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-

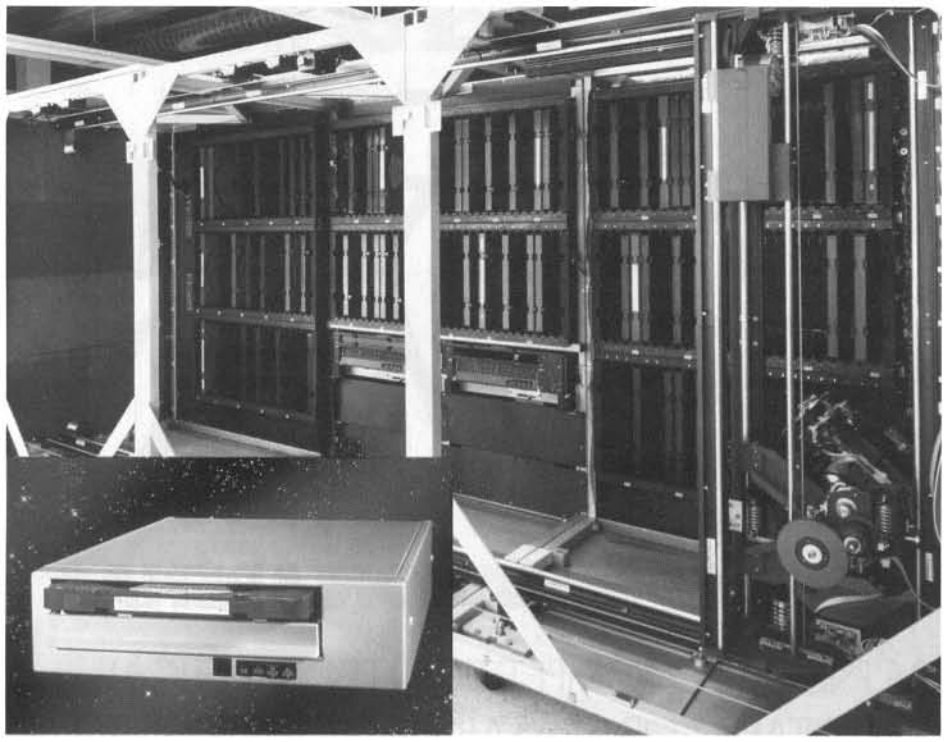


**Figure 1—FileNet's OSAR-200 optical storage library puts** *204 disks on-line for 530 Gbytes storage capacity. Up to eight 204-disk units may be configured in a single FileNet system, providing more than 4 terabytes of on-line storage capacity. This is equal to storing the text in approximately five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

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

## 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<br>Accounting<br>Billing<br>Directories<br>Usage<br>Filing<br>Electronic mail<br>Records | X-ray images<br>CAT scan images<br>Patient records<br>Hospital administration<br>Archiving | Engineering drawings<br>Catalogs<br>Documentation | Demand deposits<br>Credit cards<br>Journaling<br>POS<br>Customer accounts | Seismic<br>Oceanographic<br>Weather<br>Mapping | IRS<br>Patents Office<br>Library of Congress<br>Welfare records<br>Statistics<br>Fingerprints<br>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 |
|---|---|---|---|---|---|

Courtesy Freeman Assoc.

