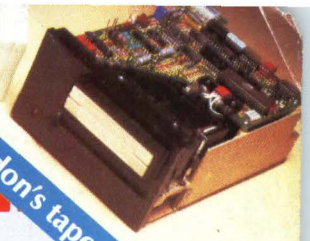
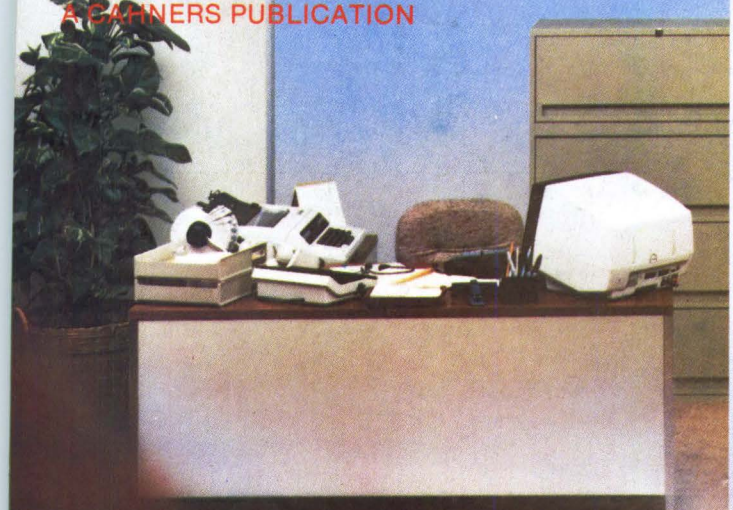
Mini-Micro Syste

A CAHNERS PUBLICATION

MAY 1983



Tandon's tape drive



Test systems grow smarter

OA a hot topic for corporations

Integrating voice, graphics and data

You've concluded that you need the performance and capacity that only an 8 inch Winchester drive can provide. Which one should you buy?

There are 109 different models available.

Of this 109, only 39 are 8 inch floppy form-factor compatible.

28 of these 109 perform an average seek in 30 milliseconds or less.

And of this 109, only 17 offer true SMD compatibility.

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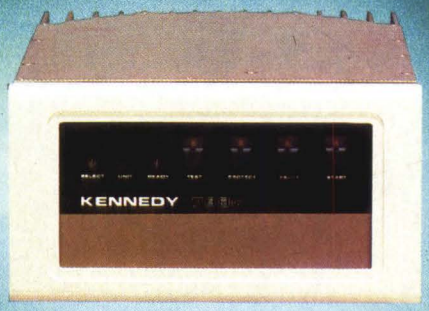

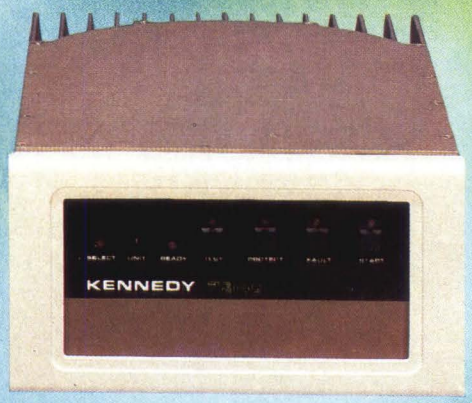

SPECIFICATIONS:

- 41 and 82 MB Capacities
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- 1209 KByte/sec. transfer rate
- Available 30-45 days ARO
- Q100: $2,560/$3,195

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The new COMPAQ Portable Computer. IBM compatibility to go.

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There's really only one big difference. The COMPAQ Computer is designed to travel.

Carry the COMPAQ Computer from office to office. Carry it home on the weekend. Or take it on business trips.

If you're a consultant, take it to your client's office.

If you use a portable typewriter, you can use the COMPAQ Computer as a portable word processor instead.

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Portable as a mobile unit that can use the same programs, the same data disks, and even the same user manuals.

There are more programs available for the COMPAQ Computer than for any other portable. More, in fact, than for most nonportables. You can buy them in hundreds of computer stores nationwide, and they run as is, right off the shelf.

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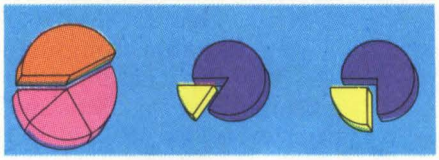
The most computer you can carry

CIRCLE NO. 1 ON INQUIRY CARD

Mini-Micro Systems

p. 193. . .(cover by Sydis, Inc., concept by Blankenship-Tavares, Inc., airbrushing by Bill Echart, photo by Sollecito Photography)



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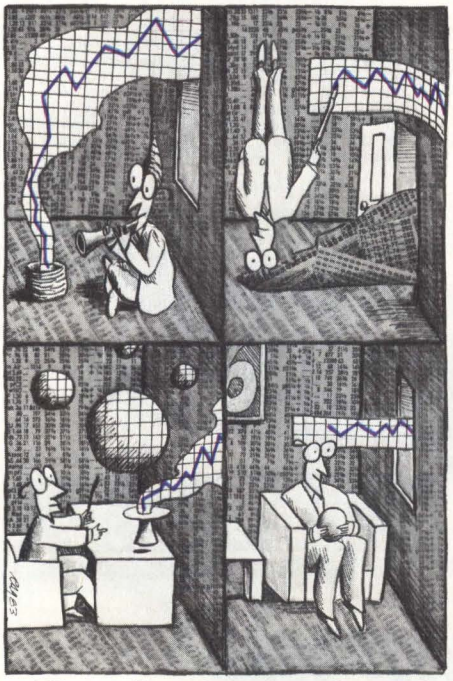

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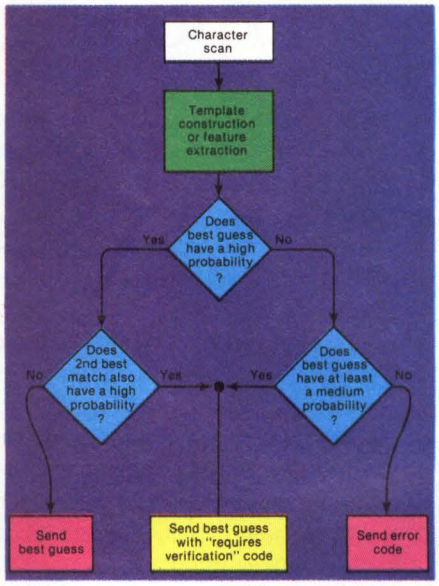

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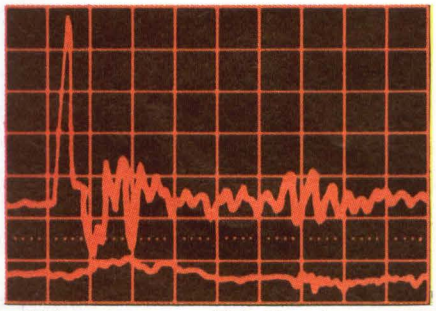

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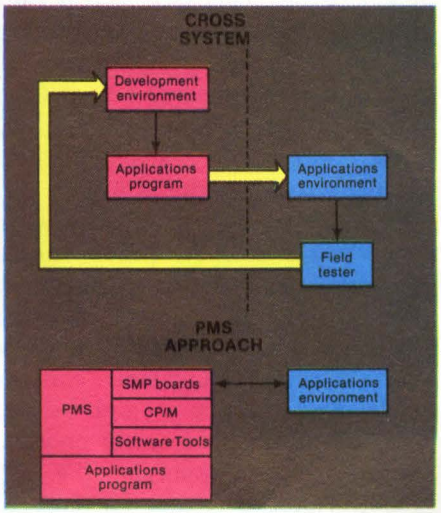

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Editorial

Exporting high-tech

After years of operating under outdated and inequitable licensing regulations, exporters of computers, peripherals and other high-tech equipment are pushing for legislative reforms during this year's renewal of the Export Administration Act of 1979. Organizations such as the American Electronics Association and the Computer and Business Equipment Manufacturers Association lobby for needed changes including strict limitations on the use of U.S. unilateral controls, a reduction of the number and types of products on the commodities control list and a greater government awareness of the foreign availability of many products (see "High-tech exports...," p. 113). Ironically, the associations, at the same time find themselves battling forces that would place even greater restrictions on the export of high-technology goods.

The premise of those pushing for tighter controls—that the acquisition of some technologies and products by our enemies outweighs the benefits of much high-tech trade—has merits. High-tech companies don't discount the problems associated with such technology leakage, but they correctly believe that economic considerations must also play a role in decisions about what products can be shipped to what destinations.

Many high-tech vendors believe the Department of Commerce can provide a balanced evaluation in granting export licenses—considering both the business aspects of the trade and, in conjunction with the Department of Defense, the national security risks associated with the trade. These same vendors are justified in their fears that moving the control of exports out of Commerce and into a new Office of Strategic Trade—as proposed by Senator Jake Garn and others—would effectively place all trade decisions in the single-minded security realm of the DOD.

The U.S. high-tech industry, which battles in an extremely competitive world market, needs encouragement and support from its government to export products, not more restrictions. The way to limit the export of high-tech products to proscribed countries is to strengthen the international CoCom regulations that affect both ourselves and our allies. National security considerations must always play a role in high-tech export decisions. But placing increased restrictions solely on U.S. exports would simply result in other countries supplying the international markets, to the detriment of U.S. firms and our national economy.

Dwight B. Davis

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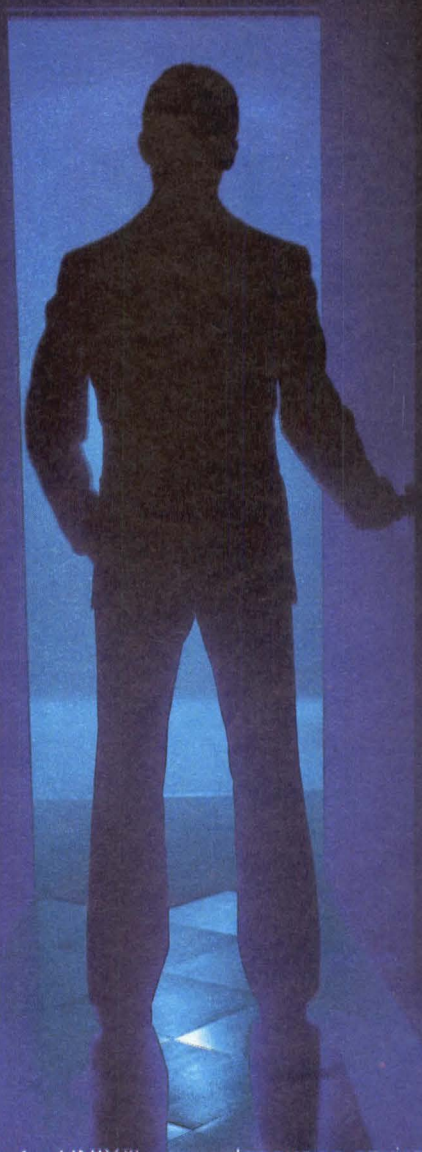
Open the door to a new UNIX™ performance environment.



Exciting new doors are opening up for UNIX™ users. The Gould CONCEPT 32/87 is the key. Now there's a powerful alternative for the VAX-bound user. Running the authorized version of Bell Laboratories' UNIX operating system, the Gould CONCEPT 32/87 benchmarks at triple the performance of the VAX 11/780*. This new processing power can make you more productive. Whether you are dealing with VLSI design, molecular modeling, or simulation processing, the 32/87 has the versatility and performance you need for increased productivity.

Now Gould S.E.L. minicomputers offer a comprehensive ICSC-Ada† language translator to open new doors into the state-of-the-art DOD language environment. The ICSC-Ada translator operates in conjunction with the C compiler under UNIX to enable users of Gould computers to learn Ada and to develop programs to satisfy emerging Ada requirements of military and scientific computer applications.

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SEE US AT NCC BOOTH #5362

We'll take on any other line printer in the magazine.

When you compare CIE matrix line printers with others, you'll find others either do a lot less. Or cost a lot more.

Or both.

Our CI-300 gives you 300 LPM for data processing and 85 LPM of letter quality. Our CI-600 increases DP to 600 LPM and letter quality to 170 LPM.

Both are plug-in compatible with virtually every type of computer system, including IBM.

Both have variable shuttle speeds.

Both give you graphics, up to 2400 DLPM on the 300 and up to 4800 DLPM on the 600.

Both bring high resolution to Bar Codes, Optical Character Recognition, Form Generation, Labels and Word Processing.

Both have an unusually small print head diameter for needle-sharp character clarity.

Both give you hundreds of unique character fonts. And you have broad customization potential with RAM and EAROM.

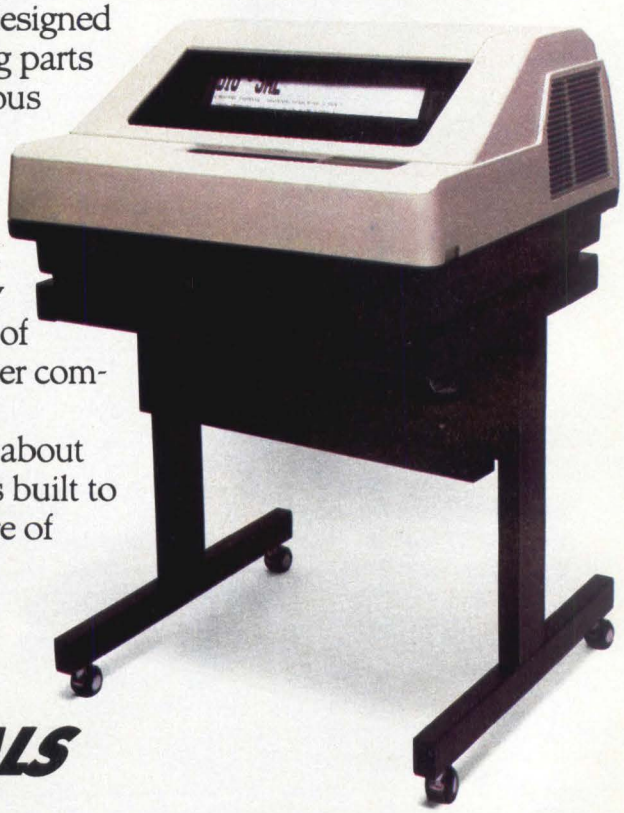
Both come with three built-in interfaces, two parallel and one serial.

Both give you flexible line spacing, line feed speed and three paper-loading points—front, bottom and back.

And because they're designed with a minimum of moving parts and have undergone rigorous testing, both give you unmatched reliability.

They're printers that could only come from CIE Terminals, a new company of C. Itoh Electronics, one of the most experienced printer companies in the world.

For more information about these low-cost line printers built to higher standards, and more of them, just write or call.



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CIRCLE NO. 6 ON INQUIRY CARD

Breakpoints

CONCURRENT CP/M READY FOR RELEASE TO OEMS

Digital Research Inc. this month is scheduled to release an OEM version of its Concurrent CP/M operating system for Intel 8086-based microcomputers. DRI officials say that some 25 major OEMs including Texas Instruments Inc., NCR Corp., Fujitsu America Inc., Vector Graphic Inc., Eagle Computer Inc., Corona Data Systems and Digital Equipment Corp. (for its Rainbow) have signed for the package. A retail version of IBM Corp.'s PC has been shipped since late last year, but IBM has not signed up. However, DRI says it has sold several thousand copies of Concurrent CP/M for the PC. The operating system carries a suggested end-user price of $350 and can support as many as 16 concurrent tasks. DRI engineers see it as a major building block for designers of integrated application packages. Written in C, Concurrent CP/M will be adapted to the Motorola MC68000 and Zilog Z8000. Intel 286 and National 16032 versions are expected.

ZILOG Z800 TRIPLES Z80 PERFORMANCE, MAINTAINS COMPATIBILITY

The full description just emerging from Zilog Inc. of its Z800 microprocessor depicts a fast (25-MHz clock) and powerful (performance as great as 5 million instructions per sec.) chip. The Z800 family is an upgrade of the Z80 and is available in 8- and 16-bit bus versions. Both feature Z80 binary-code compatibility and tripled performance over the Z80. The increased performance is achieved through use of an on-board cache memory and pipelining. Running in Z800 mode is said to double throughput again via additional instructions, including hardware multiply and divide, and to increase the addressing range to 16M bytes. Sampling of the four family members will begin in the first quarter of 1984, and quantity production of 10-MHz versions will begin by early 1985. Two members of the family, one for an 8-bit bus and one for the 16-bit ZBUS, come in 64-pin packages and support four DMA channels, four 16-bit counter/timers and a full-duplex, asynchronous serial channel integrated on-chip.

COMPUTER AUTOMATION INTRODUCES INTEL 80186-BASED SYSTEM

Computer Automation's Naked Mini division, a longtime source of low-end, board-level minicomputers, will market the new Omnix 186 multi-user business system based on an 8-MHz Intel 80186 with an 8087 math co-processor. A Naked Mini 4/04 SBC is relegated to handling I/O for as many as 16 terminals and printers. The Omnix 186 retains compatibility with the Omnix workstation introduced last year and with the rest of Naked Mini's line of single-board computers by offering CA's TRANS-BASIC language under the proprietary OPUS-1 operating system. More significantly, the Omnix 186 also runs CP/M-86 and MP/M-86 as well as MS-DOS tasks under OPUS-1, giving CA its first product aimed at OEM system packagers with an investment in industry-standard software. The basic configuration of the Omnix 186 includes 384K bytes of RAM, four serial ports, a 5M-byte, 5¼-in. Winchester disk drive and a 1M-byte floppy disk drive for a suggested single-unit list price of $8990.

UNIX SOFTWARE VENDORS SEEK DEC CONTRACTS

Digital Equipment Corp. still has not officially announced a UNIX operating system package for its high-end Professional 325/350 personal computers, but independent UNIX software vendors are lining up to offer their application packages on an OEM basis. Handle Corp. and Horizon Software Systems Inc. are reportedly in the running for the word-processing/office-automation utilities needed on the F-11 processor-based systems. Handle, Tahoe City, Calif., and Houston, is a spin-off of Houston software company Microlab. Handle has a $2.2-million R&D partnership with Microlab and reportedly will have $5 million more available over the next five years to develop a family of UNIX products. Horizon, which has contracts with Altos Computer Systems, Intel Corp. and Gould S.E.L., is enriching its offering this month with mail/merge, graphics, sort, spelling and spread-sheet functions. Handle, which is working on an integrated office package for release in the third or fourth quarter of this year, is understood to have a contract with

Four-Phase Systems Inc. to provide its Handlewriter word-processing package on an as-yet-unannounced system built around parent Motorola Inc.'s MC68000.

APPLICATION GENERATOR SLATED FOR UNIX MARKET

Software Express, a spin-off formed this year from Sunbelt Data Services, Houston, is readying a UNIX version of the APPGEN application generator it developed for the Pick operating system. The package, along with nine accounting modules, was introduced to Pick OEMs and system houses at a March gathering of Pick users. Initial shipments of that version are scheduled for this month. APPGEN is intended to provide about 90 percent of what is needed to create an end-user application package and can automatically incorporate user-written BASIC code for the remaining subroutines. Software Express claims the parameter-driven system can save as much as 75 percent of the time and money required to write a new application and as much as 90 percent of the effort in modifying packages. The UNIX version, due out this year, will have its own C programs, not interpreted BASIC, and is understood to be under consideration at Plexus Computers Inc.

SEC CHARGES PARADYNE WITH FRAUD

The Securities and Exchange Commission has charged Paradyne Corp. with fraud in connection with Paradyne's $84-million contract with the Social Security Administration for PDN 8400 intelligent data-communication terminals. According to the SEC, Paradyne demonstrated a competitor's microprocessor and controller to SSA officials after relabeling the equipment with Paradyne labels. Paradyne has been subpoenaed by a U.S. attorney to produce all documents relating to the 1981 contract on May 11. Paradyne maintains that the SEC's allegations are false.

CENTRONICS INTRODUCES NEW IMPACT PRINTERS

Centronics Data Computer Corp., Hudson, N.H., this month will upgrade its 350 series of serial dot-matrix printers with the models 355, 357 and 358. The new models operate at 400 cps and have stored-energy print head design. The model 358 is a four-color unit. Centronics has also introduced the Linewriter 400, the first of a family of line printers that features a compact, quiet design. Typical throughput of the machine, aimed at office use, is 400 lpm, with speeds as high as 500 lpm possible.

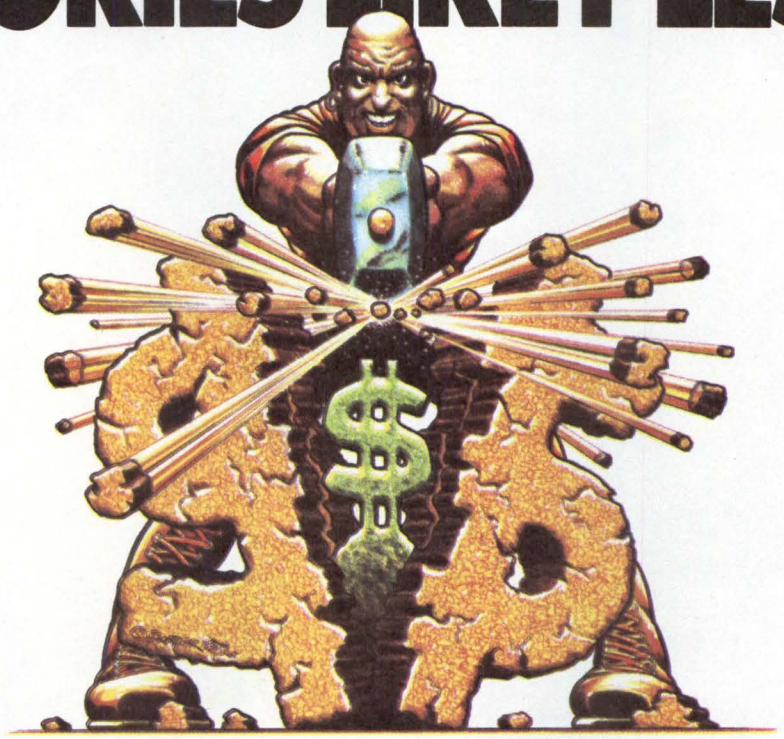
TECHFILES: A QUICK LOOK AT INDUSTRY DEVELOPMENTS

Hanover Fair Review: Germany's Hanover Fair, April 13-20, this year again brought a plethora of new products. Joining the ranks of Epson America Inc. and others with portable hand-held and briefcase-sized computers are at least a half-dozen newcomers. **Sord Computer Systems Inc.,** which has had U.S. offices in New York since November, introduced the M5 lap-sized computer. The product will be available in the U.S. soon at a price of about $190. Key features include a Z80A processor; a video controller; a sound generator; 8K bytes of built-in monitor ROM; 250K bytes of RAM, of which 16K bytes are video memory; a QWERTY, calculator-style keyboard; video, audio and RF output; an audio cassette interface; a parallel printer interface; a cartridge connector; and BASIC-1 cartridge and text. Options include other BASIC cartridges and a printer.

A newcomer in Hewlett-Packard Co.'s booth, which is planned for U.S. introduction in late June or early July, **was the 16-bit Micro 1000**, code-named "Shoehorn." The Micro 1000, available in a floor-standing cabinet or a tabletop box, includes an HP1000 A series microprocessor, a 10M-byte Winchester disk drive, a Sony microfloppy disk drive and the RTEA operating system. With the low-end A600 series processor, the price is expected to be about $9500. The system is targeted at real-time industrial applications and supports color terminals such as HP's 2627. The Micro 1000 has a fiber-optic link option.

Diablo Systems Inc. displayed its recently introduced thermal printer, which prints as many as 6 pages per min. at a resolution of 200 × 200 dots per in. Several other manufacturers showed new products using the same technology. **Toshiba Corp. introduced**

NOBODY PRICES DEC MEMORIES LIKE PLESSEY.



But all you give up is cost.

Because while our DEC-compatible memories are typically 30% less expensive, they'll run up to 30% faster. Occupy less space. Are 100% burned-in and tested. Are run on the computers they were designed for before we ship them out the door. And come with an extensive 1-year warranty.

When you add in our OEM, GSA or educational discounts, you've got reliable high-density storage at a refreshingly low-density price. Check the chart for the memory you need, then check us out at (800) 992-8744.

We can also help your budgets and your systems with Plessey communications multiplexers. And with one of the broadest line of DEC-compatible disc controllers in the world—for floppies, cartridges, disc packs, Winchesters and magnetic tape, including a proven ¼" streamer. (Complete subsystems with savings of up to 50%, too).

And we'll back you up with our own worldwide network of factory-trained specialists. They can service products from a variety of vendors and answer all your questions about configuration, operation or software. You get the responsiveness of an in-house technician at a fraction of the cost. Nobody else even comes close.

For the rest of the story, contact: Plessey Peripheral Systems, Computer Products Division, 1674 McGaw Avenue, Irvine, CA 92714. Telephone (800) 992-8744 or (714) 540-9945.

PLESSEY'S DEC-COMPATIBLE MEMORIES

MODEL	TYPE	CPU: LSI-11/2	CPU: LSI-11/23	CPU: LSI-11/23+	CPU: PDP-11/24	CPU: PDP-11/34	CPU: PDP-11/44	CPU: PDP-11/70	CPU: VAX-11/730	CPU: VAX-11/750	CPU: Q-BUS	BUS: UNIBUS	BUS: EXT. UNIBUS	BUS: MEM. BUS	CAPACITY: 32K	CAPACITY: 64K	CAPACITY: 128K	CAPACITY: 256K	CAPACITY: 512K	CAPACITY: 768K	CAPACITY: 1.0M	PARITY: On-Board Parity	PARITY: Bits Only	PARITY: Non-Parity	ECC: 16-bit	ECC: 18-bit	ADDRESSING: 22-bit	ADDRESSING: Dual	ADDRESSING: Quad	BOARD SIZE: Hex
SV32AP	MOS	●	●								●				●	●						●	●		●	●	1			
SV128A	MOS		●	●							●						●	●			●		●			●	1			
SV512	MOS		●	●							●						●	●	●	●	●		●			●	●	1		
S11L/F	MOS				●	●	●				●	●				●	●	●			●			●		●	●			1
S11E/4	MOS				●	●	●				●	●				●	●	●		●	●			●		●	●			1
S750	MOS							●	●				●				●							●						1
✓ S780	MOS									●			●				●							●						1
1116B	CORE				●						●			●									●		●	●				1*
1132A	CORE				●						●				●							●	●		●	●				1*

*Memory is contained on a single board but requires space of two slots due to stack overhang.

✓ **Check this one: about ⅓ the price of the DEC equivalent!**

See us at NCC, Booth #A3208

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CIRCLE NO. 8 ON INQUIRY CARD

two thermal transfer printers, the TN-5000 line printer and the TH-100H serial printer. The TN-5000 operates at 6 pages per min. and has a resolution of 8 × 8 dots per sq. mm. The 36-cps, plain-paper TH-100H may soon make its debut in the U.S. under another company's name. **Tandy Corp. is believed to be evaluating the TH-100H to be modified and released as a separate product.** The TH-100H has a 24-dot thermal print head, a dot-addressable graphics mode, 96 ASCII and 32 international characters and a reloadable cartridge ribbon. Centronics-type parallel and RS232C serial interfaces are available. Price is not yet available.

Siemens Corp. demonstrated a prototpye ink-jet printer with 28 nozzles and a 180-dpi density. The printer, aimed at word-processing applications, was part of the company's OEM products exhibit. Siemens OEM marketer, Reinhard Christgau, reveals that the unit's 28 nozzles compare with the 12 available on Siemens's high-end commercially available PT8012, which is sold in the U.S. as the 2712. The prototype's speed is 200 to 270 cps, depending on the complexity of the printed matter. The 2712's speed is 270 cps. Christgau says the high-density unit needs further technical development and notes that Siemens is waiting for a de facto density standard for ink-jet, word-processing printers.

Facit introduced its Twist video terminal, which can be rotated 90 degrees. The display unit includes all logic and electronics and is integrated with a 15-in., 40-MHz monitor. The monitor can be tilted, lifted and twisted. Twist comes in VT100, ANSI and other compatible versions. The U.S. price is expected to be about $2100 in single-unit quantities and is scheduled to be available in the third quarter of this year.

Hewlett-Packard Co.'s booth caught the eye of many passersby with the model 3081 ruggedized data-entry terminal, which was demonstrated in a fish tank. The product, a prototype developed in Grenoble, France, is expected to be introduced next month in the U.S. First shipments are scheduled for the end of August. The product is targeted at applications in rugged industrial environments in which the air contains particulates. An alphanumeric version and a version that can be used with bar-code readers are available. The terminal has a 1-line, 32-character display. It has no power supply, but a 92922A four-channel adapter used with a larger computer can convert the terminal's current loop to RS232C input. Price per terminal, excluding the interface and host computer, is expected to be about $1000 to $1100.

Toshiba Corp.'s prototype integrated voice/data system is expected to become the core of the company's office-automation systems. Company officials will not say when the product will be comercially available. The product has three subsystems. One is an integrated voice/data PBX that runs on telephone lines and has a capacity of 32 trunks with 120 lines. The second is an integrated voice/facsimile/text mail system that can store a 40-sec. voice message for two hours. It can address as many as 100 locations. Elements needed for the subsystem include a push-button telephone, a high function set and a Computer Phone. The third subsystem, the Computer Phone, includes a video screen, a keyboard, and a telephone switchboard. Voice signals can move at 64K bps, and data can move at 48K bps. The Z80-based Computer Phone can digitally transmit voice, data, and graphics.

Nixdorf Computer AG, the parent of Nixdorf Computer Corp., Waltham, Mass., has three microcomputers and an artificial-intelligence system in the works. The microcomputers are intended to build a foundation for the company's office-automation strategy. Perhaps the most noteworthy of the three is a fault-tolerant, multiple-MC68000-based microcomputer running UNIX. It is the product of a joint effort with start-up Auragen, formerly Parallel Computer, New Jersey. The agreement allows Nixdorf to manufacture and market a derivative of the Auragen product in Europe under license, while both companies can market their respective versions of the product in the U.S. Nixdorf started a new division in Germany called Fault Tolerant Information Systems to handle the product. The product will initially be manufactured in Nixdorf's North Reading, Mass., plant. It will be introduced by Nixdorf in Europe and the U.S. in mid-1984.

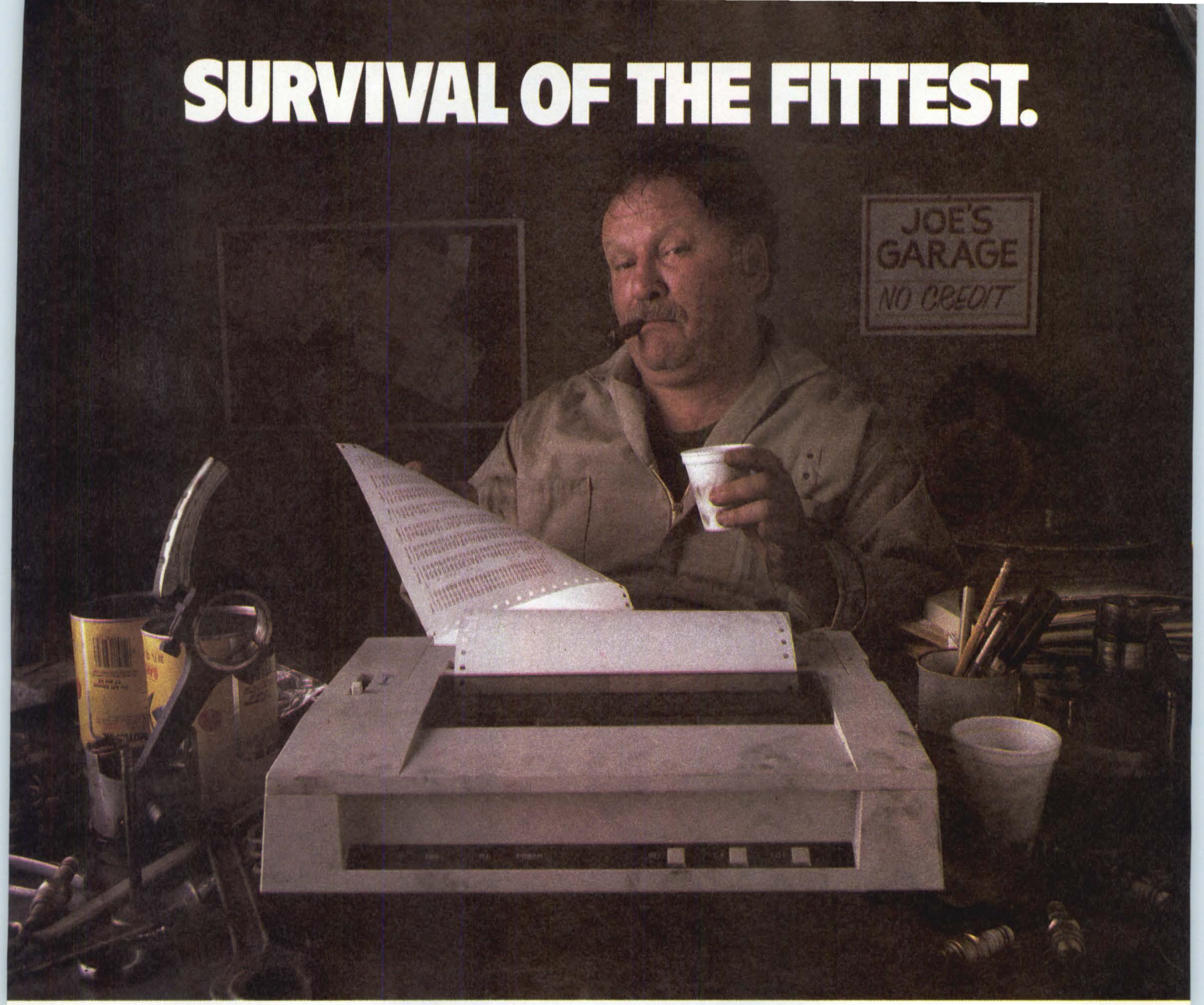
The fault-tolerant product, the 88FT system, will be targeted at manufacturing applications requiring resilience. Nixdorf will eventually turn the product toward office-

automation applications. Code-named "Delta," the computer employs dual 16M-bit-per-sec. system buses and dual 10M-bps cluster buses. Attached to the cluster buses are a message processor, an application processor, a disk controller, memory and an I/O controller. The system also has dual I/O buses, so that if the system fails, the peripherals can operate on the backup cluster. As many as 32 clusters can comprise the Delta system.

At NCC, look for...Priam Corp. to reintroduce its 5¼-in., high-performance drive some six months after removing it from the market because the company had wanted to concentrate on its 8- and 14-in. products. Observers expect the drive to be modified to meet the requirements of the new Enhanced Small Disk Interface and to accept a boost in capacity from 36M to more than 50M bytes....**Fujitsu America Inc.**, meanwhile, has followed its usual pattern in doubling the capacity of its 8-in.,2312K drives from 84M to168M bytes at a 25-percent increase in price. The drive will be shown for the first time at NCC....**Maxtor Corp.**, which recently shipped its first evaluation units of the eight-platter, 5¼-in., 140M-byte drive announced at last fall's Comdex, will introduce four drives with various numbers of platters. The drives range from a low-end, two-platter model with 75M bytes to a high-end, eight-platter, 380M-byte version. The drives will implement the ESDI and run-length-limited code....**Tandon Corp.** will add a 50M-byte disk drive to the high end of its line to accompany its new 50M-byte, ¼-in. tape drive. Both the tape and disk drives will operate from the same controller....If **Cynthia Peripheral Corp.'s** French parent, Cii Honeywell Bull, puts the finishing touches on a 70M-byte, 5¼-in. disk drive employing thin-film heads and plated media, Cynthia will show the drive at its NCC booth. Cynthia will formally unveil the first member of a family of high-speed printers incorporating the magnetic technology developed by Cii Honeywell Bull (MMS, January, p. 169). Cynthia showed a prototype magnetic printer privately at last year's Houston show. Cynthia president Francois Peleyras reveals the printer will be a mid-range unit in a planned family of six and will operate at nearly 90 pages per min. He says evaluation units will be available by the third quarter of this year, and volume shipments will start in early 1984 ....**Altos Computer Systems** plans to introduce an optional communications board that adds an Ethernet interface and four serial ports to its multi-user 586 system. The price is approximately $1500. Installed 586s with the Multibus option can be upgraded in the field. Also due from Altos, Anaheim, Calif., is the formal announcement of the Altos II terminal that has been appearing in the company's ads since November. The ANSI 3.64-compatible Altos II features a 14-in. screen, 80/132 columns, smooth scrolling in forward and reverse, a time-out screen saver, double-height/double-width characters, character graphics and 16 programmable function keys....**Gould S.E.L.'s** booth will serve as a launchpad for the company's new Distributed Systems family and as a showcase for a Convergent Technologies Inc. workstation that Convergent does not plan to ship until 1984. The new Gould line, which has its own business unit under John Muczko, includes products based on Convergent's MegaFrame multiple-MC68000/UNIX system (MMS, April, p. 157), Gould-built Advanced Micro Devices 2091-based systems and a version of the Concept 32/87. The new low-end Convergent workstation, which is based on the Intel 80186, is said to have a list price as low as $5000 and is packaged in snap-together modules with a variety of floppy and hard disk options. The desk-top system runs XENIX, CP/M-86, MS-DOS and Convergent's CTOS operating system. Convergent officials point out they are not planning to enter the personal computer market.

Graphics Files: Tektronix Inc.'s locally programmable graphics terminals, which run CP/M-86, should be available with a run-time version of UNIX in early 1984. The Beaverton, Ore., firm also is making the first move toward price reductions of its high-end terminals by implementing their architectures in proprietary VLSI....Look for **Genisco Computers Corp.** to appear with two higher performance, rack-mount versions of its 6100 terminal. Genisco says the new units will better serve its traditional base of system integrators. The display systems include Gencore, Genisco's proprietary local software that performs most of the 3D graphics manipulation functions specified in SIGGRAPH's Core recommendation. The 6210's resolution is 1392 × 1024, interlaced, while the 6220

SURVIVAL OF THE FITTEST.

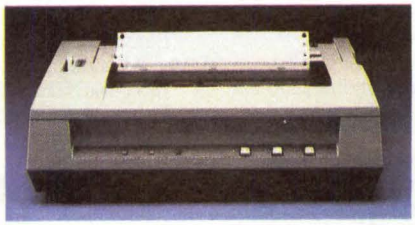


Ask major OEMS and they'll tell you that when it comes to reliable printers, the one they choose time and again is the C. Itoh 8510 Pro/Writer.

You see, many of today's printers achieve high speeds only by pushing their low-speed mechanisms to the limit of endurance. So what you seemingly gain in capabilities you lose in reliability.

C. Itoh's 8510 Pro/Writer, on the other hand, was designed from the very beginning to run at full speed (120 cps)—without breakdowns or noise. Its heavy duty stepper motor, base castings and synthetic-ruby print-head mechanism are built to take a lot of punishment. So you get superior print quality throughout its 100 million-plus character life.

The 8510 also offers advanced paper handling features. You get bi-directional tractor and friction feed capability to handle paper widths from 4.5" to 10." Positive paper positioning for rapid bi-directional paper motion without short repetitive motions. Manual form alignment—even with power on. And a print line that can be easily observed during printing.



Other features include built-in graphics with excellent resolution (144 x 160 dots per square inch). Five unique alphabets, eight character sizes. Mixed fonts during a single line pass bi-directionally. Variable form length, 6-channel electronic vertical formatting. The list goes on and on.

It's no wonder that so many major OEMs have selected the 8510 Pro/Writer design as their standard printer.

They know that in the real world, only the fittest survive.

For full details, contact C. Itoh Electronics, Inc., 5301 Beethoven Street, Los Angeles, CA 90066. (213) 306-6700.

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The NPC-764 includes a 48-channel State Analyzer and a 16-channel, high-speed Timing Analyzer. And, as optional plug-ins, a single-channel Digital Storage Oscilloscope, a 5-function Counter-Timer/Signature Analyzer, and bidirectional Serial Tester.

But the NPC-764 is more than just a multiple-function instrument. It also incorporates a GPIB controller and RS-232 MASTER/SLAVE capability. Standard. A common set of commands lets you control the internal analyzers and any GPIB- or RS-232-compatible devices you include in your setup—pattern generators, emulators, spectrum analyzers, PROM programmers . . .

And that's not all. The NPC-764 is a full desk-top computer, with floppy disk storage and a CP/M® operating system. Use it for general-purpose computational tasks or the execution of commercially available CP/M programs.

The NPC-764, with all its internal measurement functions, requires less than *half* the investment of the equivalent instruments purchased separately. And the ASCII keyboard and menus are so user friendly it sets a new standard for the industry.

Not quite ready for all this capability? Start with our basic NPC-748. It provides exactly the same measurement functions, but 16 fewer state channels and no floppy disk drive. Upgrade easily to the NPC-764 at any time.

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offers 768 × 512, noninterlaced. Both include 512K bytes of display list memory expandable to 1M byte, a 19-in. monitor, a detachable keyboard with an adjustable-rate joystick,an asynchronous serial host interface, six additional interactive device ports, a full-screen interactive cursor and display of as many as 4096 colors from a palette of 16 million. Single-unit suggested list price is $21,950 for either of the 6200 family display systems....**Megatek Corp.** will introduce its 1645 terminal at NCC. The 1645 is a 1280-× 980-dot resolution, black-and-white version of the 640 × 480 1650 desk-top color graphics terminal. Both terminals feature display list processing and a separate VT100-compatible alphanumeric plane. Also coming soon from Megatek is a 50K-baud interface to IBM 4300 series mainframes....**Zentec Corp.'s** entry into graphics is a 640-× 480-dot resolution, eight-color terminal that will compete with the new Tektronix 4107 and Envision 220 terminals of the same resolution. The Zentec graphics terminal is an 8-MHz, 8086-based unit using the NEC 7220 graphics controller. An Intel 8087 co-processor option will be available to bolster performance when 8-MHz 8087s are available from Intel. Display list storage and full local-transformation capabilities will be available soon thereafter. The terminal's single-unit suggested list price is less that $7000. The terminal is the basis for a Zentec 2000-series color workstation running UNIX.

DEXPO Preview: DEXPO/East will be held May 22-24 at Kiel Auditorium in St. Louis. Representative new products to be featured at the show include a file-transfer networking package using the IEEE-488 bus standard. It is scheduled to be announced by **National Instruments Corp.**, Austin. NET488 links any combination of Unibus- and Q-bus-based computers running under RSX-11, RT-11, UNIX or the VMS operating system. The operator interface to the file-transfer software consists of simple query responses. File transfers also can be initiated from user-written application programs. List price for an NET488 package, including hardware and software for a network of four Q-bus-based computers (with 50m. separation) running RT-11, is $15,000....**Applied Information Systems Inc.**, Chapel Hill, N.C., is expected to announce a full-screen forms-design and data-entry system for the Digital Equipment Corp. Professional 300 series. EasyEntry, which also runs on PDP-11 and VAX computers, allows the Professional to be used as an application-development system or as a data-entry station. AIS also should announce run-time support for the AIS-PL/1 compiler on the Professional 350....More software that can be down-loaded from the PDP-11 and VAX to the Professional 300 series is the CT*OS office-automation package from **Compu-Tome Inc.**, Pasadena, Calif. The system features word processing with spelling correction, a spread sheet, electronic mail and the ability to transfer CT*OS files to PDP-11 or VAX computers that also have CT*OS installed....**SAS Institute Inc.**, Cary, N.C., will show the Beta test version of an integrated decision-support tool for the VAX/VMS. The portable SAS system offers data-management, statistical-analysis, word-processing, color-graphics, interactive data-entry and edit and retrieval functions. The system will also be marketed by DEC. First-year licenses will range from $5000 to $7500....**Minntronics Corp.**, St. Paul, Minn., will show several DEC-compatible cache-memory and interface boards for the first time. Minntronics claims its cache-memory board for the PDP-11/34, -11/35 and -11/40 and the board for the -11/45, -11/50 and -11/55 speed system performance by as much as 50 percent. A quad serial interface board is said to provide the functional equivalent of four standard DEC DL-11s on a single quad-sized board, and another model is said to provide the functional equivalent of four standard DL-11E boards. Minntronics will also show the Octomux eight-port serial multiplexer that is a replacement for two DZV-11 boards....An MC68000-based security system for one or more computers will be demonstrated by **Compion Corp.**, Urbana, Ill. The Protector provides six security functions independent of the host controls: access control, command filtering, audit capture and trail search, encryption and user authentication....**Nassau Systems**, Cincinnati, will display an over-temperature-protection system for all DEC computers equipped with DEC standard power control and distribution.

The system sounds a warning alarm and shuts down power at pre-set temperature limits specified in DEC field-service contracts. The system is said to be endorsed by DEC field-service operations....**Computer Mathematics Corp.**, Culver City, Calif., will demonstrate a program for VAXs that performs mathematical manipulation in symbolic form. Targeted for industrial and university applications, the symbolic-manipulation program is said to perform the most common mathematical operations, such as manipulating polynomials and rational functions, solving linear and non-linear equations and graphing mathematical expressions in 2D or 3D....**Disc Tech One Inc.**, Santa Barbara, Calif. will unveil two DEC-compatible, rack-mountable disk drives. The 80M-byte model is RM0-2 compatible, and the 160M-byte model is compatible with two RA-80s.

Micro Files: Corona Data Systems had hoped to raise about $3 million in venture capital last fall, but could not put together an acceptable deal. After shipments of its IBM PC-compatible systems commenced last winter, however, the company was able to scrape up $5.5 million in first-round financing from an eight-member group led by Burr, Egan & Deleage. The company planned to start shipping limited numbers of its portable PC this month....As **Pertec Computer Corp.** gets ready to expand its hardware line with higher and lower end versions of its year-old MC68000-based systems family, the company is also expected to broaden its software repertoire by starting to offer the Pick operating system this spring....**Intel Corp. hoped to announce the first of a group of Ada-oriented products for the 32-bit iAPX 432 chip set by the beginning of this month.** David Mayes, Intel's marketing director for Northern Europe, says the products resulted from close cooperation between Intel and High Integrity Systems, Sawbridgeworth, England. Mayes says High Integrity has expertise with both Ada and 432 technologies. High Integrity has been developing the HIS 432, an OEM implementation of a 432 system product. Mayes says Intel and High Integrity are looking at "the exchange of rights on products." High Integrity is also helping Systime Plc, Leeds, England, with a powerful fail-safe database file server based on four 432 processors. It will be programmed in Ada and aimed at networked systems. Control Data Corp. is acquiring a 38-percent share in Systime, which is one of the largest system integrators in Europe. Systime managing director John Gow says CDC is interested in the database machine, which will be built in Leeds....**Silicon Valley Micro Inc.**, a Cupertino, Calif., start-up looking for venture capital, suffers no lack of ambition. The company made a low-key appearance at the West Coast Computer Faire to encourage software companies to develop applications in the 94 vertical markets it considers suitable for one of its four planned models, two of which will be portables. Lack of a target machine should not hinder such third-party development much, the company claims, since even their low-end desk-top computer will concurrently run at least UNIX, the UCSD p-system and CP/M. Zilog Inc.'s Z80, Commodore Business Machines'/MOS Technology's 6502, Intel Corp.'s 8088, National Semiconductor Corp.'s 32032 and Motorola Inc.'s 68020 processors will be available on the bus, with Intel's iAPX 386 to follow when it is released. The last three processors listed have full 32-bit data paths internally and externally; Silicon Valley Micro expects to be the second company, after Hewlett-Packard Co. with its HP9000, to introduce a full 32-bit microcomputer. One last wrinkle: Silicon Valley Micro's unit will add bit-slice emulation of Digital Equipment Corp.'s VAX computers to run that library of software as well. The company is evaluating whether to do volume production offshore or with robotics in the U.S. Plans call for a prototype within 10 months of initial funding and public unveiling in the spring of 1984.

Printer Files: The acquisition of Data Printer Corp. by Printronix Inc. appears a near certainty, with the definitive agreement between the two companies now complete. Printronix is also moving ahead with its patent-infringement suit against C. Itoh and Citizen Watch Co. Ltd., the U.S. distributor and Japanese manufacturer of a matrix line printer that Printronix alleges violates its patented technology.

When you're costing out a computer system, you've got to put a very sharp pencil to the paper.

Because adding value can be a losing proposition if your software has to make up for shortcomings of the hardware. Which is bound to be the case if the hardware has to fit every situation.

Or suppose you're scaling up the system from a low-end, single-user version to a large-scale, multi-user configuration. If your value added software has to be rewritten to fully utilize the capabilities of the bigger system, you also lose on a large scale.

THE FLEXIBLE OMNIX.

The answer is adaptability. OMNIX is built around a 16-bit processor, two 5.25" Floppy Disks, a nine-slot card cage (for lots of expansion), and four asynchronous I/O channels.

When it's time to add more on-line storage, OMNIX is ready with 5, 10, 15 and 20 Mbyte (formatted) Winchester disks. And, if the end-user requires additional I/O, up to 16 asynchronous channels are available.

All this without costly and time-consuming SYSGENS. Only a few menu-driven parameters need be adjusted.

It's also reassuring to know that OMNIX is upgradable through the entire Computer-Automation NAKED MINI 4 line of computers. This gives the OEM and end-user an unlimited growth path with virtually no application reprogramming.

And, to take advantage of the abundant offerings of CPM compatible software, OMNIX offers the CP-80 8-bit co-processor which allows concurrent operation of CPM and OMNIX applications.

THE ADAPTABLE OMNIX.

Then there's the software. To speed up the development of your application software, OMNIX utilizes our Trans-Basic compiler which combines the data handling power of COBOL with the programming ease of BASIC. The file access methods and data handling features provide you with enormous flexibility in tailoring the system to specific application requirements.

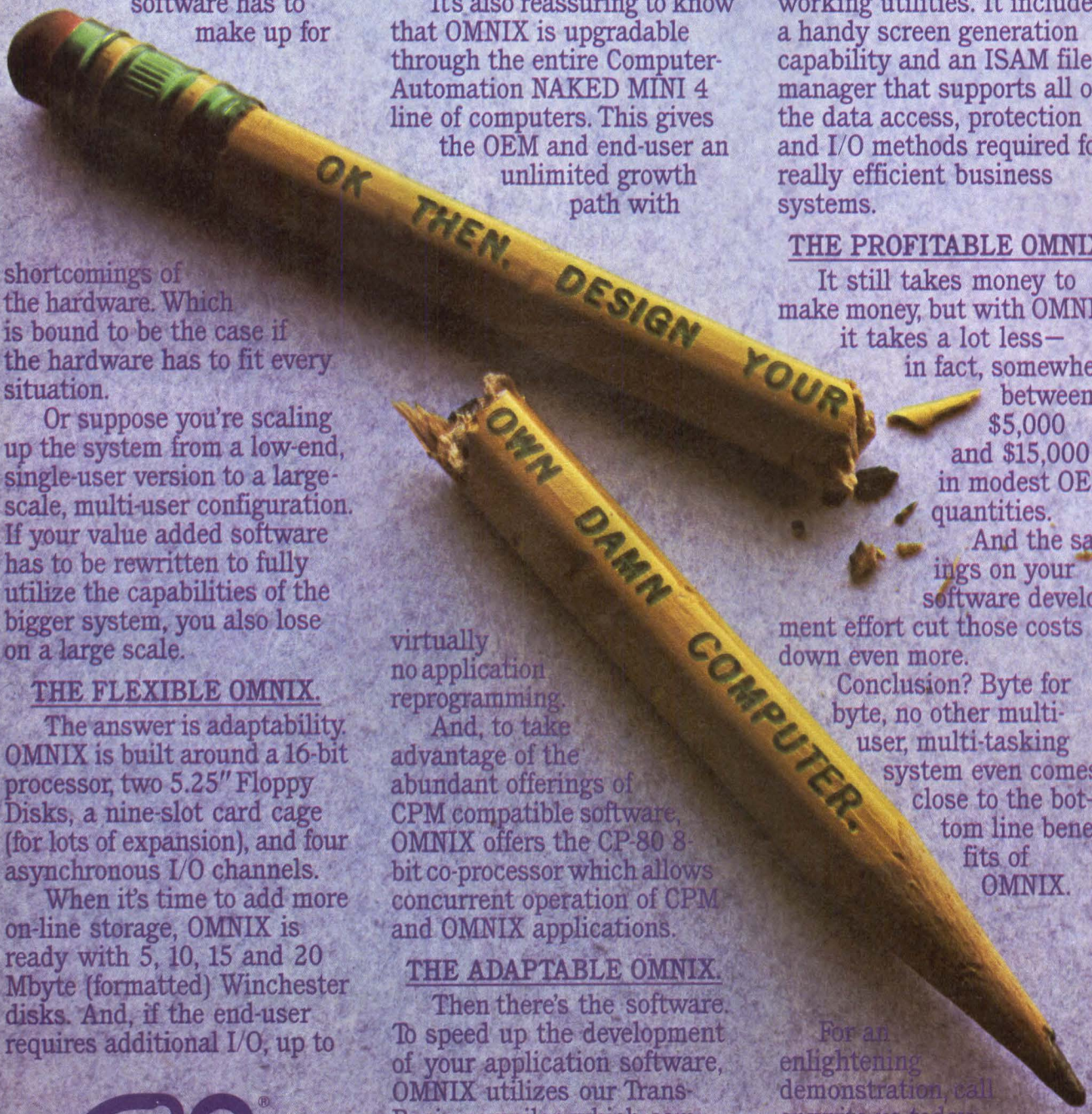
Our powerful multi-user operating system gives you a full complement of hard-working utilities. It includes a handy screen generation capability and an ISAM file manager that supports all of the data access, protection and I/O methods required for really efficient business systems.

THE PROFITABLE OMNIX.

It still takes money to make money, but with OMNIX it takes a lot less—in fact, somewhere between $5,000 and $15,000 in modest OEM quantities.

And the savings on your software development effort cut those costs down even more.

Conclusion? Byte for byte, no other multi-user, multi-tasking system even comes close to the bottom line benefits of OMNIX.



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John Faivre
Ernest Sandoval
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Jerry Resnikoff

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Take a look at PPC™! Short for Pertec Peripherals Corporation, our new name symbolizes not only a new autonomy (from Pertec Computer Corporation), but a new dedication to aggressive leadership in tape technology. Our engineers are committed to ensuring that "state-of-the-art" starts with PPC—and we're backing them with double the R & D dollars to help them meet that challenge. Frankly, with over 100,000 tape drives shipped, we owe it to our customers worldwide to provide the newest and best solutions possible for OEM tape requirements.

Introducing the VINDICATOR.™ Our fine engineering team has combined the economy of streaming tape with extended gap start/stop performance in PPC's new VINDICATOR. The gap is front panel selectable from 0.6" to 10," which allows for the optimization of throughput and capacity and makes the VINDICATOR a logical choice for traditionally non-streaming applications.

The VINDICATOR ½-inch streaming tape drive offers 46 or 92Mb capacity and includes many automatic features to meet OEM demands for high reliability and a minimum of operator intervention. For example, the drawer mount VINDICATOR provides auto-load, load-on-line, auto power restart, a diagnostic package with automatic self-test on power up and a programmable front panel. Whether you have traditional or backup applications, the low cost, high performance VINDICATOR is the clear OEM choice.

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In today's everybody-wants-a-piece-of-it desktop market, manufacturers are sending more and more systems into the office.

And customers are sending more and more back—because of drive problems.

To counter this counter-movement, Shugart offers two solutions:

Our SA460 and SA600 desktop drives.

Each has unique features that make the drive dependable when it really has to be.

Take our 96TPI double-sided Minifloppy,™ the SA460. Its 4-step-per-track, HeliCam™ lead screw actuator makes head positioning faster. More accurate. More reliable. So diskettes can be switched without a hitch. And changes in environment won't mean changes in data.

The heads are specially contoured to optimize compliance. For improved signal/noise ratio. Minimum media wear. And increased data reliability.

All of which comes in a high performance design, with up to 1 megabyte of storage. (Incidentally, for those who don't need as much storage, our single-sided SA410 gives you the same reliability and performance at an even lower cost.)

For applications that require yet more capacity and performance, we have another 5¼" solution. The fixed disk SA600.

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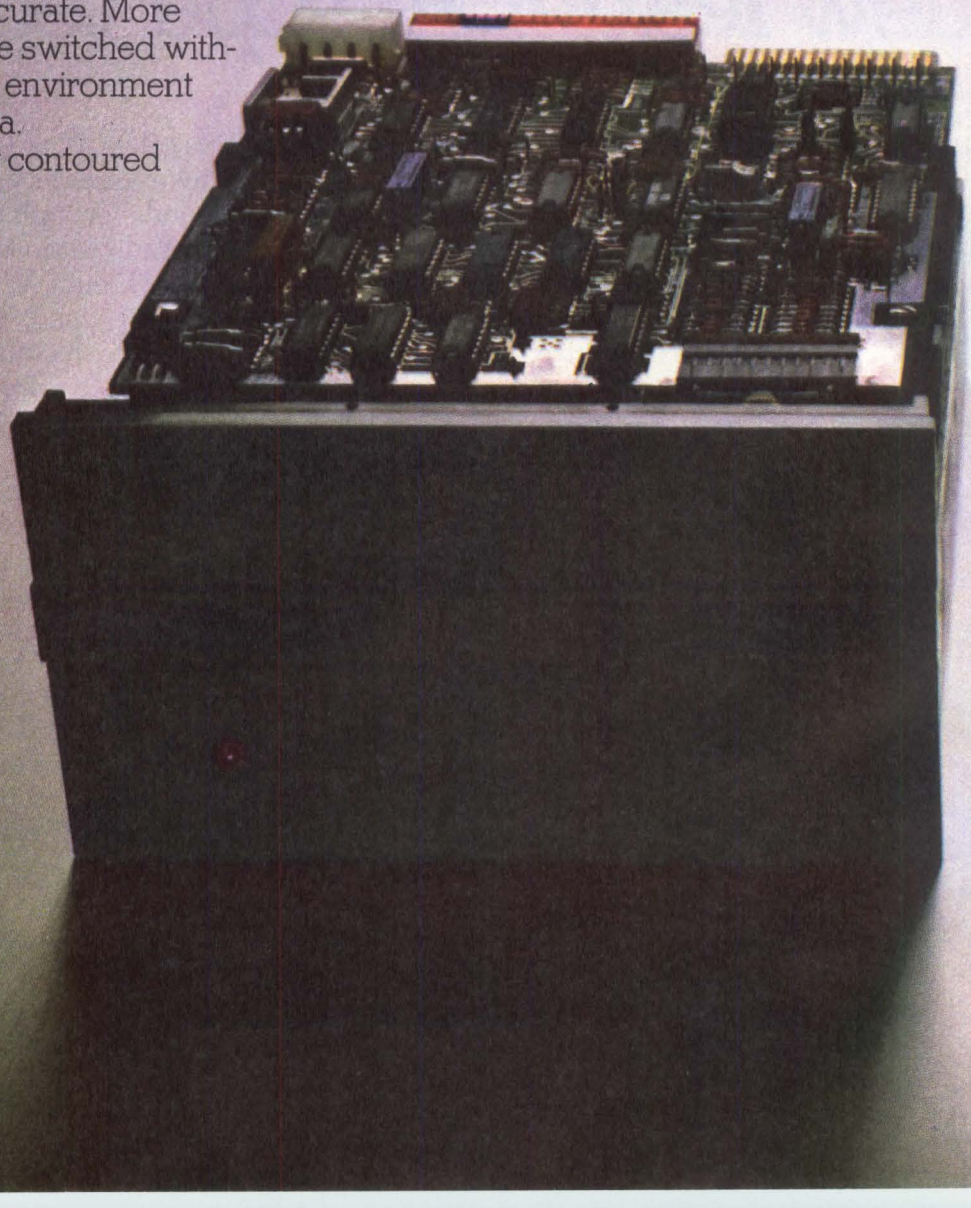

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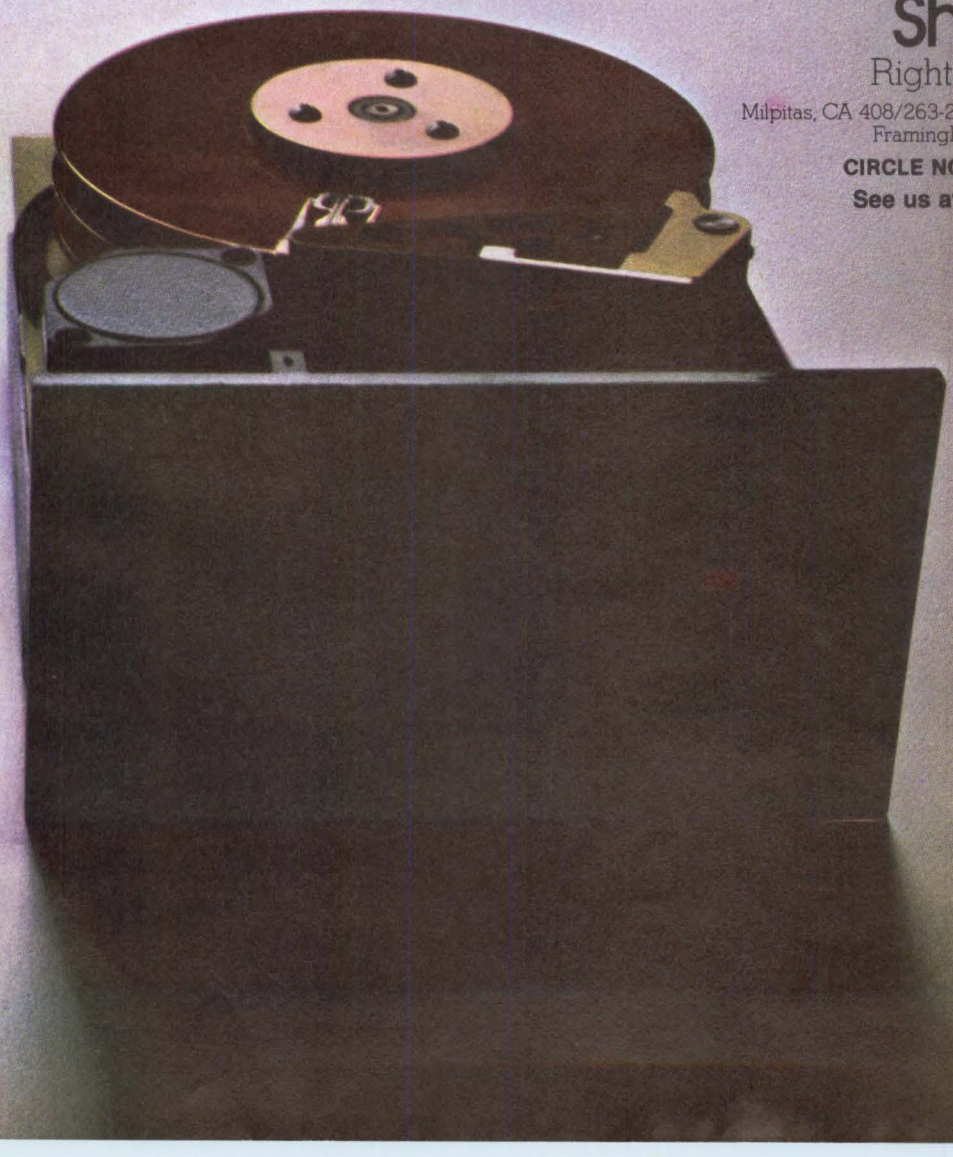

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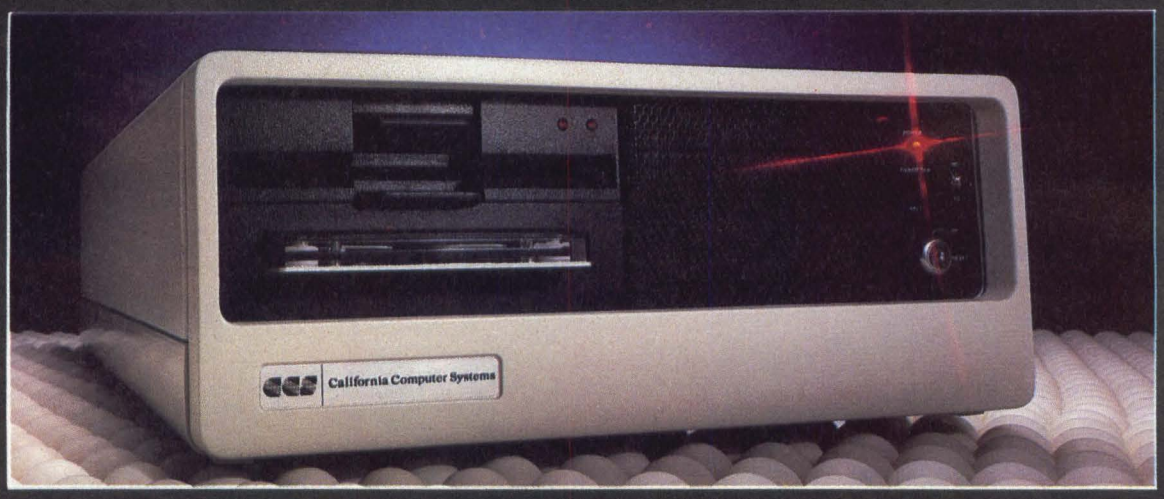

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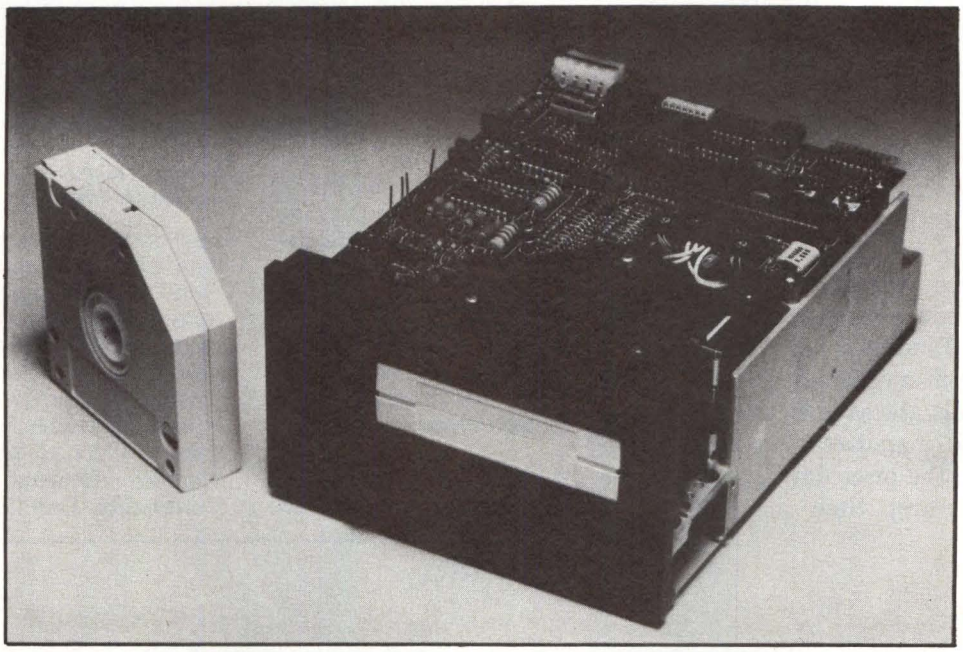
CIRCLE NO. 15 ON INQUIRY CARD

Tandon enters the reel world



Tandon Corp.'s TM951 ½-in. streaming tape-cartridge drive *is the disk drive manufacturer's first tape drive product. The drive has a 50M-byte capacity. Price will be in the $500 to $800 range in OEM quantities of 10,000 or more.*

With the market for higher capacity storage products for small computers and office-automation equipment beckoning, Tandon Corp. is extending its already-broad and vertically integrated disk drive line with a ½-in. streaming-tape drive that can back up a 50M-byte 5¼-in. Winchester drive (see "Tape drives emerge as need for small-computer disk backup grows," p. 24). The TM951, to be introduced at the NCC, marks Tandon's entry into the disk-backup market and the first product the company has developed.

Until now, Tandon has taken proven products and added its manufacturing efficiency to produce massive volumes of products at very competitive costs. Tandon offers a line of half-height 5¼-in. floppy and Winchester drives, 8-in. half-height floppy drives and 3½-in. microfloppy drives. Such a lineup, coupled with the ability to reach the recent milestone of delivering 1 million 5¼-in. floppy drives, gives Tandon an apparent advantage in successfully entering a new market and technology. "The TM951 is physically compatible and electronically similar to both standard 5¼-in. flexible and Winchester disk drives," says Sirjang Lal Tandon, company chairman and president. "An OEM price of less than $15 per megabyte provides an affordable backup medium for computers using the new higher capacity Winchester drives."

A video-style single-reel cartridge of standard ½-in. computer tape with 20 recording tracks is incorporated into the drive. Reading and writing can be done in both directions through a serpentine recording format of standard MFM. The recording heads are similar to those used in floppy drives. Track density is 48 tpi. The drive's dual heads verify data by a read-after-write operation. Recording density is 6400 bpi, and speed is 39.1 ips. Data-transfer rates are the same as standard 5¼-in. floppy drives—250K bits per sec. The tape drive's single-reel cartridges, which can be stacked easily, are self-threading. They measure 1 × 3⅜ × 3⅜ in. The estimated OEM price is $20. Tandon has yet to announce second sources to manufacture the cartridge.

The drive's 50M-byte capacity places it at the low end of ½-in. tape drives that range to 400M bytes in large form factors. Most ¼-in.

streaming drives have capacities as high as 50M bytes, except for 3M Co.'s HLD 67 streamer that stores 67M bytes.

While the tape drive contains some firsts for Tandon, it fits well into the company's vertical integration strategy. The tape drive is one of the first on the market that can be controlled by a disk drive controller, meaning that a single controller board can operate both disk and tape. It is also the first tape drive to use floppy disk drive heads to read and write data.

Few in the industry need to be reminded that Tandon is also the largest manufacturer of floppy drive heads. As a result, the savings from the high-volume manufacturing of heads help keep the price down.

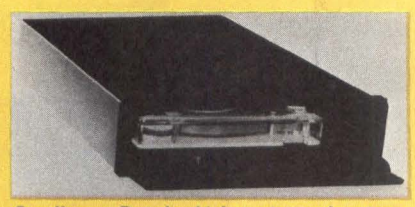
Yet, for the first time in its

TAPE DRIVES EMERGE AS NEED FOR SMALL-COMPUTER

After operating in the shadow of the more glamorous microcomputer and disk drive industries, tape drives—especially streaming drives—will undergo a boost at NCC. Wangtek and Tandberg Data, for example, were expected to unveil some of the first ¼-in. streaming-tape drives to use the QIC-24 interface standard.

At the core of the renewed interest is the industry's efforts—begun at the NCC in Houston last year—to standardize interface and format. The pressure was especially strong for the 5¼-in. disk drive form factor, for which high-performance operating systems such as UNIX made Winchester disks more attractive. Winchesters in turn cried out for high-speed, cost-efficient backup.

Now that the QIC-02 interface and the QIC-24 format standards have



Tandberg Data's ¼-in. streaming-tape drive *is one of the first to use the QIC-24 interface in the 5¼-in. form factor. Its capacity is 45M bytes.*

spawned interchangeability among data cartridges commonly used in ¼-in. streaming-tape drives, manufacturers are rushing to put into production their first 5¼-in. form factor drives with QIC standards.

Wangtek's QIC-24 compatible drive is expected to backup 45M bytes of data and double as an I/O device. Wangtek (formerly Wangco) is a Culver City, Calif., start-up founded

Two Exxon Enterprises veterans tackle portable-computer market in separate ventures

A concept put forth within the inner councils of Exxon Enterprises more than two years ago has emerged in two products. The concept is the computer in a briefcase, designed to fill the gap between limited-function, hand-held computers and bulky "portables" such as Osborne, Kaypro and Compaq.

Neither product bears the Exxon name, but both spring from companies established by Exxon alumni. The first, Gavilan Computer Corp., was established by former Zilog Inc., president Manny Fernandez after he left the Exxon semiconductor facility last year (see "A look at the Gavilan system," p. 26). MicroOffice Systems Technology was founded 18 months ago by James P. Dunn, who had been a member of the Exxon Enterprises corporate staff (see "A look at the MicroOffice Portawriter, "p. 26).

