Mini-Micro Systems

A CAHNERS PUBLICATION

APRIL 1984

Prices and bit rates tumble in digital voice processing

Tough times for software pirates

Minicomputer companies grope for software standards

WIDE WORD™

200 MB/second!

World's Fastest Bulk Memory System

It's true. WIDE WORD, Dataram Corporation's new, third generation of its popular BULK SEMI memory systems, delivers an incredible data rate of 200 MB/sec! Achieved by utilizing a word length of 80 or 160 bits and four-way interleaving.

Much faster than even the fastest minicomputers can handle...but not too fast for your real-time applications, image processing, array processing or data acquisition needs.

Dataram's WIDE WORD BULK SEMI is ready to perform for you. Now! Multi-port capability makes it possible to interface WIDE WORD BULK SEMI to your host minicomputer: Connect one port to your high-speed input; the other to your mini.

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WIDE WORD BULK SEMI. 32 MB of high-performance memory in a compact 15¾" system. Word lengths up to 160 bits. And, of course, a data rate of 200 MB/second.

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DATARAM

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WHAT'S THE BIG IDEA?

☐ Send me your 16-page brochure detailing BULK SEMI.
☐ Please call me to discuss my application.

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Company _____

Address _____

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Telephone _____

Minicomputer _____

CIRCLE NO. 1 ON INQUIRY CARD

The most successful first year in the history of American business.

It's true. COMPAQ® Computer Corporation had greater first-year sales than any new company in American business history.

We sold $111 million worth of our personal computers, the COMPAQ Portable and the COMPAQ PLUS™.

How did we do it?

We followed two principles.

Principle One: Offer people personal computers that work better. We gave them the COMPAQ Portable. This rugged, full-function system is truly IBM®-compatible. So it runs without modification all the most important, most useful software; literally hundreds of programs.

We followed with the COMPAQ PLUS, a high-performance version with an integrated ten-megabyte disk drive.

Besides being portable, both offer more capabilities than most other personal computers. They display high-resolution text *and* graphics on the same built-in screen. Expansion slots take IBM-compatible boards. There's even a kit to convert the COMPAQ Portable to the COMPAQ PLUS.

The sales figures say we did pretty well on Principle One.

Principle Two: Make it easy for people to get what they need. More than one thousand of the country's best computer dealers are now Authorized COMPAQ Computer Dealers. We back those dealers with training, service, and support to make life simpler for our users. That's one reason 98 percent said in a recent survey that they would recommend COMPAQ to a friend.

We were honored to have a history-making first year. But it's only history now. How should a company follow up the all-time best beginning?

Principle Three: Stick with Principle One and Principle Two.

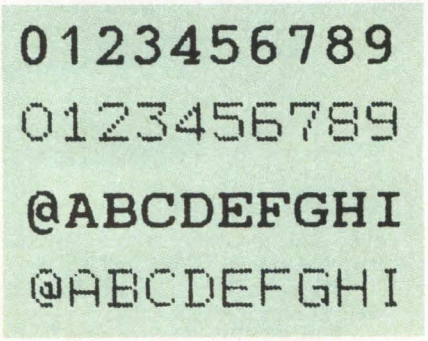
For the location of your nearest Authorized Dealer, call 1-800-231-0900.

COMPAQ®

It simply works better.

Mini-Micro Systems

p. 33...Cover photography and artwork provided courtesy of Digital Sound Corp.



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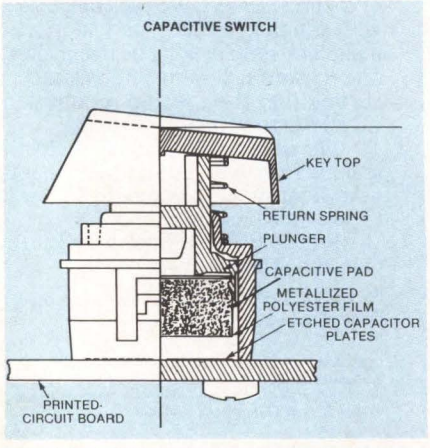

p. 97...Intelligent keyboards are the trend

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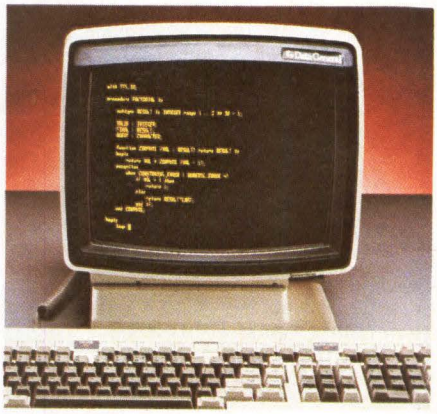

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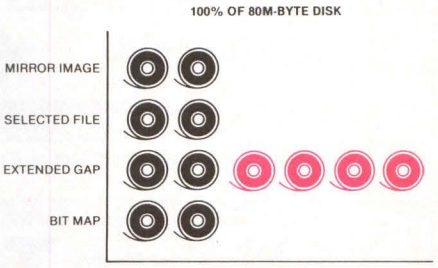

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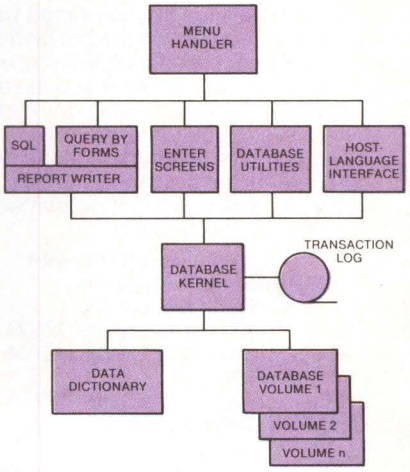

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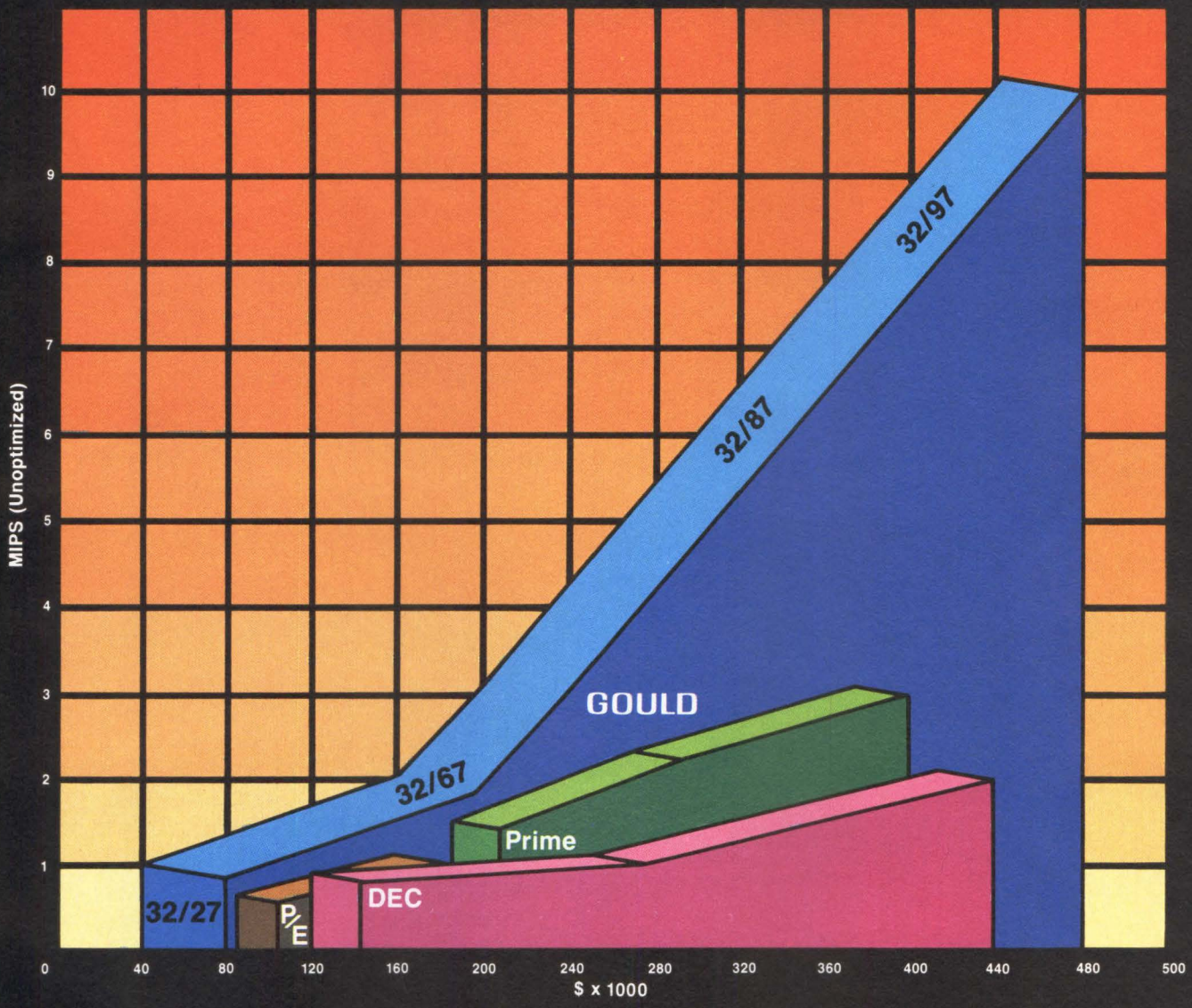
Gould...Innovation and Quality in Superminicomputers

We've drawn the line on computer price/performance.



Gould has set new supermini-computer performance standards with its CONCEPT/32™ family of 32-bit machines. The cost-effective, wide-ranging capabilities of Gould minicomputers make Gould Computer Systems the dominant source for the compute power you need, at a price you can afford.

The competition just doesn't tow the line in either price or performance. Whatever the requirement. The Gould CONCEPT/32 family offers the widest range of superior performance while keeping the price in line. Our low-end CONCEPT 32/27 incorporates high density packaging for lower cost. The mid-range 32/67 combines a minimal footprint and cost with superior computational power. For heavy duty scientific and engineering applications, the Gould CONCEPT 32/8780 offers mainframe performance at a fraction of the cost. And if you're worried about where your application falls on the line, don't be. Upward compatibility and software transportability allow you to move up our line as far as you need to go.

Gould has drawn a new price/performance line. One that shows it takes more than 32-bits to make a supermini. A line the competition can't cross. Call or write for more information.

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GOULD
Electronics

CIRCLE NO. 6 ON INQUIRY CARD

You're the of our

We build computers for the way you do business.

Cromemco builds some of the most advanced micro and supermicro computers in the world.

And we sell them to people who design and package total computing solutions.

People who need flexible computers so they can respond quickly with exact solutions to their customers' problems.

People who want computers they can upgrade and expand without creating new problems for themselves or their customers.

People very much like you.

Computers matched to your customers' applications.

If your customers' needs can be met with a micro or supermicro, Cromemco can deliver the right one to do the job. Right from the pages of our catalog, you can select from more than two dozen 68000- and Z-80-based computers. They're all built on the IEEE-696 (S-100) bus. And they're all compatible. So you can move from one to another without losing your software investment.

To fine-tune your system, our computers include up to 21 board slots. And over 35 system boards to fill the slots just about any way you choose. We can back the CPU with as much as 16 Mb of error-correcting RAM. An SMD interface that can support 1200Mb of disk storage. High resolution color graphics. Communications. You name it.

Cromemco

DEDICATED TO SYSTEMS BUILDERS

FOUNDED 1975

cornerstone business.

And you can choose the right storage solution from our selection of high-performance floppy, hard disk and tape systems. For distributed processing applications, you'll want to take a look at our C-10 personal computer. It can serve any of our computer systems as an intelligent workstation.

What does all that mean? Just this. With Cromemco you can offer your customers individually tailored, expandable computing solutions. At off-the-shelf prices. Immediately.

Software that speaks your customers' language.

Our software tools help you and your customer get down to business quicker, too.

Our UNIX™-like operating system can execute both 68000- and Z-80-based programs. And our high-level language support for both microprocessors is superior. From Macro Assemblers. To Fortran 77, PASCAL, C, BASIC and GSA-certified high-level COBOL.

Cromemco means business. Your business.

What it comes down to is this.

Since our founding in 1975, you've been the cornerstone of our business. So Cromemco computers are designed specifically for the way you do business.

And whether you provide computing solutions for business, science or industry, you really should be doing business with Cromemco.

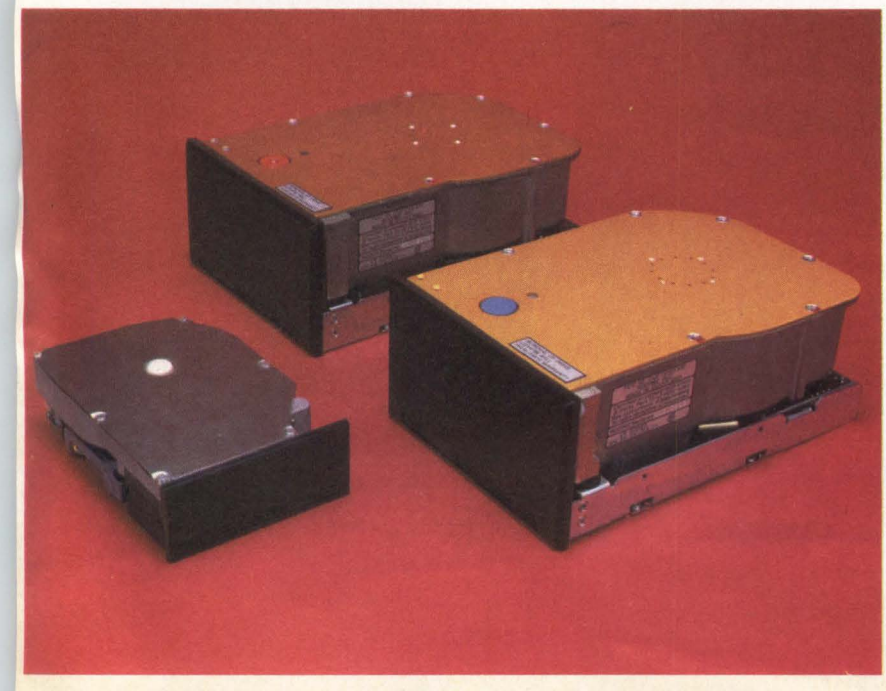
For a copy of our Systems Catalog, contact: Cromemco, Inc., 280 Bernardo Ave., P.O. Box 7400, Mountain View, CA 94039, (415) 964-7400, TWX 910-379-6988.

In Europe: Cromemco/GmbH, 6236 Eschborne 1, Frankfurter Str. 33-35, P.O. 5267, Frankfurt Main, Germany or Cromemco Ltd., The Cambridge House, 178-182 Upper Richmond Rd., Putney, London SW15 England.

CIRCLE NO. 7 ON INQUIRY CARD

Cromemco®

Add it all up, and you get today's finest range of Winchester disk drives



You can figure it out for yourself. With storage capacities of between 5 and 40 megabytes (formatted), and offering both 5¼" and 3½" models, Rodime has developed today's finest range of Winchester disk drives.

Take the Rodime 200 series. Launched in April 1982, it was the first to offer a full range of storage capacities from 5 to 20 megabytes and is currently providing reliable memory storage for many of the leading manufacturers of 8- and 16-bit business microcomputers.

Take the Rodime RO 206 and RO 208. With storage capacities of 30 and 40 megabytes, these high-performance drives have an average access time of 60 ms. As you'd expect, they're designed specifically to meet the memory requirements of today's 16-bit multi-user microcomputers, at highly competitive prices.

And, finally, take Rodime's RO 350 3½" Winchester. With storage capacities of 5 and 10 megabytes, the RO 350 is the first of a new generation of rugged Winchesters designed primarily to bring the benefits of Winchester technology to the hostile environment of portable microcomputers.

It all adds up. Take Rodime's RO 200, 206, 208 and 350 together and you've got the finest range of Winchester disk drives. Add Rodime's outstanding reputation for reliability, its manufacturing capacity, and its ability to deliver large volumes reliably, and you'll see why Rodime has its numbers resoundingly right.

If your systems still aren't using Rodime Winchesters, then someone, somewhere has got their numbers wrong.

RODIME

right from the beginning

CIRCLE NO. 8 ON INQUIRY CARD

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Boca Raton, Florida 33431

Editorial

Superminicomputers resist competitive onslaught

Caught in an ever-narrowing vise, with supermicro computers encroaching from one side and micromainframes intruding from the other side, minicomputers in general and superminicomputers in particular continue, nevertheless, to demonstrate significant market growth. For example, International Data Corp. (IDC), a Framingham, Mass., information service company, predicts a 20 percent to 25 percent annual growth rate over the next few years. According to the IDC report, "Small and Medium Scale Systems Marketplace," superminicomputers will grab 79 percent of minicomputer dollar sales in 1986, up from 69 percent in 1983. Furthermore, along with higher reliability, the average price of a fully configured unit will drop from the current $60,000 to less than $45,000 in 1987.

In another study, "Superminicomputer Industry 1981-1986: A Strategic Analysis," Venture Development Corp. (VDC), a Wellesley, Mass., management consulting company, paints an even brighter picture. VDC forecasts that superminicomputer unit shipments will skyrocket from 7,400 units in 1981 to 46,820 units in 1986, for a compounded annual growth rate of 44.6 percent. Likewise, superminicomputer dollar shipments will zoom at a compounded annual growth rate of 31.9 percent, from $1.2 billion in 1981 to $4.8 billion in 1986. Compared to the estimated minicomputer installed base of approximately 900,000 units, the superminicomputer industry represents an emerging market.

On the other hand, Electronic Trends Publications, Cupertino, Calif., sees the supermicrocomputer, or microminicomputer, as the dominant future player in the minicomputer arena. This company's latest study, "Managing the Microminicomputer Explosion: A Guide for Manufacturers, Users and Third-Party Participants,"ascertains that the total minicomputer market will nearly triple from 1982 to 1987, going from $9 billion to $25 billion. And during that time, superminicomputers will increase from 28 percent to 34 percent of market share, minicomputers will plummet from 66 percent to 18 percent and microminicomputers will orbit from 6 percent to 48 percent.

But what do all of these numbers mean to system integrators? The Electronic Trends Publications' report provides some noteworthy observations. For instance, system integrators will be inundated with minicomputer products, capabilities and applications. Expected technology advances should produce improvements in memory capacity, response time, processor power, numerical accuracy, database and instruction-set size, reliability, price and software. Similarly, applications should abound in real-time transactions: scientific and engineering computation; timesharing; business and data processing; graphics, imaging, computer-aided design, engineering and manufacturing; fault tolerance and management.

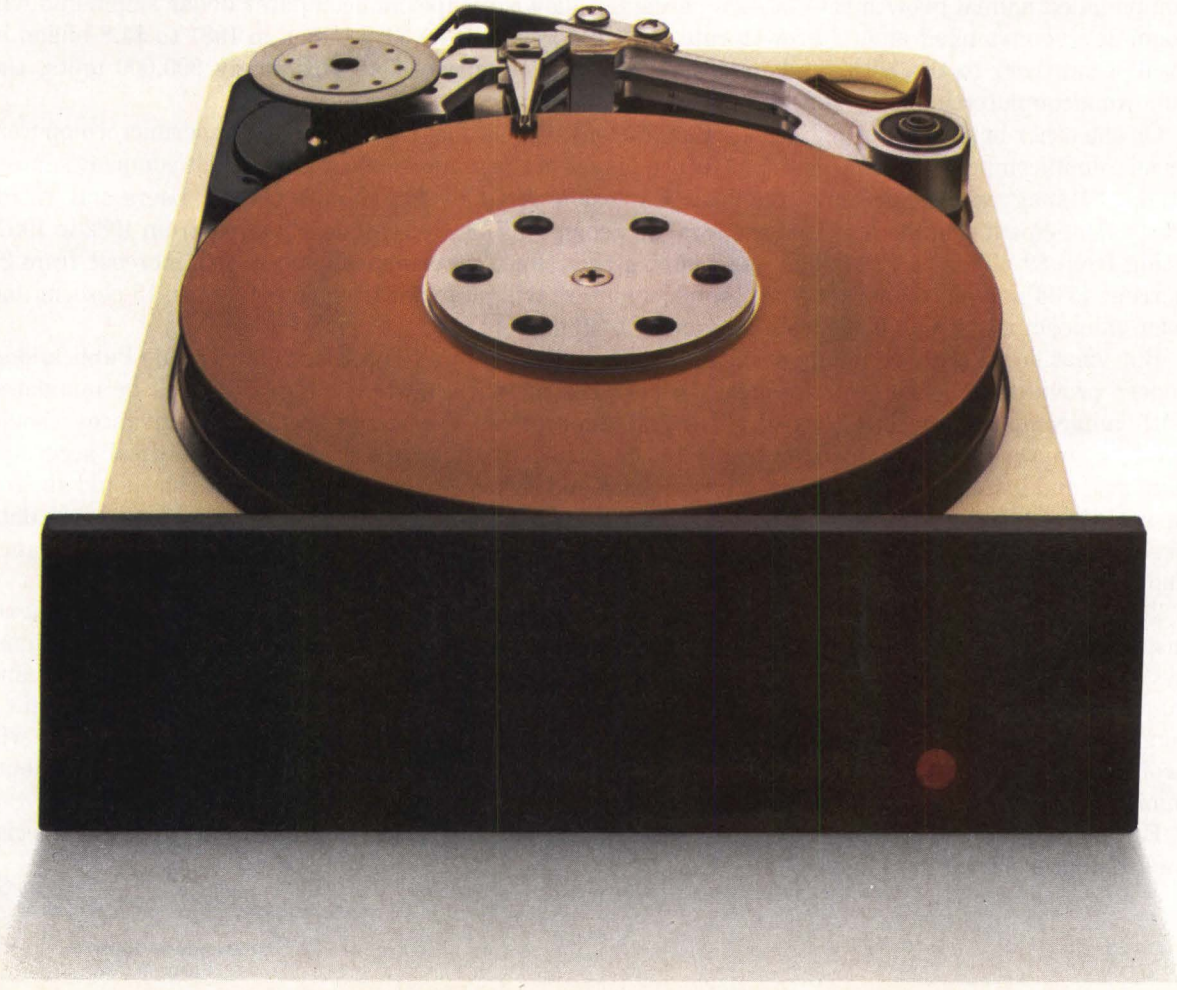
These products and services will, therefore, mandate careful evaluation, selection, procurement, installation and maintenance. Accordingly, for new and updated minicomputer-based implementations, system integration planning should thoroughly evaluate overall information goals, objectives and management, as well as operators' needs. And, what's more, all system integration groups within a company should share such planning. Failure to institute these guidelines, warns the report, will probably result in a costly proliferation of essentially similar, but incompatible and inefficient, minicomputer-based systems.

For more perspective and insight on these issues, see Associate Editor Roy Friedman's special minicomputer survey on Page 137.

George V. Kotelly

George V. Kotelly
Editor-in-Chief

TAKE A SHORT 20,000-HOUR DRIVE.



And wave goodbye to the competition.

Presenting the Shugart 712. Our new 5.25" half-height 10 Mbyte Winchester.

It's a high performance compact that redefines reliability. So much so, it outdistances all other half-height Winchesters.

For starters, it runs at an MTBF of 20,000 power-on hours. That's 60% longer than other drives.

And it's roomy. With 10 Mbytes of formatted storage.

Plus four-point shock and vibration mountings, for a very smooth ride. And rugged enough to withstand up to 40 G's.

The 712 is based on 3370 flexure technology, bringing mainframe horsepower down to size.

And our new, low-mass head design complete with pre-amp is standard equipment, too. This makes flying height more uniform. And data integrity a given.

All this was made possible by our venture group approach. A specially chartered engineering and manufacturing team that makes sure the bugs are out the first time out.

And we make sure they have everything they need. Like the $40 million investment we made in capital equipment.

Which includes more progressive assembly lines. Class 100 clean tunnels. Even a more advanced spindle motor.

In short, everything you need for single-user personal computers. Intelligent workstations. And, down the road, multi-tasking software.

You won't have to reinvent the wheel every time you want to redesign, either. Thanks to our 1600 controller with built-in SCSI. Plus the drive level interface standard.

So test drive the 712 today. Or its 5 Mbyte version, the 706.

Just call your local Shugart sales office. Or, contact Hamilton/Avnet, our authorized distributor.

And find out how a little drive can take you a lot further.

Shugart

Right from the start.

Milpitas, CA (408) 263-2600; Costa Mesa, CA (714) 979-1935; Thousand Oaks, CA (805) 496-5388; Minneapolis, MN (612) 546-4411; Richardson, TX (214) 234-3568; Framingham, MA (617) 879-1700; Saddle Brook, NJ (201) 368-8445; Atlanta, GA (404) 436-0953; Toronto, ONT (416) 475-2655; Paris, France (1) 687-31-41; Munich, West Germany (089) 786-021; London, U.K. (44) 4862-24527

CIRCLE NO. 9 ON INQUIRY CARD

Letters

Huch at Dataroyal

To the editor:

On page 17 in the December issue, you state that Ronald Huch helped found Dataroyal Inc. before it was purchased by Facit Data Products division. Mr. Huch did not help found Dataroyal. Dataroyal was founded in 1969. Huch joined Dataroyal as president in late 1976 or early 1977. He was an employee of Centronics Data Computer Corp. before joining Dataroyal.

David A. Lambarth
Development Manager
Digital Equipment Corp.
Merrimack, N.H.

Character limitations

To the editor:

Purchasers of some of the less expensive daisy-wheel printers (MMS, January 1984, Page 167) should beware that some ASCII character sets do not include all of the characters specified in that standard. Since some of these low-end products are derived from older, European office typewriters, true ASCII character sets are often not available.

Before buying one of these bargain machines, make sure that the print-wheel characters that do not conform to ASCII will not pose a problem. I was not too careful and have been inconvenienced by the differences, although otherwise I am happy with the print quality and reliability of the machine.

Ken Barbier
Borrego Springs, Calif.

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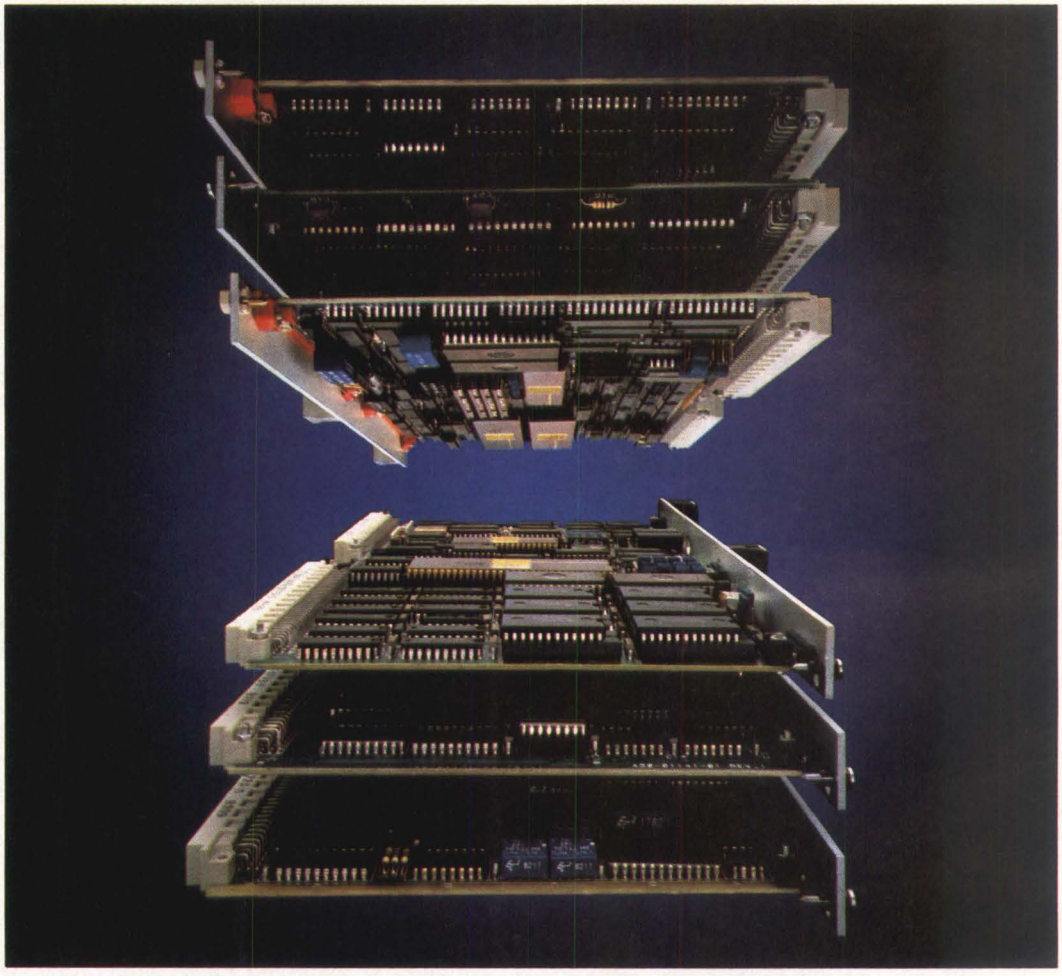
To keep your free subscription to Mini-Micro Systems, watch for the requalification card in next month's issue. Please fill it out and return it to us right away.

SPRING



BOARDS

Get ready to make a quantum leap past your competition. Because with our new 68000 VMEbus boards and UNIX™-based development system, that's exactly what you'll be able to do. What's more, these new board-level solutions are just the first of many that will be available from Mostek. So now, there's no reason not to be launching into the future with the Mostek MK68000.

First, consider the VMEbus itself, a very compact board structure with truly high-performance timing parameters. Plus inherent expansion to 32-bit address and data.

Second is the selection of VMEbus boards available from Mostek: VME-MMCPU: Memory-managed CPU with on-board 128K bytes DRAM and full multiprocessor capability. VME-SASI: A SASI™ controller with DMA. VME-FLP: A double-sided, double-density floppy disk controller with DMA and sector buffer for 8" and/or 5¼" drives. VME-SIO: Four-channel (RS-422/RS-232). VME-DRAM: ¼ MB DRAM with byte parity, plus full 32-bit VME interface. VME-SBC: A single-board computer with an SIO port, BYTEWYDE™ memory and a firmware monitor. VME-SYSCON: System controller with battery-backed, real-time clock, SIO port and parallel printer port.

Now look at a powerful way we have already put some of these VMEbus boards together: The Matrix 68K™, a multi-user microcomputer with a UniPlus + ™ UNIX operating system. It's flexible. Expandable. And well-suited for program development, text preparation and general-purpose processing.

The point is, if you want a powerful and versatile VMEbus solution, we have all the tools you need to hit the ground running. To find out more, contact Mostek, 1215 W. Crosby Road, MS2205, Carrollton, Texas 75006, (214) 466-6000. In Europe, (32) 02/762.18.80. In Japan, 03/496-4221. In the Far East (Hong Kong), 296.886.

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SASI is a trademark of Shugart Associates, Inc.
UniPlus + is a trademark of UniSoft Systems.

UniPlus + is derived from UNIX Systems III under license from AT&T.
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CIRCLE NO. 12 ON INQUIRY CARD

2X the speed, 3X the density, 4X the capacity, ⅓ the cost.

The first low cost GCR Tri-Density Tape System offering large system performance.

Kennedy is, and has always been, the leader in peripheral tape technology. With Model 9400, Kennedy has done it again. For instance:

2X the speed. Model 9400 is a dual speed transport, operating at 45 ips in the GCR mode and 75 ips in the PE/NRZI modes with a maximum rewind speed of 500 ips.

3X the density. The drive utilizes Group Coded Recording at 6250 BPI along with previous industry standard densities of 1600 BPI/PE recording and 800 BPI/NRZI recording.

4X the capacity. In GCR mode, the Model 9400 can store up to 180M BYTES of data (four times more capacity than the traditional 1600 BPI drive).

More? The Model 9400 features multiple processors to separate data handling and control functions. An 8088 processor provides overall system control and accommodates a variety of industry standard interfaces.

Among the many features of the 9400 is its RS-232 communication port and complete internal software which permits off-line diagnostic operations via a terminal, the host computer or by a remote test facility with a phone modem.

1/3 the cost. Best of all, the Model 9400 is priced at about 1/3 the cost of a conventional GCR tape system. Kennedy Company . . . designers of the finest peripheral tape products for 20 years.

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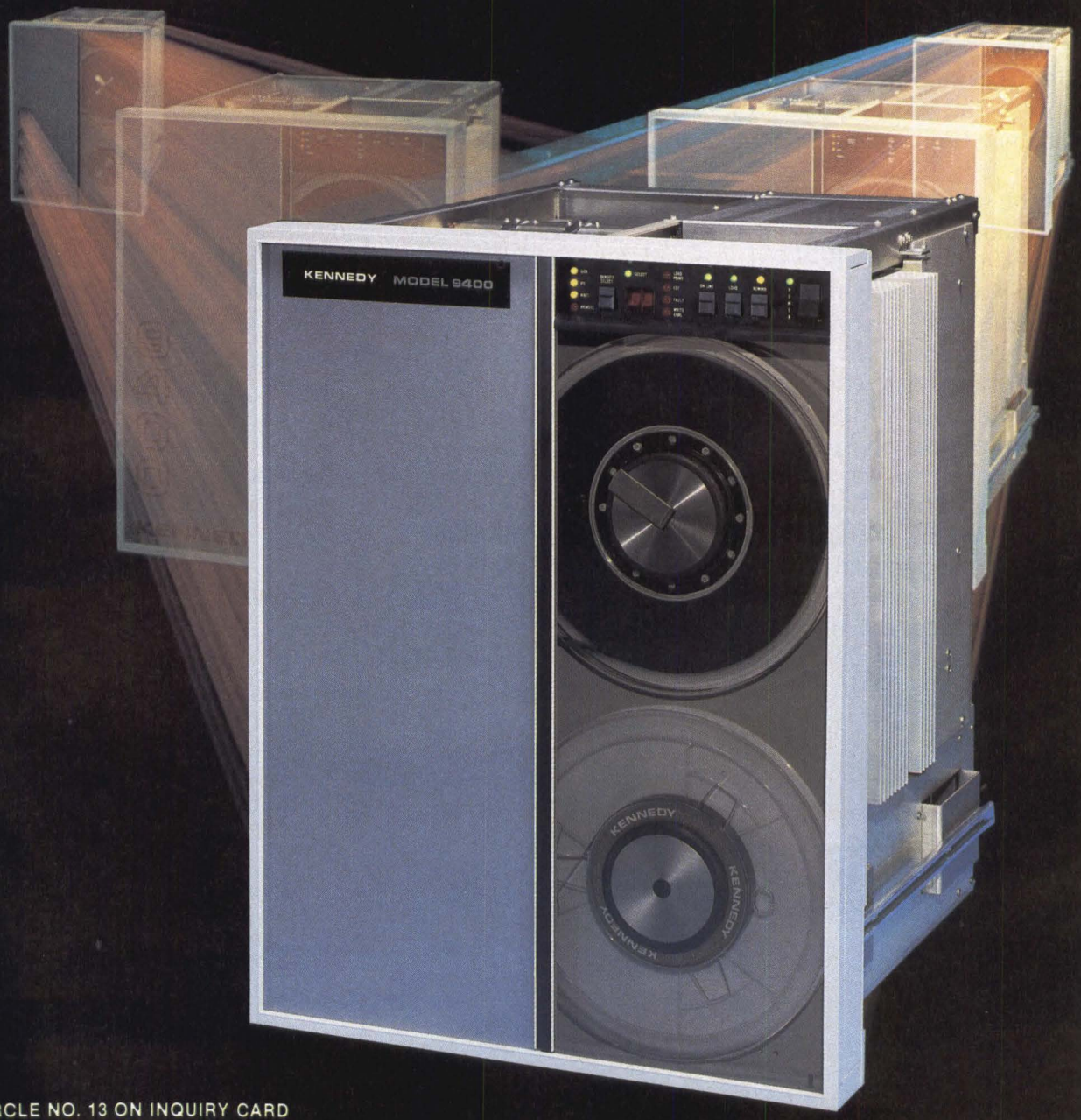

CIRCLE NO. 13 ON INQUIRY CARD

KENNEDY • QUALITY • COUNT ON IT

Breakpoints

NCR REPORTEDLY ADOPTS FARADAY PC MOTHERBOARD

NCR Corp., Dayton, Ohio, reportedly plans to become one of the earliest large computer manufacturers to adopt the IBM PC-motherboard from Faraday Electronics, Palo Alto, Calif., and use it as the basis of a PC-compatible microcomputer. Although NCR officials have disclosed few details about the imminent NCR system, the Faraday board includes features required to give certain levels of IBM PC compatibility. For example, it houses an 8088 processor, 64K bytes of RAM, five expansion slots, ROM BIOS supporting MS-DOS and options to include as much as 256K bytes of RAM. The NCR system, expected at the Spring Comdex Show, is reportedly the first in a family of IBM PC-compatibles that should eventually run UNIX, MS-DOS, Concurrent CP/M, and Convergent Technologies Inc.'s CTOS operating systems. It should fit below NCR's current Decision Mate microcomputer, which is less IBM-compatible than the new system. Deliveries are expected in June or July. An NCR spokesman declines to comment about the system. — L. Valigra, M. O'Gara

SHUGART 1.6M-BYTE MINIFLOPPY USES 8-INCH FORMAT

Shugart Corp., Sunnyvale, Calif., is introducing the Shugart 475, a half-height 5¼-inch floppy disk drive with the same performance and recording format as 8-inch floppies. The double-sided, 96-track-per-inch (tpi) 475 can read but not write data at 48 tpi, allowing easy transfer of existing software and data files to the higher density diskettes. The 475 is available in single- or dual-density versions with capacities of 800K bytes and 1.6M bytes, respectively. The new member of Shugart's family of half-height, double-sided 5¼-inch drives has an average track-to-track access time of 3 msec. and a data-transfer rate of 500K bits per second made possible by increasing the disk rotation rate from 300 to 360 rotations per minute. The single- and dual-density versions of the 475 will record 4,823 and 9,646 bits per inch, respectively. The 475 uses 600-oersted media. Shugart plans to ship evaluation units in the second quarter followed by production quantities in the third quarter. The 475 will be priced at less than $200 each in OEM quantities. — T. Moran, C. Warren

DEC UNVEILS NEW VAX, VIDEOTEX, TWO DATABASE MANAGERS

Early this month, Digital Equipment Corp. was poised to release several long-awaited products: the VAX-11/785 superminicomputer, two relational database-management systems, and a videotex system. The VAX-11/785 is the new top-of-the-line DEC standalone processor, sporting 50 percent to 70 percent greater throughput than the VAX-11/780 while retaining software compatibility, a company spokesman claims. The two relational databases are Rdb/VMS and Rdb/ELN. Rdb/VMS is for VAX or microVAX systems running the VMS or microVMS operating systems, respectively. Target applications for Rdb/VMS are commercial information management, engineering computer-aided design/computer-aided manufacturing, laboratory analysis and office use. DEC sources peg Rdb/ELN (ELN is a VMS subset used primarily on the microVAX) as a high-functionality, high-concurrency relational database-management system aimed at dedicated, time-critical applications and/or distributed applications. The videotex product, VAX VTX, is a VMS software product for electronic storage and retrieval of information. VAX VTX software is accessible from any standard DEC ASCII terminal device. Pricing and availability information was not available at press time. — L. Valigra

Breakpoints

RELATIONAL TECHNOLOGIES OPTIMIZES VAX/VMS DATABASE SYSTEM

Relational Technologies Inc., Berkeley, Calif., this month should introduce version 3.0 of its INGRES relational database-management system executing under VAX/VMS operating system environments. The new optimized version offers two enhanced front-end tools, QBF + (Query by Forms) and ABF + (Applications by Forms), that will enable professional users to write their own forms-oriented applications. Previously, operations other than simple updates and queries required application programming in a high level language. With QBF + and ABF +, users can directly create screen-oriented applications without using a high-level language. This allows users to bypass the programming department and build their own applications. RTI has boosted Rel. 3.0 transactional speeds by 100 percent over the 2.1 version. The $20,000 to $40,000 package will initially run only on VAXs, but Relational Technologies plans to support MC68000-based supermicrocomputers running UNIX. — C. Bailey

FOUR-PHASE READIES MC68010-BASED OA SYSTEMS

Four Phase Systems Inc., Cupertino, Calif., was expected to formally introduce late last month a family of office information systems based on the MC68010 and aimed at large corporations. The System 6600 supports multiple CM68010 processors, multiple 37M-byte hard disk drives and as many as 128 users. The System 6300 supports eight users on a single CPU. The systems use a UNIX-derived operating system that is System V-compatible and has virtual-memory support. The systems include Uniview, a user-friendly shell that provides windowing and menu-driven operation. Available software packages include word processing, data processing, electronic spreadsheet and the Oracle relational database management system. A typical eight-user 6600 configuration is priced at $70,650. A two-user 6300 sells for $15,181. COBOL, BASIC, C, SIBOL and Pascal are available separately. The systems are available now. — C. Bailey

Q-BUS-BASED COMPUTER CAN SWAP PROCESSORS

Ford/Higgins Ltd., Boulder, Colo., planned to unveil its Powerframe super-minicomputer, a variable-architecture, Q-bus system whose $13,990 basic system price includes 256K bytes of RAM, a 40M-byte (formatted) fixed/removable Winchester disk drive, a disk controller, a nine-card slot chassis, dual I/O ports, a 400W power supply and a choice of microprocessors and operating systems. The Powerframe model 2340 will initially contain Digital Equipment Corp.'s LSI-11/23 Plus processor and the model 6840 will use Motorola Inc.'s MC68000. Between them, the two models will run the RSTS, RT-11, RSX and UNIX operating systems. The company also plans to offer two 32-bit microprocessors for the system during 1984. To change from the PDP-11/23 Plus to the MC68000 entails swapping one board and inserting a removable Winchester disk. The LSI-11/23 Plus will support eight to 10 users, and the MC68000 will support about twice as many. The system addresses as much as 4M bytes of RAM, and disk storage can be expanded in increments of 80M and 160M bytes. Ford/Higgins is shipping evaluation units of the systems to its OEM customers and expects to reach production quantities in the fourth quarter of 1984.— T. Moran

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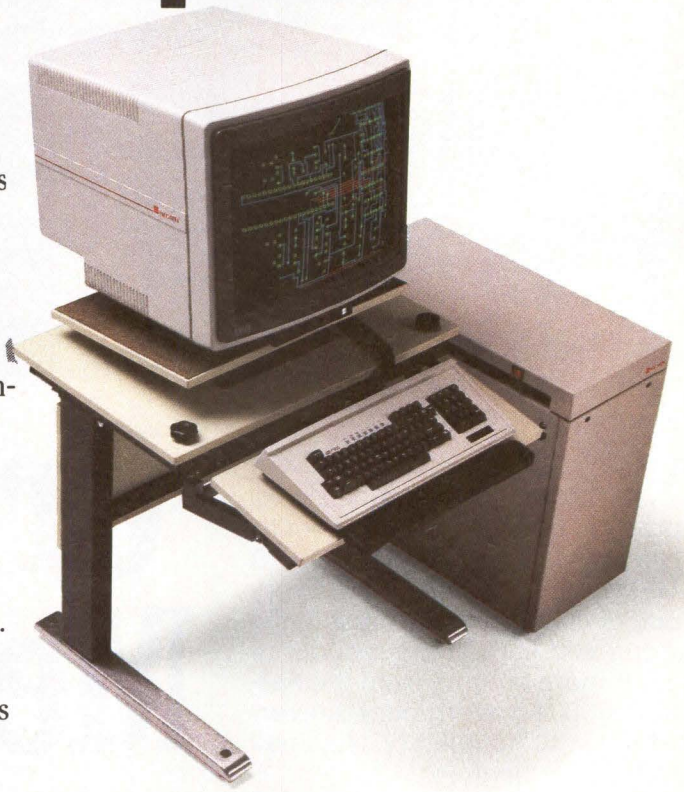

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CIRCLE NO. 15 ON INQUIRY CARD

Breakpoints

MULTIPLE NSC32023 SYSTEM IS FOR OEMS WITH REAL-TIME APPLICATIONS

Flexible Computer Corp., Dallas, plans to have a computer prototype of its Flex/32 expandable system running by June and a multiple computer version up by the fourth quarter. The concept of the system is to pack as many as 10 NSC32032-based single-board computers (SBCs) into a single, 20-slot box mounted in a 19-inch rack. Each SBC will have a CPU, a floating-point processor, cache memory and 1M-byte of RAM. Each SBC would be assigned to a particular job and would be able to communicate with the other SBCs. Expansion boards with 8M bytes of RAM could be used in any of the slots, and be assigned (singly or in multiples) to any of the CPUs. Prices for systems including two SBCs, UNIX System V, FORTRAN, the company's proprietary Concurrent C and a 168M-byte Winchester will start at $126,000. Deliveries are scheduled to begin by the first quarter of 1985. — D. Bright

PACKAGE SMOOTHS MICRO-TO-MAINFRAME DATA TRANSFERS

System Center Corp., Irving, Texas, should introduce next month the Micro Network Data Mover communications package. This microcomputer package is an extension of System Center's mainframe package that runs under IBM's VM operating system and permits the transfer of large blocks of data throughout a mainframe-based Systems Network Architecture (SNA) network. The Data Mover operates with IBM PCs and Corvus Systems Inc.'s Concept workstations connected to a SNA communication network. It facilitates smooth data transfers between both microcomputer-based workstations and the mainframe host. Price is $200 in OEM quantities. — C. Bailey

3½-INCH WINCHESTERS TO HALLMARK NCC

To meet the demands of the fast-growing portable computer market, and with hopes of matching Rodime Plc.'s success with its 3½-inch Winchester (currently being used by Compaq Computer Corp.), at least five companies plan to field 12M-byte (unformatted), sub-4-inch Winchester disk drives at the National Computer Conference in July. The companies include Seagate Technology, Scotts Valley, Calif., Tandon Corp., Chatsworth, Calif., and Miniscribe Corp., Longmont, Colo., and start-ups Microcomputer Memories Inc., Van Nuys, Calif., and Lapine Technology, Santa Clara, Calif. Although Seagate's 3½-inch product is expected to use Dysan Corp.'s 600-oersted media — as does Rodime's drive — it is rumored that other manufacturers will opt for plated media, possibly from Evotek, which recently bowed out of the Winchester market. The new Seagate drive most likely will remain compatible with Seagate's ST412. According to Jim Porter, industry consultant and publisher of *Disk/Trend Report,* this compatibility is necessary to allow system integrators to plug the small drive in and operate it. — C. Warren

TECH FILES: A QUICK LOOK AT INDUSTRY DEVELOPMENTS

MICRO FILES: Ikon Corp., Seattle, Wash., **this month plans to introduce a family of single-board Digital Equipment Corp. DR-11W emulators for Multibus, VersaBus and Prime Computer Inc. computers.** The DR-11W is a high-speed parallel direct-memory-access interface. The 8-, 16- or 24-bit Multibus and the 16-bit Prime interface boards support DEC's specified 2M-byte-per-second data-transfer rate. The 32-bit VersaBus board uses microprogrammable bit-slice

processors to achieve a 6M-byte-per-second data rate. Prices are $2,150 for the Multibus interface, $2,300 for the VersaBus version and $5,000 for the Prime interface. — C. Bailey

Leading Edge Products Inc. has completed its recall of 1,170 IBM-compatible personal computers that were shipped before Feb. 3, 1984. The company is replacing power supplies in the CPU that may be defective and could cause electric shock with prolonged use. Mitsubishi Electric Co. manufactures the Leading Edge CPU. — M. Stenzler-Centonze

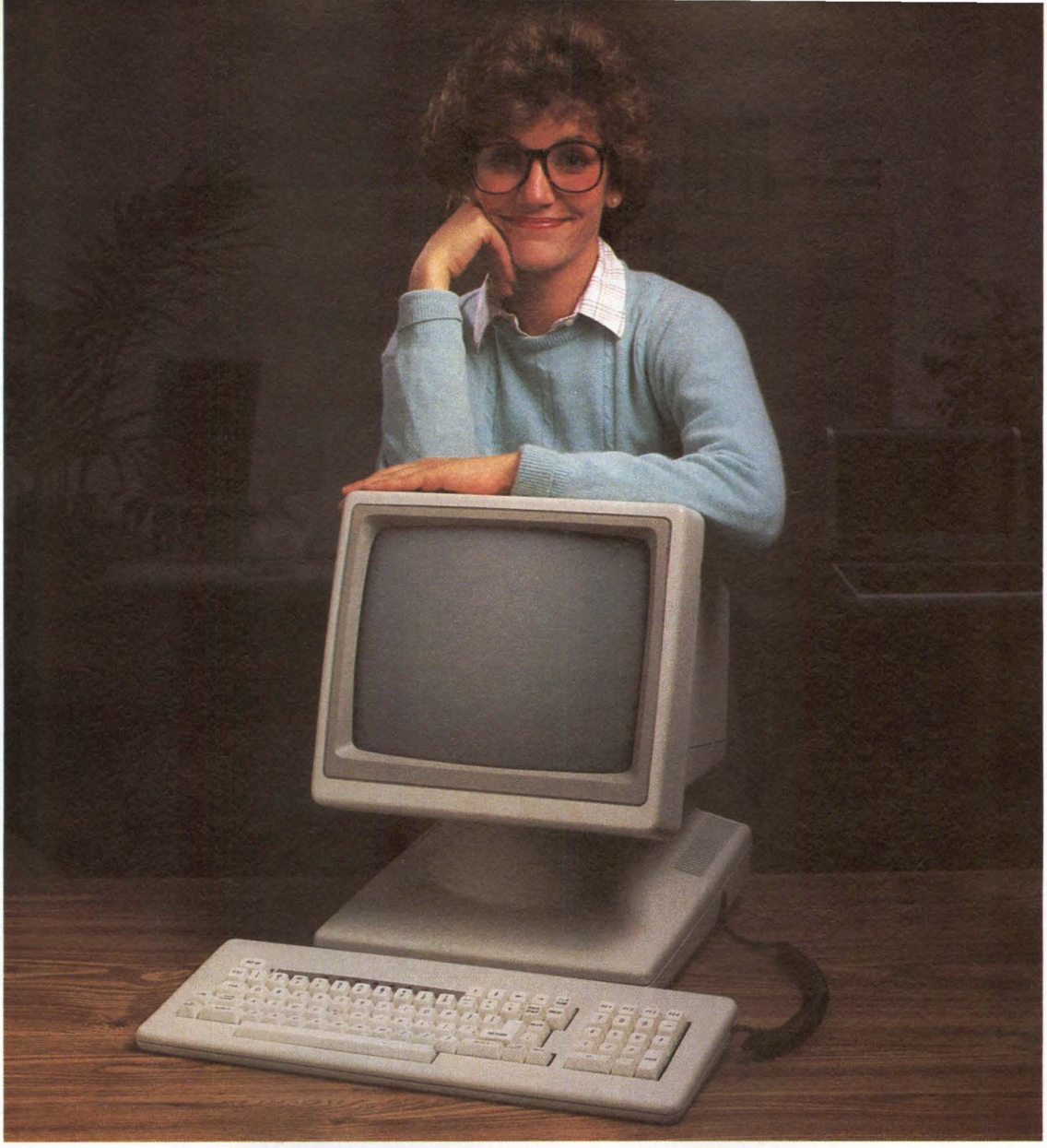
Gavilan Computer Corp., Campbell, Calif., **has licensed Miltope Corp. to develop a militarized version and the TEMPEST-certified version of Gavilan's portable computer. The TEMPEST version would suppress RFI emissions.** Miltope has exclusive rights to sell the militarized Gavilan to the Department of Defense and security agencies. Gavilan retains the right to purchase militarized units from Miltope and sell them to other federal agencies and into the commercial market. Gavilan will manufacture and sell the TEMPEST units. Shipments of both units are expected to begin in the fourth quarter. — D. Bright

RANDOM DISK FILES: A 5¼-inch floppy diskette with dual data-protection notches and dual index holes represents Capitol Records Inc.'s Data Systems division's entry into the data-storage market. The Los Angeles division's Platinum series is said to run on single-sided/single-density, single-sided/double-density, double-sided/double-density and quad-density floppy disk drives. Both sides of the diskette can be used, essentially doubling the amount of storage available to users of single-sided drives. The suggested retail price for a box of 10 diskettes is $55. — L. Valigra

Origin Inc., Los Angeles, **has created the QR-86RLQ 600K-byte disk cache for Digital Equipment Corp. RL01 and RL02 drives.** The intelligent board works with an RLV11/RLV1 controller and doubles the speed of disk transfers. The board keeps only the most readily accessed data available. Single-unit price is $3,300. Origin plans to make volume shipments in the second quarter. — C. Warren

Interdyne Corp.'s family of backup tape systems fit the same form factor as 3½-inch Winchester disk drives. Interdyne, Milpitas, Calif., plans to sell the backup system for $255 in OEM quantities of 2,500. SA-450, SA-300 or SA-850 interfaces are available. The drive uses a single self-threading reel and a fixed-head system with varying channels to increase storage capacity. The 5M-byte model 1005 uses a one-channel head, the 20M-byte model 1020 has eight heads, and the model 1040 ½-inch tape version uses a 16-channel head. — C. Warren

SOFTWARE FILES: Mosaic Software Inc., Cambridge, Mass., **which began developing its Integrated-6 integrated software package more than a year ago, says it will ship its first product on June 1.** The package has relational-database, spreadsheet, graphics, word-processing, communications and terminal-emulation functions. A $495 IBM PC version includes a transfer utility to interchange files from other spreadsheets, as well as Integrated-6 DOS, which enables users to execute



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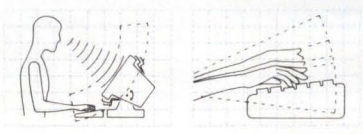

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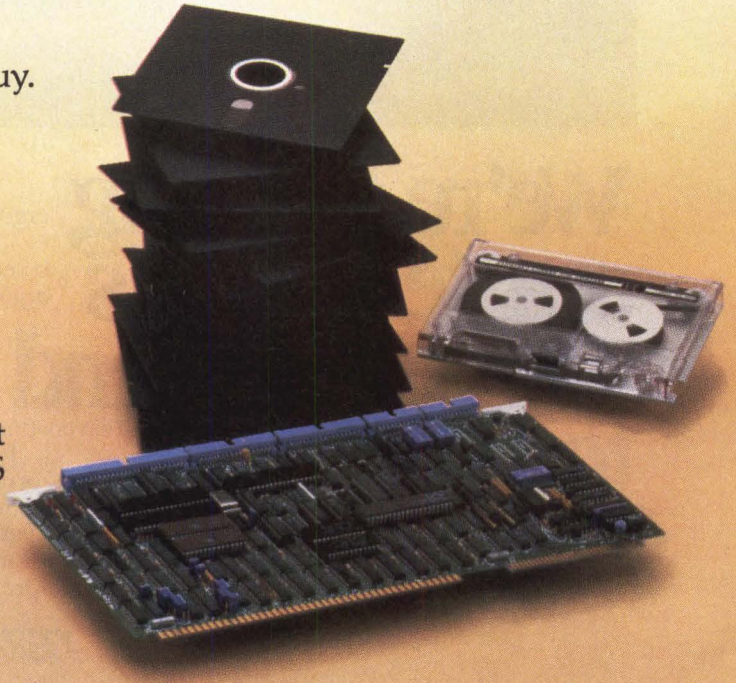

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CIRCLE NO. 17 ON INQUIRY CARD

DOS-level commands without first saving data on disk. — M. Stenzler-Centonze

Lotus Development Corp., Cambridge, Mass., **now offers a version of its 1-2-3 integrated program for Tandy Corp.'s Radio Shack TRS-80 model 2000 desktop microcomputer.** Radio Shack should offer the program by mid-year through its more than 1,000 Computer Centers. — M. Stenzler-Centonze

Start-up Uniform Software Systems Inc., New York, **is developing a program for the IBM PC that will allow PC-DOS programs to run under UNIX.** The product may be ready by mid-year. Peter Wiener, the company's founder, also founded Interactive Systems Corp., which developed the PC-IX operating system on IBM's PC. Uniform's chairman is William Agee, formerly chairman of Bendix Corp. and president of Allied Corp. — D. Bright

GRAPHICS FILES: Spectragraphics Corp., San Diego, **will add three enhancements to its System 1500 multistation graphics workstations.** The first, "Perspective," is an algorithm said to improve the perception of line drawings by converging the more distant parts of drawings. The second, Z-axis clipping, displays continuous slices through a moving geometric model. The third, depth cueing, changes the intensity or color of an element in proportion to the Z-axis. The 1500 is priced at $30,000 to $35,000, depending on the configuration. The programs will come on one 5¼-inch diskette free to owners of 1500 systems. The Perspective and Z-axis clipping, however, require a $4,000 transformation processor board. Spectragraphics should show the enhancements at the National Computer Graphics Association show in May after their release this month. — T. Moran

NOTES FROM OVERSEAS: Third-party sources are whispering that IBM Europe is ready to commit to a European-style value-added remarketer (VAR) program. In mid-April, IBM U.K. should kick off an alternative distribution scheme including a dedicated internal IBM management structure and covering IBM's 43XX series; Series/1; Systems 34, 36 and 38; System 23; and the Displaywriter. IBM might offer a maximum 30 percent discount to third parties selling 100 units over 36 months. IBM is expected to cap its proposals by offering substantial support, such as accompanying third-party distributors on customer presentations and helping with hefty advertising campaigns. — M. O'Gara

The West German government will contribute about $1 billion over the next four years to computer-related R&D. Recipient companies are expected to match the amount and collaborate among themselves and with academic institutions. About 20 percent of the funds will go to fundamental research of innovative computer architectures, 20 percent to industrial control technologies and 25 percent to developing sub-micrometer integrated-circuit manufacturing. The German government's handouts are about five times those it contributes to the European Strategic Program of R&D in Information Technology (ESPRIT), the Pan-European research program. — K. Jones

Breakpoints

While the U.K.'s ACT/Sirius Plc. was busily stirring up the major European press with reports that it has worldwide manufacturing and marketing rights to the Victor 9000 in its pocket, financially troubled Victor Technologies Inc. was secretly looking for a different buyer. In an apparent effort to stall while starting other negotiations, Victor's board voted to send lawyers to England to study the ACT proposal, say Victor insiders. — M. O'Gara

ACT recently introduced a hard disk version of its 8086-based Apricot microcomputer. Called the Apricot xi, the new machine includes either 5M- or 10M-byte, 3½-inch Winchester drives from Rodime Plc., Glenrothes, Scotland. The U.K. prices for the Apricot versions are $3,775 for the 5M-byte version and $4,195 for the 10M-byte version. This casts the products as strong competitors to IBM's PC, the price of which was pared last month. Apricot is estimated to be 35 percent less pricey than the equivalent PC XT, despite IBM cuts of 7 percent to 10 percent on the XT. IBM decreased the price of the PC an average of 20 percent, depending on the local European market. — M. O'Gara

Fledgling U.K. software house Sphinx Ltd., chartered to become a worldwide clearinghouse for UNIX application packages, is preparing to move into Silicon Valley and should have an operation up and running in two months. Sphinx also is waiting to begin its latest project, a catalog of software that should run on American Telephone & Telegraph Co.'s 3B computer series. One holdup is getting the hardware from Olivetti SpA, in which AT&T recently invested. — M. O'Gara

It didn't take the board of directors of British semiconductor maker Inmos Ltd. long to reject AT&T's second takeover bid. Two weeks after AT&T offered about $63 million for 75 percent of Inmos, the offer was declined. The decision is hardly a surprise: the British government valued Inmos at $140 million. **In the wake of the rejection, AT&T turned to other negotiations, this time with the socialist government of Spain.** AT&T is talking with the government's Ministry of Industry and with the semiprivate Spanish telecommunications authority Compañia Telefónia Nacional de España. The goal of the negotiations is to set up a semiconductor joint venture in Spain that would produce items mainly for export. It would involve a $200 million investment by AT&T. Spain reportedly has had similar talks with Motorola Inc. and National Semiconductor Corp. — M. O'Gara

Two-year-old **Hafenlog Corp.,** Iowa City, Iowa, **is said to be scouting for European distributors and private-label OEMs for its forthcoming MC68000-based UNIX Iodat single-user and multiuser computers.** The company should announce the products at the Federal DP Expo in Washington this month. Company officials estimate single-user price of a basic cluster unit would be $21,000, including the MC68000, the UNIX System V operating system, 256K bytes of on-board memory, a 1M-byte, half-height floppy drive and controller, a 33M- or 72M-byte, 5¼-inch Winchester drive and controller, a 20M-byte cartridge-tape drive for backup, a terminal and a printer. — M. O'Gara

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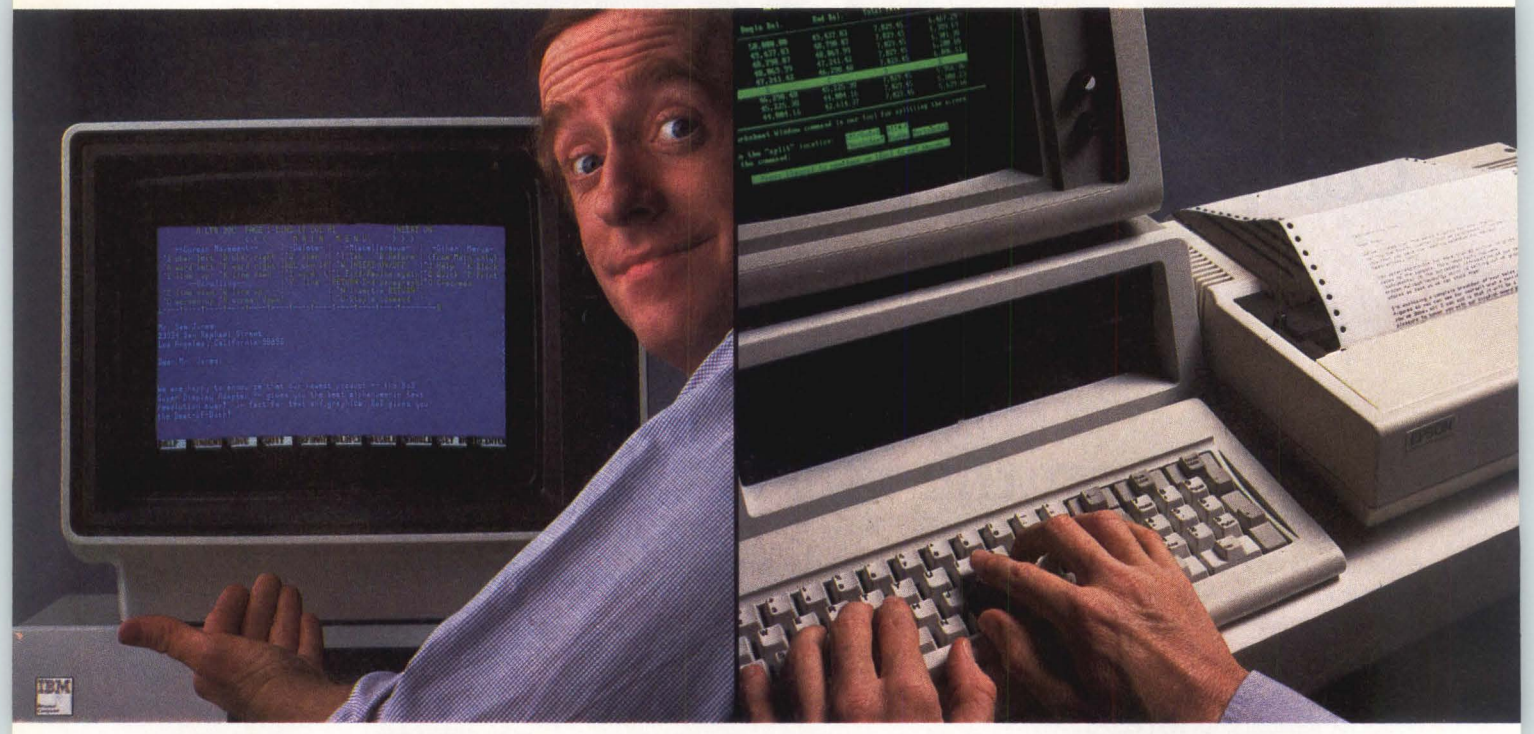

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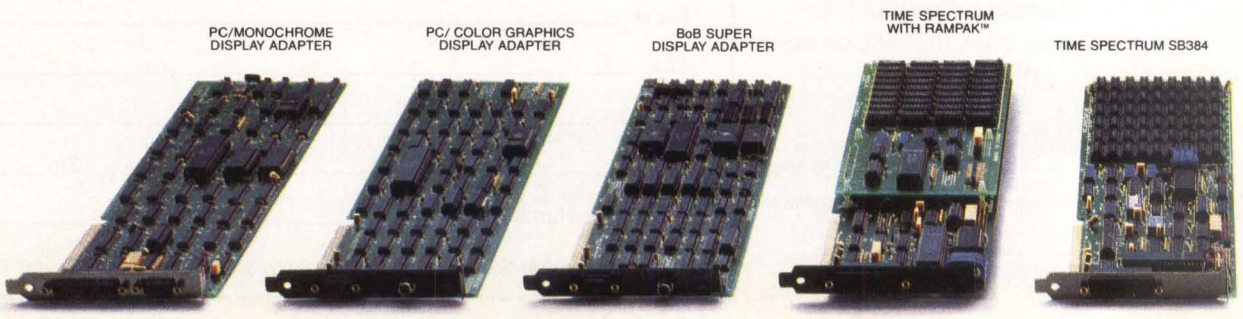
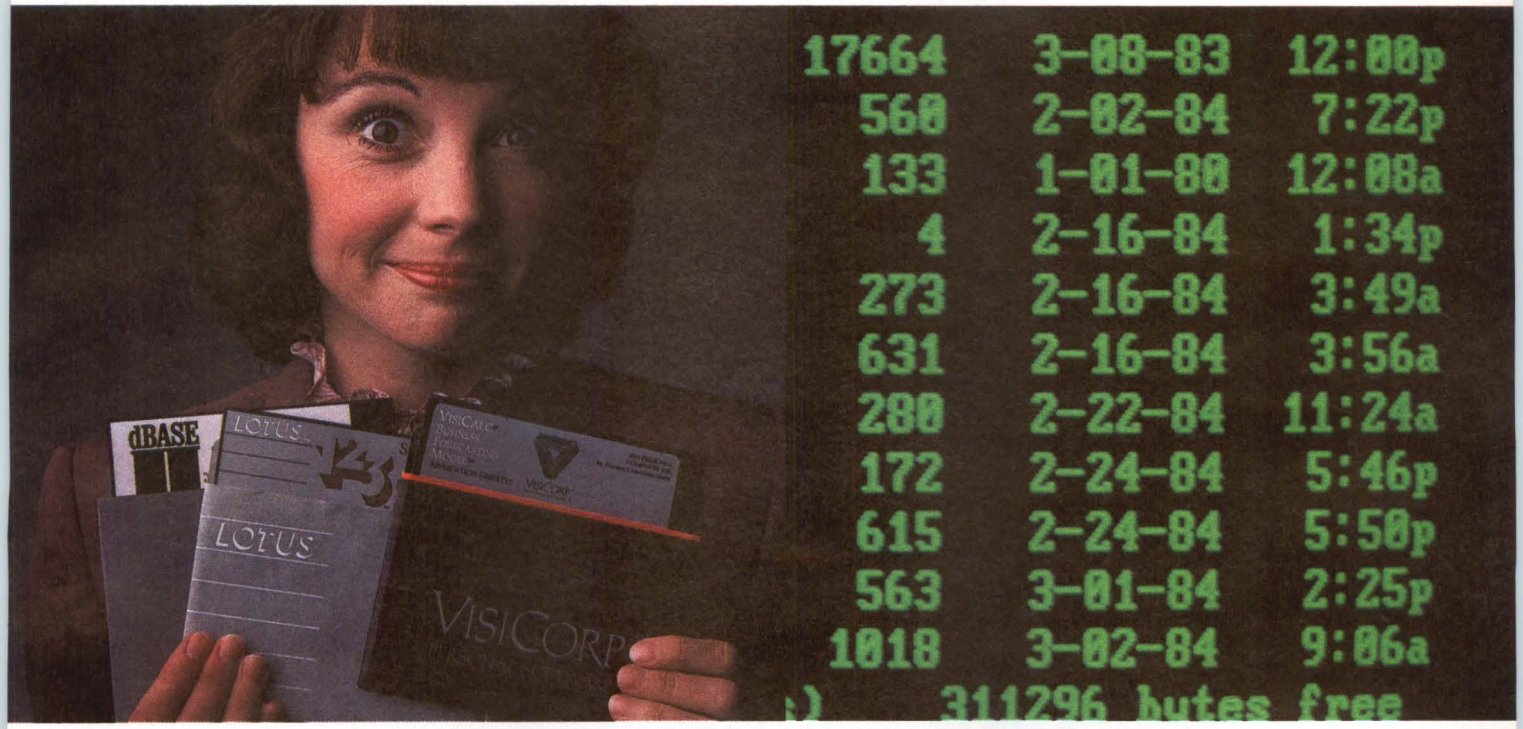


ways to expand the power of your IBM PC.



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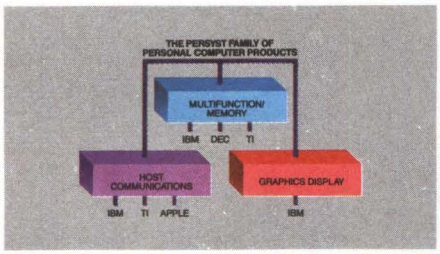

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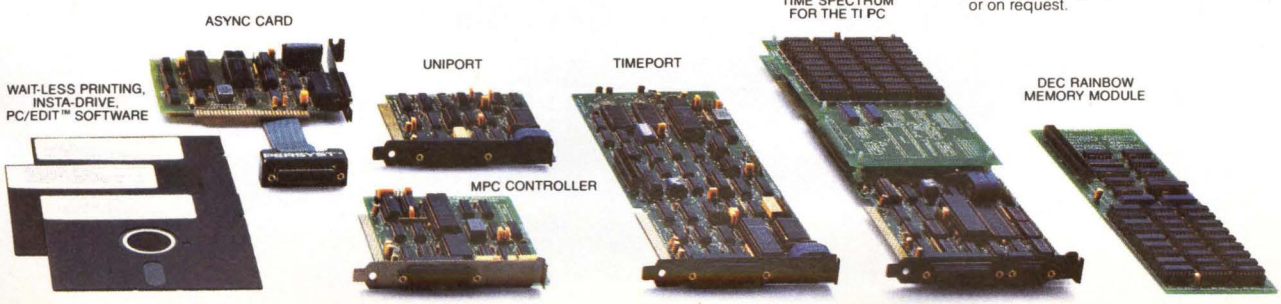

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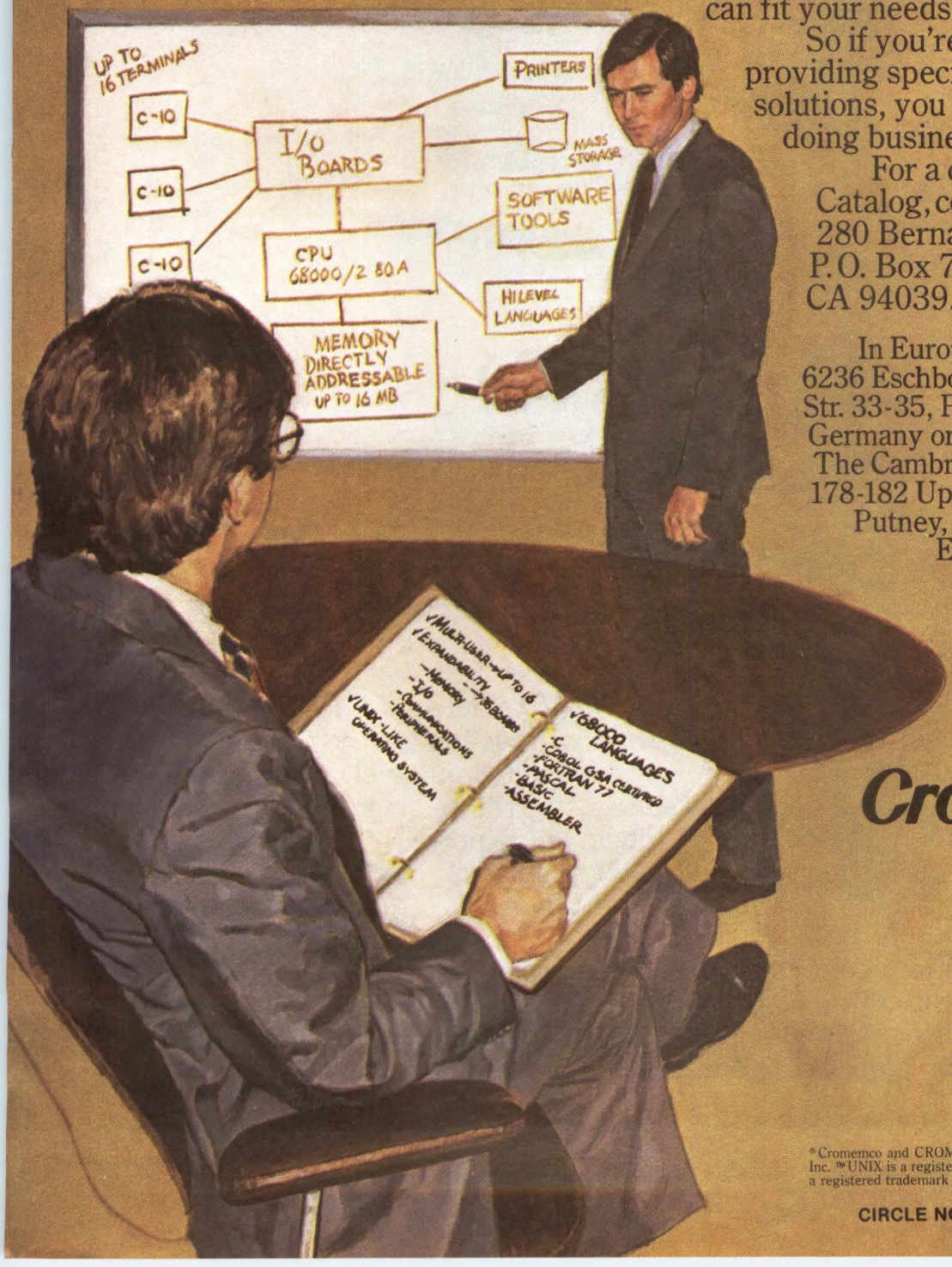

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CIRCLE NO. 21 ON INQUIRY CARD

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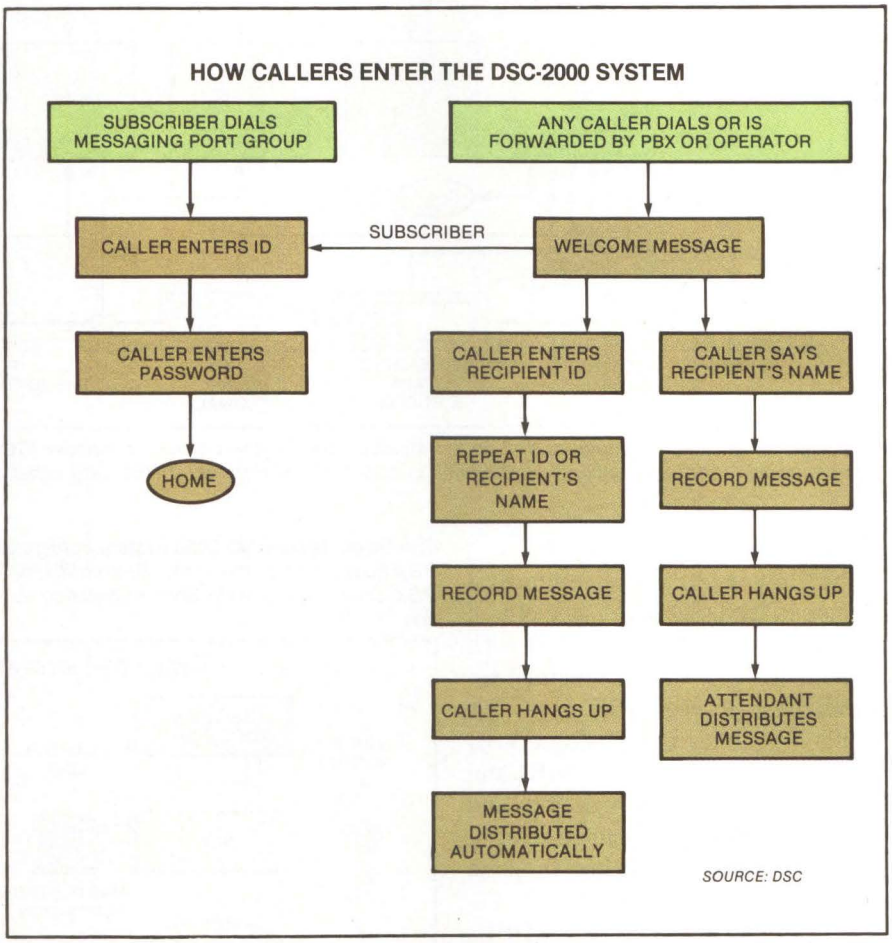
OEM digital voice-processing system sets new mark for low price and bit rate

Ron Shinn, Senior Editor

A new digital voice-processing system for voice-mail and -file applications establishes new industry lows in both price and bit rates and is available to OEMs either as Multibus-compatible, off-the-shelf boards or as a complete voice store-and-forward system. It's the DSC-2000 VoiceServer from Digital Sound Corp. (DSC), Santa Barbara, Calif.

The DSC-2000 VoiceServer features an open-ended Multibus architecture, Motorola Inc. MC-68000 CPUs, Texas Instruments Inc. TM5320 digital signal-processing components, a real-time UNIX-like operating system, 5¼-inch Winchester disk storage and DSC's proprietary voice-processing algorithms.

The DSC technology achieves digitized voice at 9.2K bits per second (bps) that is of the quality normally associated with bit rates between 24K and 32K bps. The higher bit rates are derived from waveform-encoding techniques such as continuously variable slope delta (CVSD) modulation. Highly proprietary, the algorithms used in the DSC system are described by company scientists as "a hybrid between waveform encoding and vocoding that takes the best of both to get the low bit rate and high-quality voice."

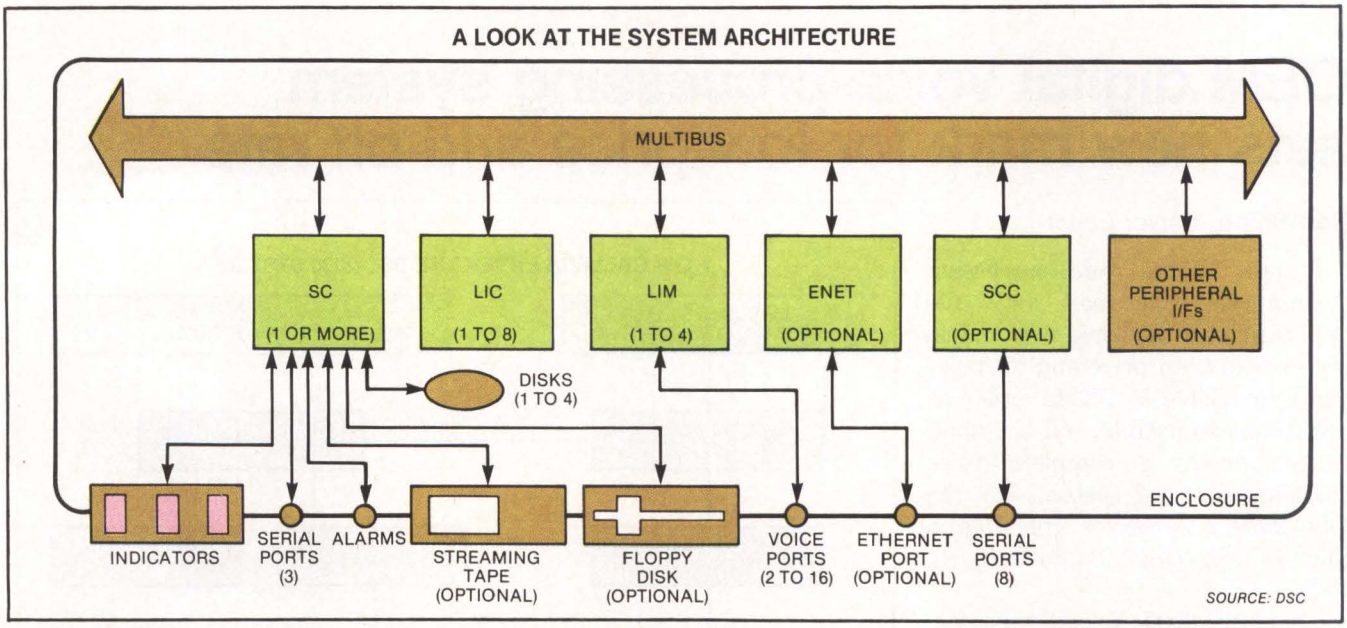


Entry into the DSC-2000 *VoiceServer operating as a voice-mail system is done by either subscribers or outside callers. They access a variety of voice-messaging functions following voice and tone prompts from the system. The callers respond with Touch-Tone telephone-keypad commands.*

OEM prices reach new lows

The cost savings realized in the implementation of the VoiceServer design reduce OEM prices for digital voice messaging (DVM) to new industry lows. For example, a two-port system with two hours of storage supporting 30 subscribers has an OEM price tag of about $13,000, while a 16-port, 32-hours-of-storage, 1,000-subscriber system built from the same basic board elements and added to the initial VoiceServer enclosure in two-port increments is priced at approximately $45,000.

