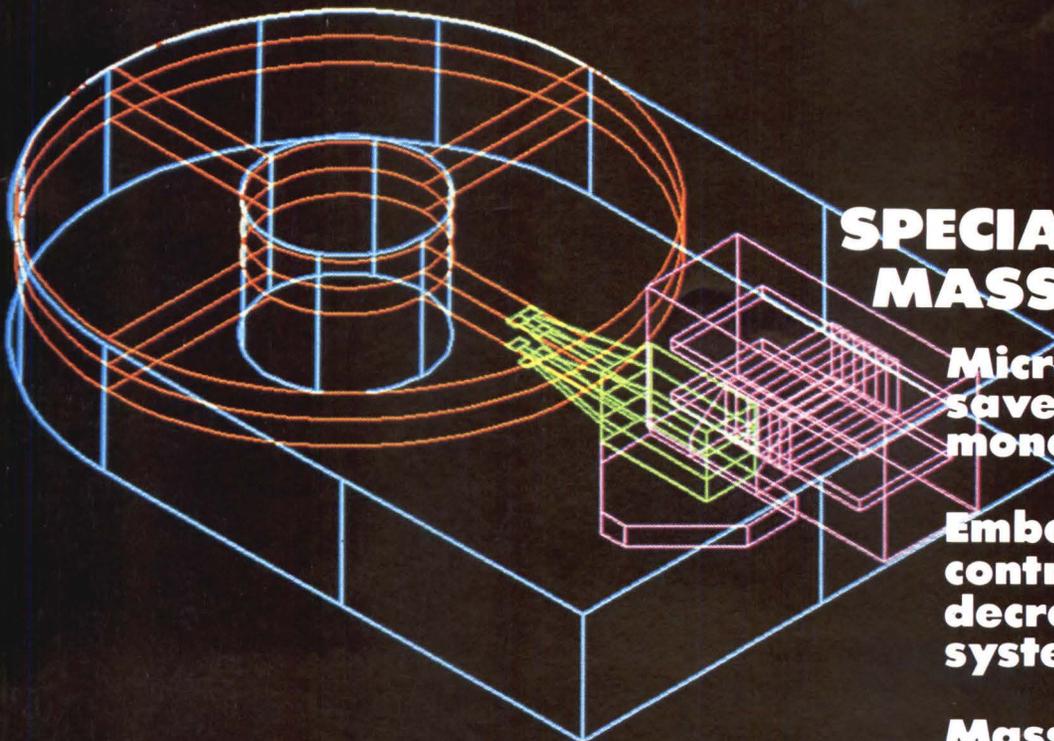
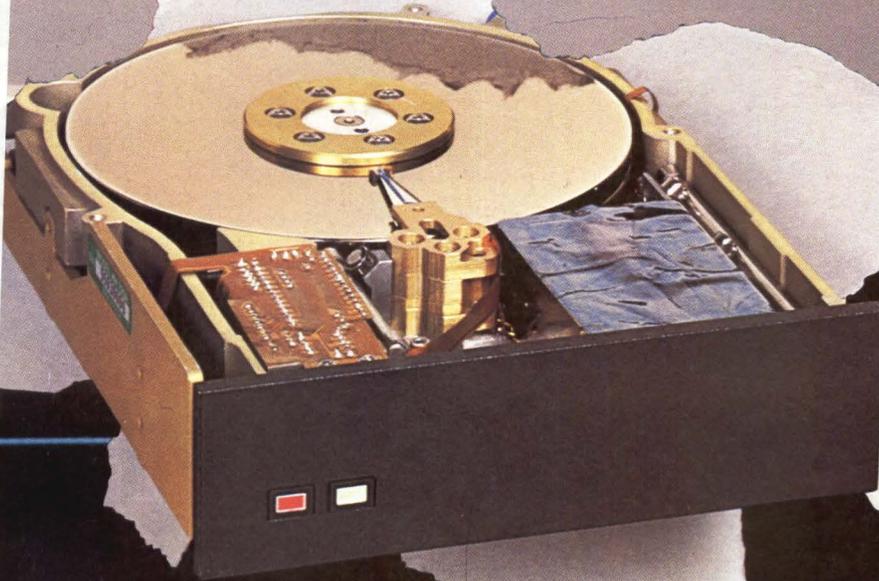


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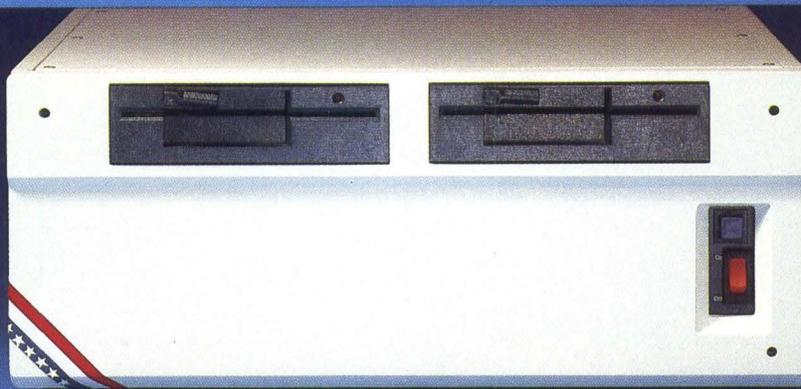
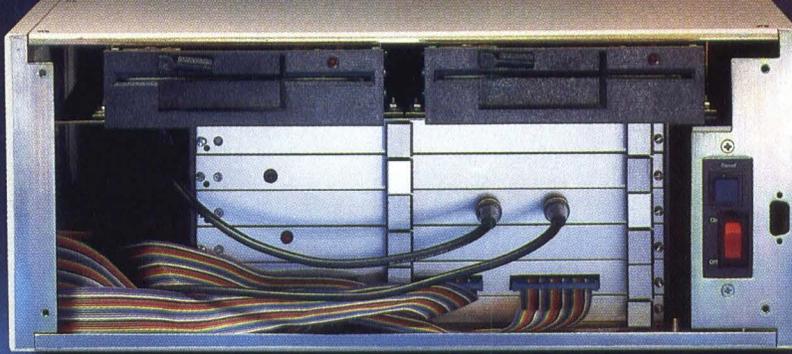


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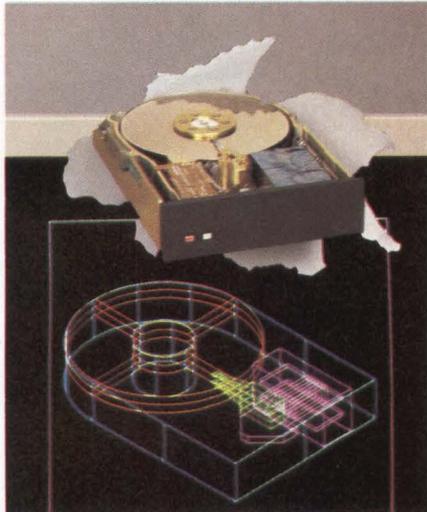
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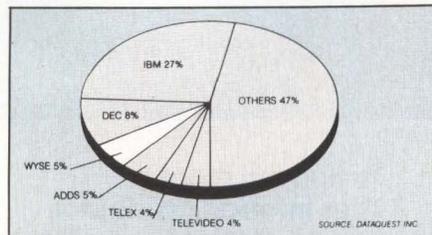
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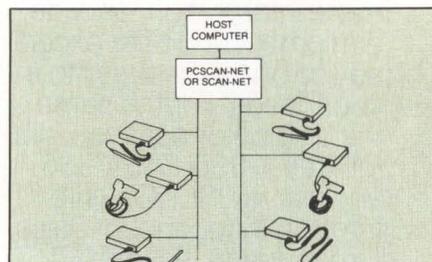
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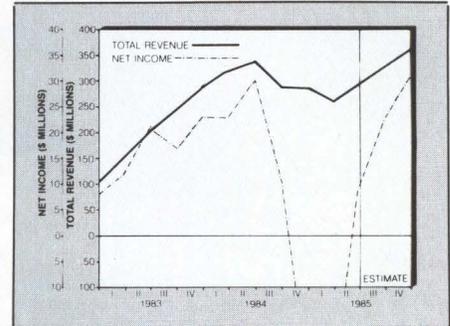
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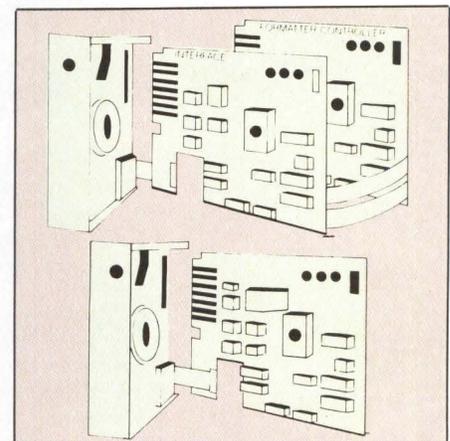
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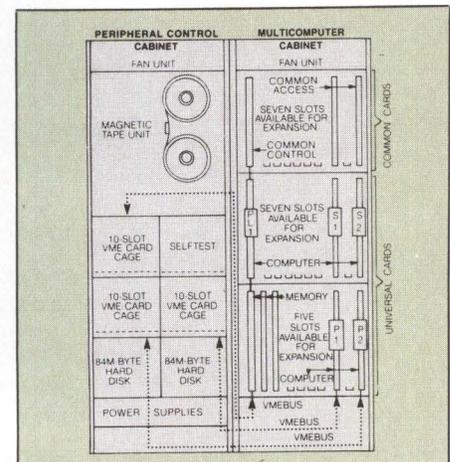
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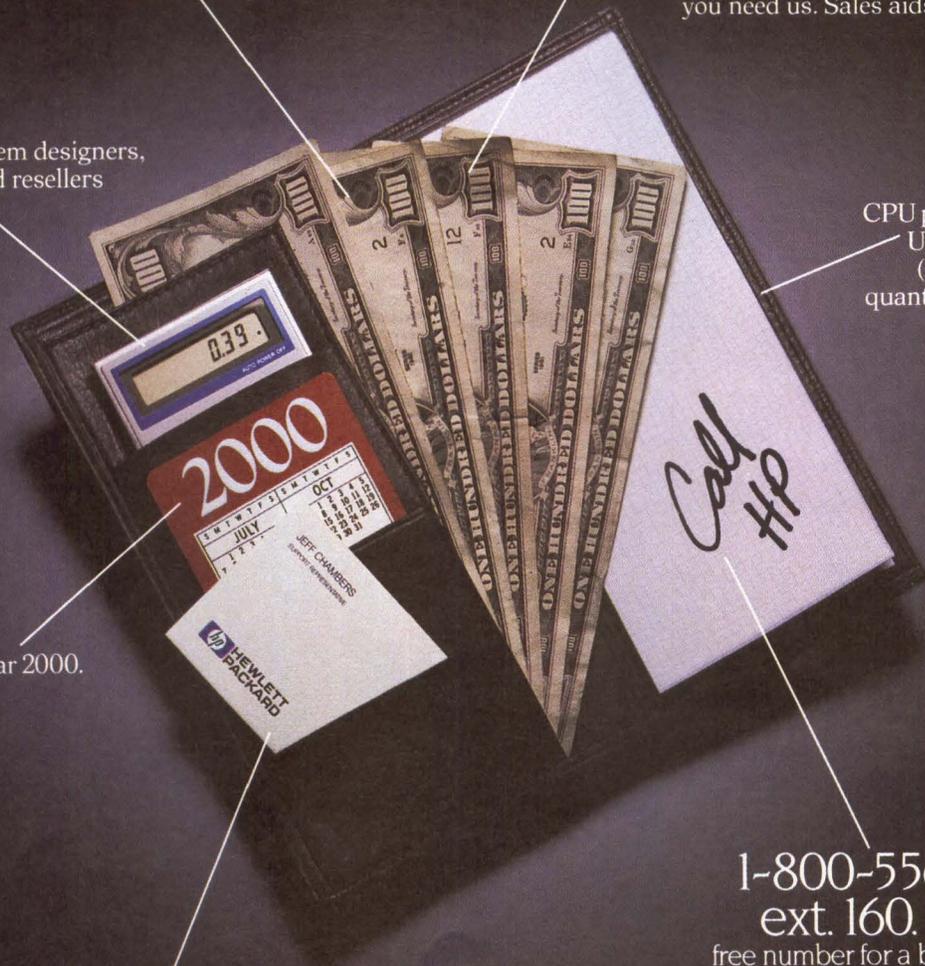
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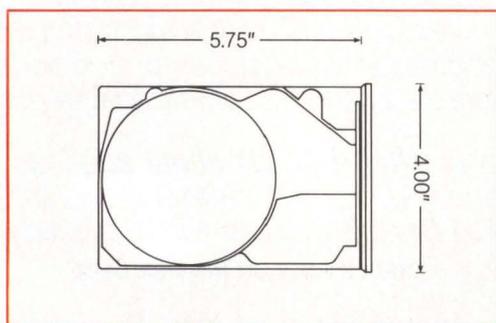
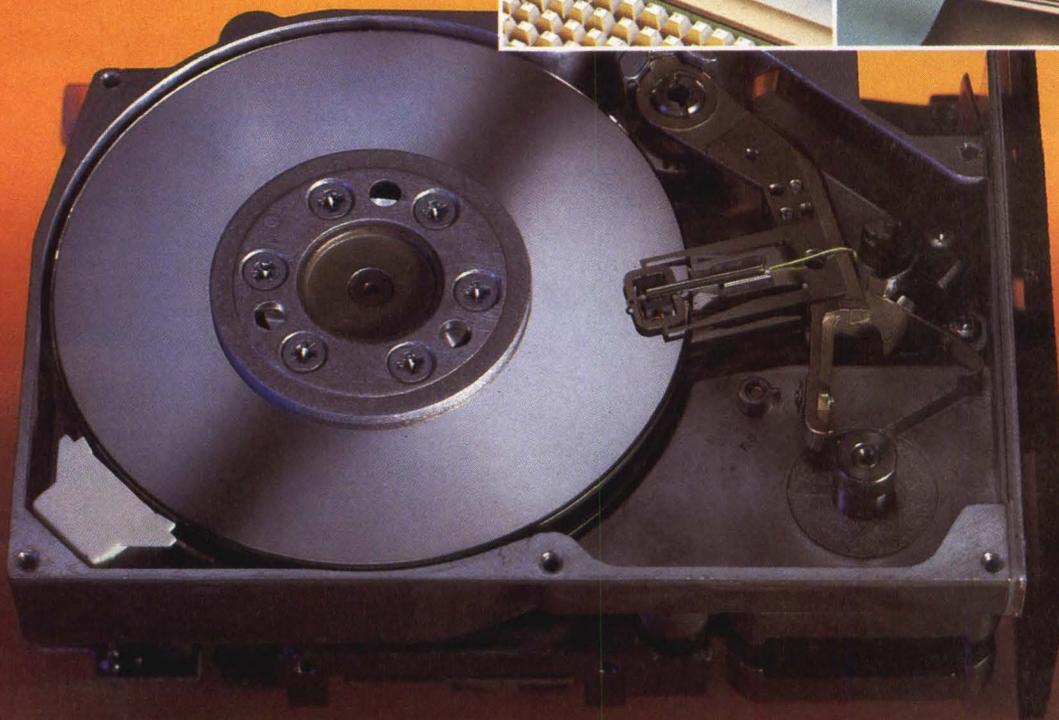
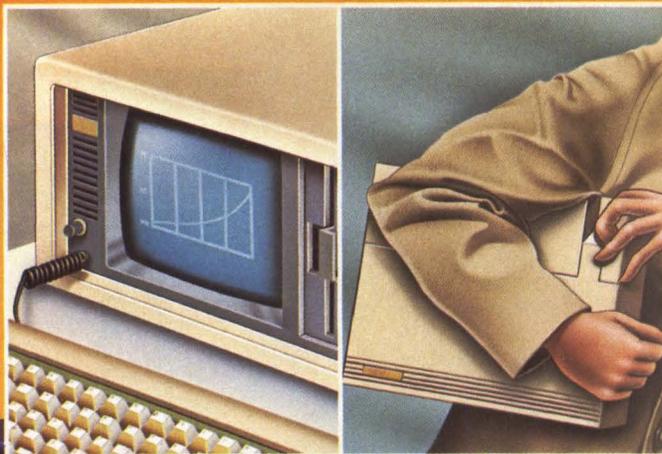


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CIRCLE NO. 9 ON INQUIRY CARD

EDITORIAL

A YEAR OF LIVING DANGEROUSLY



Next year promises turbulence for the disk-drive industry. The reasons? Big Blue and Japan Inc. For others, it will be a year of living dangerously as those two forces thin out the herd of companies that currently crowd the marketplace.

Unquestionably, Japan Inc. will dominate the floppy-disk-drive arena. Currently, about 30 Japanese companies make floppy drives. However, that number will probably drop to around 10 in a few years because too many companies are chasing after a diminishing demand. Nevertheless, Japanese product quality and price remain practically unbeatable (1.6M-byte floppy drives sell for about \$80 in OEM quantities).

Interestingly, Japanese manufacturers don't make much money on floppy disk drive sales. Jim Porter, the author of *Disk/Trend Report*, Los Altos, Calif.—who visits each Japanese drive manufacturer annually—doubts that any Japanese company profits significantly on its floppy-drive operations. Tough competition.

In hard disk drives, Japan Inc. is gaining ground at the low end and remains competitive in the high end. Witness the success of Fujitsu America Inc., Hitachi America Ltd. and NEC Information Systems Inc.

Recent Japanese entries probably sound the death knell for several U.S. manufacturers that are pinning their hopes on low-end sales, particularly for drives containing stepper-motors, and for all drives in the 3½-inch form factor. Signs of this are evident in recent announcements of micro-Winchesters by Alps Electric USA Inc. and Mitsubishi Electronics America Inc.

Expect Japanese manufacturers with Winchester experience to enter the 3½-inch-drive market. In fact, you'll probably see them at next month's Comdex/Fall show. The influx of 3½-inch drives is probably premature, but that situation should change by mid-1986.

To stay competitive, U.S. companies will

have to go through rapid changes in product lines. Unfortunately, this squeezes margins because of short product life cycles (which currently are about 18 months). It appears, therefore, that the surviving companies will be those with cash to react to product-line shifts. Of course, this condition favors established drive manufacturers.

The other major force influencing next year's disk scenario, IBM Corp., consumes 40 percent to 50 percent of all U.S. drives sold. The well-publicized problems between Computer Memories Inc. (CMI)—for a while, the sole supplier of the PC/AT's 20M-byte drive—and IBM attest to the high price a company pays to play in IBM's park. (The problems revolved around the drive itself, as well as IBM's order fluctuations. Late this summer, IBM announced that it would terminate its OEM relationship with CMI by the year end, a blow that put CMI in serious jeopardy.)

Many speculators predict that IBM will roll out an AT successor next year with a 40M-byte drive with fast-access (under 40 msec). However, don't be surprised if they stick to the 20M-byte drive. IBM will ask itself, "How many more boxes can we sell if we change the current design, or the form factor?" The answer may be, "Not enough to justify it."

IBM will probably introduce soon some sort of product with a 3½-inch hard disk drive. The rumor mill speculates that IBM has placed a significant order with Miniscribe Corp. for 3½-inch Winchesters.

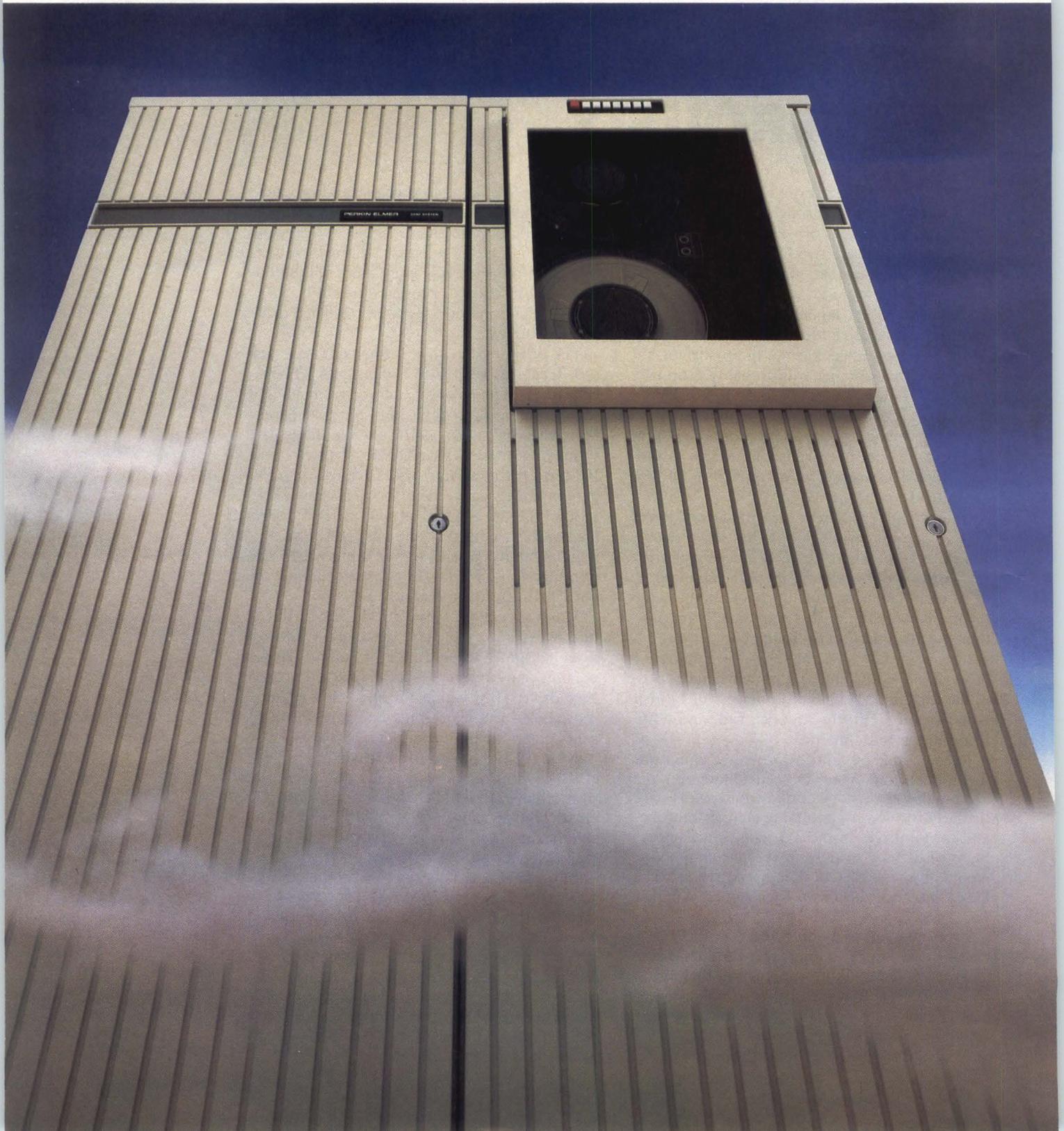
But ask system integrators who they think will get the next big IBM disk contract—or whether the entry of Japanese companies will weed out smaller U.S. companies—and you'll get one answer: It doesn't really matter. What's important is that IBM is setting standards, and the competition is heating up. Both mean that reliability, performance and price will determine the winners. And that's good news for system integrators.

A handwritten signature in dark ink, appearing to read "David Simpson".

David Simpson
Senior Associate Editor

The Power a

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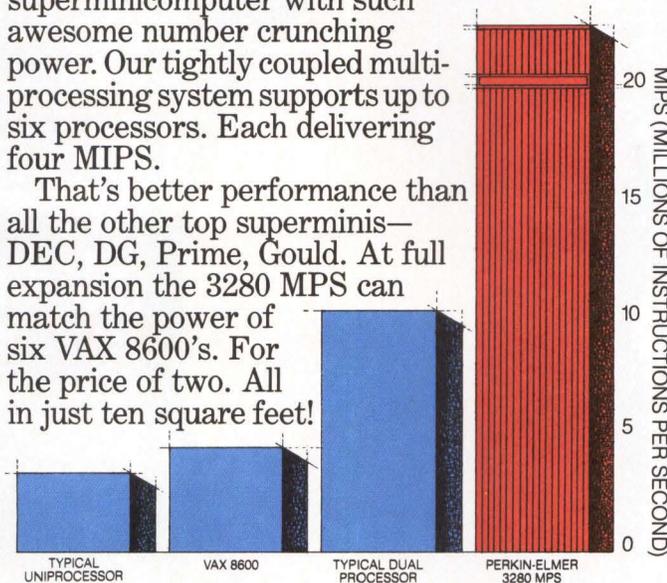
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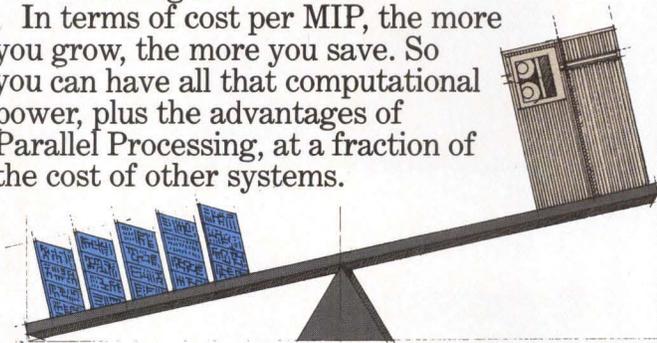
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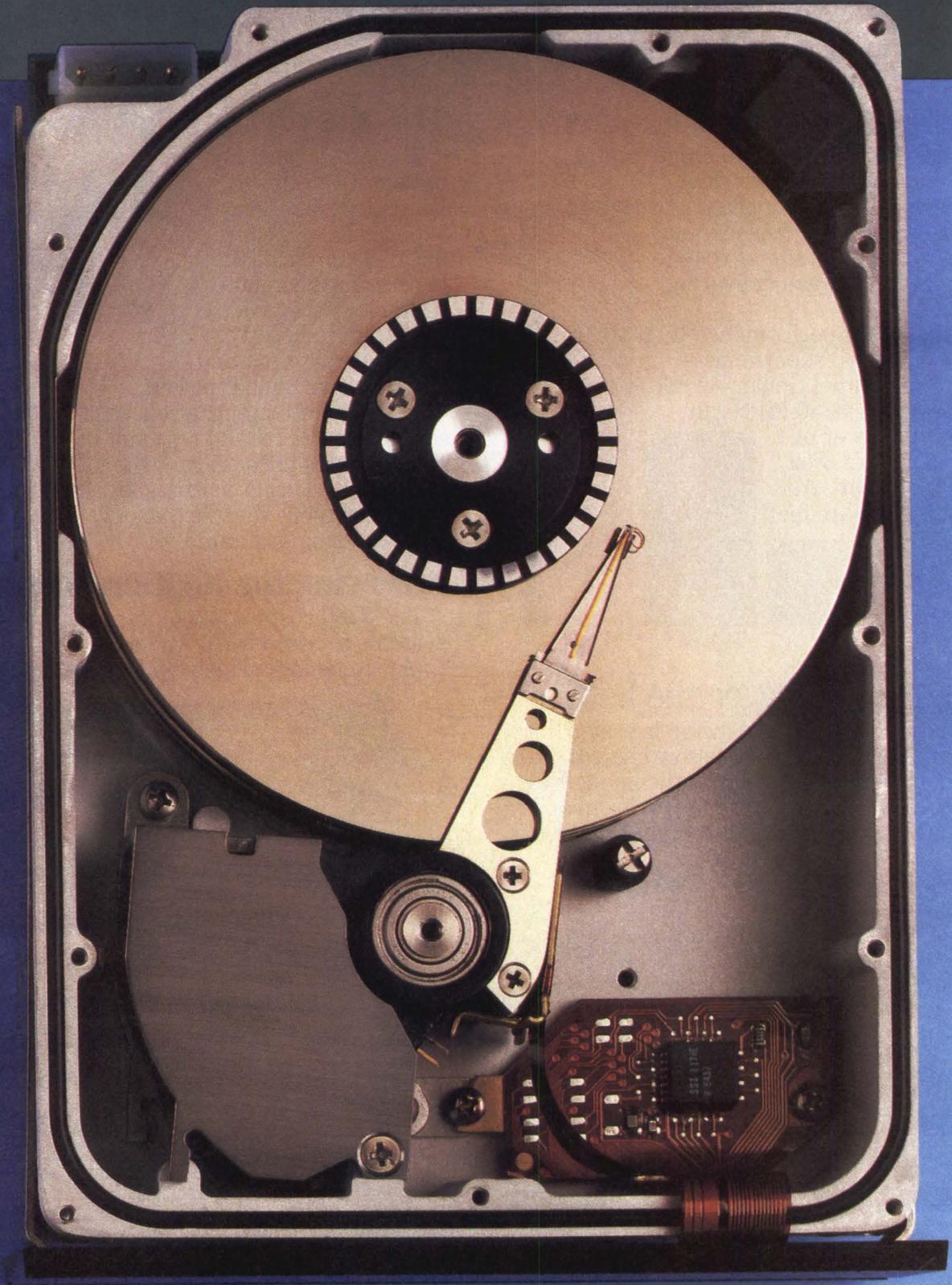
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With the SCSI interface, the Q200 breaks through the limits of existing drive technology, into a new way of thinking about system architecture as a whole. Your system no longer has to be designed and redesigned to accommodate a mixed bag of peripheral interfaces. System upgrades will no longer mean expensive hardware and software overhauls.

And like every Quantum drive that's come before it, our latest brain child was born to run longer, on less power, with fewer parts. This lean breeding not only delivers more in your system, but makes it possible for us to deliver the Q200 to you in very high volumes. At prices that will make this baby look very, very smart, indeed.

Please call us for more information.

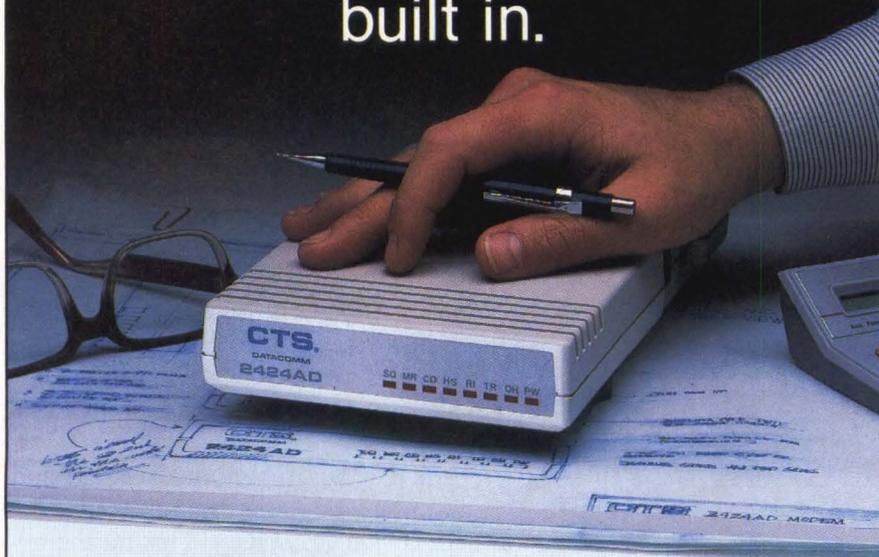
Quantum Corporation, 1804 McCarthy Boulevard, Milpitas, CA 95035, (408) 262-1100. TWX 910-338-2203. Eastern Regional Sales Office: Salem, NH (603) 893-2672. Western Regional Sales Office: Santa Clara, CA (408) 980-8555. European Sales Office: Frankfurt, West Germany 069-666-6167. Quantum products are distributed in the United States and Canada by Arrow Electronics.

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CIRCLE NO. 11 ON INQUIRY CARD

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CTS has been manufacturing reliable products since 1896 when we introduced our first hand cranked, wall mounted, wooden telephone. Today, we're introducing a sophisticated, full duplex, autodial, 2400 baud modem, and our **promise of reliability** stays the same.

The CTS 2424AD modem offers **technological reliability** in its signal processor. Originally designed for more expensive and complex modems, the patent pending CTS signal processor provides integral adaptive equalizing for noticeably clearer, error free transmissions.

Our 2424AD meets CCITT V.22bis requirements and operates both synchronously and asynchronously at 2400 and 1200 bits per second. Other features include autodial with memory storage of up to ten telephone numbers (40 characters per number).

The CTS 2424AD offers **field reliability** with its two year warranty. And we demand our distributors provide you with the service you deserve.

Brand reliability is important at CTS, because it's important to you. That's why we suggest you check out our 2424AD before you buy a 2400 baud modem. You'll find what's built in to a CTS DATA COMM product is what you're looking for.

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LETTERS

PRODUCT UPDATE

To the editor:

I am writing to point out some inaccuracies in your news article (MMS, July, Page 39) on Rockwell International Corp.'s chip set and its adoption by some 2,400-bit-per-second (bps) modem vendors.

The sidebar accompanying the article cites my client, Concord Data Systems Inc., as being among the companies not using Rockwell chips in their modems. In fact, Concord Data has introduced two new products that incorporate the F-level chips. One [announced June 10] is a single-card, internal modem compatible with the IBM Corp. PC, PC/XT, PC/AT and compatibles. It is available for immediate delivery. The second, a standalone modem, began shipping in August. Both modems operate at 300, 1,200 and 2,400 bps.

The sidebar also incorrectly cites the prices of the CDS224 modem as \$695. As of June 10, the price dropped again to \$450. The popular CDS224 auto-dial modem is now \$495.

Nancy Fliesler

**Account Executive/Publicity
Impact Marketing & Communications
Boston, Mass.**

Editor's response

Our printing schedule requires us to complete articles well in advance of an issue's publication date—in this case before June 10, when Concord Data announced its new products and price reductions.

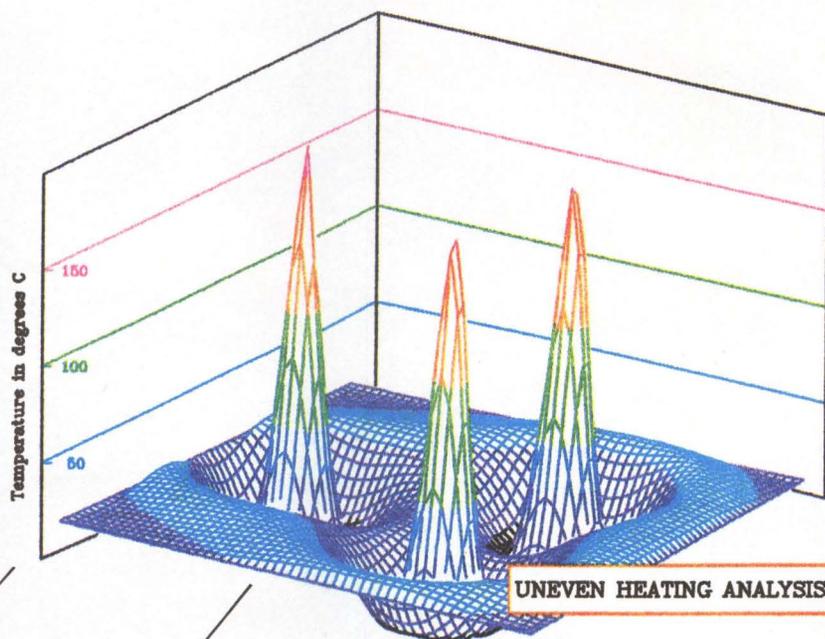
—B. MacDonald

LOOKING AHEAD IN MMS

The Fall issue of the Mini-Micro Systems Peripherals Digest is scheduled for mid November.

"DOTS INCREDIBLE."

You're looking at letter-quality text created by an AMT printer. The same printer that produced the CAD/CAE diagram you see on the right. **Dots incredible!** But that's not all. With the AMT, you can print letters or documentation at 45, 100 and 250 cps. Print in *italics* and different **type styles** and **sizes**. Print scientific and special symbols--even other languages 中文字. You can print on transparencies and multipart forms. And you can do it all in a **RAINBOW** of **COLOR**.



Actual size—you can't get quality like this on a plotter, but you can with AMT.

AMT is the highest resolution dot matrix color printer available—with dot addressable graphics to 480x240 dpi.

Naturally, AMT prints bar graphs and pie charts. But it also does incredible, 3-dimensional diagrams so precise you can use them for measurements.

You're looking at AMT, the first dot matrix color printer so advanced it's better than a desk top plotter. Why?

Because our new AMT color printer is the first dot matrix to combine letter-quality text with plotter-quality graphics. You get the speed, flexibility and industrial strength reliability of a top-notch dot matrix. Without the toner, pens and nuisance of a plotter.

And as you can see, AMT actually out-performs many plotters, large or small, on high precision applications.

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



Advanced Matrix Technology Inc.

CIRCLE NO. 13 ON INQUIRY CARD

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A 24 megabit per second data transfer rate (3 megabytes per second), and a 16 millisecond data access rate provided by a special high-performance linear actuator, combine to make the XMD II one powerful systems performer.

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Convenient 14" rack mount design allows high-capacity storage in a standard cabinet configuration.

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A 16 MILLISECOND SEEK TIME GIVES YOU ULTRA-FAST DATA ACCESS.

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XMD II is *the* highest capacity 14" rack mount disk drive available.

What's more, a dual channel option and daisy-chain capability make it ideally suited for multi-processing environments such as medical imaging or CAD/CAM.

Whatever your application, the XMD II is a drive you can depend on. It's built by Control Data, the leader in OEM storage peripheral design for over twenty five years.

For more information, or to arrange for use of an evaluation unit, call your local Control Data OEM sales representative direct, or our toll-free HOTLINE: 1-800/828-8001 ext. 82. Or, write: Control Data, OEM Product Sales HQW08X, P.O. Box 0, Minneapolis, MN 55440.

CONVENIENT DIAGNOSTICS

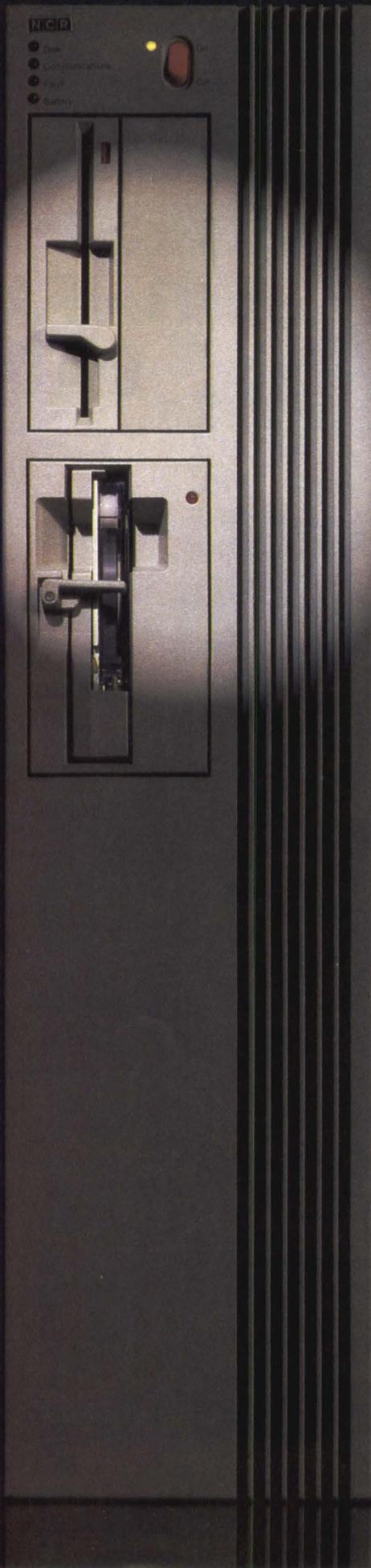
On-board diagnostics provide simplified troubleshooting and fault isolation without external test equipment.

BUILT IN RELIABILITY TOO

Extensive use of LSI circuitry for a reduced parts count, plus a design specification that provides a 20,000 hour MTBF. Your customers can expect years of trouble-free operation. And, they'll get it.

 CONTROL DATA

CIRCLE NO. 14 ON INQUIRY CARD



IF A POWER LINE FALLS IN THE MIDDLE OF THE NIGHT AND NO ONE'S AROUND, IS THERE A CRASH?

There's a very strong work ethic at NCR. Every system we build must work. And work. And work. And our reliability fanatics spend thousands of hours making sure that every Tower[®] XP lives up to that philosophy.

But we've gone even further, protecting the XP from circumstances beyond your control. Power failure.



When the Tower XP's power supply senses voltage fluctuation beyond an acceptable threshold, the automatic Power Failure Recovery (PFR) feature instantly interrupts the main processor with a failure indication. The system immediately takes control to preserve all applications, including the all-important super block, for up to six hours. In competitive systems without PFR, this entire chunk of the file system could just disappear, leaving your customers in the dark.

But the Tower XP recovers so smoothly, so completely, your customers may never know there was a power failure. And that means no more late night calls to restart systems or rebuild lost files. You save time, money and headaches.

Add to this the Tower's other integral reliability features: extensive remote and in-service diagnostics, consistent error logging, an NCR-enhanced UNIX* that virtually never PANICs. And you've got an irrefutable argument for selling Tower XP.

If you've had enough of systems that go crash in the night, look to NCR and the Tower XP. The power of the Tower never fails for OEMs.

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OEM Systems Division

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The terminal
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outperforms the
competition.
And costs less.

The computer
on the left
doesn't care
about
the price.



A computer is born to perform. No matter what the price.

You, however, have practicalities to think about. Making your computer perform the way it's meant to is one. Watching costs is another. And you have to blend the two to create the most valuable, cost effective system possible.

CIE Terminals has a video terminal that'll make you both happy. The CIT-220+.

It's a remarkably reliable piece of technology that yearns to show its stuff as much as the computer it's hooked up to. Something they'll both get plenty of chances to do. That's because the 220+ is so reliable, it's always up and running. Which

means your computer is, too.

The 220+ is compatible with the DEC VT220. But it's not comparable. That's where the plus is. You'll find no less than 20 improvements and additions that make the most of your computer.

And because the 220+'s price is in direct contrast to its high performance, you get the best value for your money. So although the computer doesn't care about the cost, you don't have to think about it, either. For more information on the CIT 220+, contact your distributor or CIE Terminals at 2505 McCabe Way, Irvine, CA 92714-6297 (800) 624-2516.



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Because your computer is only as good as its peripherals.

BREAKPOINTS

BELL ATLANTIC DEMONSTRATES ISDN NETWORK

Bell Atlantic, the regional operating telephone company for the mid-Atlantic states, is reportedly the first telephone carrier to demonstrate Integrated Services Digital Network (ISDN) applications through the public switched telephone network. The company recently showed through its local central office in Washington that the ISDN, an all-digital network able to transmit voice, data and video images simultaneously over existing phone lines, could run three separate communications circuits. Bell Atlantic will hold additional ISDN trials internally during the next 12 months and hopes to introduce ISDN services to its Centrex customers in late 1986.
—*Stephen Shaw*

CASE TARGETS PACKET-SWITCHED NETWORKS WITH CARLOS

Packet-switched networks of devices using different protocols are targeted by CASE Communications Inc.'s Communications Architecture for Layered Open Systems (CARLOS). CARLOS comprises a packet assembler and disassembler (PAD) that converts protocols, such as those employed by Digital Equipment Corp.'s VT100 terminal, into the Virtual Terminal Protocols of the Application layer of the open systems interconnection (OSI) standard. It then adds protocols of the lower OSI layers to enable transmission over an X.25 network. CARLOS may also implement OSI PAD protocol-handling in a personal computer from RC Computer A/S of Aarhus, Denmark, Case's partner in the project.—*Keith Jones*

ENCORE INTRODUCES MULTIPROCESSOR SUPERMINI

The Multimax family of general-purpose superminicomputers from Encore Computer Corp., Marlborough, Mass., is said by the company to be the first commercial product specifically designed to allow up to 20 main processors to share a common memory. Handling from 1.5 million to 15 million instructions per second through 20 32-bit multiprocessors, the Multimax series is available with memory capacity from 4M to 32M bytes and from one to 10 I/O channels. Prices range from \$112,000 to \$340,000.—*Stephen Shaw*

INTEL MAP COMMUNICATIONS BOARD DEBUTS AT AUTOFACT

Looking for a way to connect equipment to a factory-floor local area network using General Motors Corp.'s Manufacturing Automation Protocol (MAP)? If so, Intel Corp. wants to talk to you at the Autofact '85 show in Detroit, Nov. 4-7. That's where the Sunnyvale, Calif., company will demonstrate its new MAP communications board, the iSXM 554. The Multibus board contains a 10M-bit-per-second modem, 256K RAM, an 80186 CPU and software to meet the International Standards Organization's first four MAP layers. Intel's MAP board will cost \$3,750 in OEM quantities.—*Mike Seither*

BREAKPOINTS

ICON READIES LOW-COST 32-BIT, 3-MIPS MACHINE

Icon Systems and Software Inc., Orem, Utah, is taking direct aim at Digital Equipment Corp.'s MicroVAX II with its model MPS-020-2, a 32-bit, 3-million-instructions-per-second machine for 32 users. The \$19,950 system concurrently supports Berkeley UNIX Version 4.2 and System V, MS-DOS and IBM Corp.'s System 370, and includes a 2M-byte disk cache and a 50M-byte Winchester disk drive. Built by Sanyo Electric of Japan, the MPS reportedly achieves its fast throughput by using one Motorola Inc. MC68020 CPU for processing and another for handling disk I/O and caching.—*Carl Warren*

FALCON, C. ITOH SIGN DEFENSE LOGISTICS AGREEMENT

In a contract worth \$115 million to Falcon Systems Inc., Bethesda, Md., the system integrator will supply the Defense Logistics Agency (DLA) with workstations to operate on the agency's Gould System 9050 computer system. In turn, Falcon has signed a \$4.5 million agreement with C. Itoh Digital Products Inc. (CIDP) of Torrance, Calif., for CIDP to supply up to 12,000 ProWriter dot-matrix printers as part of the DLA contract. CIDP and Falcon recently signed a letter of agreement authorizing Falcon to represent CIDP as a value-added reseller.—*Stephen Shaw*

CHEROKEE OPTS FOR ESDI IN NEW OPTICAL DRIVE

Evaluation models of the Pathfinder 5¼-inch optical drive from Cherokee Data Systems will be ready in January, according to the Boulder, Colo., company. The write-once, read-many (WORM) drive will use a polycarbonate substrate media with a concentric track format—Cherokee says it can use spiral track formats as well—and support more than 300M bytes on a side. The company has opted for the enhanced small device interface, which will manage data rates in excess of 10M bits per second. Full production is expected by late 1987.—*Carl Warren*

Q-BUS SUBSYSTEM TRANSFERS 9.3M BYTES PER SECOND

Storage Concepts Inc.'s Concept 15 is reportedly the first Q-bus subsystem capable of accommodating the Fujitsu Ltd. model 2350A 474M-byte parallel-transfer disk drive. The Concept 15 can command five channels of disk I/O from a single drive with each operating at 1.86M bytes per second—or a total of 9.3M bytes per second. The Costa Mesa, Calif., company plans shipment of the \$14,100 subsystem this month.—*Carl Warren*

TECH FILES: A QUICK LOOK AT NEW PRODUCTS AND TECHNOLOGY

Inmos Corp. is quoting a maximum price of \$500 for its single-chip microprocessor, the Transputer, scheduled for launching by the Colorado Springs, Colo., company this month. Designed for concurrent computing



RACE is the new high-speed, full duplex, intelligent modem developed by Data Race, Inc. to meet the needs of today's computing community.

It's designed for that legion of interactive users who employ asynchronous ASCII - based terminals or PC's to communicate with a variety of host computers. Sometimes this communication is now achieved inefficiently over standard dial-up telephone service, sometimes expensively over leased telephone lines. With **RACE** you can dramatically cut the expense and remove the inefficiency while working exclusively with low cost dial-up telephone service.

With **RACE**, the wait for a screen display in response to your instructions is over — literally. No more finger-tapping by users waiting for a terminal to chug-chug-chug through a display command. Now it's **ZAP**, and it's all there. Less time is spent waiting, more time is spent doing, resulting in lower line costs and higher user productivity. At Data Race we estimate effective throughput of the **RACE** modem to be four to ten times faster than with standard dial-up modems.

The extraordinary throughput possible with **RACE** translates to greater individual productivity, reduced line costs and an end to the chafing and frustration interactive users now suffer having to wait on a computer in the problem solving and information seeking process.

MORE THAN A FAST MODEM

But **RACE** is much more than just an extremely fast modem. By incorporating innovative proprietary software techniques, it offers a comprehensive error detection and correction capability that guarantees the total integrity of data as it moves from terminal to computer, and back again, despite line noise and related problems.



AVAILABLE NOW: RACE I: \$1,995., RACE II, \$2,495.

With **RACE** you can work upon and transmit your most important files with complete confidence that what you send is what's received at

the other end, and vice versa, even at extremely high speeds of transmission.

RACE offers numerous other automatic features, including automatic dial up, automatic redial, automatic hangup, automatic Bell-103 mode, speed translation, line equalization, line quality display and flow control, among others. The high throughput and other **RACE** features make possible new terminal based applications such as spread sheet, text processing, data base inquiry and other office automation uses that have been impractical with standard dial-up modems.

PC users can also employ **RACE** to improve host computer response time, and reduce line costs for many data base services and related applications. A companion **RACE** unit, **RACE II**, permits simultaneous transmissions to a remote terminal and an associated printer unit where that is desired.

FREES USERS FROM OUTMODED TECHNOLOGY

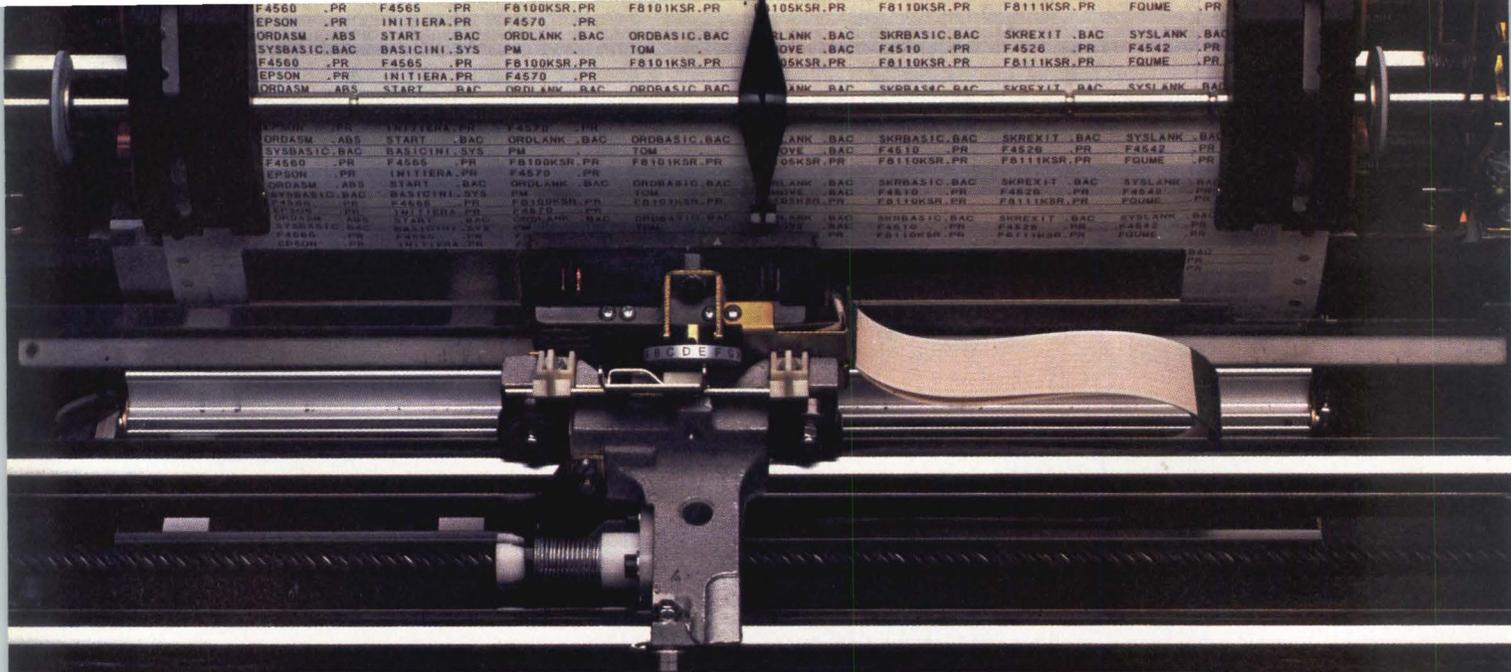
What this new "intelligent" modem from Data Race does is free the interactive user from the shackles of outdated transmission technology. It's a breakthrough product whose benefits will be best appreciated by those individuals who do their daily work in front of computer terminals and PC's, and by their data processing managers and other corporate executives who recognize the need for better communications cost control and improved personal productivity from their investment in distributed data processing.

For more information on the **RACE** product line, please contact Mr. Chuck Webster, Vice President, Sales, at:

DATA RACE

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(512) 692-3909

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THE 1,000,000,000th CHARACTER AS PERFECT AS THE FIRST

Facit 4571 Matrix Printer incorporates all the essential qualities that define it as your central printer for large-volume printouts. As well as for handling draft and NLQ-printouts from several wordprocessing workstations with automatic sheet-feeding.

Built for professional heavy-duty operations around the clock, it features Facit's unique Flexhammer Printhead. The innovation that gives you all-perfect, non-

deteriorating printouts throughout the printhead's more than 1,000,000,000-character service life. At a speed of 350 cps draft or 80 cps NLQ.

Integrated in your word- and dataprocessing systems, its software intelligence and printing capability will convince you of its versatility and competitive edge.

Italic, bold and elongated characters in any combinations – as well as 16 different monospaced or proportional fonts – are easily selected from the keypad or host computer. All fonts are available in 12 national versions.

So when performance and 100% reliability are unconditional demands on the printer in your system, compare the one billionth character with the first.

You can't go wrong with the Facit 4571.

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applications such as signal processing and database access, multiple "transputers" can be connected to one another in a matrix. Discounts are available for large-volume orders.—*Keith Jones*

With an IBM Corp. PC to configure test parameters and store test results, **KJ Instruments Inc.'s** Winchester analyzer can accommodate 5¼- and 3½-inch ST506/412-compatible disks. The \$3,500 tester from the Laguna Hills, Calif., company will perform all digital read/write and seek testing, including reformatting to account for defect maps. Included with the tester is a 5¼-inch floppy disk with full testing diagnostics that users can tailor to specific needs.—*Carl Warren*

Eicon Research Inc., New York, claims the fastest average access time of any IBM Corp. PC/XT or PC/AT hard disk system with its PC DisCache. The system achieves an access speed of 8 msec through a 256K-byte RAM cache with a proprietary processor that handles 90 percent of all disk accesses, rather than passing them on to the Winchester. PC DisCache, with a 10M-byte Winchester for standalone PCs, is priced at \$3,595; a unit with a 40M-byte Winchester for sharing PCs over local area networks is \$5,950. A required direct-memory access interface is \$495.—*Keith Jones*

Hardware and software based on **Honeywell Information Systems Inc.'s** Distributed Systems Architecture (DSA) have been developed by the Minneapolis company for networking and communications. Called DSA 300, the products include new models of Honeywell's Datanet 8 front-end processor; enhanced operating-system software; a network-control facility; and a gateway from DSA to IBM Corp.'s Systems Network Architecture. DSA implements all seven layers of the open systems interconnection reference model.—*Lynn Haber*

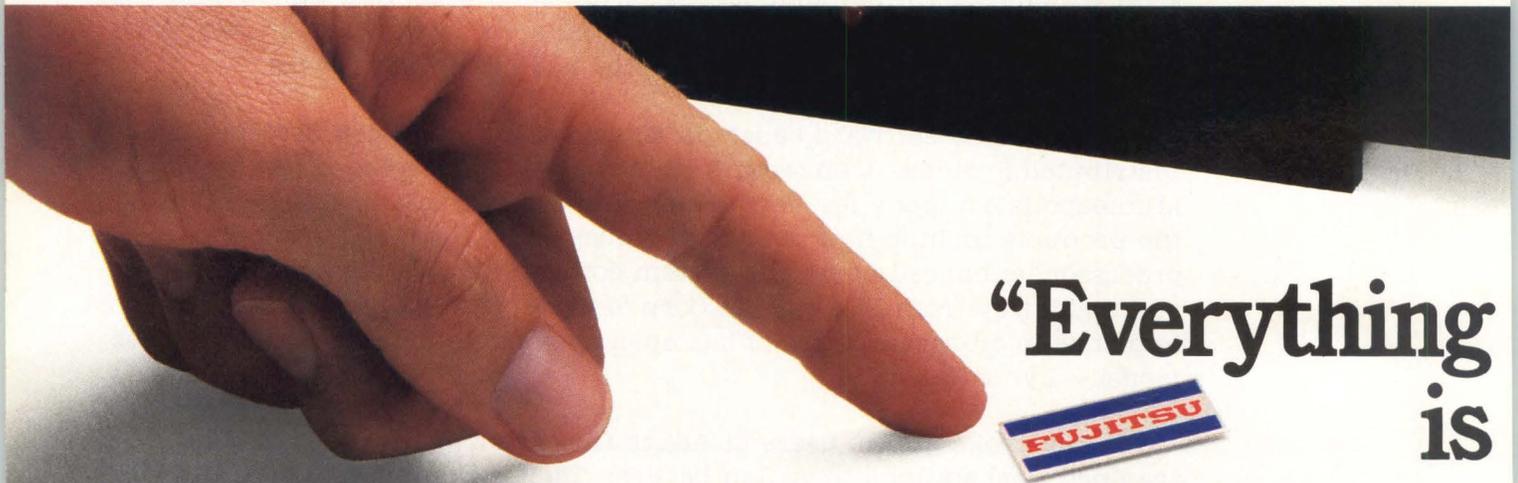
One keystroke allows users of **Adage Inc.'s** new 6500 series of color graphics workstations to switch between Digital Equipment Corp. and IBM Corp. environments. The two high-end members of the Billerica, Mass., company's four-product family support both DEC-compatible graphics software—such as PATRAN, ANSYS and MSC/NASTRAN—and all IBM 5080-compatible programs such as CADAM, CATIA, CAEDS AND CBDS2. The workstations are based on the Adage OCEAN graphics engine, the DEC MicroVAX II and the MicroVMS operating system. Multiwindowing is among the units' capabilities.—*Dave Simpson*

Genisco Computers Corp. of Costa Mesa, Calif., is using price and functionality to position its new color graphics terminals against Tektronix Inc.'s high-end products. Genisco's HS32, HS34, HS50 and HS60 all feature 19-inch monitors with 1,280-by-1,029-pixel resolution; 60-Hz, non-

BREAKPOINTS

interlaced refresh; and operating speeds of 60,000 vectors per second for 3-D and 28,000 for 2-D. The HS32 and HS34 come with palettes of 4,096 colors and four planes; the HS50 and HS60 feature 16.7 million colors and can be built with up to 12 planes. Prices range from \$14,950 to \$20,000.—*Mike Seither*

SOFTWARE NOTES: Release 2 of Lotus Development Corp.'s Lotus 1-2-3 integrated software lists among its new features spreadsheet equality with Symphony; added macro capabilities; access to DOS without re-entering 1-2-3; and Intel Corp. 8087 and 80287 coprocessor support. The Cambridge, Mass., company also has a new 1-2-3 Report Writer companion product that stores 30 formats per file and generates custom reports. . . . Personal Consultant Plus second-generation, expert-system development software from **Texas Instruments**, Dallas, includes a compiled version of LISP, pop-up windows and a problem-structuring technique called "Frames" . . . Version 4.1 of the Concurrent DOS operating system from **Digital Research Inc.**, Monterey, Calif., now



"Everything is



Norman B. Petersen
President, Storage and Peripheral Products
Fujitsu America, Inc.

Throughout the disk drive industry, the Fujitsu name stands for proven technology, superior performance and unmatched reliability.

Throughout the world, the name represents a company that comes through with products instead of promises.

And when it comes to 5¼" Winchester disk drives, Fujitsu America has a new 172MB drive, with units available today for your evaluation.

It's the newest member of our 5¼" disk drive family—and it's based on the same proven technologies. It's fully compatible with industry standards. And it gives you a significant price/performance advantage.

This drive represents a major step in the evolution of your

runs on the AT&T Co. 6300 and IBM Corp. PC/AT systems, handles both MS-DOS 2.1 and GEM applications and will be available to OEMs.—*Eileen Milauskas*

SYSTEM NOTES: **Corona Data Systems Inc.**, Thousand Oaks, Calif., has announced 47 percent price reductions on its 400 Series of four desktop and three transportable IBM Corp. PC-compatible microcomputers. . . . The 32-bit Balance 8000 parallel-processing system by **Sequent Computer Systems Inc.** of Portland, Ore., now employs National Semiconductor Corp.'s 32032 10-MHz CPU and supports CCA Uniworks' CCA-EMACS UNIX text editor and Unify Corp.'s UNIFY relational database-management system. . . . **Metaphor Computer Systems** of Mountain View, Calif., can now connect up to eight file servers on a network to its information and retrieval-analysis system. Its new 200S communications server enables up to 24 emulation tools to gain access to an IBM mainframe via 3270 Systems Network Architecture connection.—*Eileen Milauskas*

this name represents built into these 5¼" drives."

multi-user system. And Fujitsu America has the technology, the strength and the experience to help you continue on that growth path.

So no matter what capacity 5¼" drive you need, you can be sure of its performance, reliability and delivery. We keep close control of all three by manufacturing virtually every component of our drives ourselves. And we recently opened a plant that adds 220,000 square feet to our 5¼" and 3½" manufacturing capacity.