Given the same market requirements and similar technology, however, the two firms have come up with strikingly different solutions. The Gavilan product comes in with a basic $4000 price tag. It includes a proprietary operating system with an integrated application software environment and a touch-pad implementation of a mouse—sort of a traveling executive's Lisa. MicroOffice, on the other hand, has developed a $1500 CP/M package intended for high-volume distribution. Both are aimed at the unknown percentage of the nation's nearly 60 million white-collar workers who want a full-fledged personal computer to take home or to take with them on the road.

MicroOffice's Dunn maintains that he promoted the concept at Exxon meetings attended by Zilog staffers two years ago, but Gavilan's Fernandez says there's "absolutely no relationship between Exxon and us" and claims he "never saw anything like it" at Exxon. However, the two designs have more than a passing physical similarity. For example, both incorporate a RAM/ROM cartridge system with plug-in cartridges similar to those used in video games. Both systems accommodate as many as four such cartridges and feature partial-page LCDs housed in hinged lids. When the lids are lifted, both systems automatically boot up their operating-system software.

However, the systems may be more noteworthy for their differences. The two companies have handled

DISK BACKUP GROWS

by Ben Wang, founder of Wangco in the early 1970s.

Tanberg Data, the U.S. marketing arm of Tandberg Data A/S in Norway, will make available its TDC-3300 drive with a QIC-24 interface in the 5¼-in. form factor in 20M- and 45M-byte versions. Tandberg officials, however, say they will not put the 20M-byte version into production until there is demand for it. The drive will be manufactured in Norway and marketed in the U.S. Both the Tandberg and Wangtek drives are scheduled to go into production this summer, but the prices of the drives are unavailable.

Other companies, including Archive Corp., Data Electronics Inc. and Cipher Data Products Inc. also have 5¼-in. form factor, QIC-24 format drives in the works, but details were unavailable at press time.

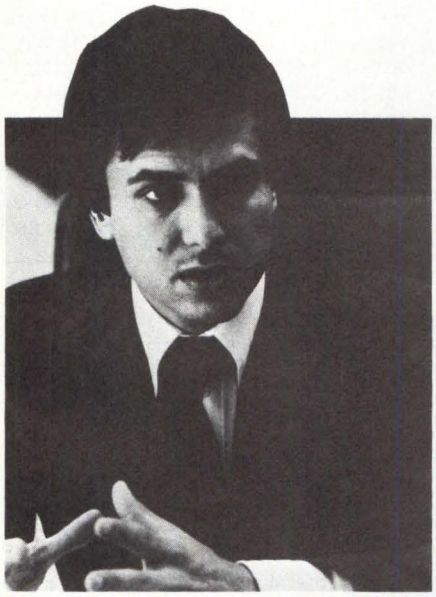
six-year history, with the TM951, Tandon is pioneering a product of its own. "This will be the first time they have the monkey on their own back," says Jim Porter, author of *Disk/Trend Report*. "They're going to have to do a lot of pioneering for the first time." Porter says that doesn't mean that the tape drive will be unsuccessful. To the contrary, he says, Tandon has the experience and the finances to weather the storms that come with any new product.

The price for the Tandon tape drive will be in the $500 to $800 range in OEM quantities of 10,000 or more. In contrast, the 45M-byte ½-in., 8-in. form factor Cipher Streamer from Cipher Data Products Inc. is priced at almost $2000 in the same quantities.

The drive is expected to be in production by July and will be manufactured in a new tape drive division in San Jose near Tandon's R&D labs which developed the drive. No second source for the drive is being negotiated.

A Tandon spokesman discounts concerns that the drive will not be well-accepted in the absence of a second source. He says customers will have more faith in the future of Tandon and its commitment to the tape drive and thus be willing to risk the lack of a second source. "If we were truly concerned about not having a second source, we could have easily set one up on our own," a Tandon spokesman says.

—Robert A. Sehr



Gavilan Computer Corp. president Manny Fernandez, *former Zilog president, claims Gavilan's briefcase computer concept was developed independently of Exxon, although MicroOffice's James P. Dunn, also an Exxon alumnus, claims to have promoted the concept at Exxon meetings two years ago.*

the trade-offs between what is technologically feasible and what is desirable in the target market differently. MicroOffice, for example, feels low power consumption and long battery life are more important than 16-bit microprocessor technology, and its system is built around the National Semiconductor Corp. NSC800 CMOS processor, an Intel 8085 architecture microprocessor. Gavilan opted for the more power-hungry, but increasingly popular Intel 8088.

MicroOffice, which received one-fourth of its $2 million in venture capital from Olivetti Corp., will provide hard-copy output through connections to Olivetti electronic typewriters. Gavilan has adopted a compact dot-matrix thermal ribbon printer that will be offered as a $1000 option and can be attached to the back of the system unit to form one rigid package. MicroOffice has chosen to forego disk storage in its systems's first version, but plans to offer a separate 5¼-in. disk in the future. Gavilan provides a 3-in. microfloppy and a controller that supports a second drive. For compactness, MicroOffice has omitted an RF modulator CRT hookup, which is standard on the Gavilan system, but Dunn claims advancements in LCD technology will enable his company to offer a full-page, bit-mapped display in the existing cabinet by 1985.

Fernandez and Dunn maintain their companies are headed for different parts of the market. "It's such a big market we'll never run into each other," Dunn says. That observation is borne out by projections recently compiled at InfoCorp, a Cupertino, Calif., market research firm. Richard J. Matlack, InfoCorp president, has identified the full-keyboard, battery-powered portable segment as the most rapidly growing among all mobile computer types (MMS, January, p. 54.) These products are expected to comprise a $2.3-billion market by 1987, and Matlack says there will be plenty of room in that field for both types of systems.

"A $1500 to $2000 CP/M system

like the MicroOffice product would be addressing the part of the market now addressed by Osborne, but with the added advantage of battery power and true portability," Matlack observes, adding that such a system should appeal to a broad base that approaches a mass market.

On the other hand, Matlack points out, the Gavilan MS/DOS/8088 combination clearly positions the Gavilan system in the professional market. He expects products like the Gavilan system to be more application specific. They will be sold into vertical markets in which, for example, public accounting and insurance firms provide traveling executives and sales personnel with custom applications. "The market is not as broad at that upper end, but it can be more lucrative. In those sales, price will not be as critical as functionality," Matlack says. He adds, however, that there will be heavy competition for that market and anticipates participation by IBM Corp. there in the next two or three months.

—Geoff Lewis

A LOOK AT THE GAVILAN SYSTEM

The 11.4- × 11.4- × 2.7-in. Gavilan computer weighs 9 lbs. and, Gavilan officials say, provides the data-processing and personal-productivity tools a traveling professional needs—in a format he can use. The well-heeled start-up, Gavilan Computer Corp. recently concluded a second round of venture financing to bring its capitalization to $8.5 million. It plans to ship its first systems in September.

The $4000 Gavilan package includes 80K bytes of built-in RAM sockets to plug in as many as four battery-powered RAM/ROM cartridges, a 3-in. floppy disk with a formatted capacity of 320K bytes, a full IBM PC-type keyboard, a 420- × 64-pixel LCD that has an 8-line × 66-character alphanumeric display format and a touch panel with a series of function keys and a central mouse that can be used to point to and select among data displayed on multiple screen windows. Options include a $1000, 50-cps thermal ribbon printer packaged in a separate 5-in.-deep, 5-lb. module that attaches to the back of the system unit. The disk drive controller accommodates a second 3-in. floppy drive. The disk drive section has space for a 128K-byte addition to system memory.

The Gavilan's system is powered by a rechargeable battery pack intended to deliver 8 hours of use on one charge, depending on the amount of disk activity. An optional printer has its own battery pack, which is designed to print 60,000 characters per charge.

Gavilan includes an RS232 interface and a built-in 300-bps modem with a direct telephone connection. The system also includes a CRT monitor interface for connection to a 24 × 80 monochrome display. The Gavilan LCD screen is supplied by Sharp, with Toshiba as a second source. The system is being shipped initially with Hitachi sub-4-in. drives, but can also accommodate floppies manufactured by Tandon Corp. Tabor Corp. or Sony Corp. company officials say.

Gavilan hopes to stand out in the portable market, however, with its software. "Most mobile professionals are naive users," says company president Manny Fernandez, explaining that Gavilan provides a proprietary operating system with a consistent user interface, a help facility and a set of five application programs. "The software is designed to help these professionals on the road. There is no

A LOOK AT THE MICROOFFICE PORTAWRITER

MicroOffice Systems Technology took many of the parts used by Gavilan Computer Corp. in its $4000 system and applied a "less-is-more" philosophy in putting together its Portawriter. The MicroOffice system weighs 5 lbs. and measures 11 × 7¾ × 2¾ in. and includes an 8-line × 80-character (64- × 480-pixel) display. The company hopes to prove less is more in pricing. At a suggested end-user price in the $1500 to $2000 range, the MicroOffice Portawriter is aimed at gaining more of the market—at least in unit sales.

While the Portawriter is aimed at the same mobile white-collar workers that Gavilan and other portable computer manufacturers have targeted, the MicroOffice view of that worker is slghtly different. "People want something as simple as a dictation machine and something that ties into existing systems," MicroOffice president James P. Dunn explains.

The Portawriter has a single-board CPU built around the NSC800 CMOS 8-bit microprocessor. Coupled with RAM and ROM program and data storage, Dunn claims the speed of the RAM disk delivers faster performance than a 16-bit microprocessor working with disk storage. As many as four 2- × 2-in. cartridges can be used simultaneously in the machine for a maximum of 128K bytes of plug-in memory and 64K bytes of built-in memory. Dunn says the CP/M-compatible operating system leaves a user with as much as 52K bytes of internal memory for work space.

MicroOffice plans to provide about eight standard applications in cartridge form. These will include four proprietary packages for text editing, scheduling, name and address files and TTY communications, emulating a Digital Equipment Corp. VT100 terminal and using a slide-in 300-bps modem module. A series of eight soft function keys at the top of the typewriter keyboard align with screen descriptors, which vary according to

room to bring along manuals, so it must be self-teaching. It must have a consistent interface that is highly visual like the Xerox Star, and it must be integrated because in the field you don't have the luxury of physically maneuvering between files," Fernandez says.

The result is the Gavilan operating system, which is compressed into 48K bytes, but which includes a data-structuring scheme that links Gavilan applications. As in Apple Computer Inc.'s Lisa and Xerox Corp.'s Star workstations, data are organized according to hypothetical file cabinets, drawers and folders. By moving a finger across the mouse area of the touch pad, an operator can move the cursor on the screen to point at data. By tapping the touch pad, he selects the data. The Gavilan system's applications are word processing, spread-sheet analysis, calendaring, communications and forms control.

"Our operating system will be 100-percent open to third-party software development," Fernandez says. "Any software package can be adapted to work under our data manager." Applications for the system can be developed under Pascal or BASIC using a development package that runs on the IBM PC. Price for that package has not been set. The Gavilan packages are published in cartridge form, and any four can be installed at once. Each cartridge has ROM, RAM and built-in batteries to maintain the RAM. In the word-processing carrtridge, for example, the basic program is in ROM, and a user's frequently used form letters are in RAM. The system automatically monitors the cartridge's battery charge and recharges the battery when the AC adapter is used. Similar cartridges can be used for adding as much as 128K bytes of memory to the system.

"We think the world also likes to use standard operating systems," Fernandez points out, "and, therefore, we think it would be irresponsible for us to offer this system without MS/DOS." For users who have more data-processing experience or those who own IBM PCs, the Gavilan system can appear as an IBM-compatible device —within the limitations of the LCD screen. The touch panel, which has 10 function-key areas for Gavilan operations, emulates IBM function keys when MS/DOS is loaded.

Fernandez is working with software developers and publishers to get software in Gavilan cartridges and 3-in. floppies.

John Duffy, Gavilan's vice president of marketing, says the system is being aimed primarily at private-label customers and "self-sufficient" OEMs in vertical markets, such as insurance companies. Another outlet is software houses that can configure portable versions of their vertical packages for the Gavilan system. The company has opened a European sales office in Geneva, Switzerland, from which it hopes to develop OEM sales through distributors. The company does not foresee channeling the system through U.S. retail distribution.

—Geoff Lewis

the program in use.

In addition to the MicroOffice packages, Dunn expects to supply several top-selling CP/M packages and is negotiating with software publishers to supply other packages in MicroOffice cartridge format. Dunn also expects OEM customers to write software onto MicroOffice cartridges. Dunn expects the data cartridges to be priced from about $50 for an 8K-byte package to $200 for the 32K-byte version.

To fit the computer into work routines, MicroOffice has plans with Olivetti to tie the Portawriter into Olivetti electronic typewriters. Initially in Europe, where Olivetti has exclusive distribution rights for the system, Olivetti will offer an adapter for its electronic typewriters, which will accept the data cartridges from the Portawriter for printout. Dunn reasons that the "decision maker" who will use the system will need to create documents but should not have to spend time editing, formatting and printing them. Similarly, the system will be able to interact with Olivetti's M20 personal computer. Plans for these connections to Olivetti systems sold in the U.S. were incomplete at press time. However, Olivetti-Docutel is expected to handle the product.

Dunn says the first Portawriter release—scheduled in the U.S. market this summer and through Olivetti this spring—will be followed by a 5¼-in. disk module to give users a mass-storage option. The unit, he says, may also include an Intel 8088 card running MS/DOS so that Portawriter users can run IBM PC software in their offices.

MicroOffice is looking for a handful of domestic OEMs and several major accounts such as insurance companies to purchase the system in large quantities. Dunn anticipates "controlled growth" in the first year, Dunn anticipates in the range of 5000 to 10,000 units and sales of as many as 20,000 systems in 1984.

Continues on page 32

HP's 64000 Logic Development and you won't worry

Timely Processor Support.
Ever have to settle for a second-choice microprocessor because language and emulation support wasn't available for your first choice? Put HP's 64000 Logic Development System in your lab and that frustration is gone.

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That's where new software often ends up. But the 64000, with the state analysis subsystem, gets you back on track quickly. First, because this analyzer speaks a programmer's language. Symbolic tracing lets you define parameters in familiar source-code symbols and labels. For example, you can instruct the analyzer to find sequences and trigger points by module names and labels. And with HP's directed-syntax softkeys, defining a measurement is usually just a matter of a few keystrokes.

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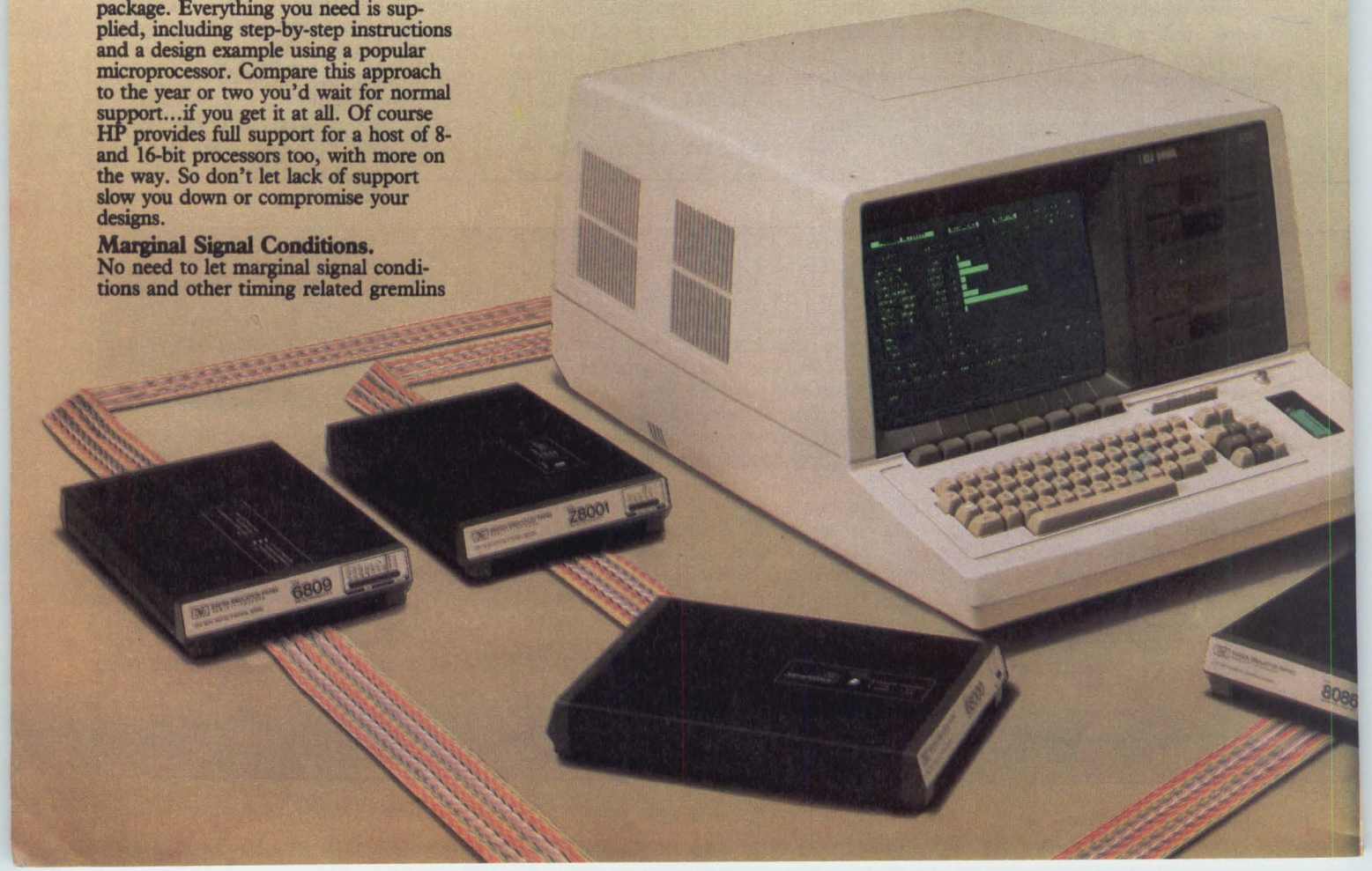
But it's also important to be able to position the measurement window with precision. We do that too.

Extended trace specification features let you navigate through complex code to the portion you want...and display only



System...standardize on a system like this about problems like these:

pertinent information. That's because you can combine trigger, store and count functions in any combination, to a total of eight terms, each as wide as the number of channels installed (to 120). Add to that the ability to define up to 15 sequence terms, or a combination of sequence terms and enable/disable windows, and there aren't many nooks or crannies where software bugs can hide. That means you'll debug software pronto.

Hardware/Software Fingerpointing.
Whose fault? Software or hardware? The 64000, with both timing and state subsystems, and even emulation, can resolve that quarrel in short order. That's because one subsystem can arm or trigger another for real-time interactive measurements.

For example, you can set the timing analyzer to trigger on a middle threshold that lasts too long. Then view state flow to see the affect. Or, you can trigger on state and view timing, which is useful for debugging I/O port malfunctions.

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Take this logical path in settling fingerpointing debates and you'll push those designs closer to production.

Software Bottlenecks.
The 64000, with software performance measurement capability, quickly eliminates these nightmares. Symbolic tracing makes measurements a programmer's dream. And histogram displays give you a graphic picture of bottlenecks and software inefficiencies. This new tool shows system activity as a function of software modules so you can see where the concentrated action is. You can determine how long it takes to execute a given module of code as you vary input parameters. See software traffic patterns. And compare software modules in terms of the percentage of time and occurrence they require in your programs.

These measurements are real-time, not post-processed trace data, which means you can interact with trace displays as well as perform overview measurements on single-shot events.

Blast through those bottlenecks and you'll enhance your system performance. That could give you a competitive edge.

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From start to finish of the development cycle, HP's 64000 Logic Development System can help you speed your designs along. It covers software development, downloading, emulation, hardware and software analysis, and system performance measurements. All with a single keyboard and display that speeds setups and simplifies measurement interpretation.

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Whichever mainframe you choose, you can configure for dedicated function or combination measurements. You can use each in a standalone situation or as part of a multiuser, distributed processing network. It's a development system that makes sense for labs both large and small.

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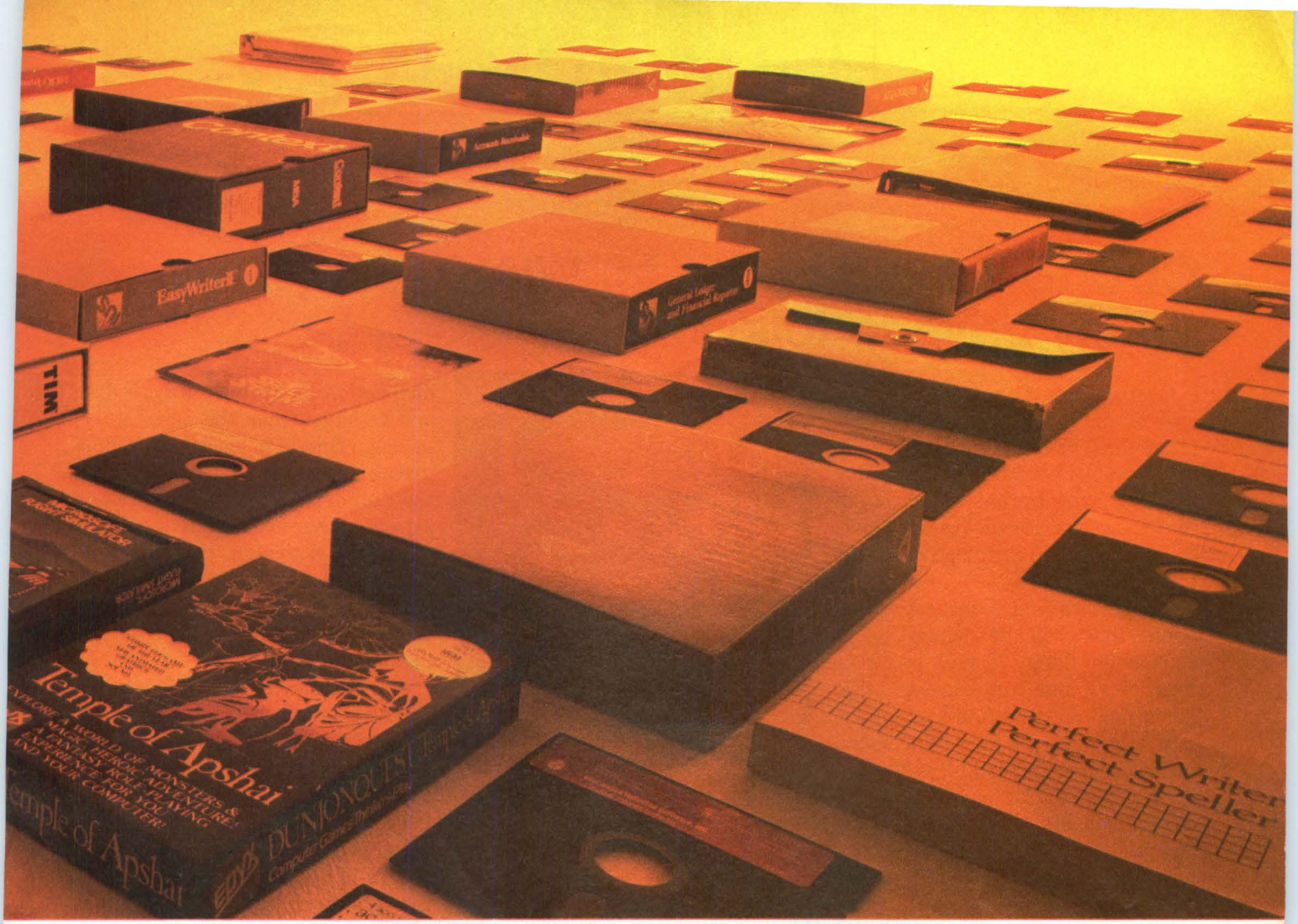

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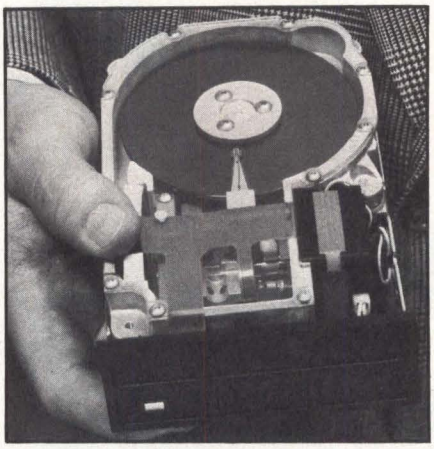
CIRCLE NO. 17 ON INQUIRY CARD

Continues from page 27

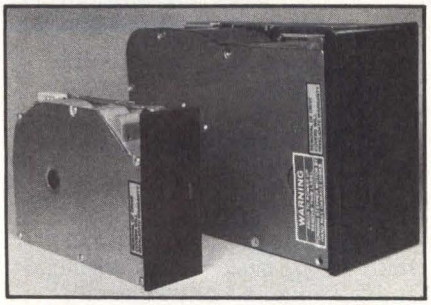
CDC to announce 3½-in. Winchester; floppy drive to follow

Control Data Corp. has dropped out of its lofty perches where heretofore "Larks" and "Wrens" were nested into the common meadow to hatch a pair of "Crickets" that it believes will leave the competition chirping well into the night.

Cricket, a 3½-in. Winchester disk drive that will be joined by a companion floppy drive, is CDC's first entry into the low-end disk drive field and the first U.S. entry into the sub-5¼-in. Winchester market. Most importantly, however, Cricket will be one of the first drives outside the IBM plug-compatible market to use thin-film-head technology.



CDC claims the thin-film-head technology *used in its 6.38M-byte 3½-in. Cricket Winchester disk drive is ideal for portable computers because the heads never actually touch the media, thereby lessening potential abuse.*



Designed for portable computers, Rodime Ltd.'s 3½-in. Winchester disk drive *occupies one-quarter the volume of Rodime's standard 5¼-in. Winchester and weighs 2.2 lbs. The Rodime drive, like the CDC drive, has a 6.38M-byte unformatted capacity on a single platter.*

Cricket is scheduled to make its debut at this month's National Computer Conference, at which it will share the spotlight with another 3½-in. drive from Scotland-based Rodime Ltd. The Rodime drive, which was introduced in Europe in March, uses conventional ferrite heads and oxide media.

Both the CDC and Rodime drives have 6.38M bytes of unformatted capacity on a single platter. Rodime also offers a second two-platter drive with 12.76M bytes of unformatted or 10M bytes of formatted capacity. Both CDC and Rodime are targeting the potential $2-billion portable-computer market that is in its infancy. CDC believes this market will give thin-film-head technology an important advantage.

Richard C. Stauning, manager of OEM marketing requirements for CDC, says portable computer users will require much more durability from both media and heads than current technology provides. Because portable units are by definition moved frequently, both heads and media are subject to intense abuse. Because thin-film heads never touch the media, there is less likelihood of media and head wear, Stauning says.

Rodime says it has answered the portability problem through the use of enhanced shock mountings and a dual-action brake to lock both disk and actuator when the drive is not in use. Thin-film heads also allow greater recording densities, giving the CDC drive a potentially greater capacity than competitive ferrite products. Although thin-film-head technology costs more than conventional heads, Stauning believes those costs will ultimately even out in volume production.

CDC manufactures thin-film heads for its line of IBM plug-compatible 14-in. disk drives and therefore has in-house availability of both heads and plated media. As a result, CDC believes it can avoid the trauma suffered by Seagate Technology in 1981 when it introduced a 5¼-in., thin-film-head drive that it was ultimately forced to withdraw from the market. Seagate depended on its fellow Dysan Corp.-supported vendor, Dastek Corp., which could not produce thin-film heads in the volumes required by Seagate. "We're prepared to turn these drives out in high volume," Stauning says, "and we'll be in production by the end of 1983."

The price of the drive is not yet available, but Stauning says the drive will compete with low-end, 5¼-in. Winchesters and SyQuest Technology Corp.'s 3.9-in. fixed/removable drive. Rodime also has not yet fixed a U.S. price on its drive as it will manufacture and distribute its drive only in Europe until it can get sufficient in production to supply the U.S. market. That should occur before the end of this year, Rodime officials say.

CDC does not elaborate on how many Cricket drives it is committed to produce in its first year, but says the company is dedicated to

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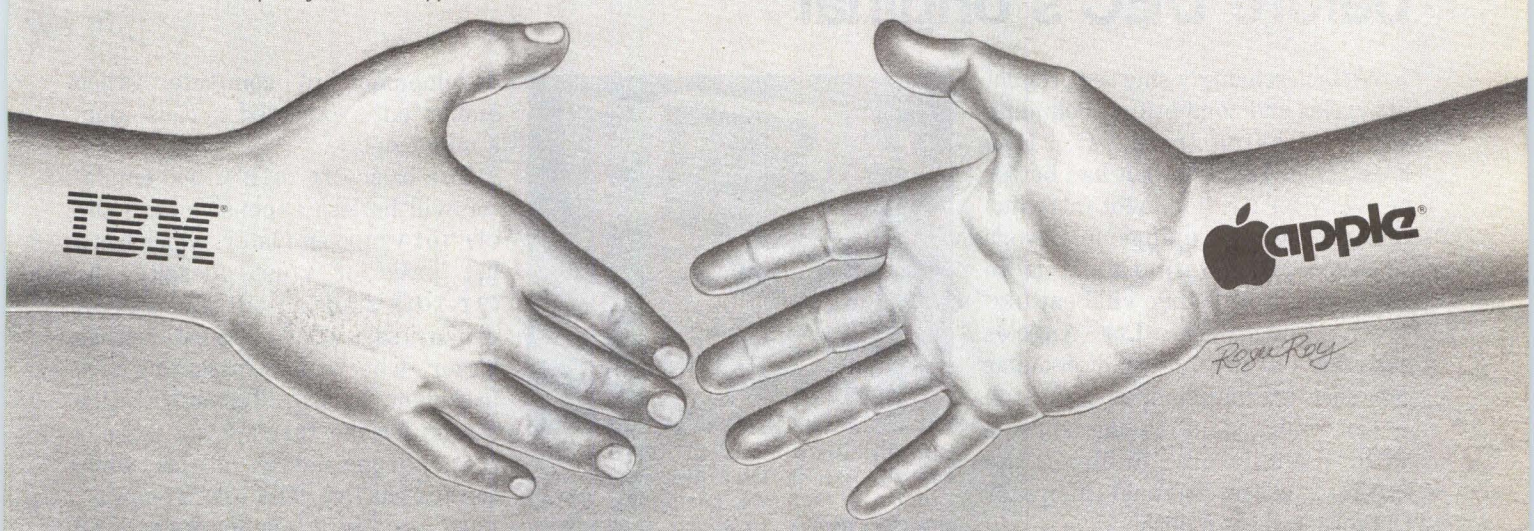

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competing head-on with high-volume, low-end rivals Seagate and Tandon Corp. "We are committed to reduce the integration costs for our customers through standardization while increasing the performance of our products," Stauning says.

The standardization effort includes CDC's commitment to the form factor proposed by an industry committee led by Shugart Associates and Verbatim Corp. CDC has supported the work of the industry committee "from a distance," Stauning says, since it fears active participation might invite antitrust questions. "There is no question that the 3½-in. form factor has become the de facto standard for sub-5¼-in. drives," Stauning says. "Most of the major suppliers of floppies, including Shugart and Tandon, have committed products to it."

Rodime is also firmly committed to the 3½-in. standard and has urged others to join the cause to clear the confusion facing system manufacturers looking for sub-5¼-in. drives. "If the disk drive industry is to fulfill its obligations to microcomputer manufacturers effectively, then it is imperative for us to establish the right standards, and quickly," says Malcolm Dudson, director of marketing for Rodime. "If this can be achieved, then microcomputer manufacturers will soon be able to choose from a wide variety of sub-5¼-in. Winchesters, all of which will be plug compatible with existing drives and systems."

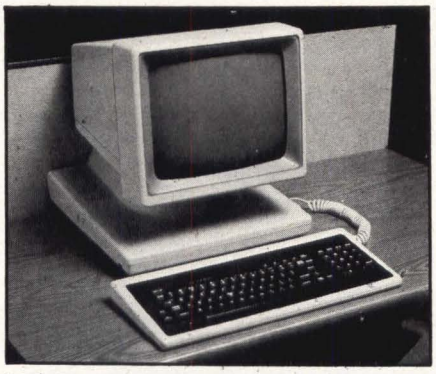
Stauning gives no estimate of when Cricket's companion floppy drive will be ready. The two drives were developed as separate projects, and the Winchester was completed in time for NCC. The floppy will probably be announced before this fall's Comdex.

—Robert A. Sehr

C. Itoh VT200 emulator anticipated before DEC's original

With increasingly shorter product life cycles and competition bounding at a dizzying rate, C. Itoh Electronics Inc. knows it had better be ready for the imminent introduction of Digital Equipment Corp.'s next-generation terminal. It is so ready that it probably will beat DEC to the punch. The Los Angeles subsidiary of the multi-billion-dollar Japanese trading company (C. Itoh & Co. Ltd.) plans to introduce a VT200 emulator, dubbed the CIT-101E, at the National Computer Conference this month.

Besides matching the VT200, which is expected to be an improved version of DEC's VT100 in the ergonomic skin of DEC's Professional Computer series, C. Itoh is also gearing up for a tough battle, with additional sales troops and a simplified, more responsive chain of command under a new banner, CIE Terminals Inc. CIE Terminals, Irvine, Calif., combines C. Itoh's terminal group with its exclusive U.S. sales agent, ACRO Corp.

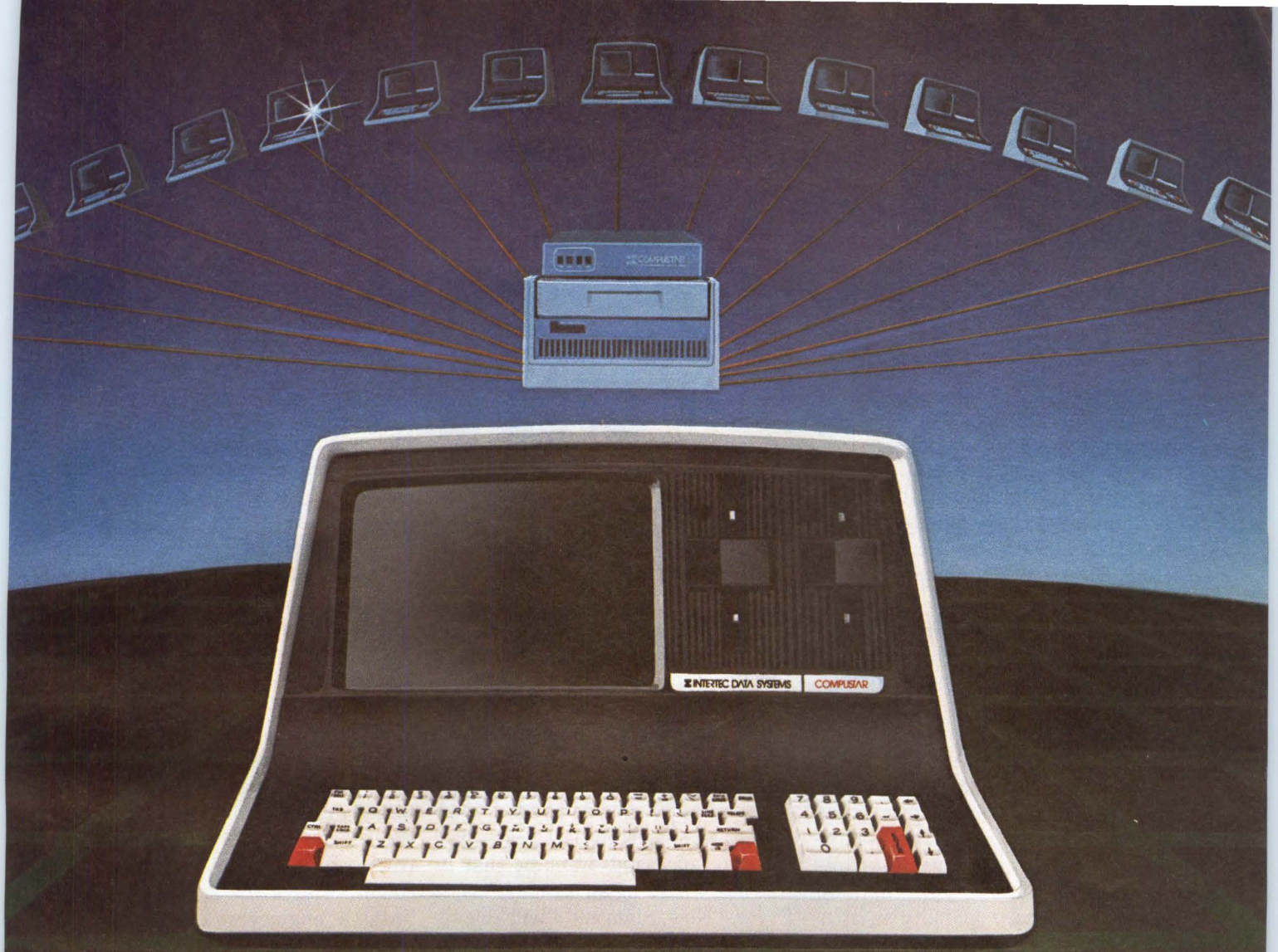


CIE Terminals Inc.'s CIT-101E VT200 emulator, *selling for $1695, will be less expensive than the company's VT100 emulator, despite an added tilt-and-swivel display feature on the new terminal. The CIT-101E will offer optional color bit-mapped graphics.*

C. Itoh says it sold more than 25,000 terminals last year, nearly all of which were VT100 emulators, through ACRO. Anticipating high-volume sales of VT200 products, CIE Terminals already has tooling completed for the next generation's 14-in. screen and the Professional/Rainbow style keyboard. Firmware development to complete VT200 emulation is expected to cause only a minor delay.

The basic CIT-101E VT200 emulator will be less expensive than the CIT-101 VT100 emulator, which has a list price of $1695, despite the CIT-101E's added tilt-and-swivel display, says ACRO co-founder Steve Fryer, who is now marketing vice president at CIE Terminals. One reason for the 101E's lower price is that only one slot is available, while the 101 has five. The 101E's one slot, however, will accommodate an optional card for color bit-mapped graphics that emulates the VT200's anticipated graphics option.

Fryer also expects the CIT-101E to carry a lower price than DEC's VT200. The VT200 price will not be known until DEC's formal announcement, which is not expected until July at the earliest. "It's not absolutely necessary, though," says Fryer. "On the last go-around, we've actually been as expensive as DEC without hurting our sales." He



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cites features such as an off-line indicator light and printer port, neither of which are offered on the VT100 by DEC, and C. Itoh's reputation for high quality as reasons for the emulator's success without a price advantage.

This strategy is essentially the same as the thinking that first brought ACRO Corp. founders Fryer and Harry Slam together with C. Itoh Electronics president Mark Tageouchi in 1979. Slam and Fryer saw that DEC's VT100—the first terminal with double-height, double-width characters, smooth scrolling, split screen, a detachable keyboard and ANSI X3.64 code structure would create a huge market—the worldwide installed base of the VT100 family is approaching 500,000. But unlike other companies with business plans perhaps unwittingly pinned on DEC's momentary inability in 1979 to keep up with demand for the VT100, Fryer and Slam felt high quality and precise emulation were the most important factors for long-term success. Tageouchi, through C. Itoh's influence in Japan, gave ACRO access to the quality of Japanese manufacturing and the precision of Japanese engineering. The resulting products, the CIT-101 and its successors (all VT100 family emulators), which first appeared in prototype form at NCC 1980, have sold well enough to make C. Itoh one of the top seven independent terminal suppliers.

Fryer says the other key to CIE Terminals' potential is the financial and managerial backing of C. Itoh, which will allow the new company to put twice as many people behind sales efforts and to free salespeople from management demands. "Our growth—450 percent last year—has been so quick and dramatic that it was like wrestling an octopus," says Fryer. "Now, Slam and I will able to take a minute to put things in perspective instead of just trying to keep all those arms under control."

CIE Terminals marketing vice president Steve Fryer (left) and C. Itoh Electronics president Mark Tageouchi *believe C. Itoh's reputation for high-quality terminals will lead to healthy sales of the company's VT200 emulator.*

Steve Tatum, vice president of marketing and sales for TeleVideo Systems Inc.'s terminal line and an ACRO alumnus, doubts that the merger of C. Itoh's terminal group and ACRO into CIE Terminals will have significant impact on operations. But the principals of the new corporation say it was sometimes clumsy to have ACRO make sales while C. Itoh carried the contract; in general, two heads are not better than one in the fast-paced terminal market, they say. "The typical life of a terminal product has shrunk. It may be only 1½ years now," says Tageouchi, who will serve as president of CIE Terminals. "We feel we need the efficiency of single-line management to get products into such a small window."

The task of getting a Japanese manufacturer through that window is particularly tough. In the case of C. Itoh's VT131 emulator, the CIT-161, Fryer and Slam directed a group of American consulting engineers, who quickly developed a design that incorporated all the features—good and bad—of the DEC product. But Tageouchi says Toshiba Japan refused to manufacture it because its engineering department felt the firmware contained design errors. "For example, the DEC terminal's command to go from an 80- to a 132-character column erases the screen, and the Toshiba engineers knew a lot of users would want to keep the contents of the screen when going to wide format," explains Fryer. But allowing Toshiba to correct that mistake would have sabotaged the terminal's chances in the DEC market because DEC editing routines had been written that used the 80- to 132-character command's erasure quirk. Tageouchi thus had to go to General Corp., which is much smaller than Toshiba. There, he managed to overcome the perfectionism of Toshiba's engineers and get the terminal built exactly to the ACRO specification.

—Kevin Strehlo

NCR builds VAX 730-level CPU around VLSI 32-bit chip set

Six months after introducing its 32-bit VLSI microprocessor, NCR Corp. has built what it is calling a 32-bit mainframe computer based on the NCR/32 technology. Prices for the 9300 system will start at $24,235 including the processor, the memory, an I/O controller and a proprietary operating system. The system is positioned to compete with systems such as IBM Corp.'s

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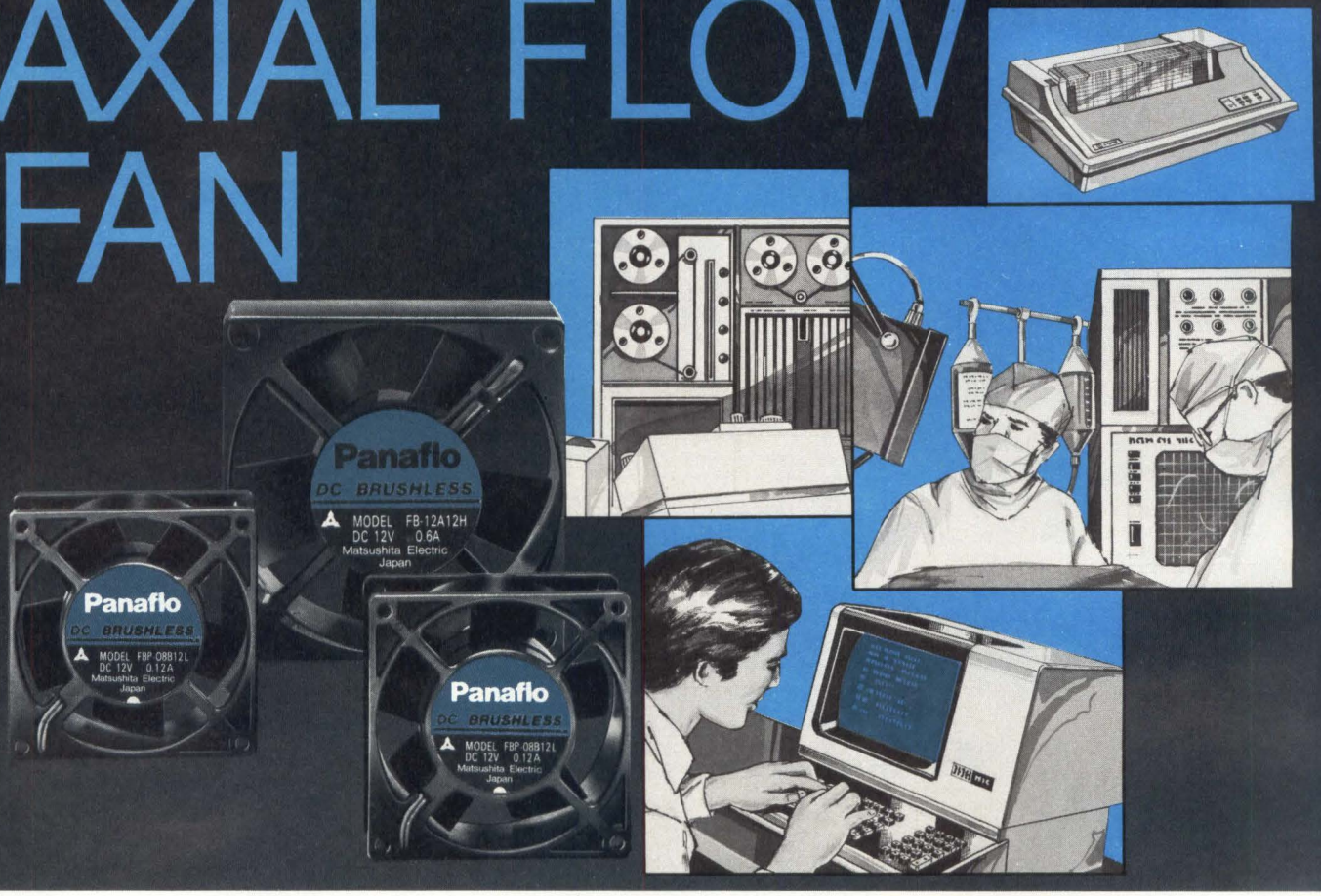

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System/38 and Digital Equipment Corp.'s VAX/11-730, according to NCR officials.

While the 9300 is restricted to direct sales through traditional NCR channels, the company plans to introduce a single-board Multibus-compatible version of the 9300 CPU in the fourth quarter of this year, says Dr. James Van Tassel, vice president of the Microelectronics division. That product will be sold to OEM customers by the Microelectronics division and is expected to compete in the market with products based on the Motorola MC68020 and National Semiconductor 16032, says Van Tassel.

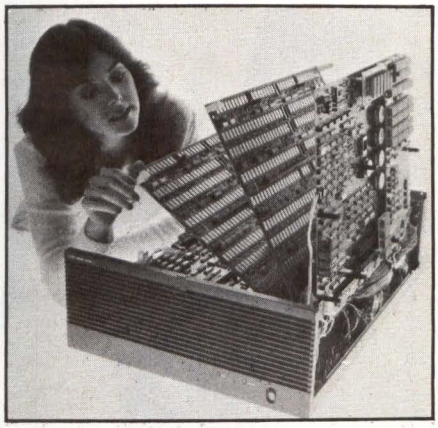
He adds that NCR is taking sample orders for the NCR/32 chip set and plans to start shipping samples in the second quarter. He declines to identify potential customers, but says the company has talked to "most of the U.S. electronics industry" about the part. "Although the development of the chip set and the 9300 were parallel, we still are two years ahead of somebody buying the chips today," for integration into the system, claims NCR president Charles E. Exley Jr.

Van Tassel maintains that the product has created a high degree of interest because it is externally programmable and does not have an embedded instruction set that would limit its applications and markets.

The 9300 system is positioned above the NCR I-9020 line and is said to offer twice the performance of the best-selling 9020-II in a $54,000 configuration supporting as many as nine users. The 9300 is priced approximately 15 percent higher than the 9020-II. Exley says the 9020 series will be repriced to reflect 93200 price/performance levels. In a 10- to 14-user system with 1M byte of main memory, a 162M-byte disk drive and a 360-lpm printer, the 9300 sells for $72,071. NCR says a comparable VAX-11/730 or an HP 3000 configuration sells for about $100,000. NCR also says the 9300 has a rating of 0.33 million instructions per sec., slightly lower than the VAX-11/730.

The 9300, which was scheduled for first customer shipments last month, is the product of the three year-old Scrippps Ranch facility of NCR in San Diego, Calif. The system is constructed with a single CPU board, one or two memory boards accommodating as much as 4M bytes of 64K-bit RAM and a communications board. NCR's 32-bit CPU is constructed around a VLSI central-processor chip, two system-interface chips and an address-generator chip. The central-processor chip incorporates more than 49,000 transistors and includes six internal 32-bit data paths, 16 32-bit registers, a 32-bit arithmetic-logic unit, a three-stage microinstruction pipeline and eight microinstruction jump registers. The chip has a claimed gate-delay period of 3 to 7 nsec., a register-to-register 32-bit binary addition speed of 150 nsec. and a real-memory fetch-cycle time of 450 nsec. NCR officials say the CPU has a 13.3-MHz clock rate and is capable of single-precision, floating-point addition in the average range of 1.6 nsec. The company is considering the addition of a floating-point processor, officials say.

The processor board also includes a piggyback board with 126K bytes of ROM and 2K bytes of PROM that store system microcode. The address-translation chip can address as much as 16M bytes of main memory, although the system currently is limited to a maximum of 4M bytes. The system interface chips support data-transfer rates to disk at speeds as high as 16 bits per sec. and data communications as fast as 1M bps. The current version of the system can address more than 3G bytes of disk storage.



Using its own VLSI-based, 32-bit microprocessor, NCR Corp. has constructed a desk-top system *that is positioned as an upgrade for the NCR I-9020 and as competition for IBM System/38s, HP 3000s and VAX 11/730s. The initial four-board version (the four-chip CPU section is in the middle of the top board) can accommodate as much as 4M bytes of main memory (on the two middle cards) and a seven-line communications controller (the bottom board). With an expansion chassis, the system can support as many as 42 terminals.*

The memory boards are composed of 64-bit RAMs, but are designed to accept 256K-bit parts as well. Memory is priced at $10,000 per megabyte. The 9300 features a memory "scrubbing" technique that scans all 4M bytes of memory every 16 sec., correcting single-bit errors and detecting double-bit errors.

The communications board appears to the CPU board as a communications multiplexer with asynchronous and synchronous adapters. As many as six communications boards can be attached (using a separate cabinet) for a total of 42 RS232C lines. A planned communications subsystem will enable users to attach as many as 120 terminals, says an NCR spokesman.

The basic four-board 9300 comes in a 50-lb. package that measures 17.6 × 25.8 × 7.5 in. and operates off of standard 120V current without

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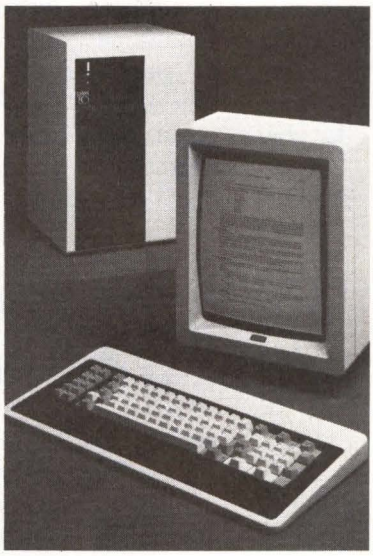

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special cooling or ventilation. NCR officials say the VLSI processor alone replaces the functionality of 10 11- × 14-in. boards.

With the 9300, NCR has introduced a new version of its interactive operating system, a database-management/query system and a package for nonprogrammers to use with the database system. Interactive Transaction Executive (ITX), priced at $1940, is described as a multiprocessing, interactive operating system that runs packages developed under the company's earlier IMOS operating system. ITX supports a $1500 ANSI 74 COBOL and BASIC priced at $2500. Pascal is scheduled for a later release, NCR officials say. Under ITX, the company is offering ITX/DBS, a $6770 relational-database package with a $3000 NCR/Query package. Solon, an English-language programming product that can be used by non-programmers or as a productivity aid for experienced programmers, has also been added. Another programming tool, TAPS, speeds development of on-line transaction-processing applications. Solon and TAPS will be available in September and have not been priced yet. NCR offers a $2500 DDP package for distributed data processing and a $2000 Word-wise package for word processing.

—Geoff Lewis

UNIX community anticipates smoother sailing with AT&T support

UNIX, which set sail into commercial waters 18 months ago, has been subject to a major course correction, taken on new passengers for its first-class staterooms and is building a new head of steam with an improved version of last year's AT&T UNIX System III called System V.

The course correction involves a proposed consensus among UNIX and UNIX-like operating-system suppliers and computer manufacturers to head the UNIX effort toward a standard, following a year of confusion and occasional dissension among UNIX proponents. With System V, AT&T introduced a product that supports the /usr/Group committee's proposed common systems interface derived from the UNIX handbook, rather than what some feared would be a product that flowed against standards efforts. And to build an even larger head of steam for commercialized UNIX, AT&T has maintained reasonable upgrade licensing fees and will include first-time source-code license support for System V. AT&T will also help back UNIX efforts by pledging to maintain a stable System V kernel and discussing changes and improvements with the industry at large. An additional boost to UNIX passengers is the backing of the computer industry elite—Digital Equipment Corp., IBM Corp. and Hewlett-Packard Co.—which recently have extended UNIX support to their customers for the first time. A host of industry notables is queuing up for berths as well.

Illustration by Jim Wiley

Ma Bell is now helping to steer efforts toward gaining a UNIX "core" *standard and more applications software. The giant company's System V supports the proposed systems interface standard and is reasonably priced for initial licensees or upgrades from earlier versions.*

Together, these developments indicate smoother sailing for the UNIX effort, but they don't eliminate all the dangers: UNIX proponents still acknowledge that a shortage of standard business application programs has hindered

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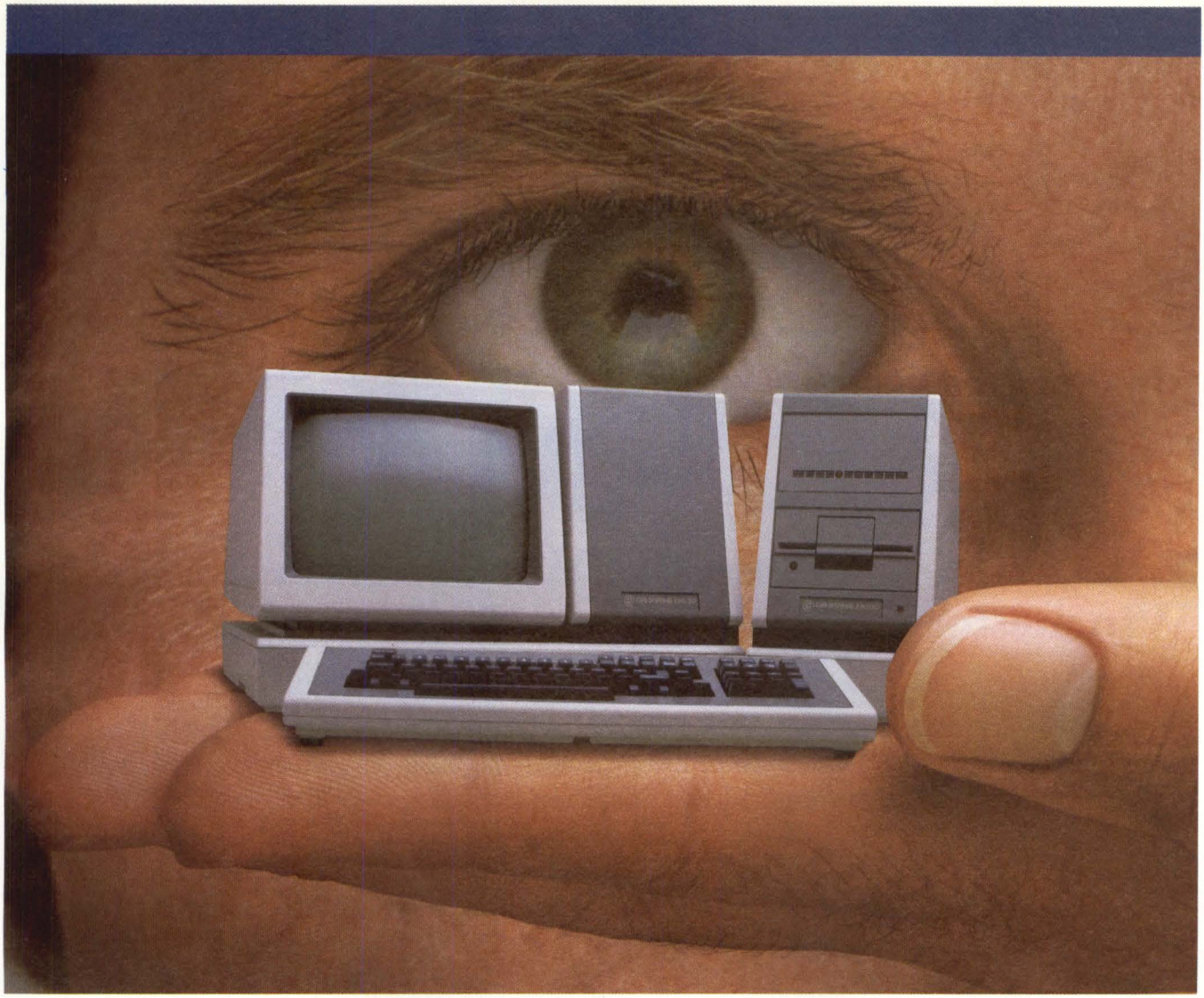

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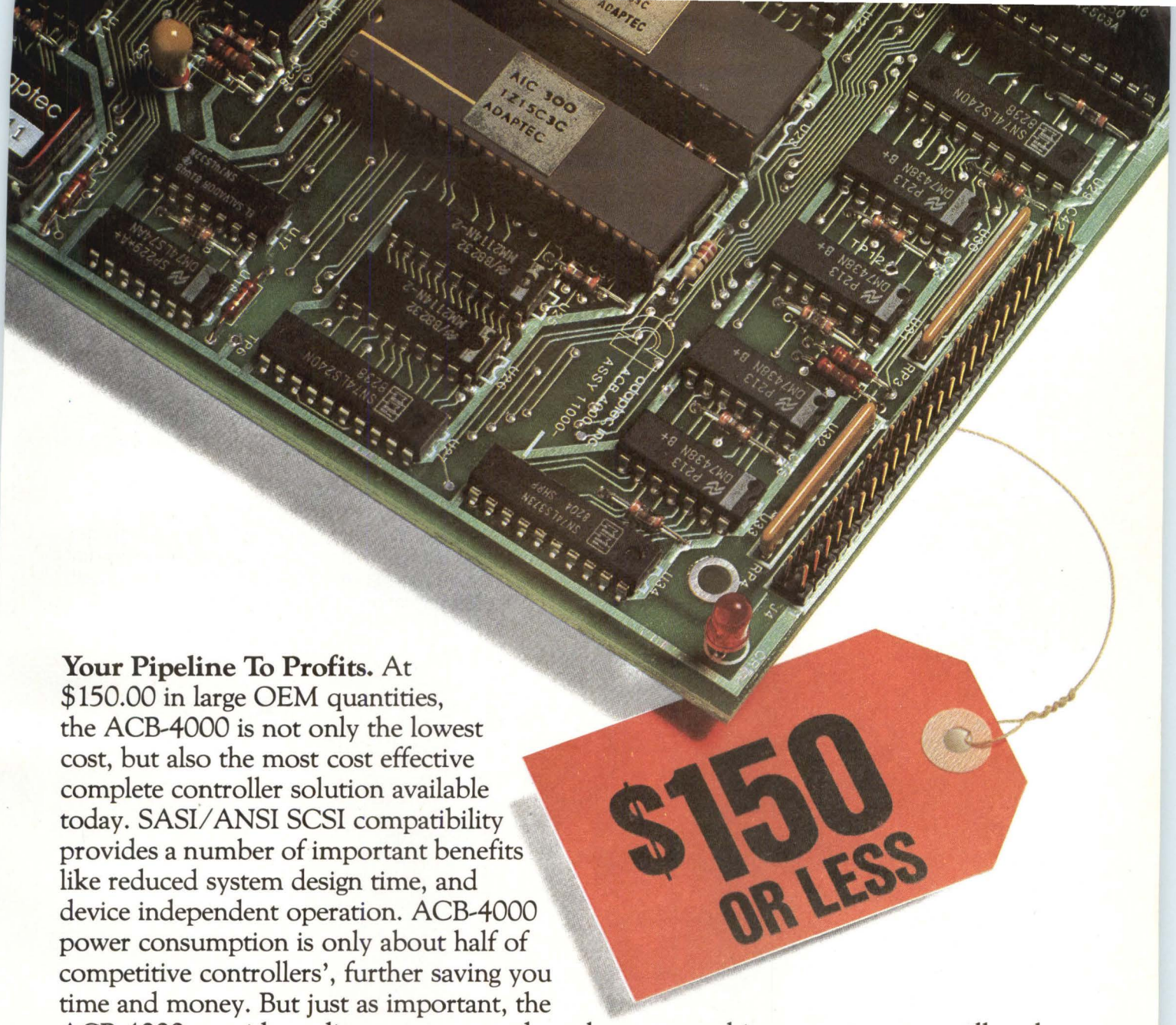

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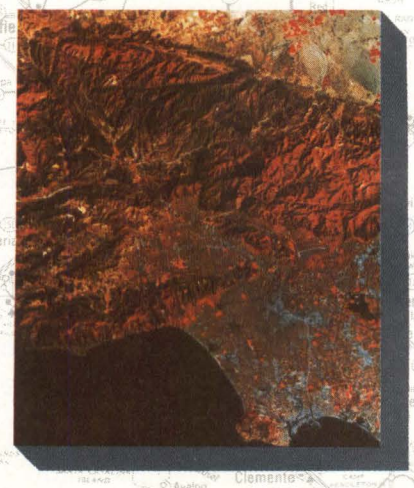

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UNIX's progress into commercial markets. The influx of UNIX-based products in the past year (MMS, November, 1982, p. 17) has yet to generate substantial end-user sales, manufacturers concede. Now they are predicting that a rash of application software in the coming months will begin fueling sales growth late this year.

Some positive signs are announcements by Apple Computer Inc. and Tandy Corp. of UNIX versions on their high-end systems and Microsoft's commitment to bring its XENIX version of UNIX to the IBM Personal Computer market. At the same time, a number of word-processing, database-management, accounting and personal-productivity packages is becoming available directly under UNIX or through Ryan-McFarland Corp.'s RM/COBOL and Science Management Corp.'s SMC BASIC.

However, the developments that have most improved the UNIX outlook come from AT&T. At the recent Unicom conference, jointly sponsored by the commercially oriented /usr/ Group and the technically oriented Usenix group, AT&T clarified many of the unresolved questions about its position, which had been looming like storm clouds on the horizon (see "DEC supports Berkeley UNIX on VAX," below). With the UNIX System V product announcement at Unicom, AT&T gave the following assurances:

- Director of technical licensing Bob Guffey said the company would not pull any more suprise moves with its product announcements. Noting the jarring shift between UNIX Version 7 and last year's System III announcement, Guffey assured the Unicom audience that there would be no more unexpected major revisions. "You're not going to have those kinds of heartaches anymore," he promised.
- With System V, AT&T will promulgate the concept of parity—the UNIX licensed to the outside world will be the same as the version used internally at Bell. In the past, rumors of forthcoming changes based on UNIX versions used within Bell have sometimes caused postponed manufacturers' commitments to the operating system.
- AT&T, which has had two active members on the /usr/ Group standards committee since last summer, declared its support for a UNIX standard. "We have a stable kernel now in System V, and we will maintain upward compatibility with future versions. What is there is unalterable. We support a standard, and that does not mean just a Bell standard [anymore]," Guffey said.
- Future releases may involve unbundling additional features and utilities. Instead of releasing entire new versions of UNIX when new features are developed, AT&T indicated it will probably release new enhancements separately. Larry K.

DEC SUPPORTS BERKELEY UNIX ON VAX

The most significant vendor development at Unicom probably was Digital Equipment Corp.'s announcement that it will sell and support Berkeley 4.1 UNIX on VAX systems by the end of the year. The DEC move follows introductions last year of a UNIX Version 7 package for PDP-11s and VNX, a program to provide UNIX-like functions and a C language package under the VAX VMS operating system. DEC has also committed to supporting a UNIX package on the Professional 325/350 personal computer.

However, DEC has not committed to selling and supporting System V. The Berkeley package is aimed at customers in the academic and computer-science markets who prefer BSD 4.1 and now will be able to get hardware, software and support from a single source. Armando Stettner, senior software engineer at DEC's UNIX group, estimates that as many as 25 percent of all VAXs are equipped with 4.1.

Bill Munson, group manager of systems engineering at DEC, says the company plans to address needs for UNIX among commercial VAX users through the VMS/VNX program. "In the commercial market, it is important to have standards, and we strongly support an industry standard. Our intention is, if System V becomes the basis for an industry standard, [to] incorporate the standard in VMS/VNX. Eventually, you could put anything designed to run under System V up under VMS/VNX. Everything above the kernel will appear the same," Munson says.

Other developments that could advance UNIX as a commercial operating system were in evidence at Unicom. IBM Corp.'s CPIX package, based on UNIX Version 7, was being shown by an IBM Value Added Remarketer, International Data Services, Sunnyvale, Calif. The company, an 11-year-old DEC commercial OEM, has configured a turnkey software-development system using the IBM Series/1 minicomputer. IDS UNIX group manager Dick Cavanaugh expects other IBM VARs to implement CPIX.

New implementations were also shown on National Semiconductor Corp.'s 16032 microprocessor: one on a prototype development system that National plans to market and another by Human Computing Resources, a Toronto, Canada, firm that performs second-source implementations for Microsoft. The Santa Cruz Operation showed XENIX on Convergent Technologies Inc. and Victor Technologies systems.

Isley, manager of technology licensing, left open the possibility of backward unbundling as well. That would mean separately pricing some existing features or utilities and presumably reducing the basic UNIX price.

• Through a support center at a Lisle, Ill., Western Electric Corp. facility, AT&T is offering two levels of support to source-code licensees. AT&T officials stressed the support offerings are not intended to compete with end-user consulting services, and took the opportunity to repeat AT&T's pledge not to compete with other UNIX vendors by marketing binary-code licenses directly to end users. The basic Level One support package is priced at $150 per month for the first system with UNIX System V at a site and includes a newsletter, periodic software and documentation updates, a means for users to report problems and listings of known problems and solutions. Support for additional machines at the same site is $50 per month. Beyond Level One services, Level Two support includes a toll-free hot line available from 8 AM to 5 PM Central Standard Time. An after-hours service will be available for a fee. Level Two support is $350 per month for UNIX on the first machine and $100 per month on subsequent systems.

• With System V, AT&T also promises to provide better documentation and to open communications channels with the user community. "We don't know exactly how, but we are going to get industry feedback. You [the UNIX community] are going to be part of our decisions on what to do with UNIX," Guffey said.

System V was almost an anticlimax for many UNIX vendors, says Bernard Silverman, director of marketing for Unisoft, whose UniPlus implementation is used on many MC68000-based systems. "If AT&T were a commercial software company, they would have called it System 3.1," he quips.

To the relief of those who had feared another major revision, System V is, says Guffey "a fine-tuning of System III." Improvements include the adoption of some features developed at the University of California at Berkeley for its Berkeley System Distribution 4.1 version of UNIX, which is widely used among academic and computer-science customers. The Berkeley features of System V include a visual screen editor and a terminal-management facility. Other System V features are support for 1K-byte block files and semaphores that can be used to make sure a process is completed before another is initiated.

System V pricing policies are also a relief to the UNIX community. For supported DEC PDP-11 and VAX systems, an initial source-code license is $43,000, the same price as that established with System III. For users who have migrated to System III, AT&T offers a one-time upgrade price of $1000 for all CPUs at a customer site licensed for System III. Customer provisions under System V allow multi-tier distribution "to the nth degree," a free binary license for demonstration machines and installation of UNIX on leased machines.

Bob Marsh, chairman of Plexus Computer Systems and outgoing president of /usr/ Group, says, "The most positive thing was that there wasn't something negative. I feared the problems we had between Version 7 and System III. This will accelerate the pace of UNIX growth."

Doug Michaels, vice president of The Santa Cruz Operation, a "second source" for Microsoft XENIX implementations, says, "It was the most profound announcement AT&T ever made, although they said almost nothing. System III was a totally garbled announcement that created vast uncertainty and left the impression that AT&T might be dangerous or even erratic. They hurt a lot of people by not giving credit for existing licenses or a cheap upgrade from Version 7. Now they are showing they are truly committed to us with an almost-free upgrade."

Because it does not diverge significantly from System III, the System V announcement bodes well for the standards effort, says Heinz Lycklama, vice president of technology development for Interactive Systems and a member of the /usr/ Group standards committee. Noting the commitment from both Berkeley Systems Distribution officials and AT&T to support a standard, Lycklama says the chances appear good that a standard can be adopted on a schedule by a /usr/ Group vote this summer.

He points out that the standard is restricted to the systems interface —the system calls and subroutines delineated in Sections 2 and 3 of the UNIX handbook. As such, it is neither System V nor BSD 4.1. "The /usr/ Group standard is a core standard. System V and BSD 4.1 have extensions beyond it but don't conflict with it," he says.

—Geoff Lewis

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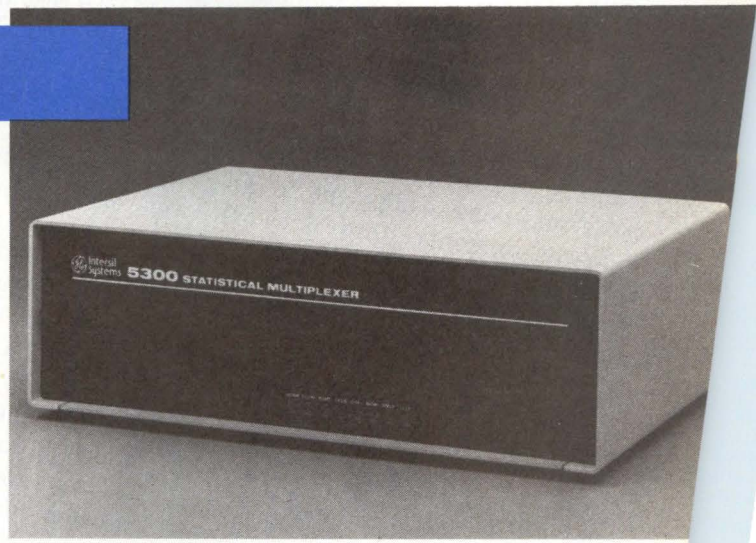

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Standard controllers for satellite networks are scarce, but in demand

With the number of private satellite communications networks growing for intra-company voice, data, facsimile and video applications, new classes of microprocessor hardware and software are being created to handle the high-speed, 56K- to 60M-bps, digital communications. Customized digital-communications equipment is appearing in controlling network configurations, bandwidth allocations, transmission speeds, analog/digital signal conversion and network diagnosis.

Essential to the new all-digital satellite networks are network controllers, which perform a variety of functions in different networks. The lack of standard control equipment from major computer manufacturers and OEMs has irked some satellite network integrators and forced them to develop the hardware integration and software programming required internally.

For its common carrier subsidiary, American Satellite Co., Fairchild Industries Inc. has developed an integrated digital communications controller called the Starburst system that allows several private networks to share a single satellite transponder. Designed for users with data-transmission requirements between 56K and 20M bps, the controller accepts any type of data or voice input and digitizes the signal for transmission on a single digital stream. Video signals, however, must be digitized before input into the controller's standard data ports. Voice signals are converted to a 32K-bps stream, requiring about one-half the bandwidth required for Bell's digital voice services.

The Fairchild product, like other controllers, use a Motorola 6800 microprocessor with Fairchild-designed software that permits the bandwidth resources to be allocated either dynamically in response to real-time traffic requirements, or pre-set by a network operator. For cost-efficiency, 100 or more channels should be available for installation of the controller, the company says.

Fairchild developed the unit internally in response to the growing use of digital communications and the lack of products from major computer manufacturers. "By 1990, there won't be any analog signals on satellites except for junk TV," says Dan Robinson, marketing manager for Fairchild Communications and Electronics Co. To obtain the required digital-communications equipment, he says "you can't go to Wang, DEC or IBM. They're not offering the necessary software packages for protocol conversion."