A summary of DVM equipment from other manufacturers included in a 1983 Quantum Science Corp. market study lists these prices for complete eight- to 10-port systems with 35 hours of storage: Wang Laboratories Inc. (DVX on OIS 145 computer), $97,300; ROLM Corp., $138,650; Commterm Inc., $145,000; Wang (standalone DVX), $160,300; Sperry Univac, $182,000; IBM Corp., $237,000. The smallest system, from industry leader VMX (formerly ECS Telecommunications Inc.), has 16 ports, 42 hours of



The system architecture *is open-ended on the Multibus and contains system controller (SC) cards, a line interface controller (LIC), a line interface module (LIM) and optional off-the-shelf boards such as Ethernet (ENET) and serial communication cards (SCC).*

storage and sells for $195,000.

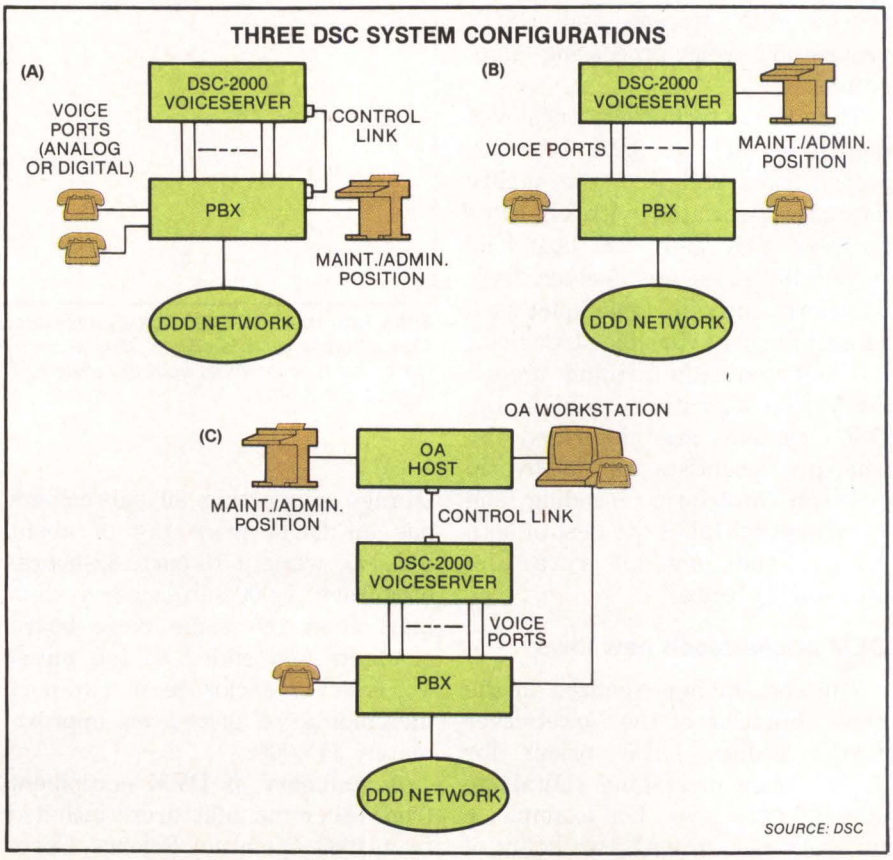
The lower bit-rate encoding developed by DSC addresses one of the major problems associated with cost-effective DVM: reducing required disk storage. Bit rates for telephone-quality voice using CVSD typically run between 24K and 32K bps. Pause compression and other algorithmic treatments bring that rate down to 16K bps in some instances.

The encoding used at DSC, however, at most requires only half the storage compared to that normally associated with CVSD. DSC spokesmen claim "excellent, robust" speech at 16K bps and "robust" speech at the 9.2K-bps rate targeted for standard use in the system. The bit rate is selectable by varying the sampling time under software control to achieve a voice quality acceptable to the user.

Lower bit rates have benefits

Another beneficial result of lower bit rates is compatibility with peripherals operating on local-area networks (LANs) at 9.6K bps.

The three basic DSC-2000 *system configurations for voice-file and -mail operation are (A) a PBX host with a control link, (B) an office-automation CPU host with a control link and (C) a PBX connected to VoiceServer operating as a standalone voice peripheral without a control link.*



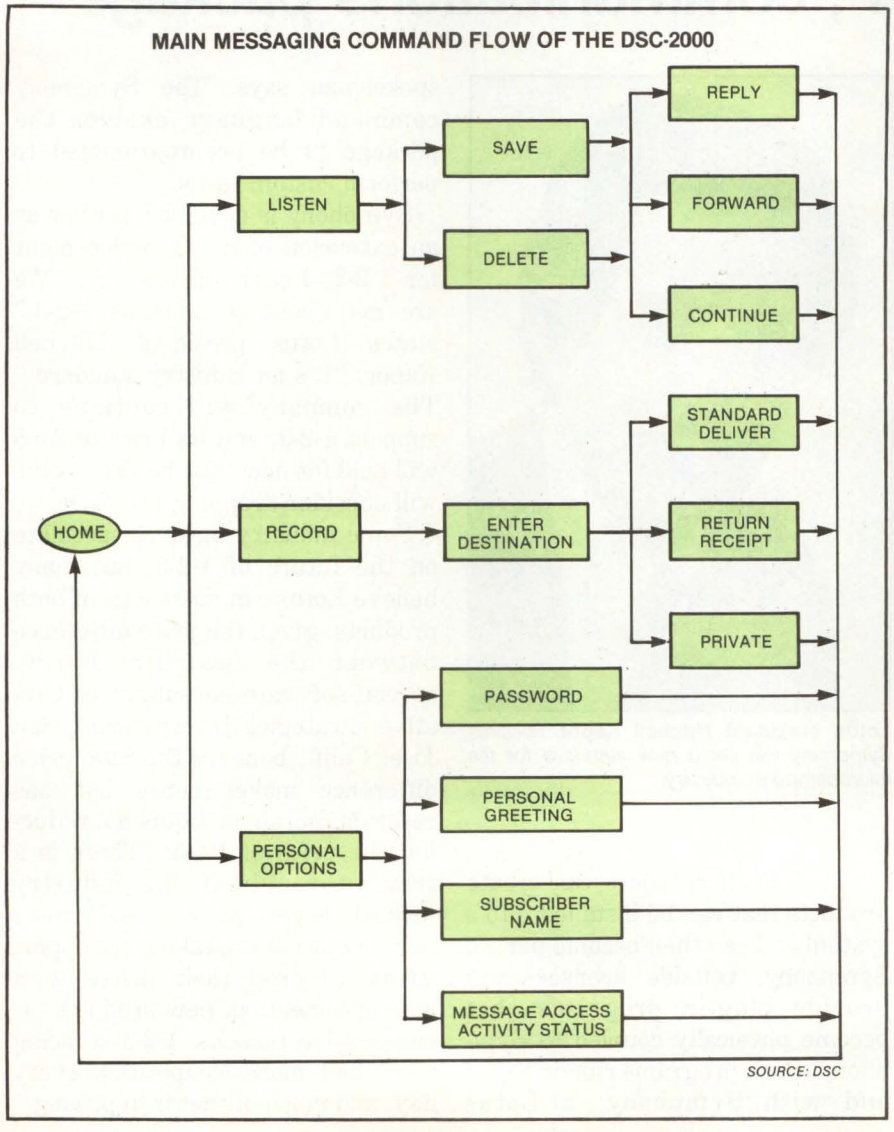
Compatibility with these peripherals puts the DSC-2000 to work in office-automation environments. Subscribers can access the VoiceServer from workstations and terminals as well as from telephones. The terminal display and keyboard can be used to control mailboxes, message attributes and messaging functions.

Multiple DSC-2000s can be clustered on the LAN so that it appears to be one larger system. The maximum size suggested by DSC is a 6,000-subscriber, 24-port system that can be assembled two ports at a time for a total of four fully loaded DSC-2000 cabinets.

VoiceServer is available either as board sets for integration into OEM equipment or in its own floor cabinet (29 inches high by 29 inches wide by 22 inches deep) with power supply, coding, optional brownout protection and compliance with U.S., Canadian, European and Underwriters Laboratories standards.

Board-level system elements for the DSC-2000 enclosure include the system controller (one or more) with a 68000 CPU, 512K bytes to 1M byte of RAM, a memory-management unit, serial ports and peripheral interfaces, a line interface controller (one to four) that performs all signal processing, voice-data buffering and voice-port management. The system also includes a line interface module (one to four) that interfaces external voice ports such as telephone lines and trunks to VoiceServer and a variety of widely available optional Multibus boards including Ethernet, X.25, RB-2320 and a storage-module drive controller. A 5¼-inch floppy disk drive can be added to enter third-party software and to update DSC software. Each VoiceSaver can hold one to four 5¼-inch, 50M-byte Winchester drives with each drive providing approximately eight hours of storage.

A subscriber to the DSC-2000-based *system can select three messaging functions to perform a variety of voice store-and-forward operations. He uses a Touch-Tone telephone keypad as control or he can use a terminal connected to the DSC-2000.*



At the heart: laboratory science

Laboratory science is at the heart of the DSC-2000, says Jim McGill, DSC president. "The algorithms we're using are coming out of the minds of our designers, not out of journals and textbooks. The algorithms are advanced, state-of-the-art R&D efforts."

McGill explains that DSC has done all of its speech processing in software running on general-purpose components rather than on custom silicon. That means it's easy to add technology refinements. "Our signal-processing algorithms run out of RAM, and they're loaded off the disk at boot time. We don't use ROMs, which can be quickly outdated. This means that entirely new algorithms and system functions can be loaded from cartridge tape or floppy disk to completely change the operation and signal-processing level of the DSC-2000 at any time."

The DSC-2000 represents third-

generation DVM, says McGill. "The first-generation machines came out in the late 1970s from VMX, Wang and IBM. They were built around speech-coding technology that was not as efficient as more modern techniques in terms of bit-rate reduction. That meant use of large, high-performance disks and architectures that were not compact. IBM invested a lot of engineering in their first machine, which was mated to the Series/1 minicomputer. If you were really optimizing for the application, you wouldn't start that way.

"The second generation, represented by Octel Inc. or Centigram Corp., optimizes the architecture but continues to rely on off-the-shelf speech-compression technology such as CVSD that codes down to as low as 16K bps but is typically 24K bps. With the addition of open-ended Multibus architecture and our proprietary algorithms, we really have a third-generation machine."

The R&D effort at DSC will continue for at least two years, McGill says. The next processing goal is to reduce bit rates to around 4K bps. "Putting a group like this together at a large company is difficult," he says. "We're trying to get this technology out as quickly as possible and offer it to companies

Lotus makes second pitch in integrated software with WP, communications package

Marjorie Stenzler-Centonze
Associate Editor

Lotus Development Corp., Cambridge, Mass., which pioneered in the integrated software market with its successful 1-2-3 program, has unveiled the Symphony integrated program. Lotus officials believe Symphony will cause quite a stir among its competitors.

The menu-driven program combines word-processing, communications, database-management, spreadsheet and graphics functions with a window-management system. Symphony will be available by midyear at a price of $695. According to Lotus, Symphony will be attractive to end users and system integrators who want to customize the program for vertical market customers.

The program's communications module enables users to read files from any product and transfer them directly into Symphony. The forms-oriented database offers users mail/merge. The windows-management system simplifies use because its word-processing document windows look like word processors, its communications windows look like computer terminals, and so forth.

Lotus president Mitchell Kapor *believes Symphony will set a new standard for the microcomputer industry.*

Value-added resellers can create products that can be installed into a system and can then become part of Symphony. Outside licensees can provide plug-in programs that become physically coupled to Symphony. Such programs run on top of and with Symphony, a Lotus spokesman says. The Symphony command language enables the package to be preprogrammed to perform custom tasks.

Symphony is designed neither as an extension of nor a replacement for 1-2-3, Lotus officials say. "We are not about to abandon 1-2-3," states Lotus president Mitchell Kapor. "It's an industry standard." The company will continue to support 1-2-3, and its price of $495 will hold for now. But he says Lotus will consider dropping the price.

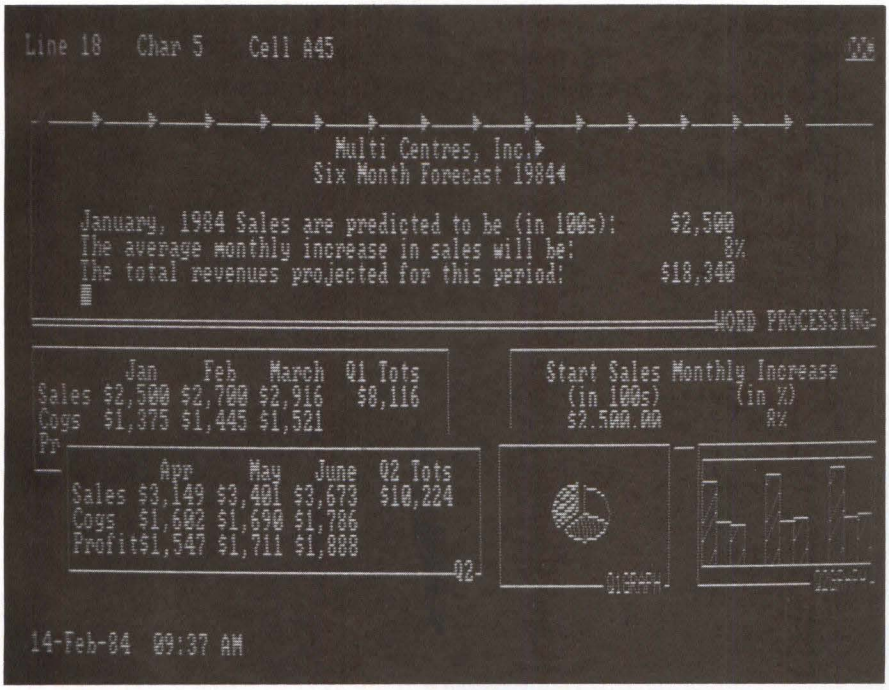
Some industry insiders speculate on the future of 1-2-3, but many believe Lotus can make a go of both products, given the price difference between the two. Tim Berry, special software consultant to Creative Strategies International, San Jose, Calif., believes the $200 price difference makes sense but has reservations about Lotus not reducing the price of 1-2-3: "There is a trend throughout the industry toward lower prices, and many manufacturers are taking the opportunity to drop their prices with announcements of new products for competitive reasons. 1-2-3 is facing more and more competition every day, and much of that is in pricing."

that could clearly buy what they need in a development group but might miss their market window because of the time impediments found at large companies. So, we're trying to run ahead of the big guys and sell them something."

The DSC-2000 VoiceServer can be connected as either a standalone peripheral operating downstream but transparent to a private-branch exchange (PBX) system or as an integrated control link into a PBX or office-automation system. VoiceServer can be connected directly to a public or private telecommunications network operating in response to standard telephone features.

The DSC-2000 is compatible with full voice-messaging functions tailored to the modern telephone environment. Using the dual-tone, multifrequency Touch-Tone telephone as a control keypad, callers can access a wide variety of DSC-2000 functions.

Operating as a voice-mail system, the VoiceServer is accessed through ordinary telephone lines via the PBX. The caller controls the VoiceServer using Touch-Tone commands with the responses played back as a combination of prerecorded speech and tones. The caller can be either a subscriber familiar with the system or an outside caller. □



Lotus' Symphony integrated software package *combines spreadsheet, word processing, communications, database management and graphics with a window-management system.*

Berry believes Lotus will now have to reduce the prices of both packages at once.

Users of 1-2-3 who want to trade in the software for Symphony may send the 1-2-3 program plus $200 to Lotus.

Symphony will be available initially for the IBM PC and PC XT. It requires a minimum hardware configuration of one disk drive and 320K bytes of memory. A hard disk is not essential, but it is a plus, a Lotus spokesman says.

The company is working on a custom program for Apple Computer Inc.'s Macintosh microcomputer. Lotus wants to combine features of 1-2-3 and Symphony to take advantage of the Macintosh's special features.

Lotus officials believe Symphony's word-processing program will give dedicated word-processing programs a run for their money. Some 1-2-3 users have complained about the program's minimal word-processing capability and have purchased separate word-processing packages.

The price/performance ratio of Symphony will enable it to compete with both integrated and dedicated software packages, Lotus officials believe. Kapor says Symphony will have such an impact on the integrated software market that it will set a new standard for the microcomputer industry. "Anyone trying to knock off 1-2-3 is looking at a trail of dust." Kapor says, "We're way beyond it now."

Strong marketing effort required

Even with its capabilities and price, Symphony's success will be closely tied to its ability to pull off another spectacular marketing effort, observers say. The company claims to have spent an unprecedented amount advertising and promoting 1-2-3. "Right now, the market has a lot of noise in it, and it will take a good deal more money to rise above the noise now than it did a year ago," the Lotus spokesman points out.

But Creative Strategies' Berry contends that marketing is Lotus' greatest strength: "There are dozens of good software products out there that don't make one-tenth the impact of 1-2-3. Lotus really knows how to market and is prepared to spend the money to do it." □

TI offers natural-language tool for TI, IBM PC software developers

Lori Valigra, Senior Editor

Texas Instruments Inc.'s natural language, at first available only for access and retrieval of information from the Dow Jones financial service, now will be available by license to qualified application software developers. The TI Professional microcomputer is the current target host, while IBM PC support is forthcoming in three to six months.

TI is offering the natural language and a set of interactive utilities for software development in a package called NaturalLink. With the package, TI hopes to enlarge the number of easy-to-use applications available to users of the Professional.

The grammar-driven, knowledge-based NaturalLink package was scheduled for introduction and availability in late March on the TI Professional. It allows easy and flexible changes by housing grammar rules, a lexicon dictionary and CRT screen descriptions in one file rather than in program code. The lexicon maps a user's input language, English, to the computer's target language.

TI offers utilities for NaturalLink

Three interactive utilities come with the package: the NaturalLink screen builder, which aids software developers in specifying the appearance of a screen in an application, the NaturalLink message builder, which lets developers write help and error messages, and the NaturalLink interface builder, which helps developers debug grammar, specify lexicons and build and test the interface file that drives the NaturalLink software.

Additionally, the package includes linkable object code high-level language-interface routines that allow users to call the NaturalLink software from Microsoft Corp.'s MS-FORTRAN or Lattice Inc.'s Lattice-C, a window manager's users guide, a NaturalLink Toolkit users guide and a tutorial on writing grammar.

A developer using NaturalLink on the TI Professional requires a minimum of 256K bytes of RAM. TI recommends using a Winchester disk drive with the package, but dual floppy disk drives are sufficient. Price of the TI Professional version of NaturalLink is $8,000 with royalty payments. The IBM version, which uses a different module from the TI version to "talk" to the keyboard, is not yet priced. TI has yet to determine royalty fees for developed software incorporating NaturalLink.

Applications developed with the NaturalLink package use advanced screen-management techniques to present the command choices in an application in English. Users can select only from the items in screen windows, thus minimizing typing errors and guaranteeing that a user constructs valid commands. If a user chooses an inactive window, a bell rings to indicate the mistake. To make sure a user makes valid

The TI natural-language database query system, *a software program designed for use on the TI Professional computer, provides a simple menu series that enables non-technical users to obtain stored information by constructing questions with natural word order.*

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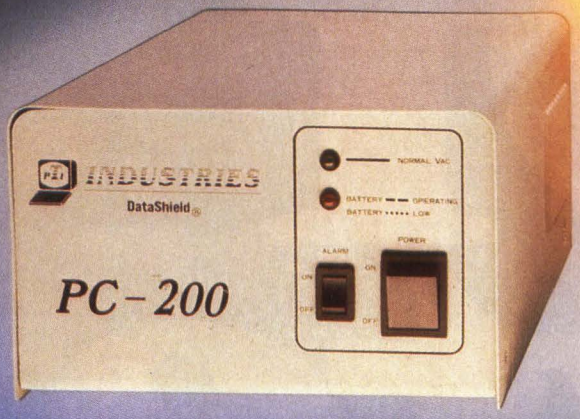

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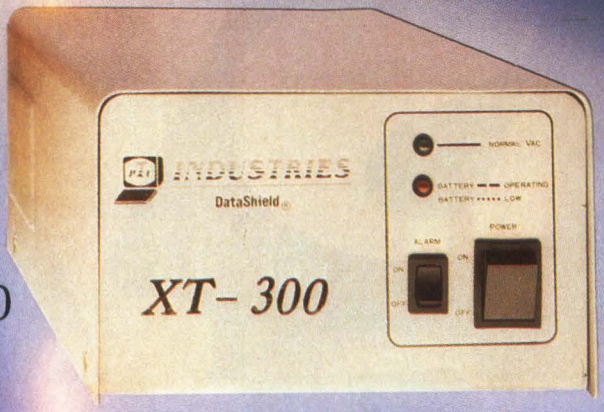

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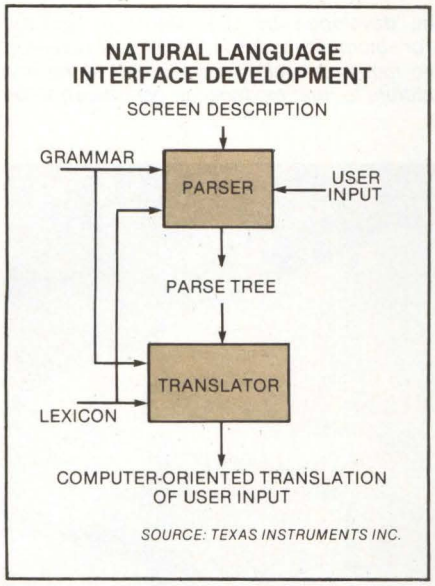


With TI's NaturalLink, *the appearance of a CRT screen is controlled by the contents of the grammar and lexicon and the progression of user phrases in developing an application. The process begins when a user selects an English word or phrase from an active window. The parser determines grammatical components of the selections. As the user builds an application, the parser passes a tree structure describing syntactical relationships to the translator. The translator maps the grammatical components into the computer's language by "looking" in the lexicon dictionary.*

selections, the natural-language system must determine when each window is active and what data are displayed in each window. To accomplish this task, the natural language uses three types of input: grammar, a lexicon and a screen description. The grammar defines how the words and phrases of the natural language can be combined and mapped into the computer's target language. The lexicon defines the text of the target language and the text to be displayed in the window. The screen description specifies placement and content of windows.

NaturalLink simplifies development of interactive software by giving developers powerful routines to handle screen I/O. It does this through direct calls to the window manager or to the grammar-driven software. NaturalLink also controls user input to reduce the amount of code necessary for error checking and data validation, thus speeding application development, TI claims.

Screen builder cuts time

Accelerated application development is important to Intelligent Information Systems Inc., Dallas, a start-up that hopes to introduce its first product by year-end. The company is evaluating NaturalLink to develop an integrated, general-purpose business software package.

NaturalLink's screen-handling abilities considerably reduce the time to develop a user interface, says Mary Lynne Henry, systems engineer at Intelligent Information Systems. "Once the developer is proficient with using the screen builder, screens can be built in one-third the time it [would take] to write a Pascal program to handle I/O from the screen," she says. Without such development tools, Henry adds, the company couldn't introduce its first product as quickly.

A screen is made of a set of windows. The screen builder has screen- and window-level functions that allow developers to specify window descriptions for inclusion in the screen description. The window descriptions can be filed and easily modified. TI offers a training program to aid users in learning the screen and natural-language procedures, such as setting up the grammar, which can be time-consuming, Henry says.

NaturalLink automatically writes programs and formats queries for a database, thus increasing time savings. "We can customize inquiries into the database in an easy-to-use English procedure and have the flexibility to alter queries," Henry explains.

NaturalLink lends itself to applications requiring the use of a small database, says Bobby Watson, vice president of business applications for Intelligent Information Systems. One major drawback of NaturalLink, he says, is its lack of a Pascal interface. However, Watson expected TI to introduce such an interface in March. □

INTEL SEEKS SOFTWARE FOR iAPX 286 SYSTEMS

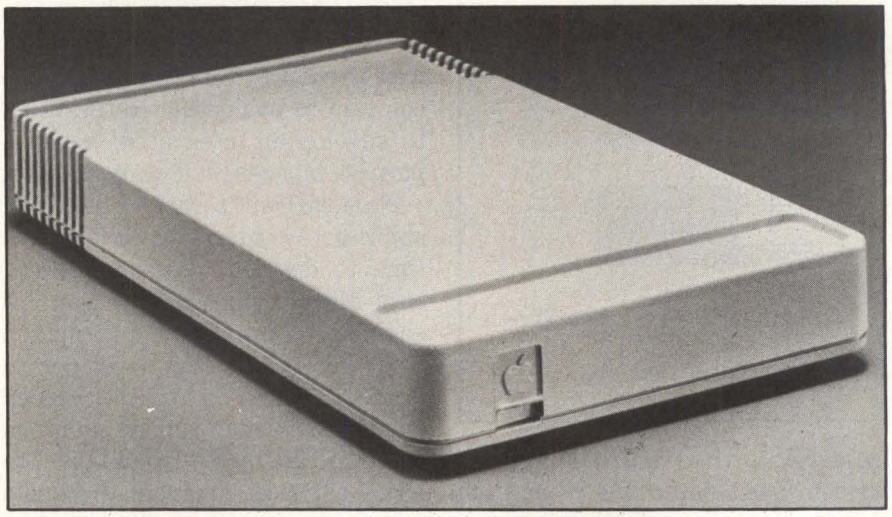
Intel Corp., Hillsboro, Ore., will provide 50 of its new iAPX 286-based, OEM multiuser 286/310 supermicrocomputer systems to third-party software vendors. In return, the vendors will write software for the systems that runs under the XENIX or iRMX operating system. The software vendors will market and support the software they produce. Vendors signed up so far include Science Management Corp. for SMC BASIC and Ryan-McFarland Corp. for RM COBOL.

GRAPHICS MARKET MAY HIT $23 BILLION IN 1992

A Frost & Sullivan Inc. market study predicts worldwide graphics hardware and software sales for manufacturing industries will grow at a compound rate of 30 percent per year through 1992. That market, which totaled $1.7 billion in 1982, will jump to $6 billion in 1987 and to $23.3 billion in 1992, according to the study. Computer-aided design will remain the largest application area, with 53 percent of the market in 1982 and 43 percent in 1992. The other major market segments, in order of size, are computer-aided manufacturing, business graphics and monitoring and control applications.

Apple to offer private-label modems

Apple's Apple Modem, *developed by U.S. Robotics, features user-selectable, manual or automatic modes for initiating or receiving telephone calls. With the modem, Apple becomes one of the first microcomputer manufacturers to treat modems as peripherals to be sold at the point of sale.*



Stephen J. Shaw
Washington Editor

In a testimony to the importance of communications capabilities for desktop and personal computers, Apple Computer Inc. will sell private-label modems and communications software alongside its computer systems. The company has signed an agreement with modem manufacturer U.S. Robotics Inc. (USR), Chicago, under which USR will supply modems that Apple will market under its own label. USR began shipments to Apple in February and was expected to begin shipments to OEM and retail outlets in March.

Apple will sell the modems with accessory kits containing AppleTerm communications software and cables with phone jacks and RS232 connectors. The communications software for Apple II, IIe and III computers will be available immediately, and communications software for Lisa and Macintosh will be introduced in late spring, according to an Apple spokesperson.

Two modems are available

Two models of the asynchronous, full-duplex modems are available. Apple Modem 300, which operates at transmission speeds of 300 bits per second (bps), and Apple Modem 1200, a 300- to 1,200-bps device. The 300-bps modem, including the accessory kit, sells for $225; the higher-speed unit, including the kit, sells for $495. For Apple IIs, accessories include a $75 serial interface card that provides database-access and electronic-mail applications.

The modems feature user-selectable, manual or automatic modes for initiating and receiving telephone calls and a diagnostics program that displays modem status characteristics on-screen. The units also incorporate tone- and pulse-dialing options and an internal speaker to monitor data transfer.

Although USR and Apple have not released financial details of their agreement or their expectations of sales volume for the new modems, a USR spokesman says the company can produce as many as 20,000 units per month of each model if required. The agreement guarantees Apple's modem supply for as long as three years, according to USR marketing director John Cleave.

AppleTerm software is new

The AppleTerm modems come with communications software, which can be modified for each Apple computer system. The menu-driven program allows the use of electronic subscription databases but does not provide sophisticated file-transfer and electronic-mail applications. For Apple II+ computers, the software requires a minimum of 64K bytes of memory. AppleTerm is compatible with the Hayes Microcomputer Products Inc. SmartModem, according to Apple.

The Apple/USR deal is one of the first whereby a computer system manufacturer will treat modems as another peripheral, point-of-sale system option. The modems will not initially be sold bundled, but Apple is considering that option. For modem manufacturers, the agreement may signal the opening of a market among personal computer vendors.

Apple leads in communications

"Computer manufacturers are driven by what their competition is doing," remarks USR's Cleave. "This deal will legitimize the data-communications market in the eyes of personal computer manufacturers and cause definite waves." Cleave predicts that, within two years, personal computer manufacturers will dominate half the market for low-speed, 300- to 1,200-bps modems. Only 20 percent of installed personal computers cur-

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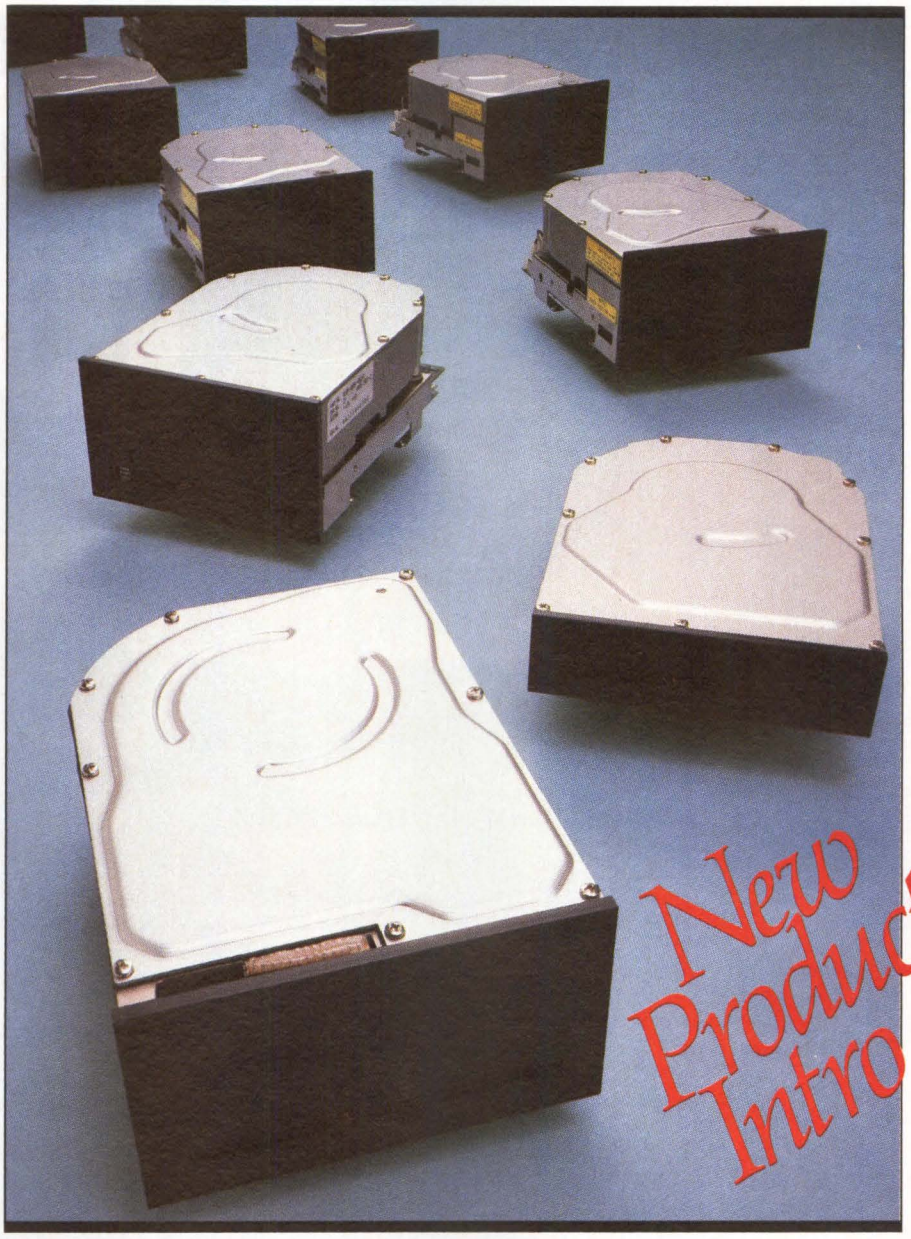

	HALF HIGH	STANDARD	HIGH PERFORMANCE
CAPACITY (MBytes)	7 / 13	7 / 13 / 20 / 27	31 / 55 / 86
AVERAGE POSITIONING TIME (ms)	95	83	35
DIMENSIONS (inch) (HxWxD)	1.6x5.7x8.0	3.3x5.7x8.0	3.3x5.7x8.0
INTERFACE	ST506 / SA4000	ST506 / SA4000	ST506 / SA4000
POSITIONING METHOD	Buffered Stepper	Buffered Stepper	Rotary Voice-Coil

New products are indicated in red.

STORAGE PRODUCTS DIVISION

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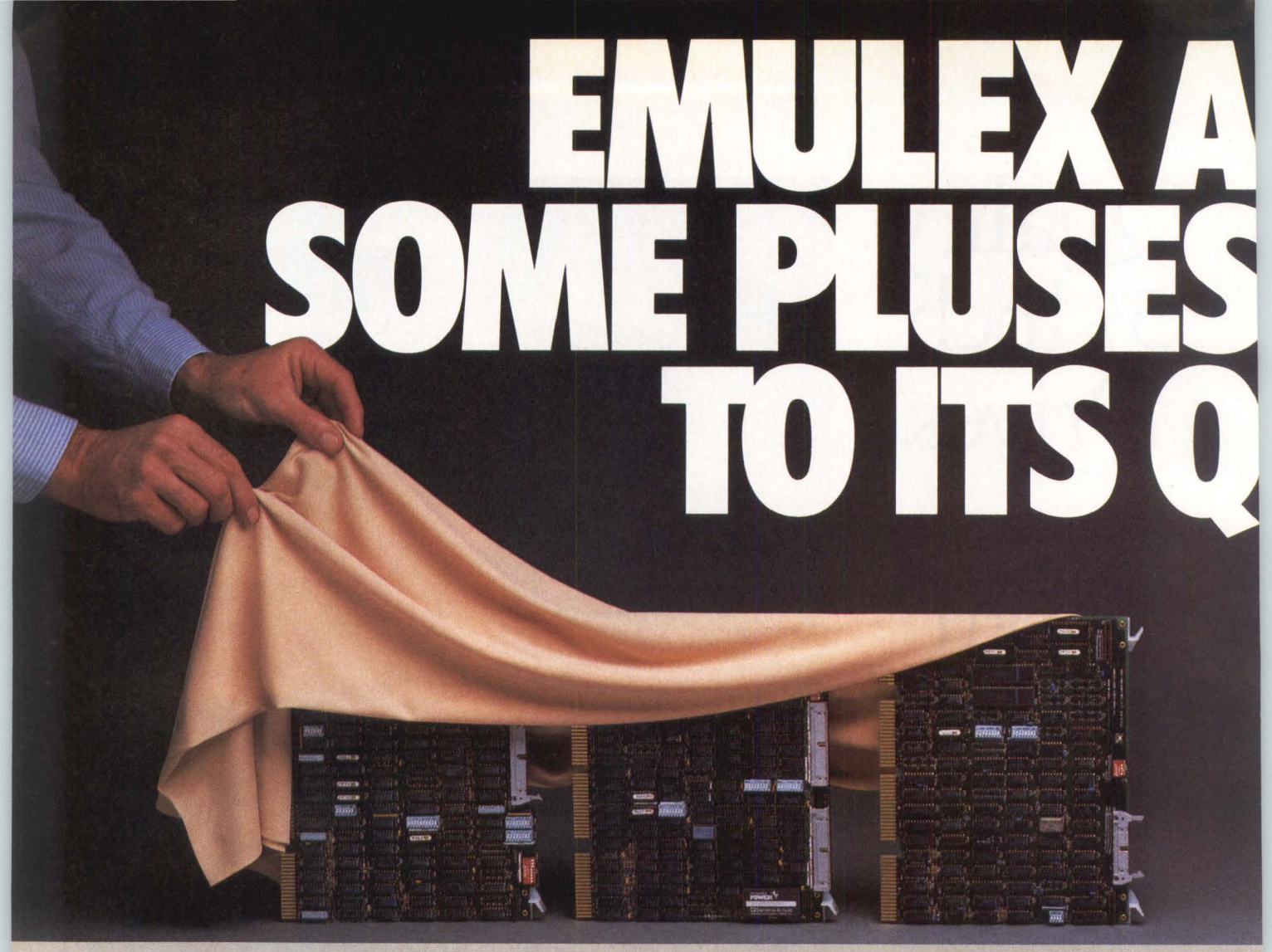
EMULEX A SOME PLUSES TO ITS Q



New UC02 emulating host adapter using Mass Storage Control Protocol (MSCP).

New CS02 multiplexer for LSI-11 through 11/23 PLUS and MICRO/PDP-11 computers.

New TC05 tape coupler for CDC Sentinel ¼" streaming tape drives emulates DEC TS11.

Once again, Emulex gives you more, while charging you less. We're introducing three new controllers for QBus users, and reducing prices on four of our most popular products.

FIRST, THE NEW INTRODUCTIONS.

Our CS02 is a high-performance asynchronous multiplexer for LSI-11 through 11/23 PLUS and MICRO/PDP-11 computers. Both versions can handle 16 lines—eight lines more than DEC's DHV11—yet they fit into existing space within the DEC system.

Also available is our TC05 tape coupler featuring DEC TS11 software transparency and standard operating system support on your QBus. It allows you to interface CDC Sentinel ¼" streaming tape drives without using special streaming software.

Last, but not least, is the UC02 emulating host adapter, with unique features like automatic drive sizing, command stacking, seek ordering and error control.

By using the Mass Storage Control Protocol (MSCP), the UC02 allows the operating system to utilize the precise characteristics of the Winchester disk drive without patches or modifications to the operating system. The UC02 plugs into any single quad width QBus slot and provides you the versatility of using the Small Computer System Interface (SCSI) bus.

NOW, THE PRICE REDUCTIONS.

First, we've slashed 33% off the price of our TC02 TS11-compatible tape coupler.

Likewise, we've cut 33% off the price of our SC02 SMD-interface disk controller.

Our UC01 emulating host adapter for SCSI interface has been reduced 21%.

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TC02 TS11-compatible tape coupler.

SC02 small/medium disk controller for DEC's QBus.

UC01 emulating host adapter emulates DEC's RL01/RL02.

SC03 large disk controller handles the new 1.8 MByte/second drives – like the Fujitsu "Eagle."

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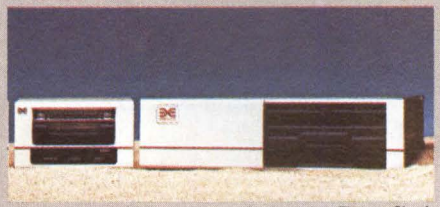
Vault is a ¼" streaming tape that gives you up to 70 MBytes of storage at maximum block size.



SABRE™ combines a 31.2 MByte 5¼" Winchester with a 10.4 MByte removable 8" cartridge disk. It gives you an overall capacity equivalent to four (4) DEC RL02s.

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Over the years, Emulex has earned a reputation for performance. For example, our TC01 disk controller has a calculated MTBF of 41,000 hours. But field operations have proven that its actual MTBF is a whopping 164,930 hours.

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CIRCLE NO. 25 ON INQUIRY CARD

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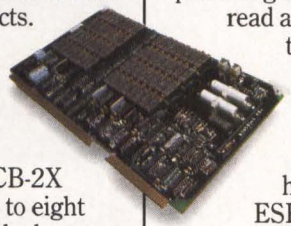
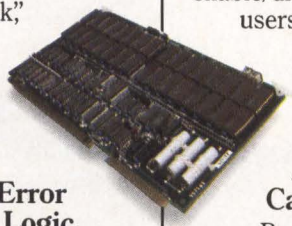
And that was just the beginning.

Squeezing 2 megabytes of memory onto a single Multibus* card is quite an accomplishment in itself. But we believe it takes more than just memory to meet the increasing needs of today's systems. That's why our new MCB-2X Multibus card is designed with a number of significant special features. And why Intersil Systems is truly a leader in Multibus memory products.


MCB-364

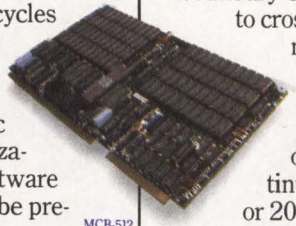
Superior Dynamic Memory Relocation.

The new MCB-2X can relocate up to eight 64K or 256K blocks independently—making it a very powerful tool for "RAM disk," graphics display or multiple table look-up applications.


MCB-332

Expanded Error Correction Logic.

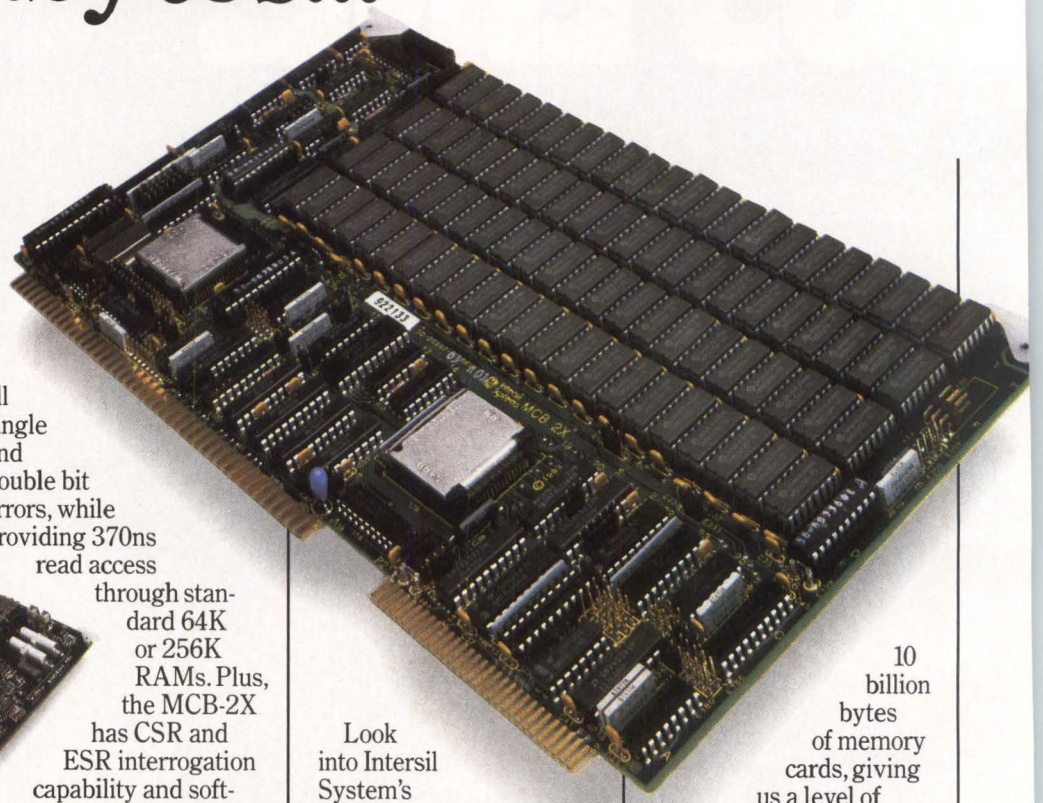
All single bit errors are automatically scrubbed during refresh cycles without system interruption. And thanks to the automatic memory initialization feature, software doesn't have to be preconditioned.


MCB-512

On-board ECC detects all single and double bit errors, while providing 370ns read access through standard 64K or 256K RAMs. Plus, the MCB-2X has CSR and ESR interrogation capability and software control of ECC enable/disable, allowing users to provide comprehensive system-level diagnostics.

Flexible Addressing Capabilities.

Board addresses starting on any 4K boundary can be mapped to cross 1 and 4 megabyte boundaries. The MCB-2X can also occupy a continuous 512K or 2048K memory space within its 16 megabyte range.



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CIRCLE NO. 26 ON INQUIRY CARD

rently employ a datacommunications device, according to a USR market analysis, but that percentage is expected to increase rapidly as end users and system integrators recognize telecommunications capabilities as integral to system packages, as are monitors and disk drives.

While terminal and home computer makers TeleVideo Systems Inc., Commodore Business Machines Inc. and Texas Instruments Inc. are already offering modems with their terminals, the personal computer segment has lagged in packaging third-party-supplied modems into systems. The reasons for their reluctance are that modems increase overall system price and that there is wide availability of third-party sources to end users and OEMs, according to Tom Bredt, an analyst with Dataquest Inc., a San Jose, Calif., market research organization. But market demand for communications capabilities, evidenced by the growth of portable and transportable computers with integrated modems, has gotten so strong that vendors are starting to view modems as basic system components rather than add-ons.

"There's a substantial market for low-end modems based on the sale of personal computers," says John Borden, research analyst with market researcher The Yankee Group, Boston.

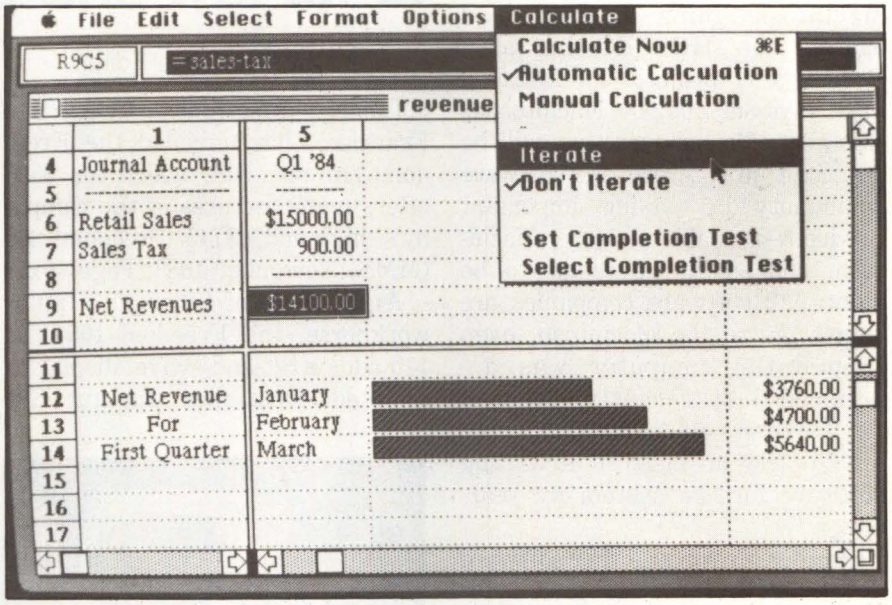
Bredt agrees: "Personal modems will drive all other modem markets through 1987," he predicts, "and more and more PC manufacturers will ship modems as part of their standard products." □

Apple turns to third-party vendors for Macintosh software

Marjorie Stenzler-Centonze
Associate Editor

Apple Computer Inc. is launching a major third-party software effort to propel its new Macintosh microcomputer into the crowded microcomputer market. Apple officials expect third-party vendors to develop some 90 percent of Macintosh software. As an incentive, Apple is offering substantial discounts to third parties. The company will sell a full Macintosh system to them for $1,250—less than half the regular price.

"We don't view ourselves as a major player in the software business," comments Mike Boich, who heads Apple's third-party software effort. "We provide the vehicle for the innovation and dedication to purpose that's likely to come from outside software companies."



Microsoft's Multiplan *enables Macintosh users to cut and paste between spreadsheets and to turn spreadsheet data into presentation graphics using Microsoft Chart.*

Microsoft commits to Apple

Chief among third-party software vendors developing Macintosh programs is Microsoft Corp., Bellevue, Wash., which spent the last two years working alongside Apple on the Macintosh, according to Boich. "Microsoft agreed to work on applications well before Macintosh was finished," Boich says, "and they were very helpful in working with us to debug the system."

Four application programs came out of the early efforts. Available now are an enhanced version of Multiplan, featuring an Undo command to reverse the last change made on a spreadsheet, Chart for business graphics and BASIC. Word for word processing and File for database management will be avail-

able during the second quarter of this year. "We wanted to have a full range of applications programs ready for the Macintosh at introduction, so we rolled up our sleeves and got involved in the development, debugging and fine-tuning of the machine," comments Microsoft chairman William Gates. Microsoft expects about 50 percent of its applications revenue this year to come from Macintosh software.

"The full range of software already available and under way for Macintosh shows a solid commitment to the product," says Kenneth G. Bosomworth, president of International Resource Development, a Norwalk, Conn., research company. "It's clear that it is Apple's intention not to have Macintosh be an orphan product," Bosomworth says.

Although he does not see the Macintosh going head-to-head against the IBM PC in sales, Bosomworth projects an installed base of about 400,000 Macintoshes this year. He believes that will be sufficient to interest the software community in making important products available for the Macintosh, and so far he seems to be right: 110 software companies are committed to the Macintosh, even though the computer was announced just recently. Apple's Boich expects 800 to 1,000 developers to show an interest in writing software for the system by year-end.

Besides Microsoft, other software developers writing programs for the system include Lotus Development Corp., Cambridge, Mass., which will make available a version of its popular 1-2-3 integrated software package. Ashton-Tate, Culver City, Calif., is working on a Macintosh version of dBASE II, and Software Publishing Corp. will introduce a version of its PFS: series of productivity tools. Think Technologies Inc., Danvers, Mass., is writing MacPascal, an interpretive interactive Pascal for Macintosh that will be available this month for marketing by Apple. Software companies Continental Software, BPI Systems Inc., Sorcim Corp. and State of the Art Inc. are also developing Macintosh software.

Meanwhile, Apple itself is developing Macintosh BASIC and an assembler/debugger, which are expected to be available in the third-quarter. "There's still a great deal of opportunity in developing software for the Macintosh," Boich says. He expects continued development activity in generic productivity tools, terminal emulation, communication, development tools and program languages. Software developers have yet to address vertical market applications, he says.

The company planned a major push at the recent Softcon show in New Orleans with a seminar program explaining the development process. This program will be taken to major cities throughout the country. A formal training program for those who commit to development will begin by early summer. □

Liberty adds ergonomics to its low-end terminal

Tom Moran, Associate Editor

Liberty Electronics USA, San Francisco, has unveiled the Freedom 110 terminal, which for $595 offers many features of the company's high-end, $745 Freedom 200 (MMS, November 1983, Page 46).

An upgrade of Liberty's popular workhorse, the Freedom 100, the 110 adds a tilt-and-swivel display, a sculpted Deutsches Institut für Normung- (DIN-) standard keyboard and an optional amber phosphor for its etched 12-inch screen. The 110 has the same styling and the same ergonomic display, function keys and keyboard as the Freedom 200.

Liberty USA's $595 Freedom 110 *is an ergonomic upgrade of its popular Freedom 100 alphanumeric terminal*

Liberty president George Chao says Liberty will continue to offer the Freedom 100. "The service and spares will still be in place. [The 100 and 110] will be positioned slightly differently, and market forces will determine what's going to happen."

The 110's 10 programmable function keys shift to provide 20 functions, while the 100's 10 shiftable function keys are not programmable. Other features of the 110 include non-volatile screen setup using software instead of dual-in-line-package switches and a screen saver that automatically dims the CRT when not in use. Liberty has also replaced its linear power supply with a 40W switching power supply. Liberty planned to ship the Freedom 110 in March. The $595 list price is for single units.

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You know about the advantages of a Micro/11 computer system. What you may not know is that it's available now. Our MDB Micro/11 is functionally equivalent to the DEC Micro/PDP-11* providing an 11/23 Plus, 256KB RAM, 10.4 MB Winchester and 1 MB Dual Floppy sub-system. But there's more.

This low-cost, compact and highly flexible work station provides the exclusive feature of being software driver and media compatible to the RX02. This unique capability allows diskette transfer to and from other DEC systems. Also, unlike the DEC unit, our Winchester is RL02 software compatible. Even optional 20 MB RL02 or RP02 emulating Winchesters are available to enhance your system.

When it comes to interface modules, however, the MDB Micro/11 has lots of company. The system, with its 8 quad slot (16 dual slot), Q-22 backplane and its rear distribution panel, accommodates all of MDB's unequalled repertoire of FCC compliant Q-bus controllers and interfaces. They include multiplexors, line printer controllers, disk and tape controllers, high speed DMA modules and interprocessor-links.

FOR ITS AVAILABILITY AND CAPABILITY

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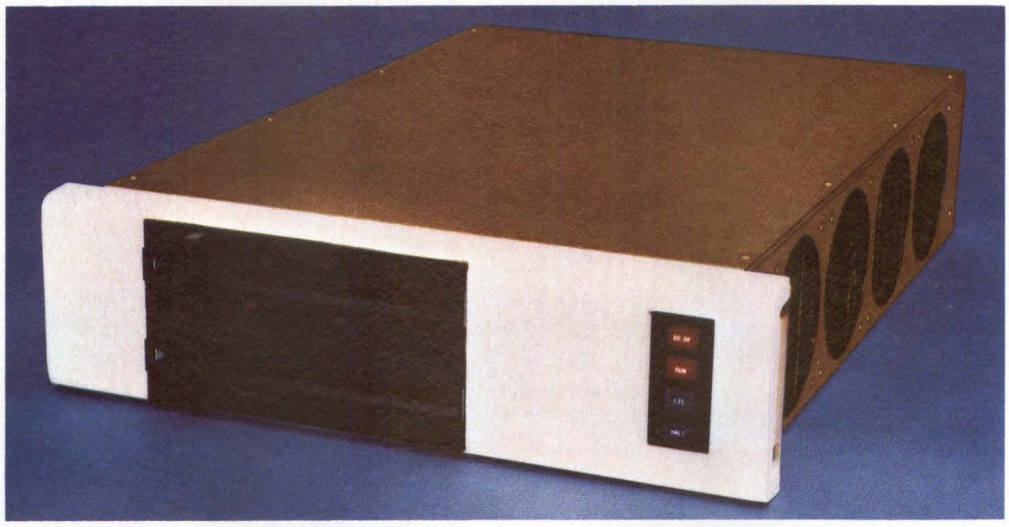

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HOW TO CHOOSE A DISK DRIVE, PART I:

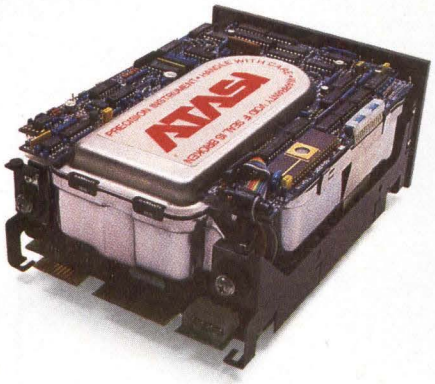
Your new computer system may be in for a cool reception.

Here's a cold, hard fact that should influence your selection of a disk drive for multi-user computer systems or local area networks: In today's energy-conscious offices, temperatures can vary enough during the day to affect the performance of a disk drive. We made the operating range of ATASI drives up to 25% greater than most competitive drives because poor performance under thermal stress can result in system downtime and even lost data. Here's how it happens.

In most drives, the bottom of the bowl serves as the base-plate where the carriage and spindle assemblies are

THERMAL STRESS

mounted. There is no thermal isolation. Heat from the motor, PC boards or a power supply can result in differential expansion of the baseplate, so that it temporarily warps. This can change the alignment of the carriage and spindle, which in turn affects the drive's ability to find data reliably.



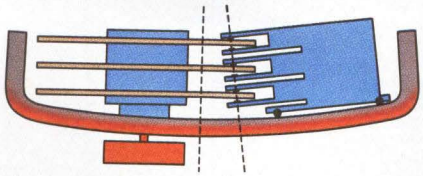
ATASI's 46 Mbyte, 5¼-inch Winchester disk drives are available in production quantities immediately.

Alignment problems

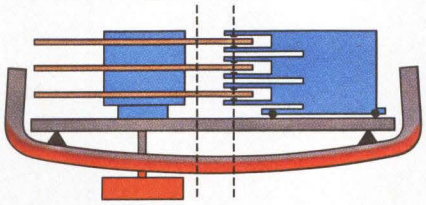
In high-performance, closed-loop drives, servo information carried on the bottom surface of the disk stack is used to position the data heads on all other surfaces. Assume that data is recorded when the drive is "cold." If the carriage and spindle go out of alignment when the drive gets "hot," the servo system cannot properly position the read/write heads to recover the data. This may mean that data written in the morning won't be accessible the same afternoon!

Thermal isolation

To prevent this from happening with ATASI's 5¼-inch Winchester disk drives, the ATASI design incorporates a baseplate which is separate and thermally isolated from



Heat can temporarily warp a drive's baseplate, causing alignment problems between carriage and spindle.



Thermal isolation in ATASI's proprietary design eliminates the problem.

the lower half of the bowl. The baseplate is therefore protected from external sources of localized heat. Even if the drive heats up, it does so uniformly, with no resultant deformation of the baseplate, and no alignment problems.

Extra margins

Thermally isolating key mechanical components is one way we improve the performance of ATASI drives, but not the only one. Everywhere in the design there are margins of safety other drives don't offer. For example, our proprietary spindle motor design provides substantially greater dissipation of heat away from the disk module than competitive drives.

The ATASI White Paper

At ATASI, we are proud of the quality we build into every drive we make, and we encourage clients to test our products rigorously. To help, we have prepared a White Paper on thermal testing which discusses test methods and interpretation of test data in detail.

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PERFORMANCE SPECIFICATIONS

MODEL NO.	3033	3046
CAPACITY	33 MB	46 MB
ACCESS TIME (AVG.)	30 ms	30 ms
DATA RATE	5 Mbits	5 Mbits
INTERFACE	ST 506	ST 506

Available in high volume today.

MODEL NO.	3065	3075
CAPACITY	65 MB	75 MB
ACCESS TIME (AVG.)	24 ms	24 ms
DATA RATE	5 Mbits	5 Mbits
INTERFACE	ST 506	ST 506

Available second half, 1984.

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FEATURE COMPARISON *	VT220 VT220 emulation mode	VISION 2200 VT220 emulation mode
VT220 Command Set	YES	YES
Function System Memory	256	1024
Programmable Functions (PF)	15	64
PF in VT100 Mode	0	64
Data Routing From Function Keys	NO	YES
Non-Volatile Function Memory	NO	YES
Four-Page Memory	NO	YES
Eight-Page Memory Option	N/A**	YES
Bi-Directional Printer Port	NO	YES
Dual Set Up Tables	NO	YES
Dual Host Support	NO	YES
Compose Key	YES	YES
Graphics Option	NO	YES
PRICE QUANTITY ONE	$1295	$1245

* Based on latest information supplied by manufacturer. ** Not applicable.

LANPAR

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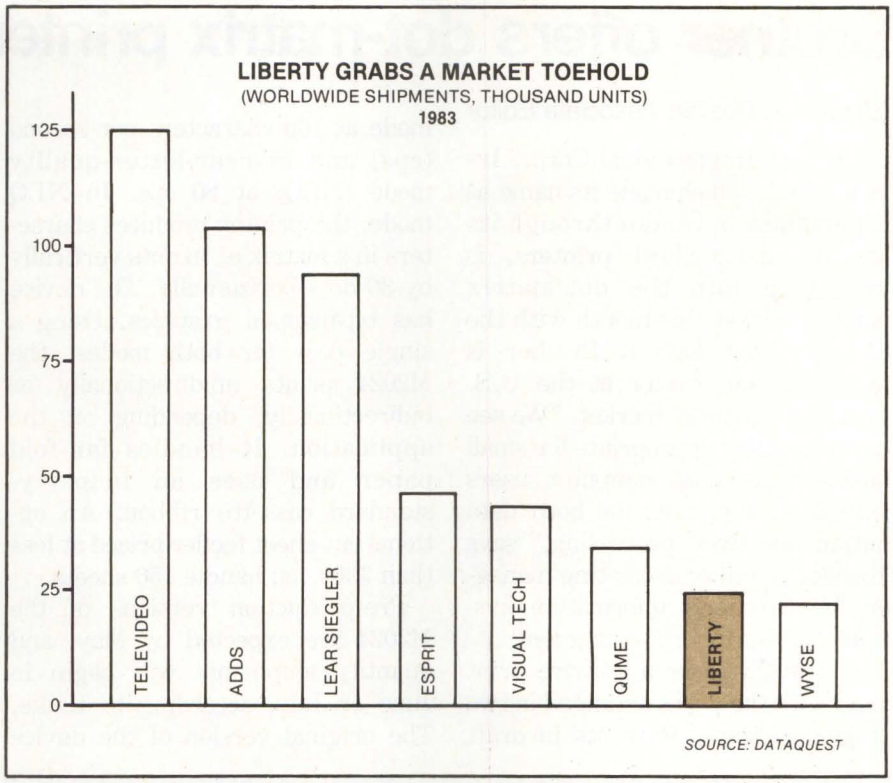
Status line acts as setup screen

The 110's screen displays 80 columns by 24 rows with a 25th status line that can be used in place of the full-page setup screen. If a user wishes to change the setup of the system without exiting from an application, he can press a setup key, which sequentially pages the setup menus for the terminal's parameter into the 25th line. With this feature, a user can change the terminal mode and baud rate without losing time or data.

The 110 offers a standard 128-character ASCII set and 15 business graphics characters for use in creating forms. Like the Freedom 100 and 200, the 110's character matrix is 7 by 9 dots in a 9-by-12-dot field, and the system includes seven foreign-character sets in ROM. The 110's 2K bytes of RAM provide one page of screen memory, and 2K bytes support non-embedded attributes.



Liberty Electronics USA *has become a major contender among independent suppliers of alphanumeric display terminals*

Unit uses RAM for function keys

The 110's 94-key, low profile, detachable keyboard includes a numeric keypad. The keycaps and the keyboard are sculpted, and the "f" and "j" keys are textured to aid touch typists. The unit dynamically allocates 256 bytes of non-volatile RAM to the 20 functions of the function keys. Like the 100, the 110 has 20 preprogrammed functions.

A bidirectional RS232 port connects the 110 to other terminals and printers. The 110 has a 1K-byte buffer that spools data through the RS232 port and relays printer status signals through hardware or software control. It supports block and local modes and allows users to set transmission rates from 110 to 19.2K baud.

Unit has movable frame

Like the Freedom 200, the 110 is designed for easy service. One sliding frame in the base of the display gives access to the power-supply and logic boards. Liberty intends to supply dealers with repair kits for quick board-swapping in the field. The sliding frame allows for the addition of a 7-by-11-inch custom board under the logic board and a 4-by-6-inch board over the power supply.

"We have basically got the same guts inside [the Freedom 110] as the Freedom 100. We've done an awful lot of learning with the Freedom 100, so we won't be doing a lot of coding changes," says Liberty product marketing manager Jim Handy. He expects the 110 to compete well in the low-end alphanumeric terminal market. It is priced about $100 below the going market price for similar units, he claims. He says Liberty realized that, if it wanted to continue to sell terminals, it would have to follow the market for ergonomic terminals.

Terminal prices will fall

Chao predicts that alphanumeric terminal prices will continue to fall. "Within a few years, you will see terminals of this flavor for $300 or less," he says. Aggressive pricing is largely responsible for Liberty's rapid growth. According to Bob Sanekoff, director of display terminals industry service for research company Dataquest Inc., Liberty has gone from negligible sales in 1982 to shipments of about 25,000 units in 1983. "That puts them in the top eight among independent suppliers of alphanumeric terminals," says Sanekoff. "They're trying to capture the low-end market, and I think they're doing it." □

Brother offers dot-matrix printer

Edward S. Foster, Associate Editor

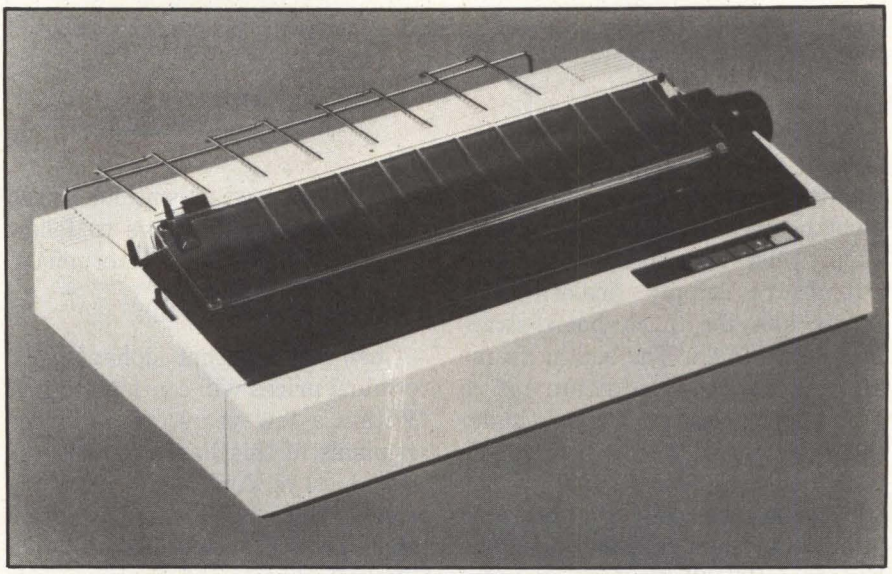
Brother International Corp., Irvine, Calif., which made its name as a peripherals vendor through its low-cost daisy-wheel printers, is venturing into the dot-matrix printer market this month with the $1,500 model M2024. Brother is targeting the printer at the U.S. personal computer market. "We see it as especially appropriate for small business personal computer users who need a printer for both data output and word processing," says Toshikazu Koike, marketing manager for Brother's information systems and peripheral equipment.

The M2024 uses a 24-wire print head with the wires arranged in two staggered rows. It prints in draft mode at 160 characters per second (cps) and in near-letter-quality mode (NLQ) at 80 cps. In NLQ mode, the printer produces characters in a matrix of 16 dots vertically by 30 dots horizontally. The device has bit-mapped graphics. Using a single pass for both modes, the M2024 prints unidirectionally or bidirectionally, depending on the application. It handles fan-fold paper and uses an industry-standard cassette ribbon. An optional cut-sheet feeder priced at less than $300 can handle 150 sheets.

Pre-production versions of the M2024 are expected by May, and quantity shipments will begin in June or July, according to Koike. The original version of the device comes with a standard parallel interface, and Koike predicts that serial interfaces will be available by the third quarter of this year.

The M2024 is the first impact dot-matrix printer Brother offers in the United States, although the company makes several models for the Japanese market. Brother also supplies dot-matrix printer mechanisms to Centronics Data Computer Corp., Hudson, N.H. Koike says Brother plans to offer the M2024 only under its own label. Neither he nor Centronics officials comment on the possibility that Centronics will offer an OEM version of the product.

While Koike says the M2024 will be used at least in part for word-processing applications, he does not predict that dot-matrix devices will eclipse daisy-wheel technology for this application. "It is still just *near* letter quality," he stresses. "Some users will find the print quality of the M2024 acceptable [for word processors], and some users will not. Those who want to save money and space by having just one printer for both data processing and word processing are the most likely customers for this kind of printer." Therefore, Brother does not expect any direct conflict between its low-speed daisy-wheel printers and the M2024. Brother is also considering other matrix printer offerings using impact and non-impact technologies. □



The Brother M2024 dot-matrix printer *is targeted at small business and personal computer users. Retail price is $1,500.*

(A)

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(B)

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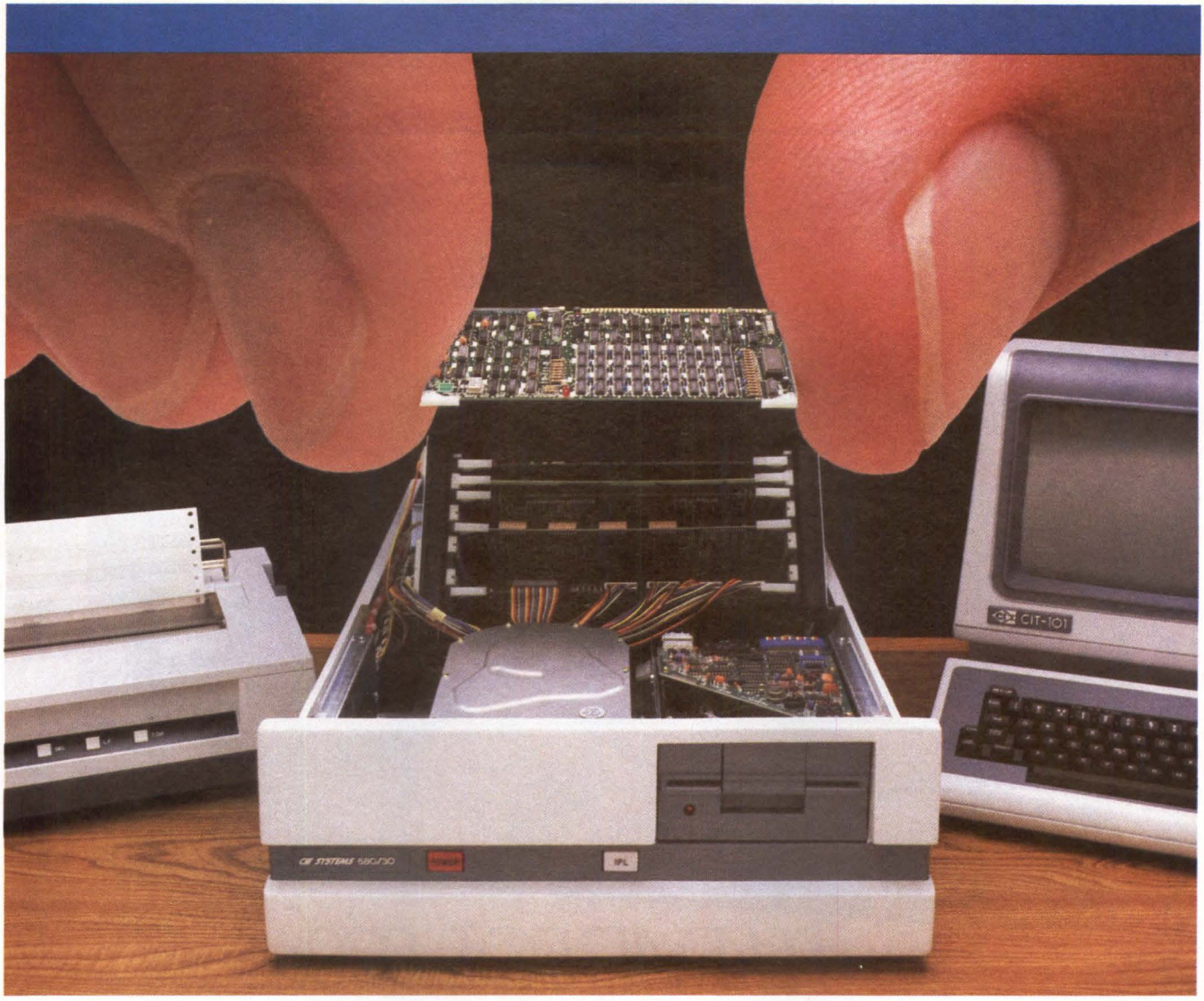
The M2024 dot-matrix printer *from Brother prints draft characters (line A) at 160 cps and NLQ characters (line B) at 80 cps.*



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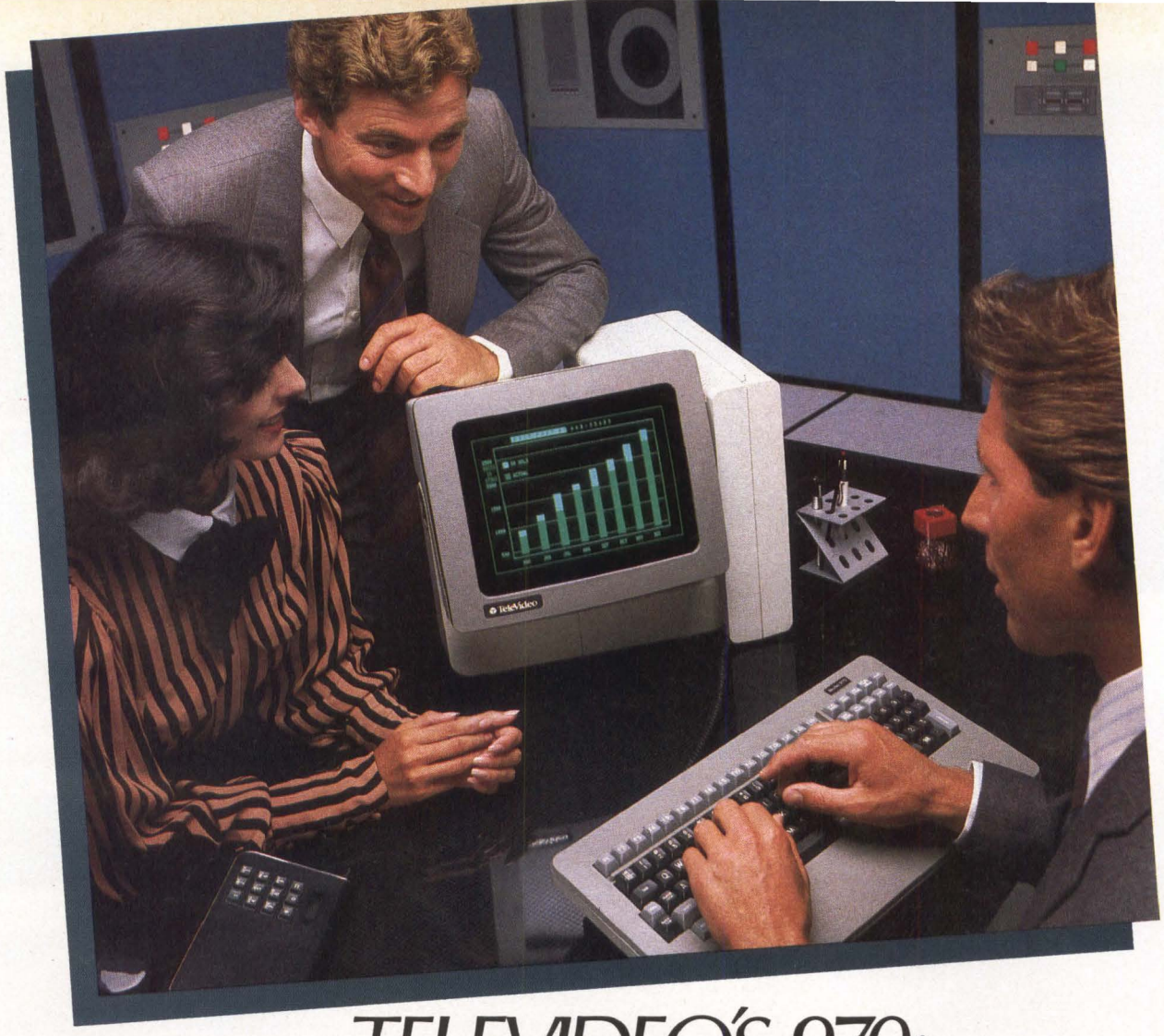

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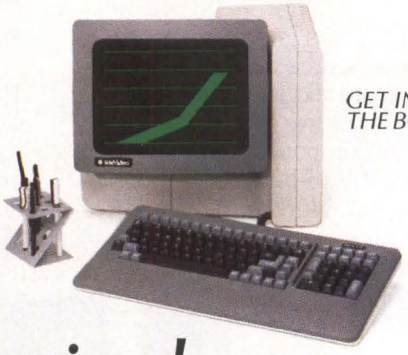

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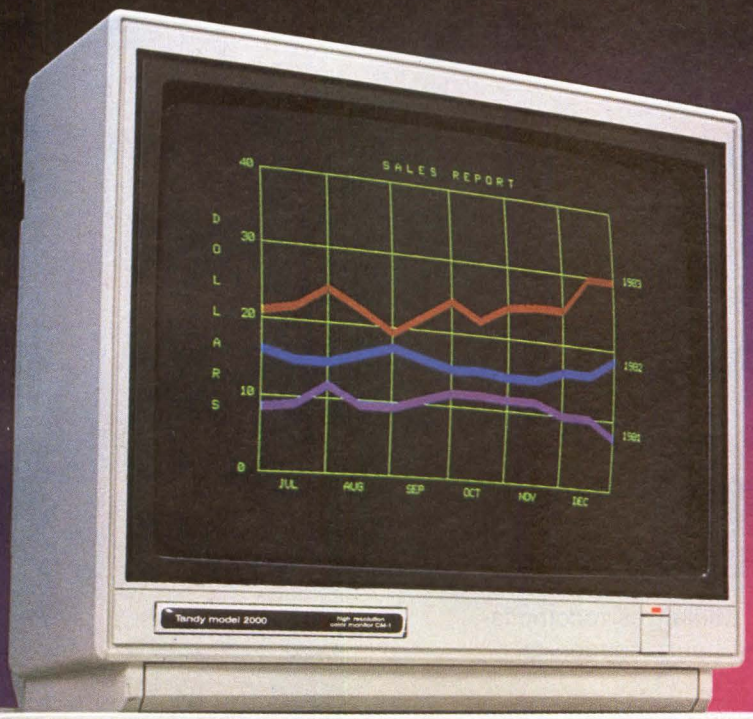

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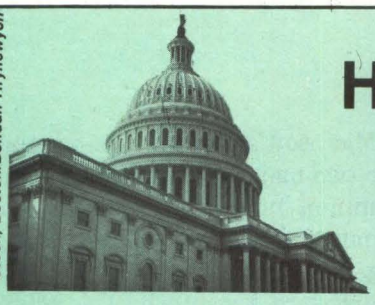

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HEARD ON THE HILL

Postal Service's E-COM comes under fire from House committee

Stephen J. Shaw, Washington Editor

The U.S. Postal Service's excursion into electronic-mail services would be laughable if it weren't so expensive for the U.S. taxpayer. The Postal Service has been zealously overoptimistic in its economic projections and hopelessly inept in its efforts to compete with private enterprises.

The Postal Service commenced its electronic computer-originated mail (E-COM) service at the beginning of 1982. The service was intended to allow bulk mailers to transmit messages over telephone lines to any combination of 25 special computer-equipped post offices across the continental United States. The post office then produced a hard copy of the message and delivered it within two days to its final destination.

Theoretically, the Postal Service's strategy was fine. E-COM would provide a foot in the door in a market the Postal Service estimates at 1.5 billion messages through 1987. It also anticipated that E-COM would give the service valuable experience in running a computer-based telecommunications network and help to stave off future threats to its paper-based postal monopoly.

E-COM has proven a disaster

Practically, however, E-COM has been a political and economic disaster. According to a report released by the House Committee on Government Operations, E-COM has:

- incurred losses totaling almost $40 million during its two years of operation;
- lost $1.25 on each message handled during fiscal year 1983, double the loss estimated in mid-1983;
- lost $5.25 on each message sent during 1982;
- delivered only 15.3 million messages in fiscal year 1983 after telling Congress in rate-justification hearings that it would deliver 50 million messages;
- delivered only 7 million messages during the first third of fiscal 1984, out of the initially projected 45 million for the year;
- deliberately manipulated the release of information about E-COM to make the service appear more successful than it was.

The Postal Service charges 26 cents for a one-page message, a price that does not come close to covering the actual cost of handling and delivery. Law requires the Postal Service to base all charges on actual service cost. The Postal Rate Commission is proposing a rate hike of 26 cents per message—to 52 cents—through fiscal 1985.

Stanford Weinstein, vice president of Graphnet Inc., a competitor to the Postal Service, says per-message costs are between 52 cents and 68 cents. So a rate of 52 cents a message might at least make E-COM a breakeven business.

Weinstein and others, however, believe such a rate "would do E-COM in completely."

Anyway, says Weinstein, "E-COM is a total disaster. The U.S. government should not be competing with private enterprise."

Customer projections are off

Not surprisingly, the Postal Service blames its deficits on a lack of customers. More than half of E-COM's messages are coming from one customer, Automotive Development Co., which distributes automotive brochures.

In a prepared statement, the Postal Service responded to the House Committee report by saying that the report would receive "careful scrutiny and resolution." And, despite the scathing reception E-COM has received on Capitol Hill, "the Postal Service remains committed to the premise that E-COM is a viable service."

The next target for scrutiny by the Government Committee is E-COM's international counterpart, Intelpost, an overseas facsimile service. According to a committee staff attorney, Intelpost has earned $58,800 in gross revenues during its three years of operation while expenditures have reached $6.23 million. If the committee accepts the staff's draft report, which it was expected to vote on in March, it will issue the report this month.