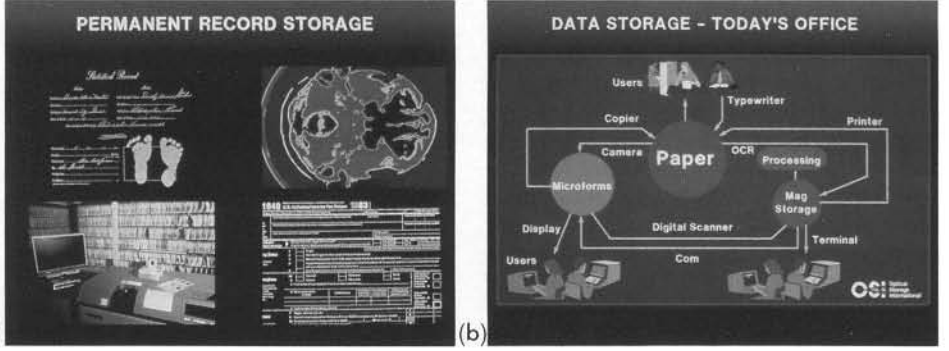



**Figure 2—As the information age progresses,** *new means of storing data are sought. Traditional repositories* (a) *have included human memory, file cabinets, and micromedia. But the demand for more efficient methods is growing as today's office* (b) *accumulates an ever-greater amount of data that 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.*

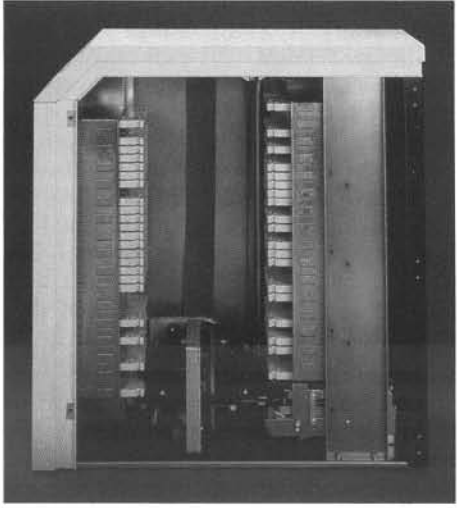


**Figure 3—Optotech's Optofile offers** *26.4 Gbytes of user capacity. Its small footprint allows users to store the unit under a desk for space efficiency. Optofile can hold up to sixty-six 400-Mbyte write-once disks and up to four drives.*

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.

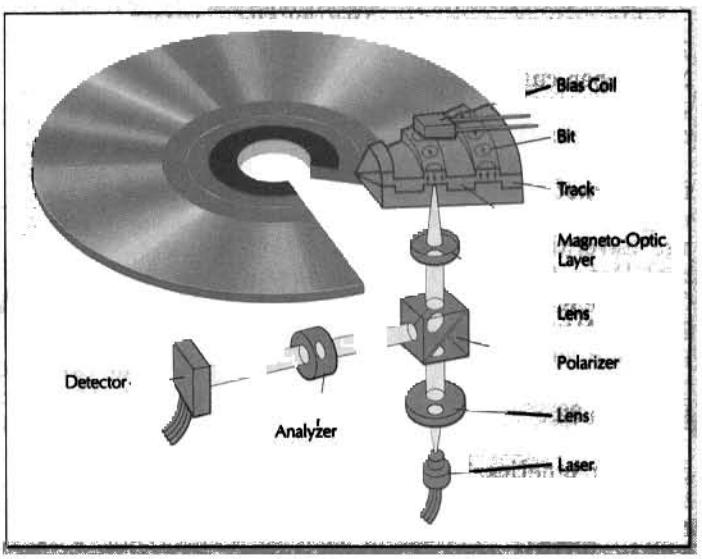
In MO recording, a spot on the sensitive layer of the disk is first heated by a laser beam, then a magnetic coil applies a magnetic field to the spot, resulting in a magnetic flux reversal in the laser-heated spot. This spot is equal to a logical "1"; a logical "0" is where no flux reversal occurs.