Fairchild is gearing up a marketing campaign to begin offering its controllers for use in networks other than those of American Satellite. The company is also reportedly working on a new device that can handle traffic at rates as high as 120M bps for use in future wideband satellite transponders. Deliveries are expected to begin in the first half of 1984.

Vitalink, a specialized satellite carrier in Mountain View, Calif., also uses the Motorola 6800 microprocessor for control of earth stations in its private networks. The CS/1 controller is supplied by Bridge Communications Inc., Cupertino, Calif., under an OEM agreement. The CS/1 is suited for packet data transmissions and incorporates multiple 128K-byte buffers and 384K bytes of memory. While the device can handle network-management functions, such as providing the interconnection link and dynamically managing the bandwidth allocations, the voice and data inputs must be pre-digitized. "The CS/1 allows the user to get into a distributed data-processing environment with such applications as intelligent switching, MIS functions such as shared databases or host-to-slave computer transmission," says Jonak Pathak, Bridge director of marketing.

The Vitalink/Bridge controller does not perform digital multiplexing because the channels are carried on separate frequencies within the satellite transponder, not multiplexed on a time-division basis as in other transmission approaches. In Vitalink's networks, each earth station is allocated a unique portion of the bandwidth and can handle data requirements from 28K to 3M bps. Two controllers, each handling rates as high as 1.544M bps are required for each Vitalink earth station.

A Vitalink spokesman expresses "amazement" that the major computer vendors do not offer more digital-communications equipment. "We've talked with IBM 3705 designers," he says, "and they did not understand satellite communications. There's a real need to offer the terminal-earth station interface, and [we plan] more meetings to educate them further."

While IBM Corp. does not have standard network-control products, it has developed a sophisticated unit for Satellite Business Systems, in which IBM holds a one-third interest. The IBM Communications

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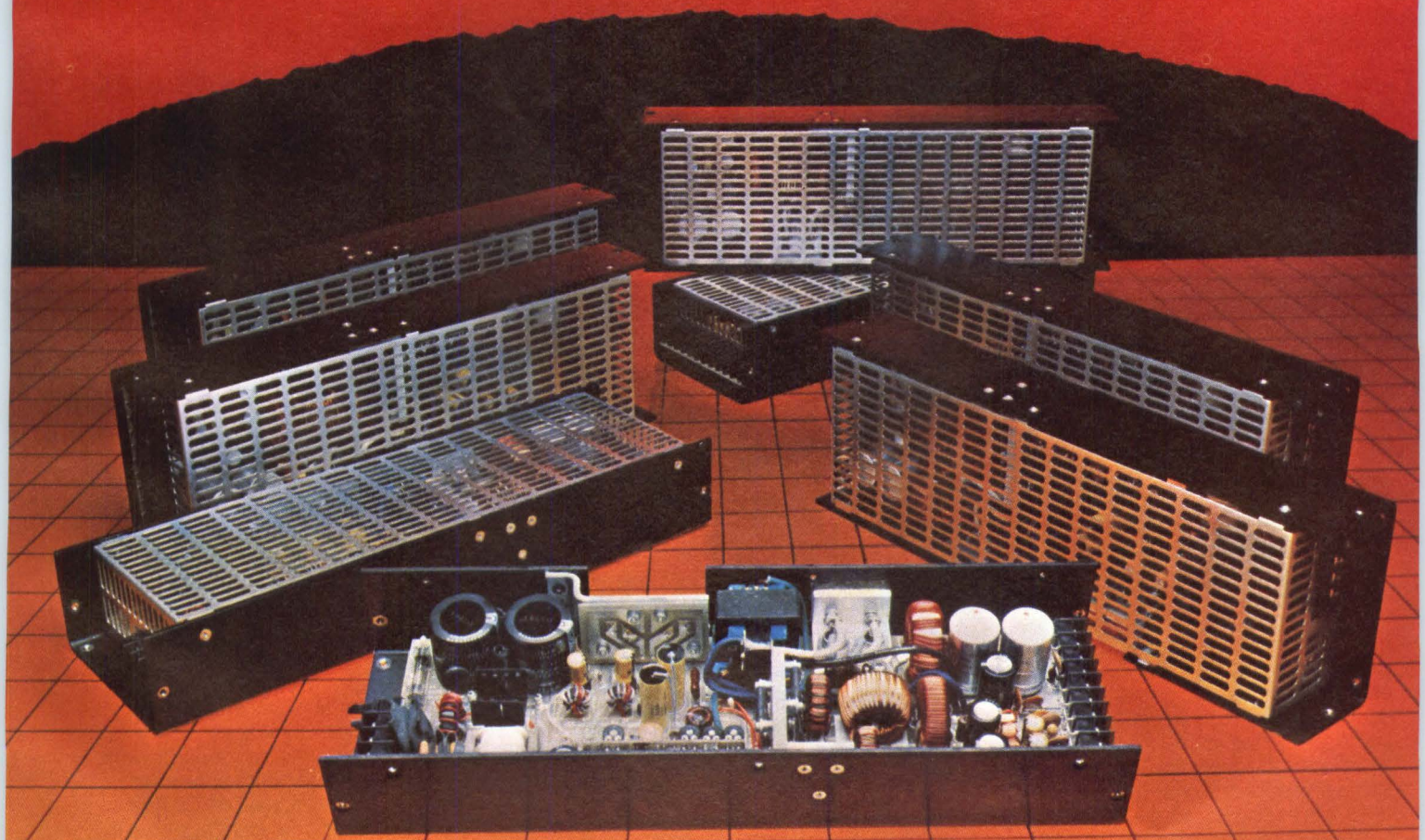

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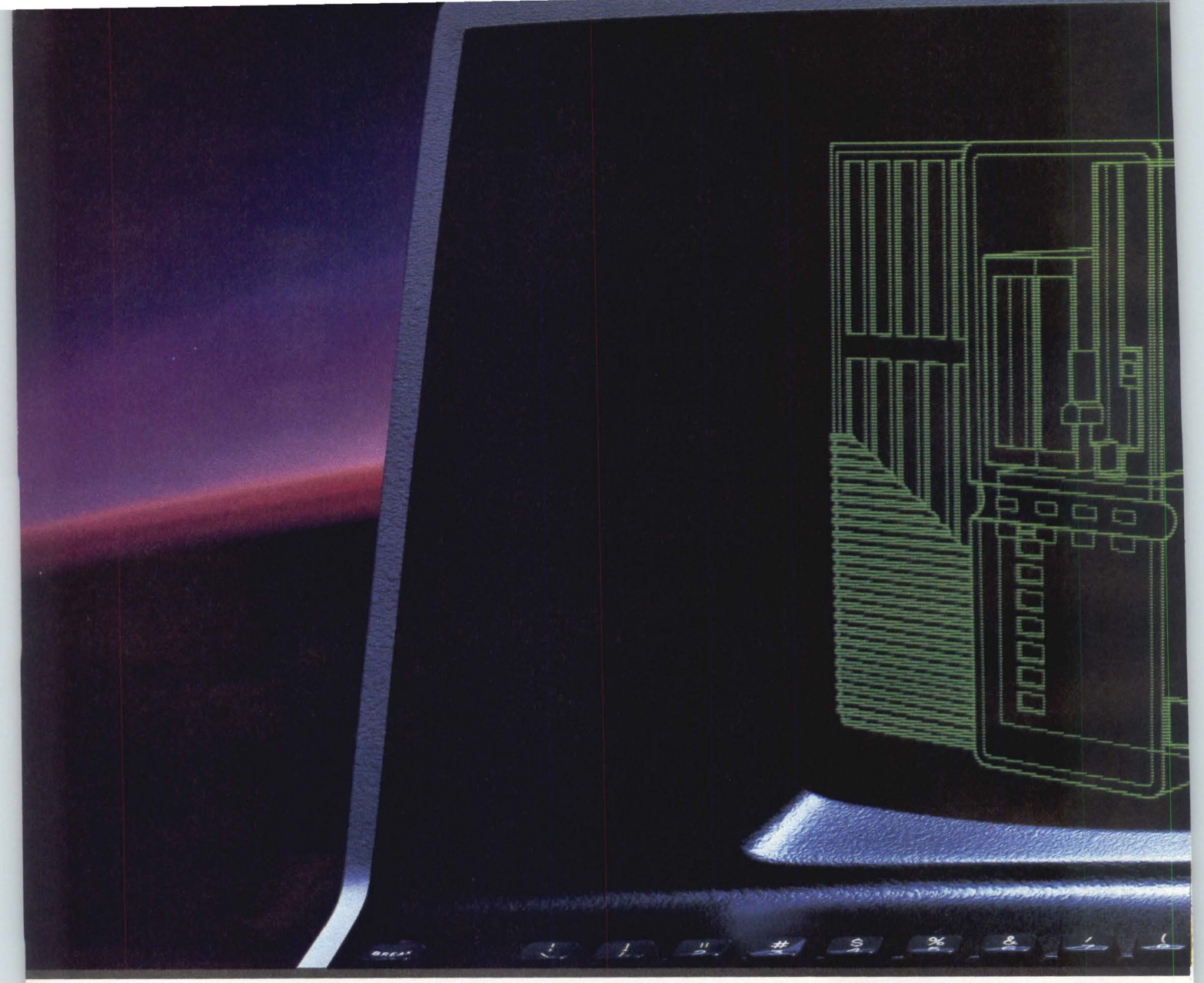

THE ARCHITECTURE YOU THOUGHT WAS YEARS

Victory Computer Systems has assembled the speed, power, and expandability of today's most advanced microcomputer technologies. Then we brought them together with the world's leading mass storage peripherals in one modular, growth-oriented, multi-user system.

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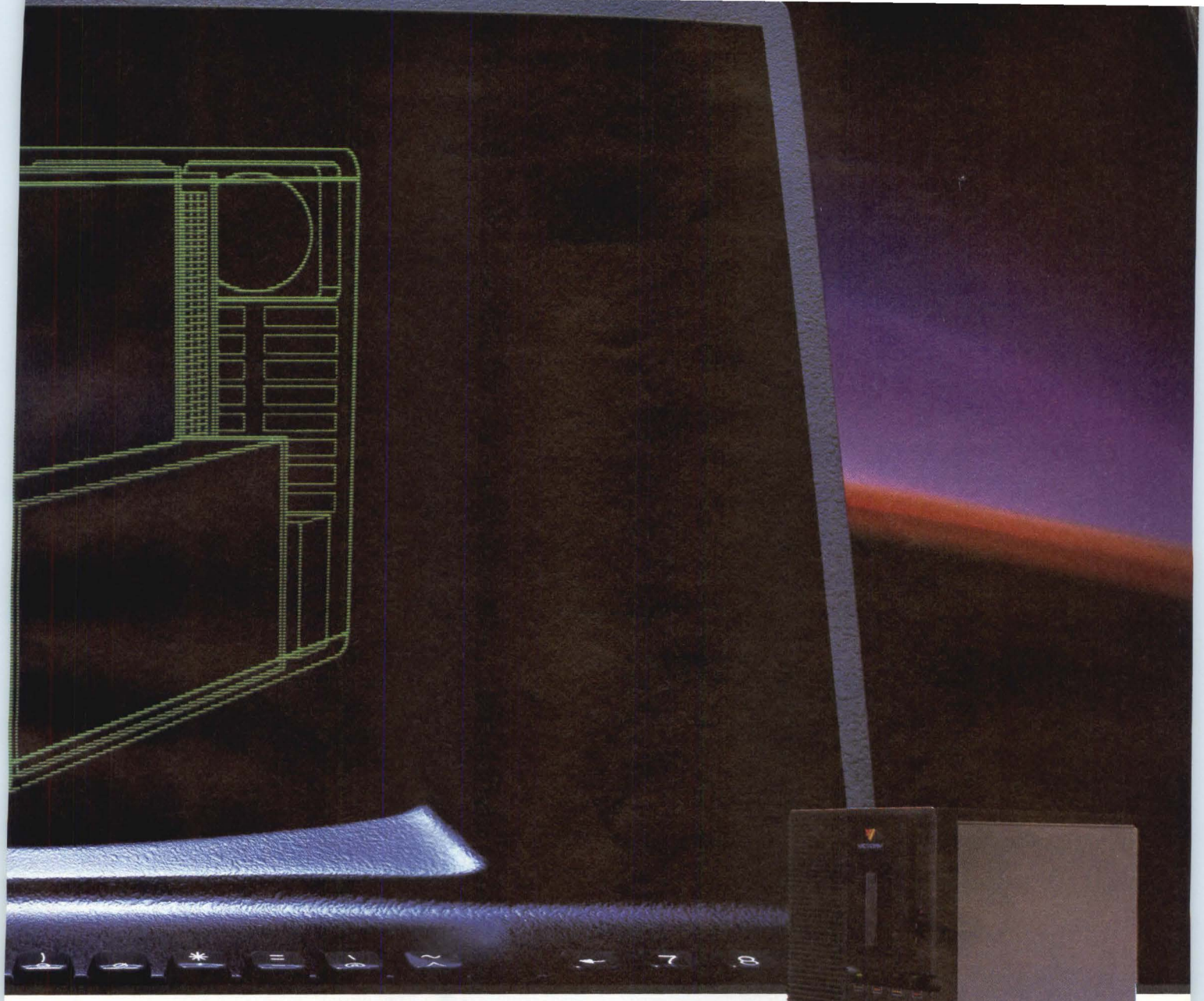

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THE ARCHITECTURE OF INTELLIGENT COMPUTING.

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Product Division in Gaithersburg, Md., has supplied more than 100 network controllers for SBS's 25 customers for private satellite networks.

The IBM SBS satellite communications controller can provide interface conversions from the SBS standard interface, a subset of the EIA RS449 and RS422A data interfaces, to most of the standard data interfaces in a user's digital termination equipment. Standard transmission speeds range from 2.4K to 1.544M bps.

The controller also provides the A/D conversion of voice, video and data signals, and automatically handles signal switching from network node to network node. It allocates the bandwidth capacity needed for the real-time transmission requirements on a dynamic basis and monitors the performance of the network's earth stations, receiving status reports from all stations every 300 msec. An IBM spokesman refuses to provide details of the controller's hardware and software.

Another pioneer in the digital signal-processing field is Digital Communications Co., a M/A-Com company. For international satellite networks and other applications, the company has developed a monitor and control unit that is the heart of its time-division-multiple-access transmission system. The MCU contains a 16-bit microprocessor, supports ROM and RAM, monitors the status of the earth station terminal, performs self-diagnostics and fault isolation and tracks the bit-error rate of traffic bursts. It also provides a host of user peripheral-support interfaces, including interconnection with a CRT terminal at all earth terminals to display critical status information.

DCC's dynamic assignment of transmission bandwidth is similar to the approach taken by other network providers. As assigned by the controller, capacity is allocated on demand. Unused capacity is returned to a pool from which it can be reallocated to any earth station on the network when needed. The technique provides a 2:1 increase in channel throughput, the company says.

Work is under way on satellite networks that will allow transmission speeds of 250M bps or more. While the market for associated ground digital-communications hardware and software is still in its

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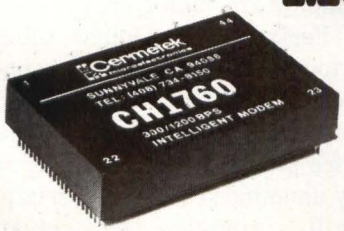

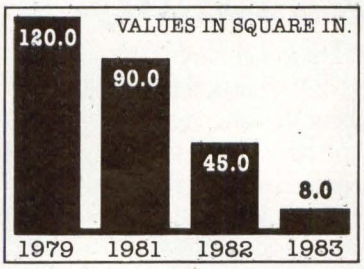

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infancy, the growing popularity of private networks for business communications and the rapid increases in transmission efficiencies and speed will force the major computer manufacturers to take a look at this market and offer standard products. —*Stephen J. Shaw*

Magnetic-printer technology surfaces in two products

Magnetic printing, a technology that has yet to be brought successfully to market in a product, will appear soon in at least two printers that have been in development for several years.

The MP-60 from Cii Honeywell Bull, which was demonstrated privately at last year's National Computer Conference, will make a new debut in revised form at this year's show (MMS, January, p. 169). Evaluation units of the magnetic printer are expected by the fourth quarter of this year, say company officials, with deliveries to begin in 1984.

Non-impact technology buffs are also eagerly anticipating another magnetic-printing product from Ferix Corp. While Ferix's as-yet-unnamed magnetographic printer is not scheduled for introduction until early 1984, the basic technology and marketing approach Ferix plans to employ are taking shape.

Ferix aims to follow the Xerox 2700 into the still relatively uncharted waters of the low-end page-printer market. Ferix founder and vice president Gib Springer recently announced that the Ferix printer will target the clustered-workstation and line-printer-replacement markets. "We see the word-processing market becoming more closely tied to the data-processing market in the near future," says Springer, "particularly as the trend for data processing into the office environment continues. We expect to see 2700 placements continue to do well in that respect and increase market awareness of what non-impact printing can do."

Springer feels that Ferix's weapon against laser/xerographic systems is the company's recording-head technology. The technology betters laser/xerographic systems

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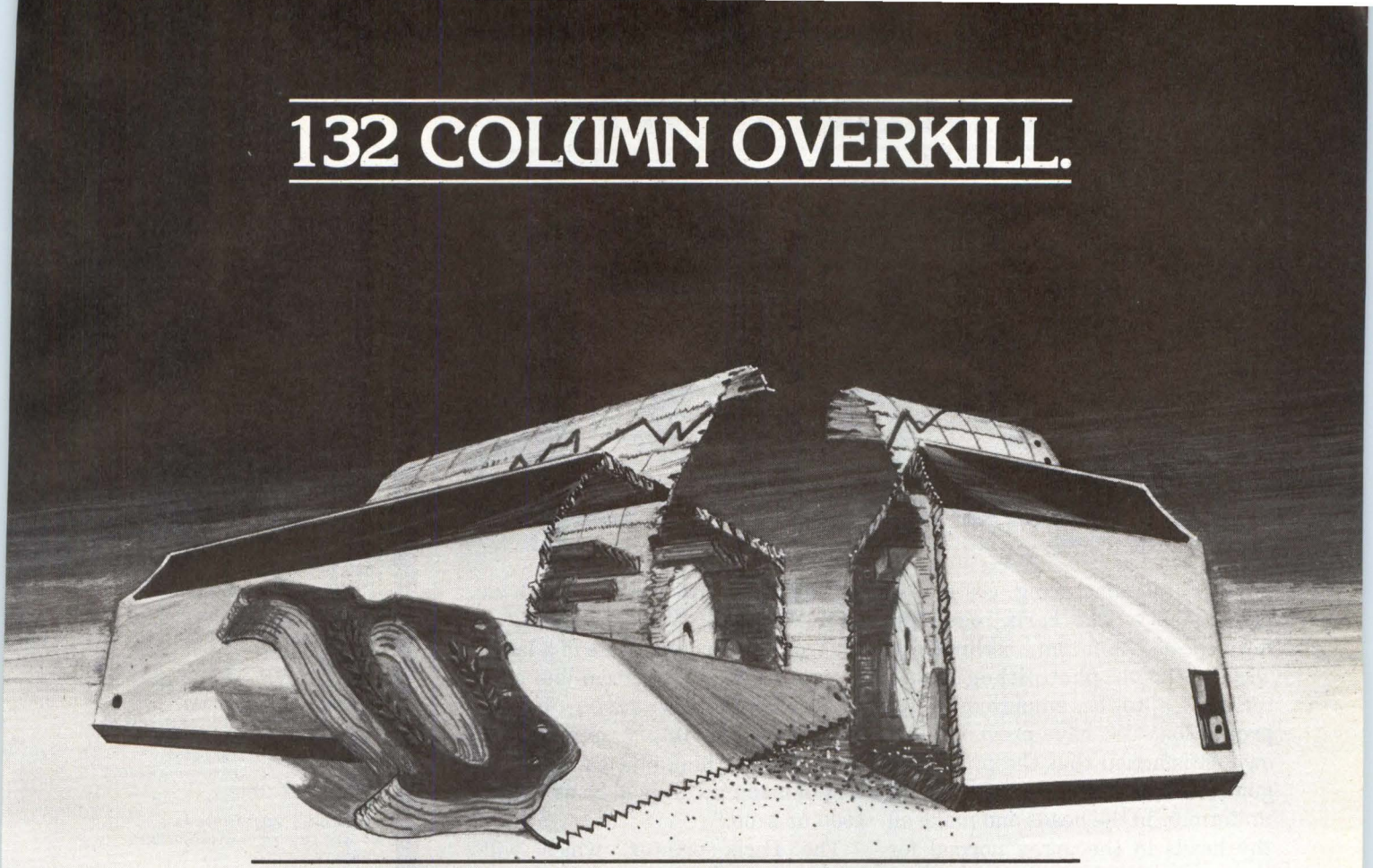
132 COLUMN OVERKILL.



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- Print speed: 150 CPS
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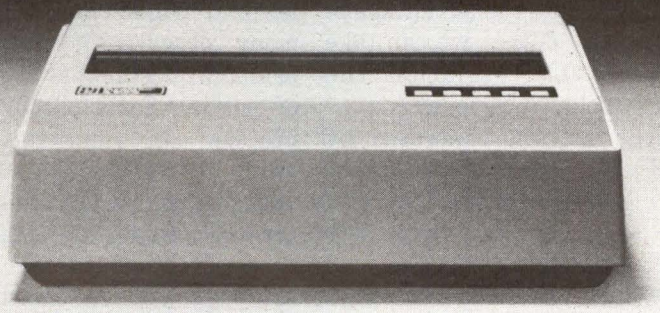
- Demand document forms printing – model available

132-Column Performance.Without 132-Column Price



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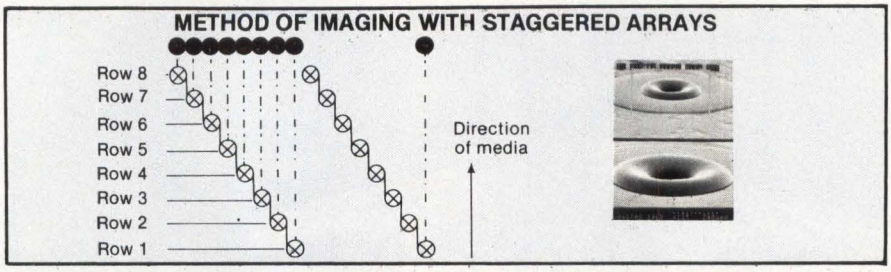
NEWS



Ferix's printing system *produces images through a system of staggered recording heads in an array. The printer's recording head, magnified 125 times (inset), can be manufactured by a photolithographic process.*

both in manufacturing costs and print quality. The Ferix recording head uses thin-film technology, which allows photolithographic techniques to be employed in its production. "We have proven to our own satisfaction that the process is going to provide us with strong uniformity in the heads and make all the heads in the array normal for the appropriate intensity in the final image," says Springer. The donut-shaped thin-film recording heads are placed on a thin-film substrate. The heads can be placed to an accuracy of 1 mm. in an array of 240 heads per in. over an 8-in. expanse. Springer says Ferix can with relative ease increase the density of the heads beyond that. "There are no nominal limits to how dense we can make the array," he says. "We are going to look at the marketplace for a standard, and the advantage of this technology is that we can take it to whatever resolution the marketplace shows it wants."

The field pattern generated by the head will produce what Springer calls "an intelligent pixel." Because of properties of the field patterns, large toner particles will be drawn to the center of the round pixel, and fine particles will congregate at the edge, providing better definition. Springer believes this technology will allow the Ferix magnetic printer to compete on a strong price/performance basis with the Xerox 2700 and other non-impact systems. "The cost ratio between laser/xerography and our system could prove to be as high as 10:1," he says. "When you look at the front-end components of a laser system, there is a bottom-line cost of approximately $2000, below which costs simply cannot be reduced. We think our comparative cost of manufacture will be as low as $300 or $400."

The Ferix printer, which will initially be marketed only on an OEM or licensee basis, is expected to run at speeds as high as 40 pages per min., with the first model printing 240 dots per in. The flexible recording head and substrate are expected to increase drum life and, Springer believes, allow for significant power savings as well.

If Ferix can achieve such price/performance advantages with its new product, it may be able to stake out a very strong position in the low-end page-printer market, say many observers. "Certainly, the primary question has to be whether or not the Ferix photolithographic process can yield the recording heads in large enough and homogeneous enough quantities for large arrays," says Ian Mallender of Advanced Technology Resources. Mallender believes that if Ferix can do that, there's not much doubt it can capture the market it is aggressively targeting. "One thing to keep in mind as they are aiming at the Xerox 2700 market," says Mallender, "is that many 2700 customers are also Xerox competitors. Obviously, they would love to have an independent supplier."

Continues on page 64

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Cipher's extensive distribution network offers sales and service support for lower volume customers. Cipher's authorized distributors are located throughout the United States, Europe, and other international areas. All distribution centers are equipped to provide Cipher products and total subsystems with immediate availability.

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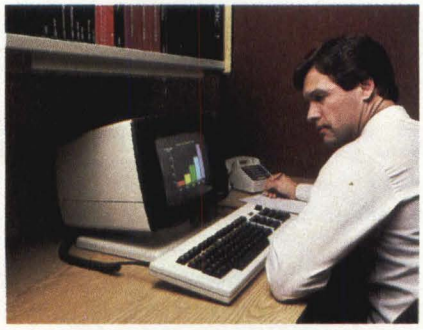

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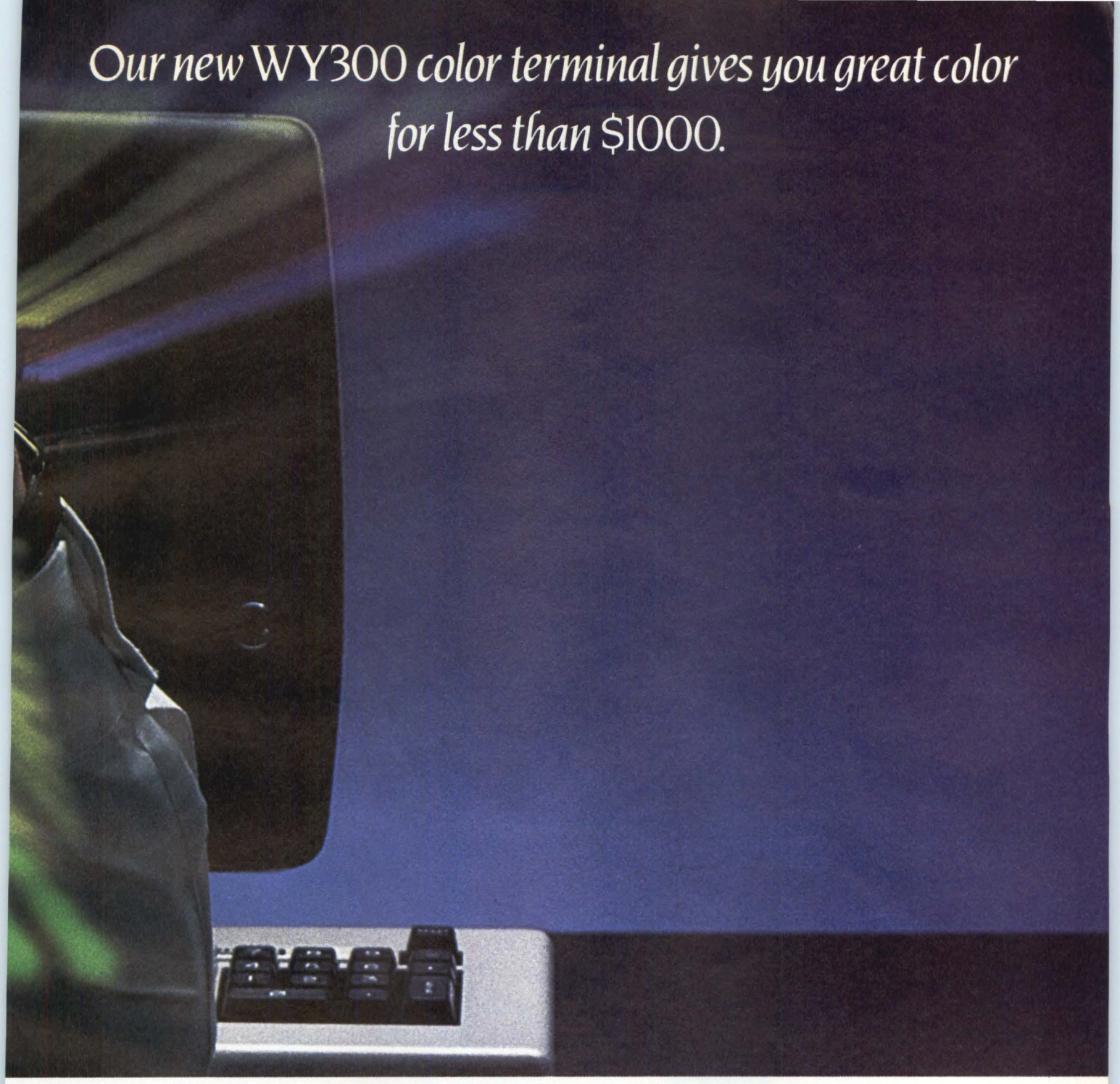

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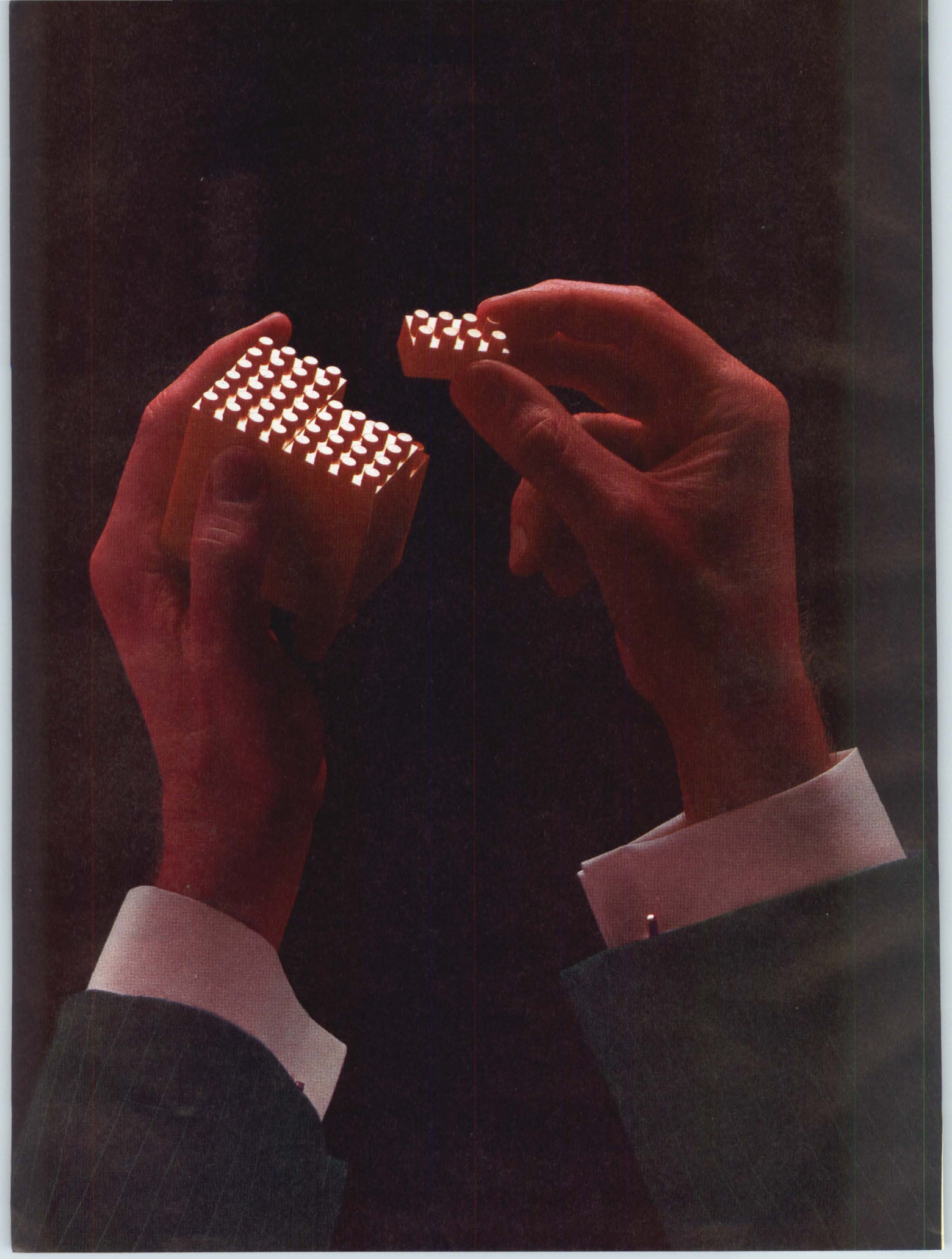

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Reliable, portable RCA VP 3000 series Interactive Data Terminals feature: video and audio output; color-locking circuitry for sharp color graphics and rainbow-free characters; reverse video; tone and noise generator; 20 and 40 character formats; resident and programmable character set; LSI video and microprocessor control. All have a unitized 58-key, 128 character keyboard with flexible membrane switches, plus the features of the ASCII keyboards below.

VP 3501 Videotex Data Terminal. *(Shown)* Built-in RF modulator and 300 baud direct-connect modem. Ideal for time sharing data base applications. Works with standard TV or monitor. Also has expansion interface and 16-key calculator keypad. As low as $275.*

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RCA VP 600 series ASCII keyboards feature: flexible membrane keys with contact-life over 10 million operations; unitized keyboards are spillproof, dustproof with finger positioning overlay and positive keypress; 2-key rollover circuitry; tone feedback; high noise immunity CMOS circuitry; 5V DC operation and 58-key, 128-character keyboard, selectable "upper case only."

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VP 611. Similar to VP 616 with 8 bit parallel output. As low as $70.*

VP 606. Same as VP 616, less calculator keypad. As low as $73.*

VP 601. *(Shown)* Same as VP 611, less calculator keypad. As low as $56.*

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RCA

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CIRCLE NO. 36 ON INQUIRY CARD

Mini-Micro World

NEWS

Continues from page 58

Ferix officials believe that on large-quantity orders, the company's printer will be priced similarly to the Xerox 2700, which Mallender says is selling for as little as $7000 on an OEM basis. Xerox's quoted end-user price for single units is $18,995. Mallender believes another attraction of the Ferix machine might lie in the dot geometry of the recording heads. "There's much to be said for it," he says, because the heads are round and have short lines of flux. Thus, the pixels are well-formed. He says that with the lines of flux radiating symmetrically from the center of the pixel, the stair-stepping effect and the built-in structural disadvantages of unidirectional lines of flux of other magnetic-printing technologies are avoided. "The round pixels cooperate more favorably to fill in the image and give a better outline," Mallender says.

Mallender and other observers agree that one of Ferix's main challenges in introducing its new printer will be overcoming customers' reluctance to accepting a pioneer technology in which past products have come to naught. As such, the Cii Honeywell Bull introduction could greatly help Ferix in legitimizing magnetic printing.

John Freeman of Cii Honeywell Bull marketing subsidiary Cynthia Peripheral Corp. says his company is approaching the market differently from Ferix. "We are aiming directly at the data-processing environment," says Freeman, "because we believe it is a mature enough market to accept new technology like this as a replacement for impact line printers." Freeman believes Cynthia products offer better print quality than band printers, but stresses, "Reliability and secondarily cost are what this market is demanding."

Edward S. Foster

TANDON ADMITS NO ONE COMPANY CAN HANDLE ALL YOUR DISK DRIVE NEEDS.

THAT'S WHY WE'RE THREE COMPANIES.

No company that builds a wide range of disk drives can provide the same efficiency and economy as a manufacturer that specializes in doing one thing better than anyone else.

Delays on one product affect the other lines. Inventory and labor costs are difficult to control. Research and development lag, and what was once leading edge technology becomes yesterday's news.

That's why Tandon Corporation, from its inception, has organized itself as a series of companies by product line.

There's our 5¼" Floppy Company. Our 5¼" Winchester Company. And our 8" and 3½" Floppy Company.

Each is an autonomous entity, a specialist in its own complex field with all the resources of a separate company from purchasing to engineering and quality control. Our companies can concentrate their energies on producing what they know best better than anyone else in the business. That concept is what's made each a world leader in its particular product line.

Our companies are all free to organize themselves internally to maximize their efficiency and economy and to allow them to respond rapidly to their fast-changing markets. They each do things a little differently. But all three are the most successful disk drive companies you ever heard of.

And they're all named Tandon.

Tandon

5¼" FLOPPY COMPANY

20320 PRAIRIE STREET
CHATSWORTH, CALIFORNIA 91311

Tandon

5¼" WINCHESTER COMPANY

49 STRATHEARN
SIMI VALLEY, CALIFORNIA 93065

Tandon

8" AND 3½" FLOPPY COMPANY

375 CONEJO RIDGE AVE.
THOUSAND OAKS, CALIFORNIA 91360

TO BECOME THE WORLD LEADER IN 5¼" FLOPPIES, IT TOOK A LOT OF DRIVE.

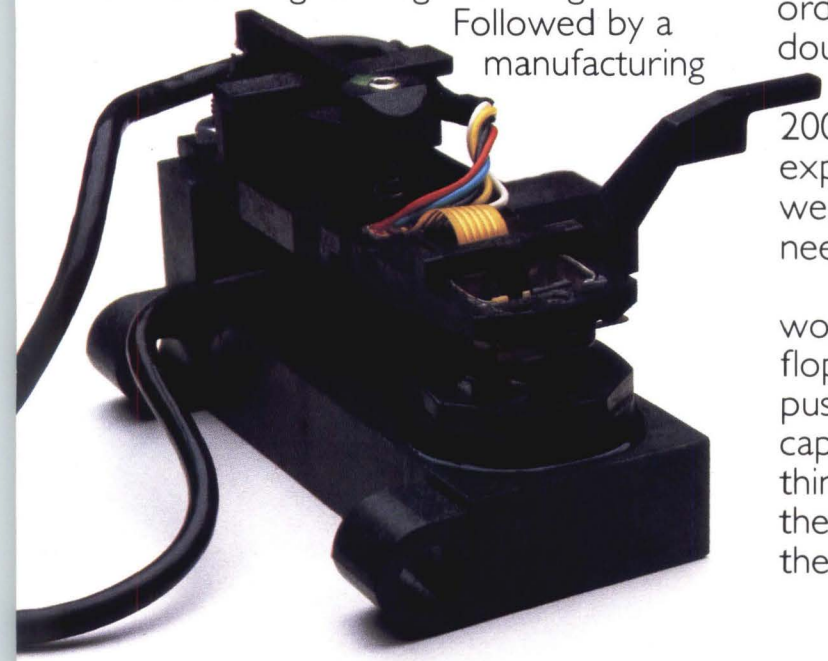
And the Tandon 5¼" Floppy Company has plenty of drive. Both in terms of ambition and in terms of product.

Tandon's unique corporate structure lets us focus our drive on one goal: to build more of the best possible 5¼" drives than anyone else in the world. At the lowest possible cost.

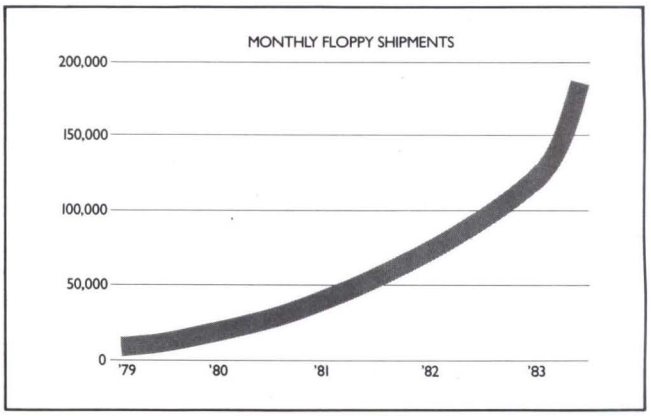
And that's just what we've done. In less time than anyone but Tandon thought possible, we've become the biggest name in 5¼" floppies. Even bigger than such established names as... well, you know who they are. And so do they.

But all the drive in the world wouldn't have made us number one if we didn't have the product to back it up.

We do. Starting where it counts, with innovative engineering and design.



Followed by a manufacturing



operation that features the highest degree of vertical integration in the industry. 80% of the material cost of our drives consists of parts we manufacture ourselves. So we can keep far tighter control over quality and cost. And avoid what other companies call "unavoidable supplier-caused delays."

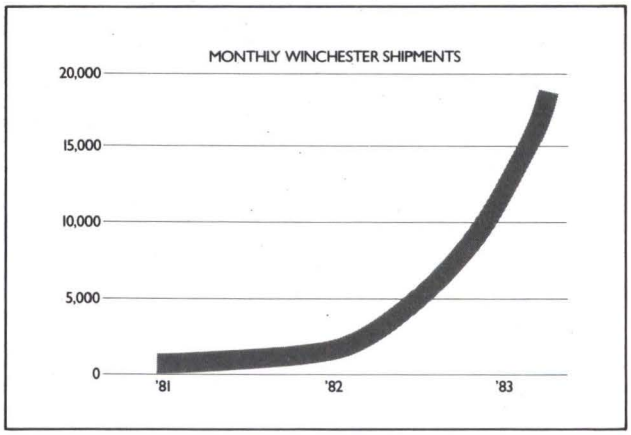
Our aim is always to maintain production capacity higher than actual orders. Last year, we more than doubled our production capacity with facilities that can easily exceed 200,000 drives a month. In 1983, we are expanding still further. To be sure that we can always deliver the drives you need, when you need them.

That's how we plan to stay the world's number one supplier of 5¼" floppy drives. By building drives that push the limits of performance and capacity further than our competitors think possible. In greater numbers than they can produce. At lower costs than they can match.

TANDON 5¼" FLOPPY COMPANY.

WE DON'T MEASURE WINCHESTER CAPACITY JUST IN MEGABYTES.

We measure it in terms of production capacity. Capacity for technological innovation. And capacity for building-in quality at the lowest possible cost.



We're the Tandon 5¼" Winchester Company. And we're at a disadvantage. Unlike our Tandon sister companies, we're not the world's production leader in our field. We're only number two. Though not by much. Like the Tandon 5¼" Floppy Company, we didn't start first, but we intend to finish first.

We build a wide range of drives. Open-loop and high performance closed-loop models. Right now, we have the capacity to build and ship 60,000 drives a month. That means that we have the capacity in place to be number one in 5¼" Winchesters. And we intend to be. By offering you what no other Winchester manufacturer can.

No other Winchester company makes so many of the parts that go into its drives.

No other Winchester company builds its own heads.

No other Winchester company manufactures more of its own plated media and its own PC board assemblies.

Our innovative products are backed with a 105% guarantee. Including our brand-new half-height 5¼" drives. With 6.4 and 12.8MB in half the space of traditional 5¼" Winchesters.

We're dedicated to building more drives with more capacity in less space for less cost.

Which means we're dedicated to being the world's leading producer of 5¼" Winchesters.

TANDON 5¼" WINCHESTER COMPANY.

OUR SMALLEST ACHIEVEMENT IS THE INDUSTRY'S BIGGEST SUCCESS.

The Tandon 8" and 3½" Floppy Company is the world's largest producer of 8" ThinLine™ drives.

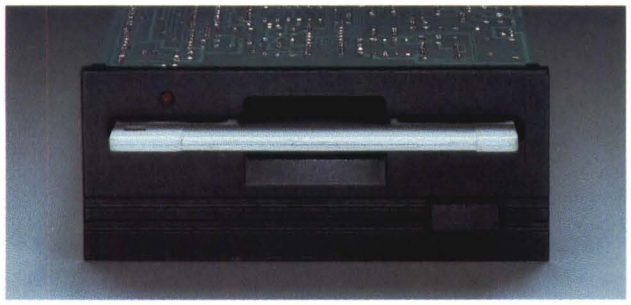
And now we're ramping up for high volume production of single and double-sided 3½" drives.

When we introduced the half-height 8" floppy drive, we expected system designers to go wild over it.

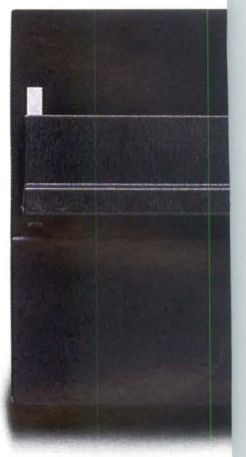
You did. Some of you stacked two of our drives to double system storage to as much as 3.2MB without increasing system size. Others took advantage of our small achievement to reduce system size instead.

Whatever you've done with our ThinLines, we want to thank you for having the confidence in them to give us an overwhelming lead in the half-height 8" market.

Now we're using our experience in making drives small to make them even smaller.



Our new 3½" drives are now in production in four versions. 500K byte single-sided and 1MB double-sided Tandon interface models. And Sony interface-compatible drives of the same capacities.



We plan on becoming the world's leader in 3½" the same way we became the world's leader in half-height 8." By focusing our energies on building more drives, better, at a lower cost than anyone else.

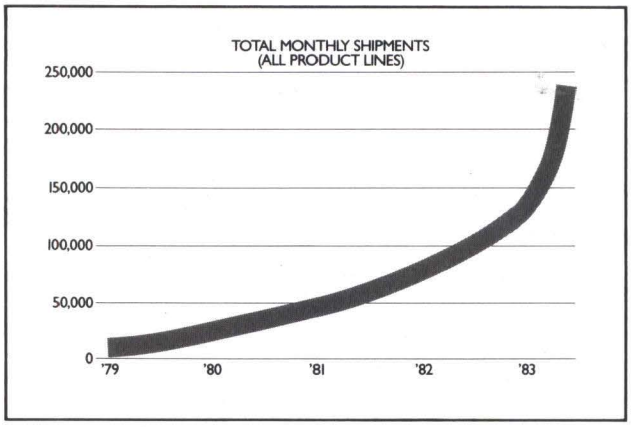
Like all Tandon companies, we start with a high degree of vertical integration. And an aggressive commitment to R&D no one can match.

We've also established ourselves in a brand-new facility with all the latest manufacturing and test equipment. So we can triple our current leading monthly production rate while ramping up to meet the burgeoning 3½" market.

Just because we've become a success by thinking small doesn't mean our plans are modest.

TANDON 8" AND 3½" FLOPPY COMPANY.

WE MAKE 24 DRIVES A DAY. NO WONDER WE'RE THE WORLD'S PRODUCTION LEADER.



With 24 different drive models in production each and every day, it's not surprising we're the number one supplier of micro peripheral disk drives in the world.

We're producing upwards of 10,000 drives every business day. Over 200,000 a month. And at this rate more than 2½ million drives a year.

Here's how the Tandon Companies have become the most successful disk drive companies you ever heard of:

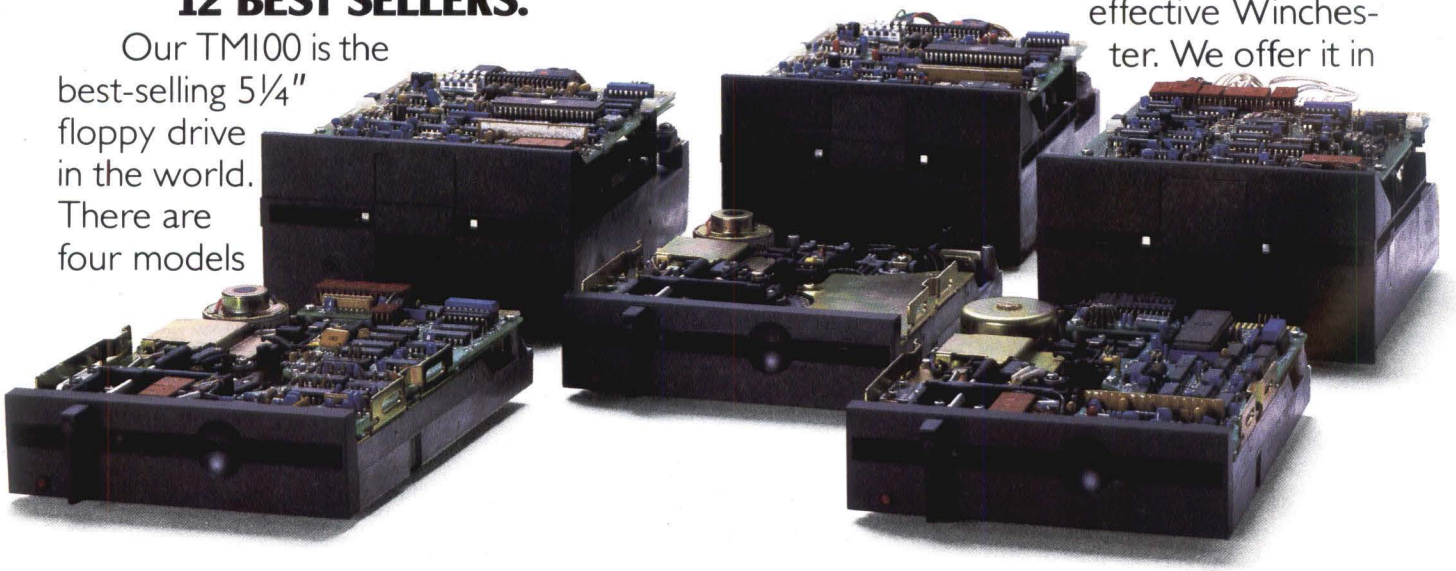
TANDON 5¼" FLOPPY COMPANY. 12 BEST SELLERS.

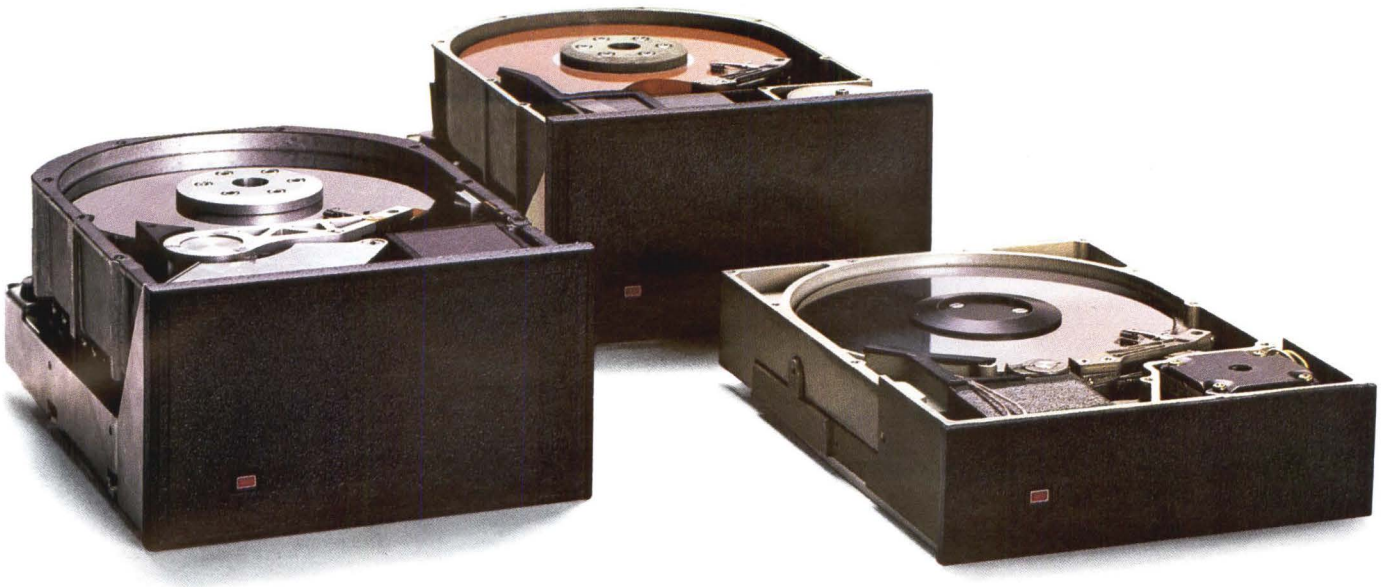
Our TM100 is the best-selling 5¼" floppy drive in the world. There are four models to choose from. 48TPI with 250KB. 48TPI with 500KB. 96TPI with 500KB. And 96TPI with 1MB. Our TM101-4 is a microprocessor-controlled model offering 96TPI with 1MB. And our TM102-2 has 96TPI with a full 2MB capacity.

Then there are our half-height 5¼" ThinLine floppies. Our ultra low cost TM50 comes in four versions. Two mechanics-only models for high-volume OEMs who want to provide their own added value and two models with fully operational electronics. Both versions come in 48TPI 250KB and 500KB capacity models. For microprocessor-controlled performance, our two model TM55 5¼" ThinLines offer 48TPI with a 500KB capacity and 96TPI with a 1MB capacity.

TANDON 5¼" WINCHESTER COMPANY. 6 DRIVES IS JUST THE BEGINNING OF OUR CAPACITY.

Our TM500 is an exceptionally cost-effective Winchester. We offer it in





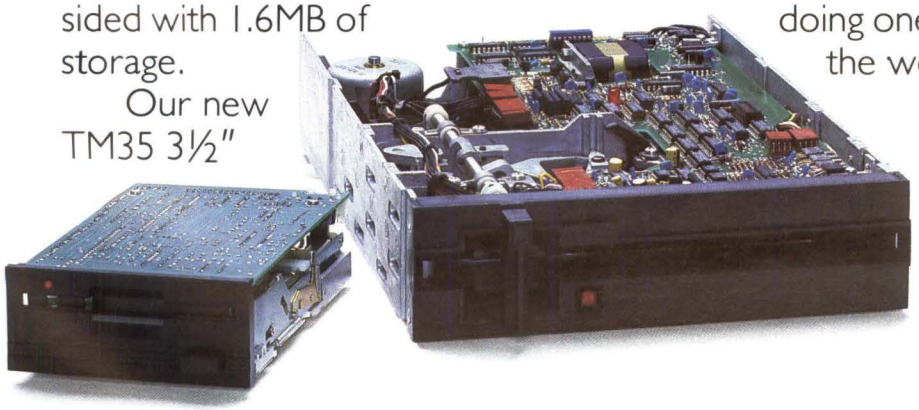
three models: 6.4MB, 12.8MB, and 19.2MB unformatted capacities. Our TM703 is a high-performance, closed-loop 5¼" drive with a full 30MB of storage.

We're proudest of our new TM250 half-height 5¼" Winchester. It's available now in 6.4MB and 12.8MB versions. With all the performance of a full height Winchester in half the space.

TANDON 8" AND 3½" FLOPPY COMPANY. 6 SMALL DRIVES. NO SMALL ACHIEVEMENT.

Our TM848, our first half-height 8" floppy, is still the world's best seller. It comes in two models. 48TPI single-sided with 800KB capacity and 48TPI double-sided with 1.6MB of storage.

Our new TM35 3½" drives are available in four models. Two Tandon TM100 interface-compatible versions—500KB and 1MB. And two Sony interface-compatible versions—also 500KB and 1MB capacities.



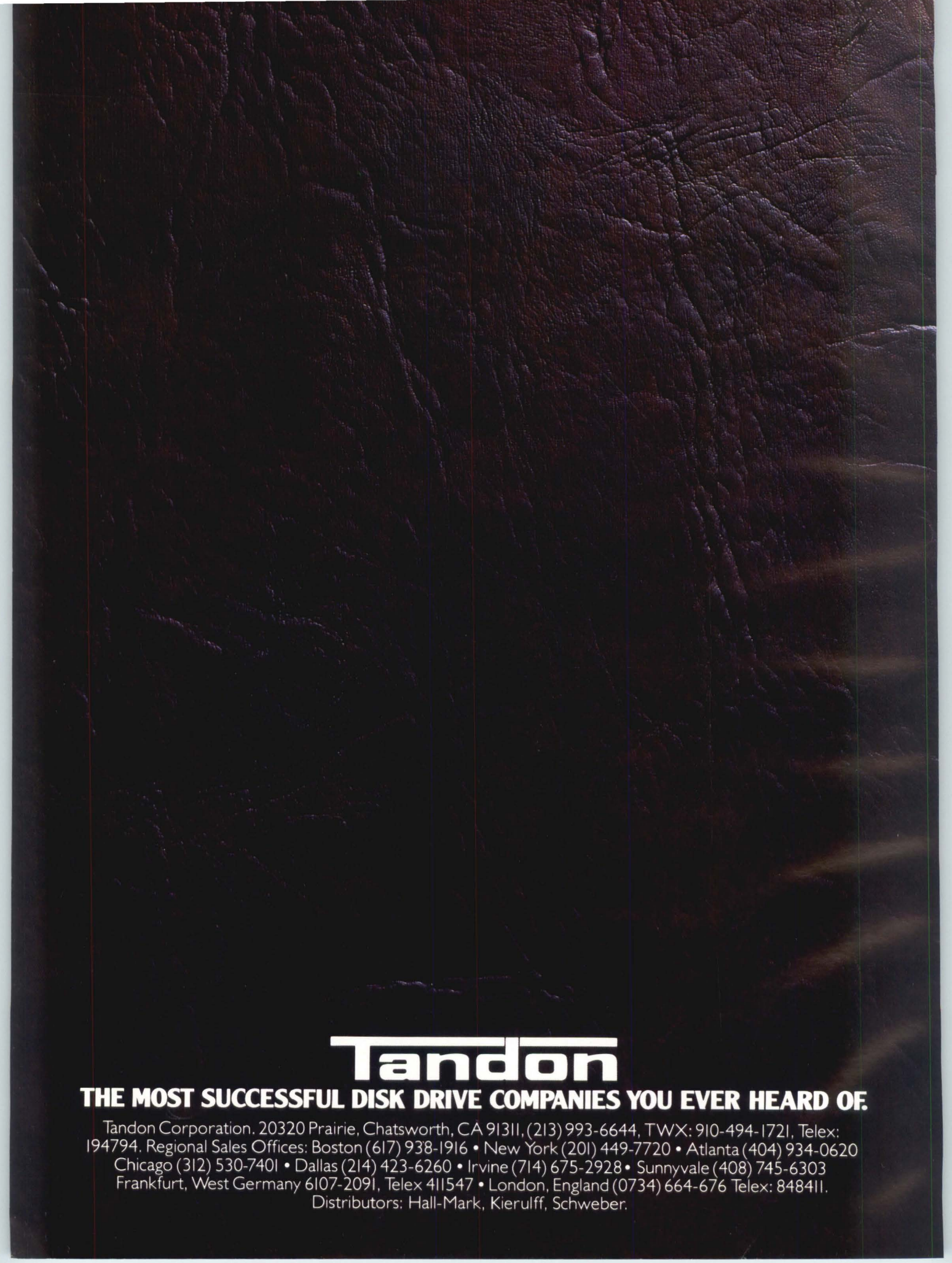
THE TANDON COMPANIES. THE DIFFERENCE IS OUR SUCCESS.

Separately, we offer products no competitor can match. Together, we're a corporation that has doubled or tripled its growth every year for the past 5 years.

Buying from the Tandon Companies offers you all the advantages of buying from a single source. *And* all the advantages of buying from a supplier who has concentrated all its resources on doing one job better than anyone else in the world.

That's the Tandon philosophy. It's given us an all-important edge on our competitors. And it's made us the most successful disk drive companies you ever heard of.

THE TANDON COMPANIES.

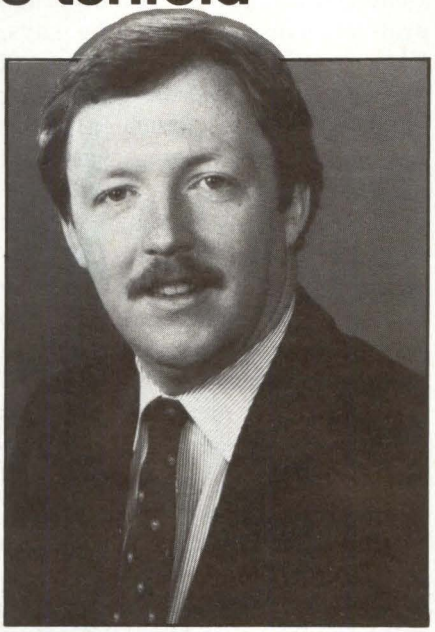

Tandon
THE MOST SUCCESSFUL DISK DRIVE COMPANIES YOU EVER HEARD OF.
Tandon Corporation. 20320 Prairie, Chatsworth, CA 91311, (213) 993-6644, TWX: 910-494-1721, Telex: 194794. Regional Sales Offices: Boston (617) 938-1916 • New York (201) 449-7720 • Atlanta (404) 934-0620 Chicago (312) 530-7401 • Dallas (214) 423-6260 • Irvine (714) 675-2928 • Sunnyvale (408) 745-6303 Frankfurt, West Germany 6107-2091, Telex 411547 • London, England (0734) 664-676 Telex: 848411. Distributors: Hall-Mark, Kierulff, Schweber.

Wang hopes to boost its third-party reseller business tenfold

Richard J. Connaughton has his work cut out for him. As group director of Wang Laboratories Inc.'s Indirect Sales Organization, he recently told newly appointed president and chief operating officer John F. Cunningham that he could boost Wang's ISO channel into a $1-billion business by 1990. About $400 million of that, led by the company's PC, is expected to be in new markets through dealer/retail channels, in which earlier Wang efforts have failed to generate substantial revenues.

Making good on those claims will take some doing, Connaughton concedes. It means increasing the ISO business from less than $100 million last year and taking a wide range of Wang products into markets the company has not previously penetrated. "Wang has always been closely modeled on IBM," observes Connaughton, a 10-year Wang veteran. Like its model, Wang has succeeded in the market largely because of an aggressive and expensive direct sales organization that includes more than 130 domestic branches and direct or distributor outlets throughout the world. Wang also has found itself playing catch-up in small systems markets that rely more and more heavily on third-party distribution. "There's increasing contention for third-party channels, and if we don't stay in contention, we could be in trouble in the market," Connaughton explains.

Connaughton says Wang would like to see about 10 percent of its sales to major accounts (companies with $100 million to $1 billion in annual revenues) go through the ISO organization and about 50 percent of sales to mid-range companies go through ISOs. He sees almost all sales to companies with revenues of less than $25 million a year going through third-party channels. This represents a part of the market that Wang has never penetrated and on which it will concentrate its dealer/retail effort.



Richard J. Connaughton, *Wang's group director for the indirect sales organization, is behind an ambitious company effort to expand ISO business tenfold throughout its product line to $1 billion by 1990.*

Wang has used systems houses and value-added resellers to sell its 2200 series small-business systems and VS minicomputers since those systems began appearing on the market in the mid-1970s. But in the fiscal year that ended last June, these third-party outlets accounted for only about $60 million of the estimated $560 million in Wang computer systems sales for the period. The company also has dabbled in the dealer and retail channels with its low-end Wangwriter word processor, signing 55 independent dealers and retail chains such as Sears, ComputerLand and Control Data Corp. Business Centers. The dealer and retail efforts thus far have been "false starts," says Sanford R. Fox, director of dealer/retail operations. That is partly because Wangwriter has been too expensive for those channels, Fox says. He predicts better response to Wangwriter after a recent price reduction that put an entry-level configuration at $5400.

Fox is one of five functional directors reporting to Connaughton in the recently organized ISO group in Wang. The others are: Carman Reitan, director of ISO (systems house) marketing; Eugene Schulz, director of international ISO marketing; Paul Gill, director of software vendor development; and an unfilled slot for a director of national ISO development who will oversee systems house operations in the field.

Connaughton, who returned to Wang headquarters in Lowell, Mass., from a stint as Central European area manager to become group director of the ISO operation, sees the systems house market as a major opportunity for Wang. He says the company has added 40 systems houses this year to bring the total to 200. He would like to have 300 systems houses signed by year-end.

Systems houses will extend Wang's penetration into vertical markets the direct marketing force has not addressed, Connaughton says. "We have great national accounts marketing in distribution insurance and manufacturing indus-

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tries, for example, but you never see us in hotels," he points out. Systems houses are attracted to Wang, he maintains, because of its name, its outstanding growth record and the office-automation concept. Wang's track record may be its greatest attraction, he says. The aging 2200 line managed a respectable 22-percent growth rate last year, while traditional rivals such as Basic Four Corp. suffered setbacks. Similarly, the VS minicomputer business grew 129 percent in the first six months of this fiscal year, while many minicomputer vendors languished.

Another compelling angle for Wang's sales to value added resellers is its office-automation capabilities. The level of word processing, electronic mail and other office facilities offered on Wang VS and 2200 computers is not generally available on other OEM and systems house products such as Digital Equipment Corp.'s PDP-11 and Data General Corp.'s Eclipse, Connaughton claims. To encourage systems houses further, he says, Wang is reviewing the idea of adding industry-standard operating systems to its 2200s and VS systems, acknowledging that UNIX has been considered.

To reach a broad range of new systems houses, Wang has integrated the ISO marketing team into the field sales organization. About 80 field salespeople are supported by a 60-employee headquarters operation. A complement to the systems house effort, Connaughton points out, is Wang's well-established third-party software program, under which products from 1100 independent vendors are available to ISO and direct sales customers.

As director of dealer/retail operations, Fox is responsible for getting Wang products into the dealer/retail channel for resale to smaller users. Fox, who joined Wang from Canon USA last spring, has had a 25-year career with various companies that sold through office-equipment dealers. "My expertise is that I know most of the good dealers in the country," Fox says. He hopes to have 300 of them selling Wang products by next June.

While the company plans to add the Wang Professional personal computer to the dealer/retail product list this month, Fox does not expect to rely heavily on computer stores. Wang expects to sell the PC through Sears and CDC outlets, but will rely most heavily on office-equipment dealers and the emerging "hybrid" computer stores with outside sales forces and system integration expertise, Fox says.

—Geoff Lewis

GUEST FORUM

A column for guest experts to speak out

Eenie, meenie, minie, mo— with which microfloppy should I go?

By James F. Moore
Dataquest, Inc.

It is no secret that we are on the brink of the microfloppy era. With the increased number of small computer systems being developed and introduced, the need for these smaller physical volume (down to 48 percent of the size of a half-height minifloppy), lower power (down to 56 percent of the power required by minifloppies) drives should soar. Additionally, the average microfloppy's quantity pricing is 10 to 15 percent less than similarly capable 5¼-in. drives.

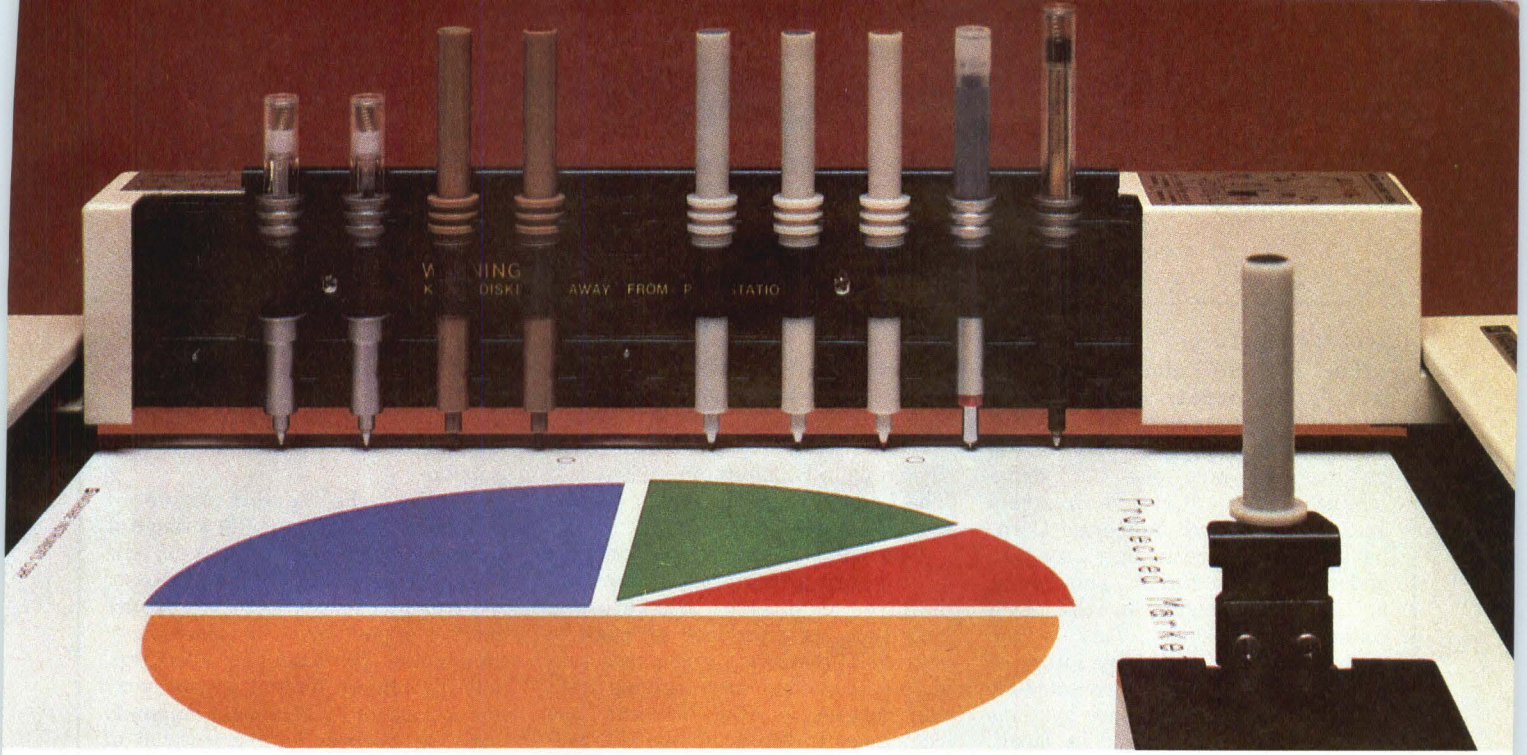
Certainly the designers of any new home, personal, portable or very small business computer; portable test or general instrumentation system; and intelligent typerwriter or portable terminal and workstation should be evaluating the various available microfloppies. Shipments of units to North American OEMs for use in those applications are expected to rise from 58,900 this year to 1.65 million in 1986. The dilemma is, however, just which microfloppy drive/media format to choose.

There are four basic media formats from which to make this choice: the Microfloppy Standards Committee 3½-in. hard-jacket diskette, the Hitachi Ltd./Panasonic Co./Maxell Corp. 3-in. hard-jacket diskette, the Dysan Corp./Seagate Technology/Tabor Corp. 3¼-in. soft-jacket diskette and the IBM Corp. 4-in. hard-jacket diskette. Each format offers credible design advantages for consideration by system integrators. But because of the youth of this market, none can boast of being the obvious winner in terms of achieved market share.

Contributing to the confusion about microfloppy format standards is the composition of the ANSI X3B8 working committee, tasked with determining a physical media standard. At the committee's meeting this January, about 53 companies were represented. Of those, only seven were organizations that produce computer systems, and all seven produce storage peripherals. The remaining 46 (excepting the National Bureau of Standards) are producers of floppy drives, media or components for drives or media. The message here is clear: while system integrators desire the benefits of standardization, they want no part in determining that standard (at least at ANSI).

The MSC 3½-in. format appears to be the one favored by U.S. manufacturers. It has made significant inroads in U.S. system designs (most notably with Hewlett-Packard Co.), has the largest number of U.S. floppy disk manufacturers endorsing it, has a number of media manufacturers endorsing it and is the leading contender in the ANSI committee.

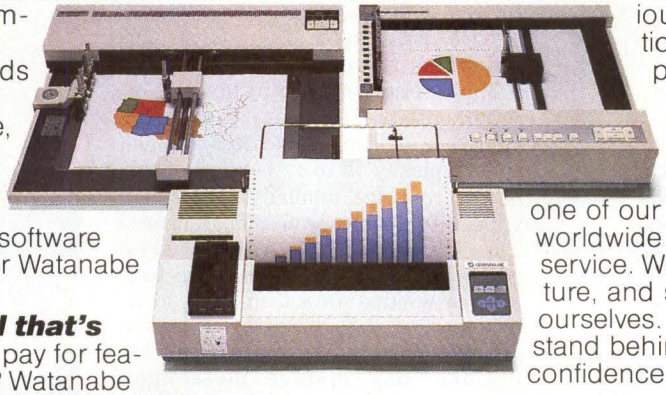
Continues on page 80



Watanabe plots color. Fast, accurate and easy as pie.