Microsoft makes major push in application software

Marjorie Stenzler-Centonze
Associate Editor

Primed by a major commitment to develop application software for Apple Computer Inc.'s Macintosh microcomputer, Microsoft Corp.—already well-entrenched in the system software market—wants to become a dominant force in application software.

"Classically, we've been in the system software business, but the really big market of the future is in applications," says Leo Nikora, group product marketing manager at the Bellevue, Wash., company. He points out, however, that Microsoft is not abandoning its efforts in operating systems, such as MS-DOS and XENIX, and in languages. The company currently divides its interests equally between system and application software. Microsoft expects to draw about 50 percent of its application software revenue this year from Macintosh software sales.

Nikora says Microsoft's focus will change to applications over the next couple of years, as the systems software market becomes saturated. According to a study by Future Computing Inc., Richardson, Texas, the value of software sold for business personal computers totaled $1.4 billion in 1983 and will top $6.7 billion by 1988.

'Windows' represents ISV thrust

Approximately 30 manufacturers have signed with Microsoft to sell Microsoft Windows, the software extension of MS-DOS, with their computers. Microsoft announced Windows late last year and will release it this month. Nikora says Microsoft will continue seeking manufacturers to support Windows and will also look for independent software vendors (ISVs). So far, 60 software vendors have signed to purchase the Windows tool kit, which will enable them to rewrite their software using Windows. To attract software vendors, Microsoft recently held its first hands-on training seminar to teach software vendors how to design for and write software for Windows.

Jon Shirley, *who became president of Microsoft eight months ago, has had 25 years of experience with Tandy. He is expected to lead Microsoft into retail marketing as the company expands its application software market share.*

User interfaces and application environments such as Windows will be important in Microsoft's future. "We believe the two application environments ISVs will be writing in are MS-DOS [machines] and the Apple Macintosh," Nikora says. "We are putting a good deal of effort into writing applications for Macintosh, bringing up Windows in the MS-DOS environment and creating an application base there."

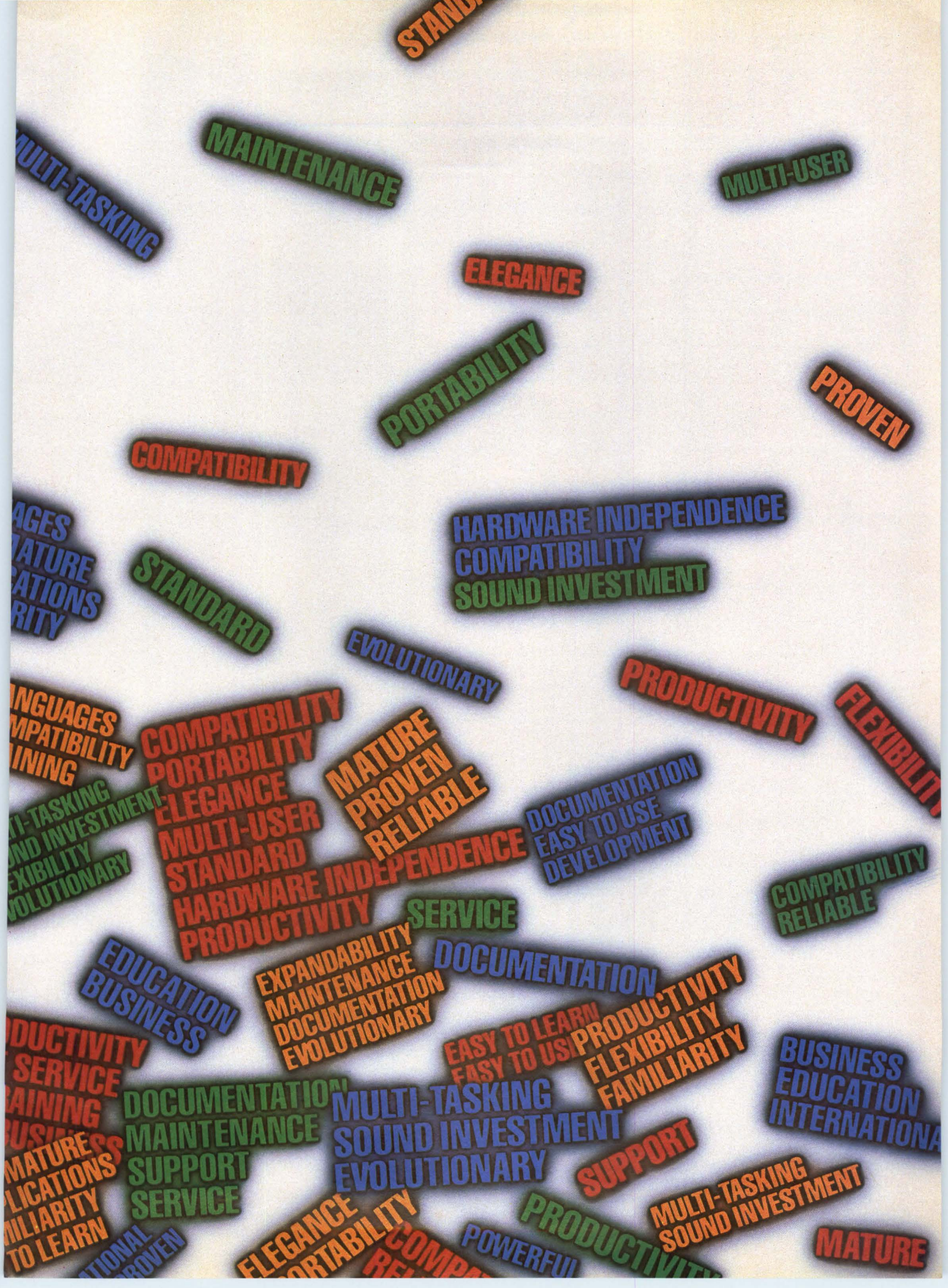
Microsoft's strategy is to unify the two major environments with a common user interface, Nikora comments. The company is adjusting the Windows user interface to adapt it to Macintosh. The adjustments will allow a software vendor designing an application using graphics and Windows to design it only once and implement it in both Windows and the Macintosh, Nikora claims.

Different marketing approach

Along with its plans to increase the application software side of its business, Microsoft will make some marketing strides. "It's a lot different competing in operating system territory, where you can count your competitors on one hand," Nikora remarks. "Competing against numerous application software companies will be a big change for us."

Selling system software to OEMs is a different ball game from selling application software to retailers, he says. Nikora believes that the appointment of Microsoft's president of eight months, Jon Shirley, who spent 25 years with Tandy Corp., evidences this change. "Shirley represents the swing into retail marketing. While our OEM effort will remain strong, he will guide us through the rather complex chain of wholesalers, distributors and retail stores," Nikora says.

Networking software will be hot for the rest of this year, he says. He expects to see some serious product offerings in that area. Microsoft will announce a networking product this year, according to Nikora, probably around the time that IBM Corp. announces one. "Then the gates will burst open, and things will really begin to happen." □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PROVEN
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COMPATIBILITY
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STANDARD
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PRODUCTIVITY
COMPATIBILITY
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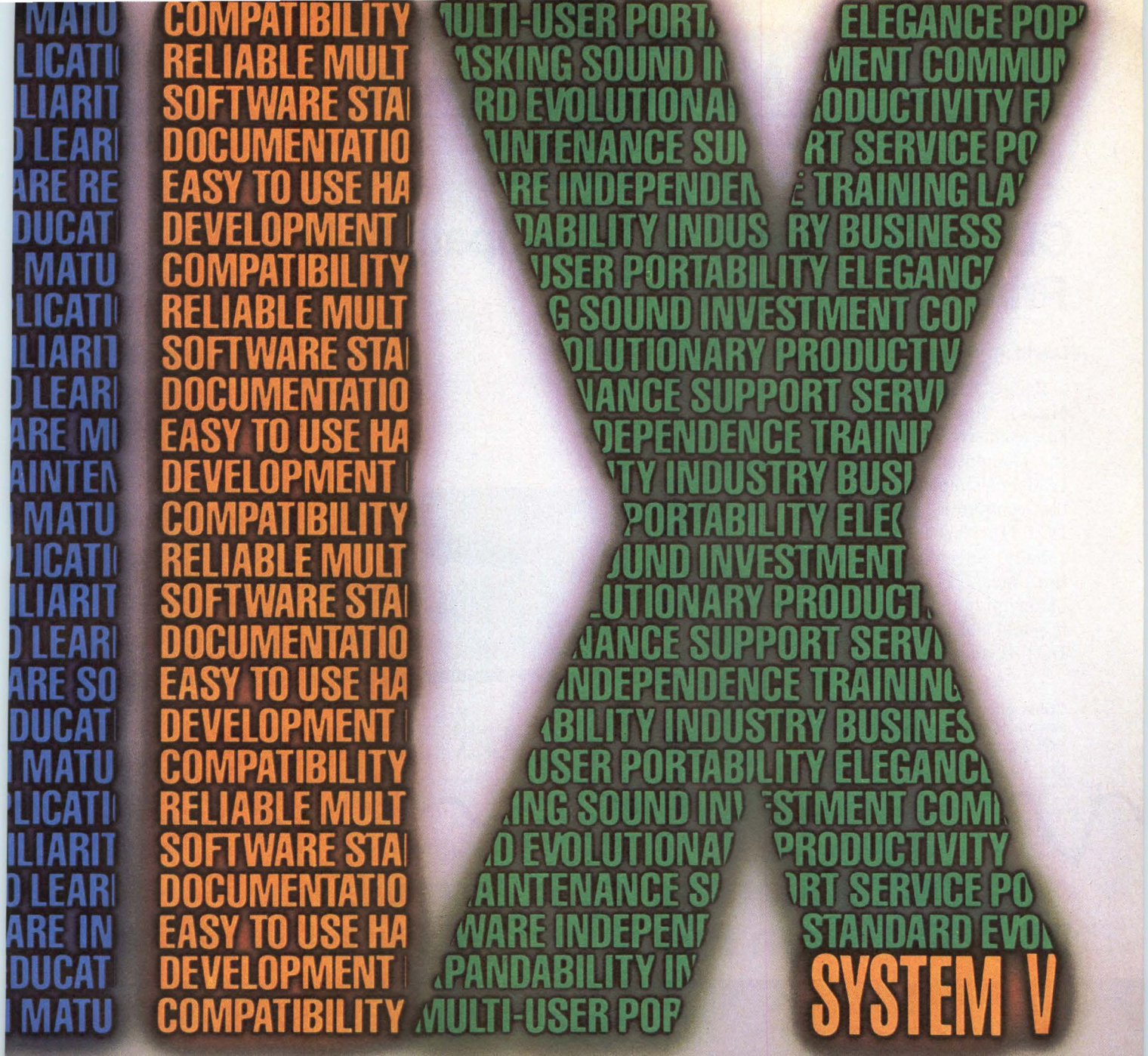

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Other_____

UNIX System Licensee ☐ Yes ☐ No ☐ Don't know

CDI sells rights to PC-compatible DOT II, Prime is first buyer

David A. Bright, Assistant Editor

Prime Computer Inc., Natick, Mass., has paid $200,000 for non-exclusive rights to the design of the Computer Devices Inc. (CDI) IBM PC-compatible DOT II portable computer. CDI unveiled the DOT II at last fall's Comdex show.

Last November, CDI, Burlington, Mass., filed for Chapter 11 bankruptcy protection. As a result, it could not afford to produce the DOT II and decided to put some of

CDI is offering non-exclusive rights *to the design of parts of its IBM PC-compatible DOT II portable computer.*

NEWSBITS

APRIL 1984

New seven acre site dedicated to board manufacturing.

In response to sustained growth in demand for the Company's board level products,, Western Digital has purchased a seven acre site adjacent to its current automated board assembly and test facility in Camarillo, California. The new complex, which currently includes 64,000 square feet of manufacturing, office and warehouse buildings, will soon be expanded into a master-planned and fully integrated automated manufacturing center for disk controller and network communications boards. WD also maintains a board manufacturing facility in Cork, Ireland.

Communications market booming.

Demand for communications products will increase dramatically over the next several years, according to an independent study commissioned by WD. A fivefold increase in the annual number of LAN node installations is forecast between 1983 and 1987. X.25 packet switching network installations should increase even more rapidly. To help capitalize on WD's strengths in this area, Stanley H. Reese has been named to the newly created position of Vice President, Communications Products. Reese will have marketing and planning responsibility for WD's data communications and network products.

X.25 network links DEC mainframes with terminal clusters.

ABLE Computer's new ATTACH communication system enables DEC VAX and PDP computer users to distribute computing power to up to 128 remote terminals per interface. Multiple DEC UNIBUS host computers can be linked with the first terminal cluster as far as two-thirds of a mile away, using a single cable. The ATTACH system uses the NetSource/25 X.25 packet switching controller from Western Digital to control the flow of data between nodes in the network and to automatically seek and correct transmission errors.

Proprietary CAD software speeds board design.

A new, proprietary software system, developed at WD's computer-aided design center, integrates logic checking and printed circuit board layout validation. The system speeds turnaround of customized variations of WD's disk controller and communications boards, and improves both manufacturability and product quality. It integrates Tegate software, which captures logical schematics and does consistency checks, with a Calma system, which captures board layouts and does spacing and connectivity checks. The resulting board artwork is error-free and ready for manufacturing.

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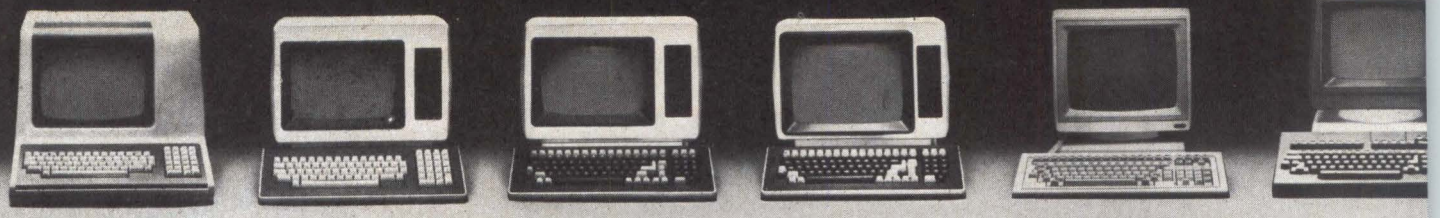

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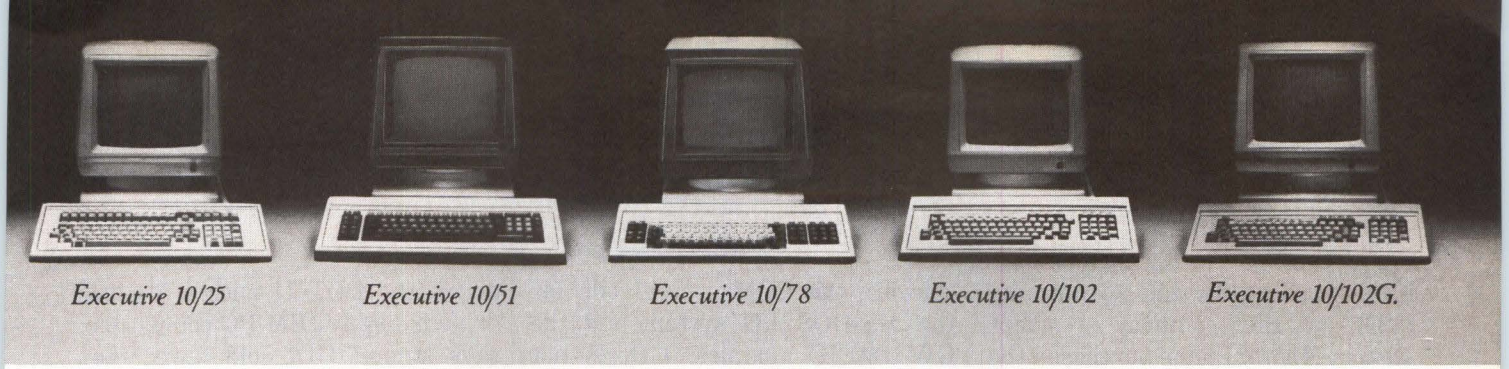

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its designs up for sale to help dig itself out, says company president Robert Moore. Prime purchased the circuit design schematics for the DOT II's motherboard, RAM board and 5¼-inch floppy disk drive controller and the ROM source code for the BIOS. Other designs up for sale are the ROM source code for the MS-DOS I/O system and the GW BASIC modules. CDI is not selling its 162-character-per-second thermal printer, which is built into the 32-pound DOT II.

Unlike its predecessor, the DOT, which used a 3½-inch floppy disk drive, the DOT II with a 5¼-inch drive is highly IBM PC compatible, says Moore. CDI sold fewer than 600 units of the original DOT.

Prime downplays the significance of the purchase. "We have no plans at this point [for the CDI designs]," says a Prime spokesman. □

AT&T signs Convergent for information-processing line

Marjorie Stenzler-Centonze
Associate Editor

The dust had barely settled on the divestiture of AT&T when the company began jockeying for a position in the office-automation field. Toward that end, AT&T recently signed a major long-term OEM agreement with Convergent Technologies Inc., Santa Clara, Calif., for Convergent to develop, design and manufacture products on an exclusive basis for AT&T Information Systems.

Neither company will comment on the forthcoming products, except to say that a line of information-processing products will be released this year. The companies decline to discuss the value of the deal, but insiders say the arrangement could put more than $1.5 billion in Convergent's pocket over the next

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five years. An AT&T spokesman says the deal will not affect AT&T's future potential to offer internally developed products.

"AT&T's entrance into the market changes the competitive nature of things significantly," says Pauline Alker, vice president and general manager of the telecommunications division of Convergent. "Amateur hour is over, and now the world will evolve about the giants."

Although AT&T hasn't yet become a factor in the industry, Alker believes the company offers the necessary strengths and resources to take on IBM. "It ultimately means that AT&T and Convergent are linking up against IBM," Alker states. IBM refuses to comment on its newest competitor. But after the AT&T/Convergent announcement, IBM did unveil a version of AT&T's UNIX operating system for its PC. Interactive Systems Corp., Santa Monica, Calif., is supplying the operating system, which IBM calls the Personal Computer Interactive Executive (PC-IX).

Convergent identified AT&T as a strategic market partner last spring and assembled its "strategic strike force" aimed at AT&T, Alker says. Some industry observers have criticized AT&T's decision to contract for the design and manufacture of the new line, but others feel that it will help the company play catch-up in the information-processing market.

Cliff Lindsey, vice president for office automation services at Dataquest Inc., a San Jose, Calif., market research company, believes the Convergent deal will save AT&T time. "Besides," he says, "IBM has shown us that you don't have to make all [your products] in-house. It's smart for AT&T to get products from the outside; they need to have excellent products the first time around." He expects AT&T's line to feature systems

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competitive with both the private-branch exchange companies' desktop workstations and IBM's personal computers.

He believes that distribution is more important in the long run than manufacturing. AT&T does not provide details of its distribution plans for the line, except to say that it will sell the systems through the Information Systems' direct sales force and other appropriate channels. Lindsey speculates that AT&T will eventually examine retail channels and explore upgrading its retail stores to sell computer systems. □

Raytheon will buy 16-bit business system from Convergent

Convergent Technologies Inc., Santa Clara, Calif., has signed an agreement with Raytheon Data Systems, Norwood, Mass. Under the terms of the agreement, Raytheon will buy Convergent hardware and customize it with software and some Raytheon peripherals for vertical market customers in transportation, financial and government operations. The resulting Raytheon product line will be the RDS Signature 8200 16-bit computer series.

The decision to go with Convergent was based largely on price, says Jane Ellis, Raytheon's product marketing manager for interactive and distributed data-processing systems. "To compete today requires a good deal of flexibility in terms of pricing, and Convergent's got a very successful product at a much more attractive price than we could have come up with on our own," Ellis says.

Raytheon has been considering the introduction of the Signature family for more than three years, Ellis says. Part of the reason for waiting to bring the product to market was that Raytheon decided to use an extremely focused marketing strategy, says Agit N. Maira, Raytheon's vice president of marketing. "The sophistication of our customers now gives us a real opportunity to provide systems tailored to their needs," Maira says.

The RDS Signature 8200 multifunction system, the first product in the Signature 8000 line, is available in single-user versions and in clusters of as many as eight workstations. It features snap-together expansion modules, is based on the Intel 80186 and houses three operating systems. The resident operating system is RDSOS, which allows simultaneous execution of as many as 10 foreground tasks. CP/M-86 and MS-DOS run concurrently with the host operating system. Although the 8200 runs MS-DOS application programs, it is not fully hardware-compatible with the IBM PC, Ellis says. Applications that do more than talk to the operating system, such as Lotus Development Corp.'s Lotus 1-2-3, which works directly with the hardware, must be modified to run on the 8200, she says.

The system offers word processing with multiple on-screen windows, business graphics, electronic mail and Multiplan, which interfaces directly with graphics. Prices for a typical word-processing configuration—including a 12-inch monochrome display, a keyboard, a processor module with dual floppy disk drives, 512K bytes of RAM, a letter-quality printer and related software—begin at $9,050. A typical data-processing cluster configuration, including four 12-inch monochrome displays, keyboards, a processor module with a floppy drive, a 20M-byte hard disk, 512K bytes of RAM, a graphics processor and a 55-character-per-second letter-quality printer, a high speed, dot matrix printer and a 80-column, dot matrix printer is priced at $32,502.

Enhancements planned for the 8200 include 15-inch monochrome monitors; an Ethernet module for local-area network connections; extended communications facilities; and additional printers, plotters and other peripherals. The 8200 is available for immediate delivery. Raytheon hopes to install about 8,000 clustered systems this year.

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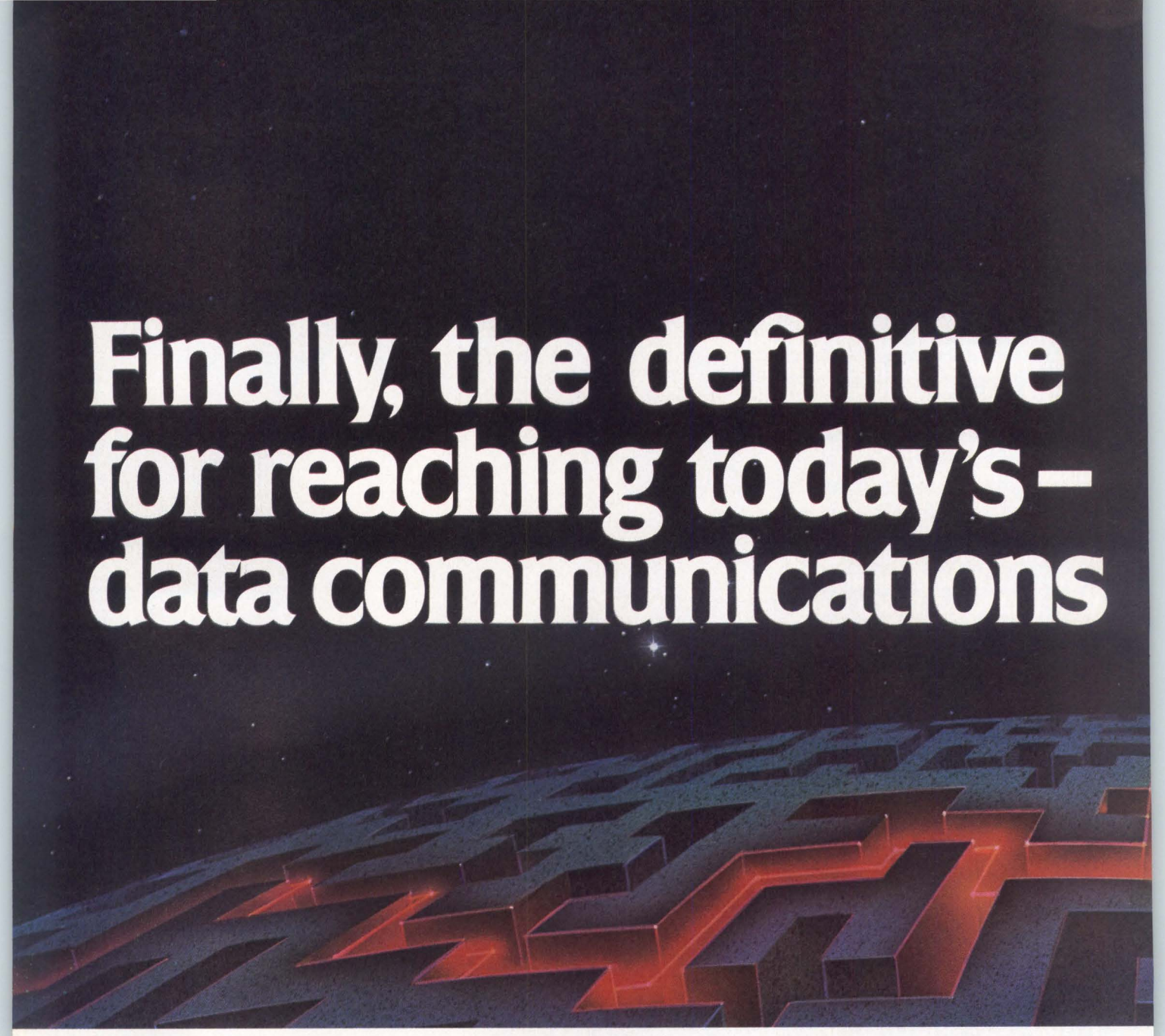

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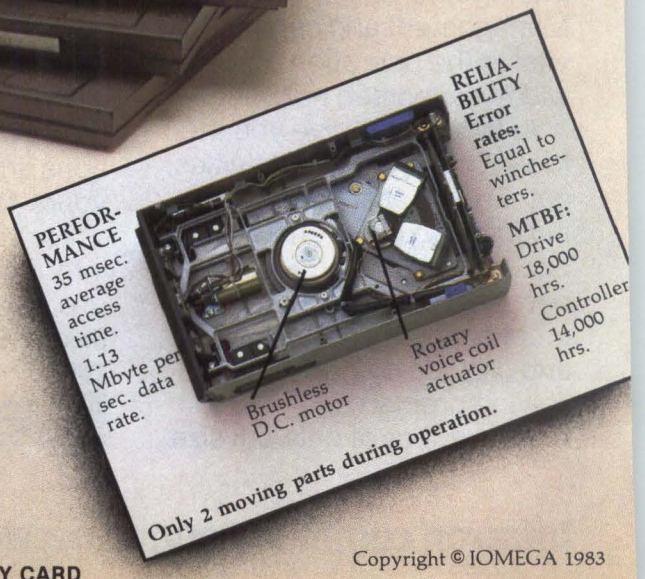

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CIRCLE NO. 41 ON INQUIRY CARD

MARKET BAROMETER

A column devoted to an expert's look at an industry

Sol Sherr, president of Hartsdale, N.Y., consulting company Westland Electronics Ltd., directed a soon-to-be-published study of the flat-panel display market for Frost & Sullivan Inc., New York.

Flat-panel displays: technology choices multiply

Sol Sherr, Frost & Sullivan Inc.

Over the next few years, OEMs designing alphanumeric and graphics CRT terminals, test-and-measurement instruments, cockpit displays and automobile dashboards will find a widening range of well-developed technologies from which to specify flat-panel displays. Applications in which these displays are popular include portable computers and multiterminal systems for banks and other financial institutions. In general, any application of business graphics in which space is at a premium will be a prime market for flat-panel displays.

A forthcoming Frost & Sullivan Inc. study concludes that flat-panel display sales will grow at a compounded annual rate of 34 percent between 1983 and 1987, slowing to 10 percent per year through 1992 in constant-dollar terms. Flat-panel displays accounted for about 49 percent of the display market in 1983, and that share will increase to 60 percent by 1992.

The relative importance of the many technologies involved will shift markedly over the period analyzed. The major trends to watch are:

- **Light-emitting diodes (LEDs),** the first flat-panel display technology to achieve significant success. They will continue to be strong in applications in which high reliability, fast response time and long life are important, which means a large, though gradually decreasing, market share.
- **Thin-film electroluminescence,** which shows great promise for the future. Favored by the military for mobile field units, the technology offers high light-output levels. Its major drawbacks are its relatively high voltage—200V—and frequencies —5 to 10 kHz—which are required for best performance and which result in high power consumption. Work is under way to expand the technology's limited color capability.
- **Gas discharge (plasma),** which promises to become more popular in applications that require many points to be addressed and displayed. Burroughs Corp. developed the DC plasma panel under the Self Scan name. It has since been modified using an AC drive signal on the viewing side of the display and a DC signal on the scanning side. The AC drive offers inherent memory for better light output.
- **Liquid - crystal displays (LCDs),** developed in the United States, although most are now made in Asia. From watch and calculator applications, LCDs have spread to automobile-dashboard displays. Temperature limitations are a problem. Users of LCDs include instrument and matrix-display makers. Matrix-display manufacturers see LCDs as alternatives to CRTs when low power consumption is a requirement. Unless AC and DC gas-discharge displays are combined, LCDs will remain the top-selling flat-panel display technology through 1992.
- **Flat CRTs,** developed in the early 1950s, which have re-emerged as contenders in the market. Frost & Sullivan believes that problems of small displays, limited luminance, low resolution and lack of color capability will keep a cap on sales.
- **Incandescence,** which is used in applications requiring high luminance. Its disadvantages include high power consumption and short lifetimes.
- **Electromechanical displays,** traditionally found in airports and securities-exchange floors. These displays are much too slow for most computer systems, but Sony Corp. is working on a faster display. It will use an electric field that causes small spheres to rotate in liquid.
- **Electrochromics** and **electrophoretics,** which Frost & Sullivan deems not likely to yield viable products by 1992.

Competition for flat-panel display sales is very heavy. Frost & Sullivan identifies 34 domestic suppliers in the market. Among large U.S. companies battling Asian suppliers are Hewlett-Packard Co., General Instrument Corp. and National Semiconductor Corp. for LEDs; Smith Kline Beckman Corp. and Cherry Electrical Products Corp. for DC plasma; IBM Corp. and NCR Corp. for AC plasma; and Hamlin Inc. for LCDs.

U.S. MARKET FOR FLAT-PANEL DISPLAYS
(in constant $ millions)

Technology	1983	%	1992	%
Light emitting diodes	$90	29.5	$180	11.1
Thin-film electroluminescence	5	1.6	225	13.9
Gas discharge (plasma)	55	18.1	555	34.3
Liquid-crystal displays	99	32.4	405	25.0
CRT	5	1.6	100	6.2
Other	51	16.8	155	9.5
Total	$305	100	$1,620	100

Source: Frost & Sullivan Inc.

Financings

Local-area-network (LAN) vendor **Bridge Communications Inc.**, Cupertino, Calif., has raised $9.8 million in its third round of venture-capital financing. The money will be used for marketing, sales and general working capital. Main investors include Abingworth Ltd.; Weiss, Peck and Greer-Lawrence; and The Hillman Foundation. Bridge's Ethernet system product line links computer devices to an Ethernet network and links Ethernet to other networks such as X.25. Two previous rounds of venture financing netted the company $5.8 million.

Another LAN vendor, **Proteon Associates Inc.**, Waltham, Mass., recently received almost $2.4 million from a group led by Sevin, Rosen, Bayless & Borovoy and Kleiner, Perkins, Caufield & Byers III. Proteon's proNET network links mainframes, minicomputers and personal computers.

Metagraphics Inc., Woburn, Mass., recently received $4.7 million in its second round of venture financing. The two-year-old company sells a drawing-conversion system for computer-aided-design/computer - aided - manufacturing (CAD/CAM) systems. Lead investors are Sutter Hill Ventures and Eastech Management.

Annual report

Intel Corp. has passed the $1 billion mark in revenues. For the fiscal year that ended Dec. 31, the company's revenues totaled $1.1 billion, vs. $899.8 million the previous year. Intel chairman Gordon Moore says, "The deluge of orders that began last June shows no sign of abating, so we expect that 1984 will be an excellent growth year for us." Net income for the year more than tripled from $30 million, or 32 cents per share, to $116.1 million, or $1.05 per share. Fourth-quarter revenues were $332.4 million, vs. $239.4 million in the same period a year earlier. Net income was $47.1 million, or 40 cents per share, compared to $8 million, or 9 cents per share a year earlier.

BOX SCORE OF EARNINGS

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

Company	Period		Revenues	Earnings	EpS
Alpha Microsystems	9 mos.	11/27/83	$37,739,000	2,744,000	.95
	9 mos.	11/28/82	20,422,000	1,032,000	.38
Burroughs Corp.	year	12/31/83	4,389,700,000	196,900,000	4.60
	year	12/31/82	4,186,300,000	117,600,000	2.80
Comshare Inc.	6 mos.	12/31/83	36,208,900	499,800	.12
	6 mos.	12/31/82	38,672,400	374,500	.09
Corvus Systems Inc.	6 mos.	11/30/83	27,315,000	(1,086,000)	(.10)
	6 mos.	11/30/82	21,330,000	1,855,000	.20
Data General Corp.	12 wks.	12/17/83	219,600,000	9,000,000	.36
	12 wks.	12/18/82	181,400,000	3,100,000	.14
Entré Computer Centers Inc.	3 mos.	11/30/83	5,416,000	1,081,000	.13
	3 mos.	11/30/82	831,000	(136,000)	(.02)
Harris Corp.	6 mos.	12/30/83	904,773,000	36,738,000	.92
	6 mos.	12/31/82	854,555,000	36,150,000	.92
Honeywell Inc.	year	12/31/83	5,753,100,000	231,200,000	5.03
	year	12/31/82	5,490,400,000	272,900,000	6.08
IBM Corp.	year	12/31/83	40,180,000,000	5,485,000,000	9.04
	year	12/31/82	34,364,000,000	4,409,000,000	7.39
MCI Communications Corp.	12 mos.	12/31/83	1,521,460,000	202,912,000	.89
	12 mos.	12/31/82	906,596,000	151,415,000	.78
NCR Corp.	year	12/31/83	3,730,951,000	287,665,000	10.55
	year	12/31/82	3,526,217,000	234,411,000	8.75
Prime Computer Inc.	year	12/31/83	516,503,000	32,503,000	.68
	year	12/31/82	435,826,000	44,926,000	.99
ROLM Corp.	6 mos.	12/30/83	288,112,000	15,760,000	.60
	6 mos.	12/31/82	241,459,000	17,190,000	.95
Sykes Datatronics Inc.	9 mos.	11/30/83	25,814,020	(3,122,112)	(.24)
	9 mos.	11/30/82	33,367,217	1,255,682	.10
Tandy Corp.	6 mos.	12/31/83	1,481,695,000	160,880,000	1.54
	6 mos.	12/31/82	1,295,266,000	146,676,000	1.41
Ziyad Inc.	9 mos.	11/30/83	15,381,000	1,643,000	.33
	9 mos.	11/30/82	10,203,000	836,000	.21

Comments: Data General Corp.'s per-share data have been adjusted to reflect a two-for-one stock split that took effect last Nov. 18. DG president Edson deCastro said orders and shipments continued to improve, but future growth would also depend on the availability of raw materials and components, especially semiconductors. **Entré Computer Centers Inc.** opened 41 stores during its first quarter, bringing the total to 100 at the end of the quarter. Entré expected that growth rate to continue during the second quarter. In December Entré gained $11.8 million from its initial public offering. **Prime Computer Inc.'s** fourth-quarter revenues increased to $142.8 million from $118.3 million a year earlier. Net earnings for the quarter were $10 million, or 21 cents per share, vs. $12.2 million, or 26 cents per share, a year earlier. Prime said orders increased during the quarter, particularly for the new high-end 9950 superminicomputer. Prime plans an "aggressive" product-introduction schedule for this year.

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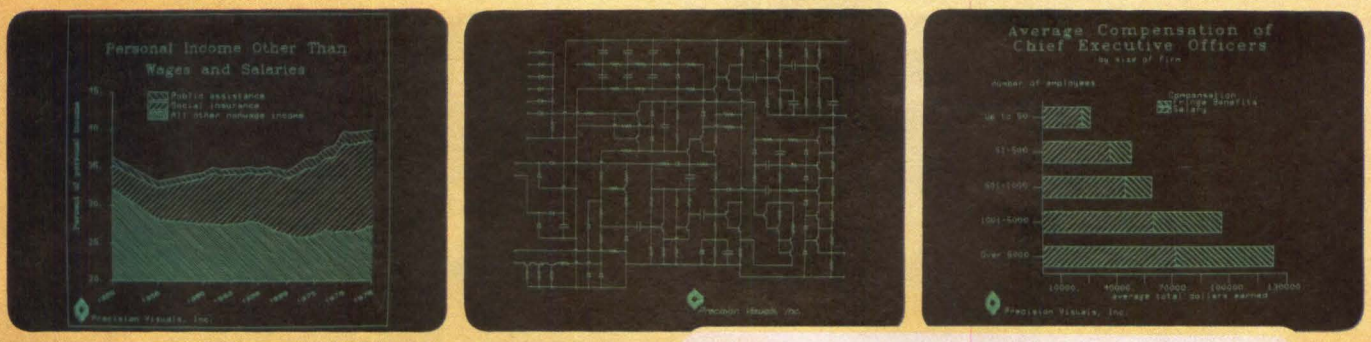

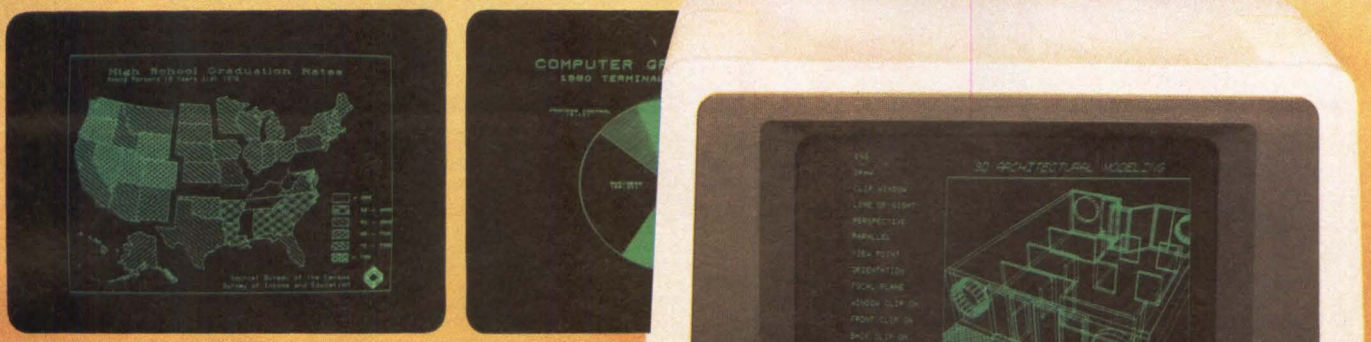

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Horizontal Resolution	768	768	640	640	800	800	1225	1225	780
Dot Density Ratio	1:1	1:1	1:2	1:1	1:3	1:1	1:4	1:4	1:1
Screen Size	14"	14"	12"	12"	12"	12"	12"	12"	12"
Tektronix 4014 Compatible	STD	STD	NO	NO	NO	STD	NO	STD	STD
Data Tablet Support	STD	STD	NO	NO	OPT	OPT	NO	NO	NO
Multi-Vendor Printer Support	STD	STD	OPT	OPT	OPT	OPT	OPT	OPT	OPT
8 Dir. Cross Hair Cursor	STD	STD	NO	NO	NO	NO	OPT	OPT	OPT
Programmable Function Keys	STD	STD	NO	NO	NO	NO	NO	NO	NO
Tilt/Swivel Enclosure	STD	STD	NO	NO	NO	NO	NO	NO	NO
Compatibility	VT52 ADM3A H1500 D200	VT100 VT52 ANSI X3.64	VT100 VT52	VT100 VT52	VT100 VT52	VT100 VT52	VT100 VT52	VT100 VT52	VT100 VT52
PRICE (suggested list*)	$2,495	2,695	3,025	3,355	3,025	3,510	2,890	3,390	3,190

*Retrothoughts price includes DEC VT100® terminal based on published information as of 4/1/83.

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CIRCLE NO. 43 ON INQUIRY CARD

Sinclair's $499 microcomputer may make U.S. debut this year

Keith Jones, European Editor

Famous for crashing price barriers in the home computer market, Sinclair Research Ltd., London, is now using low cost to attract professional users. The bait is the Sinclair QL, which was launched in Europe in January and should make its U.S. debut in the third quarter of this year.

QL stands for quantum leap, a deserved title in Sinclair's view because the system includes a Motorola Inc. MC68008 CPU with a 32-bit internal word length and 8-bit data bus for $499. Other features include 128K bytes of main memory, a color monitor port and four integrated software packages for word processing, spreadsheet manipulation, database management and business graphics. The QL runs the proprietary single-user, multitasking QDOS operating system.

Two integral devices, called Microdrives, provide mass storage. Each provides 100K bytes of memory on match-box-sized removable tape cartridges. Average access time is 3½ seconds, making the Microdrives suitable only for program loading. Users can add as many as six extra Microdrives using an external extension slot.

Sinclair plans to add 0.5M bytes of plug-in RAM *to its new QL business computer, scheduled for U.S. debut in the third quarter.*

A GLANCE AT THE SINCLAIR QL

- MC68008 based
- 128K-byte main memory
- Color monitor port
- Four integrated software packages
- Proprietary QDOS operating system
- Two 100K-byte integral Microdrive tape cartridges
- SuperBASIC programming
- Priced at $499
- U.S. debut scheduled for third quarter

Expected features

- O.5M-byte plug-in RAM
- Parallel printer interface
- Interface for separate Winchester disk subsystem

Mail order is first route

The QL will initially be available in the United States only by mail order. To succeed it needs retail outlets and extensive support facilities, says Clive Smith, director of research at the Yankee Group, Boston. Only then can it achieve the kind of sales levels that will encourage third-party software vendors to develop packages for the machine. "The QL is clearly a price breakthrough," acknowledges Smith, "but such a machine needs to sell half a million units in its first year. Otherwise, it is dead in the water."

Maggie Bruzelius, marketing director at Sinclair's U.S. headquarters, Sinclair Research Inc., Boston, notes that Sinclair is developing support systems for the QL in the United States. She says the Boston office has received inquiries from several software houses interested in creating packages for vertical markets. She believes that, although British software house Psion Ltd., London, developed the QL's four bundled packages, they are suitable for U.S. users.

Bruzelius notes that Sinclair will control U.S. marketing of the QL, rather than Timex Corp., Middlebury, Conn., which handled U.S. sales of Sinclair's home computers until earlier this year.

OS poses no hindrance

Smith at the Yankee Group doubts that the non-compatibility of the QL's QDOS operating system with IBM Corp.'s PC-DOS will limit the QL's success in the United States. QDOS' windowing features enable each running program to be independently scrolled within its window. The system uses the SuperBASIC programming language, which Sinclair claims offers major advantages over conventional BASIC. The advantages include a

procedure facility that allows code to be written in clearly defined blocks and an execution speed independent of program size. Sinclair plans to introduce an MC68000 assembler and compilers for Pascal and C.

Users can carry the 3-pound QL between home and office. The system can be plugged into a television receiver or a red-green-blue monitor. It has two display modes—four colors at a 512-by-256-pixel resolution and eight colors at 256 by 256 pixels.

Sinclair plans to add a plug-in memory expansion board providing 0.5M bytes of additional storage, a parallel printer interface and an interface for a physically separate Winchester disk drive subsystem.

The QL uses four semi-custom ICs to control display, memory and Microdrive functions. Use of semi-custom chips contributes significantly to the low cost and compactness of the QL, according to a Sinclair spokesman. □

Psion makes Sinclair programs generally available

British software house Psion Ltd., London, which developed the software for Sinclair Research Ltd.'s QL microcomputer, plans to offer the packages to other personal computer manufacturers.

Psion projects manager Peter Norman believes the four Sinclair programs can be tailored to run on other machines. He claims they provide a combination of word-processing, spreadsheet, database-management and graphics facilities. The packages allow data to be transferred between programs using import and export commands.

Psion also offers a free mail service to QL users in Britain who pay a $50 annual fee to belong to the QL Users Bureau. The service offers users mail advice from Psion, an annual update of each program and a bimonthly newsletter from Sinclair that includes information on the Psion software and the QL hardware. Maggie Bruzelius, marketing director of Sinclair's U.S. headquarters, Sinclair Research Inc., Boston, says Sinclair will establish a comparable users bureau for QL in the United States.

ISO, ANSI collaborate on text-interchange standards

Keith Jones, European Editor

Standards makers on both sides of the Atlantic are establishing formats, procedures and protocols for transferring text information between different manufacturers' computer systems. The standards will define the functions needed to specify a document, package it for transmission and direct it from one system to another.

One standards-making body, the International Standards Organization (ISO), is expected to draft proposals for international text-preparation and -interchange standards this year. A key area for which ISO will define standards is document structure.

David Terrie, director of office automation at The Yankee Group, a Boston market research company, says interchange standards must make a quantum leap in complexity from today's data-only standards. Future standards will define control and formatting for compound documents that mix data, text, graphics, facsimile and digitized voice. Terrie says such standards will substantially affect systems vendors' application software.

ISO's subcommittee (SC) 18 of technical committee (TC) 97, which oversees all information-processing standards, is formulating the proposals. Michael Bedford, SC 18 chairman and manager of data communications at Burroughs Corp., Detroit, expects ISO to submit draft proposals after SC 18's annual May meeting in Berlin. He predicts that TC 97 will approve the proposals as draft international standards in 1985. System integrators and users could then implement the proposed standards in systems. After formal ISO approval, the proposals will become official standards.

Closely cooperating with ISO is the American National Standards Institute (ANSI). "I encouraged ANSI to parallel the structure of SC 18," says Bedford. The ANSI committee corresponding to SC 18 is X3V1, which has nearly 60 members on the ISO subcommittee. X3V1 chairman Millard Collins, who works in the office systems standards section of IBM Corp.'s National Accounts division, says ANSI is eager to establish an international standard for text interchange. He believes IBM's developments in document structure are similar to the SC 18's activities.

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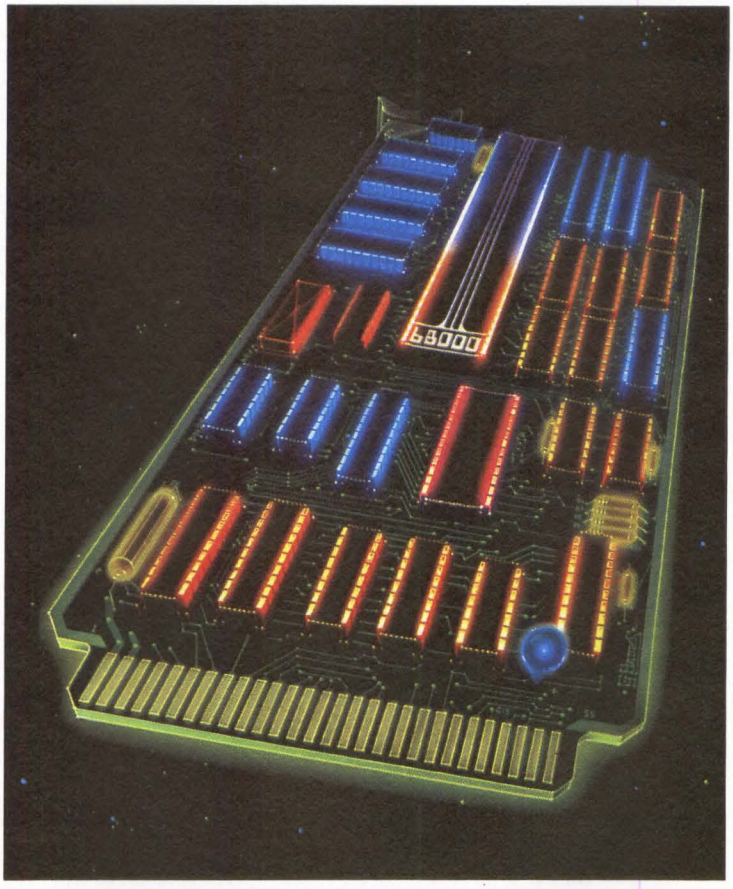

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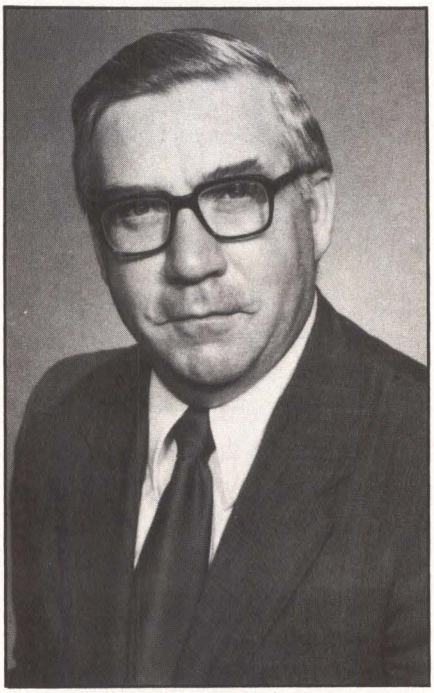
SC 18 document-structure proposals are office-document architecture (ODA) and office document-interchange format. IBM's equivalent offerings are document-content architecture (DCA) and document-interchange architecture (DIA).

Data General Corp. and Hewlett-Packard Co. have announced their intentions to support IBM's DCA/DIA proposals. Gordon Dennis, information systems marketing manager at DG's European headquarters in Paris, believes manufacturers will have to provide bridges between ISO and IBM if the two announce proposals with incompatibilities. HP is preparing a DCA/DIA interface for its Deskmanager software at its Crowthorne, England, software-development center. Martin Lambert, worldwide product manager for Deskmanager, believes interfaces for both the IBM and ISO proposals are needed.

Reinforcing SC 18's document-structure proposal is the European Computer Manufacturers Association (ECMA), which has contributed to the SC 18's document-structure working group, according to the group's chairman Dr. Tim Wells. ECMA document-structure committee chairman Loek Zeckendorf of Philips Data Systems B.V., Apeldoorn, the Netherlands, notes that his committee's ODA proposals to ISO account for both the logical structure and the physical layout of documents. The already-published ODA draft defines the logical structure using text objects, such as chapters, sections, paragraphs, forewords, abstracts and footnotes. It defines the physical layout using "objects," such as page, frame and block. Layout directives relate layout and text objects, specifying, for example, on which page a chapter should start. The ECMA proposal embraces graphics and text.



Michael Bedford, chairman of the ISO SC 18 subcommittee, *says, "I encouraged ANSI to parallel the structure of SC 18."*

Other SC 18 projects that could soon become standards include:

- Defining computer languages for text processing. The SC 18 is working with ANSI in this area. ANSI officials say the definition will provide functions for processing raster and vector graphics, North American standard videotex and straight text. The proposed standard will be ideal for use with 16- and 32-bit microcomputers with 128K bytes of RAM.
- Interchanging text messages, including addressing and routing. The ISO is working in this area with the International Consultative Committee for Telephone and Telegraph (CCITT), which is based in Geneva, Switzerland.
- Positioning text for hard-copy devices.
- Imaging text to be presented in readable form, such as color. □

IEM ANNOUNCES FORTRAN-77 COMPILER

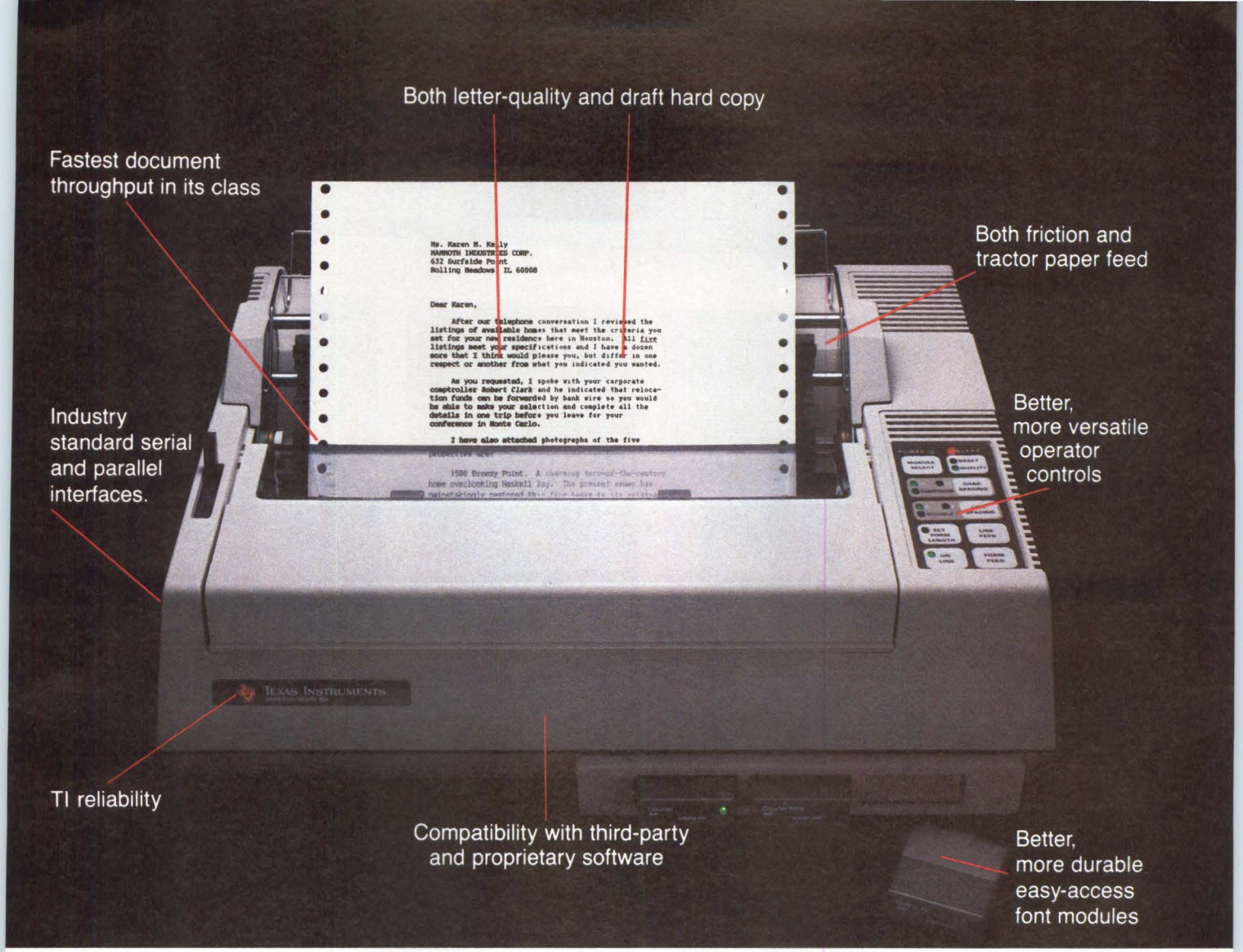
International Electronic Machinery (IEM) Inc., Fort Collins, Colo., has introduced an ANSI FORTRAN-77-compatible compiler for Hewlett-Packard Co.'s 68000-based Series 200 desktop computer. IEM officials say the compiler's ANSI FORTRAN-77 compatibility makes the system attractive to those who use FORTRAN-77 on mainframes and want to run it on a single-user machine. Price of the compiler is $1,200.

NUMBER OF BANKING PACKAGES INCREASES

The winter edition of *Data Sources* lists 1,150 banking packages, including 358 new releases. Most of the packages are for IBM Corp. machines—31.5 percent for mainframes and 21.5 percent for the IBM PC. Only 5.9 percent of the packages run under Digital Equipment Corp. machines. The number of financial-services applications has also increased. *Data Sources'* list of 1,327 packages includes 543 new releases.

CCG UNVEILS HIGH-DENSITY GCR SUBSYSTEMS

California Computer Group Inc., Costa Mesa, Calif., has introduced two magnetic-tape subsystems using low-cost, high-density group code recording (GCR). The STC 2920 and Kennedy 9400 subsystems are designed for use in minicomputers from Digital Equipment Corp., Data General Corp. and others. Bit density of the two subsystems is 6,250 bits per inch. A standard 10½-inch reel of magnetic tape holds 180M bytes of data. Single-unit price of the 2920, which operates at 50 inches per second (ips) in start/stop mode, is $11,300. The 9400 operates at 45 ips in start/stop mode and includes built-in data buffering, which allows the drive to transfer data at rates compatible with slower interfaces. Price is $12,100.



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Software Compatible. The TI 855 uses industry standard escape sequences for compatibility with virtually all third-party software. And for those with proprietary software needs, a model is available with ANSI standard escape sequences.

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CIRCLE NO. 47 ON INQUIRY CARD

OVERHEAD OVERSEAS

AT&T gets a bargain with Olivetti investment

Tim Palmer, European Contributor

There's some confusion about whether the agreement in principle under which AT&T will pay $260 million for a 25 percent stake in Italy's Olivetti SpA commits AT&T to sell Olivetti products in the United States. AT&T says no; Olivetti says yes. If the agreement is consummated, AT&T would buy access to a bewildering array of products and high-technology investments.

When Olivetti head Carlo de Benedetti stepped in to rescue the floundering typewriter and small systems company in 1978, he inherited visible-record computers, banking terminals, VDTs and small scientific and business computers—many of which Olivetti had purchased from OEMs or licensed from the likes of Digital Equipment Corp., Northern Telecom-Sycor and Microdata Corp.

Olivetti unifies product lineup

Under de Benedetti, Olivetti has swept away all those products, replacing them with a unified product line called Linea Uno, which ranges from the low-end M20 to the forthcoming M60 UNIX microcomputers. The M60 is based on single or multiple configurations of the Zilog Inc. 16-bit Z8000 microprocessor.

Because of the logic of unifying the product line, one might wonder why Olivetti chose the Z8000 over clearly more successful processors, such as the MC68000. Olivetti chose the Z8000 because the Italian government owns Zilog's European second source, SGS. Europeans tend to be nationalistic in such choices.

Linea Uno will employ multiple M30 and M40 microcomputers, the workhorses of the line. They will be networked, but each workstation will have a dedicated function, such as word processing, graphics or data processing, determined by software.

The M30 and M40 feature one or two central Z8000s and support Z8000 workstations: between them they emulate a line of DEC PDP-11-based bank terminals, an 8080-based office computer line and an intelligent 3270-type terminal. Next up will be an M60 running UNIX, and 32-bit, Z80000-based M80s and M90s are expected to follow.

Gaining access to holdings

AT&T is buying access to a wealth of disparate—mainly American—products as a result of investments made by Olivetti over the past three years. Olivetti-controlled company Logabax is building a variant of Eagle Computer Inc.'s IBM-compatible personal computer in France and an electronic-cash-register version of the M20. Olivetti also owns 24 percent of IPL Systems Inc., which makes IBM 4300-compatible systems, 7.8 percent of Lee Data Corp., which makes 3270-type terminals, and, hedging its bets on PC compatibility, less than 10 percent of Corona Data Systems, another PC "clone" supplier.

In private-branch exchanges, it has 6.5 percent of InteCom Inc. and 22.4 percent of David Systems. It has 9.5 percent of fault-tolerant computer manufacturer Stratus Computer Inc., 34.9 percent of disk drive and printer maker Irwin Magnetics and 3.2 percent of Tabor Corp., which is pushing the 3¼-inch floppy disk drive. It also owns 18.9 percent of Syntrex Inc., which used to be in the business of turning IBM Selectric typewriters into word processors. Its products are now adapted to Olivetti's typewriters, redesigned and integrated into Linea Uno.

Olivetti is off on a second round of investments, the first of which is to buy 25 percent of a new British company, Sphinx, which was formed to offer one-stop shopping to system integrators specializing in UNIX.

In many ways, AT&T gets a bargain under the Olivetti agreement. For about the same price, IBM Corp. paid for a 12 percent share of Intel Corp., AT&T got 25 percent of a company twice Intel's size.

It's very puzzling, in light of all this, that AT&T should snub its new bride and sign an enormous order with Convergent Technologies Inc. Convergent will design and manufacture as-yet-unspecified microcomputers for AT&T.

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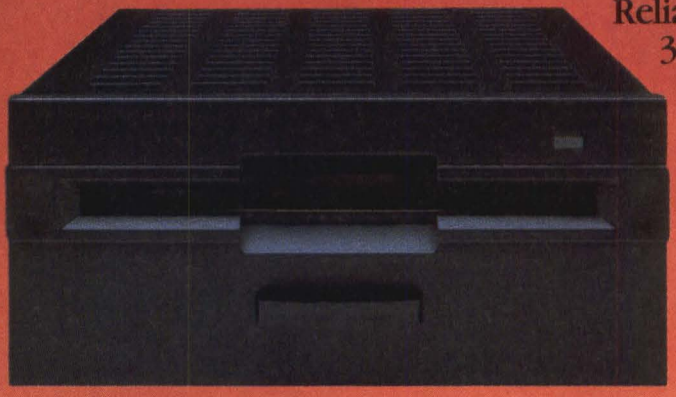

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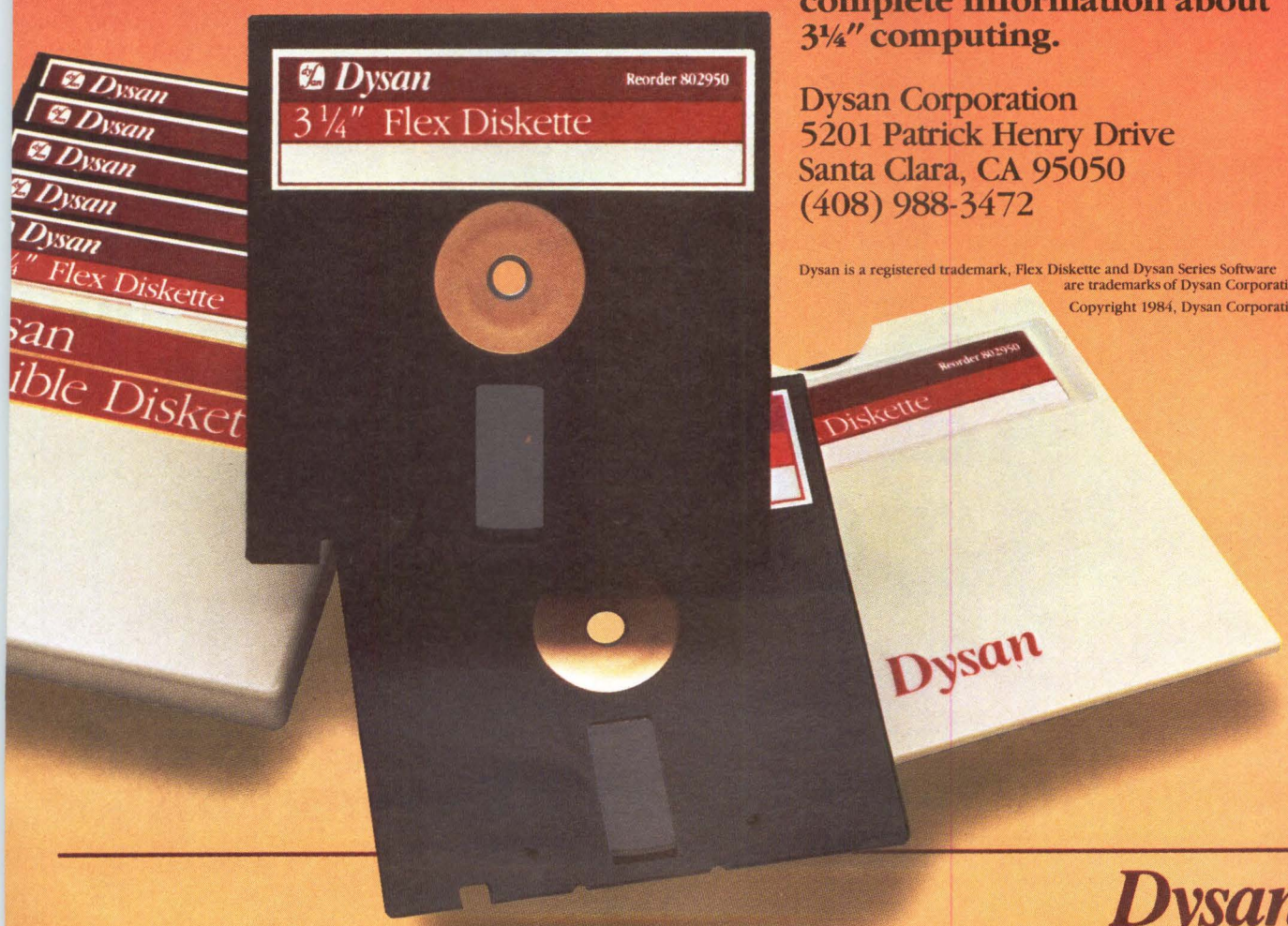

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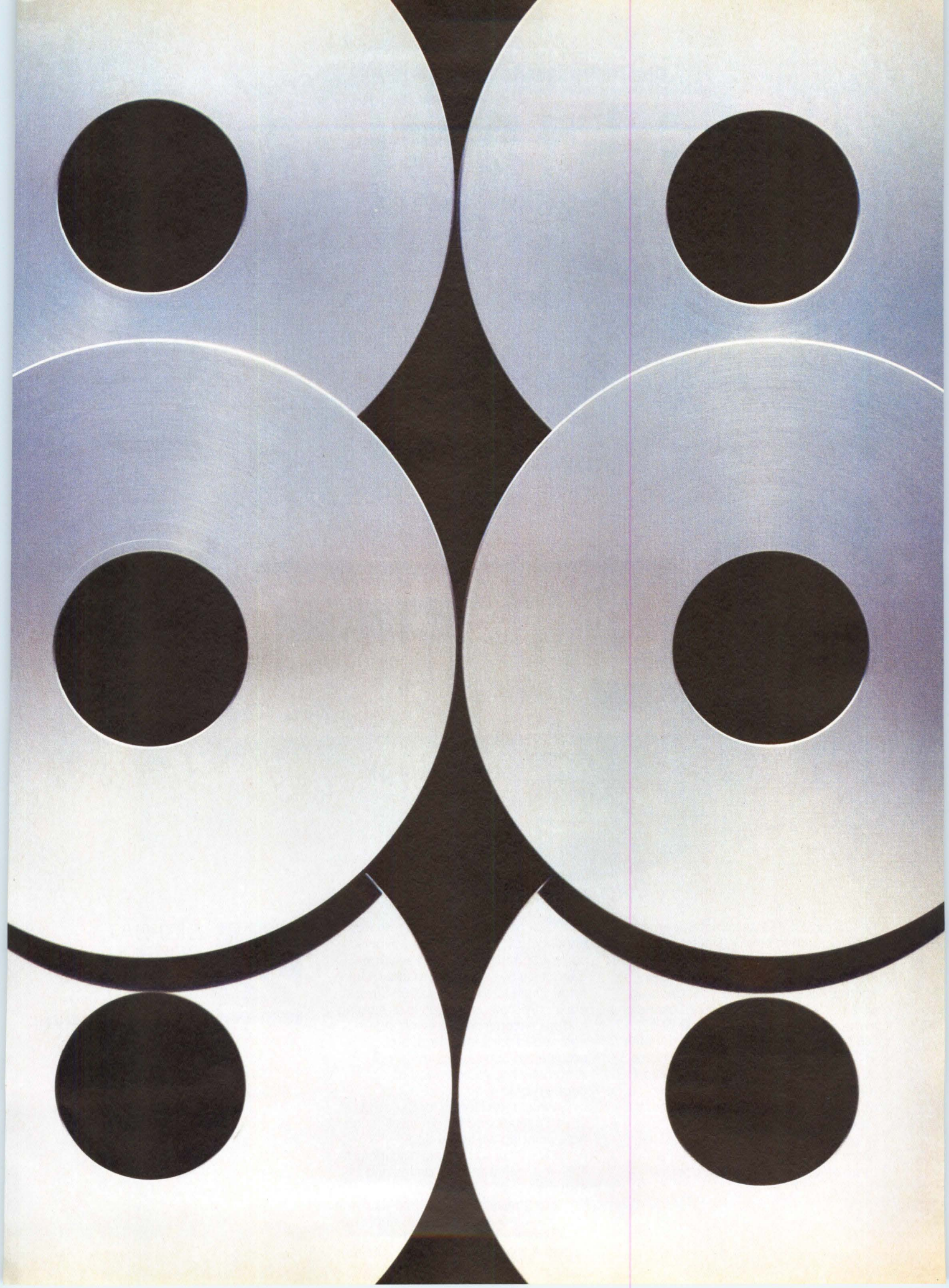

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Keyboards become the latest computer peripheral

Trend toward detached, intelligent keyboards opens doors for manufacturers

Sarah Glazer, Senior Editor

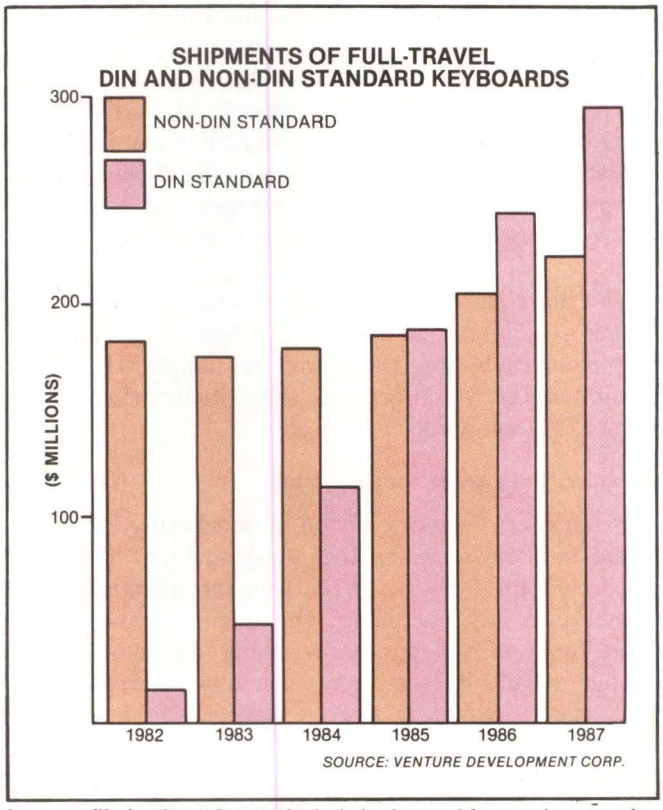
A few years ago, keyboards were typical computer components. They shared a case with a monitor or processor, wired in like other parts. But that's not so anymore. Today, many keyboards come from a factory in their own cases. They're ready to plug into a computer or monitor and contain their own printed-circuit boards. Keyboard suppliers are now tapping this intelligence to build in extras such as interfaces for mice or for voice recognition, and some suppliers are starting to sell directly to end users and system integrators.

"Awareness of keyboards becoming peripherals is just starting to grow," reports Mark Tiddens, corporate marketing manager of Key Tronic Corp., Spokane, Wash., the leading independent U.S. manufacturer of computer keyboards. "The only thing a keyboard doesn't have is an RS232 interface." Because it is virtually the only part of a computer that isn't shrinking, a keyboard is the logical place to put an interface for a mouse, a voice-recognition device or an optical character reader.

The trend toward enhanced keyboards is one reason manufacturers are changing their marketing rule of selling only to OEMs. Another reason is that OEMs themselves are changing the rules by unbundling their products. IBM Corp.'s announcement last summer that it would sell its PC keyboard (which it makes at its own keyboard plant) separately opened the door to a spate of plug-compatible keyboards from independent manufacturers.

"Selling to end users is a whole new business for us," Tiddens acknowledges. Key Tronic conducts its end-user business through advertising and distributors. An unexpected bonus from developing products for end users was gaining new OEM contracts—to supply keyboards to PC-compatible manufacturers, including Compaq Computer Corp., Columbia Data Products Inc., Eagle Computer Inc. and Corona Data Systems Inc. Tiddens reports that shipments to end users and OEMs of "standard" items—plug-compatible keyboards for the IBM PC and the Apple II, among others—represent 20 percent of Key Tronic's total units shipped. Tiddens also expects to start selling directly to system integrators. "This market is totally new to us," he admits. "We're just now developing relationships with system integrators and software houses."

Independent suppliers are accustomed to working with small customers because most big computer companies rely on captive suppliers for their keyboards. One widely publicized recent exception is IBM, which is buying keyboards for its PCjr from independent manufacturer Advanced Input Devices (AID) Inc., Coeur d'Alene, Idaho. The non-captive market for full-travel keyboards (including those used in equipment other than computers) totaled almost $195 million in 1982, estimates Venture Development Corp. (VDC), a Wellesley, Mass., research organization.



Low-profile keyboards, *particularly in demand for word processing and data entry, conform with German Deutsche Industrie Norm (DIN) standards for user comfort and safety. Because most new full-travel keyboards meet these requirements, research organization Venture Development predicts DIN-standard keyboards will lead in this market segment by 1986.*

As keyboards become more uniform, they move closer to being true peripherals, believes marketing manager James Wieser of the Cortron division of Illinois Tool Works Inc., another keyboard supplier beginning to sell to end users. Not long ago, each OEM wanted its keyboard to be unique. Wieser reports that Cortron may develop a family of standard products, although its only current off-the-shelf keyboard is an IBM PC-compatible. He attributes today's move toward standardization to the IBM PC's popularity: "The IBM PC keyboard is the closest thing to a standard in our industry." Although Wieser believes keyboard manufacturing will remain overwhelmingly a custom business, he predicts that standard products could account for 20 percent of the market.

Because it is virtually the only part of a computer that isn't shrinking, a keyboard is the logical place to put an interface for a mouse, a voice-recognition device or an optical character reader.

Skeptical of this prediction is Ed Waters, planning manager for Micro Switch, Freeport, Ill., a division of Honeywell Inc. and a longtime leader in the keyboard industry. Micro Switch has no immediate plans to sell directly to end users or system integrators. "Basically, you're competing with your own customers," Waters says.

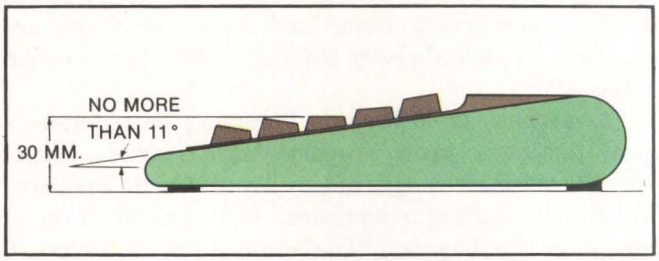
"We don't see a conflict with OEMs," counters Key Tronic's Tiddens. When Key Tronic introduced a plug-compatible keyboard for the Apple II, Apple Computer Inc. volunteered to share its drawings of the Apple IIe keyboard.

New technologies reduce cost

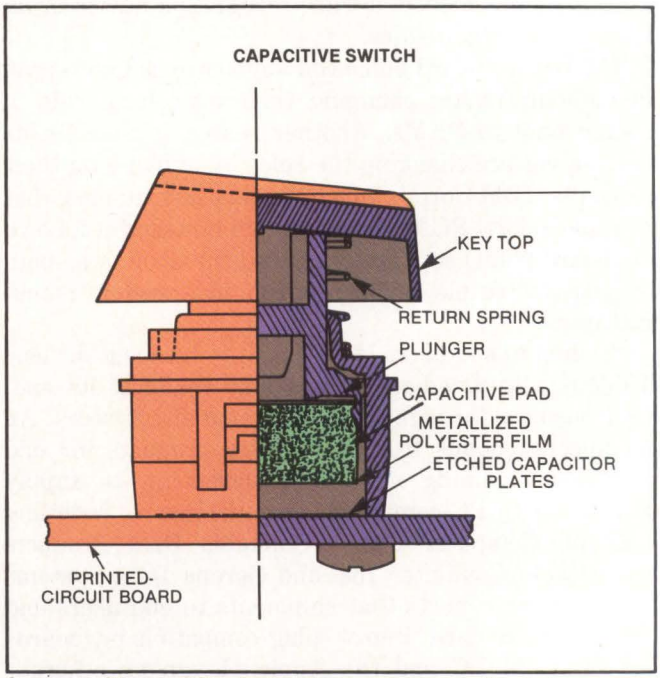
Despite new energy aimed at marketing, the keyboard industry remains technology-driven. The most important force in the 1970s was the introduction of capacitance key switching, the dominant technology used today. Capacitance switching depends on the change in capacity between two charged plates or pads that occurs when a key is depressed. It quickly outpaced more expensive, magnet-based technologies, including Hall-effect, inductive-core and reed switching —all still used in applications requiring keyboards with particularly long lifetimes.

Capacitance keyboards will remain the industry leader for the next five years, predicts VDC. Used mostly in computers and business machines for high-speed data entry, full-travel capacitance keyboards "give the feel people are used to and are reliable enough to last the lifetime of the product," reports VDC analyst Lisa DiRocco. Full-travel keys mimic the feel of popular electric typewriter keyboards, while less expensive "micromotion" keys and flat panels give an unfamiliar feel.

Key Tronic's development of the first capacitance keyboard catapulted it to first place among independent keyboard suppliers. Although other suppliers have since developed capacitance products, Key Tronic estimates that it made 80 percent of the capacitance keyboards sold to domestic manufacturers in 1982 and that capacitance keyboards represented one-third of that year's non-captive domestic market. The company's fiscal 1983 revenues of $80.5 million were more



A low-profile keyboard conforms to DIN standards *that limit the distance between the home row of keys and the tabletop. German researchers found that this measurement and the angle of the key rows are crucial in preventing operator fatigue.*



In capacitive-switch technology, *the capacity between two charged plates or pads changes as a key is depressed. (Courtesy of Key Tronic Corp.)*

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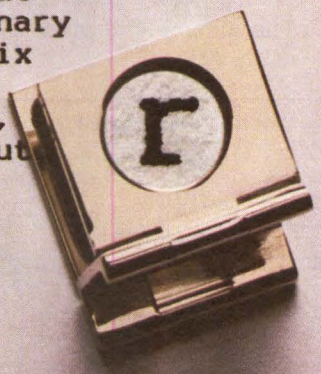

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than twice the $35 million that Key Tronic's Tiddens estimates for its closest rival, Micro Switch.

Today, two new contenders threaten the supremacy of capacitance switching: membrane and conductive-rubber technologies. Although keyboards based on these technologies are less expensive than capacitance keyboards, both have problems ranging from unreliabilility to unacceptable feel.

Horror stories haunt membrane technology

Membrane key panels usually consist of two layers of polyester film traced with silver ink, separated by a spacer sheet that has holes in contact areas. Primarily used in flat panels for instrument, appliance and game controls, membranes fully seal a control panel, which is especially useful in industrial, medical and other harsh-environment applications. A conventional key set can also press down the top membrane, bringing these keyboards into the high-duty data-entry arena. Although developers heralded membranes as the low-cost keyboard of the future, persistent problems muted their praise.

"Horror stories," is how AID president John Overby describes the industry's problems with membrane keyboards. Although AID is developing a membrane keyboard, the project is taking a back seat to current products. Overby says the most disturbing problem about membrane keyboards is "latent failure," in which the units become unreliable two or three years after delivery. He claims that many of AID's customers for its micromotion keyboards are former users of membrane keyboards who "are getting burned on reliability and are coming in to do a retrofit."

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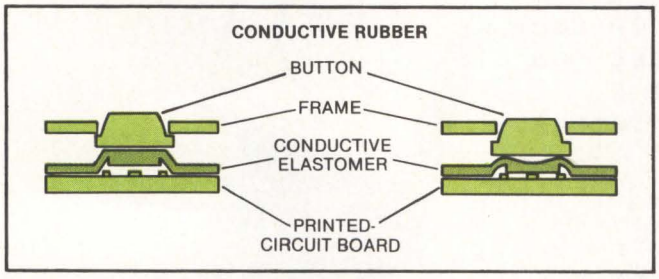
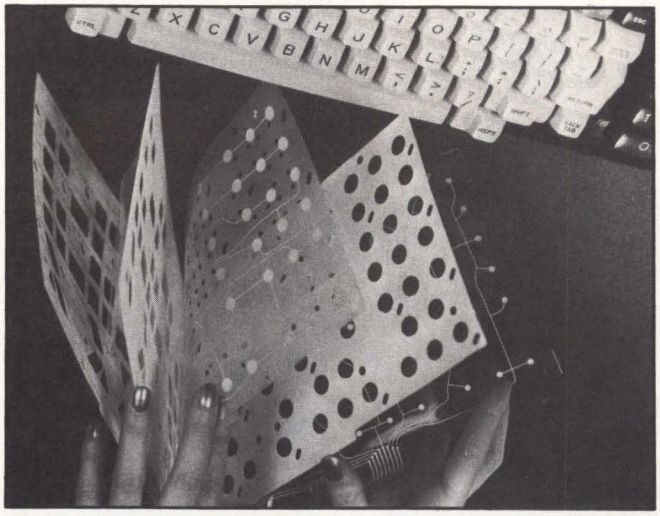


Conductive-rubber switch technolgy *uses a molded sheet of rubber that forms a dome beneath each key. When a key is depressed, the dome collapses and makes contact with the circuit below it. The dome then pops up again.*



Membrane-switch technology *uses a plastic sandwich that contains a spacer sheet with holes for the contact areas. Although many membrane keyboards are flat panels, they can also be actuated by full-travel keys. (Courtesy of Micro Switch)*

"We don't claim [our membrane keyboards have]as high a life as Hall-effect keyboards," says Micro Switch's Waters. The Micro Switch full-travel membrane keyboard is actuated by capacitance key switches. He rates Micro Switch's membrane keyboard at 30 million actuations compared with 100 million actuations for the life cycle of a Hall-effect keyboard. A typical capacitance keyboard is rated at 100 million actuations.