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Model	M2233	M2235	M2243	M2246E
Capacity (MB) (unformatted)	13	27	86	172
Access Time (msec)	95	83	33	28
Interface	ST506/412	ST506/412	ST506/412	ESDI
Transfer Rate (KB/sec)	625	625	625	1250
Technology	Composite ferrite heads, Oxide media			



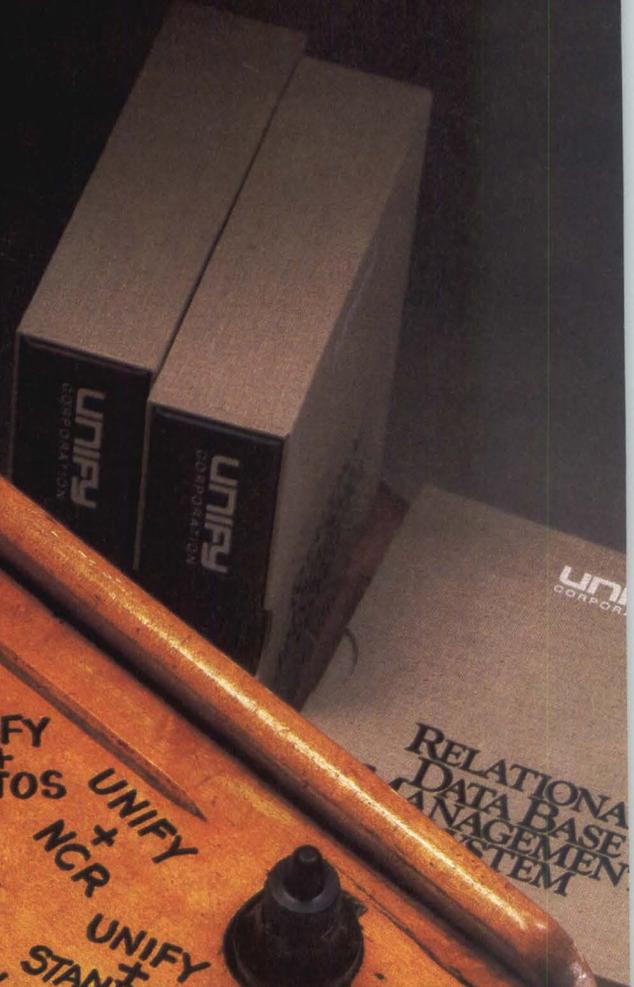
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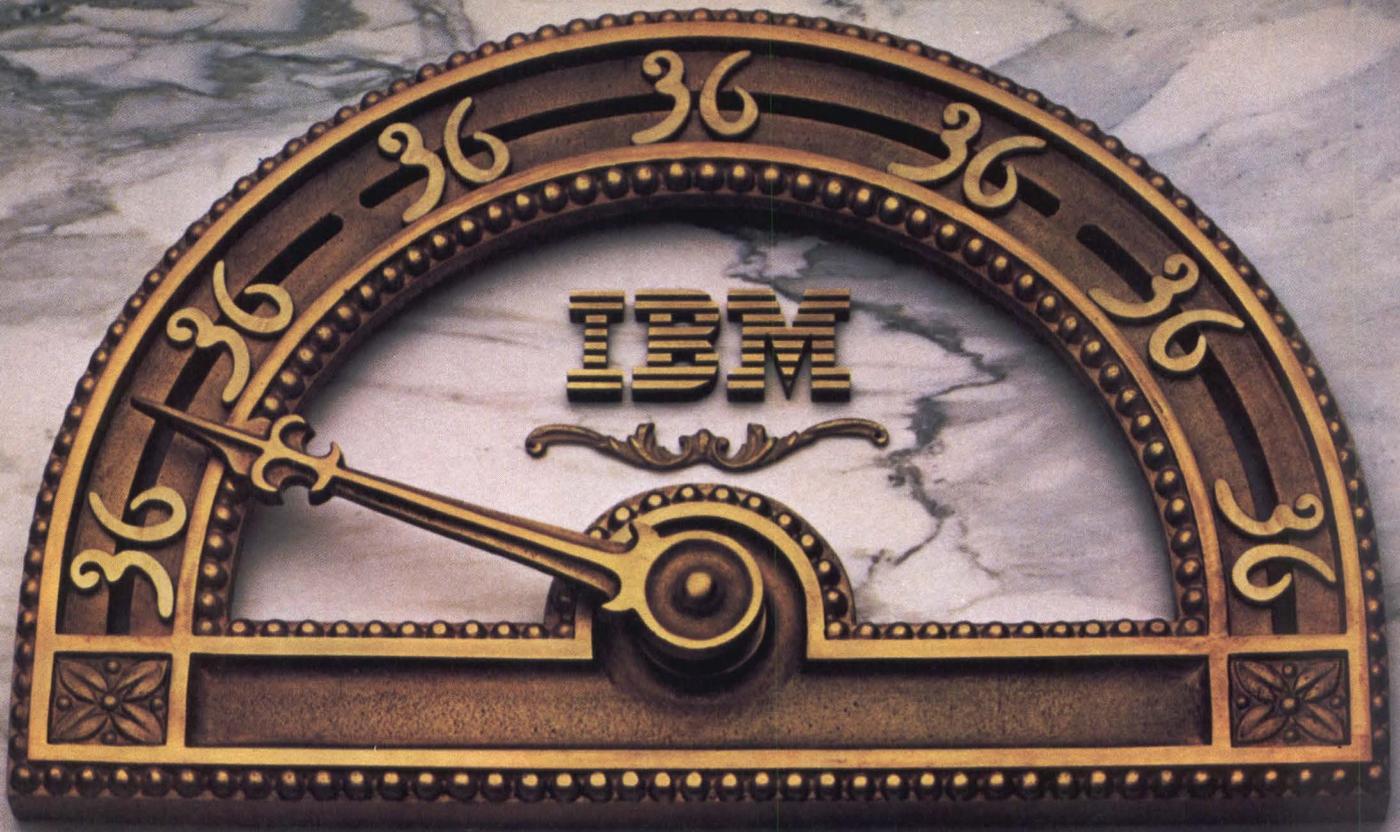
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CIRCLE NO. 21 ON INQUIRY CARD

Microscience packs 50M bytes in half-height, 5¼-inch Winchester

Mike Seither

Associate Western Editor

Microscience International Corp., the 3-year-old Mountain View, Calif., Winchester disk drive manufacturer, plans to unveil a 50M-byte, half-height 5¼-inch drive at Comdex/Fall '85 in November. With an average access time of 35 msec, the drive is Microscience's fastest and most powerful product yet.

Microscience marketing director Ron Schlitzkus says evaluation units of the model HH-1050 will be available in November. Volume production is expected to begin in January, with pricing under \$1,000 in OEM quantities.

Microscience is targeting the HH-1050 at OEMs who are building systems around IBM Corp.'s PC/AT or compatibles. "We believe there is a strong market for applications where speed and memory capacity are critical," says Schlitzkus, citing multiuser systems, computer aided design and manufacturing, and finance as potential areas for the new drive.

Uses voice-coil motor

The HH-1050 brings the number of Microscience drives to five—all of them half-heights. The company manufactures 10M- and 20M-byte models in 5¼-inch and 3½-inch versions. But unlike those drives, which use stepper motors, the HH-1050 incorporates a voice-coil motor to position the read/write head over the disk.

Voice-coil motors have been used



A voice-coil motor helps the 50M-byte Microscience HH-1050 achieve an average access time of 35 msec.

for some time on 8-inch and 14-inch drives, and on some high-capacity, 5¼-inch, full-height Winchesters. Faster than stepper motors, they allow closed-loop positioning of the head over the track where data is to be written or read. Schlitzkus says the HH-1050 is technologically significant because Microscience has been able to engineer a voice-coil motor to fit inside a half-height unit.

Unlike stepper motors, which tick their way to their destination much like the second hand on a watch, voice-coil motors are under a constant magnetic force and require a dedicated, closed-loop servo mechanism. That system feeds back track-location data from the dedicated servo surface to position the read/write transducers in the heads. Microscience accomplishes this

through the use of a full-track servo that reads positioning data from one side of one of the drive's three platters. The remaining five platter surfaces, each with an unformatted capacity of 10.21M bytes, are used for data storage.

Microscience is not the first company to announce a half-height, 5¼-inch Winchester with an average access time of less than 40 msec. In April, Quantum Corp. of Milpitas, Calif., announced its Q200 line, which includes two 30-msec drives, one with a capacity of 53M bytes and the other with 80M bytes. According to Quantum officials, evaluation units will be available in October; volume production is expected to begin in December. The 80M-byte unit will be priced at \$995 in quantities of 1,000; the 53M-

byte drive will be priced at \$875.

Quantum has elected to manufacture its fast half-heights with the small computer systems interface, believing that SCSI will offer OEMs more flexibility in configuring their systems. One difference between the SCSI and ST506/412 lies in data-transfer rates. SCSI can operate at up to 10M bits per second (bps), compared to 5M bps for the ST506/412. Microscience, on the other hand, has decided to use the industry-standard ST506/412 drive interface, at least initially. "We'll look at SCSI seriously," says Microscience's Schlitzkus, "when there is an SCSI standard." (ANSI is expected to approve the proposed SCSI standard next year.)

Industry observer James Porter, president of Disk/Trend Inc., Los Altos, Calif., believes that Microscience and Quantum will do well with their new drives. Both companies, he notes, have reputations for delivering

quality products when promised. "The Quantum drive will be very successful, but you'll have to take it their way, without a drive-level interface," says Porter. "The Microscience drive will appeal to controller houses and subsystem builders who want to add their own value."

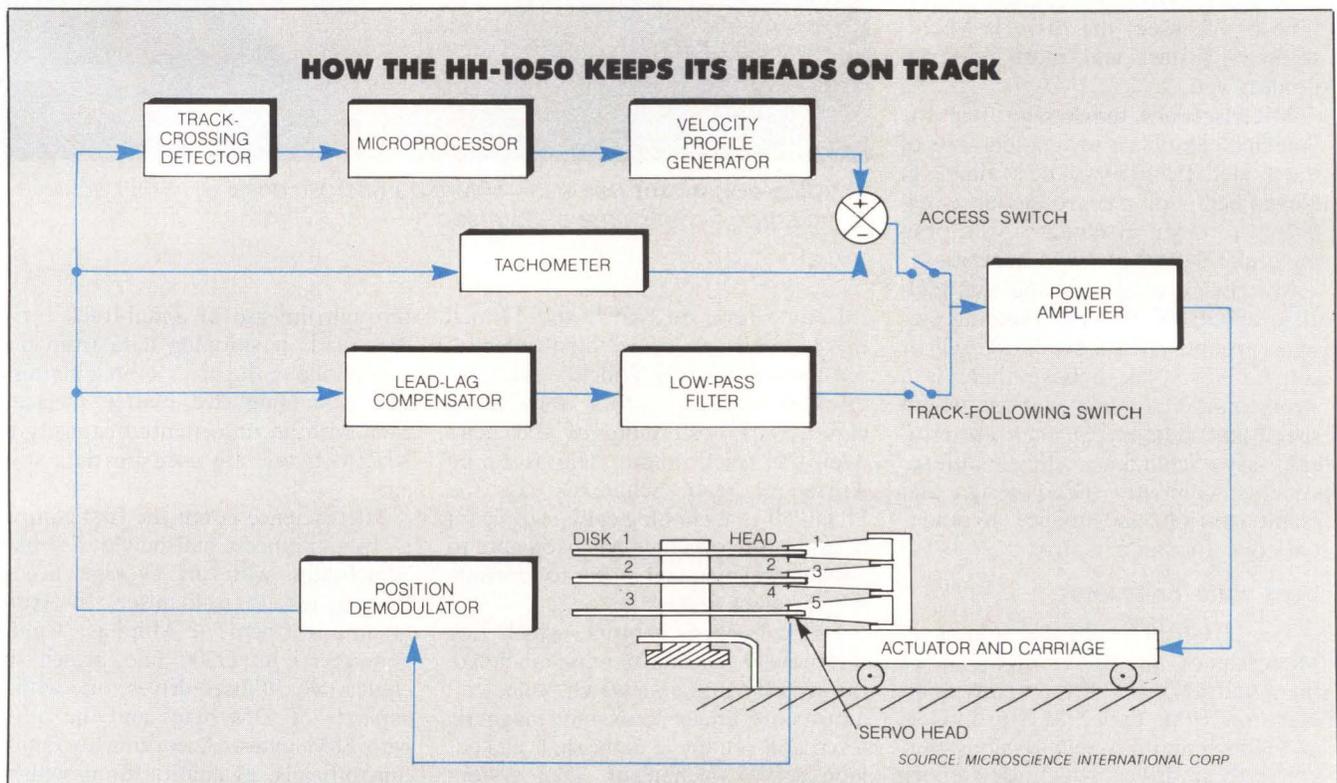
Industry analyst Dave Velante of International Data Corp., Framingham, Mass., says it is advantageous for Microscience to use the ST506/412 interface. "Most of the personal computers out there are running the ST506/412," says Velante. "Not only are there a lot of off-the-shelf controllers already available, but Microscience might be correct in thinking that an ST506 drive might be easier to manufacture now [than an SCSI drive]."

Timing called critical

Whatever interface is used, Microscience and Quantum are taking a major step by offering drives with ac-

cess times less than 40 msec, say analysts. Porter is unequivocal about the importance of speed, particularly where multiuser environments are concerned. "With a given system, the access time is directly related to the number of workstations that can be supported," he explains. "At 45 msec, say, you can support two or three users. At 35 msec, you could add another user. With an access time of 30 msec, you might be able to add yet another." Thus, faster drives are significantly broadening the salability of systems, he adds.

But at least two other drive makers are not targeting their new half-heights at the multiuser market. For example, Computer Memories Inc., Chatsworth, Calif., hopes its Series 4000 Winchester—a 40-msec, 20M-byte drive—will appeal to computer manufacturers planning smaller PC/AT-type machines. Says product marketing manager Joe Lloyd, "Only a small



The closed-loop system on the Microscience HH-1050 provides a continuous flow of track-positioning data between a dedicated servo on the underside of disk 3 and the read/write transducers on the remaining five data-storage surfaces. Such a system is necessary on drives, like the HH-1050, that use voice-coil motors.

percentage of ATs are being tied into multiuser systems." For single users, he adds, the difference between an access time of 30 msec and 40 msec is barely noticeable. The Series 4000 will sell for \$725 in quantities of 1,000, says Lloyd.

Tulin Corp., a San Jose, Calif., Winchester manufacturer, also is looking at the low end of the PC/AT market with its new half-heights, which it will introduce at Comdex. The TL 326 and the TL 340 have unformatted capacities of 26.7M bytes and 40M bytes, respectively. Both have an average access time of 45 msec. Tulin president Chua Lin would not discuss prices, except to say that they would be competitive. Like Computer Memories, Tulin believes the more compact drives are what PC manufacturers want for their next generation of machines.

In the midst of intense pressure on disk drive makers, Microscience has scored an impressive performance. Analysts estimate that the privately held company has shipped between 60,000 and 70,000 units since introducing its first drive two years ago. Although the company won't reveal financial details, industry observers estimate that Microscience had revenues in excess of \$20 million last year, and that number may well double this year. Among its main OEM accounts is Compaq Computer Corp. of Houston.

Microscience is careful not to let any single OEM account for more than 30 percent of its business, a strategy that others may wish they had followed. The latest victim to rely too heavily on one customer is Computer Memories. In August, IBM failed to renew its contract for disk drives with that company. More than 80 percent of Computer Memories' first-quarter revenues had derived from its IBM business.

Until this year, all Microscience manufacturing took place in its Mountain View and Sunnyvale, Calif., facilities. But in March, the company formed a partnership with Wearn's Technology, a Singapore manufacturer of castings and printed-circuit boards. Under that partnership, Microscience begins production of its drives in the United States, then completes the

Spec summary

- **Model:** HH-1050 50M-byte, half-height, 5¼-inch Winchester disk drive
- **Manufacturer:** Microscience International Corp., 575 E. Middlefield Road, Mountain View, Calif., 94043 (415) 961-2212
- **Media:** Plated
- **Capacity:** 51M bytes unformatted; 40M bytes formatted
- **Platters:** 3
- **Average access time:** 35 msec
- **Rotation speed:** 3,600 revolutions per minute
- **Data transfer rate:** 0.625M bytes per second
- **Bytes per track:** 10,416
- **Dimensions:** 1.65 by 5.75 by 8 inches
- **Weight:** 3½ pounds
- **Price:** Under \$1,000 (OEM quantities)

COMPARING THE NEWEST HALF-HEIGHTS

Vendor	Interface	Media	Access time (msec)	Capacity (M bytes) (*formatted)	Price† (\$)
Advanced Storage Technology Inc.					
Series 96200	ESDI	thin film w/ carbon overcoat	30	61.8 103.1	1,150 1,475
Computer Memories Inc.					
Series 4000	ST506/412	oxide	40	26.5	725
Microscience International Corp.					
Model HH-1050	ST506/412	plated	35	51	under 1,000
Mitsubishi Electronics America Inc.					
Model MR-533	ST506/412	oxide	38	30	770
Model MR-535	ST506/412	oxide	38	50	900
Model MR-5310	ESDI, SCSI	oxide	38	101	1,125
Quantum Corp.					
Model Q250	SCSI	sputtered	30	53*	N/A
Model Q280	SCSI	sputtered	30	80*	995
Tulin Corp.					
Model TL326	ST506/412	sputtered	45	26.7	N/A
Model TL340	ST506/412	sputtered	45	40	N/A

†Most prices quoted are for OEM quantities

units in Singapore.

Schlitzkus says the company's long-range strategy is to establish parallel manufacturing facilities in the United States and overseas. Then, as a drive reaches the peak of its product cycle and prices begin to erode, Microscience can switch the entire manufacture overseas, where labor costs are

lower. Meanwhile, the company will bring new products on-board in the United States. "Almost everyone who's tried to blow manufacturing offshore has had problems," admits Schlitzkus. Those include culture, communications and engineering. "We're taking a conservative approach with duplicate facilities." □

Minisupercomputers challenge superminicomputer turf

Lynn Haber, Associate Editor

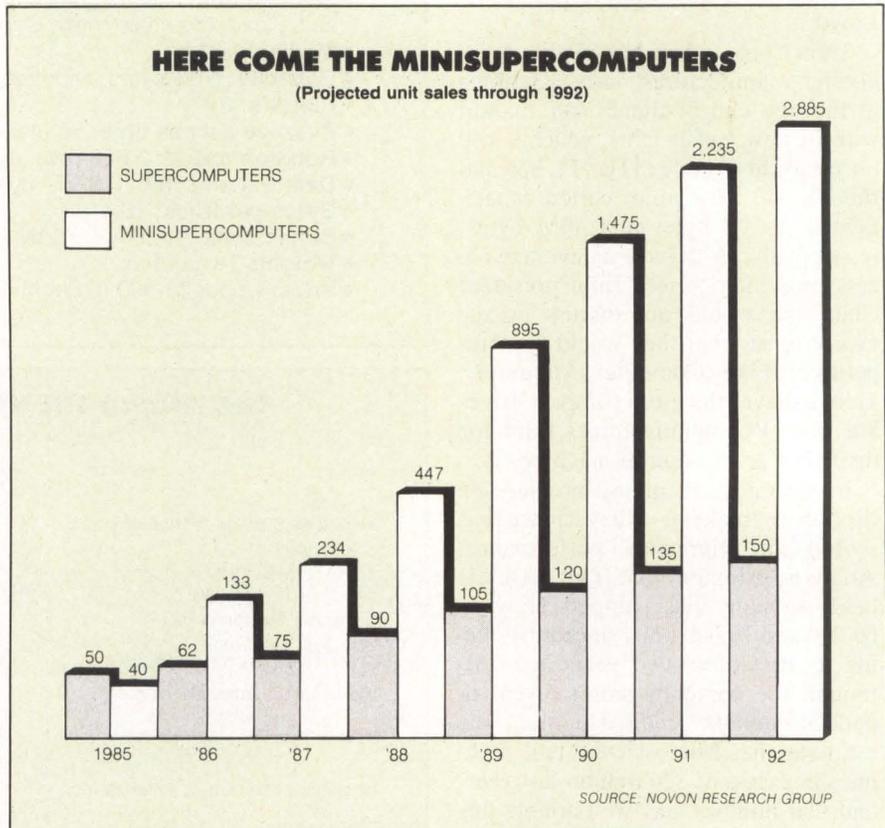
Digital Equipment Corp.'s VAX computer has become the target of an army of energetic, start-up companies busily developing "minisupercomputers"—machines delivering one-fifth the performance of a supercomputer at one-tenth the price. The challengers are aimed squarely at computation-intensive scientific and engineering markets. Is the Maynard, Mass., company worried?

"Minimally," says Robert Alessio, DEC VAX marketing manager. He contends that, "Customers aren't looking for niche manufacturers. They're looking for vendors committed to their product line. I think the days of customers buying products from three, four, five different vendors are gone."

In the same way that the personal computer created the need for more powerful I/O and transaction-processing minicomputers, advanced scientific and engineering workstations have created a bottom-to-top drive for faster and cheaper computation-intensive high-end computers. The new minisupercomputer is designed to fill the gap in processing power between that of superminicomputers/mainframes and the more powerful supercomputers.

Financial analyst Jeffrey Canin of Hambrecht & Quist, San Francisco, contends minisupercomputer sales will account this year for \$125 million in sales across the entire scientific/engineering market, expected to hit \$6 billion by the year-end. This computation-intensive niche market will exceed \$1 billion by 1990, predicts Canin.

Makers of the new minisupercomputers—also referred to as "near-supercomputers" or "Crayettes" in a takeoff on Cray Research Inc.'s supercomputer—hope to grab a slice of the niche. The start-ups include Alliant Computer Systems Corp., Acton, Mass.; Convex Computer Corp., Rich-



ardson, Texas; Multiflow Systems, Branford, Conn.; Scientific Computers Systems Corp., Wilsonville, Ore.; and Vitesse Electronics Corp., Camarillo, Calif., to name a few.

"The near-supercomputers," says Oscar Rothenbuecker, senior consultant with Arthur D. Little, Cambridge, Mass., "address the market that lies on top of [and overlaps] the present market of VAXes used in engineering, design and development and artificial intelligence applications." Such industry-specific, computation-intensive applications include geophysical and seismic processing, electronic and mechanical computer aided design, general signal processing and image analysis.

Analysts agree that minisupercomputers will pose the greatest threat to

manufacturers such as DEC, Gould SEL Inc. and IBM Corp., whose presence in the scientific and engineering markets is substantial. DEC, in particular, say industry observers, will face the greatest, perhaps most direct, challenge.

Omri Serlin, president of ITOM International Co., a research and consulting concern in Los Altos, Calif., believes that there's a misconception among minisupercomputer manufacturers as to who might buy their machines. "It's a grave mistake to assume that the Cray market would be interested in the minisupercomputer," he states. A manufacturer looking for budget-conscious Cray buyers, he suggests, is like a racing car driver buying a reconfigured Volkswagen because of its lower price tag. "These customers'

How to increase computer speed

Brian Boyle

Faster devices make a computer run faster. The base of all performance measurements is raw scalar speed, which is determined almost entirely by the computer clock speed in megahertz. Scalar processors operate on one arithmetic element at a time. This is referred to as the single-instruction, single-data (SISD) stream aspect of all computer systems. SISD involves no parallelism and represents the classic von Neumann machine in which the CPU reads a single instruction and applies it to the specified single data element in memory, register, cache or wherever.

All other improvements derive from some form of parallel execution of discrete parts of a program.

The first two levels of such parallelism are subclasses of the single-instruction, multiple-data (SIMD) stream approach, labeled "pipe" and "vector." These are the two most common methods of partitioning a problem among several arithmetic units at the level closest to the individual instruction—also known as "fine-grain parallelism" or "small granularity."

The first mechanism, the pipeline, partitions the single-instruction sequence vertically, allocating the pro-

gram in short, but repeatedly executed, steps to multiple data-computation elements in an assembly line fashion. The second form of SIMD partitions the task horizontally and a single instruction is executed simultaneously by a vector, or array, of several data-processing elements, like soldiers following the orders of a drill sergeant.

Adding more complete processing units to decode and execute multiple instruction streams operating on multiple data streams constitutes the multiple instruction, multiple data (MIMD) approach, known as "large-grain parallelism." The additional processors operate like any well-run team, with different individuals performing different functions but working towards a common goal. Similar to human team operations, the problems that arise in this class of approaches are typically those of coordination, management and task synchronization.

Brian Boyle is president and director of research with Novon Research Group, a consulting company in San Francisco.

interest is in absolute performance," he contends.

Hambrecht & Quist's Canin agrees. "In part, minisupercomputer revenue will come from superminicomputer manufacturers," he says. "A small portion will come from the supercomputer community, but the minisuper will not be a threat to the supercomputer."

While industry critics and minisupercomputer manufacturers recognize the marketing pitfalls that face unknown companies with untried products, they can also see that near-supercomputers are an undeniably effective solution for a host of scientific and engineering applications that would otherwise take days, weeks or maybe months to compute.

DEC already recognizes its customer's requirements for faster computing. About a year ago, the company negotiated cooperative marketing agreements for array processors from Floating Point Systems, Beaverton, Ore.; CSP Inc., Billerica, Mass.; and Sky Computers Inc., Lowell, Mass. In

array, or vector, processing a single instruction operates on groups of data (vectors) simultaneously, thereby speeding up the execution of a problem.

"We want to be able to provide users who want to stay in the VAX environment—and whose applications require high-performance array processing—that opportunity, while still offering them a cost-effective solution," says DEC's Alessio.

ITOM's Serlin maintains that, while he suspects DEC's cooperative marketing agreements could satisfy many VAX customers, the tactic will not make up for the attraction of minisupercomputer capabilities. "The near-supercomputers incorporate array processing into the instruction set, which means there's tight integration," he explains. "With off-board array processing you create a loosely integrated architecture."

Response deemed archaic

Calling such a solution a quick fix to the problem, Brian Boyle, president

and director of research with Novon Research Group, San Francisco, reports that over 50 percent of the Floating Point System 5000 processors series are used as back ends to IBM systems (40 percent on the 4300 systems alone) while the remainder mostly support VAX-11/780 processors.

David Rome, director of marketing for Alliant, says DEC's strategy "results in an incredibly archaic architecture. There's nothing elegant about attaching an array processor to a VAX. It's a method that's filled with architectural bottlenecks."

Boyle notes that most of these attached processors are 32-bit and that speed is achieved more by high degrees of vector parallelization than raw device speed or true multiple-instruction, multiple-data (MIMD) architectures (see "How to increase computer speed," above).

Alliant recently introduced the FX/8 minisupercomputer priced between \$270,000 and \$1 million. The machine reportedly provides both parallel and vector processing. Alliant

WHEN DOES A 'SUPERMINI' BECOME A 'MINISUPER' ?

Computer type	Architecture	Type of processing	Requirements	Performance (64-bit MFLOPS)		Price (\$)
				Linpack	Peak	
Superminicomputers	32-bit fixed	scalar-SISD; some pipelining	conventional UNIX operating system software and standardized third-party applications	Linpack .2-.5	Peak .2-.2	100,000-500,000
Minisupercomputers	64-bit and 32-bit floating point operations	scalar and vector pipelining-SIMD, MIMD	familiar languages (e.g., FORTRAN); familiar network and interface standards	Linpack (low-end) 2.0 (high-end) 16	Peak 20- 100	300,000-1.5 million
Supercomputers	64-bit floating point operations	vector and pipeline	complex software; usually requires specialized operators	Linpack (low-end) 10 (high-end) 50	Peak 160- 1300	5 million-20 million

claims that a fully configured FX/8 delivers more than 12 times the performance of a VAX 8600.

At the same time, Alliant introduced the FX/1, a multiprocessing superminicomputer that provides integrated vector processing. The company claims the unit can deliver twice the performance of the VAX 8600. The company also says that the \$132,000 machine runs software programs written for VAX systems without modification. Shipment of both new models was scheduled to begin in October.

Another company with a minisupercomputer off the drawing board is Convex Computer Corp. The C-1 is a 64-bit system with integrated vector and scalar processing. According to a Convex spokeswoman, the company has sold 10 systems since beginning shipments in April.

DEC's products are the most likely to be targeted by minisupercomputers because of its large installed base in the scientific and engineering markets. But ITOM's Serlin says, "I think a company like Gould is in a more dangerous position than DEC because they don't have as large an installed base or as much developed software for their machines." Serlin adds that Gould aims specifically at the engineering-oriented market, thereby putting the company in an even more vulnerable position.

Parallel and array processing are priority technologies for computation-intensive processing applications. And while it appears as if the start-ups aim

to corner the market, the more established manufacturers don't appear as though they plan to be left behind.

While refusing to discuss specific products, DEC's Alessio claims that his company has products on the draw-

ing board that incorporate parallel processing. Meanwhile, IBM is also reportedly experimenting with integrating, at the instruction-set level, an array processor to the company's mainframe computers. □

SBA offers \$500 million in R&D to integrators

Michael Tucker, Associate Editor

The federal government has announced plans to make half a billion dollars in research and development funds available to selected system integrators. The Small Business Administration already is working with 12 fed-

eral agencies to farm out R&D projects to companies of less than 500 employees under the Small Business Innovation Research (SBIR) program. According to the latest announcement, the \$500 million in R&D is earmarked for distribution in 1987.

Research topics available to comput-

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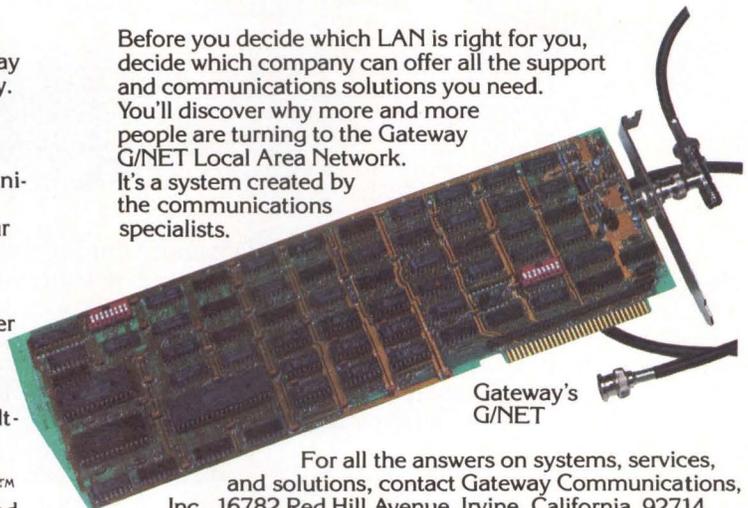
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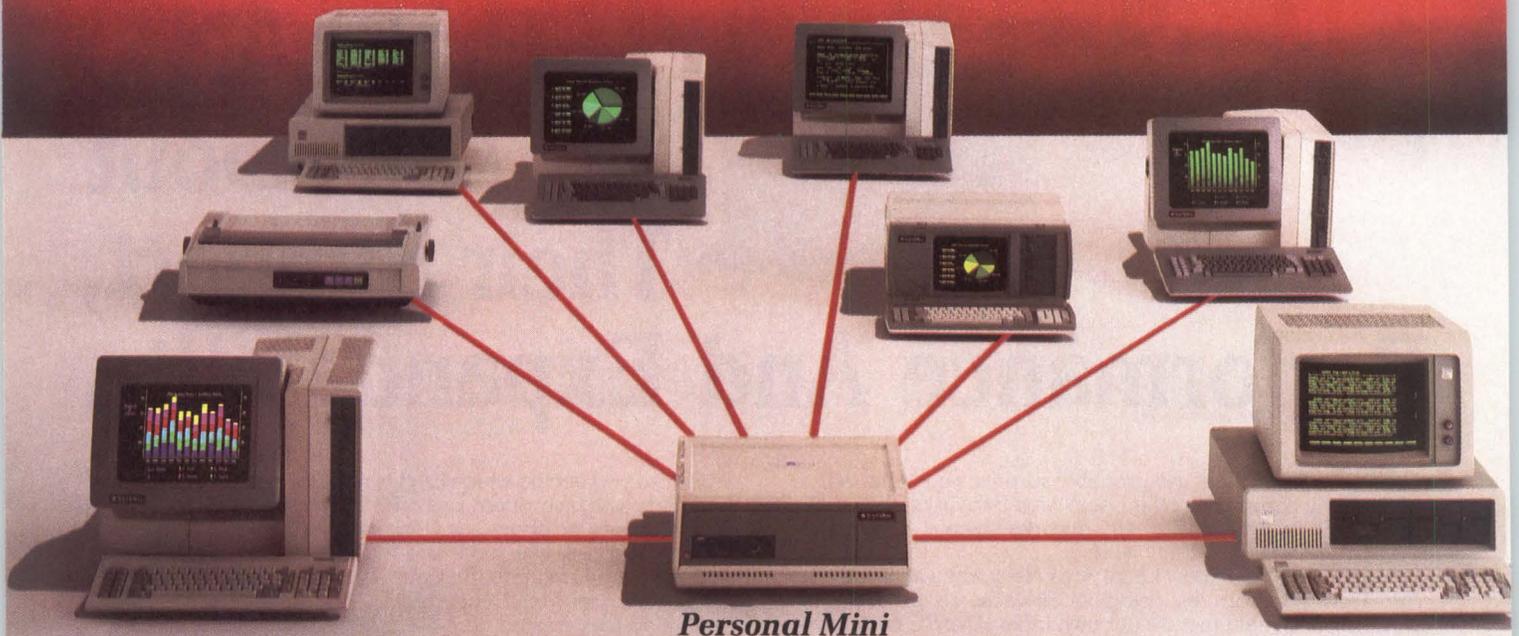
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er system integrators vary from "Improving the Usability of Software," for the Department of Education, to the more esoteric-sounding "Quantum Electronics," for the National Science Foundation. Companies and individuals who can convince the government of their ability to do significant R&D in those fields can get initial "Phase I" grants of up to \$50,000. Successful completion of Phase I projects can qualify recipients to compete for "Phase II" grants of up to \$500,000.

Finally, under Phase III of the program, the SBA acts as a matchmaker between Phase II awardees and larger companies that might be interested in marketing the results of the research.

There are some regulations, however. "You can't just do research on any topic that happens to interest you," says Juanita Weaver, the SBA's assistant director of public affairs. "You have to work from the list of topics the individual agency provides you." But

those lists are long, the topics are broad and the SBIR can provide companies with seed money that, says Weaver, "can be very hard to find nowadays."

The SBIR program was established in 1982 when President Reagan signed the Small Business Innovation Development Act. The Act requires all federal agencies with R&D budgets of \$100 million or more to farm out a percentage of their research work to small businesses. The program was inspired by a similar program the National Science Foundation had been running for some time.

An interested system integrator should ask the SBA, 1441 L St., N.W., Washington, D.C., for what it calls a "Pre-Solicitation Announcement." This lists agencies participating in the program and describes general R&D topics available from each. The March 1985 entry for the Department of Defense, for example, lists computer ar-

chitecture, artificial intelligence, directed-energy weapons and "high-velocity penetration/destructive devices."

If interested in a particular topic, an integrator can then contact the sponsoring agency directly for a program solicitation (see "SBIR spells \$500 million," below). Instructions are also available for drawing up a proposal—which is limited to 20 pages so that small companies or individuals won't be handicapped by a lack of clerical staff.

One 1984 Phase I recipient was Flexible Computer Corp. of Dallas, which received \$50,000 through the National Aeronautics and Space Administration to develop a floating-point array processor for the company's Flex/32 Multicomputer.

The Flex/32 is a multiprocessing machine that can contain up to 20 32-bit supermicrocomputers. A floating-point processor would make it much

SBIR spells \$500 million

Twelve federal agencies currently participate in the Small Business Innovation Research (SBIR) program. For further information and program solicitations, contact them at:

- **Department of Agriculture:** Office of Grants and Program Systems, Department of Agriculture, Room 112, West Auditors Building, 15th and Independence Ave., S.W., Washington, D.C. 20251, (202) 475-5022

- **Department of Commerce:** Director, Office of Small and Disadvantaged Business Utilization, Department of Commerce, Room 6411, 14th and Constitution Ave., N.W., Washington, D.C. 20230, (202) 475-5022

- **Department of Defense:** Director, Small Business and Economic Utilization Policy, Office of the Secretary of Defense, Room 2A340-The Pentagon, Washington, D.C. 20301, (202) 697-9383

- **Department of Education:** SBIR Program Coordinator, Office of Educational Research and Improvement, Department of Education, Mail Stop 40, Washington, D.C. 20208, (202) 254-8247

- **Department of Energy:** SBIR Program Manager, U.S. Department of Energy, Washington, D.C. 20545, (301) 353-5867

- **Department of Health and Human Services:** Director, Office of Small and Disadvantaged Business Utilization, Department of Health and Human Services,

200 Independence Ave., S.W., Room 513D, Washington, D.C. 20201, (202) 245-7300

- **Department of the Interior:** Office of the Chief Scientist, Bureau of Mines, U.S. Department of the Interior, 2401 E. St., N.W., Washington, D.C. 20241, (202) 494-2051

- **Department of Transportation:** SBIR Program Manager, Transportation Systems Center, Department of Transportation, Kendall Square, Cambridge, Mass. 02142, (617) 494-2051

- **Environmental Protection Agency:** Office of Research and Development, Environmental Protection Agency, Research Grants Staff (RD-675), 401 M Street, S.W., Washington, D.C. 20460, (202) 382-7445

- **National Aeronautics and Space Administration:** NASA, Administration, SBIR Office-Code RS, 600 Independence Ave., S.W., Washington, D.C. 20546, (202) 453-2848

- **National Science Foundation:** SBIR Program Managers, National Science Foundation, 1800 G Street, N.W., Washington, D.C. 20550, (202) 357-7527

- **Nuclear Regulatory Commission:** Office of Nuclear Regulatory Research, Nuclear Regulatory Commission, Washington, D.C., 20550, (202) 427-4250.

For general information on the SBIR program, contact the U.S. Small Business Administration, 1441 L St., N.W., Washington, D.C. 20416.

more powerful. "Eventually, we would have done the research anyway," says Flexible president Nicholas Matelan. "But certainly not this soon...it would have been a gamble for us. But [under the SBIR program] we're not giving up anything. We did a very successful feasibility study that showed we could produce a card that would operate in the 4-to-10 megaflop [million floating-point operations per second] range....With the advent of that card, we will be able to crack a much larger scientific market."

Flexible will retain all rights to work done under the program. The government requires only that it has access to the data resulting from the research.

Phase II means more research

Creare R&D Inc., Hanover, N.H., recently received a Phase II grant from the Department of Education to develop an "Education Data Acquisition System," hardware and software for secondary school science laboratories.

"The main issues on our minds, and the reasons we continued with a Phase II, were educational issues," says Paul Rothe, Creare's vice president and senior engineer. "If it were just a question of hardware or software, we wouldn't have bothered because we knew that worked. What we needed to find out was whether teachers would actually use it [the system]."

Creare used its grant to install the system in a school. "Without federal money, a small business like Creare is never going to spend the money for the kind of research that makes something go from a concept to a viable product," says Rothe. "We don't view the money we get from the SBIR program as dumb contract revenue...we view it as the beginnings of what may be a new business."

Not every Phase I project results in a Phase II. But even limited success under the SBIR program can benefit a small business. In 1983, for instance, Transtech International Corp., Natick, Mass., failed to receive a Phase II grant to perfect a Chinese character typesetting system which it had already developed under a 1982 Phase I award

from the National Science Foundation.

"After about a half year of research, we took the system to the NSF," explains Peter Kang, Transtech's general manager. "They came back and said, 'Your idea is excellent, your research is superb, but there just isn't a commercial market for the product in the United States.'"

Even so, Transtech's initial research on the project had been completed

without cost to Transtech. "We didn't give up," says Kang. "We're now developing the system ourselves with our own funding." The company may market the product in Taiwan.

"Basically," says the SBA's Weaver, "the bottom line of the program is that we're trying to get more research, more technology and just, well, more inventing into the economy as a whole." □

U.S. high-tech, Japan unite against trade bills

Stephen J. Shaw

Washington Editor

As oft said, politics make strange bedfellows. International politics simply adds language problems.

The U.S. computer industry finds its latest bedfellow speaking Japanese. Both the Japanese government and the U.S. computer industry are desperately trying to head off a potentially disastrous trade war between the two countries that could dash any hope of an economic rebound for the stagnant computer industry.

The two parties, so often at odds, are now politically allied in attempts to

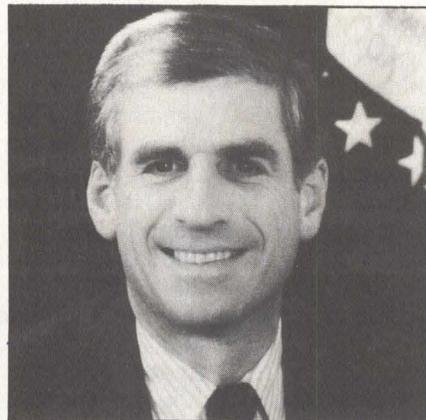
forestall a variety of protectionist trade legislation now pending in an angry U.S. Congress. U.S. computer and other high-technology trade organizations are fighting the most extreme proposal—a flat surcharge on all goods coming from several countries, including Japan—because of the added cost to U.S. computer products manufactured or assembled overseas. For its part, the Japanese government hopes to placate U.S. legislators with a new liberalization program to open their domestic market and is encouraging industry and public alike to go along with the reforms.

Unfortunately, both industry lobbyists and Japanese reformers are likely to fail in achieving their objectives on Capitol Hill. Analysts predict that the U.S. Congress will enact some form of restrictive import legislation this year that is almost certain to spark retaliation from U.S. trading partners.

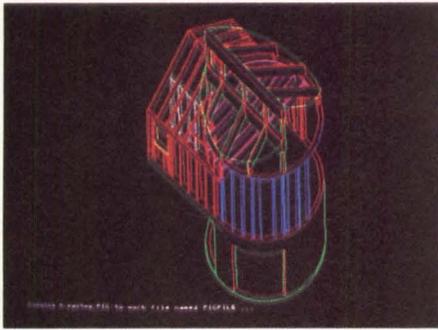
"Clearly, there's an attitude toward protectionism in Congress," observes Jack Hart, an international trade analyst with International Data Corp., Framingham, Mass., a high-technology consulting organization.

Protectionist sentiments are being fanned on Capitol Hill by anger over Japan's \$37 billion trade surplus with the United States last year. In 1985, the surplus is expected to balloon to more than \$50 billion.

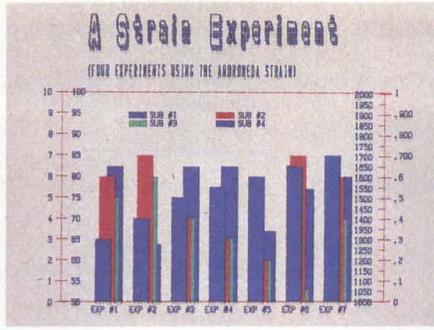
According to U.S. Department of Commerce figures, the Japanese ex-



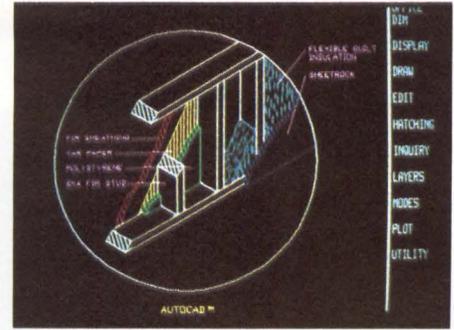
Sen. John Danforth favors increasing the president's negotiating power and retaliating against Japanese imports, if Japanese markets remain closed.



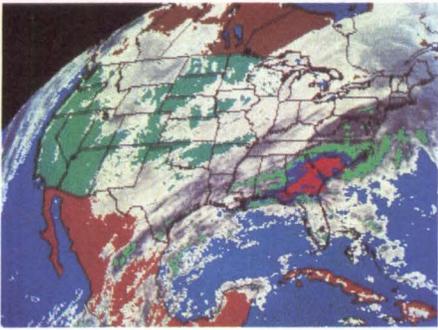
1. High Speed (MicroCAD Software)



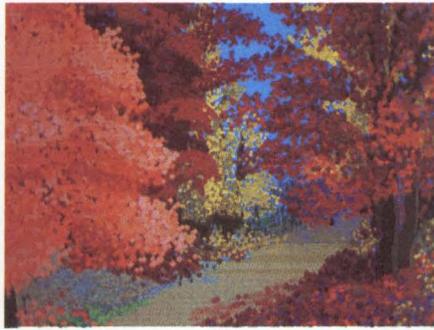
2. Dual Display Modes (Energraphics Software)



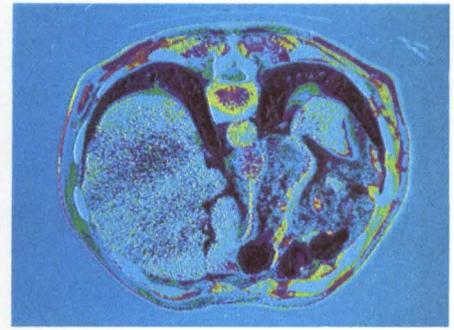
3. Simplified Processing (AutoCAD Software)



4. 9 Bit Planes (Courtesy WSI Inc., Bedford, MA)



5. 16.8M Color Shades (Courtesy Catherine Del Tito, Wave Graphics)



6. High Resolution (Courtesy University of North Carolina at Chapel Hill, Depts of Computer Science and Radiology)

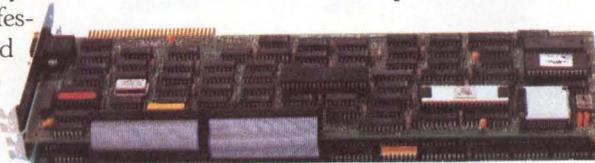
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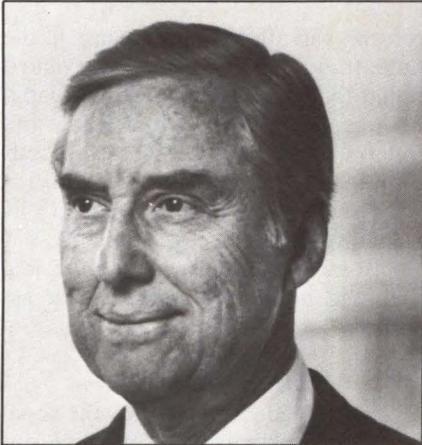
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CIRCLE NO. 25 ON INQUIRY CARD





Sen. Lloyd Bentsen is taking the hardest line with Japan: Cut trade surplus by 5 percent or face a 25 percent surcharge on exports.

ported \$3.3 billion worth of electronic computing equipment to the United States last year, including processors, terminals, storage devices and printers. In the first quarter of 1985 alone, they exported \$867 million worth of such equipment.

In contrast, 1984 U.S. exports to Japan of computers and related equipment totaled \$1.74 billion, accounting for a \$1.56 billion deficit. First-quarter 1985 exports were valued at \$350 million. If the trade disparity continues, the U.S. will import \$2.1 billion more in computer equipment from Japan than it will sell this year.

Swept along by growing popular demands for some response to the situation, Congressional legislators have introduced a variety of measures to help offset the imbalance. Although the authors of the legislation decry "protectionism," the proposals could, by various means, restrict imports into the United States unless steps are taken by the Japanese to open their markets and reduce the trade deficit.

Sen. John Danforth, R-Mo., chairman of the International Trade Subcommittee of the Senate Finance Committee, has sponsored two bills to improve U.S.-Japanese trade. One would give the president additional powers to negotiate access to Japanese markets for telecommunications

equipment. The other would require retaliatory action against Japanese imports, if Japanese markets remain closed.

Reps. Timothy Wirth, D-Colo., and James Florio, D-N.J., have introduced similar legislation into the House of Representatives. The House bill would authorize the Federal Communications Commission to delay the entry of telecommunications equipment and services into the United States in retaliation against countries that limit American imports.

A trade measure sponsored by Sen. Robert Packwood, R-Ore., has already been approved by the Senate Finance Committee and was headed for the full Senate. If passed, the measure would require that the president seek to eliminate unfair Japanese trade practices so as to increase U.S. access to the Japanese market. To the extent that the president fails, he is required to limit Japanese access to the U.S. market.

Sen. Lloyd Bentsen, D-Texas, and Reps. Richard Gephardt, D-Mo., and Dan Rostenkowski, D-Ill., have offered the most extreme trade sanctions. The legislation would require Japan, along with Taiwan, Brazil and Korea, to cut their trade surplus with the United States by 5 percent or face a 25 percent surcharge on their exports here beginning Oct. 15, 1986.

The legislation, the "Trade Emergency Act of 1985," would declare a national trade emergency. It would also require the United States to charge both Japan and the Common Market with unfair trade practices in international trade organizations, mandate action by the secretary of the treasury to lower the value of the dollar and strip the president of any policy-making role in trade issues and centralize that role in the office of the U.S. Trade Representative (USTR).

A staff assistant on trade matters to Bentsen says that the measure does not represent protectionism. "We hope the surcharge would never be used against Japan or any country," the aide explains. "But we're going to stem the tide of jobs [going] offshore."

Other observers feel that the trade



Rep. Dan Rostenkowski's Trade Emergency Act would require the United States to charge Japan and the EEC with unfair trade practices.

bills are aimed more at Ronald Reagan than at the Japanese. "Reagan has more than enough statutory authority already to go after the Japanese under the bilateral General System of Preferences," says one computer industry executive. "These initiatives are coming from Democrats who are tired of waiting for Reagan to act." Administration trade officials, including Clayton Yeutter of the USTR, have labeled the Bentsen bill "protectionist" and in violation of international trade accords.

Japan promises reforms

"The Japanese understand American politics. They know it's very popular now to engage in 'Japan-bashing' and they feel threatened enough to try and do something about it," comments John Choy, an analyst with the Japanese Economic Institute, an international policy think tank in Washington.

Hoping to mute Congressional saber-rattling over its trade surplus, the Japanese Cabinet and leaders of the ruling Liberal Democratic Party formally adopted at the end of July a plan dubbed "Reform 88" that contains modifications to 88 import regulations. Several of the steps promise to ease time-consuming and costly administrative barriers to the import of U.S. computers and related equipment.

Among them are:

- Accepting data from designated foreign testing organizations to certify equipment for the Japanese market

- Accepting, in certain circumstances, manufacturers' data to certify equipment

- Liberalizing Japan's financial markets to strengthen the yen, thereby reducing prices on American equipment.

Japan recently made one definitive step toward reducing barriers by eliminating tariffs on computer systems, parts and peripherals that ranged from approximately 5 percent to 8 percent.

In another tension-easing effort, Japan's Ministry of International Trade and Industry (MITI) has agreed to license advanced computer technology to IBM Corp. The licensing agreement reportedly includes approximately 500 patents involving semiconductor manufacturing techniques.

On the industrial front, Hitachi Ltd. says it will spend \$120 million on U.S. semiconductors and telecommunications equipment and pump an additional \$280 million in capital investment into the United States for three factories. At the same time, Sanyo Electric Co. announced that it will manufacture video tape recorders in the United States.

Computer trade groups officially applauded the Japanese announcements, but privately expressed fears that the new initiatives were too little and too late to divert Congressional action.

William Krist, a former USTR trade official and currently the director of international trade affairs at the American Electronics Association, says the Japanese reform proposals may slow down the protectionist tide in Congress, but won't stop it. He pessimistically points out that neither Congressional legislation nor the Japanese

reforms can affect a major cause of the huge trade imbalance—an overvalued dollar that drives prices down on Japanese exports to the United States and inflates the prices of American goods on the Japanese market.

“The Japanese have to deal with its [Japan's] market-access problems, but the [Reagan] administration must deal with the dollar problems,” Krist asserts.

Senate remains skeptical

Senate leaders reacted to the Japanese announcement of import reforms with unabashed skepticism. Citing \$10 billion in lost sales due to Japanese import restrictions, Danforth reiterated his stance that Japan should open its markets to U.S. products to the same degree that the U.S. market is open to Japan.

“The announcement that Japan will take another series of steps to open markets sounds good. But we have heard fine-sounding words before and have seen very little by way of results. Congress should enact legislation insisting on results and imposing penalties, if results are not forthcoming,” said Danforth in a prepared statement.

Bentsen echoed the comments of his Senate colleague, saying the Japanese have not yet carried through on earlier promises. “The Japanese bureaucracy long ago mastered the hidden trade barrier. Back in 1979 we held the Tokyo round of international trade negotiations intended to eliminate those hidden barriers to imports. The Japanese trade surplus with the U.S. is more than five times greater than it was in 1979. There is little reason to hope that the new Japanese program will be more effective than the Tokyo round of negotiations,” the senator stated.

Not everyone is so skeptical. “There is real reason to believe that the Japanese are trying to improve the trade picture,” counters a Computer and Business Equipment Manufacturers Association spokeswoman. “We know they share our recognition of the political dangers of not addressing the trade imbalance.” □

Light-operated processor developed for handicapped

Ichiro Kakehashi
Tokyo Correspondent

Japanese researchers have developed a word processor that operates by sensed changes in light reflected from the eyes of a handicapped person who can't type. Scientists at NHK (the Japanese broadcasting corporation), Takei & Co., which makes medical equipment, and a neurologist at the Tokyo Metropolitan Neurological Hospital worked to develop the system, which runs on NEC Corp.'s PC-9801 personal computer.

Based on a 16-bit, Intel Corp. 8086 microprocessor with 128K bytes of RAM and 64K bytes of ROM, the computer arranges characters for entry in a left-to-right, top-to-bottom order on the display. Essential text-manipulation commands, such as Enter, Delete and Print, together with a box that serves as the command execution position, are placed to the right of the

character display.

To operate the word processor, the handicapped person wears sensors mounted in spectacle-like frames. A 5mm, infrared-ray light-emitting diode is in front of the center of the eye, and two reflective, 5-mm photosensors are on either side of the iris. The handicapped person selects a framed row of characters from a framed column of characters by focusing on them as they appear on the screen. By moving the eye to Enter, he registers the row of characters and the other columns disappear.

The patient then looks at the desired character within the selected framed row, again shifts his gaze to the Enter box, and the desired character appears on the screen.

The light reflected from the iris serves as a signal to the photosensitive switch that performs the desired operation at a rate—with some practice—of 17 characters a minute. □



H. Pyle. *Victory Parade*, 1783. Courtesy The Bettman Archive.

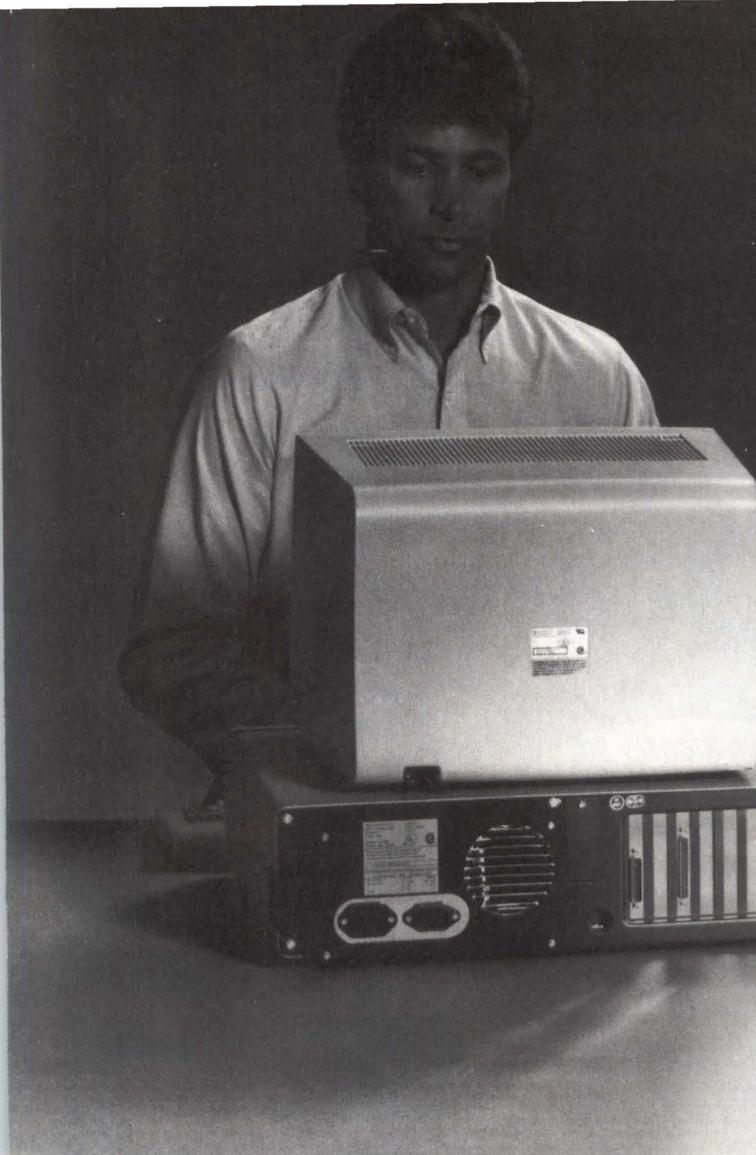
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Wyse joins crowded field with \$399 ASCII terminal

Mike Seither

Associate Western Editor

Wyse Technology, the leading independent manufacturer of terminals, has entered the low end of the market with a \$399 ASCII terminal, the WY-30.

The move by the San Jose, Calif., company pits Wyse squarely against a number of other terminal manufacturers that have recently introduced similarly priced terminals. Those include Esprit Systems Inc., Melville, N.Y., and three California companies: Lear Siegler Inc.'s Data Products Division, Anaheim; Qume Corp., San Jose; and TeleVideo Systems Inc., Sunnyvale.

Wyse officials say the WY-30, developed over 18 months, was designed as an entry-level ASCII terminal. Industry analyst Greg Blatnik of Dataquest Inc., a San Jose market research company, says there is some substance to that claim. "Qume's QVT-101 [introduced earlier this year as the first smart terminal priced at less than \$400]

was not a new product. It's very similar to Qume's earlier QVT-102," says Blatnik. He adds that Esprit's \$395 ESP-6110 was simply reduced by \$100 to match Qume. "There was nothing revolutionary about those two terminals except that the price was lower than anyone was used to."

The end of curvature

One of the main features that separates the WY-30 from competing terminals is its flat 14-inch screen. Unlike convex screens, Wyse says, the flat surface prevents distortion of characters around the edges and provides a larger viewing area.

Another standard ergonomic feature is a spring-loaded foot on the base of the unit that lets users alter the vertical adjustment by pushing or pulling the top of the screen. Two options provide additional range-of-screen movement. A \$20 base offers tilt-and-swivel mobility, while a \$99 arm provides height adjustment (see photo). Two screws attach either of those options to the

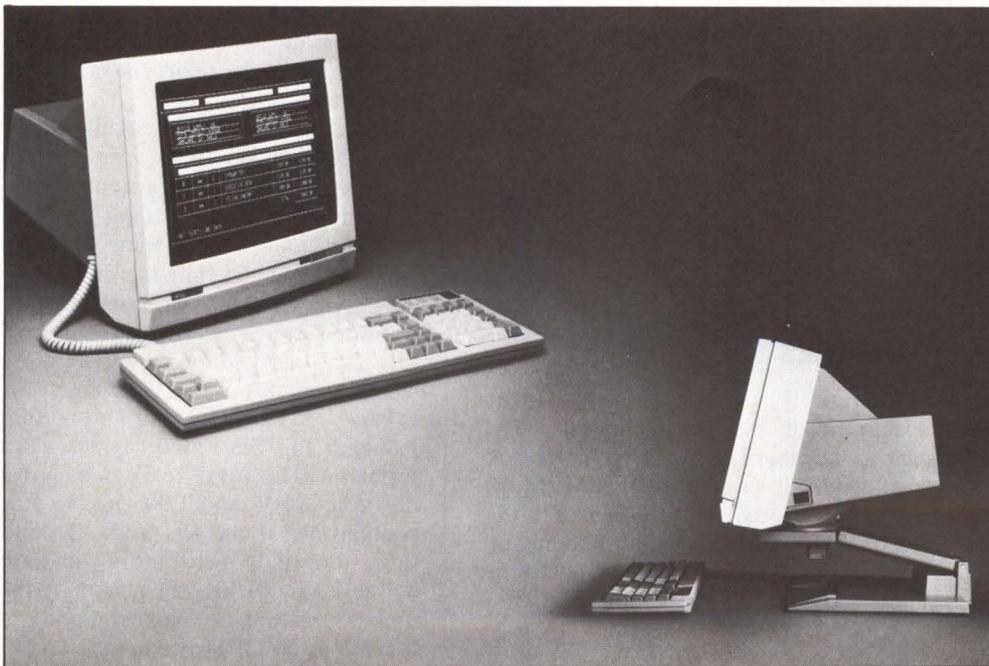
bottom of the monitor.

The WY-30 marks the first time the company has introduced an 80-column monitor. Wyse's other terminals and computer systems all have 132-column screens. "Our research with customers shows that 80 columns is adequate for an entry-level system," says Charles Comiso, vice president of marketing at Wyse.

That same research, according to Comiso, indicates that customers do not want to compromise on the keyboard. The new terminal borrows heavily from the keyboard design of the WY-50, the best-selling Wyse terminal that has largely been responsible for the company's meteoric growth over the last few years. The keyboard features mechanical key switches and four dedicated function keys. Various keys used together produce a total of 41 programmable functions.

Emulates the competition

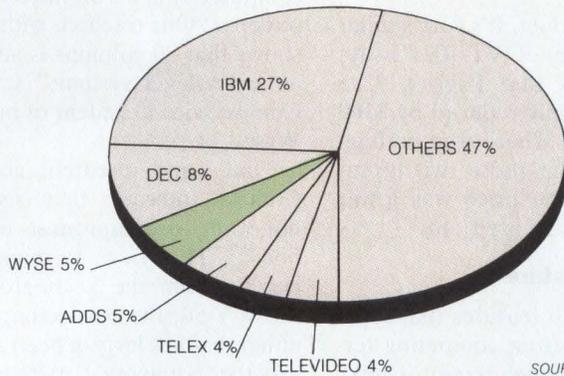
In addition to compatibility with the WY-50, the WY-30 also emulates the Lear Siegler ADM 3A and ADM 5; TeleVideo's 910+ and 925; and the Viewpoint from Applied Digital Data Systems Inc. (ADDS), Hauppauge, N.Y. "These emulations are critical to



The standard WY-30 ASCII terminal from Wyse Technology (upper left) has a tilting screen. An arm that adjusts for height (lower right) is optional.

WHO'S WHO IN TERMINALS

(2.19 million units shipped in 1984)



SOURCE: DATAQUEST INC.

A LOOK AT THE LATEST LOW-END TERMINALS

Manufacturer/ model	Price (\$)	Display	Programmable keys	Emulation
Esprit ESP-6110	395	80 x 24	14	Hazeltine 1500; Lear Siegler ADM3A/5; ADDS Viewpoint
Lear Siegler ADM 3E	399	80 x 24	14	Lear Siegler ADM3A/5; ADDS Viewpoint A2 and A3
Qume QVT-101	395	80 x 24	16	Hazeltine 1500; Lear Siegler ADM3A/5; TeleVideo 910
TeleVideo 905	419	80 x 24	16	TeleVideo 910 and 925; Lear Siegler ADM3A/5; ADDS A2
Wyse WY-30	399	80 x 24	16	Wyse WY-50; Lear Siegler ADM3A/5; TeleVideo 910 and 925; ADDS Viewpoint

CONVERTER TIES ASCII DEVICES TO IBM SYSTEMS

The InterLynx/5251 multiprocessor protocol converter, developed by Local Data Inc., Torrance, Calif., is reportedly the first to connect one to seven low-cost ASCII devices such as keyboard displays, printers and personal computers to a standard twinaxial port on an IBM Corp. System/34, 36 or 38 computer. The ASCII devices can be attached to the InterLynx/5251 directly or remotely through an asynchronous modem and appear to the host as an IBM 5251 display station or as an IBM model 5256 matrix printer. A single-port, non-expandable unit is priced at \$1,595; a seven-port unit, \$5,795.