Watanabe brings you a multi-pen digital plotter you can even use at your desk. Its low cost makes it affordable. And its sophistication makes it the answer to your need for economical high-speed, hard-copy graphics. Whether for engineering drawings, scientific plotting, architectural design, or business graphics.

Easy to program and use. You don't have to be an engineer to use a Watanabe plotter. Yet it can produce complex engineering drawings. Intelligence is built into the plotter through our unique microprocessor controllers. So it can perform complex tasks using the single-letter commands you give it. Programs are also simple to write, making the plotter very convenient to use. Or you can use one of the many software packages available for Watanabe plotters.



Choose the model that's right for you. Why pay for features you don't need? Watanabe plotters are available in a variety of models. One will be best for your budget and graphics needs. Choose from our low cost, single-pen plotter, through a range of multi-pen configurations, to our high-speed, intelligent plotters. Or select a machine that blends analog and digital technology.

Use water or oil-based pens, or ink pens. Choose from sheet-feed or roll-feed models, or produce drawings on acetate for overhead projection. In addition to programmable graphics and function commands, the complete ASCII character set is standard. Each plotter can interface to any computer with an RS-232-C serial interface, IEEE-488 interface, or parallel port.

Designed for long use. Just one example of Watanabe's built-in reliability is the ingeniously simple, automatic mechanical pen pickup used on the multi-pen models.

When your plotter does need maintenance or repair, one of our many locations worldwide will provide prompt service. We design, manufacture, and service our plotters ourselves. So we know we can stand behind them with confidence.

Let us put a plotter at your fingertips. Call Don Pierson toll-free at (800) 854-8385 to arrange a demonstration. In California call (714) 770-6010. Or write: Watanabe Instruments Corporation, 12 Chrysler Street, Irvine, California, 92714.

WATANABE

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The Hitachi/Panasonic/Maxell 3-in. format appears to be the one favored by Japanese manufacturers other than Sony. So far, it is endorsed by only one U.S. drive manufacturer—Micro Peripherals Inc., 3M Co. and Memorex Corp. have media interests only. 3M also endorsed the MSC format. This format is not a contender in the ANSI committee workings. This is the probable leader for systems integrated by Japanese manufacturers and for systems that emulate those systems but are not manufactured in Japan.

The Dysan/Seagate/Tabor 3¼-in. soft-jacket format has yet to gain significant attention from system integrators and appears to be losing to the MSC format in the ANSI committee. Ignoring the potential economies of scale advantages of the MSC format, this soft-jacket approach would appear to offer lower, long-term cost advantages for both the media and the drive over hard-jacket approaches. It appears destined, however, to a significant, albeit minority role.

I believe that, in its current form, the 4-in. device and follow-on emulating drives will be of primary interest within IBM and in the general market in applications including document archiving, local storage for new-generation video terminals and microprogram and diagnostic loading devices for peripherals. Because IBM is its sponsor, the format will persist, but because of its capacity and performance, it probably will not dominate.

James F. Moore is director of the Computer Memory Industry Service at Dataquest Inc., Cupertino, Calif.

Customer service: the competitive edge in microcomputer sales

By Stephen H. Thurston
The Ledgeway Group Inc.

The personal/professional computer industry is comprised of several hundred companies marketing a multitude of products through a myriad of distribution channels to a diverse customer base ranging from the largest of the Fortune 500 companies to the professional small-business user.

Because of such diversities and the increasing reliance of individuals on computers to conduct their businesses, service offerings are becoming more important selling tools for microcomputer manufacturers and third-party distributors. Service and support options are the icing on the cake to those sellers and resellers that already have a good reputation for offering a strong assortment of software, good hardware features and competitive pricing.

User requirements for service vary. Those familiar with the service offered by mainframe and minicomputer vendors may demand a highly responsive, personalized on-site approach, which is an expensive alternative. Such a service arrangement may cost 16 to 20 percent per year of the hardware purchase price. In the office environment, on-site service has been the norm for typewriter and copier equipment.

Many options offered by vendors or retail outlets emphasize a carry-in approach, which, while less expensive (typically 10 to 12 percent of the hardware price annually), does not appeal to many professional users. They do not have the time to ferry equipment back and forth, even to a service window in a computer store or depot.

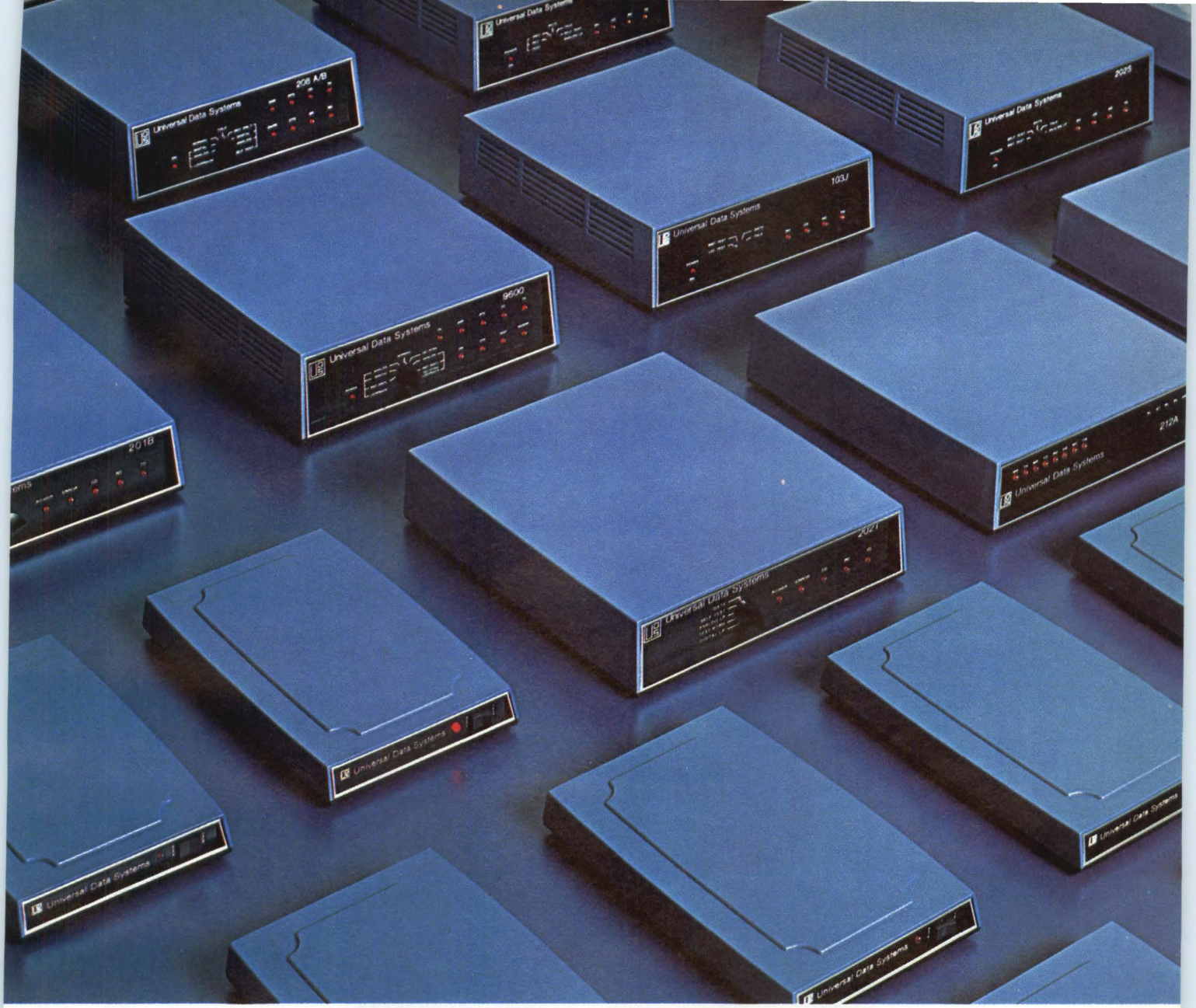
Variations in hardware service options may involve messenger pickup and delivery, with or without a loaner. Costs for this variation typically fall in between the user carry-in and on-site arrangements.

For software support and training there are also a variety of approaches from instructor-delivered training to a toll-free hot line. In most cases, users receive a self-paced instructional manual, although interactive training disks are becoming more popular.

Ideally, the vendor or retail channel will be able to offer a range of service and support options for the varied requirements of its user base. Where deficiencies exist, there are market opportunities for third-party companies. For example, IBM Corp. initially offered limited on-site service options for its Personal Computer, and the Sorbus Service division of MAI followed with a more comprehensive on-site coverage from its nationwide network of locations. IBM has since extended its on-site options. Third-party software support plans also are becoming available. These plans typically are telephone services for independent software packages.

Those manufacturers and resellers able to design responsive and cost-effective service and support programs and provide delivery of those programs are expected to be the ones with "staying power" in this rapidly growing market.

Stephen H. Thurston is a principal with The Ledgeway Group Inc., a Lexington, Mass., consulting firm engaged in a major research effort on service strategies for retail and ISO channels.



MULTIPLE CHOICE: The UDS Modem Family

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(bps)	MODEL	PRICE	MODEL	PRICE	MODEL	PRICE
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0-1800			202T	$425		
1200/300	212A* 212A/D	$675 $745			212 LP**	$445
2400	201C*	$775	201B	$695		
4800	208A/B*	$1750	208A/B	$1750		
9600			9600	$2650		

*Auto-answer **1200 bps only Single unit prices.

At speeds through 4800 bps, UDS modems are Bell-compatible and FCC certified for direct connection to the PSTN. The 9600 bps unit conforms to CCITT V.29 standards. All models are available as OEM boards and in multi-channel packages for central site applications.

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CIRCLE NO. 39 ON INQUIRY CARD

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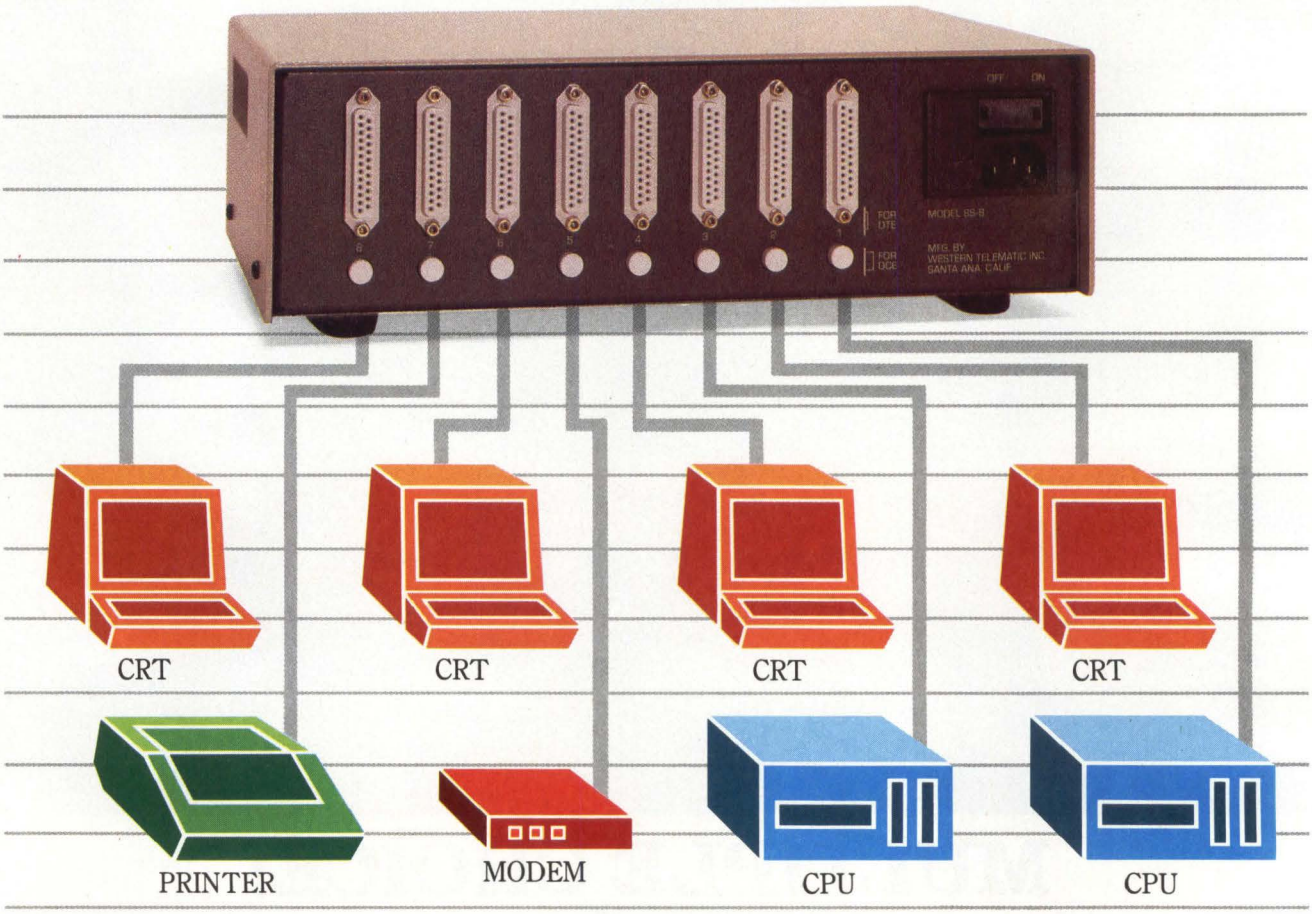

Here's an affordable way to switch up to eight RS-232 ports in any interconnection. Any port can select any other port, with up to four pairs of ports communicating at the same time. Push-buttons define each port as either DTE or DCE, for quick and easy installation.

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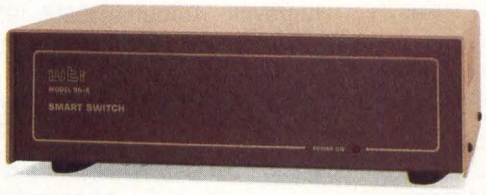
Use the Smart Switch to create your own low-cost network linking a number of terminals, printers or computers. Use it to give as many as seven users access to a single I/O port on your computer, or six users access to two different computer systems. Or use it with any distributed computer environment.



To learn more about the SS-8 Smart Switch, call David Shumway toll-free at (800) 854-7226. In California call (714) 979-0363. Or write Western Telematic, Inc., 2435 South Anne Street, Santa Ana, California 92704. Or telex 467741.

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CIRCLE NO. 40 ON INQUIRY CARD

MARKET BAROMETER

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

Superminicomputers offer market opportunities in four major areas

By Timothy F. McMahon
Venture Development Corp.

Shipments of superminicomputers, one of the fastest growing computer products, will increase at a compound annual rate of 31.9 percent from $1.2 billion in 1981 to $4.8 billion in 1986. The industry has been dominated by six suppliers—Digital Equipment Corp., Prime Computer Inc., Gould Systems, Perkin-Elmer Corp., Harris Corp. and Data General Corp.—that have shaped the definition of four market segments. These are the real-time, computational/processing, time-sharing and general-purpose business markets.

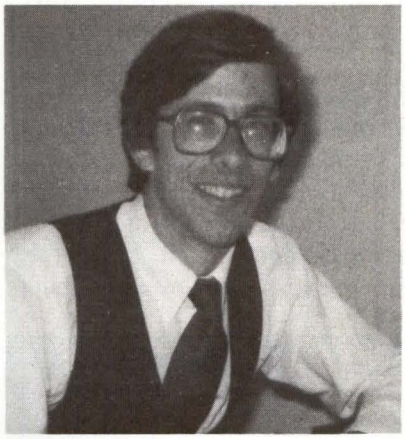
The first two areas provided the main impetus for the development and adoption of superminis (Fig. 1). Simulation is the most prevalent real-time application, both today and in 1986 projections. Test and inspection systems are next, followed by communications applications. General-purpose business-system suppliers and users only recently have turned to superminis for higher performance at lower prices. However, this segment is the largest potential market and fastest growing of the four areas.

Computational systems are expected to grow at an annual average compound rate of 40.3 percent. In 1981, this segment constituted the largest superminicomputer application. By 1986, however, it will be surpassed slightly by general-purpose business-computer shipments. The six major firms have been joined recently by new vendors, which are intensifying competition.

Venture Development Corp. identifies computational applications as laboratory computation, CAD/CAM, government-agency computation, image processing, seismic processing and medical instrumentation. Laboratory computation applications have the leading share of the computational supermini shipments in 1981 and 1986. However, CAD/CAM is the fastest growing application for superminis because it requires processing of large amounts of data quickly and interactively and high I/O data rates to drive the high-performance graphics peripherals attached. Major CAD/CAM areas include aircraft design, automotive design, marine construction modeling, PC-board design, mapping, architecture, engineering, other construction and finite-element analysis.

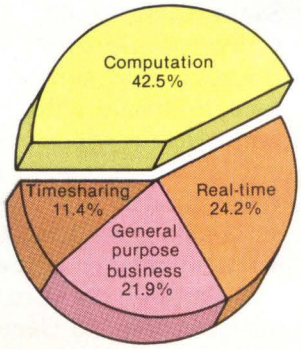
VDC's definition of a supermini is a computer whose CPU has a word length of 24, 32 or 48 bits; with a maximum main-memory capacity of 1M byte or more; with a logical address space of 1M byte or more; with a maximum program size of 1M byte or more; and with a bus structure rather than the point-to-point-structure typical of mainframes.

I anticipate the appearance of low-cost superminis, perhaps incorporating 32-bit microprocessors during the next several years from minicomputer and microcomputer vendors. Fig. 2 shows the relative impact superminis have made and will have made upon minicomputer products, thus prompting product-line expansions by manufacturers and system builders. The new low-priced systems will prove quite popular in all four applications. With their large 32-bit address space, superminis are of value to both system designers and end users. Designers and integrators will be more easily able to implement memory protection, virtual-memory schemes and multitasking architecture with a 32-bit address space. End users will find 32 bits affords them faster computation and easier, more accurate handling of large numbers.

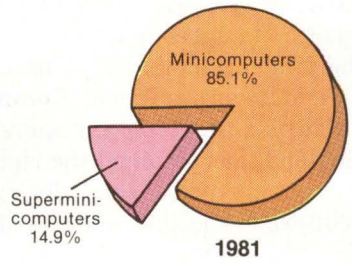


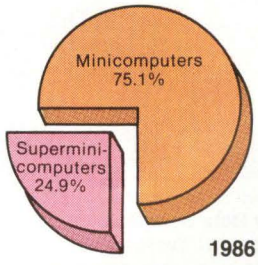
Timothy F. McMahon is manager of the computer division at Venture Development Corp., Wellesley, Mass., a management consulting firm.

YEAR-END 1981 INSTALLED BASE OF SUPERMINICOMPUTERS BY APPLICATION AREA



COMPUTER SYSTEM SHIPMENTS (% OF DOLLARS)





Source: Venture Development Corp.

Financings

Corona Data Systems Inc., a Westlake Village, Calif., manufacturer of IBM PC-compatible computers, has received $5.5 million in its first round of venture-capital financing. Major investors include Burr, Egan, Deleage and Co., Boston, Pathfinder Venture Capital Fund, Minneapolis, Brentwood Associates, Los Angeles, and Morgenthaler Management Corp., Cleveland. Sirjang Lal Tandon, chairman of Tandon Corp., Chatsworth, Calif., is one of the private investors in the company.

Formations

Valley Data Sciences Inc., Mountain View, Calif., was founded recently to offer a series of intelligent-chip-support and cross-development systems. "Total market segments addressed are expected to reach $250 million for the chip-support unit and $1.2 billion for the cross-development system by 1986," claims company co-founder, chairman and president Eugene R. Anderson. Anderson, a co-founder of Measurex Corp., expects his new company to obtain at least "a measurable percentage" of those markets by 1986. Initial venture-capital funding of $1 million came through Chappell and Co., San Francisco, from several European and Hong Kong investors.

Eugene R. Anderson, chairman of start-up Valley Data Sciences Inc., *predicts the total markets addressed by intelligent-chip-support and cross-development systems will reach $250 million and $1.2 billion, respectively, by 1986.*

Distribution/service deals

Digital Equipment Corp. and **Molecular Design Limited,** Hayward, Calif., have entered a cooperative marketing agreement to promote use of MDL application-software packages on DEC VAX/VMS superminis. The companies will refer each other's products to potential customers and support them at major chemical expositions. Initial products, both database-management systems, covered by the agreement include MAACS, a graphical system for molecular information, and REACCS, for handling chemical reaction information....A multi-million-dollar agreement has been signed by **Olivetti Tecnost** and **Telesis Systems Corp.,** Chelmsford, Mass., for Olivetti Tecnost to become exclusive distributor of Telesis's CAD/CAM system for schematic entry and printed-circuit board layout in Europe. In the second phase of the deal, Olivetti Tecnost will be licensed to manufacture the CAD/CAM systems in its Ivrea, Italy, plant. The agreement also calls for the joint development of hardware and software....**Trend Communications Ltd.,** Buckinghamshire, England, has obtained the rights to market **Printek Inc.** dot-matrix printers in the U.K. and the Middle East. The printers will be known as the Trend Printer 900 series. Printek is based is Benton Harbor, Mich....**TRW Inc.,** Fairfield, N.J., has been appointed the exclusive U.S. service representative for Rexon Business Machines, Culver City, Calif. The TRW Customer Service division has 200 service offices across the country.

Wet ink

Apollo Computer Corp., Chelmsford, Mass., has received the largest order in its three-year history—$19.8 million—from Mentor Graphics Corp., Portland, Ore., for the Apollo Domain engineering workstations. They will be used for Mentor's Idea 1000 electronic-design workstation products. The contract extends through 1983....**Centronics Data Computer Corp.,** Hudson, N.H., will supply $3 million worth of custom-designed Printstation 350 printers to Redshaw Inc., Pittsburgh, over a three-year period. The modified printer will be used for Redshaw's insurance-applications systems....**Cipher Data Products Inc.,** San Diego, Calif., will deliver approximately 1000 of its ¼-in. streaming-cartridge tape drives to Plessey Peripheral Systems Inc., Irvine, Calif., through February, 1984. The drives will provide Winchester backup for Plessey's Digital Equipment Corp.-based System 6200/6400 and 6600/6700....Prime Computer Inc., Natick, Mass., has signed with **Convergent Technologies Inc.,** Santa Clara, Calif., to purchase Convergent's application workstations. The equipment will be used in Prime office-support systems. Details will not be announced until the second half of this year....In a 10-year contract valued at $3 million for 1983, **Gould Inc.'s** S.E.L. Computer Systems division will supply its Concept 32/27 minicomputers to General Electric Information Services Co., Rock-

Continues on page 88

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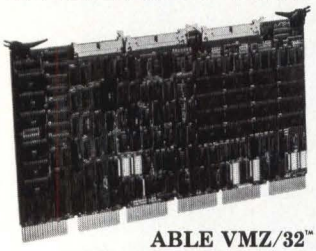

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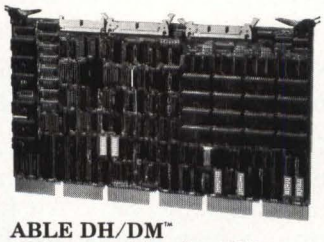

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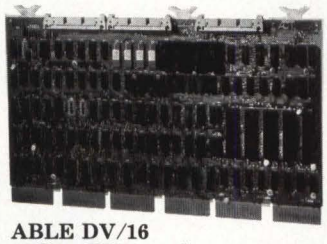

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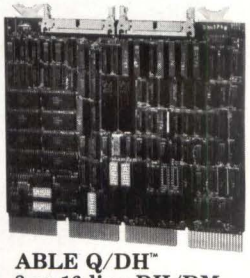
Q-BUS DMA.



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CORPORATE AND FINANCIAL

BOX SCORE OF EARNINGS

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

Company	Period		Revenues	Earnings	EpS
Analog Devices Inc.	3 mos	1/29/83	45,262,000	2,544,000	.21
	3 mos	1/30/82	41,036,000	2,005,000	.17
AM International Inc.	6 mos.	1/29/83	273,297,000	(2,560,000)	(.25)
	6 mos.	1/30/82	305,488,000	(44,489,000)	(4.34)
Burroughs Corp.	year	12/31/82	4,186,251,000	117,628,000	2.80
	year	12/31/81	3,405,428,000	148,926,000	3.58
Computer Memories Inc.	9 mos.	12/31/82	9,728,219	798,392	.14
	9 mos	12/31/81	1,138,090	(404,237)	(.14)
Control Data Corp.	year	12/31/82	4,292,000,000	155,100,000	4.11
	year	12/31/81	4,100,700,000	170,600,000	4.48
Datapoint Corp.	6 mos	1/31/83	266,267,000	2,263,000	.11
	6 mos	1/31/82	268,286,000	22,094,000	1.08
Electronic Data Systems Corp.	6 mos.	12/31/82	298,826,000	27,751,000	.99
	6 mos	12/31/81	246,303,000	21,741,000	.80
Gould Inc.	year	12/31/82	1,643,100,000	90,500,000	2.10
	year	12/31/81	1,561,600,000	87,400,000	1.96
IBM Corp.	year	12/31/82	34,364,000,000	4,409,000,000	7.39
	year	12/31/81	29,070,000,000	3,610,000,000	6.14
Intel Corp.	year	12/31/82	899,812,000	30,046,000	.65
	year	12/31/81	788,676,000	27,359,000	.61
Management Assistance Inc.	3 mos	12/31/82	90,141,000	2,031,00	.25
	3 mos	12/31/81	94,354,000	2,750,000	.33
Micom Systems Inc.	9 mos	12/31/82	60,818,000	9,578,000	1.31
	9 mos	12/31/81	40,455,000	5,875,000	.83
Paradyne Corp	year	12/31/82	207,341,000	26,872,000	1.86
	year	12/31/81	139,023,000	18,261,000	1.40
Tandon Corp.	3 mos.	12/24/82	52,539,359	5,731,486	.25
	3 mos.	12/25/81	25,976,365	2,467,765	.12
Texas Instruments Inc.	year	12/31/82	4,326,600,000	144,000,000	6.10
	year	12/31/81	4,206,000,000	108,500,000	4.62
Wang Laboratories Inc.	6 mos	12/31/82	672,550,000	59,674,000	.48
	6 mos	12/31/81	510,354,000	43,212,000	36

Comments: Computer Memories Inc. states its improved profit margins were due to manufacturing economies and increased shipments of its 5¼-in. Winchester disk drives. Third-quarter revenues increased 442 percent to $4.9 million from $0.9 million a year earlier. Net earnings for the quarter were $331,737 or 6¢ per share, as compared to a loss of $112,237 for 3¢ per share, a year earlier. The figures for **DBM Corp.** are preliminary. **Micom Systems Inc.** reported increased sales of its Micro 600 data PBX modem led the 51-percent surge in sales. **Paradyne Corp.** says order delays and cancellations were offset by large contracts, tighter business controls and increased productivity. Fourth quarter revenues grew to $61.5 million from $44.1 million a year earlier. Net income for the quarter was $7.5 million, or 50¢ per share, compared to $5.6 million, or 42¢ per share, a year earlier. **Texas Instruments Inc.** reports that the only bright spots in its fiscal year were the garnering of large government contracts and increased home computer demand. **Wang Laboratories Inc.'s** second quarter revenues of $367.5 million were up 34 percent from $273.4 million a year earlier. Earnings for the quarter increased 38 percent from $25.2 million, or 21¢ per share, to $34.7 million, or 27¢ per share. New orders increased 40 percent over the previous year's second quarter, enabling the company to increase its backlog by $95 million.

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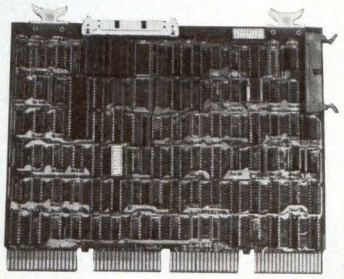

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Mini-Micro World

CORPORATE AND FINANCIAL

Continues from page 84

ville, Md. Gould's computers will be used in GE's worldwide teleprocessing network....**Micro Peripherals Inc.,** Chatsworth, Calif., has garnered contracts totaling $10 million from Research Computer, Standon Controls and VSC Corp. for its 5¼-in. floppy disk drives....**Non-Linear Systems Inc.,** Solano Beach, Calif., plans to purchase as much as $80 million worth of half-height 5¼-in. Winchester drives and floppies from Tandon Corp., Chatsworth, over the next two years. The drives will be integrated into the Kaypro 10 portable computer.

Industry monitor

Will the real Wangco Inc. please stand up? In response to legal action filed by Cipher Data Systems, the Wangco Inc. subsidiary of Rexon Business Machines Corp. has changed its name to **Wangtek Inc.** The original Wangco, formed by Dr. Ben C. Wang in 1969, was bought by Perkin-Elmer Corp. in 1976 and then sold to Cipher in 1981. Dr. Wang started the new company in 1982. Wangtek, based in Culver City, Calif., was expected to begin production of its ¼-in. streaming-tape cartridge drives last month.

Personalities

Avram Miller, formerly program manager for professional computers at Digital Equipment Corp., and credited with being the principal architect and implementor of DEC's personal computer program, has been appointed executive vice president of manufacturing and engineering at Franklin Computer Corp., Cherry Hill, N.J. Miller had also served as development manager for small systems engineering at DEC. Franklin markets Apple-compatible computers. With Miller, the company plans to expand its product line.

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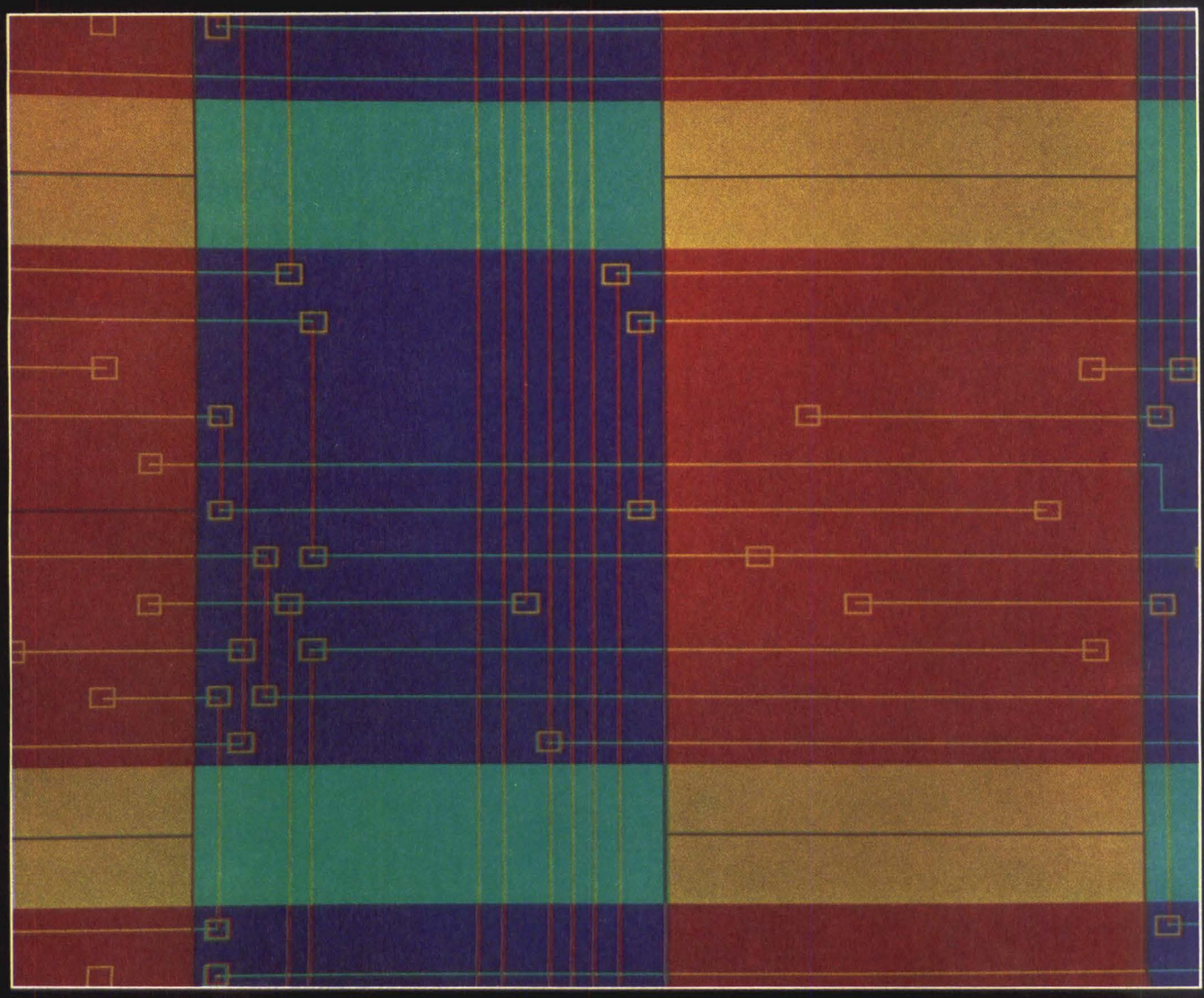

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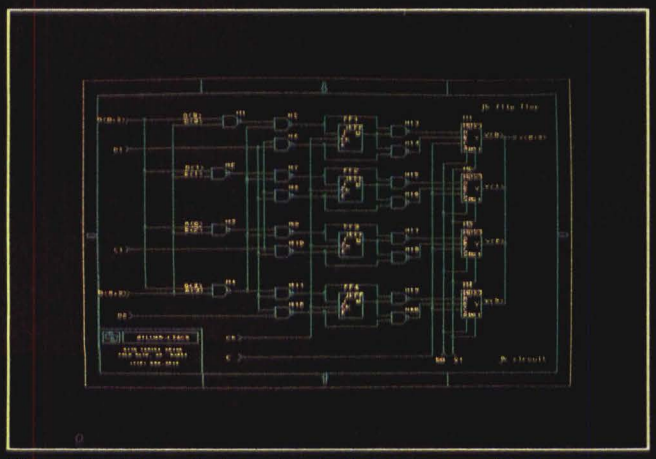

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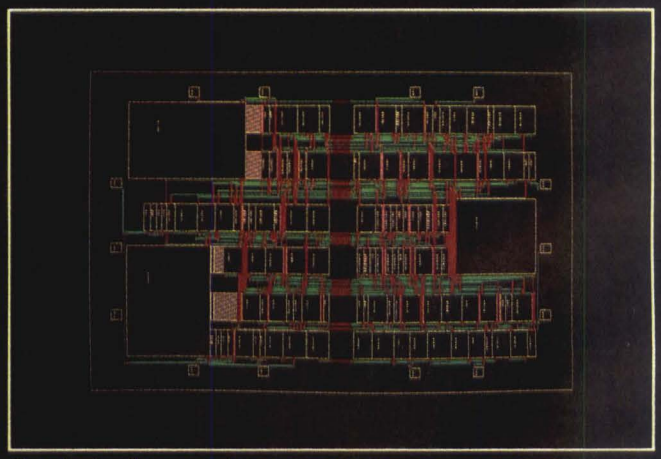

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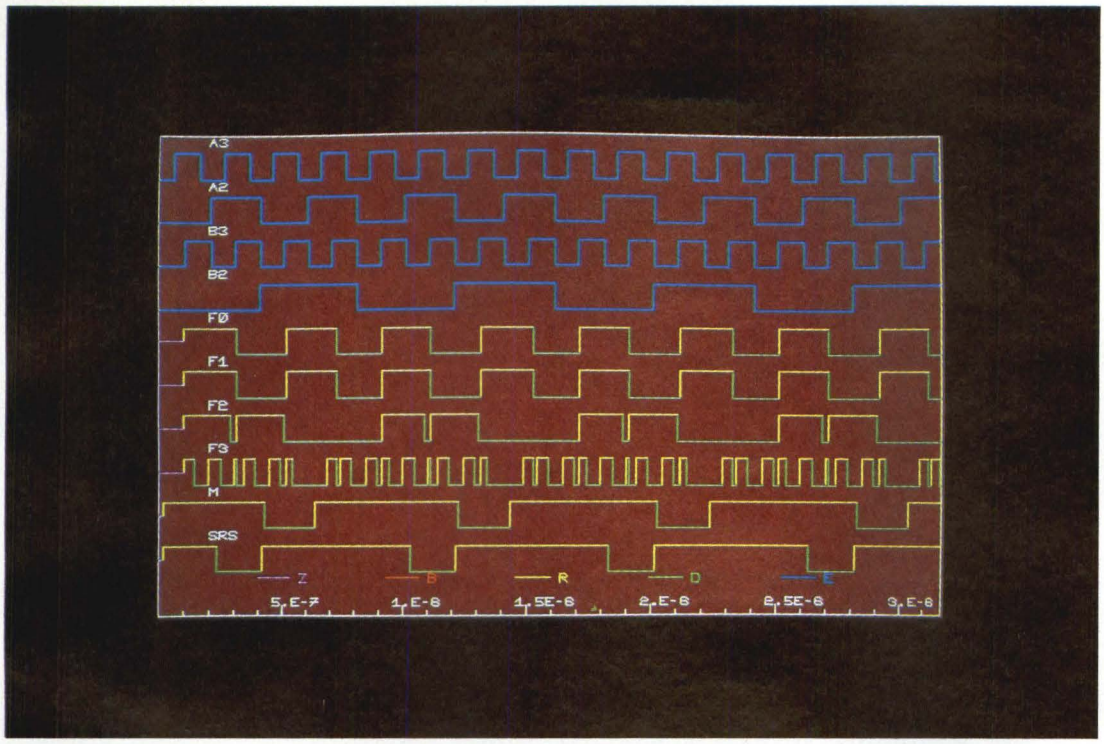

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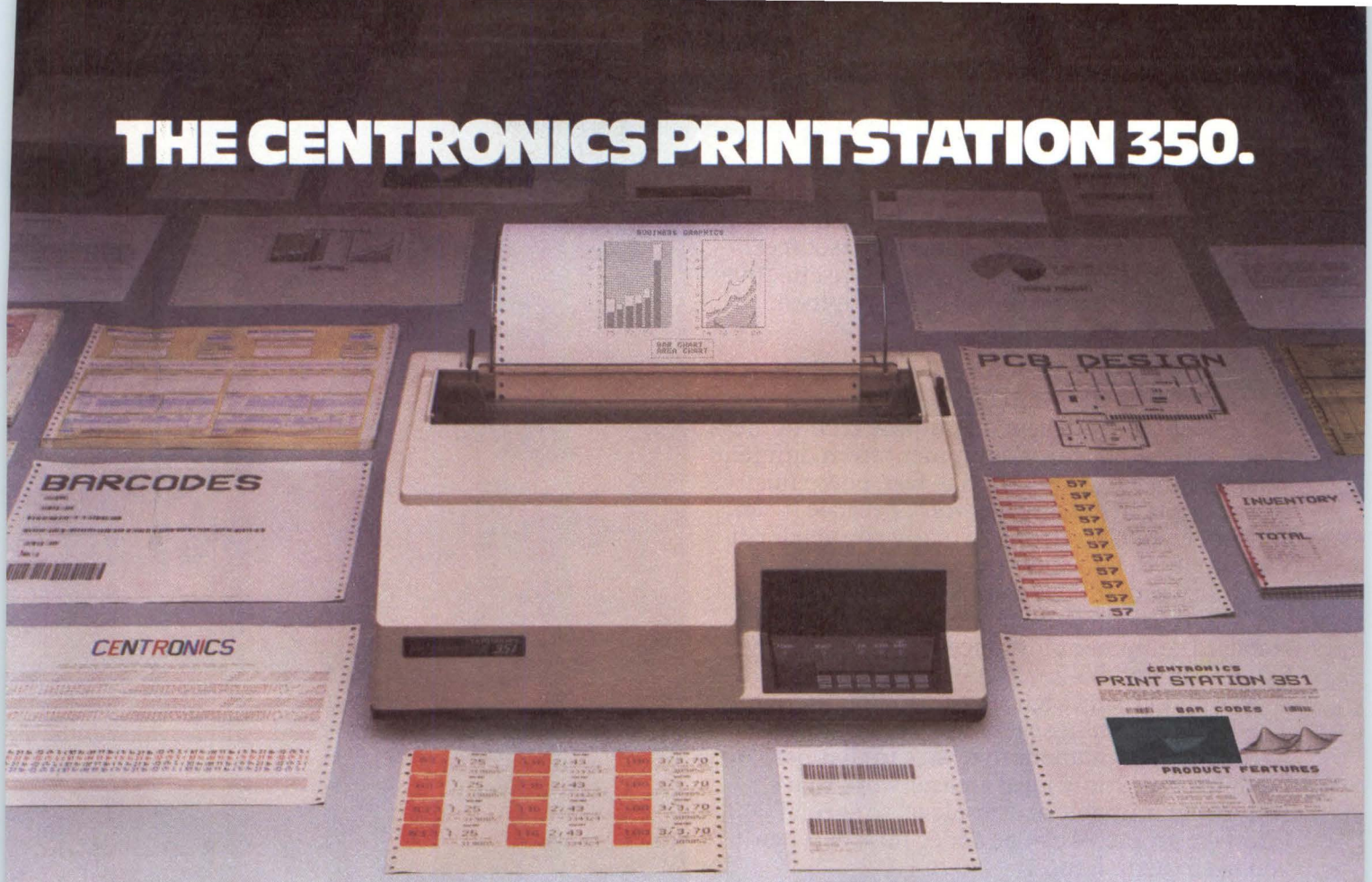

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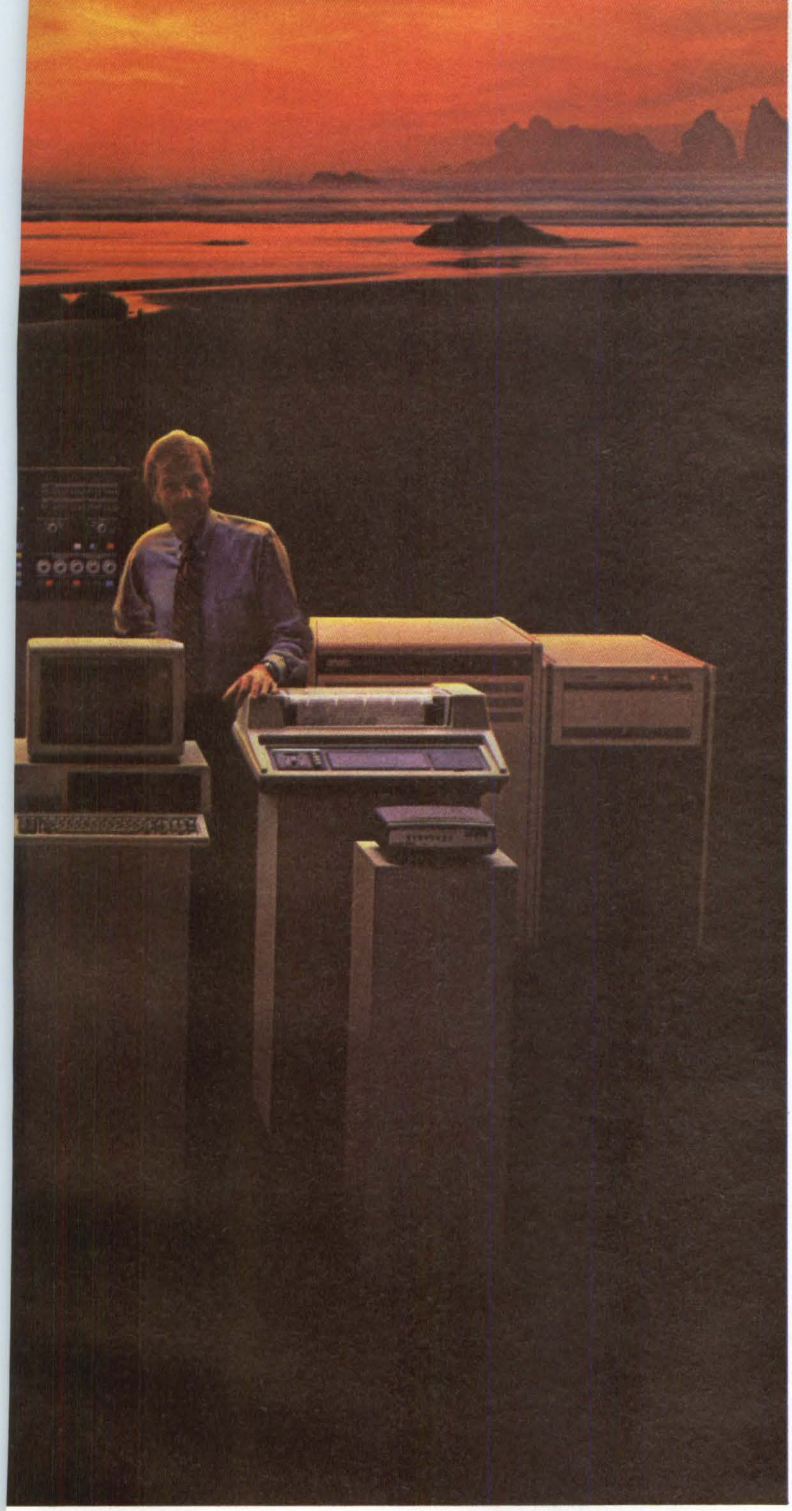

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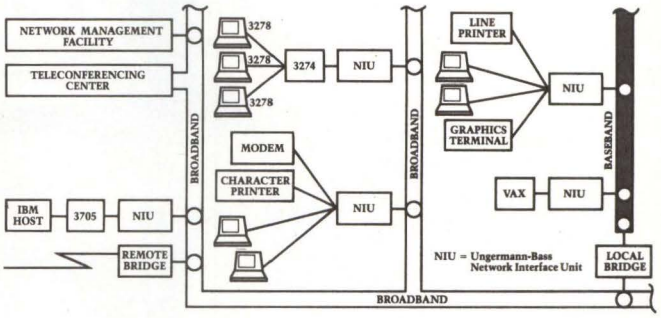

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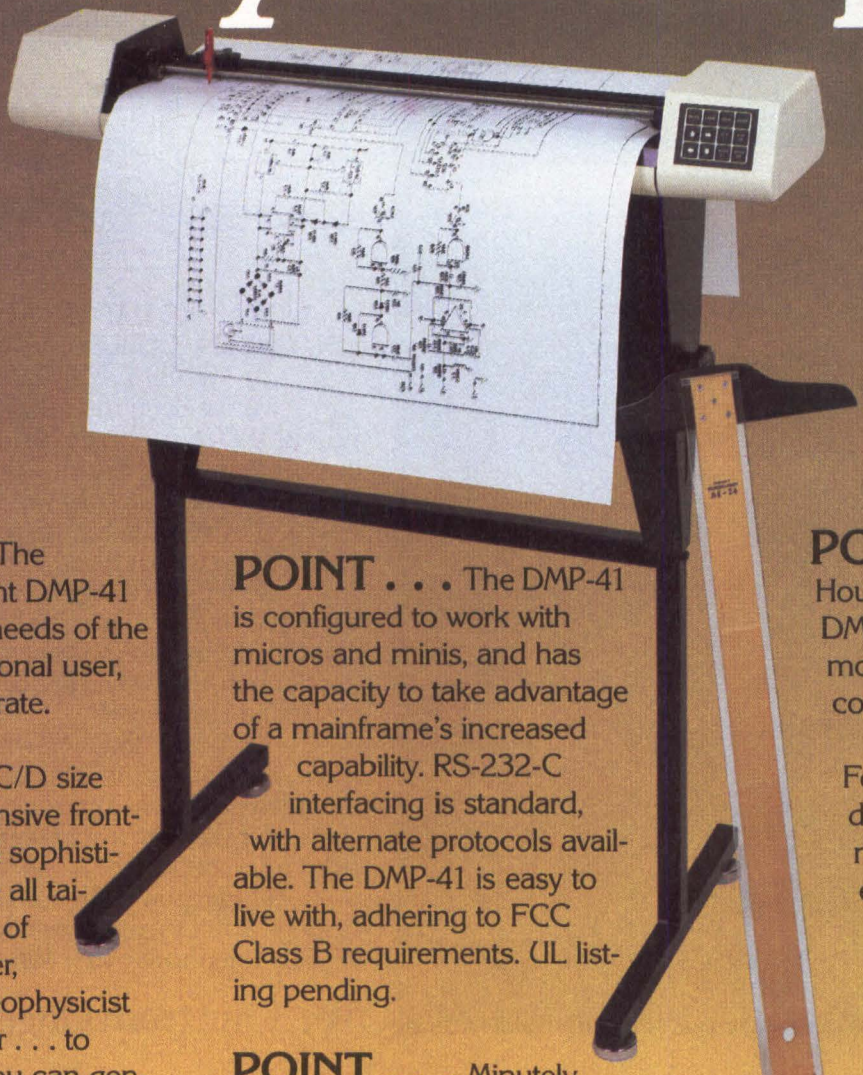

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CIRCLE NO. 50 ON INQUIRY CARD

IBM PC entry in Europe sparks peripheral-component-supplier activity

IBM Corp. is plunging into the European personal-computer market. The company recently announced plans to build an IBM Personal Computer factory in Greenock, Scotland.

Gordon Curran, a consultant with Intelligent Electronics Europe, Paris, says IBM PC sales could reach 60,000 units this year. Curran predicts IBM—which sold an estimated 150,000 PCs in the U.S. last year—will soon overtake Commodore Business Machines Inc. and Apple Computer Inc., the two top European suppliers.

Meanwhile, the arrival of the IBM PC in Europe provides European manufacturers of peripherals and components with attractive sales opportunities. Although IBM has yet to announce formally the availability of Winchester disk storage for the PC, at least one external source of 5¼-in. Winchester drives, Seagate Technology, has been identified as a potential U.S. supplier. In Europe, Francois Peleyras, OEM marketing manager of the peripheral manufacturing arm of Compagnie des Machines Bull, France's largest computer builder, is negotiating with IBM to supply Winchesters. Peleyras believes his company has an advantage over other potential suppliers in Europe. "We build Seagate drives under license," Peleyras explains, "so IBM will be able to use the same spare parts as in the U.S. But we do not expect IBM to start taking Winchester deliveries until 1984."

Another potential Winchester disk supplier, Rodime Ltd., Glenrothes, Scotland, is only 50 miles from Greenock—a big advantage, says Rodime sales director, Malcolm Dudson. "If IBM has a requirement, we will be in there selling hard," he declares, although he does not confirm negotiations with IBM.

Meanwhile, Intel Corp. is already shipping 8088 microprocessors to Greenock from its Swindon, England, warehouse. A potential 8088 second source is Matra Harris Semiconducteur, Nantes, France, which is negotiating with IBM, says the company's marketing manager, Jean-Pierre Libeaut. Siemens AG, Munich, Germany, a large Intel second source, is also believed to be a potential supplier of devices for the IBM PC. Curran sees the IBM PC quickly winning market leadership in West Germany. Citing the relatively sluggish growth of the West German business microcomputer market thus far, Curran says, "The Germans have been waiting for some established manufacturer to give the seal of approval to business micros. It depends on the performance of the Greenock plant, but IBM could get 20 percent of West German sales this year and overtake Apple and Commodore." Explaining that West German distributors tend to handle just one or two makes of microcomputer, Curran says that the existing German market leader, Commodore, which manufactures in Germany and holds a 22-percent share, could lose distributors following the arrival of the PC.

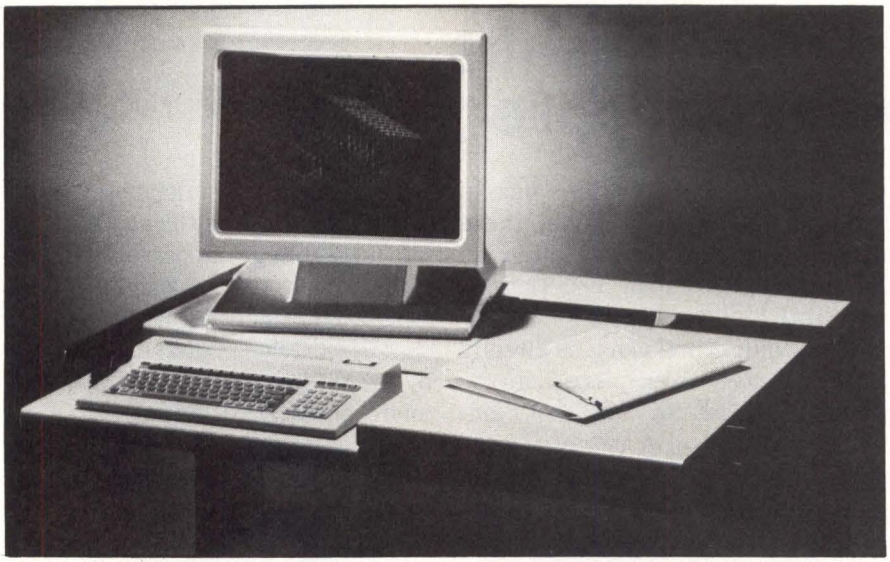
Curran says IBM is wise to move into Germany now, before the Japanese. Curran notes that German distributors expect Japanese vendors, notably Nippon Electric Co. Ltd., Hitachi Ltd. and Sony Ltd., to move in this year in force. They are expected to offer 16-bit machines that Curran believes will be well received because the Germans are impressed by the quality of Japanese computer hardware.

—Keith Jones

Sigma workstations support GKS graphics in firmware

Sigma Electronic Systems Ltd., Horsham, England, has introduced what it claims are some of the first graphics workstations incorporating firmware functions defined in the International Standards Organization Graphics Kernel System 7.2 standard. The Sigma 6100 series of intelligent raster graphics workstations reportedly can be interfaced with any host computer and are aimed at OEMs, system integrators and end users. Their launch follows the decision last year by the American National Standards Institute to support GKS rather than the Association of Computing Machinery's SIGGRAPH CORE standard (MMS, November, 1982, p. 175).

The 6100 series comprises two workstations—the 6150 monochrome and 6160 color. Both come with a 20-in. screen, and both incorporate the 6140 display generator, which acts as a GKS workstation. According to Sigma, the 6140 provides local support for all GKS primitives, workstation transformations and segment functions. The complete system is controlled by an



The Sigma 6100 series of intelligent raster graphics workstations *features GKS functions built in firmware. Resolution on both the monochrome and color displays is 1448 × 1024 dots. Pictured is the 6150 monochrome version.*

MC68000 microprocessor and employs a high-speed vector processor for drawing primitives into the pixel memory.

The 6100 series will be built in the U.S. by Sigma's parent, Lundy Electronic Systems, Charlotte, N.C., and sold as the Lundy 6100 series. Prototypes are scheduled to be shipped in the third quarter of this year. U.S. prices have not been set, but British prices range from roughly $16,000 to $26,000.

On the advantages of implementing the GKS standard in firmware, Lundy's graphics products vice president, Victor Weisenbloom, says, "The firmware is compact and fixed and, most importantly, offers superior performance over software." Some observers, however, have many unanswered questions about implementing GKS in firmware. David Straayer, a software engineer at Tektronix Inc., which plans to support GKS in products within a year, says one hindrance may be the lack of language bindings.

The 6100's firmware incorporates a structured display file definition based on GKS 7.2 segmentation requirements. The structures contain a complete description of the display primitives representing the picture segment. A macro primitive facility can be defined and controlled via a generalized drawing-primitive function at the user-interface level of GKS. The representation of primitives on the display can be controlled by individual or bundled attributes.

Viewing control features include transformation and clipping as required for a GKS workstation. Input control involves firmware-based device-handling code. Sigma says the code provides mapping between the physical devices connected and the logical device classes forming part of GKS input model.

The 6140 can operate in two states. One consists of a GKS workstation in graphics mode with emulation of the Digital Equipment Corp. VT100 terminal in alphanumeric mode. The other state resembles that of the Sigma 5484 color workstation with Tektronix 4014 emulation.

The pixel memory in the 6140 provides four pixel planes with a display resolution of 1488 × 1024 dots. Pictures are defined within a 64K × 64K virtual space.

For connection to a host computer, asynchronous serial and bidirectional parallel interfaces are both available. The parallel interface provides data transfer in 8- or 16-bit mode, according to Sigma.

Because of Sigma's familiarity with GKS features through dealings with British government research departments, Sigma managing director John Massey claims his company has "caught American manufacturers with their pants down." However, Data General Corp. recently unveiled a GKS terminal, and at least two other American manufacturers are preparing to produce GKS terminals. A spokeswoman for the Information Display division of Tektronix, Beaverton, Ore., claims products supporting GKS are likely to be introduced by Tektronix within the next year. However, Tektronix's new 4100 series of terminals does not support GKS (MMS, April, p. 20).

Tektronix's Straayer, who is also chairman of ANSI's X3H31 graphics subcommittee, does not want to see SIGGRAPH's CORE stage a comeback as a 3D standard, preferring instead to see GKS expanded to support 3D drawing. "I do not share the view that GKS is not suitable for 3D," Straayer states, noting that the reemergence of CORE would oblige Tektronix to support three standards—Plot-10, GKS and CORE.

Formal ANSI approval for GKS is all that Ramtek Corp. is waiting for before moving into the GKS market, says Bob Heilman, Ramtek director of software product management. But Heilman does not see CORE being wiped out by the acceptance of GKS as a standard. "CORE has been used in the U.S. for four years and is a de facto standard. There will always be a market for CORE products," Heilman insists.

—Keith Jones

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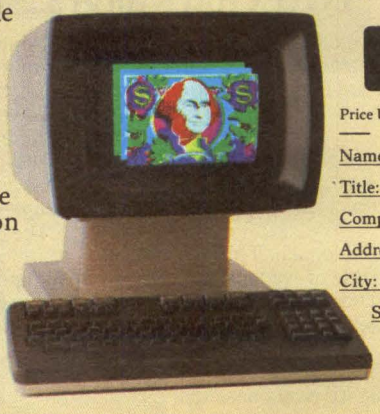

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CIRCLE NO. 52 ON INQUIRY CARD

Honeywell enters high-reliability market with resilient system

The success of Tandem Computers Inc.'s redundant NonStop minicomputers has underlined the appeal of system resilience in industrial-control and transaction-processing environments. Honeywell Information Systems Inc., Waltham, Mass., will follow IBM Corp. and Hewlett-Packard Co. into the high-availability systems market (MMS, December, 1982, p. 20). Honeywell is set to offer system integrators a resilient configuration based on two loosely coupled DPS 6 minicomputers running under the GCOS 6 operating system with TPS 6 transaction-processing monitor software. Application development is said to be the same as it is on single-processor systems.

The resilient HIS product, expected in July, will add 30 to 40 percent to the cost of the central hardware used in a network, says Marilyn Maleckas, Honeywell manager for DPS 6 marketing support. She believes the system will find favor among builders of order-processing and industrial-control networks and cites its adoption by Honeywell divisions, including the Automatic Response Centers that handle customer problems.

The resilient system, called the Resilient TPS, is a development from Honeywell's minicomputer group in Hemel Hempstead, England. Malcolm Murdoch, group manager there, explains its origins. "We have been supplying tailor-made resilient systems from Hemel since the early '70s to customers in Europe. But, by 1979, our salesmen were asking for a standard resilient product. We chose to build it around TPS 6 partly because Hemel is the worldwide TPS 6 development center, but also because about 30 percent of all of Honeywell's minicomputer shipments are TPS 6-based systems."

Resilient TPS project leader Ian Eagle explains that the Honeywell system employs two loosely coupled DPS 6 processors, one serving as a master and one as a tracker. This differs from the approach taken by Tandem, which sells machines designed from the ground up to be resilient and comprising two to 16 processors on one dual bus.

Eagle says Honeywell faced three ways of connecting the buses on two DPS 6 processors. The fastest was extending the buses of the machine to join each other. But this approach was rejected partly because it would limit the distance between the two processors to about 25 ft. It was also rejected because it was dangerous. It could cause both halves of the system to fail simultaneously if one machine developed a fault because the faulty machine and the memory of the other processor would be directly linked.

The other two approaches to linking the machines will be offered to customers. Both involve connecting the buses of the two machines with simple, dual cables. The fiber-optic cables offer the attractions of high-speed—2.5M bits per sec.—and data security—optical fibers are very difficult to tap. The more conventional approach, employing twin electrical cables that at 72K bps are much slower, offers the advantage over fiber-optic links of interfacing with leased telephone lines. That approach is well-suited to applications in which the two machines must be separated by several miles.

Another vital piece of hardware is a mechanism for switching communications lines between the two machines. One approach is to have an automatic switching box with a manual override in the same place as at least one of the processors. Alternatively, for even greater security, each line can have its own manual switch, although this method demands duplication of lines from terminal locations to the computers. This method increases costs substantially unless multiple terminals are dropped at one location.

One source of the automatic switching system is Lion Systems Developments, High Wycombe, England. Lion is one of the only switch manufacturers to provide microcode supporting the special protocols adopted by Honeywell to check the status of the switches and central processors. Eagle claims there are no problems in microcoding other makes of the switch to handle the protocols. Under development at Lion, meanwhile, is an additional facility to enable lines to be switched individually between machines so some can perform nonresilient work.

Key to the software of the Resilient TPS is the ability of system integrators to develop applications the same way as on a single DPS 6 computer. "Our goal was to hide from the user the fact that he is dealing with a dual system," Eagle says. He cites the way the Resilient TPS software has been designed to relieve users of the need to create tracking software. Eagle explains

that the Resilient TPS software is integrated with TPS 6, forming an optional version of TPS 6 that will be available with all future releases of the product. He stresses that the resilient version incorporates all the security features of the standard TPS 6, such as protecting against logical corruption of databases, removing the effects of incomplete transactions and providing restart facilities.

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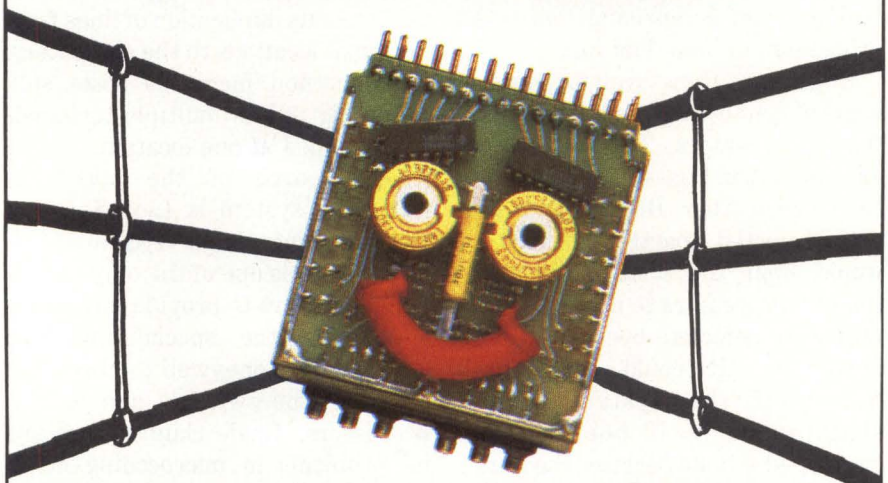

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Both DPS 6 processors—master and tracker—are hosts to the Resilient TPS 6. The machines also maintain identical databases and update logs. The resilient software in either processor can act as though it is hosted by either the master or the tracker. However, only the processor acting as the master runs the transaction application programs.

The resilience functions in TPS 6 send transaction data from the master to the tracker, dump files from the tracker while the master continues transaction processing, handle the procedures by which the tracker takes over if the master goes down and supervise the reintroduction of a repaired master in its new role as tracker. The last function involves the transfer to the new tracker of all disk updates that took place since it failed as the original master.

Eagle says the new tracker cannot provide backup during this transfer period. He believes many transactions during repair time do not involve upating of records on disk. As an alternative, the user can take the system off the air for about 15 min. and transfer the update file to the new tracker using a disk copy.

Eagle also concedes that the tracker cannot play its backup role during a database dump. Failure of the master during a dump means that the user must abort the dump and allow the tracker to take over processing transactions or let the dump finish, if it is near the end, risking transaction loss. Eagle believes this risk may be worthwhile because aborting the dump can greatly extend the time to transfer all disk updates to the new tracker. The updates must include those that have happened between the previous successful dump and the aborted dump as well as those

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during repair time.

In normal operation, the tracker handles a light work load, simply recording updates. It can therefore be used simultaneously for running applications other than the critical network operation, such as batch processing, data entry and word processing.

Honeywell is not the only minicomputer vendor to offer a special configuration for resilience. IBM was preparing a Series/1-based product for release in April. Last year, HP introduced Systemsafe/1000, which provides Series 1000 minicomputers with what HP calls "high availability." Like Resilient TPS, Systemsafe involves two machines, the primary and the backup. One significant difference is that the primary machine, which is equivalent to Honeywell's master, can continue running even if there is a disk failure because Systemsafe employs dual-ported disk drives. With Resilient TPS, any fault in the master machine, including a disk failure, means the tracker has to take over. But Honeywell notes that the dual porting on Systemsafe demands that the two machines be located no more than a few feet away from each other, a point accepted by HP. In contrast, the two machines in Resilient TPS can be any distance from each other. Digital Equipment Corp. has yet to announce a standard resilient system, although many DEC users run custom-designed resilient configurations.

—Keith Jones

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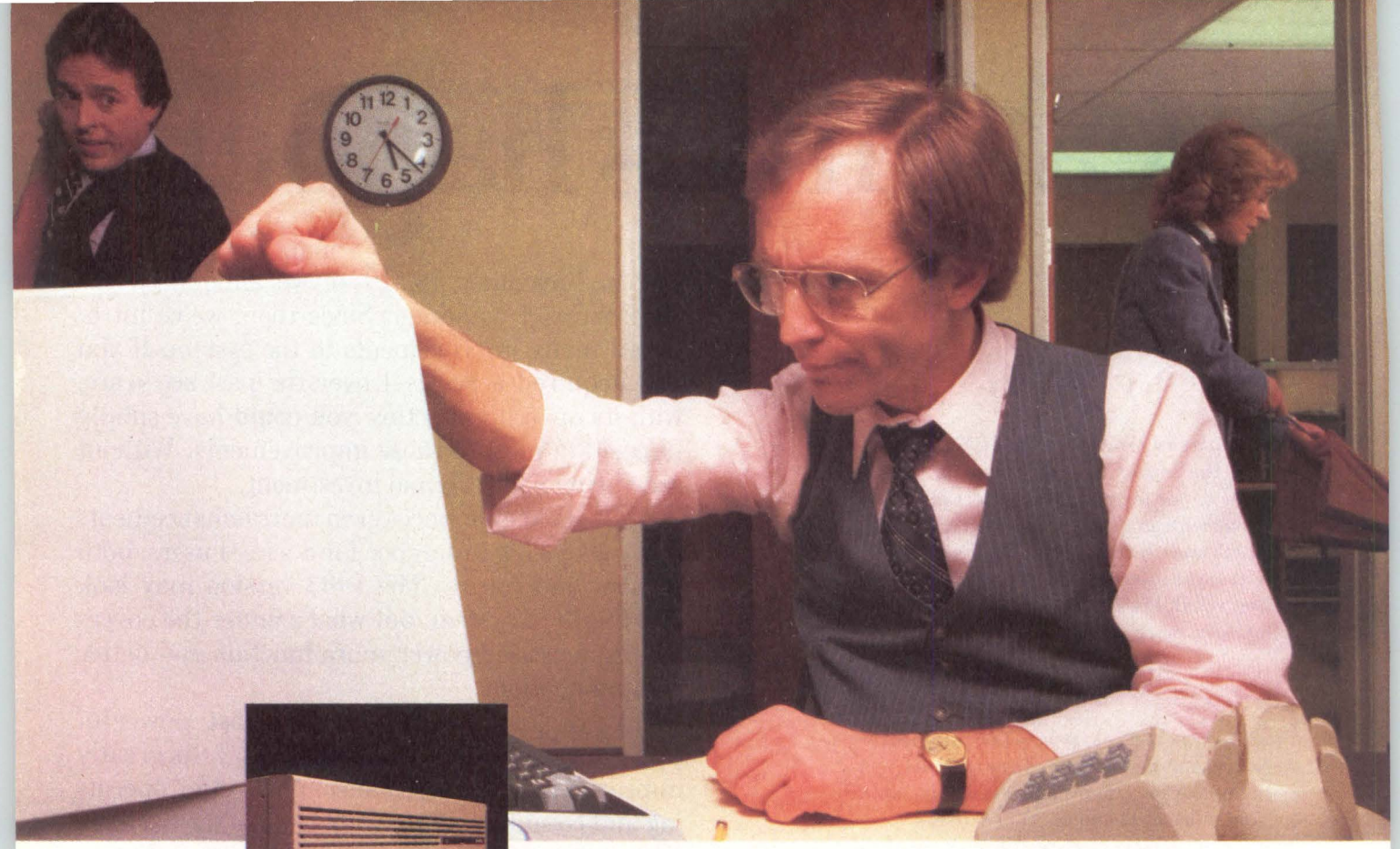

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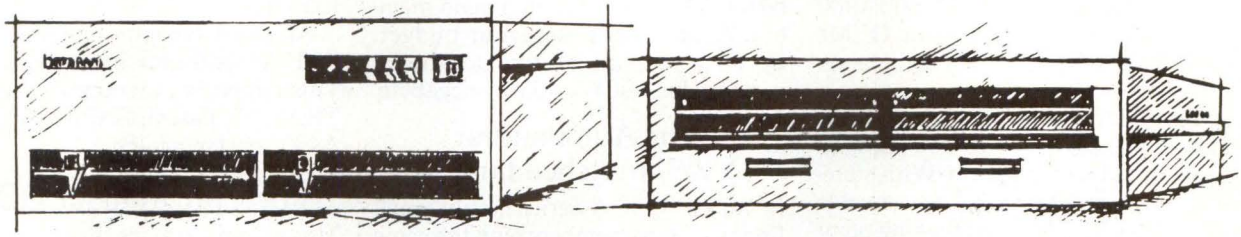

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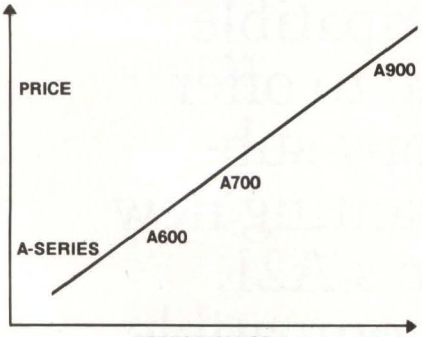

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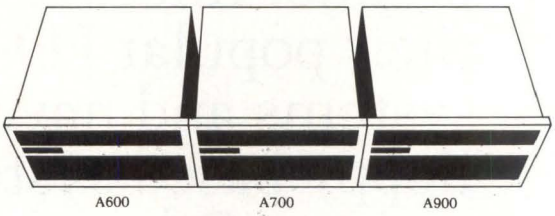

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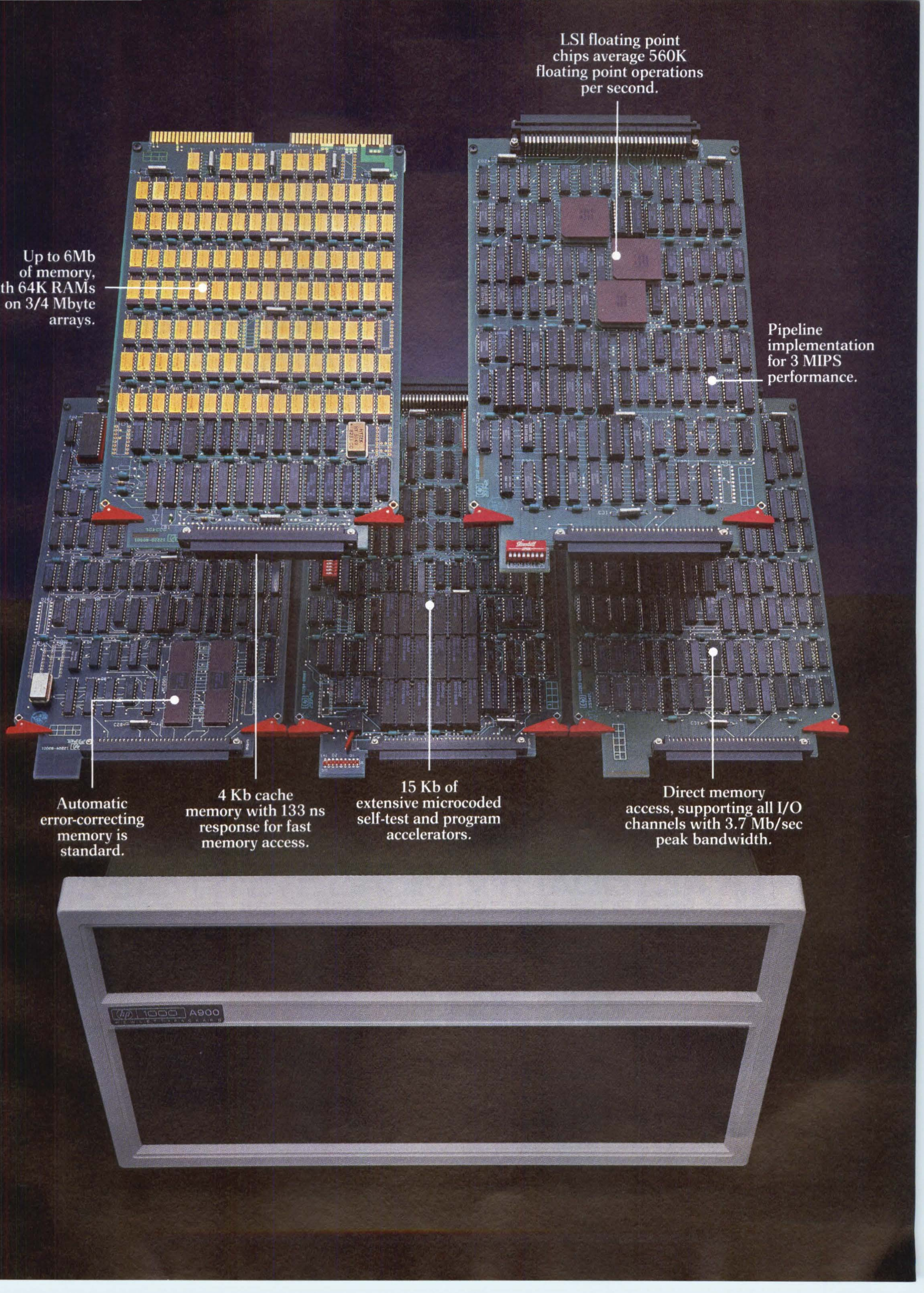
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High-tech exports: trading off between opportunities and restrictions

By Dwight B. Davis

Hardly a week goes by this year without a federal official's pointing to increased exports of American goods as a sure way to improve our country's economic situation. Few disagree with this thesis, but companies producing high-technology products sometimes find their attempts to export stymied by Department of Commerce trade rules and restrictions. This year, the Export Administration Act of 1979 is up for renewal, and manufacturers of computer and peripheral equipment are moving on several fronts to lessen U.S. restrictions on high-tech exports, while still taking into account legitimate government concerns about the national security implications of such trade.