Key Tronic also manufactures a membrane keyboard, which it rates at 50 million actuations. Key Tronic's Tiddens admits that, in two years, the keyboard attracted only one significant customer: Gavilan Computer Corp. Because a membrane keyboard doesn't require a printed-circuit board, it is particularly useful in equipment without detached keyboards, such as portable computers.

"The membrane keyboard has a problem now with market acceptance," says Craig Stout, president of Maxi Switch, Minneapolis, which is developing a membrane keyboard. "Customers are perceptive about the problems, and they're gun-shy." Although Stout believes membrane technology holds advantages, particularly in price, that will be tapped in the future, he says Maxi Switch will not bring its membrane keyboard to market yet.

Another technology that promises reduced cost is conductive-rubber switching. The technology, especially popular in Japan, is not new. But recently developed materials have for the first time made its use viable for high-end applications. To produce a conductive-rubber keyboard, manufacturers mold a sheet of conductive

Controversy surrounds IBM PCjr keyboard

"It's not a typeable keyboard. I've typed on the PCjr keyboard, and it's really tiring," claims Mark Tiddens, marketing manager for Key Tronic Corp., Spokane, Wash. For one thing, the 3 ounces of force needed to depress a key is much higher than the 2 ounces Tiddens claims is required for minimum fatigue. For another, the keyboard is so flat that "your fingers just won't stay on the keys" and keep slipping off the home row, he reports.

That's not what IBM Corp. found when it performed "extensive tests" on the keyboard with a cross section of users ranging from high-speed typists to people who had no experience in using keyboards, insists John Overby, president of Advanced Input Devices (AID) Inc., the Coeur d'Alene, Idaho, company that manufactures the PCjr keyboard. In a test that included 29 keyboards, the top two choices were the IBM PC and PCjr keyboards, he claims.

IBM's desire for a changeable bezel overlay for the key legends dictated the unusual rectangular ("Chicklet") key shape on the PCjr keyboard, Overby says. The PCjr keyboard is a modified version of an earlier AID design called the Ergokey. "It's a particularly good idea for the education market or even for the business market where people want to change the overlay to match different software," Overby maintains.

Tiddens concedes that IBM may well be committed to the bezel keyboard for the educational market, but he believes IBM will introduce another, more standard keyboard for the business market. "I think IBM is just fooling the whole world in its direction on the PCjr," he speculates. "I don't think it was intended for the home market." Overby refuses to comment on future AID products, but he does not deny that other PCjr keyboards might be in the works.

Whether or not IBM offers alternative keyboards, other suppliers will. They include Key Tronic, Maxi Switch, Minneapolis, and the Cortron division of Illinois Tool Works Inc., Elmhurst, Ill. The very fact that the original keyboard is not standard "provides a good opportunity for many keyboard manufacturers to market an emulation with the same key tops as their existing lines," says Cortron marketing manager James Wieser.

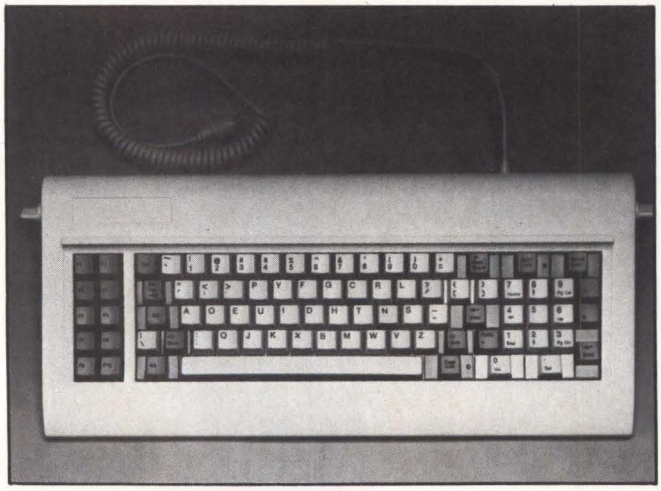
The rectangular shape of keys for the IBM PCjr *(lower keyboard) allows enough room between rows to accommodate a bezel template, explains John Overby, president of Advanced Input Devices, which manufactures the keyboard. The flexibility provided by changeable templates is particularly useful in the education market, he says.*

Wieser predicts that plug-compatible keyboards will also omit another controversial feature of the PCjr keyboard: the infrared link that connects the keyboard to the computer. Instead of using a cable, the keyboard emits infrared signals that a receptor on the computer decodes. Craig Stout, president of Maxi Switch, calls the infrared link a "neat gimmick," but he believes it will be used primarily for games because interference problems make it impossible to use more than one PCjr per room. He expects a conventional cable connection to be a feature of most plug-compatibles: "Someone who's going to invest more dollars in the PCjr is doing it for serious keyboard use."

A third controversy surrounding the PCjr keyboard is its price. IBM surprised the computer industry by buying keyboards from an independent supplier. It's the first time the giant, said to have the world's biggest keyboard-manufacturing capacity, has used an independent source.

Key Tronic's Tiddens claims IBM wanted to pay as little as $12 to $15 per keyboard—far below the price of a keyboard based on the dominant capacitance-switching technology. AID uses a conductive-rubber switching technology that requires fewer parts than a capacitance keyboard but is considered more reliable than the industry's other inexpensive alternative, the membrane keyboard. But the PCjr keyboard's estimated price of $26, says Tiddens, "is almost enough for a capacitance keyboard."

Overby maintains that a comparable capacitance keyboard would cost closer to $50 and that his company's keyboard beat even membrane products in price. Far from being worried about competition from plug-compatible keyboards, Overby reports that AID plans to double its production capacity from 5,000 to 10,000 keyboards a day and expects to have "the world's largest keyboard capacity" within a year.



Using the Dvorak keyboard, *which puts the most-used keys on the home row, makes a high-speed typist as much as 40 percent more efficient than when using the more common QWERTY keyboard, says Craig Stout, president of Maxi Switch. "The Dvorak keyboard is a trend for the future," he maintains. (Courtesy of Maxi Switch)*

rubber so it forms a dome under each key. When a key is pressed, the dome collapses to close a circuit and then pops up again.

Older materials, usually silicon-based elastomers, tend to degrade before reaching 30 million actuations. As a result, they are useful only for equipment such as calculators. However, new materials, such as Japanese-developed non-silicon elastomers, overcome this problem. AID rates the conductive-rubber keyboard it makes for the IBM PCjr at 69 million actuations. Another advantage AID's Overby cites for the company's conductive-rubber keyboard is that the enclosure is an integral part of the keyboard, eliminating 250 parts. "The simplicity is where the major cost breakthrough is," Overby maintains.

However, a problem for the conductive-rubber keyboard is its feel: an excessive amount of force is required to depress the keys. "It doesn't have the feel people like—that secretaries are used to," claims VDC's DiRocco. Suppliers have been unable to improve the feel, she maintains. If conductive-rubber keyboards do find acceptance in high-end applications, she warns that U.S. suppliers may face increased competition from Japan: "That's the biggest technology in the East, and a lot of Japanese vendors are waiting to jump in."

Suppliers move overseas

Because manufacturing switches, key tops and enclosures can differ slightly for each customer, most keyboard suppliers are vertically integrated and have complex manufacturing capability. Therefore, keeping manufacturing and assembly costs down is a major concern for suppliers. As a result, some have opened plants outside the United States.

Building offshore plants also helps keyboard makers fend off Japanese competition. That's the main reason Key Tronic recently opened a plant in Taiwan, says the company's Far East sales manager, Buck Zietzel. "We saw so many of our customers going to Taiwan to assemble," he reports. "We couldn't let the Japanese take over their keyboard needs and use that as a stepping stone to take over our market share." Most computer manufacturers use only one source for keyboards, Zietzel explains, because even when made to the same specifications, different suppliers' products have a noticeably different feel. If an OEM finds using Japanese keyboards for offshore assembly plants attractive enough, the company might easily turn to the Japanese supplier for all its keyboard business.

Capacitance keyboards will remain the industry leader for the next five years, predicts Venture Development.

Key Tronic's Taiwan plant serves only its Far East customers—it ships no products back to the United States, Zietzel declares. In fact, until the plant proves itself, the company plans to ship plastics to Taiwan from its Spokane operation. Although Zietzel believes the Far East venture will become more self-sufficient, he says it won't be vertically integrated but will instead be primarily an assembly operation. Micro Switch has also opened plants outside the United States. Micro Switch's Waters reports that the company's plants in Scotland and Japan supply only European and Far East customers, although its plant in Mexico augments its U.S. manufacturing capacity.

Supplying OEMs that have moved production or assembly overseas is a problem for a company without nearby facilities, admits Maxi Switch's Stout. Maxi Switch is currently shipping keyboards to the Orient for some customers and may open plants overseas, he says, although it has no immediate plans to do so.

Of more pressing concern to Stout is the overall direction of the keyboard industry. "If keyboards are becoming a peripheral, then the after-market business is going to become a major part for those keyboard manufacturers who want to pursue it," he asserts. And, when a keyboard routinely controls devices such as mice, optical character readers and voice-recognition devices, "frankly, you have a system," he comments. The question he asks about the keyboard industry is: "How soon is it going to become a systems business?" □

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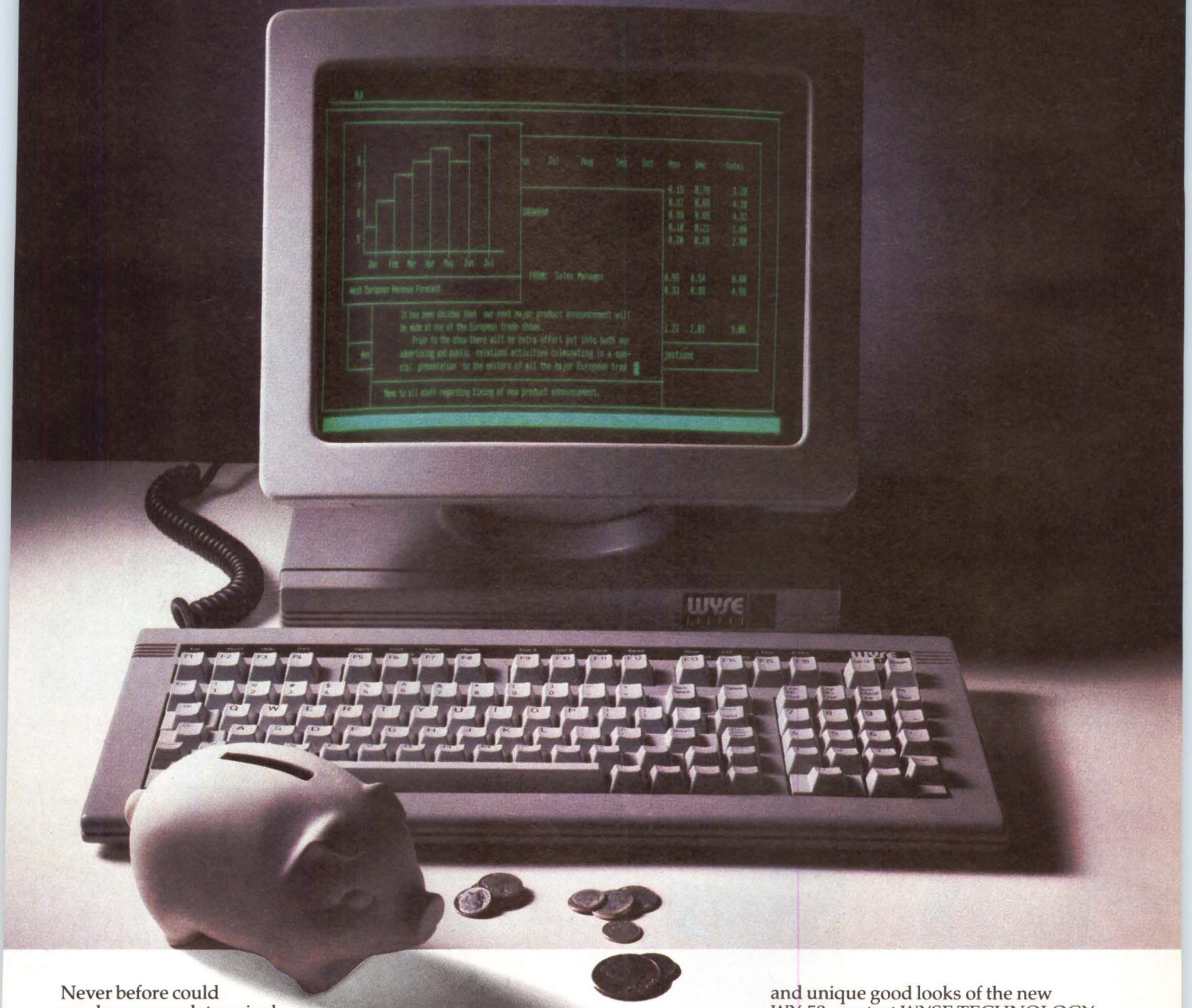

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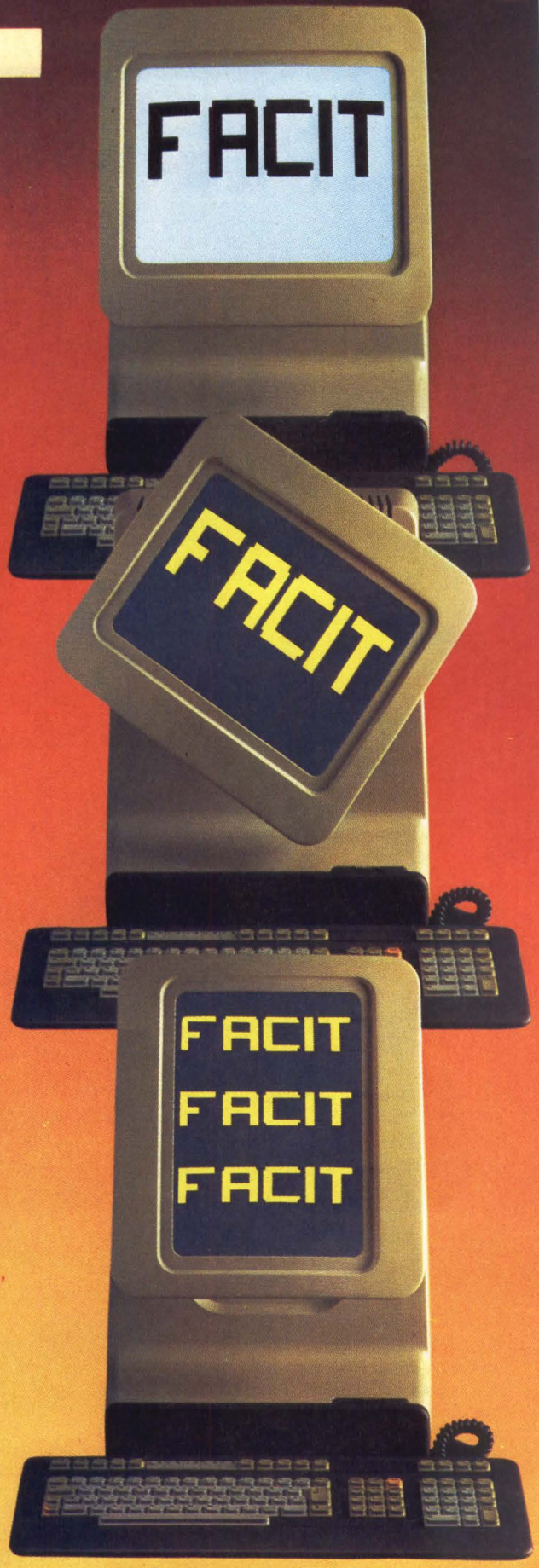

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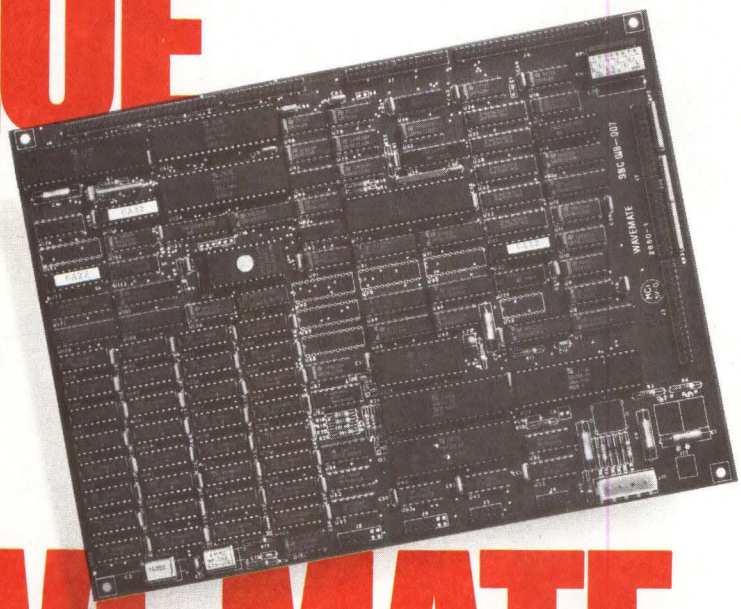

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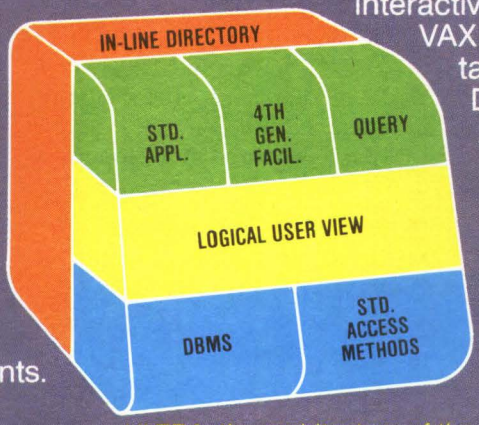

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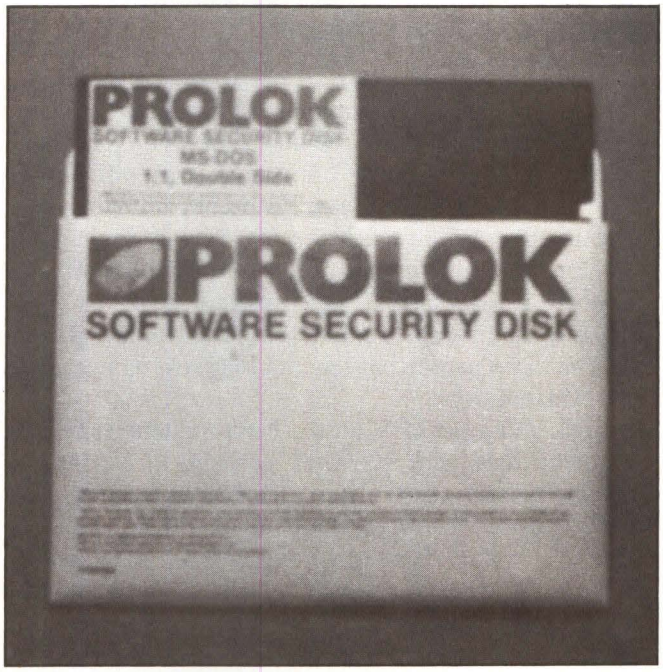
New technical methods, litigation restrict illicit software use

Although new approaches for protecting programs have obvious appeal for software publishers, system integrators also stand to benefit

Gary Legg, Associate Editor

After years of virtual helplessness against unauthorized copying and illicit use of their valuable software products, software publishers and system houses now are fighting back. On one front, they're eyeing new anti-copying methods that make the unauthorized use of software more difficult. On another front, they're succeeding through litigation: the courts seem increasingly able to comprehend the value of software developers' investments.

For software publishers, especially those supplying the personal-computer market, effective software protection has long been an obvious but elusive goal. Some software companies estimate that, for every legitimate copy of their programs, as many as 10 copies are in illegal use. Among system integrators, however, many of which serve application-specific vertical markets, the need for software protection is less obvious but just as compelling. Although these companies don't serve mass markets, their software tends to be valuable; often, it's a system's largest (or only) value-added component. In addition, much of this software goes to customers who buy it for use on one system, but who can easily copy it for use on other, unauthorized systems.



A specially manufactured "fingerprinted" diskette *is the basis for several software-protection products from Vault Corp.*

Are new protection methods effective?

Even though most recent court rulings have favored software developers, protecting software through litigation is still a slow, expensive and often ineffective procedure. Not surprisingly, much attention has focused on technical protection methods. But technical methods used in the past have been either economically infeasible or ineffective, fostering doubts about new methods.

According to executives at Vault Corp., Westlake, Calif., many of the doubts are unfounded. Officials at the year-old company, founded to develop and market software-protection technology, say its line of products provides extraordinary protection at low cost. Its Prolok software-protection product, for example, uses a specially manufactured diskette and sells for $10; in large quantities, the price is as little as $1. In addition, the procedures implemented in Prolok place a minimal burden on end users, are applicable to different operating systems and require no special hardware.

In contrast, previous protection schemes either require special hardware—which computer manufacturers and owners resist adding to their machines—or are subject to circumvention by a generalized software approach. The vulnerability to software unlocking has led to the commercial availability of numerous backup programs, which allow users to duplicate their copy-protected software for safekeeping. Numerous purchasers apparently use the products to make and distribute unauthorized software copies, although the

suppliers of such programs publicly deplore such practices.

Vault's director of research and development, Peter Avritch, says his company's protection schemes aren't vulnerable to such a generalized software approach. If someone manages to unlock one protected program, Avritch says, the method used would be of no use in unlocking other programs or additional protected copies of the same program. Thus, the method couldn't serve as the basis for a commercial product.

The courts seem increasingly able to comprehend the value of software developers' investments.

Furthermore, Avritch claims that even one such solution would be very expensive and difficult to achieve. "We figure the cost to break, on a business level, is going to approach $50,000," he states, adding that the solution would require a skilled software engineer using special instruments such as logic analyzers and in-circuit emulators. But Vault is adding features to its protection scheme to guard against such aids, Avritch says.

Prolok and most of Vault's other products come on a "fingerprinted" diskette that contains a variety of encryption and decryption algorithms. A software supplier uses the fingerprint—a modification of the diskette's surface that is unique to each diskette—to create an encrypted version of its software on the diskette. Software users employ a reverse process, using the fingerprint in a brief decryption process to produce an executable version of the software. The fingerprinted diskette must be in a system disk drive only during decryption; after decryption, ordinary diskettes can be used.

Vault won't say how it creates a fingerprint; a patent is pending on the process. Each fingerprint appears as a barely visible speck on a diskette's surface, and the fingerprints of different diskettes reside in different tracks and sectors. According to Avritch, the Vault encryption and decryption algorithms use a fingerprint's location as well as its information content. The Vault software also informs a computer's operating system that the diskette track containing the fingerprint cannot be used for storing programs or data.

Combined schemes increase protection

A combination of procedures provides increased software protection in Prolok and other Vault products. For example, each Prolok diskette includes a variety of encryption and decryption algorithms, and Vault's software uses random numbers to select an encryption algorithm. In addition to their unique fingerprints, different diskettes also contain different sets of algorithms.

Vault's protection software also guards against the use of debuggers or other software tools that might aid in copying protected software. The software detects exits from a decrypted program and erases the program from memory to prevent subsequent recovery. In addition, Vault constantly revises its schemes for protecting against use of instruments such as logic analyzers and in-circuit emulators.

Prolok and other Vault products also apparently overcome a serious weakness found in the protection schemes of some expensive business programs. These programs contain embedded subroutine calls, the

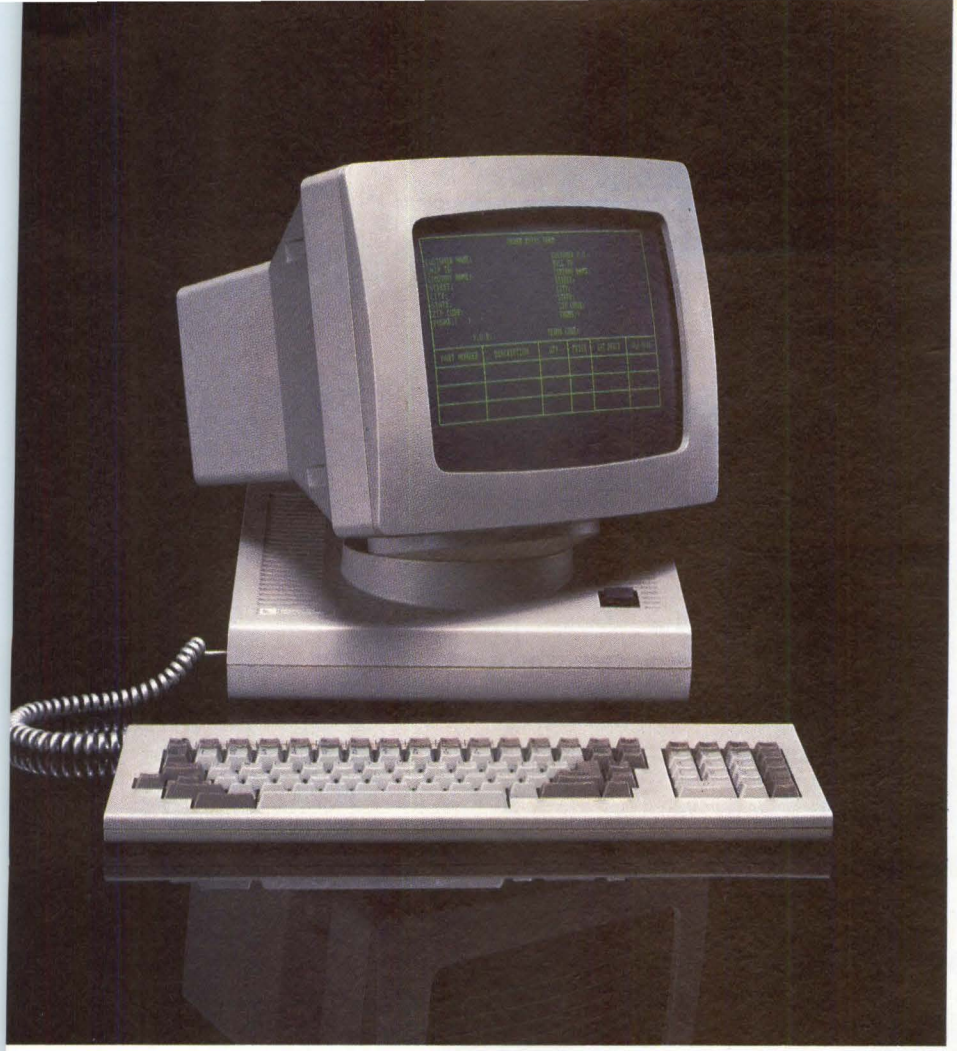
The ideal software-protection scheme

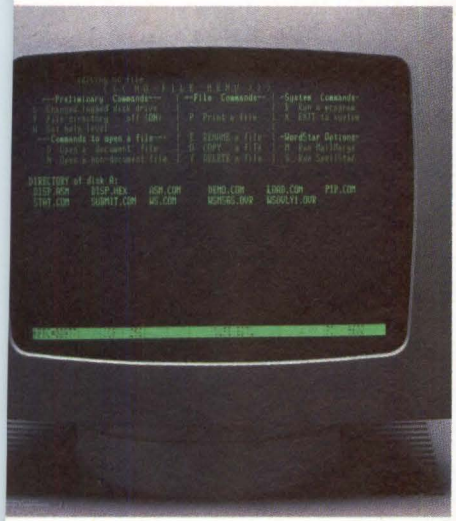
The Association of Data Processing Service Organizations (ADAPSO) has defined a series of desirable attributes for a software-protection system. According to ADAPSO, the system should be low cost, easy to use, easy to install, widely available, compatible with a wide variety of hardware, compatible with a wide variety of operating systems and secure against unauthorized code duplication.

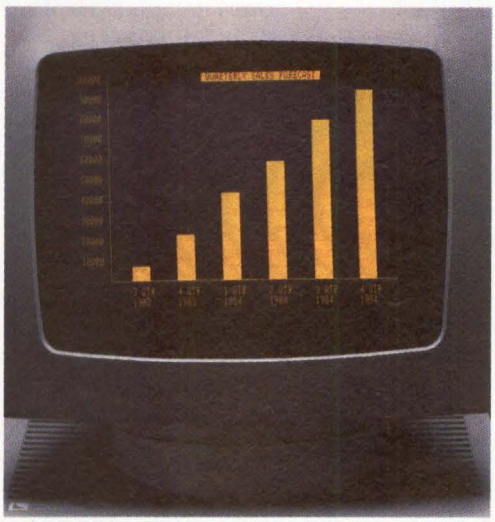
Specifically, a software-protection mechanism should be low in cost to end users and should not contribute significantly to the overall manufacturing cost of a software product. It should be relatively easy for manufacturers to install and should require no installation by end users. The protection scheme should be transparent to end users during program operation; it should not affect a program's execution, speed or performance. The system should not require a user to remember different codes or keys for different products, and it should allow users to make copies of their software.

ADAPSO's hardware requirements for the software-protection system include compatibility with all floppy disk sizes and formats, use of a minimal amount of computer RAM and operability with a hard disk. The organization also requires that the system be implementable on most microcomputers, be transferrable among different computers and transferable with a computer to a new owner. The protection should not interfere with an operating system's performance and should not require any modifications to the operating system.

Finally, the ideal software-protection system described by ADAPSO should provide adequate protection against unauthorized code duplication —not only by end users but also by commercial software pirates.







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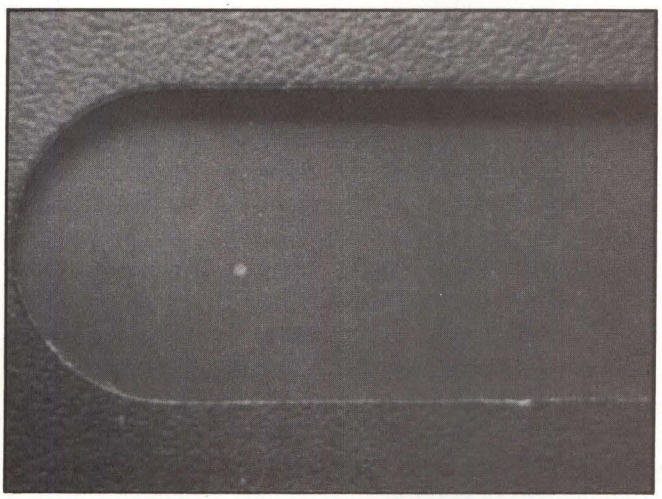


A barely visible fingerprint, *seen here as a dot on a diskette's surface, contains information that allows encrypting and decrypting of programs stored on the diskette. Vault Corp. has applied for a patent on the process that creates the fingerprint.*

locations of which are supposed to be secret, that invoke special software-protection routines. The problem is that computer user groups have published instructions for patching the programs to branch around the subroutine calls. Attempts to patch a Prolok-protected program in this manner are ineffective, however. Each byte of an encrypted program is dependent on all preceding encrypted bytes, so patching the program, even if possible, would result in erroneous decryption.

Prolok also guards against duplication of a fingerprint to unlock software. Vault's decryption program erases fingerprints made via a normal disk-write operation. In addition, the fact that each fingerprint is unique wasn't part of a plan. "It's not possible to make two the same," Avritch says, "because of the mechanics of how they're made."

Some software-protection specialists say even these combined features won't be adequate. The difficulty of cracking a protected program will only serve as a challenge, they say, and the result will be commercially available programs for nullifying whatever protection schemes are conceived. According to Avritch, though, Vault will always be at least one step ahead of those who create such unlocking programs. "It's definitely a cat-and-mouse thing," he says, "but we're at least six months or a year ahead of these guys. A year from now, they might have a way of breaking what we have now, but we'll have developed new schemes by then."

Are backup copies really backups?

Another problem with Vault's protection scheme, according to some critics, is that it doesn't allow software users to make true backup copies of the programs they buy. Although Prolok allows copying protected programs to ordinary diskettes, the original fingerprinted diskette must be in a system disk drive to decrypt the program. Because the fingerprint itself can't be duplicated, these critics say, backup is only partial.

Vault officials contend that Vault's scheme does provide adequate backup capability because users can make as many copies of a protected program as they want. They need only the fingerprinted diskette to begin executing those programs. Furthermore, says Avritch, it's possible to lose part or all of a program on the original Prolok diskette and still use that diskette to decrypt and run a backup copy stored on another diskette. "The only thing you can't blow," Avritch claims, "is that track with the fingerprint on it." Furthermore, Avritch says, the fingerprint isn't subject to erasure and so is unlikely to be damaged. Critics reply that common hazards such as spilled coffee or the heat from strong sunlight could physically damage a Prolok diskette, rendering it useless.

Although the suppliers of backup programs publicly deplore any unlawful or improper usage, numerous purchasers apparently use the products to make and distribute unauthorized software copies.

Prolok and other Vault products have some minor limitations that Vault is working to overcome. If a protected program is stored on a hard disk, for example, the Prolok diskette must still be in a floppy disk drive for the program to begin running. In the future, Vault says, it will be possible to place a fingerprint on the hard disk itself, eliminating this inconvenience. Another limitation of Prolok is that it doesn't guard against a customer's buying one copy of protected software and using it simultaneously in many systems. The Prolok diskette is needed only to begin running the software, so people in a business office, for example, could use the same fingerprinted diskette to boot up copies of a program on numerous computers. Now, however, Vault provides OEM customers with an option to protect against such use. In this optional Prolok implementation, the protected software will frequently check for the fingerprinted diskette's presence in the system.

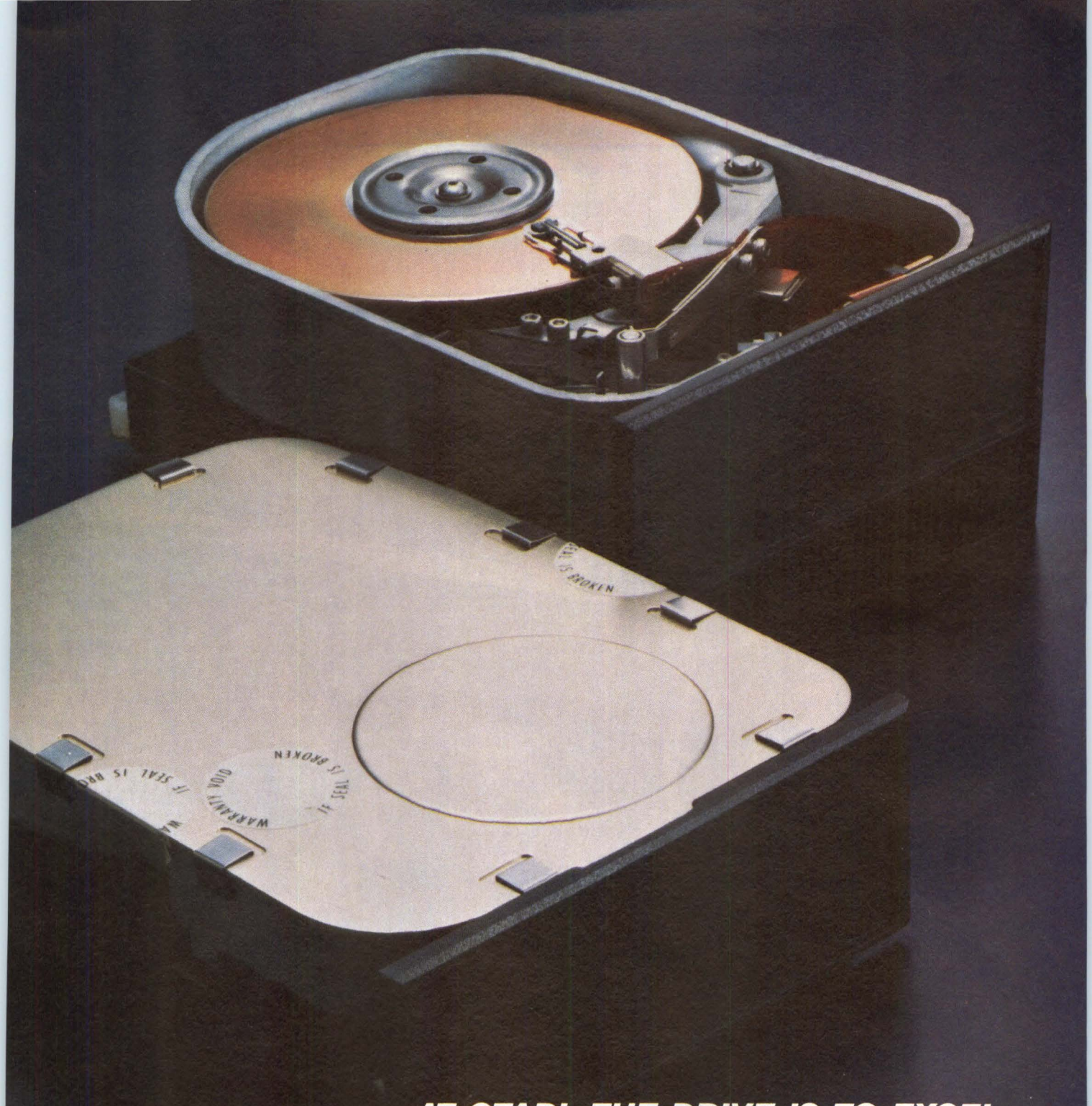
Other software-protection products that implement a

scheme similar to Prolok's are available from Vault for special functions. Telelok, for example, allows transmitting software via modem while retaining protection. Chronolok allows a software supplier to distribute limited-use programs for demonstration purposes; the programs operate only a predetermined number of times. Other products include ROMlok, for protecting programs stored in ROM modules, and Commlok, for electronic mail.

The significance of these products depends on whether they provide adequate protection and whether users accept the level of backup capability they provide. However, Vault has already made an impact. Software publisher Ashton-Tate recently made a 20 percent equity investment in the company for $500,000, and American Telephone & Telegraph Co. has entered an expensive agreement with Vault for use of Telelok.

The issue of whether Vault's products provide legally acceptable backup software copies might ultimately be decided through litigation. The law permits users to make backup copies, but whether copies made by Vault's scheme are legally acceptable hasn't been decided. "We know we're going to end up in court," Avritch says. "It's just a matter of when." He is optimistic about the outcome, however. "We feel our method allows you to make a legitimate backup," he says.

Software vendors plan other legal challenges toward those who misuse copyrighted software. According to Dixon Smith, Vault vice president, "A number of major powers in the microcomputer industry are putting together a fund specifically to bring litigation against corporations, dealers, schools and government offices that have not been exercising their responsibilities as licensees to protect licensors' copyrighted material." A common complaint against some of these users, Dixon explains, is that they allow their employees to use unauthorized software copies. As a result, he says, the organization of software companies is "going to give a two-month moratorium and say, 'Clean up your act.' Then, the suits are going to start hitting the streets." The result, Dixon claims, will be an industry-wide benefit. "Everyone will win," he says. "It will act as a catalyst to bring forth a lot of new creative software and lots of new interest in people being in that industry." □



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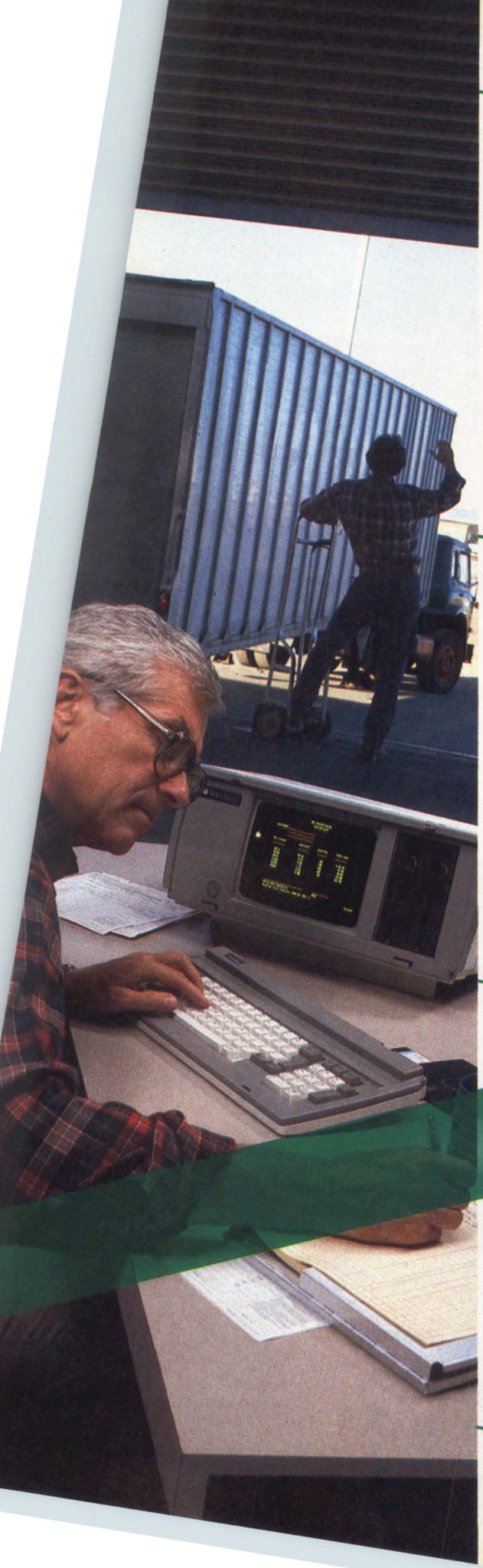

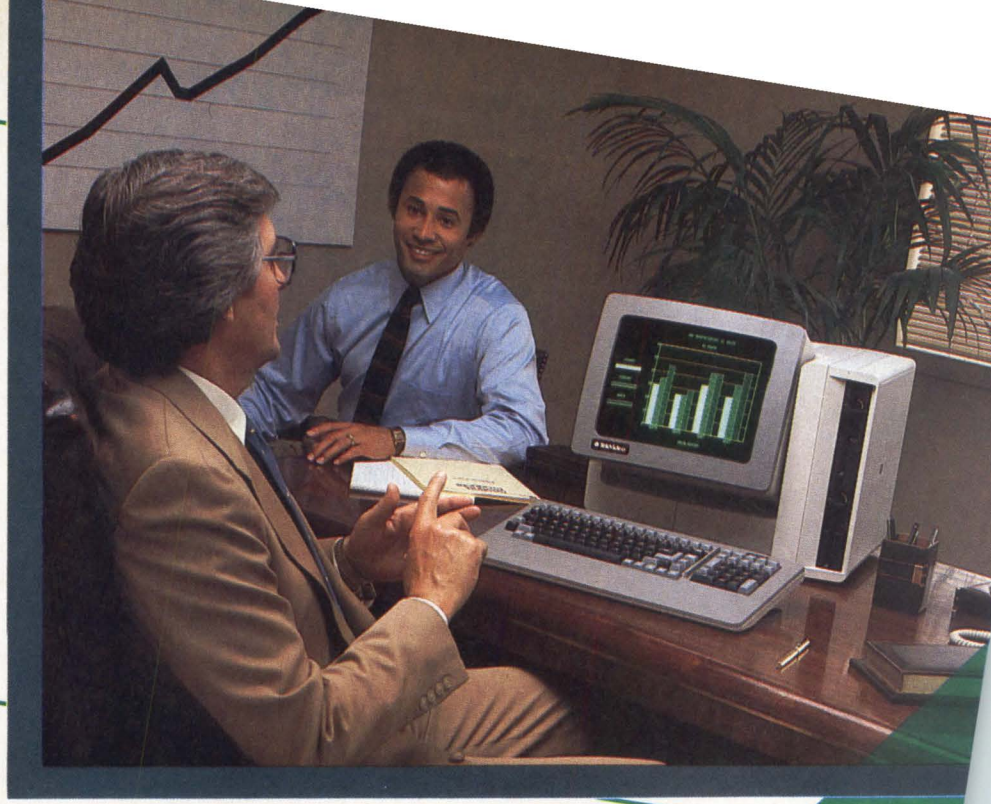

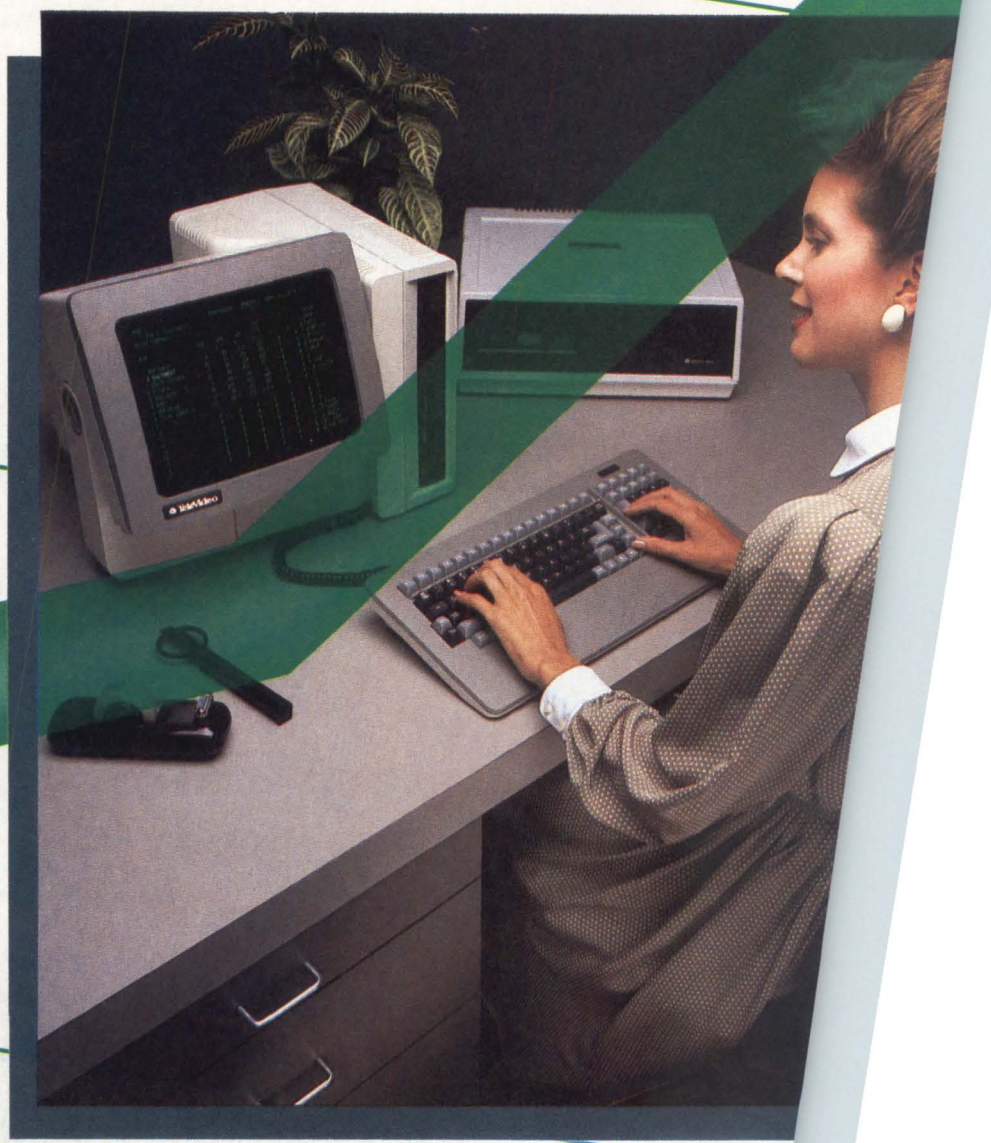

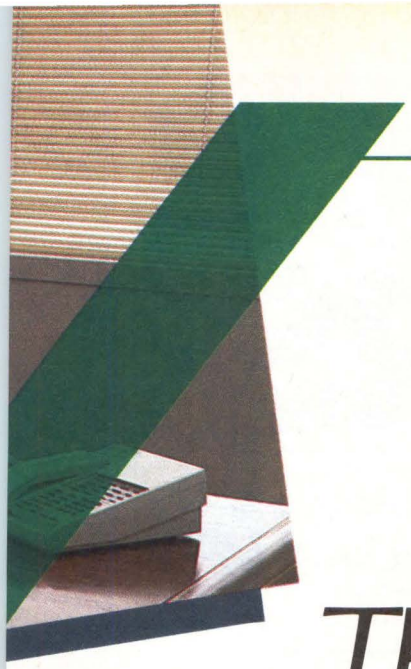

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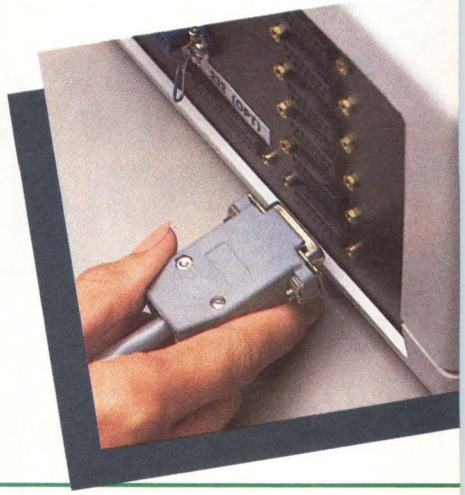

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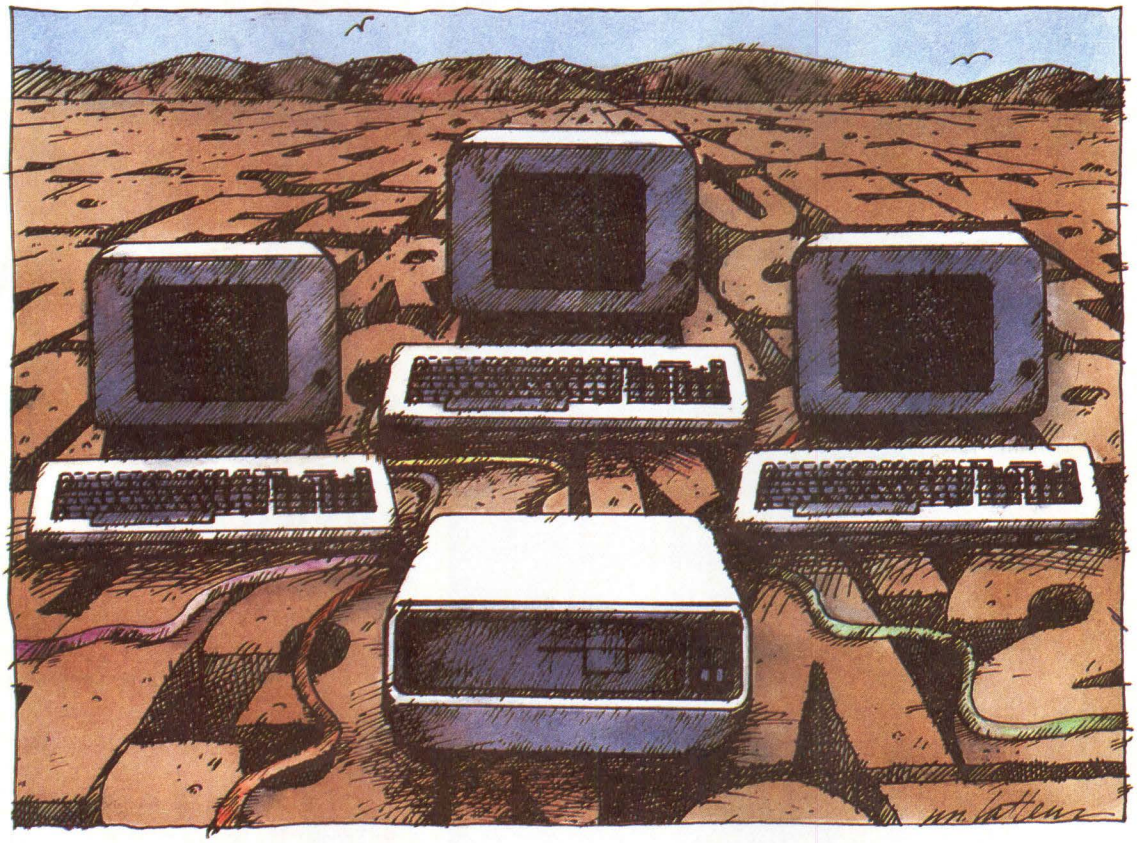

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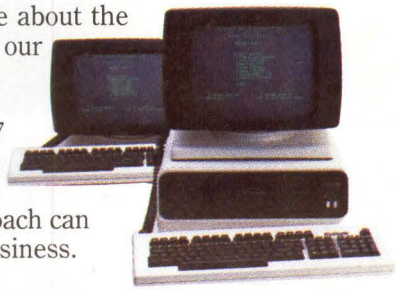

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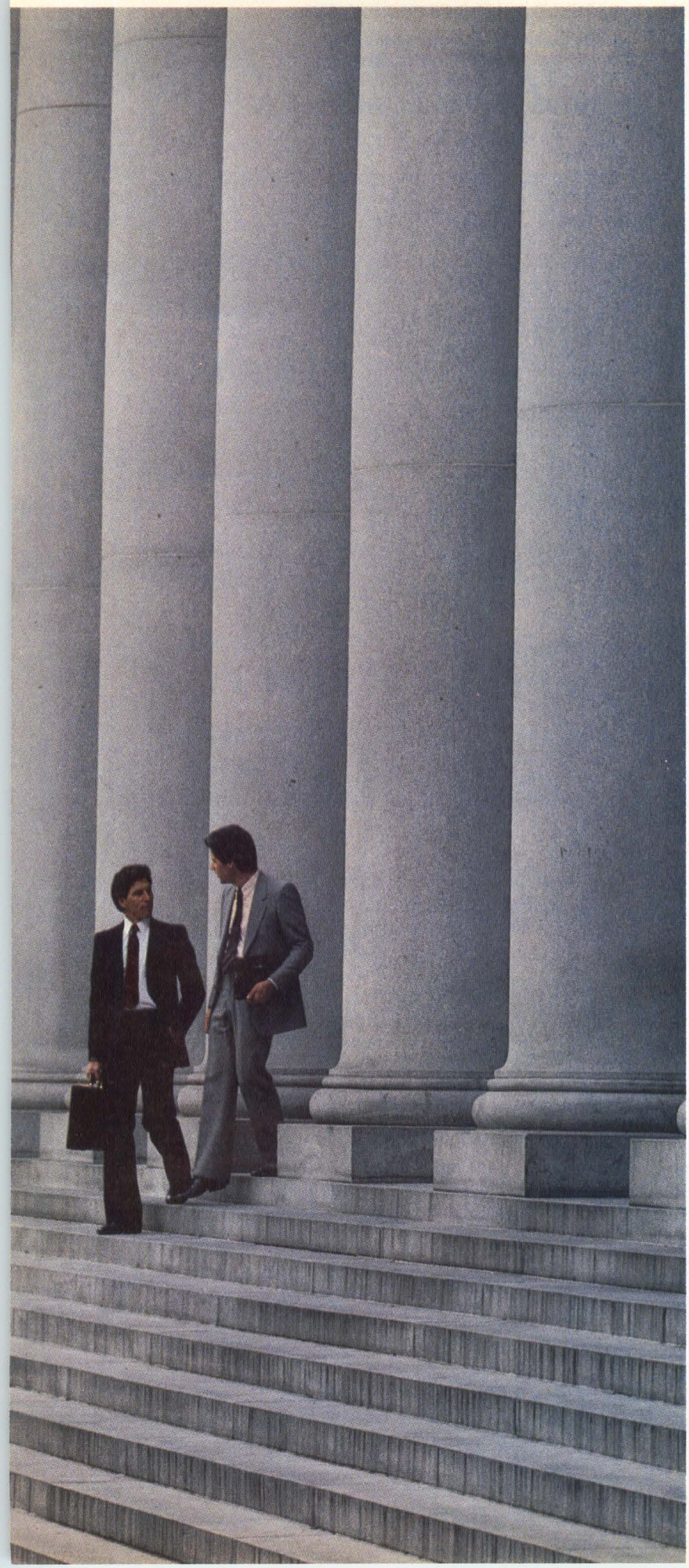

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Fail-safe computers increase reliability, lower costs

Fault-tolerant systems contain redundant hardware, but their reduced maintenance can actually lower costs

Gary Kravetz, Fail-Safe Technology

Fail-safe computers—also known as fault-tolerant, redundant, survivable, robust or non-stop computers—have one important goal: error-free computing with low maintenance and no downtime. And, although most systems that fail-safe computers go into are those that simply must be reliable, system integrators receive an added benefit: less downtime and lower maintenance mean reduced costs.

Costs can be lower despite the fact that fail-safe operation occurs only as a result of redundancy in a system. But redundancy doesn't necessarily mean a complete duplication of hardware; it might instead mean software redundancy or only a small addition of hardware. Furthermore, rapidly falling hardware costs can make redundancy a minimal investment in comparison with a fail-safe system's potential savings.

In some cases, the savings that result from using a fail-safe computer can far surpass a system's original cost. If computer-generated errors, downtime and maintenance have a high enough cost over an ordinary system's lifetime, a fail-safe system is justified. If occasional failures are acceptable, however, a fail-safe computer might be too expensive.

Fail-safe computer systems containing ordinary commercial components allow fewer failures and cost much less than conventional systems built with more expensive parts that have been screened for high reliability. Conventional high-reliability systems also require high-quality manufacturing. Fail-safe computers automatically detect errors and faults, allowing prompt automatic or semiautomatic system reconfiguration to minimize downtime, computing errors and maintenance.

Availability approaches 100 percent

Minimizing of downtime results in increased system availability, where availability is defined as the total time the computer is operational divided by the total time it is needed. This number is often between 95 percent and 98 percent in conventional systems, but this level is inadequate for some applications. Fail-safe systems can be much more reliable, however. In a system designed recently for the U.S. Department of Transportation, the predicted availability is 99.999999 percent.

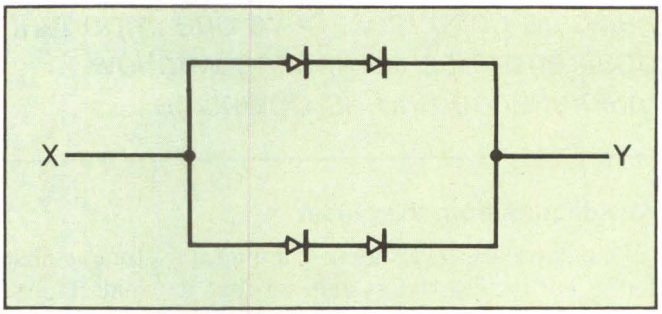

Fig. 1. Diode masking prevents either an open or a short *between nodes X and Y as a result of any diode's failure. The implementation uses four diodes instead of the usual one.*

Decreased computer errors are an added benefit of fault-tolerant systems; in many applications, the cost of a single computational error can be extremely high. Applications in which fail-safe systems can help avoid costly errors include breathing-assistance systems for hospital patients, on-board airliner-control systems, banking-transaction systems, emergency-shutdown systems for nuclear reactors and spacecraft-positioning systems.

Maintenance costs, especially expensive in complex systems, are much lower in fail-safe systems. Because maintenance costs often exceed a conventional system's original purchase price, the value of using fail-safe systems becomes obvious: their self-test capabilities (built-in tests or diagnostics) can reduce testing and maintenance costs.

Although most requests for fault diagnosis and easy maintenance are for military systems, the IBM Personal Computer is an inexpensive commercial product using built-in testing. It performs self-testing each time it's turned on, informing a user of any fault's existence and location.

The seemingly high cost of adding built-in tests to other manufacturing costs is often justifiable. For example, in VLSI systems, the design of separate test equipment is complex and difficult. Potential savings in field maintenance also add to self-testing's cost advantages. Adding built-in testing typically increases total system cost by less than 5 percent, yet results in self-diagnosis with 90 percent to 95 percent accuracy.

Fail-safe computers have one important goal: error-free computing with low maintenance and no downtime.

Avoid faults from the outset

One approach to protecting a digital system against faults is to build the system so that it avoids faults. Fault avoidance achieves reliability by:

- using the most reliable components available
- exhaustively testing the components under the range of conditions expected for the system
- using mature technologies for interconnecting components and assemblies
- adding shielding to reduce the likelihood of external electromagnetic interference
- exhaustively testing the completed system to verify that it meets all performance and reliability requirements

One of the most effective techniques guaranteeing the correct initial operation of a complex digital system is independent verification and validation (V&V). Conventional systems cannot degrade gracefully because design "bugs" often lead to unpredictable and disastrous results. Critical applications, therefore, require finding design errors before they appear in operation.

V&V uses a twofold approach to certify correctness of a digital system. The first part of the approach examines the design and searches for errors in system specifications and implementation. The second part tests the implementation. The testing can be limited to software or can include software and hardware.

An independent party can most effectively perform V&V because, when system designers themselves perform V&V, they bring with them the same assumptions, misunderstandings and blind spots they had when designing the system. Even if other engineers in the same organization as the system integrators conduct the review, the same influences, prejudices and background information often affect the result.

V&V is usually necessary before a fault-tolerant system's use in a critical application because design flaws are the most common cause of failure in complex systems. For example, one analysis of failures observed in thousands of hours of spacecraft operation showed that more than 90 percent of the failures resulted from design errors.

Protective redundancy is the key

The key to designing a fault-tolerant system is to provide protective redundancy using hardware, software and time. These redundancies implement fault-detection algorithms, which are followed in use by diagnostic algorithms that pinpoint faults. To repair a faulty system, spare modules must be installed.

Fault-detection methods consist of three general types. The first type, initial testing performed by a system's manufacturer, occurs before final system integration to establish that fabrication and assembly processes haven't produced defective hardware. The second, concurrent on-line testing, occurs during normal system operation. It looks primarily for faults that might have appeared after system installation and is useful for detecting short, or transient, faults. Unlike off-line techniques, on-line techniques can detect faults early enough to protect against massive disruption of operation or irreparable data contamination. The third type of fault detection tests a system's redundancy to verify that fault-tolerance features will function correctly.

Hardware techniques are probably the best-known methods for on-line testing, having been used since the earliest digital systems. Typical techniques include error coding (parity, Hamming and checksums, for example), self-checking circuits, duplication and comparison, majority voters with disagreement detectors, watchdog timers, completion signals and special circuitry to monitor critical elements such as power supplies and clocks.

Software can be used both for on-line and off-line testing. On-line software testing occurs through concurrent execution of multiple copies of a program or through special checking procedures built into software. With multiple program copies, each executing program stores results or summaries of results in shared memory locations; each program can also retrieve the information deposited by other programs for comparison. The other software technique uses monitoring software running in a dedicated subsystem.

Software fault-tolerance techniques are not as

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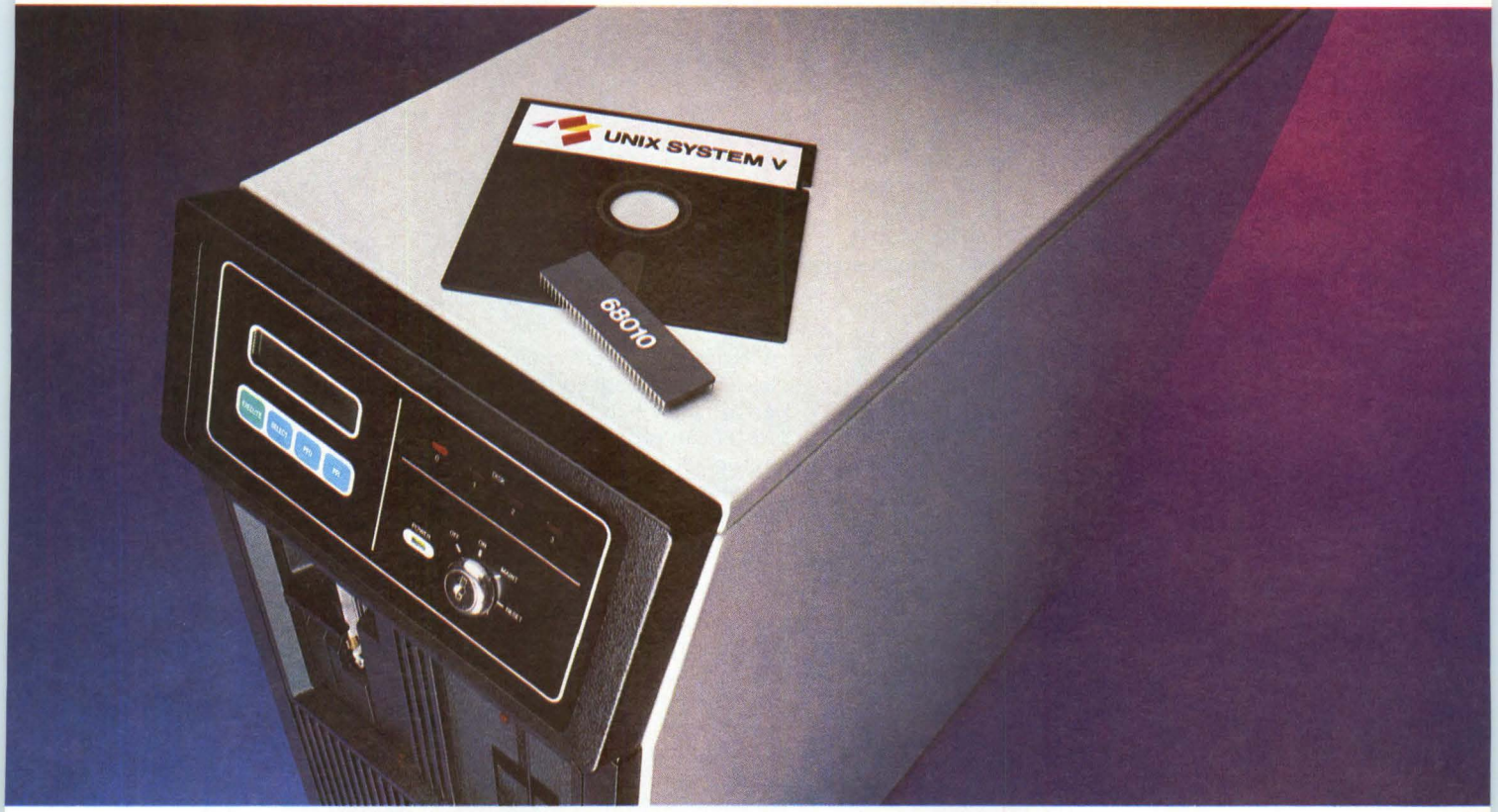

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prompt to detect faults as hardware techniques. Futhermore, the very nature of software fault tolerance makes it susceptible to the faults that it is intended to prevent. However, it is relatively easy to install in existing systems.

Diagnostics locate the fault

After fault detection, fault diagnosis locates the source of a fault to the least replaceable unit—a component, circuit or subsystem. In general, diagnostic algorithms use detection hardware and special test sequences. In some cases, the detection hardware points directly to the faulty unit; thus, additional isolation is not required. In other cases, the detection hardware can indicate several units, any one of which might have failed. In such cases, additional diagnostic routines must pinpoint the fault.

For example, when two non-redundant processors are executing the same program, a comparator checking both processors' outputs can determine when a disagreement occurs but can't determine the fault's source. A quickly executing diagnostic program, however, can minimize the disturbance caused by the detected error. The diagnostic isolates the failed processor so that it can be taken off-line while the other continues to operate. The diagnostic needn't analyze the component or subsystem within the faulty processor.

After detecting a failure, a system must recover from it. If possible, the recovery process restores the system to normal operation; otherwise, it may allow degraded operation or may invoke a systematic shutdown. Recovery algorithms can be manual or automatic.

Rapidly falling hardware costs can make redundancy a minimal investment in comparison with a fail-safe system's potential savings.

In full recovery, a system returns to normal operation with all its usual processing power and memory capacity, and all damaged information gets restored to its fault-free values. In degraded recovery, also known as graceful degradation, or "fail-soft," a system returns

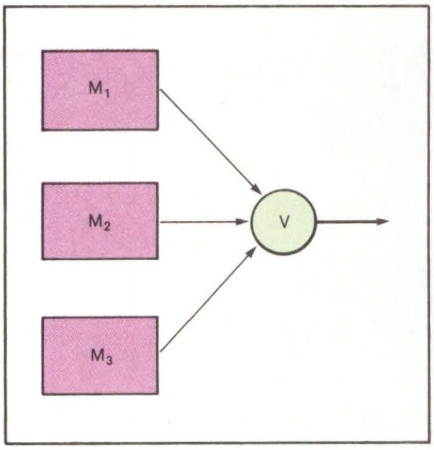


Fig. 2. Triple-modular redundancy (TMR) *provides three identical modules and a "voting" circuit. The voting circuit (V), presents a majority vote of the three modules' outputs, thus masking a faulty module.*

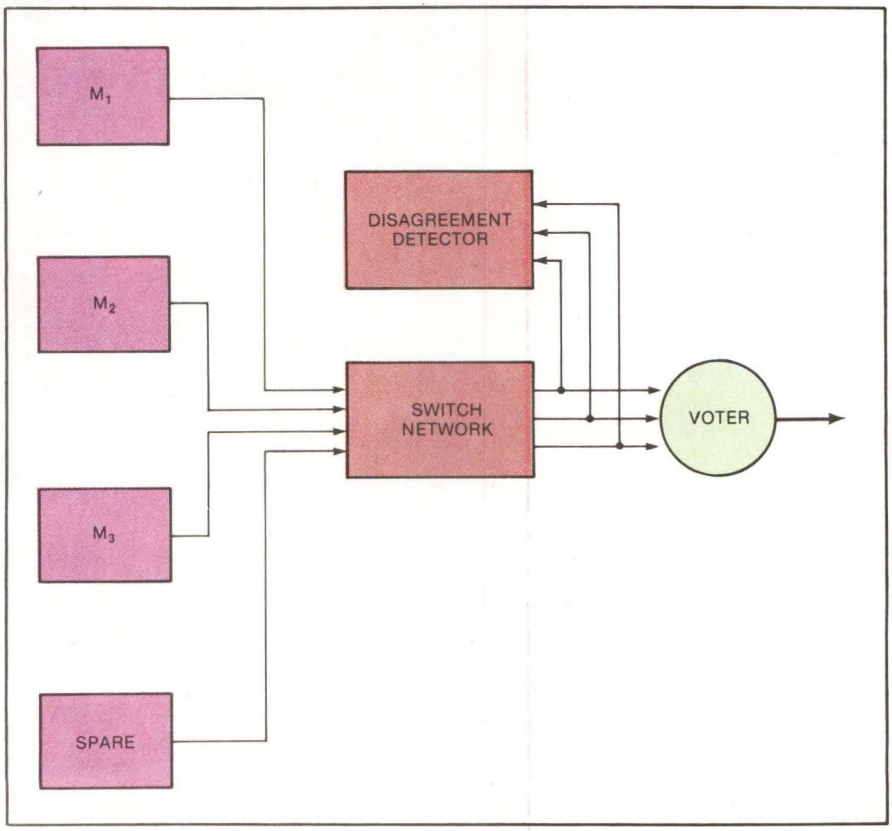
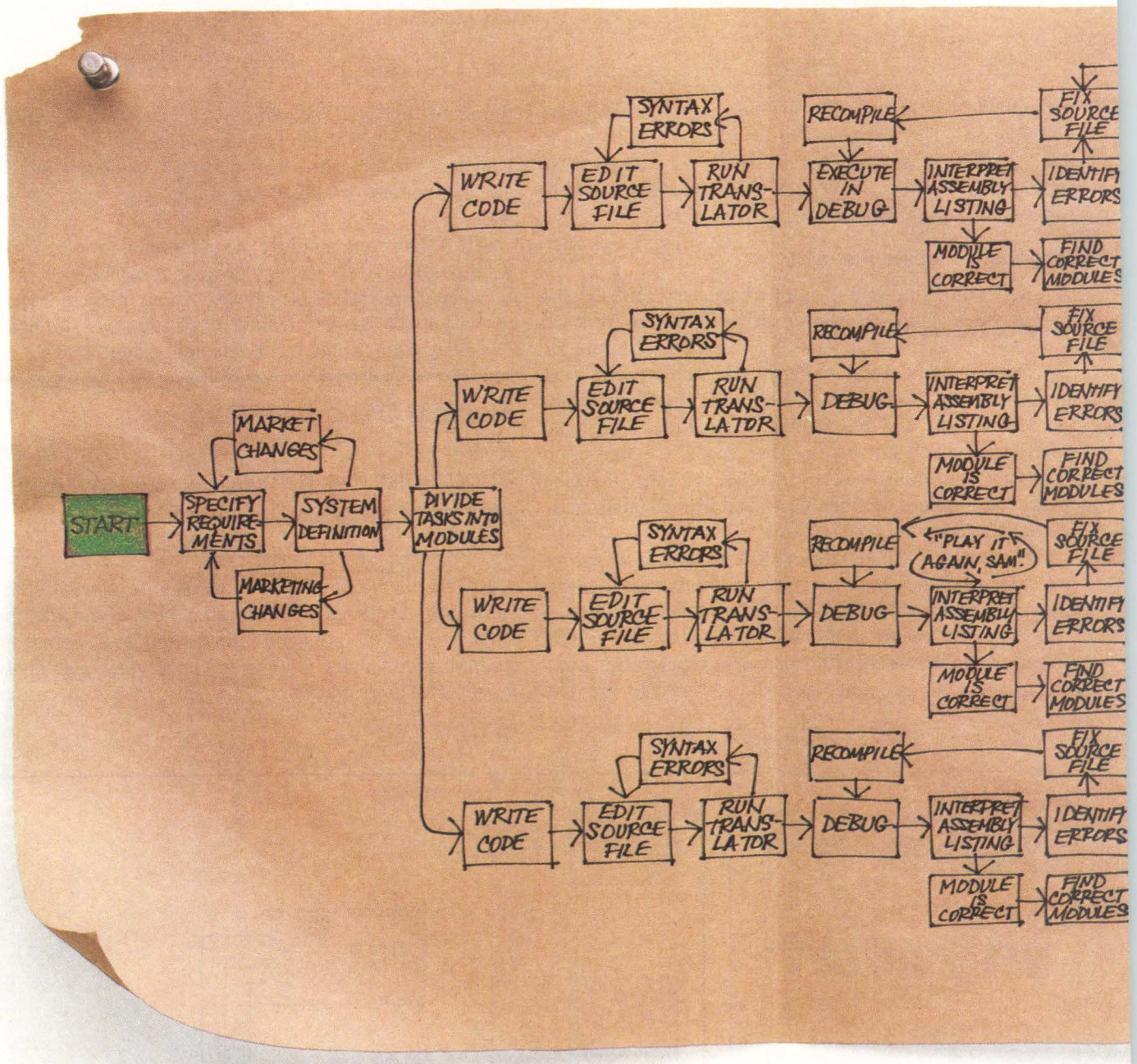


Fig. 3. A hybrid TMR system *combines masking TMR and spares. A disagreement detector compares a voter's output with the output of each active module. When a disagreement occurs, the detector flags the corresponding unit as having failed, and the unit is replaced by a spare.*

WHOEVER FINIS



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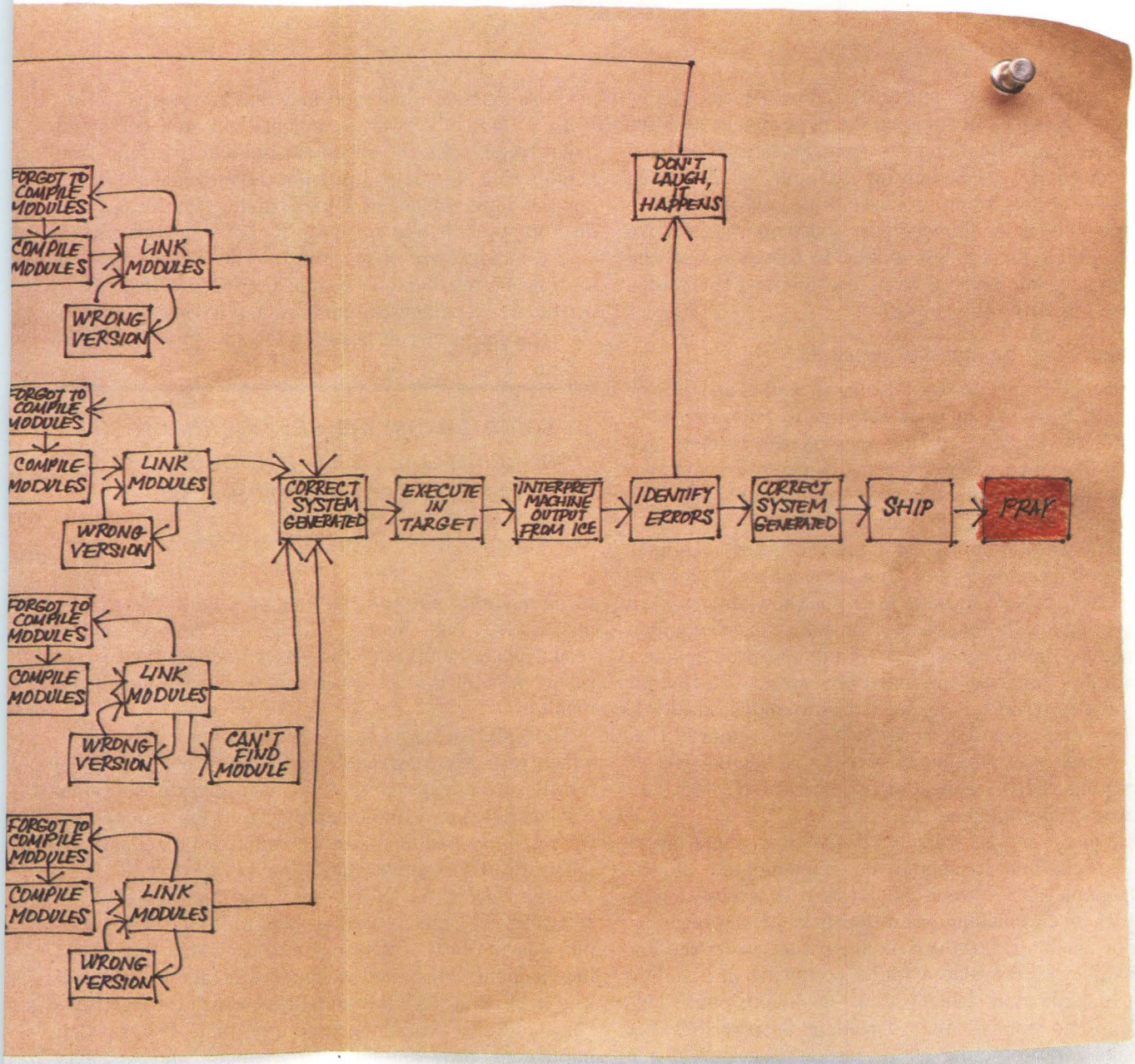

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to a fault-free state but loses some processing or memory capacity. In some cases, it permanently loses information and the ability to perform some functions. Safe shutdown, the limiting example of degraded recovery, occurs when no spare units are available to replace failed units and when continued operation above an acceptable level is impossible. In this situation, the system saves as much data as possible and then stops interacting with other systems.

Recovery can be static or dynamic

Automatic recovery can also be classified as static or dynamic. Static techniques attempt to hide, or mask, the effects of a fault, and dynamic recovery substitutes spares for failed units. Systems can contain combinations of static and dynamic techniques that suit reliability and availability requirements.

The purpose of fault masking is to contain the effects of a fault completely within a module. A module protected by fault masking does not show any outward signs of failure, but successful masking can occur only if a module hasn't used its redundant submodules. Masking eliminates the need for special testing or diagnostics because one mechanism handles masking, testing, diagnosis and repair. Masking requires that spare units always be powered and ready. Error-correcting codes, replicated hardware and redundant software can implement masking.

One of the most fundamental questions about masking is whether it should be implemented at the component, gate, circuit, subsystem or system level. At each level, masking has different costs and benefits. Use of masking, however, is always based on the low probability of correlated faults occurring in a redundant module and causing that module to fail. This assumption implies that masking is probably not feasible for protecting an IC package because if one component in the masking scheme fails another will be similarly faulty.

Diodes in a series/parallel arrangement can accomplish masking at the device level (Fig. 1). Using diodes arranged in this way prevents one diode's failure from causing an open or a short circuit between the X and Y nodes. Such an implementation uses four diodes instead of the one typically used.

"Quadded" logic masks at gate level

At the gate level, a masking scheme called "quadded" logic can protect both combinatorial and sequential networks, which is effective when gates occupy different packages because it reduces the probability of correlated faults. Quadded logic implies that a logic network exists in quadruplicate, that an error resulting from a faulty network element will get corrected downstream from the error's origin and that fault-free neighboring signals will provide the means for correcting the fault. Quadded logic, popular in the days of discrete logic, is less suited to IC implementations.

A common form of masking at the module level is known as triple-modular redundancy (TMR) (Fig. 2). It provides three identical modules and a "voting" circuit (V). The voting circuit presents the majority vote of the three modules' outputs. As long as a fault affects only one module and doesn't damage the voter itself—a reasonable assumption—the voter produces the correct result. A voter is much less complex than the modules it monitors.

In some cases, the savings that result from using a fail-safe computer can far surpass a system's original cost.

The TMR technique also extends to more modules, in which case it's referred to as N-modular redundancy (NMR). Its advantage is that it can tolerate additional bad modules; in a five-module system, for example, it tolerates two bad modules. The number of modules, N, must always be odd so that a majority exists.