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 VD |
| Dimensions (mm) | 145Wx82.5Hx203L |
| | 1 Mbyte/second |
| | $10^{-12}$ |
| | SCSI |
| | 100–120 VAC |
| | 245Wx203Hx310L |
| | 5.25 in. |
| | 135Wx11Hx153L |
| | 512 bytes |
| | 240 Mbytes |

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) | Host Bus | Controller | | Drive | Capacity |
|---|---|---|---|---|---|---|---|
| | | | | Model | DEC Emulation | | |
| ADEPT DIGITAL SYSTEMS INC.<br>2381 Zanker Rd. #150<br>San Jose, CA 95131<br>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<br>650 Tenrod Rd.<br>N. Kingstown, RI 02852<br>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.<br>26 Cummings Pk.,<br>Woburn, MA 01801<br>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.<br>1 Maritime Plaza<br>San Francisco, CA 94111<br>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.<br>2910 E. La Palma, Ste. A<br>Anaheim, CA 92806<br>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.<br>601 W. California Ave.<br>Sunnyvale, CA 94086<br>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.<br>689 S. Canterbury Rd.<br>Shakopee, MN 55379<br>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.<br>171 South St.<br>Hopkinton, MA 01748<br>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.<br>3545 Harbor Blvd.<br>Costa Mesa, CA 92626<br>714-385-1685 **Circle No. 110** | LX400 | $17,000 | Q-bus, Unibus | UC04, UC14 | MSCP | Optimem, LMS/OSI | 1-2 Gbytes |
| IPS TECHNOLOGY INC.<br>11201 Richmond Ave., Ste. A102<br>Houston, TX 77082<br>713-870-0880 **Circle No. 111** | Model 2000 | $24,495 | Q-bus, Unibus | Models 3350, 2250 | Custom drivers | Any SCSI | 1-6 Gbytes |
| ISI<br>2768 Janitell Rd.<br>Colorado Springs, CO 80906<br>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.<br>145 Spruce St.<br>Ottawa, Ontario<br>Canada K1R 6P1<br>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.<br>2785 White Bear Ave.<br>St. Paul, MN 55109<br>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.<br>Inwood Pk. #200<br>17310 Redhill<br>Irvine, CA 92714<br>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 Model | Controller DEC Emulation | Drive | Capacity |
|---|---|---|---|---|---|---|---|
| OPTOTECH<br>740 Wooten Rd.<br>Colorado Springs, CO80915<br>303-570-7500 **Circle No. 116** | VAX Laser Databank | $6,950 | Q-bus | TD Systems Viking ODO | Custom driver | Optotech 5984 | 400 Mbytes |
| PERCEPTICS<br>725 Pelissippi Ctr.<br>P.O. Box 22991<br>Knoxville, TN 37932<br>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<br>1061 S. Melrose Ave.<br>Placentia, CA 92670<br>714-632-6672 **Circle No. 118** | TX-2200 | ,500 | Q-bus, Unibus | TX-1500 Interface (CDC, Cipher, Pertec protocol) | TS11, TM11, TU | OSI | -2 Gbytes |
| | TEC-OAS/1 | $17,50( | Q-bus, Unibus | TX-QB01 (Q-bus), TX-UB01 (Unibus) | MSCP | OSI | I-2 Gbytes |
| U.S. DESIGN CORP.<br>4311 Forbes Blvd.<br>Lanham, MD 20706<br>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 | $3,50 | 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.<br>15239 Springdale<br>Huntington Beach, CA 92649<br>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 g contact Cindy Grant-Thurman at* *ponded to a surve :924. INP—inf* *conducted by* Hardcopy. *To be ation not provided, POR—pric* *ncluded in the* Hardcopy *optical subsyst on request, N/A—not applicable.* *tabase, please*

of he Small Computer Systems In (SCSI) that allows attachm to a ber of

ching an optical disk isn't an easy c cision. "You have to consider data l e, how often it changes, and whethe on-line storage is important," counse s Optotech's Dulude. "WORM offers ng data life, some change, and immed ate access," he claims. Howev-

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 consid-

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

M er, using write-on instead of magnetic poses seve l problems to the operating system. Specifi-

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

ally, all ope tin items ar ng to see al vices th writing ove

thing that could damage t stored on a WORM device. Con equen ly, special device handlers are equir to properly manage the device.