With a few exceptions, high-technology products are the only products that must receive "validated" export licenses before shipment abroad. About 95 percent of U.S. exports qualify for "general licenses," which require no government review or approval. Exports of any products can be restricted due to foreign-policy controls or, when domestic availability is severely limited, to short-supply controls. But only high-tech equipment is singled out for national security controls because of the potential military applicability of these products and technologies.

Despite the heavy control burden it bears, the U.S. computer and peripherals industry parlays its worldwide leadership position into substantial export revenues. In 1982, U.S. exports of electronic computing equipment were valued at $9.1 billion, compared to imports of $2.3 billion (see chart, right). The U.S. Department of Commerce processed approximately 80,000 requests for validated licenses during 1982, and only a few of these were denied, says Vincent DeCain, deputy to the deputy assistant secretary for export administration.

Still, the paperwork, the delays and the threat of restrictions aggravate those who do export and dissuade many high-tech companies from exporting at all. To qualify for a validated license, a company completes an application form, describing its product in detail, indicating the product's country and company destination and the proposed end use of the product. Exports to friendly countries are examined to ensure that sensitive equipment or technology won't be reexported to communist bloc countries. The Department of Defense gets involved in the application review only when the destination is a communist country, DeCain says, just as the State Department takes part in the review only when questions of foreign policy arise. Otherwise, he says, the licensing decision is solely in the hands of the Commerce Department.

An outdated control list

A key aspect of the license application procedure is the assignment of a commodity-control number to the product destined for export. Commerce maintains a commodity-control list of all regulated products and technologies, buy many in the computer industry believe the list is outdated and unrealistic. "There are some product classifications on the control list that have remained constant for 15 years," says Thomas A. Christiansen, manager of international trade relations at Hewlett-Packard Co., Palo Alto, Calif. He says it's unlikely that the industry has remained static over that time, either domestically or in foreign countries. "More likely," Christiansen says, "is that the basic parameters of the list have never been examined."

1982 profile
COMPUTING EQUIPMENT

SIC code: 3573

Industry data	
Value of industry shipments (mil $)	34,060
Value added (mil $)	18,390
Total employment (000)	351
Total no. of establishments[1]	932
No. of establishments with less than 20 employees[1]	497
Percent of industry shipments accounted for by 4 largest companies[1]	44
Major producing states accounting for largest percent of industry shipments: CA (30%), MA (13%), NY (11%), MN (11%)	
Product data	
Value of product shipments (mil $)	32,870
Value of exports (mil $)	948
Value of imports (mil $)	2296
Exports as a % of shipments[2]	27.7
Imports as a % of new supply[3]	6.5
Imports as a % of apparent consumption[3]	8.8

[1]1977 Census of manufacturers.
[2]New supply is the sum of product shipments plus imports.
[3]Apparent consumption is the sum of product shipments plus imports less exports.
Source: Bureau of the Census and Bureau of Industrial Economics. Estimates by Bureau of Industrial Economics.

Complicating the export issue is the U.S. participation in an international organization called the Coordinating Committee on Export Controls (CoCom). Composed of representatives of the U.S., Western Europe, Japan and Canada, CoCom publishes its own list of controlled products. "The CoCom computer controls have not been modified in many years," Christiansen says, "because of a virtual standoff with the U.S. on one side and the other countries, who want to be more liberal, on the other side. So the compromise has been to just let the list sit there unchanged."

Since January, CoCom has been updating its control list. However, even if it succeeds in this endeavor, problems associated with the international organization will remain. Judith Levy, manager of international affairs for the American Electronics Association, points out that "CoCom is essentially just a gentleman's agreement." As such, the extent to which exporters are held to CoCom's rules and restrictions depends largely upon the discretion of each member country. U.S. exporters and the federal government agree that the other CoCom members are more lax than the U.S. in policing adherence to CoCom guidelines—to the disadvantage of U.S. exporters. One option to strengthen CoCom, Levy says, might be to raise its status to a treaty, while increasing its budget, which now totals only about $400,000 per year.

Dissatisfaction with unilateral controls

The variance between countries in enforcing CoCom regulations touches on one of the most charged topics within the export control debate—unilateral U.S. controls. "We're constantly striving to achieve a proper balance between controls on our products and the need to be commercially viable in the international market," says Bruce Holbein, manager of government relations at Digital Equipment Corp., Maynard, Mass. "The key theme we try to give to our government is that export controls for national security purposes, while necessary, cannot be unilateral."

Because trade to Eastern bloc countries represents such a small fraction of the total volume of computer-equipment exports, Holbein says, the industry isn't overly concerned about restrictions on exports to communist destinations. "But if we have unilateral controls at different levels of technology than our allies, we have to impose West-West controls as well as East-West controls," he explains. In other words, with unilateral controls, the U.S. must restrict sales to its allies, because they can freely reexport the products and technology to U.S.-proscribed countries.

The threat of such West-West controls prompts the AEA's Levy to state: "We want to completely eliminate unilateral national security controls." The computer

COMPUTING EQUIPMENT (SIC 3573): TRENDS AND PROJECTIONS (1972-83)
(in millions of dollars except as noted)

Item	1972	1977	1979	1980	1981[1]	1982[2]	Compound annual rate of growth 1972-82	1983[3]	Percent change 1982-83[3]
Industry data									
Value of shipments[4]	6471	12,924	21,466	26,498	30,596	34,060	—	—	—
Value of shipments (1972 $)[4]	6471	12,924	21,466	26,598	30,596	34,060	18.1	40,190	18
Total employment (000)	145	193	274	305	335	351	9.2	383	9.1
Production workers (000)	65	86	122	135	141	148	8.6	160	8.1
Average hourly earnings of production workers ($)	4.19	5.68	6.34	6.98	7.70	8.03	6.7	—	—
Capital expenditures	213	652	1317	1738	—	—	—	—	—
Product data									
Value of shipments[5]	6108	12,673	20,399	25,658	25,525	32,870	—	—	—
Value of shipments (1972 $)[5]	6108	12,673	20,399	25,658	29,525	32,870	18.3	38,780	18
Product price index (1972 = 100)	100	100	100	100	100	100	—	—	—
Trade									
Value of exports	1341	3264	5389	7468	8493	8875[8]	—	10,650	20
Value of imports	176[6]	253[6]	969	1159	1647	2140[8]	—	2,889	35
Export/shipment ratio	0.219	0.258	0.264	0.291	0.280	0.270	—	—	—
Import/new supply ratio[7]	0.028	0.020	0.045	0.043	0.052	0.061	—	—	—

[1]Estimated except for product price index, exports, and imports.
[2]Estimated.
[3]Forecast.
[4]Value of all products and services sold by industry SIC 3573.
[5]Value of shipments of computing equipment products produced by all industries.
[6]Does not include parts for computers.
[7]New supply is the sum of product shipments plus imports.
[8]Actual figures recently published by the Bureau of Industrial Economics report computing equipment exports of $9,117,694 for 1982 and computing equipment imports of $2,296,278 for 1982.

Source: Bureau of the Census and Bureau of Industrial Economics. Estimates and forecasts by the Bureau of Industrial Economics.

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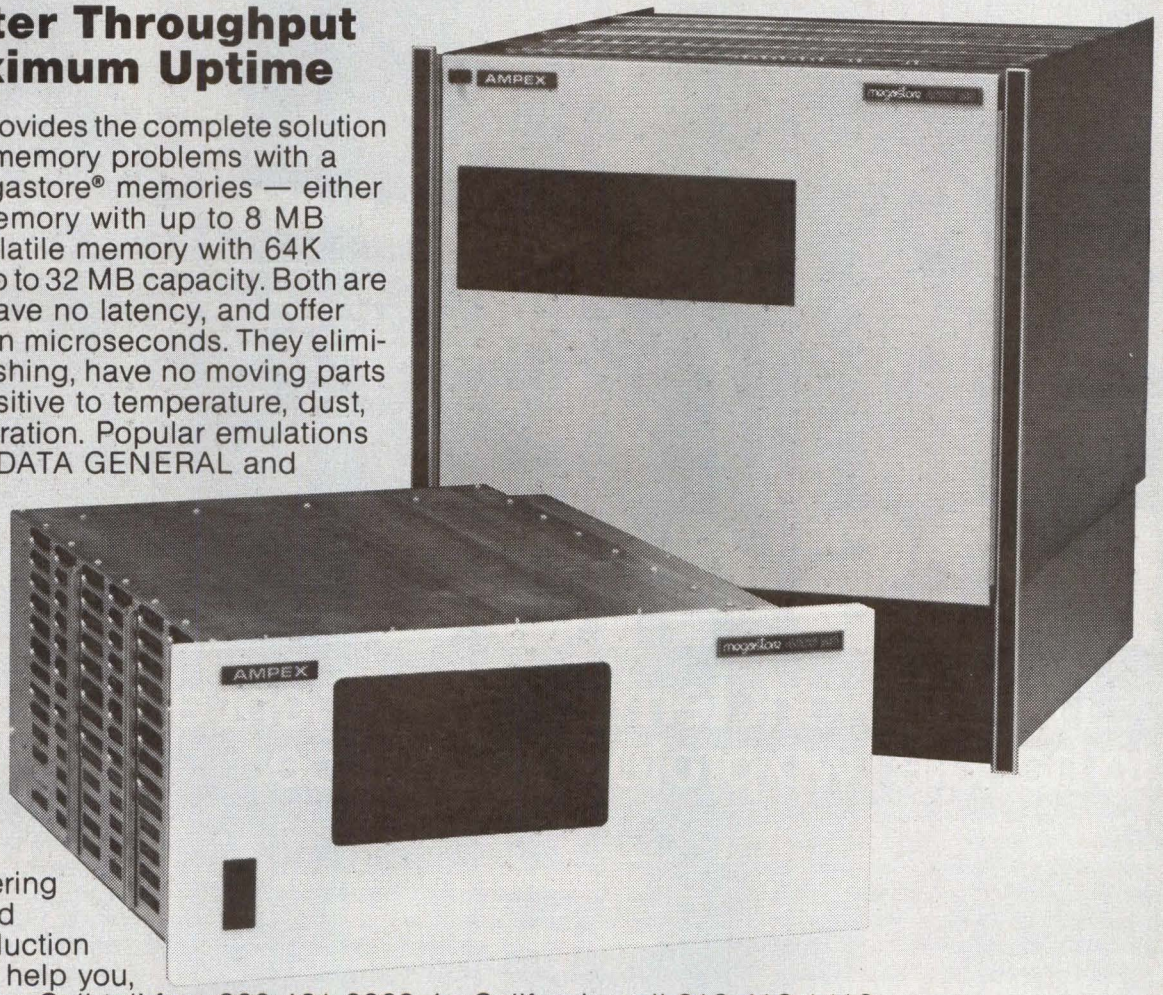

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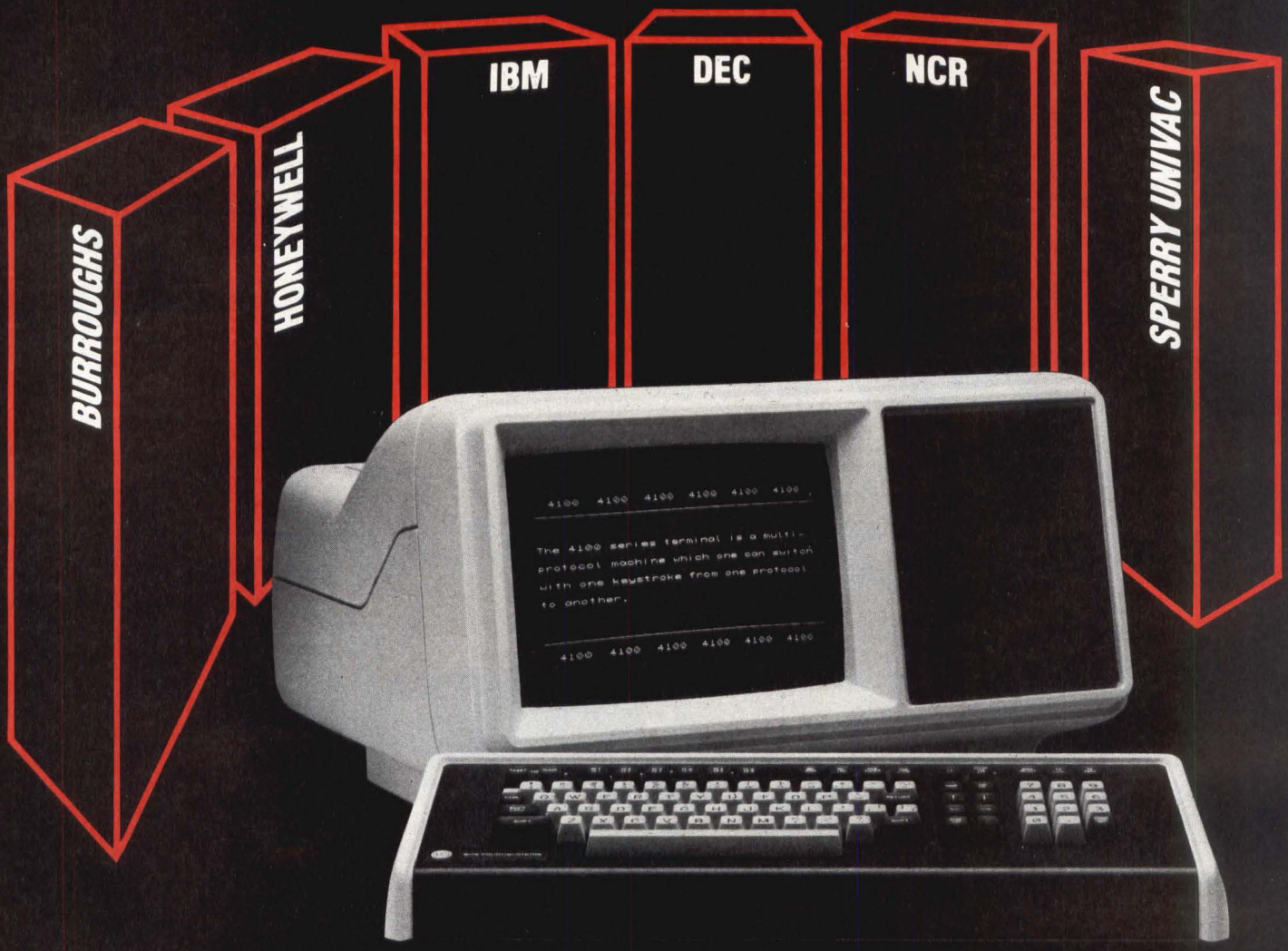

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COMPUTER PRODUCTION AND TRADE OF SIX LEADING SUPPLIER NATIONS

Country	1981 production ($ million)	Compound growth 1978-81 (%)	1981 exports ($ million)	Compound growth 1978-81 (%)	1981 imports ($ million)	Compound growth 1978-81 (%)	1981 trade balance ($ million)
United States	29,525	23.2	8493	26.5	1647	29.7	+6846
Japan	6703[1]	17.5	1204	36.4	948	23.5	+256
France	4876	18.1	1693	20.8	2079	29.1	−386
West Germany	3500	13.3	2326	23.	2681	23.1	−355
United Kingdom	2332	12.2	1947 (E)	15.1	2231 (E)	10	−284
Italy	1188	30.4	887	42.1	1284	38.4	−397
Total	48,124	20.6	16,550	25	10,870	23.1	—
Estimated shares of world total (%)[2]	94	—	89	—	58	—	—

[1]Does not include parts.
[2]Does not include Eastern Bloc countries.
(E) Estimated.
Source: Compiled by the Bureau of Industrial Economics.

industry's focus is on national security controls because, unlike variable foreign-policy controls, the national security restrictions constantly apply to high-tech shipments. But foreign-policy controls, which by their nature are often unilateral, can also cause problems for high-tech exporters, says HP's Christiansen. He worries about customers viewing U.S. companies as unreliable suppliers, saying, "Many of the products we export are used by our customers as components in the products they make. And foreign companies often have a considerable international business." These foreign companies might choose to avoid the risk of relying on U.S. components, he says, knowing that an unanticipated U.S. foreign-policy control could suddenly restrict the availability of the components the company buys and reexports.

Export Administration Act battleground

All the issues crucial to exporters in the computer and peripheral field are under review, as the Export Administration Act of 1979 approaches its Sept. 30, 1983, expiration date. The renewal of this act, says a source within the Department of Commerce, "is going to be one of the biggest bloodbaths down here in a long time."

While there are many lobbyists championing narrow causes in the renewal, the possible results of the renewal fall into two general realms, in the opinion of some in the computer industry. In the scenario preferred by the industry, the act will not be subject to major revisions, but will undergo modifications aimed at facilitating high-tech exports and limiting unilateral controls. The second scenario, much opposed by the industry, would involve major changes in the administration of export controls and a likely increase in the number of such high-tech controls.

One flagship proposal of the second camp has been introduced in the Senate Banking Committee by its chairman, Senator Jake Garn of Utah, and 17 other senators. This prosposal calls for the formation of an Office of Strategic Trade, which would take over the Commerce Department's role of administering export controls. Garn, writing in the Feb. 13, 1983, issue of *The New York Times*, argues that, in the past, the Soviet acquisition of sensitive U.S. technology has had a negative impact on our national security and on defense costs that outweighs the benefits of trade with the U.S.S.R. and its satellites. While he believes some controls may be excessive—such as the need for many export license applications, given the fact that 98.8 percent of those made in 1982 were granted—Garn nevertheless thinks Commerce has failed in controlling certain highly sensitive exports. To solve this problem, the director of the Office of Strategic Trade "would be a member of the National Security Council, where he could insure that attention at the highest levels of Government was being devoted to our export control strategy," Garn writes.

Many in the computer industry, however, read Garn's proposal as a plan to place export controls almost entirely under the jurisdiction of the DOD. "People have been talking about who would be staffing the Office of Strategic Trade, and it sounds like it would all be DOD personnel," says the AEA's Levy. "Commerce is able to give a business outlook as part of the consideration," she continues. "We're afraid that taking it away from Commerce would mean more controls being placed on us."

Rather, Levy says, the focus should be on enforcing the Act as it is now written. For example, the section covering consideration of foreign availability of products has never been addressed by the current Administration, she claims. High-tech manufacturers believe they have lost overseas business because of U.S.

restrictions, even when foreign competitors were willing and able to provide similar products to those markets. "Even if there were no changes made in the act," Levy says, "all we'd want the government to do is really implement what's already there."

Overcoming the export hurdles

As if the federal export regulations weren't enough of a barrier for high-tech exporters, the exporters must overcome many other obstacles to succeed in overseas markets. Potential problems include language and cultural differences, distribution routes, servicing arrangements, financing requirements and shipping methods. Large companies such as DEC, with almost 40 percent of its business overseas, and HP with about half of its business abroad, can justify dedicated staff and overseas offices for handling exports. Smaller firms often can't afford such luxuries. "The smaller exporter,

BROAD OPPORTUNITIES FOR EXPORT TRADING COMPANIES

Companies that specialize in providing services to exporters have been around for years. Some offer limited support, handle narrow product lines and focus on just a few countries, while others are more comprehensive, providing a complete range of export services for many types of products and to many areas of the world. Now, under legislation passed by Congress last October and signed into Public Law 97-290, firms designated export trading companies are free to pursue the exporting business much more aggressively.

The ETC legislation applies to all exporters, although it encourages the formation of ETCs. The key elements of the law, says Peter Wilson, project manager of the ETC Implementation Task Force within the Department of Commerce, are protection of qualified exporters from prosecution under antitrust laws; permission for bank holding companies and other financial institutions to finance, form or acquire ETCs; and a directive to the Export-Import Bank of the U.S. to establish a guaranteed-loan program for loans secured by export accounts receivable or inventories of exportable goods.

One common misconception about the legislation, Wilson says, is the belief that Commerce will set criteria for how to establish ETCs and will then issue a certification to those organizations meeting the criteria. "We are not going to do that," Wilson explains, noting that ETCs are under no obligation to even let the Commerce Department know they exist. ETCs that so desire may ask the Commerce Department to certify that the companies meet the requirements for antitrust immunity, but this certification is optional.

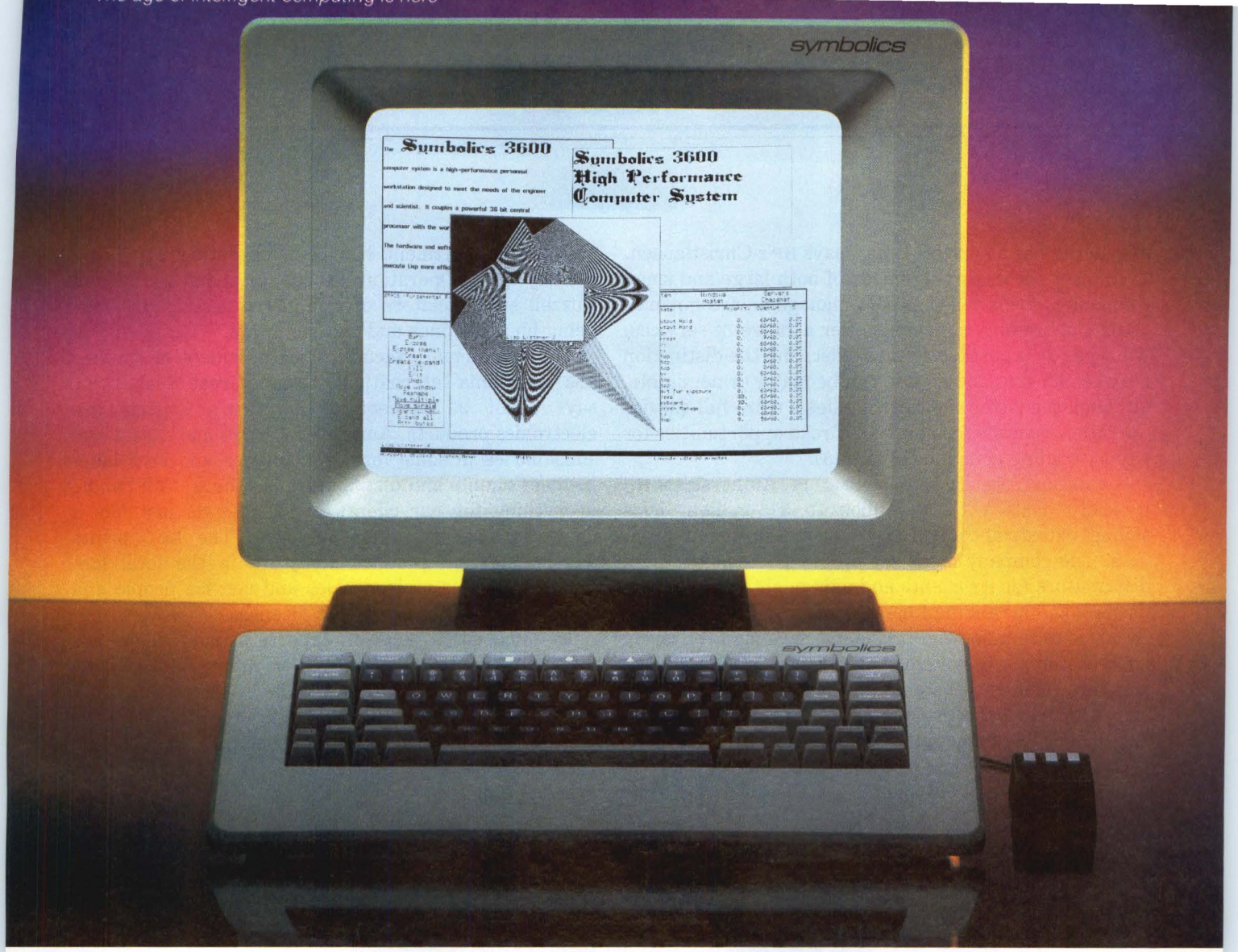
"We believe the legislation creates the climate for American business to take aggressive action in the exporting area," Wilson says. "It's up to their own ingenuity as to how the legislation can be used." A key intent of the legislation is to encourage the formation of ETCs that will help the "tens of thousands small- and medium-sized United States businesses" that produce exportable goods or services but do not yet export. Two basic types of ETCs can help such smaller exporters, Wilson says.

Probably the most typical type of ETC will be formed by a limited number of large companies that may, in turn, export products of smaller firms as well as their own. Two trading companies that fit this description are those formed by General Electric Co. and Control Data Corp. At the other end of the spectrum, several small companies could combine to form an ETC, possibly under the umbrella of a relevant trade association, such as the American Electronics Association. Judith Levy, manager of international affairs at the AEA, says the association has never considered the possibility of forming an ETC for its members. And, Wilson points out, if none of the small companies forming an ETC have exporting expertise and overseas contacts and distributors, "even if they band together, they're not a hell of a lot better off than they were before."

GE's Trading Company, which was estabished before the most recent ETC legislation, probably won't change its operation much because of the freer antitrust and banking regulations, says Bob Foster, manager of product selection at GETC. So far, the trading company has handled primarily medium-technology products, he says, although it does plan to export its own and other firms' high-tech products eventually. GETC, which has targeted developing countries as its main export focus, will handle products that "either fit into part of an overall turnkey system from GE or will serve customers addressed by our existing sales and distribution network," Foster says. These products could include computer and peripheral equipment, he says, although "We would not knowingly handle a product that is a direct marketing competitor with one of GE's own products."

The opportunity for banks to become involved in ETCs may actually concern some banks, says James Buzzell, president of Symbicon Associates, because large banks that form ETCs may attempt to steal smaller high-tech customers from banks that don't offer export services. Odgen White, senior vice president at the First National Bank of Boston, admits there is some "visceral concern" about this possibility, but he views existing ETCs as more likely competitors than large banks. First National has acquired the World Trade Group, Portland. Me.—an international market research and consulting company —but has not yet established an ETC.

White believes the ETC legislation will raise the consciousness of smaller firms about the benefits of exporting, and he thinks the number and quality of services available to exporting manufacturers will improve because of the ETC law. But he questions Wilson's belief that the loan guarantee program will be a key element of the legislation. "To date, neither the Export-Import Bank or FCIA has been very responsive to the demands of the small client," White says.



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in general, has a horrible time," says HP's Christiansen.

To meet the exporting needs of both large and small companies, firms called export-management companies or export-trading companies offer a range of services. All types of export companies exist, and the distinction between an EMC and an ETC can be major or negligible, although the latter typically implies a more full-service operation than the former (see "Broad opportunities for export trading companies," p. 118).

Symbicon Associates, an EMC in Amherst, N.H., typically deals with $5-million to $15-million firms selling industrial-control and test-measurement products. The company helps set up independent overseas distributors for its clients and aids in obtaining export licenses and arranging financing. James H. Buzzell Jr., Symbicon's founder and president, says his firm rarely handles complete systems, preferring to ship components to overseas customers who assemble systems, write software and provide service for their markets. Buzzell says a major problem in the high-tech industry is the lack of awareness of a crackdown on questionable shipments to countries behind the Iron Curtain. The Customs Department has been operating a policing activity called Operation Exodus for about a year, and Buzzell says violators of Commerce restrictions "are being hit with fines and thrown in jail."

Mark Auriema, executive vice president of another EMC, Auriema International Group, Great Neck, N.Y., says about 35 percent of his firm's exports are electronics products. Aureima International has its own subsidiaries in some foreign countries and uses independent agents and distributors in others. "We handle everything for our clients, who treat us just like a domestic account," Auriema says. The EMC prints advertising and product literature in the local language, provides trained sales and service people and handles all required export licenses.

In some cases, smaller exporters make their own arrangements with overseas distributors. This was the case with Stratus Computer Inc., Natick, Mass., a manufacturer of fault-tolerant computer systems. Julie Ambrose, manager of import/export at Stratus, admits that the company didn't initially plan to export its systems until it had established a strong domestic market for its machines. "Some people in Olivetti were very interested in Stratus and in promoting us overseas," she explains. Because of Olivetti's interest, Stratus entered the export market earlier than it planned, with Olivetti serving as a European distributor.

Ambrose, who started with "zero knowledge about export regulations," received initial guidance from the Boston District Commerce office. Beyond that, she says, "I think the most helpful thing anyone can have when they're exporting overseas is a very good freight forwarder." Stratus uses Burlington Northern, and, Ambrose says, "They've been very helpful whenever I have questions." Ambrose says the company has had no problems in obtaining export licenses so far, although she has noticed a toughening in the government's requirements for product information over the past year.

Because Stratus has an open line credit with Olivetti, financing has not been a problem, Ambrose says: "We have an agreement that says Olivetti will pay us within a certain period, and we give them a discount off the list price of the product." She believes one of the major benefits of using an EMC or an ETC would be its handling of letters of credit and other financing requirements, a "complicated and messy" situation that Stratus avoids through its simple arrangement with Olivetti. "An export trading company would protect you from really being killed in the financing area," she says. "That's a very big hurdle to get over." □

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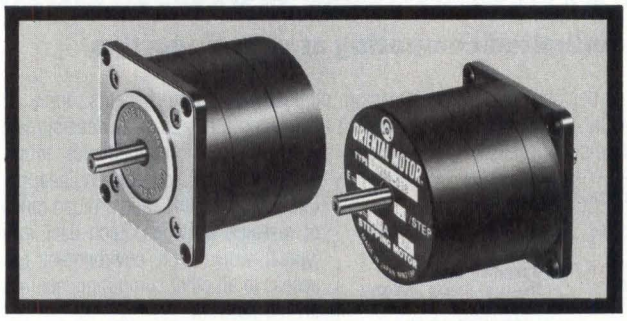

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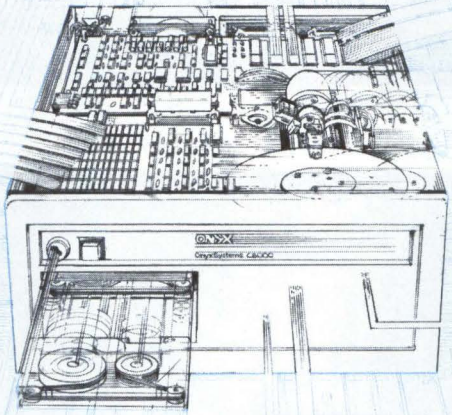

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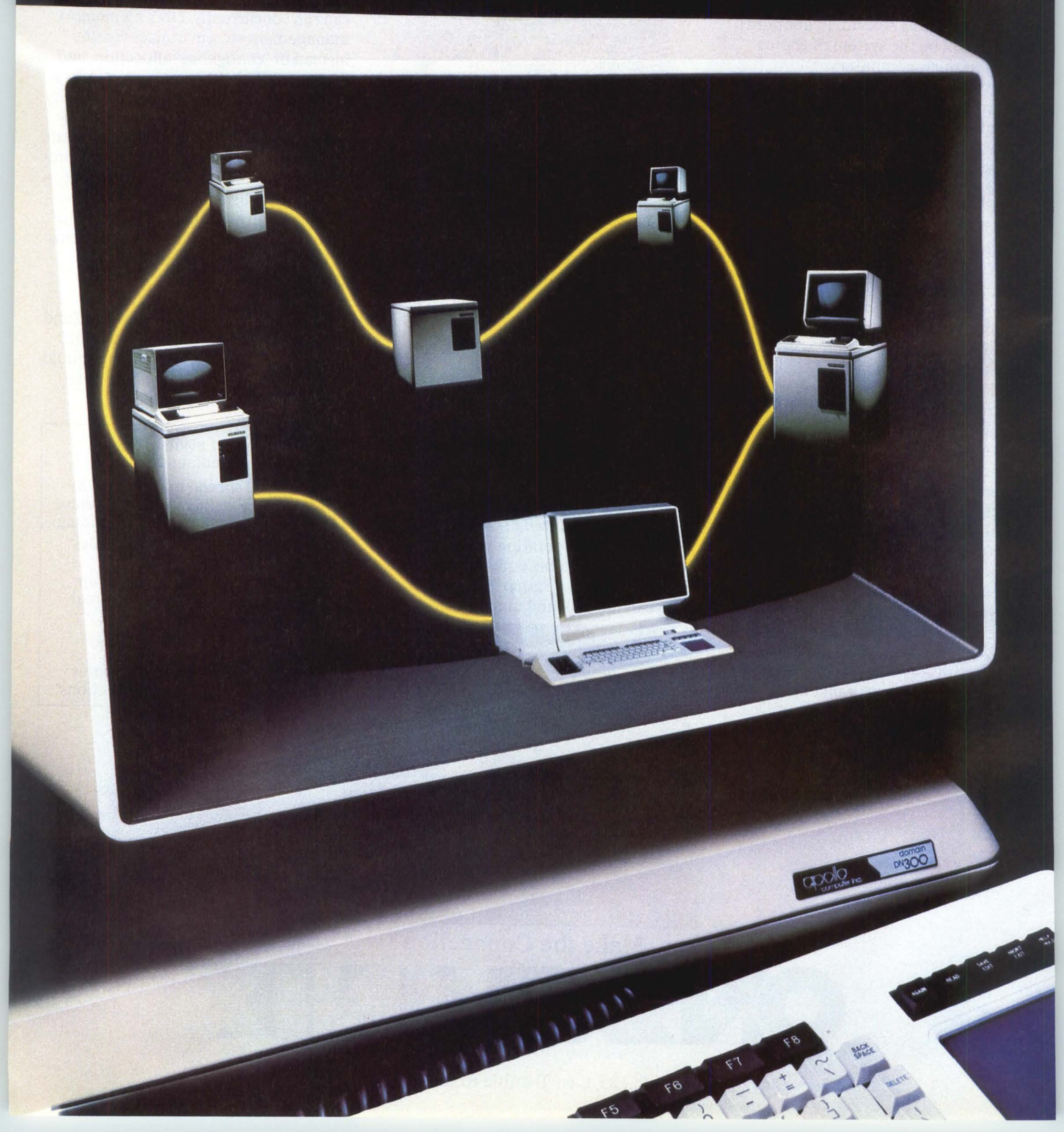

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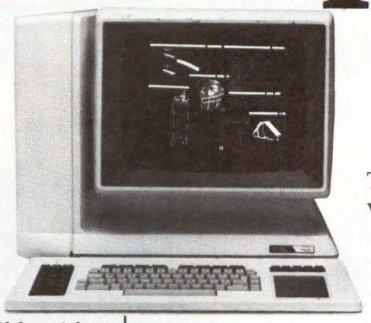

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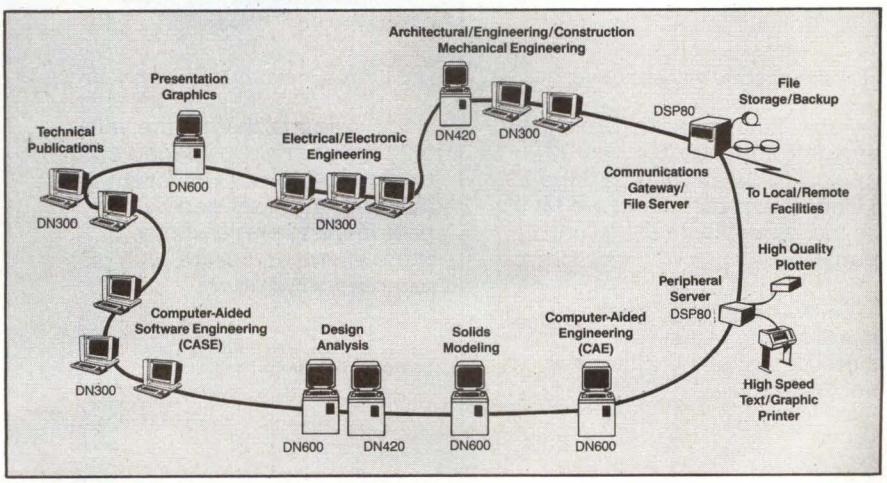

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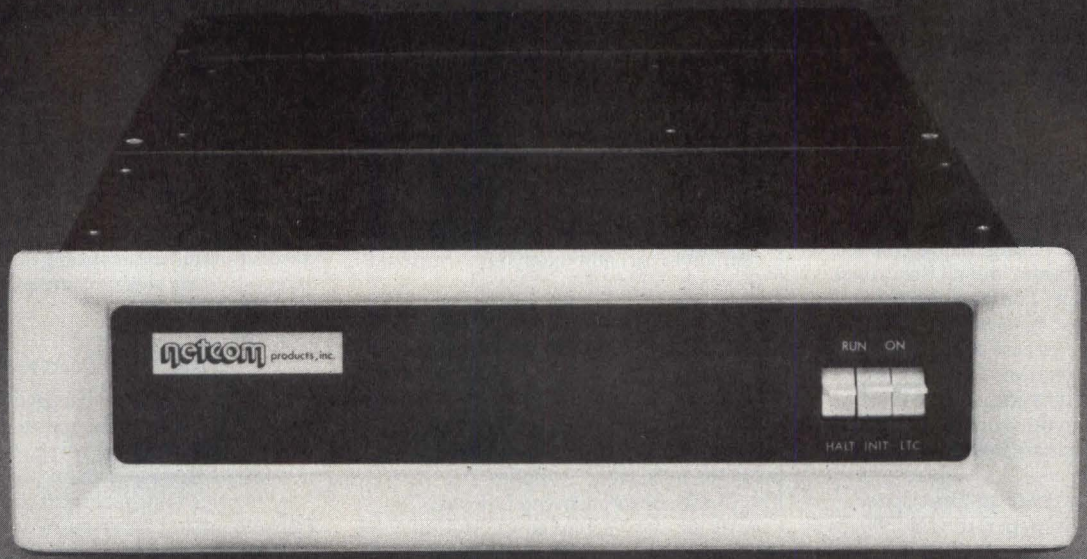

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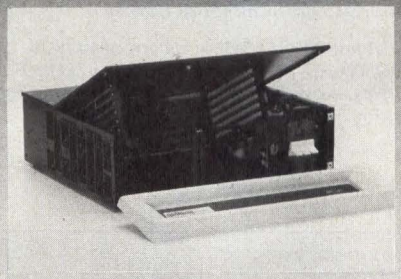

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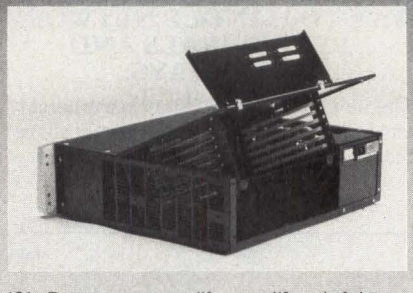

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CIRCLE NO. 67 ON INQUIRY CARD

Application generators: automating the art of programming

By Sarah Glazer

Software programming has been alternately cursed and revered ever since it became possible to place the information to operate a machine in the machine itself. Now, new tools called application generators are taking some of the mystery and difficulty out of the art of programming computers. Marketed primarily, say manufacturers, to system integrators and to large companies that do their own application programming, these generators create and customize application software in a way quite different from conventional methods.

Manufacturers of some application generators claim they can be used by non-programmers to create programs. All the generators are credited with improving productivity of trained programmers—some by more than 10 times, although users of these tools have more conservative estimates than manufacturers. In addition to faster software development, says Ann Morley of Framingham, Mass., research firm International Data Corp., program maintenance is much easier because program structure is consistent from application to application. "A new programmer can pick up where another one has left off," she says, noting that this can create a tremendous savings in labor.

Although application generators for small computers differ widely in what they do and how they do it, some common characteristics exist. Whether they begin with menus, tables or English language queries, the generators lead a user through a preset framework. As the user answers questions, fills in the blanks or "paints" a screen to define data format, the generator automatically translates the input into the programming code needed to run the applicaction.

"An application generator doesn't mean a programmerless computer," says Thomas Zender, vice president of marketing at Database Systems Corp., Phoenix, which makes TAGS, an application generator that runs on computers manufactured by Prime Computer Inc., Natick, Mass. "Instead of programming per se," he continues, "the user sits at an interactive CRT and begins to describe an application by answering prompts, by picking items from menus and by filling in blanks."

Forms appear on screens, or the user can create new forms by a process called "screen painting" (see illustration, above). This means "literally putting on a screen what they want to see," Zender says, "including characteristics like underlining, blinking and reverse video." At the keyboard, the user creates a layout for variables, defines the size of the field—the number of characters in a file entry, for example—and specifies how data entry will be made.

```
NAME AND ADDRESS COLLECTION

NAME      &&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&
ADDRESS   &&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&
CITY      &&&&&&&&&&&&&&&& STATE && ZIP #####

DATE      @ @ / @ @ / @ @

DOLLARS   ######.##
```

In this example of screen painting, the symbol "&" is used for an alphanumeric variable, *"#" for a numeric variable and "@" for a date. The layout the user "paints" on the screen defines the data format for the application. (Source: Informatics General Corp.)*

In describing another generator, TAPS, from the TAPS Division of Informatics General Corp., New York, director of marketing Bob Gildenberg explains, "Almost all the coding traditionally required to build one of these application systems is provided as a standard feature." TAPS is designed for business transaction-processing applications and can be used on computer systems ranging from mainframes to microprocessors. "TAPS is centered around the screen," Gildenberg says. "When you build the system, you identify which screens you want and which transactions are going to be executed before the user sees the screen, after the user sees the screen and so forth."

Glowing reports from users

"One programmer can do so much now so quickly," says Joe Patrina, who manages foreign-exchange treasury systems for the European American Bank, New York. Since October, 1982, Patrina has been using a version of an application generator called Pro-IV on minicomputers manufactured by General Automation Inc., Anaheim, Calif. Pro-IV, which was developed by Data Technical Analysts, Honolulu, has been sublicensed for development on different computer lines to five companies. The product Patrina uses is produced

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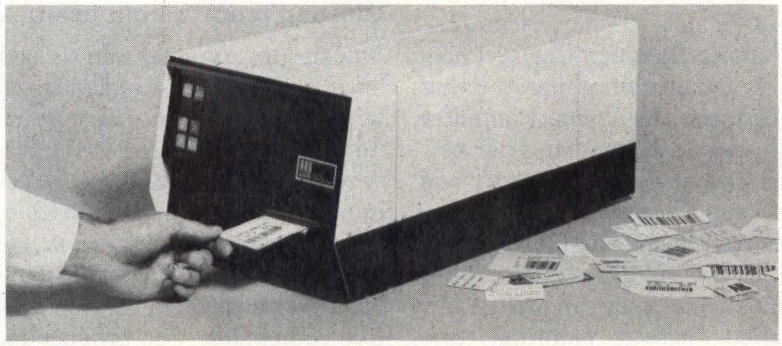


CIRCLE NO. 68 ON INQUIRY CARD

by Pro-IV Inc., Littleton, Mass.

"Our project teams have two members: an analyst who can write documentation well and a good programmer," Patrina says. "The amount of work they're doing would have taken five COBOL programmers in the past." He describes a system such a team recently wrote in one month as having about 15 screen programs. "A larger system may take three months. But, in the past, with even more staff," he estimates, "it could have taken nine months to a year."

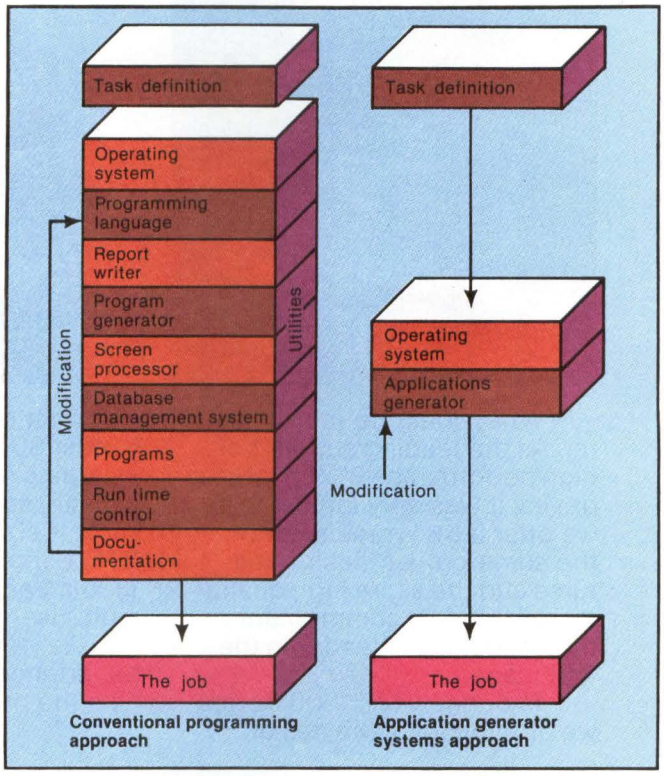
Patrina describes his decision to use an application generator as a gamble. "At first, I was very skeptical," he says. But he was responsible for a system he knew could not be ready on schedule if he depended on conventional COBOL programming. "Either I took a gamble on something like this, or we would definitely not be on time," he says."So we took the gamble, and it worked."

In a different environment and using a different application generator, another user reports similar results. "It takes about one-tenth the time it used to take to customize applications," says Cecil Glovier, vice president of software and support for Turnkey Computer System, Amarillo, Texas, which uses RIMS/MPG, an application generator made by Information and Systems Research Inc., Coraopolis, Pa.

System integrator Turnkey Computer System builds systems around Digital Equipment Corp. PDP-11s. "We do a lot of custom programming," Glovier says. He explains that his company's systems often include application programs produced by Minicomputer Business Associates, a major producer of application programs for DEC computers, and that RIMS uses the same logic flow as these programs. "We can install basic packages for the customer, and if they want some additional reports, we can use RIMS to go in and create a program," he says. These additions are then on the screen as part of the menu for the package.

TCS also sells RIMS as part of a system if a customer wants it. "Internally, we use it mainly to save time on keypunching; it creates code so we don't have to type it in," Glovier says. "We've really increased how much we can output with RIMS."

Users also report encouraging results in software maintenance. A TAGS user, who is the MIS manager of a large bank in New York, explains that it was formerly much more difficult to find the part of a program that needed changing. "Any time you have a different programmer look at somebody else's code, it's always difficult to figure out how that person was thinking," he says. "These applications are structured, so it's easy to follow the flow without getting lost."



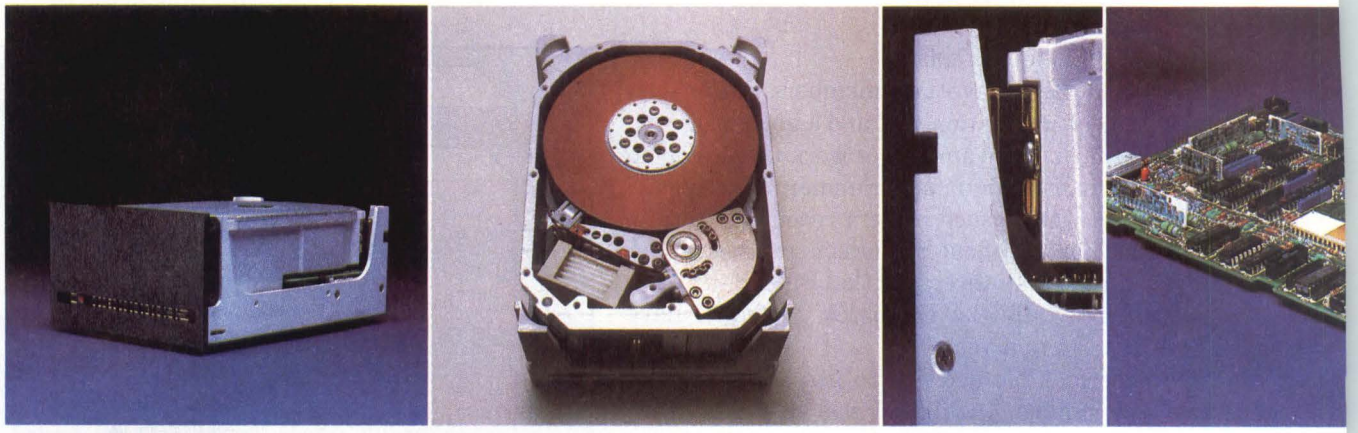
A comparison of functional tasks involved in developing an application *using an application generator versus a conventional programming approach. (Source: Pro-IV Inc.)*

Programmer versus non-programmer

Application-generator manufacturers say some systems can be used by people with no programming experience. "This brings a new person into the world of application development—the person who has expertise in the application but no knowledge of computers," says Nancy Zawadzki, vice president of marketing for Rubel Software, Cambridge, Mass., which produces BLOX Graphics Builder, a generator for interactive graphics applications.

However, industry analyst Esther Dyson of Rosen Research Inc., New York, believes this is an overstatement. "The day when you can give anyone an application generator and have them do something useful with it isn't here yet," she says. "The problem is not the coding; it's the system analysis."

Most manufacturers concede that some formal training is required for non-programmers to use their products. Tom Campbell, president of Pro-IV Inc., says his company offers training from one to five days, depending on the level of expertise of those in the class. The manufacturer of RIMS offers two days of training, and training for TAGS takes seven days for the entire package.



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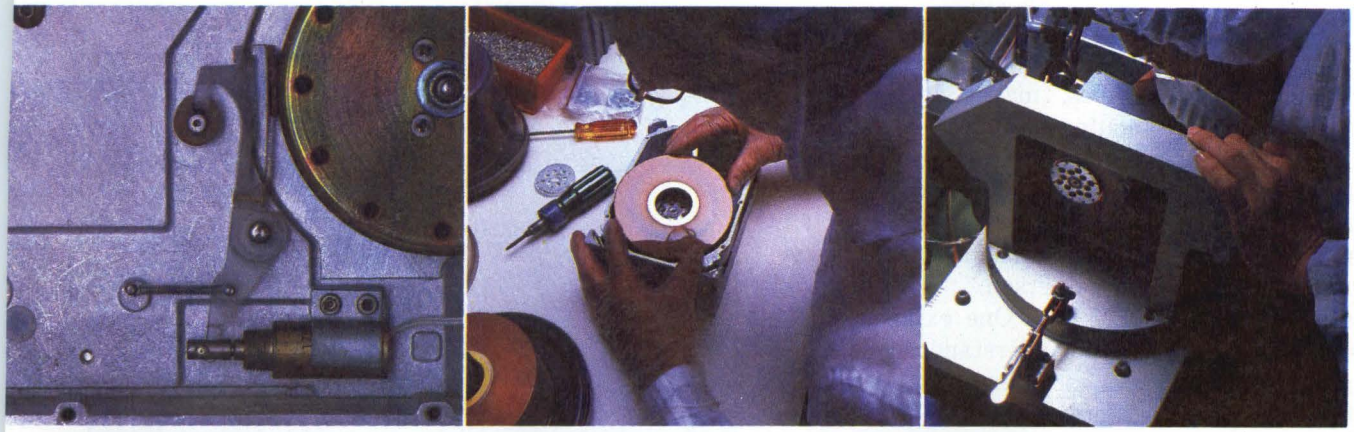

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The Interpreter

The U.S. division of the British software company DJ "AI" Systems, Los Angeles, makes an application generator for microcomputers called The Last One (MMS, October, 1981, p. 78). Company president Larry Downing believes training is unnecessary, however. "People who are not technically literate can run it in from 8 to 20 hours," he says. "It all depends on the level of intellectual capacity of the person."

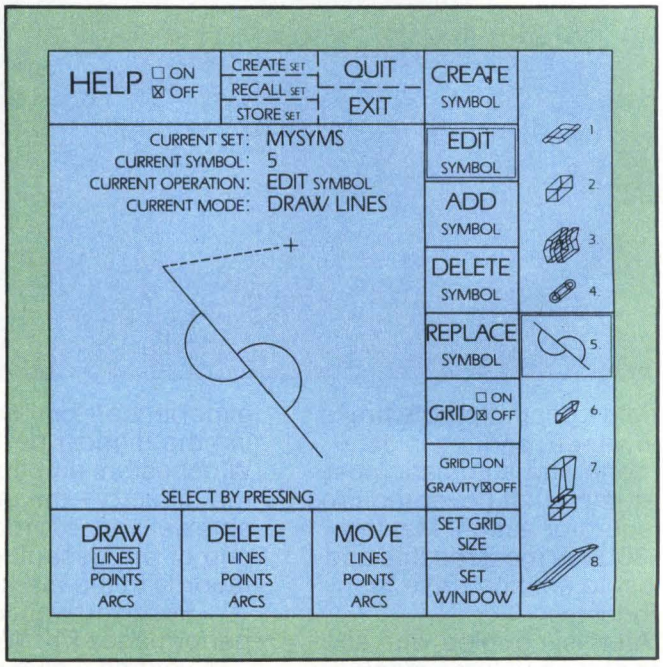
However, a user of The Last One explains that a successful user would have to understand the data flow of an application program, including such concepts as branching, file pointers, data-entry mode and duplication. Bobb Partridge, president of Rep-Tech, an electronics distributor in Terrell, Texas, uses The Last One on his company's two Apple IIs and likes it so much he has signed on as a distributor. "For someone with no experience, it would probably take about 10 hours of training to get to the level to be able to read the manual," he says. "Then they would still need prompting as to the data flow."

"Clearly, application generators are going to be very useful for end-user computing—once they become friendly enough," says IDC's Morley. "The friendliness to make them effective for end users is just catching on now." She questions whether non-programmers are ready to accept them, though. "The manager who can't program is still learning to use spread sheets," she says, "much less requesting reports off a central computer."

There is consensus, however, that experienced programmers will find application generators useful. Phil Meyfarth, a lecturer in the department of mechanical engineering at the Massachusetts Institute of Technology, who uses BLOX Graphics Builder in a graduate course he teaches in computer-aided design, explains why: "What BLOX does is take a lot of the tedium out of generating menus and controlling the flow of a program," he says. "You have a much more powerful tool. If you want some major thing to happen, you don't have to worry about every little nitty gritty," he adds.

"There will be two primary markets for application generators," says Roseann MacLean, product manager at Digital Equipment Corp.'s Software Services Business Applications group in Stow, Mass. DEC has signed a contract with Pro-IV Inc. to sublicense Pro-IV. DEC will manufacture and market the product, which is scheduled to be announced by press time.

"The larger market will be OEMs," MacLean says, "and the second will be large companies that will use it for office applications." Although pricing was not settled by press time, MacLean estimates the DEC product will sell for about $10,000. "Over time, I think DEC will bring to market quite a few application generators," she says. "There are quite a few fine products out there, none of which meets everybody's needs." She adds that application generator developers sometimes prefer to omit the extra steps of having a computer manufacturer market their products.



This screen, part of BLOX Graphics Builder, *is used to create symbols and icons used in a graphics application. The user can choose figures displayed on the screen or can draw a symbol with a light pen.*

Frank Fukunaga, president of Data Technical Analysts, explains that the strategy of marketing Pro-IV through computer manufacturers results from problems in reaching the second market—large companies. "Pro-IV will be accepted more readily by the system integrator than by the MIS [management information system] department," he says, "because it gives the system builder a tool to quickly develop applications to bundle with the black box." In contrast, he believes that large in-house departments of COBOL programmers see application generators as a threat to their stability.

The two markets mean two price structures for most products. For example, TAGS from Database Systems sells for $38,000 to a user, but less when sold to a system integrator. "System integrators use our product to build vertical applications and then remarket the whole thing," says Zender. "They pay us when they resell it."

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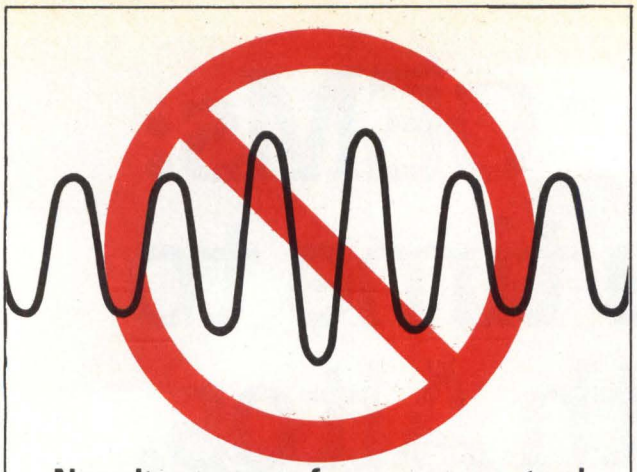

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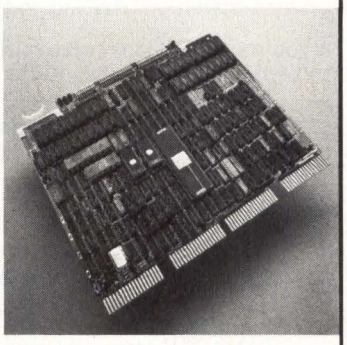

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The Interpreter

In some cases, there are two products: software used to develop applications and a subset of that software used to control the flow of the application. BLOX Graphics Builder from Rubel Software sells for $7000 for the entire development system, but only $1000 for a run-time system. "If they use the development system, then the application they create contains the run-time system," says Rubel Software's Zawadzki. "That's the part of the software that calls the subroutines and controls the flow of the application."

TAPS from Informatics also has an execute-only version, says Gildenberg, that is tied to an application and is far less expensive than the development version: $5000 (execute only) compared to $15,000 (development) for the microprocessor version of TAPS. But TAPS user Phil Logan, vice president, minicomputers, at Comserv Corp., a Mendota Heights, Minn., software house, points out that despite the difference in price, some "limited" versions are not limited at all. "We sublicense TAPS for use with our applications so that a user can generate additional screens within our application," he explains. The sublicense prohibits the user from generating screens outside that application. "But there's not a heck of a lot that prevents him from doing that," Logan notes. "He gets the entire TAPS software, not just the application."

Further price distinctions for products depend on the language or complexity of the operating system for portable generators—those that can be used on more than one type of computer. TAPS ranges from $15,000 for the Intel 86/445 microprocessor version to $45,000 for the IBM mainframe version. RIMS from Information and Systems Research, which is available for DEC computers, ranges from $5000 to $15,000, depending on the host's operating system and language combination. The Last One from DJ "AI" Systems ranges from $395 for the Apple version to $595 for the IBM PC version.

As reflected in the variations in price, system integrators have the widest number of options for using application generators, says IDC's Morley. "They provide system houses with the tools not only to design software for their systems," she says, "but to offer friendly tools to their clientele to make the systems more attractive as well." She sees application generators as the logical extensions of other programming tools that are widely accepted. An application generator is a tool that helps build applications from the data stored in a database, Morley explains. "The database-management system organizes your data," she says. "Then the application generator helps you use that data in a way that is effective for the end user—be that a programmer or a novice." □

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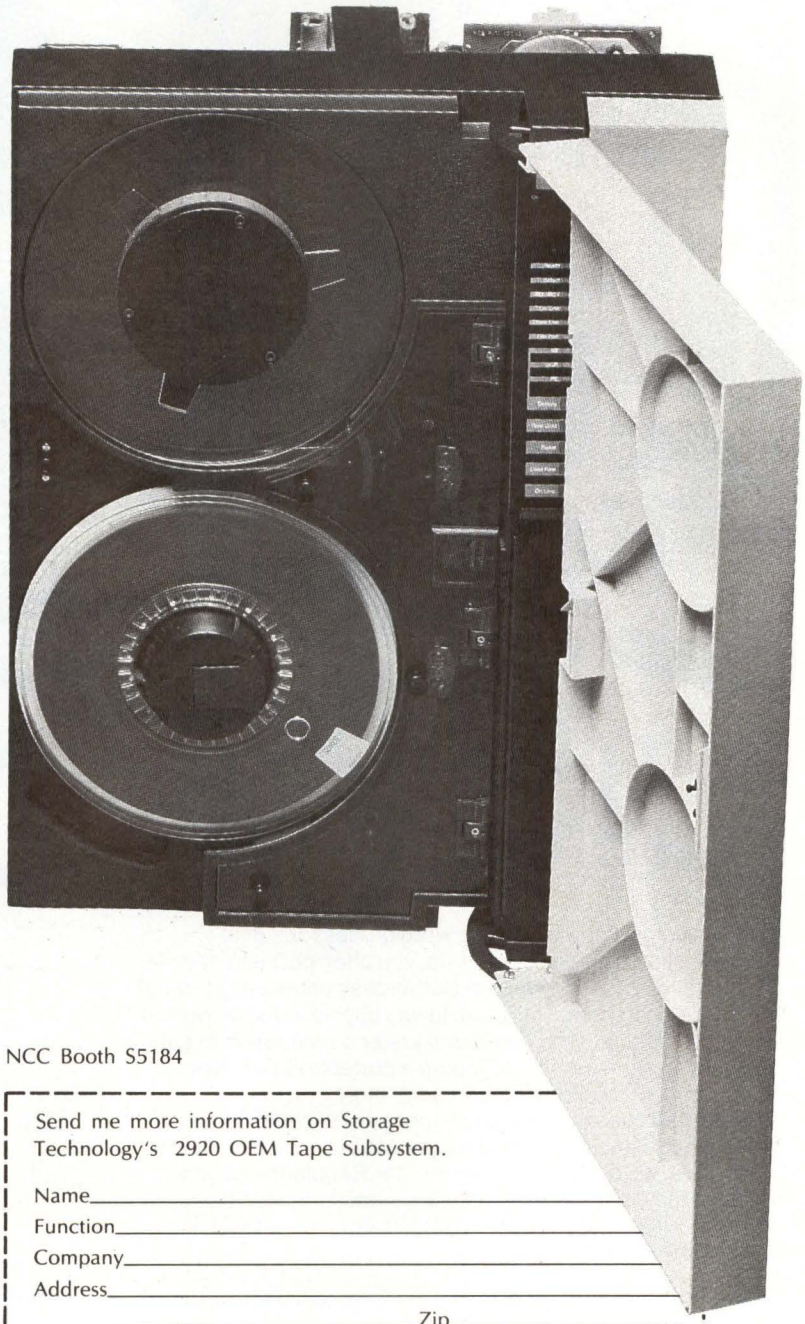

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Dedicated lines, at best, minimize power disturbances that are caused by other equipment in your building. Sola Power Protectors guard you against all kinds of power line disturbances regardless of where they originate. Check this chart to compare effectiveness.

	spikes and faults	dips and surges	line noise		Brownout	Blackout
			common-mode · transverse mode			
	momentary sharp voltage peaks or split-second power outages	short-term high or low voltages due to load start-up or shut-down	Unwanted voltages or frequencies due to bad grounding, switching, or radio-type interference		Planned voltage reductions in response to high demand	Total loss of line power
			line-to-ground interference	line-to-line interference		
Dedicated Line (with dedicated ground)	some, internal only	some, internal only	some, internal only	some, internal only	No	No
Isolation Transformer	No	No	Yes	No	No	No
Sola Micro-Minicomputer Regulator	Yes	Yes	Yes	Yes	Yes	No
Sola Mini-UPS	Yes	Yes	Yes	Yes	Yes	Yes

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Developers/investors profit through R&D partnerships

By Kevin Strehlo

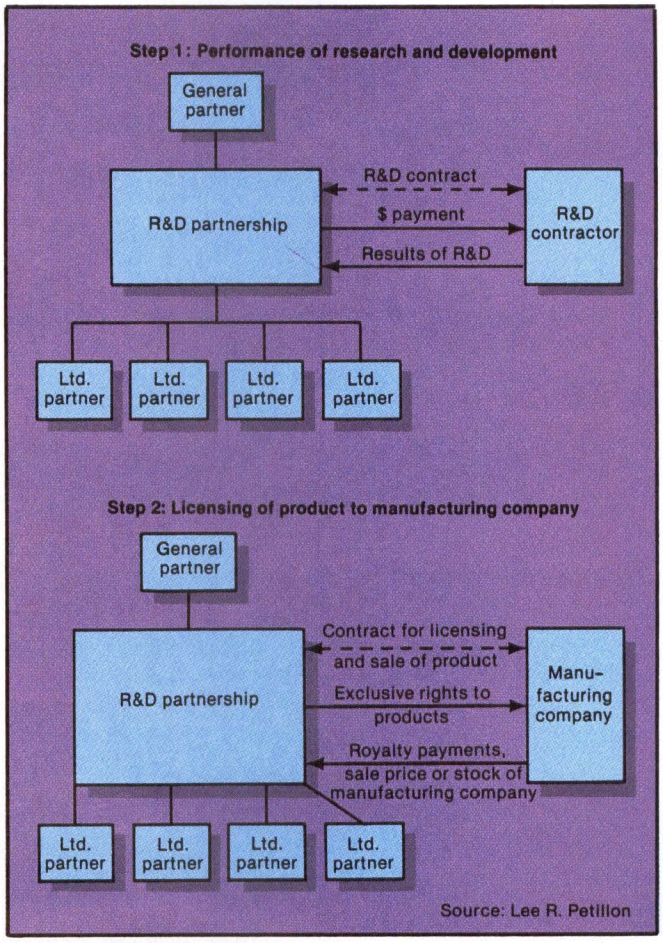
Innovation was once the province of small companies. But increasingly complex technology has priced most computer product development out of the reach of all but well-financed firms. And, even though entrepreneurs with solid credentials can often attract sufficient venture capital to develop a new product, they gain the money only by sacrificing equity and control to the investors. Such investors are usually reluctant to take risks, and without risk, significant innovation is unlikely.

However, recent public policy decisions, recognizing the need to encourage innovation if the U.S. is to maintain its technological leadership, have created an alternative to traditional venture-capital financing. Called the research and development limited partnership, this financing option offers tax advantages and potentially large returns to attract backing for product development, without taking control from a product's creators. Over the past few years, both large and small computer companies have taken advantage of this financing method. Advocates of high technology such as Representative Edwin Zschau (R.-Calif.) laud the R&D partnership's potential to restore vigor to an industry slipping into an increasingly competitive worldwide market.

The advantages of the R&D partnership can become painfully obvious, says Terry Marsh, former vice president of sales for turnkey business systems manufacturer Qantel Corp., Hayward, Calif. Marsh says he watched the company grow from a net worth of less than $10 million to $70 million—only to find that venture capitalists had acquired 91 percent of the company's equity in the several rounds of financing that preceded the company's initial public stock offering.

Marsh learned from his Qantel experience and established R&D partnerships when he founded and became president of Western Business Computers Inc., San Jose, Calif. "I had invested in coal, gas and oil exploration for tax purposes," he says. "So capitalizing on a similar tax shelter to finance a turnkey systems company that differed from Qantel only in using brand-name hardware to attract the first-time user made a lot of sense." Marsh says three privately offered R&D partnerships allowed him to raise $8 million without giving up any equity in Western Business Computers.

Once the R&D was completed last June for WBC's first product—an operating system called Liberty One that allows Quantel software to run on Honeywell hardware—Marsh sought venture capital to finance marketing efforts. But because he was offering a finished product instead of just an idea, Marsh says, he was in complete



Management of an R&D limited partnership *is performed by the general partner, which may be a corporation or an individual and is usually the inventor or sponsor of the R&D. The actual research and development is performed by an R&D contractor. Once the R&D is complete, the contractor passes the process or product back to the R&D partnership, which, in turn, licenses or sells it to a manufacturing company. The general partner, R&D contractor and manufacturing company may be the same or related entities. The influence of the limited partners over the R&D process is virtually nil, giving the inventor or sponsor a free hand in managing the R&D without investor interference. Under extraordinary circumstances, however, the limited partners can vote to replace the general partner.*

control. "If it is ever deemed appropriate for WBC to go public," he says, "I'll be comfortable with trading stock for the royalty stream, which begins flowing to limited partners in July, because I haven't had to dilute my equity to get there."

Deductions of 80 percent

From an investor's point of view, an R&D limited partnership is an entity under the guidance of a general partner with the charter of developing a specified product or process that will be licensed on a royalty basis or sold for a lump sum. Buying the product or process is a third party that is often the parent firm of the general partner. Typical investors are in the 50-percent tax bracket and expect a deduction equal to at least 80 percent of the investment.