The concept of NMR masking also extends to software. So-called N-version programming uses multiple, concurrently executing programs that have been independently designed, coded, tested and maintained. The N-version software system, on which the programs run, contains voting procedures and drivers that implement program-output exchanges and majority voting. N-version programming masks the effects of a software failure because the probability of two independently generated software programs containing the same "bug" is very small. When N-version programs run on independent processors, they offer the additional benefit of masking hardware faults.

On-line redundancy switches units

Dynamic-recovery methods, unlike static methods such as masking, switch on-line redundant units into a system to replace faulty units. Spare hardware units can be left turned off until needed or can be left switched on in standby mode.

The critical component in on-line redundancy is the switching mechanism. After diagnostics identify a

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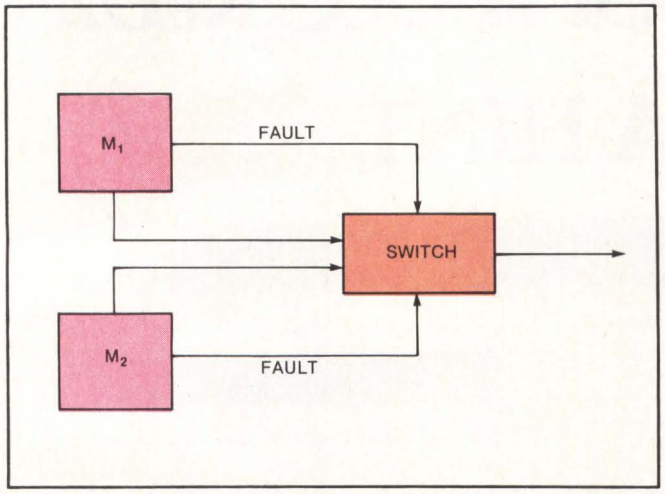

Fig. 4. An alternate fault-tolerant approach *features module self-checking. Surrounding modules can query to determine when a module has failed and then can disconnect the faulty module from the system and use a spare module. Alternatively, the remaining modules can assume the processing tasks of the failed module.*

faulty module, the switching mechanism must disconnect the failed unit and substitute a spare. If the switching mechanism functions incorrectly, the system cannot recover.

There are at least two ways to switch spares. In one approach, the system removes power from the faulty unit and applies power to the replacement. The design of interface logic among units in such a system must render the units unable to send signals when power is removed. Furthermore, the power switch's design must virtually guarantee that the switch won't fail in the on position when instructed to turn off. Similarly, the switch must have a high probability to turn on when instructed. These switches frequently contain dual-coil relays in a series-parallel masking configuration.

A second approach to switching spares disconnects a failed unit's outputs and connects those of the spare. Called cross-strapping, this technique uses ultra-high-reliability switches in a masking configuration. The switches can be dual-coil relays or special networks of IC multiplexers.

In a combination masking TMR/spare implementation of a switch with a hybrid TMR system (Fig. 3), a disagreement detector compares the voter's output with the output of each active module. When a disagreement occurs, the detector flags the corresponding unit as having failed, and the unit is replaced by a spare. The approach can also extend to a hybrid NMR system.

In another possible architecture, each module performs internal self-checking; each module records its own failure (Fig. 4). Through a query mechanism, surrounding modules can determine when a module has failed. These modules can then agree to disconnect the faulty module from the system and use a spare module. Alternatively, the remaining modules can assume the processing tasks of the failed module.

Failed modules can be replaced as long as a pool of spares exists. When the pool becomes depleted, some systems can operate at a degraded level. A faulty unit is switched off-line in a degraded mode, but the system must operate without it because the system does not have a replacement for it. Although system performance typically degenerates, perhaps resulting in decreased memory capacity or bus bandwidth, it otherwise runs normally. If enough modules fail, however, the system can no longer provide useful service. In such a situation, the surviving circuitry's primary function is to shut down the system safely.

Provision of software-module spares, using recovery blocks, is also possible. This approach structures the software into blocks, each of which contains a conventional non-redundant module that can detect errors. Each block also has at least one spare module. Acceptance testing is critical to the recovery-block methodology. When it indicates a problem in the block being executed, another block gets selected and run. The recovery-block technique can protect against software errors by requiring that each block be independently coded.

Fault tolerance has many parameters

The implementation of fault tolerance must take into account many parameters, including initial cost, life-cycle cost, performance, reliability, availability, the fault set, response to faults and expectations for system use. Each application of fault tolerance is unique; a general-purpose fault-tolerant computer system does not exist.

For example, in one application it might be permissible to temporarily remove a faulty computer from service during repair. In another application, removal might result in a disaster, necessitating use of fault-masking techniques. These scenarios significantly impact design decisions, cost and system reliability. Consequently, a system designer must carefully analyze each application to determine the most appropriate design. □

Gary Kravetz is vice president of engineering at Fail-Safe Technology, Los Angeles.

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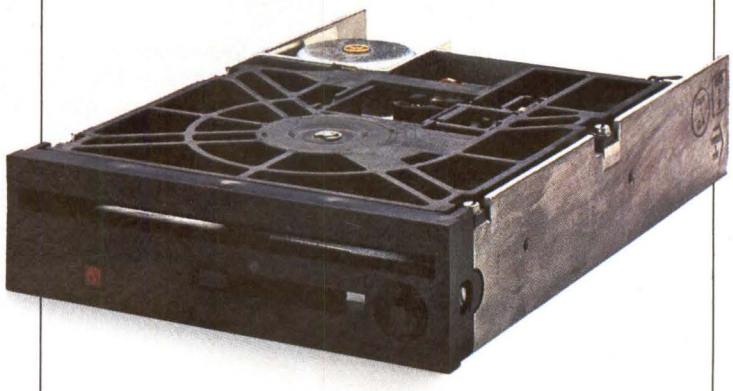

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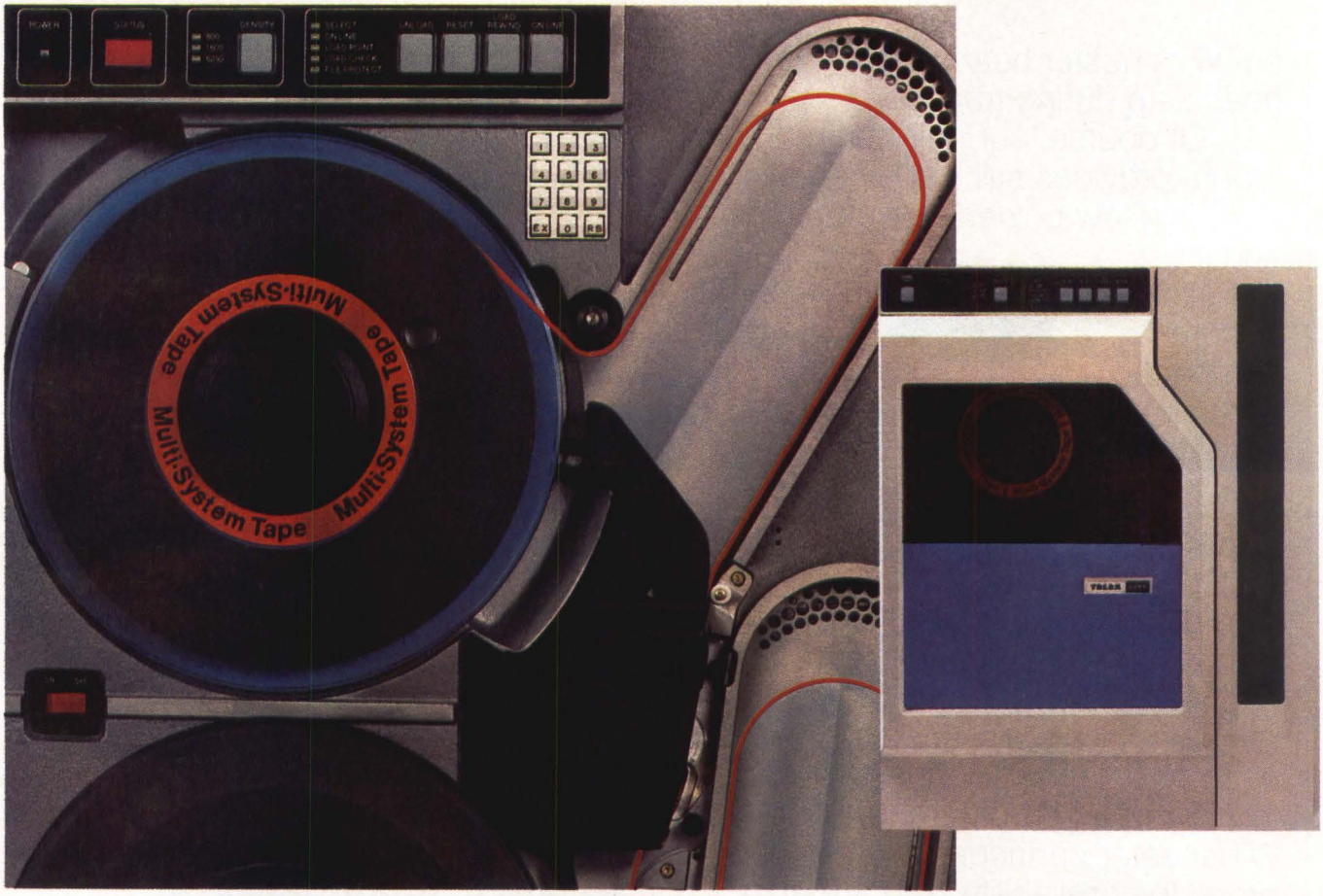

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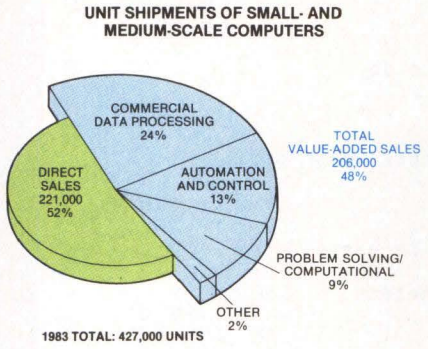
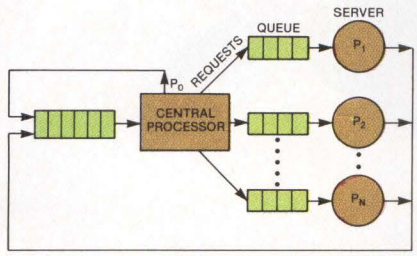
CIRCLE NO. 70 ON INQUIRY CARD

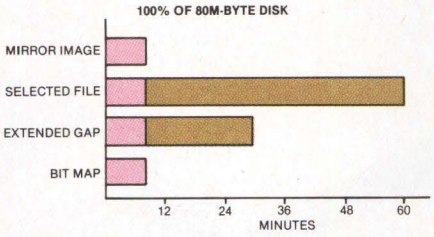
FEATURE HIGHLIGHTS



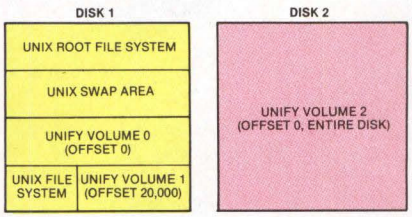
SOFTWARE: The most significant trend in the minicomputer industry isn't a new technology, it's **industry-standard system software.** Until now, most vendors were reluctant to sell their systems with a portable operating system such as UNIX. As more customers insist on portable software, these minicomputer companies must oblige or risk losing a big chunk of potential business. Starting on p. 137, MMS presents a survey of the top 10 minicomputer vendors and their products...



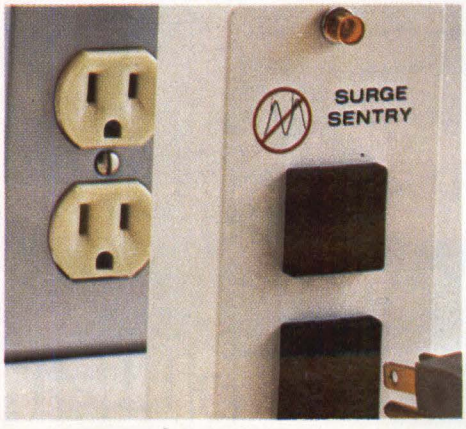
Benchmark tests can measure single-user, standalone system performance by measuring processor and peripheral capabilities. The more complex, multitasking, multiprogramming systems, however, require sophisticated **measurement and evaluation software.** For a look at how such software can pinpoint system bottlenecks, plus a vendor list, see p. 157...



Streaming-tape drives can be used as efficient backup and restore devices if the system they are used on can transfer data between the disk and the tape fast enough to keep the tape drive operating without interruption. Spectra Logic Corp. has developed **"streaming software,"** which uses bit mapping to achieve continuous streaming. Check out the details on p. 203...



Many applications running on UNIX-based minis and micros demand quick access to large databases. System integrators have found that basing applications on **preprogrammed database-management system (DBMS) tools** is an attractive solution because most applications involve repetitive tasks. For more information, turn to p. 215.



POWER SUPPLIES: Head crashes, lost data, software snafus and other problems, such as costly rekeying and customer ill will, are just a few of the consequences of improper selection of an uninterruptible power system (UPS). Until recently, only a handful of UPS vendors existed, offering a few models. Today, the choices are many, which can translate into confusion for the first-time buyer. To those, MMS offers a product survey of UPS vendors and their products, beginning on p. 169.

Changing our ribbon is a snap.

Most printers make you fool with a messy ribbon.
But with Digital's Letterprinter 100, all you have to do
is snap in one of our replacement cartridges.
You'll instantly get at least 5 million more characters' worth of ink.
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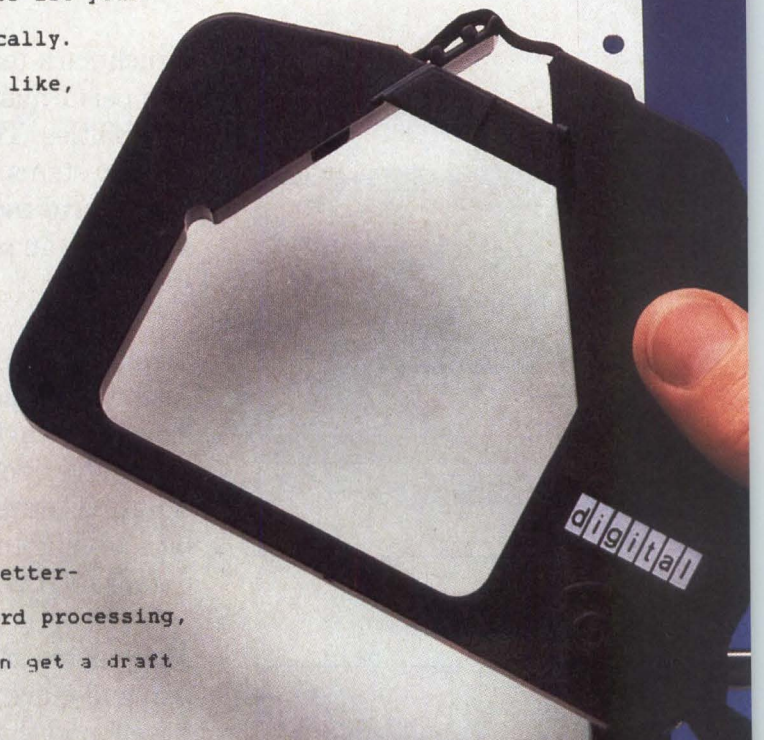


digital

CIRCLE NO. 71 ON INQUIRY CARD

Minicomputer companies move toward industry-standard software

UNIX, the de facto standard operating system for multiuser microcomputers, now competes with vendor-specific operating systems for minicomputers. Ada, the military's official software language, continues to gain strength for industry-wide recognition

Roy R. Friedman, Associate Editor

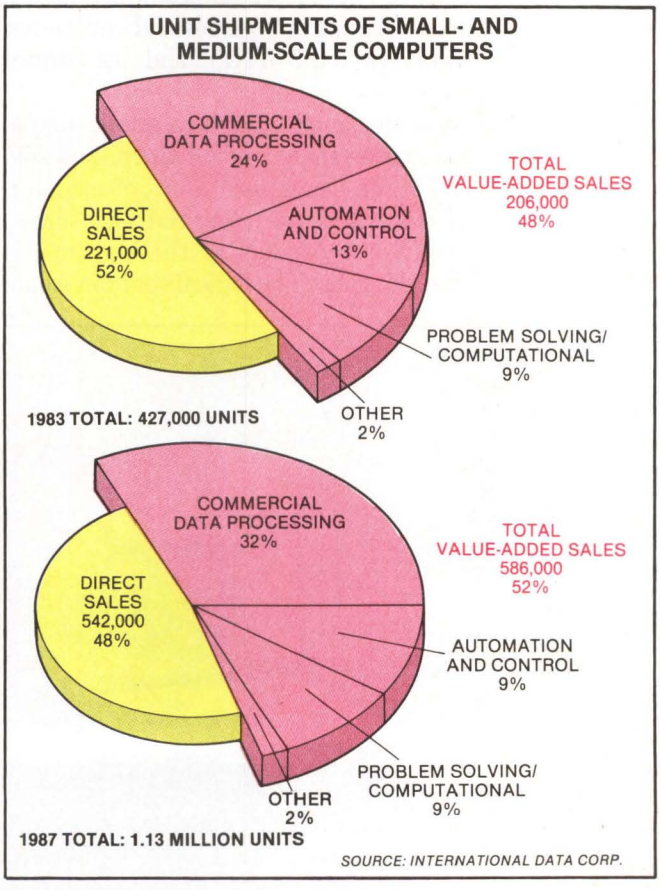
The most significant trend in today's minicomputer industry can't be measured in megabytes, mips, flops or nanoseconds. It isn't even a new technology; it's industry-standard system software. Minicomputer buyers and value-added resellers are questioning their traditional relationships with hardware vendors. In those relationships, proprietary system software makes it difficult for buyers to switch vendors without a catastrophic loss of application investment. This "software lock" protects a minicomputer vendor's customer base, so, until recently, most vendors were reluctant to sell their systems with a portable operating system such as UNIX. But, as more and more customers insist on portable software, minicomputer companies must oblige or risk losing a big chunk of potential business.

The movement toward industry-standard system software for minicomputers has several ramifications:

- System integrators can more easily incorporate off-the-shelf application software into minicomputer-based turnkey systems for vertical markets.
- Application-software manufacturers can reach a wider market by writing programs that run on multiple families of minicomputers with little or no modification.
- Software quality should improve as application developers spend more time developing and less time rewriting code to move applications to new hardware.

IBM clouds UNIX's future

The trend toward a standard minicomputer operating system is clear, but it is not yet certain which will



Value-added unit shipments *of small- and medium-scale systems will nearly triple between 1983 and 1987 because of overall market growth and an increasing share for the value-added portion. Most of the value-added growth will come from the commercial data processing segment, which will account for more than 60 percent of the value-added segment of the market by 1987.*

ultimately be the standard. Most hardware vendors have gravitated toward AT&T's UNIX, which the company developed in the late 1960s and began offering commercially in the 1970s. AT&T sold approximately 31,000 UNIX licenses in 1983, and more than 100 hardware vendors in the high-end microcomputer market offer UNIX on MC68000-based systems. Now that minicomputer vendors are endorsing UNIX, an observer might conclude that UNIX is unstoppable.

But some industry analysts caution that IBM Corp. might decide to market its own UNIX-like operating system, even though the company's decision to offer UNIX on its Personal Computer family suggests otherwise. According to Richard Ross of research company The Gartner Group, "UNIX has little incremental value for PC users, so IBM's UNIX announcement is probably a prelude to a much bigger UNIX-related development from the company." Meanwhile, IBM has been quietly offering CPIX, a UNIX-like operating system, since 1982. One of IBM's independent business units sells Series/1 minicomputers with CPIX to telephone operating companies and equipment suppliers who compete with AT&T and its former operating subsidiaries.

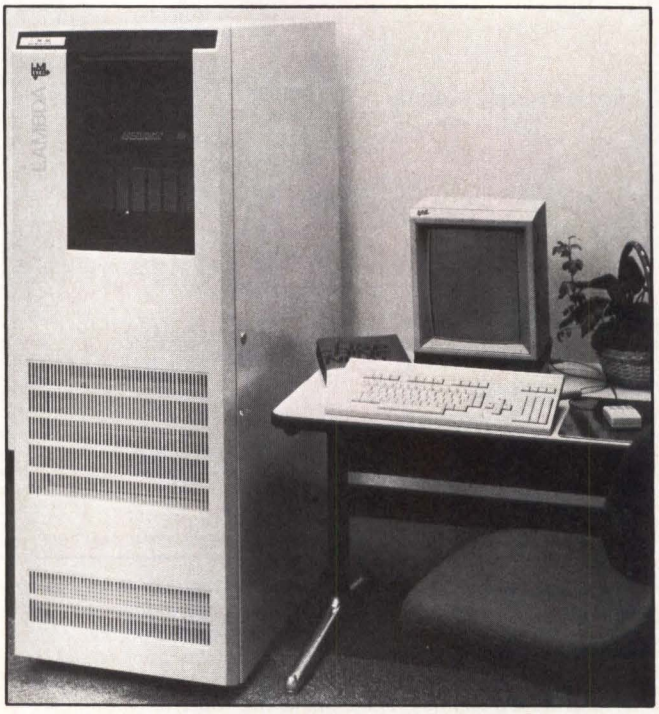
Mike Dubrall, a senior analyst with research company Yates Ventures, notes that Amdahl Corp. has sold more than 50 UNIX sub-licenses to users of medium- and large-scale IBM systems including the 4300 series. "Not having a UNIX-like product at the high end is hurting IBM," says Dubrall. "The logical solution would be for IBM to offer a proprietary UNIX-like operating system across its entire product line from micro to mainframe. But, if this happens, the UNIX market as we know it today will cease to exist." Dubrall says virtually all of the microcomputer vendors tied to UNIX are ready to convert to an IBM UNIX-like standard. With such a tidal wave of defections, it would be difficult for minicomputer vendors not to follow suit.

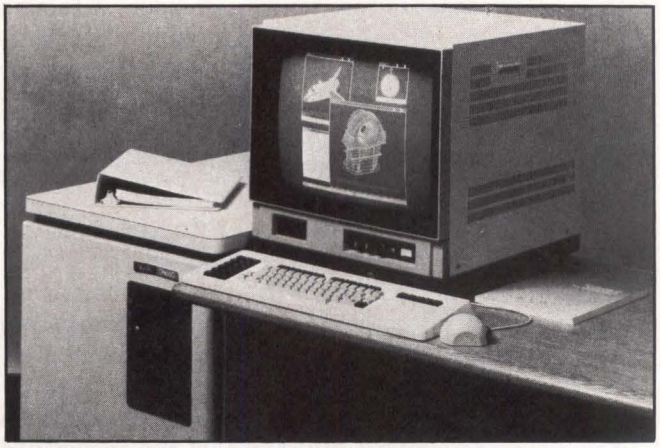
IBM has announced its intention to achieve a major share of all segments of the information-processing industry. Since the U.S. Department of Justice dropped its 13-year antitrust suit against IBM in 1982, everything has gone IBM's way. The company has acquired sizable minority interests in Intel Corp. and Rolm Corp., assumed the leading role in the personal computer industry, introduced two models in the 4300 series and signed a lucrative OEM contract with Computervision Corp. The contract involves the new 4361 supermini, which competes with top-of-the-line machines from Digital Equipment Corp., Data General Corp. and Prime Computer Inc.

Financially, IBM is looking stronger than ever. With heavy lease-to-purchase conversions of installed equipment, 1983 revenues increased 17 percent and net income increased 24 percent over 1982. Securities analysts predict 15 percent to 20 percent increases in revenues and profits for 1984.

DEC contends with increased competition

Until IBM clarifies its intentions, DEC will remain the major presence in the UNIX market. Industry





Apollo's DN 660 computational node *aims at complex solids-modeling and image-analysis applications. The color display incorporates 2M bytes of dedicated RAM providing 1,024-by-1,024-pixel resolution. All Apollo nodes are network-compatible and can concurrently run UNIX and Apollo's Aegis operating system.*

LISP Machine's Lambda, *a LISP-based minicomputer, employs an optional 68010 processor to run UNIX. In the dual-processor configuration, UNIX serves as a multiuser front-end processor to package and send requests to the LISP CPU.*

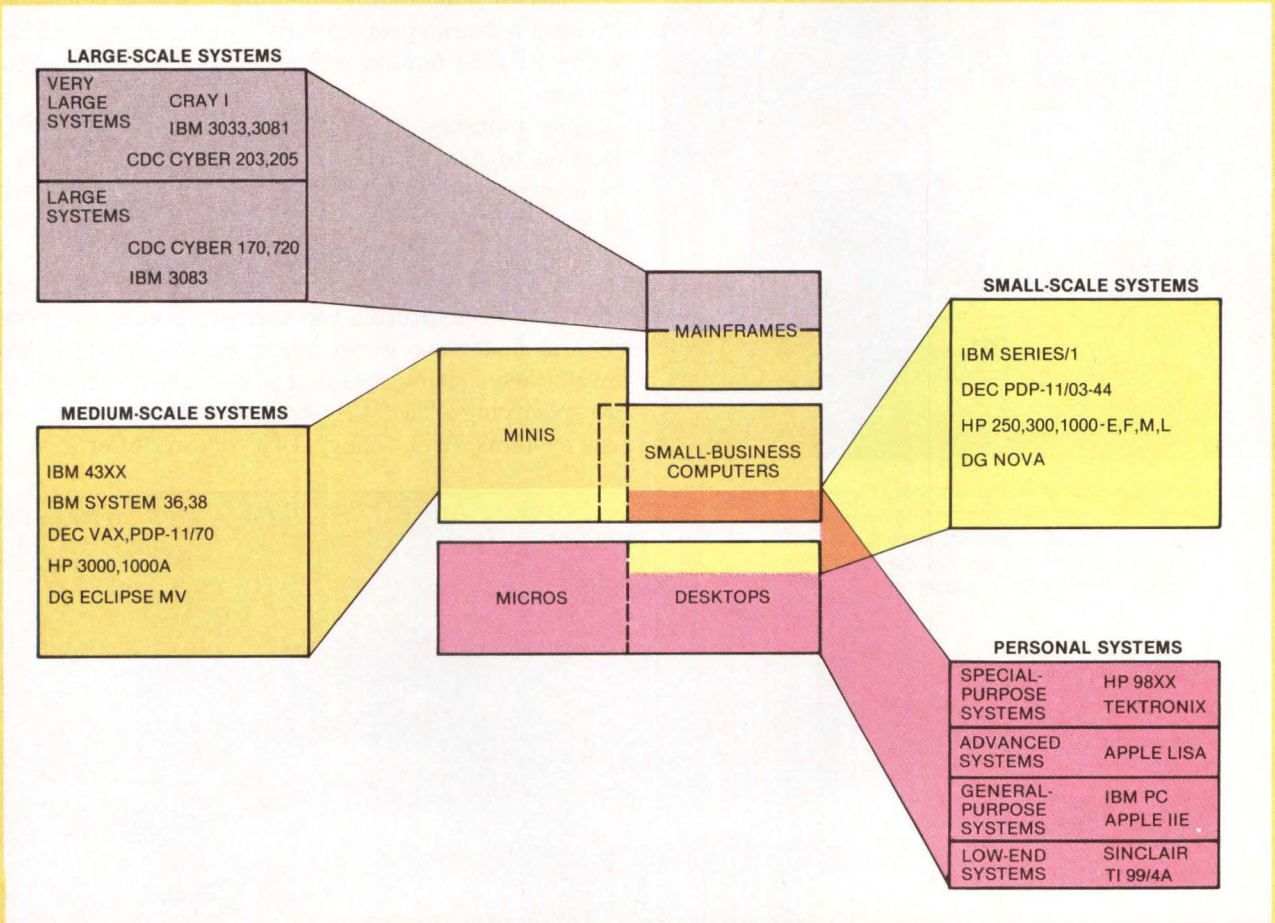
What is a minicomputer?

Many computer professionals no longer refer to systems as "micros," "minis" or "mainframes." Advances in technology have allowed microprocessor-based systems to provide performance levels traditionally associated with minicomputers. Moreover, the trend toward industry-standard software makes classification even more difficult because vendors of all classes of machines now offer the same operating systems and languages.

Some vendors and industry analysts are going so far as to pretend that they've never even heard of a "minicomputer." A company spokesman asked to categorize a product is likely to say, "I'll tell you what it costs and what it does; you tell me what it is." Such a response should not be dismissed as unreasonable. Microprocessors, gate arrays, bit slices and buses—the design criteria traditionally used to separate micros, minis and mainframes—are merely means to an end. The raison d'être of any product is to compete effectively for market share, so competitive posture should be a sensible way to segment the market.

International Data Corp. (IDC), a Framingham, Mass., consulting company, has devised a new classification system based solely on competition (see Figure). IDC determines the appropriate class for a computer by identifying the major products with which it competes. For example, anything that competes with IBM Corp.'s 4300 or System 36/38 or Digital Equipment Corp.'s VAX or PDP 11/70 is a "medium-scale system." Anything that competes with IBM's Series/1 or DEC's PDP 11/34 is a "small-scale system."

The purpose of this discussion is not to endorse IDC's classification methods but to draw attention to an issue of increasing industry concern. Until a new terminology comes into widespread use, *Mini-Micro Systems* will probably continue to talk about "minis" and "micros." But change is inevitable, or the terminology will eventually make no more sense than talking about a "full-sized car."



IDC's new classification system *maps five traditional categories (micros, desktops, small business computers, minis and mainframes) into four new ones (personal systems, small-scale systems, medium-scale systems and large-scale systems). The traditional categories are based largely on machine architecture, but IDC's new method uses competitive posture in the market as the sole criterion for classifying a product.*

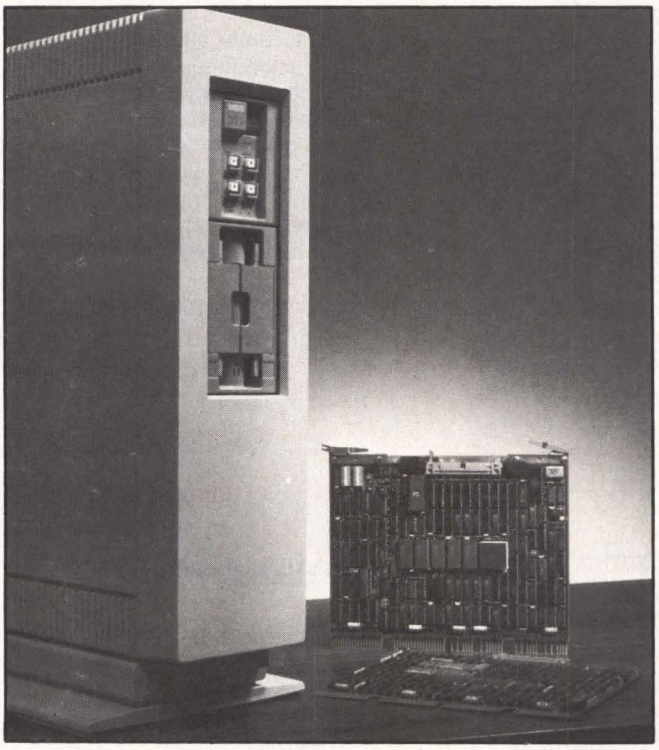
analysts estimate that DEC's VAX accounts for more than 80 percent of all superminis running UNIX. However, this market penetration cannot be attributed to DEC. Most VAX users running UNIX acquire the operating system from AT&T, the University of California's Berkeley Software Distribution (BSD) or other third-party vendors.

For many years, DEC enjoyed a virtual monopoly on commercial hardware supporting UNIX because AT&T's original UNIX port was on a DEC PDP-11. Moreover, the University of California at Berkeley designed its popular BSD UNIX enhancements to run on the VAX, so that vendors must retune the BSD software to run on other systems.

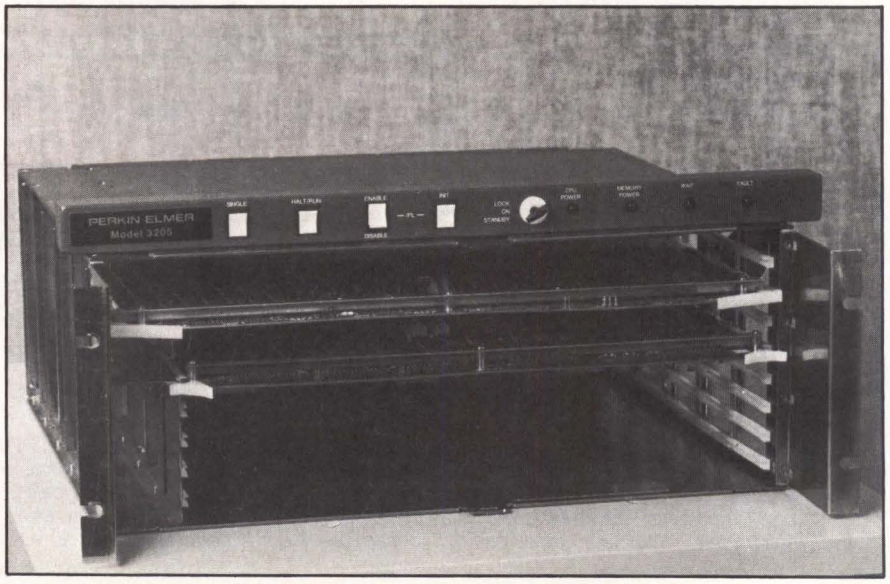
DEC's head start with UNIX may have become a handicap, however. Yates' Dubrall says DEC had it so easy for so long that it assumed it could own the UNIX market without any effort. "They don't even keep track of how many systems they sell with UNIX," says Dubrall.

UNIX products that are incompatible with each other also cause problems. DEC offers one version of UNIX—V7M-11, a derivative of AT&T's outdated UNIX Version 7—on its PDP-11 family, and another—ULTRIX-32, based on Berkeley release 4.2—on the VAX line. The two versions have different tools and are not fully compatible at the application-source-code level. ULTRIX achieves performance levels comparable to DEC's proprietary VMS operating system because it employs virtual-memory techniques and runs in a native-code environment. But these performance-oriented features prevent DEC from porting ULTRIX to the PDP-11 family, which does not support virtual memory.

Some industry analysts view as misguided DEC's decision to promote ULTRIX. Although ULTRIX is well-suited to traditional UNIX users who are interested in sophisticated tools for developing scientific and engineering applications, it is not as attractive as AT&T's UNIX System V for business and government users, who constitute a much larger potential market. Federal and state government agencies, which have always been strong customers for DEC, increasingly are specifying AT&T's System V in their contracts for new systems, even though DEC doesn't offer it.



DEC's MicroVAX I, *a two-board implementation of a subset of the 32-bit VAX architecture, provides 35 percent of the CPU performance of a VAX 11/780. The MicroVAX will run the ULTRIX-32 version of UNIX or a subset of VAX/VMS.*



P-E's 3205, *an OEM version of the company's 32-bit superminis, includes the CPU, 1M byte of RAM and a peripheral controller for less than $10,000 and runs UNIX or P-E's real-time OS/32.*

Now you don't have to be rich to be powerful.

Riches and power don't always go together. Take Plexus, for instance. The world's most powerful UNIX*-based supermicros.

Powerful because multiple processors share the UNIX load. So processing power is distributed to where it does the most good.

Terminal I/O. Disk I/O. Data communications. And, of course, data processing.

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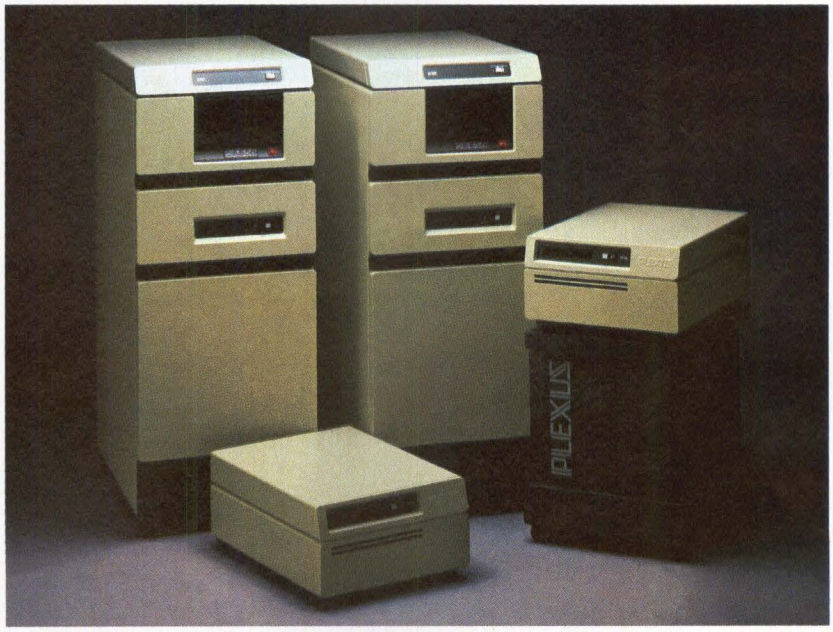
Plus our own software and maintenance support. And even a software referral service for your OEM programs.

Does all this make us expensive?

Absolutely not.

In fact, Plexus systems cost thousands of dollars less than the minicomputers we outperform.



To get a better idea of just how good that performance is, come get a demonstration. Call *800-528-6050*, ext. *1444*. In Arizona, *800-352-0458*, ext. *1444*. Or write Ralph Mele at Plexus Computers, Inc., 2230 Martin Avenue, Santa Clara, CA 95050.

You see? You don't have to be rich to be powerful. Just smart.

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Ordinary computers, yes. But not a Pyramid Technology 90x.

After all, here's a supermini not just capable of running UNIX,™ but born to run it. And run it up to four times faster than the most popular UNIX host. For a lot less money.

The secrets of this Pyramid are a thorough understanding of UNIX, a few fundamentals of RISC (Reduced Instruction Set Computer) theory, more registers than 30 VAXs, and a 32-bit proprietary architecture that outperforms a roomful of micros.

All combined to speed up UNIX just where it likes to slow down.

For example, gone are 85% of performance-robbing memory references. The endless parameter shuffling of yesterday's technology has been replaced with a hardware register win-

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It's amazing what hardware architects can do, given the chance. It's almost as startling as what our software wizards did.

They crafted OSx, a dual port of Berkeley's 4.2 BSD and Bell's System V. Because you can switch environments at will, no UNIX port offers more capabilities. With absolutely no loss of compatibility.

Well, almost.

We do admit to one feature not compatible with other UNIX systems. Our single-source support.

One telephone number instantly connects you to both hardware and software experts. In-house pros, who spend their energy pointing you towards solutions. Not pointing fingers at each other.

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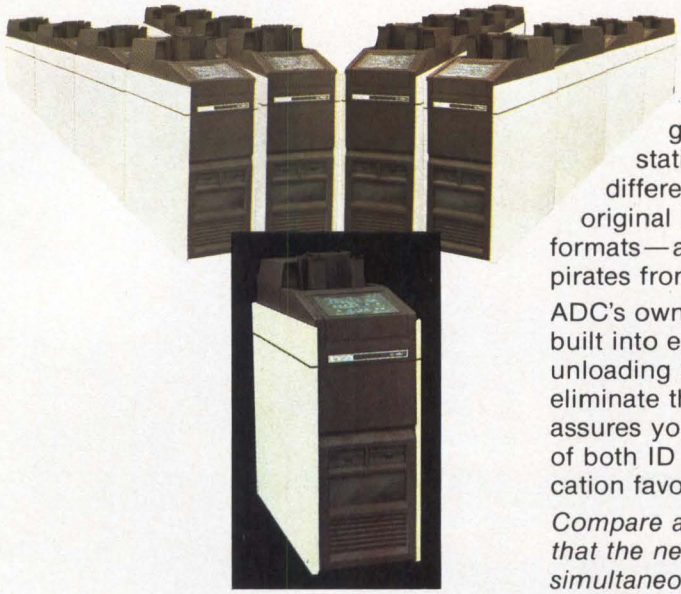

Just as efficiently and smoothly as your office copier, ADC's new Series 4000 Floppie Coppier® automatically initializes and copies thousands of duplicate diskettes per hour—and doubles your throughput for double-sided diskettes!

Unlike other blackbox-type duplicators, Series 4000 gives you total single-master control of up to 16 slave stations—each simultaneously working on an entirely different diskette size and format. Since inventing the original Floppie Coppier, ADC's developed over 300 different formats—and dozens of different protection schemes to prevent pirates from copying your Floppie Coppier "coppies."

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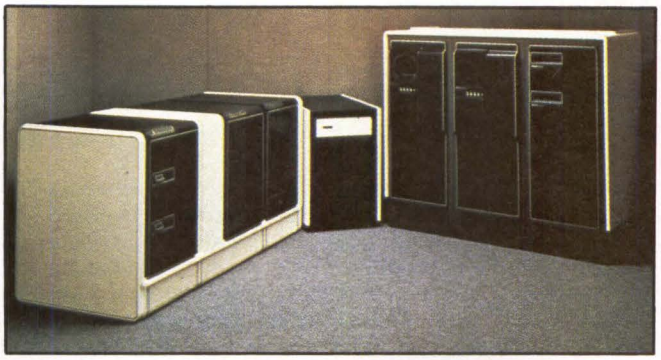

DG's Eclipse MV/10000 *(left), the company's top-of-the-line supermini, achieves one of the highest per-dollar performance rates in the industry. The Eclipse MV is the host for DG's Ada work environment (right), which contains a validated, production-quality Ada compiler.*

DEC is facing vigorous competition in the UNIX market from such companies as Sun Microsystems Inc. at the low end and Pyramid Technology Corp. at the high end. Pyramid's 90x supermini, which competes with DEC's VAX-11/780, is a reduced-instruction-set machine designed from the ground up for UNIX. It supports both AT&T's System V and Berkeley release 4.2. Pyramid recently sold 11 systems to a large New York law firm, and it has installed the 90x at Yale University and SPSS Inc., producer of a world-famous statistical research package.

Fiscal year 1983 saw DEC's profits plunge by more than one-third, and the first quarter of fiscal year 1984 was one of the worst in the company's history. In the second quarter (ending December 1983), profits recovered strongly thanks to better-than-expected demand for the VAX-11/780 and the Micro PDP-11. But securities analysts are still burning from the first-quarter fiasco when DEC reported an earnings decline of 73 percent shortly after announcing that earnings for the quarter would be flat. According to David Wu of Montgomery Securities, San Francisco, DEC desperately needs a top-of-the-line machine to compete with the superior per-dollar performance of machines such as DG's MV/10000.

DG implements layered OS and validated Ada

Data General offers Eclipse MV users the resources of both UNIX and DG's AOS/VS operating system in one integrated environment. Unlike DEC's VAX customers, who must choose between ULTRIX-32 and VMS, DG's users can run UNIX as a software layer on top of AOS/VS. DG product manager John Anderson says AOS/VS is functionally a superset of UNIX, so it can map UNIX system calls into AOS/VS calls with little or no loss of system performance. DG's UNIX product, UNX/VS, is based on AT&T's System V along with such Berkeley-compatible features as the "termcap" utility and C shell. The termcap utility enables users and system integrators to configure systems with a wide variety of terminals, and the C shell provides job-control functions not available with AT&T's Bourne shell.

Prime and Wang Laboratories Inc. view the layered approach to UNIX as so sensible that they plan to implement UNIX in essentially the same manner as DG. Prime will offer a version of AT&T's UNIX to run as a software layer above the company's proprietary operating system, PRIMOS. Wang's product, called UVS (UNIX on the VS), will run on top of its proprietary VS operating system and will debut in 1985. Wang will license UVS from the Wollongong Group, a Palo Alto, Calif., software company that has ported UNIX to several families of minicomputers.

DG's biggest achievement in industry-standard software is its joint development with Rolm of an Ada compiler and program-support environment for the Eclipse MV series. The compiler generates production-quality object code for the full Ada language as specified by the U.S. Department of Defense. The program-support environment is compatible with DOD's "Stoneman" specifications and includes a utility that facilitates large-program development by tracking multiple versions of each program module. Both the Ada compiler and the support environment can coexist with UNX/VS.

The Ada software sells for $84,000 by itself or for $150,000 to $380,000 in a fully configured hardware/software package called the Ada work environment. The primary application for the Ada work environment is developing and testing programs for embedded military computers such as those in missile systems. However, Ada marketing manager Lee Erlichman claims that DG is selling a number of Ada systems to non-military users. One such customer is Informatique Internationale, the French subsidiary of Groupe CISI, which develops computer systems for nuclear-energy, oil-exploration and aerospace applications. Erlichman

The top 20 companies in minicomputer revenues

Mini-Micro Systems' table of top companies highlights the health and breadth of the minicomputer industry. In 1983, 17 companies generated minicomputer-related revenues of at least $100 million. In 1984, Apollo Computer Inc. will likely join these 17 companies. Apollo's 1983 revenues ($81 million) jumped more than 300 percent relative to 1982.

Comparing minicomputer revenues to total corporate revenues indicates the degree to which a company is a "pure" minicomputer company. Of the 20 companies in the table, only five—Digital Equipment Corp., Data General Corp., Prime Computer Inc., Apollo and Modular Computer Systems Inc.—derive substantially all of their business from minis. The remaining 15 are involved in numerous businesses including the microcomputer, mainframe, office-automation, electronic-test and precision

		MINICOMPUTER DATA (1983)					CORPORATE DATA (LATEST FISCAL YEAR)					
Rank	Company	Revenues ($ million)	Units shipped	Year-end installed base	Avg. price per system ($)	% of revenues non-U.S.	Revenues ($ million)	% change	Net income ($ million)	% change	No. of employees	Fiscal year ending
1	**IBM Corp.,** Armonk, N.Y.	12,800	59,000	260,000	217,000	45	40,100	+17	5,480	+24	360,000	12/83
2	**Digital Equipment Corp.,** Maynard, Mass.	4,200	85,000	540,000	46,000	36	4,270	+10	283	−32	73,000	6/83
3	**Hewlett-Packard Co.,** Palo Alto, Calif.	1,900	18,000	107,000	114,000	46	4,710	+11	432	+13	72,000	10/83
4	**Honeywell Information Systems Inc.** (subsidiary of Honeywell Inc.), Minneapolis, Minn.	1,100	4,100	46,000	270,000	60	1,670	−1	131	+64	23,000	12/83
5	**Wang Laboratories, Inc.** Lowell, Mass.	890	9,800	61,000	90,000	31	1,540	+33	152	+42	24,800	6/83
6	**Data General Corp.,** Westboro, Mass.	860	17,000	140,000	55,000	29	829	+3	23.1	+17	14,900	9/83
7	**Texas Instruments Inc.,** Dallas, Texas	700	19,000	88,000	36,000	31	4,580	+6	(145)	N/A	81,000	12/83
8	**NCR Corp.,** Dayton, Ohio	660	6,600	37,000	86,000	54	3,730	+6	288	+23	62,000	12/83
9	**Burroughs Corp.,** Detroit, Mich.	650	6,500	51,000	128,000	42	4,300	+5	197	+12	64,000	12/83
10	**Prime Computer Inc.,** Natick, Mass.	517	2,400	12,000	215,000	37	517	+19	32.5	−28	6,000	12/83
11	**Four-Phase Systems Inc.,** (subsidiary of Motorola Inc.), Cupertino, Calif.	300	3,400	21,000	88,000	23	514*	+6*	(5)*	N/A	N/A	12/83
12	**Sperry Corp.,** New York, N.Y.	240	2,800	31,000	89,000	47	5,080	−9	118	−47	70,500	3/83
13	**Management Assistance Inc.,** New York, N.Y.	220	2,100	19,000	105,000	59	376	+5	1.05	−86	6,000	9/83
14	**Perkin-Elmer Corp.,** Norwalk, Conn.	200	1,700	21,000	119,000	17	1,020	−2	50.2	−20	14,400	7/83
15	**Gould Inc.,** Rolling Meadows, Ill.	180	1,000	4,300	174,000	14	1,320	+5	79.2	0	21,000	12/83
16	**Harris Corp.,** Melbourne, Fla.	140	570	4,200	240,000	30	1,420	−17	55.9	−26	22,200	6/83
17	**Datapoint Corp.,** San Antonio, Texas	110	3,200	15,000	36,000	35	540	+6	8.1	+238	8,900	7/83
18	**Apollo Computer Inc.,** Chelmsford, Mass.	81	2,700	3,300	N/A	12	81	+345	13.1	+4,200	1,300	12/83
19	**Modular Computer Systems Inc.,** Ft. Lauderdale, Fla.	74	500	7,000	150,000	18	57†	−20†	(13)†	N/A	1,100	†
20	**General Automation Inc.,** Anaheim, Calif.	58	1,400	30,000	42,000	54	66	−33	(10.5)	N/A	940	7/83

*Motorola Inc. Information Systems Group **Motorola Inc. †Data for 9 months ending 9/83

instrument industries.

In the stock market, the high price-to-earnings ratios and low dividend yields of minicomputer companies indicate the confidence investors have in future growth. The average price-to-earnings ratio of the companies in the table is 25—more than double the average of all the companies on the New York Stock Exchange.

STOCK MARKET DATA (1983)

1983 high	1983 low	% change during year	Year-end price/earnings ratio	Year-end dividend yield	No. of shareholders	Exchange
134.3	92.3	+27	14	3.1	726,000	NYSE
132.1	64	−28	17	none	40,100	NYSE
48.3	34.3	+16	25	0.4	52,000	NYSE
139.5	83	+52	13	2.8	49,700	NYSE
42.5	28	+21	29	0.3	30,100	ASE
41.4	19.3	+87	38	none	9,100	NYSE
176	101	+3	N/A	1.4	29,000	NYSE
136.8	82	+49	13	2.0	32,400	NYSE
57.6	40.3	+21	21	5.2	56,000	NYSE
30.3	13.3	−24	24	none	14,600	NYSE
150**	82**	+57**	26**	1.2**	10,700**	NYSE**
47.4	31.8	+40	15	4.0	75,300	NYSE
19.3	9.4	+70	N/A	none	13,700	NYSE
37.5	23.5	+4	27	1.7	15,800	NYSE
43.8	25.8	−19	18	2.2	29,300	NYSE
51.9	33.3	+9	23	2.2	19,500	NYSE
30	17.8	+50	42	none	7,300	NYSE
50.5	25.3	+24	50	none	N/A	OTC
16.5	7.1	−27	N/A	none	N/A	NYSE
16.8	5.1	+87	N/A	none	1,300	OTC

Source for minicomputer data: Mini-Micro Systems and International Data Corp.

expects non-military applications to account for 25 percent of DG's Ada business by 1986.

DG's Eclipse MV series, bolstered by UNX/VS and Ada, now accounts for about half of the company's equipment sales and it is rapidly making up for DG's late entry into the 32-bit supermini market. After posting sharp profit declines in fiscal years 1981 and 1982, DG had flat results in 1983 and sharply higher earnings in the first quarter of fiscal year 1984. The turnaround in profits and prospects has caused DG's stock price to soar to almost five times its 1982 low.

UNIX penetrates real-time development market

Not every minicomputer vendor offers UNIX or a UNIX-like operating system, but there will probably be few holdouts by the end of this year. In addition to IBM, DEC and DG, major minicomputer companies marketing UNIX include Hewlett-Packard Co., Honeywell Information Systems Inc., Perkin-Elmer Corp. and Gould Inc. These companies have traditionally sold systems to users in a real-time industrial environment, to which UNIX is poorly suited because of its high run-time overhead for such functions as file access. However, UNIX has excellent tools for *developing* real-time applications. To capitalize on UNIX's strong points, P-E and Gould are augmenting UNIX with hardware and software tools that allow users to create and test applications with UNIX and then execute the applications using a proprietary real-time operating system.

P-E's UNIX product, the Edition 7 workbench, runs on all members of the company's 3200 series and is operationally independent of OS/32, P-E's real-time operating system. Customers can order systems with UNIX, OS/32 or both. P-E has sold UNIX-only systems for use in banking, office automation and university research. But OS/32 customers running real-time applications are becoming interested in UNIX because P-E has developed a set of conversion utilities to transport object code from UNIX to OS/32. P-E also has developed a set of optimizing FORTRAN-77 compilers, which the company will offer under UNIX and OS/32. According to software product manager Russ Lombardo, P.E.'s FORTRAN-77 compilers generate faster code than any other FORTRAN compiler, and support industry-standard language extensions such as 36-character names, lowercase input and free-format "namelist" I/O. "Although most UNIX users prefer C, an optimized FORTRAN is still hard to beat at run-time," says Lombardo.

Gould's UNIX product UTX-32 runs in a native-code environment on the Concept 32 series. A multitarget executive (MTX) package enables users to develop

applications with UNIX and down-load them to execute under MPX-32, Gould's proprietary real-time operating system. MTX consists of two Concept 32-series minicomputers, one running UNIX and the other MPX-32, connected by a high-speed communications link.

Gould also offers the Ada learning environment, which implements a subset of Ada and runs with UTX-32. A typical configuration for the Concept 32/8750 supermini with the Ada learning environment sells for approximately $370,000. According to product manager Chris Howkins, Gould will soon offer a validated implementation of the full Ada language using the compiler from Irvine Computer Sciences Corp.

General Automation bets on Zebra

With an installed base of 30,000 systems, General Automation (GA) Inc. has been a major minicomputer vendor in the industrial-automation market for 15 years. But the company's 16-bit minicomputers are tied to the fortunes of the "smokestack" industries. GA sells minicomputers that direct such automotive processes as adjusting carburetors and measuring bumper heights. "General Motors [Corp.] used to buy hundreds of systems from us," says John Murray, GA's chief financial officer, "but now all they can say is that they might need a few systems in 1985 or 1986. Instead of buying new systems, they are closing plants and relocating the systems they already have."

When recession hit the United States in the early 1980s, GA's minicomputer business all but evaporated. The company lost $15 million in fiscal year 1980, broke even in 1981 and lost $16 million in 1982 and 1983. But, unlike previous recessions, which were always followed by booming prosperity, the sluggishness of the early 1980s lingers for U.S. heavy industry.

GA's response to economic adversity has been to diversify into the commercial small business market with the Zebra family of multiuser systems. The company will continue to support its customer base in industrial automation but will direct development and marketing resources to the Zebra. What sets Zebra apart from the crowded small business market is that it uses the Pick operating system. GA licensed Pick from Pick Computer Works, Irvine, Calif. Although Pick is not nearly as widespread as UNIX, several OEMs license it to run on IBM, DEC and Honeywell hardware. Virtually everyone familiar with Pick agrees that it is the easiest operating system for business users to learn and operate. What makes Pick so usable is its English-like command interface and a simple relational database that forms its core. Rene Caron, GA's marketing director for Zebra says "Pick is ideal for business users who need to work with a database but don't require the sophistication and expense of a mainframe-like database-management system." GA has sold more than 400 Zebra systems since it introduced them last year. Buyers include government agencies, wholesale/retail distributors, financial managers and food services in the United States, Britain, Singapore, Australia, France and South Africa. The price for a fully configured Zebra ranges from $55,000 to approximately $100,000, including the Pick operating system and software packages for word processing, spreadsheet analysis and business graphics.

The Ada market could soon be a significant portion of supermini sales.

GA's top-of-the-line Zebra model 5500 supports as many as 48 users on a 68000 CPU. Such a heavy load for one microprocessor is a testament to the streamlined design of the Pick operating system."Pick carries a lot less baggage than UNIX," says Caron. "Running 48 users on a 68000 under UNIX would be out of the question." However, GA is not betting against UNIX. This year, the company will begin shipping Zebra systems that run XENIX, an enhanced version of UNIX from Microsoft Corp. Zebra with XENIX will contain a 68010 CPU and will support as many as 16 users.

The Zebra line is boosting GA's net income. The company posted a long-awaited profit in the first quarter of fiscal year 1984 and expects more of the same in the second quarter. Investors have responded by bidding up the price of GA's stock to more than three times the 1983 low.

Ada advances opportunities for superminis

As the official language of DOD, Ada will assume two distinct roles: as DOD's internal program-development language and as the implementation language that defense contractors must use for "mission-critical" embedded computers. The 32-bit supermini is the ideal hardware environment for Ada's development role and the logical host for Ada cross compilers that generate code for microprocessor-based weapon systems. Although it is technologically feasible to host Ada on a 16-bit machine, Ada makes such extensive demands of a system that doing so usually isn't practical.

Because DOD is the world's largest computer user, the Ada market could soon become a significant portion of supermini sales. According to the Electronics Industry Association (EIA), DOD will spend $11 billion on embedded computer systems in fiscal year 1984, of which $8.5 billion will be for software. EIA forecasts DOD spending of $37 billion on embedded systems by

1990, of which $32 billion will be for software. Steve Weissman, editor of the *AdaData* newsletter published by market research company International Resource Development, predicts that the market for Ada development systems, including hardware, Ada compilers and program-support tools, will reach $600 million by 1986.

These numbers mean good news for the minicomputer vendors that are scrambling to offer an Ada product to compete with DG's. Many of these vendors are turning to Telesoft, a San Diego software company that has implemented an Ada compiler that can generate code for several target machines, including the 68000 and 8086 microprocessors commonly embedded in weapon systems. Telesoft marketing director Tom Dent says DEC will soon offer the Telesoft compiler hosted on the VAX (running VMS or UNIX) and targeted for the VAX and the 68000, and IBM's Federal Systems Group will acquire the compiler (hosted on a 370 or 4300) to generate code for the U.S. Navy's AN/UYK 44 computer. Moreover, Dent claims that at least four other major minicomputer vendors will offer Telesoft's compiler by year-end.

As more Ada products reach the market, the DOD validation process remains a potential stumbling block. Validation of an Ada compiler requires that the compiler correctly implement the full Ada language in each target environment. But Dent says this requirement is illogical because many of DOD's embedded computers run in execute-only mode without the support of file systems and mass storage. "Missiles don't have disk drives, so how do you test Ada's I/O routines in that environment?" asks Dent. Difficulties such as this should disappear as DOD reviews and modifies the validation process.

Minicomputer market will remain healthy

The minicomputer market may never return to the hectic 30 percent to 50 percent growth rates of the 1970s, but it will almost certainly grow faster than the overall economy for the indefinite future. International Data Corp. (IDC) expects a 20 percent to 25 percent annual growth rate for 32-bit superminis and a 10 percent to 15 percent rate for 16-bit minis during the next several years. According to IDC, the share of the total minicomputer market that can be attributed to superminis will grow from 25 percent of shipments and 69 percent of dollar sales in 1983 to 36 percent of shipments and 79 percent of dollar sales in 1986. But, even as high-end systems increase their market penetration, technological advances will cause the average price of a fully configured minicomputer to drop from approximately $60,000 today to less than $45,000 by 1987. □

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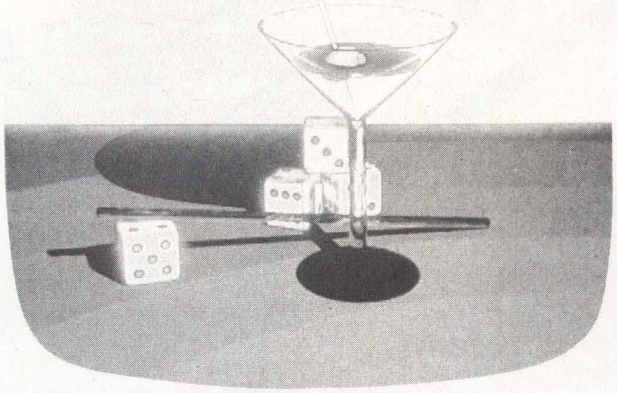

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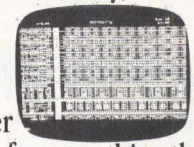

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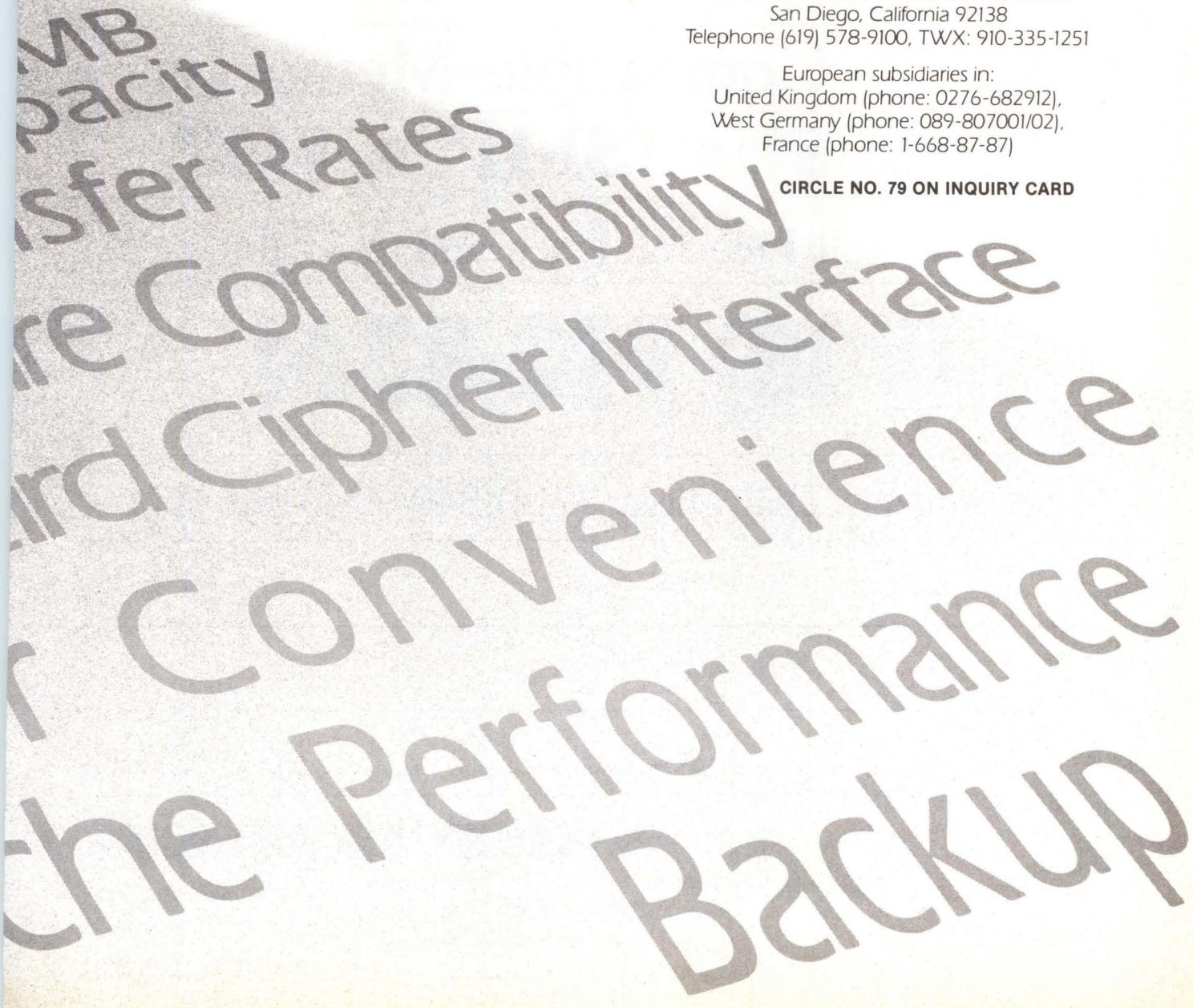


Performance-measurement software pinpoints system bottlenecks

Once confined to mainframes, performance-measurement software furnishes usage data for evaluating minicomputer/microcomputer systems

Roger Kovach, Boole and Babbage Inc.
Armond Inselberg, Synapse Computer Corp.

Performance-evaluation or -measurement software, a proven technology for testing mainframe and large-scale systems, has now been adapted to multiuser supermicrocomputer and minicomputer systems. Benchmark tests can measure single-user, standalone system performance by measuring processor and peripheral capabilities. However, performance evaluation of multitasking, multiprogramming systems is more complex. It requires sophisticated measurement and evaluation software.

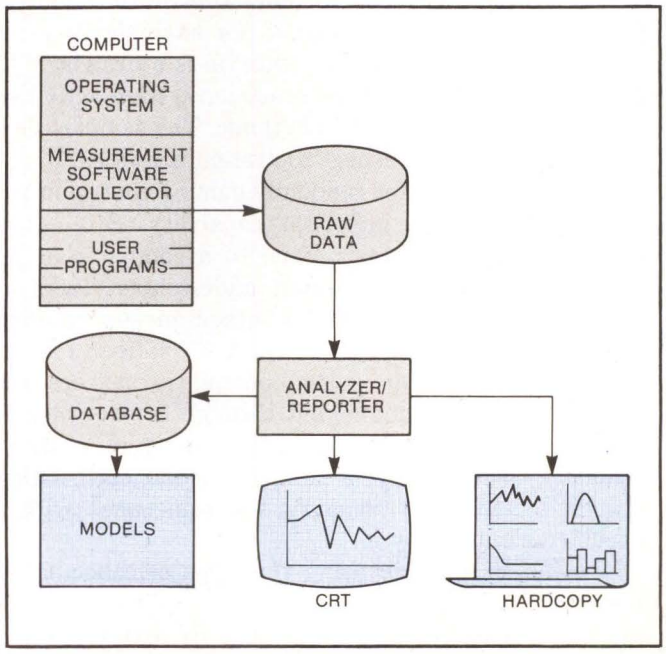
Performance software monitors work load

Performance-measurement software code resides in a system with the operating system and the user's software. Called a "monitor," it takes time counts and functional measurements of the system components executing the operating system and the user's work load.

Monitor software does not include software and synthetic benchmarks or simulation and analytic models. Benchmarks establish the capacity of a system in terms of its ability to run a user's work load. Synthetic benchmarks perform the same task using an artificial work load rather than subsets of the user's work load. Simulation and analytical models try to predict system behavior after changes in the work load or the system configuration. They typically require measurements from performance monitors for their inputs.

Performance-measurement software contains two major parts—a "data collector" and an "analytical reporter." The collector takes counts, times and other measurements during system execution. It performs little or no data reduction or collation, mainly because events occur too rapidly for detection. Measurement

Fig. 1. Performance-measurement software *consists of a data collector and an analyzer/reporter. The data collector extracts measurements during system execution. The analyzer/reporter reduces, summarizes and displays or prints performance information.*



software should impose little burden on a system for economic reasons and should avoid disturbing the observed system. To avoid burdening the system, the collector stores raw data on disk or tape for later reduction, analysis and reporting (Fig. 1).

Data collectors extract measurements

Data collectors comprise two principal strategies—event-driven and timer-driven, or sampling, measurements. Event-driven collectors are traps planted in the operating system's code, or function, that cause a class of events, such as starting a disk I/O, to occur. The software then takes counts related to the class of events and attaches time stamps.

The form of work-load characterization data depends on usage.

The traps can be permanently embedded, or "patched" into code or structured as optional user exits. Depending on the information available when an event is trapped, detailed information, such as the number of I/Os by device, can be recorded. Event-driven monitoring, although usually thorough, can be costly in terms of CPU usage and in primary and secondary storage needs.

Sampling is achieved by seizing the CPU at points that have no previous relationship to system activities. Timer-driven sampling is based on the availability of an interval timer or time-of-day clock and the capability for a clock interrupt. It assumes control on a metronomic basis—every half-second, for example. Lack of randomness in the sampling interval is a drawback to the technique; however, in practice, system activities are typically chaotic and arrhythmic. The samples thus prove random with respect to system activities.

Other techniques for randomly gaining control of the system rely on an interrupt capability. Still other techniques use features unique to a computer or an architecture. Systems without addressable clocks or interrupt logic must employ other means to gain system control, such as using the CRT refresh rate.

After the sampler gains control, it gathers the required data by rummaging through control blocks, tables, queues, buffers and other system sources. Usually, several different samplers exist, each with a specified domain to measure and sometimes with a specified sampling cycle.

A common error in using this type of collector—is specifying a higher-than-needed sampling rate. To determine phenomena that occur only a fraction of a percent of the time, only a few thousand samples are required to obtain 95 percent or better accuracy. If the sampler is running continuously, it is unlikely that more than one sample per second is needed. Sampling can be combined with the event-driven approach, taking a sample every nth event, but this method is not commonplace.

Sampling collectors are strongly connected to their operating system and to at least some of the system's hardware characteristics. Among other considerations, these connections imply that when an operating system is revised or system hardware properties are changed, the collector software must also be revised. Although these changes primarily concern the software vendor, the user also becomes involved. When such changes affect event-driven collectors, the impact on the system is alleviated.

Both varieties of collectors have an established relationship to the operating system and the user's programs. They might be a part of the operating system (common with event-driven functions), might appear as just another application program or, rarely, might execute programs before the operating system. In this case, the collector seizes control of the CPU at certain transition points and decides whether to relinquish control to the operating system or keep it. Other collectors, those that measure application program performance, operate as part of the application program.

The relationship of the performance monitor to the operating system can limit the range of measurable phenomena. For instance, if the collector operates as an application program, it might not measure CPU time in the system state. Alternatively, it might measure CPU time but not time when the system is uninterruptible.

Analyzer/reporters output plots

The analyzer/reporter reads the collector data from disk or tape; reduces, orders, groups, summarizes and computes values of interest; and displays the information in a logical manner. It can also use data collected by system facilities rather than by the collector. A system facility can be, for example, another collector, a system accounting routine or a hardware monitor. Data values typically represent totals, averages and rates that are meaningful as performance indicators, such as totals for observation time, CPU seconds, number of I/Os by type and device within type and sub-configurations according to system architecture. In a multiuser, multiprogrammed system, these totals are important for each user and each program or job.

Typical parameters that analyzer/reporters can provide include dividing the number of samples for a device, sub-configuration, program or active user by

Checklist for computer performance-evaluation packages

Name of product:

Type: Data collector _____
Data analyzer/report creator _____
On-line monitor and display _____

Machine(s) measured: _____
Operating system(s): _____

Language product is written in: _____
Support requirements:
Memory required _____
Disks — drives _____
— space _____
Tape drives _____
Addressable clock or timer _____
Interrupt logic _____
Printers _____
Microcomputers (for processing, output) _____
Displays _____
Plotters _____
Other hardware _____
External software (e.g., report writers) _____
Support libraries (e.g., for language) _____
Other software _____

Methods and operating modes:
Collectors:
Sampler types: Timer driven _____
Other interrupt driven _____
Other (specify) _____
Event driven: System-provided exits _____
"Patched-in" traps _____
Other (specify) _____
Relationship to operating system:
Prior to operating system _____
Appears to be part of operating system _____
An application program _____
In other application programs _____
Other (specify) _____

Analyzer/reporters:
Inputs: Special collectors (as above) _____
Existing system facilities (e.g., built-in accounting routine) _____
Historical performance database _____
External systems (hardware monitors, front-end processors, etc.) _____
Outputs: Display
"Canned" reports _____
User-definable reports _____
elements _____
Menu driven _____
Command language _____
Hard-copy reports _____
User options _____
Graphics output _____
Varieties (line, bar, etc.) _____
Historical performance database _____

Data collected/reported:
General:
Measurement interval ("wall clock" time) _____
System active time _____
System downtime _____
System idle time _____
System components (hardware and operating system):
CPU utilization or time _____
Percent in operating system _____
Percent in centralized services _____
Percent in user program _____
Percent in performance monitor _____
Other (specify) _____

I/O:
Drives/devices:
I/O counts or throughputs
by drive _____
by file _____
Device times or utilizations _____
Data transferred _____
Channels/controllers:
I/O counts (throughputs)
by channel/controller _____
Times or utilizations _____
Terminals/communications lines:
Messages transferred _____
by terminal _____
by user _____
by line _____
Data transferred _____
Line utilization _____
Connect time by terminal _____

Work-load and service characteristics:
Queuing data: _____
Average tasks enqueued on CPU _____
Average requests enqueued for (by) chans/controllers _____
Average requests enqueued for (by) devices _____
Averages for input message queues _____
Averages for output message queues _____
Batch job data: _____
CPU time by job _____
Turnaround time by job _____
I/O counts by job (each device) _____
Print lines _____
Other (specify) _____
Transaction data: _____
Transaction counts by type _____
CPU time by transaction type _____
Response time by tranaction type _____
I/O counts by transaction type _____
User/terminal data: _____
Transaction counts by type:
by user _____
by term _____
CPU time by type:
by user _____
by term _____
Response time by type:
by user _____
by term _____
I/O counts _____
by device type _____
or by device _____
by transaction type _____
by term _____
by user _____

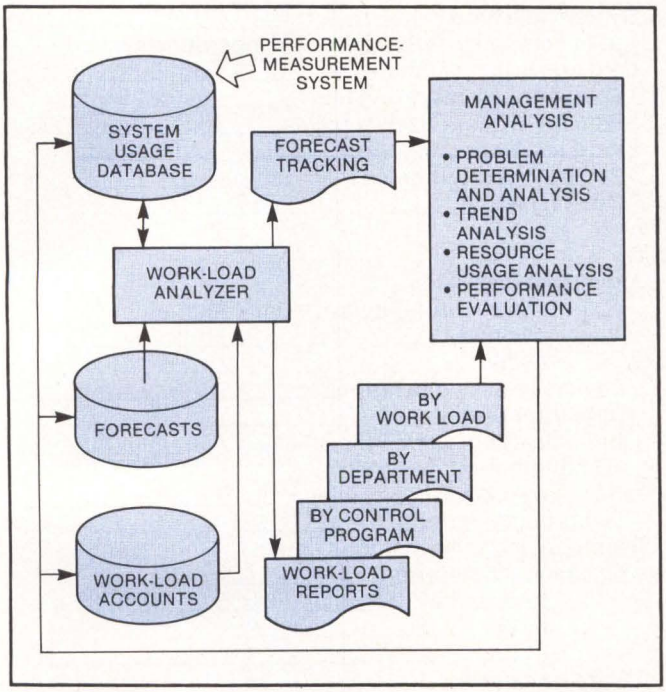


Fig. 2. A work-load analyzer *provides plots of work-load patterns over time, reporting the capacity usage by equipment class, and enhances trend and forecasting capabilities. Reports are produced daily, weekly or monthly and indicate work-load activity levels. Report analysis helps modify system usage and forecasts.*

the total number of samples, yielding the usage factor, or "percent of time busy"; multiplying these data by the observation time, yielding a total active time for each component; dividing the total active time by the number of requests, jobs or transactions—that is, whatever the collector counts—yielding an average service, busy or response time per request; totaling requests divided by the total time, to produce a flow rate (service rates or throughputs); multiplying throughput and service time to give utilizations; and measuring certain queue lengths, these averages divided by the throughputs of the servers, result in the average response time of that part of the system.

If a user knows the block sizes and the number of requests that hardware and software subsystems handle, then the user can establish work load distribution. This knowledge is important for such usage areas as balancing work loads, scheduling, cost accounting and billing. Projections of work loads, based on trends and predictable work factors, combined with usage, enable users to forecast hardware needs and plan timely and cost-effective hardware acquisition.

Analyzer/reporters differ in presentation, media and control methods and content. Some types output to hard-copy printers with fixed report formats, offering at most a parametric selection of reports. Other types output to display terminals and printers with the same canned format. Employing high-performance types, users can define their measurements, report formats and contents via a menu-driven or command-language report-control system. Graphics outputs on display screens and printouts improve presentation. Furthermore, the analyzer/reporter can direct results to a performance database. This database can be used as an input to the analyzer/reporter for accrued results, trend analyses and comparative analyses. It can also be employed to provide input to modeling systems, work-load analyses and forecasting, cost accounting, budgeting and hardware planning.

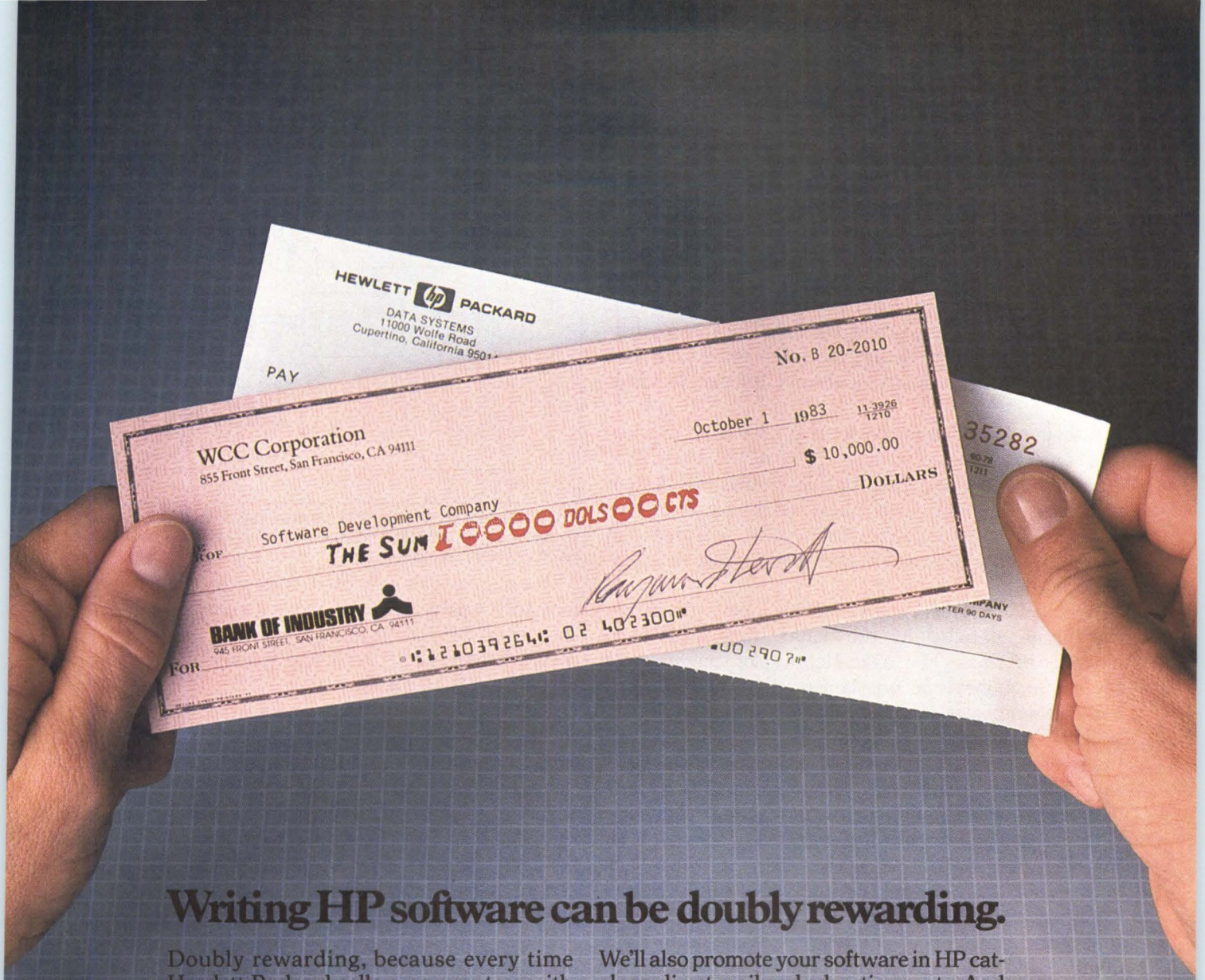
Work-load analyses characterizing sub-work loads

Understanding a system's work loads is fundamental to performance analysis. The work load involves a system's current and future work load, size, schedule and service-level requirements. Work load characterization and analysis, therefore, call for an integrated set of software tools, procedures and methods that define the work loads, track their growth or change, compare actual and projected usage against equipment capacity, determine work-load/capacity conflicts and congestion and provide useful data for forecasting and planning purposes (Fig. 2).

Work loads are essentially characterized by resource usage and by patterns. In a business environment, for example, to achieve better planning and work-load forecasting, computer work-load requirements must relate to corporate business plans. However, two problems arise when considering future work loads. First, new applications must be forecast, and system impact must be defined. Second, new work-load sources, such as more terminals or end users, must be estimated.

The form of the work load's characterization data depends on usage. Essentially, work-load characterization defines the inherent and non-inherent properties of work loads. Additionally, a unit of work is defined, and each work load is expressed in such units. Inherent work-load properties are values that cannot change without changing the nature of the work load. Examples of inherent work load characteristics include the total work performed by the CPU, tape and disk equipment classes and the amount of work per transaction for each equipment class. Non-inherent work-load characteristics cover the work load's schedule window and service level. Once the work-load-characterization data is collected, equipment requirements can be determined. Next, after the equipment has been configured and the data sets assigned, service times can be calculated.

The three basic work load classifications include service, billing and cost-analyses and control-program work loads. The service work-load classification predicts the service requirements of the work loads in terms of completion time and completion rate and



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predicts the capacity to meet service requirements.

Billing and cost-analysis work loads track billable and non-billable work loads. This work-load classification indicates the costs to provide the computing service and determines the pricing mechanism to recover total costs. The control-program work load classification tracks system overhead consumption. The three work-load classes actually contain the same work loads but with different data requirements and different levels of detail.

Although the transaction arrival rate of an application is not an inherent characteristic of the work load, the arrival rates and patterns determine the system response time under various load conditions. To ensure sufficient system capacity, the cyclic, seasonal and trend growth patterns of the work loads must be considered.