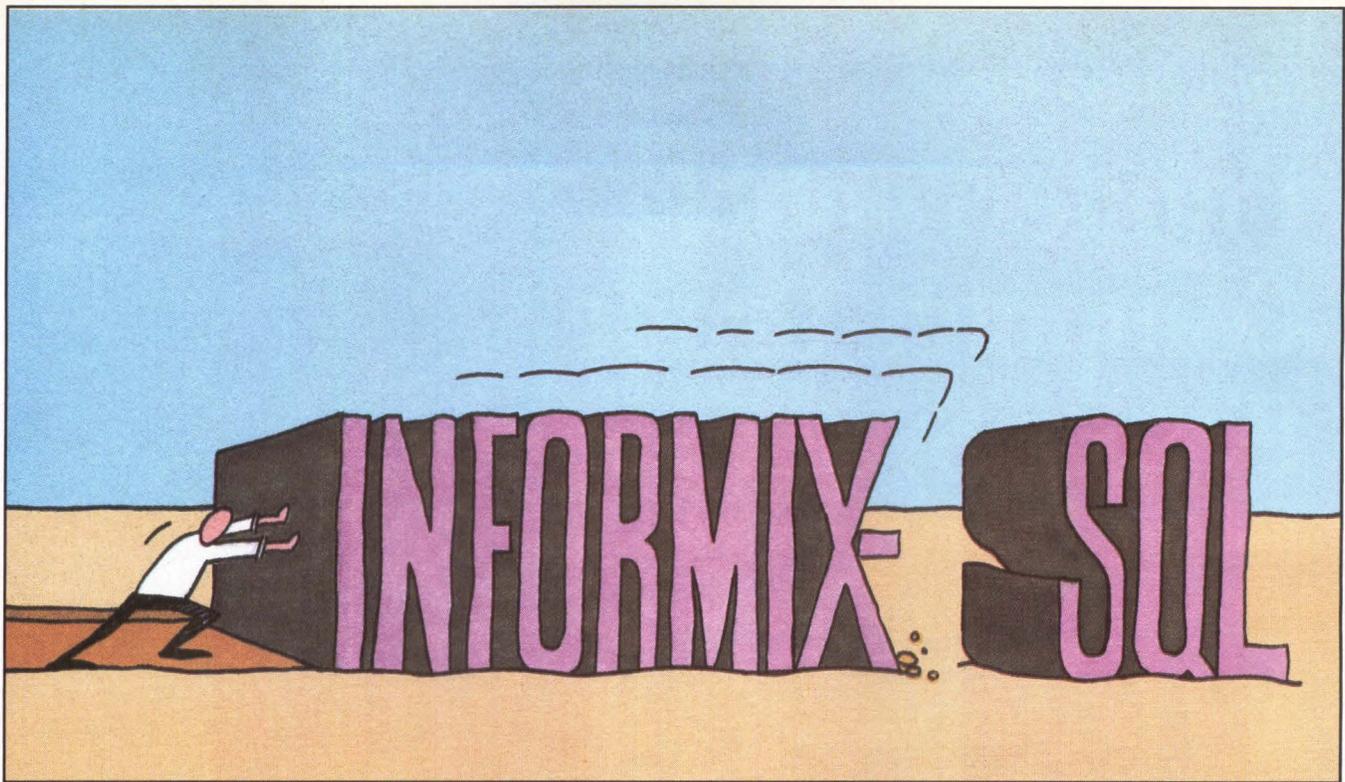
us because those terminals dominate the entry-level market," says Comiso. "They are the target of WY-30."

Although some analysts question whether manufacturers can earn acceptable profits on terminals priced at less than \$400, Wyse is confident that the WY-30 will be a money-maker. Wyse claims an advantage in that it completely owns and controls its manufacturing facilities in Taiwan. The company does not rely on other manufacturers for subassemblies, monitor electronics or power supplies, thereby eliminating markups. The result, says Wyse's Comiso, is a 10 percent to 20 percent cost advantage over other manufacturers with limited control over design, volume procurement and factory costs.

That edge has paid off handsomely for Wyse. The company has been on a steady growth path for the last three years, reporting its 12th consecutive profitable quarter in June. In its 1984 fiscal year, Wyse shipped 37,000 terminals and had a net income of \$1.6 million on sales of \$18 million. In fiscal year 1985, which ended in March, Wyse had earned \$7.5 million on revenues of \$77.6 million. Shipments were up more than 500 percent, to 191,000 units. "Wyse is clearly the No. 3 company [in total terminal sales], and I can unequivocally say they will be stronger by the end of the year," says analyst Blatnick.

Whether the WY-30 actually will be the money-maker Wyse projects remains to be seen. The percentage distributors receive for selling low-cost terminals may be the same as for a high-end terminal, but the dollars are not. Says one industry observer: "Distributors are concerned about how they can [both] sell and support these cheap terminals at the same time."

Charles Klug, terminal product manager for TeleVideo, agrees it's a problem. He says TeleVideo introduced its \$419 model 905 just to stay competitive at the low end. "I don't think too many distributors will want it," he says. "I know I wouldn't; the dollars aren't there. We're looking at the 905 as an OEM product." □



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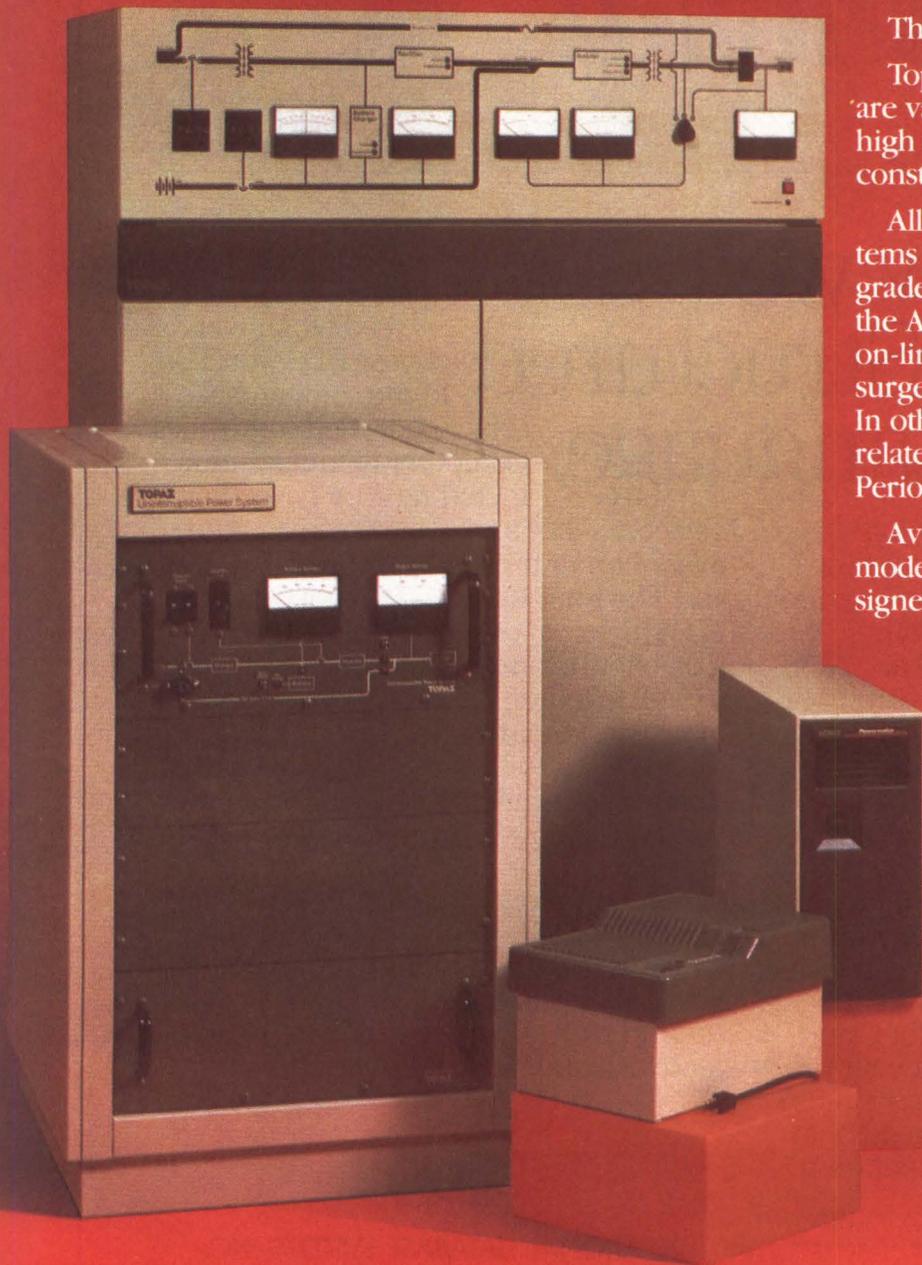
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HEARD ON THE HILL

Export Act trims red tape for U.S. computer makers

Stephen J. Shaw
Washington Editor

Most U.S. computer makers appear satisfied that the Export Administration Act (EAA) of 1985 strikes a reasonable compromise between the nation's need to prevent high technology from being exported to the Soviet bloc and their need to sell computers overseas.

The new law allows U.S. companies to obtain a comprehensive operations license for one-time approval for transferring technology, equipment and material to pre-approved overseas receivers. This covers subsidiaries, affiliates, joint-venture partners and licensees that have a "defined relationship" with the exporter. Companies will be able to establish internal company controls, subject to Commerce Department review, to prevent technology diversion to Soviet-bloc countries.

Meanwhile, distribution licenses, which allow export of certain products in quantity to pre-approved consignees in countries outside the Soviet bloc, will remain unchanged. But the new EAA does give the commerce secretary more freedom to decontrol products that are found to be available in sufficient quantity and quality from foreign sources not subject to multilateral export controls.

Revision of the EAA, the basic statute governing U.S. trade practices with other nations, had been held up during most of the 98th Congress in a turf squabble between the Departments of Defense and Commerce. They disputed final say over high-technology exports to both friendly and communist countries. EEA seemed close to passage earlier this year, but was held up over a rider that would have stopped computer sales to South Africa.

Over the years, national defense advocates have urged that stringent

controls be placed on high-technology items to prevent their diversion to Soviet-bloc countries. Computer industry groups, allied with other industry organizations and Commerce, have argued that simpler requirements would ease licensing delays and improve the competitiveness of U.S. companies.

A compromise, then acceptable to commercial interests, was hammered out and formally recognized in a memorandum of understanding signed last year by the secretaries of commerce and defense. Under it, the Department of Defense agreed to settle for a role that, by an earlier presidential directive, had allowed the agency to review some export license applications for goods going to friendly countries, as well as shipments intended for communist and non-allied nations. However, when it came to the new EAA, commercial interests lobbied successfully to remove the DOD from any say in trade between the United States and Western allies.

Computer makers claim victory

Computer industry representatives consider this a victory, relative to what could have happened. "This gain is important and DOD review procedures should be more flexible and sensitive to commercial trading realities," said the American Electronics Association (AEA) in a prepared statement. "The stiff curbs originally proposed by DOD's congressional advocates would have further delayed the already cumbersome license process, resulting in additional lost sales by U.S. multinational firms engaged in legitimate West/West trade."

Other changes incorporated into the new law include decontrol of shipments of low-level computer technology to U.S. allies belonging to the Coordinating Committee for Trade with Eastern Bloc Countries (CoCom) that oversees export controls. For ex-

ample, embedded microprocessors can no longer be the sole reason for a full-scale review of export applications by Commerce, Defense and other agencies.

Computer systems with a processing data rate (PDR) of 28 or less can now be shipped to CoCom countries, primarily Western European countries and Japan, without first having to be licensed by Commerce. (PDR is derived from a CoCom-originated formula involving a processor's clock rate, processing power and number-crunching capability. An IBM Corp. PC has a PDR of 28.)

This decontrol of lower technology items will eliminate the need for about 30,000 export licenses required for items shipped to CoCom member countries, says one Commerce official.

"We're pretty positive about EAA," comments Charlotte LeGates, a spokeswoman for the Computer and Business Equipment Manufacturers Association. "The comprehensive operations license is clearly a plus, but we would have liked even stronger language on distribution licenses."

"We're pleased that DOD concerns did not win out," says a spokesman for the Association of Data Processing Service Organizations.

The real test of how well EAA will meet industry concerns is under way now at Commerce. The Office of Export Administration is drafting specific regulations that are expected to flesh out Commerce's administration of the Act.

"We're analyzing the language of the Act right now," comments Dan Hoydysh, a trade official with the Export Administration. "Some language offers specific instructions, other language presents definite timetables for designing the administrative regulations, and other parts of the Act are simply vague." He believes Commerce may have to go back to Congress for guidance on how to interpret certain sections of the EAA.

Hoydysh refused to speculate on when the administrative regulations will be published for industry review and comment.

Commodore seeks to befriend business users with Amiga

Lynn Haber, Associate Editor

With much of the fanfare surrounding the introduction of Commodore Business Machines Inc.'s Amiga Personal Computer now ended, questions regarding its viability as a business machine remain to be addressed. Can the Amiga help Commodore successfully compete against the market's No. 1 and No. 2 personal computer manufacturers?

According to Richard J. Matlack, president and director of consulting services at market research company InfoCorp, Cupertino, Calif., "The Amiga has everything one could want in a machine of its class." But he cautions that unless more software is developed for the Amiga, it will miss its business-market target. And business is a market that Commodore, of West Chester, Pa., has clearly targeted. "Marketing and software," Matlack asserts, "will be the key to success for the Amiga."

Up against the likes of IBM Corp.'s PC with Digital Research Inc.'s (DRI) Graphics Environment Manager (GEM) software, and Apple Computer Inc.'s Macintosh, Commodore will find that the path to business users' doors is uphill all the way.

Frank Leonardi, vice president of sales at Commodore, agrees with Matlack. "Amiga has all of the ingredients to be a business machine, but now the important thing to do is to get software developers to write programs that take advantage of the machine's features," Leonardi says. These features include the graphics-user interface and multitasking ability. Commodore is actively wooing independent software developers to write applications for the Amiga.

As far as marketing goes, Leonardi says Commodore hopes to establish a reputable business image by sticking with its commitments in hardware, software and sales. "We turned down



Commodore's Amiga offers voice and music synthesis, graphics and animation for less than \$2,000.

the temptation of the quick sale via the mass-merchandise channel and opted for computer-specialty stores instead," comments Leonardi.

Tossed into market crossfire

"Commodore's image as a home and toy computer company has got to hurt them in the business arena," comments Bennett E. Wiseman, director of office information networks at InfoCorp. "A lot of the joys of Amiga, such as the sound-synthesis and animation, are features people associate with a game machine as opposed to a business machine."

According to a spokesman for Commodore, the company hopes to entice not only traditional business users, but also new personal computer users. "Commodore is looking to create new markets in areas where existing personal computers haven't been able to perform," says the spokesman.

In this regard, Commodore promotes the Amiga as a particularly good machine for tasks that require visual presentations, such as those in archi-

ture, computer aided design and instruction and technical documentation.

This positioning places Amiga in the center of a highly competitive market despite some unique characteristics: a four-channel, multivoice music capability that delivers a full range of tones, video input and output ports, and a Genlock interface for synchronizing video and graphics. While these may make it a technical trend-setter for its price/performance characteristics, it faces two tough opponents in the IBM PC and Apple Macintosh.

Viewed by industry analysts as a direct competitor to the Macintosh, Amiga reportedly is faster, and includes features such as multitasking, not provided with the Macintosh. As for challenging IBM, Amiga also offers PC compatibility via MS/DOS emulation software, which sells for \$100. Certainly a key attraction to users resistant to anything non-IBM, the software reportedly runs most applications written for the PC, but at the expense of Amiga's unique features. The MS/DOS emulation mode takes over the entire Amiga screen, at which time Amiga's unique features cannot be supported.

The PC applications also run slower on the Amiga compared with the PC. "The speed varies upon the application, but some applications run at only 50 percent to 60 percent of the speed on the Amiga," concedes Leonardi. To help rectify this problem, Commodore will announce an accelerator that, according to Leonardi, will increase the speed of Amiga-run MS/DOS applications to approximately 90 percent to 95 percent of the speed on a PC.

However, the Macintosh can also run IBM PC applications. Darna Communications, Salt Lake City, recently introduced MacCharlie, a hardware and software product that enables the Macintosh to use software written for the IBM PC.



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Commodore's Leonardi says that his company is not looking to replace the PC with Amiga and doesn't see Big Blue as head-to-head competition. "IBM does whatever IBM wants to do," he quips. Whatever Leonardi's sentiments in the matter, no new product escapes the attention of computer giant IBM.

As a case in point, DRI's GEM provides the PC with an answer to the graphics-oriented interfaces implemented on the Macintosh and on the Amiga.

But there are, as yet, few applications written that take advantage of GEM's features. Here, says Robert M. Lefkowitz, director of the software industry research program at InfoCorp,

is where Amiga is, right now, at an advantage.

"I believe that there's room in this world for non-IBM-compatible machines," says Wiseman. "But getting there is just not that easy." The InfoCorp analyst believes that the Amiga is attractive enough to gain attention but that Commodore has a great task ahead in winning over software developers because of its innovative technology, such as the three proprietary chips, bus sharing and multitasking.

To help overcome this, Wiseman advises, "It's important that Commodore get enough boxes out there for developers to get interested and build software for it." Commodore plans to sell the Amiga through computer retail

stores. But like many manufacturers with untried products, Amiga, over time, will simply have to prove itself.

Still, Wiseman contends, the Amiga can be an important technology tool for future office-automation requirements such as compound documents combining voice, data, text and graphics. Although Commodore doesn't have experience in the value-added reseller channels, Wiseman also thinks that the Amiga could be targeted for industry-specific applications. "VARs can look at the Amiga as an information engine to which you add software," he says. The company doesn't have a particular VAR program in hand, Leonardi says, but it is talking with VARs. □

PACIFIC PERSPECTIVE

Japan's lead in optical disks sets pace for standard

Ichiro Kakehashi
Tokyo Correspondent

In Japan, optical disks have begun to present a serious alternative to magnetic technology for large-volume storage. Important for system integrators looking for new markets is the fact that optical storage is increasingly being used in computer aided design and computer aided manufacturing systems and image and archival processing combinations.

About 1,000 optical-disk drives were sold in Japan last year, according to the Electronic Industries Association of Japan. That number may sound small, but the sales have encouraged more than 20 Japanese companies to pursue research in such systems—companies outside of electronics, including suppliers of chemicals, pharmaceuticals and ceramics.

Primarily, optical disks come in three sizes: 13 cm, 20 cm and 30 cm (5¼, 8 and 12 inches). Moves are afoot, however, to standardize on one size. It appears as though 13 cm will be

selected, because the drives will fit into the 5¼-inch form factor.

Japan leading the band

Because Japanese companies have invested so much research and development in optical-disk systems, they were able to lead a preliminary meeting on optical-disk standards in June. The meeting, held in Japan, was attended by representatives from the United States and Europe, including members of the European Computer Manufacturers Association and ANSI. Proposals for standards will be narrowed down at a further meeting in Amsterdam this month before formal recommendations are made to the International Standards Organization, which is expected to decide the issue in Geneva next September.

Several Japanese manufacturers are currently proposing optical-disk specifications that provide for write-read-erase-write capability. Among those proponents are makers of CAD/CAM equipment, where the large storage capacity of optical disks—1.8G bytes

on a 20.5-cm disk, or the equivalent of 60,000 pages of image information or 600,000 pages of text—could be used to greater advantage.

For example, graphics processing, especially modeling and 3-D design simulations, currently requires substantial computing power and a great deal of memory. Among Japanese companies offering such capacities with optical-disk equipment (and their products) are Fuji Photo Film Co., FIRS-OD2000; Hitachi Ltd., HIT-FILE; Matsushita Electric Industrial Co., Panafile; Sanyo Electric Co., SOF-8500D; and Toshiba Corp., TOSFILE.

Other companies with minicomputer-based graphics workstations incorporating optical-disk technology include Nippon Telegraph and Telephone Corp. (NTT), Ricoh Corp. and Sony Corp. Ricoh's Rifle 4500 includes a 2.6G-byte drive for 30-cm disks, a 15-inch display, input scanner and laser printer. Sony Corp. has teamed up with NTT to develop the INS Telefile that boasts a color printer.

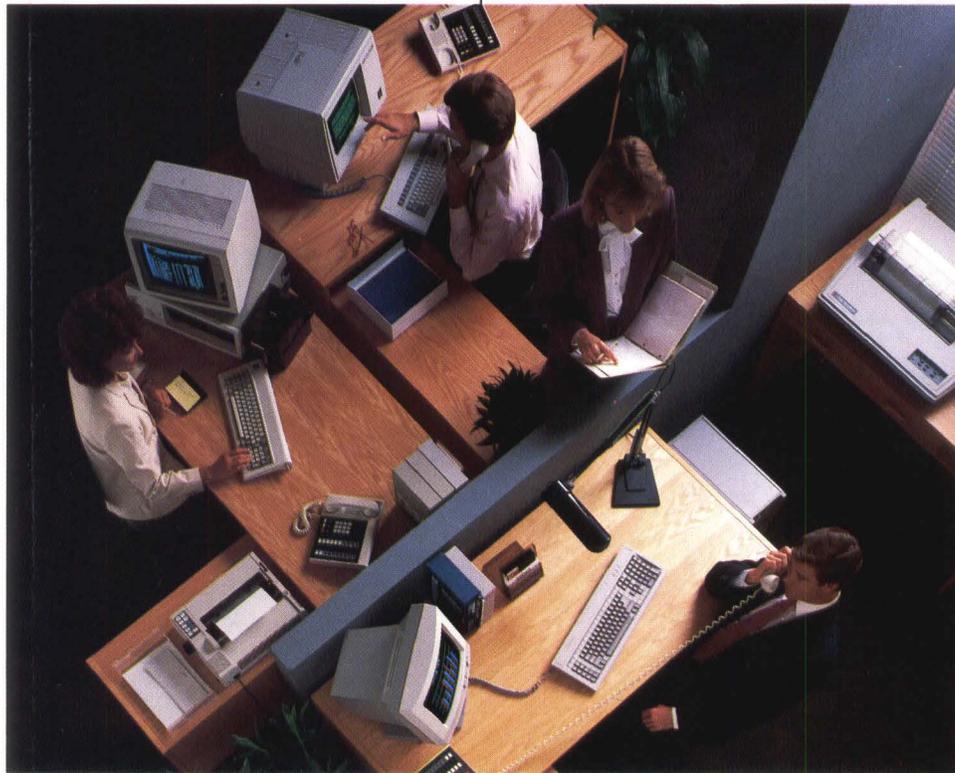


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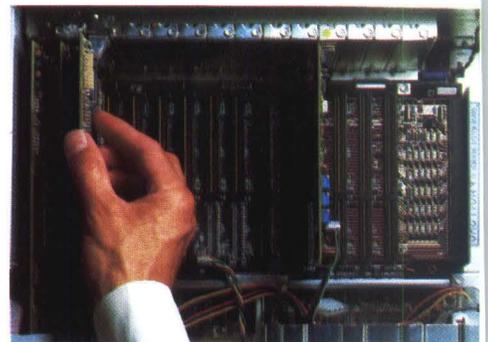
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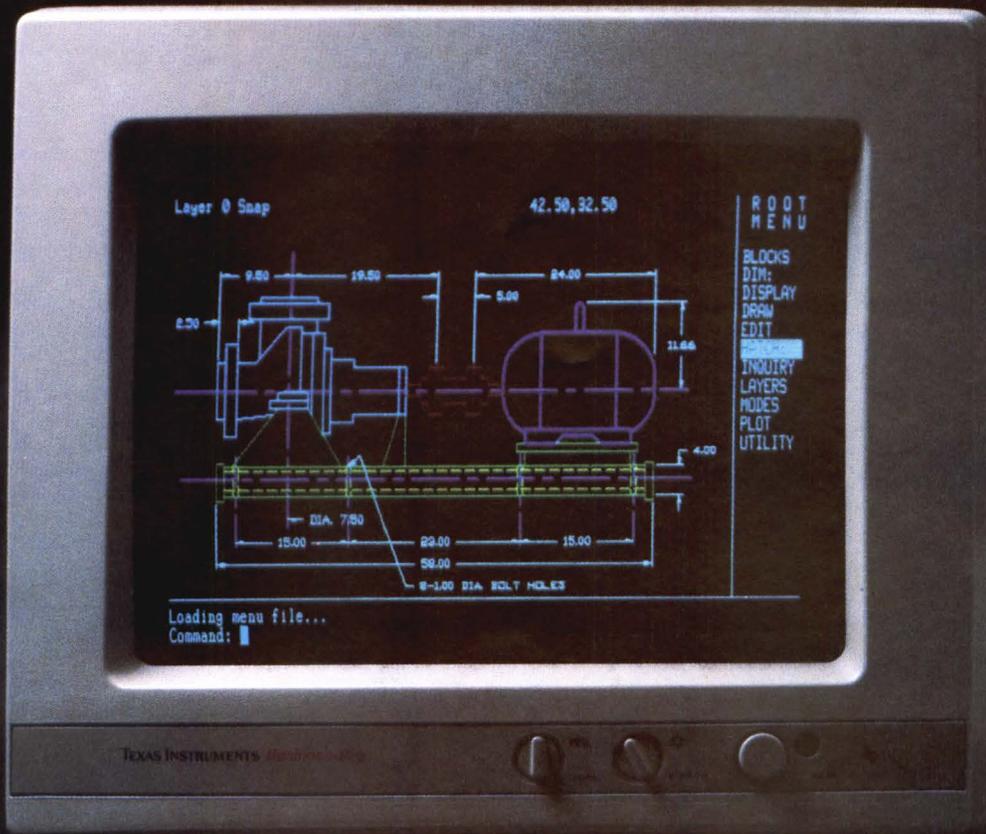
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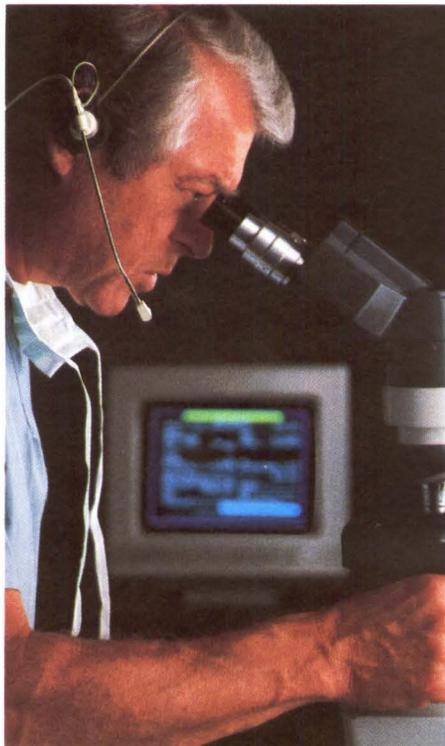
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- 512 Kbyte RAM standard, expandable to a total of 15 Mbytes.
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Power Requirements

Voltage: 90-130 Vac.

Frequency: 47 through 63 Hz.

Power: 225 watts maximum.

Physical Dimensions

System Unit:

19.8 cm (7.8 in) W.

47.0 cm (18.5 in) D.

47.2 cm (18.6 in) H.

Monitor (monochrome or color):

33.8 cm (13.3 in) W.

32.3 cm (12.7 in) D.

36.6 cm (14.4 in) H.

Keyboard:

54.1 cm (21.3 in) W.

19.3 cm (7.6 in) D.

4.5 cm (1.8 in) H.

Weight

System Unit (fully loaded):

26.1 kg (58.0 lbs).

Monochrome Monitor:

6.8 kg (15.0 lbs).

Color Monitor: 11.7 kg (26.0 lbs).

Keyboard: 2.1 kg (4.8 lbs).



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National Production Systems cuts costs in half and doubles sales using an HP minicomputer system and electronic-mail, word-processing and graphics software

Thomas P. Hill, Hewlett-Packard Co.

In 1980, National Supply Co., a Houston manufacturer of equipment for the petroleum industry, targeted its division, National Production Systems (NPS), as the one most likely to grow within the next decade. But, because its management-information system (MIS) was not up to date, NPS, a Los Nietos, Calif., producer of fluid controls and rod and hydraulic pumping systems, was not equipped to handle such growth.

However, after purchasing a minicomputer system from Hewlett-Packard Co., Palo Alto, Calif., NPS doubled sales and reduced by more than 50 percent the costs of sending financial information to company headquarters.

Before buying the HP equipment, the Los Nietos facility had been using a computer terminal linked to the company's Houston-based IBM Corp. computers. The Los Nietos terminal transmitted daily, weekly and monthly sales, shipment and departmental expense information to the Houston system.

In addition, NPS employed a manual system using some 120,000 coded cards—as many as 10 per sales order—for manufacturing system control. The manual system entailed entering handwritten work orders, pending receipts and stock and shipment records—an error-prone procedure, according to NPS manager of material management Darryl Makepeace. "In addition, the information on the cards could be three to five days out of date at any time," he says.

With the growth forecast in mind, NPS immediately began to search for an updated MIS



solution. Toward that end, the company formed a seven-member task force headed by Makepeace. The group represented each major business segment of the company: production and inventory control, marketing services, product design, manufacturing engineering, systems, accounting and finance and shop-floor supervision. The task force's job was to evaluate the company's needs; select a new computer system; select accounting, word-processing and manufacturing software; supervise installation of the new systems; and train personnel.

Working with divisional personnel, the task force identified more than 300 key tasks to be accomplished. They then developed a program-evaluation-and-review-technique chart mapping those tasks, including estimated man-hours and a path for project completion. Temporary trailers on the work premises housed the task force and, later, the training classes for the NPS work

Using HP Draw graphics software, a data-processing system analyst can create, store and update pie charts, line graphs and charts.



NPS uses an HP minicomputer to streamline production on the factory floor.

force. Working full-time, the task force completed the project in 14 months.

NPS had a long list of criteria it required for its MIS. Says Makepeace, "We wanted a fully integrated, on-line, interactive, user-friendly hardware and software system that could be used by all levels of factory and management personnel in the Los Nietos facility. We needed hardware that could support sophisticated software and be rugged enough for our plant's machine-shop environment, and we wanted suppliers that could support our growth."

Hardware proves reliable

In late 1981, NPS purchased an HP 3000 Series 44 minicomputer, which they upgraded to the HP 3000 Series 64 in early 1982. They have recently upgraded again to the HP 3000 Series 68. Makepeace claims that all upgrades have gone smoothly and that the system has worked reliably. "Even though we developed a complicated network of peripherals, programs and communications networks, we've had near zero downtime," he says.

The multiuser, multiprogramming Series 68 stores 3M to 8M bytes, has a 16-bit word and a 2-by-16-bit transfer word and performs 1 million to 1.6 million instructions per second. A typical system including a 3M-byte RAM, the system console, 12 terminal ports, a 404M-byte disk drive, a 1,600-bit-per-inch tape drive and two I/O channels and the operating system sells for \$245,295.

Other HP equipment currently installed at NPS includes 109 direct-connect terminals, seven printers, seven word-processing stations and one HP 150 Touchscreen personal computer connected to an HP ThinkJet printer and a six-pen HP plotter.

NPS has implemented HP's Distributed Systems/3000 data-communications software, which links NPS employees to users at company head-

quarters in Houston and 25 nationwide service centers. In addition, NPS has fully integrated HP Word word-processing, HP DeskManager electronic-mail and HP Draw graphics-slide-making software packages into the office environment.

HP DeskManager combines electronic mail, electronic filing, word processing and personal calendaring. Employees sign on to DeskManager each morning and are advised of appointment times and subjects. Users can designate other users to receive, answer or file their messages during vacations or absences. With HP Slate, a word-processing function built into HP DeskManager, employees create messages on their screens, and DeskManager sends the messages to other employees, eliminating "telephone tag" within the plant.

NPS employees use the desk calendar function to schedule meetings in the company's conference room. To perform this task, DeskManager provides reminder functions, lists free time available and automatically flags meeting conflicts. In addition, users can view their personal calendars for a day, week or year at their terminals or on a printout. With one command, users can add reminders to their calendars for meetings occurring weekly, monthly or at other intervals.

According to Makepeace, a major benefit of DeskManager is that it allows employees to control when they will receive their messages or unscheduled visitors—rather than be interrupted while they are on the phone. "The nature of the message is communicated to the recipient so that time-dependent messages are answered immediately," he says, adding, "I can instantly send a message to more than 125 people, which we do with messages of wide interest. For example, we recently announced a reorganization. I sent a message about it simultaneously to 26 people, and they got the information long before the posting and perhaps faster than had we called a meeting."

Company personnel also routinely use the reply-and-forward feature of DeskManager, which allows the receiver of a message to reply immediately and to pass the message along to other workers who might need the information. In addition, DeskManager has considerably reduced communication time at NPS. For example, a shop general supervisor claims that the package reduced from hours to minutes the time he spent communicating with his 12 supervisors.

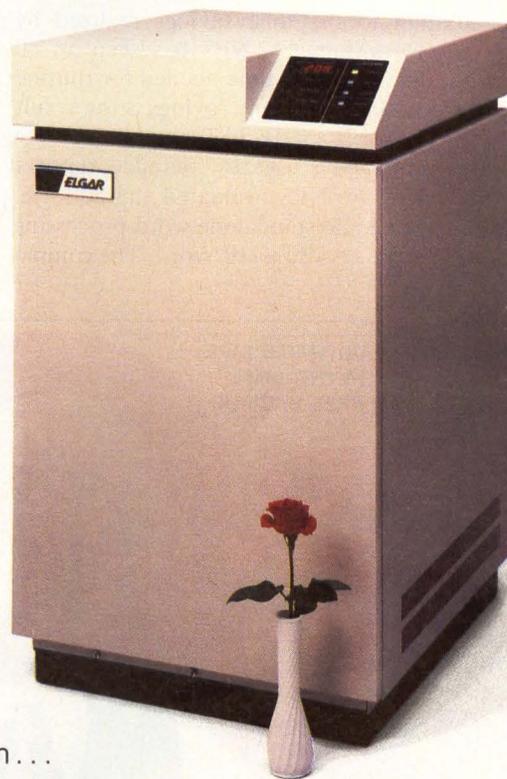
NPS has also established a quality-control committee that allows employees to discuss problems that cause errors. Recent input from a plant supervisor resulted in the creation of a product engineering group that allows supervi-

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sors from different shifts to communicate with each other via DeskManager about technical problems. Previously, supervisors would come in early or stay late to discuss problems with workers from other shifts. "Now they can use their time more productively and instantly communicate any problems to the engineers, their fellow supervisors or their bosses," says Makepeace.

NPS has also created an electronic maintenance system, which allows offices to use electronic mail to contact maintenance for repairs.

HP Word smooths report processing

In addition to the time savings realized by using HP DeskManager, NPS has seen an 80 percent reduction in the time needed for routine report processing. This time savings is the result of using HP Word, an HP 3000 word-processing package, which NPS uses for detailed reports.

Makepeace says NPS evaluated shared-logic, shared-resource and standalone word-processing packages before choosing HP Word. The compa-

ny chose HP Word because it allows users to perform more than one activity at a terminal. For example, users can access HP Draw graphics, HP DeskManager, any data file or another application package. Further, there is no danger of losing and storing disks or of data loss caused by handling disks.

Previously, NPS had used a team of secretaries to prepare large reports. But, with HP Word, document-preparation time is cut significantly because the work load is split among several processors. Each team member works on part of the document, and joining the parts for compilation takes only a few minutes.

In addition, HP Word cuts typing time by 25 percent to 50 percent over an electric typewriter, and Makepeace claims that the word-processing systems have required almost no maintenance. □

Thomas P. Hill is market manager of the Office Systems Group of Hewlett-Packard Co., Cupertino, Calif. His responsibilities include market planning for office systems technologies related to local area networks, personal computers and software.

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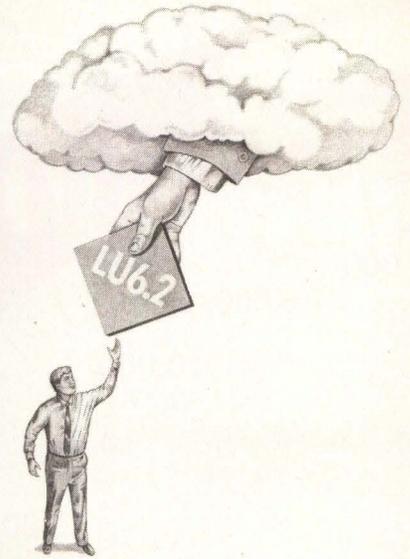
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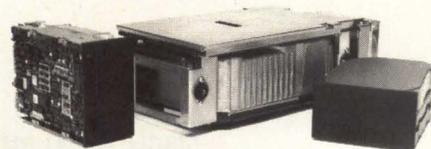
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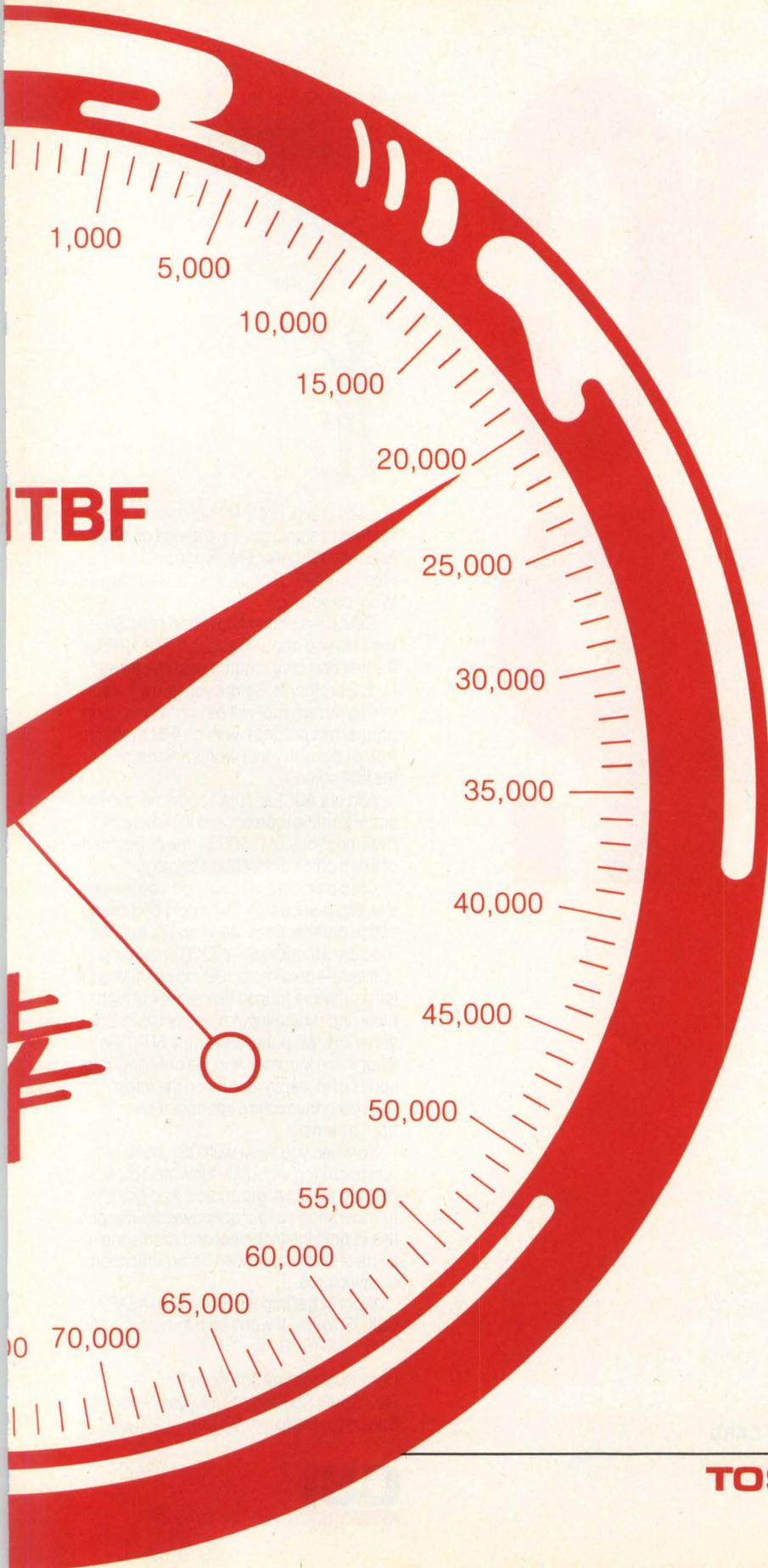
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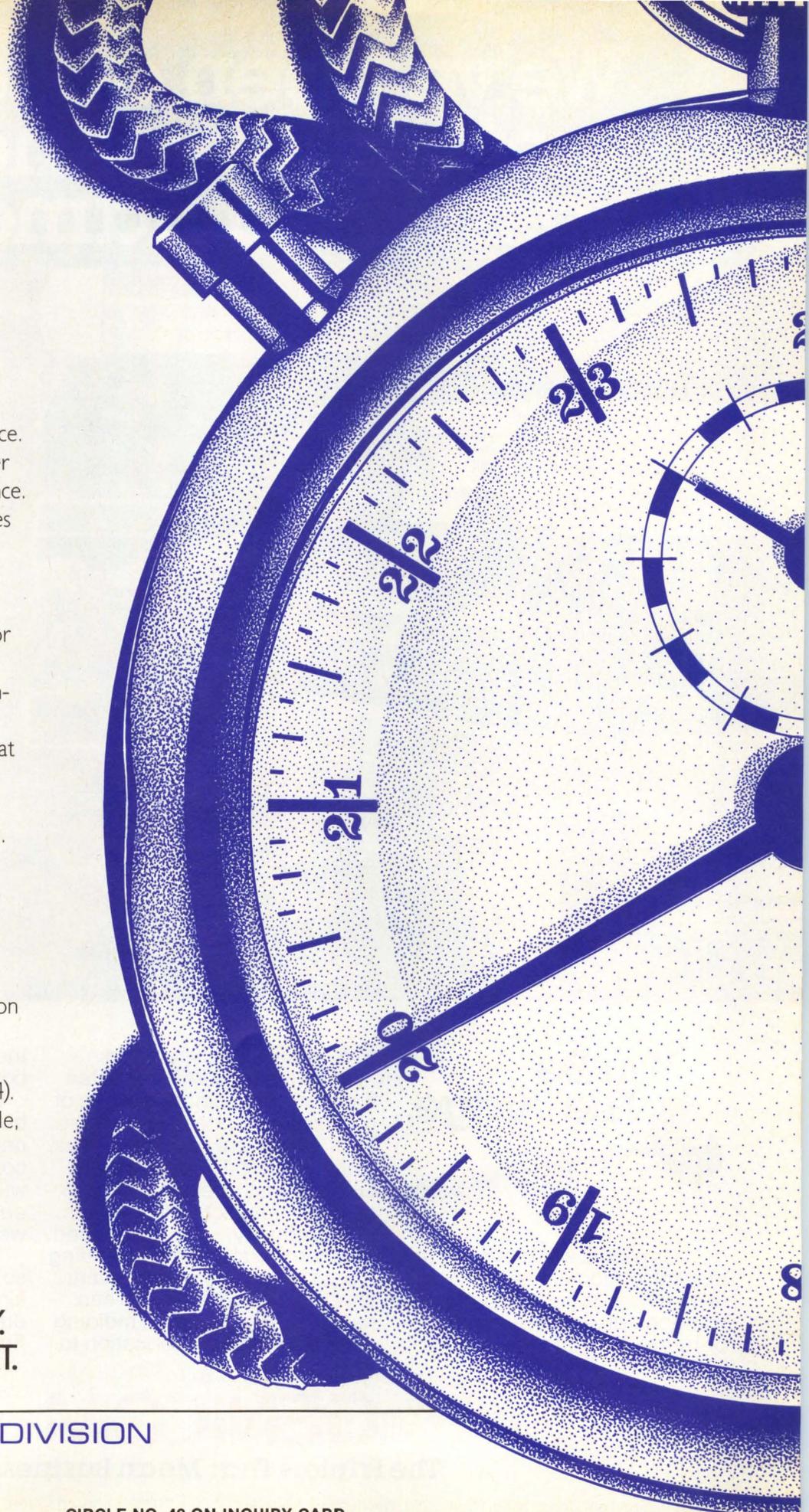
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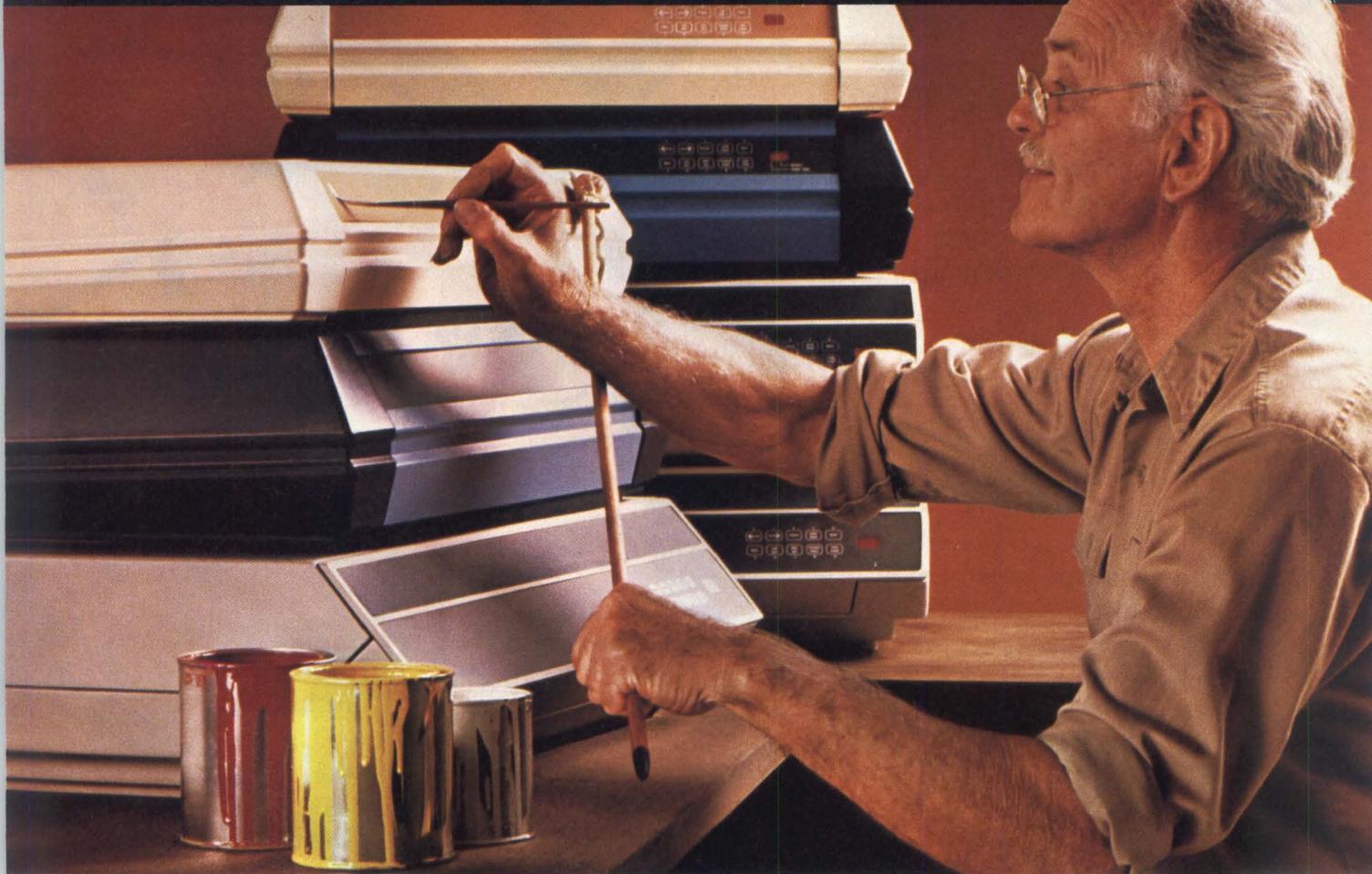
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Networks of bar-code readers linked to IBM PCs, compatibles or other host computers provide fast, accurate factory-floor data collection

Terry Livermore, Caere Corp.

Manufacturers using a bar-code-scanner network based on the IBM Corp. PC, PC compatibles or other host computers can collect data from the factory floor more efficiently and cost-effectively than is possible with conventional bar-code technology.

The PCScan-Net and Scan-Net systems developed by Caere Corp., Los Gatos, Calif., can be used in making products ranging from computer peripherals to air conditioners. They allow users to network as many as 64 bar-code scanners through the PC's asynchronous communications line or, with Scan-Net, through an RS232 communications port on a host computer. Networks of scanners can be arranged in a daisy-chain sequence. In addition, PCScan-Net and Scan-Net provide for two-way communications—from

bar-code reader to host and vice versa.

The PCScan-Net system, a printed-circuit board that fits into a PC expansion slot, converts an RS485 networking line into an RS232 data-communications line, allowing operators to enter data from multiple bar-code scanners to the PC. Scan-Net connects a multiplexer that uses a programmable protocol to a two-wire, twisted-pair RS485 line for data transmission. PCScan-Net and Scan-Net are compatible with both laser and light-pen bar-code readers.

These networks cut installation costs, compared to conventional bar-code readers, by reducing to one the number of multiplexer controllers needed to connect multiple reader devices to host computers. The single controller transmits bidirectional data between the 64 bar-code units and the host system. In contrast, most competing systems require users to purchase an additional

The PCScan-Net and Scan-Net factory-automation networks use as many as 64 laser or light-pen readers connected to a PC or other host computer.



multiplexer—and tie up another host communications port—for every 16 readers on a network.

Using these systems also cuts the amount of software required to integrate the network into a management-information-system environment because one communications port on the central computer can handle the entire network. Thus, programmers need to write less code to bring the system on-line.

Scanners provide two-way link

Manufacturers using Scan-Net or PCScan-Net can also improve data collection and product quality control. Traditionally, manufacturers collect data along the assembly line in one of two ways: Workers either write the information manually and later transfer it to a host computer, or they input the information directly to the host using keyboards attached to CRTs. Both methods are tedious and error-prone.

PCScan-Net and Scan-Net provide a two-way communications link between the scanners and the host PC. That link permits users to connect 32 scanners along each of two assembly lines, with a maximum distance of 4,000 feet between the last device on the line and the controller. The systems track work in progress, send information in real-time to a central location, maintain inventory control, diminish paperwork and reduce

errors over traditional methods.

To use the PCScan-Net or Scan-Net, operators enter data at workstations along the assembly line by using the bar-code reader's keypad or by scanning a multiple-digit, alphanumeric, bar-code label attached to the product component that is being scanned. The multiplexer continuously polls each bar-code reader to see if any information is present. Upon receiving a positive acknowledgement, the network controller converts the information into RS232 format and sends it to the central computer via a communications port. The bar-code networks also provide a 32K-byte data buffer with battery backup to protect stored information and to permit continued scanning while the host is unavailable.

In addition, the two-way system allows the host to send messages to a scanner. When the host relays a message to a reader through Scan-Net or PCScan-Net, the multiplexer delivers an acknowledgement to the host that it has received the message correctly. The system then buffers the message until the polling cycle reaches the addressed reader, and the message is delivered.

Operators receive messages via the bar-code reader's built-in 40-character message display. For manufacturers with CRTs already installed on their shop floors, displayless readers can be connected to a terminal's RS232 port.

With 64 scanners on a network, manufacturers can configure their assembly lines and change the product mix on each line to suit the application. For instance, they can set up one line for printed-circuit boards, another for terminals and another for keyboards. As requirements change, the manufacturer can rearrange the network to track work in progress.

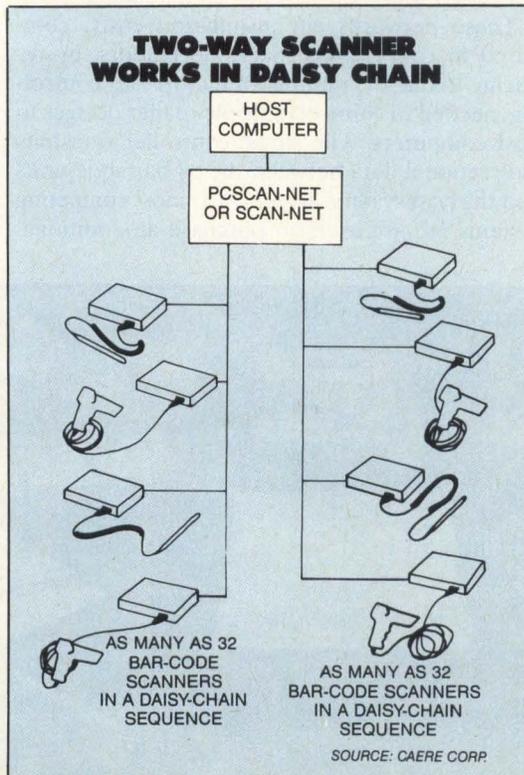
Software relieves burden on host

For use with the PCScan-Net and Scan-Net systems, the System One distributed data-acquisition software package provides an interface with the PCScan-Net system via a PC's asynchronous communications port and interfaces with a mainframe computer through a host communications interface card within the PC.

System One serves as a front end for host data-collection applications. The system controls, collects and processes data collected from bar-code workstations and forwards the data to the host. It also performs device polling, local validation, error recovery and basic transaction processing, thus freeing the host for other tasks. As a result, System One allows users with remote data-collection requirements to distribute processing and avoid overburdening the host.

In a typical PCScan-Net operation, a manufac-

The Caere bar-code network operates in a daisy-chained sequence. It allows as many as 64 bar-code scanners to be linked via two-wire, twisted-pair lines.



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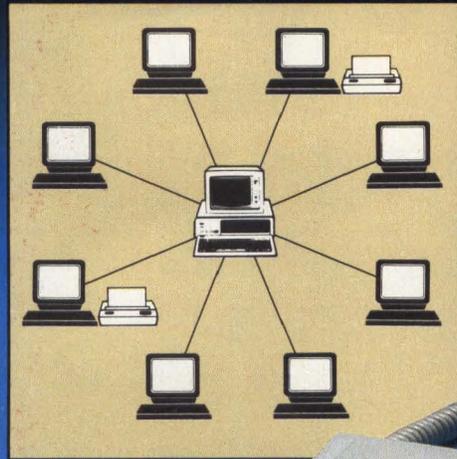
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turer of video display terminals builds and tests subassemblies station by station and, if necessary, returns them for rework. When the subassemblies are acceptable, the manufacturer builds the complete terminal.

The process starts when the various components, such as printed-circuit boards, keyboards and monitors, are tagged with bar-code labels when they enter the production-control area. A line worker inputs job-tracking and operator-identification numbers to the host by scanning a bar-coded menu. PCScan-Net processes the information and transmits it to the host PC, which automatically date- and time-stamps the transaction. Next, the operator scans the bar-code label on the component using a hand-held laser or light-pen scanner.

As an assembly, such as a printed-circuit board, passes through a workstation, an operator adds parts, such as electronic components, and again scans the bar-code label with a hand-held laser or light-pen scanner. This scan informs the host that the task has been completed and

updates the work-in-progress inventory. As a result, plant supervisors are informed as to which assemblies have passed by, when they passed and what parts have been deducted from inventory.

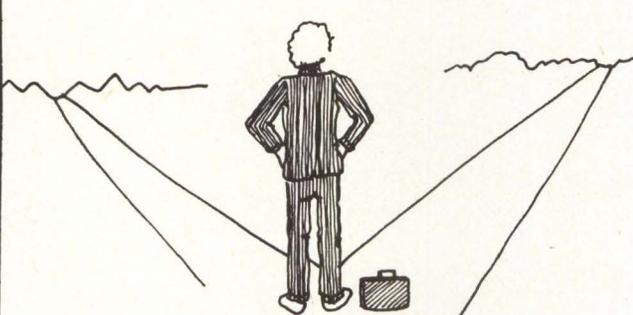
During product testing, operators use the keypad on the bar-code readers to input quality-control information, such as the number of completed, rejected or reworked assemblies. Using this data, quality-assurance personnel can monitor the process flow and immediately deal with problems that arise on the production line.

In the last assembly stage, the keyboard and terminal are united, and an operator scans the bar-code label on the keyboard to match it with the terminal's serial number. Finally, after passing another test, the completed terminal is boxed and prepared for shipment. □

Terry Livermore is marketing manager for bar-code products at Caere Corp., Los Gatos, Calif. Before joining Caere, he was a product line manager of optical disk drives at Magnetic Peripherals Inc.

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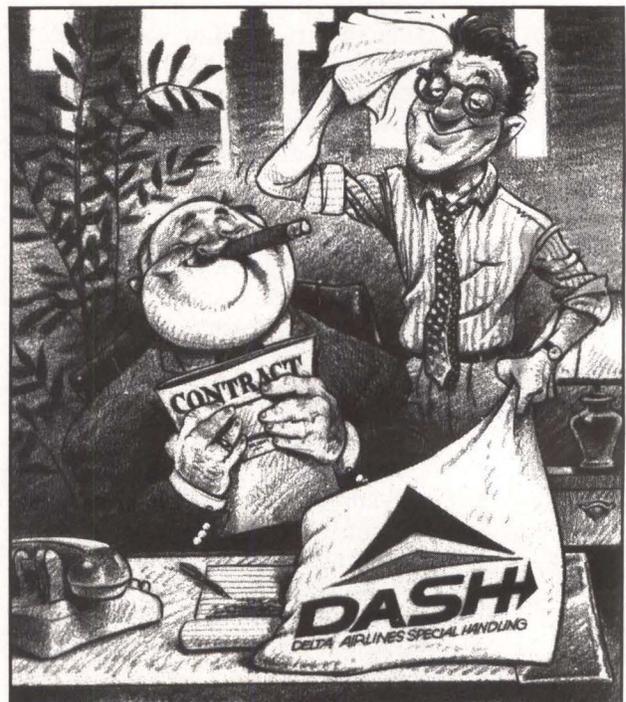
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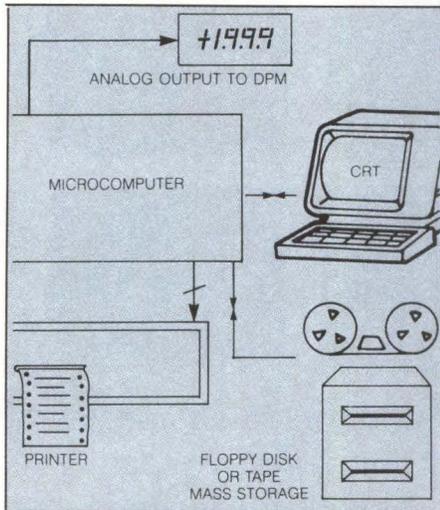
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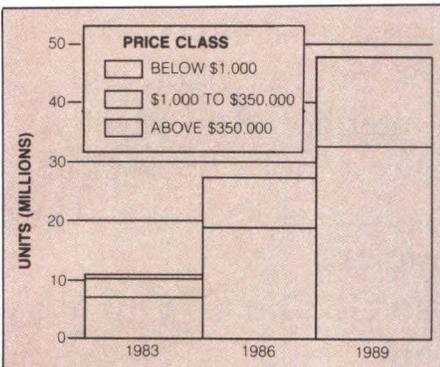
p. 85 . Handling high-end applications

ADD-IN/ADD-ON BOARDS EXTEND MICROS' REACH... 85

In the first of a two-part series on add-in/add-on boards, we take a close look at low-cost data acquisition and coprocessor boards for industrial/scientific applications. The advantages of these boards for system integrators are clear. For example, you can now configure a \$5,000 PC-based data-acquisition system that rivals the performance of a \$15,000 standalone system.

MICRO-WINCHESTERS SAVE MONEY, SPACE AND WATTS 99

More than 12 manufacturers have already produced sub-4-inch Winchester, anticipating a boom for these devices next year. In fact, one research company predicts that worldwide shipments of micro-Winchesters will increase from 482,000 this year to over 10.5 million in 1989, exceeding shipments of 5 1/4-inch Winchesters.



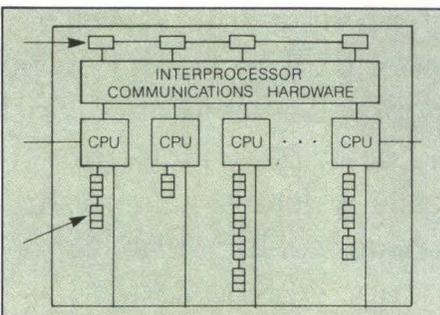
p. 115 . . Mass storage sales rebound

MASS STORAGE SALES RIDE COMPUTER COATTAILS 115

It's no surprise that computer sales spur mass storage sales, but the relationship is often unclear. Our mass storage market survey takes an analytical look at the relationship between the demand for computers and the outlook for the various mass storage markets, including Winchesters, floppy disk drives and tape drives.

EMBEDDED CONTROLLER CUTS SYSTEM COSTS..... 129

Although most major disk drive and controller manufacturers have *plans* to move toward embedded controllers, one of the first to accomplish this move—along with Xebec—is Western Digital. An exclusive look at the company's 3 1/2-inch Winchester reveals the advantages of embedded controllers over discrete controllers.



p. 153 . . Multicomputers open doors

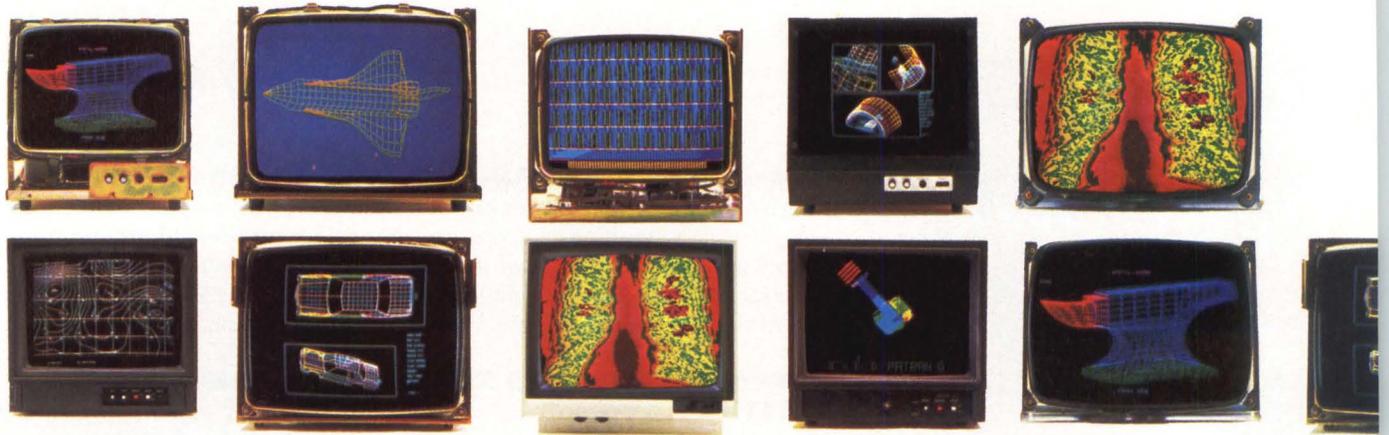
STANDARDS SERVE AS ROAD MAPS..... 141

Standards are probably the most hotly debated issue in the computer industry. Questions range from "Which one?" to "Do we need them at all?" Are they merely road maps, or destinations in themselves?