Grounds for this deduction are in section 174 of the Internal Revenue Service tax code, enacted by Congress in 1954, which permits deduction of expenditures for experiments or research in connection with a

Comparison of several recent R&D parterships

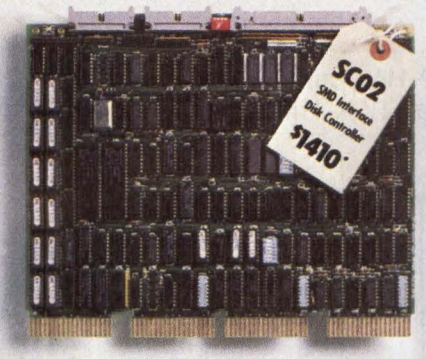
	A	B	C	D	E
Approx. date of offering:	11/79	12/79	2/81	8/81	7/81
Type of offering:	private placement	private placement	private placement	public offering	private placement
Maximum offering:	$2,500,000	$1,950,000	$50,000,000	$55,000,000	$3,500,000
Selling commissions: (%)	10	7	9	7	8
Maximum no. of investors:	35	35	333	5,500	35
Minimum investment	$50,000	$35,000	$150,000	$10,000	$100,000
Min. suitability standards: [1]	$250,000 N.W. plus 50% tax bracket	$175,000 N.W. plus 50% tax bracket, or $400,000	$500,000 or 3 × investment, plus $125,000 A.G.I., plus 50% tax bracket, or $500.000 and $125,000 A.G.I.	$100,000 or 4 × investment plus $65,000 taxable income	$250,000 N.W. plus 50% tax bracket, or $500,000 N.W.
Cash notes	100% cash	50% cash, 50% notes P & I payable in next year	100% cash, or $30,000 cash in 1st year, $50,000 in 2nd year, $70,000 in 3rd year	100% cash	75% cash, 25% note payable in next year
Write-off as % of cash investment	80	81	90	92	86
General partner [4]	syndicator (corp.) & individual (presi- of the mfg. corp.)	4 individuals/2 syndi- cators and 2 owners of the R&D contractor corp.	R&D contractor and subsidiary of licensee/ manufacturer	R&D contractor and subsidiary of licensee/ manufacturer	1 individual who is principal shareholder of R&D contractor and licensee/manufacturer
General partner's compensation					
· **Initial organization fee**	5% of G.O.P.[2]	—	—	—	—
· **Expenses, (legal, consulting, accounting, printing):**	$20,000	$55,000	$490,000	$561,000	$160,000
· **Initial management fee:**	1% of G.O.P.	3% of G.O.P.	—	—	—
· **On-going management fee:**	1% of G.O.P. (annually)	—	—	—	$2,000/mo. during R&D contract
· **General partner's share of profits:**	1% of profits and losses until LPs receive 100% capital contribu- tions; then 20% of profits and losses	10% of profits and 1% of losses until LP's receive 130% of capi- tal contributions; then 40% of profits, losses and distributable cash flow	1% of profits	1% of profits, losses and cash distributions	10% of profits until LPs receive 100% of capital contributions; then 35% until GP receives100% of capital contribution then 33% to GP (and 2% to placement agent)
Royalties to partnership:					
· **Royalties**	$10/unit-$.10/unit	to be negotiated (R&D contractor to receive 30% of royalties received by partner- ship)	joint venture profits 40% to partnership, 60% to mfgr.; after technology sale, initially 8% of sales until LPs receive 2 × investment, then 4½% of sales	7% of sales until LP's are paid 200% of capital contributions; then 3⅓% of sales	3% of selling price per unit [3]
Buyout of limited partners:	—	—	—	4 × investment in cash or stock of license/manufacturer	4.3 × investment in 2½ years; 4.85 in 3½ years, in cash

Notes:

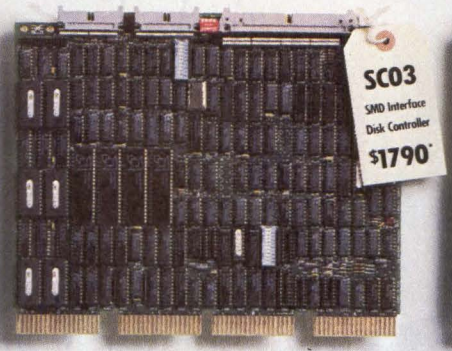
1. In all cases, it's exclusive of homes, furnishings and automobiles
2. G.O.P. = gross offering price
3. Licensee/manufacturer must also spend $500,000 annually for marketing of product
4. General partner (GP); limited partner (LP)

Source: Lee R. Petillon

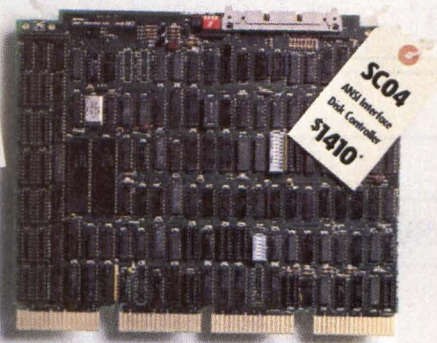
The LSI-11 controllers with features comptrollers love.



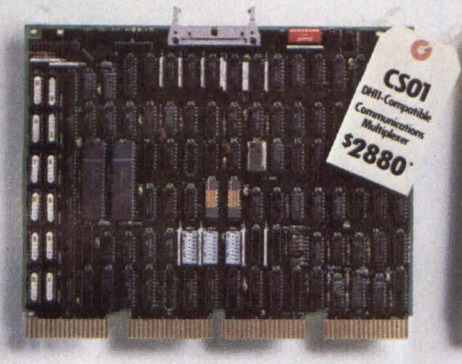
Handles small 12-80MB disks, emulates RP02/03, RK06/07 and RL01/02.



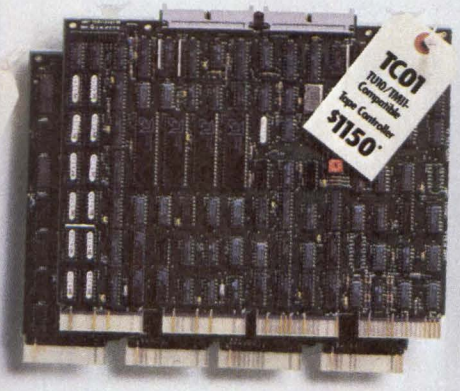
Operates with new high-performance 80MB and larger disks on LSI-11/23.



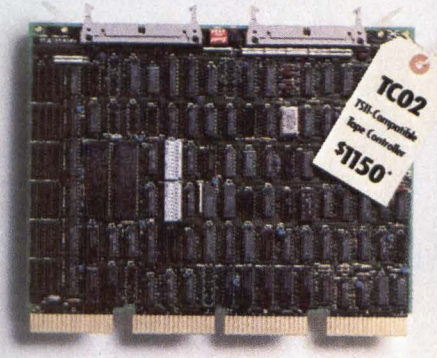
Handles up to eight ANSI 8" Winchesters, emulates RK06/07 and RL01/02.



Handles 8-64 channels, 16-bit word transfers (DMA), 22-bit addressing. (16-channel price)



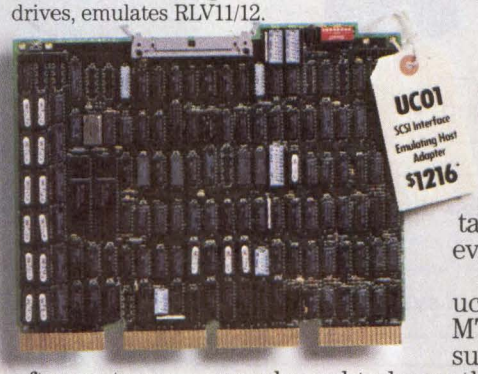
Dual density at up to 75 ips, handles up to four ½" transports.



Coupler works with all NRZI, PE, GCR formatters at speeds from 12.5 to 125 ips.

*Quantity 100

Handles new cartridge Winchester disk drives, emulates RLV11/12.



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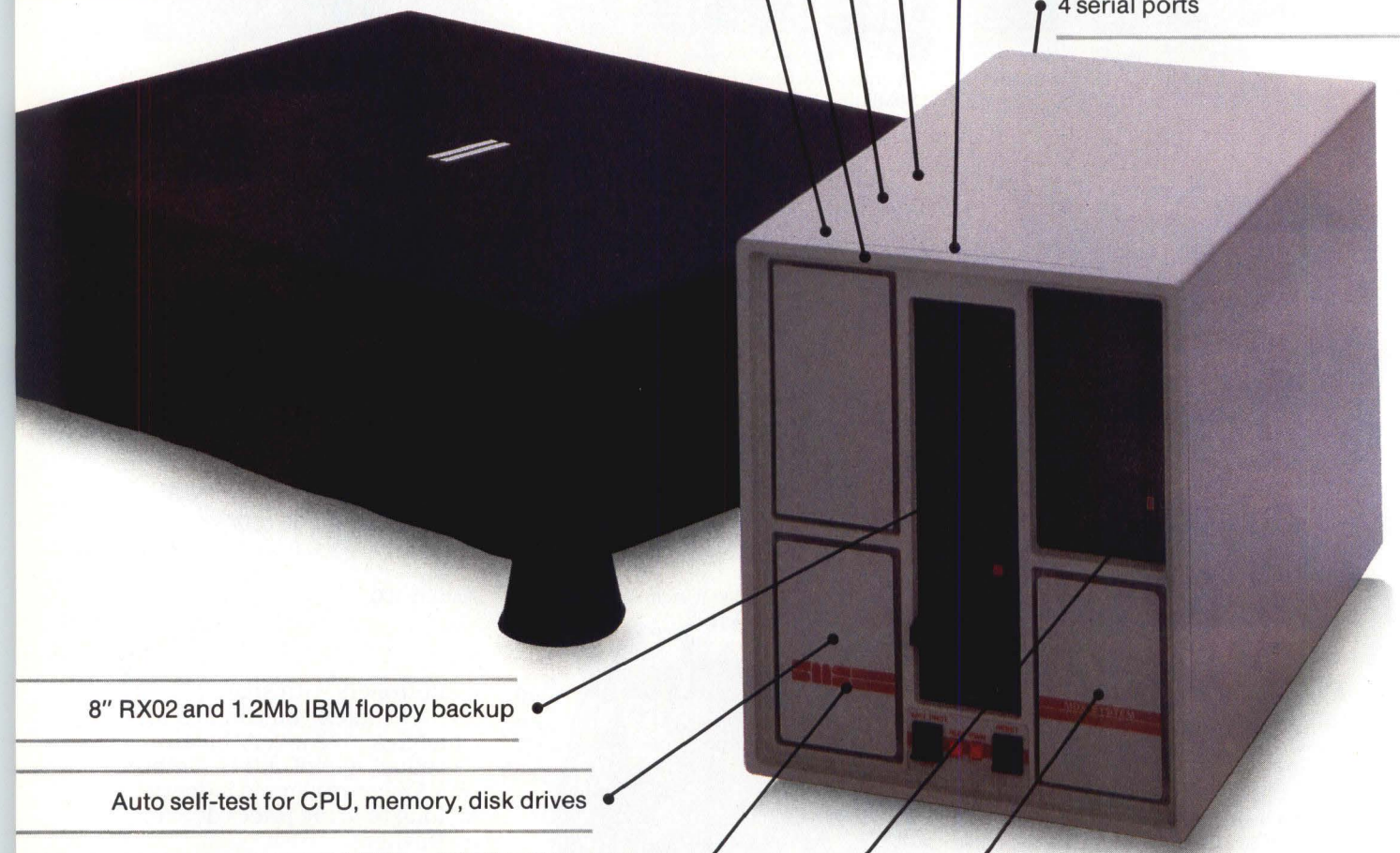

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taxpayer's trade or business.

As with most other tax shelters, a public policy was formulated before the R&D deduction was added to the IRS code. As recorded in the Congressional Record and quoted by the U.S. Supreme Court, the Congressional hearings on the adoption of section 174 established that it was intended "to greatly stimulate the search for new products and new inventions upon which the future economic and military strength of our nation depends. It will be particularly valuable to small and growing businesses."

That section 174 was not specifically intended to provide a deduction for a limited partner is evident, however, because such investors do not satisfy the requirement that only R&D expenditures incurred in connection with a taxpayer's actual trade or business are deductible. But an extension of the letter of the law to satisfy the intent of Congress was made when the U.S. Supreme Court, in its 1974 decision in Snow versus Commissioner, confirmed R&D deductions by limited partners were allowable.

News of what is believed to be the first public offering of an R&D partnership reached the pages of the *Wall Street Journal* only in 1977. That first public R&D partnership was formed in Clearwater, Fla., by Concept Inc. to develop new medical sensing equipment that Concept subsequently licensed from the partnership for manufacture and sale.

Subsequent R&D partnerships have also attracted attention, notably one formed by Lear Corp. to develop a corporate jet. But perhaps the most famous, and, at the outset, seemingly one of the most successful end products of an R&D limited partnership has since been tainted: the stainless-steel, gull-winged DeLorean sports car.

Computer R&D partnerships

William Brennan, publisher of Valley Forge, Pa., tax-shelter newsletter *Brennan Reports*, says it was not until 1981 that R&D partnerships began to gain momentum in the computer industry, and it is still too early to judge what success rate the R&D partnership will enjoy in bringing computer products to market. A number of computer companies have cut R&D limited partnerships, including Gene Amdahl's Trilogy Computers, Pro-IV Inc., Newport Beach, Calif., which is converting an application generator to run under Digital Equipment Corp.'s operating systems, and Energy Scientific Inc., Seattle, which is developing software to manage utility usage in large buildings.

One of the first computer-oriented ventures was organized on January 26, 1981, as a limited partnership to raise $50 million to finance development of a series of IBM-compatible, high-performance computers using VLSI circuitry. The managing general partner of that project is a wholly owned subsidiary of STC Computer Systems Corp., Louisville, Colo. A spokesman for STC declines to comment on the project's progress. According to a document filed with the Securities and Exchange Commission, however, if the project progresses as planned, first customer shipments of the new computers will begin during the first half of 1984.

If Storage Technology Partners is successful, STC gets first crack at the technology and preferred treatment as well. According to the same SEC document, "STC Computer Systems will have the right to enter into a joint venture with the partnership to manufacture and market the computers and, under certain circumstances, to purchase the partnership's computer technology outright on a deferred-payment basis."

Ironically, developing IBM plug-compatible computers was not the kind of innovation Congress had in mind in writing section 174, nor is STC, with more than $600 million in annual revenues for 1982, the kind of small company that Congress intended to aid. But another limited partnership set up by STC and underwritten by Smith, Barney, Harris & Upham & Co. Inc. and L.F. Rothschild, Unterberg, Towbin, New York, is right up section 174's innovation alley: Storage Technology Partners II, formed to design and develop high-performance disk drives using optical recording techniques to record data on and read data from a removable media.

The $40-million investment opportunity, with minimum ante of $150,000 and a high degree of risk, is not for dabblers. In the private placement memorandum, potential investors are warned: "The Partnership may be unable to (a) successfully complete the development of the Technology, (b) manufacture and market optical disk drives through the joint venture arrangement or otherwise, (c) sell or license the Technology to STC or any other entity or (d) realize economic benefits if STC purchases the Technology and then fails to manufacture and market optical disk drives."

Brennan says such high risk is integral to R&D partnerships. "They're as risky from an investor's point of view as gas and oil exploration," he says. "It's hard to say if you're going to bring in a gusher." And, although he says the tax deductions from such investments are clear-cut and almost never questioned by the IRS, they are not sufficient to recoup the investment.

So what attracts investors? According to Lee R. Petillon, an attorney in Los Angeles who specializes in

R&D partnerships, typical returns from profitable partnerships not only average 20 percent and go as high as 40 percent, but are taxed at the low 20-percent rate reserved for capital gains. This potential for large return on investment, coupled with his expectation that R&D partnerships will continue to receive favorable tax treatment, makes Petillon confident his specialty will continue to keep him busy.

But Jennifer Springer, an adviser in the tax advantage investment department of L.F. Rothschild, Unterberg, Towbin, warns that it can be difficult to sell R&D partnerships to investors. The 40-percent profit that might accrue to a limited partner is peanuts compared to the returns venture capitalists enjoy if a start-up company succeeds and goes public. And investors should beware, she says, because not all limited partnerships are created equal. "Some real garbage is floating around in the small private offerings," she says.

There are other rumblings that could shake the foundations of high tech's favorite tax shelter. Brennan notes that the Tax Equity Responsibility Act of 1982 now affects deductions for R&D expenditures. "It means taxpayers might still have to pay the alternative minimum tax, which can reach 20 percent, even if their reductions from a large R&D expenditure reduced their taxable income to zero," he says.

A potentially more damaging ground swell in Congress and the Reagan administration is a flat tax structure, which would eliminate tax loopholes. But Brennan says the threat from such a flat tax rate is minor. "It would be hard for the government to go to a pure flat-tax structure," he says. "I don't think Congress will give up the ability to invest in desired directions."

Given Ronald Reagan's recent conversion to high-tech advocacy, computer companies will be able to take advantage of R&D limited partnerships for some time, Brennan says. "I don't think the limited-partnership market nor *Brennan Reports*, for that matter, will be going out of business soon." □

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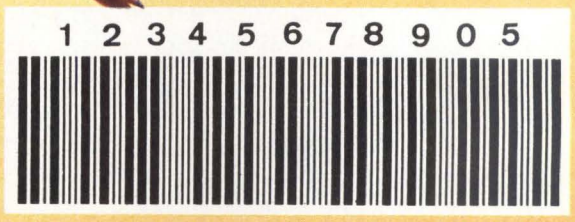

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CIRCLE NO. 80 ON INQUIRY CARD

Computer market researchers do more than tell fortunes

By Frank Catalano

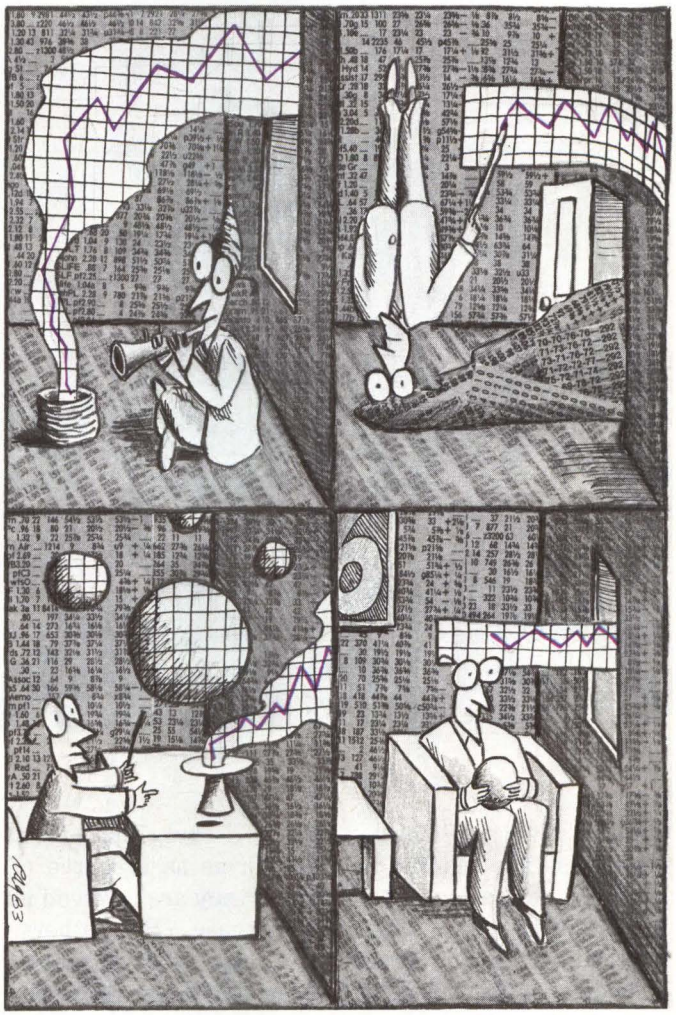

Illustration by Richard A. Goldberg

They're often referred to as industry gurus, and sometimes what they have to say seems like it's been conjured from a crystal ball. But, although you see their predictions, projections and prognostications quoted in such prestigious publications as the *Wall Street Journal*, *Business Week* and, yes, *Mini-Micro Systems*, market researchers do not consider themselves infallible fortune tellers. "If we had some magic crystal ball that we could use to predict the future, we'd be making millions on Wall Street and not wasting our time publishing market research reports," notes Ken Bosomworth, president of International Resource Development Corp., Norwalk, Conn. "But there is no crystal ball either here or anywhere else."

Rather than fortune tellers, Bosomworth and his professional peers see themselves as analysts who use historical and current market data to estimate the extent of future market opportunities as well as competitive situations. Included in those estimates—or, more typically guesstimates—is information about up-and-coming technologies, products and market trends. "What we try to do is provide our clients with the necessary information to make a proper assessment of what's going to happen in a market that they're interested in," says Jack Hart, vice president of marketing at International Data Corp., Framingham, Mass. "The computer industry has changed faster in the last two years than it has in the last two decades, and that's why people need market research. They need to be kept continually updated as to what's going on in markets that affect them and to be on guard against becoming obsolete."

Investment community roots

Although the primary customers of market research firms are now suppliers and users of computer hardware, software and services, Hart says, the first customers were members of the investment community. He says that, before 1975, the Securities and Exchange Commission allowed brokerage houses to charge a fixed commission for trading stocks. "Since such firms could not compete on a price basis, they competed on a service basis," Hart says. "One of the services they offered was research from companies like market research firms."

But when the commission laws changed in 1975 and stock brokers were permitted to charge whatever fee the market would bear, the customers of market research firms began to change. Hart says that the number of computer companies at that time began to grow, as did the competition in various market segments. The companies that market research firms once studied for investment purposes started to subscribe to those firms' services. "Our emphasis changed from providing financial information on a company in the computer industry to providing market information," he says.

Edward Ross, a senior consultant at Venture Devel-

SELECTED COMPUTER INDUSTRY MARKET RESEARCH FIRMS

	Full-time researchers	Subscription fee	Ongoing services	Reports	Newsletters	Seminars/ conferences	Telephone inquiry	Database access	Proprietary research
Dataquest Inc. 19055 Pruneridge Ave. Cupertino, Calif. 95014 408-996-0194	300+	±$10,000	yes	yes	yes	yes	yes	yes	yes
Gnostic Concepts Inc. (McGraw Hill/ Data Resources Inc.) 2710 Sand Hill Rd. Menlo Park, Calif. 94025 415-854-4672	35	±$10,000	yes	yes	yes	yes	yes	yes	yes
International Data Corp. 5 Speen St. Framingham, Mass. 01701 617-872-8200	100+	$9000-$20,000	yes	yes	yes	yes	yes	yes	yes
International Resource Development Corp. 30 High St. Norwalk, Conn. 06851 203-866-6914	23	$985-$1285	no	yes	yes	no	no	no	no
The Yankee Group 89 Broad St. Boston, Mass. 02110 617-542-0100	20+	$12,500-$24,000	yes	yes	yes	yes	yes	yes	no
Venture Development Corp. 1 Washington St. Wellesley, Mass. 02181 617-237-5080	20	$2500-$3000	no	yes	yes	no	yes	yes	yes

opment Corp., Wellesley, Mass., says that most companies use market research firms as a source of general information about markets they are involved in or products they wish to purchase. But others, particularly large corporations, use such firms to provide a validity check of their own in-house research. "It's in the interest of the sales manager of the fiber-optics department at General Electric, for example, to be very optimistic in his reports on the growth potential of the fiber-optics market," says Ross. "While that guy's professional future may depend on a healthy fiber-optics market, outside parties don't gain anything if the market is growing at 2 percent or 200 percent. We provide companies a disinterested analysis."

About 4000 companies have purchased reports from IRD, Bosomworth says, adding that some companies purchase several reports. Last year, Dataquest Inc., Cupertino, Calif., sold more than 2000 subscriptions to its services, while IDC sold more than 3000. Although all three companies compete with one another as well as with other market research firms covering the computer industry (see table, above), they list their primary competition as the in-house research staffs of their potential customers.

Competing with/aiding in-house research

"For every $1 million spent on outside market research, hundreds of millions of dollars are spent on in-house efforts trying to dig up the same information that we provide," says Bosomworth. While it may take a company six months to research the local-area network market in-house, for instance, he adds, the company could have a report from a market research firm in a day. "I'm not saying that any one of our reports will provide 100 percent of the information that a customer needs, but it will provide at least 60 percent," says Bosomworth. "Why should someone waste time trying to uncover information that already exists?"

Denny Paul, a senior vice president in charge of Dataquest's computer services group, notes that by buying reports from outside market research firms, companies can devote their in-house staffs to more focused research and thus save labor dollars. "Our

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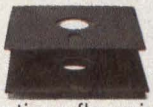

but micros have already outgrown low-capacity, poor-reliability, slow-access-time floppies.

Winchester with floppy is better...

but it's really just a glorified floppy memory system.

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service costs less than 20 percent of one staff person at these companies," he says. "Companies can get broad, general research from us and then use their in-house staffs to concentrate their research in the area that is of particular interest to them. That way, they don't have to waste time or talent."

Hewlett-Packard Co. relies on outside market research expertise for estimates of the size of various markets as well as for an idea of the trends developing within the industry. Richard Edwards, director of strategic market planning at HP, says that, although the company employs 86,000 people worldwide, only a handful of them perform general market research duties. Most of HP's marketing personnel, he says, concentrate on supporting specific products within the company's divisions. "It's the same as a company hiring outside legal assistance to secure a patent," Edwards says. "Patent law is an area of specialization that in-house lawyers might not be equipped or have time to handle. The same is true for market research—it's an area of specialization that we find more cost-effective to purchase outside."

Interlan, Westboro, Mass., a supplier of Ethernet-compatible controllers and network software products, has only recently begun using the services provided by market research firms. Patrick Clark, vice president of marketing for the 2-year-old company, says that as the local-area-network market heats up, market research is becoming more important to his company. "We need to keep our eyes on the new vendors coming into the market, new technologies and the application of new products," says Clark. "Since we're a relatively small company, we depend on the market research reports for market overviews and trend analyses and to give us an idea of the strategic directions of our various competitors. Then, we use our own marketing people to do direct-mail surveys and more in-depth research."

Wide range of services

Market research services available in the industry differ from firm to firm. While IRD offers only research reports on various topics, companies such as IDC and Dataquest also offer their subscribers telephone inquiry services and conferences. The reports available

from IDC and Dataquest are continually upated. "Because this market is so volatile, we stress ongoing services at IDC as opposed to individual reports," says Hart. "The numbers we attribute to a particular market today may change tomorrow. By giving our customers access to updates and revisions, we can provide accurate up-to-the-minute market data throughout the year."

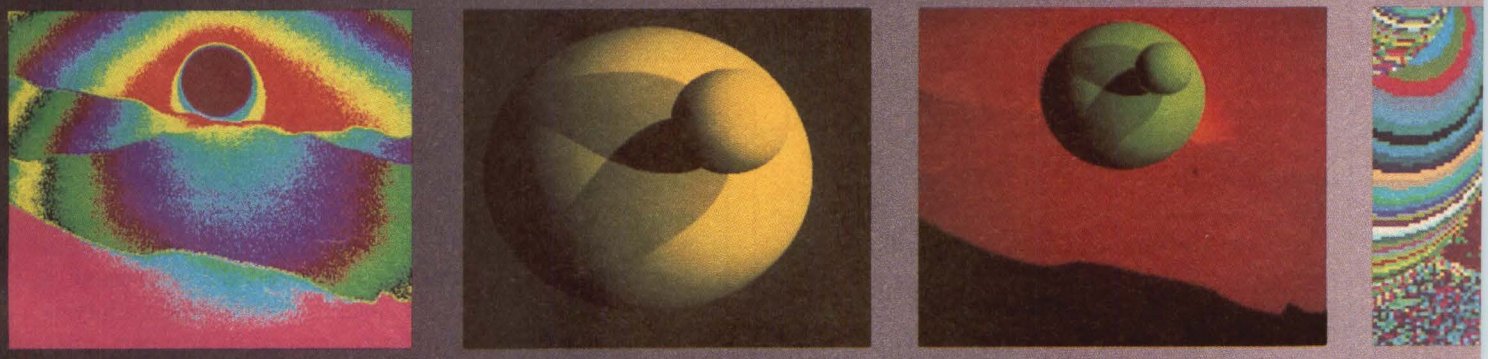
Although IRD does not provide its clients access to updated reports or a telephone inquiry service, Bosomworth says, customers can call to ask questions about the reports that they've bought. IRD's reports range in price from $985 to $1285, and IDC's reports range from $9000 to $20,000 per year. Average price for Dataquest reports is $10,000 per year.

IRD published 40 reports last year and expects to publish 70 this year. Bosomworth employs a full-time research staff of 23 and uses the services of 40 to 50 outside consultants. In choosing report topics, Bosomworth says, he looks for commercially important markets or technologies in which an "information gap" exists. "We choose areas in which there doesn't seem to be a satisfactory body of literature around that helps people understand the magnitude of the opportunity in that area or the nature of the competition," he says. "Sometimes, that information gap may be a lack of understanding of what customers want from a particular product class; other times it may be an understanding of the technology."

IDC and Dataquest do not cover as many topics as IRD. That is because customers subscribing to research from IRD and Dataquest receive updates to reports throughout the year. Dataquest offers research services in about nine high-technology markets each year, and IRD surveys about 15. However, the staffs of Dataquest and IDC are significantly larger than IRD's. Dataquest employs 300 full-time researchers, and IDC employs more than 100.

Paul notes that Dataquest's topics remain the same from year to year. They include semiconductors, small computers, printers, computer memory, display terminals, word processing, telecommunications, copying/duplicating and CAD/CAM. About 25 to 30 researchers work on each topic, and Paul says the researchers

ion run wild, not your budget.



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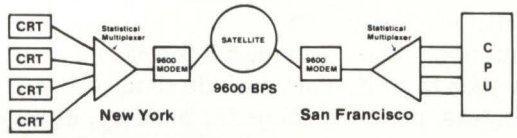
THE DATA DETECTIVE #1

The Case of the Missing 9.4 Seconds

The call came at 8:30 a.m. Monday. Most early morning calls are trouble calls in this business, but expecting trouble at any hour is our business. The call was from the communications manager of a Fortune 500 company. During the weekend his multiplexing system between New York and San Francisco, consisting of two four-channel statistical multiplexers and two 9600 BPS modems, had been shifted from an AT&T leased line to a new, less expensive RCA satellite line. The system was working, but the multiplexing delay had increased from a few character times to nearly ten seconds, and throughput was way down. RCA claimed their satellite line could only account for 600 milliseconds. What was causing the missing 9.4 seconds? The CRT terminals being used over this link were protocol-less and so the delay could not be attributed to polling timeouts, or ACK-NACK control. Neither the modems nor the statistical multiplexers indicated any errors on the line that could cause a back-up of data transmission. Yet the switchover to the satellite line was clearly having a deleterious effect.



Perplexity yielded to a sudden flash of intuition. The statistical multiplexers used an SDLC type format in which the block length depended on data activity and varied from seven characters to sixty-four characters. Up to seven blocks could be outstanding before an acknowledgement had to be received. Whenever the terminals were active but sending only a few characters at a time the satellite pipe line could easily contain more than seven blocks, since seven frames of, say, 10 characters each is 700 bits, and at 9600 BPS 700 bits is not even 100 milliseconds. Thus the statistical multiplexer was timing out and going into a time consuming recovery mode. As the seconds went by the block size grew, because more data was arriving from the terminals for addition to the frame. Eventually the frames got long enough so that seven of them were no longer in transit at once and the system functioned normally until the blocks got too small again.

Immediate relief was provided by dropping the modem speed to 2400 BPS to lengthen the blocks; a longer range solution was provided by the manufacturer of the statistical multiplexer who installed a transmission protocol that permitted more frames to be outstanding before initiating resync procedures.

—*R.G.*

NEXT MONTH: The case of the spurious x-off

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The Interpreter

follow one topic throughout the year.

Although IDC covers certain markets each year, some reports vary from one year to the next. By sending surveys to clients and by monitoring the questions that customers ask, Hart says, the company identifies markets of industry interest. "If people continually ask certain questions about certain kinds of markets, like local-area networks, that gives us a feel for the kinds of information requirements that are out there," he says.

Besides general market studies, all three companies offer newsletters. IDC and Dataquest also provide customized consulting.

Data-file access

As an additional service, IDC offers customers access to the company's data files. IDC's computer-installation data file, which has been compiled since the company was founded in 1964, contains lists of more than 150,000 computer-product installations around the world. A separate vendor file lists more than 100,000 product suppliers. "If a company is selling IBM-compatible 3270 terminals and they go to the computer-installation data file, they can select all the companies out there that have 3270s installed in their operations," says Hart. "That's a very targeted prospect list for a customer wishing to do direct sales or marketing." Prices for access to the data files range from $1200 to $19,500, depending on the number of installations or vendors a customer wants.

But despite all the services that market research firms offer, industry gurus are best known for their numbers. Bosomworth notes that numbers shouldn't be taken at face value but should be used only to give a customer an indication of how large a market is or will be. "Market analysts are best equipped to make forecasts because it's their business to know this industry," says Bosomworth. "But no matter how good we are at our trade, nobody can state any definite facts about the future. The best we can do is present a reasonable, sensible and carefully constructed analysis of what we think is going to happen in any particular market. Sometimes we turn out to be right on the money, and other times we don't." □

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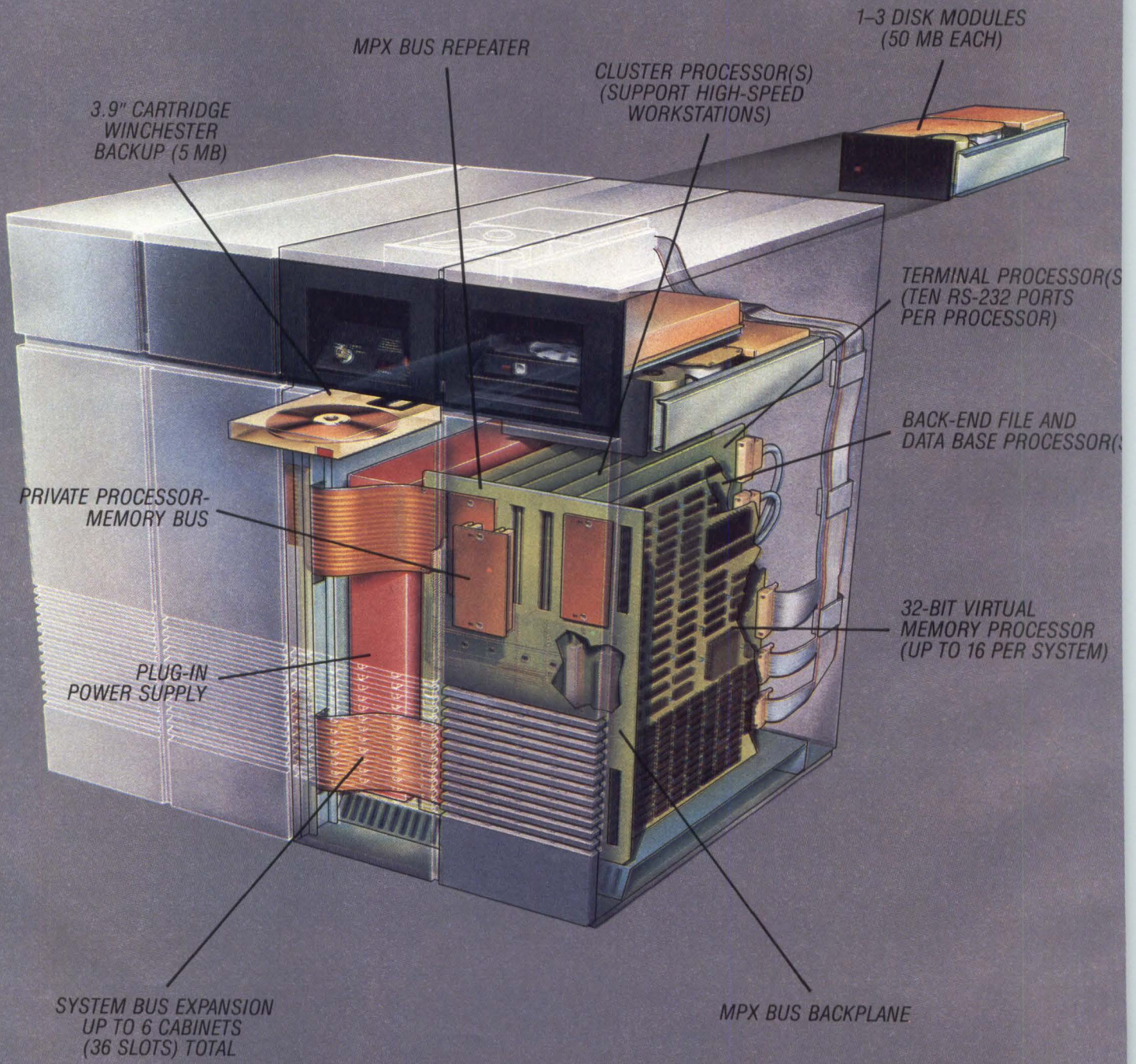

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☐ **Multiple specialized processors distribute the workload to achieve outstanding performance.**

☐ **Designed to support workstations and terminals to achieve a least-cost fit for any application.**

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Configurable to exactly match application load profile

The various Megaframe processors can be installed in multiples, depending on the requirements of the specific application.

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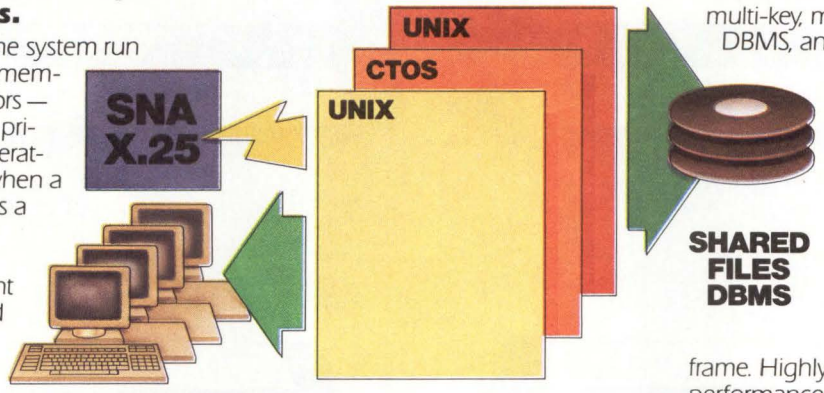

SMD devices can be attached via a separate intelligent interface processor. File backup utilizes compact Winchester cartridges, ½" magnetic tape, or both.

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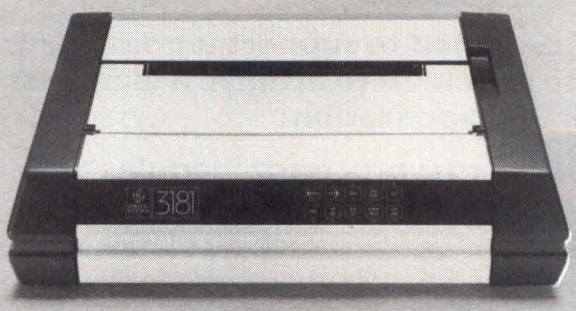
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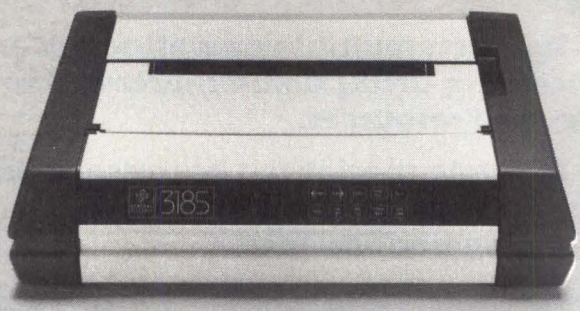
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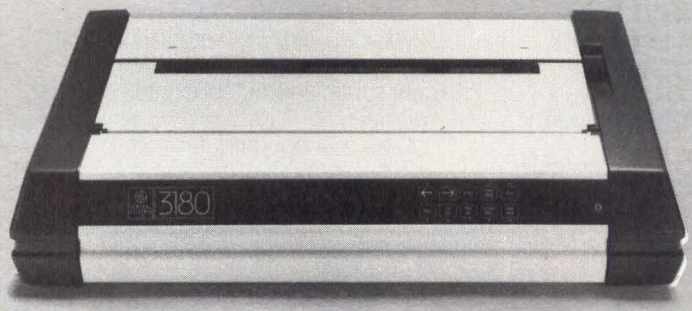
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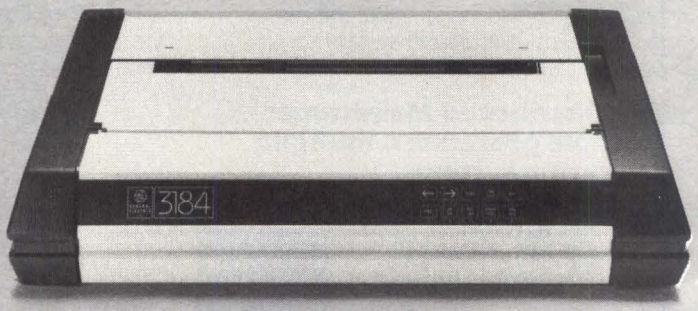
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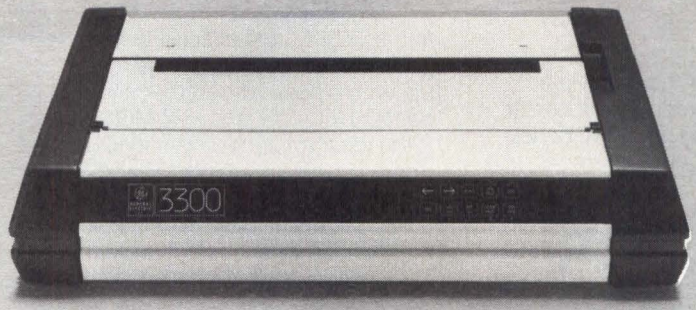
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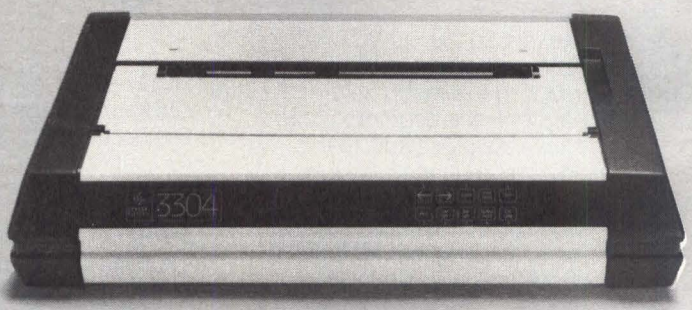
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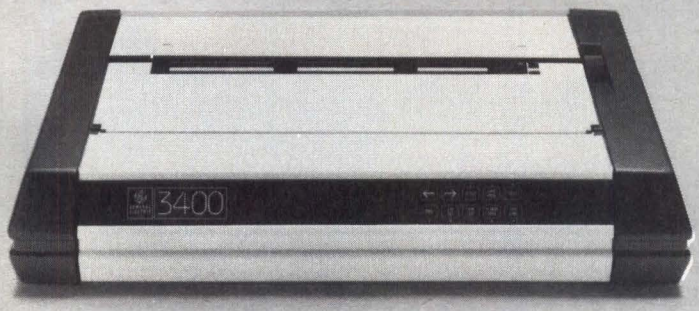
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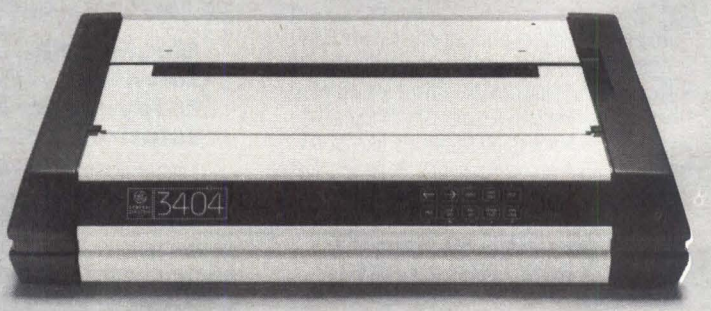
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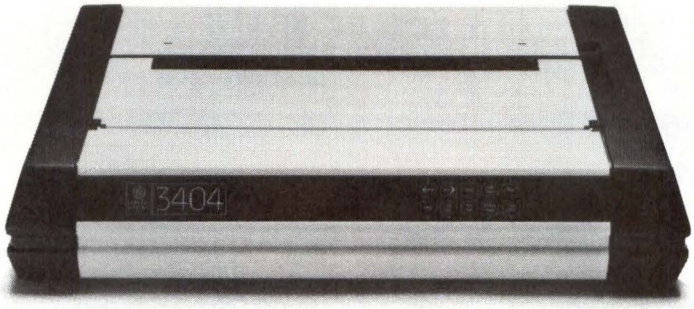

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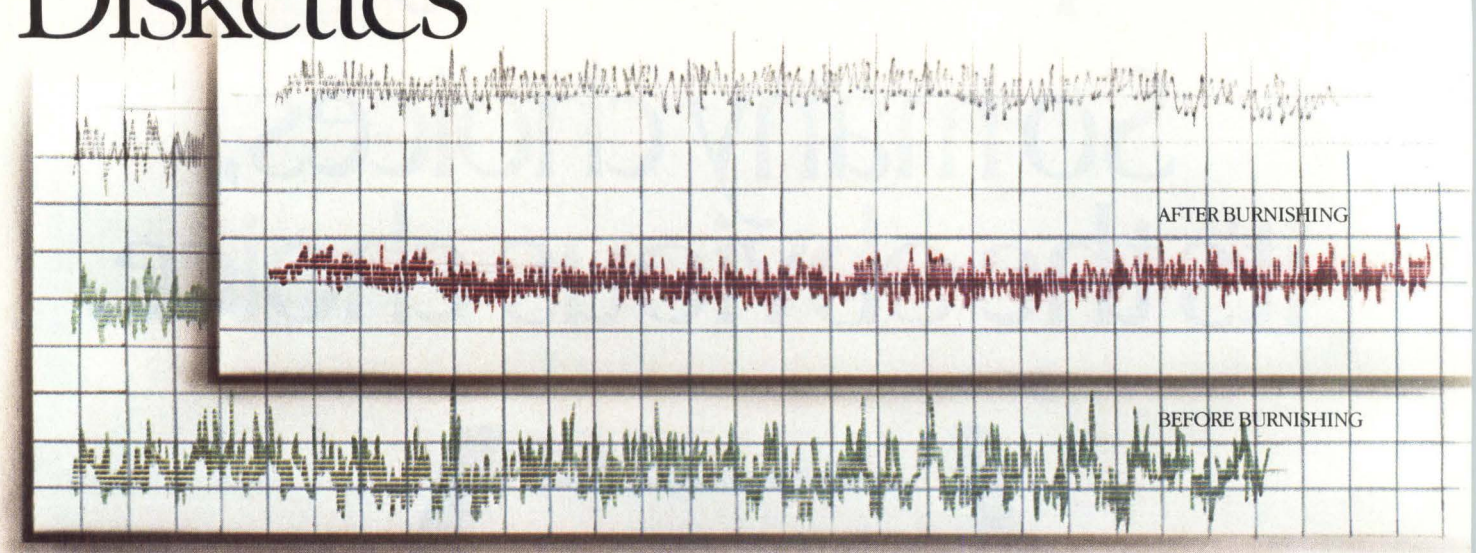

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CIRCLE NO. 87 ON INQUIRY CARD

Automatic test equipment: where quality control and automation cross paths

By Sarah Glazer

The word "quality" surfaces quickly in discussions about manufacturing processes. It's the sought-after, often-elusive goal that can spell the difference between a profitable operation and yet another casualty of the recession. For the electronics industry, the demands of quality control dictated moving beyond the limitations of manual testing and inspection into the realm of automatic test equipment. Today, advanced test systems continue to evolve. They can interact with other automated factory systems, as when using a database for computer-aided-design equipment to create test programs. In the not-so-distant future, testers may be able to monitor and help control the production process itself.

In many segments of the electronics industry, automated testing is already the norm, with complex programmable testers commonplace. ATE for the worldwide electronics industry had a $1-billion market in 1982, according to Prime Data, San Jose, Calif., a research firm that follows the ATE industry and until recently was part of Dataquest Inc., in neighboring Cupertino. Prime Data divides ATE into three segments: semiconductor testers, circuit-board testers and continuity testers (also called interconnect verification analyzers).

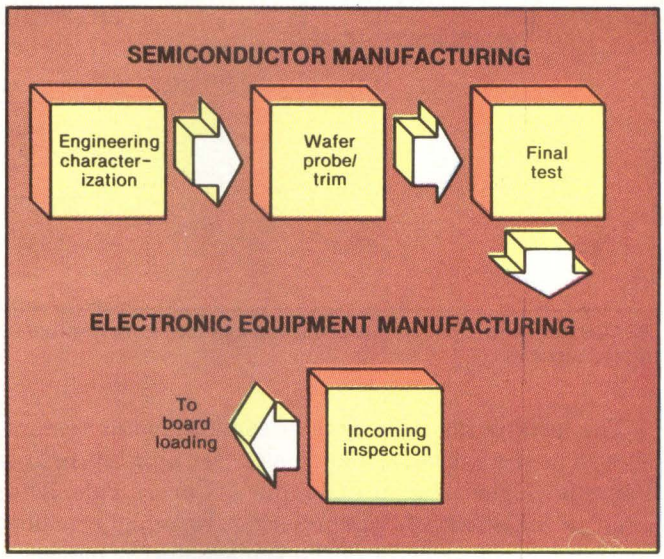
For some products, says Ken Neff, director of ATE industry service at Prime Data, using ATE is the only alternative. "When you have multilayer circuit boards, it's almost impossible to test visually," he says. "So you must have automatic testing, or you might as well not test at all."

ATE is used in manufacturing in both production-line testing and in incoming inspection, although Neff says most (more than 75 percent in 1981) is used in production. A small but increasing application for ATE is in engineering, to evaluate new devices.

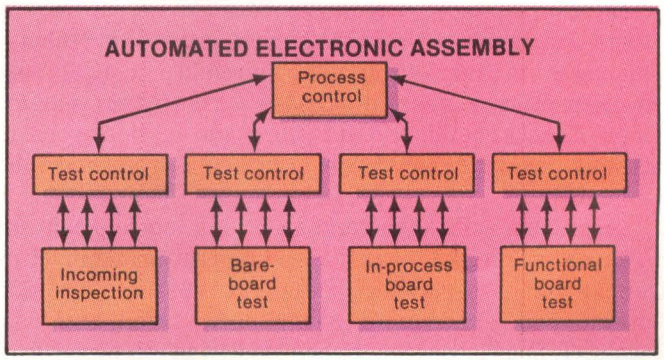
"ATE is very important to production economics," says Russel Craig, a specialist in ATE for McKinsey & Co., Boston, a management consulting firm. The critical determinant of manufacturing economics, he claims, is process yields. And ATE can provide consistent data about the results of a process to improve its effectiveness. Automating the entire manufacturing process can also bring advantages, says Craig, who notes, "For the electronics industry, computer-aided manufacturing is robotics and ATE."

Semiconductor testers

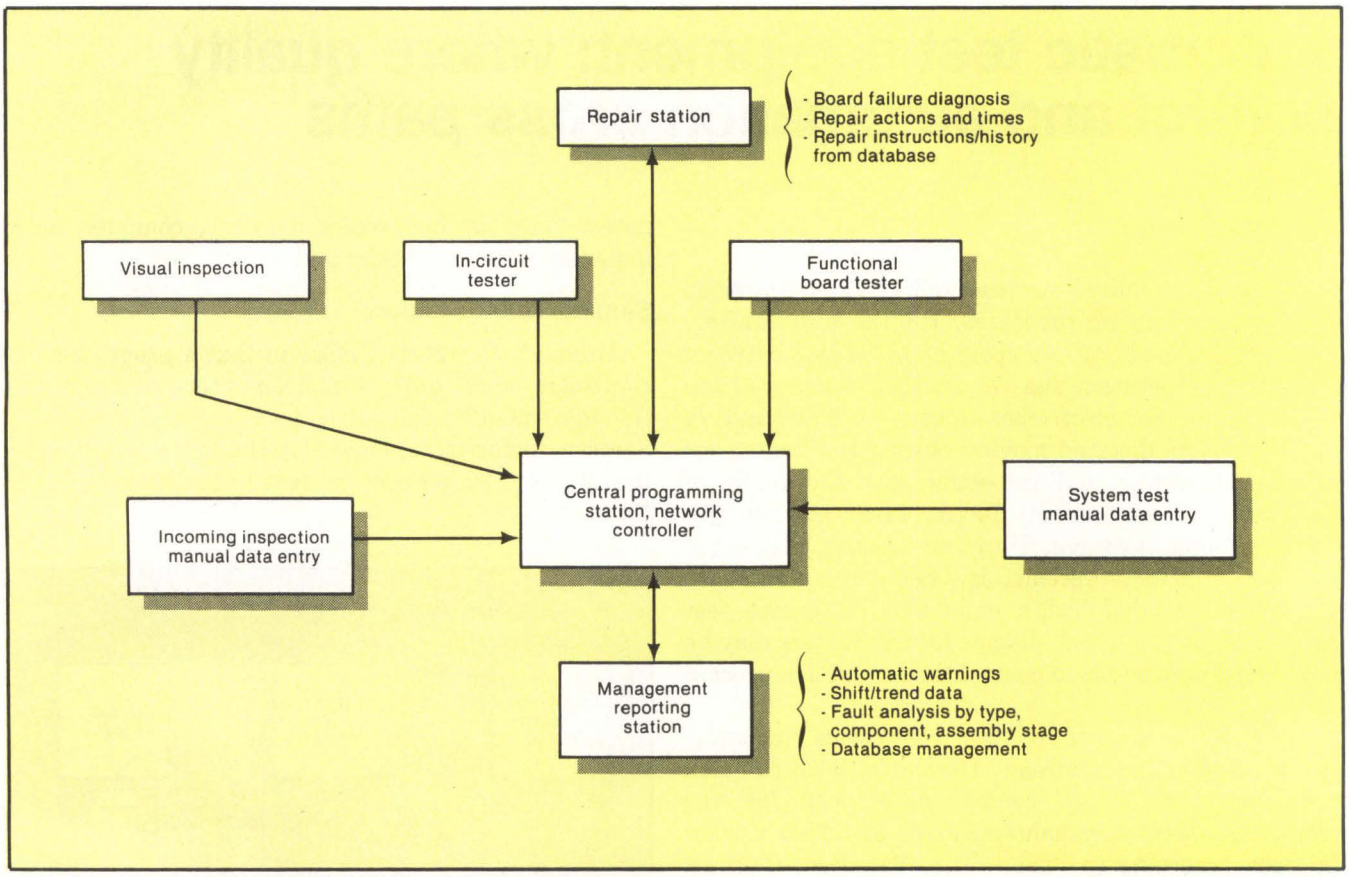
Although all ATE is similar in that a programmable controller—most often a minicomputer—is at its core, the equipment's applications lead to many differences. Semiconductor testers make up the largest segment of the market: 52 percent in 1981, according to Prime Data.



Where semiconductor test equipment is used. *Although most ATE, including semiconductor testers, is used in production, other applications include engineering and incoming inspection. (Source: LTX Corp.)*



Automatic test equipment will play an important role in the automated factory *of the future, with information from testers helping control the production process itself. (Source: Teradyne)*



TRACS (test and repair analysis/control system) from GenRad *uses optical character recognition/bar codes to identify circuit cards and to record test data.*

The leading manufacturer of semiconductor testers, as well as the overall leader in ATE (see chart, p.162), is Fairchild Camera and Instrument Corp., Palo Alto, Calif., a subsidiary of Schlumberger. Fairchild produces testers for every sector of the semiconductor industry, including logic, memory, VLSI, analog and discrete semiconductors.

Most equipment of this type is becoming more complex and more expensive because the devices it tests are becoming more complex, says Jim Mulady, manager of marketing for Fairchild's digital test systems. Some general-purpose VLSI testers sell for more than $1 million. "More pins and higher speed in tested devices mean more accuracy is required," he explains.

Agreeing with this analysis is a spokesman for Takeda Riken Ltd., Japan's leading tester manufacturer and the worldwide leader in VLSI testers and memory testers, according to VLSI Research, San Jose, Calif. Tohru Kazamaki, vice president of engineering at Takeda Systems Inc., Englewood Cliffs, N.J., explains that memory testing requires that timing accuracy be very consistent. "A high-fidelity waveform and devices to test the interfaces are very important, as is power testing to improve production throughput," he says. "This will drive the prices of testers up." However, he adds, lower cost, dedicated production-line testers for memory chips are also in demand in Japan.

Another rapidly growing segment of the semiconductor tester market is for analog—or linear, as they are often called—semiconductors. Test requirements for analog circuits are quite different from those for digital circuits, and so is test equipment for the two types of devices. Although digital circuits have only two states —off and on—analog circuits can have an infinite number of values, explains Philip Nutburn, director of marketing at LTX Corp., Westwood, Mass., a market leader in linear ATE. Traditional analog test equipment, such as oscilloscopes, can represent these many states as waveforms. The problem for ATE is to simulate analog test instruments with software, he explains.

"Having software equivalents of hardware techniques for testing is desirable because [software equivalents are] faster, more accurate and more

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controlled than hardware testing," says Nutburn. Complicated mathematical algorithms transform analog signals to the digital domain in which they can be analyzed by software.

Many new devices, known as hybrids, have both analog and digital circuitry and are reaching VLSI complexities, says Dan Hutcheson of VLSI Research. Analog circuits allow communications functions to be added to a digital chip. "The issue is integration," he says. "There are many functions in analog format that can't change. So as you increase your integration ability, you have to incorporate them into the circuit itself."

Hutcheson says Teradyne Inc., Boston, and LTX are vying for first place as suppliers of linear testers. It's a fast-growing market, he says, "with room for new designs, new software and new program structuring." He believes the market's main problem is technological —the complex mathematics has yet to be fine-tuned. "There are no good testing theories for linear devices yet," Hutcheson maintains.

Another area in linear testing in which further refinements in mathematical algorithms are needed, says Nutburn of LTX, is laser trim systems. These ATE units not only test resistors but also employ a laser beam to burn away part of each resistor to adjust its value. Most resistors produced today are trimmed, Nutburn says, because it's too difficult to control the material while depositing it on a substrate. Breakthroughs are taking place in functional control, he says, "in developing algorithms that make laser cuts much quicker."

Circuit-board and continuity testers

Like semiconductor testers, circuit-board testers have become increasingly complex and expensive. Four or five years ago, says Neff of Prime Data, most circuit boards were tested by functional testers, which test fully assembled boards to see that they function properly. But as this equipment grew more complex and more expensive, users started looking for an alternative. "There's been a whole switch in approach to testing in the last three years," Neff says. Lower priced in-circuit testers, which verify that the board was assembled correctly, began to be used as screeners, before functional testing. At first, Neff says, in-circuit testers could find only 80 to 90 percent of faults, so were used merely to screen before further testing. But as their capabilities improved, many users began to rely on them exclusively.

However, a new phase in board testing began when in-circuit testers, as functional testers before them, grew more expensive. "Now people want a prescreener because in-circuit prices are so high," says Neff. "This has opened the door for continuity testers." These test bare boards, cables and backplanes. Especially in the case of densely packed, multilayer boards, such bare-board testing can find problems that would be more expensive to fix after components were mounted on them, says a spokesman for Teradyne, a leading manufacturer of continuity testers.

In the market for board tesers, GenRad Inc., Waltham, Mass., is the leader, and Fairchild is in second place. Many recent advances in board testing center around automating the board-test and -repair loop on the factory floor. The first such system, called TRACS, was announced by GenRad in early 1982 (see diagram, p. 158). It automatically feeds test results and diagnostics into a central database, from which they can be accessed for board repair or for analysis. "This allows you to use a less highly paid technician because information about what's wrong with a part is stored on a coding strip as it goes through inspection," says Craig of McKinsey & Co. "So the technician just has to read off the information to fix the part."

Another system he calls "advanced" is a board tester by Zehntel Inc., Walnut Creek, Calif. It includes a six-axis robot arm that the company claims can pick up a board to be tested, place it in a fixture, reorient it, if necessary, and start the tester.

Networking trends

Many advanced ATE products rely on communications networks that link different equipment. "Our factory-automation strategy is based on networking products," says Beth Sulak, product manager for Teradyne's TERANET. TERANET can tie testers to a central controller and includes software to analyze test data, develop test programs, supervise the test floor and support factory communications, she says.

Many ATE companies have developed networks that tie testers together and, in some cases, to other factory systems (MMS, December, 1982, p. 119). GenRad's McKenzie says of his company's networking product, "GRnet is used to optimize the flow of information within the test work center. Then we provide interfaces from central stations to other types of networks." Kazamaki of Takeda Systems says Takeda Riken's network, called Testarium, uses fiber-optic cable and allows testers to share a database for purposes such as program development.

"The days of the large tester standing by itself are going away," says Dave Frazel, marketing manager of Tektronix Inc.'s Semiconductor Test Systems group in

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Beaverton, Ore. To optimize expensive test equipment, it's increasingly important to avoid burdening the tester with program-development requirements, he continues. "Programs could be developed off-line on a host computer and then down-loaded to the tester," he adds. Tektronix will soon be using a standard Digital Equipment Corp. operating system and will use DECnet for networking, says Frazel.

Another company using a nonproprietary test-equipment network is Fairchild. "We use an Ethernet local-area network that supports all the ATE that Fairchild manufactures," says Mulady.

The computer-aided design connection

"No one designs VLSI without computer-aided design anymore," says Hutcheson of VLSI Research, "but it's very easy to design a circuit that can't be tested." He explains that circuits that have two outputs dependent on each other's input, called races, may be logically correct but impossible to test. The needs of the tester must be built into the design of the circuits, which can be done automatically by making these requirements part of the CAD system software, he adds.

Several CAD system manufacturers, such as Calma Co. and Applicon Inc., incorporate these features, says Frazel of Tektronix. "Several CAD systems used for LSI, VLSI and gate arrays can, as the logic is defined and implemented, develop functional test patterns," he explains. "These are run against the software simulator that is designing the part."

The next step is using the output of the CAD system to help generate test programs. Although networking can allow testers to communicate with other factory systems such as CAD equipment, few ATE companies have software that can actually use a CAD database.

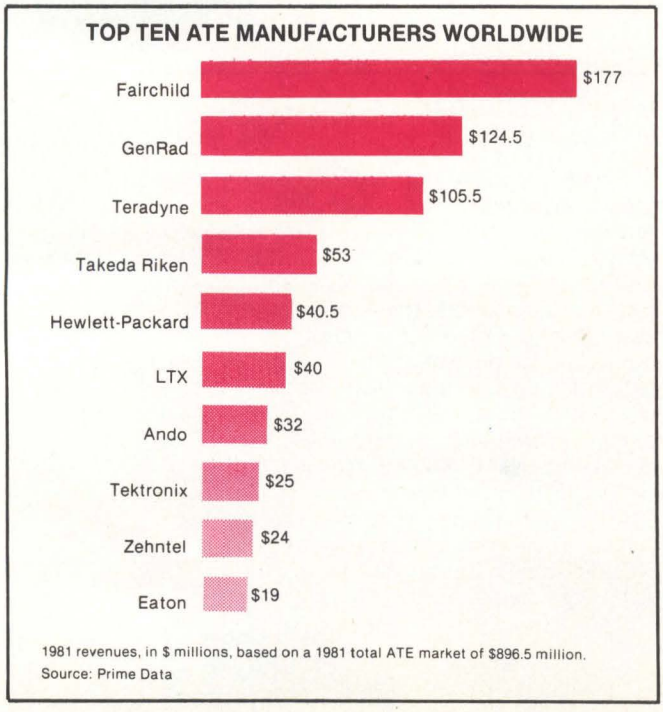
GenRad's CADMATE is an interface between its board test systems and CAD systems made by Applicon, Computervision Corp., Scientific Calculations Inc. and Racal-Redac (MMS, March, p. 127). "The software that actually does the translation between the CAD output and our circuit descriptions for test generation was developed by the CAD companies," says Roy McKenzie, an engineer at GenRad's board test division. CADMATE allows the tester to use the circuit diagram in the CAD database, eliminating the need for a test engineer's recreating it.

Fairchild plans to announce a similar product for its digital and analog semiconductor testers, called CADPORT, says Mulady. The software is also a joint effort with the CAD companies, he says. The first project is taking place with Applicon, a sister Schlumberger company, which has CAD systems for both digital and analog electronics. "But we intend to be able to tie in with other CAD companies' systems," he adds.

Some ATE companies have no plans to interface with CAD systems. Takeda Riken has no such plans, says Kazamaki of Takeda Systems, nor does LTX, says Nutburn of that company. Nutburn adds that in comparison with digital semiconductors, far fewer analog and hybrid devices are designed on CAD systems. "There's an awful lot of hype in this area," says Frederick Van Veen, vice president of corporate relations at Teradyne, about interfaces with CAD systems. He says that Teradyne is working on CAD interfaces, but declines to say when such a product will be available or which CAD companies' systems are involved. "This is an obvious thing to do, as are robotics and working with handlers," he says, "and we're working on those, too."

Tie-in with process control

The eventual goal for architects of factory automation in electronics plants is to automate the entire manufacturing process, and this is where ATE may play a pivotol role. "By correlating and reducing data produced at test, you can help the product engineer know where in the process to take corrective action," says Nutburn of LTX. "Eventually, you'll eliminate the product engineers, and the process will be controlled automatically."



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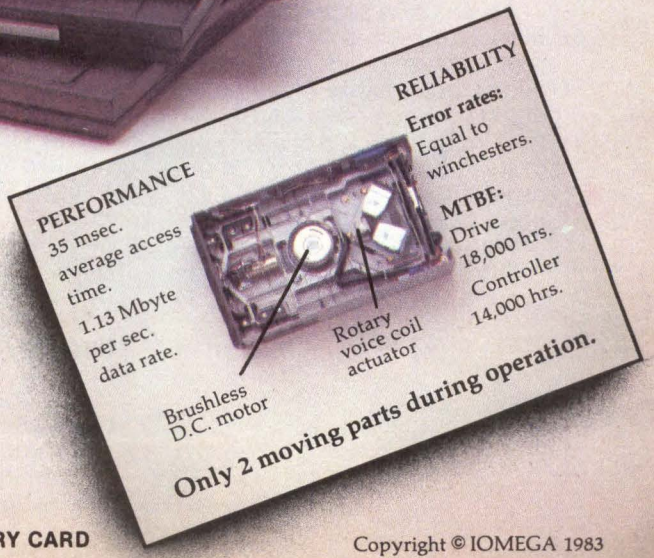

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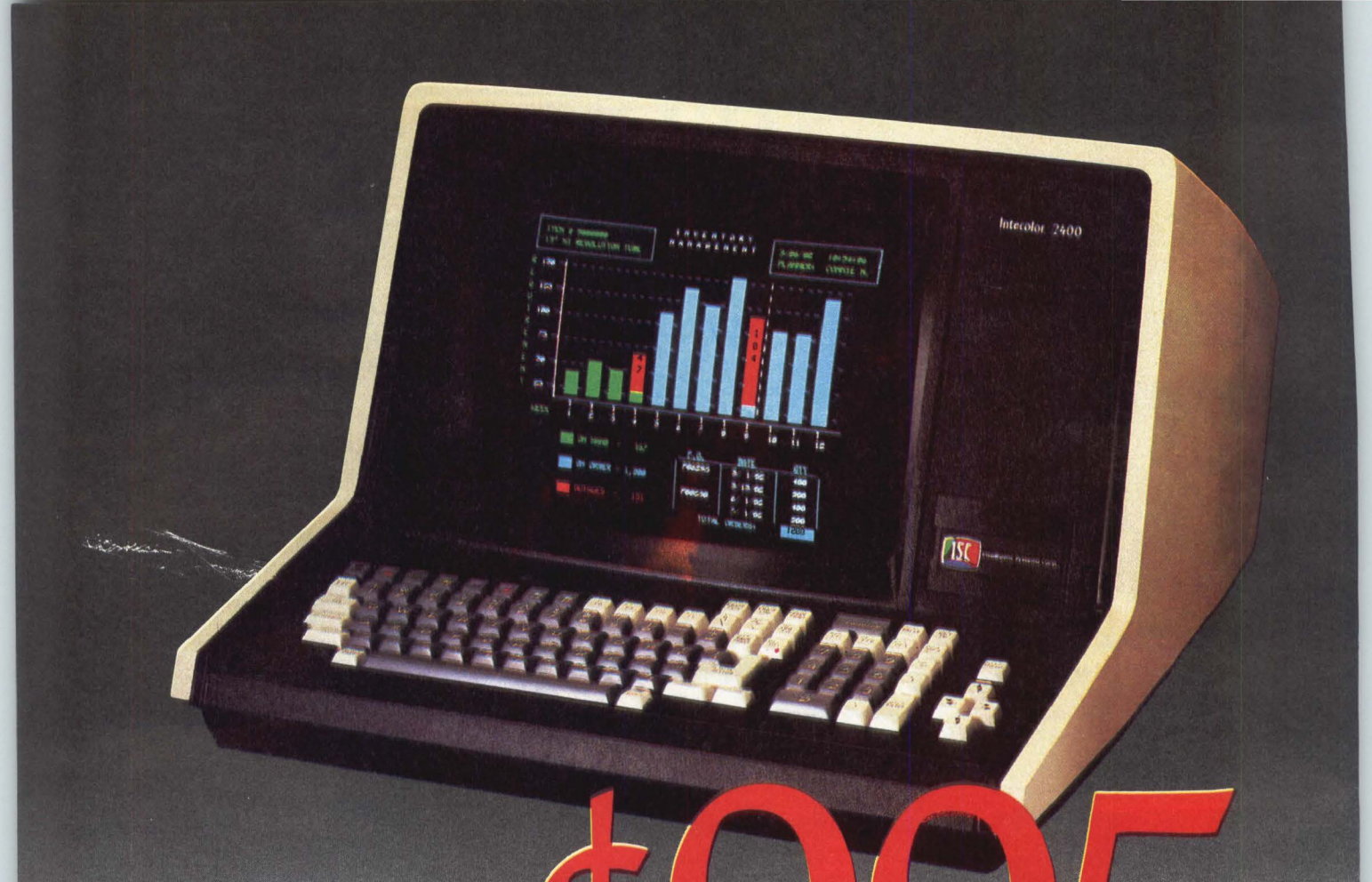

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As far as his company is concerned, though, Nutburn believes this goal is still a few years away. Problems he cites for automating semiconductor manufacturing are that the manufacturing period is long and that the entire process may not take place at one location. "Wafers can be sent abroad for assembly and then come back for final test," he explains. "So automating that section is difficult."

Van Veen of Teradyne agrees that such tie-ins with process control are still futuristic, and he downplays their importance. "If you made a list of the great unmet needs of technology, I don't think that would be high on the list," he says. Higher on his list of needs is generating test programs, a problem being addressed by his company's LASAR program generator. "It greatly speeds up the writing of test programs for VLSI," he says, "but it doesn't solve it." He says Teradyne is concentrating much energy in this area. In contrast, he says, "Feeding test data into the diffusion area of a plant or to the front end of the wafer-fabrication line is probably a long way away."

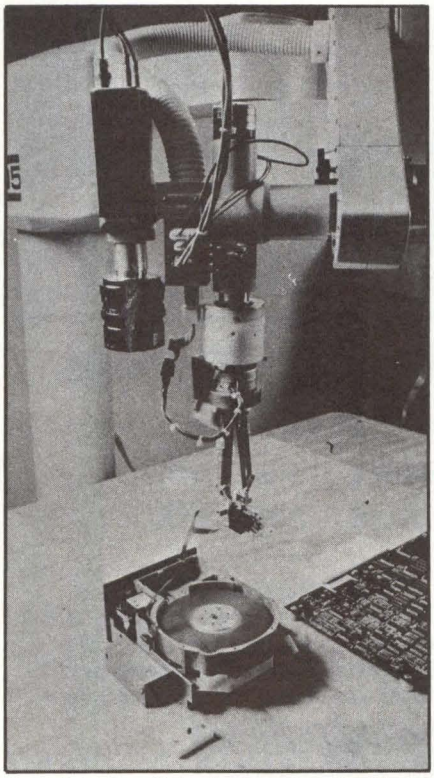
Fairchild's Mulady disagrees with this timetable. "The next step is a tie-in with process control," he maintains. He claims that Fairchild is already working on such products. "I would expect products tied to process control for wafer production to be out in 1984," he says. The intention of these products, he explains, is not to stop and to start a process, but to fine-tune or adjust it continually. He describes the role of ATE in such a scheme as central: "to tie the test floor into the processing floor at one end and to the final quality assurance and inventory at the other end." □

Intellidex aims light-assembly robot at electronics industry

A robot designed to handle light-assembly tasks that are typical of the electronics industry was introduced by Intellidex Inc., Corvallis, Ore. The Intel 8086-based Intellidex 605 system is programmed in Microsoft BASIC via an IBM Personal Computer.

Approximately 400 light-assembly robots—primarily Puma systems from Unimation Inc.—were installed last year for small-parts assembly applications, according to estimates from the Prudential Bache Research Institute. The Robot Institute of America projects that more than 37,000 robots will be installed for such applications by 1987.