Work-load analysis reports include a plot of monthly disk usage, detailed by the major work loads as a function of time. For example, a plot might show several functions from, say, January 1984 through April 1984. It emphasizes significant long-term work-load trends. Work-load analysis reports also show plots of the weekly or hourly total work-load usage of the CPU as a function of time, with a maximum-capacity line indicated. For example, such a plot might show that CPU usage rises from a low on Sunday to a high on Tuesday, dips for Thursday, rises for Friday and then declines for the weekend. Of interest is the peak-load condition. Peak-load analysis is important to assure that sufficient computer capacity is available to meet demand and to avoid a service failure. A mismatch in equipment capacity and peak-load demands could emerge if equipment needs are planned only in terms of work-load averages.

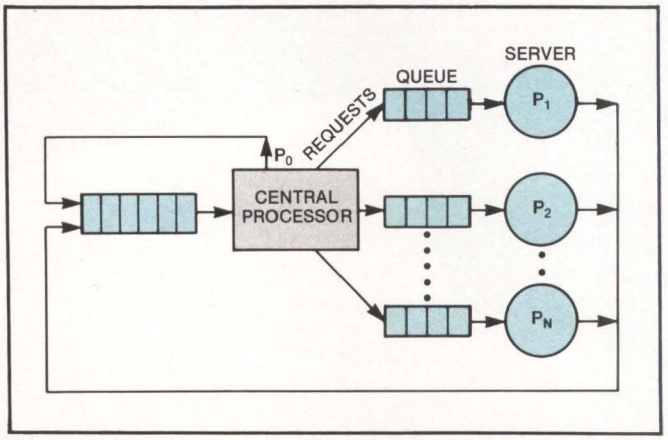

Fig. 3. Central server models portray tasks in queues *awaiting servers. Such analytical queuing models aid in performance measurement of a system that cannot be evaluated directly.*

Queuing models are used widely in computer performance analyses. Such models consist of servers, such as a CPU or a disk drive, and requests to be serviced, such as I/O requests. When a server is busy, requests wait in queues.

The simplest queuing model, the single-server, consists of a server (processor) and a queue of requests (tasks). The requests enter the queue, then advance to the server. An important characteristic of requests is arrival rate, and of servers, service rate. A common simplification assumes that the distribution of times between successive arrivals and the distribution of service times are exponential—the basic kind of random distribution.

The "Utilization Law" indicates that when server utilization—the arrival rate divided by the service rate—approaches unity, then utilization approaches 100 percent, and response time becomes indefinitely large.

Queuing models evaluate two fundamental parame-

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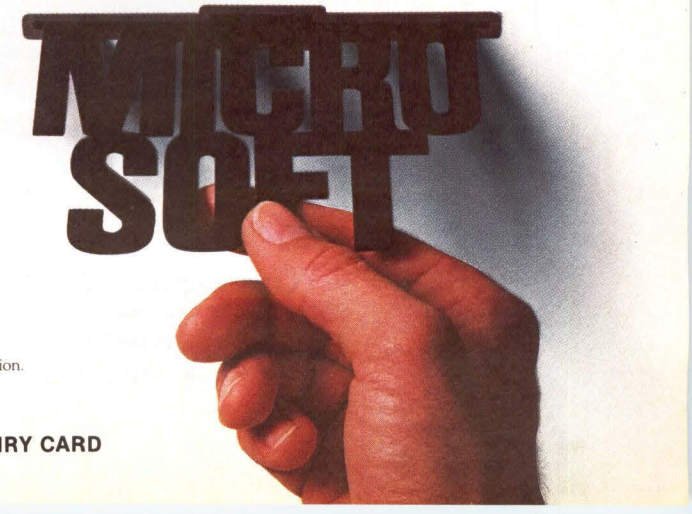

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ters— the *throughput*, or number of requests the server completes per unit of time and the response time, or total time a request waits in the system. Response time differs from throughput.

A system can be modeled as a network of queues. A common method of modeling a computer system is called the central server model (Fig. 3).

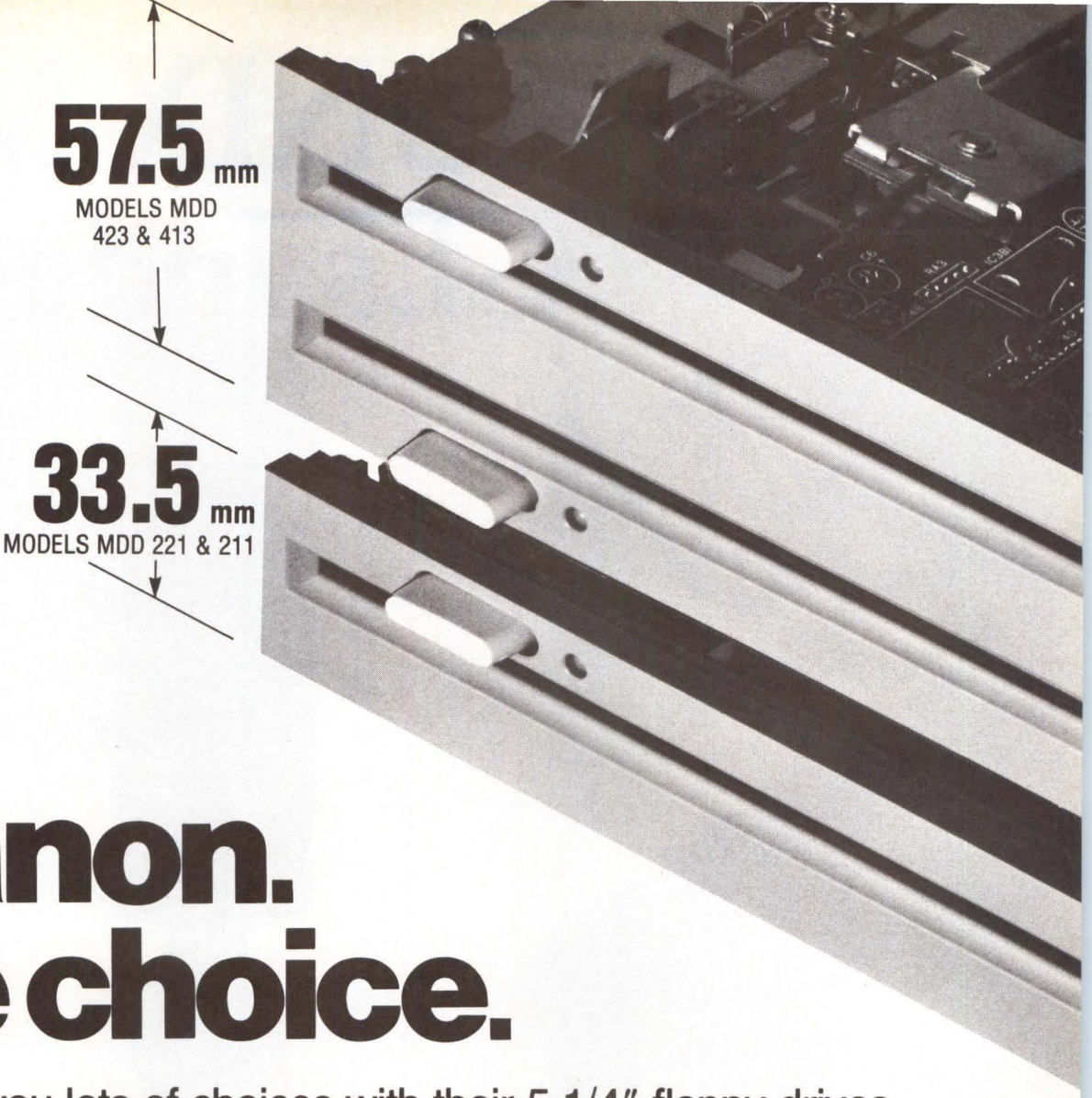
Requests serviced by the central processor have a probability of requesting a peripheral process or of being completed. The state of a queuing network is characterized by the number of tasks waiting at each server. If all service times and inter-arrival times are exponentially distributed, each server and its queue can be analyzed independently.

Measurements and modeling are complementary activities. Evaluating a system not implemented or otherwise unavailable for measurement calls for a model of that system. Performance measurements are obtained analytically or by simulation from the model. The model provides a framework for measurement and allows for testing various hypotheses. Measurements provide data for validating the model.

Queuing models are examples of analytical models. When a situation cannot be solved analytically, it becomes reasonable to use simulation. A simulation model can include factors, such as system overhead, that are difficult to incorporate into an analytical model. Thus, simulation can examine computer systems in more detail. In general, simulation is a highly flexible and powerful technique for evaluating system performance at the cost of increased effort and computation. □

Roger Kovach, is a senior scientist at the Applied Systems Engineering Division of Boole and Babbage Inc., specializing in queuing network models and I/O analysis. He was previously manager for technical development at the University of California and, at Pacific Gas and Electric, designed and implemented teleprocessing software for a privately owned communications network. Kovach attended the University of Chicago.

Dr. Armond Inselberg is product manager at Synapse Computer Corp., Milpitas, Calif. He is also adjunct professor for the University of Santa Clara graduate business school. He was previously strategic marketing manager at Boole & Babbage Inc. Prior positions were with Intel Corp., IBM Corp., Stanford University and the National Aeronautics and Space Administration. A member of the ACM and the IEEE, he received his Ph.D in computer science from Washington University and his MBA from the University of Santa Clara.



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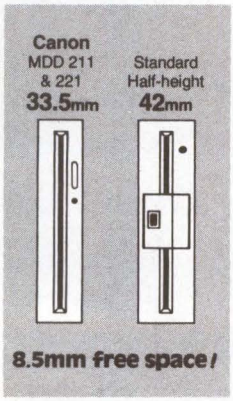

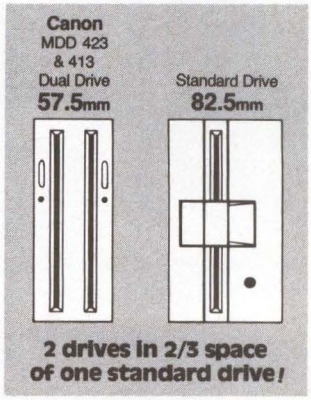

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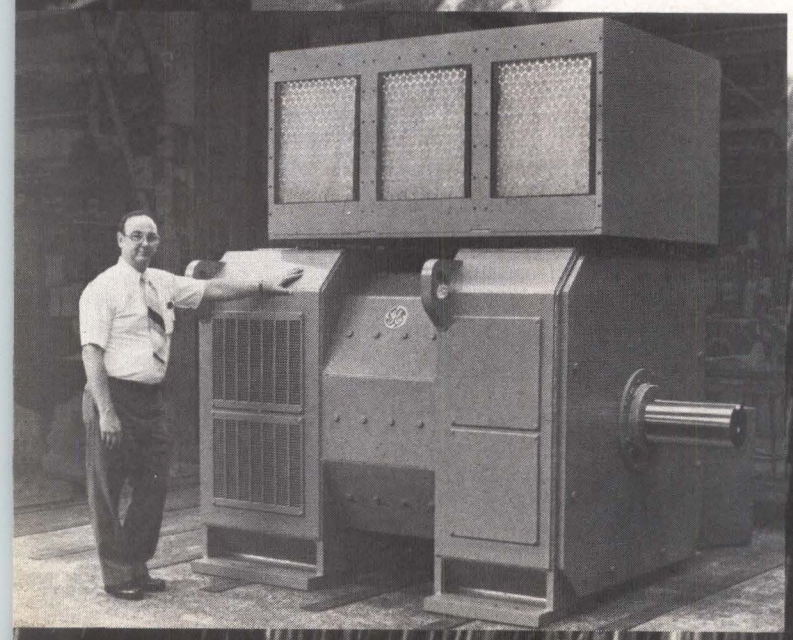

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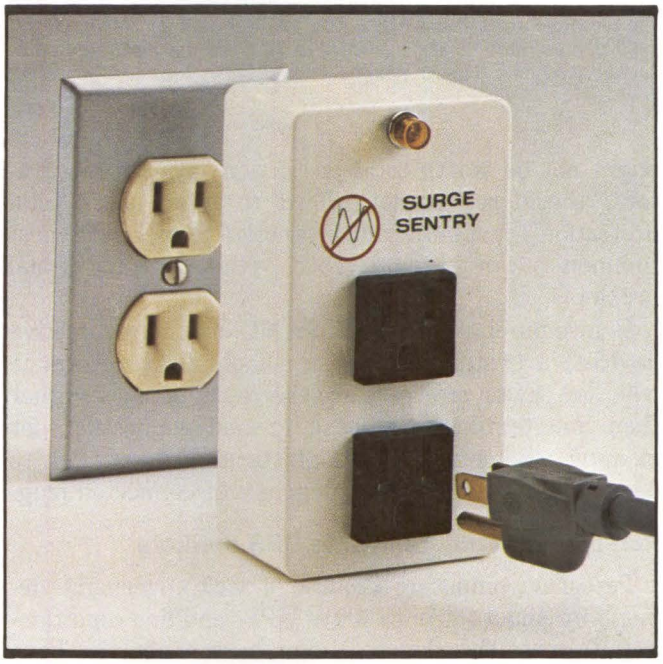
Uninterruptible power systems exhibit increased flexibility and diversity

UPS noise, grounding and power-line monitoring and isolation properties prove critical for supporting microcomputers and minicomputers

Paul Sniger, Senior Editor

When a computer loses power, the system goes down—sometimes gracefully, sometimes with a crash. "Head crashes," lost data, software snafus and other problems, such as costly rekeying and customer ill will, are just a few of the consequences of improper selection of uninterruptible power system (UPS) or—even worse—no UPS used at all. Damaged and degraded computers and peripherals due to inadequate line conditioning only add to users' and system integrators' woes.

Most users ignore UPS and power-line conditioning because of simple oversight, but relegating power protection to an afterthought in the system-integration cycle translates into trouble. Until recently, only a handful of UPS vendors existed, each offering just a few models. Today, the varieties and models established companies and the many newcomers are offering can create bewildering choices.

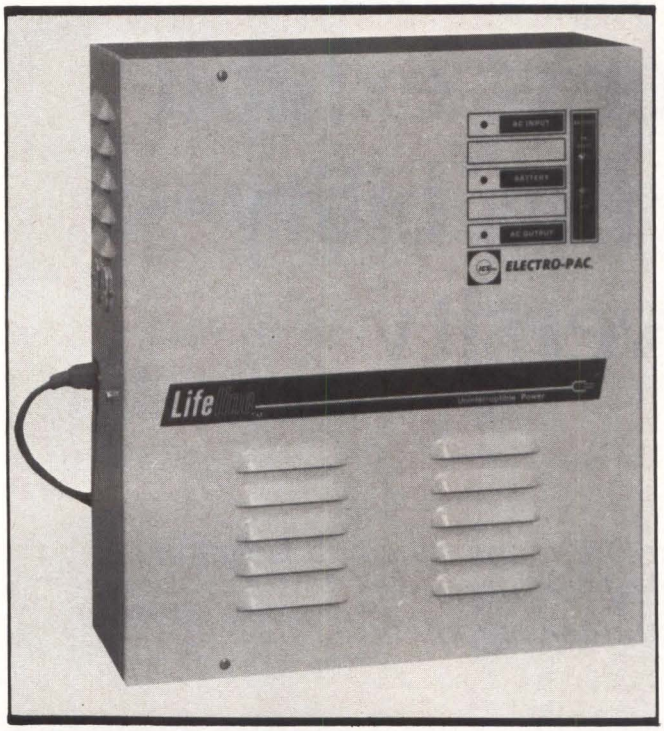


The "SurgeSentry" three-stage surge suppressor *uses a gas-tube, silicon avalanche suppressor and metal-oxide variator to detect a spike in less than 5 psec. The device is tested to the IEEE 587 and UL 1449 standards.*

Buy UPSs like insurance

Providing total system protection entails high cost. It's like buying life insurance. For most users, the steep UPS price tag—$2,000 to $3,500 per kilovoltampere (kVA)—might not be justified. If the system's operational application is critical—requiring 24-hour-a-day, seven-day-a-week, on-line transactions—redundant power supplies, two on-line UPSs and more conditioning and filtering are then not overkill.

History shows that half of all recorded outages persist for less than 6 seconds. And only 15 percent last for more than 11 minutes, depending on location and environment. To provide power protection beyond these limits via costly battery packs and racks might prove unwarrantable if a motor generator (MG) could do the job cheaply. Otherwise, the losses involved



The Electro-Pac "Lifeline" UPS *(220 VA, 600 VA, 1.2 kVA) recharges to 95 percent of full charge in eight to 16 times the discharge time. Backup time runs 5 to 10 minutes.*

might not be worth total protection. System integrators, therefore, cannot afford to offer users total protection—just sufficient protection to meet the most common power threats, with options for individual problems.

Before purchasing a UPS, an MG or other protective devices, a system integrator should first determine whether power problems are the result of causes other than line problems—a loose ground connection, for example. Sometimes, unsophisticated users fail to detect such an obvious problem as a disconnected plug.

Personal computers invade UPS markets

Personal computers created a vast, overnight demand for small 150W to 500W UPSs and line conditioners. To meet this demand, many new companies have entered the market, and UPS products have improved rapidly. Personal computers and small business computers, however, can usually resist power anomalies. For example, the IBM PC can handle 20 percent voltage dips. Moreover, if its CRT goes down because of a brownout, RAMs can still retain data.

If system integrators anticipate severe power dips, they should install regulators that handle 200W, which sell for approximately $250. Filtering and suppression devices are also available at prices from $50 to $100 each. Installing metal-oxide varistors on other components inside a PC works as well but voids the warranty.

On-line UPSs for personal computer and small business computer users are decreasing in cost. Though they will always cost more than off-line UPSs, on-line UPSs are now half the price they were two years ago and half the weight and size. What's more, they are quieter and more reliable. By using switching designs and 20- to 75-kHz frequencies, on-line UPSs can digitally control and synthesize nearly perfect sine waves without filtering. This capability reduces component count and losses and increases efficiencies. In addition, heat dissipation goes down, and mean time between failures goes up. Two years ago, a PC UPS weighed 150 pounds (plus 40 pounds for batteries), occupied 5,000 inches^3 and had a 10-minute holdup time. It now weighs 80 pounds, occupies 2,600 inches^3 and provides a 15-minute holdup time from the same battery.

Rotating machinery sparks innovations

MG sets operate best at 10-kVA and higher levels and at 3-megavoltampere levels if 500-kVA MGs are paralleled. Tough and dependable, MG sets are almost impervious to abuses that would kill a static UPS. Disadvantages include slow response times and hard-to-control voltages, currents and frequencies. Also, earlier MG sets were troublesome and noisy, but recent units have improved. They can even operate when one phase goes down. They can also provide excellent isolation, so that the worst transients don't get through. Battery-type UPSs predominate today, but innovations are appearing.

New entrants include Power Systems and Controls Inc., Richmond, Va., with its hybrid UPS. In this unit, the line drives an MG set and UPS drives the AC motor of the MG if a blackout occurs. The rotary UPS from Computer Power Products, Gardena, Calif., runs as a 2,800-rotation-per-minute AC-AC, synchronous MG. If a power failure occurs, the DC motor takes over for DC-DC operation. When line power is restored, a field change reverses the DC motor armature current, and the DC motor becomes a DC generator to recharge the batteries. It can even operate with the loss of one phase.

Precise Power Corp., Bradenton, Fla., manufactures a non-interruptive power system (NIPS) that provides an inertial 10- to 45-second ride-through of constant 60 Hz. These vertical units stand 24 by 30 and 96½ inches, weigh 2,400 pounds and provide 7½ kVA. Horizontal units with higher kilovoltampere NIPS will soon be introduced. The NIPS units allow an orderly shutdown or turn on a standby MG within 10 seconds, as mandated by the National Electrical Code. It maintains a constant frequency by means of a patented process.

If you think a UPS is just for "lights out"...

think again.

A UPS, if it's a *true* UPS, offers more than just blackout protection. Because it's always "on-line," a *true* UPS protects your system and data against all kinds of irregular voltage conditions, including brownouts and blackouts.

The difference between a *true* UPS and a standby UPS is like night and day.

A standby (off-line) unit is designed solely for blackouts. While some models do offer a limited amount of noise filtering, they do not provide continuous, conditioned power. And that leaves you vulnerable to the costly effects of brownouts, overvoltages, sudden power surges, transverse-mode and common-mode noise.

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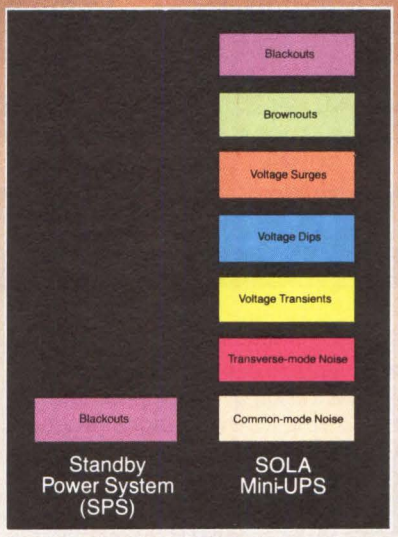

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That's why, from the very beginning, C.Itoh Electronics has consistently maintained a strategy of total involvement in the high technology electronics industry. This includes marketing a wide variety of industrial electronic products, while at the same time, engaging in research and development, cross licensing and venture capital investing.

In addition to developing and marketing its own unique products, C.Itoh Electronics buys products from many international manufacturers and sells them through U.S. sales offices, sales representatives, distributors and OEM's. More than 10 Japanese manufacturers who market their products in the U.S. are currently represented.

C.Itoh Electronics also procures products from more than 30 U.S. based manufacturers and markets them worldwide, mainly to Japan, where these products are then distributed through C.Itoh's affiliate companies. C.Itoh Electronics is always searching for new product ideas to develop and bring to market.

No other company is better at bringing high technology to market. Perhaps, because in addition to exploring new ways of doing business, few other companies can draw on the experience and global resources of C.Itoh & Co., Ltd., our parent company. This multi-national organization has more than 125 years of business experience and thousands of employees linked through a worldwide network of 181 offices in 81 nations. These include 41 offices in Japan and 403 affiliated companies around the world—with annual sales exceeding $50 billion.

It's no wonder that when it comes to bringing high technology to market, C.Itoh Electronics has the best ideas.

C.ITOH ELECTRONICS

A World of Quality

CIRCLE NO. 87 ON INQUIRY CARD

Battery selection is critical

Most UPS users are unaware of pertinent battery selection criteria. Literature usually lists only size, life and battery power cell cost, model numbers and reserve times. Manufacturers that offer a range of models document such parameters as I/O voltages and currents, efficiency, inverter input, dimensions and weight, as well as battery pack part numbers vs. reserve time. Some vendors list the protection time for full load and 75 percent and 50 percent of full load and life expectancy in years or full-discharge cycles at full load. Some even provide battery pack size and weight in both decimal and metric units. But such specifications as capacity (voltamperes, signified by "C"), voltage, storage, ambient temperature and relative humidity and often omitted.

Several battery categories exist. The older, wet-cell batteries are used with larger UPSs. They are typically mounted in open-frame, two- to three-tier racks. They are shipped wet and charged for full-capacity start-up. Conventional lead-calcium, wet batteries offer superb reliability with little maintenance (terminal cleaning and watering twice a year) and are warranted for 10 to 12 years, prorated. A short lifetime, typically five years, is offset by ease of installation and adaptability to remote locations. The batteries do generate hydrogen, however, when charged—though much less than standard lead-antimony batteries—so ventilation is important. Accordingly, the battery room should be ventilated and checked periodically. Stacked in open-frame racks and usually stored in the basement because of their weight, lead-calcium batteries are worth the inconvenience for use in large installations. Semi-sealed, these units provide pressure-relief vents that remain sealed until pressure caused by improper overcharging or some other aberration causes them to vent briefly, then self-seal.

Lead-antimony batteries, or lead-acid stationary batteries, are roughly equivalent in capability and performance to the lead-calcium variety. But their life spans are half those of lead-calcium units. They need maintenance four times a year and monthly equalize charging to retain cell capacity.

Analyzers monitor line

Power-line analyzers or monitors, such as those from Dranetz Engineering Labs Inc., Edison, N.J., can be purchased or leased and are used to reconstruct conditions before power-system perturbations. They trace the source of transients, providing a hard-copy record. These line-disturbance analyzers record amplitude, durations and occurrences of surges and frequency variations.

Fault detectors monitor levels, record the nature of the fault and identify the supply causing it in multioutput supplies. They then initiate a power-down sequence signal to the controller. Over-/under-voltage detectors identify excursions by comparing them with a reference. First-fault detectors lock out additional faults; others detect and record numerous faults. Some are built into the large UPSs and have one terminal to measure fault detection.

Some larger UPS makers, like Emerson Electric Co., provide terminals; large cabinets complete with CRT, keyboard, printer and an auto-dial option to the company's data link; and field service support. These monitoring and diagnostics systems continually scan the system's vital operating points, verifying system status every 4 msec., or 250 times a second.

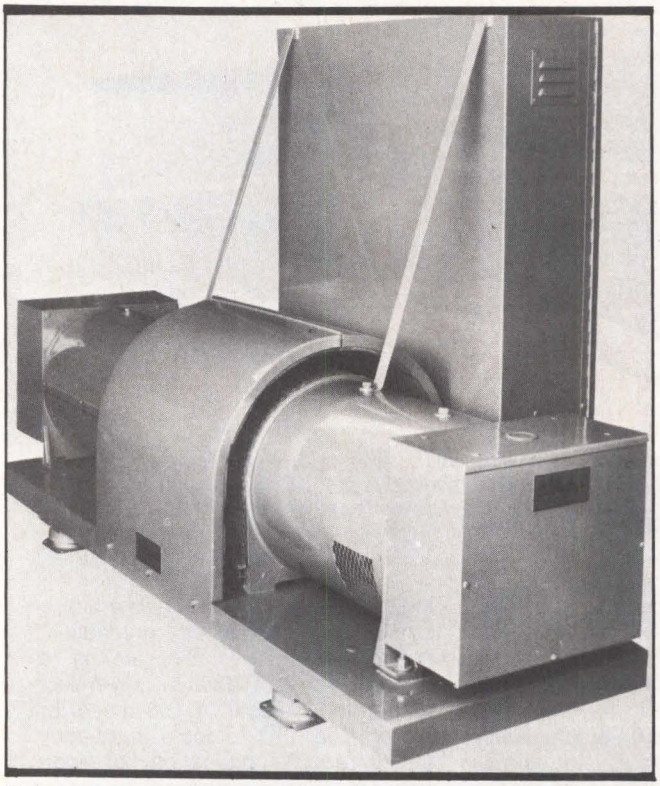
Power-line monitors *detect power dips, spikes, surges, low and high voltages and anomalies. This $245 RLM power-line monitor from RKS Industries can monitor individual workstations or any location to determine the nature of a problem at minimal cost. More sophisticated detectors/monitors can be leased from instrument-rental companies.*

Emerson's ACT-2 unit, for example, monitors over 150 key points and stores pertinent historical data for review. Whenever the unit detects an abnormal condition, it performs system diagnostics and automatically displays and prints the system status report with recommended corrective action in terms geared to non-technical personnel. Remote monitoring and diagnostics terminals are also available. As a safety precaution, memory is non-volatile, storing a status history of data in a 4-msec. time-frame window of 150 msec. or more. The unit outputs hard-copy status reports once a day or upon request. For maintenance, many system users buy an UPS repair kit, which is also under warranty.

Nickel-cadmium batteries, the most expensive, are compact and light and have excellent temperature characteristics. At 32 degrees Fahrenheit, for example, lead-calcium and lead-antimony batteries maintain 65 percent of their capacity; nickel-cadmium units retain 80 percent. Monthly equalize charging and periodic deep discharging are required to retain capacity, however. But, if this is done, their life span almost equals that of lead calcium batteries. Instead of using self-sealing vents, nickel-cadmium units expand when overchaged, breaking electrical continuity and possibly opening their seals to relieve pressure. Improved nickel-cadmium units feature an electrode structure that provides longer life at temperatures as high as 160 degrees Fahrenheit.

Other newcomers provide backup with improved self-discharge characteristics, exceeding the 1 percent to 8 percent capacity discharge per month during storage. Although a number of rechargeable battery chemistries exist, few can withstand the number of charge/discharge cycles that nickel-cadmium and lead-antimony units can.

In evaluating rechargeable batteries, system integrators should consider several categories—electrical requirements (capacity, voltage, energy, power, self-discharge, state-of-charge determination), mechanical requirements (volume, weight, shock and vibration), life, warranty and charging. Battery makers provide spec sheets that should be scrutinized for detailed performance data before selecting a battery.



Rotary motor generators *such as this Atlas unit come with power cables and are about one-third to one-half the cost of static UPSs. They have a 5- to 750-kVA rating and are housed in a soundproof, weatherproof enclosure.*

The key electrical requirement, capacity (C), is expressed in ampere-hours (AH). High currents and low temperatures reduce this value. Specific battery temperatures, discharge rates and end-of-discharge voltages always have specific numerical values. Discharge rates are stated in time, not amps, thus providing normalization for comparison. If the rated capacity in amp-hours is removed in a given time (t), expressed in hours, the discharge or charge rate is C/t. Therefore, a 100-AH battery discharged at a C/5-rate is discharged in five hours with a 20A discharge current. Recharging a battery at a C/10-rate requires a 10A recharge current. For example, a 30-minute rate is 2C, a 10-hour rate is 0.1C, and a 1-hour rate is C-rate. A battery's capacity rating permits calculation of the time it takes to supply a given current.

Under mechanical requirements, battery volume and weight are functions of the energy and power supplied to the UPS. These values are given in the literature and are chosen by the manufacturer. However, in selecting batteries, the system integrator should determine the required battery types and capacity from energy and power-density data, after calculating voltage and power requirements. In certain applications, weight and volume are restricted, so energy and power density can be used to calculate power and energy. Generally, larger cells have greater energy density, and nickel-cadmium units outclass sealed lead units.

Useful battery life is defined as the time it takes for capacity to fall to 50 percent of rated value, while battery life is specified in terms of years or charge/discharge cycles. Rechargeable batteries are adversely affected by heat, which significantly reduces operating life, even voiding the warranty. To obtain good battery life, heat-producing ambients should be avoided. Otherwise, the user should consult the UPS manufacturer for special high-temperature, sealed batteries. Spec sheets list capacity vs. discharge rates and voltage specifications but seldom provide information regarding effects on temperature or capacity.

Many UPS manufacturers—particularly the newer ones scrambling to get in at the lower end of the market—sometimes make inaccurate blanket statements about a specific battery type. Most vendors specify battery performance at 25 degrees Celsius (77 degrees Fahrenheit) and promote battery life expectancy and warranty around this assumption. Most battery warranties specify a maximum temperature of 110 degrees Fahrenheit. Some vendors attach temperature-sensitive dots or strips that change color when a certain temperature is exceeded. □

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THE CASE F

No, we're not talking about the shipping container. Our *"Case For Quality"* has to do with the product housed within it—namely, another shipment of Xebec S1410 controllers for yet another in a long list of OEM customers. A list of customers that has made this board the best selling disk controller in the world—and has helped turn its creators into the industry's largest independent manufacturer of disk drive controllers.

The evidence is persuasive. First, the superior quality of design resides with a team of engineers that has been setting standards in disk controller technology for almost a decade. Quality that continues to be supported by the most sophisticated CAD equipment of its kind in the country. Little wonder, then, that the S1410 reached the market as such a feature-rich offering. With patented VLSI architecture. Industry-standard SASI host bus. Automatic data error detection and correction, seek and position verification, command retry on drive errors, and alternate track capability. Extensive controller and disk drive diagnostics and hardware-selectable sector size. All on one compact PCB that fits the 5.25" form factor.

Translating a superior design into superior finished goods leads us to submit *"The Case For Quality's"* second major piece of evidence: Superior quality of manufacture. This evidence includes the use of the most sophisticated and automated production facilities in the industry.

A $20 million investment in computer-aided manufacturing, from advanced robotic devices to automatic insertion equipment to ATE.

The most convincing testimony in *"The Case For Quality"* comes from the customers. Customers like IBM, Lanier, Hewlett-Packard, Eagle, ICL, CPT, and Phillips. Customers who have chosen Xebec because "time to market" and "cost to market" are critical considerations. And most importantly, perhaps, customers who know that when a shipping case with our "Xero D" quality signature on its side arrives on their shipping dock, it can go right to stock.

Case closed.

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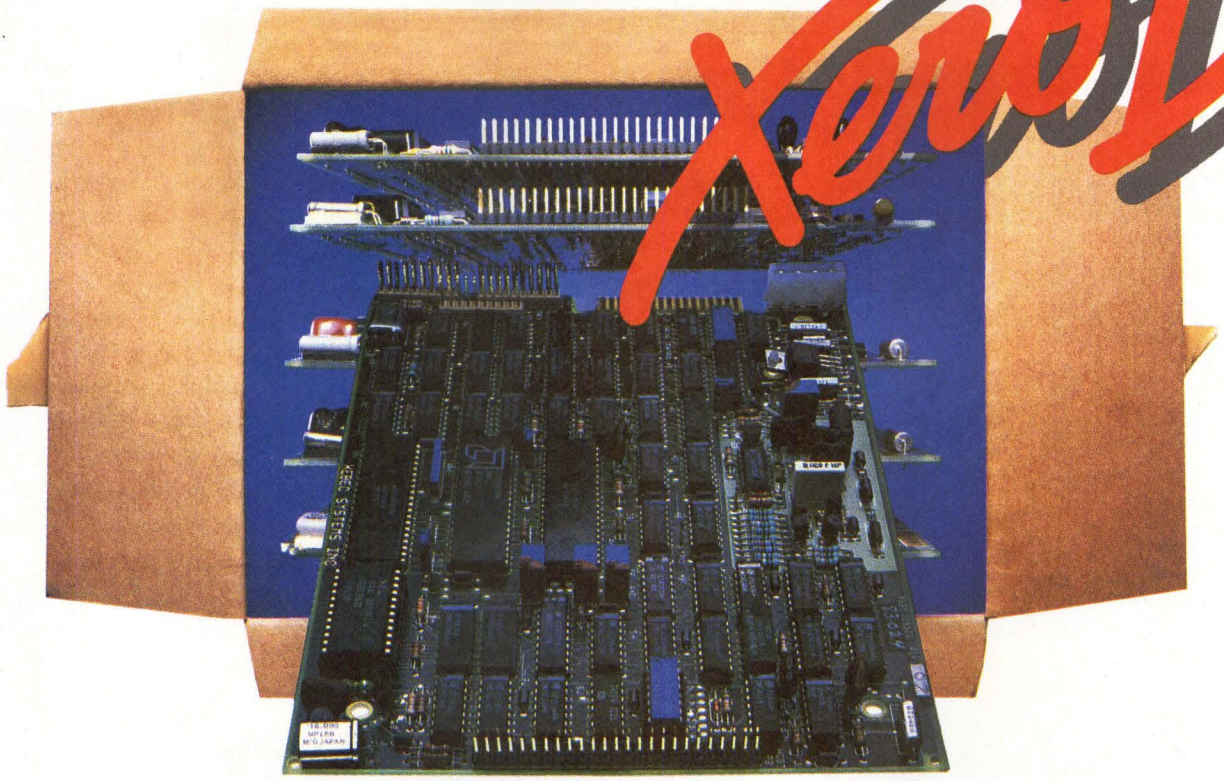

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CIRCLE NO. 89 ON INQUIRY CARD

UNINTERRUPTIBLE POWER SYSTEMS

Company Model	Type	Power rating (KVA)	Input voltage (VAC at 60 Hz)	Input current (amps/phase)	Input/output phase	Size (HxWxD inches)	Weight (lbs.)	Price ($)	Circle no.
ABACUS CONTROLS INC. 16 Readington Rd. Somerville, NJ 08876 (201) 526-6101									825
913-4	on-line solid state	1	120	11	2 wire+GND 2 wire+GND	19×20×21 (rack)	210	4,210	
918-4	on-line solid state	1.6	120/208	5	4 wire+GND 4 wire+GND	19×20×33 (rack)	255	5,870	
923-4	on-line solid state	2	120	21	2 wire+GND	19×20×30 (rack)	310	6,270	
938-4	on-line solid state	3	120/208	10	4 wire+GND 4 wire+GND	22×30×61 (cabinet)	420	8,890	
968-4	on-line solid state	6	120/208	21	4 wire+GND 4 wire+GND	22×30×79 (cabinet)	925	14,850	
963-4	on-line solid state	6	120	63	2 wire×GND 2 wire+GND	22×30×70 (cabinet)	1,075	14,730	
983-4	on-line solid state	8	120/208	28	4 wire+GND 2 wire+GND	44×30×61 (cabinet)	1,120	18,150	
914-4/10	on-line solid state	10	120/208	35	4 wire+GND 2 wire+GND	44×30×61 (cabinet)	1,620	19,730	
978-4	on-line solid state	7.5	120/208	26	4 wire+GND 4 wire+GND	44×30×61 (cabinet)	1,130	16,920	
919-4	on-line solid	10	120/208	35	4 wire+GND 2 wire+GND	55×30×61 (cabinet)	1,470	20,030	
ATLAS ENERGY SYSTEMS 9457 Rush St. South El Monte, CA 91733 (213) 575-0755									826
RP66010	on-line rotary motor	10	480	16			1,200		
BEHLMAN ENGINEERING 1142 Mark Ave. Carpenteria, CA 93013 (805) 684-8311									827
UPS-10-11	on-line solid state	.1	115 or 220	2.5	2 wire+GND	5.25×19×19 (rack)	28	2,375	
UPS-25-11	on-line solid state	.250	115 or 220	5	2 wire+GND	5.25×19×19 (rack)	41	2,700	
UPS-35-11	on-line solid state	.350	115 or 220	7	2 wire+GND	5.25×19×19 (rack)	54	2,950	
UPS-50-11	on-line solid state	.5	115	10	2 wire+GND	5.25×19×19 (rack)	105	3,825	
UPS-75-11	on-line solid state	.75	115	15	2 wire+GND	5.25×19×19 (rack)	175	4,450	
UPS-100-11	on-line solid state	1	115	20	2 wire+GND	8.75×19×22 (rack)	207	5,060	
UPS-150-11	on-line solid state	1.5	115	30	2 wire+GND	14×19×19 (rack)	349	5,875	
UPS-200-11	on-line solid state	2	115	40	2 wire+GND	14×19×19 (rack)	295	7,950	
UPS-300-11	on-line solid state	3	115	60	2 wire+GND	21×19×22 (rack)	714	11,650	
UPS-500-11	on-line solid state	5	115	100	2 wire+GND	28×19×22 (rack)	758	17,750	
UPS-750-11	on-line solid state	7.5	115	150	2 wire+GND	33.25×19×22 (rack)	918	22,200	
UPS-3-100-31	on-line solid state	1	120/208	20	3 wire+GND 4 wire+GND	33.25×19×22 (rack)	515	13,925	
UPS-3-150-31	on-line solid state	1.5	120/208	30	3 wire+GND 4 wire+GND	33.25×19×22 (rack)	601	16,300	

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Electronics

CIRCLE NO. 90 ON INQUIRY CARD

UNINTERRUPTIBLE POWER SYSTEMS

Company Model	Type	Power rating (KVA)	Input voltage (VAC at 60 Hz)	Input current (amps/phase)	Input/output phase	Size (HxWxD inches)	Weight (lbs.)	Price ($)	Circle no.
UPS-3-200-31	on-line solid state	2	120/208	40	3 wire+GND 4 wire+GND	36.75×19×22 (rack)	799	21,000	
UPS-3-300-31	on-line solid state	3	120/208	60	3 wire+GND 4 wire+GND	44.5×19×22 (rack)	1,020	29,500	
UPS-3-500-31	on-line solid state	5	120/128	120	3 wire+GND 4 wire+GND	68.25×19×22 (rack)	1,850	42,500	
UPS-3-600-31	on-line solid state	6	120/238	120	3 wire+GND 4 wire+GND	44.5×19×22 (rack)	2,310	58,250	
CLARY CORP. 320 W. Clary Ave. San Gabriel, CA 91776 (818) 287-6111									828
UPS1-750VA-1A	on-line	.75	115	15	2 wire+GND	12.25×19×21 (rack)	290		
UPS3-15k-1	on-line solid state	15	120/208	79	4 wire +GND	72×55×27 (cabinet)	2,500		
UPS3-30K-1	on-line solid state	30	120/208	158	4 wire+GND	72×68×27 (cabinet)	3,800		
UPS1-1.25K-1A	on-line solid state	1.25	115	23	2 wire+GND	12.25×19×21 (rack)	290		
UPS1-2.5K-1A	on-line solid state	2.5	115	46	2 wire+GND	21×19×21 (rack)	400		
UPS1-3.75K-1A	on-line solid state	3.75	115	78	2 wire+GND	53.5×25.5×26 (cabinet)	1,200		
UPS1-5K-1A	on-line solid state	5	115	91	2 wire+GND	53.5×25.5×26 (cabinet)	1,260		
UPS3-10K-1	on-line solid state	10	120/208	53	4 wire+GND	72×55×27 (cabinet)	2,400		
UPS1-7.5K-1	on-line solid state	7.5	115/230	85	3 wire+GND	72×55×27 (cabinet)	1,900		
UPS1-10k-1	on-line solid state	10	115/230	99	3 wire+GND	72×55×27 (cabinet)	2,230		
UPS3/1-10K-1	on-line solid state	10	120/208	53	3 wire+GND	72×55×27 (cabinet)	2,400		
COMPUTER POWER INC. 124 West Main St. High Bridge, NJ 08829 (201) 735-8000									829
ETUPS-24-700	on-line solid state	.7	120	10	2 wire+GND	48.5×39×18 (cabinet)	325	4,265	
FTUPS-48-3000	on-line solid state	3	120	35	2 wire+GND	60.5×39×18 (cabinet)	950	6,255	
FTUPS-60-10000	on-line solid state	10	120	130	2 wire+GND	68.5×39×18 (cabinet)	3,000	13,420	
OUPS-48-500	on-line solid state	.5	120	8	2 wire+GND	11.5×12.5×20 (cabinet)	135	1,450	
UPS-36-500	on-line solid state	.5	120	8	2 wire+GND	32×32×10 (cabinet)	250	1,690	
UPS-48-3000	on-line solid state	3	120	50	2 wire+GND	60.5×39×10 (cabinet)	1,077	7,980	
COMPUTER POWER PRODUCTS A Div. of Sweinhart Electric Co., Inc. 227 E. Compton Blvd. Gardena, CA 90248 (213) 277-6957									830
ANB-12	on-line rotary motor	12.5	208/480		3 wire+GND 3 wire+GND				
ANB-18	on-line rotary motor	18.75	208/480		3 wire+GND 3 wire+GND				
ANB-25	on-line rotary motor	25	208/480		3 wire+GND 3 wire+GND				
ANB-37	on-line rotary motor	37.5	208/480		3 wire+GND 3 wire+GND				

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MOTOROLA INC.
Information Systems Group

CIRCLE NO. 91 ON INQUIRY CARD

EMULEX TALKS DEC 11

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Emulex has done it again—twice. Two new products for QBus CPUs. Both major enhancements over previous Emulex models—which puts them far, far ahead of any competitive products, including those offered by DEC.

EMULATING MSCP...

First, there is the new UC02 host adapter for connecting up to four high-performance SCSI (Small Computer System Interface) disk drives. The UC02 uses the Mass Storage Control Protocol to automatically self-size each drive without patches or modifications to the operating system. Seek times are sharply reduced—and throughput increased—by using the computer memory as a communication link. The host keeps loading commands for the drives into a designated memory block. The UC02 can then access them, 13 commands at a time, and seek-order them to optimize the flow of data on the SCSI bus. The Emulex unit also simulates error-free media by never reporting routine errors. Instead, it automatically retries and corrects all errors, reporting only uncorrected errors to the host. Remapping for bad blocks, if required, is commanded by the host.

DHV11 or DH11...

Second is the new CS02 low-cost asynchronous multiplexer for adding high-performance data communication facilities to your MICRO/PDP-11 and LSI-11 through 11/23 PLUS computers. The CS02 emulates* both *the DH11 and DEC's new DHV11—with important pluses and bonus benefits. Like 16 lines, instead of eight, as with DHV11, without taking up any more system space. Like data rates to 38.4 Kbaud for a typical total throughput of 60K characters on the 16 lines. Like a 256-character FIFO buffer in the DH11 emulation mode—four times the FIFO capacity of the DEC product—and a separate 256-character buffer for each group of eight lines in the DHV11 emulation mode. Like 22-bit hardware addressing to handle the 4-megabyte memory capacity of the LSI-11/23 PLUS.

FROM THE EMULEX FILE...

The rich get richer. The same is true of technical superiority. Emulex's astonishing record as a technical leader in the development of DEC-compatible controllers is now allowing it to leapfrog ahead to customized LSI and VLSI chips that will further increase the technical superiority of its products. Result: even higher levels of flexibility, reliability, and power, at even lower costs to the OEM and end user. And this is just the beginning.

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UNINTERRUPTIBLE POWER SYSTEMS

Company Model	Type	Power rating (KVA)	Input voltage (VAC at 60 Hz)	Input current (amps/phase)	Input/output phase	Size (HxWxD inches)	Weight (lbs.)	Price ($)	Circle no.
CONTROL TECHNOLOGY INC. 8200 N. Classen Blvd. Suite 101 Oklahoma City, OK 73114 (405) 840-3163									831
RBS-AC300	standby (response time: 5 msec.)	.3	120	3.125		5.37×13.75×11.5 (cabinet)	32	569	
RBS-AC500	standby (response time: 5 msec.)	.5	120	4.8		5.37×13.75×11.5 (cabinet)	42	695	
CUESTA SYSTEMS INC. 3440 Roberto Court San Luis Obispo, CA 93401 (805) 541-4160									832
9012060	standby (response time: 2 msec.)	.09	120	1	NEMA 5-15	4×6×8.75 (cabinet)	9	395	
20012060	standby (response time: 2 msec.)	.2	120	2	NEMA 5-15	4×6×8.75 (cabinet)	14	695	
21124050	standby (response time: 2 msec.)	.2	240	1	NEMA 5-15	4×6×8.75 (cabinet)	14	730	
CYBEREX INC. 7171 Industrial Park Blvd. Mentor, OH 44060 (216) 946-1783									833
18.75/2B1	on-line solid state	18.75	208/480	93.2/40.4	2 wire+GND	78×60×24 (cabinet)	2,300	23,000	
30/2B3	on-line solid state	30	208/480	146/63.2	4 wire+GND	84×78×30 (cabinet)	2,700	31,000	
50/2B3	on-line solid state	50	208/480	243/105	4 wire+GND	84×90×32 (cabinet)	3,200	43,000	
DISPLEX INC. 79 Hazel St. Glen Cove, NY 11542 (516) 671-4400									834
DPL-8	on-line solid state	1	115	8	2 wire+GND	8.75×9×18 (rack)	85	3,495	
ELGAR CORP. 8225 Mercury Court San Diego, CA 92111 (619) 565-1155									835
SPR 201/401	standby (response time: 8-10 msec.)	.02-.035	120	4.0	2 wire+GND	(desktop)	32	645	
UPS102-1B	on-line solid state	1	120	22	2 wire+GND	8.7×19×18 (rack)	100	3,395	
UPS-302-1B	on-line solid state	3	120	60	2 wire+GND	14×19×20 (rack)	220	4,995	
ELECTRONIC PROTECTION DEVICES INC.(EDP) P.O. Box 673 Waltham, MA 02254 (800) 343-1813									836
Grizzly EPD 200/Watt	standby (response time: 8 msec.)	.2	120	2.5	2 wire+GND	5.875×9.125×14.5 (cabinet)	35	895	
Grizzly EPD 500/Watt	on-line solid state	1.5	115	10	2 wire+GND	7×17×14 (cabinet)	100	2,400	
Grizzly EPD 1000/Watt	on-line solid state	1	115	20	2 wire+GND	23.5×23×23 (cabinet)	304	5,200	
EMERGENCY POWER ENGINEERING 3580 Cadillac Ave. Costa Mesa,, CA 92626 (714) 557-1636									837
SYSTEM 50	on-line solid state	2-5	208	20-45	2 wire+GND 3 wire+GND	54×22×21 (cabinet)	1,260	9,000-14,000	

Now, A Brand Preference And Attributes Report That Tells You Where Your Product Stands *And Why*

Mini-Micro Systems' new PAR (Preference and Attributes Research) Report tells you where you and your competitors stand in the value-added market and why.

Conducted separately among two major value-added sample groups (*Mini-Micro Systems'* value-added OEMs and resellers, and value-added users), PAR is a guide to your present sales potential in one of the fastest growing segments of the computer market. But, PAR goes beyond the basics. It also provides powerful insights into what you must do to increase your share of the market against intensifying competition.

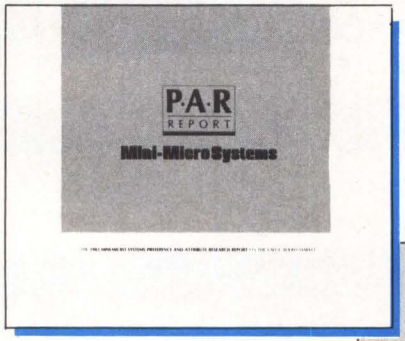
PAR respondents were asked to list their first, second and third brand choices in PAR's unaided survey of 35 distinct product categories that include:

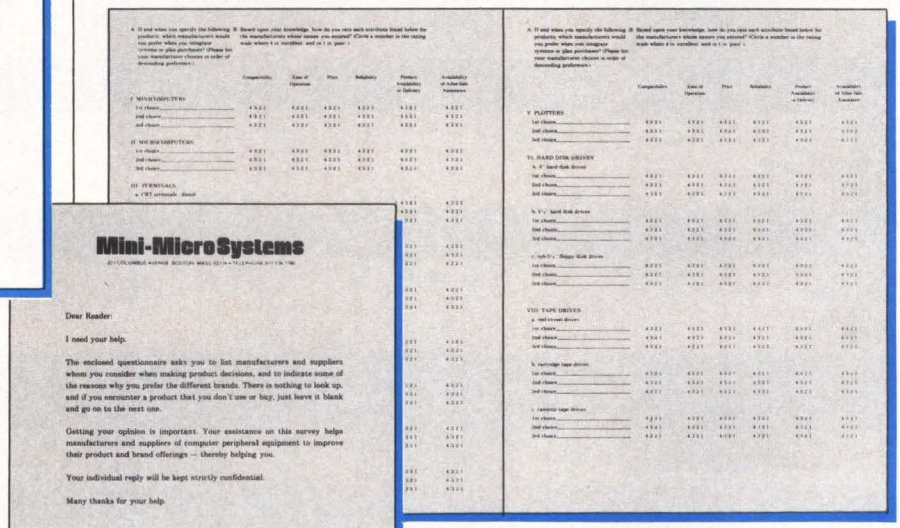
- Minicomputers
- Microcomputers
- Terminals
- Printers
- Plotters
- Hard Disk Drives
- Floppy Disk Drives
- Tape Drives
- Add-in/Add-on Memories
- Modems
- Multiplexers/Concentrators
- Controllers
- Software
- Media

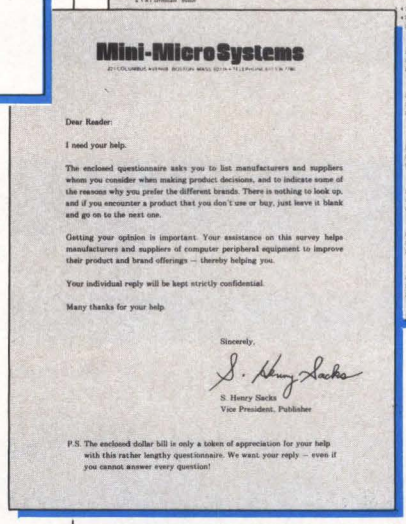
They were asked to substantiate their choices by indicating each brand's perceived strengths and weaknesses:

- Compatibility
- Ease of operation
- Price
- Reliability
- Availability/Delivery
- Availability of Aftersale Assistance

The PAR Report provides valuable insights you need to build successful marketing and sales programs in today's more competitive arena. And it's available now! To receive your copy, send your check for $250* to PAR Report, *Mini- Micro Systems*, 221 Columbus Ave., Boston, MA 02116.







- Do volume buyers in the value-added market prefer your product(s)? Or your competitor's?
- What do they think of your product's availability and delivery?
- Do they think your aftersales assistance is below or above average?
- Is your price right?
- Is your product readily available? Compatible? Reliable?
- Are you on PAR?

P·A·R REPORT

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CIRCLE NO. 93 ON INQUIRY CARD

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Torn whether to choose letter quality reproduction or data processing speed in a printer? With the multimode Qantex 7030 you don't have to make a choice.

Rated one of today's most flexible dot matrix printers, the advanced 7030 does everything you can ask a printer to do—now or as your needs change. All at a very competitive price.

As a letter quality printer (37 cps) the 7030 gives you high density double pass printing in a 24 x 18 matrix. You choose from almost 20 fonts such as Script, Courier and APL, plus you get proportional spacing, justification, auto underline, overprint, bold and a host of other features.

As a near letter quality word processor (75 cps) the 7030 uses a 12 x 9 matrix in a single pass mode.

As a data processor, the 7030 produces copy at 180 or 150 cps bidirectionally. When you need multipart forms, it gives you 6-part forms capability as well as user definable formats with programmable lengths, programmable vertical and horizontal margins and tabs.

As a graphics printer, the dot addressable 7030 has a resolution up to 144 x 144 dots per square inch, and offers a full complement of line drawing graphics.

The 7030 even makes available an enlarged character mode useful in producing custom labels. It also provides a complete printed status report of operating parameters or diagnostics when ordered by the operator. And its heavy duty print head and industrial quality construction are designed for long hard use.

Discover all the ways the 7030 can fit your computer system, no matter what size. Contact Qantex for details or a demo at 60 Plant Ave., Hauppauge, NY 11788. Call toll-free 800-645-5292; in New York State 516-582-6060.

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CIRCLE NO. 94 ON INQUIRY CARD

UNINTERRUPTIBLE POWER SYSTEMS

Company Model	Type	Power rating (KVA)	Input voltage (VAC at 60 Hz)	Input current (amps/phase)	Input/output phase	Size (HxWxD inches)	Weight (lbs.)	Price ($)	Circle no.
SYSTEM100	on-line solid-state	6-20	208, 240, 480	24-80	3 wire+GND	47×27×25 (cabinet)	1,750	15,000-27,000	
SYSTEM 400	on-line solid state	10-25	208, 240, 480	32-80	3 wire+GND 4 wire+GND	71×32×32 (cabinet)	3,200	20,000-35,000	
EMERSON ELECTRIC CO. INDUSTRIALS CONTROLS DIV. 3300 S. Standard St. (714) 545-5581									838
AP105	on-line	5	120	81		66×48×30 (cabinet)	950		
AP110	on-line solid state	10	208	72.2		66×48×30 (cabinet)	1,170		
AP115	on-line solid state	15	208	108.3		66×48×30 (cabinet)	1,400		
AP502	on-line solid state	20	208/480	75/32		78×60×28 (cabinet)	2,200		
AP503	on-line solid state	37.5	208/480	139/160		78×60×28 (cabinet)	2,300		
AP504	on-line solid state	50	208/480	180/78		78×60×28 (cabinet)	2,400		
AP594	on-line solid state	60	208/480	220/96		78×60×28 (cabinet)	2,400		
AP592	on-line solid state	80	208/480	290/126		78×60×36 (cabinet)	3,300		
EXIDE ELECTRONICS P.O. Box 58789 Raleigh, NC 27658 (919) 872-3020									839
SERIES 1000/1003	on-line solid state	3	120, 208, 240, 277	28, 16, 14, 12	2 wire+GND	36×17×21 (cabinet)	370	15,730	
SERIES 2000/2015	on-line solid state	18.75	208, 480, 600	63, 28	3 wire+GND 4 wire+GND	72×77×30 (cabinet)	2,950	38,700	
SERIES 2000/2030	on-line solid state	37.5	208, 480, 600	123, 53	3 wire+GND 4 wire+GND	72×77×30 (cabinet)	4,100	49,400	
SERIES 2000/2045	on-line solid state	56.25	208, 480, 600	181, 79	3 wire+GND 3 or 4 wire+GND	72×77×30 (cabinet)	4,750	58,800	
SERIES 2000/2715	on-line solid state	18.75	208, 480, 600	66, 28	3 wire+GND 2 wire+GND	72×72×30 (cabinet)	2,950	31,000	
SERIES 2000/2730	on-line solid state	37.5	208, 480, 600	127, 55	3 wire+GND 2 wire+GND	72×77×30 (cabinet)	4,100	48,700	
GENERAL INTERFACE 12919 Alcosta Blvd. San Ramone, CA 94583 (415) 838-2683									840
650	on-line solid state	.65	90-130	6.5	2 wire+GND	9×16×17 (cabinet)	98	1,395	
350	on-line solid state	.65	90-130	3.5	2 wire+GND	7×12×15 (cabinet)	50	750	
GENERAL POWER SYSTEMS 2400 N. Baxter Anaheim, CA 92806 (714) 956-9321									841
GPS-906	standby (response time: 10 msec.)	.09	115 or 230	.8, .4	2 wire+GND	4×6.1×8.9 (cabinet)	8	395	
GPS-2006	standby (response time: 10 msec.)	.2	115 or 230	1.75, .875	2 wire+GND	6×7.3×13.9 (cabinet)	25	695	
GPS-3006	on-line solid state	.3	115 or 230	10, 5	2 wire+GND	7.7×19×19 (cabinet)	110	1,350	
GPS-5006	on-line solid state	.5	115 or 230	15 or 7.5	2 wire+GND	7.7×17×19.1 (cabinet)	110	1,650	
GPS 1K120-61	on-line solid state	1	115 or 230	20 or 10	2 wire+GND	23.25×23.3×22.6 (cabinet)	320	2,495	

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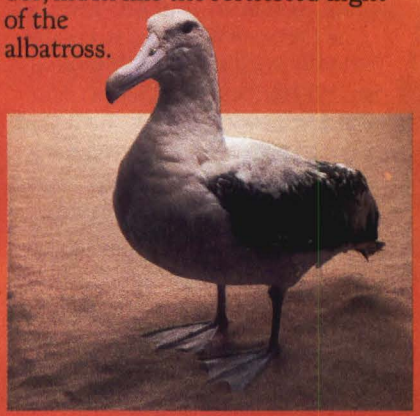

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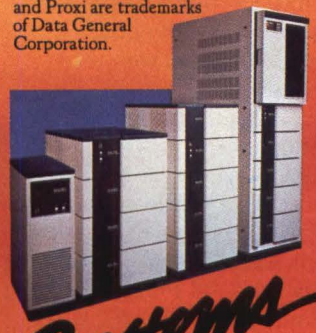

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CIRCLE NO. 96 ON INQUIRY CARD

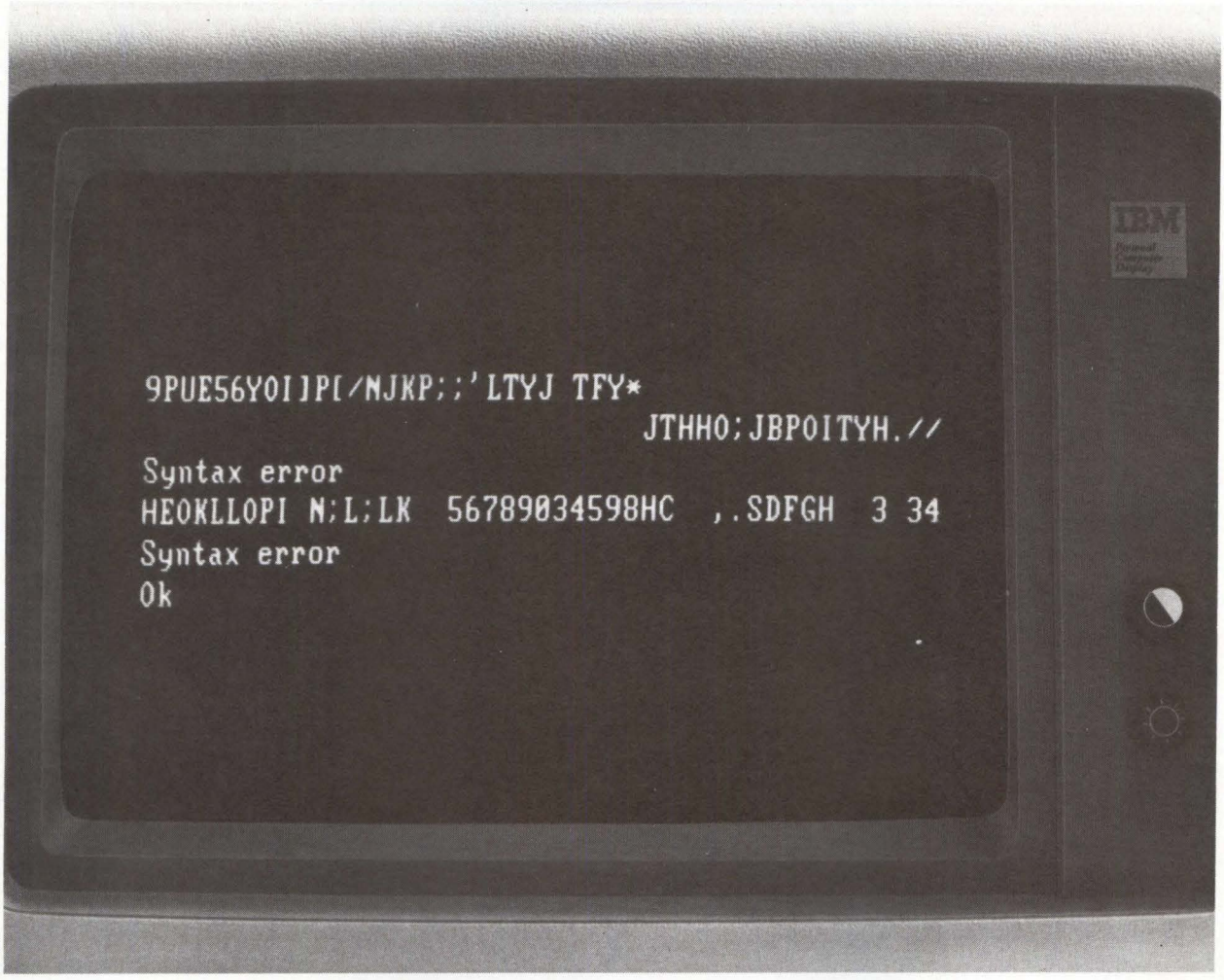
UNINTERRUPTIBLE POWER SYSTEMS

Company Model	Type	Power rating (KVA)	Input voltage (VAC at 60 Hz)	Input current (amps/phase)	Input/output phase	Size (HxWxD inches)	Weight (lbs.)	Price ($)	Circle no.
GPS-2K120-61	on-line solid state	2	115 or 230	42 or 21	2 wire+GND	30.5×23.4×24.6 (cabinet)	460	3,950	
GPS-3K120-61	on-line solid state	3	115 or 230	62, 31	2 wire+GND	44.5×23.5×25 (cabinet)	612	5,800	
GPS-5K120-61	on-line solid state	5	115/230 120/208	104,52, 32	2 wire+GND 4 wire+GND	61×23.5×30.9 (cabinet)	610	9,850	
GOULD INC., POWER CONVERSION DIV. 2727 Kurtz St. San Diego, CA 92110 (619) 291-4211									842
5248A	on-line solid state	5	Any std.	various	as desired 2 wire+GND	61×24×30 (cabinet)	1,300	12,950	
5254A	on-line solid state	10	Any std.	various	as desired 2 wire+GND	61×56×32 (cabinet)	2,350	18,950	
5255A	on-line	15	Any std.	various	as desired	61×56×32 (cabinet)	2,750	22,000	
GSU-3056	on-line solid state	.5	120	6	2 wire+GND	5.25×19×23 (rack)		1,690	
GSU-3106	on-line solid state	1	120	11.7	2 wire+GND	7×19×23 (cabinet)	135	2,290	
DSU-1820	on-line solid state	1.8	120	25	2 wire+GND	14×19×21 (rack)	183	3,895	
7026	on-line solid state	2.5	120	30	2 wire+GND	40×23×26 (cabinet)	540	6,240	
6156	on-line solid state	16.7	120/208	61	4 wire+GND	79×60×30 (cabinet)	2,200	27,900	
6306	on-line solid state	33.3	120	120	4 wire+GND	79×60×30 (cabinet)	2,975	39,500	
HILTRAN CORP. Route 31, RD5-65 Flemington, NJ 08822 (201) 782-5525									843
UPS-BA0206	on-line solid state	1	120	18	2 wire+GND	52×38×24 (cabinet)	650	3,500	
UPS-BA0207	on-line solid state	2.5	120	44	2 wire+GND	52×38×24 (cabinet)	850	5,000	
UPS-BA0208	on-line solid state	5	120	87	2 wire+GND	62×42×24 (cabinet)	1,700	9,000	
ICS INC., ELECTRO-PAC DIV. 520 Interstate Rd. Addison, IL 60101 (312) 543-6200									844
'E'	on-line solid state	2-20	120, 208, 240, 480 single phase; 208, 240, 430 3 phase	120, 240, single phase	3, 2 wire +GND 2 wire+GND	51×36×18/ 75×66×30 (cabinet)	350-3,500	8,000-25,000	
M95-200	on-line solid state	.2	120	3	2 wire+GND	20×16×6.5 (cabinet)	55	1,117	
M95-600	on-line solid state	.6	120	7	2 wire+GND	24×20×10.5 (cabinet)	140	1,560	
INTERNATIONAL POWER MACHINES 11534 Page Mill Rd. Dallas, TX 75243 (214) 343-6076									845
ENDLESS POWER	on-line solid state	40-80	custom	custom	3 or 4 wire+GND				
SCR UPS	on-line solid state	12.5-413	custom	custom	3 or 4 wire+GND				
JEFFERSON ELECTRIC 840 25th Ave. Bellwood, IL 60104 (312) 544-2200									846
370-411-100	on-line solid state	.250	120	2.08	2 wire+GND	11.125×15×20.25 (cabinet)	110	1,510	

UNINTERRUPTIBLE POWER SYSTEMS

Company Model	Type	Power rating (KVA)	Input voltage (VAC at 60 Hz)	Input current (amps/phase)	Input/output phase	Size (HxWxD inches)	Weight (lbs.)	Price ($)	Circle no.
370-611-100	on-line solid state	.5	120	4.16	2 wire+GND	11.125×15×20.25 (cabinet)	120	1,645	
370-811-100	on-line solid state	.75	120	6.25	2 wire+GND	11.125×15×20.25 (cabinet)	130	1,715	
370-1011-100	on-line solid state	1	120	8.33	2 wire+GND	11.125×15×20.25 (cabinet)	185	2,185	
LADCO DEVELOPMENT CO., INC. P.O. Box 464 Olean, NY 14760 (716) 372-0168									847
250B	standby (response time: 4 msec.)	.25	115	2.1	2 wire+GND 2 wire+GND	10.5×14.5×20 (cabinet)	42	625	
500-115UV	standby (response time: 4 msec.)	.5	115	4.35	2 wire+GND 2 wire+GND	12×17.5×20 (cabinet)	37	750	
1000-115UV	standby (respnse time: 4 msec.)	1	115	8.7	2 wire+GND 2 wire+GND	12×18×25 (cabinet)	50	925	
500-230-50	standby (response time: 4 msec.)	.5	220	2.3	2 wire+GND 2 wire+GND	12×17×20 (cabinet)	40	865	
1000-230-50	standby (response time: 4 msec.)	1	220	4.6	2 wire+GND 2 wire+GND	12×18×25 (cabinet)	52	1,125	
LIEBERT CORP. 1050 Dearborn Dr. P.O. Box 29186 Columbus, OH, 43229 (614) 888-0246									848
650	on-line solid state	50	480	65	3 wire+GND 4 wire+GND	72×72×36 (cabinet)	4,000	59,200	
LORAIN PRODUCTS 1122 F St. Lorain, OH 44052 (800) 792-1122									849
4864-484	on-line solid state	.15	120/240	4	2 wire+GND phase	7×19×15 (rack)	35		
CONSTAC WDA 502B	on line solid state	5	120	64	2 wire+GND	72×21×15.25 (cabinet)	690	7,910	
CONSTAC WDA103B	on-line solid state	10	120	130	2 wire+GND	72×36×21.25 (cabinet)	1,080	12,335	
CONSTAC WDA 361M	on-line solid state	.36	120	5.8	2 wire+GND	11×17×13.5 (cabinet)	180	1,265	
CONSTAC WDA102B	on-line solid state	1	120	14.5	2 wire+GND	42×16×15.25 (cabinet)	227	3,405	
CONSTAC WDA302B	on-line solid state	3	120	40	2 wire+GND	72×21×15.25 (cabinet)	496	6,120	
LORTEC POWER SYSTEMS 5214 Mills Industrial Parkway North Ridgeville, OH 44039 (216) 327-5050									850
Lortec UPS Systems	on-line solid state	15-156	various	various	3 and 4 wire+GND 3 and 4 wire+GND		various	25,000-125,000	
NOVA ELECTRIC MFG. CO. 263 Hillside Ave. Nutley, NJ 07110 (201) 661-3434									851
12-4060-1A	standby (response time: 4 msec.)	.4	120	5	2 wire+GND	14.25×6×19.5 (cabinet)	43	645	
12-4080-1A	standby (response time: 4 msec.)	.8	120	10	2 wire+GND	14.25×6×19.5 (cabinet)	73	840	
11-3K60-Y11	on-line solid state	3	120	65	2 wire+GND	14×19×21 (rack)	245	5,565	

THE FASTEST STANDBY SYSTEM REACTS IN 1/60TH OF A SECOND.



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But the Gould Series 3000 Uninterruptible Power System is always on line. So when the utility fails, your computer gets 500 watts of continuous power, no waiting. In fact, as far as your computer is concerned, it's like nothing happened.

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Of course you could add a line conditioner to the standby unit, and take your chances with blackouts. But for less money, you can have a Gould Uninterruptible Power System, and a lot more peace of mind.

For the name of your local computer dealer carrying the Micro-UPS call Toll Free 800-854-2658. In California (619) 291-4211. Gould Inc., Power Conversion Division.

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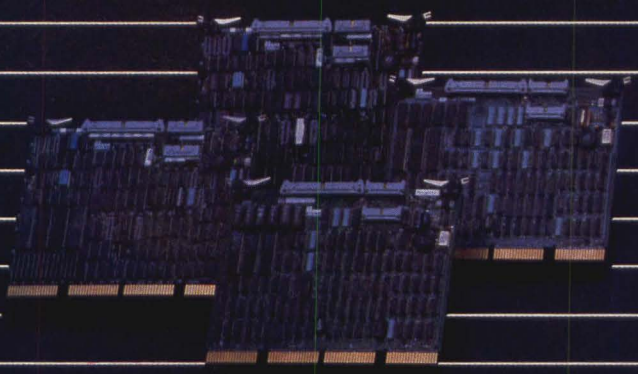

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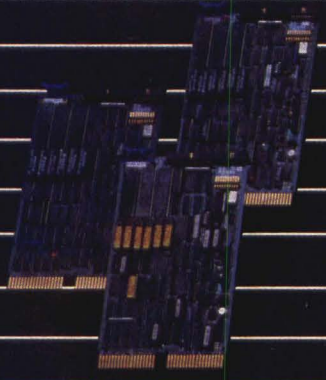

WINCHESTER 5¼″—ST506/412 & DMA I/0
• RL01/RL02, RK06/RK07 emulations

Q-BUS

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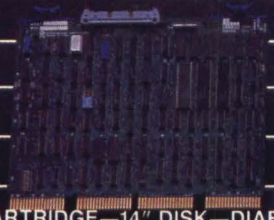
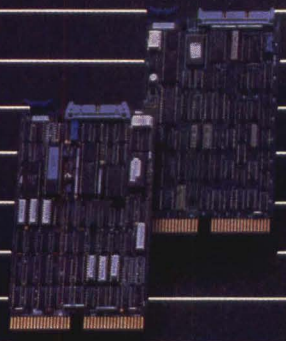
• RL01/RL02, RP02/RP03 emulations



CARTRIDGE—14″ DISK—DIABLO 44B
• RX05 emulation



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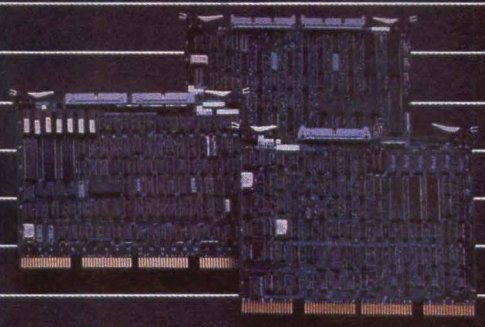

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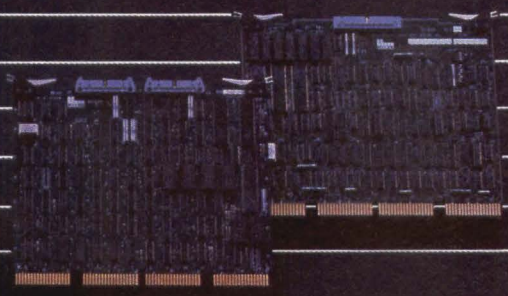

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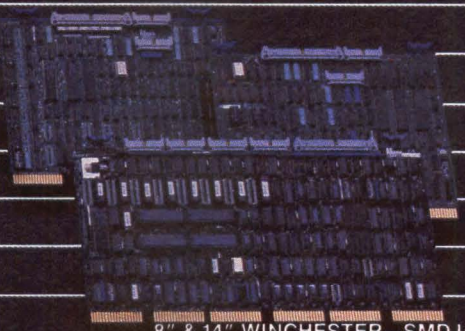

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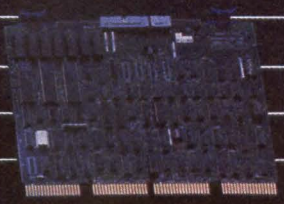
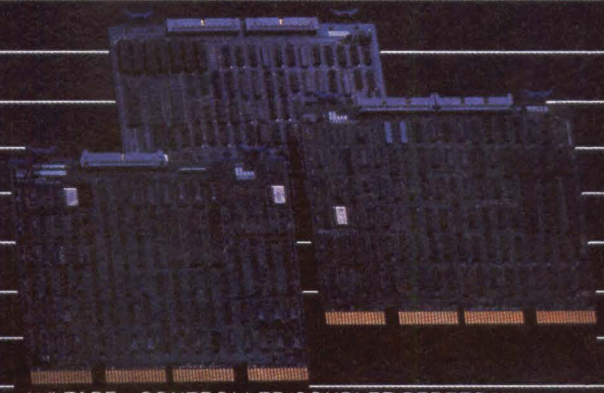


¼" TAPE—CDC SENTINAL I/O
• TS-II emulation



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11-5K60 to 11-15K60	on-line solid state	5-25	120 or 240 208 or 480	63 to 155	2 wire+GND 2 wire+GND	various	various	11,000-29,000	
11-7.5K-3/6 to 11-50K-3/6	on-line solid state	7.5-50	208, 220, 480	30 to 200	3 wire+GND	various	various	17,000-42,000	
PAN A MAX 150 Mitchell Blvd. San Rafael, CA 94903 (415) 472-5547									852
POWERMAX-200	standby (response time: 5 msec.)	.5	120	15	2 wire+GND	5×6.5×10 (cabinet)	16	429	
PARA SYSTEMS 2409 D Ave. J Arlington, TX 76011 (817) 640-0837									853
MINUTEMAN/PS 120V	on-line solid state	.12	102-132	2.5	2 wire+GND	5×6.5×10 (cabinet)	15	435	
MINUTEMAN PS 220V	on-line solid state	.22	190-250	1.5	2 wire+GND	6×.5×10 (cabinet)	15	495	
PRECISE POWER CORP. P.O. Box 2006 Bradenton, FL 33508 (813) 746-3515									854
9-60	on-line rotary motor	9	208/240/460	27	3 wire+GND 1 or 3 phase	39×60×36 (cabinet)	2,250	14,500	
15-60	on-line rotary motor	15	208/240/460	44	3 wire+GND 3 wire+GND	39×60×36 (cabinet)	2,650	18,500	
R.H. ELECTRONICS INC. 566 Irelan Buellton, CA 93427 (805) 688-2047									855
Guardian Angel	standby (response time: 10 msec.)	.2	120	3	2 wire+GND	4×6×9 (cabinet)	16	595	
Power Angel	standby (response time: 10 msec.)	.85	120	10	2 wire+GND	15×7×18 (cabinet)	75	1,295	
RKS INDUSTRIES INC. 4865 Scotts Valley Drive Scotts Valley, CA 95066 (408) 438-5760									856
DS200	on-line solid state	.2	120	117	2 wire+GND	10.75×12.62×6 (cabinet)	32	695	
DS400	on-line solid state	.4	120	117	2 wire+GND	10.75×12.65×6 (cabinet)	35	995	
SAFT AMERICA, ELECTRONIC SYSTEMS DIV. 2414 W. 14th St. Tempe, AZ 85281 (602) 894-6864									857
SPS0200	on-line solid state	.2	120	1.83	2 wire+GND	6×10.75×12.625 (cabinet)	32	549	
SPS0400	on-line solid state	.4	120	3.66	2 wire+GND	6×10.75×12.65 (cabinet)	35	749	
SPS0800	on-line solid state	.8	120	7.32	2 wire+GND	7×8.5×12.625 (cabinet)	50	995	
SOLA ELECTRIC 1717 Busse Rd. Elk Grove, IL 60007 (312) 439-2800									858
260050400-3001	on-line solid state	.4	120	3.3	3 wire+GND	10.5×12×19 (rack)	100	1,617	
11 50750-3000	on-line solid state	.75	120	5.8	3 wire+GND	10.5×12×19 (rack)	120	1,722	
DELUX 50750 3100	on-line solid state	.75	120	5.8	3 wire+GND	10.5×12×19 (rack)	120	1,808	

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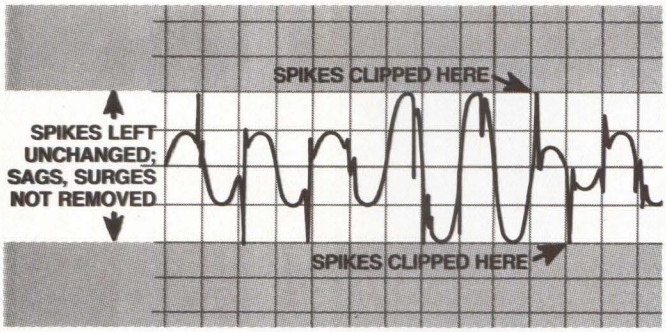

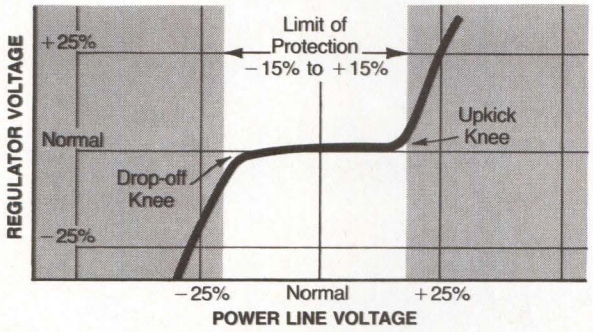

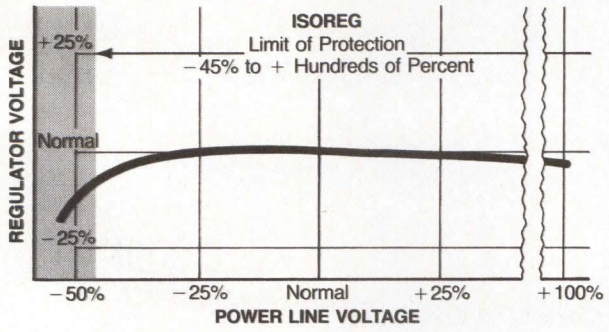

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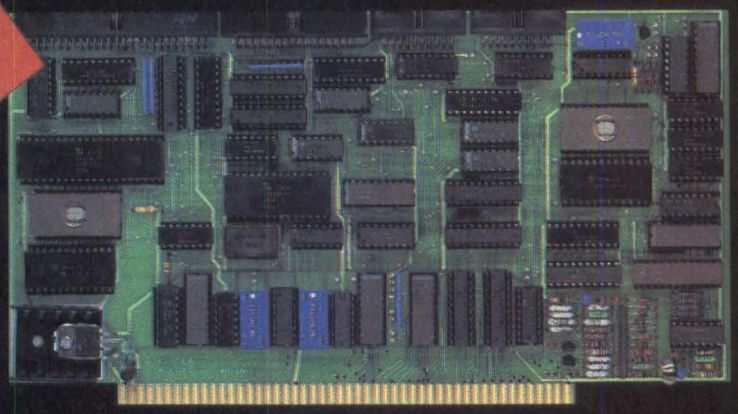

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- Two 28-pin sockets allowing the use of up to 16K bytes of on-board EPROM and up to 8K bytes of on-board RAM.
- Individual software reset capability.
- Conforms to the proposed IEEE-696 S-100 standard.
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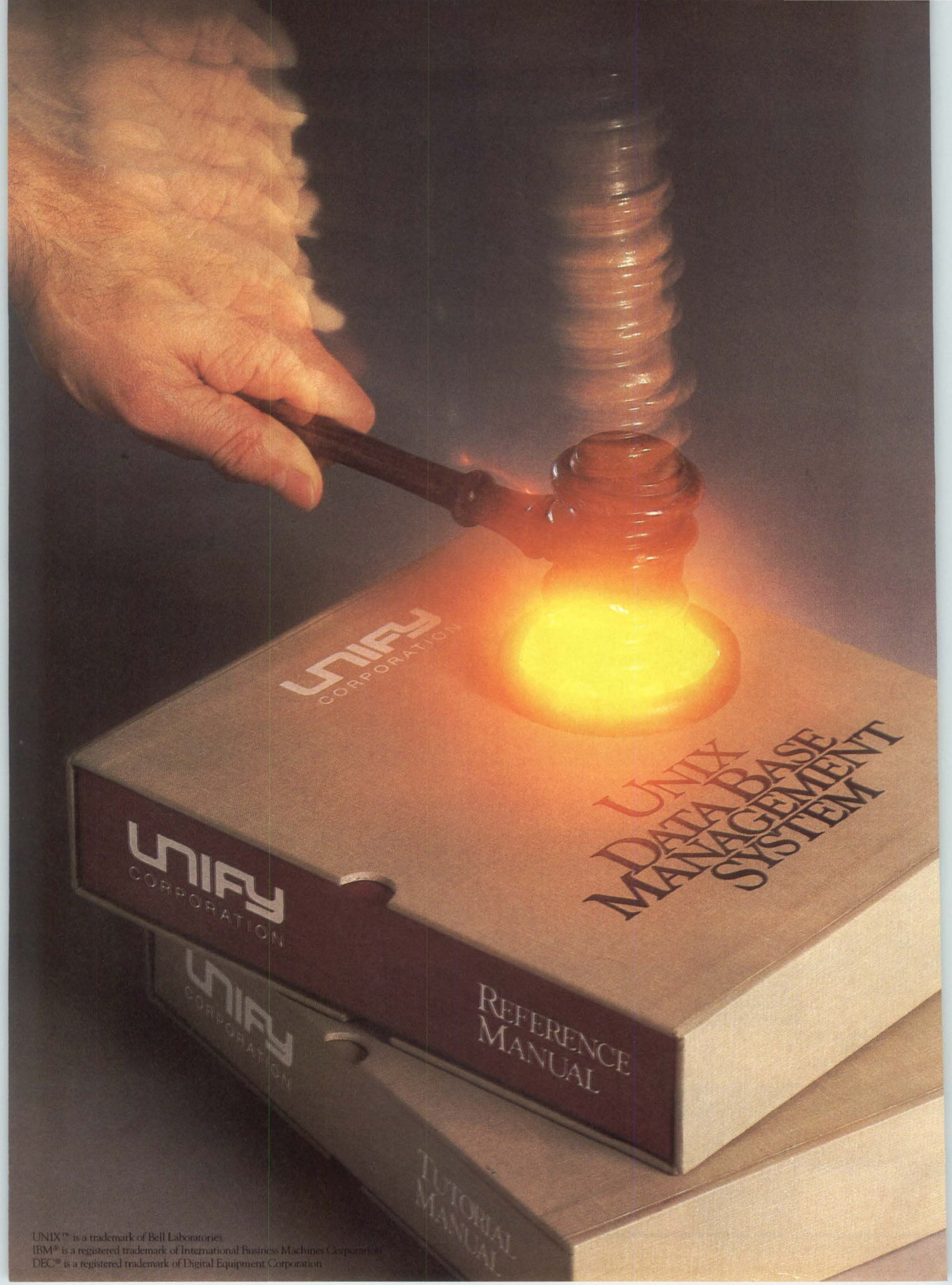
SUN RESEARCH INC. Box 210 Old Bay Rd. New Durham, NH 03855 (603) 859-7110									859
Mayday	standby (response time: 6-8 msec.)	.15	115	1.3	2 wire+GND	7×11×12 (cabinet)	42	240	
Mayday 60	standby (response time: 8-12 msec.)	.15	115	1.3	2 wire+GND	7×11×12 (cabinet)	48	400	
Mayday 60+6	standby (response time: 8-12 msec.)	.6	115	5.2	2 wire+GND	8×14×17	94	900	
Mayday 60+3C	on-line solid state	.3	115	2.6	2wire+GND	10×17×22 (cabinet)	95	850	
Mayday 60+3H	on-line solid state	.3	115	2.6	2wire+GND	10×17×22 (cabinet)	105	980	
Mayday 60+3W	on-line solid state	.3	12 volt DC			10×17×22 (cabinet)	45	565	
TAB PRODUCTS CO. 1451 California Ave. Palo Alto, CA 94304 (415) 852-2400									860
7725	on-line solid state	2.5	117.5	22	2 wire+GND	14×16.75×32 (cabinet)	280	3,975	
TOPAZ/SQUARE 'D' 9192 Topaz Way San Diego, CA 92123-1165 (619) 279-0111									861
Powermaker Micro UPS 84462	standby (response time: 4 msec.)	.4	120	3.4	2 wire+GND	15×17×18 (cabinet)	66.5	750	
Powermaker Micro UPS 84864	standby (response time: 4 msec.)	.8	120	6.7	2 wire+GND	15×17×18 (cabinet)	71.5	890	
Powermaker Micro UPS 84126-01	standby (response time: 4 msec.)	1	120	8.4	2 wire+GND	15×17×18 (cabinet)	74.5	995	
TRANSWESTERN PRODUCTS 1711 Senter Rd. San Jose, CA 95112 (408) 279-2544									862
Ultraguard	standby (response time: 4 msec.)	.2	120	2.2	2 wire+GND	4×8×9.25 (cabinet)	15	649	
TRIPP LITE DIV. OF TRIPPE MFG. 500 N. Orleans Chicago, IL 60610 (312) 329-1777									863
BC200	standby (response time: 10 msec.)	.2	117	18		6.25×8.75×12 (cabinet)	36	399	
BC425FC	standby (response time: 10 msec.)	.425	117	37		6.25×8.75×12 (cabinet)	38.5	539	
WELCO INDUSTRIES 9027 Shell Rd. Cincinnati, OH 45236 (513) 891-6600									864
UPA-400	on-line solid state	.4	120	5	2 wire+GND	8.75×19×15 (rack)	132	1,300	
UPS-750	on-line solid state	.75	120	10	2 wire+GND	8.75×19×20 (rack)	230	2,965	
UPS-1000	on-line solid state	.75	120	14	2 wire+GND	8.75×19×20 (rack)	150	3,390	
UPS-1500	on-line solid state	1.5	120	21	2 wire+GND	8.75×19×20 (rack)	150	3,525	



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Streaming-tape software uses bit-map copying

Technique reduces disk-backup time and tape usage

Anton Polivka, Spectra Logic Corp.