COMPUTER ARCHITECTURE: MULTICOMPUTERS BOOST MIPS AND MODULARITY..... 153

One company claims to have completed the vault to fifth generation computing with a multiple instruction stream/multiple data stream multicomputer that consists of groups of parallel 32-bit computers.

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CIRCLE NO. 48 ON INQUIRY CARD

ADD-IN/ADD-ON BOARDS EXTEND MICROS' REACH

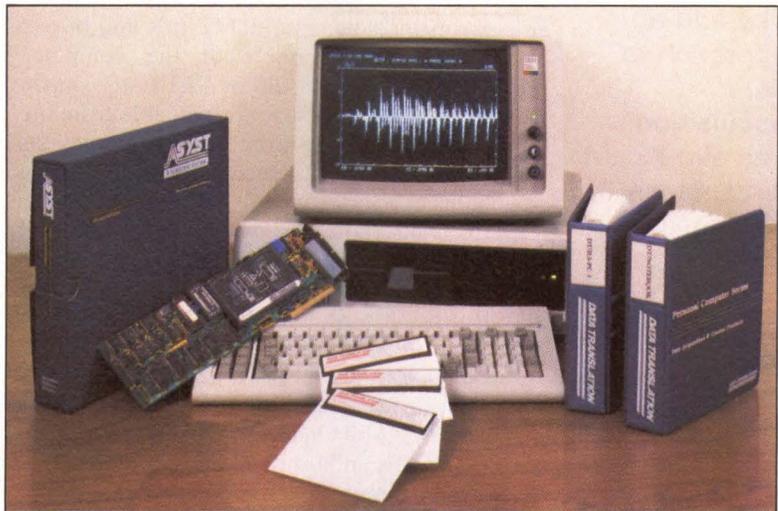
Low-cost data-acquisition and coprocessor boards enable microcomputers to handle high-end industrial and scientific applications

Jesse Victor, Associate Editor

The rapidly increasing availability of relatively low-cost industrial/scientific add-in/add-on boards is good news for microcomputer users. Personal computers equipped with these data-acquisition and coprocessor boards can acquire and analyze data from thermocouples, strain gauges or pressure sensors, speed up signal processing with fast Fourier transforms (FFTs) and guide robots or control processes in industrial applications.

The boards' modularity and improving circuit integration enable system integrators to configure a \$5,000 personal computer-based data-acquisition system to rival a \$15,000 to \$20,000 standalone system's performance for many applications, without incurring the cost of expensive and unneeded capabilities. And vendors of industrial/scientific add-in boards can ride a burgeoning wave of microcomputer-based applications while avoiding the considerable uncertainties of the graphics, memory and multifunction plug-in-card market.

At stake is a significant slice of a multibillion dollar hardware add-in market—estimated by Frost & Sullivan Inc., New York to have been \$5.2 billion in 1984. The industrial data-acquisi-

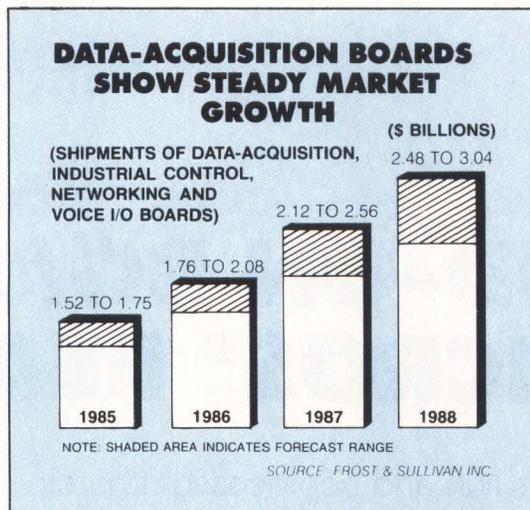


Microcomputer-based add-in boards implement real-time data acquisition, analysis and process-control functions under the control of vendor-supplied packages.

tion-and-control market, pegged at \$50 million to \$100 million this year, will grow at a 15 percent to 20 percent compound annual growth rate through 1989—faster than the add-in memory expansion, graphics or multifunction card market, according to Frost & Sullivan. The total market for industrial add-ins, including networking and voice I/O boards, should climb to between \$1.76 billion and \$2.08 billion next year and to between \$2.48 billion and \$3.04 billion in 1988, the market-research company predicts.

Data-acquisition-product vendors follow dif-

This is the first of two articles on microprocessor-based add-in/add-on boards. The second article, to appear in a future issue of Mini-Micro Systems, will focus on image-processing cards.



The add-on approach to data acquisition has significant advantages over less costly plug-in cards.

ferent approaches to microcomputer-based systems. They offer plug-in boards for the computer's expansion slots, external boards and boxes, or modules that connect to the computer through RS232C, RS422 or IEEE-488 links. Data-acquisition packages are available from the vendors themselves or from outside sources for specialized applications, such as materials testing or geological data logging.

Data Translation Inc. is one of a score of vendors offering plug-in data-acquisition cards for the IBM Corp. PC and compatibles. The DT801 series furnishes as many as 16 channels of high-level or low-level analog inputs, 12- or 16-bit analog-to-digital (A/D)-converter resolution, sampling speeds up to 27.5K per second, as many as 24 12-bit digital-to-analog (D/A)-converter channels and up to 72 lines of digital I/O. Software encompasses programs for data acquisition and analysis, process control, digital signal processing and real-time chromatography and spectroscopy.

The menu-driven DT/Notebook, for example, includes process-control, curve-fitting and FFT routines and automatically sends data to integrated packages—such as Lotus Development Corp.'s 1-2-3—for further analysis. Data can be collected at rates to 20,000 samples per second, continuously streamed to disk at a rate of 400 samples per second and displayed in real time as fast as 600 samples per second.

Half-height cards select functions

The company's new line of DT2814, DT2815 and DT2817 half-height cards addresses the need for low-cost, personal computer-based dedicated functions, according to product marketing manager Jack Worthin. "In breaking down the func-

tions of our larger cards," he says, "we are targeting users who need only data acquisition, analog outputs or digital-I/O capability."

System integrators who want only A/D functions, for instance, can specify the \$299 DT-2814. It supplies 16 single-ended analog inputs, a 12-bit 25- μ sec A/D converter and a sample/hold amplifier. Throughput to 30K samples per second exceeds the multifunction \$1,095 DT2801A board's 27.5K rate.

Action Instruments Inc. supplies a full line of analog and/or digital I/O cards plus Actionware data-acquisition and control software for the IBM PC, PC/XT or 5531 industrial computer. The company also provides interface boards for thermocouples, resistance temperature detectors (RTDs), strain gauges, pressure transducers and other sensors. For example, its A104 board combines functions. In addition to four differential analog inputs, a 12-bit A/D converter, 12 channels of digital I/O and external interrupt control, it furnishes two RTD interfaces with a temperature range of -200 C to 650 C, two precision voltage-reference outputs and two constant-current sources.

Specialized, high-performance applications might require the Lab Master plug-in from Scientific Solutions Inc. It speeds A/D conversions to 80 kHz, with optional 16-bit resolution, from as many as 256 channels. Five independent 16-bit timer/counters can sample data on different channels at precise intervals. MetraByte Corp.'s 16-channel Dash-16 board for IBM PCs and compatibles performs 12-bit A/D conversions at speeds to 50 kHz. Direct-memory access (DMA) data transfers to the PC allow the board to acquire data in the background without interfering with the computer's processing.

iSBX connectors add capability

For system integrators needing more functions than most basic plug-in cards provide, Data Translation and other companies furnish boards with iSBX connectors to support plug-in modules as well as cards to implement remote, intelligent data-acquisition nodes. For instance, Data Translation's DT806 multifunction I/O board has three programmable counter/timers and three iSBX bus connectors for the DTX300 series of analog-input modules, output modules and digital-I/O modules.

Factory networks and remote-data acquisition, requiring high data security and fast data transfer, are served by the DTX344 Bitbus interface module, which interfaces to the DT901 intelligent, remote, I/O expansion board. The module holds as many as four DTX modules;

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sensors connect to the board via signal-conditioning screw-terminal panels.

Worthin sees the microcomputer-based industrial-networking approach as a significant cost-effective alternative to more expensive, programmable-controller-based, factory-networking schemes. "You can write programming from the IBM PC to remote intelligent nodes out in the factory," explains Worthin. "The nodes will then program an A/D card and transfer data, when it is acquired, back to the PC."

Although most add-in data-acquisition-card vendors target IBM PCs and compatibles, Data Translation, Analog Devices Inc. and other vendors also provide boards for Digital Equipment Corp. LSI-11 microcomputers. Data Translation and R.C. Electronics Inc. are joined by Interactive Microware Inc., Interactive Structures Inc., Mountain Computer Inc. and Strawberry Tree Computers in offering data-acquisition, process-monitoring and process-control cards for Apple Computer Inc. microcomputers.

Add-on boards boost flexibility

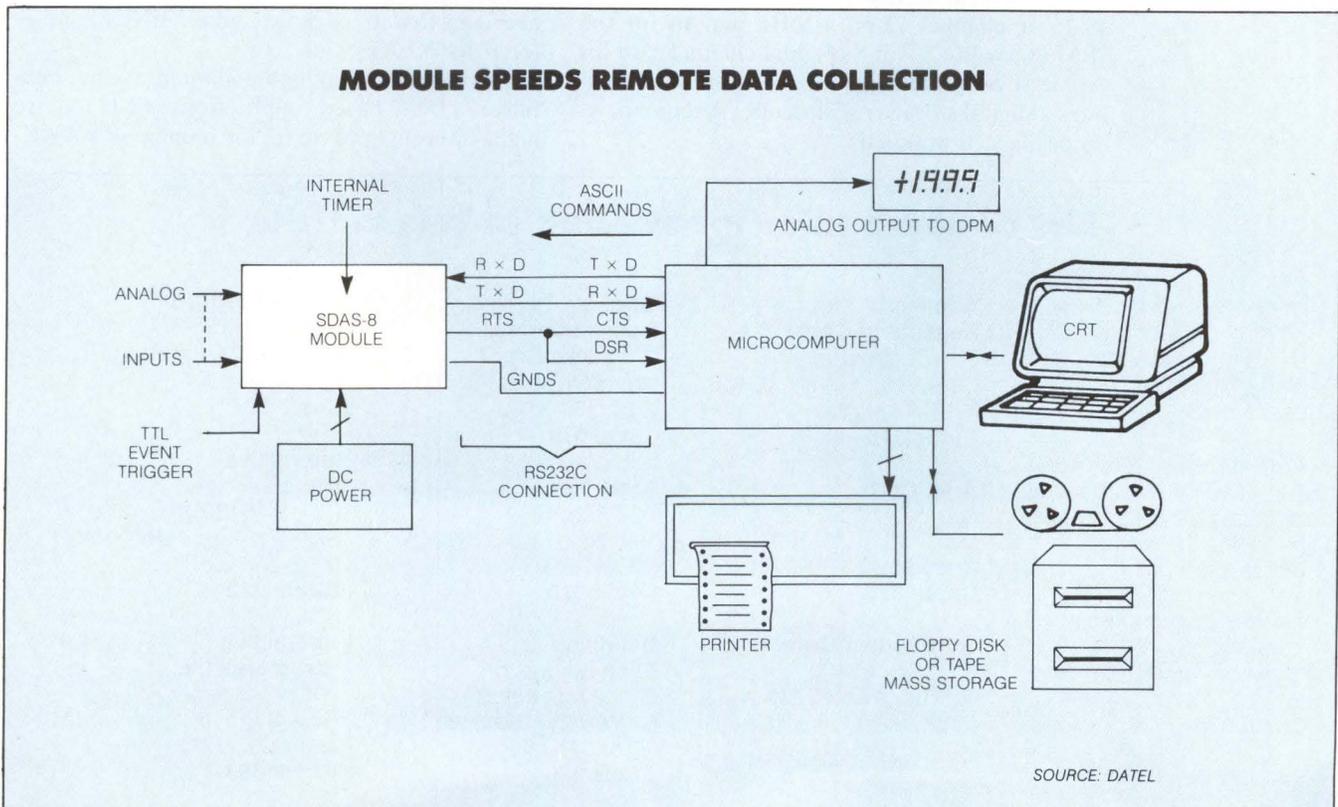
The boards-in-boxes, expansion-board or add-on modules approach to personal computer-based data-acquisition, as exemplified by Analog Devices, Burr-Brown Corp., Datel, Qua-Tech

Inc. and other manufacturers, has significant advantages over less costly plug-in cards. Specifically, this approach avoids problems with the IBM PC's small convection-cooled power supply, preserves valuable expansion slots, provides greater noise immunity in factory-floor applications and furnishes more functionality and flexibility for remote data acquisition.

Burr-Brown's PCI-2000 series of modular add-ons is based on carriers and one-function data-acquisition instrument modules. Inserting in IBM PC, PC/XT, PC/AT or Compaq Computer Corp. expansion slots, the carriers provide power and intermodule communications for as many as three modules. A proprietary I³ bus passes synchronization and trigger signals between modules. One instrument module processes and conditions a signal from another module in a daisy-chain configuration. Ribbon cables connect the modules to termination panels for analog or digital I/O and sensors. BASIC calls in the PCI-20014S-1 package support error-checking and data-acquisition functions.

For remote data acquisition, up to hundreds of feet from the host computer, consider Datel's SDAS-8, an eight-channel analog-input module. Connecting to host computers via a full-duplex on-board-microprocessor-controlled RS232C

Connecting to any microcomputer via an RS232C port, Datel's SDAS-8 add-on module can collect data hundreds of feet away from the host computer using a TTL event trigger, internal timer or, by ASCII commands.



IEEE-488 links relieve system integrators of the task of developing separate interfaces for each connected device.

link, the steel-cased 4-by-6-by-0.4-inch unit includes a 12-bit A/D converter, a crystal-controlled clock and direct thermocouple input and linearization. Input data can be transmitted using a TTL trigger, by host ASCII command or controlled by the autostart interval timer. The module also comes as an add-on board with power supply.

Interfaces meet tough demands

Analog Devices' new series of compatibility kits converts an IBM PC, PC/XT or 5531 PC into a measurement-and-control workstation. KIT120 functions with the company's Series 120 plug-in A/D I/O cards, which offer as many as 32 analog-input channels. For more demanding industrial applications, KIT200 and KIT259 provide interfaces to the company's MACSYM 200, 150 and 260 intelligent data-acquisition-and-control front ends.

More specialized data-acquisition products from smaller vendors fill the gaps in the larger manufacturers' product lines. Qua-Tech, for example, in addition to plug-in data-acquisition cards, has an IBM PC-compatible RS422 board with balanced differential drivers, shielded connectors and optional transient suppressors for long-distance communications (to 4,000 feet) in noisy industrial environments. R.C. Electronics' IS-16 16-channel 12-bit 1-MHz plug-in for the IBM PC or PC/XT or 8-bit dual-channel card for Apple II computers includes software that emulates a digital storage oscilloscope. A data-analysis package is optional.

Ariel Corp. furnishes FFT array-processor boards for the PC and Hewlett-Packard Co. Series 200 microcomputers as well as a spectrum-analyzer card for the PC. The PC FFT board executes a 16-bit-integer complex FFT with 1,024 points in 9.2 msec. Geocomp Corp. offers PC-compatible packages for material-properties testing and geological analysis in addition to on-site and remote, unattended data acquisition.

RS232C or RS422 links might be inadequate for linking and controlling computers and data-acquisition instruments in complex laboratory or factory-floor networks. For high-end applications, IEEE-488 general-purpose interface bus (GPIB) links relieve system integrators of the task of developing separate interfaces for each connected device. They also afford higher data-transfer rates than do RS232Cs (450K bits per second vs. 19.2K bps), the security of handshaking for every byte transferred, higher noise immunity and the ability to connect industrial buses, such as STDBus, VMEbus or Multibus, to the host microcomputer.

National Instruments Corp.'s new top-of-the-line GPIB-PC3 board supports all of the IEEE-488 bus' "talker," "listener" and "controller" features but boosts continuous data-transfer throughput to 1M byte per second. Software includes a full-function DOS handler, an engineering software package and a XENIX handler for IBM PC/ATs.

The board aims at high-end multitasking, multiuser UNIX-based applications that require higher throughput than the company's 300K-

List of companies mentioned in this article

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Circle 382

Interactive Structures Inc.
146 Montgomery Ave.
Bala Cynwyd, Penn. 19004
(215) 667-1713
Circle 383

byte-per-second GPIB-PC2, says president James Truchard. He contends, "The hardware increases throughput by unburdening the software from having to perform a lot of the higher level GPIB functions. With XENIX, it is not satisfactory to have other users in the loop burning processor time."

National also supports Apple's Macintosh and DEC's MicroVAX II with its GPIB11V-2 board. National's new GPIB-MAC add-on box connects the personal computer's RS422 port to the IEEE-488 bus. Its software supports BASIC, C, FORTRAN, Pascal and assembly languages.

Board extends IEEE-488 limit

Ziatech Corp.'s 450K-byte-per-second ZT 1488A board supplies iSBX module sockets for adding functions without using PC expansion slots. Configured with an additional GPIB channel, the board enables a PC to control more devices than the IEEE-488 bus limit of 15 or isolate slow and faster devices on separate GPIB channels for faster throughput, explains director of marketing, Jim Eckford.

Eckford and Truchard foresee future benefits for system integrators from the efforts of the IEEE P981 committee in standardizing GPIB codes and formats. "One of the reasons GPIB is so effective is that you can plug any hardware together and it always works," Truchard maintains. "The reason it works is that everything has been standardized at the hardware level, including internal programming and bus lines. Standardization has been more nebulous at the software

level, though. We are trying to simplify a user's interaction with instruments on the bus."

Plug-in coprocessor cards can boost throughput in concentrated data-acquisition applications, perform specialized tasks such as number crunching or computing FFTs or add multitasking/multiuser capabilities in laboratory or industrial networks.

General-purpose coprocessor boards utilizing National Semiconductor Corp.'s NS32010 or 32032, Intel Corp.'s 80186 or 80286 or Motorola Inc.'s MC68010 or 68020 microprocessors work with standard microcomputer software. Specialized signal-processing or FFT cards usually require system integrators to develop control programs in BASIC, C or other languages.

Provides a UNIX V port

Definicon Systems Inc. and Opus Systems offer plug-in boards based on the 32-bit NS32032 CPU. Operating under the control of MS-DOS or Concurrent DOS, Definicon's DSI-32 runs at 10 MHz and includes the N32081 floating-point accelerator, as much as 2M bytes of dual-port RAM, a 16-bit interrupt-driven counter/timer, two 38K-baud serial ports and an optional NS32082 memory-management unit.

As with most coprocessor cards, the board takes over number-crunching tasks from the host processor, relegating intelligent-I/O functions to the PC. DSI-32 runs single-pass compilers for C, Pascal, FORTH and FORTRAN and will, in the near future, support AT&T Co.'s UNIX System V, says Definicon president Vincent Williams.

Plug-in coprocessor cards can boost throughput in concentrated data-acquisition applications.

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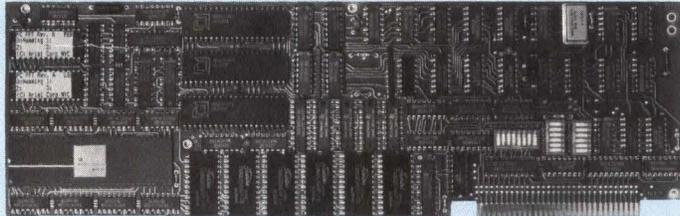
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San Luis Obispo
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Circle 395



Points		Execution time
	Complex Fast Fourier Transform (FFT)	
32		144 μ sec
64		350 μ sec
128		800 μ sec
256		1.8 msec
512		4.2 msec
1,024		9.2 msec
	Power spectral density	
1,024		1.8 msec
	Windowing	
1,024		1.8 msec

Executing a 16-bit-integer complex FFT with 1,024 points in 9.2 msec, Ariel's PC FFT card implements signal-processing functions for the IBM PC.

"The coprocessor board does complex image processing and other computation-intensive tasks with [DEC] VAX-750-like performance," Williams asserts. "It can do an FFT 15 to 17 times faster than an unaided PC/XT or PC/AT." Concurrent DOS allows the PC to handle other tasks while number crunching goes on in the background.

VAX-750 performance for many applications is also claimed for the Opus System's Opus 516 Personal Mainframe, which turns an PC/XT or PC/AT into a UNIX workstation. Providing a complete port of UNIX System V, the system comes with an NS32016 processor (slated to be upgraded to the 32032 by the end of the year), floating-point and memory management and as much as 2M bytes of RAM. A keyboard command switches between the UNIX and PC-DOS operating systems.

Sritek Inc.'s coprocessor boards come in two versions: a 10-MHz 32016 running GENIX (a version of Berkeley UNIX Version 4.2), MMU and floating-point coprocessor, or an MC68000 running UNIX System V. Both cards can be loaded with as much as 8M bytes of memory, and permit fast switching between PC-DOS and GENIX or UNIX.

Applied Reasoning Corp. and Phoenix Software Associates Ltd. offer coprocessor boards based on the 80286 that they claim can boost 4.77-MHz 8088-based or 6-MHz 80286-based computers' performance with the added 80286s operating at a faster, 8-MHz clock rate. Applied Reasoning's PC-elevATor enables a PC or PC/XT to emulate a PC/AT, but runs PC-DOS 3.0 and 3.1 applications 50 percent faster than the PC/AT, according to the company. Phoenix asserts that a PC or PC/XT equipped with its Pfaster286 board can run MS-DOS programs as much as five times faster than the PC/XT and 60 percent faster than the PC/AT. As with the Definicon Systems board, the 286 card off-loads

processing tasks from the 8088.

An 80186-based system, Orchid Technology Inc.'s PCTurbo-186, differs from other coprocessor boards in its relationship to the host computer. It acts as a DMA-linked peripheral, with the board adding as much as 640K of its own RAM, not mapped into the PC's. Users can switch back to 8088 control by entering Gopc. On-board software implements non-volatile disk caching and RAM disks to boost throughput.

Ampro Computer Inc.'s Little Board/186 also uses an 8-MHz 80186 but stands out from most coprocessor boards in several respects. It interfaces to any computer with a small computer systems interface port, and it qualifies as one of the least expensive add-ons (\$649 with 512K bytes of RAM). Measuring only 5¾ by 7¼ inches, the unit includes two RS232 ports, a floppy disk controller and a parallel printer port.

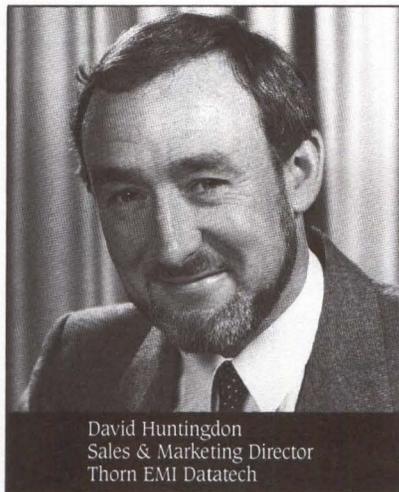
Continued progress in circuit integration will ensure lower prices and higher functionality for tomorrow's data-acquisition boards. Faster processors (and coprocessors) and 32-bit-wide data paths will make 16-bit or higher A/D accuracy the norm, along with throughput beyond 50,000 samples per second. This reduces the tradeoff between A/D converter resolution and sampling rate. Increased use of CMOS technology will enable boards to function over a wider temperature range and in harsher industrial environments. Software will continue to play a significant role both in boosting throughput and in making data-acquisition systems easier to configure and operate. Such simplification of the user interface could lead to artificial intelligence becoming a driving force in the next generation of microprocessor-based data-acquisition systems. □

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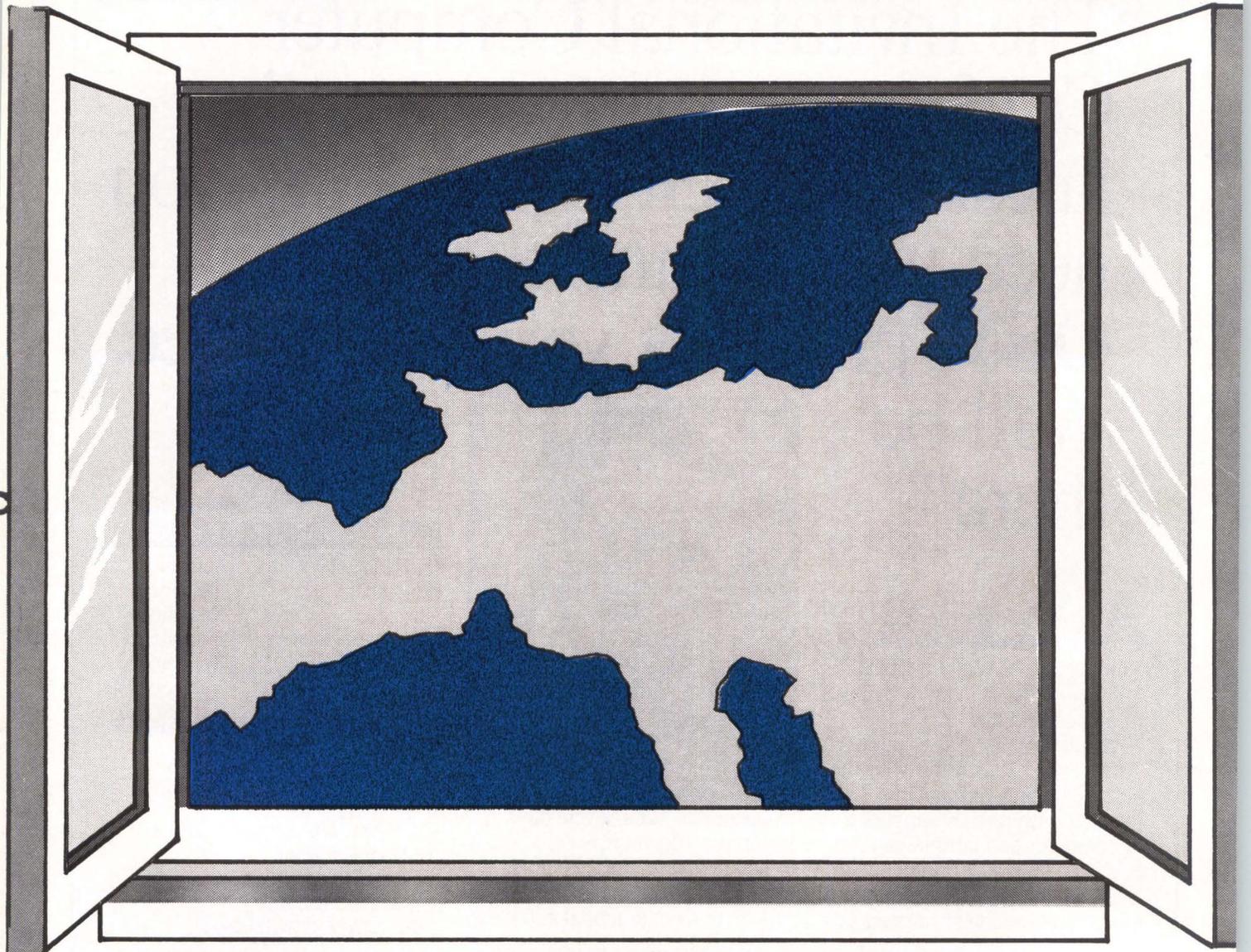
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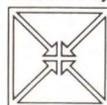
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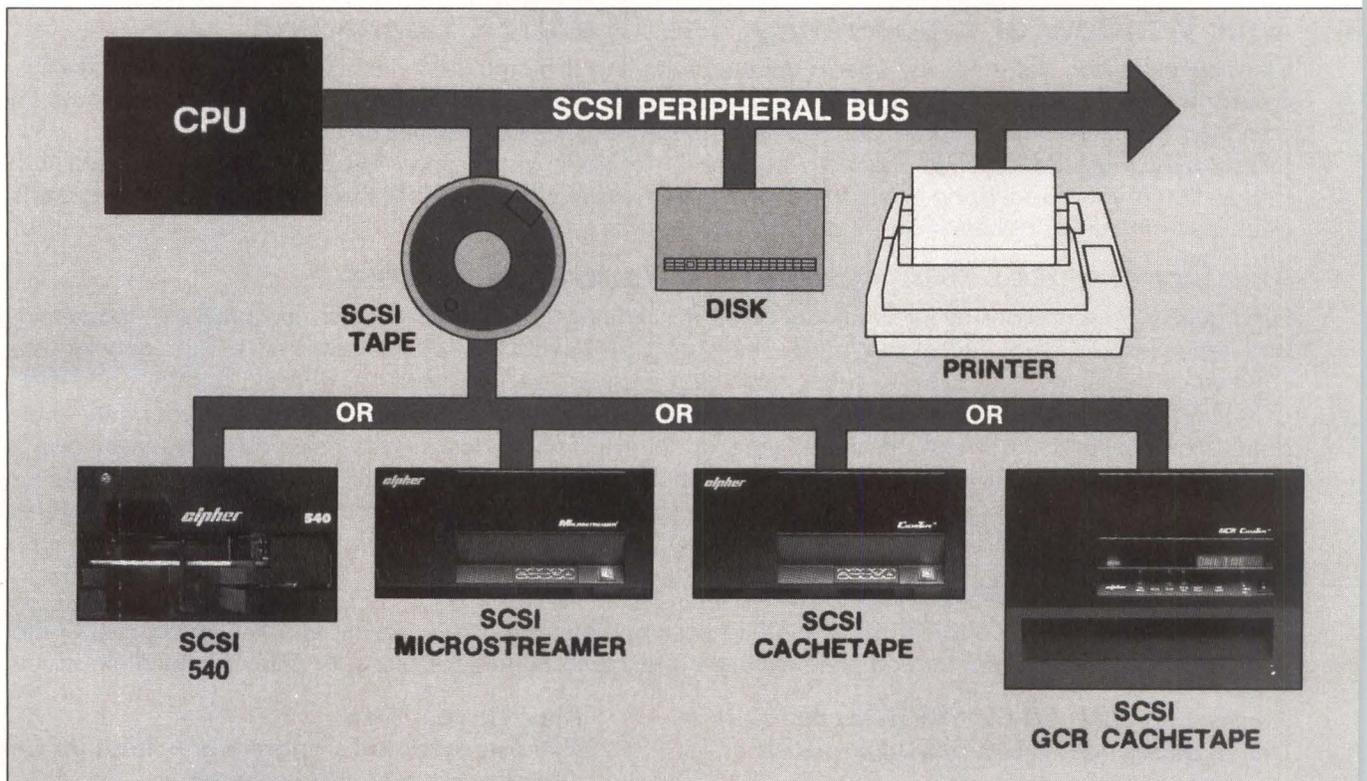


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CIRCLE NO. 52 ON INQUIRY CARD

The Cipher



Cipher announces SCSI-compatible 1/2-inch tape peripherals.

SCSI, known as the new standard interface for small, low-end computer systems, is also gaining ground in the high-performance market. With the continuing delay in the development of the Intelligent Peripherals Interface (IPI) for disks, SCSI has found its way into larger systems as well.

Cipher has taken the lead in bringing a full line of easy-to-integrate tape drives to this emerging marketplace. In addition to the 540S 1/4-inch streamer, three 1/2-inch products, the Microstreamer[®], CacheTape[®] and GCR CacheTape[®], are also available in SCSI-compatible versions.

SCSI enables integrators to use a single hardware interface, regardless of which drives are being used.

Cipher's SCSI option is a full implementation of the interface specifications being reviewed by ANSI. It offers all of the standard features found with most intelligent interfaces, plus ANSI-supported bus arbitration, disconnect/reconnect and copy command. Multiple initiator and multiple target features to improve tape management and backup efficiency are also included.

Cipher engineers can provide expertise to help you integrate tape drives into SCSI systems. For more information call 1-800-4-CIPHER, ext. 9.

Nixdorf cuts tape integration costs with CacheTape.

When Nixdorf Computer AG needed a new tape drive for their System 8850[™], their first choice was Cipher's Microstreamer. "It offered both streaming and 25 ips

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start-stop capability at a lower cost than the standard 25 ips drive we were using," said Rainer Muhlenweg, director of OEM product selection.

However, rather than spend time changing software to integrate the Microstreamer, Nixdorf found that Cipher's CacheTape could be integrated immediately, without modification.

"The intelligent cache memory enabled the drive's performance to be matched to that of the computer by managing the differences internally," said Muhlenweg. "And the additional cost of the cache memory was insignificant, compared to what the integration costs would have been without it."

As for the Microstreamer, Nixdorf will be using it in three other systems whose software already allows streaming.

Cipher introduces mainframe-to-PC connection.

If you have an IBM PC®, XT® or AT® you can now access 9-track tape. Just insert the tape into any Cipher Series 9000 ½-inch Tape Subsystem.™ From there, you can upload and download data directly with your PC.

These subsystems act as low-cost, transportable links to large computers and tape libraries. They allow you to freely access and manipulate data, without accessing the mainframe.

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If you'd like to access 9-track tape with your PC, call 1-800-4-CIPHER, ext. 9.



CacheTape: The streamer for systems that can't stream.

Adding a streamer to systems that can't stream leaves integrators with a difficult choice. They can modify the software to fit the streamer. Or they can keep the software the same and sacrifice streaming performance.

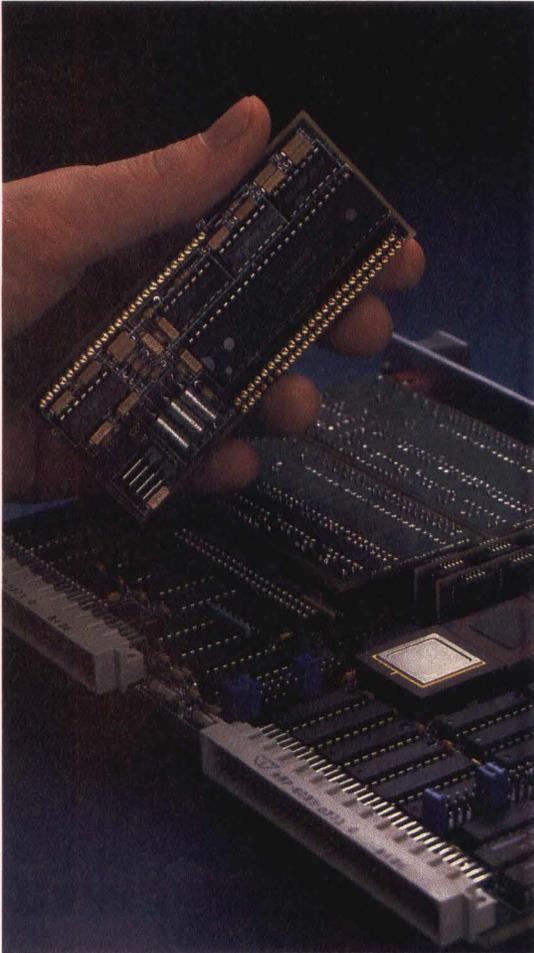
Cipher's CacheTape® solves both problems. It gives you three to four times the performance of traditional streamers, and it works with existing start-stop software. And it's only 40% of the price of traditional start-stop drives.

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MICRO-WINCHESTERS SAVE MONEY, SPACE AND WATTS

In industrial and portable applications, OEMs and system integrators employ sub-4-inch Winchester that are more efficient—and sometimes less expensive—than their 5¼-inch counterparts

David Simpson
Senior Associate Editor

After a dismal 1984, which saw the eight top Winchester disk drive manufacturers plummet from combined profits of about \$30 million in the second quarter to losses of over \$10 million in the fourth quarter, the disk drive industry is showing signs of recovery. With once-major manufacturers such as International Memories Inc. and Shugart Corp. out of business, the survivors plow ahead. One of the most promising areas for drive manufacturers is 3½-inch models—both flexible and fixed.

Analysts predict that more than 4 million 3½-inch floppy drives will be shipped this year, and 3½-inch Winchester, or micro-Winchester, are beginning to follow that phenomenal growth rate. In fact, Dataquest Inc., a San Jose, Calif., research company, predicts that worldwide shipments of micro-Winchesters will soar from 482,000 units shipped this year to more than 10.5 million units shipped in 1989. Moreover, micro-Winchester shipments are expected to eclipse those of 5¼-inch hard disk drives by 1988.

Although some end users find the 3½-inch form factor a minor convenience, its importance is clear to system integrators and OEMs, who continually try to pack more performance into less space while keeping integration problems to a minimum. And, having achieved the small form factor, manufacturers of 3½-inch storage devices are concentrating on other size and



Micro-Winchesters, such as Hewlett-Packard's HP97501A, usually employ 3½-inch disks. An exception is SyQuest's line of sub-4-inch fixed and removable drives, which use 3.9-inch media.

performance improvements such as reduced height, lower power consumption and, of course, lower prices.

The benefits of micro-Winchesters are similar to those of microfloppy units. To ease integration into portable computers, manufacturers keep power consumption and weight to a minimum. The dozen or so manufacturers, reacting to stiffening competition, are pushing prices

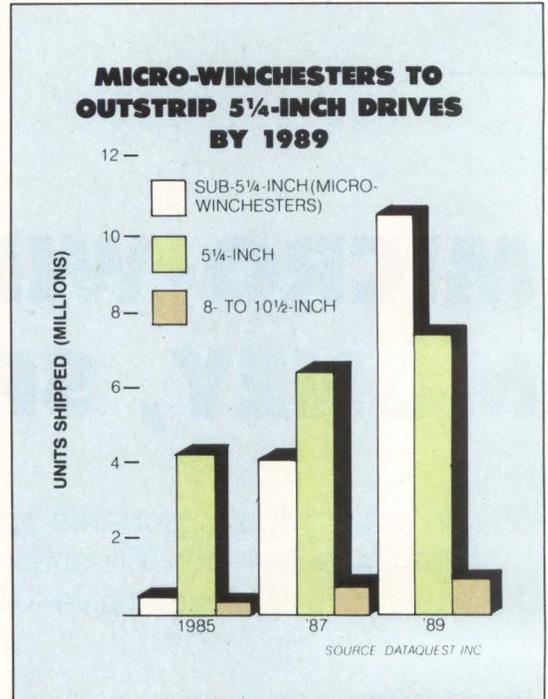


down, with little variance in cost-per-megabyte among drives. Furthermore, manufacturers are reluctant to quote prices because volume discounts are highly negotiable. And, to enable system integration into harsh environments, such as the factory floor, manufacturers are introducing rugged versions with impressive environment-operation specifications.

Survives severe environments

System integrators use 3 1/2-inch Winchesters in two key ways: To structure a system around the 3 1/2-inch form factor, or to integrate the smaller drive into an existing 5 1/4-inch slot. Because micro-Winchesters are, for the most part, just beginning to reach production quantities, most integrators are taking the latter route. This approach allows adding shock mounts for harsh environments. However, even without shock mounts, the new drives are particularly well-suited to rugged applications, including those involving portable computers and instruments.

LaPine Technology developed a ruggedized 3 1/2-inch drive before developing a standard (non-ruggedized) version. The standard version suits system integrators who don't need the ruggedized features and, therefore, aren't willing to pay for them. LaPine's ruggedized drive costs \$325 in OEM quantities of 500, compared with \$285 for the non-ruggedized version.



Micro-Winchesters currently account for about 10 percent of the worldwide market for 10 1/2-inch and smaller Winchester disk drives. That market share is expected to increase to 56 percent by 1989.

HIGH-CAPACITY, FAST ACCESS 3 1/2-INCH WINCHESTERS TO EMERGE BY 1986				
Capacity (M bytes)	3 1/2 inches	5 1/4 inches		
		Slow access		Fast access
		Full height	Half height	
10 F	current major sub-5-inch market, but relatively small and will fade by late 1985	current volume product that will fade by end of 1985	small now and will fade	NR
20 F	new market; will dominate low-cost segment by early 1986	small market	important in 1985 and then will fade by 1986 in favor of 3 1/2 inches	emerging market but will be eclipsed in 1986 by 40M bytes
40 UF 30F	Leading edge, fast-access product to emerge by early 1986	small market	may emerge, but not important now	small now, but will be largest market in 1986
50-100 UF	NR	NR	some initial interest by large OEMs, status unclear	center of action for 1985 leading edge market
>100 UF	NR	NR	NR	starting to emerge, center of leading edge market in late 1986 or 1987

NR=negligible requirements in 1985 and 1986
F=formatted
UF=unformatted

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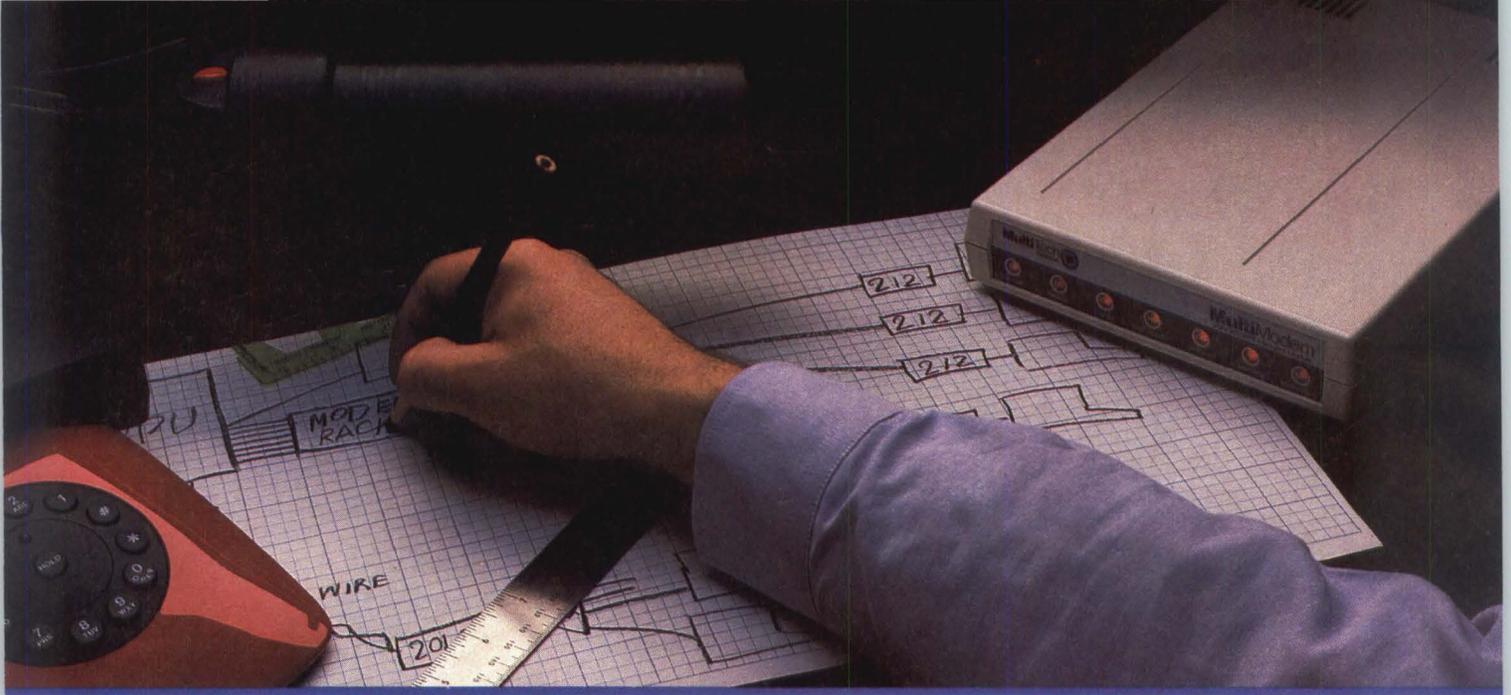
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The ruggedized drive withstands 60G and operates in temperatures between 0 C and 65 C. These figures compare to the 40G and a 5 C to 50 C temperature range on most other 3 1/2-inch Winchester. Tom Finnegan, LaPine's vice president of sales, emphasizes the 10M-byte, 3 1/2-inch Ranger 3522's acceptance in industrial and robotic applications, but says that the company is also trying to sell into the portable business computer market. Users usually integrate the drives into 5 1/4-inch slots, but Finnegan adds that the move toward 3 1/2-inch slots is under way.

The company sells the Ranger 3522 with either standard oxide or plated media. Although plated and sputtered thin-film media are the wave of the future for higher density drives, the track and bit densities of 10M- and 20M-byte drives typically don't require these higher cost media.

Another manufacturer that touts the ruggedness of its 3 1/2-inch Winchester is Microscience International Corp. The company claims a shock tolerance of 70G and an operating temperature range of 5 C to 50 C on its 10M-byte HH-312 and 20M-byte HH-325. The key to the drives' ruggedness is a proprietary closed-loop wedge servo positioning system that compensates for shock vibration, thermal expansion and system hysteresis. Also contributing to their ruggedness are a thermally isolated stepper motor, a linear actuator assembly and a buffered seek mode.

Anticipating the demands of even higher capacities (over 20M bytes), Microscience uses sputtered media. This allows a track density of 855 tracks per inch (tpi). However, the tpi leader in the 3 1/2-inch Winchester market is Hewlett-Packard Co. with its 1,100-tpi HP97501A, which also uses sputtered media. The company incorporates the drive into its own systems, but also wears the OEM hat. By manufacturing its own media, drive and controller, HP offers system integrators a one-stop solution while ensuring drive/controller compatibility.

Low power consumption a plus

Ruggedness, however, is only one advantage of 3 1/2-inch Winchester. Other benefits include reduced power consumption and weight, particularly when integrating a hard disk into a portable/transportable system.

Micro-Winchesters consume between 9.7W and 13W, considerably less than normal 5 1/4-inch-drive consumption. For example, Tandon Corp.'s 20M-byte, 3 1/2-inch TM362 uses an average of 10W, whereas the company's half-height 5 1/4-inch drive uses an average of 22W. Tandon's 3 1/2-inch drive employs plated media and a closed-loop positioning system to increase track

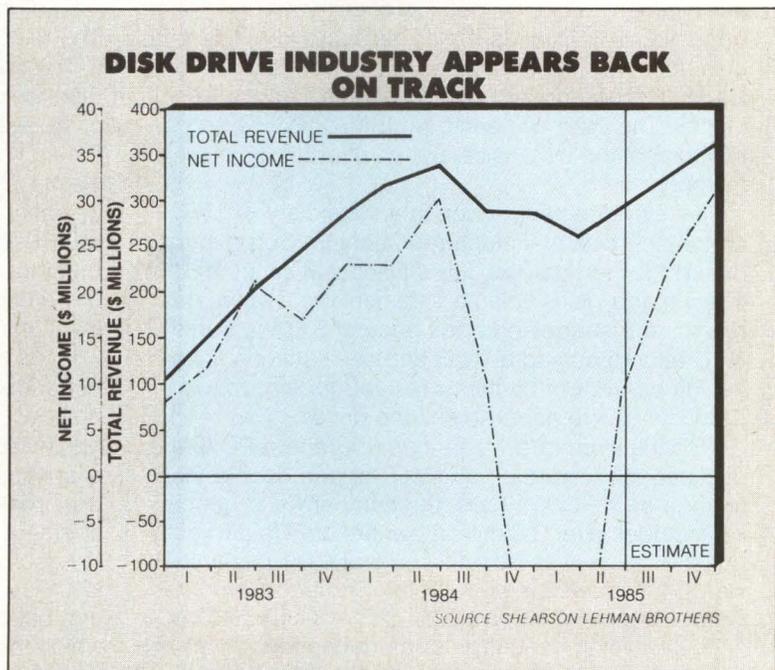
density. As do most manufacturers of 3 1/2-inch drives, Tandon offers its product in both 3 1/2- and 5 1/4-inch enclosures. Tandon, along with Seagate Technology, is a leader in shipments of small Winchester disk drives.

Another benefit for portable-computer applications is the reduced weight of 3 1/2-inch drives. At 2 pounds, the drives weigh about half as much as most half-height, 5 1/4-inch drives.

Miniscribe Corp.—a company often cited by analysts as one of those “most likely to succeed” in the 3 1/2-inch market—this year inked a deal with Applied Computer Techniques Plc. (ACT) to supply that British manufacturer with 3 1/2-inch hard disks for its small-form-factor personal computers. ACT is the largest manufacturer of personal computers in Great Britain.

Miniscribe, which started shipping its 3 1/2-inch drive early this year, sells to its traditional customer base, according to Bob Ganter, vice president of the 3 1/2-inch disk drive division, who declined to reveal other major OEM contracts. Rumors, however, indicate that IBM Corp. may already have placed orders with Miniscribe.

Most 3 1/2-inch drives adhere to a standard size—1.62 inches by 4 inches by 5.75 inches. Exceptions are HP's drive, which measures 2 inches by 4 inches by 5.1 inches (the exact size of



The figures track the eight major U.S. manufacturers of 5 1/4-inch and smaller Winchester disk drives, which together make up 80 percent of the U.S. market. They are Computer Memories Inc., Iomega Corp., Micropolis Corp., Miniscribe Corp., Priam Corp., Quantum Corp., Seagate Technology and Tandon Corp.

MASS STORAGE



most microfloppy drives), and SyQuest Technology Inc.'s SQ Series.

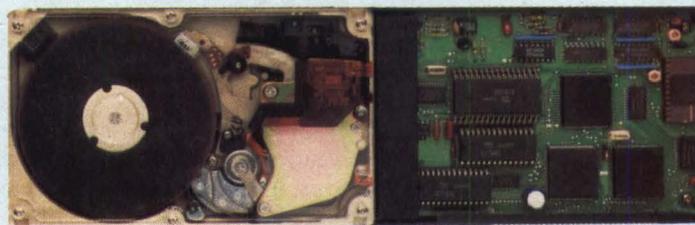
SyQuest was one of the first companies—

along with Rodime Inc., which supplies 3 1/2-inch drives to Compaq—to market a sub-4-inch Winchester. But it is the only company that uses

Hardcard disk drive fits into PC slot



Measuring 1 by 4 by 13 inches, Plus Development's Hardcard is a 10M-byte hard disk drive that plugs into a PC expansion slot.



Just when you thought that putting 10M bytes on a 3 1/2-inch disk in an enclosure measuring 1.62 by 4 by 5.75 inches was a slick technological and packaging achievement, along comes Hardcard from Plus Development Corp., Milpitas, Calif. Hardcard is a 10M-byte disk drive, replete with all drive and control electronics, on a plug-in board that measures 1 by 4 by 13 inches. The card plugs into an IBM Corp. PC or PC-compatible expansion slot as effortlessly as a memory board.

Plus Development, which is a subsidiary of 5 1/4- and 8-inch disk manufacturer Quantum Corp., introduced the Hardcard at July's National Computer Conference and plans volume shipments to dealers this month, at a suggested retail price of \$1,095. Some NCC attendees had a "wait and see" attitude toward the Hardcard, but dealers—starved for innovative products—were eager to sell the drives.

With the Hardcard, users can upgrade a PC to the disk capacity found on a PC/XT, or can double the storage on a PC/XT. Thus, the company's target market includes over 2.5 million owners of PCs and compatibles, as well as about 1 million PC/XT owners. The HardCard is compatible with the Compaq Computer Corp. Portable, Compaq Plus and AT&T Co. PC 6300.

Plus Development says its product offers an attractive alternative to hard-disk subsystems because these sometimes pose integration problems due to incompatibilities between drive and controller. In addition, the company claims price superiority over major disk-subsystem vendors, as well as space savings. The

drawback, of course, is limited capacity.

The unit consumes only 10.9W—in part due to the use of low-power CMOS chips—weighs only 2.1 pounds and has an average access time of 65 msec. The IBM PC/XT's average access time is 85 msec.

The drive is manufactured by Matsushita Kotobuki Electronics, and claims a mean time between failures of 25,000 hours, which is about twice that of many 5 1/4-inch disk subsystems. To back up reliability claims, Plus Development offers a one-year limited warranty. According to the company, if a problem with HardCard arises during that time, the user can bring the product to the dealer who sold the unit or to any authorized service location and get a replacement HardCard at no charge.

HardCard's 3 1/2-inch disk employs 600-Oe, cobalt-doped oxide media with 812 tracks per inch. The drive uses a rotary-wedge servo actuator and a Shugart Associates system interface (SASI) controller that is specially modified for the IBM PC bus. HardCard also comes with installation software and a file-management software program.

According to company president Stephen M. Berkeley, Plus Development will sell primarily through retailers, but has not excluded value-added resellers, which the company plans to reach through distributors. As of NCC, Plus Development had signed agreements with eight retail chains, but Ray Weadock, the company's director of sales, expects Hardcard to be available in more than 1,000 computer retail stores by this month.

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CIRCLE NO. 58 ON INQUIRY CARD



3.9-inch media. The drives measure 1.62 inches by 4.8 inches by 8 inches. Nevertheless, two SyQuest drives will fit in the space occupied by a minifloppy drive. SyQuest, the leading manufacturer of full-size removable-cartridge Winchester, is the only sub-4-inch disk manufacturer to offer removable cartridges.

Interfaces pose no problem

To OEMs and system integrators, interfaces and controllers are often as important as drive performance. Fortunately, manufacturers of 3½-inch Winchester have logically rallied around the ST506/412 interface, the standard for 5¼-inch Winchester.

HP is an exception to the ST506/412 rule. The company offers IEEE-488, IBM PC/XT, PC/AT or custom interfaces. HP introduced its drive with an IBM-compatible controller and interface this summer.

HP has also developed and tested a prototype small computer systems interface controller/interface for its 3½-inch Winchester, but is waiting for demand before it begins full-scale manufacturing. "We think SCSI is the wave of the future," says OEM account manager Phil Skraba, "but we don't have enough demand for it. When we get the volume demand, we'll go into manufacturing."

For current capacities, the ST506/412 interface is adequate. (The ST412 improves upon the ST506 with buffered step counts.) But next year's higher capacity drives may turn to the added intelligence afforded by SCSI (MMS, February, Page 123 and Page 135). Rodime, for one, has plans for an embedded SCSI-based drive.

Drives of 10M and 20M bytes currently dominate the sub-4-inch market, but analysts fully expect 40M-byte drives to come to the forefront next year. The first entry in this market comes from Newbury Data Recording Ltd., which produces a 40M-byte, four-platter drive called the Penny. The 3½-inch drive offers an average access time of 40 msec, compared with the 70 to 90-msec average access time on most other 3½-inch drives. All other manufacturers of sub-4-inch drives plan to increase capacities over the next year, but none have committed to specific dates for producing 40M-byte drives.

Another development centers on embedded controllers. Although the 3½-inch drive manufacturers will not discuss specific timetables, most have definite plans to offer drives with embedded controllers within the next year or two.

Embedded controllers combine drive and con-

troller electronics on a single board. This combination is achieved via VLSI and surface-mount technology. The advantages are reduced storage costs, improved performance and space efficiency. Lower cost results from the reduction in the number of parts in the subsystem, and surface-mount technology reduces overall parts size.

Sure to give tremendous impetus to the 3½-inch product class will be IBM's PC successor, the PC/II. This new personal computer—which is due sometime next year—is expected to have a 20M-byte, 3½-inch Winchester. Once the PC/II rolls out, expect a plethora of 3½-inch drives to follow in an attempt to meet the demand created by PC/II look-alikes. With the influx will come severe price cutting, which may be led by Japanese manufacturers. One sign of this is the recent entry of Alps Electric (USA) Inc. and Mitsubishi Electronics.

Among the major players expected to enter the market soon are Seagate and Quantum Corp. Quantum recently announced a 10M-byte micro-Winchester subsystem for the IBM PC. Seagate showed a 10M-byte, 3½-inch drive at last year's Comdex/Fall, and is currently waiting for a large enough order to justify a production boost. □

A list of manufacturers of sub-4-inch Winchester, including certain specifications of the drives, appears on Page 108.

Interest Quotient (Circle One)
High 480 Medium 481 Low 482

LOOKING AHEAD IN MMS

The Fall issue of the Mini-Micro Systems Peripherals Digest is scheduled for mid November.