Among the competitors in the new market are the large system suppliers such as IBM Corp., General Electric Corp. and Westinghouse Co. (through its newly acquired Unimation subsidiary), as well as smaller robot-specialized vendors such as Control Automation, Automatix Inc., United States Robots and American Robots.



An Intellidex 605 robot equipped with the vision option test loads read/write heads onto hard disk drive assemblies. The vision system is used to locate the screw hole on the drive, and the robot drives the screw to hold the disk head assembly in place.

Introduced in March, the Intellidex 605 robot is being tested in four Beta test sites and is performing such tasks as inserting read/write heads onto Winchester disk drive assemblies; stuffing resistors, capacitors and integrated circuits onto printed-circuit boards; and handling silicon wafers. Zehntel Inc., a supplier of automatic test equipment, has incorporated the Intellidex 605 into its model 600 board-handling system. In that application, the robot is inserting PC boards into ATE systems and then removing the boards after testing.

Dennis Harms, manager of research and development at Intellidex, says the robot has been performing with an accuracy of +/- 0.002 in. and a repeatability of +/- 0.001 in. at its Beta test sites. Harms defines accuracy as the ability of a robot arm to find a location and repeatability as the ability of the arm to return to that location. The 605 lifts as much as 5 lbs. and operates at speeds as high as 40 in. per sec.

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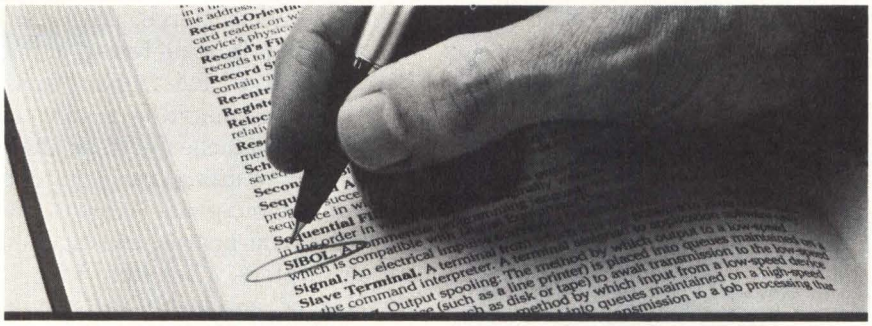

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CIRCLE NO. 93 ON INQUIRY CARD

The 605 incorporates 15 microprocessors. An Intel 8086 serves as the central processor, and an 8087 serves as a math processor. An 8088 monitors system malfunctions and controls the end effectors. A second 8086 controls an optional vision system. Each of the robot's six axes is controlled by a pair of Zilog Z8 microprocessors.

A standard 605 system sells for $48,000 and comes with 128K bytes of RAM, 128K bytes of ROM, 8K bytes of EEPROM and 2K bytes of CMOS RAM. Vision can be added for $15,000 to $16,000. Users can add as much as 128K bytes of EPROM, 64K bytes of EEPROM and 128K bytes of RAM. Harms notes that, equipped with memory-expansion modules, a 605 can store as many as 256 programmed work routines, selectable by push buttons on the robot's controller panel. He adds that each work routine requires about 30K bytes of memory.

Microsoft BASIC was chosen as the robot's programming language, says Harms, because of engineers' familiarity with that language. More than 150 robot commands and 30 vision commands were added to the language. Users can also manually program the robot with a joystick or a special menu of software commands for non-programmers.

The 605 can be linked to other robots or to a host computer via five RS232 communications ports. The system is also equipped with six peripheral connectors and four 8-bit parallel data buses.

Intellidex offers a number of standard end effectors to grip electronics parts of various sizes and shapes. The company also provides engineering assistance to users wishing to design custom grippers.

—Frank Catalano

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The TDV 2220 will operate in character, line or block mode. Up to eight pages of local memory can be recalled and amended by page or "window." Sixteen editing functions allow insertions, deletions and erasure of characters, fields, areas, lines or pages while protected and unprotected fields may be defined in ten variations for local checking. Navigation keys permit quick and easy set-up of even the most complex tabular forms and PUSH-keys implement data strings at the touch of one button.

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In addition to the advanced performance Model TDV 2220 terminal, the Tandberg TDV 2200 family includes models which emulate the DEC VT 100/VT 52, Datapoint 3600 and 8200, Data General 6053 and D 200, IBM 3101 and others. Firmware development tools and hardware building blocks are also available to the OEM who wants to develop a terminal with its own personality.

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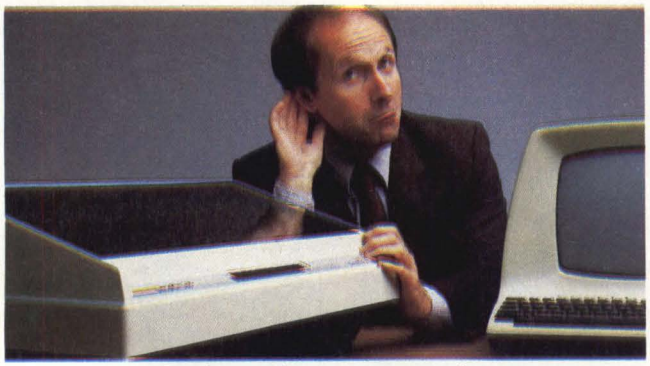
Now you can have graphics for design



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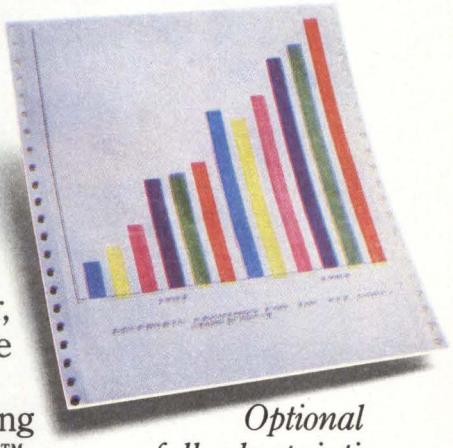

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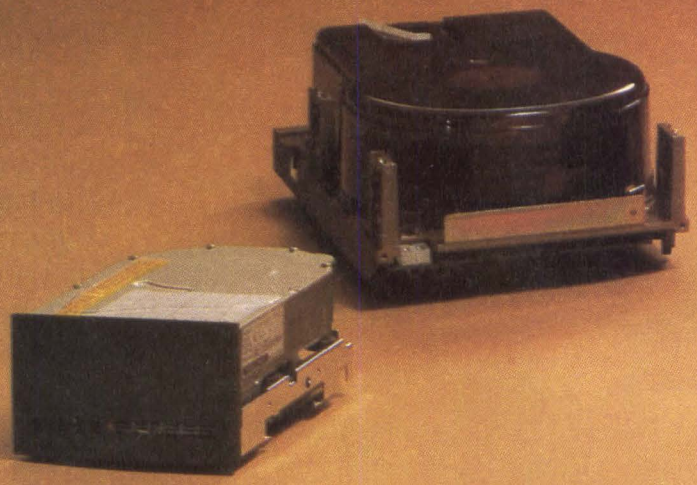
Five definitions of the word quality.

Quality: over 15 years' experience producing disk drives, total vertical integration of manufacturing, and a caliber of product support you can measure by the loyalty of our customers. Quality that is a Fujitsu exclusive. Find it in our complete line of Winchester disk drives.



	5¼-INCH			8-INCH			
MODEL	M2231	M2233	M2234	M2301B	M2302B	M2302BE	M2303BE
CAPACITY (MB)	6.7	13.3	20.0	11.7	23.4	23.7	47.5
AVG. POSITIONING TIME (ms)	95	95	95	70	70	70	70
TRANSFER RATE (KB/s)	625	625	625	593	593	1,200	1,200
INTERFACE	ST506/SA4000			SA4000			
AVERAGE LATENCY (ms)	8.3	8.3	8.3	10.1	10.1	10.1	10.1
RECORDING DENSITY (BPI)	8,020	10,200	10,200	6,100	6,100	12,360	12,360
TRACK DENSITY (TPI)	254	300	300	195	195	195	195
NUMBER OF CYLINDERS	160	320	320	244	244	244	244
NUMBER OF DATA HEADS	4	4	6	4	8	4	8
POSITIONING METHOD	Buffered Stepper			Buffered Stepper			
DIMENSIONS (HxWxD in.)	3.3x5.7x8.0			4.4x8.5x14.0			

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8-INCH		14-INCH			10½-INCH
M2311K	M2312K	M2280K/N	M2284K/N	M2294K/N	M2351
48.3	84.4	84.3	169	335	474
20	20	27	27	27	18
1,229	1,229	1,012	1,012	1,012	1,859
SMD		SMD			Modified SMD
8.3	8.3	10.1	10.1	10.1	7.58
9,550	9,550	5,580	5,580	5,580	12,790
720	720	680	680	850	880
589	589	823	823	1,024	842
4	7	5	10	16	20
Rotary Voice-Coil/Servo Controlled		Rotary Voice-Coil/Servo Controlled			Rotary Voice-Coil/Servo Controlled
5.0x8.5x15.0		9.8x16.4x25.6			10.4x19.0x27.6

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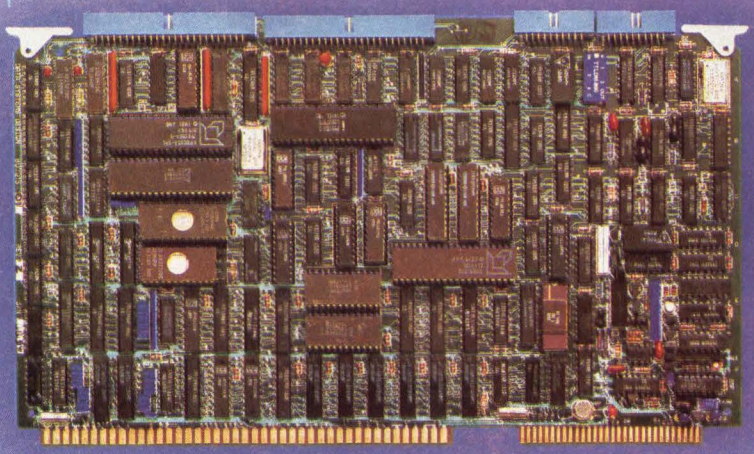

INTRODUCING THE WINCHESTER/FLOPPY/TAPE THREE-IN-ONE MULTIBUS CONTROLLER.

Try this on for size.

DSD's new 7215 single-board Multibus® controller/interface handles two SA1000-type 40Mb Winchesters, a ¼" streamer, and two 8" floppies.

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There's also a version for 5¼" drives, the 5215, with similar capabilities.

And both are very, very quick.

Thanks to a pipelined architecture that moves data at non-interleaved speeds.

Top-of-the-line performance.

The 7215 and 5215 are the highest performance controllers on the market for 8" and 5¼" drives.

And that makes them ideal for multiuser and UNIX™ applications.

They also emulate Intel®iSBC® 215 and iSBX™ 218 controllers so you can run RMX 86 anytime.

And with 24-bit addressing support, you can take advantage of high performance microprocessors like the 68000 and the new inexpensive memory chips to address larger physical RAM memory.

To tune system performance, both boards offer four alternatives for bus arbitration. As well as having the capability to boost system performance by performing overlapped seeks and multisector operations.

Plus the convenience to match.

The best part about all this performance is that it comes on one board. So it only takes up one backplane slot. And there are no extra boards to fool with.

As easy as that sounds, there are those of you who'd rather not do-it-yourself. For you, the 7215 controller is also available in our 770 storage systems.

And like all DSD products, our Multibus boards and systems are supported by our exclusive Rapid Module Exchange™ and regional service centers.

Shop around.

Compare our incomparable Multibus boards and systems to anything else you like. To make it easy, just send your business card to DSD Corporate Headquarters, Marketing Communications Department, for a free copy of "The Multibus Buyers Guide."

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DATA SYSTEMS DESIGN

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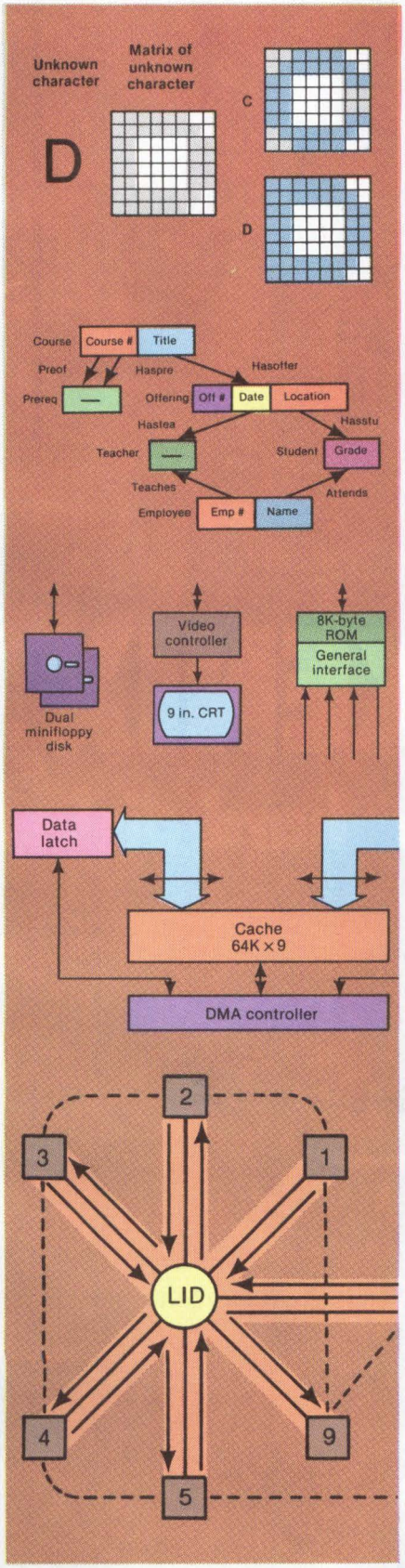
FEATURE HIGHLIGHTS



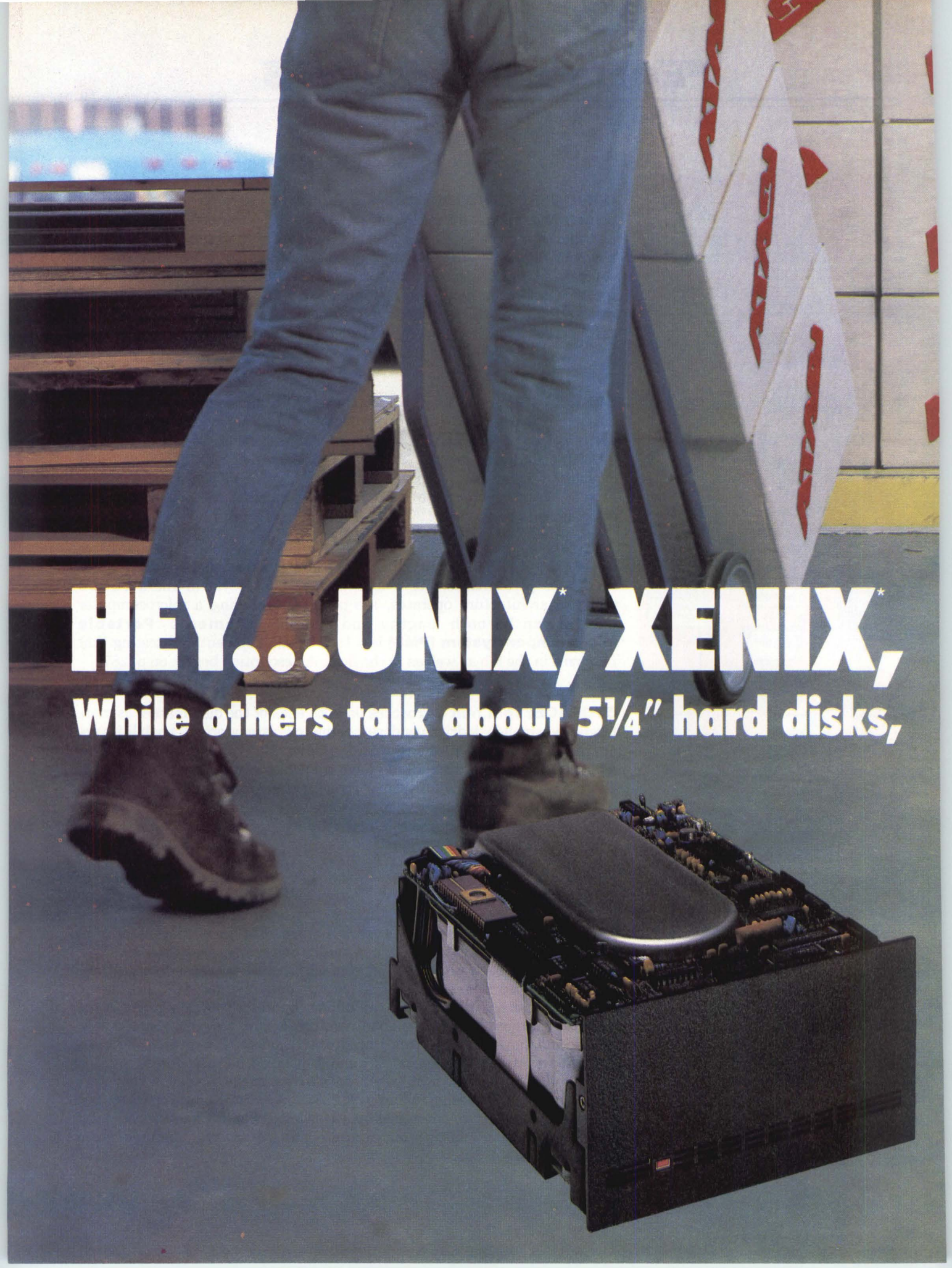
OFFICE AUTOMATION: Office-automation systems are at the same point in the product life cycle that word-processing systems were five years ago, and they promise to catch on fast. The cover story begins on p. 181 . . . A new **intelligent-workstation** from Sydis Inc. offers features from both centralized mini- and distributed micro-systems. See p. 193 for more information . . . A new generation of **OCR systems** is available for integration into office-automation systems, inspired by a growing market, ripened technology and a competitive OCR industry. See p. 211 for a closer look.

SOFTWARE: In terms of power, convenience and most other program-development criteria, **UNIX** is in a different league from most other operating systems. For an indepth look at a superior time-sharing system for building development tools, see p. 279 . . . MMS presents the eighth in a series of evaluation reports on database-management systems for minis and micros. Harvey Weiss' report on the **RTFILE system** for small-computer, multi-user environments begins on p. 305.

MICROCOMPUTERS: Intelligent I/O and memory management boost multi-user performance. For a look at how Onyx System Inc.'s **68000 system** architecture operates, see p. 227 . . . Building a microcomputer system can be both lengthy and complex. **Siemen's Portable Microcomper System (PMS)** is a tool for development and testing that performs in the lab as well as in the field. A description begins on p. 287.

STORAGE: Thin film encroaches on both ends of the disk market as more large- and small-disk drive vendors looking to bolster storage capabilities are turning to thin-film heads and media. See p. 237 for a closer look . . . **Streaming tape drives** have not achieved complete penetration of the disk-backup market because streamers require extensive software development. This problem may be solved with a new type of drive that employs a cache memory and eliminates the need for special software. Turn to p. 261 for further details.

ALSO: Data communications: Nestar Systems Inc.'s Plan 4000 is a local-area network that combines Datapoint Corp.'s Arcnet hardware, Ethernet software and proprietary server software. For more details, see p. 205 . . . **Real-time systems:** A new multi-user system from MASSCOMP keeps up with both real-time and general processing tasks through three independent processors. For a closer look at the MC-500, see p. 249 . . . **Venture capital:** If you can't find support for your new business and wish to find more information about venture capital, see p. 269 for the how, where and how much of this important resource . . . **Computer-aided design and drafting:** General Tire and Rubber Co. has been forced to speed their production process from two months to two weeks. Read how they were able to keep the tire design rolling on p. 295 . . . **Applications:** A contact lens manufacturing system controlled by a Hewlett-Packard Co. microcomputer and interferometer can turn out accurate lenses every two minutes. For a better view, see p. 301.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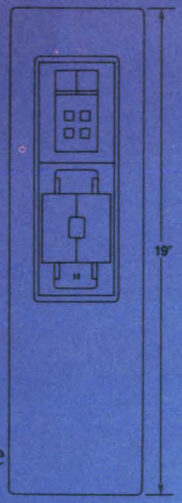

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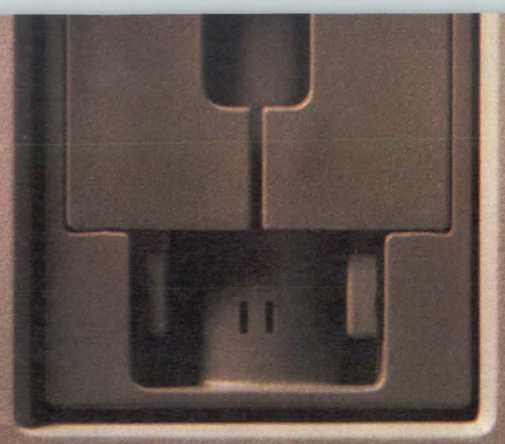

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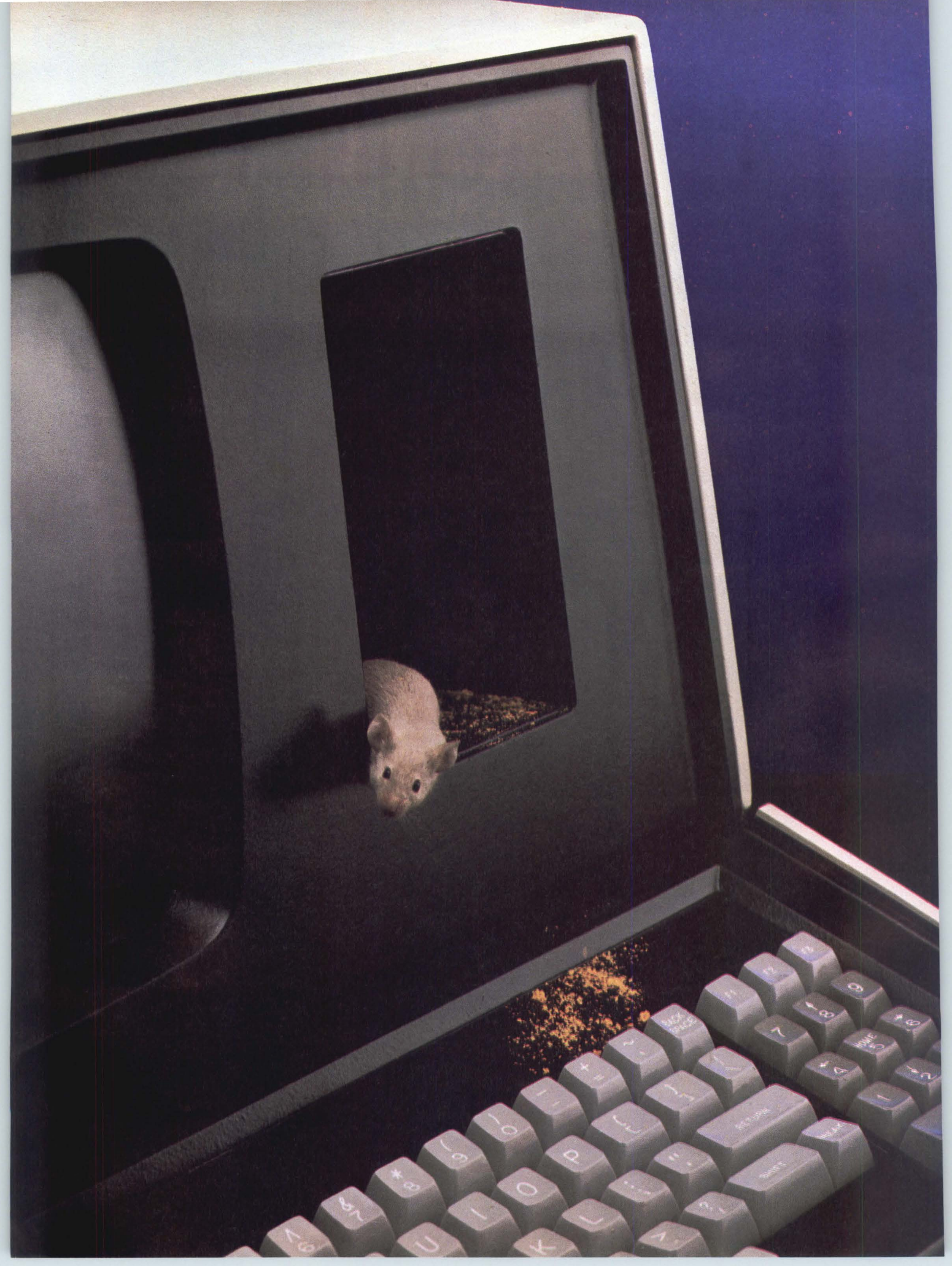

THE BEST LAID PLANS...

No matter how well you plan and design your system, lack of a key component—a disk drive, for instance—will stop you dead in your tracks. That's why you need more than a product with the right performance specs. You also need a company you can plan on supporting you with quality and volume deliveries.

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We back up this goal by 100% inspection of all critical components at the vendor level and/or incoming inspection; burn-in of all active electrical components; 160 hour burn-in of each completed drive; 100% test of all drives both before and after the 160 hour burn-in, at marginalized conditions. And at each step of the way we have a formalized checkpoint/feedback procedure so small problems never become big problems. You can plan on it.

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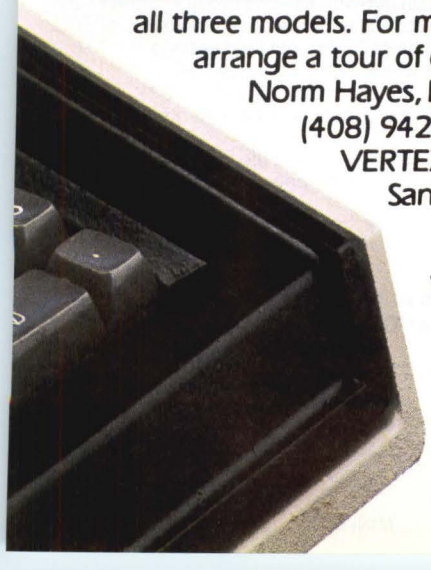

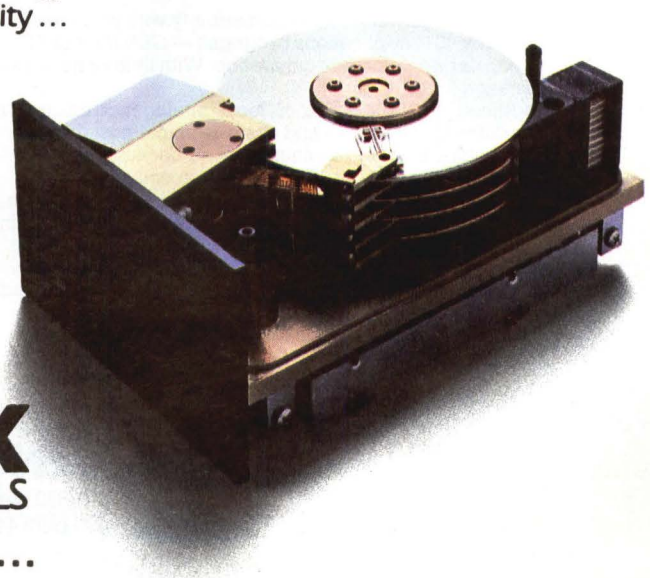

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Now GEN.II™ delivers Tek 4010/4014/4027 compatible graphics on your VT100, VT101, VT102, VT103, VT131, or VT132.

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But best of all a Retro-Graphics enhancement costs only a fraction of what you'd pay for an equivalent graphics terminal: about $1200 - 1800, depending on the GEN.II model you order.

Introducing GEN.II Retro-Graphics for DEC.
More graphics power and Tek™ simulation.

An easily installed PC card assembly, our second-generation enhancement provides emulation of the Tektronix 4010 graphics terminal *plus* one-color simulation of the Tek 4027 color graphics terminal.

And for extra power — and compatibility with your existing or future Tek 4014 applications programs — *GEN.II for DEC also features one-color 4014 simulation.* With little or no software modification.

In addition, GEN.II's 32 Kb's of "local" intelligence ensures that images come up quickly — and costly terminal-host data transmissions are held to a minimum. And because GEN.II is based on industry-standard Tektronix protocol, graphics programming and operation are considerably eased. Case in point: by entering from the keyboard or computer the following command string

!PIE 100, 0, 360, 45

an eight-sided *polygon* with a radius of 100 will be plotted and its interior will be *filled* with a shading pattern (GEN.II maps 4027 colors to dithered shades).

With similar high-level command strings, GEN.II will also perform *arc* and *vector drawing. Define* and *shape text characters. Store* and *recall* graphs. And, while in 4014 mode, *perform additional graphics annotation using all four 4014 character sets.* And you get all this with no loss of existing terminal features.

Software compatibility ensures your long-term investment.

Since our GEN.II products for DEC provide 4010/4014/4027 compatibility, their use with utility and applications programs, whether now or in the future, is guaranteed. Currently, more than 20,000 Retro-Graphics products are performing successfully on graphics programs such as DISSPLA® and TELLAGRAF®, PLOT 10™, Template™, DI-3000™, and ILS®.

Graphics I/O and solid backup throughout.

Digital Engineering has built a solid foundation of "user-chosen" interactive tools for GEN.II. For instance, a crosshair cursor and light-pen port (for our optional light pen) are standard features, while optional interfaces allow you to simultaneously interact with a digitizer while outputting to an impact or non-impact serial printer and video device.

Comprehensive documentation assists at every level of operation. A worldwide distribution network assures prompt delivery and backup. And whether you tap our service network or opt for on-site service — from one of the largest field service organizations in the world — your needs will be quickly met.

DEC's VT100, VT101™, VT102™, VT103™, VT131™, or VT132™ and Digital Engineering's GEN.II Retro-Graphics — for high-grade imaging in a low-cost graphics system.

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CIRCLE NO. 100 ON INQUIRY CARD

OFFICE AUTOMATION

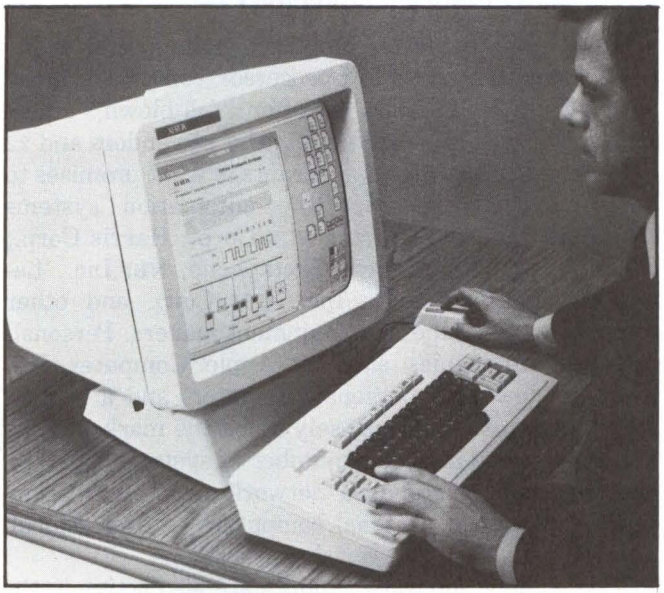
Integrated office-automation systems

JOHN A. MURPHY, Advanced Office Concepts Corp.

Functional definitions are emerging, but architectures and user interfaces vary

Office automation promises to revolutionize office work at every organizational level. Benefits will come not only from productivity enhancements and other bottom-line efficiencies related to work loads, but also from the ability to perform more varied and thought-oriented tasks. Rather than making robots of us all, office automation should open new vistas for personal fulfillment in the office, both from job-enrichment and advancement points of view.

Office-automation systems may be the hottest topic at corporate planning sessions and computer industry trade shows this year (with the possible exception of personal computers, a related product), but there is not much buying. There's plenty of talk in company task groups and committees, but relatively few office-automation systems on order or wide-scale implementations in corporate environs. This is bound to change by the end of the decade. Office-automation systems are at the same point in the product life cycle that word-processing systems were five years ago, and they promise to catch on fast, especially in Fortune 1000 companies. Like early word-processing systems, current office-automation systems use diverse architectures and offer a wide and constantly changing mix of features.



Xerox's 8010 Star professional workstation *is configured with 8000 NS (Ethernet) LAN shared-resource facilities to provide integrated office-automation electronic mail/filing and communications capabilites. Datapoint's IEOS system also employs an LAN architecture (ARC) to implement and configure office-automation systems via intelligent workstations, sharing network file (disk), printer and communications resources.*

What's an office-automation system?

The phrase "office automation" and its derivatives have been used to describe all sorts of office equipment (copiers, facsimile machines, typewriters, word processors and personal computers). While these products do automate office tasks, they do so on a stand-alone, single-task, nonintegrated basis. Advanced Office Concepts Corp. defines an office-automation system as one that can perform a variety of functions integrated under one system or software umbrella with a uniform and consistent user interface. In its most basic form, an office-automation system might offer integrated word processing, electronic mail/message distribution and electronic filing. In more advanced forms, these basic

functions might be integrated with record- and file-processing, electronic-calendar, spread-sheet, graphics and even voice store-and-forward functions.

Office-automation systems will eventually handle other functions such as text display and video teleconferencing, building-access security, time-and-attendance monitoring and phototypeset composition and printing. Full integration with data-processing functions (databases, application programs and the like) will also be accomplished before the end of the decade.

A common user interface combines diverse functions into a system. Such an interface includes menu structures, command sets, "help" aids, system prompts and consistent text editors that are easy to learn and to use. Integration also involves the ability to move documents or files easily from one function to another.

No office-automation system offers a full complement of functions or even consistent integration of the functions provided, but they're getting there.

Who's who in office automation?

Most large business-computer makers and many small computer and word-processor companies along with "Baby Bell" claim to offer "full-blown" office-automation systems (see table). The 18 vendors and 22 systems are only the early entrants in what promises to be a crowded market. Office-automation systems should be forthcoming from NCR Corp., Harris Corp., Rolm Corp., Pitney-Bowes/Dictaphone, NBI Inc., Lanier Business Products Inc., CPI Corp. and other computer, PBX and office-equipment makers. Personal-computer companies such as Apple Computer Inc. (with its new Lisa personal computer) and a host of Japanese firms are also closely eying the market. They are expected to unleash a number of systems based on shared-resource local-area network architectures employing enhanced personal computers as professional, administrative or secretarial workstations.

Independent software vendors are also active in the market. The most prominent, offering packages for mainframe systems, are Computer Corp. of America with its Comet package, BBN Information Systems Inc. with InfoMail, Applied Data Research with ETC/EM, On-Line Software with Omnicom, and Cybertek Computer Products Inc. with Cybergram. These packages provide limited multifunctional ability, primarily offering integrated electronic mail and filing, but the software houses are expected to enhance their packages with integrated word-processing, electronic-calendar and other office-automation functions. The same holds true for some personal-computer software vendors whose products will follow integrated packages such as Context MBA, Lotus 1-2-3 and Visi^{On}. They will add electronic-mail/-filing, calendar and word-processing capabilities to their word-processing, record-processing, spread-sheet and business graphics functions.

INTEGRATED OFFICE SYSTEMS

The table presents an overview of currently marketed integrated OA systems. Most (if not all) are still in a growth phase in that they are constantly being enhanced with new releases. All are subject to change resulting from market feedback from the present (albeit small) user community and from competitive offerings. They all must be fine- (or even rough-) tuned with better software and hardware interfaces, improved integration, more functions or sub-functions, and new peripherals or workstations. A few may even be candidates for eventual replacement by newer systems now in Beta test or on the drawing boards.

Company, Model	System type
AMERICAN BELL AIS/System 85	OA/PBX system based on System 85 PBX central computer
ANACONDA-ERICSSON AXXA System	Dedicated OA System based on central CPU
BASIC-FOUR CORP. OMS (Office Management System)	OA/DP system based on Basic Four 210 to 810 Series business computer systems
BURROUGHS CORP. Ofis I	Dedicated OA system based on shared-resource file and/or control cluster processors
COMPUTER CONSOLES (CCI) Office Power	Dedicated OA systsem based on central CPU
DATA GENERAL CORP. CEO (Comprehensive Electronic Office)	OA/DP system based on Eclipse Series computer systems
DATAPOINT CORP. IEOS (Integrated Electronic Office System)	OA/DP system based on Datapoint ARC local-area network shared processors and file handlers
DIGITAL EQUIPMENT CORP. All-In-One	OA/DP system based on VAX Series computer systems
EXXON OFFICE SYSTEMS 8400 Series	Dedicated OA system based on CPU
FOUR-PHASE SYSTEMS, INC. Series 5000	OA/DP system based on Four-Phase 5000 computer systems
HEWLETT-PACKARD CO. IO (Interactive Office)	OA/DP system based on HP 3000 Series computer systems
HONEYWELL INFORMATION SYSTEMS OAS (Office Automation Systems)	Dedicated OA system based on CPU; OA/DP system based on Honeywell DPS-6/Level-6 Series computer systems
IBM CORP. DISOSS (Distributed Office Support System)	OA/DP system based on IBM 8100 series clusters and 370-type host support for storage and communications tasks
Office/38	OA/DP system based on IBM System/38 computer systems
PROFS (Professional Office System)	OA/DP system based on IBM 370-type computer systems
5520 Administrative System	Dedicated OA system based on CPU
PHILIPS IMF (Information Management Facility)	Dedicated OA system based on CPU
PRIME COMPUTER INC. OAS (Office Automation System)	OA/DP system based on Prime Series 50 computer systems
SPERRY UNIVAC Sperrylink	Dedicated OA system based on CPU; OA/DP system based on Sperry Univac 1100 Series computer systems
WANG LABORATORIES, INC. Alliance 250, Alliance VS	Dedicated OA system based on CPU (Alliance 250); OA/DP system based on Wang VS Series computer systems
OIS (Office Information System)	Dedicated OA system based on CPU
XEROX CORP. 8000 NS (Ethernet)	Dedicated OA system based on Xerox 8000 Network System (Ethernet) local area network file, printer and communications processors

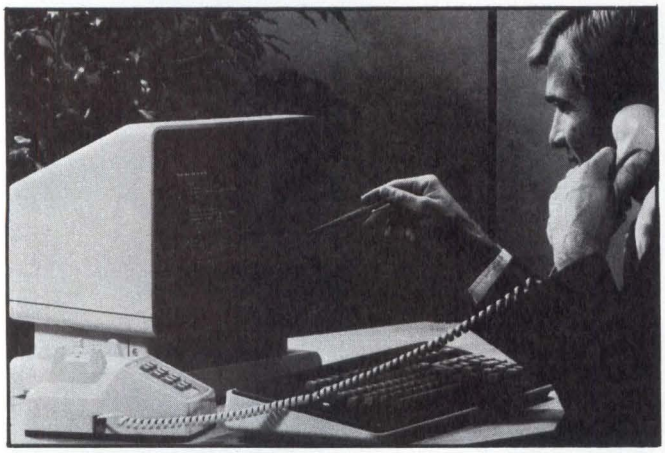
Peripherals	Word processing	Electronic mail	Decision support	Administrative support	Records processing	Electronic filing	Data processing	Voice mail	Circle No.
100+ workstations (est.), uses standard display terminals, wheel printers	Yes	Yes	No	Yes	Yes (limited)	No	No	No	847
4 to 8 professional/executive workstations, wheel printers	Y	Y	Y	Y	N	Y	N	N	848
64 workstations including standard display terminals, intelligent terminals, personal computers, wheel printers	Y	Y	Y	Y	Y	Y	Y	N	849
16 workstations (per file cluster); 165 workstations (multicluster); uses standard display terminals, stand-alone word processors and wheel printers	Y	Y	Y	Y	Y	Y	Y (limited)	N	850
32 workstations including intelligent terminals, wheel printers	Y	Y	Y	Y	Y	Y	N	N	851
128 standard display terminals; wheel printers	Y	Y	Y	Y	Y	Y	Y	N	852
1000+ workstations including standard display terminals, intelligent terminals and personal computers; also wheel printers, laser printers, facsimile I/O	Y	Y	Y	N	Y	Y	Y	N	853
128 workstations including standard display terminals, stand-alone word processors and personal computers; wheel printers	Y	Y	Y	Y	Y	Y	Y	N	854
8 or 16 workstations including stand-alone word processors and personal computers; wheel printers; ink-jet printers	Y	Y	Y	Y	Y	Y	N	N	855
128 workstations including standard display terminals, personal computers and professional/executive workstations; wheel printers	Y	Y	Y	Y	Y	Y	Y	Y	856
96 workstations including standard display terminals and personal computers; wheel printers; laser printers	Y	Y	Y	N	Y	Y	Y	N	857
4 or 16 workstations (dedicated OA); 112 workstations (OA/DP system); standard display terminals and stand-alone word processors; wheel printers	Y	Y	Y	Y	Y	Y	Y (OA/DP)	N	858
300+ workstations/printers including standard display terminals, wheel printers, ink-jet printers, laser printers, facsimile I/O	Y	Y	Y	Y	Y	Y	Y (host session)	N	859
24+ workstations including standard display terminals, wheel printers, laser printers	Y	Y	Y	Y	Y	N	Y	N	
1000+ workstations including standard display terminals and personal computers; wheel printers; ink-let printers, laser printers; facsimile I/O	Y	Y	Y	Y	Y	Y	Y	N	
32 workstations including standard display terminals and personal computers; wheel printers; ink-jet printers; laser printers; facsimile I/O	Y	Y	Y	Y	Y	Y	N	N	
16 workstations including stand-alone word processors, wheel printers	Y	Y	Y	Y	Y	Y	N	N	860
128 workstations including standard display terminals, wheel printers	Y	Y	Y	Y	Y	Y	Y	N	861
15 workstations (dedicated OA); 1000+ workstations (OA/DP system); intelligent terminals; stand-alone word processors; personal computers; wheel printers	Y	Y	Y	Y	Y	Y	Y (OA/DP)	Y	862
24 workstations (dedicated OA); 128 workstations (OA/DP system); intelligent terminals; personal computers; wheel printers; laser printers	Y	Y	Y	Y	Y	Y	Y	Y	863
24 workstations/printers including intelligent terminals, wheel printers, laser printers, facsimile I/O	Y	Y	Y	N	Y	Y (limited)	Y (limited)	Y	
1000+ workstations including stand-alone word processors, personal computers and professional/executive workstations; wheel printers; laser printers	Y	Y	Y	N	Y	Y	Y (limited)	N	864

Basic architecture

The three major office-automation system configurations are dedicated systems, designed to perform office-automation functions, office-automation/data-processing systems, in which office-automation functions have been implemented on a data-processing

system, and office-automation/PBX systems, in which office-automation functions have been added to a computer-controlled voice telephone switch.

Dedicated office-automation systems are usually oriented toward branch offices, corporate departments or small businesses in which local functions are required. These small-scale systems must depend on the support of a separate, larger host for extensive database, programming or network-support applications. Some dedicated systems are designed for "from-the-ground-up" office-automation applications. Others have evolved from word-processing systems. Many dedicated systems are configured around microcomputer-based workstations connected by a local-area network.



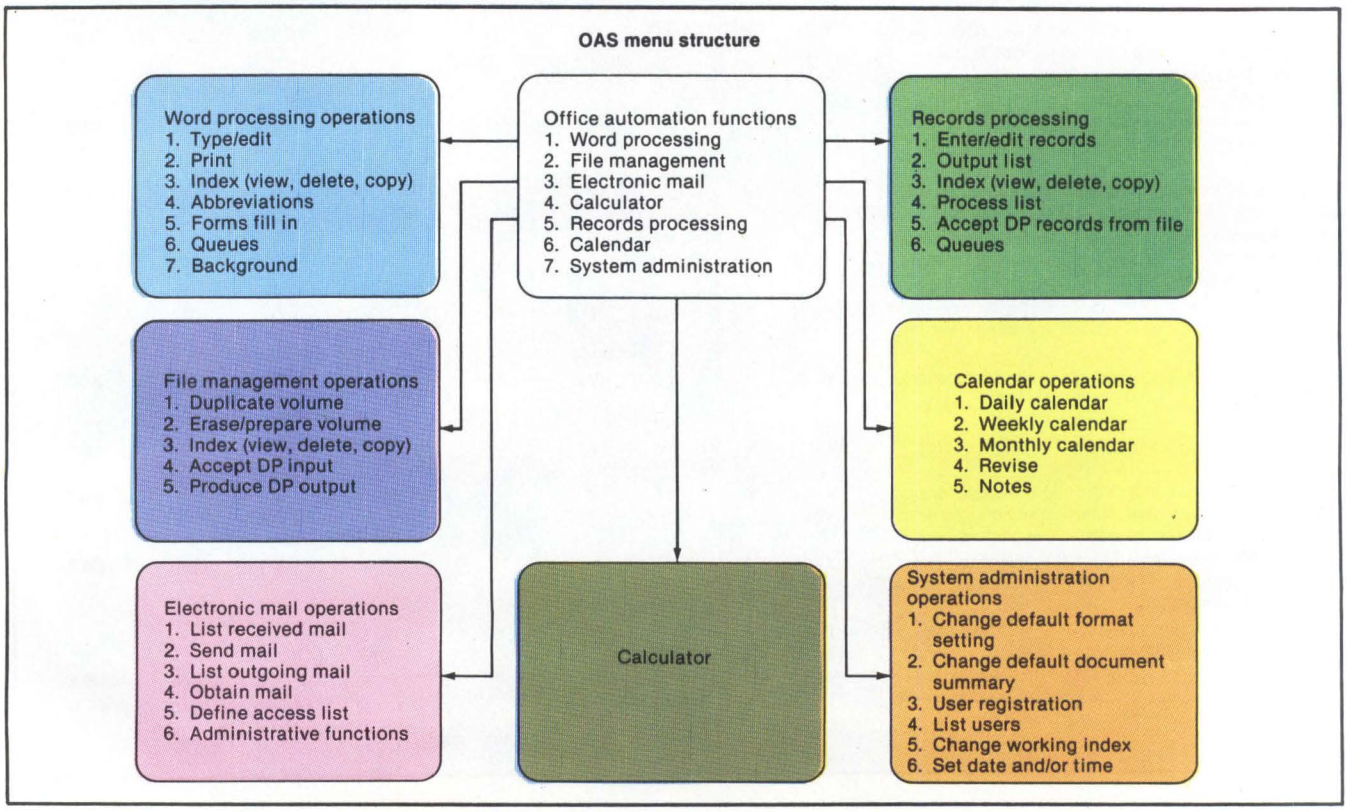
Wang's 5300 Series terminal, *just one type of display workstation employed on the Alliance and OIS series. Wang, along with Sperry and Four-Phase Systems, offers voice-mail capability on its office-automation systems—albeit, in a not completely integrated form.*

Office-automation/data-processing systems are oriented toward the medium- to large-system, Fortune 1000 environment. They add (but do not fully integrate) office-automation functions into an existing data-processing system via software and some hardware (workstation and printer) add-ons. Most computer vendors providing office-automation functions to their users take this route.

Office-automation/PBX systems are also oriented toward medium to large environments. Here, the functions are incorporated into a PBX switching system with software and display-workstation add-ons. American Bell is the only PBX vendor now offering integrated office-automation functions (in the form of full word processing, electronic mail and document filing). Other independent PBX makers should soon follow suit. Some, such as Rolm, already offer voice-mail capabilities on their PBXs.

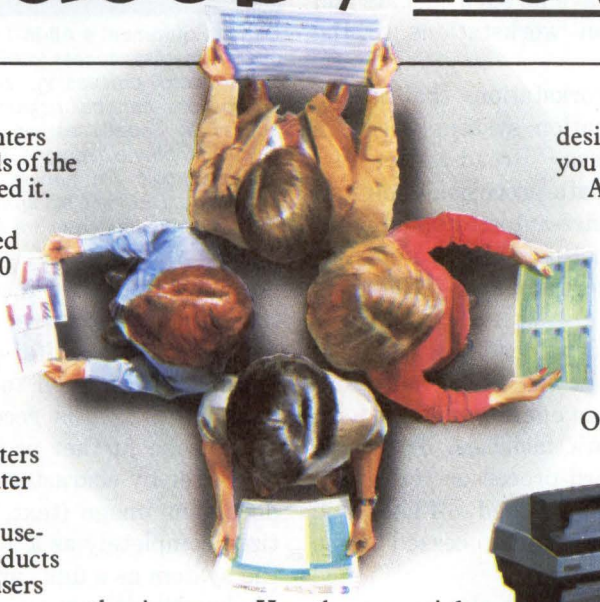
Workstations, printers and peripherals

The maximum number of workstations supported by the largest configuration of an office-automation sys-



The menu structure used on Honeywell's OAS series of office-automation systems. *Most integrated systems offer similar main and sub-menu structures and even allow users to customize menu selections to operator-oriented tasks (secretarial/clerical functions, managerial/professional functions, etc.).*

The printer for the people who need hardcopy now.



Dataproducts B-Series line printers help you put the paper in the hands of the people who need it. When they need it.

The family of three, the B-300, B-600 and the B-1000, was designed to whisk out the printout, from 300 lines per minute to as much as 1100 LPM. And to operate at those speeds day after day.

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So why isn't Dataproducts a household word? Because most Dataproducts line printers are delivered to end users with somebody else's name on them.

Virtually every major OEM in the business has selected our B-Series printers for the systems they sell. Each has made that selection after months, sometimes a year, of intensive evaluation.

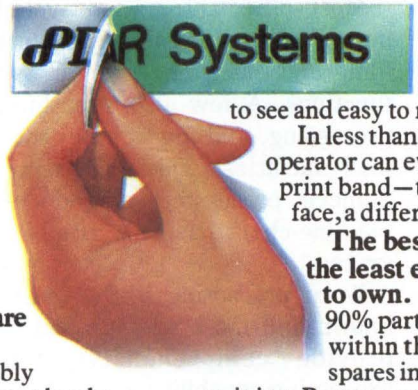
More than anything else, they look for a machine that can perform reliably over a long period of time. Their reputations are at stake.

Which is why the safest choice for your company may be a printer you've never heard of.

The best printers are the easiest to use.

Dataproducts probably knows more about the people who use computer printers than anybody. We know how they slam cabinets. How they jam paper. How they smear ink on their pants.

We conceived the B-Series for the operator. Extensive diagnostics help the operator locate and correct troubles fast. Long-life ribbon cartridges are quick and clean to load. The machines open wide so all controls are easy to see and easy to reach.



In less than a minute, the operator can even change the print band—to a different typeface, a different language.

The best printers are the least expensive to own.

90% parts commonality within the family minimizes spares inventories and training. Power consumption is low.

Operators fix most problems. When they can't, the B-Series is designed to help service people get you back on-line quickly.

And because we make so many of these printers, we don't have to charge a lot of money for yours. You get low initial cost. And low cost of ownership.

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tem family is shown in the "workstations" section of the table. The term "families" is used because, for some systems based on centralized architectures, the stated maximum applies only to the largest host complex of the system family or model line. The vendor may offer upgrade expansion capabilities on smaller office-automation complexes within the same family that would support the workstation maximum. Shared-resource, LAN-based systems have no such caveats and can be upgraded with add-on workstations to the maximum ranges.

The types of terminals or workstations that can be configured on an office-automation system affect its capabilities and user friendliness. "Bread-and-butter" dumb terminals employed on data-processing configurations are often used for office-automation applications. Those terminals are sometimes augmented with new keycaps or dedicated program keys related to office-automation functions.

Intelligent terminals can be down-loaded with office-automation, data-processing or even personal-computer programs and then can operate independently of host-computer or network facilities. The same holds true for stand-alone word-processor terminals. Word processing may be accomplished off-line, and documents can then be filed, mailed or processed by the system as with an on-line workstation.

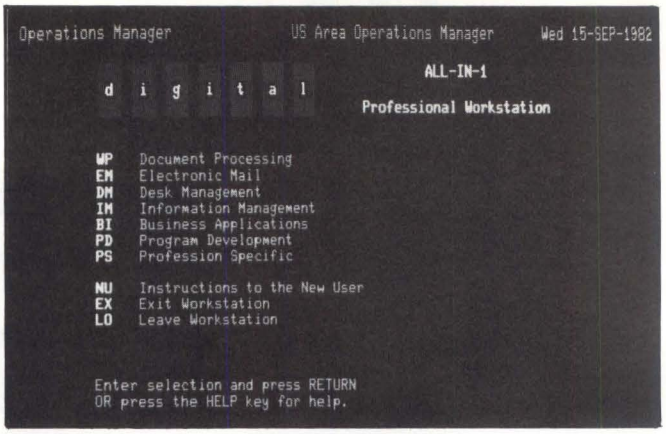
Personal-computer workstations can also operate as integrated workstations on-line with office-automation systems and can perform nonintegrated processing in an off-line, stand-alone mode. Intelligent workstations for office-automation applications are gaining popularity and are offered by Xerox Corp., Four-Phase Systems Inc. and others.

All office-automation systems support letter-quality serial or document printers, but how printers are attached to different systems varies. Printers can be attached as system-interfaced units shared by all system workstations, as cluster-interfaced printers shared by workstations within the cluster or as workstation-interfaced slave printers dedicated to a workstation.

Ink-jet and laser printers are usually interfaced as shared facilities accessible by any workstation on a system. Low-priced (less-than-$50,000) units print pages or tens of pages a minute and store multiple pre-defined fonts, forms, logos and graphics. Ink-jet or laser (electronic/intelligent-copier) printers may become viable replacements for offset presses, bringing office-automation systems into the composition and printing market.

Daisy-wheel and near-letter-quality (matrix) serial printers cost about 1/10 as much as non-impact printers and are used to support one or a few users.

Facsimile I/O peripherals allow non-system-generated



Digital Equipment's All-in-1 professional workstation menu *gives users immediate access to all software capabilities within the system. Office word processing, business data processing and other applications can be included on the menu. The menu provides access to capabilities via main or sub-menus, including desk calculator, phone directory, calendar management, action item listing and electronic file cabinet from the terminal. It also provides multi-node DECmail electronic office communication. Customized All-In-1 menu structures are also available.*

documents to be filed, retrieved and distributed throughout the system. Facsimile-document input is not the same as optical-character-recognition text input capabilities common to all office-automation systems. With OCR, text is recognized character-by-character and can be further processed, viewed or printed on a character-by-character basis. With fax, the entire document image (text, graphics or halftones) is digitized completely as a unit. It then can be processed by the system as a unit, and a user can attach a document file header or summary for storage and retrieval. Fax documents can be "read" only via printout from the fax I/O device or transceiver.

Integrated functions

Most office-automation systems have fair to good integrated word-processing, electronic-mail, electronic-filing and electronic-calendar (administrative-support) functions. A few also offer integrated records or file processing, and fewer still provide rudimentary voice-mail facilities. Decision-support functions such as numeric processing, spread-sheet planning and bar-/pie-/line-chart business graphics) are still poorly integrated.

Word processing is the most mature, most widely known and most widely used function. Most systems provide comprehensive multi-page document-processing capability with global search/replace, insert/delete, copy/move/merge, page formatting and editing sub-functions. Some systems offer spelling verifiers, user dictionaries and stored-procedure (glossary) capabilities. However, the implementation (the user interface) of these word-processing sub-functions can stand improvement.

Electronic mail is the second most popular office-automation function and is offered by almost as many vendors as word processing. Most packages let users create, distribute and forward brief messages against a

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stored distribution list of user names and mailbox addresses. All but a few mail packages can also distribute existing word-processing documents and data-processing files. A few systems do provide special electronic-mail sub-functions such as integrated telephone-call "pink-slip" messaging, integrated TWX/Telex/Mailgram communications and acknowledgement of message delivery.

Record-processing capabilities vary widely from vendor to vendor. Some vendors offer very good, fairly well-integrated file-handling functions; others employ totally separate data-processing-related facilities that are integrated only with respect to a main office-automation menu. Most offer some ascending and descending sorts and selects and Boolean operations; a few offer only primitive field-operation capabilities.

Three vendors—Wang Laboratories Inc., Four-Phase Systems and Sperry Univac—have integrated voice-mail capability, but Advanced Office Concepts has seen it run only on Wang's Alliance system. Wang's system can neither attach voice-mail messages to an electronic-mail document or message, file voice messages on main document files nor redistribute a received voice message to others with additional voice comments. Stand-alone voice-mail/PBX systems such as IBM Corp.'s ADS, VMX Inc.'s VMX or even Wang's DVX offer these and other advanced capabilities. Integrated voice-mail improvements should be forthcoming from Wang and its competitors.

Teleconferencing, a stepchild of integrated office-automation systems, is available only in a rudimentary, two-party keyboard-display, terminal-to-terminal mode on the IBM PROFS system. Advanced Office Concepts knows of at least two vendors that are working on video teleconferencing in conjunction with new executive workstations.

Electronic filing on office-automation systems takes many forms. The simplest systems employ a document-directory scheme common to most word processors, with retrieval based on selecting a document title from a system-derived alphabetical directory. More complex schemes employ the directory concept coupled with documents in "folders" within "drawers" within "cabinets." Users create and label drawers, folders and documents, and the system automatically generates the folder directory. Still more complex schemes couple cabinets or libraries with document descriptors or summaries that can be selectively searched by word, date or title. The most sophisticated schemes allow direct word and phrase searches of document text.

Other electronic-filing packages file word-processing documents, data-processing files and electronic-mail and voice messages within the same files and integrate non-system hard-copy documents into system files via fax terminals.

Administrative-support packages are usually built around personal calendars. Most let users schedule against daily calendar forms, on which a day's events are entered as if on a desk appointment calendar. The system then generates both a daily calendar and subsidiary week- or month-at-a-glance calendars. Other popular administrative-support functions include facility or resource calendars for scheduling conference rooms and equipment, sign-in/sign-out calendars and project-status calendars. A few systems can also help schedule group meetings by checking the availability of each participant, finding open time periods and scheduling a meeting on each participant's personal calendar.

Decision-support functions vary greatly from system to system and are the least integrated of all functions. Four-function row/column math is available on most systems as an integrated subset of word or record processing. Spread-sheet, project-scheduling and business-graphics capabilities are usually available on a nonintegrated basis. When provided, functions are usually performed in separate data-processing or personal computer sessions with different user interfaces and cumbersome procedures for transferring result files back into a document. □

John A. Murphy is vice president of Advanced Office Concepts Corp., a Bala Cynwyd, Pa., consulting and publishing firm that specializes in office automation.

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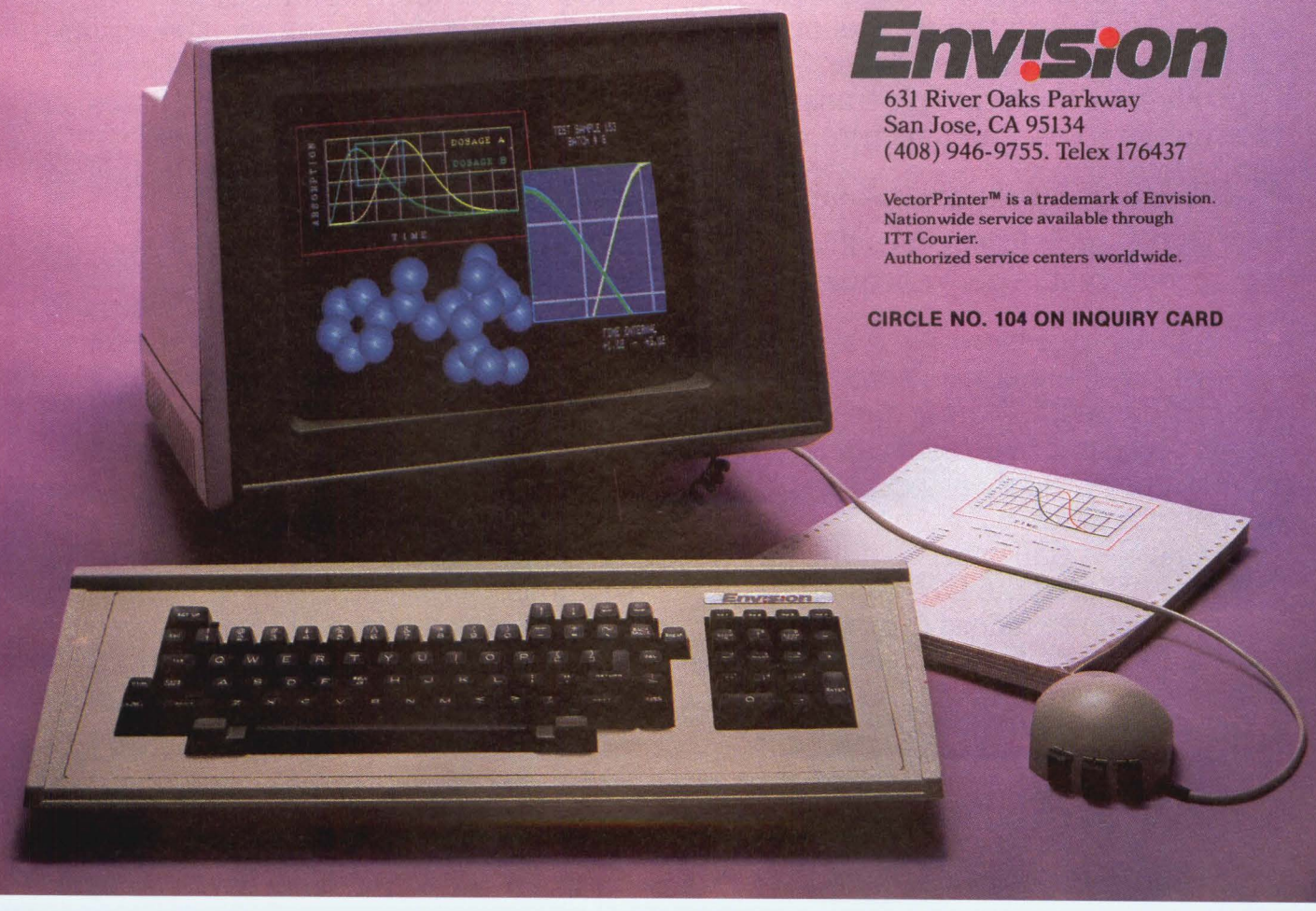

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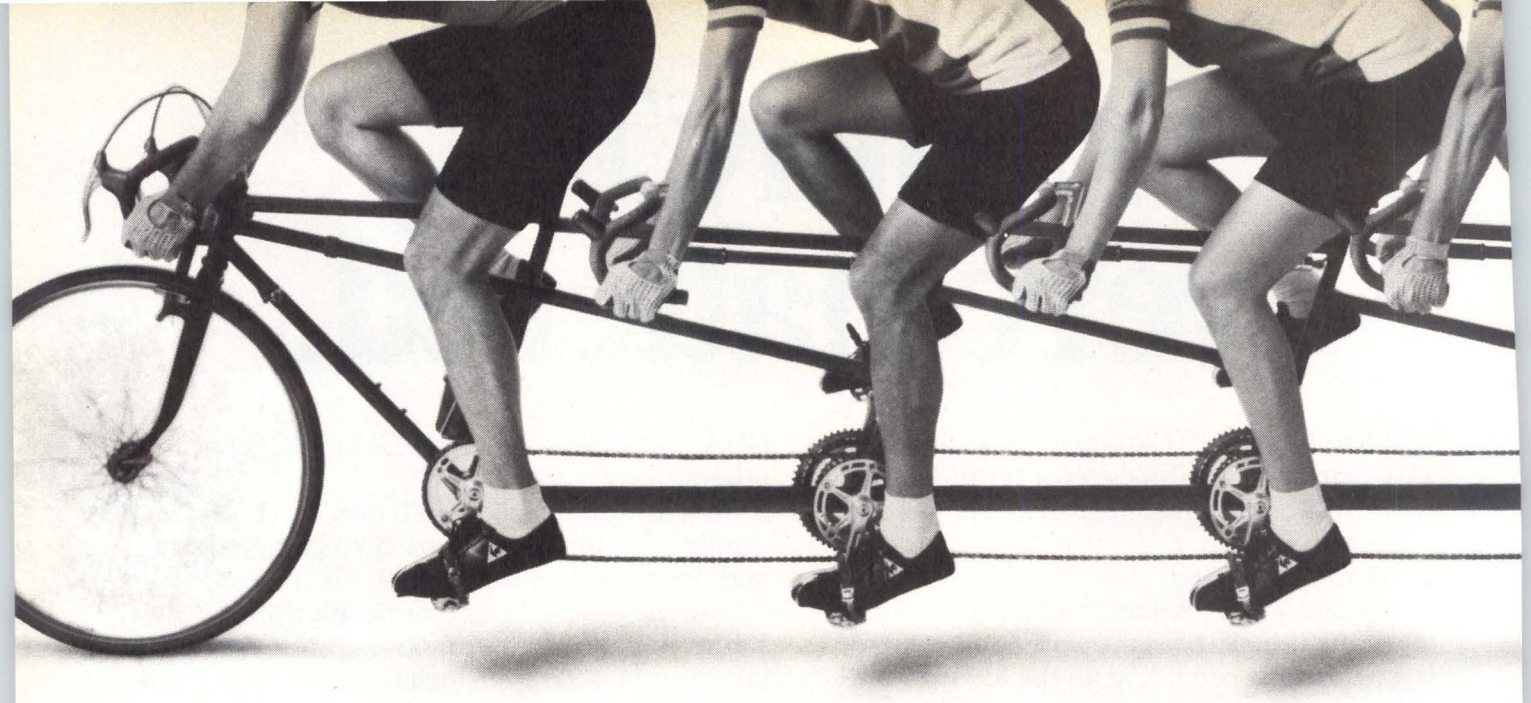

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A very simple idea that says when you divide a job up among a lot of people or machines, the job goes faster.

In our case, this principle translates to a multiprocessor architecture, up to seven, to be exact.

And that's the reason our family of four UNIX™-based systems will get you where you want to go. Very quickly.

Multiprocessors. No waiting.

Most commercial UNIX-based systems being peddled these days rely on a single processor to do everything. No wonder they drag their feet as system loading increases.

Not us. We're all speed. All the time.

We distributed the UNIX operating system to where it does the most good.

Our 16-bit Intelligent Communications Processors rush terminal I/O to and from as many as 40 users. While also taking care of low level communications so as not to interrupt the CPU.

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The performance that results is close to that of a VAX™ 11/780.

And costs about $200,000 less.

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They're both based on the 12.5 MHz MC68000. With the addition of a few, shall we say, high performance modifications.

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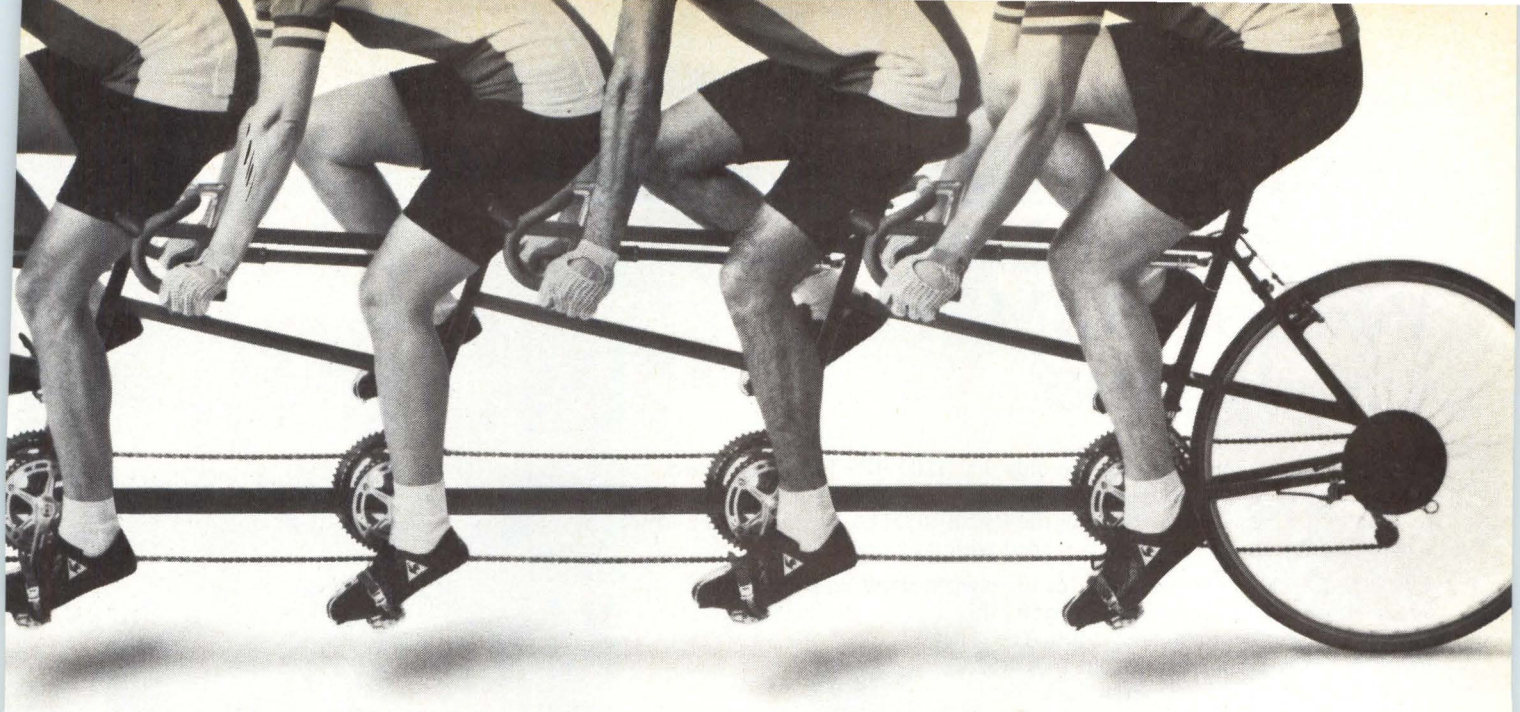

has the fastest Unix-based systems.

All of which help boost performance even further. Giving your system enough stamina to run multi-user applications at full speed all day long.

Plus more standards as standard equipment.

There are times when performance isn't everything. There's growth, too.