Because most Winchester disk drives employ fixed rather than removable media, they require use of a separate device for backup and restore operations. Streaming-tape drives can efficiently perform these functions if the system they are used on can transfer data between the disk and the tape fast enough to keep the tape drive operating without interruption. Standard copying utilities for tape drives generally cannot achieve continuous streaming, but Spectra Logic Corp. has developed "streaming software" to match the speeds of the new streaming-tape drives. After considering the mirror-image, selected-file and extended-tape-gap approaches to streaming software, Spectra Logic designed its software using bit-mapping.

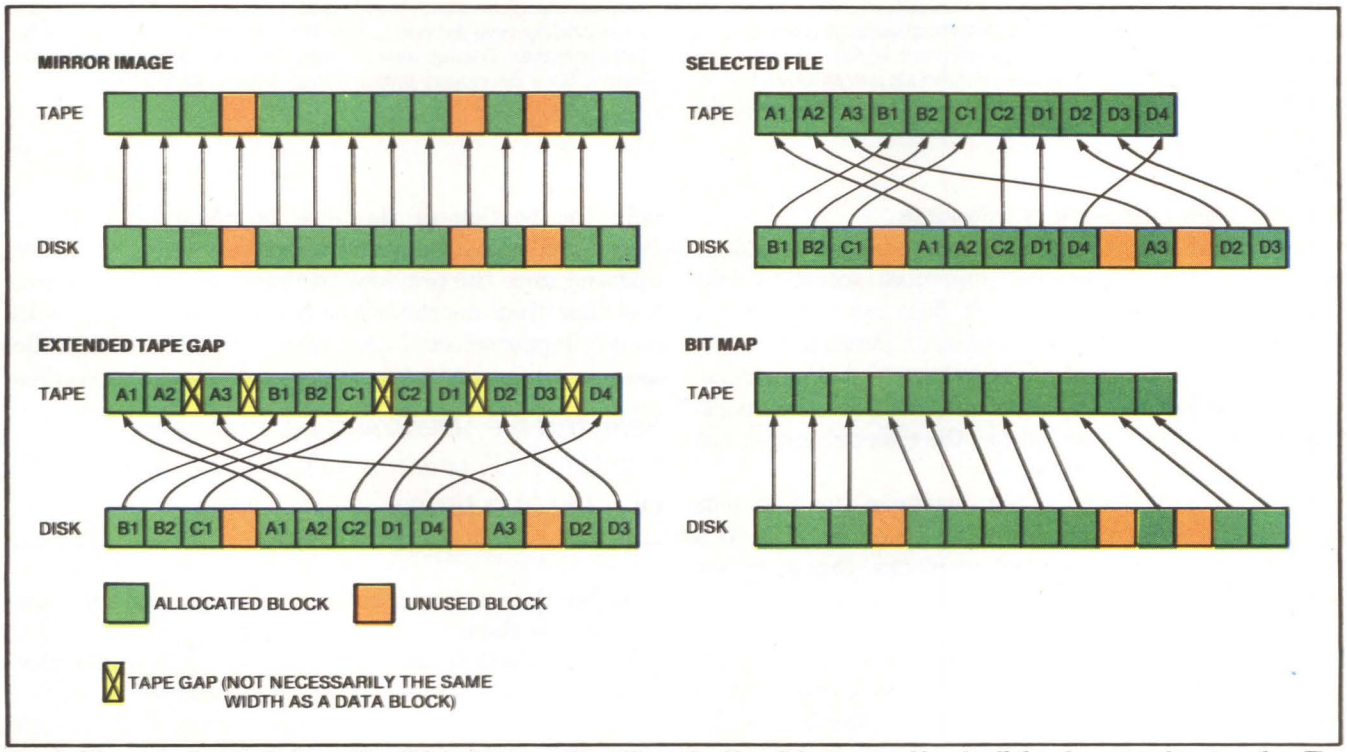


Fig. 1. There are four techniques for disk-to-tape copying. *The mirror-image approach copies disk to tape sequentially, transferring both allocated and unused disk blocks. In the selected-file approach, sequential blocks of tape represent sequential logical file blocks rather than sequential physical blocks. Therefore, unused blocks need not be transferred. The tape drive stops and starts while waiting for the disk to reposition itself for the next data transfer. The extended-tape-gap approach is identical to the selected-file approach,except that the tape drive continues moving (recording a gap) while the disk repositions itself. The bit-map approach is identical to the mirror-image approach, except that unused blocks (and bad blocks) are not transferred to tape.*

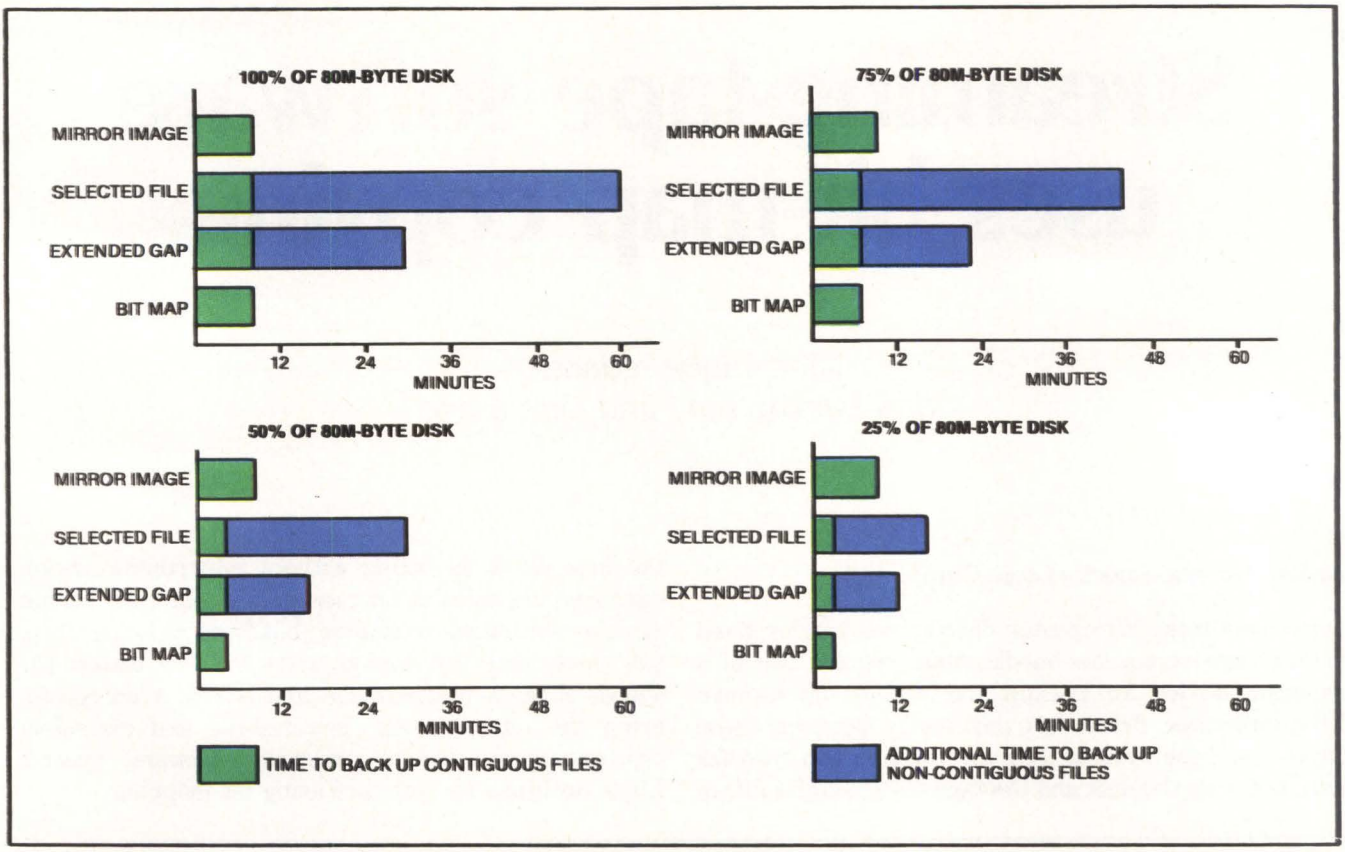


Fig. 2. The backup time for the four approaches to streaming tape *is approximately equal, as long as the disk is full and files are contiguous. The time needed by the selected-file and extended-tape-gap methods for non-contiguous files is much greater than the corresponding time for contiguous files. As the percentage of disk used decreases, backup time remains constant for the mirror-image method, but it decreases proportionally for the other three.*

Mirror-image approach is inflexible

The mirror-image streaming method copies a disk to tape "as is," requiring only sequential access to data blocks on the disk (Fig. 1). It does not involve the operating system (OS) file manager because copying occurs independently of file structure or disk organization. Mirror-image copying maintains non-stop operation of the tape drive as long as the disk drive does not encounter read or write errors.

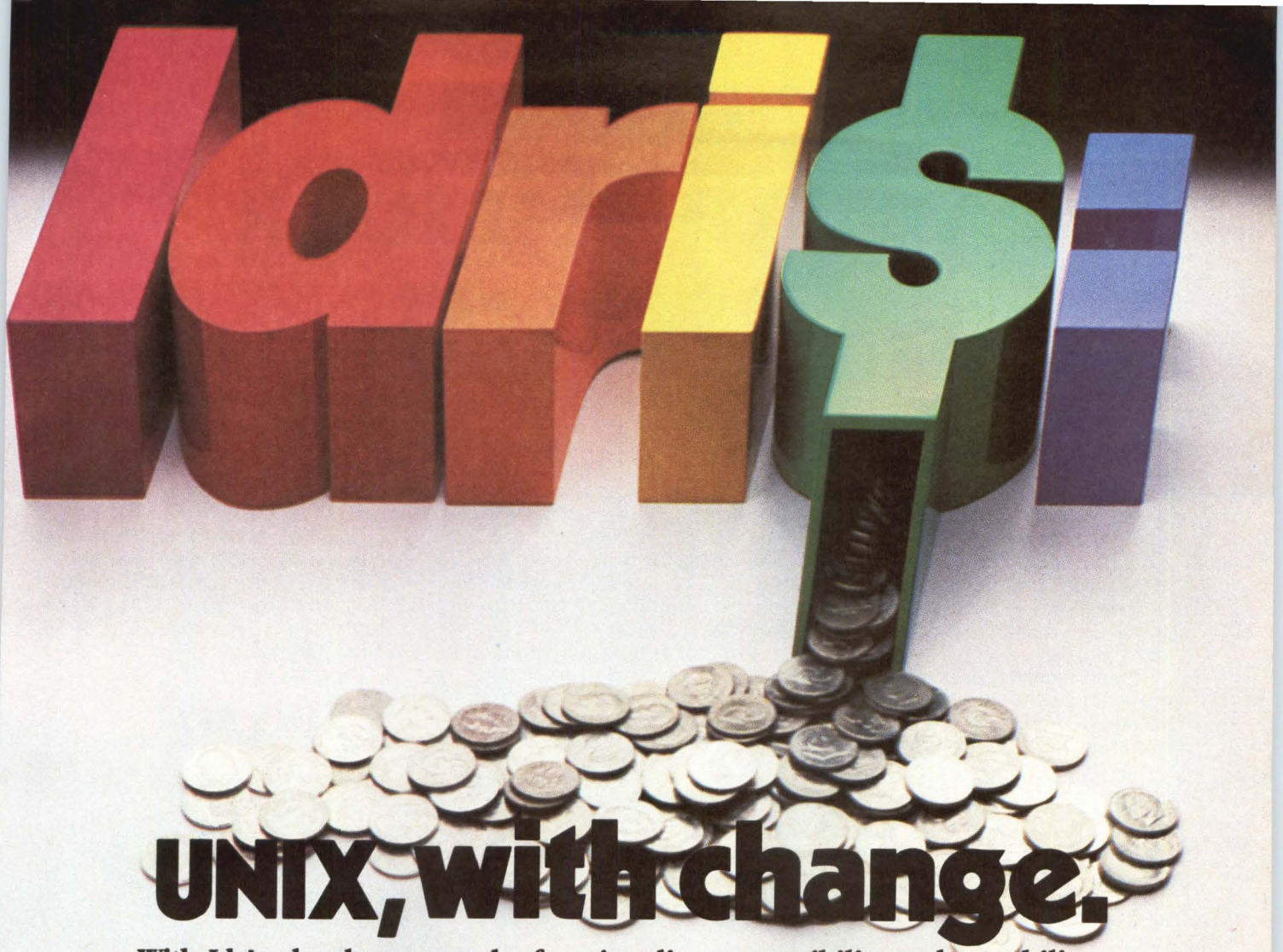
The mirror-image approach, however, has a serious drawback: it necessitates copying an entire disk. If a disk contains many unused data blocks, this approach consumes more time and tape than necessary to copy only the allocated portions of the disk. Also, mirror-image backup cannot handle media defects (bad blocks), which means that disk media must be error-free. This is an added expense because certified error-free media cost more than ordinary media.

Selected-file approach requires fast disk access

Selected-file streaming backup uses standard OS utilities to save and restore one file at a time, accessing only the portion of the disk occupied by the file. Because files can be saved selectively (e.g., only files updated since the previous backup), this approach uses less tape than mirror-image backup. Also, bad blocks do not impair selected-file backup because the OS's file manager detects them before the streaming software can process them.

Selected-file streaming backup uses standard OS utilities to save and restore one file at a time.

The drawback to selected-file backup is that disk files can be non-contiguous; that is, sequential blocks on the disk do not necessarily correspond to sequential blocks on the tape. As a result, the tape drive can't copy a data block until the file manager has determined its location and the disk drive has accessed it. On the average, approximately eight disk sectors must be accessed per disk revolution to keep a 100-inch-per-second (ips) tape



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drive moving continuously—a difficult requirement to meet using selected-file backup.

Extended-tape-gap approach underutilizes tape

The extended-tape-gap streaming method is a modification of selected-file backup, in which the tape continues moving while the disk drive accesses noncontiguous file blocks. Because no data is transferred during these periods, the tape drive simply extends the gaps between data blocks. The drive and the controller can implement this method without software changes.

The only drawback of bit-mapping is that tasks that affect files cannot be performed during backup.

Eliminating the need to start and stop the tape drive reduces backup time relative to selected-file copying, but it consumes much more tape. Often, the gaps between data blocks are longer than the blocks themselves. The amount of tape used is proportional to the time required to transfer data between disk and tape.

Bit-mapping produces efficient tape movement

Bit-mapped streaming backup is similar to the mirror-image method, but it copies only the data blocks allocated to files. The term "bit map" is used because this method uses the OS's disk-allocation map in which 1 bit represents each sector. With this method, the disk drive can easily access an average of eight sectors per revolution, allowing a 100-ips tape drive to achieve continuous streaming without long inter-block gaps.

SPECIFICATIONS OF THE SPECTRA 25 SINGLE-BOARD DISK/DRIVE CONTROLLER

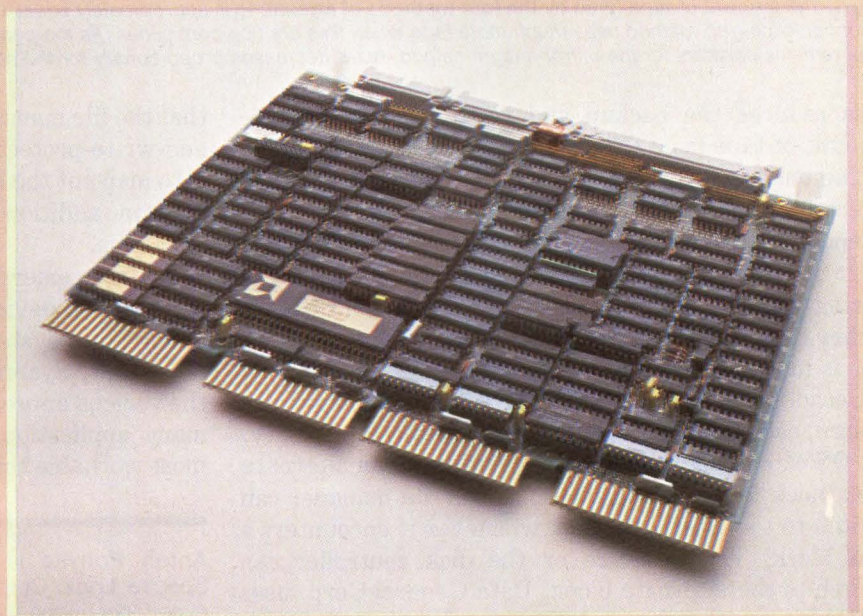
- **Manufacturer:** Spectra Logic Corp., 1227 Innsbruck Dr., Sunnyvale, Calif. 94089, (408) 744-0930
- **Emulation:** Digital Equipment Corp. Q-bus-compatible CPU
- **Addressing range:** 22, 18 or 16 bits (disk and tape)
- **Interface:** all storage module drive (SMD) (disk) and Pertec-formatted (tape)
- **Transfer rate:** 2M bytes per second (disk), 800K bytes per second (tape)
- **Error - correcting codes (32-bit):** correction in buffer or CPU
- **Board size:** DEC Quad
- **Other features:** block-mode transfer, dual ports
- **Price:** $2,400 in OEM quantity

MULTIFUNCTION CONTROLLERS REDUCE COST AND SPACE

Streaming-tape drives and streaming software play important roles in providing fast, reliable and inexpensive disk backup, but the significance of multifunction disk/tape controllers should not be underestimated. An example is Spectra Logic Corp.'s Spectra 25, a single-board controller that replaces separate disk and tape controllers for Digital Equipment Corp.'s LSI-11 and PDP-11/23 computers. The Spectra 25 can handle as many as two storage module drives (SMDs) and four streaming or formatted ½-inch stop/start tape drives. It supports 100-inch-per-second streaming tape, allowing efficient disk backup.

The Spectra 25 is reliable: compared with separate disk and tape controllers, it has fewer board-to-chassis connections and fewer ICs. Error-correcting codes and on-board self-testing diagnostics also aid reliability.

Reduced cost is another benefit. Cost savings result from having the disk- and tape-control functions share logic and PC-board space. In some applications, the Spectra 25 can further reduce cost by eliminating the need for an expansion chassis.



Two controllers in one. *Spectra Logic Corp.'s Spectra 25 is a single-board disk/tape controller for Digital Equipment Corp.'s LSI-11 and PDP-11/23 computers.*

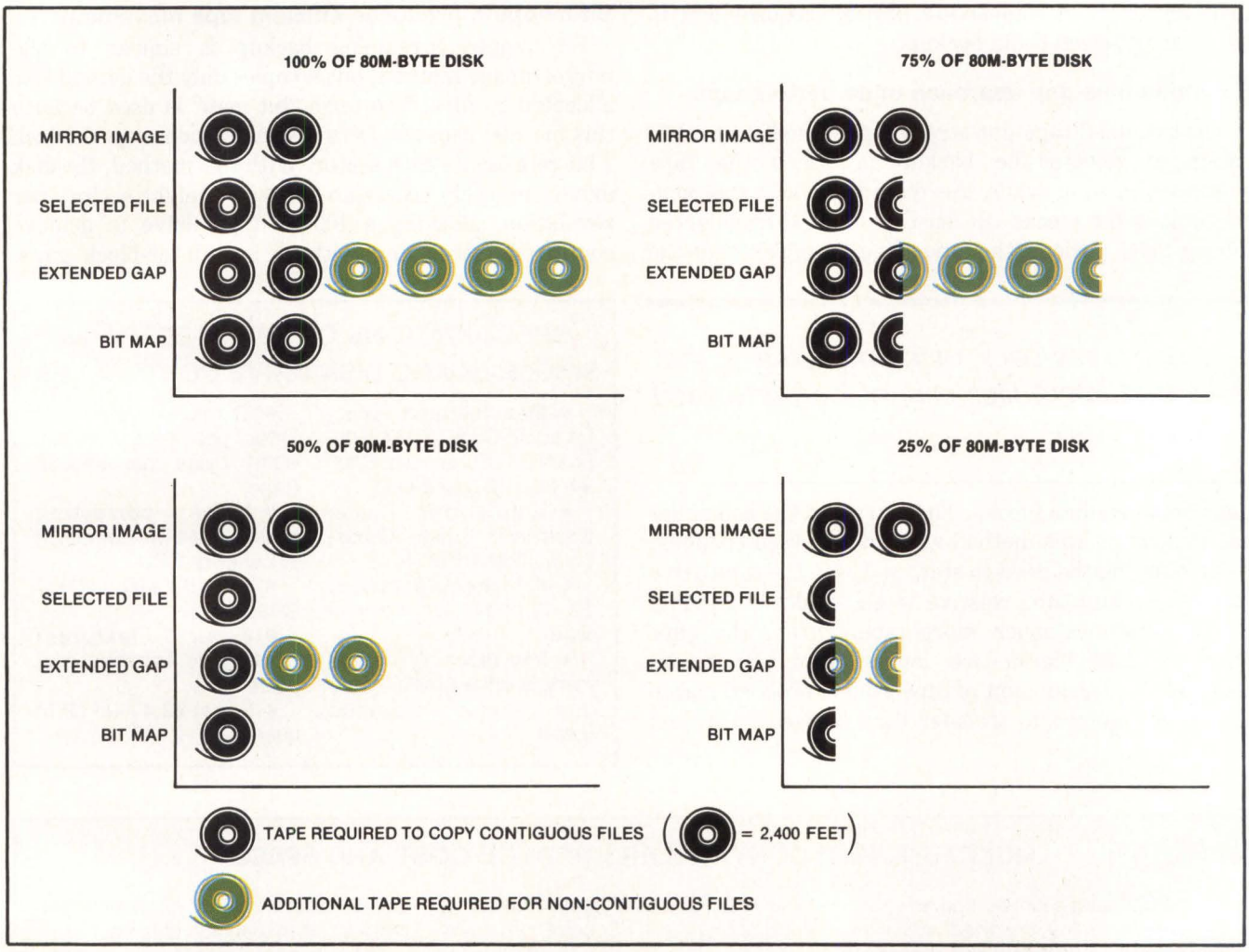


Fig. 3. The amount of tape used by the four methods of streaming *is approximately equal when the disk is full and files are contiguous. The extended-tape-gap method uses much more tape when files are non-contiguous. As the percentage of disk used decreases, the amount of tape remains constant for the mirror-image method, but it decreases proportionally for the other three.*

This reduces the backup and restore times and the amount of tape used (Figs. 2, 3).

The only drawback of bit-mapping is that tasks that affect files cannot be performed during backup. With selected-copy or extended-tape-gap backup, the OS can alert users to discrepancies created by file changes during backup. But bit-mapping operates on sectors rather than files, so information about such discrepancies is unavailable to users.

Because each OS uses a different file-management design, each requires a separate streaming-tape utility. An OS can handle bad blocks by assigning an alternate disk block for each bad block, so the file manager can switch to the alternate block whenever it encounters a bad block. The software or the disk controller can switch to the alternate block. Data General Corp. uses software to switch, and Spectra Logic and Texas Instruments Inc. use the disk controller. Another way to handle bad blocks is to map them into a bad-block file that the file manager maintains as an inaccessible (read-and-write-protected) file. A variation of this technique is to map out the bad blocks by creating a bad-sector bit map in addition to the ordinary bit map for disk allocation.

With the emergence of the Winchester disk drive as a widely-used device on desktop microcomputers as well as high-end systems, hard-disk backup is increasingly important. System integrators should be familiar with the various approaches to streaming-tape software. For many applications, the bit-map approach can be the most workable combination of speed and tape usage. □

Anton Polivka is manager of software development for Spectra Logic Corp., Sunnyvale, Calif. He has 25 years of experience in the electronics industry, including positions with Xerox Corp., Diablo Systems Inc. and Lawrence Livermore Laboratories.

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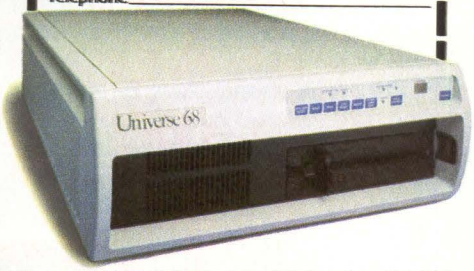

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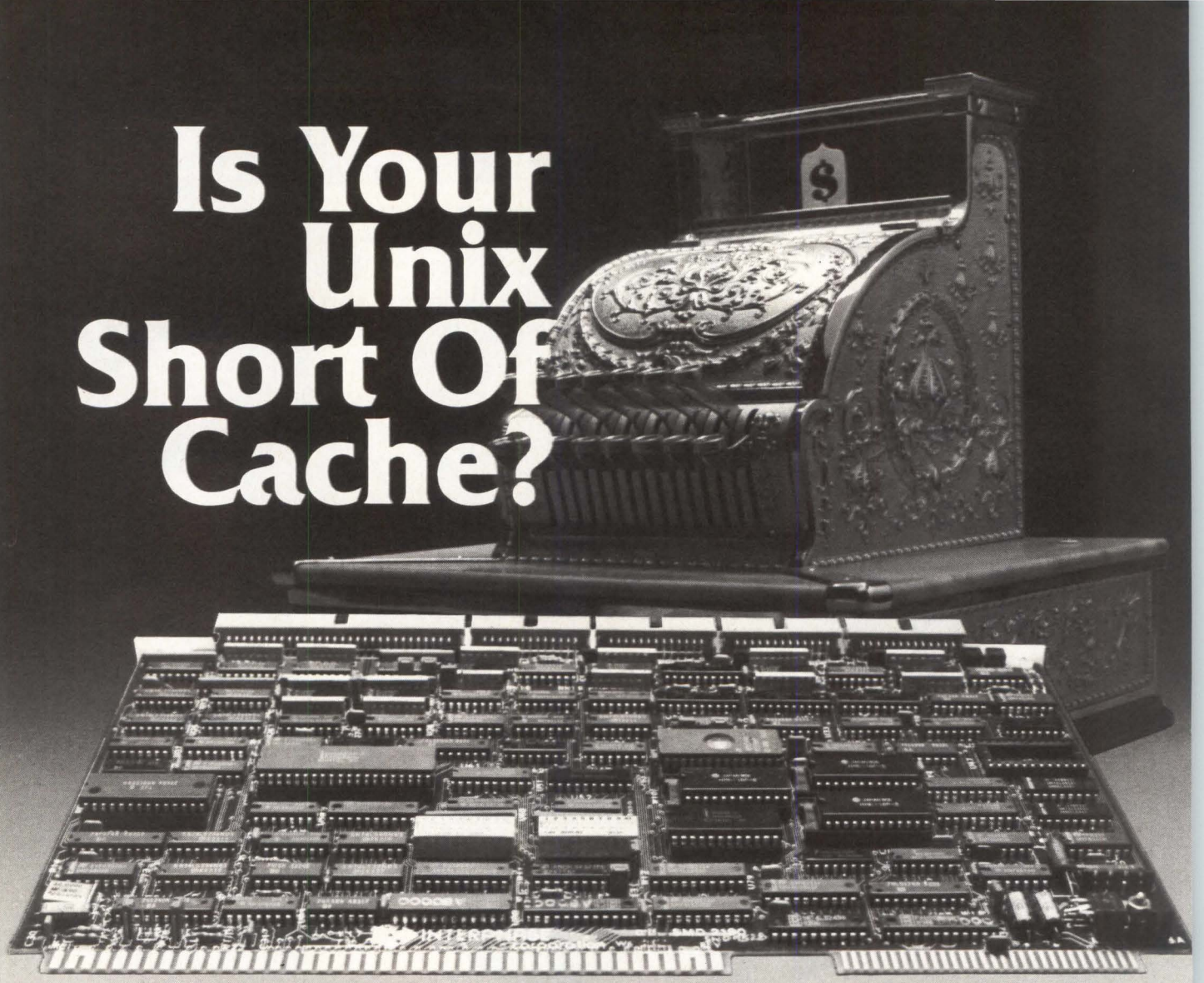

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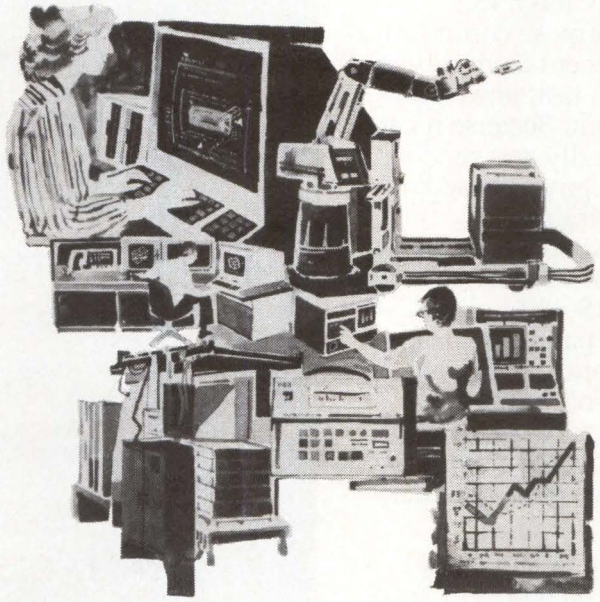

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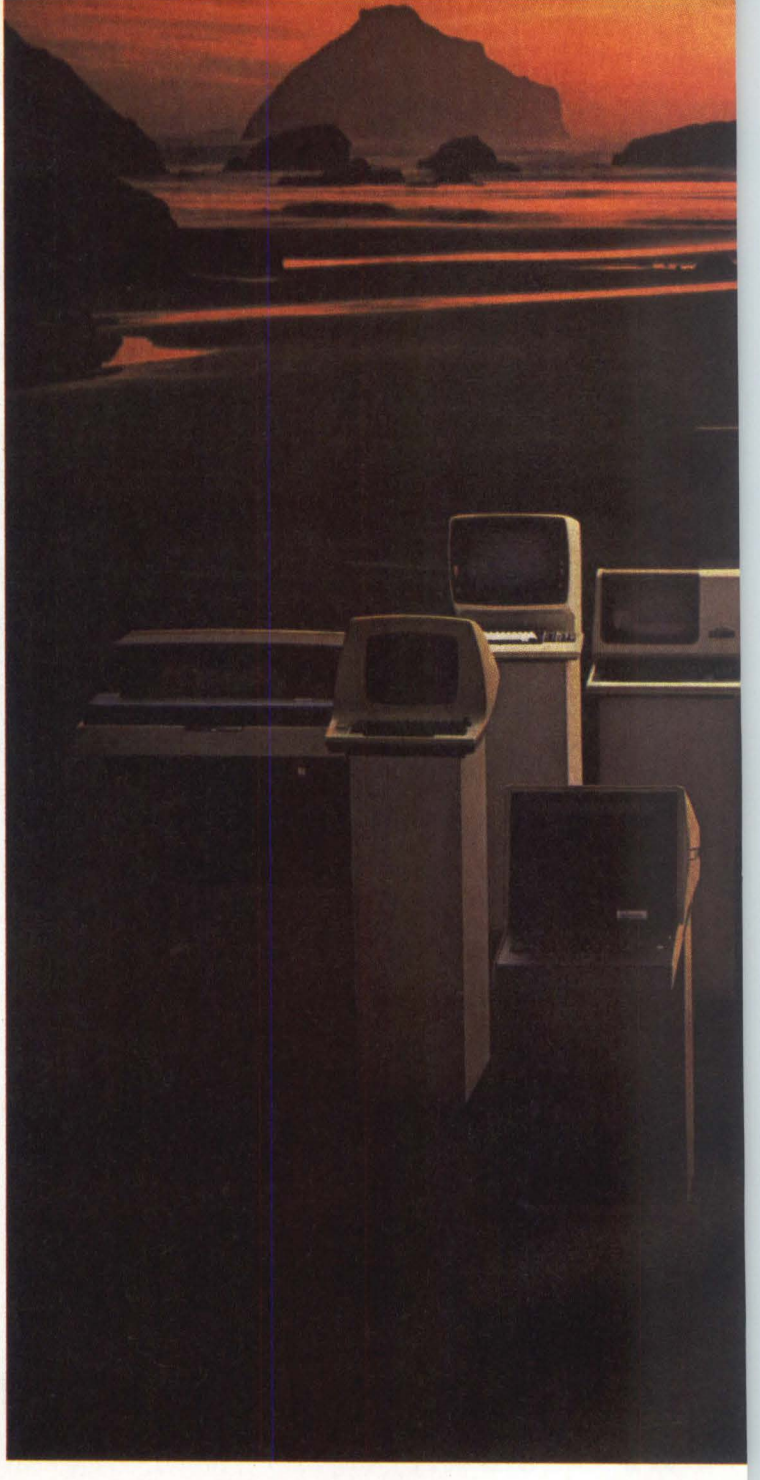

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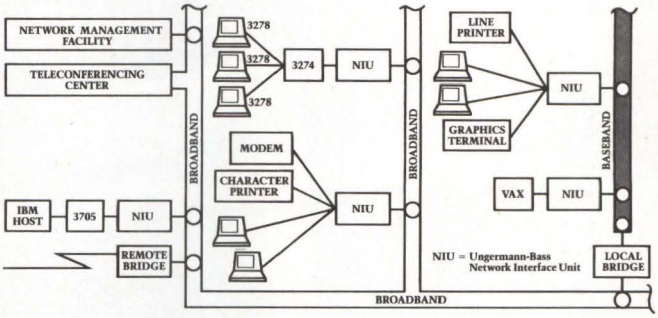

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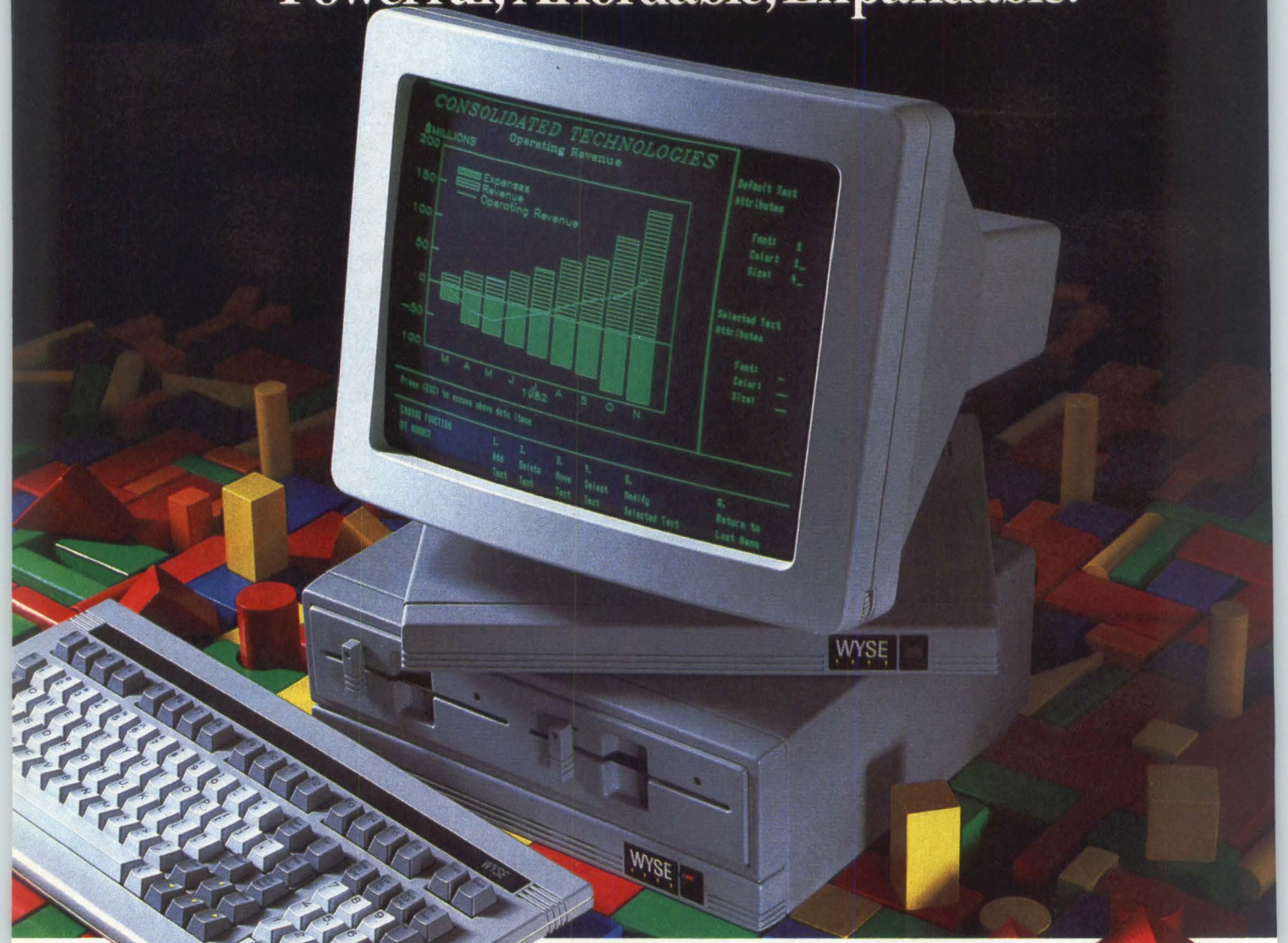

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UNIX-based DBMS extends relational model

Flexible DBMS tools, such as access by key, link or B-tree, expedite data retrieval

Nicolas Nierenberg, Unify Corp.

Many applications running on UNIX-based minicomputers and microcomputers demand quick access to large databases. System integrators are faced with the choice of adapting database systems designed for mainframes, developing applications from the ground up or basing applications on preprogrammed database-management system (DBMS) tools. Using DBMS tools is often the most attractive alternative because most applications involve repetitive tasks.

The traditional method of developing a database application requires a programmer to think about data entry, the structure of the data dictionary, access methods, data recovery, how data is linked and represented and report generation. Because most application programs have similar requirements regarding the kinds of data they use, the ground-up method results in programmers repeatedly writing the same kinds of code modules. Moreover, groups within an organization developing separate but similar applications from scratch often have different ideas about the best methods to use. Consequently, their applications diverge widely, and several approaches to access methods, internal data representations and record structures may crop up in what is supposed to be a

Table name	Field name	No. of records	REF	Type	Length	Description
manf		10				manufacturer
	*mano			numeric	4	number
	mname			string	30	name
	madd			string	30	address
model		50				model
	*mokey			combination		model_key
	monum			numeric	7	model_num
	momano		mano	numeric	4	manufacturer_num
	mdes			string	30	description
item		100				inventory_item
	*sno			numeric	9	serial_number
	imodel		mokey	combination		model_id
	iad			date		acquisition_date
	isal			amount	5	sales_price

*primary key for table

Fig. 1. Field names in the REF column *establish sets of pointers to the corresponding field name in another table. In this example,* momano *refers to* mano, *the manufacturer number. Thus, only valid manufacturer numbers (those in the* manf *table) will be stored in any record in the* model *table.*

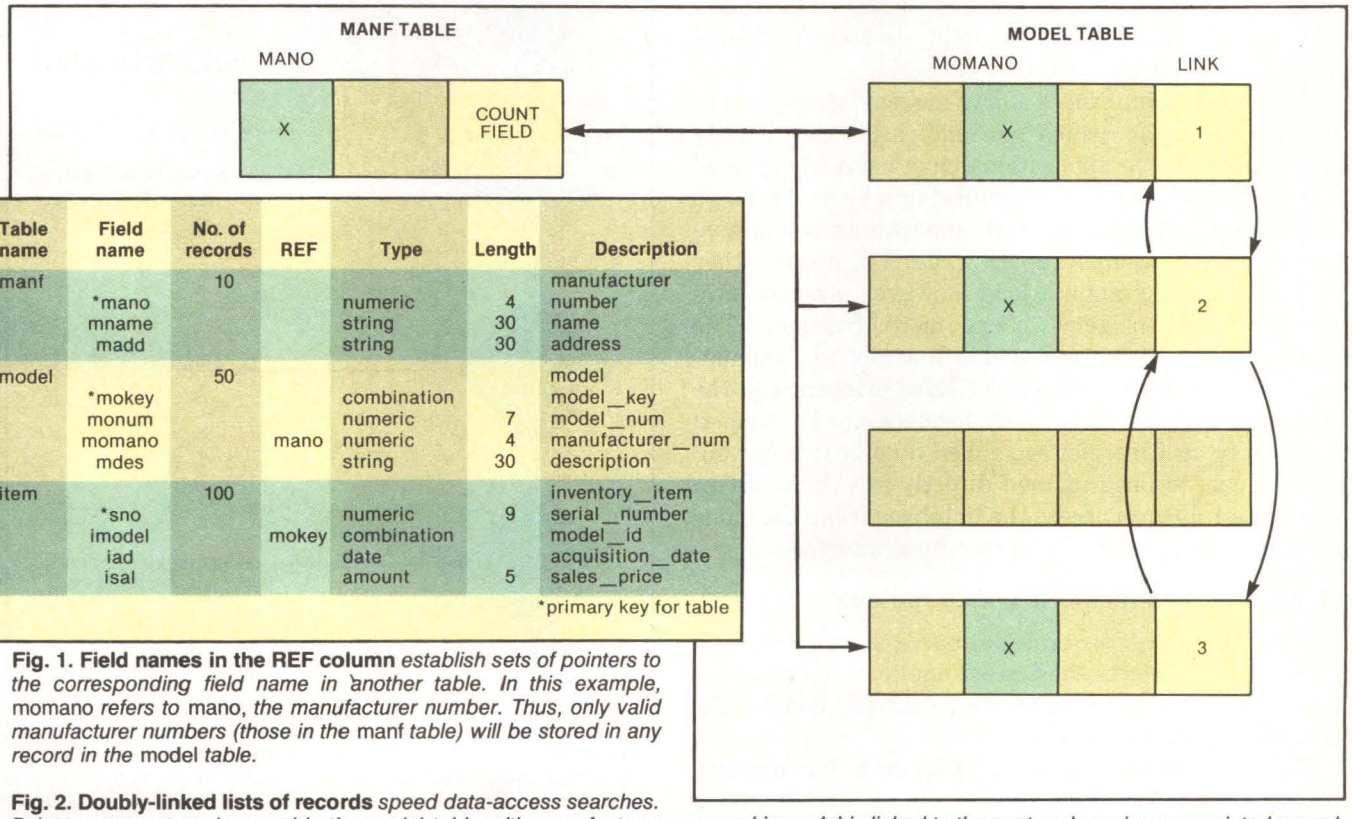

Fig. 2. Doubly-linked lists of records *speed data-access searches. Pointers connect each record in the* model *table with manufacturer number "X" to the record in the* manf *table with that manufacturer number and vice-versa. In addition, each* manf *record stores a count of the records in* model *to which it is linked, and each associated record in* model *is linked to the next and previous associated record. These pointers and count fields allow access to records in both tables with a specific manufacturer number without creating a separate manufacturer index for each table.*

smoothly running company. In the best of cases, tight organizational control can resolve these conflicts, but the development tools still must be rewritten for each application. What is needed, therefore, is a set of DBMS tools that is flexible yet capable of imposing a consistent methodology on its users.

System integrator sets user interface

The Unify DBMS from Unify Corp. provides three user interfaces: non-procedural, host-language and low-level. The non-procedural interface permits non-programmers to define data structures and develop applications using Unify's menu handler, screen processor and report writer. The host-language interface allows a high-level C or COBOL program to specify what it wants done with the data, leaving the details of data access to the DBMS. Finally, a program that cannot perform its task efficiently using the host-language interface can access the database using such low-level interfaces as hashing, B-trees and pointers. For example, programmers can write code that sets up a primary key that will always be accessed by hashing, or they can build a B-tree, so that if the primary key is not specified precisely, the system automatically goes to the B-tree. Thus, although much of the burden of choosing access methods is removed from application developers, Unify retains the ability to specify optimal methods for specific needs.

The choice of interfaces allows system integrators to set the level at which an end user can modify applications. Some applications have narrowly-defined needs in which the only modifications made by users might be report formats. Such applications would give users access to Unify's report writer but not its other utilities. In many applications, however, system integrators want to allow users more freedom. The host-language interface provides functions to communicate between user programs, CRTs, printers and the database. Screens and report formats can be created with Unify utilities that are called by a host program, or they can be programmed directly in C or COBOL. Host programs can access the database using the same access methods as the non-procedural interface.

Multiple access methods speed retrieval

Unify provides several data-access methods and automatically selects the fastest one for each database request. Two extensions to the relational model make this optimization possible.

The first extension is the provision for primary record keys, sets of one or more fields that uniquely determine a record. The second extension is the user's ability to specify links between tables using a "REF" column that references a field in another table (Fig. 1). By allowing this kind of "pre-joining," Unify can be aware of logical consistency requirements that would otherwise have to be enforced by an application program.

Unify pointers work in two ways. Each record in a table *pointed to* by a REF column stores a count of the number of associated records in the table containing the REF column, along with the addresses of the first and last associated records. Similarly, each associated record in the table *containing* the REF column has a link field to the next and previous associated record, as well as the referenced record (Fig. 2). This imposes some time and space overhead when storing a record,

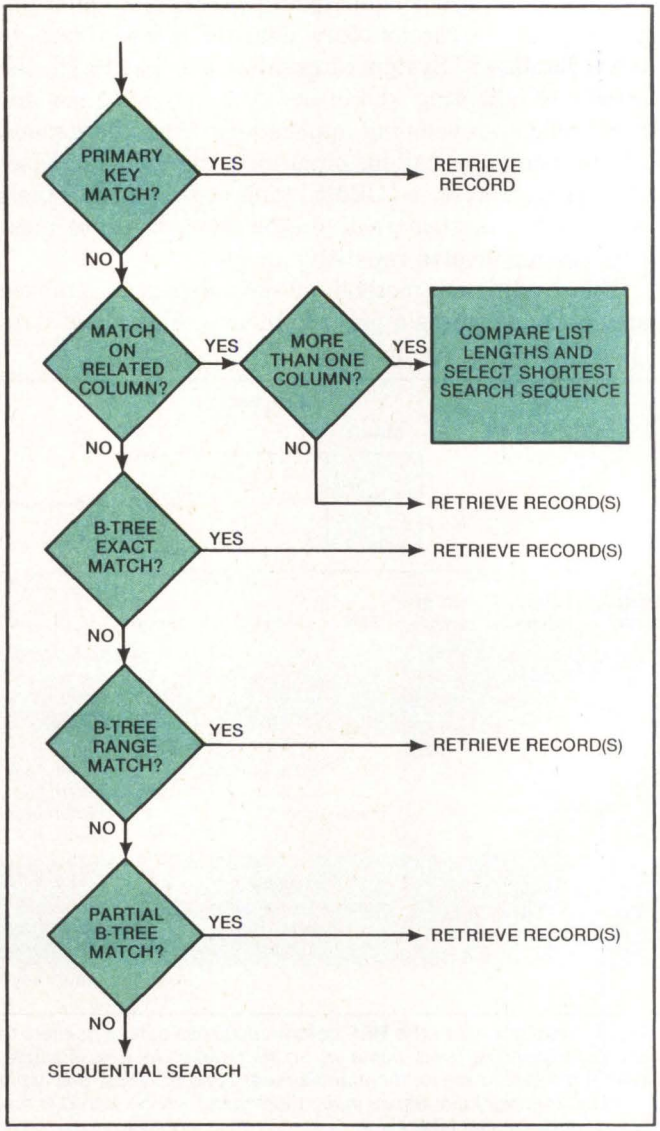

Fig. 3. Selecting an access method *involves a hierarchy of options from a primary-key match to a sequential search. In general, Unify chooses the access method on its own according to the algorithm shown. However, application developers can bypass the usual procedure by specifying any of the access methods shown in the figure.*

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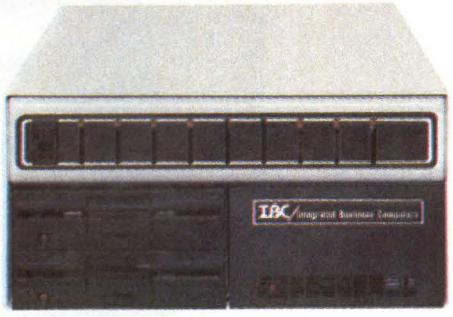

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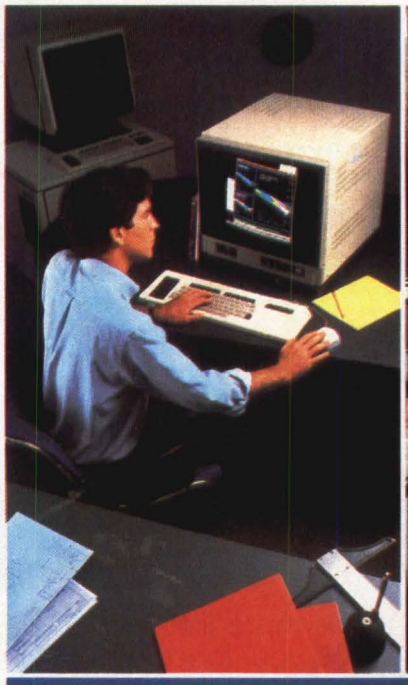

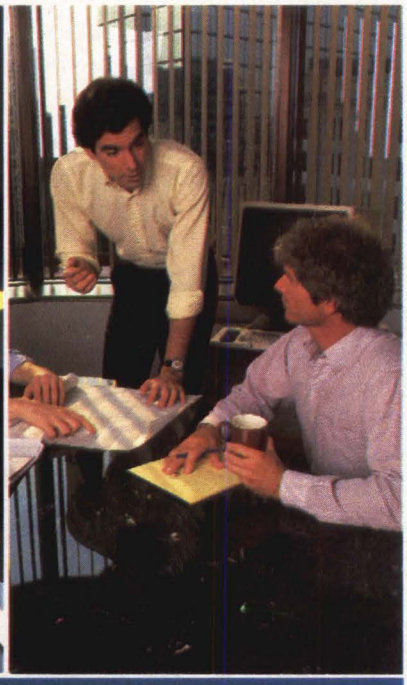

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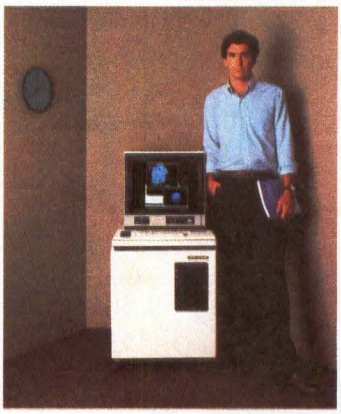

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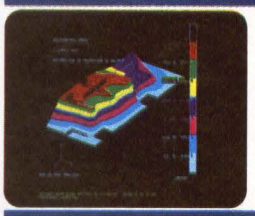

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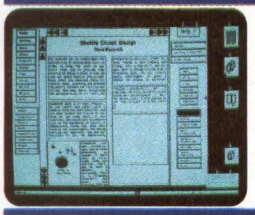

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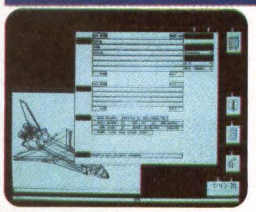

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CIRCLE NO. 111 ON INQUIRY CARD

but it avoids building indexes for every field a user wishes to reference. Unify's link and count fields take up half the space separate index fields would require.

Unify's organization of records and pointers is at the *physical* level, so it is conceptually a relational rather than a network database. Such physical design grants other advantages such as improved file maintenance. Unify uses fixed row lengths, enabling the replacement of deleted rows with new ones, thus avoiding time-consuming compression runs. This involves a trade-off: increasing disk requirements in return for preventing application degradation and system downtime for database maintenance.

Unify evaluates the access methods available to requested fields and selects the most efficient search path (Fig. 3) by assigning scores based on key, link or B-tree approaches. The key method is an exact match on a primary key. The link method uses the link and count fields relating to REF columns, and the B-tree method involves matches at the B-tree level: an exact match, a match within a range or an inexact match that defines the first few characters.

When REF columns link several fields, Unify can examine the length of the lists associated with each and search by the shortest route. Alternatively, a list may make up a very large percentage of the database, and the system might choose to do a high-speed sequential search of an entire file.

System incorporates 28 utility programs

Consistent with the UNIX philosophy of linking many small programs to perform complex tasks, Unify is organized as many small utilities. It is possible to reduce the working size of the system to about 100K bytes and to run it on a machine with 256K bytes of RAM because utilities that are not needed at run time do not occupy RAM. Unify requires 2M bytes of disk storage, plus storage for the user's database.

Unify's disk layout can bypass the UNIX file system, which often requires several physical disk accesses for each logical access (MMS, November 1983, Page 255). The Unify file system can reside outside the UNIX file space and can spread data over as many as eight devices (Fig. 4). This file organization has resulted in performance improvements of as much as 40 percent. If this configuration is not selected, the file system resides in a single UNIX disk file. The ability to extend the file system also makes it possible to split the database

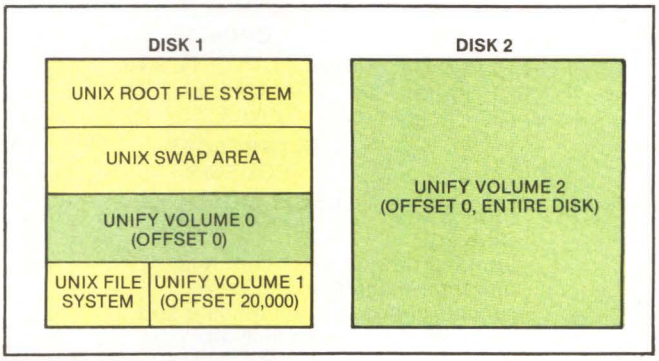

Fig. 4. Unify's disk space *can be organized as a file managed by UNIX (yellow) or as a logical or physical disk that is separate from UNIX (green).*

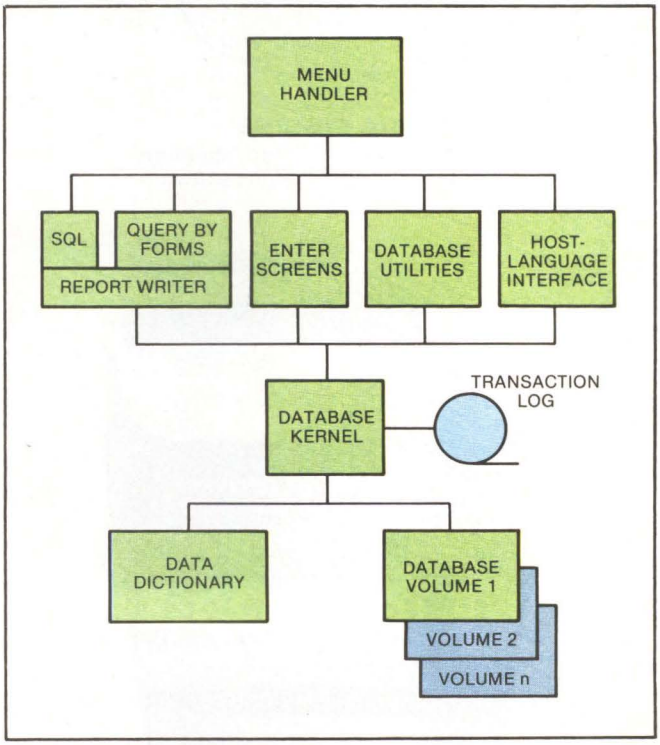

Fig. 5. User interaction with Unify *takes place via the menu handler. The database kernel manages data access for the non-procedural and host-program interfaces. The data dictionary maintains menu hierarchies and user passwords.*

Product summary of the Unify database-management system

- **Manufacturer:** Unify Corp., 95970 S.W. Barbur Blvd., Portland, Ore. 97219, (503) 245-6585
- **Memory required:** 256K bytes
- **Disk space required:** 2M bytes
- **Maximum records per database:** 2 billion
- **Primary-key access time:** 36 records per second for a 1,000-record database
- **Secondary-key access time:** 24 records per second for a 1,000-record database
- **Price:** $1,495 to $14,500, depending on hardware configuration
- **Systems supported:** Altos Computer Systems' 586; Apple Computer Inc.'s Lisa; Digital Equipment Corp.'s VAX and PDP-11; Fortune System Corp.'s 32:16; IBM Corp.'s Series/1, PC/XT and CS-9000; NCR Corp.'s Tower 1632; Radio Shack's (Tandy Corp.) TRS-80 model 16; Zilog Inc.'s S-8000; and many other 16- and 32-bit systems running UNIX.

among several machines—facilitating its adaptation to distributed systems and local-area networks.

The menu handler is the entryway to Unify's utility programs (Fig. 5). It provides three basic levels of security: menu, program and field. On the menu level, a user sees only those menus and programs he is authorized to access. On the program level, selected update capabilities can be assigned according to user password. The data dictionary stores an entry for program and application function, and a matrix for each user determines his privileges. The field level allows selected fields to be protected in a file otherwise accessible to a user.

One of Unify's most important utilities is SFORM, a tool that allows users to format screens on a CRT for entering data into selected fields. Such screens can be used with ENTER, the data-entry driver, or they can be called by other application programs.

A range of query and report options is provided by a combination of Unify's query-by-forms utility and structured query language (SQL), which is a calculus developed by IBM Corp. for use with relational databases. Query-by-forms allows relatively casual data retrieval by calling a form associated with a file. A user defines the query by filling in the blanks next to the fields on the screen. The simplest search is to specify the primary key, in which case the desired record is displayed immediately. Entering values or ranges in referenced fields provides lists of related records.

SQL allows users to build and store queries by combining clauses of English words that refer to the data in terms of records and fields. Queries can include ranges, maxima, minima and averages and can specify sorts and groupings of queries from multiple files. SQL does not require a user to set up new files to view data differently from the way that data has been stored in the database.

SQL and the query-by-forms utility are interfaced to Unify's report writer, which supports page headers, footers, multiline titles, column headings, level breaks and common mathematical functions such as MIN, MAX, AVG and TOTAL. □

Nicolas Nierenberg has been president of Unify Corp., Portland, Ore., since its founding in 1980 and was the principal technical analyst in the development of the Unify database manager. He previously was head of systems software for Rogers, Kirkman and Associates, a Sacramento, Calif., software supplier, and was a database specialist with SAI Comsystems, San Diego.

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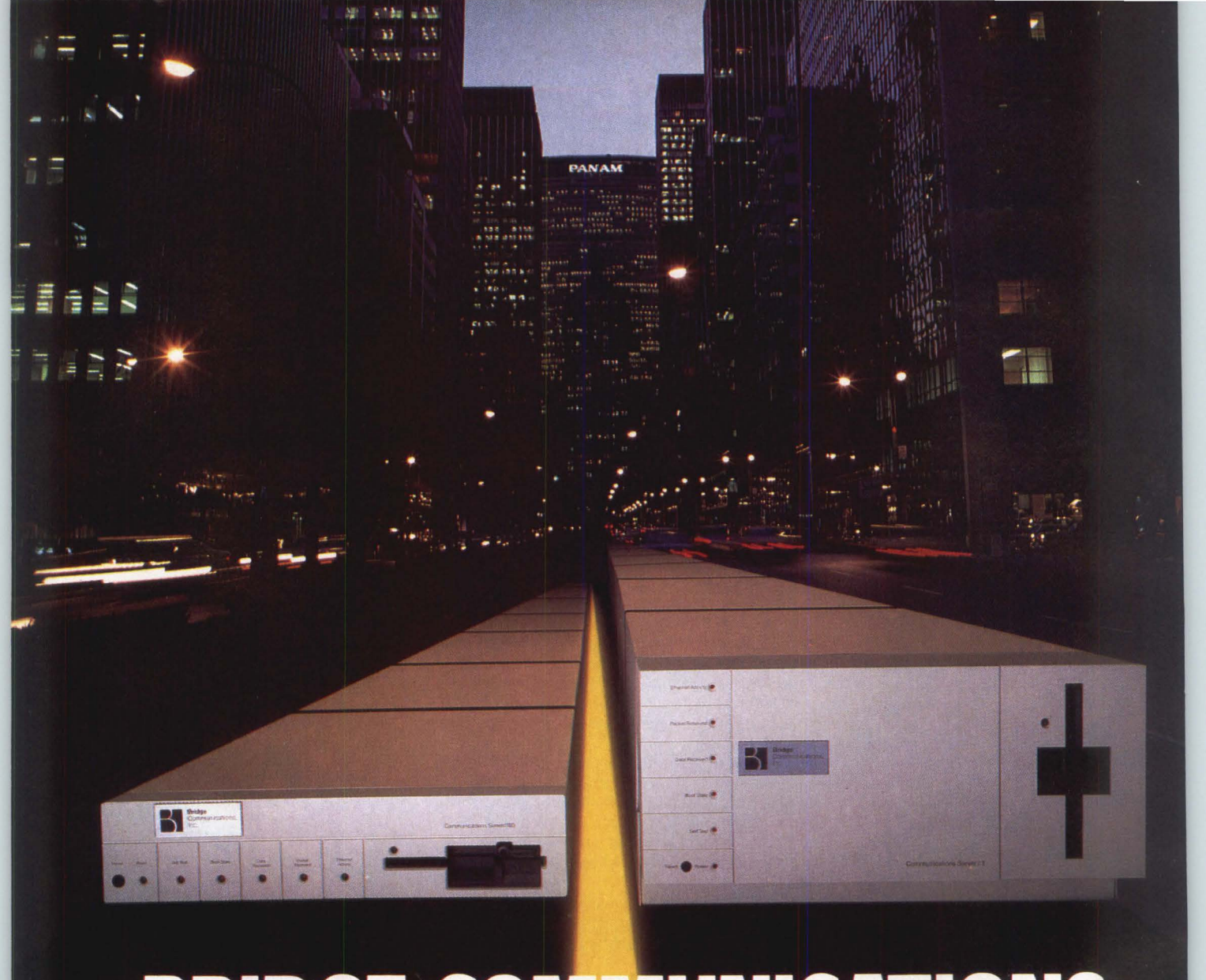

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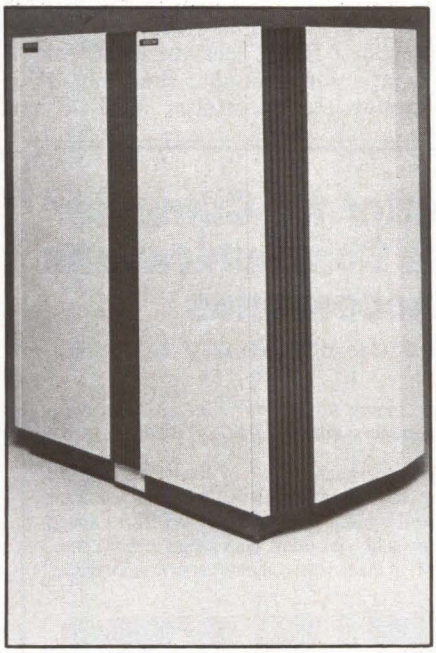
CIRCLE NO. 116 ON INQUIRY CARD

Modular Computer Systems adds 32-bit, real-time industrial computer

Modular Computer Systems Inc. has introduced its 32-bit, real-time Classic 32/85 minicomputer. The new system is fully compatible with the company's earlier 16-bit, real-time computers and suits scientific measurement-and-control, communications, process-control, aerospace, defense and factory-automation applications.

Classic 32/85 systems comprise one or more CPUs and one or more I/O controllers connected to the input ports of one to eight memory subsystems. The computer can support as much as 64M bytes of multiported memory. A memory-management unit (MMU) includes 16 memory-mapping files and handles memory addressing. The CPU can execute two instruction sets—one compatible with the Classic II/75 and the other providing full 32-bit addressability. The Classic 32/85 runs the MAX 32 or MAX IV Rev. I real-time operating system.

The CPU contains the MMU with mapping processor and cache and the instruction-set processor. The MMU provides the CPU with logical-to-physical address-translation mapping and cache memory, which consists of a four-way set associative memory with 16K bytes per set. The instruction-set processor arithmetic-logic unit consists of a microprogrammable processor with hardware multiply and floating-point arithmetic. All instructions are microcoded in a writable control store of 8K words by 104 bits.

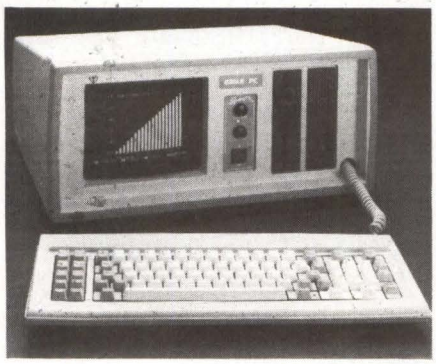


Modular Computer's 32-bit Classic 32/85 system *for real-time applications extends and is compatible with the company's 16-bit real-time systems.*

A high-speed link attaches a soft control panel/maintenance console to all functional units, enabling operators and maintenance personnel to obtain information and control over independent CPUs and I/O controllers through a CRT terminal. The console provides memory modification and display, status display of all subsystems, macroinstruction step and breakpoint and booting.

A basic configuration, including the CPU, two I/O controllers, 2M bytes of memory, a maintenance subsystem and a console controller, sells for $148,500. **Modular Computer Systems Inc.,** P.O. Box 6099, 1650 W. McNab Rd., Fort Lauderdale, Fla. 33310, (305) 974-1380.

Circle No 300



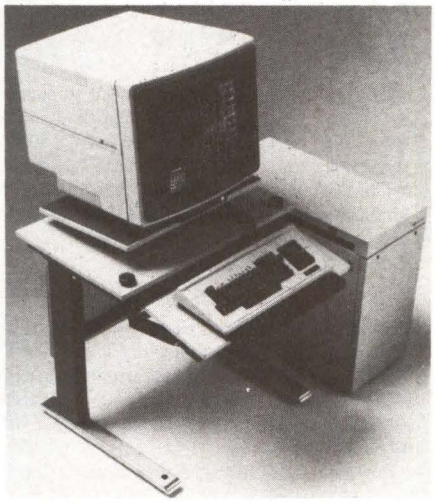
Portable incorporates 10M-byte Winchester

The Eagle Spirit XL, a 33-pound, IBM PC XT-compatible portable computer, features a 9-inch, green-phosphor monitor, a 16-bit Intel 8088 microprocessor and 8087 coprocessor option, 128K bytes of RAM, expandable to 640K bytes, a 10M-byte Winchester disk drive and a 360K-byte, 5¼-inch floppy disk drive. The main CPU board has two serial ports and one parallel port. The computer has color graphics capabilities and incorporates MS-DOS and CP/M-86 operating systems and Microsoft's GW BASIC programming language. $4,795. **Eagle Computer Inc.,** 983 University Ave., Los Gatos, Calif. 95030, (408) 395-5005.

Circle No 301

System performs graphics transformations

The Whizzard 3355 system provides real-time 2-D graphics transformations (rotate, translate, continuous scale and clip) with a high-resolution (1,024-by-1,024-pixel), 19-inch, 60-Hz non-interlaced raster-scan monitor. It also emulates a VT100 terminal for program development, debugging and documentation generation. The system features the company's Graphics Engine and local processor with host interface. The Graphics Engine includes a 32-bit graphics processor and 64K to 192K bytes of display-list memory. The local processor supports local memory management, user tasks and system diagnostics. A 12-bit (4,096-by-4,096)



virtual-address system affords pixel-by-pixel access to the memory-mapped display, and the system can simultaneously display as many as 16 software-selectable colors from a palette of 4,096. The electronics are contained in a 25-by-12-by-36-inch tower unit that includes an ANSI-compatible, lockable, ergonomic keyboard with 16 program-

New Products

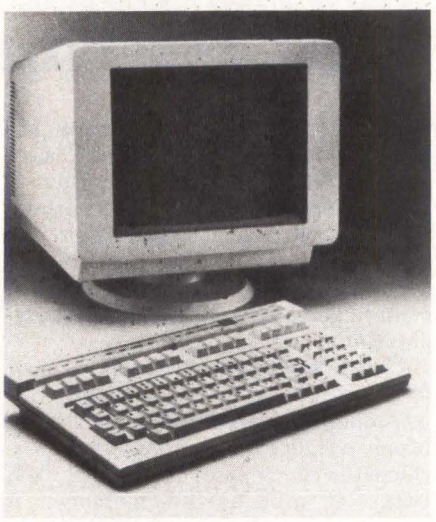
SYSTEMS

mable function keys and a numerical entry keypad. Communications with the host computer are via an RS232C interface or an optional parallel interface. $22,500. **Megatek Corp.,** 9605 Scranton Rd., San Diego, Calif. 92121, (619) 445-5590.

Circle No 302

Workstation runs MS-DOS on HiNet LAN

The DMS-816 workstation runs MS-DOS or CP/M programs on the vendor's HiNet local-area network. A companion product, the DMS-3/501 master station, stores MS-DOS and



CP/M programs on floppy and hard disks. THe DMS-816 features a 12-inch video monitor, a detachable, low-profile keyboard, dual Z80A and 8088 microprocessors, 256K bytes of RAM, a 500K-baud RS422 network port, a 19.2K-baud RS232 printer port and a parallel port. The DMS-3/501, with a 9-inch screen and a detachable keyboard, functions as a network file server for MS-DOS programs and contains a 15M-byte hard disk and a 320K-byte, double-sided, double-density 5¼-inch floppy disk drive. It uses a Z80A microprocessor and has 64K bytes of RAM. The DMS-3/501 has three 9,600-baud RS232 ports and a 500K-baud RS422 port. The products include MS-DOS, Perfect Writer, Perfect Calc, Perfect Speller and Perfect Filer. DMS-816: $1,695, DMS-3501: $6,500. **Digital Microsystems,** 1755 Embarcadero, Oakland, Calif. 94606, (415) 532-3686.

Circle No 303

System handles one to 32 users

The fully configured Ultraframe S-100-based system, using more than 2M bytes of RAM, accommodates as many as 32 users. Its modular design allows growth from single-user systems with 10M bytes of hard disk storage to 32-user systems with 1,160M bytes of hard disk storage. A Z80A master processor handles disk and printer access. Each user or pair of users has an 8-bit Z80A or a 16-bit 80186 CPU and dedicated RAM on Slavenet processor boards. The interrupt-driven system

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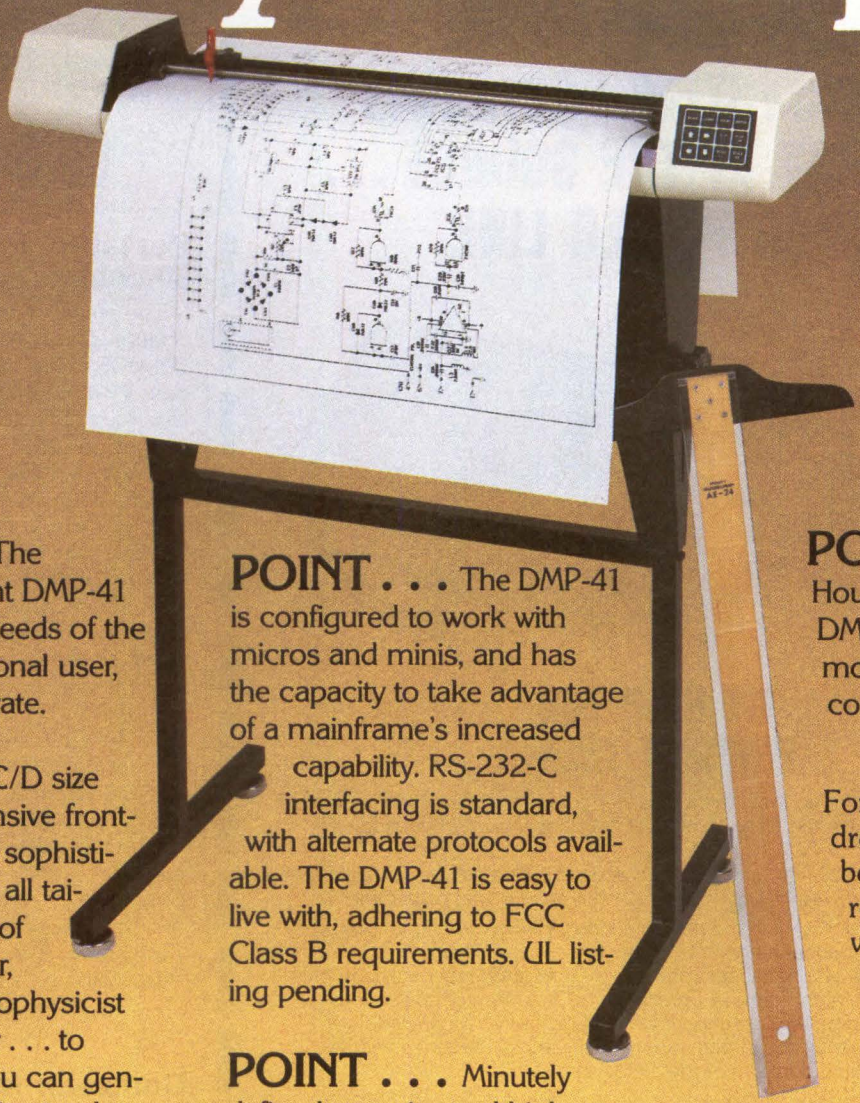

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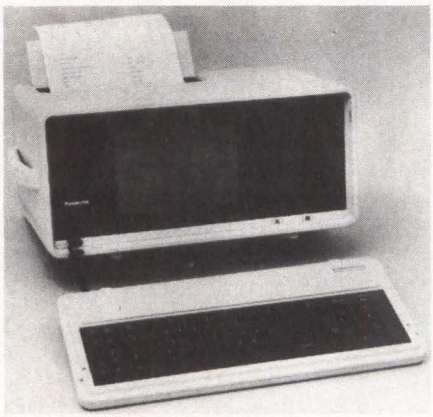
*suggested US retail $2,995

CIRCLE NO. 118 ON INQUIRY CARD

runs the vendor's p-Net (UCSD Pascal-compatible) operating system or TurboDOS. Models with prices starting at $6,495 offer a choice of 5¼-, 8- or 14-inch Winchester disk drives with storage capacities ranging from 10M to 145M bytes and 5¼- or 8-inch floppy disk drives. Backup systems include floppy disk, 3M tape cartridge and the vendor's Backstop videotape system. **Independent Business Systems Inc.,** 5915 Graham Court, Livermore, Calif. 94550, (415) 443-3131.