This year the following will be spotlighted:

- Disk drives (up to 5¼-inch)
- Disk subsystems
- Cassette and cartridge tape drives (up to ¼-inch)
- Alphanumeric terminals
- Serial printers



MANUFACTURERS OF SUB-4-INCH WINCHESTERS

Model	Formatted capacity (M bytes)	Formatted capacity (M bytes)	Average access time (msec.)	Average power (watts)	Interface	Weight (lbs)	Dimensions (H x W x D, inches)	Price (\$)* (OEM quantity)
Alps Electric USA Inc. 3553 North First St. San Jose, Calif. 95134 (408) 946-6000 Circle 433	DRL010A	10	80	12	ST506/412	2.2	1.61 x 4 x 5.93	
	DRM020A	20	80	12	ST506/412	2.2	1.61 x 4 x 5.93	
Fujitsu America Inc. 3055 Orchard Drive San Jose, Calif. 95134 (408) 946-8777 Circle 434	M2223	10	88	9.7	ST506/412	2.2	1.625 x 4 x 5.75	500 (Q100)
	M2224	15	88	9.7	ST506/412	2.2	1.625 x 4 x 5.75	625 (Q100)
Hewlett-Packard Co. Greeley Division 700 71st St. Greeley, Colo. 80634 (303) 350-4000 Circle 435	HP97501A	10	75	8.2	IEEE-488, IBM PC/XT/AT or custom	2	2 x 4 x 5.1	400
Hitachi America Ltd. 950 Elm Ave., Ste. 100 San Bruno, Calif. 94066 (415) 872-1902 Circle 436	DK301-1	10	85	11	ST506/412	2.2	1.625 x 4 x 5.75	750
	DK302-2	15	85	11	ST506/412	2.2	1.625 x 4 x 5.75	920
Lapine Technology 182 Topaz St. Milpitas, Calif. 95035 (408) 262-7077 Circle 437	Ranger 3522	10	70	12	ST506/412	2	1.625 x 4 x 5.75	375
	Titan 3525	20	68	13	ST506/412	2	1.625 x 4 x 5.75	380
	Titan 3265	20	68	13	ST506.412	2	1.625 x 4 x 5.75	430
Microcomputer Memories Inc. 7444 Valjean Ave. Van Nuys, Calif. 91406 (818) 782-2222 Circle 438	M-112	10	75	12	ST506/412	2	1.625 x 4 x 5.75	650, 340 (Q2,500)
	M-125	20	75	12	ST506/412	2.1	1.625 x 4 x 5.75	435, 279 (Q2,500)
Microscience International Corp. 575 E. Middlefield Road Mountain View, Calif. 94043 (415) 961-2212 Circle 439	HH-312	10	80	9	ST506/412	2.25	1.625 x 4 x 5.75	335 (Q2,500)
	HH-325	20	80	9	ST506/412	2.25	1.625 x 4 x 5.75	475 (Q2,500)
Miniscribe Corp. 1861 Lefthand Circle Longmont, Colo. 80501 (303) 651-6000 Circle 440	8212	10.7	68	10	ST412	1.8	1.625 x 4 x 5.75	400
	8425	21.4	68	10	ST412	1.8	1.625 x 4 x 4.75	450
Mitsubishi Electronics America 991 Knox St. Torrance, Calif. 90502 Circle 368	MR321	10	70	13	ST506	1.98	1.625 x 4 x 5.75	550
	MR-322	20	70	13	ST506	1.98	1.625 x 4 x 5.75	650
Newbury Data Recording Ltd. Staines, Middlesex England Circle 441	Penny	40	40	15	ST506/412	2.55	1.625 x 4 x 6.37	900 (Q1,000)
Rodime Inc. 901 Broken Sound Pkwy., NW Boca Raton, Fla. (305) 994-6200 Circle 442	RO 351	5	85	13	ST506	2.2	1.625 x 4 x 5.75	
	RO 352	10	85	13	ST506	2.2	1.625 x 4 x 5.75	
Syquest Technology 47923 Warm Springs Road Fremont, Calif. 94538 (415) 490-7511 Circle 443	SQ325F	20	95	13	ST506	2.4	1.625 x 4.8 x 8	425
	SQ338F	30	95	13	ST506	2.4	1.625 x 4.8 x 8	525
	SQ306RD**	5	90	13	ST506	2.4	1.625 x 4.8 x 8	480
	SQ312RD**	10	90	13	ST506	2.4	1.625 x 4.8 x 8	522
Tandon Corp. 20320 Prairie St. Chatsworth, Calif. 91311 (818) 993-6644 Circle 444	TM362	20	80	10	ST506/412	1.9	1.625 x 4.1 x 5.75	300

*Prices are approximate; quantity discounts are negotiable

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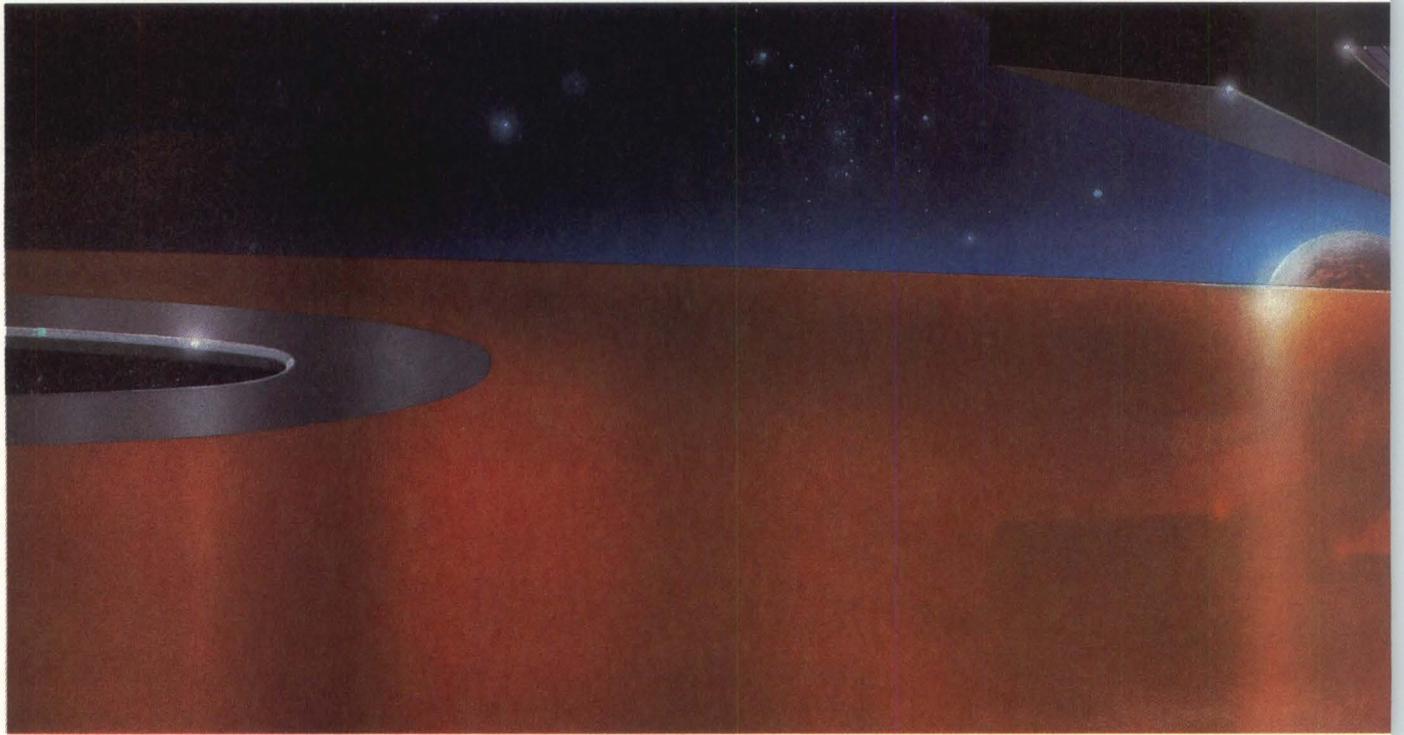
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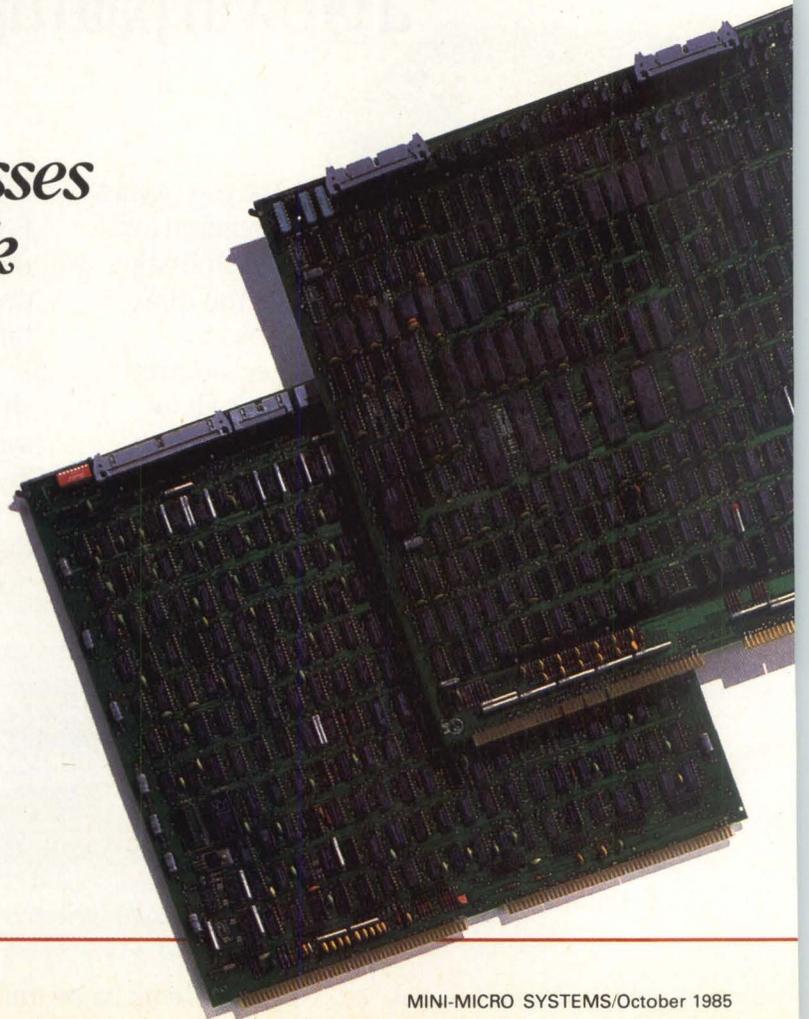
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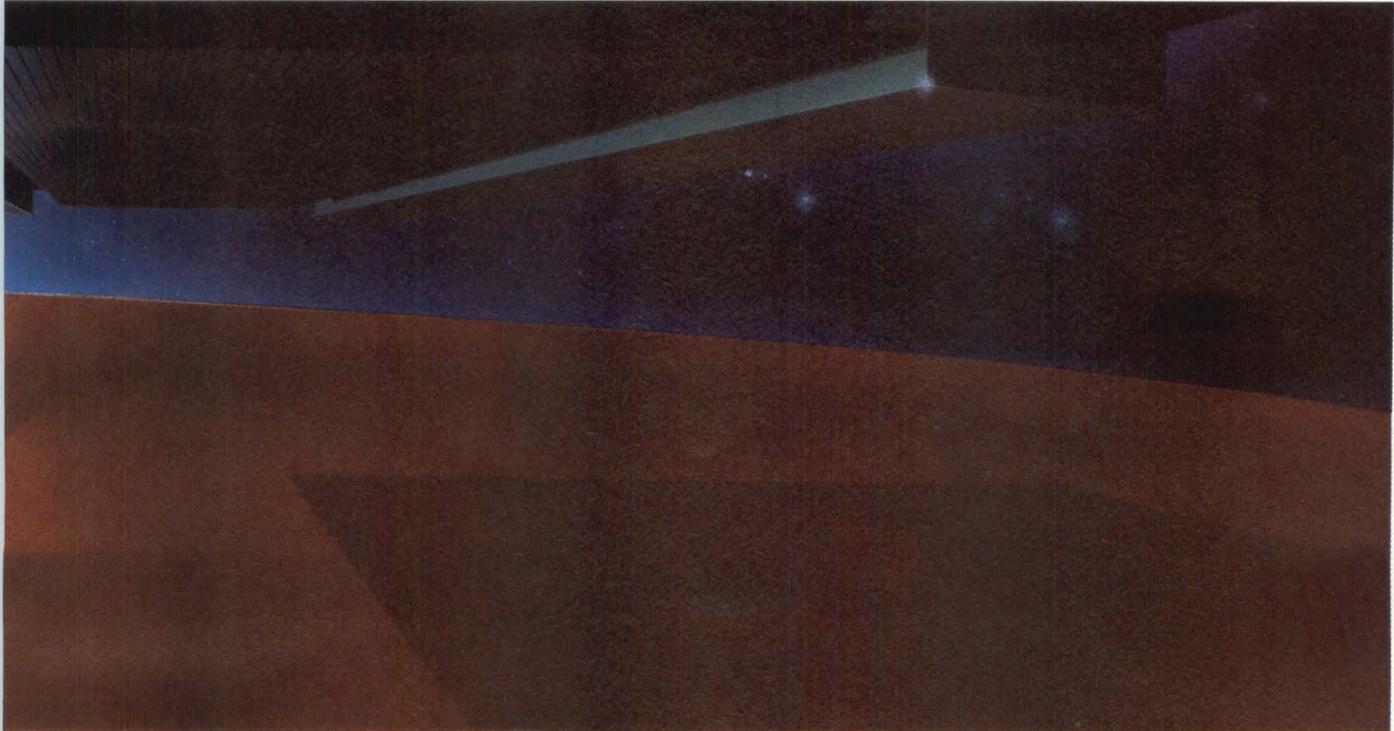
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Virtual Mapping is available now on our two new disk controllers: Model BMX-3, compatible with the high-speed Burst Multiplexor Channel on DG's MV series, and Model DC-297, designed for Data Channel interface on

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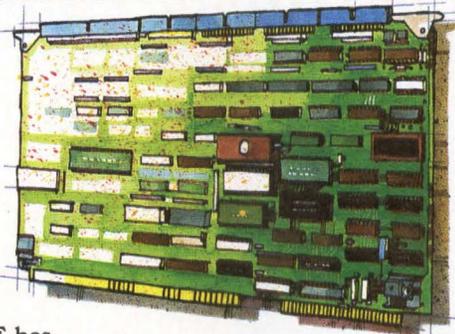
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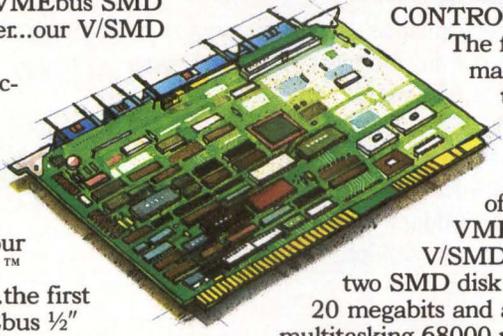
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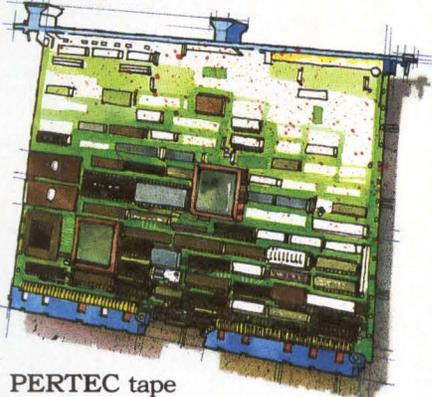
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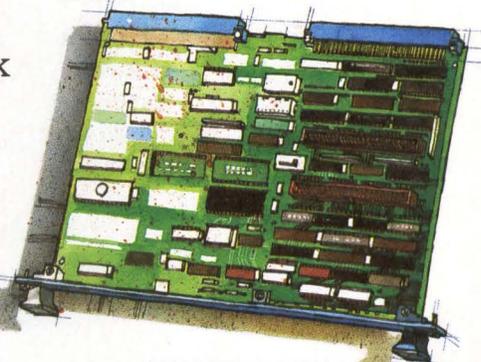
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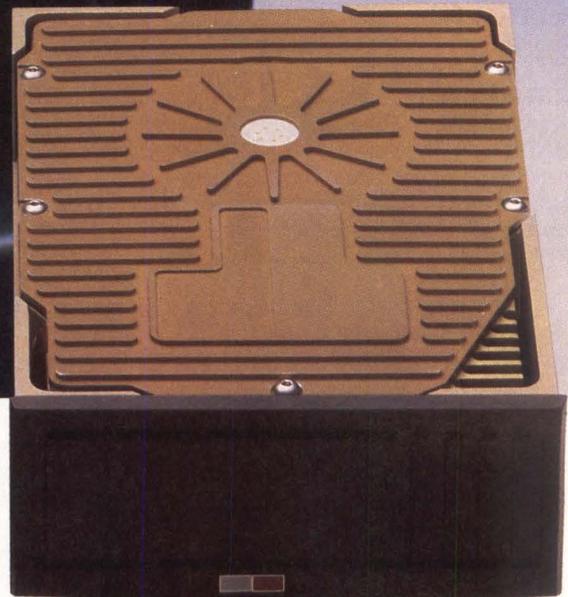
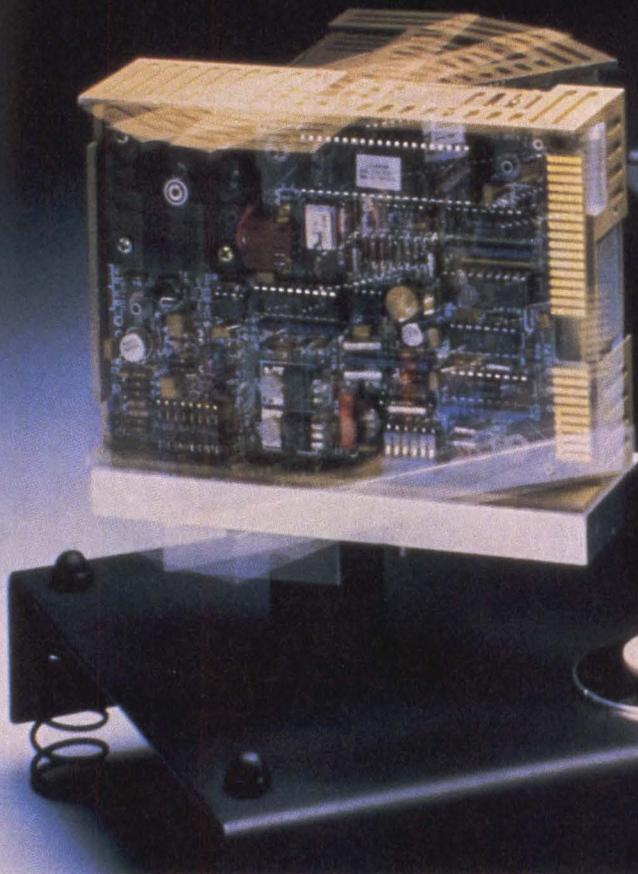
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Shock	
Operating:	6g peak accel., 10-ms duration, two per second max.
Non-Operating:	60g peak accel., 10-ms duration, six per axis max.
Vibration	
Operating:	0.014-in. displ., 5-46 Hz; 1.5g accel., 46-500 Hz
Non-Operating:	0.293-in. displ., 5-20 Hz; 10g accel., 20-500 Hz
Temperature	
Operating:	0° to +65°C
Non-Operating:	-40° to +70°C
Reliability	
MTBF, hours	35,000
MTTR, minutes	20
Service Life,	
years	5
Preventive	
Maint. Req.	none

MASS-STORAGE SALES RIDE COMPUTER COATTAILS

After a depressing 1984, mass-storage sales are holding their own, but largely because of computer demand and moves by IBM, rather than because of inherent technology

Don Collier and Wim J. Verkaik
Applied Magnetics Corp.

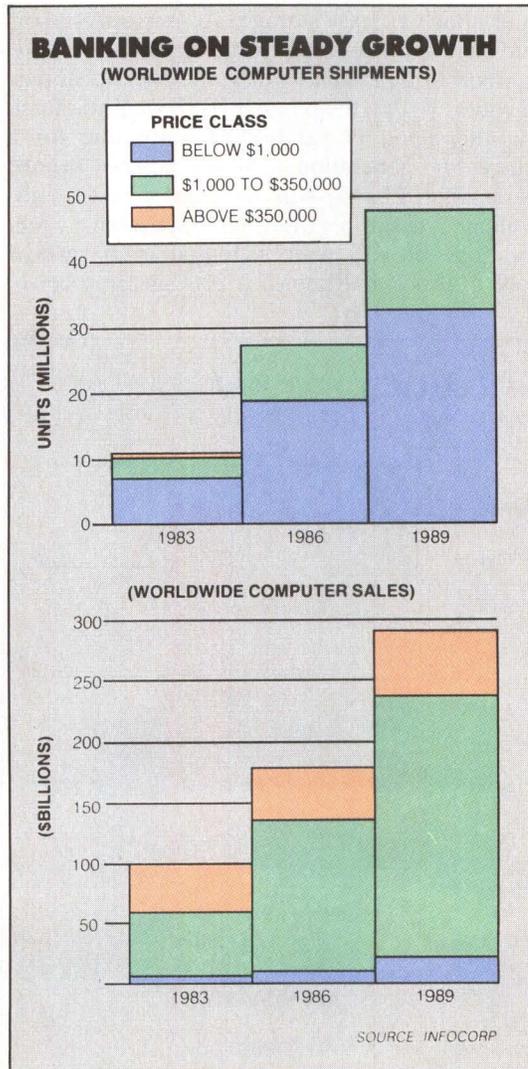
The mass-storage business is paced by the computer market. In other words, the demand for disk and tape drives is influenced more by computer sales than by their own merits.

In terms of units shipped, sub-\$1,000 computers constitute the largest market segment, but they contribute the least sales revenue (Fig. 1). The big money is in business, not the home. Today's promising and fast-changing market resides in the sale to end users of computers costing between \$1,000 and \$350,000. Sales forecasts for mass-storage devices are derived from the prospective demand for these small- to mid-range computer classes.

Sales of \$1,000 to \$350,000 computers are expected to grow from the 3.6 million units in 1983 to 19.2 million units in 1990 (Fig. 2). The lion's share of unit growth within this class should continue in the \$1,000 to \$12,000 price range, which accounted for 92 percent of units shipped in 1984. Here, IBM Corp. and Apple Computer Inc. led the pack. The figures represent a growing population of computers linked in local area networks, as well as computers with multiple terminals sharing a common processor.

However, all of these end-user computer sales generate an accompanying mass-storage demand (Fig. 3). Of this, floppy drives dominate in sheer numbers, with hard disk drives gaining in penetration, and tape making moderate headway.

The number of different mass-storage drives required per computer varies over time (Fig. 4). That is, the number of floppy drives per computer should stay about the same between 1985 and 1990; the number of tape drives, on the other



History shows PC disk storage evolves first as a form-factor change at floppy disk level.

Fig. 1

hand, should decline slightly, and the number of hard disk drives should increase. The tape drive numbers reflect a declining popularity of audio-type, low-end cassette drives in favor of floppies and low-cost cartridge drives.

A general principle applies in the world of mass storage: Economics, not technology, drives the market. The price of a given storage device determines its penetration into a computer price range. Historically, mass-storage devices have constituted 20 percent to 30 percent of the total system cost across most price ranges. Thus, as hard disk drives come down in price, more of them will appear in systems priced below, say, \$3,000. To compete, therefore, tape devices must be designed for low price, as well as high reliability.

Friendlier and more powerful software is fueling the desire for higher capacity internal RAM and attached mass storage. As microprocessors advance in processing power, they must often be supported by matching disk and backup storage devices. Within the popular IBM computer family, the aging PC and PC/XT are due for a successor generation. Many experts believe a smaller PC/AT will be IBM's next high-volume desktop offering. Successive generations of ATs with increased mass storage are also inevitable. As microprocessor

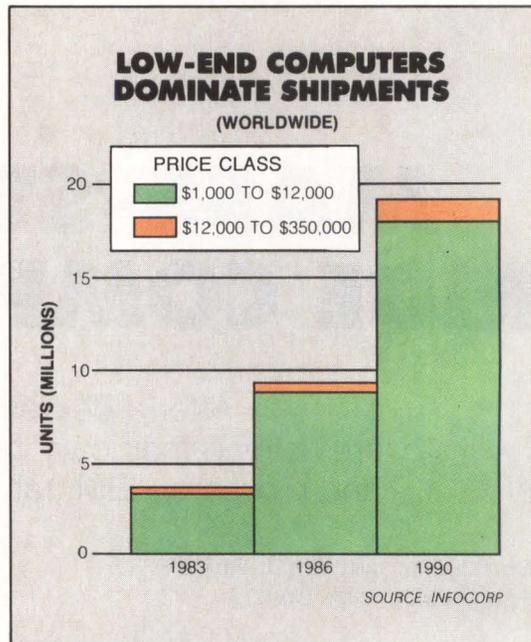


Fig. 2

power approaches 1 million instructions per second and RAM exceeds 1M byte, disk-storage capacity must increase, and access times decrease, to maximize throughput.

With the new desktop generation will come a reduction in physical size. History shows PC disk storage evolves first as a form-factor change at floppy disk level, followed later by a hard disk of the same size—witness the 8-inch to 5¼-inch changeover a few years ago. This pattern is now well-developed with 3½-inch floppy drives, leading initially to companion hard disks in the 10M-to-20M-byte range. With all of this comes price pressure, high-volume manufacturing and stringent reliability requirements. This combination favors the strong and established vendors.

Computers selling for more than \$12,000 are also enjoying growth, albeit less dramatic than desktop systems. Multiuser system sales have been stalled by lack of operating-system standards and a dearth of software. This situation will gradually change with IBM's piecemeal support of UNIX and AT&T Co.'s continued commitment to shared-processor systems. These developments, too, add up to increased need for hard-disk capacities above 40M bytes and the accompanying demand for tertiary storage as both a backup and a data-file storage medium.

There are now more 5¼-inch full-height and half-height disk drive versions, but the thunder of little 3½-inch hoofbeats can be heard: expect them to constitute 40 percent of hard disk ship-

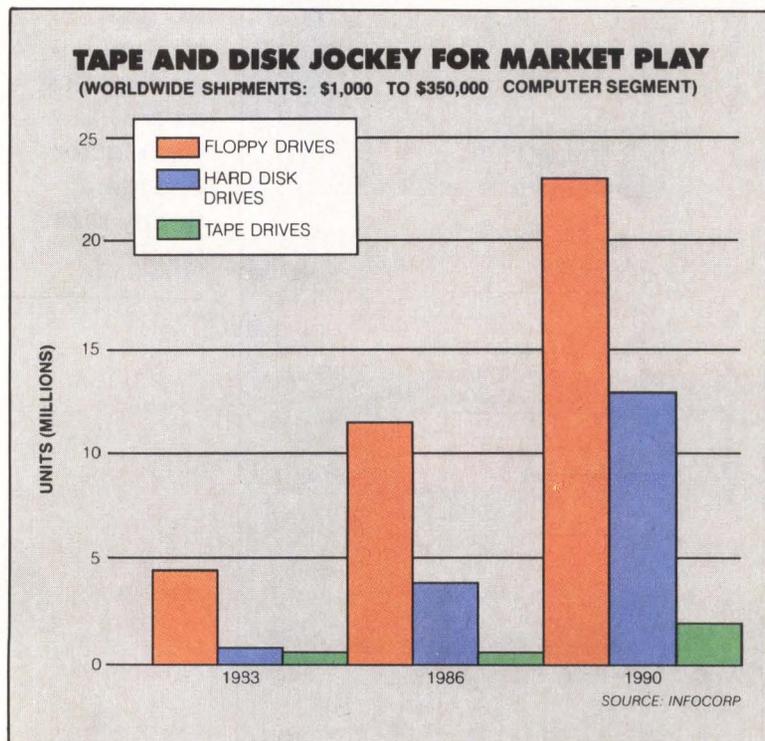
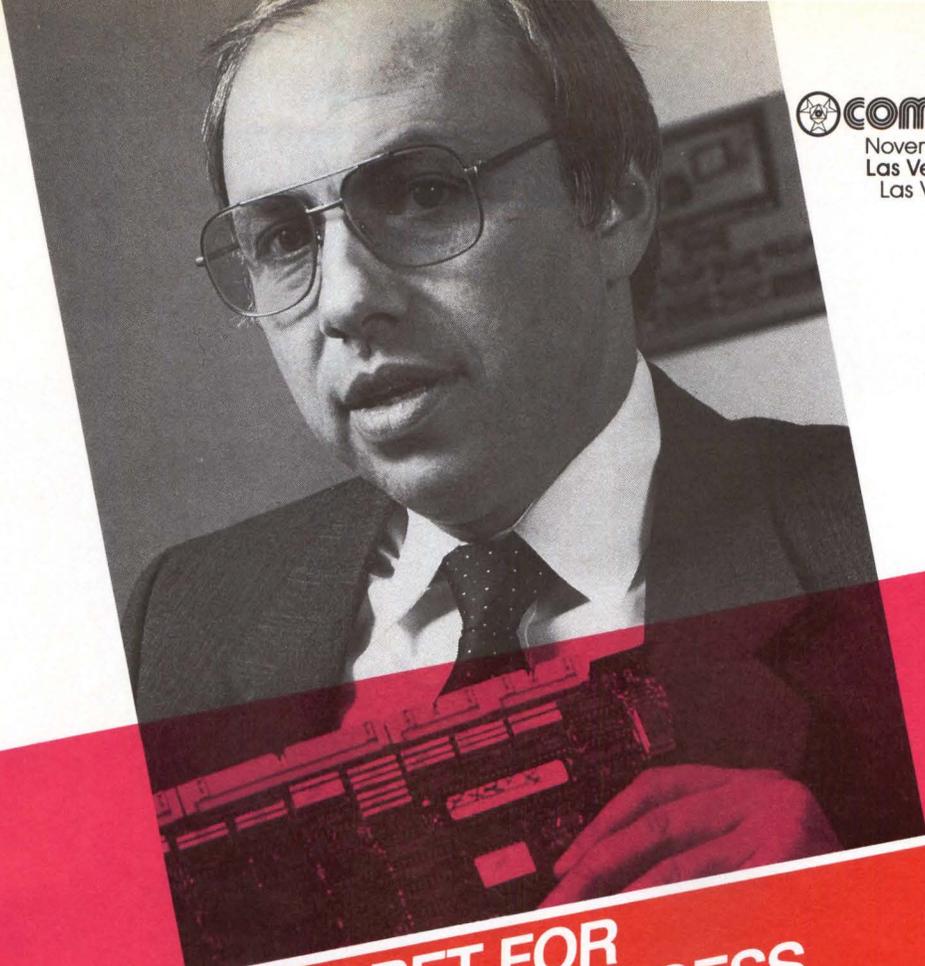


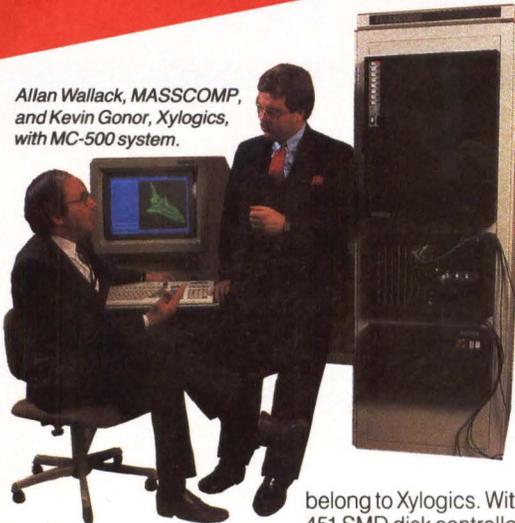
Fig. 3

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ONE SECRET FOR MASSCOMP'S SUCCESS IS NOW NO SECRET AT ALL.

Allan Wallack, MASSCOMP,
and Kevin Gonor, Xylogics,
with MC-500 system.



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

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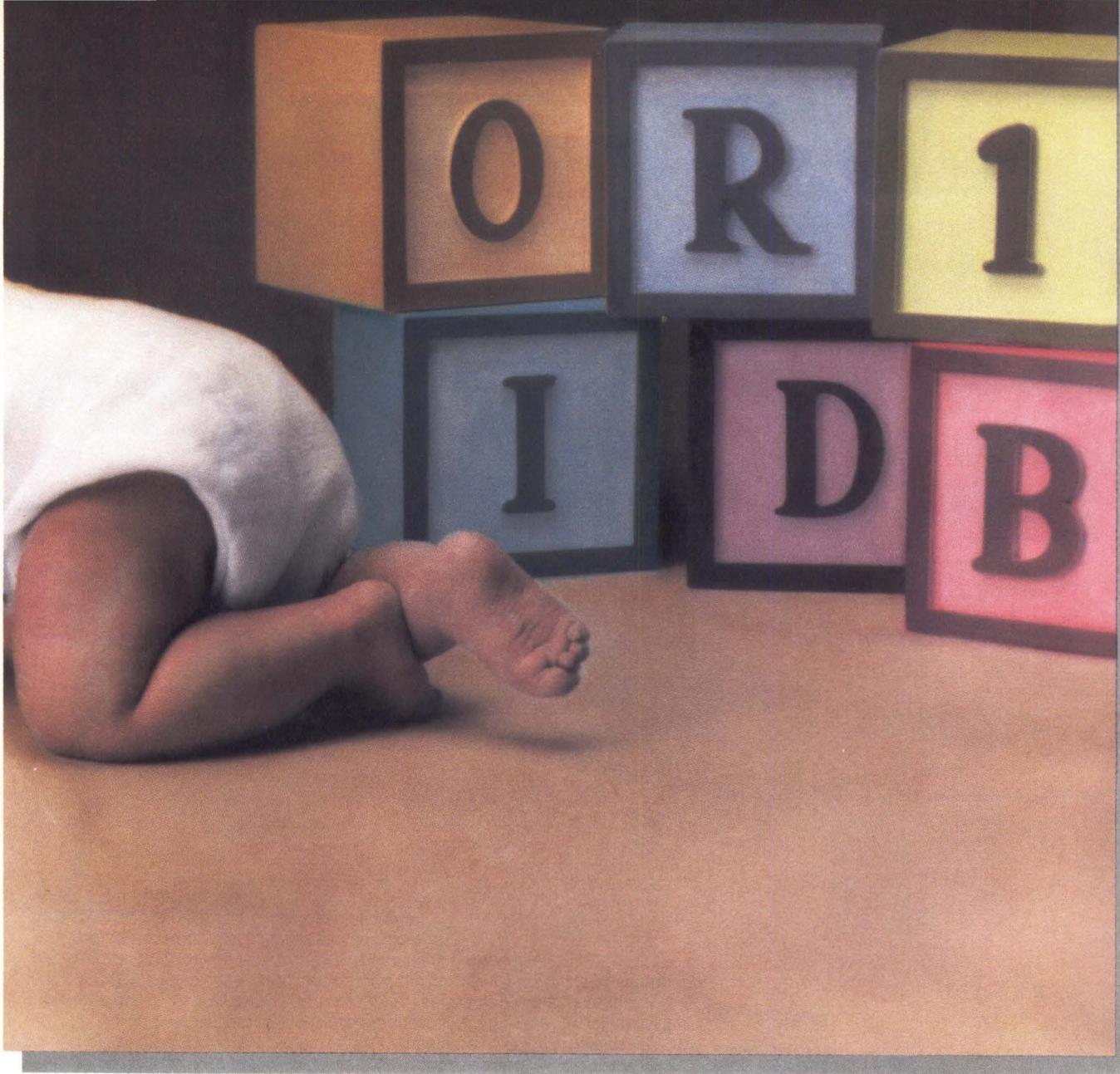
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CIRCLE NO. 64 ON INQUIRY CARD

MMS10/85

ments for \$1,000 to \$350,000 computers by 1989. The larger 8-inch and 14-inch drives will continue to attach to only multiuser and supermicrocomputer systems and thus, in terms of growth, seem destined to languish in virtually stagnant waters. In any case, total unit demand for hard disk drives will go from 1.2 million units in 1983 to about 11.8 million in 1989—a 46 percent compound annual growth (Fig. 5).

Because the high growth in systems is at the desktop level, lower capacity disk drives continue to dominate the market. In 1985, 75 percent of drives shipped will be less than 30M bytes, 87 percent of which will be 5¼-inch form factor or smaller. Fast growth can be anticipated in the 30M- to 100M-byte class, where demand will be 530,000 million units in 1985, rising to upwards of 5.2 million units by 1989; 70 percent of these are 5¼-inch form factor or smaller, and that figure will increase to 95 percent by 1989. Supply will momentarily lag behind demand in this disk-drive category, as the shift is likely to be more aggressive than first thought. Disk drives above 100M bytes will not see heavy action until 1988.

Average disk capacities per drive required for each computer price class are going up (Fig. 6). Disk drives attached to higher volume \$1,000 to \$12,000 computers will move from an average of 13M bytes today to 31M bytes by 1989. Average disk capacities for \$12,000 to \$350,000 comput-

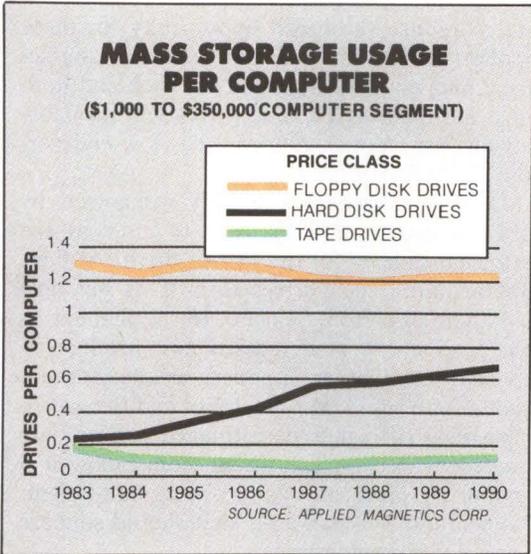


Fig. 4

ers, now at 76M bytes, will be at 108M bytes in 1989.

In low-end drives, the leaders in approximate order of disk drive market share are Seagate Technology, Miniscribe Corp., Tandon Corp., Rodime Inc. and Computer Memories Inc. (CMI). Mid-range leaders are Priam Corp., Quantum Corp., Fujitsu America Inc., Micro-polis Corp. and Control Data Corp. (CDC). IBM is the largest customer. Ominous rumors of captive programs at IBM, if they prove true, are

The fortunes of entire corporations can hinge on whether one company's standard is adopted.

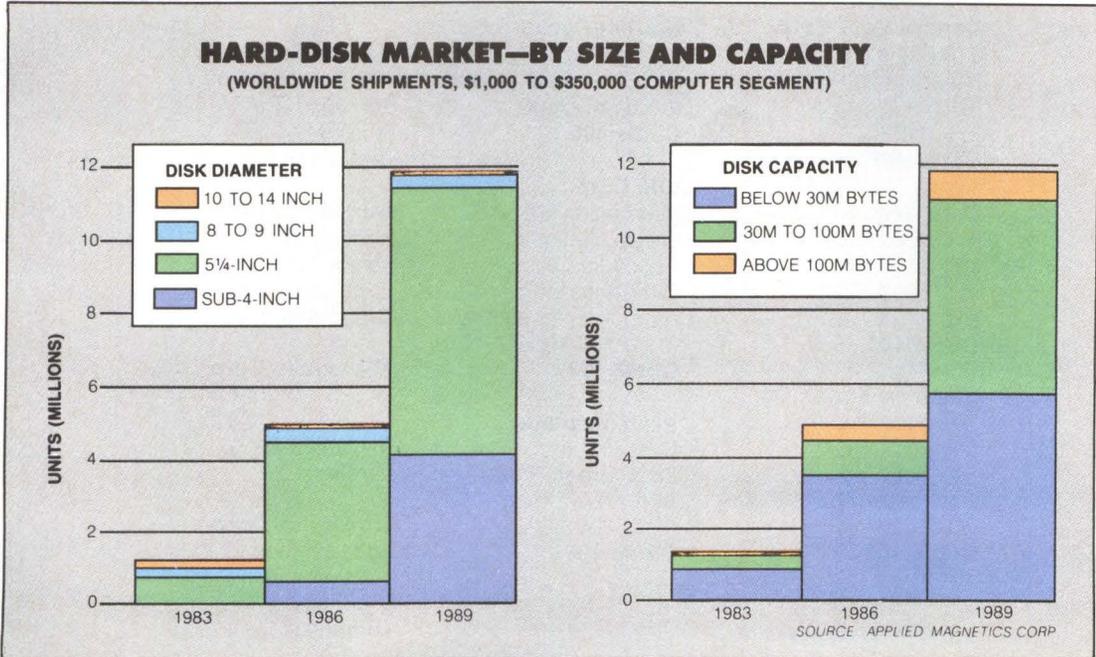


Fig. 5

sure to reduce the OEM opportunity for these suppliers. IBM plans will likely include manufacturing mid-range to high-end 5¼-inch and mid-range 3½-inch drives. The drives will probably butt against stepper-motor-based, low-end versions.

Mid-range drives are heavily influenced by IBM's selection of 20M bytes/40 msec as the performance level for the PC/AT drive. At first, IBM acquired such drives from CMI but now buys them also from Seagate, to supplement its own production. A deluge of new products is expected from other suppliers as margins are squeezed on sub-30M-byte drives and the greener pastures of higher performance versions are pursued. The Japanese threat from below is a tsunami of products in 20M-byte, half-height, 5¼-inch and 3½-inch sizes that should squeeze low-end market margins.

Eight-inch and 14-inch drives are being forced by smaller drives to capacities above 100M

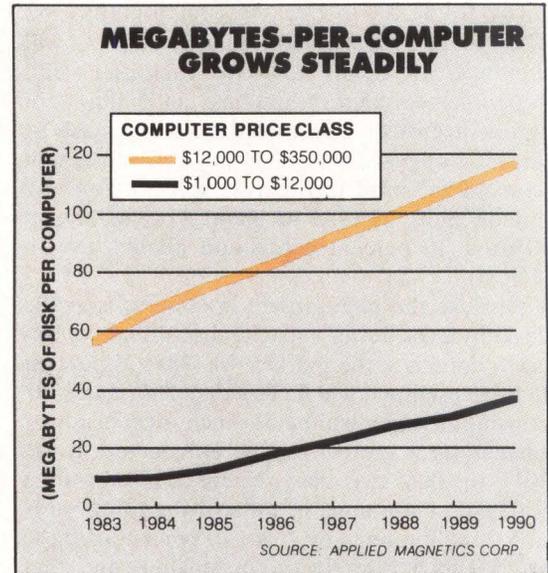


Fig. 6

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Circle 402

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Westboro, Mass. 01581
(617) 366-8911
Ext. 4723
Circle 403

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Circle 409

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bytes, and thus into lower quantity markets. As 5¼-inch drives chase higher capacities, the floor for larger drives has risen to 160M bytes.

Removable market awaits IBM

The development of removable media devices, especially floppy disk and tape drives, seems to be governed by an "As IBM goes..." attitude. Witness the progression of IBM half-inch tape standards: 556 bits per inch, 800 bpi, 1,600 bpi, 6,250 bpi and now the 3480's 19,000 bpi (38,000 bytes per inch). IBM also developed the 8-inch floppy drive and set that standard. The 5¼-inch floppy drive was someone else's idea, but, even so, IBM still set the pace, first by putting 48 tracks per inch (tpi) and 360K bytes on the PC and recently 96 tpi and 1.2M bytes on the PC/AT. The 3½-inch standard is next on the yet-to-be-announced, successor-generation PCs.

Worldwide floppy disk drive shipments will go from 1983's level of 6.1 million units to 21.5

million units in 1989 on \$1,000 to \$350,000 computers—a 23 percent compound annual growth (Fig. 7). For now, half of these are double-sided, 5¼-inch versions, but 3½-inch microfloppy drives are moving up fast. Apple, Data General Corp. and Hewlett-Packard Co. started the microfloppy movement by adopting Sony Corp. of America's drive, and, lately, IBM reportedly has been buying similar units from Alps Electric Co. Ltd. and Toshiba Inc. for their Japanese model JX, among others. Smaller devices have eclipsed 8-inch drives, which should virtually disappear by 1989.

Over 70 percent of floppy disks are now manufactured by Far East suppliers. As products achieve commodity status, prices are plummeting. The biggest captive manufacturer of floppy drives is NEC Corp. in Japan. IBM just ceased making floppies in Boulder, Colo., choosing to buy outside. The only remaining significant supplier in the United States is Tandon. CDC,

The thunder of little 3½-inch hoofbeats can be heard.

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Friendlier and more powerful software is fueling the desire for higher capacity internal RAM and attached mass storage.

recently the No. 3 domestic supplier, pulled out as of this year. The big overseas OEM suppliers are Alps, Teac Corp., Mitsubishi Electronics Inc., Matsushita Electric Co. and Y-E Data (supplier of IBM's PC/AT floppy drive), in that order, followed by a host of others. Sony remains the leading microfloppy drive supplier.

At one time, hopes ran high for large-capacity floppy drives with suppliers like Amlyn Corp., Drivetec Inc. and Eastman Kodak Co. introducing 3.3M-byte products. Only one of the three, Kodak, remains, hardly enough to form a product class "critical mass." Again, this situation leaves the job of setting a high-capacity standard to IBM, which recently adopted the 1.2M-byte drive for its next-generation PC/AT family.

Tape drives continue to be used principally in "pricier" computers. Used primarily for backup, these essentially single-function devices are bought somewhat grudgingly. Sales of tape drives for \$1,000 to \$350,000 systems are expected to grow from about 600,000 units in 1983 to 1.8 million units in 1989—still an encouraging 20 percent compound annual growth.

At the high end, half-inch reel drives continue to be the mainstay for computers priced higher than \$25,000. Competing IBM-compatible, half-inch cartridge tape drives are not expected to appear before 1987. At the low end, cassette and minicartridge drives are for now the only economical choice for systems below \$5,000. Quar-

ter-inch cartridge tape drives fill in the mid-range gap, making sense for systems between \$5,000 and \$25,000. The minicartridge product class is about to have a big brother in the form of 3M's DC-2000 quarter-inch version sometime in 1987. This may open up below-\$5,000 computers to limited use of higher performance tape drives, replacing audio-type cassettes and original versions of the minicartridge.

The long-awaited half-inch-cartridge-tape market got its start when IBM finally gave birth to the 3480 high-end tape series. OEM versions are expected from a number of suppliers who, heretofore, were going in separate directions and thus confusing potential users with a bewildering array of incompatible choices. Quarter-inch cartridge suppliers got a shot in the arm with IBM's announcement that it will sell quarter-inch cartridge subsystems for attachment to PCs through their product centers via Colorado Memory Systems and Tecmar Inc. Last year, Compaq Computer Corp. integrated an Irwin Magnetic Systems Inc. minicartridge drive into their Deskpro and AT-80286 series.

A need remains for many desktop PC users who currently don't back up their disks at all, or who feed floppy disks to their office computers on Saturdays. Market penetration of small tape drives is hampered by a clear IBM blessing as well as the difficulty of selling a single-function device to users at a disproportionate price to its computer. In the face of this, companies are starting to see solid demand for their 5¼-inch, low-cost, cartridge tape drives, particularly for multiuser PC applications.

Leading tape-drive suppliers making larger half-inch tape drives include Fujitsu America, IBM, Cipher Data Products Inc., CDC, Hitachi America Ltd. and Storage Technology Corp., among others. Leading quarter-inch suppliers are Archive Corp. (estimated to have about 50 percent of the streaming-cartridge market), followed in order by Cipher, CDC, 3M, Tandberg Data Inc., Tallgrass Technologies Corp. and Wangtek Inc. Irwin Magnetic Systems makes one of the few OEM minicartridge drives; Memtec Corp., Teac and JVC make data-quality cassette drives.

Fewer issues are stickier than that of standards. Witness recent discussions by IBM and Apple about the "office of the future." The fortunes of entire corporations can hinge on whether a particular company's standard is adopted. In the war of mass-storage devices, the field is strewn with standards-related fiascos: the 8-inch rigid disk drive, double-sided floppy drives, pre-Quarter-Inch Cartridge (QIC) com-

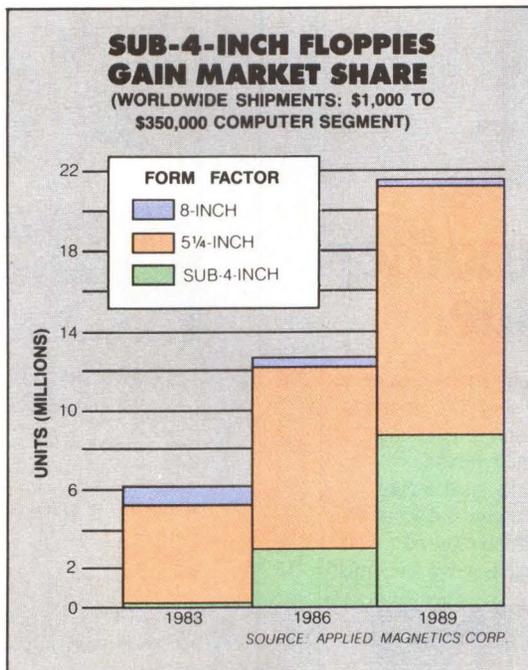


Fig. 7

mittee quarter-inch tape drives and pre-3480 half-inch cartridge tape drives. Now, device-interface standards are on the table. In small disk drives, what will succeed the ST506/412 device-level disk interface? Maxtor Corp., Micropolis, Priam, Vertex Peripherals Corp. and many others want to see the enhanced small device interface triumph. Seagate and its constituency want the ST412HP to win. At the intelligent-interface level, will the small computer systems interface or the intelligent peripheral interface (IPI-3) prevail? Larger drives will eventually move from the storage module device to more intelligent versions like IPI-2. Taking a cue from Plus Development Corp., smaller manufacturers may adopt direct PC-bus interfaces like Plus' Hardcard, a PCB-mounted 3½-inch drive.

The forces pushing interfaces forward are a combination of increased transfer rates (from 5M bps to 10M bps in small disks, for instance) and the need to decouple device-specific parameters from the host bus.

Media and recording standards related to re-

movable media devices are critical for widespread software and data-file distribution. Floppy disks must record at standard bytes/track; tape drives must record interchangeably between models. The QIC (quarter-inch-cartridge) and the HI/TC (half-inch tape cartridge) committees are responding to this need. In larger OEM and plug-compatible systems, like it or not, the IBM 3480 half-inch cartridge is another such standard, one that provides system designers and integrators with that "warm, fuzzy feeling" they often seek before committing to any new peripheral product class.

Although mass-storage demand is driven by computer demand, it's hard to underestimate the importance of drive and interface standards. If proper controllers and other support devices aren't in place, it doesn't matter how many computers are sold, or how many drives are required. □

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Don Collier is director of market analysis at Applied Magnetics Corp., Goleta, Calif. He was general manager of Freeman Reports. **Wim J. Verkaik** is director of marketing operations at Applied Magnetics, where he has also worked in marketing and business analysis.



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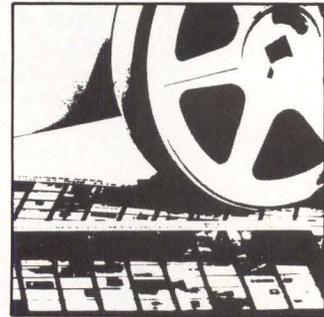
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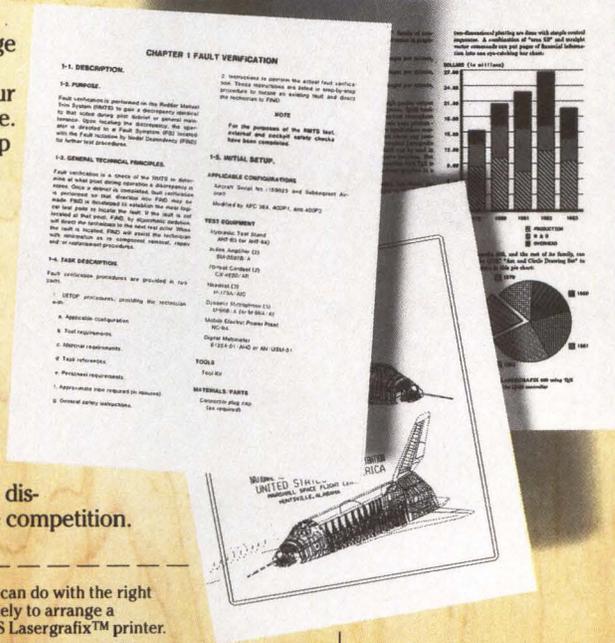
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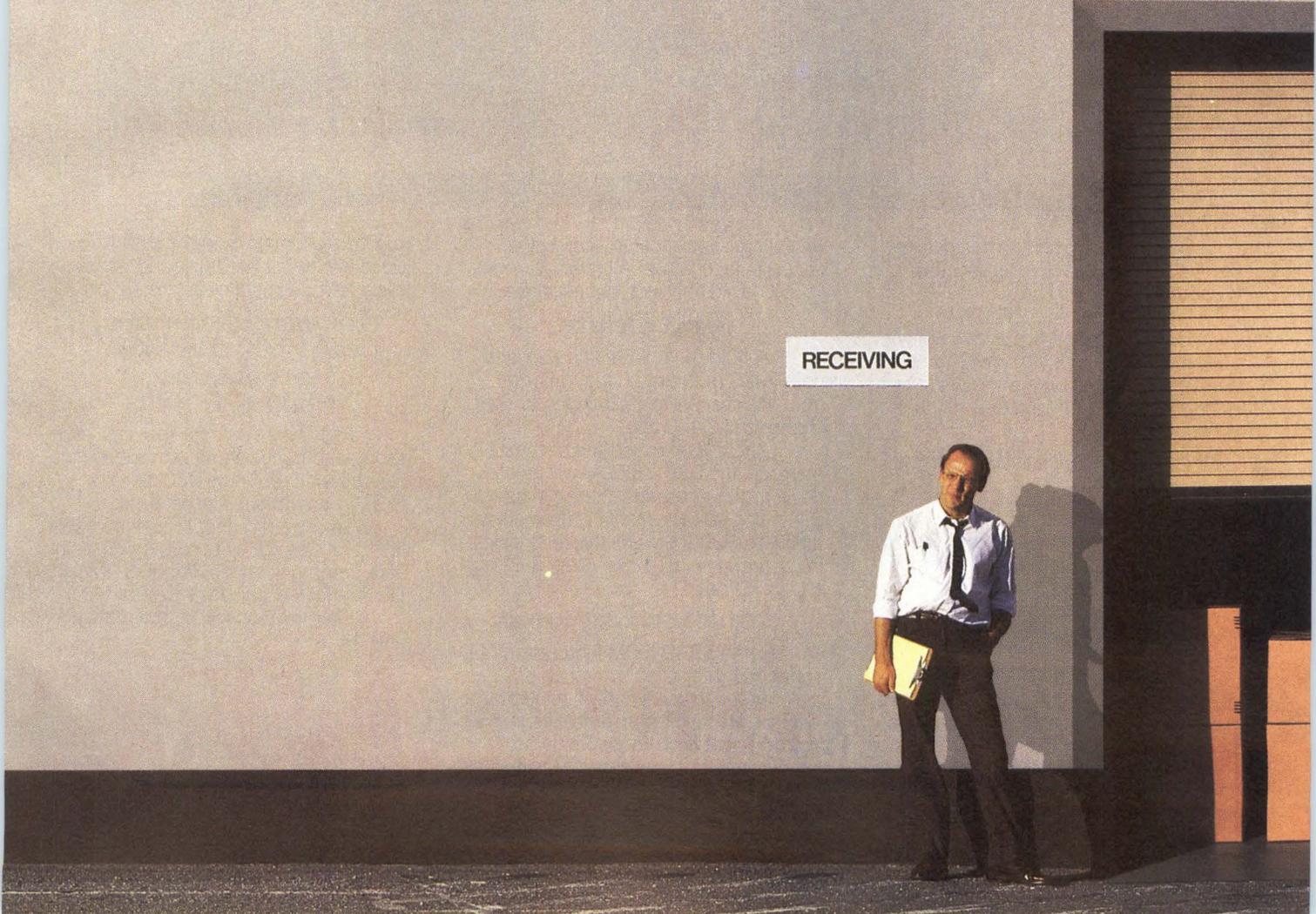
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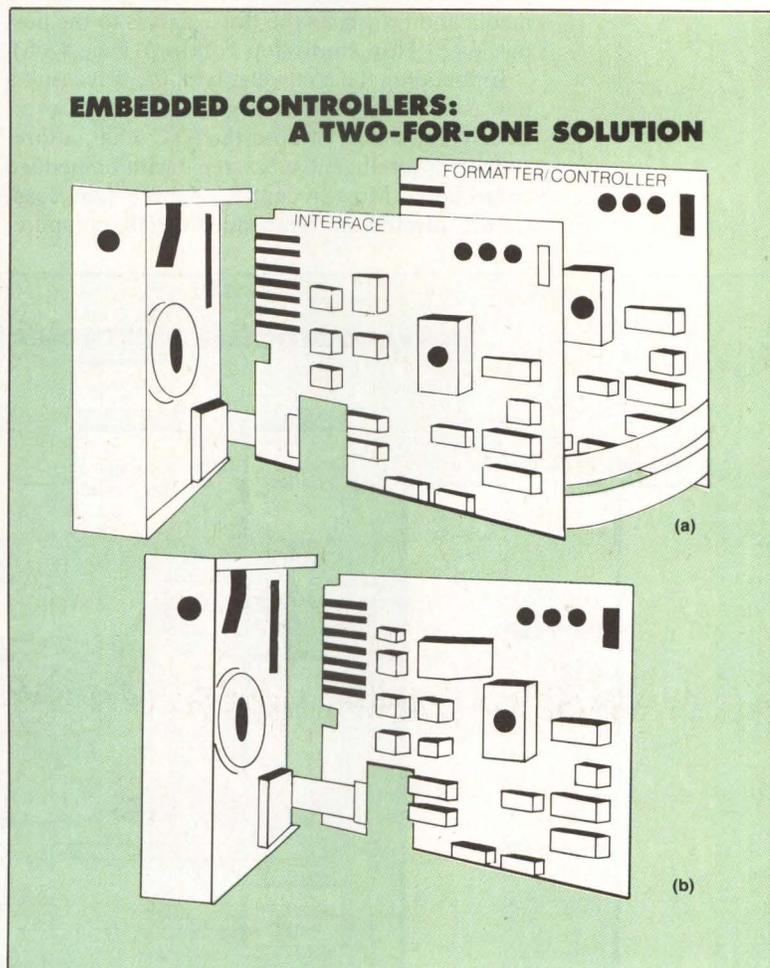
Combining drive and controller electronics on a single board reduces storage cost and integration time while improving performance

Carl Warren, Western Editor

To meet demands for low-cost and space-efficient storage in single-user workstations, Western Digital Corp., Irvine, Calif., is bundling a 20M-byte, 3½-inch Winchester disk drive with a single-board controller. The WD83020-XX series of single-board controllers matches the form factor of a 3½-inch Winchester disk drive and uses VLSI and surface-mount techniques to achieve the small size.

Analysts predict that the market for embedded controllers will be dynamic in a shift from discrete controllers, particularly for the IBM Corp. PC market (see "Embedded controllers to gain market share," Page 133). For its part, Western Digital plans to have sample quantities of the subsystem by this quarter, with full production scheduled for early next year.

System integrators can customize the embedded controller to match the operational characteristics of virtually any 3½-inch or 5¼-inch Winchester drive. The controller also eliminates many components required in systems based on non-embedded controllers, including two cables, four connectors, two transceivers, all terminal resistors, one microprocessor, up to two printed-circuit boards (interface on drive and controller on host computer), and six logic elements. Elimination of these components cuts system costs by 25 percent to 50 percent.



Current storage-system technology requires an interface board to handle drive functions and a controller to separate data and to interface to the host (a). An embedded controller (b) reduces the interface and control electronics to a single board, eliminating 25 percent to 50 percent of existing storage-system components.

Employing VLSI and surface-mounted components eliminates much of the drive electronics from the interface and controller, and allows placement of the remaining components onto a single board.

System integrators who want to develop a storage subsystem—either integrated into a workstation or as an add-on—typically have had to use discrete assemblies. A standard storage system includes a disk drive with an interface (usually, an ST506/412) that controls the disk drive's spindle motor and head positioning. In addition, the interface contains the electrical connections to the drive. The interface board is connected, via power and data cables, to a controller board that separates data, formats the media and translates the drive signals to the host bus (see "How controllers control," Page 134).

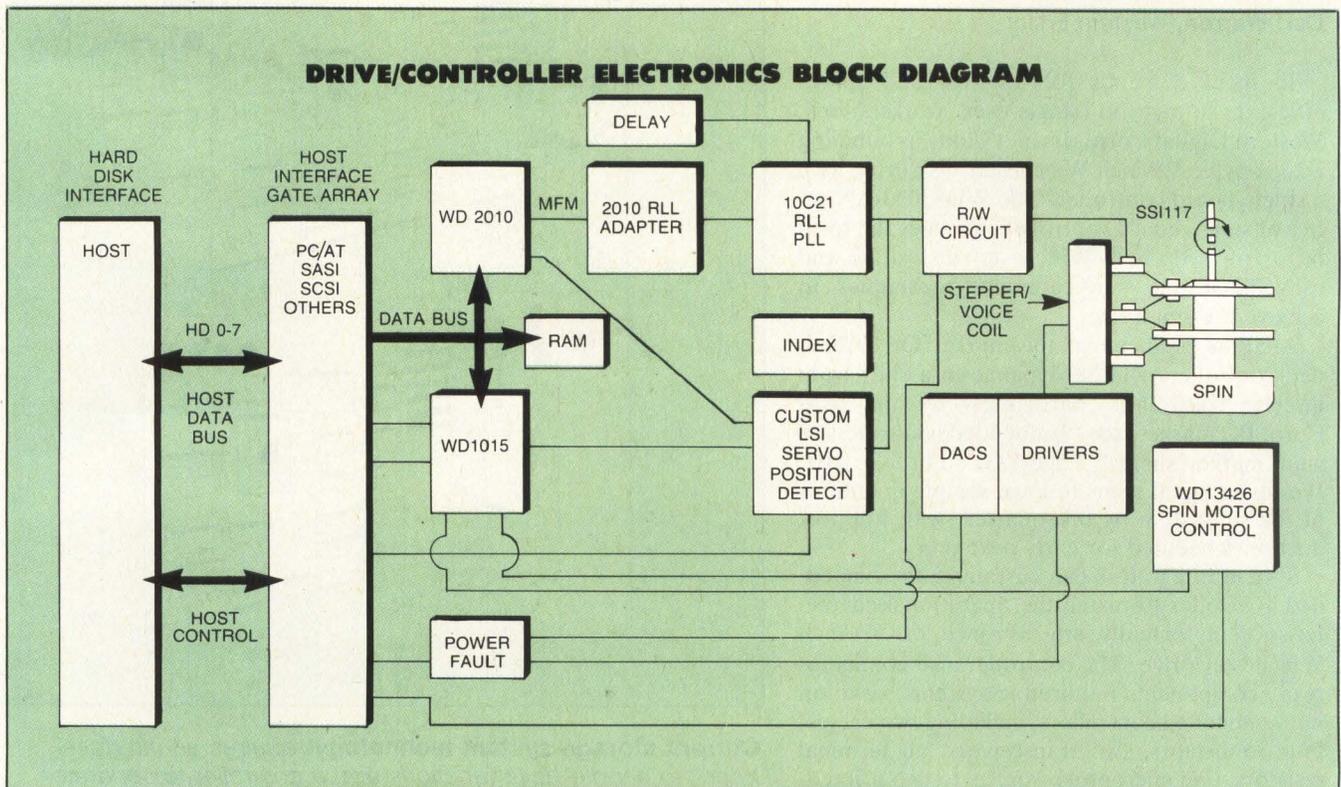
Embedding the controller with the drive isn't a new notion. In 1979, Storage Technology Corp., Louisville, Colo., offered the STC 2700, a forerunner of intelligent subsystems with embedded controllers. Most recently, Xebec, San Jose, Calif., offered an embedded small computer

systems interface controller on their 5¼-inch Owl products. Western Digital's WD83020, however, unlike the Xebec design, can be tailored to match the performance characteristics of individual drives. The WD83020 controller makes use of standard-cell, custom-cell and gate-array technology to integrate various drive and controller functions.

Surface mounting reduces size

The controller's surface-mount technology offers significant advantages over that currently used in single-board controllers. Specifically, surface mounting—compared with insertion through-hole techniques—reduces overall part size by about 70 percent and reduces weight by as much as 80 percent. Moreover, low-profile components allow surface-mounted boards to fit into tighter spaces.

Surface-mounted assemblies typically are two to five times smaller than through-hole assemblies. The Western Digital interface/controller's assembly, however, is about eight times smaller than a conventional controller in an IBM PC.



The embedded controller from Western Digital combines drive-interface logic and control on a single board. The WD2010 Winchester controller and WD10C20 self-

adjusting data separator in concert with custom-cell logic and gate arrays maximizes drive performance by determining motor speed in relation to the data.



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These throughput problems cannot be solved by acquiring a more expensive CPU which operates at higher speeds. For even if the CPU could perform calculations in zero time, your system would still bog down because most of its time is spent moving data between high-speed main memory and the much slower disk memory.

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I N C O R P O R A T E D

The surface-mount assembly method also shortens signal lines, reducing noise levels, lead capacitance, electromagnetic interference and crosstalk, which are critical parameters in a disk-drive controller. Additionally, surface mounting avails itself of both sides of the printed-circuit board for component mounting, increasing the board's surface area.

The board uses the single-chip WD2010 Winchester disk controller and the WD10C20 self-adjusting data separator. The WD2010 suits ST506-based, 5M-bit-per-second (bps), 8-inch, 5¼-inch and 3½-inch drives.

The WD2010 works with an external buffer, such as the WD1510, 12-bit-by-9-bit, first-in-first-out (FIFO) memory, a direct-memory access (DMA) controller or a combination of a 256-bit-by-8-bit static RAM and an 8-bit resettable counter. When used with a 5M-bps drive, data bits transfer to and from the buffer every 1.6 µsec. Transfers from the buffer also can be made via programmed I/O or DMA.

The WD2010 generates the necessary counter-control signals, which minimize external gating

and handshake signals, to control DMA operation for multiple-sector transfers. These signals are often required in conjunction with sophisticated operating systems such as UNIX.

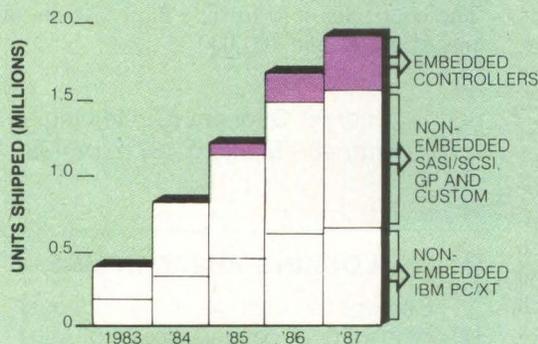
Error handling is accomplished via a 32-bit error-correction code polynomial or a 16-bit cyclic redundancy check. During a read operation, the WD2010 has three choices for handling an error: It corrects the error in the sector buffer and delivers good data to the host; it supplies the host with the error location and pattern and lets the host correct the error; or it takes no action other than set an error flag and direct the host to handle it.

The WD10C20 self-adjusting data separator works in tandem with the WD2010 disk controller. This analog CMOS device saves 50 percent in board area by replacing 10 TTL logic devices. It has a high tolerance to bit jitter (bits occurring before or after their expected time). Typically, worst case jitter—i.e. a real-time error—for a 100-nsec data window is ±20 nsec. Most data separators can adjust only on the average of ±15 nsec; the WD10C20 can adjust over the entire

Embedded controllers to gain market share

Joseph V. Jaworski

With the growing demand for smaller, less expensive solutions to system integration, the embedded controller should have a major impact on the controller market. However, to expect an immediate shift



SOURCE: PERIPHERAL CONCEPTS INC.

Embedded controllers, entering the market this year, are expected to control almost 20 percent of the disk-controller market by 1987.

from discrete add-in boards, especially for the IBM Corp. PC class of machines, is wishful thinking.

Short-term (1985 to 1986) growth of embedded controllers is expected to be relatively slow: about 72,000 devices and subsystems shipped by the end of 1986. However, by 1987, there should be almost a fivefold growth to 330,000 units shipped.

Besides Western Digital Corp., a number of companies are expected to make the embedded scene. Xebec is already a majority leader in embedded devices with its Owl series of Winchester disk drives.