To support WORM device s unde VMS, a number of companies i cludin Perceptics, KOM Inc., and Opt

ng system to view WORM drives as random access device by transparently performing opera tions that handle the drives as though they were, in fact, random access.

The software can RM

direct SCSI comm standard Mass Sto age Control Proto col (MSCP). Some SCSI host adapter allow only MSCP level control, re stricting the drive software to use c MSCP message pa kets, while other also support a SCS

's ating system ire trol the adap t the SCSI

## 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.<br>2381 Zanker Rd., Ste. 150<br>San Jose, CA 95131<br>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.<br>3851 S. Main St.<br>Santa Ana, CA 92707<br>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.<br>16850 Titan Dr.<br>Houston, TX 77058<br>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)<br>1555 S. Sinclair St.<br>Anaheim, CA 92806<br>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.<br>3545 Harbor Blvd.<br>Costa Mesa, CA 92626<br>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.<br>2241 Lundy Ave.<br>San Jose, CA 95131<br>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.<br>24 Payton St.<br>Lowell, MA 01853<br>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.<br>5100 Philadelphia Way<br>Lanham, MD 20706<br>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 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 |
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### 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-

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.**

**Control Data Corp.**
1101 E. 78th St.
Bloomington,
MN 55420-1478
612-851-4041
**Circle No. 152**

**Cygnet Systems Inc.**
601 W. California Ave.
Sunnyvale, CA 94086
408-773-0770
**Circle No. 153**

**Digi-Data Corp.**
8580 Dorsey Run Rd.
Jessup, MD 20794
301-498-0200
**Circle No. 154**

**Eastman Kodak Co.**
343 State St.
Rochester, NY 14650
716-724-4000
**Circle No. 155**

**Exabyte Corp.**
1745 38th St.
Boulder, CO 80301
303-442-4333
**Circle No. 156**

**FileNet Corp.**
3565 Harbor Blvd.
Costa Mesa, CA 92626
714-966-3400
**Circle No. 157**

**Hitachi America Ltd.**
950 Benicia Ave.
Sunnyvale, CA 94086
408-773-8833
**Circle No. 158**

**KOM Inc.**
145 Spruce St.
Ottawa, Ontario
Canada K1R 6P1
800-267-0443
**Circle No. 159**

**Laser Magnetic Storage International**
4425 ArrowsWest Dr.
Colorado Springs,
CO 80907
303-593-4237
**Circle No. 160**

**Maxtor Corp.**
211 River Oaks Pkwy.
San Jose, CA 95134
408-432-1700
**Circle No. 161**

**Olympus Corp. T.D.C.**
23456 Hawthorne Blvd.,
Ste. 120
Torrance,
CA 90505-4717
213-373-0696
**Circle No. 170**

**Optical Storage Solutions Inc.**
1130 D Burnett Ave.
Concord, CA 94520
415-825-3441
**Circle No. 162**

**Optotech**
740 Wooten Rd.,
Ste. 109
Colorado Springs,
CO 80915
303-570-7500
**Circle No. 163**

**Perceptics**
725 Pellissippi Ctr.
P.O. Box 22991
Knoxville, TN 37932
615-966-9200
**Circle No. 164**

**Qualogy Inc.**
2241 Lundy Ave.
San Jose, CA 95131
408-434-5200
**Circle No. 165**

**Ricoh Corp.**
5 Dedrick Pl.
W. Caldwell, NJ 07006
201-882-2000
**Circle No. 166**

**Scientific Micro Systems Inc.**
339 N. Bernardo Rd.
Mountain View,
CA 94043
415-964-5700
**Circle No. 206**

**TD Systems Inc.**
24 Payton St.
Lowell, MA 01853
617-937-9465
**Circle No. 167**

**Tecex**
1061 S. Melrose Ave.
Placentia, CA 92670
714-632-6672
**Circle No. 168**

**U.S. Design**
4311 Forbes Blvd.
Lanham, MD 20706
301-577-2880
**Circle No. 169**