Circle No 304



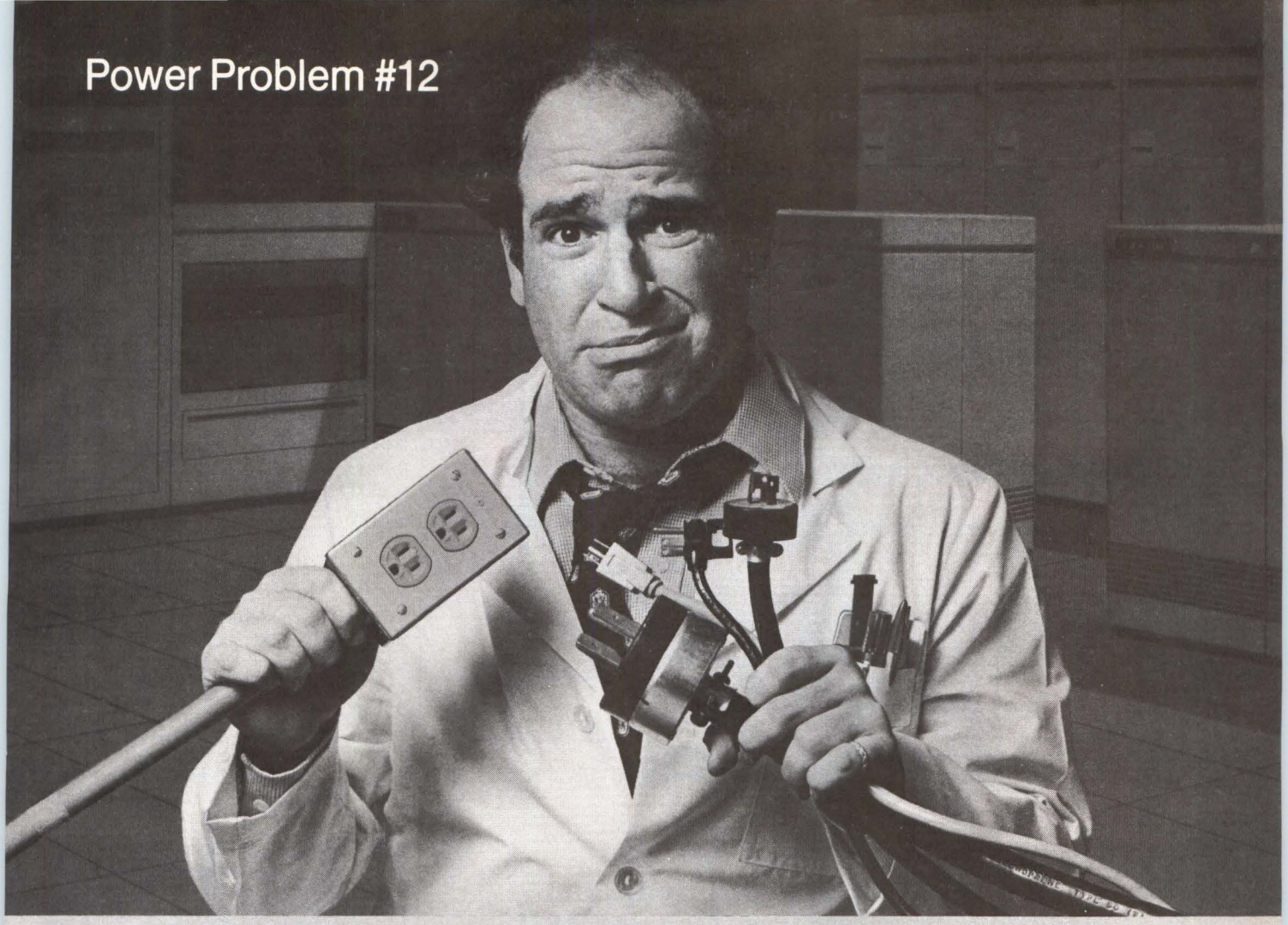
Portable computer has 80-column printer

The model RL-H7000 Senior Partner transportable computer uses the MS-DOS 2.0 operating system and can run IBM-compatible software and hardware. It features a built-in thermal printer, a 320K-byte, 5¼-inch floppy disk drive, 128K bytes of RAM and a 9-inch CRT packaged in a metal cabinet with a carrying handle. Priced at $2,495, the Senior Partner comes bundled with WordStar, VisiCalc, PFS File, PFS Graph, PFS Report and GW BASIC software. The computer uses a 16-bit 8088 microprocessor with an 8087 coprocessor socket. The built-in thermal printer can be switched from 80 to 132 cpl. The CRT displays 80 characters on each of its 25 lines. The display can be switched from 80 to 40 cpl. The unit also offers an RGB monitor output, a Centronics parallel interface I/O port and an RS232 interface port. The computer weighs 28.7 pounds and measures 18¼ by 13$^{3}/_{16}$ by 8¼ inches. **Panasonic Co.,** 1 Panasonic Way, Seacaucus, N.J. 07094, (201) 348-7000.

Circle No 305

Computer features 68000 microprocessor

The System 140 single-user computer comprises a single-board computer, a CRT controller board and a disk controller. The single-board computer contains a 68000 microprocessor, 512K bytes of RAM and memory-mapping registers. The disk controller supports 5¼-inch Winchester and floppy disk drives, interrupt-driven or polled operation, direct-memory access, or non-DMA-mode data transfers. Software offerings include MCS, the



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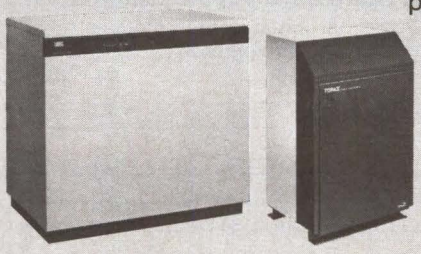

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vendor's proprietary operating system and UNIX. $7,995, including 512K bytes of memory, the CRT, a keyboard, a 10M-byte Winchester disk drive, a 1M-byte floppy disk drive, the MCS operating system and a programming language. **Wicat Systems,** P.O. Box 539, 1875 S. State, Orem, Utah 84057, (801) 224-6400. **Circle No 306**

Computer reads IBM PC diskettes

With dual 8-bit Z80B and 16-bit 8088 microprocessors and 128K bytes of RAM, expandable to 256K bytes, the Vector 4-S computer system incorporates a detached keyboard, a 12-inch, green graphics display screen, two modified S-100 expansion slots, a tone generator, an RS232 communications port, a serial printer port and two parallel printer ports. The computer is available with one or two floppy disk drives or one floppy disk drive and one 5M-, 10M- or 36M-byte hard disk drive. Each 5¼-inch, soft-sectored floppy disk drive stores 737K bytes and can read a variety of diskette formats and densities, including eight- or nine-sector

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There are lots of other good reasons to write HP-compatible software for UNIX or any of our other operating systems. To find out all about them, write to Hewlett-Packard, Attn: Gwen Miller, Dept. 08190, 19447 Pruneridge Avenue, Cupertino, CA 95014. In Europe, contact Henk van Lammeren, Hewlett-Packard Nederlands B.V., Dept. 08190, P.O. Box 529, 1180 AM Amstelveen, The Netherlands.

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BD02315

CIRCLE NO. 122 ON INQUIRY CARD

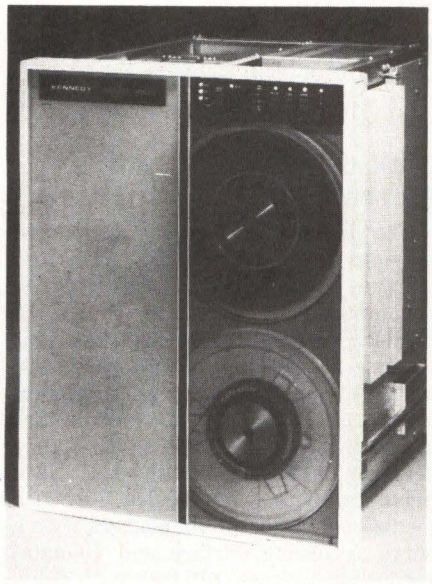
single- or double-sided CP/M-86 or MS-DOS diskettes with 48 or 96 tpi. The system includes the 16-bit CP/M-86 operating system, GSX-86 Graphics, an 8-bit Microsoft BASIC interpreter, an 8-bit CP/M simulator and other software-development tools. $3,295 to $9,995. **Vector Graphic Inc.,** 500 N. Ventu Park Rd., Thousand Oaks, Calif. 91320, (805) 449-5831. **Circle No 307**

Microcomputer offers modular expansion

The System 2000 microcomputer uses an 8-MHz, 16-bit Intel 80186 microprocessor and an optional 8-bit Z80 coprocessor. The computer comes with the CP/M-86 DPX and MS-DOS operating systems and the GW BASIC programming language. The system supports Pascal, FORTRAN, COBOL and C. It has a basic memory capacity of 128K bytes, which is expandable to 896K bytes. Mass-storage options include 5¼-inch, 640K-byte floppy disk drives and internal or external 15M-byte hard disk drives. The standard 12-inch amber monochrome video display has a 2,000-character capacity in a 25-line-by-80-column format and bit-mapped, 640-by-400-pixel graphics resolution. An optional 14-inch color monitor has a 16-color palette. The unit's detachable keyboard features 10 application-defined function keys, a dedicated cursor pad and a numeric keypad with its own enter key. Two RS232C ports with programmable baud rates and a parallel printer port are built-in. Prices start at $3,965. **Monroe Systems for Business,** The American Road, Morris Plains, N.J. 07950, (201) 993-2000. **Circle No 308**

New Products

DISK/TAPE

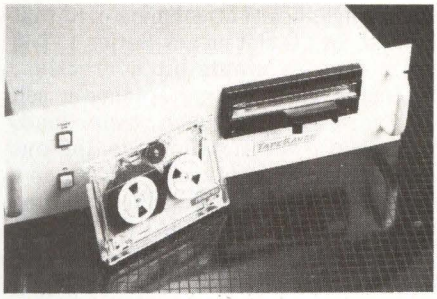


Tri-density tape transport stores 180M bytes

The model 9400 nine-track tape transport has a 6,250-bpi data density, giving an unformatted capacity of 180M bytes on a 10½-inch reel of tape. A tri-density vacuum-column unit, the transport also operates at 1,600 bpi using phase encoding and 800 bpi using non-return-to-zero encoding. The transport operates at 45 ips in group-code-recording mode and 75 ips in PE/NRZI modes. Maximum rewind speed is 500 ips. GCR peak data-transfer rate is 312.5K bytes per second with inter-record gaps of 0.3 inches. Data-transfer rates are 60K bytes per second in NRZI and 120K bytes per second in PE, with 0.6-inch record gaps. Start/stop times are 3.7 msec. at 75 ips and 2.5 msec. at 45 ips. An 8088 microprocessor controls the system and accommodates host I/O with a standard 4K-byte data buffer. A 2903 bit-slice processor handles digital write functions. The transport's RS232C communications port permits on-line diagnostics by a terminal, the host computer or with modems by a remote test facility. $7,500 (1,000-unit quantities). **Kennedy Co.,** 1600 Shamrock Ave., Monrovia, Calif. 91016, (213) 357-8831. **Circle No 309**

Tape drive fits 5¼-inch floppy footprint

The D5160 ½-inch streaming-tape drive stores 40M, 80M, or 160M bytes on 4-inch reels in a package that mounts in the same space as that typically occupied by a standard 5¼-inch floppy disk drive. Aimed at Winchester disk drive backup, file restructuring, on-line memory expansion, data exchange, data security and archival storage, the D5160 supports the basic ¼-inch tape drive, QIC-02 interface and SCSI standards. An optional nine-track interface board makes the product plug-compatible with Pertec nine-track drives. The tape drive operates at 90 or 130 ips, allowing transfer rates of 90K or 130K bytes per second. It can be configured with one of three single-board subsystem controllers that facilitate communications between a host processor with SASI and disk drives with Q2000, SA1000 or SMD interfaces. Standard features include a two-channel read/write head, 24 tracks, a serpentine track format, 8,000-bpi recording density and streaming, NRZI or GCR recording. Less than $750 (OEM quantities). **Rosscomp Corp.,** 16643 Valley View Ave., Cerritos, Calif. 90701, (213) 926-5533. **Circle No 310**



Tape drive supports IBM Series/1 computers

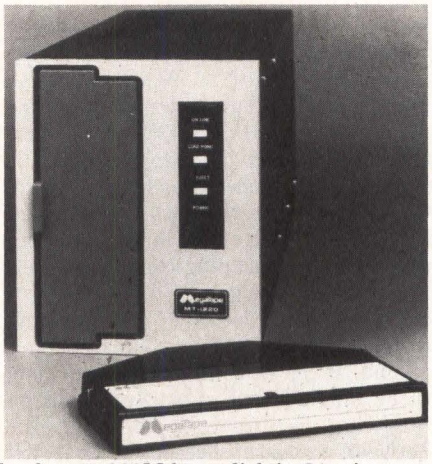
The TapeSaver series allows IBM Series/1 users to store and retrieve data on ¼-inch magnetic-tape cartridges. TapeSaver/1 operates at 30 ips, copying 67M bytes of data—the capacity of a 600-foot cartridge—in 1 hour. TapeSaver/2 operates at 60 ips, copying the same amount of data in half the time. For data retrieval, TapeSaver/1 and TapeSaver/2 operate in fast-forward or reverse at 60 and 90 ips, respectively. The subsystems consist of a cartridge-tape drive, a controller, a power supply

and a single-board attachment card that fits into an I/O slot on any Series/1. The units feature single-bit correction, automatic error retry, automatic self diagnostics with each tape load, write-data verification and log-out capabilities. In addition to serving as a data-backup system, TapeSaver can be used as an interactive I/O device that permits file indexing and random data access. Less than $7,000. **Ultimate Computer Systems Inc.,** 30 Broad St., Denville, N.J. 07834, (201) 625-8700.

Circle No 311

Half-width streamer packs 330M bytes

The MT-1220 streaming-tape drive stores 330M bytes (unformatted) on a book-sized data cartridge. The drive has an 8.5-inch-wide-by-10.2-inch-high, half-width footprint that is compatible with the CDC 9715 FSD disk drive. The MT-1220 operates at 200 or 50 ips in streaming mode and 50 ips in start/stop mode. When operating at 200 ips, it can



back up a 300M-byte disk in 24 minutes. Information is stored using a 24-track serpentine format with a 9,600-bpi density. An integral formatter that is transparent to the controller encodes data in a 4/5 GCR bit-serial format. A two-track read/write head assembly steps 12 times to create the 24 tracks. This arrangement permits recovery of stored files within an average of 30 seconds. $4,950. **MegaTape Corp.,** 1041 Hamilton Rd., P.O. Box 317, Duarte, Calif. 91010, (213) 357-9921.

Circle No 312

Disk drive subsystem stores 406M bytes

The Harris 5360 series disk drive provides 406M bytes of formatted storage. It features a 1.9M-byte-per-second data-transfer rate and an 18-msec. average seek time. The unit consists of a single-spindle drive motor; a power supply; operational electronics; a front panel; and a sealed module that contains the spindle media, the rotary actuator and the read/write heads. Each drive contains fixed, sealed 10½-inch media comprising of six platters with a servo recording surface and 10 data-recording surfaces. $19,000, with delivery 90 days ARO. **Harris Corp., Computer Systems Division,** 2101 W. Cypress Creek Rd., Fort Lauderdale, Fla. 33309, (302) 974-1700.

Circle No 313

Buy of the Century

Century Data Systems' New 590 Megabyte Winchester Disk Memory

AMS 571—our largest, fastest disk memory—is loaded with value. New thin film heads and oxide media put 590 megabytes into a very compact, very economical package. To enhance system performance we've increased the data transfer rate to 1.98 megabytes per second while reducing the average head positioning time to 19 milliseconds. All for OEMs. And all at a very competitive price!

What's more, the AMS 571 gives your system a record low cost of ownership. Combining traditional Century Data Systems quality with inherent Winchester reliability, we've created a disk memory with an MTBF in excess of 10,000 power-on hours. A disk memory with quality built in for a lifetime of reliability.

Here's a terrific disk memory with great flexibility. Design your controller to pack all this new performance into your system—or to emulate practically any other Winchester disk memory.

Find out how the buy of the Century gives you a strong competitive edge in quality, capacity, performance, and price. Contact: Century Data Systems, 1270 N. Kraemer Boulevard, Anaheim, CA; (714) 999-2660.

Century Data Systems
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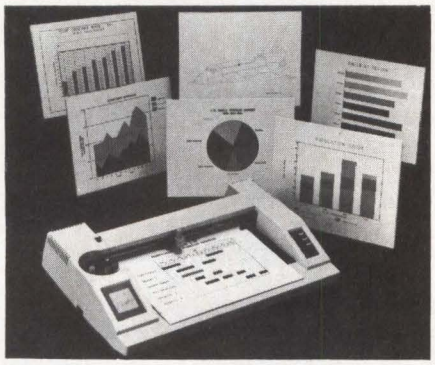
CIRCLE NO. 128 ON INQUIRY CARD

New Products

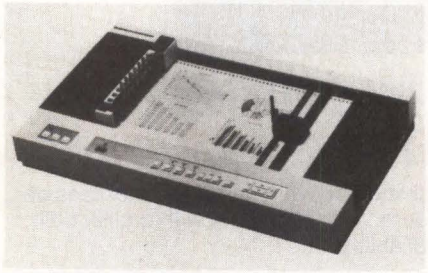
PRINTERS



Desktop plotter operates at 14 ips

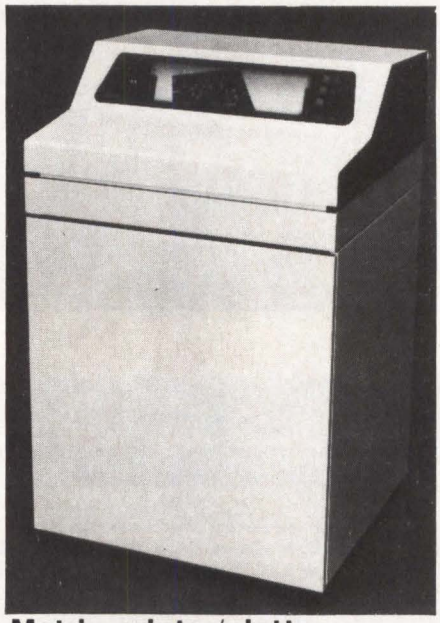
The Sweet-P model 600 Six-Shooter, a six-pen, desktop graphics plotter, features a 14-ips plotting speed, RS232 and parallel interfaces, mainframe eavesdropping, 19 English and foreign-language character sets and 2K bytes of buffer-memory storage. It operates with the vendor's Sweet-P graphics language and can be used with Apple-, IBM PC- and CP/M-compatible personal and small business computers in single-user and multiuser configurations. It is also compatible with HP graphics language. This 8-pound, portable machine handles 8½-by-11- and 11-by-17-inch paper. Users have a choice of pens in 12 colors and three tip widths for writing on paper or acetate, as well as Rapidograph-type drafting pens. Step size is 0.004 inches, and acceleration is 3G. $1,095. **Enter Computer Inc.,** 6867 Nancy Ridge Dr., San Diego, Calif. 92121, (619) 450-0601.

Circle No 314



Plotters come with one, two or 10 pens

The WX 4630 series of one-, two- or 10-pen intelligent plotters is compatible with digital-control equipment through the use of standard interfaces such as RS232C, GPIB/IEEE-488 or 8-bit parallel. Plotting area is approximately 15 by 10 inches. The units are available in flatbed, roll-feed or roll-feed with built-in paper cutter versions. They operate at 16 ips and can use ball-point, ink or fiber-tipped (water- or oil-based) pens. Resolution is 0.004 inches. The plotters can draw circles, curves and arcs and suit applications for business graphics, engineering drawings and statistical charts. $3,990 to $6,990. **Western Graphtec Inc.,** 12 Chrysler St., Irvine, Calif. 92714, (714) 770-6010 or (800) 854-8385. **Circle No 315**



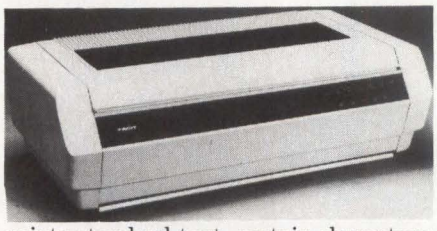
Matrix printer/plotter generates color graphics

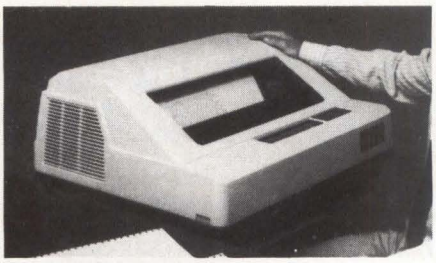
The Colorplot II (model TIP-302) dot-matrix impact line printer provides 75- to 300-lpm printing and generates full color graphics with 100-by-100-dpi resolution. It produces as many as 256 colors in three passes. The unit features two pitches of compressed printing (13.3 and 16.6 cpi), data-processing-quality printing using a 9-by-7-dot-matrix character and Trilog letter-quality printing. It accepts paper as wide as 13.2 inches. $6,900. Delivery is 90 days ARO. **Trilog Inc.,** 17391 Murphy Ave., Irvine, Calif. 92714, (714) 863-3033.

Circle No 316

Printer offers custom formatting

The Facit 4528V printer furnishes single-pass printing for data-processing use and two-pass printing for near-letter-quality applications. At 165 cps, it prints standard text, matrix characters and pin graphics. It offers 136-column printing with lengths programmable to 18 inches; 10- 12- or 17-pitch printing; proportional spacing; and bidirectional printing with boldface, condensed, extended and hybrid print styles. The printer provides nine bar-coding options, optical-character-recognition printing and variable character sizes as large as 9.6 inches. It can position characters sideways or upside down on one line. $1,995. **Facit Inc.,** 235 Main Dunstable Rd., Nashua, N.H. 03061, (603) 883-4157. **Circle No 317**

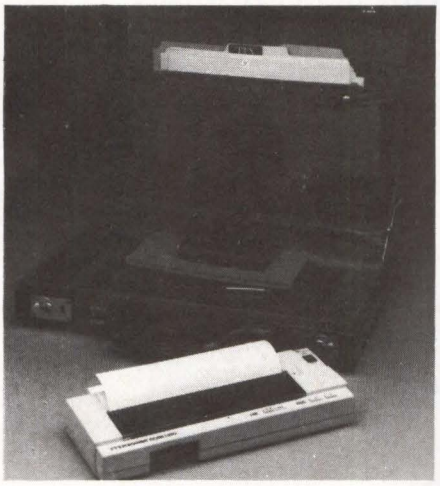




Printer operates in three modes

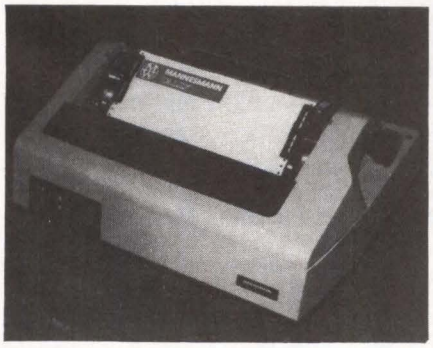
The Multi-Mode printer is compatible with most DEC and IBM computers. In data-processing mode, the printer operates at 300 or 600 lpm, in near-letter-quality mode, it operates at 85 or 170 lpm, and in graphics mode, it delivers 1,200- to 2,400- or 2,400- to 4,800-dot lpm. It is equipped with flexible character fonts that can be printed at two, four or eight times normal width and normal height. Character sets include a ruled-line generator, block characters and engineering characters in slant or bold formats. Print speed and density and character and line spacing are user selectable or down-line controllable. Dataproducts or Centronics-compatible and RS232 interfaces are available. 300-lpm model: $4,500, 600-lpm model: $6,000. **Synergy Printer Systems,** 4020 Fabian Way, Palo Alto, Calif. 94303, (415) 493-8181.

Circle No 318



Portable printer is battery operated

The TTX 1280 Portaprint 80- to 132-column, 3-pound, battery- and AC-powered thermal matrix printer suits portable and hand-held computer systems. The unit uses rechargeable or replaceable 6V batteries that provide 4,000 to 5,000 lines of print or a standard AC outlet. In battery mode, the bidirectional printer operates at 40 cps. Using AC power, the unit prints at 80 cps. Featuring a 5-by-7 matrix print head, the printer can produce a variety of character sizes and densities as well as specialized letter, line and dot-by-dot placements. An HP-IL, RS232C or Centronics interface is standard. $199. **Teletex Communications Corp.,** 3420 E. Third Ave., Foster City, Calif. 94404, (415) 341-1300. **Circle No 319**

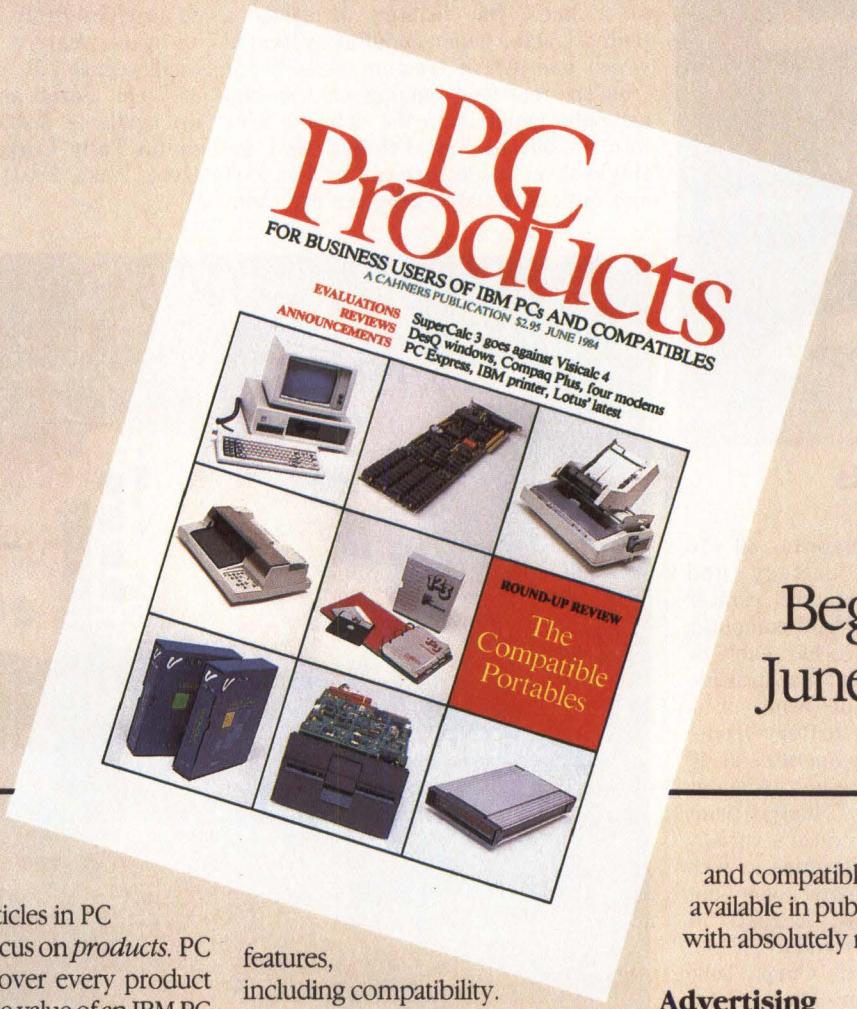


Serial printer offers paper-feed options

The multifunctional MT-440 serial dot-matrix printer operates at 400 cps in draft mode and 100 cps in letter-quality mode. A tabbing feature allows the print head to travel as fast as 650 cps when bypassing blank portions of a line. The printer furnishes a paired-tractor paper-handling system in which one set of tractors pulls paper from the rear feed opening and a second set pulls paper from the printing area into an output bin. Friction feed for single-sheet and letterhead, bottom feed and dot-addressable graphics are standard. The unit uses a 9-by-7 dot matrix to produce draft-quality print and an 18-by-40 matrix in correspondence-quality mode. It can print at 10, 12 or 16.7 cpi. Serial and parallel interfaces are available. $2,395 to $2,995. **Mannesmann Tally Corp.,** 8301 S. 180th St., Kent, Wash. 98031, (206) 251-5500. **Circle No 320**

PC Products

a new controlled circulation product review and evaluation magazine for business users of IBM PC and PC-compatible computers



Beginning June 1984

Editorial

The editorial articles in PC Products will focus on *products*. PC Products will cover every product that improves the value of an IBM PC or compatible. Every PC Products article will deal with computer/software/peripheral compatibility and the real benefits of the product to the business user.

PC Product Evaluations are articles based on hands-on evaluations that determine strengths and weaknesses of PC products when they are applied in an actual business environment.

PC Product Reviews compare specifications of products offering similar features.

PC Product Announcements utilize a format that rapidly communicates significant new product features, including compatibility.

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CIRCLE NO. 130 ON INQUIRY CARD

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New Products

TERMINALS

Envision extends color terminal line

Envision has added two new products to its family of color terminals. The model 215, a 13-inch color text/graphics terminal designed for business and scientific applications, has 640-by-409 resolution and can display eight colors from a palette of 64. It is compatible with DEC VT100 standard alphanumeric functions. This interactive terminal features a 16K-by-16K address space and graphics-drawing primitives for vectors, complex polygons and graphics characters. The model 239, a 19-inch color graphics display station, suits CAD/CAM, engineering and process-control applications. It offers 640-by-480-pixel resolution, local display-list processing, a 4,096-color palette from which 16 colors can be displayed simultaneously, user-definable symbols and hardware zoom and pan. Compatible with the DEC VT100 and the Tektronix 4105 terminals, the model 239 is supported by graphics software packages from Precision Visuals Inc., ISSCO, Megatek and SAS Institute. Model 215: $3,450, model 239: $9,450. **Envision,** 631 River Oaks Parkway, San Jose, Calif. 95134, (408) 946-9755. **Circle No 321**

Graphics products include monochrome, color models

This family of graphics terminals uses 60-Hz non-interlaced displays for flicker-free presentations on an anti-glare phosphor tube. Developed for educational, numerical-control and business graphics applications, the model 1015 features 640-by-490-pixel resolution on a 15-inch green display screen. Software compatible with the Textronix 4012 and the DEC VT52 terminals, it can provide additional graphics commands for generating circles and arcs, shape and pattern fill, rubber banding and software markers. Prices start at $3,250. The models 2015 and 2019W, 15-inch desktop display and 19-inch workstation, respectively, suit engineering, architecture and finite-element-analysis applications. Featuring 1,024-by-784-pixel resolution on a green display screen, both products have a scrolling, multipage text memory. They are software compatible with the Tektronix 4014 and DEC VT52 terminals. Like the model 1015, they provide line and block erase, block fill, software-programmable line styles and a write-through mode. 2015: $6,250, 2019W: $10,950. The model 2014 14-inch color terminal displays 16 colors from a palette of 4,096 colors at 512 by 392 pixels. $5,760. **Westward Technology Inc.,** 5 Cambridge Center, Cambridge, Mass. 02142, (617) 491-1890. **Circle No 322**

Unit replaces DEC VT102, VT131

The Executive 10/102 supports the ANSI X3.64 software protocol and replaces the DEC VT102 and VT131 display terminals. It features a 14-inch, non-glare, tilt-and-swivel green screen that displays as many as 132 characters per row in a 5-by-9-dot-matrix format. The terminal's low-profile, sculptured keyboard has the same key layout as that of the DEC products. The unit provides a menu setup mode retained in non-volatile memory for terminal configuration. Screen features include video attributes such as high/low intensity, blink, reverse video, underline and programmable double-width/-height characters. $995. Delivery is 60 days after receipt of order. **Esprit Systems Inc.,** 100 Marcus Dr., Melville, N.Y. 11747, (516) 293-5600 or (800) 645-4508. **Circle No 323**

Editing terminal features function keys

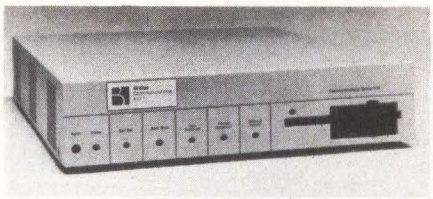
The TTX 3003 terminal features built-in editing for manipulating text and data; a 24-line-by-80-column, non-glare, 12-inch, green display with a 25th status line; a 128-character ASCII display (with 32 displayable control codes); and visual attributes such as blinking, blanking, underscoring and reverse video. Its detachable, full-stroke keyboard contains a numeric keypad. The terminal provides 19 programmable function keys (using shift mode) with 104 codes per function, N-key rollover and a two-page screen memory. OEMs can convert the terminal into a standalone microcomputer. The housing accepts one or two half-height floppy disk drives and a user-provided CPU card. $699. **Teletex Communication Corp.,** 3420 E. Third Ave., Foster City, Calif. 94404, (415) 341-1300. **Circle No 324**

Display offers 64 color combinations

The PT-600 color terminal displays 80 or 132 characters per row in eight colors and 64 programmable combinations on a 12-inch screen. It features variable-speed smooth scroll as fast as 2,400 baud, split-screen operation, window erase and a hexadecimal keypad mode. Video attributes allow normal, reverse, blinking, underline, reverse half intensity, scrolling, smooth- or jump-field formats. Using ANSI-standard communications protocols and character sequences, the unit emulates DEC's VT100 and VT52 terminals. $2,995. **Plessey Peripheral Systems Inc., Distributor Products Division,** 2632 Du Bridge Ave., Irvine, Calif. 92714, (714) 540-6288. **Circle No 325**

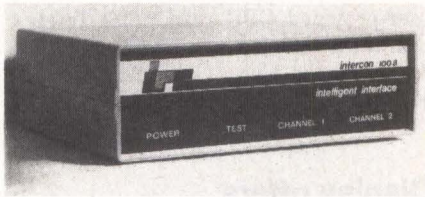
New Products

DATACOMM



Communications server links devices via Ethernet

The Communications Server/100 links as many as 10 devices with RS232C interfaces to an Ethernet local-area network. It supports the Xerox Network System high-level network protocols and can function as a terminal server, a cluster controller or a host front-end communications controller. Connection is established through a command interface that features menus, help facilities, connection requests using a logical name and executable single-line command files constructed from sequences of user-interface commands. An access-control mechanism with password protection for specified ports provides network security. The unit's multiple 68000 microprocessors permit the transfer of 125 packets per second for interactive applications and 600K bytes per second for file-transfer applications. $3,900 to $4,900. **Bridge Communications Inc.,** 10440 Bubb Rd., Cupertino, Calif. 95014, (408) 446-2981. **Circle No 326**



Processors link micros to mainframes

The models 100A and 100AM intelligent interfaces provide synchronous links between minicomputers or microcomputers and mainframe computers via dedicated or dial-up lines at data rates as high as 19.2K bps. The microprocessor-based, standalone devices, with multiple PROM-resident protocols such as CDC 200 UT, HASP and 3780, perform asynchronous-to-synchronous and synchronous-to-asynchronous conversions. They also perform character conversion between ASCII, BCD and EBCDIC codes. Software handlers are available for VMS, RSX-11M, CP/M, UNIX/XENIX, MS-DOS and CP/M-86 operating systems. Microcomputer-to-mainframe version: $1,250, mini-to-mainframe version: $4,995. **Intercon Research Corp.,** 2603 Artie St., S.W., Suite 14, Huntsville, Ala. 35805, (205) 536-6686. **Circle No 327**

Modem features auto-select RTS/CTS delay

The DataComm 4800S single-card modem provides 4,800 bps, two-wire half-duplex, asynchronous (optional) or synchronous data transmission over switched network circuits. It is line compatible with Bell 208B modems and supports point-to-point data-communications applications. The modem features auto dialing, 25-msec. Quick-Poll operation and auto-select RTS/CTS delay. The DataComm 4800S is available in a compact standalone enclosure or a high-density rack-mount shelf that accommodates 16 modems. $1,445. **General DataComm Industries Inc.,** 1 Kennedy Ave., Danbury, Conn. 06810, (203) 797-0711. **Circle No 328**

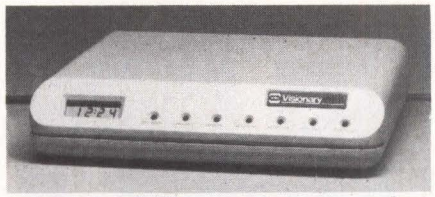
Device links IBM PCs to mainframes

The IDEAComm 3278 hardware/software communications product links IBM PCs and PC XTs to an IBM mainframe computer. The product interfaces the IBM microcomputers with the IBM 3274 or IBM 3276 cluster controller via coaxial cable. Communications from the cluster controller to the IBM mainframe can be achieved directly or through a modem using IBM's Bisync and SNA/SDLC protocols. The unit transmits at 2.35M bps. Supplied software provides the keyboard and screen functions of an IBM 3278 terminal plus additional features such as file transfer. $1,195. **IDEAssociates Inc.,** 7 Oak Park Dr., Bedford, Mass. 01730, (617) 275-4430.

Circle No 329

Modem stores incoming, outgoing messages

The Visionary 2000 1,200-/300-bps intelligent, standalone modem contains an internal clock/calendar and as much as 48K bytes (24 pages) of battery-backed RAM for sending, receiving and storing messages, including Telex and TWX. Automatic features are answer, dial, redial on busy or no answer, answer back, log-on and data capture



and retrieval. The asynchronous modem operates in orginate and answer modes and transmits in half or full duplex. It is compatible with personal computers through an RS232C connection. Prices range from $795 for a 2K-byte RAM unit to $1,095 for a 48K-byte RAM unit. **Visionary Electronics Inc.,** 141 Parker Ave., San Francisco, Calif. 94118 (415) 751-8811. **Circle No 330**

Communications processor targets custom markets

The KCT32 intelligent front-end communications processor for networking and custom communications applications on VAX computers has 56K bytes of user-programmable memory for implementing custom functions. The product implements PDP-11 instructions and uses a single, hex-width board. It can be initialized by line for bit/byte synchronous or asynchronous data transmission and reception. It supports two lines at 64K baud per line or one line in full-duplex mode at 130K baud. Line support is program selectable. Support software includes on-line and standalone diagnostics and a user-environment test program. The KCT32 accommodates RS232C, RS422, RS423 and RS449 standards. $6,900 to $7,400. **Digital Equipment Corp.,** Maynard, Mass. 01754.

Circle No 331

Modem switches voice/data

The 1,200-bps auto-dial Popcom X100 modem achieves full-duplex AT&T 212-compatible operation, tone sensing, voice/data control and smart RS232 operation. It features call-progress sensing of dial tone, busy tone and remote ring. The modem senses when the local telephone handset is lifted and switches between voice and data operation. The integral RS232 interface detects the transmit signal and switches the necessary connections. $475. **Prentice Corp.,** 266 Caspian Dr., P.O. Box 3544, Sunnyvale, Calif. 94088, (408) 734-9810.

Circle No 332

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New Products

SOFTWARE

Software monitors industrial applications

The VAX Application Control and Management System is a transaction-processing software product set designed for developing and controlling complex, interactive commercial and industrial applications on Digital Equipment Corp. VAX computer systems. The product set comprises two components: the VAX-11 ACMS/AD for developing and maintaining applications and the VAX-11 ACMS for monitoring and controlling execution of applications developed with VAX-11 ACMS/AD, as well as those developed with existing VMS tools. The VAX-11 ACMS/AD portion of the product set replaces most of the traditional application code with structured, high-level definitions. This means smaller programs that are easier to implement and maintain. The VAX-11 ACMS portion enables a user to create and change menus for task selection, control access to ACMS applications and menus, allocate system resources and monitor application usage and performance. $15,500. **Digital Equipment Corp.**, Maynard, Mass. 01754.

Circle No 334

WP/ spreadsheet share data

Compatible with Digital Equipment Corp.'s VMS, RSTS, RSX-11M/M+, RT-11 and TSX-Plus operating systems, the Plessey-WP word-processing and Plessey-Calc spreadsheet software packages can share common data. The Plessey-WP package features sort and merge functions that enable the sharing of data from other files in the system, including the Plessy-Calc spreadsheet. It also includes vertical and horizontal scroll, global and selective character/word replacements and spelling-error detection. Text-formatting features provide automatic hyphenation, index, table of contents and outline formats. Plessey-Calc, a multipaging electronic spreadsheet with optional decision-support graphics capabilities, combines trigonometric, numeric, comparative and relational functions with a variety of screen displays and formatting options. It supports unlimited cell quantities by off-loading inactive cells to the disk. Plessey-WP: $760, Plessey-Calc $400. **Plessey Peripheral Systems Inc., Computer Systems Division,** 17466 Daimler Ave., P.O. Box 19616, Irvine, Calif. 92714, (714) 540-9945.

Circle No 333

Decision-support system includes spreadsheet

The Encore! financial-analysis, planning, reporting and graphics decision-support system for the IBM PC and IBM PC-compatible computers assists managers and planners in financial forecasting and reporting, investment analysis, cash-flow forecasting, budgeting, corporate consolidations, strategic planning and corporate modeling. The package has an on-line tutorial, help messages and sample model applications. It

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Data Sentry logs all attempted contacts for audit trails and analysis of users. Its security set-up is locally controlled by a master password that is accessible only to authorized personnel. And its design includes high-reliability components, the latest LSI circuitry, plus Autodial 300/1200 baud full-duplex communications, with auto ranging for incoming data.

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comprises eight sections, including a full screen editor, a menu-driven interactive multidimensional 32,000-cell spreadsheet, an English modeling language, a function library, an exec programming language, a report writer, a graphics system and computation and analysis. $1,850. **Ferox Microsystems Inc.,** 1701 N. Fort Myer Dr., Arlington, Va. 22209, (703) 841-0800.

Circle No 335

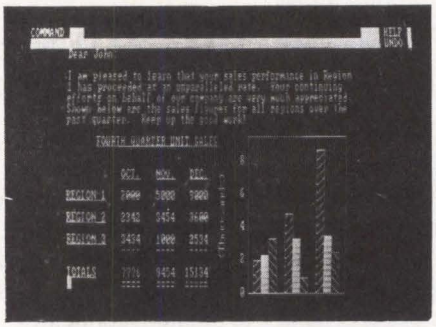
Software provides program development

The Microbench 68000 family of software products supports applications development for Motorola Inc.'s 68000 16-bit microprocessor. The programs operate on Digital Equipment Corp.'s PDP-11, LSI-11 and VAX computers and include a relocating assembler, linking loader, librarian and object-file formatter. The assembler is source compatible with the Motorola 68000 assembly language, supports macro and conditional assembly capabilities, cross-reference listings and a system macro library. The loader provides linkage facilities, selective loading from libraries, and directives for specifying ROM/RAM alignment boundaries. The object-file formatter produces binaries in compatible formats for use with popular PROM programmers and emulation systems, including equipment manufactured by Motorola, Tektronix Inc., Applied Microsystems, Data I/O Corp. and Pro-Log Corp. Microbench 68000 is coded in Macro-11 and operates under all DEC operating systems as well as UNIX. Perpetual license fees start at $2,200, including documentation and first year's maintenance. **Virtual Systems Inc.,** 1500 Newall Ave.,# 406, Walnut Creek, Calif. 94596, (415) 935-4944.

Circle No 336

Program uses common commands

With Ovation software, users can perform any application or combination of applications—spreadsheet, graphing, information management, word processing and communications—in a common work space using only 30 English commands and without switching application modes. Data entered in spreadsheets can be turned into graphs or inserted in a letter, all on the same screen. Through automatic linking,



changes made in one form, such as a spreadsheet, are automatically reflected in associate forms, such as a letter or graph. Designed to be used right out of the package, the product features on-line instructions and help, default formats and continuous prompts. It operates on IBM and IBM-compatible 8086- or 8088-based microcomputers using the MS-DOS operating system. $795. **Ovation Technologies,** 770 Dedham St., Canton, Mass. 02021, (617) 821-1420.

Circle No 337

PC design package runs on Tektronix computers

Designed for use on the Tektronix Inc. line of 4050 desktop graphics computer systems, the PC-100 PC-layout package is a ROM-driven software package for generating photo-quality PC board artwork. The package uses the 4054 keyboard or digitizing tablet for input and, for output, a variety of plotters from Tektronix, Hewlett-Packard Co., Calcomp and Houston Instrument. It also features component libraries with standard and user-defined shapes, as many as 10 trace layers for complex boards, a menu-driven interface, variable-scale artwork for photo reduction and diagram and list utilities to assist documentation. $4,500 including software and 128K bytes of memory. **Transera Corp.,** 3707 N. Canyon Rd., Provo, Utah 84604, (801) 224-6550.

Circle No 338

Macro cross assemblers run with UNIX

This set of macro cross assemblers runs with the UNIX operating system, is compatible with host systems from Digital Equipment Corp., Tandy Corp., Altos Computer Systems, Onyx Systems Inc. and Plexus Computers Inc. and supports Intel Corp.'s 8080, 8048, 8051 and 8086 and Zilog Inc.'s Z80 and Z8000 microprocessors. The macro cross assemblers use mnemonics that are compatible with the microprocessor's op-code mnemonics and assembly-language syntax and feature relocatable object modules, a common linker, a librarian and ROMable code support. Prices start at $600. **The Santa Cruz Operation Inc.,** 500 Chestnut St., Santa Cruz, Calif. 95060, (408) 425-7222.

Circle No 339

Software adds pages to spreadsheets

The Report Manager spreadsheet software for IBM Corp.'s Personal Computer boasts a 3-D matrix of more than 16 million data cells, organized as 255 rows by 255 columns by 255 pages, any of which can be addressed at any time. It offers 57 preprogrammed functions, six arithmetic operators, six relational operators, six trigonometric functions, time and date calculations, standard deviation, linear regression and payment and value calculations. Bar and scatter chart graphics can be prepared, and more than 200 characters are available for graphing. The spreadsheet can be rotated, bringing a crosscut view onto a single page. Individual column widths, horizontal and vertical title centering, and as many as four windows are offered, and the coordinate display grid can be turned on or off. $399. **Datamension Corp.,** 615 Academy Dr., Northbrook, Ill. 60062, (312) 564-5060.

Circle No 340

Debugger tests 68000 software

The Probug debugger/monitor tests software written for the 68000 microprocessor. It allows a user to print and alter memory and registers; copy, fill and search memory; assemble and disassemble instructions; down-load programs from and write programs to a host computer; boot up a disk operating system; and control program execution with commands such as jumps and breakpoints. A user can also set observation points to halt program execution when a specified memory location changes. Program instructions can be traced through ROM or RAM continually or one at a time. $250. **SBE Inc.,** 4700 San Pablo Ave., Emeryville, Calif. 94608, (415) 652-1805.

Circle No 341

Take it along for the drive.

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The PAT-2+ tests virtually any standard interface 5¼," 8" or microfloppy drive. And adaptors will be available soon for non-standard interface drives.

All this comes in an inexpensive, accurate instrument you can hold in the palm of your hand.

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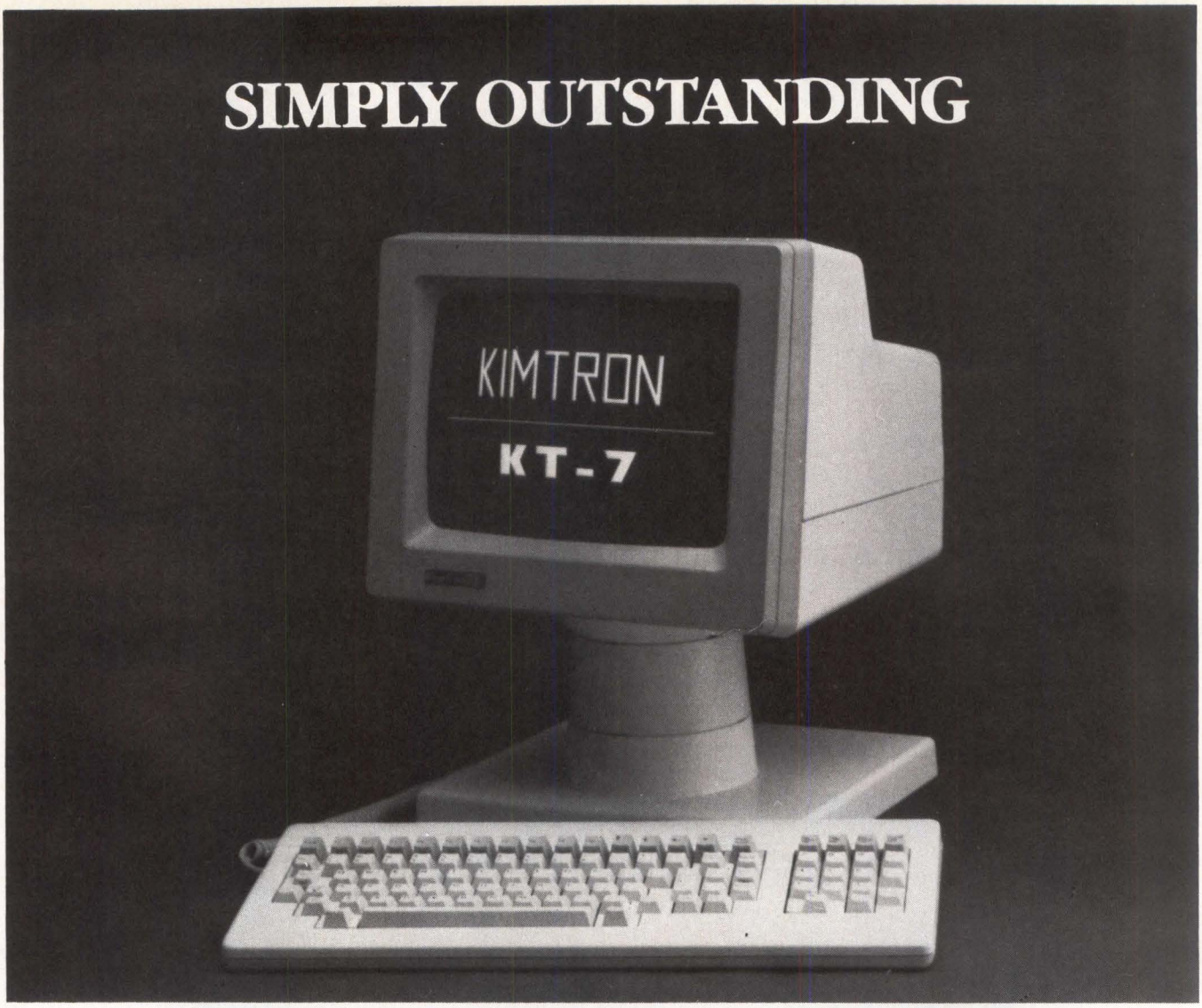

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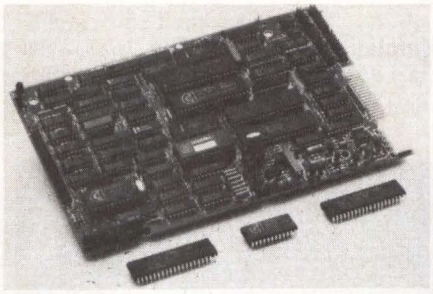
CIRCLE NO. 135 ON INQUIRY CARD

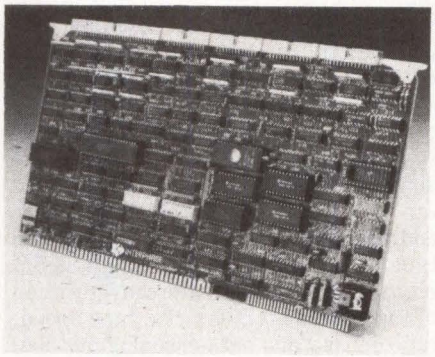
New Products

SUBASSEMBLIES



Disk controller supports multitasking operation

The ACB-5500 Winchester disk drive controller board supports as many as seven host CPUs, through the SASI/ANSI SCSI bus, and any brand and any capacity of four 5¼-inch Winchester drives, including fixed/removable drives. The board implements the full SASI/ANSI SCSI bus specification including arbitration and disconnect/reconnect functions. The controller allows command changing and non-interleaved operation. It has reserve/release capabilities to support shared-file and shared-disk applications. Approximately $300 in small OEM quantities. **Adaptec Inc.,** 580 Cottonwood Dr., Milpitas, Calif. 95035, (408) 946-8600. **Circle No 342**



Controller overcomes disk inefficiencies

The SMD 2190 hard disk controller features UNIX-optimized firmware, cache memory and an intelligent caching scheme that can be customized for different operating systems and application mixes. The controller furnishes a selective override capability that allows reading on a non-cached basis. Using direct mode, a track of information can be transferred to system memory in one disk revolution. The controller is compatible with hardware systems using the Intel Multibus. It supports microcomputers based on the Intel 8085/8086/8088, Motorola 68000 and National Semiconductor 16000 CPUs. The controller offers DMA with 24-bit addressing, automatic error correction and overlapped seeks. $2,250. **Interphase Corp.,** 2925 Merrell Rd., Dallas, Texas 75229, (214) 350-9000.

Circle No 343

Controller products support ESDI/ESTI

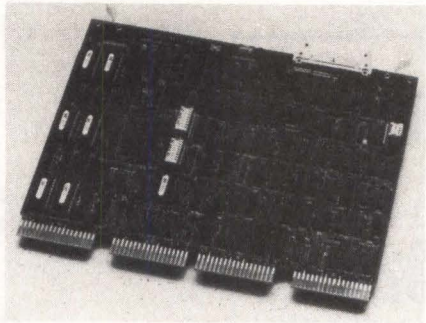
Series 6000 data controllers attach disk and tape drives having the Enhanced Small Disk/Tape Interface (ESDI/ESTI) to a variety of host

New Products

SUBASSEMBLIES

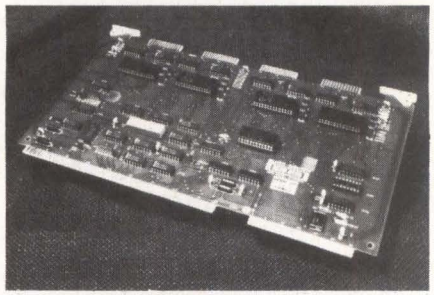
systems. The model 6100 disk controller comes in a 5¼-inch form factor, supports as many as four ESDI disk drives and features disk data rates as high as 10M bits per second, 2M-byte host data-transfer rates, consecutive sector transfers, overlapped seek operation, automatic configuration of disk parameters on power-up and 48-bit ECC with 20-bit error correction. The model 6300 disk/tape controller also comes in the 5¼-inch form factor and supports as many as four ESDI/ESTI and ST506 devices. The ESTI device can be streaming, start/stop or block-addressable. The model 6300 supports tape data-transfer rates as high as 5M bits per second, automatic configuration of tape parameters (tracks, tape speed, tape density and data-encoding method) and inter-device copies. Model 6100: $225 (1,000 units), model 6300: $350 (1,000 units). **OMTI,** 557 Salmar Ave., Campbell, Calif. 95008, (408) 370-3555.

Circle No 344



Tape couplers link CDC streamer to DEC computers

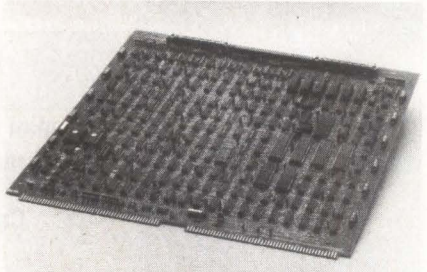
The TC05 and TC15 tape couplers provide software-transparent storage and backup capabilities, using CDC's Sentinel start/stop/streaming ¼-inch cartridge-tape drive, with DEC's LSI-11, PDP-11, Micro/PDP-11 or VAX-11 series CPUs. When combined with the Sentinel, both couplers provide functional emulation of the DEC TS11 tape subsystem and operate transparently to the standard DEC RSX11M, RSX11M-Plus, RSTS-E, RT11 and VMS operating systems and diagnostic software. Each coupler is packaged on a quad-wide PC board. The TC05 embeds directly into a Q-bus backplane slot of the LSI-11 and Micro/PDP-11. The TC15 embeds in a Unibus SPC slot of the PDP-11 or VAX-11 CPU. Both couplers handle 16-bit NPR data transfers and have 3.5K-byte data buffers. TC05: $1,300, TC15: $1,400. **Emulex Corp.,** P.O. Box 6725, 3545 Harbor Blvd., Costa Mesa, Calif. 92626, (714) 662-5600. **Circle No 345**



Board implements Multibus interface

The MP8519 interface board connects as many as four RS232 interfaces to Multibus systems. The board uses four 8251 USARTs to accomplish parallel-to-serial conversion. It also has three interval timers to control the baud rate of each USART. Baud rates and data-transmission specifications are programmable by the host computer. The board uses 16 I/O ports and is addressable on any 16-port boundary in the Multibus I/O arrangement. The 16-bit I/O address bus can determine the board's addressing. Straps for each USART can enable interrupts at the end of character transmission or reception. $350. **Burr-Brown Corp., Data Acquisition and Control Systems Division,** 3631 E. 44th St., Tucson, Ariz. 85713, (602) 747-0711.

Circle No 346



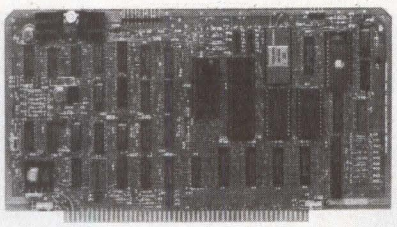
Controller joins non-DG drives to DG computers

Plug-compatible with the burst multiplexer channel on DG minicomputers, the BMX-1 disk controller allows users to select SMD-interfaced disk drives for use with DG S-140, S-280 and MV series CPUs. The controller provides four disk

drive connect ports with software-configurable drive characteristics on a port-by-port basis. An on-board 32-bit ECC, offering error dectection with burst error correction to 11 bits long, ensures data integrity and recovery. The controller supports ECC error logging with status reporting, offset positioning and strobe early/late. $4,995. **Custom Systems Inc.,** 6850 Shady Oak Rd., Eden Prairie, Minn. 55344, (612) 941-9480. **Circle No 347**

Video display module drives TTL monitor

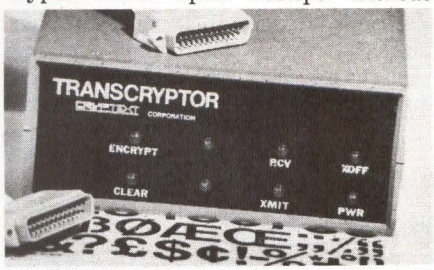
The S100-compatible VRAMS100 video display module board contains the memory and logic necessary to receive display data and drive a composite or TTL input video monitor. An on-board video attribute controller provides reverse video, character blink and intensity-display attributes and a limited graphics set and line-drawing capability. Video features include 80 or



132 characters per data row, programmable number of data rows per frame, programmable raster scans per data row, smooth or jump scroll, bidirectional partial- or full-page smooth scroll and double-height and -width data rows. $395. **Standard Microsystems Corp.,** 35 Marcus Blvd., Hauppauge, N.Y. 11788, (516) 273-3100. **Circle No 348**

Security device generates encryption keys

The Transcryptor computer-security device blocks unauthorized access to computers and terminals and can be configured to provide managerial control over access to computers and files. Based on a Z80A microprocessor and having two RS232C ports, the device stands between a terminal or computer and modem or direct line. It encrypts messages upon transmission and decrypts them upon receipt without



special operator commands. Using a proprietary encryption program, it provides approximately 2^{3000} times as many cipher texts as the Data Encryption Standard. The unit operates asynchronously and adjusts to baud rates from 150 to 9,600. $945. **Cryptext Corp.,** P.O. Box 425, Northgate Station, Seattle, Wash. 98125, (206) 364-8585. **Circle No 349**

New Products

LITERATURE

Brochure describes integrated software

A four-page, color brochure details how Vertex integrated software for microcomputers running UNIX allows users to transfer information through electronic windows to word processing, database, spreadsheet and graphics applications. **Inspiration Systems Inc.,** Production Plaza, Sewickley, Pa. 15143, (412) 771-4000.

Circle No 350

Catalog details DEC-compatible software

This software catalog lists packages for DEC computers. It covers software for accounting, communications, graphics, security, sorting, statistical analysis and word-processing applications. It also lists compilers, operating systems, database systems, microcomputer emulators, program-development utilities, spreadsheets and system-management utilities. **Midcom Corp.,** 1940 N. Tustin #117, Orange, Calif. 92665, (714) 998-6041.

Circle No 351

Document lists more than 500 computer books

The 1984 IEEE Computer Society Publications Catalog features more than 500 titles on a variety of subjects and applications in computer science and engineering. The 28-page document includes more than 60 books published since the 1983 catalog. **IEEE Computer Society Press,** 1109 Spring St., Suite 300PR, Silver Spring, Md. 20910, (301) 589-8142.

Circle No 352

Handbook describes communications products

The "Data Communications Products Handbook" describes a line of proprietary, VLSI-based communications devices including CRT and video controllers. The 438-page handbook details more than 25 products and includes comprehensive write-ups on product features, functions and applications. **Western Digital Corp., Literature Department,** 2445 McCabe Way, Irvine, Calif. 92714, (714) 863-0102.

Circle No 353

Catalog covers data-comm products

This 125-page data-communications catalog and handbook covers modems, multiplexers, port selectors, switches and 74 other types of data-communications products from more than 40 manufacturers. It also contains tutorial information on statistical multiplexers and charts of the V.35, RS449A, RS232C and CCITT-V.24 interfaces. **Glasgal Communications Inc.,** 207 Washington St., Northvale, N.J. 07647, (201) 768-8082.

Circle No 354

Catalog highlights network products

The Timeplex short-form catalog details the company's data-communications network products, including multiplexers/data concentrators, distributed switching systems, wideband facilities, modems and network-management systems. **Timeplex Inc.,** 400 Chestnut Ridge Rd., Woodcliff Lake, N.J. 07675, (201) 391-1111.

Circle No 355

Booklet focuses on LAN markets, technologies

This 20-page booklet reviews local-area network markets and techniques. Illustrated with color charts and graphs, the booklet is a transcript of an address, "Local Area Networks: A Harris Perspective," delivered by Dr. Joseph A. Boyd, chairman of Harris Corp., at the Yankee Group's August 1983 "Communications Strategy" conference. Boyd discusses the market characteristics and growth forecasts for local networking; the status of baseband, broadband, PBX and other forms of networking; network architecture and technology; and network standards. **Harris Corp.,** 1025 W. NASA Blvd., Melbourne, Fla. 32919, (305) 727-9100.

Circle No 356

Catalog features analog I/O systems

A 192-page catalog presents technical specifications and pricing information for data-acquistion products ranging from solid-state signal conditioning to analog and digital I/O systems for IBM and Apple II personal computers. Each section begins with a brief product overview, followed by detailed technical specifications. The catalog supplements the vendor's 336-page, 1983 master catalog. **Data Translation Inc.,** 100 Locke Dr., Marlboro, Mass. 01752, (617) 481-3700.

Circle No 357

Brochure solves power problems

An eight-page, color brochure explains the need for uninterruptible power systems and discusses the vendor's products. **Clary Corp.,** 320 W. Clary Ave., San Gabriel, Calif. 91776, (213) 286-6111.

Circle No 358

Reference profiles IDRIS application packages

Whitesmiths Application Software Directory lists more than 20 application packages that run on the UNIX look-alike IDRIS operating system. The directory includes product profiles, hardware requirements and pricing/ordering information for IDRIS-compatible software products, including word-processing systems, spreadsheet packages, compilers, translators, database-management systems and screen editors. **Whitesmiths Ltd.,** 97 Lowell Rd., Concord, Mass. 01742, (617) 369-8499.

Circle No 359

New Products

LITERATURE

Directory lists Pick application software

Edition Two of the *Directory of Application Software* for Pick-based computer systems lists 211 application-software packages from 70 companies in 48 classifications. $30. **International Database Management Association Inc.,** 9740 Appaloosa Rd., Suite 210, San Diego, Calif. 92131, (619) 578-3152.

Circle No 360

Report forecasts product shipments

The U.S. Computer Industry, second edition, forecasts shipments of computer products by U.S. manufacturers for 1983 and 1984 and includes historical data from 1980 through 1982. The report segments the industry into five basic product groups: computer systems, data-storage systems, terminals, printers and plotters and software and services. The 200-page report provides shipment data for approximately 40 categories within the five groups. $1,050. **Venture Development Corp.,** One Washington St., Wellesley, Mass. 02181, (617) 237-5080. **Circle No 361**

Report examines optical-memory industry

The *Optical Memory Report* examines the products and companies of the optical-memory disk, card and tape drive industry. It profiles more than 30 companies worldwide that develop optical-disk drives, more than 40 companies that are working on optical media and more than 50 companies that are licensed to manufacture digital read-only, 12-cm. disk drives. The report details product specifications, OEM and end-user prices, U.S. and worldwide market forecasts, production capacity, annual shipments and installed base, development projects, introduction timetables and future technology trends. $1,995 yearly. **Rothchild Consultants, Optical Memory Report,** P.O. Box 14817, San Francisco, Calif. 94114, (415) 621-6620. **Circle No 362**

Report examines markets for superminicomputers

"The Superminicomputer Industry: A Strategic Analysis" evaluates the markets for U.S.-based vendors of 24-, 32- and 48-bit superminicomputers. The 150-page report divides the year-end 1981 installed base and the 1982 to 1986 shipment forecasts by applications, participants, foreign vs. domestic sales and distribution channels. The report identifies application market segments and details user requirements. It also analyzes industry trends, the competitive environment within the industry and strategies for industry participants. $2,490. **Venture Development Corp.,** 1 Washington St., Wellesley, Mass. 02181, (617) 237-3000.

Circle No 363

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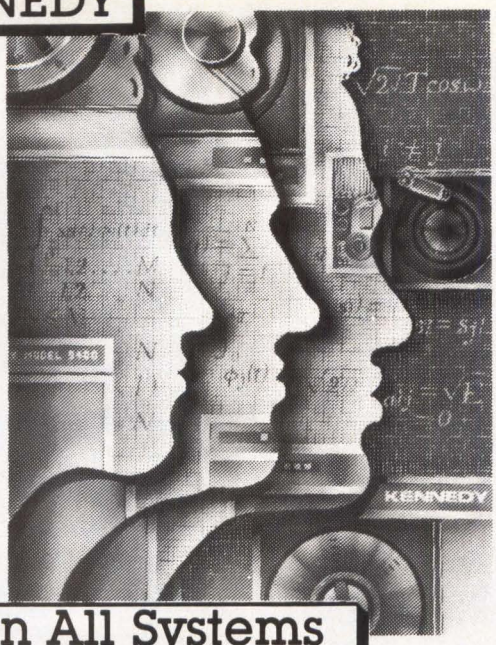

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Calendar

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16-18 Robotics Seminar, Norcross, Ga., sponsored by the Institute of Industrial Engineers (IEE). Contact: IIE Conference Department, 25 Technology Park/Atlanta, Norcross, Ga. 30092, (404) 449-0460.

16-18 Videotex '84, Chicago, sponsored by the Videotex Industry Association. Contact: Sally Summers, London Online Inc., 2 Penn Plaza, Suite 1190, New York, N.Y. 10121, (212) 279-8890.

16-18 "Selecting A Local-Area Network" Seminar, Los Angeles, sponsored by Technology Concepts Inc. Contact: James M. Moran, Technology Concepts Inc., Old County Road, Sudbury, Mass. 01776, (617) 443-7311. Also to be held on April 24-26 in Washington, May 1-3 in New York and May 15-17 in San Francisco.

17-19 10th Annual Federal Data Processing Expo & Conference, Washington, presented by The Interface Group Inc. Contact: Lewis R. Shomer, Vice President, Sales and Marketing, The Interface Group, Needham, Mass. 02194, (617) 449-6600 or (800) 325-3330.

19 California Computer Show, Palo Alto, Calif., sponsored by Norm DeNardi Enterprises. Contact: Carol Reimer, Norm DeNardi Enterprises, 289 S. San Antonio Rd., Suite 204, Los Altos, Calif. 94022, (415) 941-8440.

23-25 Telecommunications Technology Conference, Napa, Calif., sponsored by Datatquest Inc. Contact: Gail Van Tubergen, Conference Coordinator, Dataquest, 1290 Ridder Park Dr., San Jose, Calif. 95131, (408) 971-9000.

Exposium '84 Office Automation Conference, Milwaukee, sponsored by Office Technology Management Association (OTMA) Inc. Contact: OTMA, 9401 W. Beloit Rd., Suite 101, Milwaukee, Wis. 53227, (414) 321-0880.

24-26 "Manufacturers' Network Architecture: IBM/SNA, Digital/DECnet, X.25" Seminar, Boston, sponsored by Technology Concepts Inc. Contact: James M. Moran, Technology Concepts, Old County Road, Sudbury, Mass. 01776, (617) 443-7311. Also to be held on May 1-3 in San Francisco and May 8-10 in Washington and Los Angeles.

24-27 "Hands-On UNIX Workshop" Course, Washington, sponsored by Integrated Computer Systems. Contact: Ruth Dordick, Integrated Computer Systems, 6305 Arizona Place, P.O. Box 45405, Los Angeles, Calif. 90045, (213) 417-8888. Also to be held on May 8-11 in Palo Alto, Calif., June 5-8 in Boston, July 10-13 in Washington and July 24-27 in San Diego.

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26-29 **San Diego Computer Showcase Expo,** San Diego, presented by The Interface Group Inc. Contact: Linda Yogel or Peter B. Young, The Interface Group, 300 First Ave., Needham, Mass. 02194, (617) 449-6600, or (800) 325-3330.

MAY

2-3 **Networking Personal Computers Conference,** New York, sponsored by Frost & Sullivan. Contact: Ginny Kania, Account Representative, Frost & Sullivan, 106 Fulton St., New York, N.Y. 10038, (212) 233-1080.

3-6 **Personal Computer Userfest/Chicago,** Rosemont, Ill., produced by Northeast Expositions. Contact: Northeast Expositions, 822 Boylston St., Chestnut Hill, Mass. 02167, (617) 739-2000.

13-17 **Computer Graphics '84** Anaheim, Calif., sponsored by the National Computer Graphics Association (NCGA). Contact: Christine A. Rodiske or Sheila Donoghue, NCGA, 8401 Arlington Blvd., Suite 601, Fairfax, Va. 22031, (703) 698-9600.

15-16 **1984 Factory Systems Summit Conference,** Chicago, sponsored by The Yankee Group. Contact: Lisa M. Caruso, Seminar Director, 89 Broad St., Boston, Mass. 02110, (617) 542-0100.

15-17 **Electro/84 High-Technology Electronics Exhibition and Convention,** Boston, produced by Electronic Conventions Inc. Contact: Nancy Hogan or Kent Keller, Electronic Conventions, 8110 Airport Blvd., Los Angeles, Calif. 90045, (213) 772-2965.

15-17 **Mini/Micro Northeast '84 Computer Conference and Exhibition,** Boston, produced by Electronic Conventions Inc. Contact: Nancy Hogan or Kent Keller, Electronic Conventions, 8110 Airport Blvd., Los Angeles, Calif. 90045, (213) 772-2965.

15-18 **1984 National Database and Fourth-Generation Language Symposium,** Chicago, sponsored by Digital Consulting Associates Inc. Contact: Digital Consulting Associates, 339 Salem St., Wakefield, Mass. 01880, (617) 246-4850. Also to be held on April 24-27 in Washington and June 15-18 in New York.

22-24 **SEMICON/West '84,** San Mateo, Calif., sponsored by Semiconductor Equipment and Materials Institute (SEMI) Inc. Contact: Susan Castillo, SEMI, 625 Ellis St., Suite 212, Mountain View, Calif. 94043, (415) 964-5111.

29-31 **Gulf Coast Computer and Office Exhibition,** New Orleans, sponsored by the Administrative Management Society. Contact: Lori Lievonen, Show Manager, Gulf Coast Computer & Office Show, 119 Avant Garde Circle, Kenner, La. 70062, (504) 467-9949 or (416) 271-1601.

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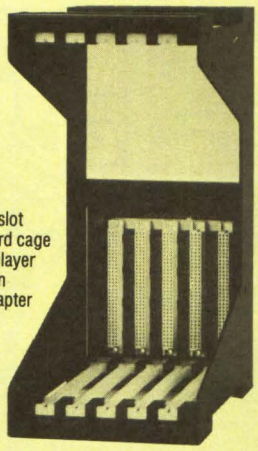

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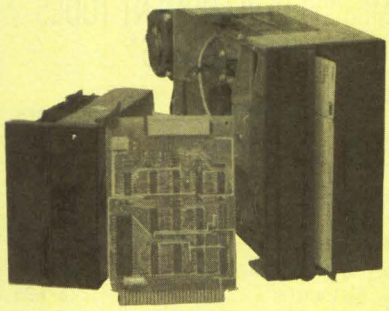

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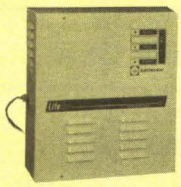

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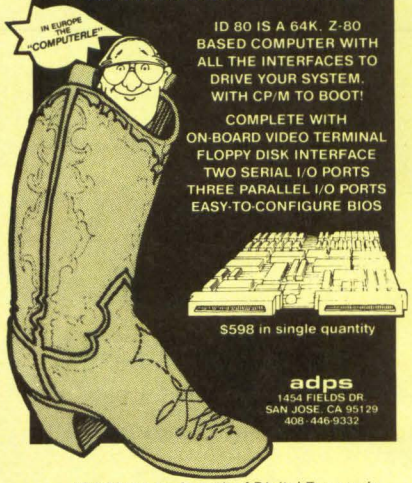

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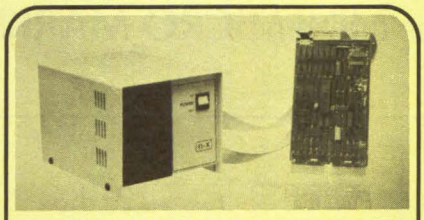

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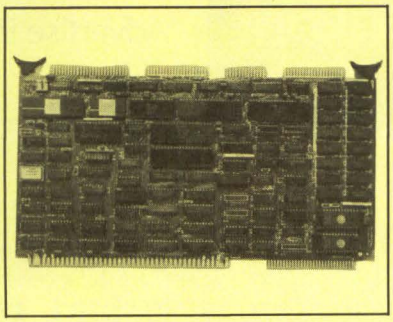

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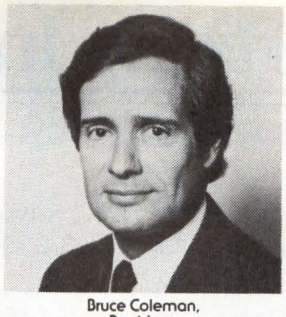

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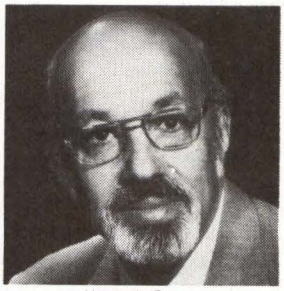

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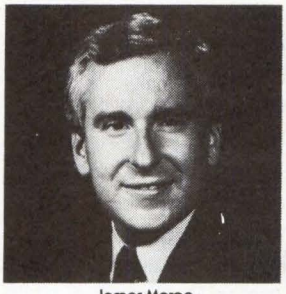

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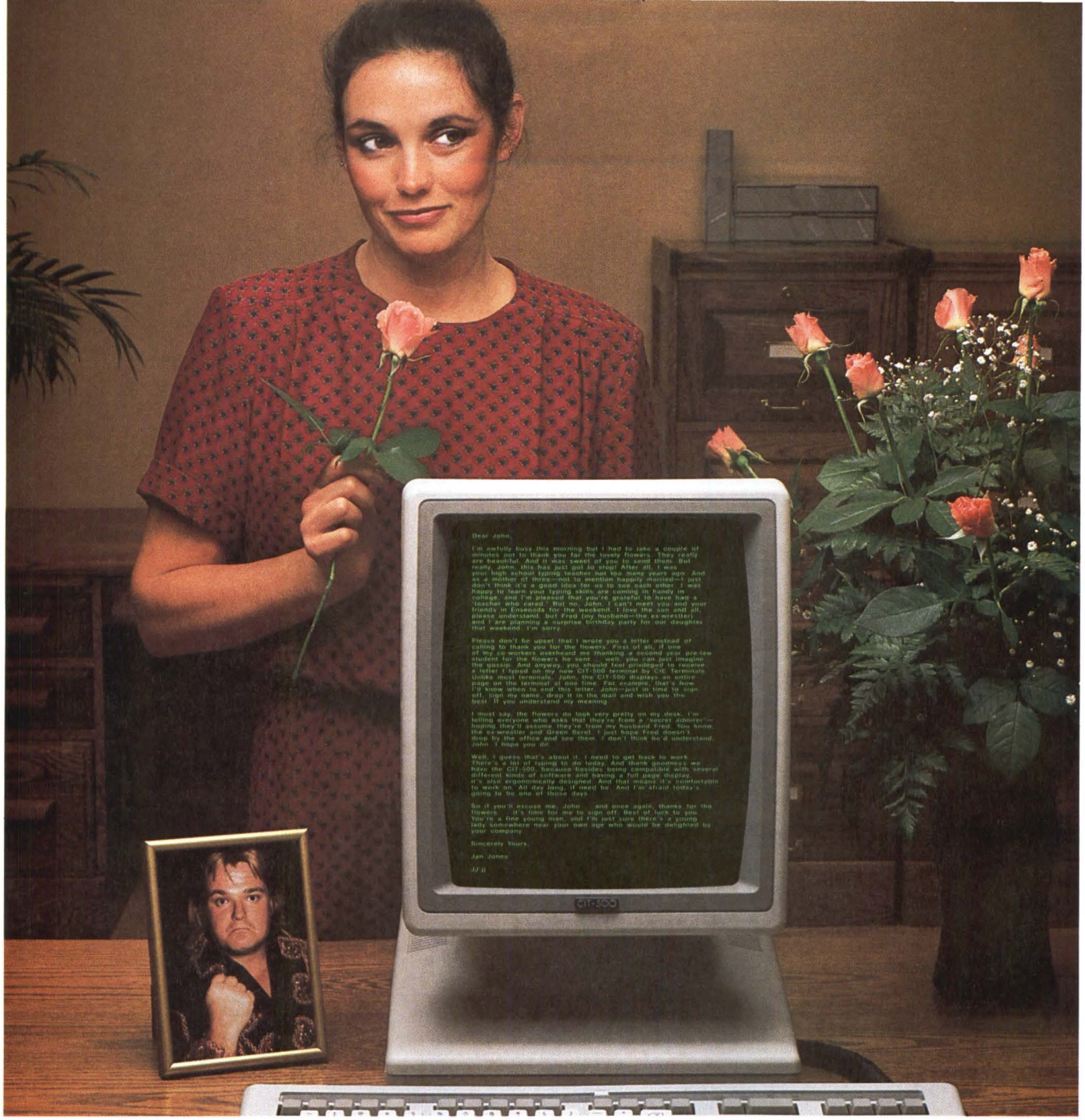

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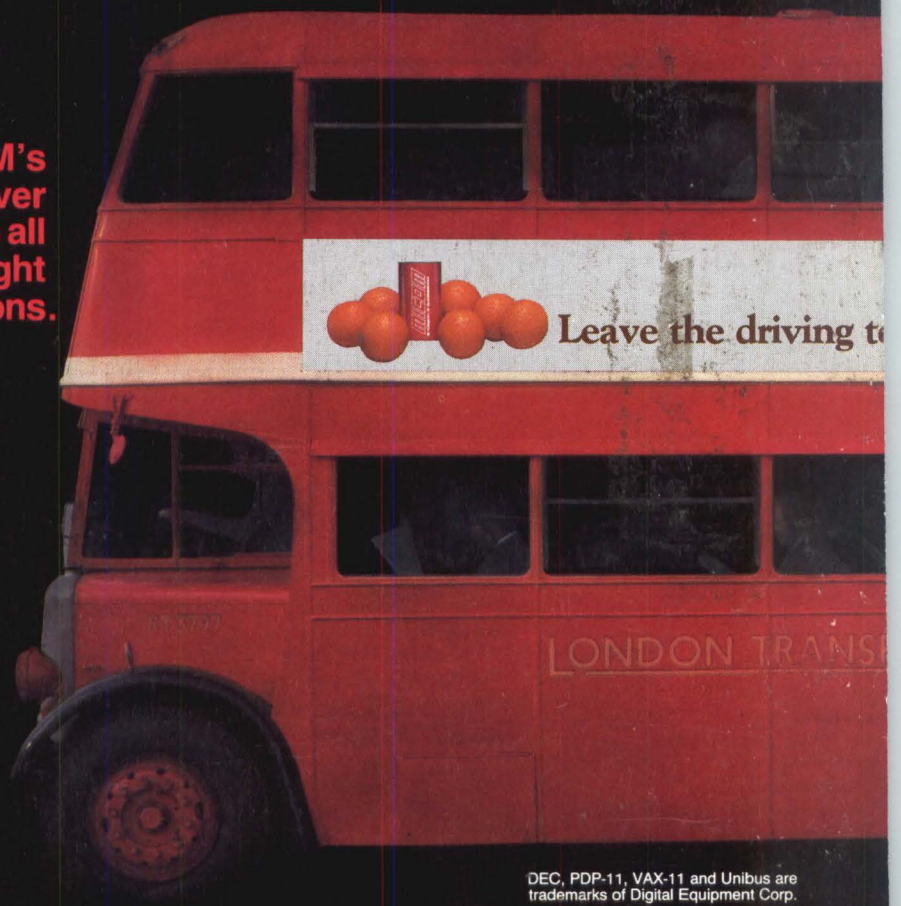

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