With a growing base of companies expected to latch on to embedded technology, pricing most likely will become a major issue. Because embedded is already being equated with low cost, OEMs are expecting to see prices that are well below those for discrete controllers. But what the price level eventually will reach is anyone's guess. What is predicted is a price decrease of more than 50 percent, compared with those of existing technologies.

Joseph V. Jaworski is president of Peripheral Concepts Inc., Irvine, Calif., a research concern specializing in interfaces, controllers and manufacturing methods.

How controllers control

Although a disk drive's access time and storage capability are key elements in a disk drive operation, they simply won't work without an electronics interface to the host computer system, a formatter to arrange the data into sectors and a controller for each function the drive performs.

Consequently, a drive consists of the electrical interface from the drive mechanics, read/write transducers to the outside world and a controller that matches the drive interface to the host computer.

The drive interface handles the electrical signals that control motor speed, the signals coming from the read/write transducers and the signals that move the transducers from track-to-track.

The controller not only provides a way to sector the

drive (using a special chip that turns the read/write transducers on at proper times to make sector marks), but also represents a single-board computer. Working with the system's operating system, the controller selects the proper disk drive in a multidisk system and the specific track and sector the data is on, and checks for illegal commands and detects errors. More sophisticated controllers perform error correction and manipulate track and sector buffers to speed I/O transfers.

Embedded controllers represent the disk drive's next evolutionary step by combining controller and interface functions into a single board on the drive. Additionally, putting the data separator on the drive shortens data lines and improves data reliability.

spectrum and lock onto the bit frequency.

Because the WD10C20 has a phase-locked variable-crystal oscillator, which operates over the entire window frequency and can synchronize in the read mode and precompensate in the write mode, bit-peak shifts are more easily detected. Most data separators can detect peak shifts from ± 8 nsec to ± 12 nsec. Wider or narrower shifts are missed.

Because the WD10C20 can adjust over the full window range and can synchronize to the drive variations, shifts are minimized to ± 4 nsec. This allows the phase-lock loop to latch onto the center bit frequency, thus reducing bit shift and jitter. As a result, system integrators and OEMs can employ less expensive disk drives. Moreover, errors due to spindle run-out, whereby the disk-rotation speed differs due to bearing wear, are minimized because the device compensates for the changes and properly lock on to the data.

The embedded controller also includes VLSI components that are responsible for the drive's read/write circuitry, and an Intel Corp. 8051 or 8751 microprocessor that handles the logic control of the drive and controller. A WD13426 spin-motor control manages the drive's spindle motor. System integrators and OEMs can match the motor control to the drive's characteristics.

The WD1015 buffer-manager-control processor manages transfers from the controller, monitors the host bus and controls the operation of the error-correcting logic.

To match the controller with the host, a combination of standard-cell chips and gate arrays is used. These devices match the logic to the IBM

PC bus, SCSI and Shugart Associates system interface bus, as well as customized buses. As drives offer greater capacities and demand more complex stepping mechanisms, system integrators can tailor the controller by adding or subtracting logic chips. For example, a simple open-loop-stepper mechanism requires a single chip in the head positioning logic, a wedge microstepper, two chips and full servo systems, four chips.

Although the embedded controller is available unbundled from the drive, the controller's benefit comes from the bundling process because system integrators can tailor the controller to the drive and to system requirements. The basic system with a 20M-byte drive and embedded controller sells for \$399 in quantities of 25,000. The controller sells for less than \$100 in quantities of more than 100,000.

Interest Quotient (Circle One)
High 486 Medium 487 Low 488

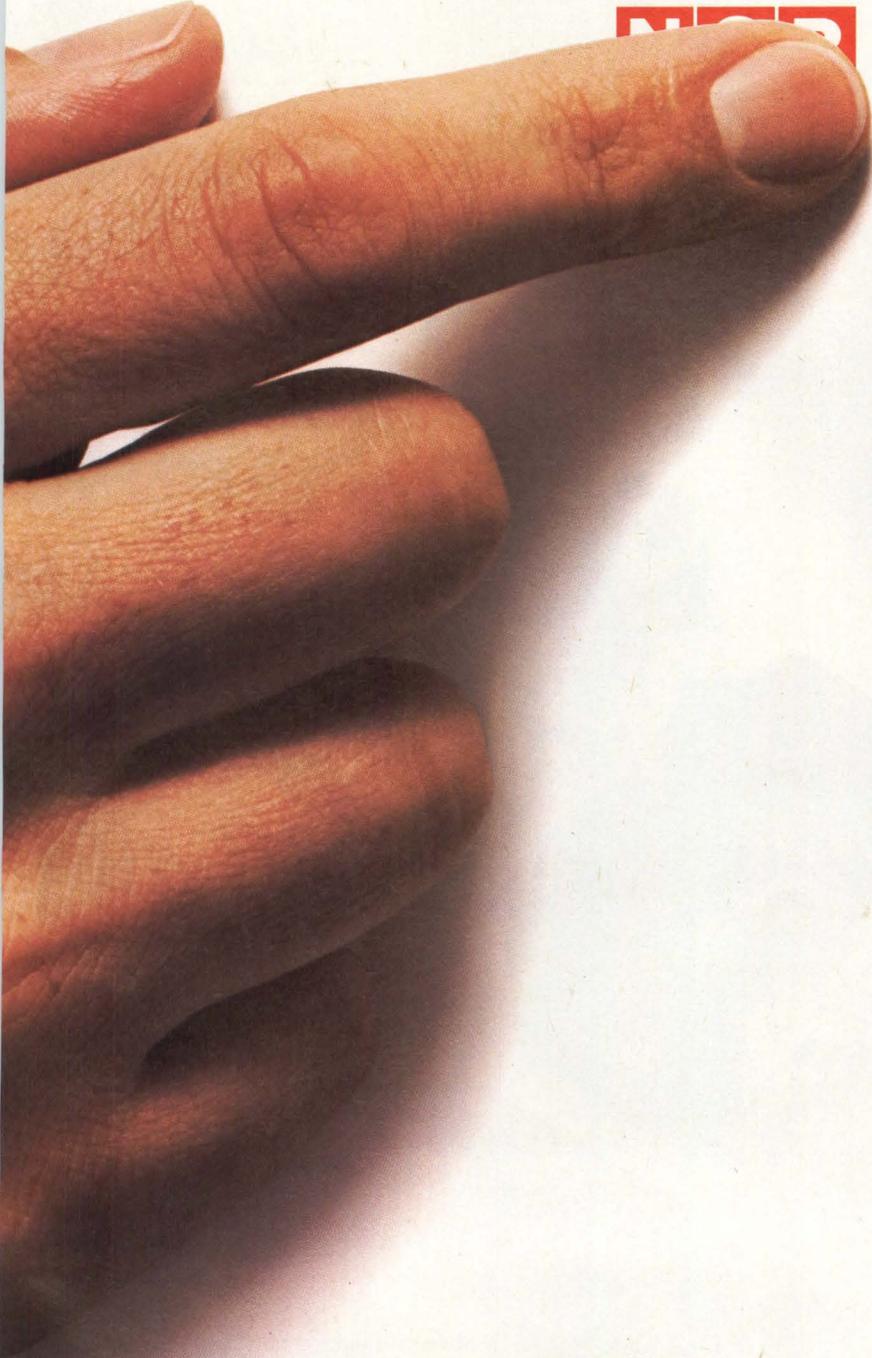
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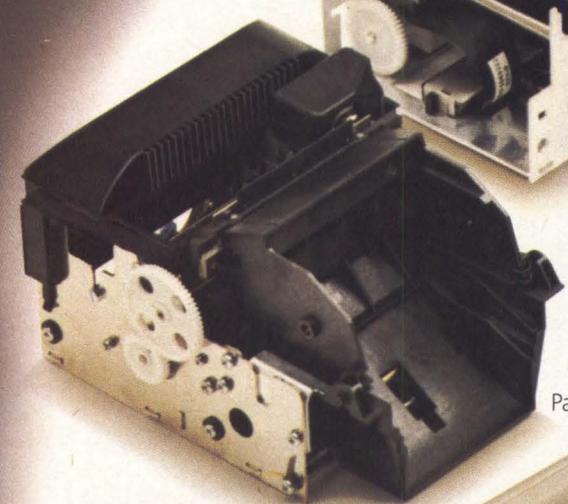
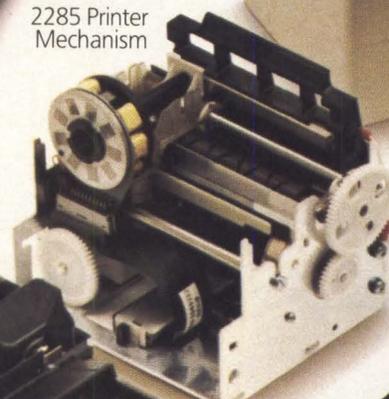
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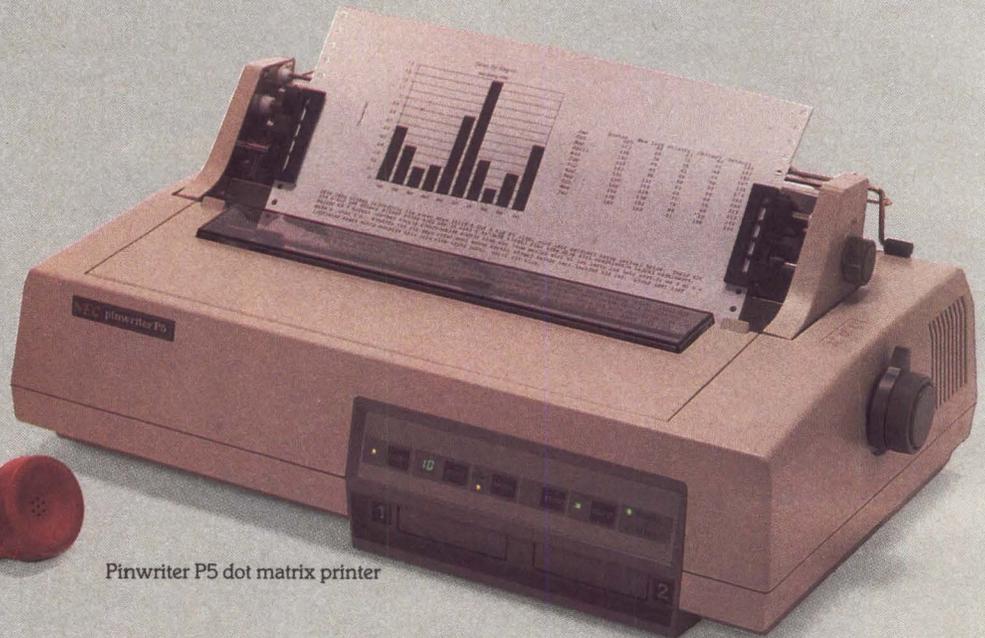
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STANDARDS SERVE AS ROAD MAPS

Accepted hardware and software standards promise portability, but system integrators still sculpt them to fit applications

Carl Warren, Western Editor

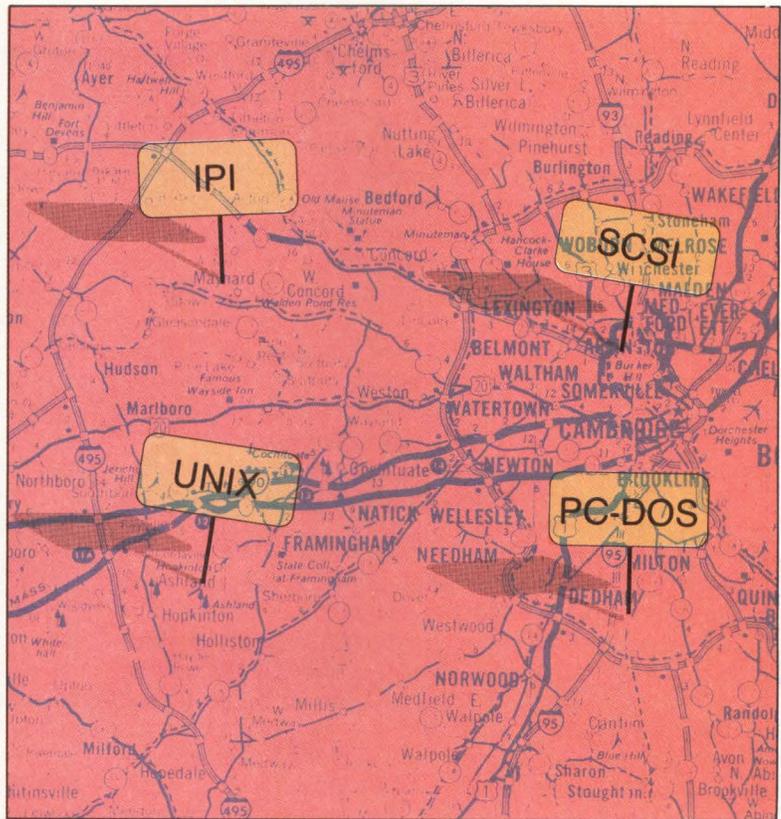
Standards, whether in hardware or software, provide system integrators with a set of implementation rules that simplify design time and reduce costs. Although system integrators welcome those benefits, none want to be locked into hard-and-fast rules that inhibit product creativity. In fact, system integrators insist that users don't care whether or not a box bulges with standards. Indeed, users seem concerned only that a system meet their application needs.

Consequently, system integrators use standards for data communications and data interchanges, rather than seek just one standard. But system integrators prefer to shape various standards to fit a desired application (see "Emulation ties standards together," Page 142).

Standards serve as base

System integrators and software developers insist that standards do serve an important purpose in system architecture design and implementation. "Standards do provide us [the industry] with a working base," says Peter Shaw, president of Genisco Computer Corp., Costa Mesa, Calif. "Standards," he says, "represent the codification of current industry practice and establish a common vocabulary." Shaw does note, however, that if everyone adhered strictly to standard implementations, advances in system performance and features would be impeded.

I. Dal Allan, founder of the computer consulting company, ENDL Inc., Saratoga, Calif., and



vice chairman of ANSI X3T9.3 for peripheral interfaces, agrees with Shaw. He contends that standards should serve as a road map for system integrators—not as the be-all and end-all of their trade. "Most standards documents provide numerous options that integrators can choose from

to meet their application needs. Just because something says standard doesn't mean it has to be followed to the letter," says Allen.

At the spring small computer systems interface and intelligent peripherals interface (IPI) conferences, sponsored by Technology Forums Ltd., Diamond Bar, Calif., more than 250 delegates representing a cross section of companies interested in implementing these proposed standards, found they held similar views on standardization. Most felt that standard definitions were good, but still believed SCSI and IPI implementations would be most creative in firmware implementations of the controlling ROM code. But, due to the large number of options in the proposed standards, many felt the question for developers was to what level of SCSI or IPI to build.

To answer that, Scientific Micro Systems Inc. has developed a minimum SCSI command subset. This subset has been accepted by more than 20 SCSI device manufacturers and the ANSI

committee. Daniel Loski, SMS marketing manager, claims this acceptance solves the problem of at what level developers should work. "Now that ANSI has agreed to append this minimum subset definition to the SCSI formal specification, a standard approach can be taken to the development of operating software for SCSI controllers and devices," he says.

The same approach of tailoring standards to match the need is taking place in other software as well. Server Technology Inc.'s \$179 EasyLAN Limited Area Network Software, for example, turns an IBM Corp. PC's RS232 port into a network connection. Based on existing standards, the EasyLAN protocol adapts the IBM Network Systems Hyperchannel. As such, it employs packet transmissions with 16-bit cyclic redundancy checks, and multiple retries. Additionally, the software uses the RS232C specifications for toggling lines and flow control.

Another company building on a standards base is Softwords Inc. with its \$59.95 LaserJet

Emulation ties standards together

Not all standards used by the computer industry are codified by ANSI or IEEE. Many standards such as Hewlett-Packard Co.'s proprietary command language (HP PCL), used on their LaserJet printer, achieve de facto status simply due to universal usage. Therefore, system integrators and value-added resellers must understand the use of de facto standards.

HP PCL ensures compatibility within the HP family of software packages and hardware systems that use the LaserJet printer. Although this compatibility solves the standard/non-standard question for users of HP equipment and software, it raises interface issues for system integrators who want to use the LaserJet with other equipment and software.

Consequently, providing compatibility from "foreign" software and hardware to the HP LaserJet calls for a protocol converter. To this end, Zvert Corp. has developed a protocol box for translating non-HP software to HP PCL equivalents for proper printer control.

The 17-by-8½-by-3-inch Zvert converter provides three ports (two RS232C and one Centronics/Epson-compatible) for multiuser sharing of the LaserJet. Thus, computer systems such as those using an IBM Corp. PC can use the Zvert converter via a choice of port configuration. In addition, the converter provides emulation of a choice of popular daisywheel printers such as those from C. Itoh Electronics Inc., Diablo Systems Inc., Epson America Inc., NEC America Inc. and Qume Corp.

In operation, the Zvert converter's front-end input

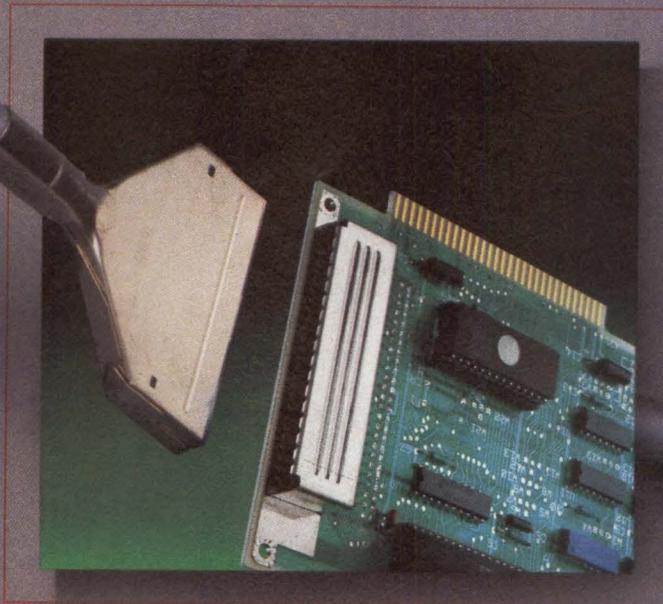
samples the channels for character input and, using interrupts, establishes flow control (on/off control of characters). Then, characters received through the input ports are put into an active buffer. Next, they go to the LaserJet marking engine.

The main portion of the Zvert ROM-based control program determines whether an emulation is needed. For example, if Ashton-Tate's Framework uses the LaserJet driver, the Zvert converter assumes a direct pass to the LaserJet printer's HP PCL and a character is printed. In the case of word-processing programs, like MicroPro International Corp.'s WordStar installed for a Diablo Model 630 daisywheel printer, the Zvert protocol converter notes that emulation is necessary and translates Diablo print commands to equivalent HP PCL commands.

Besides emulation, the Zvert converter provides extensive simulation of printer features—such as justification, centering and tabs—not implemented on the LaserJet. "The LaserJet is only a marking engine. It makes marks where it is told to," explains Philip Lieberman, Zvert president. He explains that HP PCL, as implemented on the LaserJet, relies on the host to do all the formatting work and send the results to the printer. Thus the Zvert converter not only handles the necessary protocol conversions so that the host can talk to the printer, but also removes the burden of format translation from the host as well. "Essentially, the converter matches one set of standards, or protocols, up with another set. It's really sculpting standards to match the application," explains Lieberman.

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Control Program (LCP). This program enhances MicroPro International Corp.'s WordStar 3.3 word-processing program to format output to Hewlett-Packard Co.'s LaserJet printer. "There are really three de facto standards involved here: WordStar, Hewlett-Packard's proprietary command language (HP PCL), and the MS-DOS/PC system architecture," says Softwords president Robert Byers. "The trick is to make them all work together to meet application requirements. That's really the basis of LCP."

Portability still at issue

One of the purported benefits of standard software is portability across systems. For example, the UNIX operating system is supposed to be a portable operating environment because it's written in C, and theoretically can run on any processor. Byers warns, however, that UNIX is only portable at the top levels. He contends that: "In order for UNIX to work on a system, a hardware-specific kernel has to be written. So it's more correct to say it is only partly portable...Software written for one class of machines is most likely portable across many machines in that class [e.g. software for the IBM PC and compatibles], but when moved to a different class of machine, changes typically have to be made to accommodate the attributes of that machine." In fact, Byers believes that the term "portable" is one of the most misused terms in the software industry.

Accommodating differences in machine architectures is a major problem for software developers. For example, Borland International Inc.'s Turbo Pascal is offered for both 8-bit and 16-bit machines using Digital Research Inc.'s CP/M operating system and Microsoft Corp.'s MS-DOS. Because both architectures offer different attributes, two versions are required. Where the portability exists is in the Pascal source code for an application. Thus, an application developed on an 8-bit system under CP/M theoretically can run on a 16-bit system under MS-DOS. This assumes that no hardware-specific functions are used in the source code.

Data has portability problems too

Although portability is usually discussed in terms of an operating system, language or source code, there is also the problem of portable data—that is, moving data from one system environment to another without violating its integrity or structure. One proposed standard, the independent software-interchange standard ensures the transportability of data among UNIX-based machines.

The proposed ISIS standard seeks an industry

consensus on read and write files, command-language definitions and access programs. The goal is to incorporate common headers into all application packages and allow data to pass among separate programs, users and systems. The roots of ISIS lie in the data interchange format (DIF) that defines data in tabular format for interchanging data among various programs. But ISIS also allows a definition of file formats so that data can be read and written on diverse UNIX systems. Notably, ISIS is planned to be completely portable in that no specific hardware requirements are assumed, so no vendor-unique differences exist.

Another approach to making data portable among various systems has been developed by Cipherlink Corp. The company's ANY Data-bridge product, which targets the UNIX environment, takes data from one system and matches it to the requirements of another. Eric S. Lesin, Cipherlink's president, explains that ANY isn't a file-transfer or formatting program: "Although the final outcome is to move data from one source to another, what ANY does is make the data more portable by putting it in the

List of companies mentioned in this article

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The twisted road to interchangeability is served by standards acting as sign posts.

format of the target system without violating data integrity.”

The ANY databridge works by learning about the source data, and the requirements of the target system. For example, a source document may have the data for an address list arranged as last name, first name, address1 and address2. The target expects the first and last name to exist as one field called “name,” and accommodates only one address field. In the learning process, ANY samples a source record and allows the user to place these fields in the order the target expects. Thus, first and last names are combined to create the name field. Besides providing overall portability of the data and matching target-system formats, ANY ensures adherence to the desired standard.

“Interestingly, when you discuss standards in relationship to databases, you are really addressing assumed standards,” suggests Lesin. He notes that the assumed standard is whatever the user wants for the format of the data. “If there were only one absolute standard for formatting

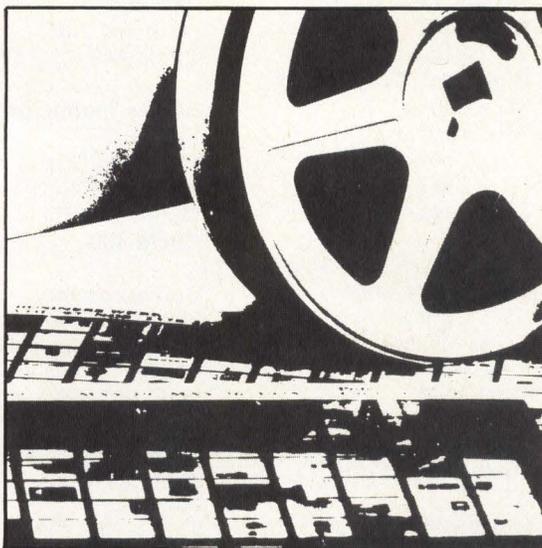
data, moving from one machine to another would be easy,” says Lesin.

A company that has developed portable software tools is Quantitative Technology Corp. Their Math Advantage library of sophisticated engineering and scientific math routines is callable from FORTRAN or C, and can be used on systems ranging from 16-bit PCs to 64-bit supercomputers. Thus, applications and data developed with Math Advantage on a mainframe can be used directly on a PC without change.

It appears that the real questions posed by system integrators in relation to standards and portability center around the final outcome. Specifically, the goal is to achieve reliability in data and interchangeability. The twisted road to this goal is, in most cases, served by standards acting as sign posts.

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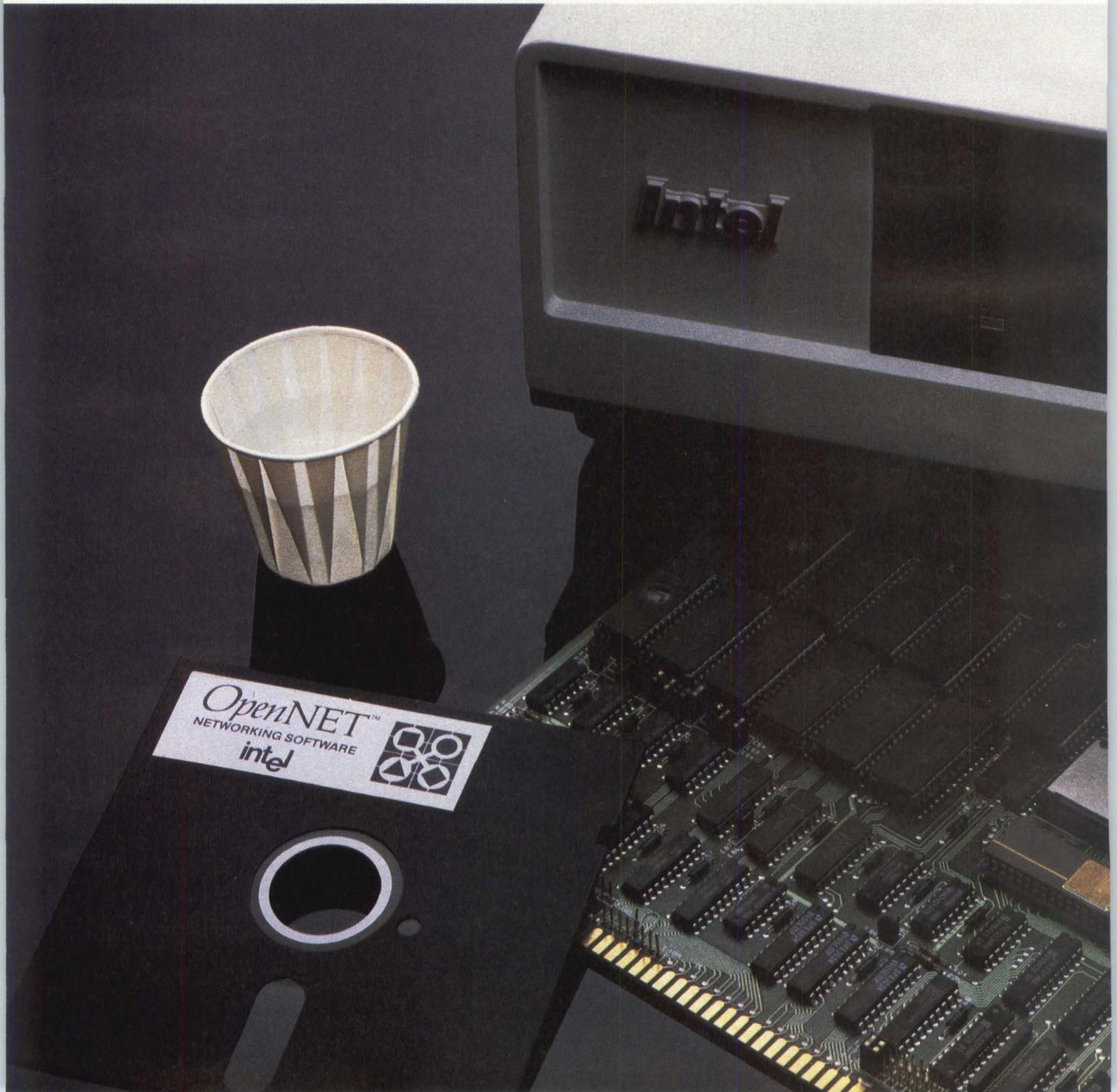
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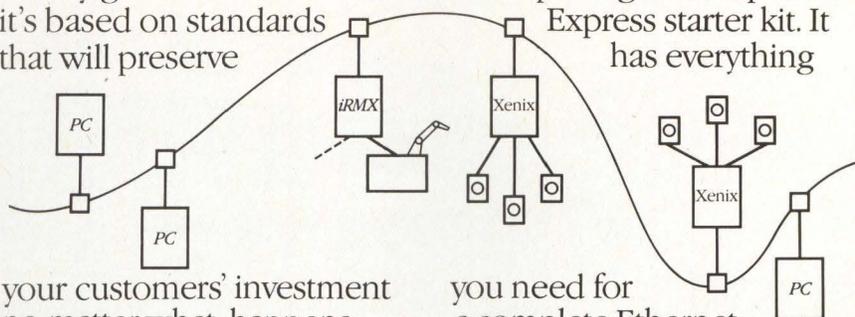
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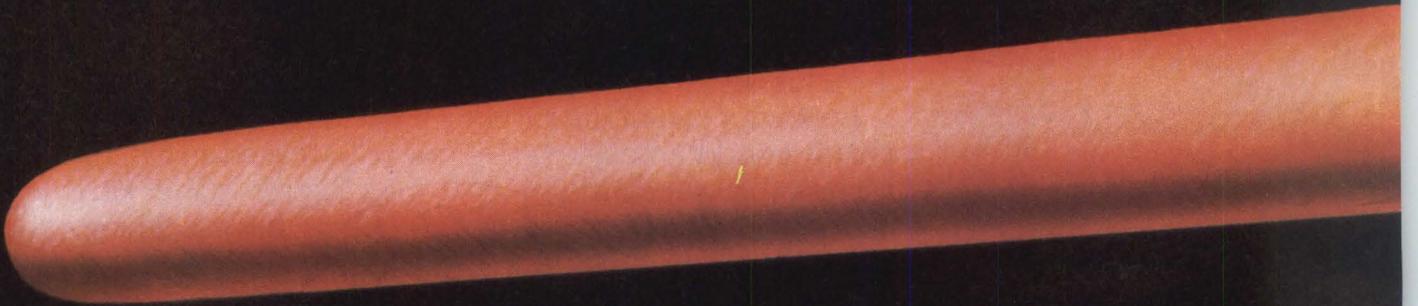
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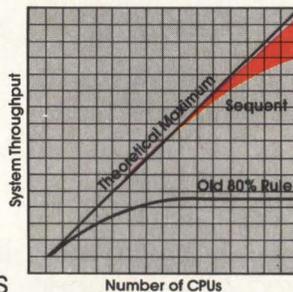


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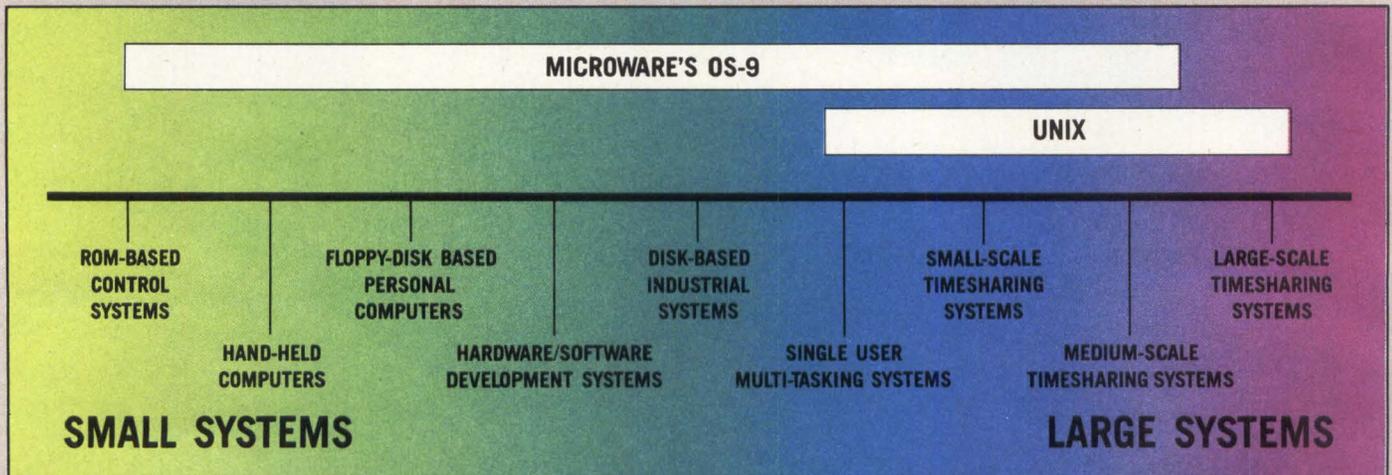
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CIRCLE NO. 79 ON INQUIRY CARD

MULTICOMPUTERS BOOST MIPS AND MODULARITY

Ranging between superminicomputers and massively parallel supercomputers, multicomputers give system integrators access to next-generation technology

Jacob Hsu, Flexible Computer Corp.

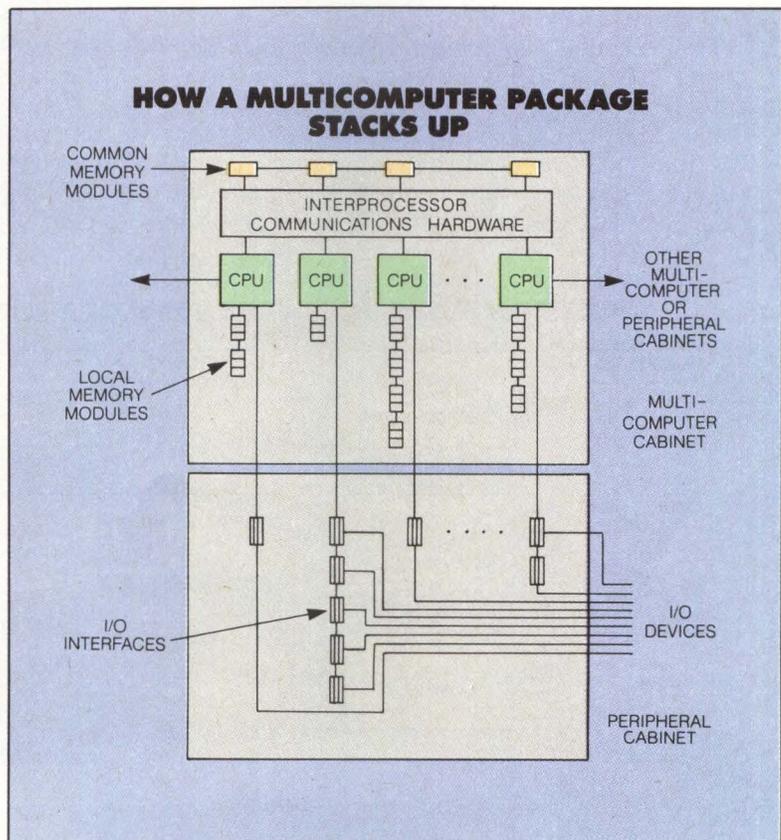
Until recently, the international effort to develop massively parallel "Fifth Generation" computers has been a bit like seeking the Land of Oz—the goal was fascinating in theory, but far removed from the real-life concerns of system integrators. Now, "multicomputers," comprised of groups of 32-bit computers, are making such next-generation technology directly available for demanding number-crunching applications.

In the past, there have been two main means of increasing processing power: Users either attached additional systems to an original computer, or they purchased a more powerful (and more expensive) machine, assuming one was available and they could afford it.

For years, system integrators have known that architectures based on multiple, parallel CPUs can vastly increase processing power. But, less well understood is that such systems can also give integrators greatly increased flexibility for configuring and reconfiguring applications.

Many computer architectures include multiple processors, such as networked computers or attached processors. Although these architectures might devote more than one processor to a given problem, they do not achieve the optimal results of a true multicomputer environment.

For example, although, generically, networked processors can all concentrate on one problem—say, in banking—they will not produce a result faster because of the physical dispersment and delays inherent in a network's method of communication. For instance, with a shared database, three bank tellers may be able



The basic building blocks of the Flex/32 are configured for intercommunication. CPUs, computer cards, shared resources and common memory cards are all directly linked by common buses. Individual computers and their local memory modules are connected by local buses. The entire multicomputer system features several individually configurable VMEbus I/O interfaces.

to process three checks, one check each, faster than one teller. However, the three tellers cannot concurrently process a check faster than one teller can working alone. As in many multiprocessor architectures, the presence of more than

one processor does not make a true multicomputing environment. In most of today's so-called multiprocessors, only one processor works on a transaction at any one time.

Unlike a processor, a computer is comprised

A new software development methodology appears

The Flex/32 from Flexible Computer Corp., Dallas, comes with three run-time environments (right). UNIX System V is used primarily for software development. Concurrent processes, however, can also run under the UNIX environment. The multicomputing, multitasking operating system (MMOS) is a run-time system that provides for the execution of multiple processes on multiple computers in a lean, efficient environment.

In addition, a Concurrency Simulator (right center) is available. This simulator provides the software needed to simulate on one computer in the Flex/32 the concurrent execution of multiple processes on multiple computers.

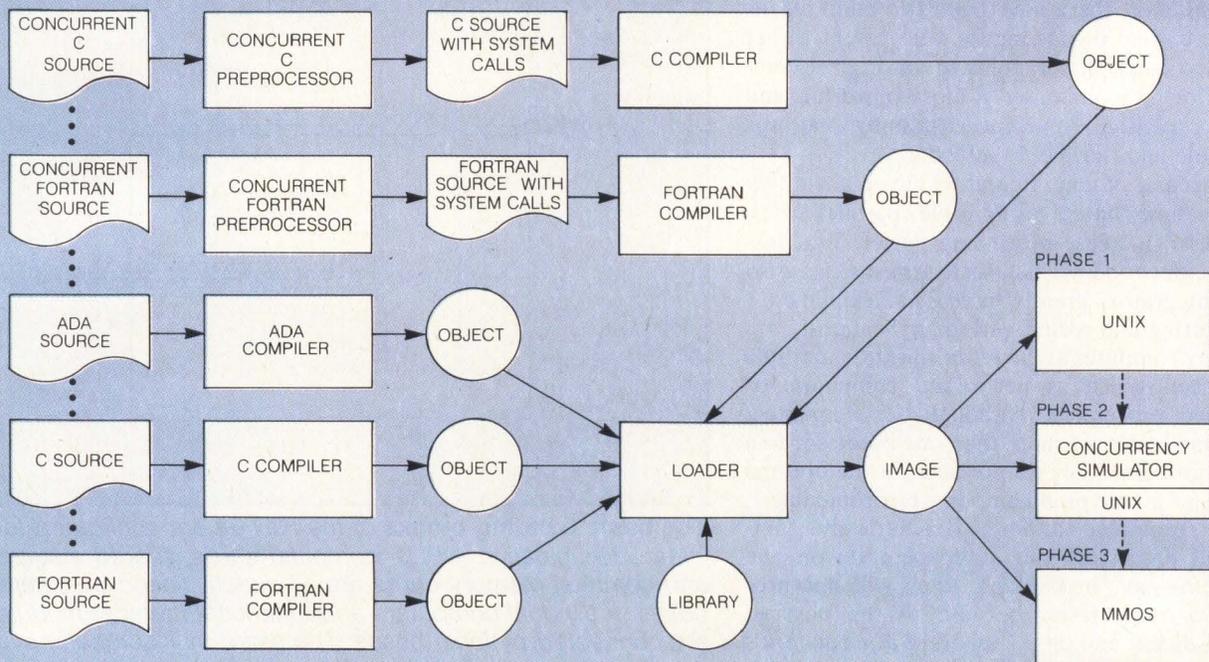
The methodology for developing concurrent programs on the Flex/32 is a phased migration of processes from one environment to another—allowing many programmers to simultaneously contribute to the development of large software systems. First, standard "garden variety" sequential programs are developed and compiled under UNIX. Second, after

these sequential programs are debugged, they can be collected and controlled as parallel processes under ConCurrent C or ConCurrent FORTRAN programs (left).

Third, the developer can use the concurrency simulator to debug these newly concurrent programs with the UNIX System V development environment from AT&T Information Systems. Fourth, if appropriate, the program can then be executed under UNIX, either directly as a sequential or distributed process, or concurrently with other processes. If, however, the application is meant for true concurrent execution directly on the multicomputer under MMOS, the processes can be moved one at a time, or all at once, from the Concurrency Simulator into individual computers.

With this phased software-development path, users can implement a true multicomputer incrementally, moving from the shelter of apparent concurrency with UNIX support to a fully concurrent system executing in an efficient run-time operating environment.

MULTICOMPUTER SOFTWARE DEVELOPMENT IS A MULTISTEP PROCESS



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CIRCLE NO. 80 ON INQUIRY CARD

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Coleco
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of a CPU plus its own local memory and I/O facilities. A true multicomputer, therefore, is a collection of computers that can solve one problem concurrently, sharing data as they work. In such a system a single problem can be decomposed and computed by parallel processors concurrently. Its architecture facilitates closely coupled data transmission and concurrent programming, allowing several computers to compute the result as a single entity faster than a sequential program on one or more processors.

New class of machine appears

To perform true multicomputing, these computers must coordinate their respective tasks by communicating with one another and synchronizing the order of their execution. In addition, to preserve the integrity of shared data, each computer must be able to operate on data in a manner that guarantees the exclusion of other computers.

Consider the Flex/32 MultiComputer—a true multiple instruction stream/multiple data stream computing environment from Flexible Computer Corp., Dallas. It can process more than one piece of data at a time via a group of directly programmable parallel computers that can concurrently operate independently or together on one or more tasks under coordinated software. In effect, it acts not so much as a single machine, but as a generic “home” for an assortment of computers—a multicomputing environment. These individual computers can differ from each other in power, memory, basic orientation and instruction sets.

The computers can also be dedicated to different applications. Some might control functions while others might perform array processing and floating-point operations.

At this time, one Flex/32 cabinet can support up to 20 National Semiconductor Corp. 32-bit 32032-based computers, each capable of approximately .75 million instructions per second (MIPS). Each also contains 1M or 4M bytes of RAM and a VMEbus interface. Computer and memory cards (up to 8M bytes) can be interconnected, mixed and matched as necessary in single or multiple cabinets to customize the system for individual applications. Additional computer cards with different processors will be available in the future. These cards will operate side by side with the 32032 card with no changes to the system's software. The entire system fits into a 6-foot-high cabinet.

A multicomputer differs from a multiprocessor machine in two respects. First, as a general-purpose computer its architecture has been de-

signed to take advantage of such features as arbitrated common memory. Second, each computer can be programmed to work either separately or with other computers. Although some multiprocessing architectures use multiple processors and pipelining to provide greater performance than can a single processor, they are limited by sequential programming techniques. What's more, task allocation to the individual computer and I/O facility is performed by the master computer's operating-system software and cannot be directly assigned by the user.

As a result, the degree of cooperation between individual multiprocessor computers working on any single problem depends on the operating system's level of technical sophistication. Until now, technology has supported only rudimentary automatic recognition of parallel structures and cosequential codes within a single machine, so task allocation and the partition of algorithms has been less than optimal.

In contrast, because the Flex/32's computers can be programmed either independently or together, the configuration is a real parallel implementation. It includes high-level programming tools and a Concurrency Simulator to support the migration of programs from sequential to parallel environments (see “A new software development methodology appears,” Page 154). With these software tools, users can determine parallelism and allocate tasks accordingly. Indeed, the direct programmability of each computer means that users can employ their expertise on their own problems, along with the algorithms used to solve those problems, with maximum efficiency.

The Flex/32 can be configured and reconfigured easily. Each multicomputer cabinet contains a 30-slot card cage that houses as many as 10 “common” cards, those which handle interprocess communications and common memory, and 20 computer and memory cards in any combination. Because, in theory, 1,024 cabinets can be connected for as many as 20,480 computers, the system can be expanded to meet the needs of virtually any application.

The Flex/32 contains local and common buses that interconnect all the system elements. Each cabinet incorporates two high-speed common buses. Each bus backs up the other in fault-tolerant applications, or provides faster interprocess-communication throughput in applications where speed is more important than resistance to failure. The system avoids delays on the common bus due to polling or interrupts by implementing in hardware the conditional critical region (CCR) form of interprocess communi-

A multicomputer acts not so much as a single machine, but as a generic ‘home’ for an assortment of computers.

cations. That is, those portions ("regions") of process code that access shared data are made mutually exclusive. This setup means a maximum of throughput can be dedicated to the true interchange of information and not to the testing needed for synchronization.

The first computer card for the system employs the 32032 chip plus 1M or 4M bytes of RAM, a full VMEbus interface—for use with 16- or 32-bit peripheral devices—and the Flex Selftest system, which performs configuration control, self diagnostics, repair validation and performance analysis. The card also incorporates a floating-point processor and full memory-management capability, error correction code logic and 128K bytes of ROM.

Depending on the level of capabilities needed, the Flex/32 has three approaches to providing scientific floating point operations and vector processing. Each computer card has a floating point processing unit or it can be equipped with a vector floating point accelerator for greater performance. The third alternative is an array pro-

cessing card that offers the greatest floating point performance. All three of the Flex/32's scientific processing alternatives function in parallel with other computers in the system and under the same software.

The VMEbus interface on each card allows system configuration with any combination of computer, memory and I/O resources to meet a wide range of application needs. For example, in a memory-intensive configuration, one computer card hosting 19 8M-byte memory cards provides 1 MIPS of processing power, 153M bytes of main storage and 20 VMEbus interfaces. At the other end of the single cabinet range, 20 computer cards, each with 1-MIPS performance, 4M bytes of memory and its own VMEbus can satisfy computer-intensive applications.

The multicomputer's basic configuration includes two computer cards. To increase memory or processing power, the appropriate card is simply inserted into the system with minimal software impact. Cards can be added or removed while the multicomputer is in operation.

A SCADA shapes up

A typical configuration of the Flex/32 involves a functionally fault-tolerant supervisory control and data acquisition system (SCADA) organized into three levels for an industrial application:

- A planning-level computer provides management information and plant-efficiency functions and interfaces with the factory's human management via terminals and printers.
- A supervisory level provides sequence control, multivariable control and similar higher order functions for various processes. The supervisory level is fully redundant.
- A process-control level performs data acquisition and actuation functions and interfaces to process I/O, such as sensors, loop controllers and actuators. This level is also fully redundant.

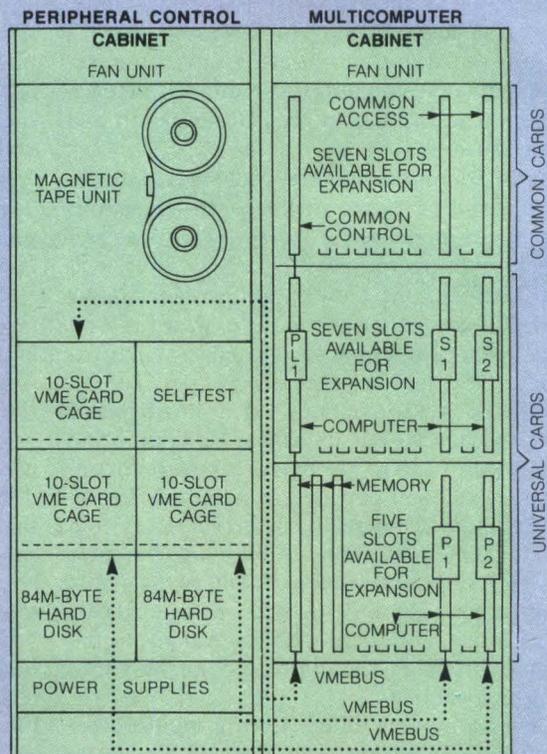
One supervisory computer and one process-control computer are paired to one local bus and one set of I/O interfaces and devices, providing I/O and commu-

nication-path redundance in addition to the redundant computers and memories.

PLANNING LEVEL (PL1)
 1 COMPUTER
 25M-BYTE MEMORY
 1 VMEBUS INTERFACE
 I/O DEVICES:
 TERMINALS
 PRINTERS
 DISK DRIVE
 TAPE DRIVE

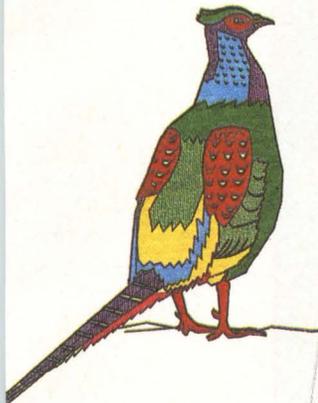
SUPERVISORY LEVEL (S1, S2)
 2 COMPUTERS
 2M-BYTE MEMORY
 2 VMEBUS INTERFACES
 I/O DEVICES:
 DISK DRIVES
 OPERATOR CONSOLES
 PRINTERS
 PROCESS COMPUTERS (P1, P2)

PROCESS CONTROL LEVEL (P1,P2)
 2 COMPUTERS
 2M-BYTE MEMORY
 2 VMEBUS INTERFACES
 I/O DEVICES:
 LOOP CONTROLLERS
 SENSORS
 ACTUATORS
 TERMINALS

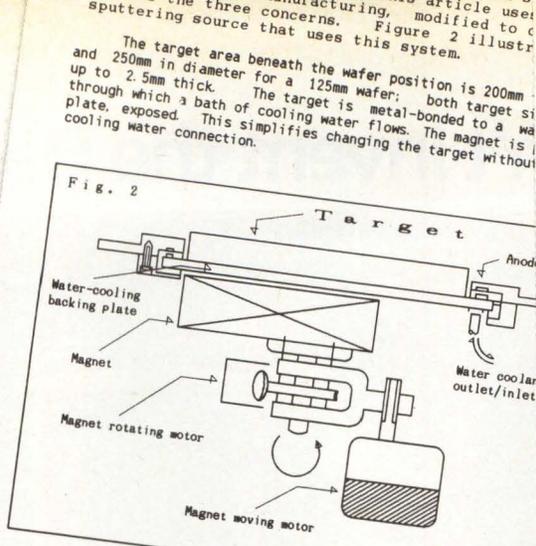


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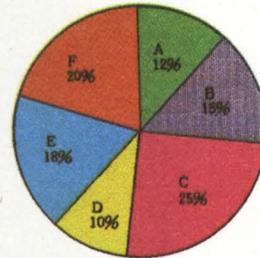
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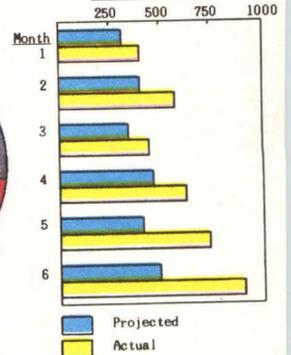
With the exception of an expected dip in March, monthly sales are continuing to increase. Given our current growth rate potential, we now expect to exceed sales of \$1,500,000 year end.

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% Revenue (by district)



Revenues (000)



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Hardware as adaptable as a multicomputer requires correspondingly high-level software support. For this reason, the Flex/32 supports several portable development tools, including UNIX System V from AT&T Information Systems, and Flexible's ConCurrent C and ConCurrent FORTRAN programming-language extensions, a multicomputing implementation of Ada, and the traditional programming languages, C and FORTRAN.

In general, software developers and end users require diametrically opposed types of operating systems. Early in a project, while software is being developed, a large operating system that supports symbolic debuggers, screen editors and other development aids proves useful. During development, though, memory capacity and speed are less important than user support.

However, once the application is developed, a lean and efficient operating system is the better choice. Two separate operating systems, then, offer the direct solution—but this approach, too, has inherent problems. Transporting software from one operating system to another can be difficult and costly and also makes later additions and changes extremely cumbersome.

Therefore, Flexible provides software-development tools for a methodical and controlled migration from UNIX to a proprietary multicomputing, multitasking operating system (MMOS) that is written in ConCurrent C. These tools include language extensions for concurrent programming in C and FORTRAN and a Concurrency Simulator.

Software developers can employ these in a series of steps from sequential code development through final concurrent program integration. Programs can be developed under UNIX with all the "safety net" features of that operating system. Then, ConCurrent C and ConCurrent FORTRAN provide the means to write the code required to join the sequential blocks of code that perform the bulk of the work in any application. These programs can run concurrently on different computers or be multitasked onto a single machine. Once the application has been functionally debugged on one computer under UNIX by using Flexible's Concurrency Simulator, it can migrate from the UNIX domain directly to MMOS and operate autonomously in a true run-time environment for concurrent, parallel processing.

This capability also means existing UNIX applications can be readily ported to the Flex/32. Moreover, source versions of generic ConCurrent C and ConCurrent FORTRAN programs are available for common user applications as

are the tools to adapt them to each user's needs.

In fact, software developers can make programs created under UNIX run faster and more efficiently under MMOS simply by redirecting the load operation. Where UNIX comes to an application with a host of options that increase user-friendliness but chew up memory and reduce speed, MMOS is automatically timed by the loader. Also, the loader handles only those functions needed for the specific program. In this way, the MMOS environment is kept as lean as possible, and programs can run in an environment with minimal operating system overhead.

At a user site, a concurrent application can run without UNIX—using much less memory or requiring less overhead.

Multisystem means multibenefits

The Flex/32 suits real-time, fault-tolerant and scientific applications. It provides users and OEMs with the flexibility to adapt to a wide range of customer needs and scalable power through the addition of computer and/or memory cards.

OEMs often run into difficulties for two reasons: Because they respond to user specifications that are incomplete or that continually change, or software has to be modified and refined to meet customer requirements after the system is operational. In either case, a multicomputer provides answers because it can grow to meet changing needs. When an application grows in size, the expanded system can continue to use the software employed on the smaller system.

The flexibility provided by a multicomputer allows for operational modes not previously known to users. For example, suppose a user has a system that controls a real-time industrial application, but wants to experiment with a new control program. Obviously, they couldn't just plug in the old software because an undetected bug in the program could prove disastrous.

However, a single Flex/32 can run candidate software side by side with the actual control application. The original industrial application controls the environment while the new software is tested and validated as it simulates control. They both use the same hardware and the same real information coming from the controlled environment, yet each can be electronically isolated from the other. This mirror simulation affords an unlimited amount of time to assess the suitability of the software before it's used. □

Interest Quotient (Circle One)
High 492 Medium 493 Low 494

Jacob Hsu is manager of customer support for Flexible Computer Corp. Previously, Hsu was senior engineer at Honeywell Communications Products. He has a bachelor of science degree and a master's degree in electrical engineering from the University of Southern California.

In the grit and dust
mill, six Mannesmann
are performing topless
24 hours a day.

of an Australian paper Tally printers

Our engineers aren't at all shocked.

It's a dirty business, printing without lids at the end of a production line.

But our six MT660's are printing bar code labels. And since quick access is a constant demand, it's off with the lids and on with the job.

That's no small task.

As they say in Australia, "Bar code printing is bloody hard on printers."

But as our engineers point out, Mannesmann Tally printers do it bloody well.

In fact, while other printers in the paper mill kept breaking down, the MT 660's kept on running, 24 hours a day, now for over 12 months.

An isolated example? Not at all. It's simply one more demonstration of the dedication to long lasting, rock-solid performance we apply to every printer, every job.

Take other applications of the 600 LPM MT660.

As an industrial graphics printer, it prints OCR A and B, up to 10-inch high letters, custom symbols and characters, logos, even signatures sharply, clearly.

As a text printer, it has the quality you need for letters, documents, management reports.

As a data processing printer, it speeds through inventory reports, program listings and document drafts in a choice of formats. It gives you 75,000 pages a month. And offers character enlargements in single and double width and up to triple the standard height.

And if 600 LPM is not fast enough, you're still in luck.

Because Mannesmann Tally is now introducing the highly competitive, highly productive MT690.

The new MT690 does all the things the MT660 does, but at 900 LPM. With the same impressive list of features. And the

same solid dependability.

So day after day, job after job, you can depend on the MT690, like the MT660, to keep on printing.

If absolutely necessary, even with the top off.

And that, according to our engineers, is the bottom line.



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MANNESMANN
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5	2	--		iSBC MEM/340 4 Mbyte Mem board
6	10	--		iSBC CSM/001 Cent. Serv. Module
7	1	--		iRMX 86II R.0 RMX86 MBII R-t OS
8	5	--		iSBC PKG/609 9 slot cardcage & PSB backplane
9	5	--		iSBC PKG/903 3 slot iLBXII backplane
10	1	--		iSDM 286 R.0 286 System Debug Mo

You've heard the announcements about MULTIBUS II specs.

But now there's an even more spectacular announcement:

The first wave of MULTIBUS II products is here.

Take the 286/100 Single Board Computer. It's the first commercially available 286-based board that runs at 8

MHz. It also introduces the iLBX II™ interface and is iSBX™ compatible.

Then there's our family of cached-based memory boards, from ½ to 4 MB, which give zero wait state performance over the iLBX II bus. And because the boards are configured in software, there are no jumpers. Anywhere.

There's software support, too, with the iRMX™ 86 MULTIBUS II support package. It supports the same tools, languages and utilities as the iRMX 86 operating system.

And for software development support, the iSDM 286 System Debug Monitor is also available. So you'll be up and running in no time with products based on the advanced MULTIBUS II architecture.

We designed the 32-bit MULTIBUS II architecture to give you a quantum leap in performance where you need it: in a multiprocessing environment.

To get such radically improved performance we had to redefine bus architectures with radically advanced concepts.

Like distributed arbitration. It breaks the bus access bottleneck and helps maximize system level performance for multiprocessing environments.

And we're taking a unique approach to interprocessor communication. It's called message passing. It'll free up

the CPU from bus management tasks and put it back to work on your application.

And the MULTIBUS II architecture has the reliability to back up that performance — reliability that surpasses everything else commercially available.

How?

By being the first open systems bus to incorporate parity protection on address, data and control lines. By being the only bus that allows every board to perform self-test.

Even the 32-bit bus inter-

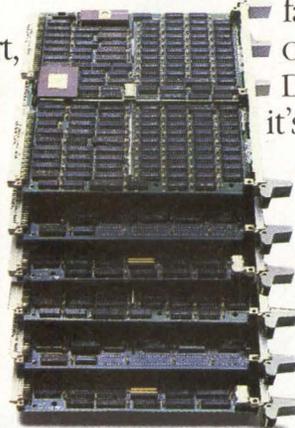
- face is reliable. It not only fits onto one DIN connector, but it's been designed to be integrated onto one VLSI chip. And that's more reliable than two or three or more.

But the most important feature of MULTIBUS II is that Intel and other manufacturers are already working on dozens more MULTIBUS II products.

Just the kinds of products you need to meet the needs of your market.

For complete information, call us toll free at (800) 538-1876. Or write Intel Corporation, Lit. Dept. W225, 3065 Bowers Avenue, Santa Clara, CA 95051.

So don't miss this bus. Because you could have a short ride on any other.



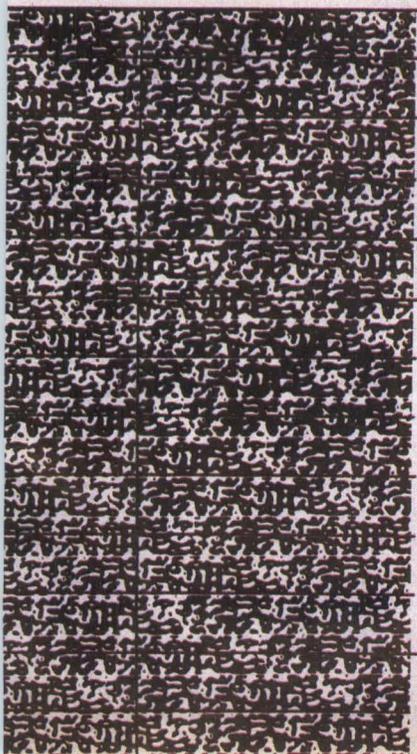
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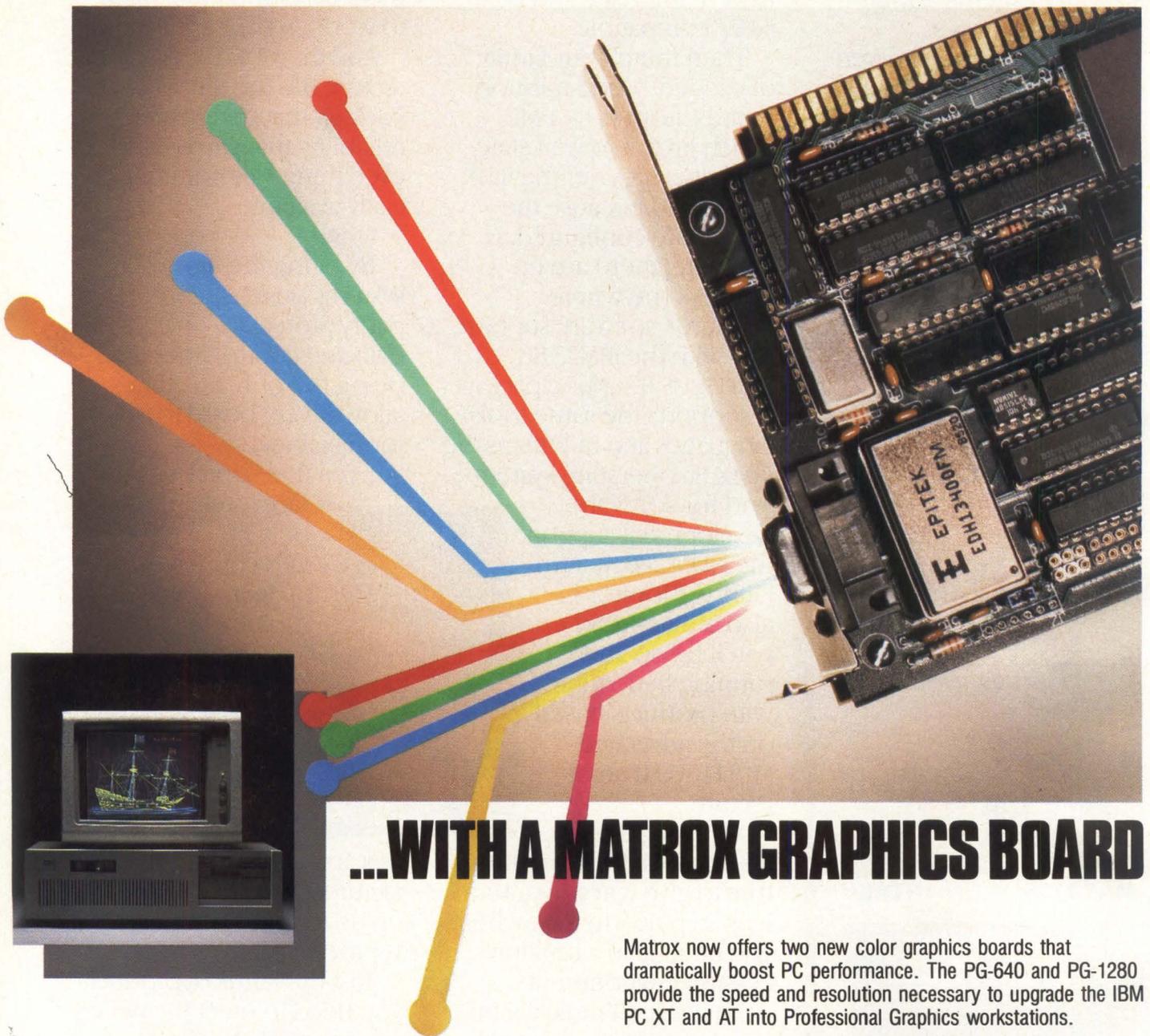


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CIRCLE NO. 85 ON INQUIRY CARD

TURBOCHARGE YOUR PC'S GRAPHICS



...WITH A MATROX GRAPHICS BOARD

- 640 x 480 x 8 display (PG-640)
- 1280 x 1024 x 8 display (PG-1280)
- 40,000 vectors/sec. drawing speed
- 100% IBM PGC compatible
- Full IBM CGA emulation
- 1 million pixels/second image load

Matrox now offers two new color graphics boards that dramatically boost PC performance. The PG-640 and PG-1280 provide the speed and resolution necessary to upgrade the IBM PC XT and AT into Professional Graphics workstations.

