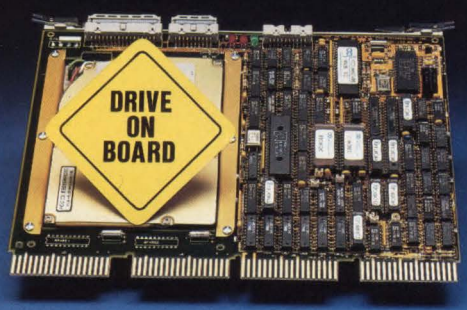

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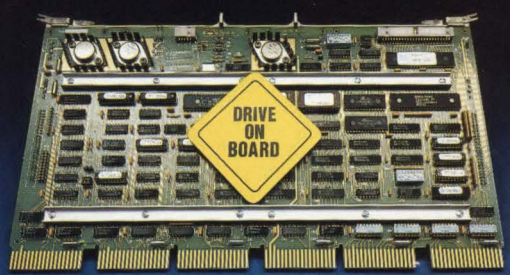

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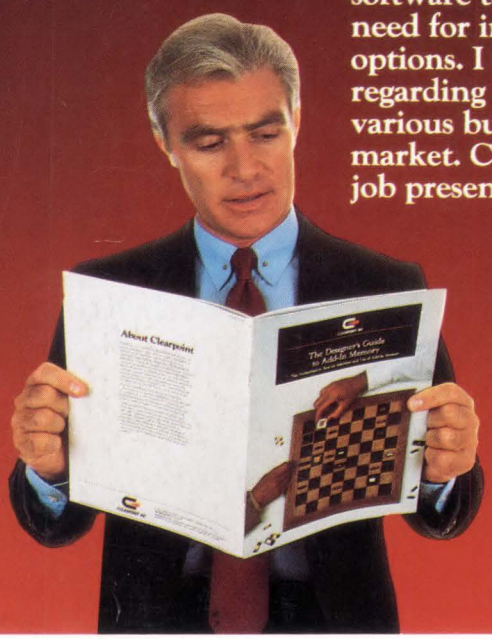

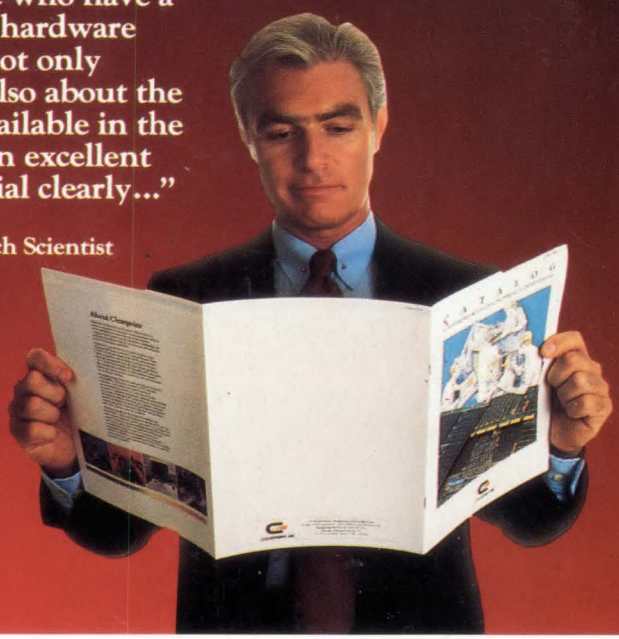

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