The PG-640 has a drawing speed of over 40,000 vectors/second and an image load speed of 1 million pixels/second. This means complex 640 x 480 pictures are drawn in under a second. The PG-1280 provides even faster picture updates, and displays four times the detail, 1280 x 1024 pixels.

Both the PG-640 and PG-1280 are 100% compatible with IBM's Professional Graphics card, and offer full Color Graphics Adapter emulation. All existing software runs without change.

Call now if you are interested in a 10 times performance boost.



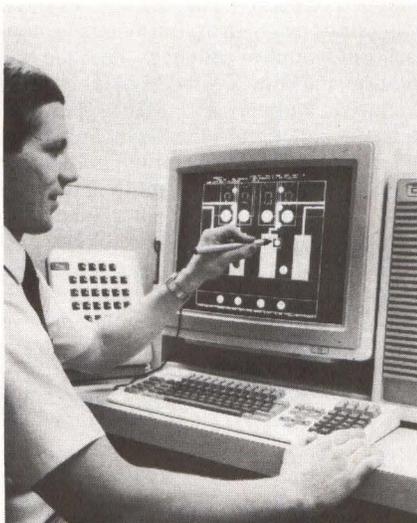
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NEW PRODUCTS

SYSTEMS

Eileen Milauskas, Assistant Editor

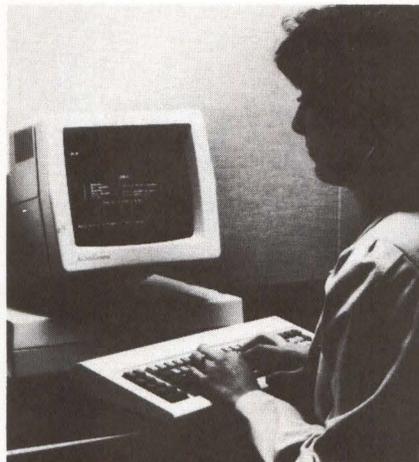


Workstations support IBM mainframe software

- 3-D graphics processor
- Visual overlay detection
- 128K-, 640K-byte memory

Used in IBM host-based CAD/CAM installations, the models 2023 and 2033 graphics workstations utilize vector display and color-raster technologies. They support mainframe software such as CADAM, CATIA, CAEDS and CGS. Functions include 3-D graphics processing, valuator dials, cursor capabilities and interfacing to large-screen projection systems. The model 2023 vector workstation, offering IBM 5080 compatibility, stores 128K bytes of memory, expandable to 1.1M bytes. The model 2033 color-raster workstation comes with 640K bytes of system memory, expandable to 1.1M byte; graphics display of 256 colors from a palette of 4,096; color-hard-copy interface and selective pick windowing and visual overlay detection hardware. Refresh rate for both systems is 60 Hz; write time is 45 nsec. \$29,700, 2023; \$33,800, 2033. **CGX Corp.**, 43 Nagog Park, Acton, Mass. 01720, (617) 263-3222.

Circle 300



Workstation runs MS-DOS environment

- 12-inch monitor
- 640-by-400-pixel resolution
- 256K to 640K bytes

Supporting the MS-DOS environment, the Dasher/One workstation implements specific business applications while providing integration with proprietary departmental systems such as the Eclipse/MV. Its 12-inch, bit-mapped, monochrome monitor comes in two models: model 1 offers 640-by-200-pixel resolution in text and graphics modes. Model 2 delivers 640-by-400-pixel resolution in text mode and 640-by-200-pixel resolution in graphics mode. All models offer a PC/AT-style keyboard or the proprietary Comprehensive Electronic Office (CEO)-compatible style keyboard. RAM memory ranges from 256K bytes to 640K bytes. Features include three expansion slots; a choice of a single, 3½-inch flexible disk with optional second flexible disk or a 3½-inch, 10M-byte, rigid disk; and an asynchronous RS232/422 communications port and a parallel printer port. \$2,100, model 1; \$2,415, model 2. **Data General Corp.**, Information Systems Division, 4400 Computer Drive, Westboro, Mass. 01581, (617) 366-8911.

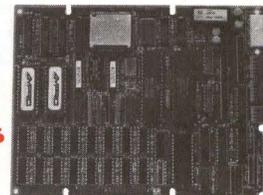
Circle 301

Available, Reliable, Affordable Solutions for Computerization

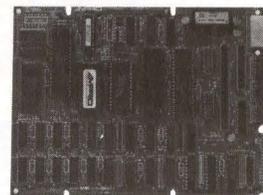
Little Board™/186 . . . \$499 with (128K)
Single Board 16-Bit Computer with SCSI/PLUS™ Bus

- Data and file compatible with IBM PC
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- Runs most MS-DOS generic software
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- Available with 512K RAM

NEW for PC-DOS



NEW for CP/M



Little Board™/PLUS . . . \$349
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- Same as Little Board/186 except:
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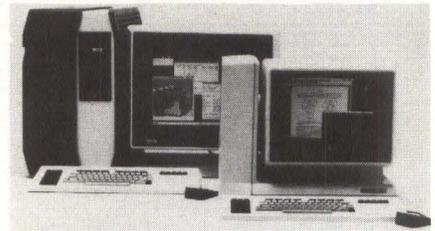
CIRCLE NO. 87 ON INQUIRY CARD

Workstations incorporate 68881 coprocessor

- 68020 CPU
- 17-, 19-inch monitor
- 2M-byte memory

Providing two to three times the level of performance of MC68010-based prod-

ucts, the DN330 monochrome and DN560 color graphics workstations employ the 32-bit, MC68020 microprocessor and include a Motorola MC68881 floating-point coprocessor. The DN560 mid-range, color workstation comes with 2M bytes of main memory, 1M byte of display memory with four planes of color, and a 19-inch, 1,024-by-800-pixel, bit-



Ethernet TCP/IP for VAX/VMSTM Off the Shelf! Complete package for \$8,795

Excelan offers a complete high-performance communications package including hardware, software, transceiver and all cables. Everything you need to perform high speed file transfers or do remote logins via Ethernet from a VAX running VMS or UNIX System V to UNIX 4.2 BSD machines and vice versa. Software includes TCP/IP protocols, and standard FTP (file transfer) and Telnet (virtual terminal) applications.

The entire VAX/VMS package is only \$8,795, including the EXOS 204 Ethernet controller (quad-size Unibus board), EXOS 8040 TCP/IP software, EXOS 1100 transceiver and cables. And the entire UNIX System V package is only \$7,295.

Excelan also offers similar packages for DEC PDPs, UNIX supermicros, and the IBM PC, XT and AT.

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CIRCLE NO. 88 ON INQUIRY CARD

mapped display. The DN330 desktop workstation's 17-inch, bit-mapped, monochrome monitor produces the same resolution and comes with 2M bytes of main memory. Running at 1 MIPS, both systems include detachable keyboard, LAN interface, 2-D and 3-D Graphics Metafile Resource (GMR), Domain/Dialogue user interface management system, language debugger, font editor, UNIX execution environment, graphics primitives, software driver for the Apple LaserWriter, printer, VT100 emulators, two RS232C ports and network-management utilities. \$15,900, DN330; \$35,500, DN560. **Apollo Computer Inc.**, 330 Billerica Road, Chelmsford, Mass. 01824, (607) 256-6600.

Circle 302

Supermini employs vector processing

- 11.8 MFLOPS
- 8M-byte memory
- 32K-byte cache

Operating as a computational server on a network of engineering workstations, a multiuser departmental system or as a personal supercomputer, the FX/1 superminicomputer delivers twice the performance of a DEC VAX 8600 at less than half the price. It incorporates vector processing and runs existing software programs for the VAX system. Running the proprietary Concentrix operating system, which is based on the Berkeley UNIX Version 4.2, FX/1 delivers 11.8 MFLOPS. Minimum configuration includes one computational element, one interactive processor, 8M bytes of physical memory, 32K bytes of cache, a flexible disk, a 67M-byte Winchester disk, a 5¼-inch cartridge tape drive, a six-slot Multibus chassis, an eight-user Concentrix license and an FX/FORTRAN license. \$132,000. **Alliant Computer Systems Corp.**, 42 Nagog Park, Acton, Mass. 01720, (617) 263-9110.

Circle 303

Power Quality Analysis the Easy Way

WITH A NEW
AND AFFORDABLE
DRANETZ ANALYZER

The new Dranetz Series 646 Power Line Disturbance Analyzer provides most of the basic AC voltage monitoring capabilities of its big brother, the Series 626—without that instrument's expandable modularity for total environmental monitoring. With the Series 646 you can pinpoint the source of power disturbances, verify the integrity of the wiring, including the grounding system, and perform pre-installation site surveys. A summary mode with a large stack memory allows unattended monitoring over long periods of time.



Operation is simple and straightforward. A self-prompting, menu-driven alphanumeric display and two-key selection of all functions makes data retrieval and changing threshold limits a snap. Real time clock, non-volatile data and set up memory, thermal printer, and an RS 232C interface are all standard. A temperature probe can be added as an accessory and factory-installed options add impulse duration measurements, an uninterruptible power supply, and integral direct connect, auto-answer, Bell 103-compatible modem.

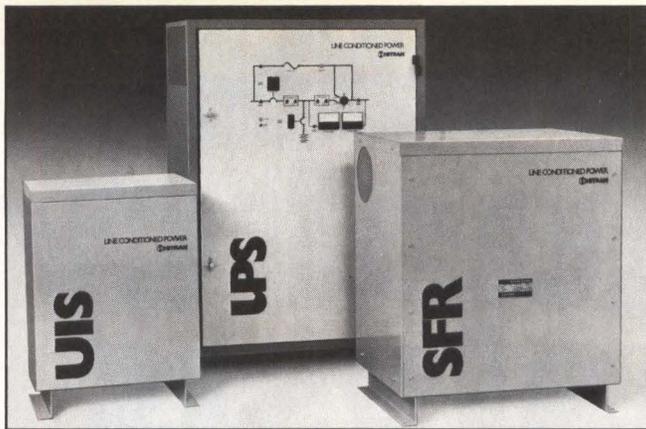
Single-phase and three-phase versions are available. Both provide separate channels for simultaneous monitoring of phase-to-neutral or phase-to-phase, and neutral-to-ground. All channels may be programmed independently. A separate DC channel allows easy correlation of DC supply events with AC power disturbances.

Now there's no need to beg, borrow, or steal a Dranetz Series 626 for those tough problems except when you need its extensive environmental monitoring capabilities. Call toll-free **1-800-DRANETC** (outside NJ) for full information and a demonstration.

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*The Quality of US Commercial AC Power," Goldstein, M. and Speranza, P.D.; IEEE April 1982

NEW PRODUCTS SYSTEMS

Microcomputer supports three operating systems

- 8-MHz 80286 CPU
- 512K-byte RAM
- Zero wait states

Running business software twice as fast as the IBM PC/AT and six times faster than the IBM PC/XT, the Advanced Professional Computer (APC) supports the MS-DOS, XENIX and IN/ix operating systems. It uses the 8-MHz, 16-bit, Intel 80286 microprocessor and stores 512K bytes of RAM memory, expandable to 2M bytes. Supporting four workstations (the IBM PC/AT supports three), the system offers zero wait states for memory address (the IBM PC/AT has one wait state). Up to three disk drives can accompany the system; two half-height disk drives and one Winchester disk drive. Features include serial and parallel ports, a 43M-byte streaming cartridge tape drive and IBM PC-DOS application compatibility. \$3,465. **Wang Laboratories Inc.**, 1 Industrial Ave., Lowell, Mass. 01851, (617) 459-5000.

Circle 304

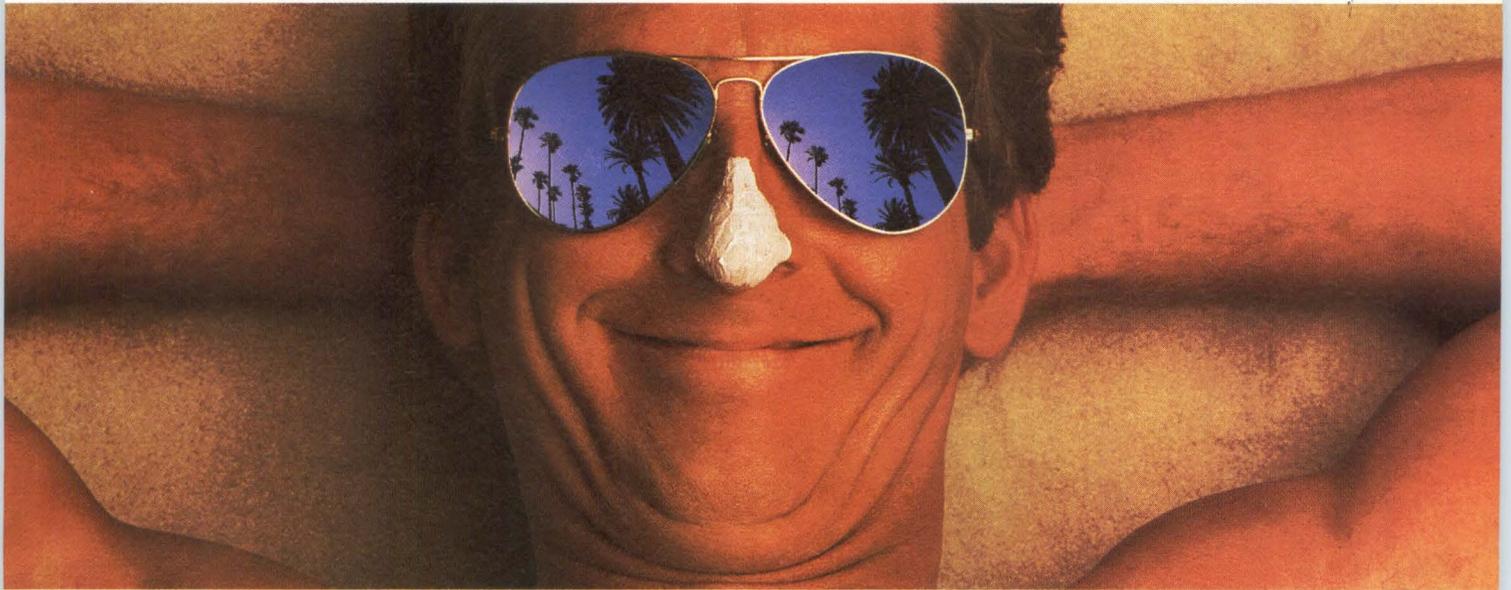
Graphics workstation CAD/CAM

- 16/32-bit, 68010 CPU
- 800-by-620-pixel resolution
- UNIX System V

Cheetah, a multitasking graphics workstation, serves as a development tool for CAD/CAM engineering environments. It uses the 10-MHz, 16/32-bit MC68010 microprocessor and comes with 1M to 4M bytes of dynamic RAM and a 15-inch monitor displaying 800 by 620 pixels of bit-mapped data. Refresh rate is 40 MHz; horizontal scan rate is 39 kHz at a 60-MHz, non-interlaced frame ratio. Its UNIX System V operating system includes a C compiler, UNIX utilities and a window display manager. A separate MC68000 CPU handles mass-storage-processing activities. Four RS232C and one RS422 communications ports are provided. The RS422 port accommodates Omninet, a proprietary, 1M-bps, baseband LAN. Minimum configuration includes a 20M-byte, rigid disk, a 640K-byte flexible disk and 1M byte of main memory. \$9,995. **Corvus Systems Inc.**, 2100 Corvus Drive, San Jose, Calif. 95124, (408) 559-7000.

Circle 305

We have 2400 feet to stick in the door.
So you can put yours in the sand.



You've all been working around the clock on the new software. It's finished. It's terrific. And you're exhausted.

You really need a vacation. But, first you have to get out there and drum up business. Unless, of course, you'd rather Hewlett-Packard did the drumming for you.

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CIRCLE NO. 91 ON INQUIRY CARD

Streaming-tape drive offers cache buffer

- 180M-byte storage
- 75, 100 ips
- IBM, ANSI compatibility

The M244XAC, a GCR streaming tape drive with a 256K cache buffer, backs up

large Winchester disk drives. Offering IBM and ANSI compatibility, the drive operates from 60K bytes per second to 1M byte per second. It stores up to 180M bytes. One model reaches 100 ips in streaming mode and 12.5 ips in start/stop mode; a second model achieves 75 ips, streaming mode, and 25 ips, start/stop mode. Block sizes, ramp times and data-

transfer rates are switch-selectable. Features include a reel-to-reel servo system, an LSI formatter and an 8,000-hour MTBF. \$6,760. **Fujitsu America Inc.**, 3055 Orchard Drive, San Jose, Calif. 95134, (408) 946-8777.

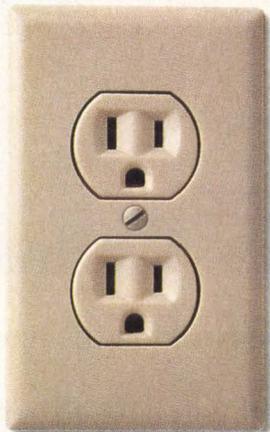
Circle 306

Subsystems contain removable Winchester

- 5¼-inch floppy
- 32M-byte storage
- Multibus-compatible

The DataSafe 8R family of Multibus-compatible, 8M-byte, 5¼-inch removable Winchester cartridge systems suit iRMX-86 operating system applications using Multibus. The series holds up to 32M bytes of storage with up to two removable cartridge disk drives and two Winchester disks, each storing 8M bytes. The subsystems include a disk formatter card, Multibus Host Adapter card with 16-bit I/O, iRMX-86 software driver and a bootstrap loader. The drives achieve a 40-msec average access time and transfer data at 5M bps. Starts at \$8,995. **Winchester Systems**, 400 W. Cummings Park, Woburn, Mass. 01801, (617) 933-8500.

Circle 307



Computer problems start here

Your power source could be the source of your computer problems. Every month, electricity averages 12 power variations. Low or high voltage and interference can erase data and damage hardware, resulting in costly repair bills. Such problems affect over 50 percent of businesses and institutions.

Triad has the solution

Triad Linestar™ Regulated Power Conditioners and Powerstar™ Uninterruptible Power Supply units keep the power that feeds your computer free from electrical interference and protects against low voltages, power surges and other variations. Linestar Power Conditioners are available in more than 70 hardware and portable models to provide clean power for computers and other microprocessor-based equipment.

Powerstar protects against blackouts

Powerstar offers an added advantage—uninterruptible power. When a blackout occurs, even a fraction of a second without power can be devastating. Powerstar provides up to an hour of back-up time, with no transfer time. That's the difference between an on-line true UPS and many other UPS units. Powerstar also runs 20 percent cooler than most UPS units, with 90 percent or better energy efficiency.

Send for a free Power Problems Manual

Don't wait for the next surge or blackout to pull the plug on your data. Send for a free Linestar/Powerstar Brochure and Power Problems and Solutions Technical Manual. Call the Triad toll-free line: 1-800-348-5032.

Your power problems are over



305 N. Briant Street, P.O. Box A, Huntington, IN 46750, 219-356-7100, TWX 810-333-1532.



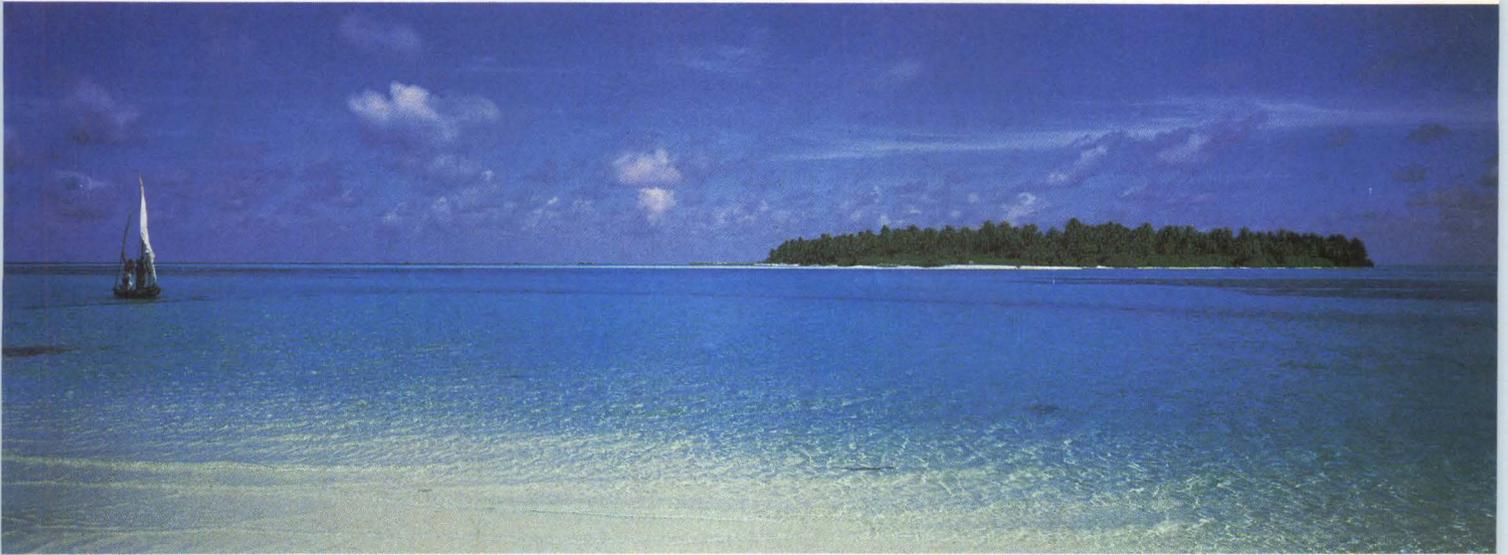
Tape subsystem links RS232 port, tape drive

- ½-inch tape
- 110 to 19.2K bps
- 1,600-bpi transport

Providing a serial communications link between an RS232 port and an IBM-compatible tape drive, the Model 1000 magnetic tape subsystem accepts 7- or 8-bit data at asynchronous transfer rates from 110 to 19.2K bps. The subsystem includes the Model 2010, 9-track, ½-inch magnetic tape transport operating at 1,600 bpi. The drive accepts ½-inch tape on reels up to 10½ inches in diameter. \$4,850. **Digi-Data Corp.**, 8580 Dorsey Run Road, Jessup, Md. 20794, (301) 498-0200.

Circle 308

Last year, people like you got away with
nearly \$200 million from us.



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It offers discounts up to 35% on HP 3000 computers and peripherals. 40% discounts on demo/development systems. 10% credits on system upgrades if your customer decides to upgrade through us.

Of course, Hewlett-Packard's commercial VAR Program offers more than discounts. For instance, worldwide service and support, rated #1 by Datapro four years in a row.

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CIRCLE NO. 92 ON INQUIRY CARD



Our Smart-Frame™ will put you in touch.

Carroll Touch

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In Touch with Technology

One of the easiest ways to interact with a computer is through a touch activated display. One that lets you merely point your finger at what you want your computer to do.

With touch, even the most complex application can become user friendly. And less susceptible to user error.

But the advantages of the highly reliable infrared touch input systems have been overshadowed by cost. Placing them out of the range of medium to low-cost turnkey systems manufacturers.

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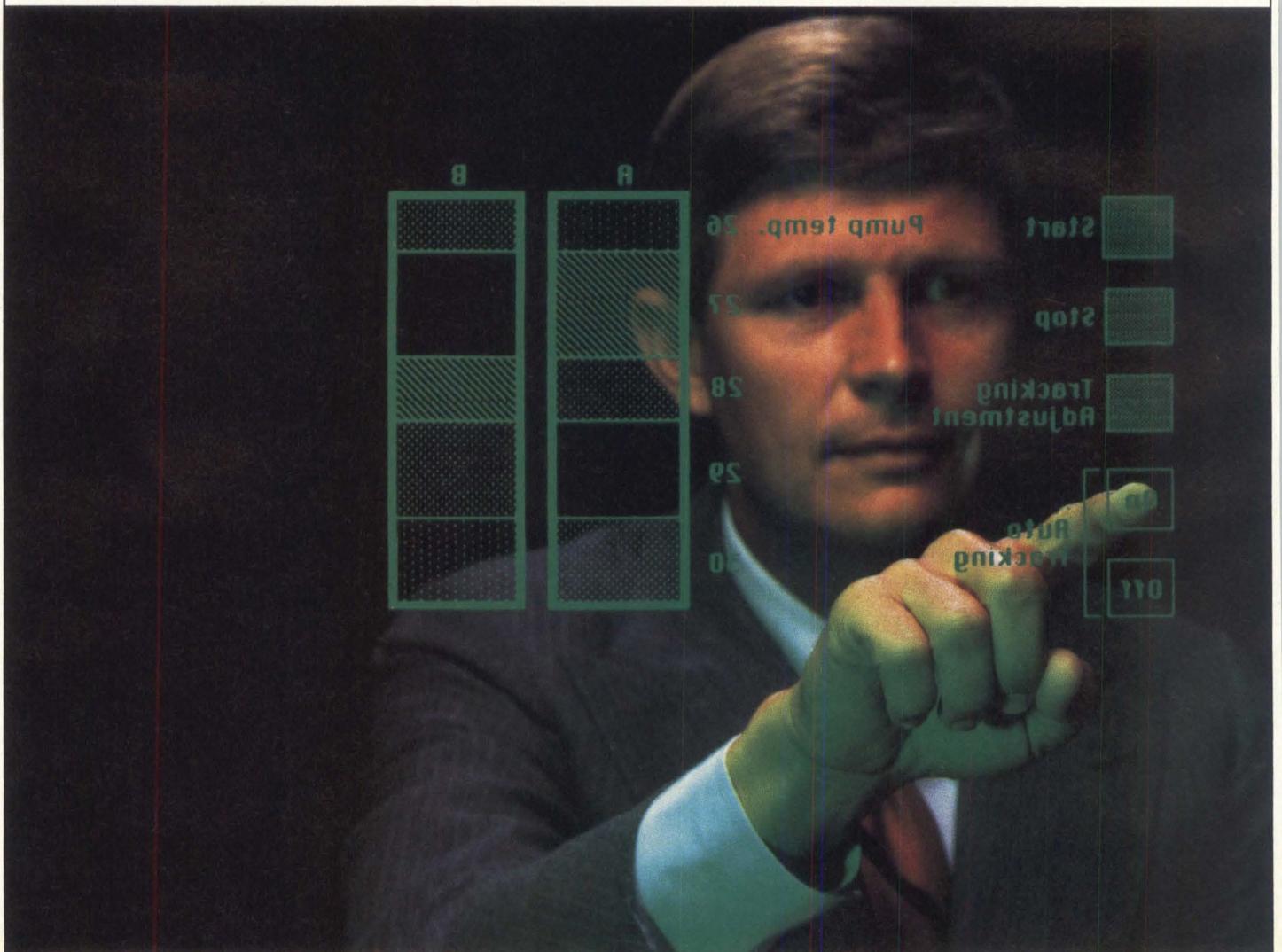
We call it Smart-Frame™. Because it contains a powerful microprocessor built into the frame. And because it uses scanning infrared technology—a touch technology which is incredibly reliable, rugged, accurate, and fast. A technology Carroll Touch pioneered and refined.

As a result of the Smart-Frame design, Carroll Touch units contain 45 percent fewer components than before. Which means the cost to you is about 50 percent lower too.

We think that's pretty smart. And Carroll Touch did it just so you could get in touch. Today.

CIRCLE NO. 94 ON INQUIRY CARD

P.O. Box 1309
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NEW PRODUCTS DISK/TAPE

Impact printer achieves multiple functions

- 120 to 480 cps
- 144 by 144 dpi
- 3K-byte buffer

Employing 95 character designs and sizes, the GP 400 L impact printer generates correspondence-quality text at 120 cps and draft-quality text at 480 cps. In graphics mode, it creates single pass-dot resolutions of 18 by 50 dots and up to 144 by 144 or 72 by 72 dpi, handling 15¾-inch-wide paper. Operating at a 51-dB noise level, the printer uses an 18-wire printhead. Paper-handling devices include platen feed, tractor feed, front insertion for triplicate forms and automatic single-sheet handler. Other features include a 3K-byte buffer and RS232C and Centronics interfaces. \$2,795. **Philips Peripherals Inc.**, Unit 12, 385 Oyster Blvd., South San Francisco, Calif. 94080.

Circle 309



Thermal printer produces seven colors

- 30, 50, 80 cps
- 180 dpi
- Centronics interface

A thermal-transfer color printer, the TP2051C prints text and graphics in seven colors on plain paper or transparencies at 80 cps, draft mode; 50 cps, near-letter-quality mode; and 30 cps, letter-quality. At a 180-dpi resolution using a 24-dot printhead, the unit prints bit-by-bit, CRT-displayed graphics and character-by-character IBM CS1 and CS2 plus nine international character sets. It accommodates 4- to 10-inch-wide paper via friction or pin feed and operates at 55 dB(a). A Centronics interface is standard. \$400. **Ricoh Corp.**, 5 Dedrick Place, W. Caldwell, N.J. 07006, (201) 882-2000.

Circle 310

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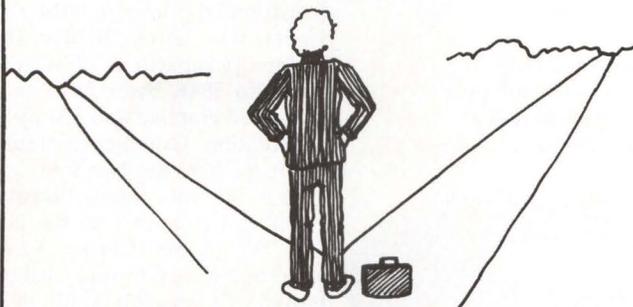
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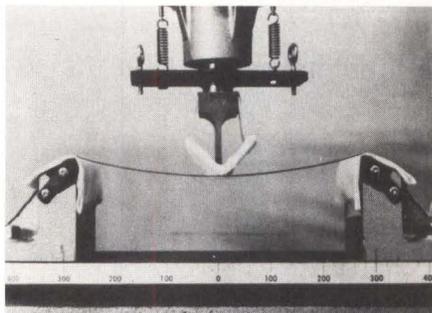
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CIRCLE NO. 124 ON INQUIRY CARD

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$X_o=13.1 \text{ kg/mm}^2$	$X_o=47.0 \text{ kg/mm}^2$
$\alpha=1.3$	$\alpha=4.2$

Number of Samples: N=20
Glass Sheet: Length=50 mm
Width=20 mm
Thickness=1.6 mm

SPINNING TEST

Untreated Disks	Treated Disks
$X_o=11,600 \text{ rpm}$	$X_o=17,780 \text{ rpm}$
$\alpha=759$	$\alpha=1,839$

Number of Samples: N=20
Outside Diameter OD=305 mm
Inside Diameter ID=35 mm
Thickness Th=1.2 mm



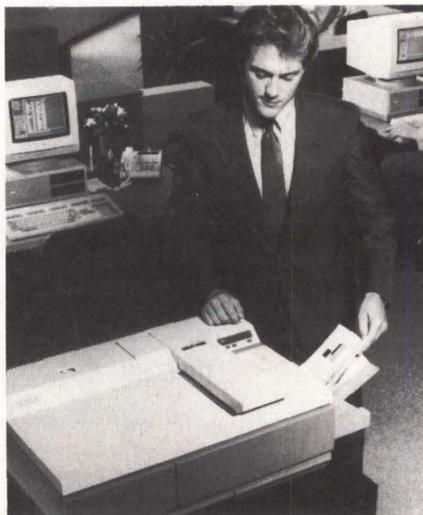
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CIRCLE NO. 95 ON INQUIRY CARD

176

NEW PRODUCTS PRINTERS



Laser printer runs at 10 ppm

- 128K-byte memory
- 300 by 330 dpi, text
- 150 by 150 dpi, graphics

Printing output from personal computers, word processors, minicomputers and distributed data processing systems, the Xerox 4045 CP laser printer accommodates 5,000 pages per month. With an optional interface device, it can be shared by as many as four personal computers. The 10-page-per-minute unit emulates Diablo 630 and proprietary 2700-II printer protocols. Through proprietary interface controllers, it operates as a distributed printer in IBM 3274 and 3276 networks using IBM's SNA/SDLC. Memory capacity is 128K bytes, expandable to 384K bytes for 5-by-7-inch, bit-mapped graphics and 300-by-300-dpi text resolution. Graphics resolution is 150 by 150 dpi. Two resident fonts are standard; up to 90 fonts can be downloaded from the host computer to the laser printer. \$4,995. **Xerox Corp.**, Xerox Systems Group, Xerox Centre, 101 Continental Blvd., El Segundo, Calif. 90245.

Circle 311

Image scanner offers dual resolution

- 200, 300 dpi
- 64 gray levels
- 26.4-second scan

The MS-300 is a desktop, dual-resolution, 200- and 300-dpi image scanner. The 300-dpi mode suits optical character recognition (OCR) applications; the 200-



dpi mode accommodates page-makeup, Group III facsimile or OCR applications with 10-point or larger typefaces. Scanning an 8½-by-11-inch paper in 26.4 seconds, the unit reduces size on X and Y directions by 95 percent to 25 percent with a 5 percent decrement. Text mode (including graphics and drawings), halftone mode, halftone dot pitches and halftone textures are accomplished by halftoning the scanned-in pictures with one of the 12 halftone screens. Capabilities of up to 64 gray levels are provided. The scanner is parallel-TTL or RS232C- and RS422-compatible. \$2,300. **Microtek Lab Inc.**, 17221 S. Western Ave., Gardena, Calif. 90247, (213) 538-5369.

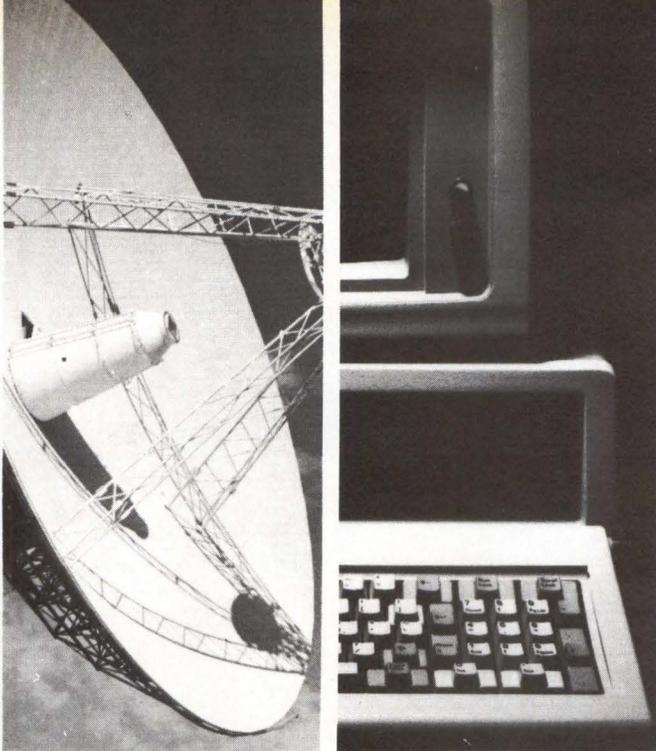
Circle 312

Laser printer handles 10,000 pages per month

- To 2M-byte memory
- Seven fonts
- 300 dpi

Ten times faster than a daisywheel printer, the QuadLaser laser printer runs at 8 ppm or 330 cps. Delivering 300-dpi resolution, the printer is one-third the cost of the Hewlett-Packard Laserjet laser printer. It comes with seven font styles and a QuadFont editor that creates additional font styles and logos. Accepting letterhead paper, forms and transparencies, the printer handles standard or European-size paper. It accommodates printing needs of up to 10,000 pages per month and performs simplex or duplex printing in portrait or landscape mode. Memory capacity of 256K bytes, expandable to 2M bytes, allows multiple page buffering, downloading of up to 60 fonts and all-points-addressable graphics. \$3,795. **Quadram Corp.**, 4355 International Blvd., Norcross, Ga. 30093, (404) 923-6666.

Circle 313



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TERMINALS



Graphics terminal shows four windows

- Eight colors
- Two screen sizes
- DEC emulation

A color-graphics display terminal, the model 2131 Open Window provides concurrent access to one or two IBM mainframes and other suppliers' host computers. Using four windows, it simultaneously displays information from separate host applications, copying data from one window to another. Each window uses up to eight colors. The terminal is formatted in either 24 lines or 32 lines by 80 columns. In asynchronous mode via the proprietary Series 400 controller, the unit emulates DEC VT52, VT100 and VT132 terminals and accesses 32 asynchronous hosts. Resolution is 720 by 408 pixels. Graphics include pie charts, maps and special mathematical and scientific symbols. \$2,995. **Lee Data Corp.**, 7075 Flying Cloud Drive, Minneapolis, Minn. 55344, (612) 828-0300.

Circle 314

Terminal offers two emulation modes

- VT102/100/52 emulation
- IBM 3278 compatibility
- Two-page memory

Finding use in LAN and protocol-converter systems, the Fame 1078 terminal is IBM 3278-compatible and emulates DEC VT102, VT100 and VT52 terminals. Screen formats can be used as a Mod 1, with 24 lines by 80 columns and a CPU message line and FDP status line; or Mod 5, with 27 lines by 132 columns and CPU message line and FDP status line. Features include two pages of memory, split-screen operation, 24 program-mable function keys, ANSI 3.64 compatibility, 14-inch screen, two bidirectional,

RS232C communication ports, and double-width, double-height characters. \$1,095. **Falco Data Products Inc.**, 1286 Lawrence Station Road, Sunnyvale, Calif. 94089, (408) 745-7123.

Circle 315

Display terminal emulates DEC VT220

- 14-inch screen
- 15 character sets
- Two data formats

Emulating the DEC VT220 terminal, the model 220 ANSI-standard video display terminal offers a 25-line-by-80-column or 25-line-by-132-column data format. Character format is a 7-by-9-dot matrix in a 9-by-12-dot field with 2-dot, lowercase descenders. Video attributes include blink, reverse video, underline and bold. The 14-inch screen displays line graphics and double-size characters. Fifteen resident national character sets can be downline loaded. \$750. **Ampex Corp.**, 401 Broadway, Redwood City, Calif. 94063-3199, (415) 367-4151.

Circle 316



Monitor serves CAD/CAM/CAE

- 340-mm-by-270-mm image
- 1,280 x 1,024 pixels
- 64 kHz horizontal scan

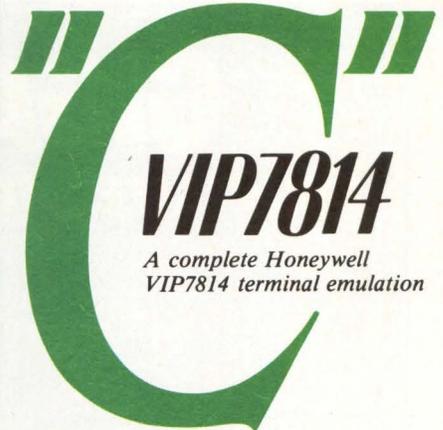
An analog, color monitor for CAD/CAM/CAE workstation applications, the model 2064 RGB offers a 340-mm-by-270-mm image containing 1,280 by 1,024 addressable pixels. Shadow mask is 0.31 mm. The unit operates at 64 kHz with a vertical frequency of 60 Hz. The horizontal scan can be modified to run at 66 kHz; vertical frequency at 80 Hz. The horizontal stage provides a retrace time of 3 μ sec and a blanking time of 3.5 μ sec. Features include non-glare faceplate, auto-degauss, self-diagnostic indicators and wide band video amplifier. MTBF is 20,000 hours. \$1,830. **Philips Subsystems and Peripherals Inc.**, 100 E. 42nd St., New York, N.Y. 10017, (212) 850-5590.

Circle 317



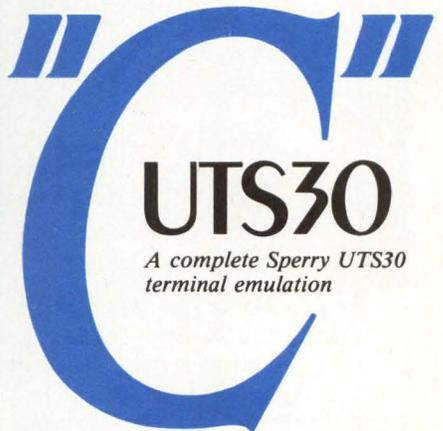
Teletex

MicroTeletex software conforms to T.62 and T.70 (X.21/X.25/V.22bis).



VIP7814

A complete Honeywell VIP7814 terminal emulation



UTS30

A complete Sperry UTS30 terminal emulation

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CIRCLE NO. 97 ON INQUIRY CARD

Terminal supports virtual operating system

- 14-inch screen
- 23 function keys
- 80, 132 columns

The V102 video terminal is compatible with the on-line features of the proprietary Virtual Operating System. Its 14-

inch, amber screen displays 24 lines of 80 or 132 columns with 10 set-up menus. An ASCII character set of 128 characters is formed by a 14-by-9-dot matrix. The detached, low-profile keyboard contains 23 function keys. Video attributes include reverse video, dual intensity, blinking and underlining. Editing functions include character insert and delete, line and page erase, line insert and delete,

clear, backspace and tab. \$950. **Stratus Computer Inc.**, 55 Fairbanks Blvd., Marlboro, Mass. 01752, (617) 460-2000.

Circle 318



Terminal offers multiple modes

- 105-key keyboard
- Full, half duplex
- 32 graphics characters

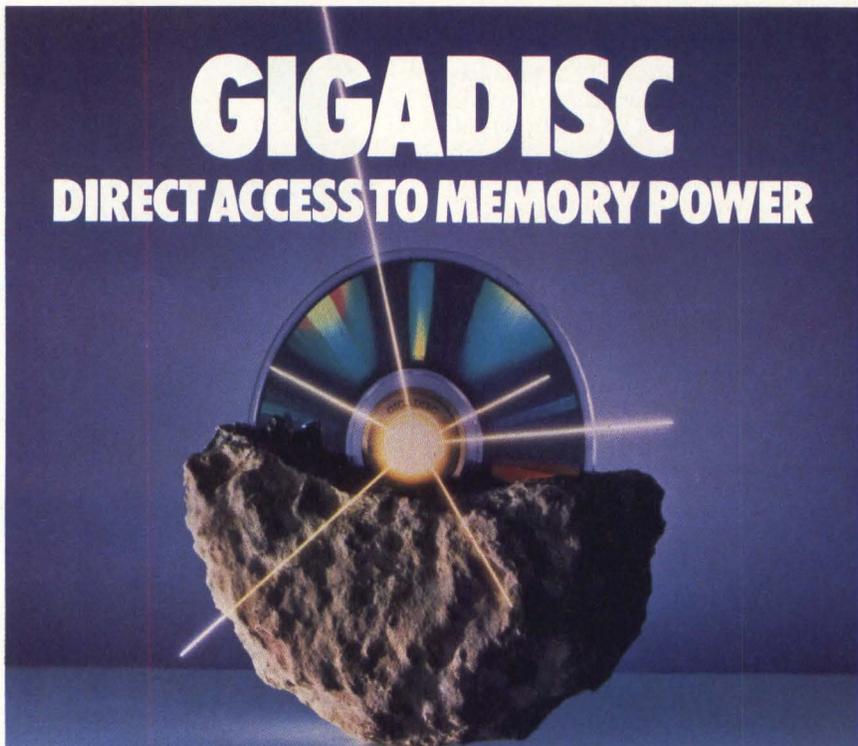
An ergonomic video display terminal emulating the DEC VT220, VT100 and VT52 terminals, the model XT-220 comes with an ASCII character set and 32 special graphics characters with 15 line-drawing characters. Character size is a 7-by-9-dot matrix with two lowercase descenders. Display format is 24 lines by 80 or 132 columns on a 12-inch, green, amber or white phosphor screen with a 50- or 60-Hz refresh rate. The low-profile, detached keyboard contains 105 keys, 19 of which are function keys. A multilanguage, menu-driven set-up mode stores operating parameters in non-volatile memory. The terminal operates in either half or full duplex, conversation mode or in monitor mode, where all control, escape and data sequences are displayed on the screen. A 20-mA current loop and RS232C and RS423 interfaces are standard. Selectable baud rates range from 75 to 19.2K. The unit is ANSI X3.64 compatible. \$750. **Carterfone Communications Corp.**, Suite 1100 W., 1341 W. Mockingbird Lane, Dallas, Texas 75247, (214) 630-9700.

Circle 319

Monitors range from 14 to 19 inches

- 750 by 790 dots per line
- 50-MHz bandwidth
- 27 colors

The QMD-1535 and QMD-1735 monochrome monitors offers 15-inch and 17-inch screens, respectively, in green, amber or white phosphor. Dots-per-line



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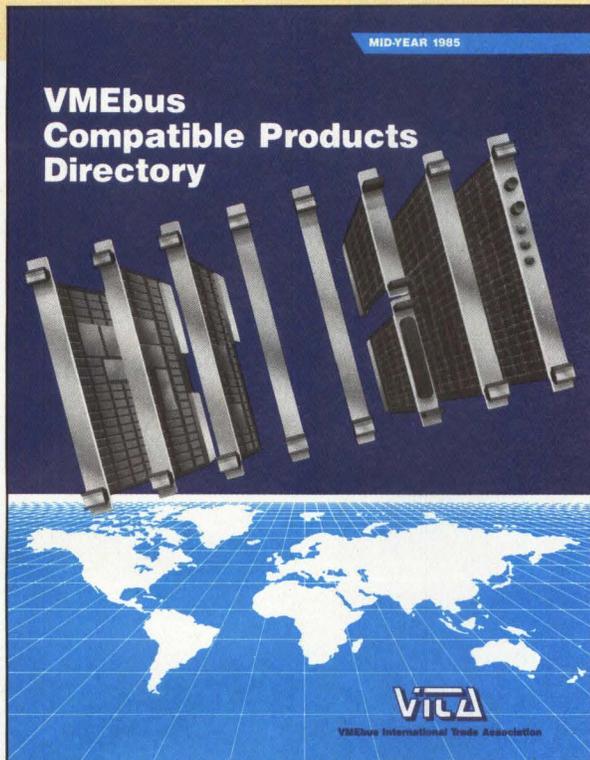


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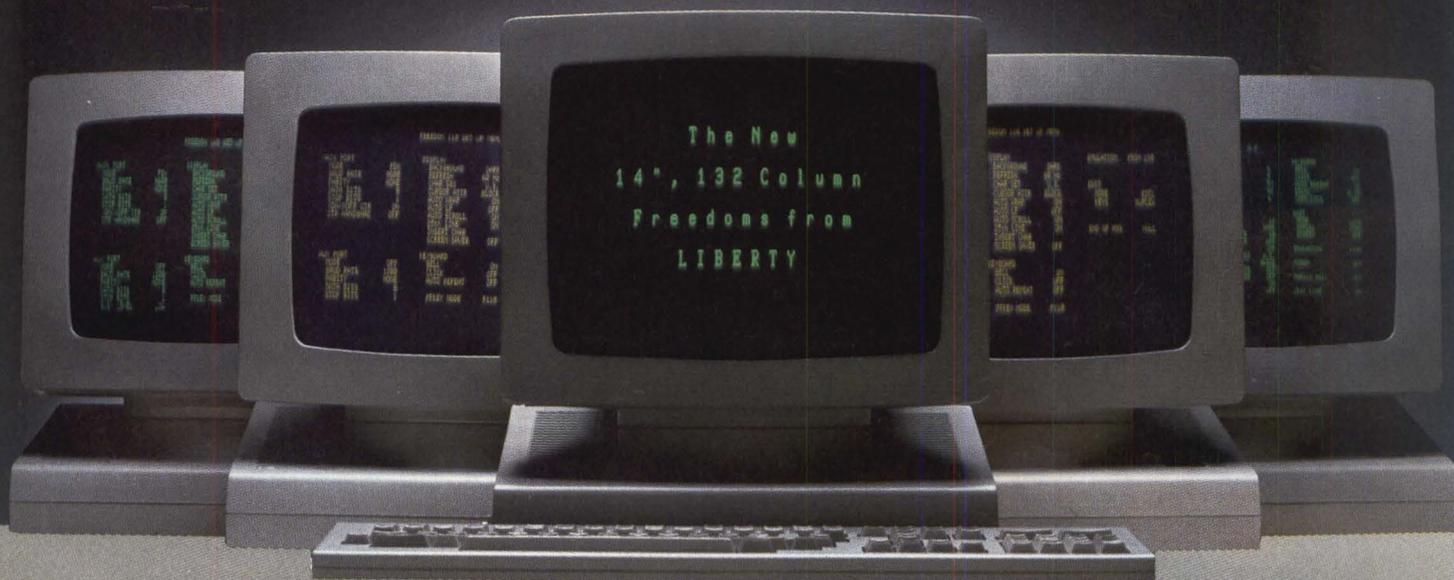
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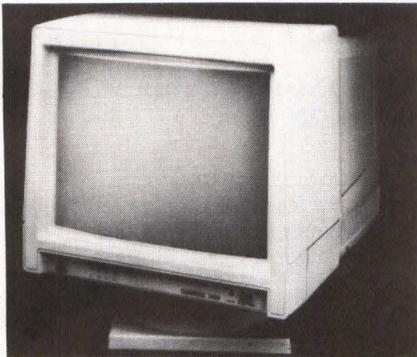
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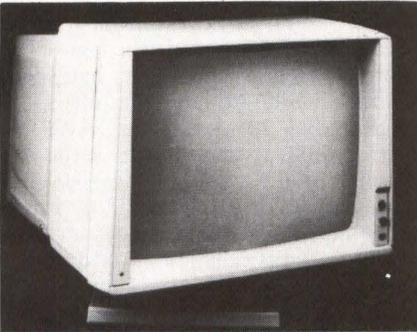
NEW PRODUCTS TERMINALS

resolution on each is 750 by 790 with a 0.31-mm dot pitch. Display size for the 15-inch model is 256 by 192 pixels; the 17-inch model, 300 by 225 pixels. Both monitors have a 50-MHz video bandwidth and employ a 50.1-kHz-by-60-Hz raster scanning system. Displaying up to 27 colors, the 14-inch model QCD-1455 displays 240 by 180 pixels; the 16-inch QCD-1655 produces 280 by 210 pixels. Video bandwidth is 50 MHz. The 19-inch QCD-2011 color monitor generates 1,280-by-1,024-dot resolution with a 120-MHz band width. Display size is 338 by 270 pixels with a 0.31-mm dot pitch. \$530, QMD-1535; \$550, QMD-1735; \$840, QCD-1455; \$3,000, QCD-2011. The QCD-1655 price is not available. **C. Itoh Electronics Inc.**, 5301 Beethoven St., P.O. Box 66903, Los Angeles, Calif. 90066, (213) 306-6700.

Circle 320



CONRAC DIVISION MODEL 7400



CONRAC DIVISION MODEL 7351

Monitors offer high resolution

- 1,280 by 1,024 pixels
- CAD/CAE applications
- 19-inch screen

Generating a 110-MHz video bandwidth, the models 7351 and 7400 color monitors serve CAD and CAE applications. Each produces 1,280-by-1,024-

pixel resolution on a 19-inch screen with a 64-kHz horizontal scan rate and a 60-Hz, non-interlaced refresh rate. Employing Sony Trinitron video-display technology, the model 7400 offers 30-foot Lambert brightness and a 0.31-mm pitch. Within a centrally located 11.4-inch circle on the 7400, no point deviates by more than 1 percent from its proper position. Center convergence on the 7351 is 0.15-mm error. Synchronous selection on both models' video processor board permits internal or external synchronization. Three separate BNC connectors are included for RGB inputs. \$4,575, model 7351; \$4,760, model 7400. **Conrac Corp.**, 600 N. Rimsdale Ave., Covina, Calif. 91722, (818) 966-3511.

Circle 321



Terminal provides 16-by-16-pixel cell

- 15-inch screen
- 32K-byte RAM
- Z80A CPU

An alphanumeric terminal with a 15-inch, 60-Hz, non-interlaced display, the j100 produces a 16-by-16-pixel, character cell. Display format is 80 characters per line with 24 to 48 lines per screen. Character attributes include low and normal intensity, underline, blinking, protect and hide. Employing a Z80A micro-processor, the unit supports synchronous and asynchronous, bit- or byte-oriented protocols at 19.2K baud. Memory capacity includes 32K bytes of programmable memory, 32K bytes of RAM and 8K bytes of 16-bit, character-display RAM. Auxiliary and printer ports are standard. \$1,499. **Lynwood International Inc.**, 60 Drum Hill Lane, Stamford, Conn. 06902, (203) 329-7124.

Circle 322

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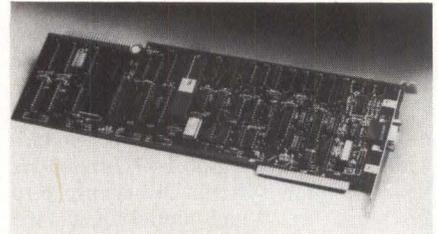
DATACOMM

Link allows PCs to access IBM mainframes

- IBM 5250/90 emulation
- File transfer
- Splice box

The Smart Alec link allows the IBM PC, PC/XT and PC/AT to emulate an IBM 5251 Model 11, 5291 or 5292 Model

1 terminal. It permits direct attachment to an IBM System/34, /36 or /38, or remote attachment via a modem to an IBM 5294 workstation controller or an IBM 5251 Model 12. The package contains a printed-circuit card that plugs into the full-length slot of the PC and a splice box that handles the twinaxial connection. An external switch on the splice box selects pass-through or terminate. The



terminal-emulation software offers multiple-session support, two- or eight-color support, cursor shape and key click. Up to three host sessions can run simultaneously in addition to the PC session. The file-transfer software program ships bidirectional data between the PC and the System/34, /36 or /38. Its features include access to the minicomputer database and translation of System/34, /36 or /38 data into formats that are usable by PC application programs. \$995. **Digital Communications Associates Inc.**, 1000 Alderman Drive, Alpharetta, Ga. 30201, (404) 442-4000.

Circle 323

Modem/multiplexer runs at 19.2K bps

- Two flow controls
- DDD or leased-line operation
- Data compression

The ADCoMM 96/48 full-duplex, asynchronous modem/multiplexer with error protection and data compression suits two-wire, DDD or leased-line operation. Operating at 19.2K bps, the unit provides automatic adaptive equalization and two forms of flow control: X-on/X-off and EIA lead control. The high-speed channel offers an automatic, half-speed fallback mode. An alternate, low-speed mode is Bell 103-compatible. Available in two versions that support serial and parallel printers, the first version furnishes a CRT receive monitor printer capability; the second includes an independent, statistically multiplexed printer channel that is host addressable. \$1,995. **Carterfone Communications Corp.**, Suite 1100 West, 1341 W. Mockingbird Lane, Dallas, Texas 75247, (214) 630-9700.

Circle 324

Gateway links PCs, SNA hosts

- PU Type 2 support
- 512K-byte memory
- Parity checking

Providing a communications link between LAN-based IBM PCs and IBM SNA mainframe hosts, the Quad3278

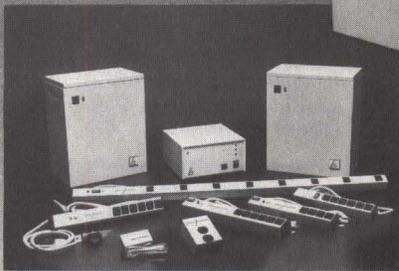
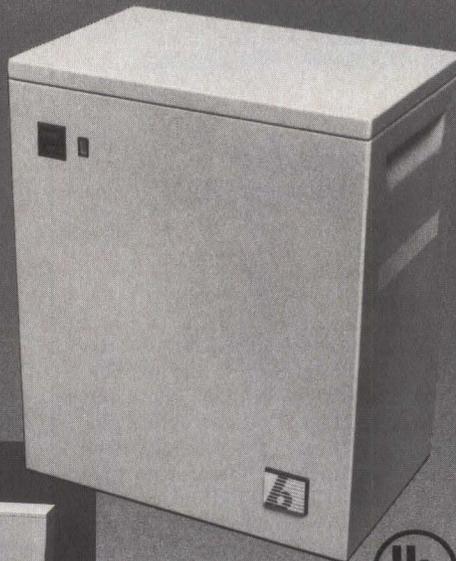
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These days, computer printer technology appears to advance at a rate faster than the speed of most computer printers. And just trying to keep pace could easily keep a battalion of engineers occupied on a full-time basis.

But over 90% of the world's major computer companies have discovered a very simple way to stay abreast of printer innovations without requiring any such reallocation of their resources:

By letting Dataproducts® do it for them.

Because computer companies who have taken on Dataproducts as their OEM supplier have found that no one makes a printer line

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One of the largest U.S. airlines found our serial matrix printers so reliable, they've hooked up over 150,000 of them to their reservations system.

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making a major impact upon the non-impact printer market with a laser printer that's faster, more compact and 15 to 40% less expensive than most others in its class.

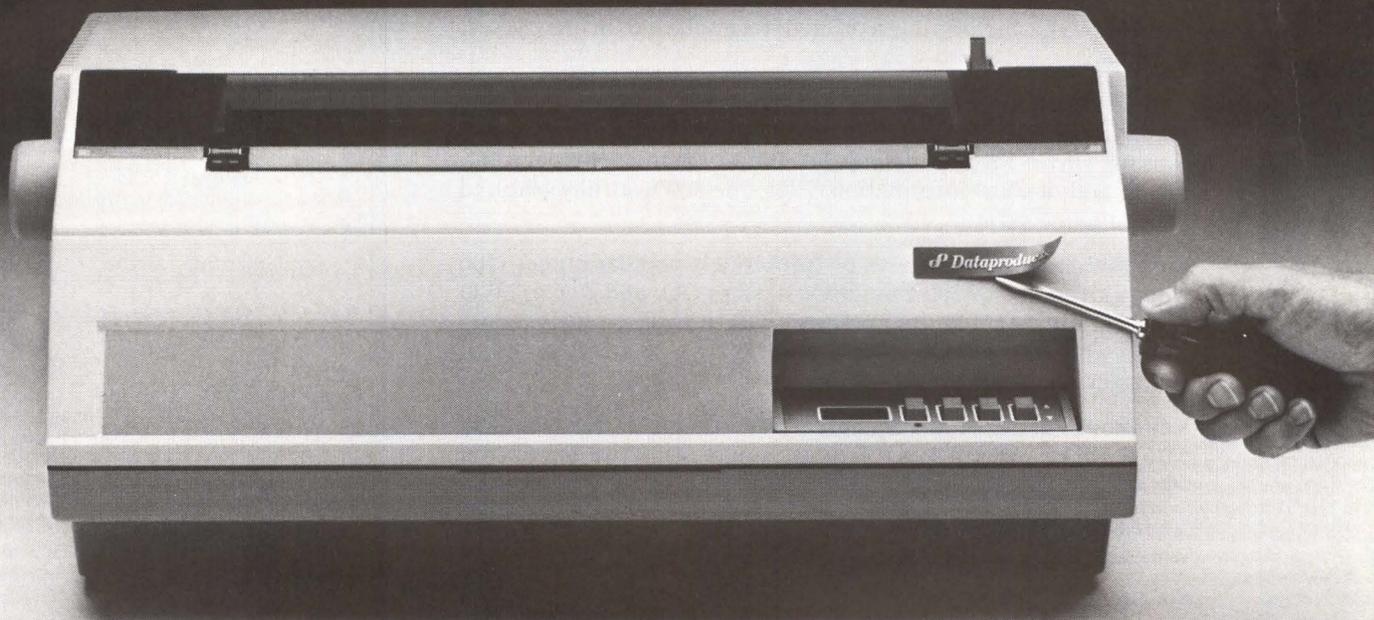
To get in on the secret that's kept 370 computer companies from lagging behind the latest developments in printer technology, just call 1-800-258-1386, or write to Dataproducts Corporation, 6200 Canoga Avenue, Woodland Hills, CA 91365.

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370 computer companies have discovered the secret to building some of the world's most advanced printers.



DATACOMM

Gateway combines data-processing and automation functions. Communications support includes PU Type 2 and LU Types 1, 2 and 3 sessions and services. It emulates a 3274-51C or 61C remote-communications controller and provides for 3278 Model 2 display emulation, four-color 3279 emulation and 3287 printer emulation. Capable of 9,600-

baud, synchronous host communications, the gateway comes with 512K bytes of main memory and a 32-bit microprocessor derived from National Semiconductor's 32016 chip set. Because it does not require a dedicated PC, the unit supports up to 32 concurrent users while the host continues to operate. Features include memory parity checking,

an RS232C modem connection, power-up diagnostics, downloading and a 25th status line. \$4,529 to \$5,742, 8- to 32-LU system. **Quadram Corp.**, 4355 International Blvd., Norcross, Ga. 30093, (404) 923-6666.

Circle 325

Card connects PC to X.25 network

- IBM 3270 emulation
- File transfer
- Two PAD ports

The XPERT PC Card links an IBM PC or compatible to four host computers through an X.25 packet-switched network. It lowers X.25 connection costs by allowing PCs to share X.25 lines and permits the IBM PC to perform as a multifunction workstation on Telenet, Tymnet, Accunet and other public and private networks. Providing two PAD ports, the card offers file-transfer capabilities and IBM 3270 and DEC VT100 emulation. Data sources are switched back and forth via keystrokes. The unit runs under MS-DOS 2.0 and TopView on the IBM PC, PC/XT and PC/AT and supports speeds to 9,600 bps. \$1,795. **Atlantic Research Corp.**, 5390 Cherokee Ave., Alexandria, Va. 22312, (703) 642-4000.

Circle 326

Modem employs MNP protocol

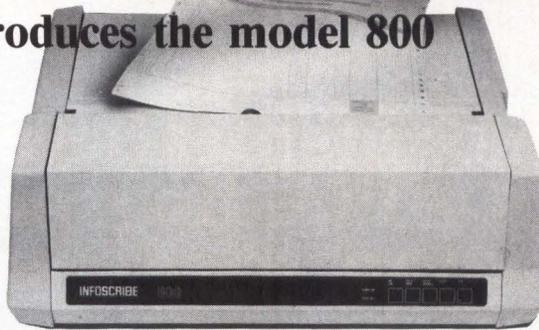
- 300; 1,200; 2,400 bps
- Synchronous, asynchronous
- 10-number storage

Implementing Microcom's Networking Protocol (MNP), the Multi-Modem 224EC operates at 300, 1,200 and 2,400 bps over dial-up or dedicated telephone lines. It offers both asynchronous and synchronous modes. In asynchronous mode, the unit operates with or without MNP capability. At 2,400 bps, the modem conforms to the CCITT V.22bis standard; at 1,200 bps, it complies with Bell 212A or CCITT V.22 standards; at 300 bps, Bell 103 and 113. Storing 10 39-digit numbers, the unit uses the Smartmodem 1200 command set. Features include analog, digital and remote digital loopback tests. \$895. **Multi-Tech Systems Inc.**, 82 Second Ave. S.E., New Brighton, Minn. 55112, (612) 631-3550.

Circle 327

INFOSCRIBE

introduces the model 800



The printer that pays for itself!

Your 800 professional demand document printer pays for itself by printing right down to the tear-off bar. This eliminates the costly 20-30% waste factor of preprinted forms found in the typical workplace.

Your 800 pays for itself through multiple applications that include filling in preprinted forms with up to 6 parts for order entry, purchasing, invoicing, shipping, labelling, contract preparation, travel, and medical information. Plus, the 800 is a fully featured multifunction printer.

Your 800 has all the features of Infoscrite's popular model 1100 with print speeds of 200 Cps DPQ, 100 Cps CQ, and 40 Cps NLQ and 72x72 or 144x144 dpi graphics. Plus, it emulates Diablo and Epson while storing up to 4 fonts in PROM with a full library of character sets.

Your 800 is designed and manufactured in the U.S. for reliability with a MTBF exceeding 4,000 hours, and a printhead life of over 500 million characters so it just keeps printing crisp and clear!

Your 800 is serviced nationwide by the Dow Jones organization who supports over 14,000 Infoscrite installations.

For more information contact: **INFOSCRIBE**

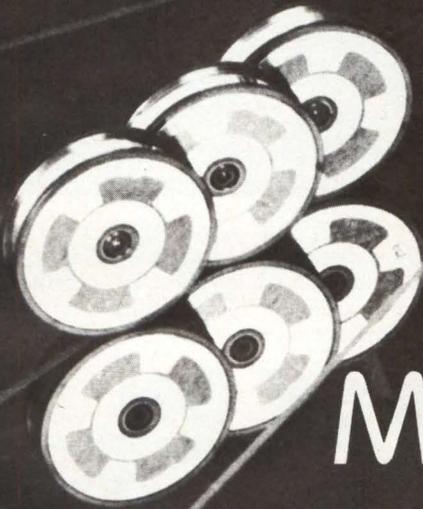
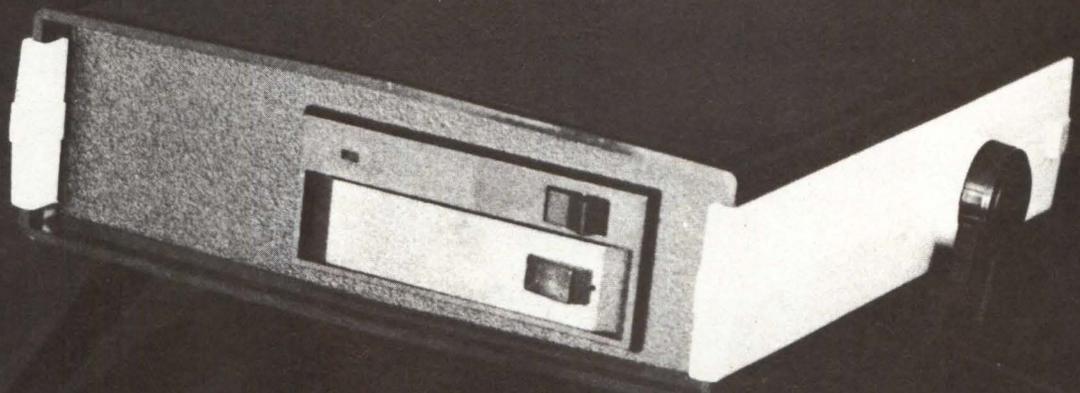
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CIRCLE NO. 102 ON INQUIRY CARD

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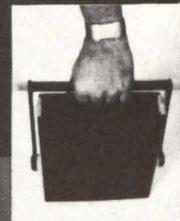
THE MT10P

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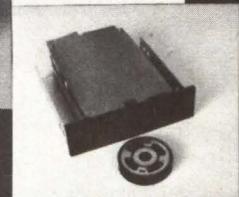
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*Single quantity price. Significant quantity discounts available.

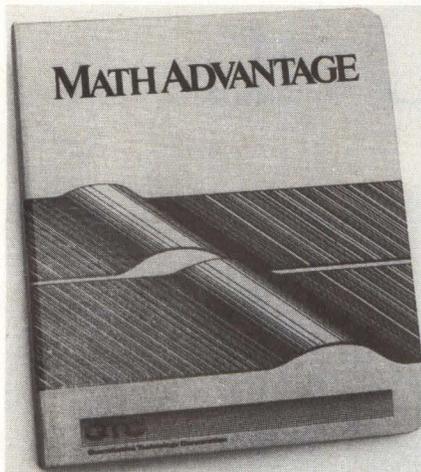
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CIRCLE NO. 104 ON INQUIRY CARD



Subroutine library aids distributed processing

- 16-, 32-bit systems
- 180 subroutines
- C or FORTRAN versions

Running on 20 different systems ranging from 16-bit microcomputers to 32-bit workstations, the Math Advantage subroutine library aids numerically intensive scientific and engineering applications. The library has 180 subroutines, including basic operations for real, integer and complex vectors; plus matrix, signal-processing and image-processing operations. Available in either C or FORTRAN, the package includes object code. Calling arguments are arranged in a consistent format. \$495, IBM PC version; \$2,000, 32-bit-workstation version; \$5,000, superminicomputer version; \$7,500, minisupercomputer version; and \$10,000, supercomputer version. **Quantitative Technology Corp.**, 8700 S.W. Creekside Place, Beaverton, Ore. 97005, (503) 626-3081.

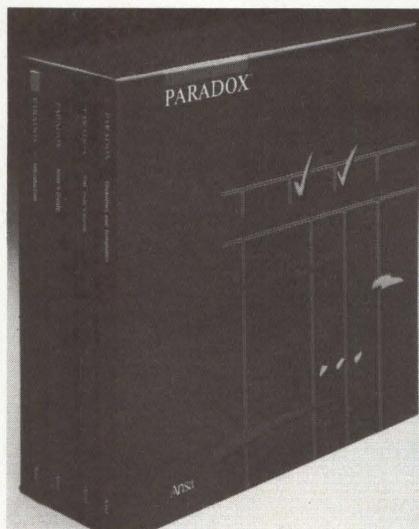
Circle 328

Software combines communications, graphics

- VDI support
- Menu-driven interface
- Device-independent

GSS-Grafstation allows a microcomputer to operate as an intelligent graphics workstation. Off-loading graphics tasks from the host to the microcomputer, the software combines communications and graphics and supports the virtual device interface. It provides access to host-resident text editors and electronic mail through its alphanumeric terminal emu-

lation mode. The device-independent software uses a menu-driven interface and requires 192K bytes of memory and an RS232C port on the host computer and on the microcomputer. The communications package provides interpreter software residing on the microcomputer and driver software on the host. Communications parameters include baud rate, parity, stop bits, flagging and data bits. \$250. **Graphic Software Systems**, 25117 S.W. Parkway, P.O. Box 673, Wilsonville, Ore. 97070, (503) 682-1606. Circle 329



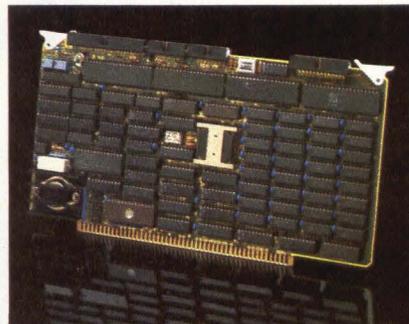
Database software uses artificial intelligence

- Lotus-like menu
- Query forms
- IBM PC-compatible

Through machine-reasoning concepts such as query-by-example, program synthesis and heuristic query optimization, Paradox software seeks the fastest way to a solution. Employing a Lotus 1-2-3-like menu, the relational database employs tables, forms, queries and reports. Each file contains up to 260 million characters consisting of 65,000 rows, 255 columns, 4,000 characters per row and 255 characters per column. Forms can be customized; changes made in the forms are reflected in the table. Hard copy can be made through the report generator. The software requires an IBM PC or PC-compatible, two flexible disk drives, 512K bytes of RAM and MS-DOS 2.0. \$695. **Ansa Software**, 1301 Shoreway Road, Belmont, Calif. 94022, (415) 595-4469.

Circle 330

Which Master Would Your Slaves Recommend?



Our New CPZ-186 Has It All

Intercontinental Micro Systems, the leader in the 8-bit single board computer world, has done it again. The CPZ-186, based on the 80186 CPU with integrated 2 channel Direct Memory Access Controller, has a 4-drive floppy controller, 2 serial I/O ports, 2 1/2 parallel I/O ports, Memory Management Unit, Interrupt Controller, up to 1 Megabyte of Dynamic RAM, and up to 8K EPROM, all on a single IEEE S-100 Bus Board.

Talk about speed and flexibility. The CPZ-186 runs at 8 MHz and can be used for single user systems or in powerful multi-user applications. As a Network Master (File Server), the CPZ-186 can network 8-bit and 16-bit S-100 Bus Slaves as well as PC's using Intercontinental's complete line of hardware and software networking products.

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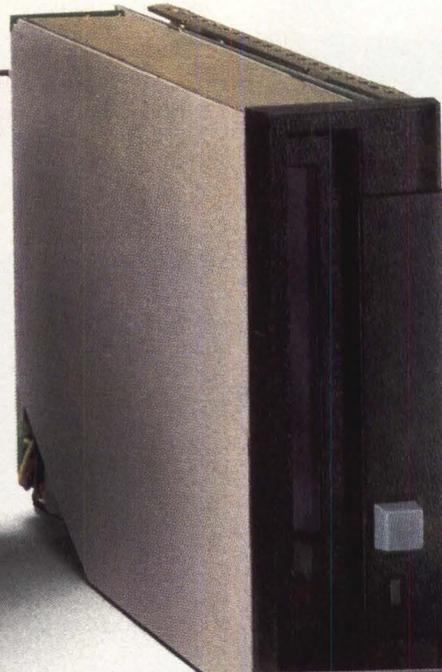
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Removable



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SyQuest 6.38 and 12.76MByte removable cartridge Winchesters, the product many said couldn't be done, are setting the standard of the industry in quality, reliability and performance. Only 4.8 inches wide and 1.625 inches high, they can be configured for a sub 5¼-inch or standard 5¼-inch half-height footprint. More than 60,000 of these drives have been delivered to date for on-line, random access storage. Combining a unique stepper motor positioner with servo control and the ultrareliability of graphite-sputtered, plated media, SyQuest half-height cartridge drives make the impossible possible.

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SyQuest Technology, 47923 Warm Springs Blvd., Fremont, California 94539. (415) 490-7511, TWX 910-381-7027.

Model	Fixed/Removable	Unformatted	Formatted
SQ306RD	Removable	6.38MByte	5.00MByte
SQ312RD	Removable	12.76MByte	10.00MByte
SQ325F	Fixed	25.50MByte	20.00MByte
SQ338F	Fixed	38.20MByte	30.00MByte



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TECHNOLOGY

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CIRCLE NO. 106 ON INQUIRY CARD

Windowing software goes with UNIX, XENIX

- 10 simultaneous windows
- Color-monitor support
- Top View-compatible

Turning an IBM PC or compatible into a multifunction, windowed terminal while linked to a UNIX or XENIX host computer, Facet software is an MS-DOS "load-and-stay-resident" program. As many as 10 session windows can be called up at a time. Windows partially or completely overlap each other. All output to an overlapped window is captured by an underlying window buffer. Color-monitor support capabilities include user-controlled coloring of each window and a set of color escape sequences. Features include a status line, window borders, caps and num lock settings, cut-and-paste and IBM Top View compatibility. It supports the X.PC multisession protocol for error-free transmission and reception. \$249, device driver for IBM PC/AT running XENIX; \$195, MS-DOS program disk. **Structured Software Solutions Inc.**, Suite 205, 4031 W. Plano Parkway, Plano, Texas 75075, (214) 985-9901.

Circle 331

CAE software runs on PC/XT, PC-AT

- Multiple windows
- Text, graphics merge
- Schematic entry

Requiring an IBM PC/XT or PC-AT with 512K bytes of memory and a monochrome or color monitor, the Workview

series of CAE software supports analog design, semicustom design and design with standard parts. The packages run under the DOS operating system and consist of three versions: the 100, 300 and 500 series. Common features include schematic entry, interactive logic simulation and waveform processor; document

processing which merges text and graphics; EDIF interface; electronic-mail and file-transfer facilities; and multiwindowing capability. \$3,500, 100 Series; \$6,500, 300 Series; \$8,500, 500 Series. **Viewlogic Systems Inc.**, 33 Boston Post Road W., Marlboro, Mass. 01752, (617) 480-0881.

Circle 332

RIP OFF THIS PRINTER.



Stop wasting forms. Get the new Datasouth 180DD—the high performance printer for true-to-form printing. It's fast, it's rugged, it's sophisticated and it prints legibly through six-part forms with 1/2 inch tear-off capability.

This makes the DS 180DD the ideal printer for hotels, motels, airlines, travel agencies—for any job that requires quality multipart form printing on demand.

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R	E	A	R			D	E	B	U	G	Y	

CIRCLE NO. 107 ON INQUIRY CARD

What you don't know can hurt you.

Issues in telecommunications management

Marketing computers with CPE

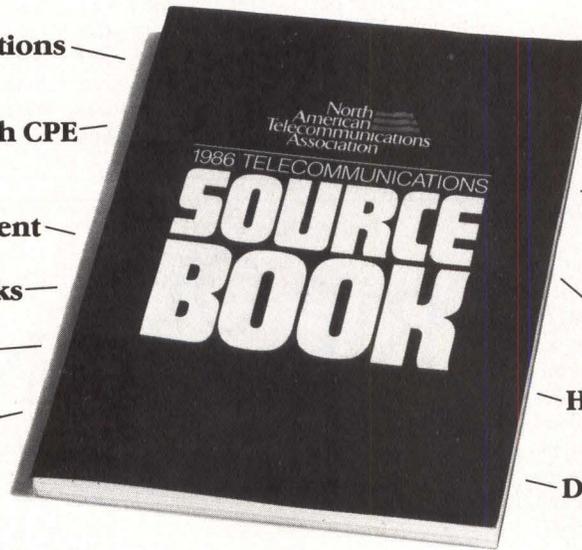
Shared tenant services: the regulatory environment

Software-defined networks

Industry periodicals

PBX/key-system product guide

Voice messaging



The future of pay telephones

COG liaison centers

Trade shows and conventions

Opportunities and pitfalls of office automation

How to deal with Centrex in the marketplace

Directory of manufacturers, suppliers and contractors

In telecommunications the difference between making it big and not making it at all is, more often than not, information or the lack of it.

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With that in mind, NATA—the preeminent trade association serving the telecommunications industry—proudly announces the availability of the 1986 *Sourcebook*—an up-to-the-second, comprehensive directory of the industry, designed to give you every

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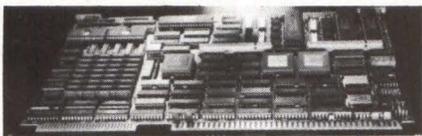


I/O board contains 48 channels

- VMEbus-compatible
- Status LED
- ID codes

The MPV930-48, a 48-channel TTL I/O board, works with VMEbus-based microcomputers. I/O channels are organized as six 8-bit I/O ports. Data from the output ports is read by the system CPU under software control. The board appears as a memory location and is byte- and word-accessible. The base address of the board, FFF000 hexadecimal, can be changed to any value. The ID code, the lower byte of the base address, can be set to any 8-bit value. The status LED is controlled by the application program and indicates error conditions. \$625. **Burr-Brown Corp.**, Data Acquisition and Control Systems Division, P.O. Box 11400, Tucson, Ariz. 85734, (602) 747-0711.

Circle 334



SBCs are Multibus-compatible

- No wait states
- 1M-byte DRAM
- 128K-byte EPROM

The HK68/M10 and HK68/ME Multi-bus-compatible, single-board computers (SBCs) address UNIX and real-time applications, respectively. The HK68/M10 employs the MC68010 CPU running at 8, 10 or 12.5 MHz; the HK68/ME, the MC68000 CPU at 10 or 12.5 MHz. Both come with 1M byte of dual-access DRAM with no wait states and up to 128K bytes of EPROM. The HK68/M10 offers an iLBX bus interface for memory

expansion up to 8M bytes, four serial ports, ANSI X3T9.2-compatible SCSI interface, QIC02 tape interface, IEEE 796 master/slave capability and twin, 16-bit iSBX connectors. The HK68/ME provides two serial ports, 42 parallel I/O lines and twin, 16-bit iSBX connectors. \$2,795 to \$3,495, 128K bytes to 1M byte, HK68/M10; \$1,295 to \$1,995, 128K bytes to 1M byte, HK68/ME; \$895, Q100, HK68/ME. **Heurikon Corp.**, 3201 Latham Drive, Madison, Wis. 53713, (608) 271-8700.

Circle 335



Keyboard includes touch pad

- PC-compatible
- Four modes
- 70-character sequence

Plug-compatible with the IBM PC, PC/XT and PC/AT, the KB 5153 Touch Pad Keyboard offers four modes of operation. The cursor-key mode is equivalent to cursor keystrokes but proves to be four to five times faster. The mouse mode combines text entry and pointing in a single unit. Moving a stylus or finger across the touch pad surface sends movement or position changes to the host. Absolute-coordinate mode serves CAD applications where direct pointing is required. In function-key mode, the touch pad surface is divided into separate function-key areas. A sequence of up to 70 characters can be defined for each function key. \$399.95. **Key Tronic Corp.**, P.O. Box 14687, Spokane, Wash. 99214, (509) 928-8000.

Circle 336

Display controller suits IBM PC/AT

- 1,024 by 768 pixels
- Four bit planes
- 16 colors

Requiring two expansion slots in the host IBM PC/AT, the Omega PC color graphics controller contains a 1,024-by-

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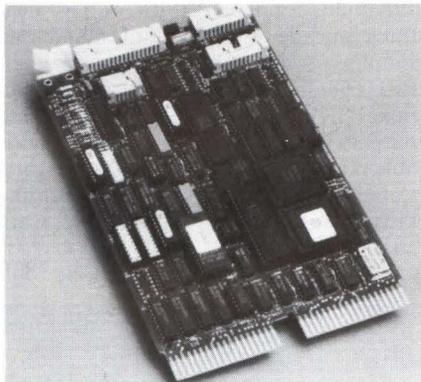
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NEW PRODUCTS

SUBASSEMBLIES

1,024-pixel memory that provides screen resolution of 1,024 by 768 pixels. Four bit planes display 16 colors from a palette of 4,096 colors. Drawing vectors at 3 million pixels per second, the unit moves or copies blocks of pixels without PC assistance at 4 million pixels per second. Polygon-fill speed is 30 million pixels per second at a 60-Hz refresh rate. The board comes with 128K bytes for off-screen image and data storage. Compatible with the VDI standard, it emulates the IBM Color Graphics Adapter. \$2,500. **Metheus Corp.**, 5510 N.E. Elam Young Parkway, P.O. Box 1049, Hillsboro, Ore. 97124, (503) 640-8000.

Circle 337



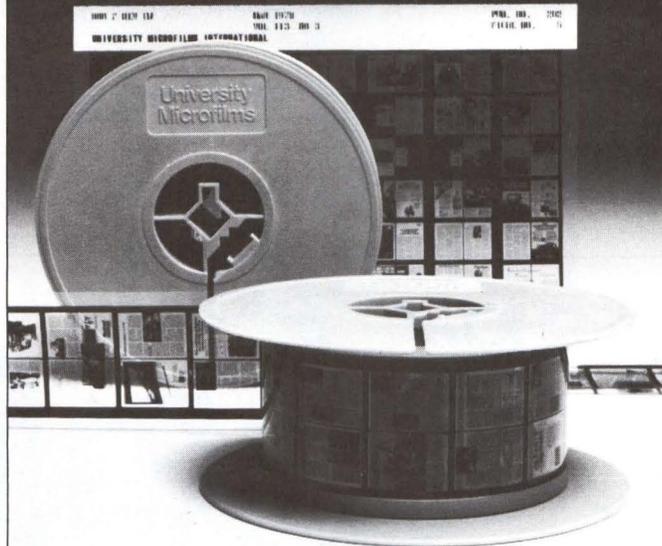
Disk controller interfaces with DEC Q-bus

- 22-bit addressing
- Block-mode DMA
- 48-bit ECC

The QD01, a microprocessor-based disk controller for the DEC Q-bus, links two ST506, 5¼-inch Winchester disk drives to the DEC Q-bus. It emulates DEC's Mass Storage Control Protocol and is compatible with the MicroVAX I and II and MicroPDP-11 systems. Block-mode support and adaptive DMA accommodate DMA data transfers. Features include non-interleaved sectors, command buffer, 22-bit addressing, internal self-test with LED support, 48-bit error correction code (ECC) and 16-bit cyclic redundancy check (CRC) for header error detection. A non-volatile, static RAM device stores drive configurations, permitting identification of drive types to the QD01. A dynamic bad-block-replacement feature provides error-free media without having to reformat and reverify the disk. \$1,650. **Emulex Corp.**, 3545 Harbor Blvd., P.O. Box 6725 Costa Mesa, Calif. 92626, (714) 662-5600.

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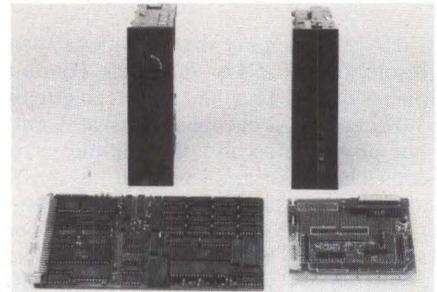
NEW PRODUCTS SUBASSEMBLIES

SBC contains three controllers

- Z80 processor
- 128K-, 256K-byte RAM
- 22 I/O lines

Employing the 6-MHz, Z80 processor, the Quark/300 single-board computer

(SBC) incorporates an ST506-compatible, rigid-disk controller, a flexible disk controller for 3½-, 5¼- and 8-inch drives and a video-display controller. The rigid disk controller has automatic error detection and software retry, buffered and non-buffered seek and full-track buffering in hardware. Programmable in single- or double-density operation, the flexible-disk controller handles four double-sided



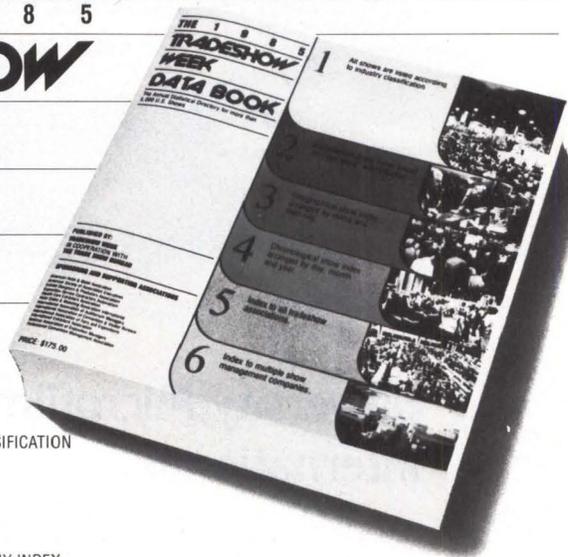
drives. The video-display controller operates in two modes: Alphanumeric mode with 80 columns by 40 rows or bit-mapped graphics mode with 640-by-320-pixel resolution. The board comes with 128K or 256K bytes of RAM; a 2K-byte, character-generator RAM; and 12K-byte, rigid disk track buffer. Features include one full-duplex and one simplex, serial, asynchronous channel; two 16-bit, counter/timers; 22 bidirectional I/O lines; five tri-state, buffered outputs for disk selection and one maskable interrupt source. \$595. **Megatel Computer Technologies**, 150 Turbine Drive, Weston, Ontario, M9L 2S2, Canada, (416) 745-7214.

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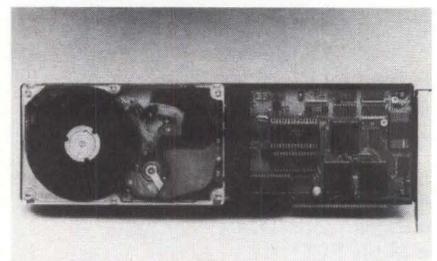
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Hard disk sits on board

- 10M-byte disk drive
- File-management software
- IBM PC-compatible

Upgrading an IBM PC to a PC-AT, Hardcard comprises a 10M-byte disk drive with controller and file-management and installation software on a plug-in card measuring 4 inches by 13 inches by 1 inch. It fits directly into an IBM PC or PC/XT expansion slot. The 3½-inch disk drive reaches an average access time of 65 msec. It comes with model 3370 heads and uses cobalt-doped media, a rotary wedge servo actuator with an optical encoder, an airlock system and a SASI controller modified for the IBM PC bus. \$1,095. **Plus Development Corp.**, 1778 McCarthy Blvd., Milpitas, Calif. 95035, (408) 946-3700.

Circle 340

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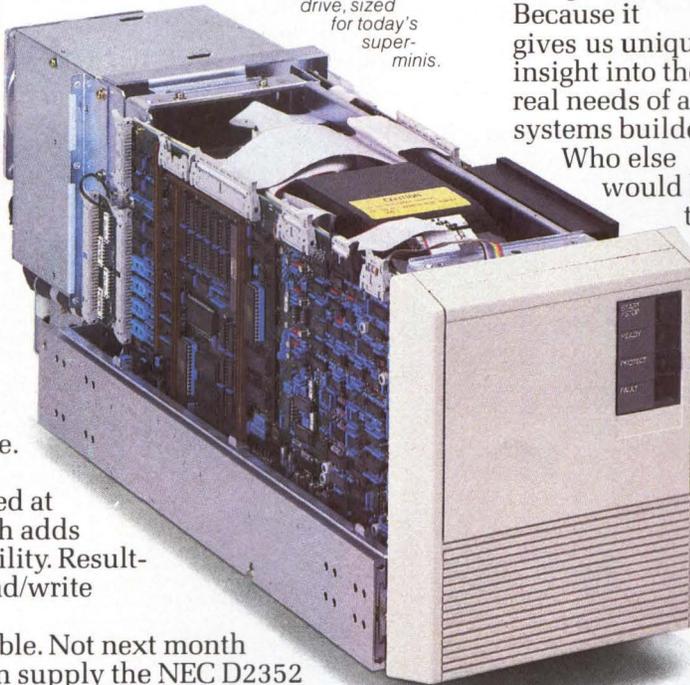
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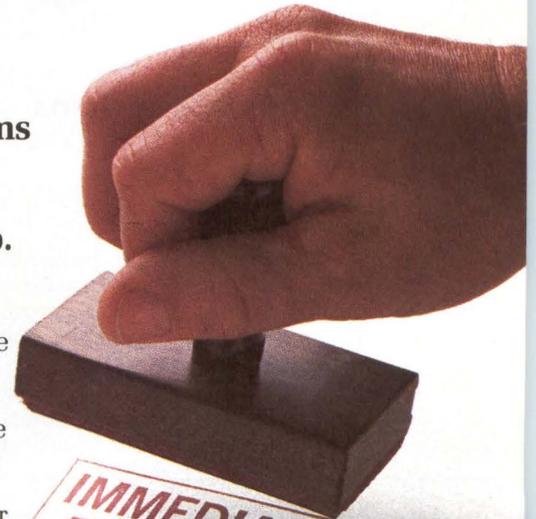
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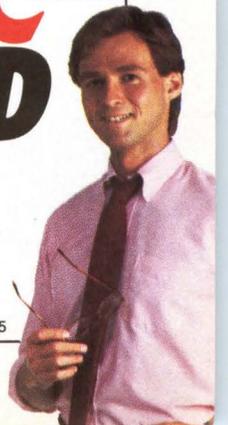
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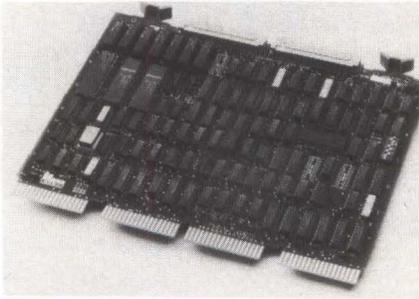
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NEW PRODUCTS SUBASSEMBLIES



Tape coupler works with DEC systems

- 4K FIFO buffer
- 9-track tape
- 800-bpi drives

The DU142 tape coupler configures any 9-track, 0.5-inch magnetic tape drive into a DEC PDP-11 or VAX system. Including a 4K FIFO buffer, the unit interfaces drives that use 800-bpi, non-return-to-zero drives, 1,600-bpi, phase-encoded drives and 6,250-bpi, group-code recording drives as well as

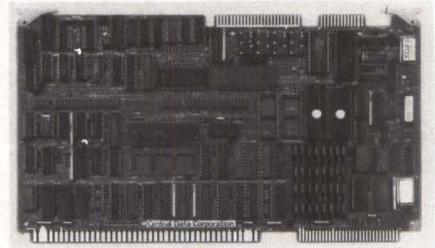
dual-density and tri-density drives. The coupler handles data rates up to 900K bytes per second and features switch-selectable DMA burst size to two or four words. A 2901 bipolar microprocessor and microprogrammed instructions permit automatic self-test. \$2,050. **Distributed Logic Corp.**, 1555 S. Sinclair St., P.O. Box 6270, Anaheim, Calif. 92806, (714) 937-5700.

Circle 341

SBC offers zero wait states

- 1M-byte RAM
- 5, 8 or 10 MHz
- Multibus compatible

Hardware- and software-compatible with the Intel 86/30 and 86/35 boards, this Multibus 8086 single-board computer is priced 30 percent less than the Intel boards. It runs at 5, 8 or 10 MHz with up to 1M byte of zero-wait-state dynamic RAM; the Intel boards run at 8 MHz with one wait state. The board holds 128K, 256K, 512K or 1M byte of memo-



ry. Features include parity checking, EPROM capacity and an 8087 numeric data-processor socket. \$1,800, 128K-byte version; \$2,000, 256K-byte version; \$2,200, 512K-byte version; \$2,550, 1M-byte version. **Central Data Corp.**, 1602 Newton Drive, Champaign, Ill. 61821-1098, (217) 359-8010.

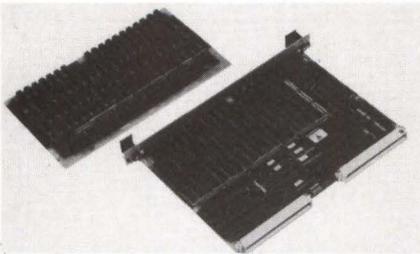
Circle 342

Memory boards store 256K to 2M bytes

- 8- to 32-bit data
- 24-bit address
- 270-nsec read

Offering byte parity with 8-, 16- or





32-bit data access, the model PME 2EP memory board holds 1M or 2M bytes of DRAM; the model PME 512EP, 256K or 512K bytes. The PME DB 2EP and DB 512EP daughterboards double the capacity of each board to 4M bytes and 1M byte, respectively, without additional board slots. Using 24-bit addressing, the boards achieve a 150-nsec-write-access time and a 270-nsec read access time. The memory array consists of up to four rows of 36 DRAMs. Each row contains 32 data RAMs and four parity RAMs. Memory is write-protected via I/O. A refresh cycle is executed by a RAS/only cycle with 256 Hz required every 4 msec. \$998, 1M-byte model PME 2EP; \$1,463,

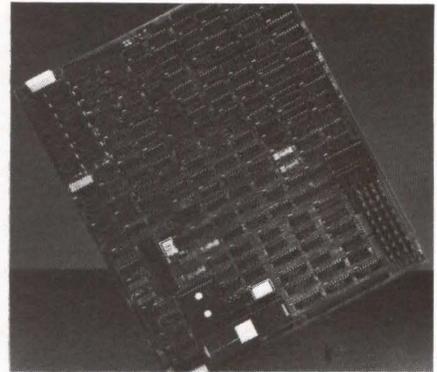
2M-byte model 2EP; \$654, 256K-byte model PME 512 EP; \$778, 512K-byte model PME DB 2EP; \$1,297, 2M-byte model PME DB 2EP; \$414, 256K-byte model PME DB 512EP; \$549, 512K-byte model PME DB 512EP. **Plessey Microsystems Inc.**, 1 Blue Hill Plaza, Pearl River, N.Y. 10965, (914) 735-4661.

Circle 343

Controller serves non-impact printers

- 384K-byte DRAM
- Business graphics
- Pixel addressing

By providing a bridge between the host computer and a non-impact printer, the Pixxon 300/SBC single-board controller generates text, business graphics and forms; text and graphics merge; multiple columns; downloading of fonts, forms and logos; and overlay applications via an English-like command language. At 15 ppm and 300 dpi, the board allows two image overlays; at 20 ppm and



300 dpi, it allows no overlays. Employing the 10-MHz, MC68000 CPU, it includes 384K bytes of DRAM, 32K to 128K bytes of ROM and RS232 serial and Centronics parallel interfaces. Capabilities include pixel addressing, dynamic status monitoring and Qume, Epson MX-80 and Diablo 630 printer emulation. \$500, Q10,000; \$540, Q2,000-5,000. **Electronic Machine Corp.**, Suite 500, 417 S. Hill St., Los Angeles, Calif. 90013-1169, (213) 687-9681.

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- 4-6 "SNA Architecture and Implementation" Seminar**, Cherry Hill, N.J., offered by Communications Solutions Inc. (CSI). Contact: Bob Beshalske, CSI, 992 S. Saratoga-Sunnyvale Road, San Jose, Calif. 95129, (408) 725-1568. Also to be held Nov. 13-15, Austin, Texas; Dec. 3-5, San Francisco.
- 5-7 Southwest Semiconductor & Electronics Exposition and Conference**, Phoenix Civic Plaza Convention Center, Phoenix, Ariz., sponsored by Cartledge & Associates Inc. Contact: Joyce Estill, Cartledge & Associates Inc., 1101 S. Winchester Blvd., M259, San Jose, Calif. 95128, (408) 554-6644.
- 5-8 The National Database and 4th Generation Language Symposium**, sponsored by Software Institute of America and conducted by Digital Consulting Associates Inc. Contact: Kristin Kittle Lynch, Digital Consulting Associates Inc., 6 Windsor St., Andover, Mass. 01810, (617) 470-3870. Also to be held Dec. 3-6, Boston.
- 6 "Design and Management of Local Area Networks" Seminar**, Sunnyvale, Calif., offered by the Center for Advanced Professional Education. Contact: Center for Advanced Professional Education, Suite 110, 1820 E. Garry St., Santa Ana, Calif. 92705, (714) 261-0240. Also to be held Dec. 4, Trevese, Pa.; Dec. 16, Boston.
- 11-13 "Network Protocols and Standards" Seminar**, San Francisco, offered by Systems Technology Forum. Contact: Heidi Chorosinski, Systems Technology Forum, 9000 Fern Park Drive, Burke, Va. 22015, (703) 425-9441 or (800) 336-7409. Also to be held Dec. 2-4, Washington.
- 11-14 First International Conference on Computer Workstations**, San Jose Convention Center, San Jose, Calif., sponsored by the IEEE Computer Society. Contact: IEEE Computer Society, 1730 Massachusetts Ave., N.W., Washington, D.C. 20046-1903, (202) 371-0101.
- 18-22 Tutorial Week San Francisco '85**, Cathedral Hill Hotel, San Francisco, sponsored by IEEE Computer Society. Contact: Martez A. Camilleri, IEEE Computer Society, 1730 Massachusetts Ave., N.W., Washington, D.C. 20046-1903, (202) 371-0101.
- 19-22 Wescon/85 High-Technology Electronics Exhibition and Convention**, Moscone Center, Brooks Hall/Civic Center, San Francisco, sponsored by Electronic Conventions Management. Contact: Jerry Fossler or Nancy Hogan, Electronic Conventions Management, 8110 Airport Blvd., Los Angeles, Calif. 90045, (213) 772-2965.

21-22 California Business Expo, Los Angeles Convention Center, Los Angeles, sponsored by California Business Expo. Contact: Diane Stone, California Business Expo, 1516 S. Pontius Ave., Los Angeles, Calif. 90025, (213) 477-8521.

25-(6) The Second International Technical Symposium on Optical and Electro-Optical Applied Science and Engineering, Cannes, France, organized by SPIE, the International Society for Optical Engineering and the Association Nationale de la Recherche Technique. Contact: SPIE, P.O. Box 10, Bellingham, Wash. 98227, (206) 676-3290.

DECEMBER

3-6 North American Telecommunications Association (NATA) 1985 Convention & Exhibition Showcase, Infomart, Dallas, sponsored by NATA. Contact: NATA Convention Department, Suite 550, 2000 M St., N.W., Washington, D.C. 20036, (202) 296-9800.

4-5 California Computer Show, Hyatt Hotel, Palo Alto, Calif., sponsored by Norm DeNardi Enterprises. Contact: Norm DeNardi Enterprises, Suite 204, 289 S. San Antonio Road, Los Altos, Calif. 94022, (415) 941-8440.

4-6 Second Southwestern State of the Art Conference and Exhibition on Computer Graphics, CAD and CAM, San Diego State University, San Diego, offered by the Department of Mathematical Sciences. Contact: Professor Nenad Marovac, Department of Mathematical Sciences, San Diego State University, San Diego, Calif. 92182, (619) 265-4345.

11-13 DEXPO West '85—The Eighth National DEC-Compatible Exposition, Anaheim Convention Center, Anaheim, Calif., organized by Expoconsul International Inc. Contact: Carol Henderson, Project Manager, Expoconsul International Inc., 55 Princeton-Hightstown Road, Princeton Junction, N.J. 08550, (609) 799-1661.

FEBRUARY

24-29 MICAD '86 Third International Conference and Exhibition on CAD/CAM, Palais des Congres, Paris, sponsored by the World Computer Graphics Association (WCGA) and the Mission pour la Conception Assistee et le Dessin par Ordinateur (MICADO). Contact: Caby C. Smith, WCGA, Suite 399, 2033 M St., N.W., Washington, D.C. 20036, (202) 775-9556.

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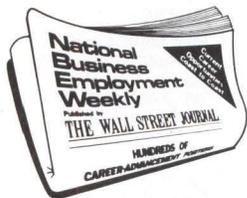
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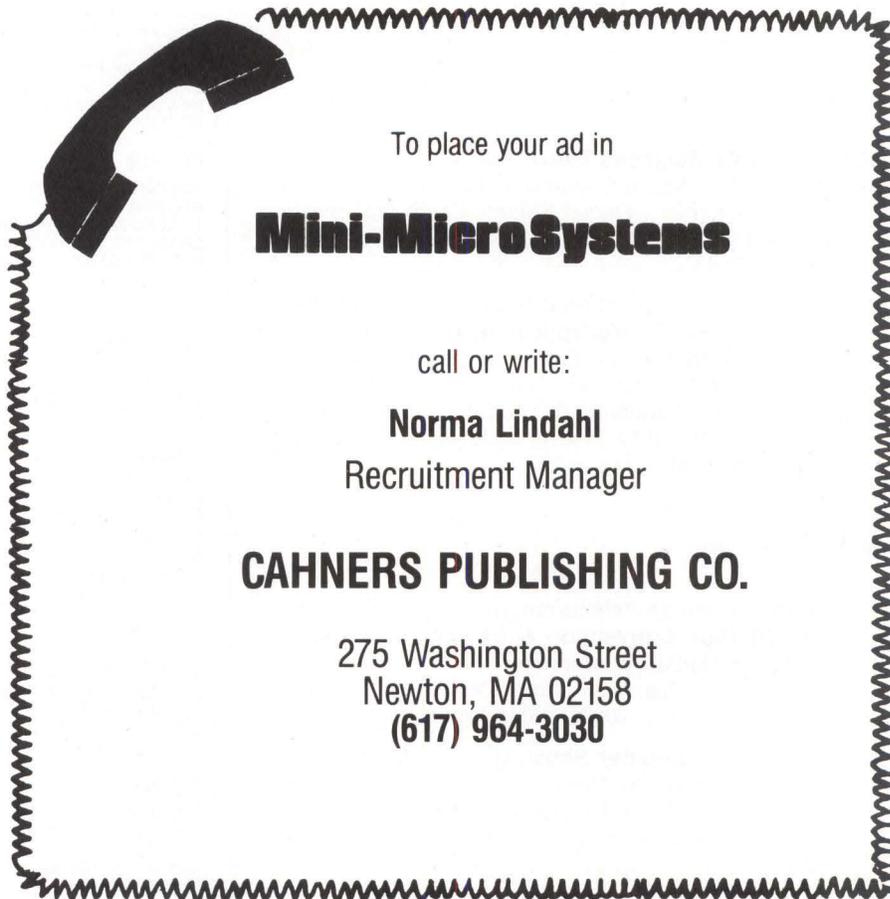
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10-85

FINANCIAL EXPERT.



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(Expressed in thousands, except percentages)

Year or Fiscal Year	1985	1984	1983	1982	1981	1980	1979	1978	1977
Net Sales	\$2,376,715	\$1,941,665	\$1,464,100	\$1,487,505	\$1,550,699	\$1,425,397	\$1,327,271	\$1,155,167	\$928,285
Cost of Goods Sold	1,839,166	1,498,620	1,112,684	1,198,076	1,125,515	1,067,467	1,009,403	884,117	718,628
Equipment Depreciation	51,114	58,865	28,651	25,258	25,766	21,375	20,997	18,454	14,704
Interest Expense	47,494	52,977	10,715	25,026	28,038	27,617	19,100	10,935	15,079
Net Earnings	100,735	85,145	64,122	72,295	76,067	65,722	63,276	48,200	37,855
Net Earnings % of Sales	4.2 %	4.4 %	4.4 %	4.9 %	5.0 %	4.6 %	4.8 %	4.2 %	4.0 %
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MARKET TRACK

Sharon Hassell, Assistant Editor

Market boom expected for modems, multiplexers

Fueled by the ever-increasing need for fast, reliable and sophisticated data communications, the U.S. market for modems and multiplexers will see unprecedented demand and technological development through 1990, according to a recent market study by Frost & Sullivan Inc. The study indicates, however, that data concentrators will show a drop in unit shipments and sales.

Modems, with sales of \$1.8 billion in 1984, will reach \$2.73 billion in sales and have shipments of 17.9 million units by 1990. Multiplexer sales, worth \$500 million in 1984 will reach \$3.7 billion with 1.43 million units shipped in 1990.

In the shadow of the increasing popularity of multiplexers, data concentrators will experience a \$20 million drop in sales between 1984 and 1990, to total only \$10 million with shipments of 3,500 units by 1990, the study says.

According to Frost & Sullivan, the personal computer market will account for steady growth for modems. By 1989, more than 60 percent of all personal computers in the United States will be equipped with a modem.

The study cites cost advantages as the major motivation for users to install multiplexers. Basic multiplexing technology offers relief from the rising cost of data communication through low-cost routing, automatic retransmission upon error detection, network management and complete diagnostics.

The market for data concentrators has eroded as the market for multiplexers has evolved, says the study. Data concentrators, which apply stored program logic to concentrate data before transmission, helped solve early problems of slow transmission and consequently enjoyed lively sales for nearly a decade. The development of increas-

MIXED EXPECTATIONS FOR DATA COMMUNICATIONS PRODUCTS

(Sales, \$)

	1984	1990
Data concentrators	30 million	10 million
Modems	1.8 billion	2.73 billion
Multiplexers	500 million	3.7 billion

Source: Frost & Sullivan Inc.

The future for data communications products is mixed, with sales increases expected for modems and multiplexers and a sales drop expected for data concentrators.

ingly sophisticated and cost-effective multiplexers has caused a loss in their popularity.

The price of the study is \$1,700 and

is available through **Frost & Sullivan Inc.**, 106 Fulton St., New York, N.Y. 10038.

Circle 360

Unit shipments to double in display-terminal market

Unit shipments of display terminals will increase an average of 16.4 percent annually between 1984 and 1989, predicts a recent market study by Advanced Resources. Development (ARD). That would bring shipments to 3,926,650 units in 1989, more than twice the number of units shipped in 1984.

ARD expects revenues to increase only 7.1 percent annually—from \$2.4 million in 1984 to \$3.4 million in 1989—reflecting price cuts, many of them due to competition among the manufacturers.

ARD forecasts that general-purpose terminals—specifically editing ASCII terminals—will show the highest growth rate in unit shipments, increasing 20.5 percent annually between 1984 and 1989.

The \$1,695 report is available through **Advanced Resources Development**, 28A Park Street Station, Medfield, Mass. 02052.

Circle 361

Interest Quotient (Circle One)
High 495 Medium 496 Low 497

LOOKING AHEAD IN MMS

Be sure to watch for these editorial highlights in coming issues of Mini-Micro Systems.

- Power supplies and terminals will be featured in the November issue.



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provided Westinghouse an eminently affordable new tool for the development of expert systems. Pessall and Schreurs were especially impressed with its ability to aid experts in developing the knowledge bases and prototyping programs which even first-time computer users could consult for expert advice.

"With Personal Consultant software," says Schreurs, "we found it far easier to teach our experts how to develop a system than teach a programmer to be an expert." In fact, the software's rapid expert system prototyping and simple debugging features enabled the two scientists to demonstrate three different expert systems in as many weeks. Schreurs produced one for training new salespeople and a second to guide repairs and maintenance for the Center's X-ray diffractometer.

Pessall's makes material recommendations for tubes and support plates in steam generators.

"Our development of expert systems isn't aimed at replacing experts," says Dr. Pessall. "Its purpose is to give them the time to extend their expertise while the expert systems handle consultations on well-established knowledge and methodology."

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ARTFUL INTELLIGENCE

By John K. Young

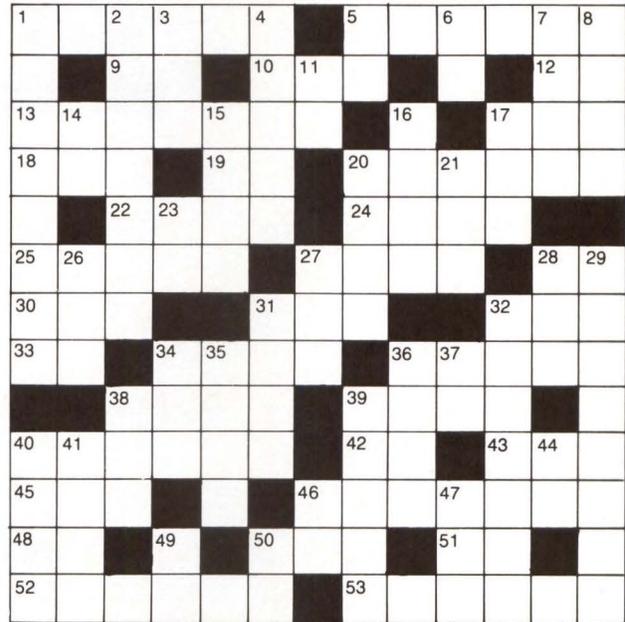
ACROSS

- 1 Command signal
- 5 People who resist computers
- 9 Its capital is Richmond (Abb.)
- 10 Permanent computer memory
- 12 Rhodium (Abb.)
- 13 Printer using matrix of heated wires
- 17 Commonly used in graphics
- 18 Automobile
- 19 Electrical current
- 20 Country hosting World Congress on Education and Technology in 1986
- 22 Couple
- 24 Hurried
- 25 Way user may feel when computer is down
- 27 Type of printer
- 28 Where prices keep going
- 30 Negative vote
- 31 Kind of computer that is battery-operated, small and light
- 32 Postgraduate degree (Abb.)
- 33 Gram (Abb.)
- 34 Call to user's attention
- 36 Trail of wild animal
- 38 There are two of these in "electronic"
- 39 Spirited self-assurance
- 40 Instruct computer to set up document for printing
- 42 Special function
- 43 Unfavorable

- 45 Function
- 46 Computer data
- 48 Logical unit (Abb.)
- 50 Statement
- 51 A port
- 52 Step to activate printer
- 53 Helical

DOWN

- 1 Tinkering with computer program
- 2 Small assembly language file
- 3 Damage
- 4 Disk's concentric circle
- 5 Afternoon (Abb.)
- 6 In the matter of
- 7 Common flowchart form
- 8 African tree yielding white fat
- 11 Suffix meaning "an alcohol"
- 14 Exclamation of triumph
- 15 Long, thick hair on neck
- 16 Largest computer frame
- 17 Keys in calculator-style layout
- 20 An integrated circuit
- 21 Born
- 23 Pronoun for microcomputer
- 26 Alterable computer memory
- 27 Polluter of electrical power
- 28 Saucer in the sky
- 29 Simultaneous data handling
- 31 Endure
- 32 Visual display screen
- 34 Of Eve's kind (Abb.)
- 35 Part of tree record



- 36 Progress with great effort
- 37 When it comes to computers, he may be pupil to the child
- 38 See 32-Down
- 39 Prepares for publication
- 40 Information stored on disk

- 41 Burden of proof
- 44 So. of Silicon Valley (Abb.)
- 46 Prefix meaning "away from"
- 47 Three, to Caesar
- 49 Silicon Valley state (Abb.)
- 50 French "the"

Solution will be printed next month.

Answers to September's puzzles can be found on Page 191.

Interest Quotient
(Circle One)
High 468
Medium 469
Low 470



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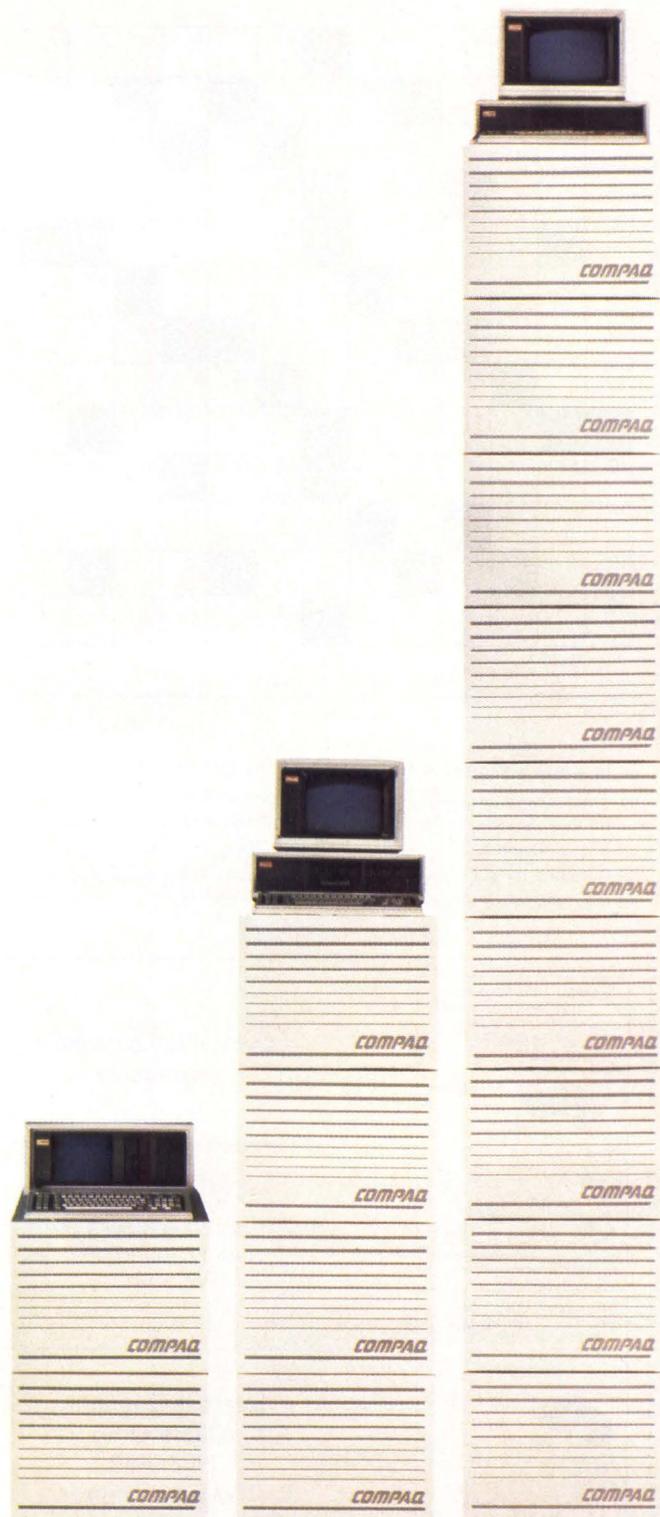
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*Source: Datamation Magazine, June 1, 1985.



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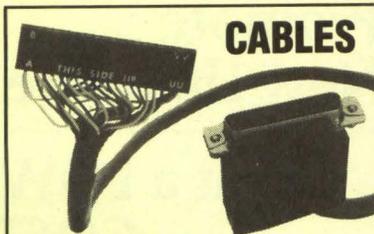
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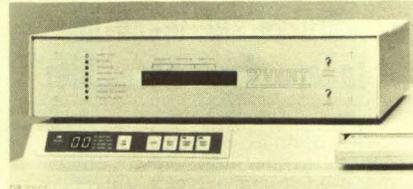
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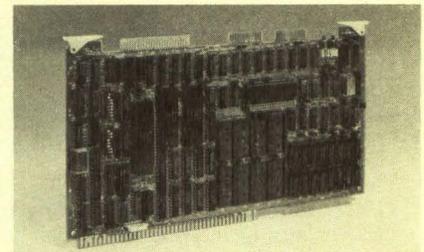
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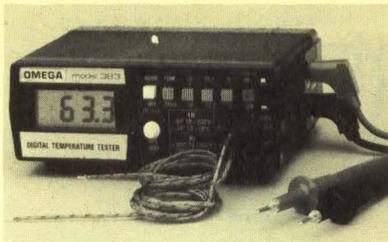
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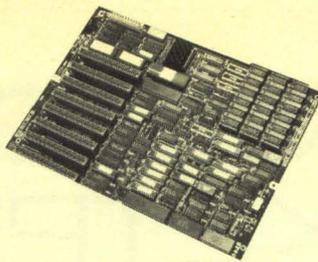


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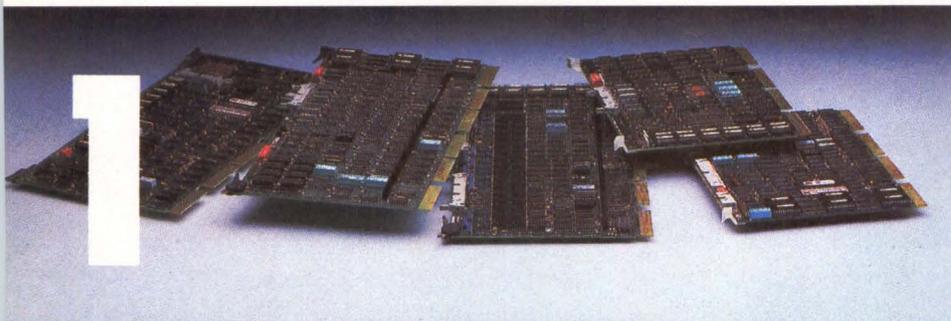
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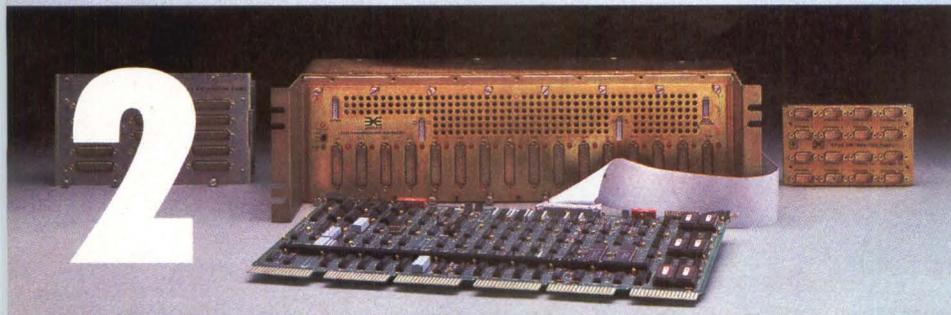
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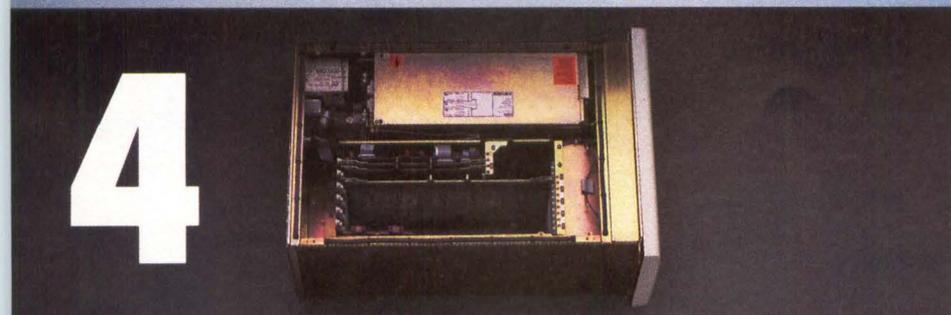
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3



4



5



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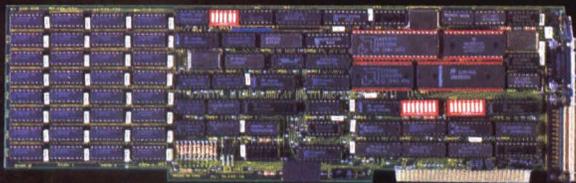
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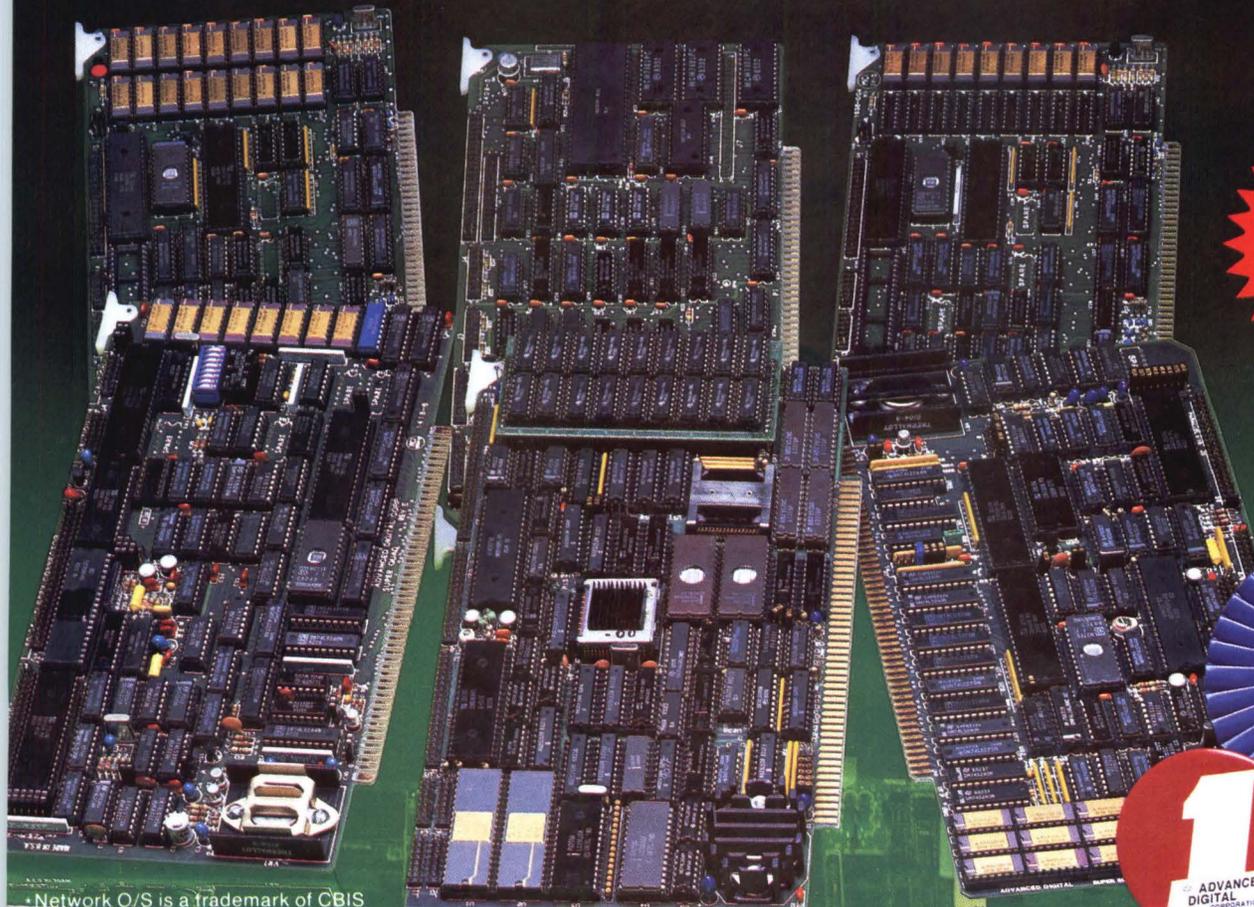
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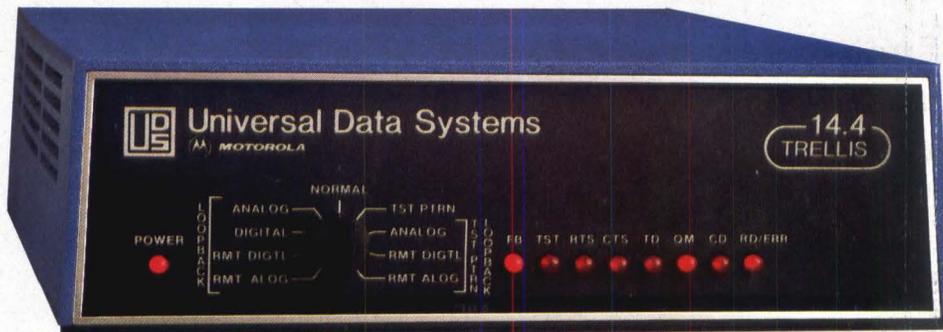
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