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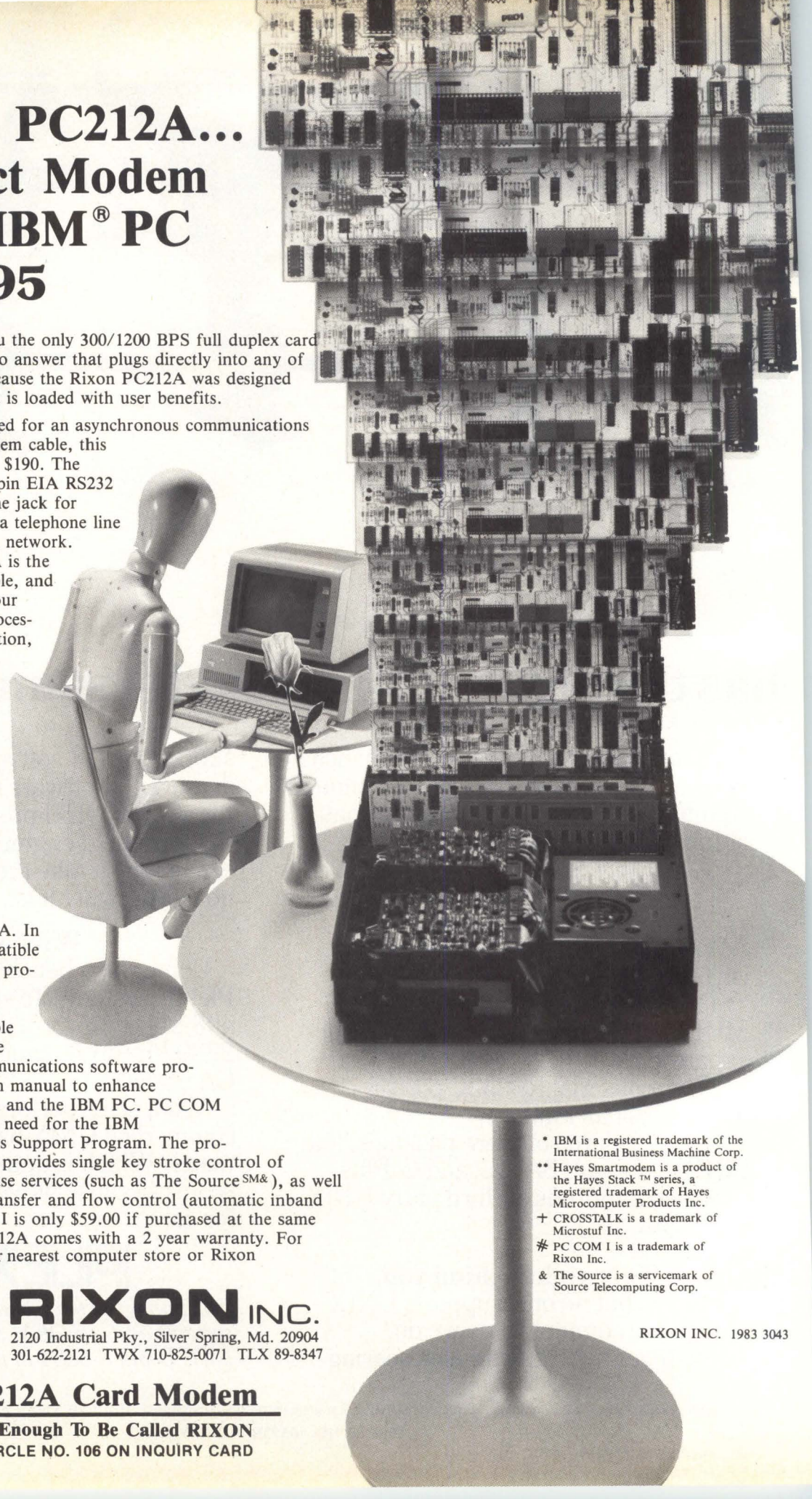

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CIRCLE NO. 106 ON INQUIRY CARD

OFFICE AUTOMATION

An intelligent-workstation approach to office automation

GAYMOND SCHULTZ, Sydis Inc.

A multiple 68000-based processor provides as many as 64 users with bit-mapped graphics, PBX switching and digitized voice storage

System integrators considering approaches to office automation typically must choose between the relative inflexibility of centralized minicomputer-based systems and the less efficient communications and lack of advanced functions in distributed microcomputer-based systems. A new system from Sydis Inc. offers features from both approaches, while providing such functions as bit-mapped graphics and digitized voice storage. The Sydis system combines a multi-microprocessor-based system manager with intelligent workstations, running an enhanced version of the UNIX-like XENIX operating system.

The VoiceStation 1 68008-based workstation *incorporates bit-mapped graphics, telephone functions and digitized voice storage for dictation. Each workstation in the Sydis system is connected to the system information manager through a 320K-bit-per-sec. dedicated line. The system is priced at $6000 to $7000 per user in OEM single-user quantities.*

The system information manager

The Sydis system is controlled by an expandable central system information manager supporting as many as 64 users. The SIM incorporates as many as 32 68000 processors, as well as interfaces for phone line and workstation communications (Fig. 1).

The SIM's multiple 68000s comprise a master processor, application-server processors, file-server processors and voice-server processors. The master processor coordinates system functions, while application-server processors are dedicated to specific users or programs. File-server processors interface to the mass-storage peripherals through a peripheral bus. Only one file-server processor is required, but additional file servers can be configured to increase throughput. The file system is organized so that multiple file servers act as one logical file system shared by all SIM users. The voice-server processor is an eight-channel "digital tape recorder" designed to support voice-to-disk and disk-to-voice operations. A voice compressor reduces 64K-bit voice channels to any user-selected lower bit rate for more efficient storage of digitized voice on disk.

Each processor includes 512K to 2M bytes of error-checking and -correcting RAM, eight direct-memory-

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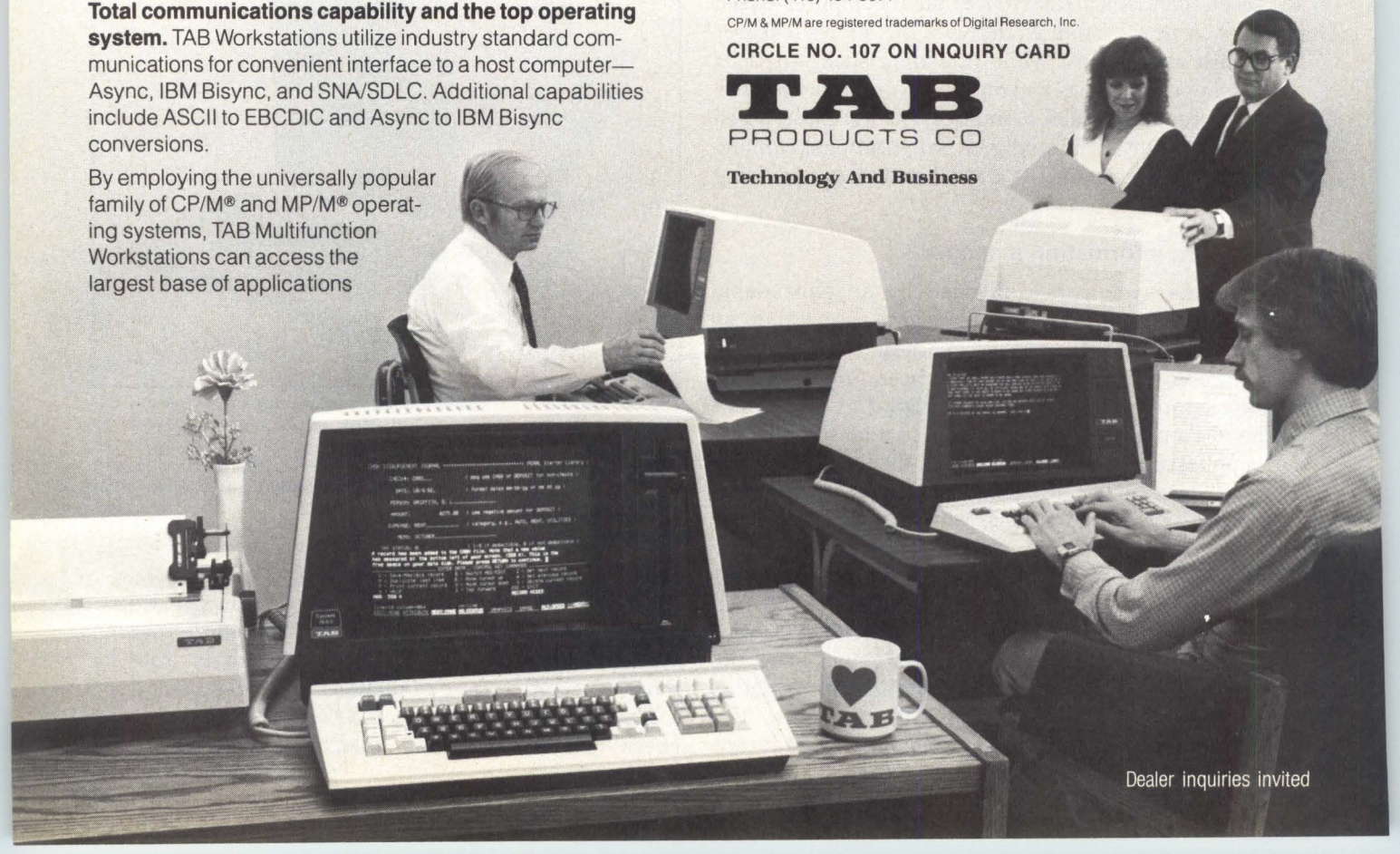


Dealer inquiries invited

access channels, 16 full-duplex ports to a communications bus, an inter-processor bus interface and an auxiliary bus for peripherals and expansion. The processor boards also have a small power-on ROM boot program and diagnostic routines.

SIM communications modules include PBX and workstation interfaces, as well as a modem pool. The PBX interface emulates a standard 12-button phone, translating digital signals into analog voice signals. The module supports connections to any PBX, central office or key system. The workstation interface module connects as many as 16 workstations to the SIM. The modem pool is a collection of eight Bell 103/212-

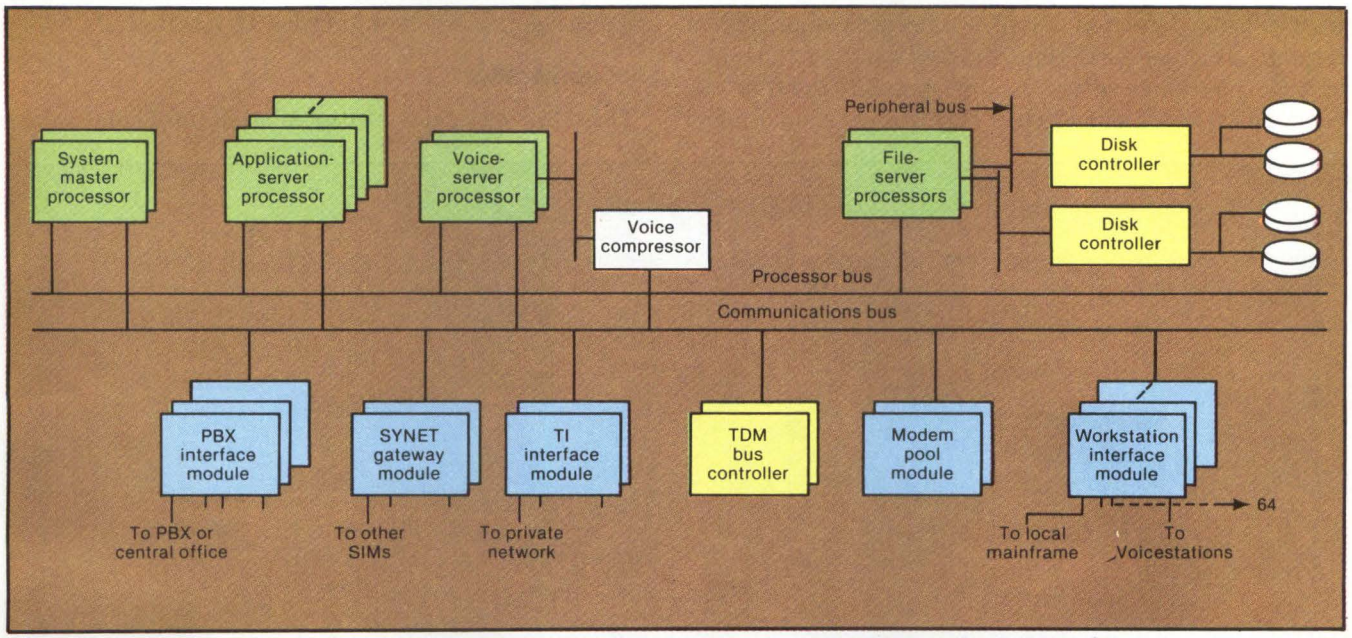


Fig. 1. The system information manager *architecture incorporates 68000-based file-, application- and voice-server processors, with one master processor coordinating all processing. Additional file- and application-server processors can be added to increase system performance and the number of users. SIM communications capabilities include interfaces for phone lines, local-area networks and additional SIMs. The logically separate processor bus and communications bus are time-division multiplexed onto a single physical bus.*

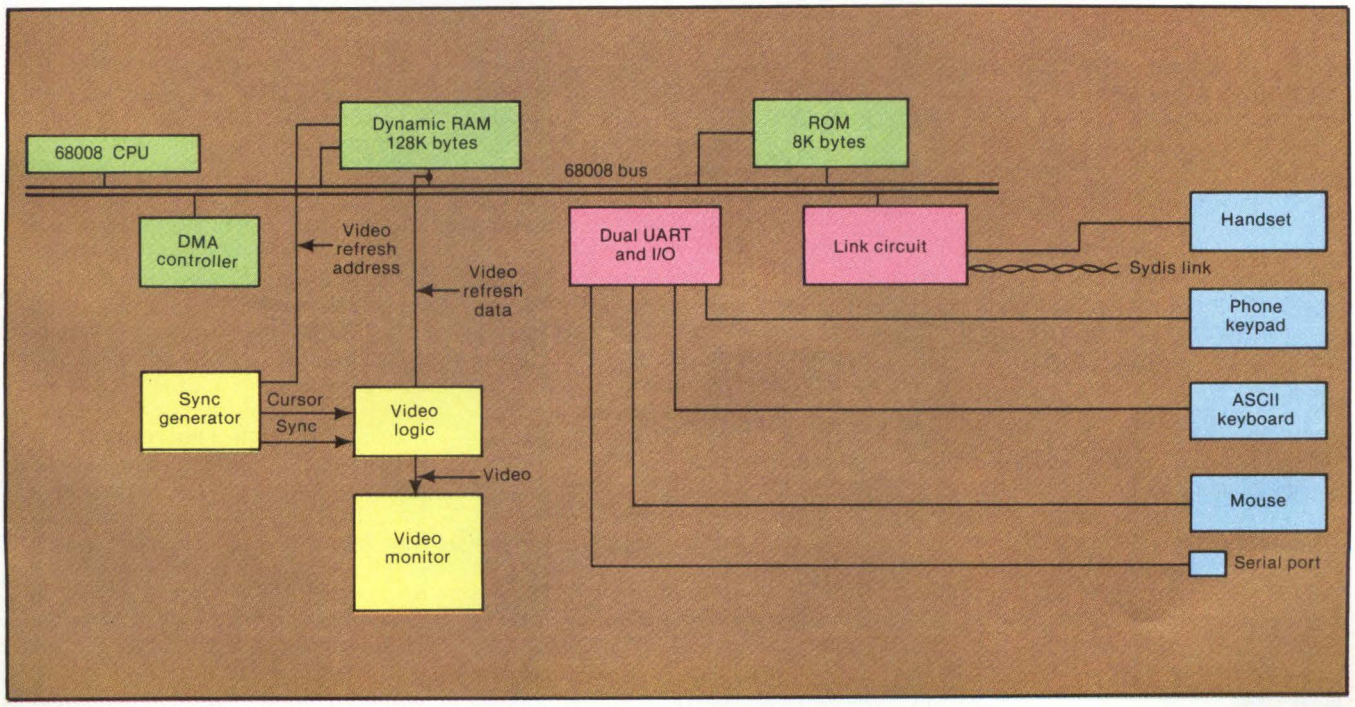


Fig. 2. The VoiceStation 1 architecture *includes a 68008 CPU, 128K bytes of RAM, phone handset circuitry and a DMA controller. The DMA controller moves bit-mapped graphics data from the RAM to the video logic for display formatting.*

compatible 300- to 1200-baud modems, shared between requesting workstations.

The SIM incorporates two logically separate buses. A high-speed parallel bus passes files and messages between processors using carrier sense multiple access with collision detection; if two or more processors try to use the bus at the same time, both wait a random length of time and then retry. A time-division multiplexed communications bus switches digitized voice and high-speed data, connecting workstations to internal processors or to external systems. Both buses are time-division multiplexed onto one physical parallel bus. This physical bus is incorporated on each processor card and on the SIM backplane to prevent a single point of failure from bringing down the system.

Peripherals supported by the SIM include a 160M-byte Winchester disk with Shugart Associates' system interface, a 160M-byte streaming-tape drive and a ½-in., nine-track tape drive. A total of 640M bytes of disk storage can be configured with a SIM.

The workstation

The Sydis system uses 68008-based intelligent work-

USING THE VOICESTATION 1

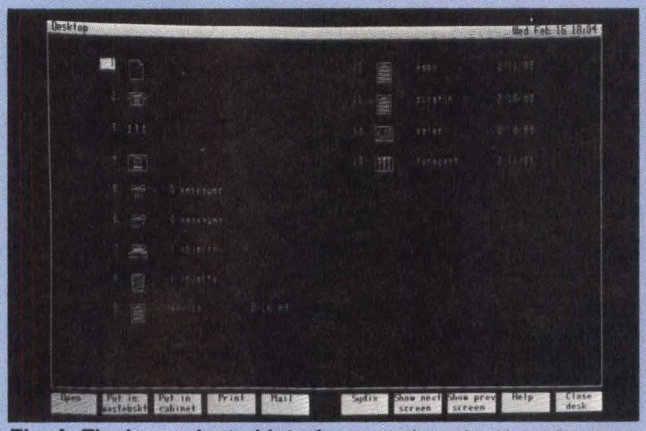


Fig. A. The icon-oriented interface *used on the VoiceStation 1 allows inexperienced users to select operations by number, name or picture. Function keys mounted underneath the screen are defined by the labels displayed on the lower part of the screen.*

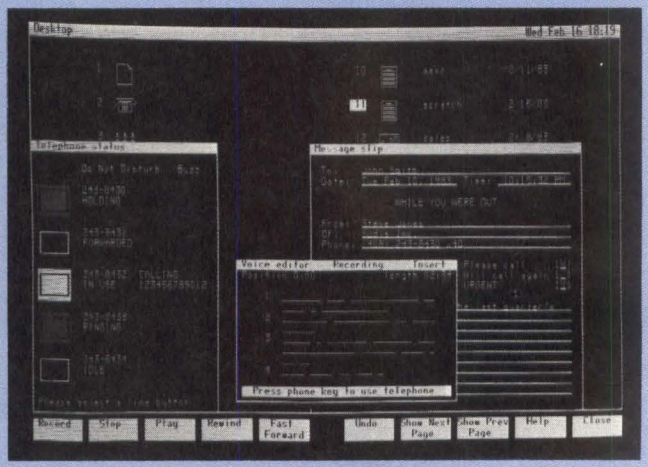


Fig. B. Display windows inform the user *of memos, phone status, messages and length of digitized voice recordings.*

The Sydis VoiceStation 1 workstation provides a user interface that is far more accommodating to inexperienced users than that of most systems. The following scenario illustrates some of these features.

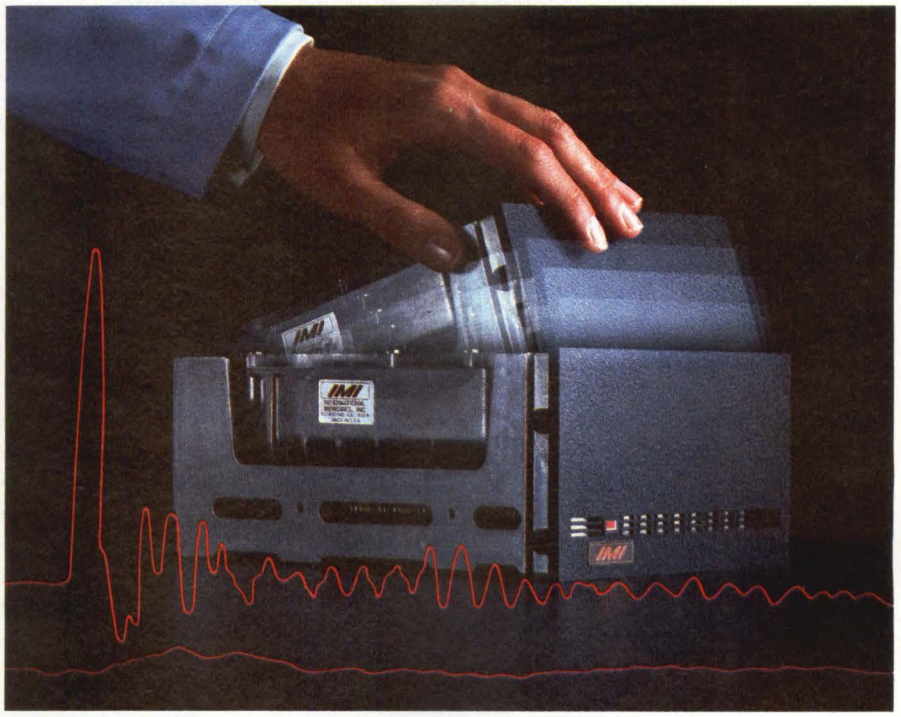
When a user activates the workstation, he is presented with a pictorial listing of system facilities (left). The bottom of the screen displays instructions, with label boxes defining each of the keys mounted underneath the screen.

The menu might inform the user that there are two items in the in basket. Using an optional mouse, the user moves the cursor to the image of the in basket on the screen, presses a button on the mouse and moves the cursor to the "OPEN" function-key label and again presses a button. (The user also could have opened the in basket by entering a "2" from the keyboard and then pressing the soft function key under the "OPEN" label.) The resulting screen now contains the same information, with the addition of a window showing the two items in the in basket: a sales memo from the company president and a short message. The user positions the cursor on the memo tag, bringing it to the screen with its accompanying graph.

The screen labels for the 10 soft keys have now changed, showing commands for the message-examination mode. The user moves or copies the memo, searches for words, undoes the previous command, looks at any other pages and quits or closes this mode. The user also has a voice option. If the user is interrupted by a phone call before selecting a function, a new window shows the status of the telephone lines. The window shows that line one is busy with a call from outside the system and line five has a call for the user. If the caller is another system user, he is identified on the screen. The screen labels change again, showing the available capabilities to handle the call. The user can then accept the call.

If the user then decides the company president should join the conversation, the user summons a phone directory to the screen and moves the cursor to the president's name. The system dials the number. If the president does not answer, the user could then hit the "leave-message" key, and a message pad would appear for the user to fill in. He could also decide to leave a verbal message, and select the "record" key, opening the voice editor window. The user speaks into the speaker phone or handset, while the voice editor show how long the user has been talking (right). The voice editor can serve as a digital tape recorder, displaying play, record, rewind and fast-forward keys. The message complete, the user hangs up by pushing a button and returning to the memo and the original phone call.

This won't hurt a bit.



Accelerometer waveforms. Upper trace: frame. Lower trace: HDA.

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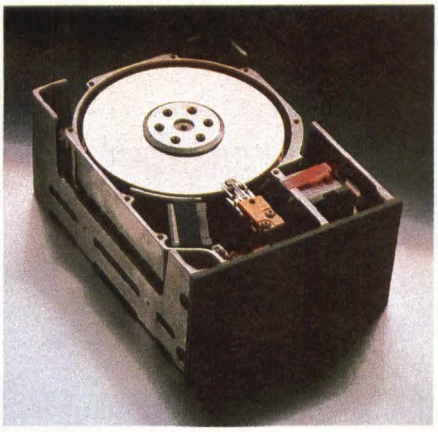
*Accelerometer reading for 3" drop-test.



They also have thin-film plated media, which is over 1000 times harder than ferric-oxide coatings, and which combines with the shock isolation design to make the drive even less vulnerable to head crashes and subsequent data loss.

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Formatted Capacity (Mbytes)	5/6.3	10/12.5	15/18.8
Access Time (msec)	68	68	68
Number of Disks	1	2	3
RPM	3600	3600	3600

**Industry standard interface and format/Industry standard interface with expanded format.

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CIRCLE NO. 108 ON INQUIRY CARD

stations with an icon-oriented user interface (see "Using the VoiceStation 1," p. 156). Each VoiceStation 1 includes high-resolution bit-mapped graphics and a telephone for phone-line and digitized-voice applications (Fig. 2).

The 12-in., 832- × 608-pixel, bit-mapped CRT is available with green, amber or white phosphors. The low-profile keyboard is detachable, with hard and soft function keys mounted on the display. The display tilts from 0 to 20 degrees and swivels, helping the VoiceStation 1 meet European DIN ergonomic standards.

The terminal provides 128K bytes of memory for the bit-map graphics, four full screens of characters or graphics and the terminal-control software. Using the standard character set, the display supports 38 lines of 104 characters, or more than one-half of a normal 8½- × 11-in. typed page. Characters are constructed from an 8 × 16 character cell and include full descenders.

A screen can be filled with text or graphics in 440 msec.

The character font is user definable, and character attributes include intensity, underline, reverse video and fast or slow blinking. The cursor can be blink or non-blink and underline or block format.

The VoiceStation 1 simultaneously supports four 64K-bit-per-sec. channels, all multiplexed onto a high-speed digital link. One channel is dedicated to the voice link and one to system usage, with channels for data. The DMA sequencer routes incoming data into the RAM, also handling bit-map manipulations and graphics generation. The video logic accesses the bit-map section of the RAM and converts it into video signals for the monitor. A screen can be filled with text or graphics in 440 msec.

Document processing incorporates voice-annotation, graphics and standard text-processing features.

The workstation incorporates a push-button phone, a familiar element to inexperienced users that helps to overcome initial hesitance with a computer. Along with the phone are a programmable sound generator, a built-in handset and a speaker phone. Options include a phone headset with microphone, a transcription foot pedal, a three-button mouse and a local serial printer. The telephone keypad acts as a set of function keys that controls telephone, dictation, transcription, annotation and message-switching operations. Telephone operations at both the workstation and the SIM level can continue to function even if the rest of the system is inoperative.

The software

The Sydis system runs an enhanced version of the XENIX operating system that is fully compatible with UNIX System III. The software also provides program-development tools and an application library in addition to the UNIX System III libraries.

The operating system includes a number of extensions to the basic UNIX operating system that improve

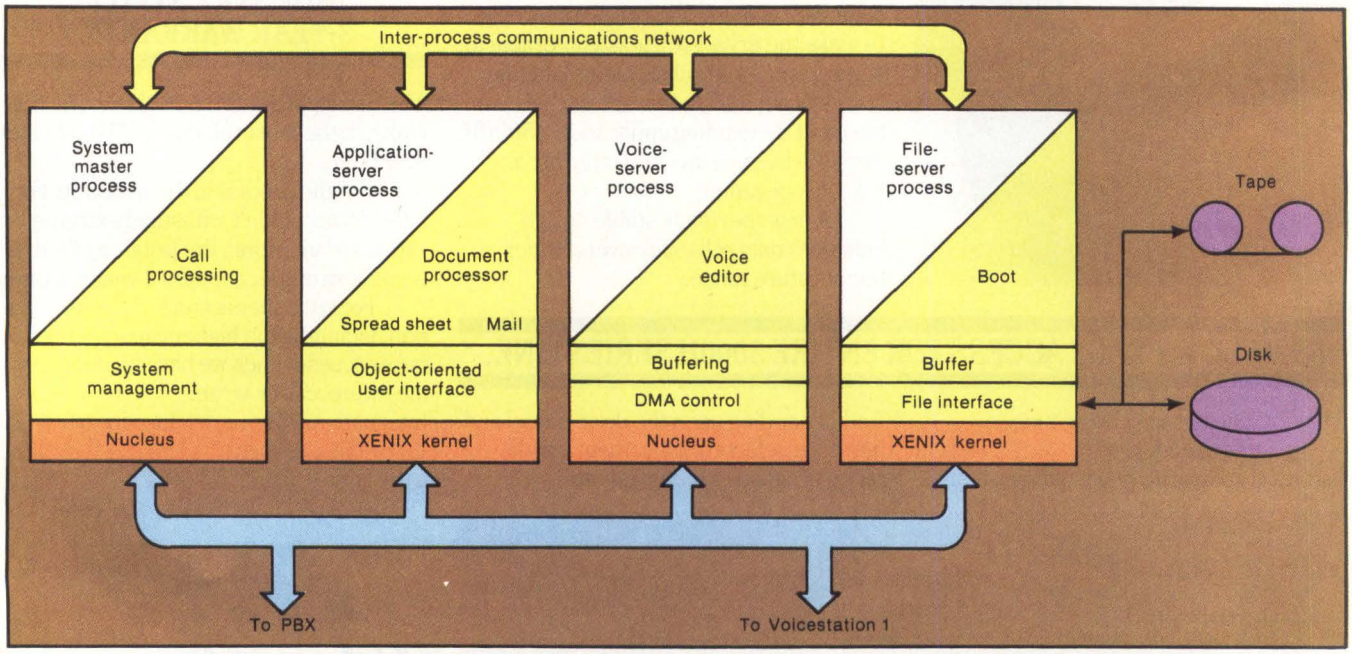

Fig. 3. SIM software processes *are divided among the four types of processors: system master, application server, voice server and file server. Processes communicate via an inter-process communications network under control of the system master processor.*

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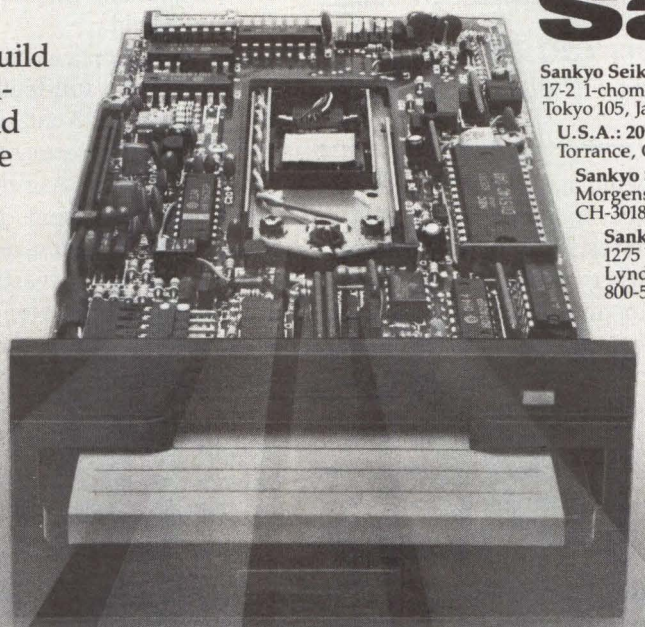
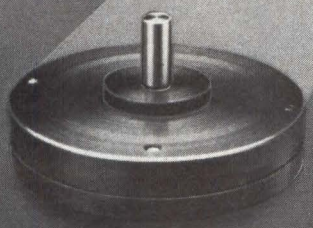
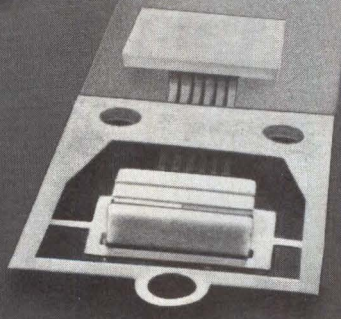




Stepping motor

Spindle drive



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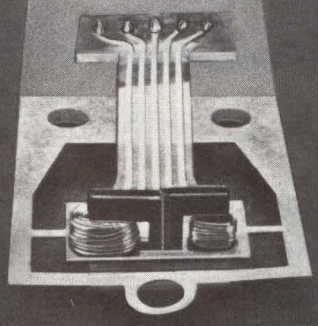

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its performance in office applications:

- **The shell,** or user interface, has been replaced with a more friendly user interface that uses icons and clearly explained operations. The interface also allows users and programs to access data from concurrently active programs.

Additional file servers can be configured to increase throughput.

- **The file system** has been made more disk-space efficient by allocating space in larger, consecutive blocks of 8192, 4096 or 512 bytes. To implement a single file system under multiple processors, UNIX file-system calls in the application-server processors are translated into network inter-process communications requests to the shared file-server processors (Fig. 3). These inter-process communications primitives can also isolate processes for reliability or performance reasons.
- **Real-time processing** has been improved for telephone management, data switching and voice processing. For example, the voice server uses the real-time facility to buffer digitized voice streams into blocks for transmission to the file server. The UNIX kernel has been modified to support multiple system processes that process interrupts to conclusion, unless preempted by higher level interrupts.

Sydis has also added program-development tools. Voice and telephone features can be accessed through program calls, while a VoiceStation 1 interface library supports the full capabilities of the workstation. Other libraries provide help capabilities, character and string manipulation, a terminal-independent I/O interface and an independent-sequential-access-method data-management facility.

End-user application software includes a package that provides a full-featured telephone to all VoiceStation 1 users, with automatic dialing and call coverage that allows a secretary to monitor a number of phones. Voice and text messaging are integrated with telephone operation. Document processing incorporates voice-annotation, dictation and transcription, graphics and standard text-processing features. Electronic mail distributes any type of data using a system directory. An electronic spread sheet, a database and graphics are also supported. □

Gaymond Schultz is vice president of engineering at Sydis Inc., San Jose, Calif.

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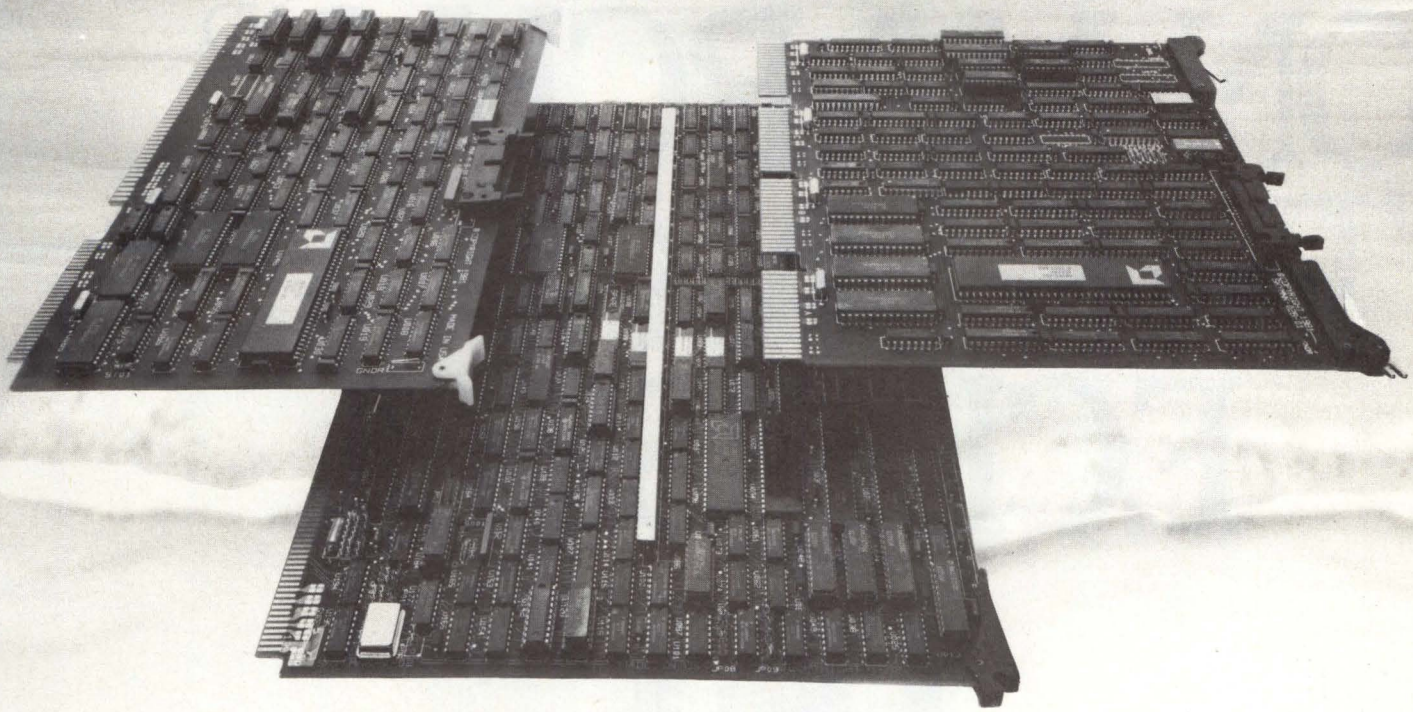

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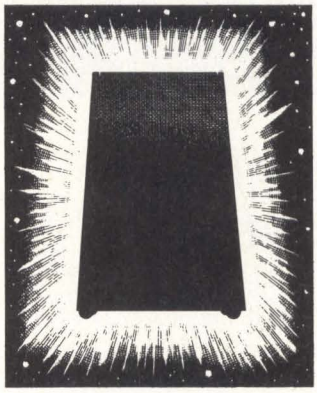
AT 11 A.M. ON MARCH 2ND, THE VAX™ WAS ECLIPSED.

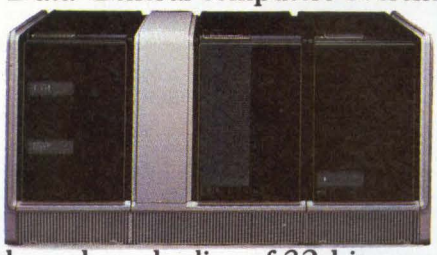


If you decided to buy a computer system before 11 A.M., March 2nd, it was possible to make a purchase decision without fully considering Data General.

But on that date, the world changed.

At 11 A.M., we introduced the most powerful 32-bit virtual supermini ever produced by a computer company. Our Eclipse™ MV/10000.

Yet the Eclipse MV/10000 is only the most recent in a series of steps we have taken to make Data General computers overshadow Digital's entire line of VAX computers.



So now, if you do a full evaluation of computer systems, the VAX no longer comes out ahead.

PERFORMANCE. The Eclipse MV/10000 executes 2500 kwets/sec. And transfers I/O at 28.6 mb/sec. The VAX 11/780 executes* 1200 kwets/sec. And transfers I/O at 13.3 mb/sec. A comparison that's no comparison.

RANGE. With the Eclipse MV/10000, Data General has a broader line of 32-bit computer capability than Digital. Which means a Data General computer will better fit your exact needs. Whatever those needs may be.

PRICE. When you compare Data General Eclipse MV computers against Digital's VAX computers on the basis of price,* you get a very interesting perspective. The Eclipse MV/10000 has the same price as the VAX 11/780, but twice the performance. And the recently announced Eclipse MV/4000 has twice the performance of a VAX 11/730 at the same price.

COMPATIBILITY. We at Data General have made it a top priority to make our system's software and I/O compatible. So if your needs ever change, you can take your investment in software and peripherals onto other Data General computers. Which is something you can't do with Digital's VAX computers.

GRAPHICS. Also, we fully support our own color graphics terminals, high resolution color workstations, color graphics controllers and standard GKS software. All of which make the job of integrating your total application considerably easier.

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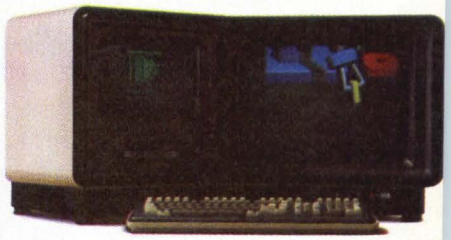

Our systems software covers a wide range of applications – including Data Communications, Networking, Time-Sharing and Office Automation. Plus all the standard development languages. All to industry standards. And third-party applications software for mechanical, electrical and architectural engineering; imaging and process control.

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So when you look at where Data General is today – and where the competition is today – the VAX has been ECLIPSED.

For additional information contact Don McDougall, Director, Technical Products, M.S. F134, Data General Corporation, 4400 Computer Drive, Westboro, MA (617) 366-8911.

Data General

*Sources include trade press articles, Digital literature, industry reporting publications and data supplied by industry reporting services.

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PC local net binds elements of Arcnet, Ethernet and Cluster/One

JOSEPH D. BAUGH, Nestar Systems Inc.

Server-based scheme blends chosen features from three commercial LANs in full-service network for Apples and IBM PCs

The local-network schemes that survive in the market will incorporate the most broadly accepted equipment and interconnection standards. Corporate America is buying personal computers in volume, and they must be able to communicate with each other and with corporate mainframes. To facilitate this, some major equipment vendors have made the hardware or software specifications for their interconnection schemes available to the general public for adoption. Nestar Systems Inc.'s Plan 4000 is a local-area network that takes advantage of these published standards.

Plan 4000 System combines Datapoint Corp.'s Arcnet hardware, Ethernet software and proprietary server software in a local network that allows Apple computers and IBM PCs to share data and communicate with IBM mainframes and other local networks. An Arcnet interface provides token passing and 2.5M-bit-per-sec. data-transfer rates over baseband coaxial cable, and Ethernet protocols handle inter-network communications. File, printer and communications servers, based on Nestar's Cluster/One software, allow workstations to share network resources and application programs, such as 3270 emulation, database management and electronic mail. These servers permit users to upgrade existing Cluster/One networks. Specialized servers and direct station-to-station communications can be developed by OEMs and users through software tools that access the Ethernet protocols. The Plan 4000 building blocks are the network interface card, the line interface device, file server hardware and software and application software.

Comparing LAN technologies

	Plan 4000	Cluster/One	Ethernet
Data rate	2.5M bps	0.24M bps	10M bps
Transmission medium	baseband, coaxial cable	16-wire ribbon or 8-wire twisted pair	baseband, coaxial cable
No. of nodes	255	64	1024
Topology	star-burst	any	linear bus
Access method	Token passing	CSMA/CA	CSMA/CD
Network length	20,000 ft. per segment	1000 ft. per segment	1600 ft. per segment
Station-connect costs	$500	$400	$1000 and up

Network interface card

The network interface card is a three-chip-set implementation of Arcnet hardware (physical and data-link layers) supported by the network and transport layers of Ethernet. Network algorithms reside on a custom MOS circuit. Because network protocols are handled in silicon, implementation is approximately 10 times faster than existing software-based methods, and implementation costs are less than $500 per station.

Data are transmitted in packets of as much as 253 bytes that contain source and destination IDs and cyclic redundancy checks for data reliability. A token-passing scheme inhibits a station from transmitting unless it has possession of the token (a constant sequence of bits), which is passed from station to station. In the Plan 4000 system, a token pass requires 28 μsec., and a message takes 4.4 μsec. per byte of data, plus 113 μsec. of overhead. An advantage of token passing over carrier sense multiple access with collision detection is that system designers can calculate a worst-case transmission time. CSMA/CD network access cannot be easily measured because of the unlimited number of collisions and retries permitted.

Plan 4000 supports as many as 255 network stations on a 20,000-ft. segment of coaxial cable. The physical topology is a star-burst with nodes (line interface devices) arranged in a logical ring (Fig. 1). The token is passed logically to the next higher station address, regardless of where that station is located on the network. A logical ring is easier to expand than a physical ring. Connecting a station removed from the heart of a physical ring network requires stringing two cables from the nearest station, as opposed to running one cable in from the line interface device to the station in a logical ring network (Fig. 2).

A line isolation device provides a multi-ported connection point for all network nodes. LIDs also provide signal-conditioning and troubleshooting capabilities (Fig. 3). Each LID has 10, 20 or 30 ports for connecting to other LIDs, workstations or servers.

Signal conditioning from the transmitting node to the rest of the network is a primary LID function. By minimizing the number of taps on the line, the LIDs eliminate serious noise problems caused by multiple reflections that occur in LAN schemes with one tap per station. Transformer isolation at both ends of each line eliminates a major source of potential electrical problems. LID implementation requires only unidirectional signal amplification because only a single node is transmitting at one time. LIDs aid system integrity as well. One node cannot disrupt the entire network because it is buffered from the rest of the network by the LID. The LID also serves as a common service and diagnostic point. Each port has diagnostic LED indicators that provide a quick visual check on its operation. In complex multi-floor installations, this capability is invaluable.

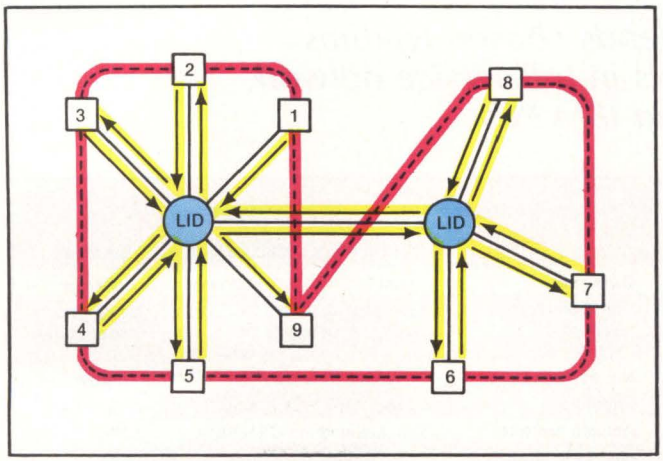


Fig. 1. Physical star network with logical ring structure. *Workstations are connected to a line interface device that connects to other LIDs. The token passes from station to station through the LIDs (yellow line). Because the token is passed logically to the next-higher address, regardless of station location, the topology is effectively a ring (pink line).*

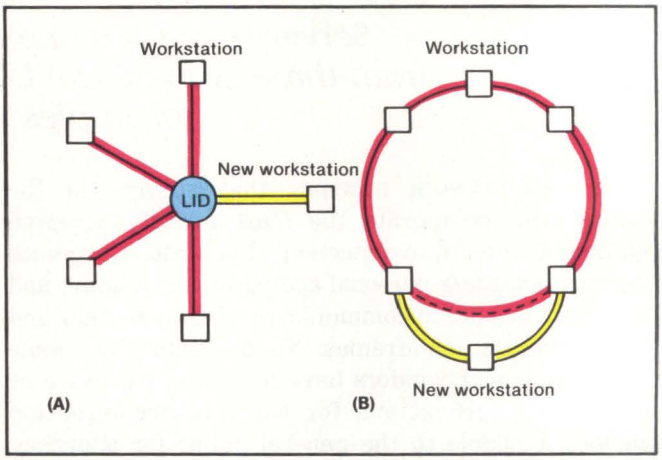


Fig. 2. Adding a station. *A star-configured cluster of stations (A) connected to a line interface device facilitates network expansion because a single line can be extended to the new station without affecting the network. A physical ring topology (B), which consists of a closed loop, requires two cables strung from the loop to the new station and means bringing the network down during installation.*

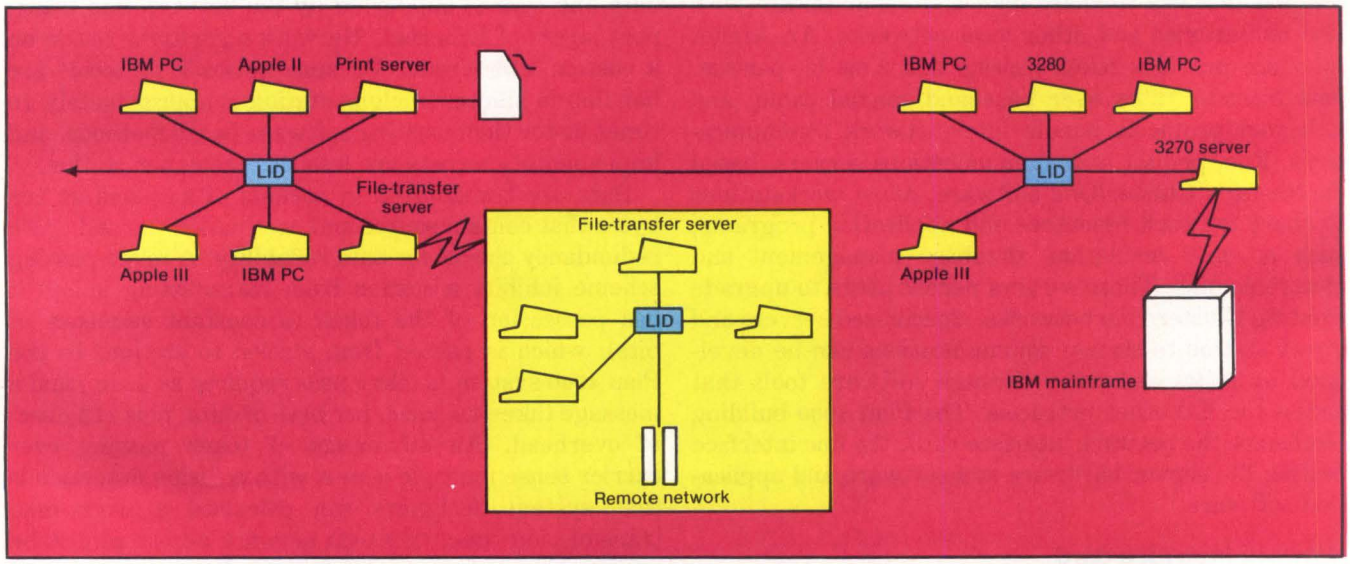
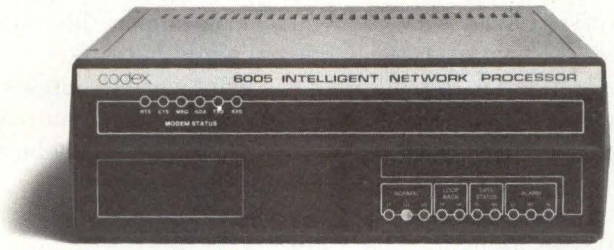


Fig. 3. Line interface device. *Each LID supports as many as 30 stations. It maintains electrical isolation and provides signal conditioning for driving the network as well as a checkpoint for detecting any node malfunctions.*

HOW TO GET A NETWORK OFF THE GROUND.



Codex 6000 Series
Intelligent Network Processors
for minicomputer networks.

Say you have a small minicomputer network. A dumb terminal here, a dumb terminal there, and a DEC, HP, Data General or some other minicomputer miles from either. They're probably joined by modems and phone lines. But that's no way to run an efficient, economical network. And it doesn't give you any room to grow.

To really get a network off the ground—to really get one running efficiently—you need to take a different route.

You need a Codex 6000 Series Intelligent Network Processor specifically designed to improve the efficiency of smaller networks.

In a minicomputer situation with as few as two dumb, asynchronous terminals, these statistical multiplexers will boost operating efficiency, reduce line costs and protect your data from errors caused by line disturbance.

The model 6001 can support as many as eight asynchronous terminals. The 6005, as many as 16 asynchronous and synchronous terminals. Or any combination of word processing or graphics terminals and printers.

Both models are inexpensively priced. So the money you save on line costs and error-free transmission will bring you a healthy return on investment quickly. Our Application Engineers offer planning expertise to help you get off the ground that much faster. And when you grow, we'll show you how these stat muxes can be linked to larger 6000 Series products as your networking needs expand.

In short, Codex 6000 Series Intelligent Network Processors can push your small network in the direction it ought to be going. Up.

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File server hardware

The Network file server is a specialized file processor with memory and mass storage that acts as a shared-file resource manager for the networked user stations (Fig. 4). In Cluster/One, it is a dedicated 64K Apple II with floppy and hard disk subsystems and streaming-tape cartridge backup. For Plan 4000, which requires a faster file server, Nestar designed an 8-MHz 68000-based file server that supports 256K bytes to 1M byte of RAM, streaming-tape cartridges and hard disk drives with 548M bytes. If more storage is needed, multiple file servers can be attached to a single network. The integrated tape drive supports 20M or 45M bytes on a single cartridge. Internal LIDs allow as many as 30 direct connections to network workstations, servers or other remote LIDs.

Server software

System server software, such as the file server, the file-transfer server, the inter-network gateway server, IBM 3270 and 3780 emulators and the print server, interact with a user and with each other to provide comprehensive communications and file-manipulation facilities. These server programs are supported on several operating systems for each of the personal computers supported by Plan 4000: for the IBM Personal Computer, PC DOS 1.1 and UCSD P-System; for the Apple II, DOS 3.2.1 and 3.3, Apple Pascal 1.1 and CP/M 2.2; for the Apple III, Apple II emulator mode and SOS 1.1 for native mode.

The file server program, which operates on the file server, manages the integrated mass-storage devices, the cartridge-tape drives and the Winchester disks. It uses a variable-sized logical volume to optimize available storage and controls access to files by password protection. Data integrity is ensured by error checking on all transmissions and by retransmitting as necessary.

The file-transfer server permits users to transfer entire files or volumes in batch mode to other workstations on the network, to workstations on other networks or to stand-alone stations not connected to a newtwork. It supports standard modems for connection to standard telephone lines and provides for maintaining records of all linking and data-transfer operations. It can automatically dial up and disconnect when used with modems supporting that feature and, with Messenger, the electronic-mail program, can transmit messages worldwide between Plan 4000 networks.

The gateway server provides a real-time way of interconnecting multiple Plan 4000 networks. It can also be used to connect Plan 4000 networks to Cluster/One networks or other networks such as Ethernet.

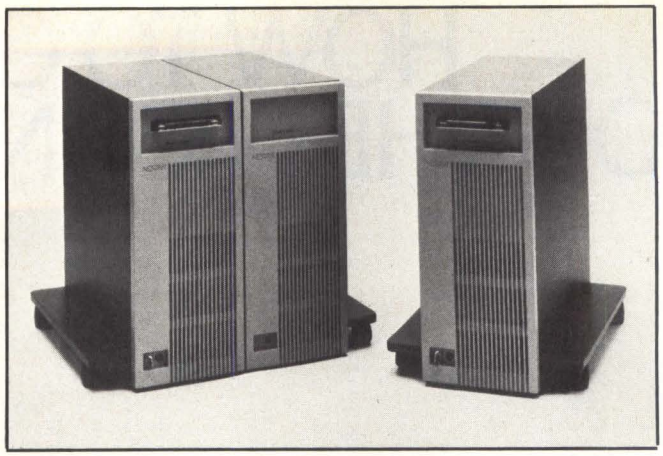

Fig. 4. File servers. *The 68000-based file server (right) supports as much as 548M bytes of mass storage on 8- or 14-in. hard disks. If additional capacity is required, multiple servers (left) can be attached to the network.*

The 3270 and 3780 emulator programs allow a Plan 4000 workstation to be used as a 3270 terminal or a 3780 remote job-entry station. This means that a user can access his corporate mainframe database and become part of the larger corporate data-processing community while maintaining his system as part of a local departmental network.

The print server contains drivers for a large number of popular printers and can establish job priorities. Printer parameters can be selected by each user or by the system manager.

Application software

Residing above this server software are application programs such as Messenger, database management and Multi-calc.

Messenger provides community messaging both within and between networks. This includes terminal-to-terminal communications, scheduling, telephone messages and interoffice mail. The user sends and receives messages, files them according to classification, forwards and arranges them and stores or prints them.

Unattended operation is possible because the program passes messages by simply creating or deleting special files on the shared hard disks of the network file server. The files contain source and destination information and other pertinent information, such as the time and date of the message. The files remain on the disk until the recipient checks for mail, usually on power-up of the workstation. Incoming messages can be quickly scanned by sender or subject category; read; and then answered, forwarded, deleted or filed for future reference.

The Multi-calc product allows users to exchange VisiCalc worksheets with other network users. The NPL database-management system provides comprehensive database-management and report-generation services similar to those provided by such popular mainframe products as Focus, Ramis II and Nomad. □

HOW TO GET A NETWORK OFF YOUR BACK.

Codex Data PABX for minicomputer networks.

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Our Data PABX monitors and controls the way your people access your minicomputers. And it does such a good job that you can get more out of DEC, Prime, Data General or other minicomputers—even add more terminals—simply by making better use of what you already have.

So, for instance, instead of having dumb terminals dedicated to any single minicomputer, Data PABX lets you get any processor, from any terminal, from any point in your network.

This approach makes even more sense when you consider that any given terminal is only on-line about 20% of the day. It's a more efficient use of computer resources, more economical, and altogether easier to implement than any other option in front of you.

What's more, this approach is backed by Codex. Before the sale and after. So you know it will work when you install it. And you know it'll work long after.

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Including the one in your lower back.

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EMULEX TALKS DEC 4

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How would you like to double (repeat, double) the throughput of your terminal-bound VAX-11/750 or 780—for less than $6,000? DEC's DMF-32 modules have already slashed the data-communications overhead of "small" VAX-11/730's. Now Emulex is extending DMF concepts to the whole VAX family. With bonus benefits. Emulex's single-board CS21/F multiplexer gives you 16 asynchronous lines (instead of 8), with modem control for remote terminals on all 16 lines (instead of just 2). Emulex CS11/F expands this to 48 lines—again on a single board.

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Because there is CPU overhead involved in setting up a DMA transfer, interrupt (DZ11) operations are more efficient for lesser amounts of data, such as character echo and data entry. The DMF driver can transfer "bursts" of up to 32 characters to the 32 character output silo on each line, under a single interrupt operation. Result: Emulex DMF emulations provide the most cost effective VAX performance enhancement currently available!!!

SOON (STAY TUNED)...

And that's just for starters. Emulex will soon offer two new DMF-type multiplexers that will allow you to expand your system, in DMF mode, to include statistical concentration (an Emulex exclusive). Result: Single-board modules that can support up to 128 or 256 local or remote terminals. *Become a Believer.* ***Write for a more extensive explanation of Emulex data communications and the new DMF emulations.***

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The word is out. Emulex communications technology has been extended to DEC System 10 and System 20 mainframes. How? Users are plugging Emulex modules into the PDP-11/34's or 40's that serve as front-ends for nearly every large DEC installation. No change in front-end or mainframe software required.

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OCR moves into office automation

DAVID H. FREEDMAN, Associate Editor

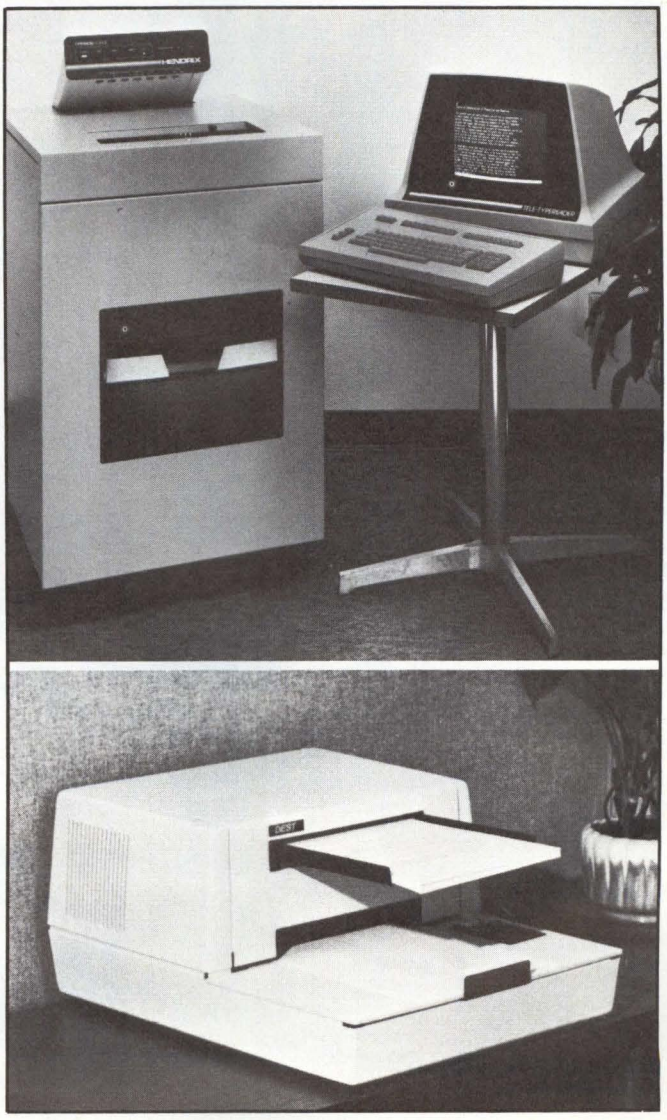
Inexpensive, compact machines could bridge the gap between typewriters and word processors

While word-processing systems can greatly ease the editing, storage and distribution of documents, text must get into the system first. Because typewritten material appears in even the most automated offices, users are forced to enter such documents by keyboard. This text entry takes up as much as 80 percent of a word-processing operator's time.

Optical-character-recognition systems—machines that convert printed characters to digital characters—provide one solution to this potential bottleneck. A new generation of OCR systems is available for integration into office-automation systems, inspired by a growing market, ripened technology and a competitive OCR industry.

The OCR market

Like other types of office-automation equipment, OCR machines have been the beneficiary of price and performance improvements. Automobile-sized OCR systems were used for mail and bill processing 15 years ago at the few companies and agencies large enough to justify the systems' several-hundred-thousand-dollar price tags. Today, OCR is available in desk-top units priced at almost $5000, reliably reading everything from business letters to magazine articles. But OCR systems also find themselves in a unique position in the office-automation field: they represent a link between



OCR systems designed for text processing *are available in a range of sizes, prices and performances. Floor-standing system from Hendrix Technologies is a medium-speed, multi-font machine, reading eight typewriter fonts at 150 cps. The CRT terminal is used for editing and transmitting Telex and other messages. Desk-top machine (below) from Dest is the first of a new generation of compact, inexpensive systems. The $7000 WorkLess Station offers performance comparable to floor-standing machines selling for three times as much.*

IBM, WANG, DEC,

Our business computer systems have all the power of an IBM,™ all the flexibility of a Wang,™ all the memory capacity of a DEC.™

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You can use an Alpha Micro system

Come see us at the NCC Show, Booth W6000.

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*17332 Von Karman, P.O. Box 18347, Irvine, CA 92714. *Who's Harvey Schmidlap?*

AND WHO?

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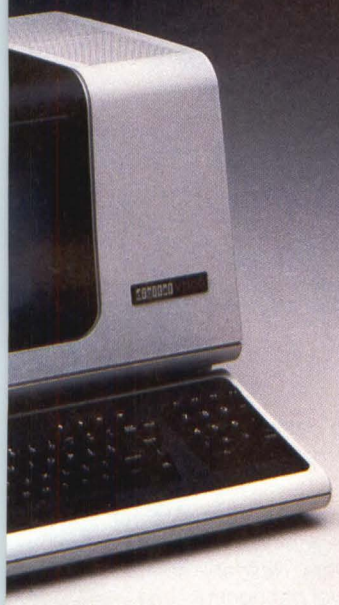

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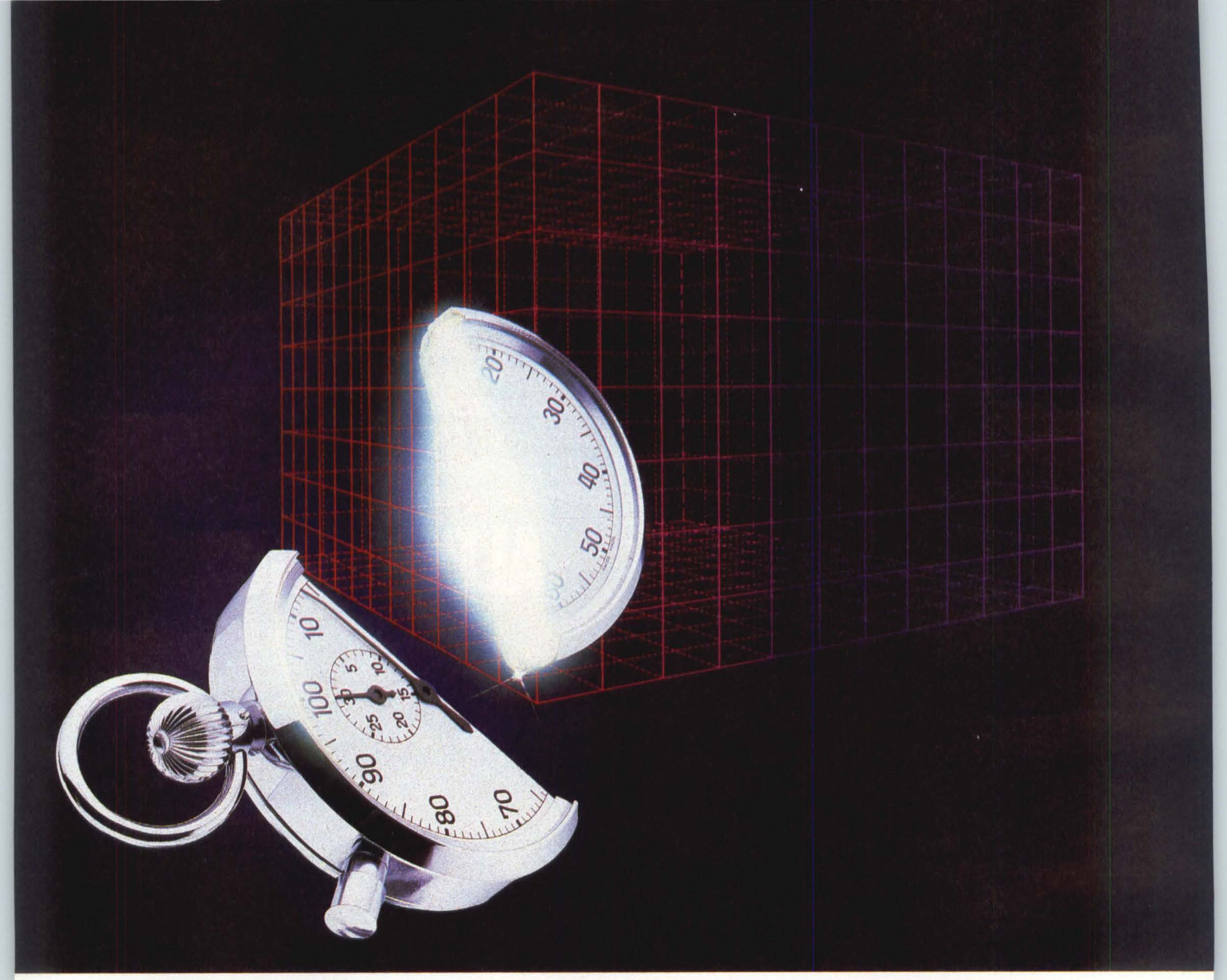

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the old and new ways of doing things—that is, between typewriters and word processors.

High-speed, limited-function forms processing is still the major market for OCR, says International Resource Development Inc. president Ken Bosomworth. This market represents more than 90 percent of the $350-million OCR market. But OCR machines designed for office text-processing applications will take a larger share of the market, says Bosomworth, growing from $20 million per year now to as much as $200 million per year by 1990.

'Vendors' error rates are like EPA mileage figures: they depend on a lot of factors.'

Why does a word-processing-equipped office need OCR if documents can be entered on a system from the beginning? First of all, the higher cost of a word-processing operator over a typist could make it cost-effective to have documents typed and then entered through an OCR machine. In addition, many office documents come from outside the office or from nonautomated departments in the same office. OCR can

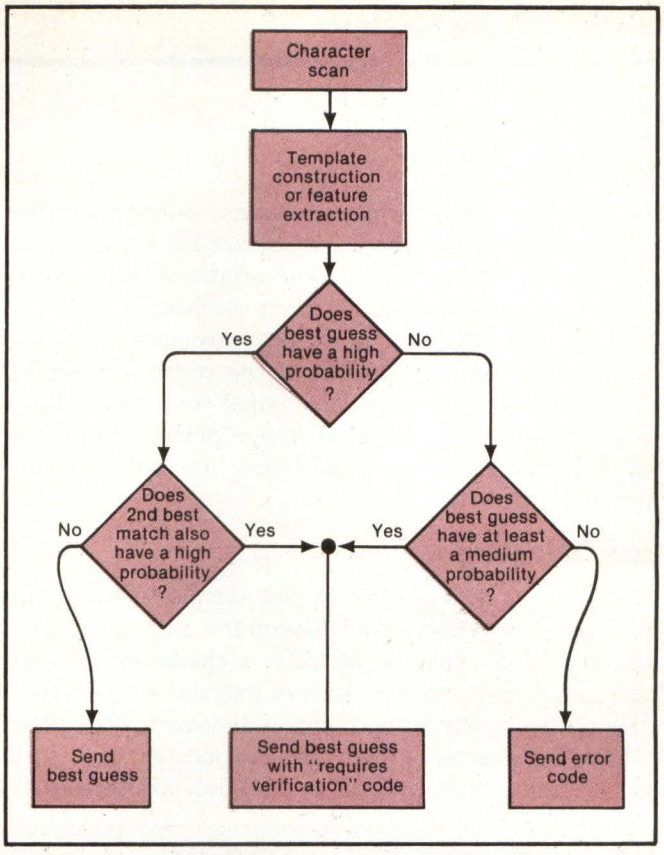

Fig. 2. Character-recognition process *used on many OCR systems involves determining a best guess of the identity of an unknown character, as well as the probability that this best guess is the correct character. Dubious guesses can be flagged with a "requires-verification" code allowing an operator to check the character on a CRT.*

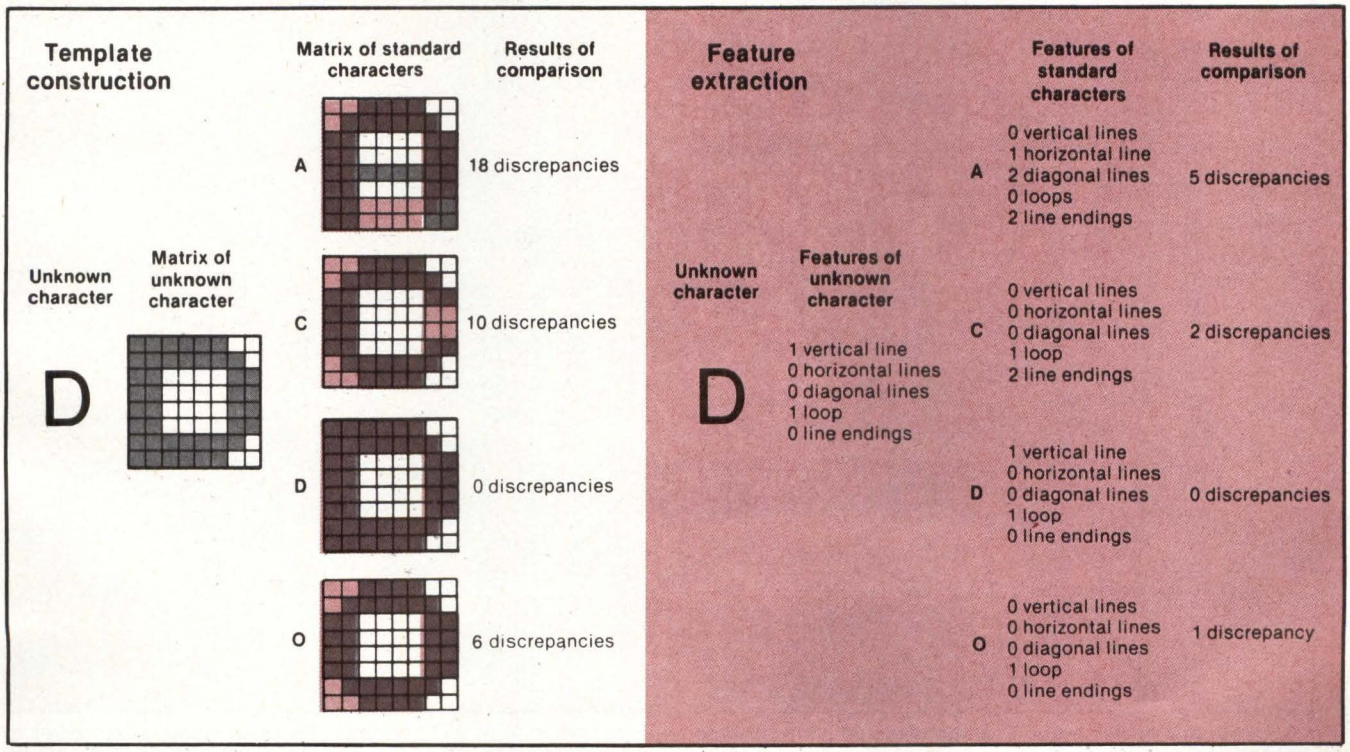

Fig. 1. Two character-recognition techniques. *Template construction converts an unknown character to a digitized image. This pixel image is then compared to images of a standard character set, and the standard character image with the fewest discrepancies is selected. Feature extraction compares selected geometric features of the unknown character to the standard character set. The above example is greatly simplified; OCR systems use as many as 100 features or pixels for each character, with as many as 100 characters in a set.*

also provide an interface between word-processing systems for which communications are too expensive or not yet available: one system produces hard copy, which is fed into a second system via OCR.

In all cases, the cost of an OCR machine—including the time required to proofread the results—must be weighed against the cost of manual text entry. Only recently, with the advent of lower priced, multi-font and more accurate OCR systems, has this formula frequently favored OCR.

How OCR works

OCR begins by scanning a print sample to detect the differences in reflectivity between ink and paper. This information is used to identify a character through template construction or feature extraction (Fig. 1).

Template construction builds a digitized image of an unknown character. Each character location is divided into an array, or matrix, of pixels. If ink is detected at a point in the array, the pixel corresponding to that point is "turned on." This digitized image is then compared to digitized images of a standard character set. The number of noncoinciding pixels between the unknown character image and each standard character image indicates the degree to which each standard character matches the unknown character. If one standard character matches the unknown character to a significantly greater degree than any other standard character, the system sends that character to an output buffer (Fig. 2).

Some systems insert formatting codes compatible with those of popular word-processing systems.

Feature extraction looks only at particular aspects of an unknown character's geometry, such as the number of loops, vertical lines and line endings. Thus, a "t" might be described as a short horizontal line, a vertical line, a small loop and four line endings, while an "o" might be characterized as a simple loop. As with

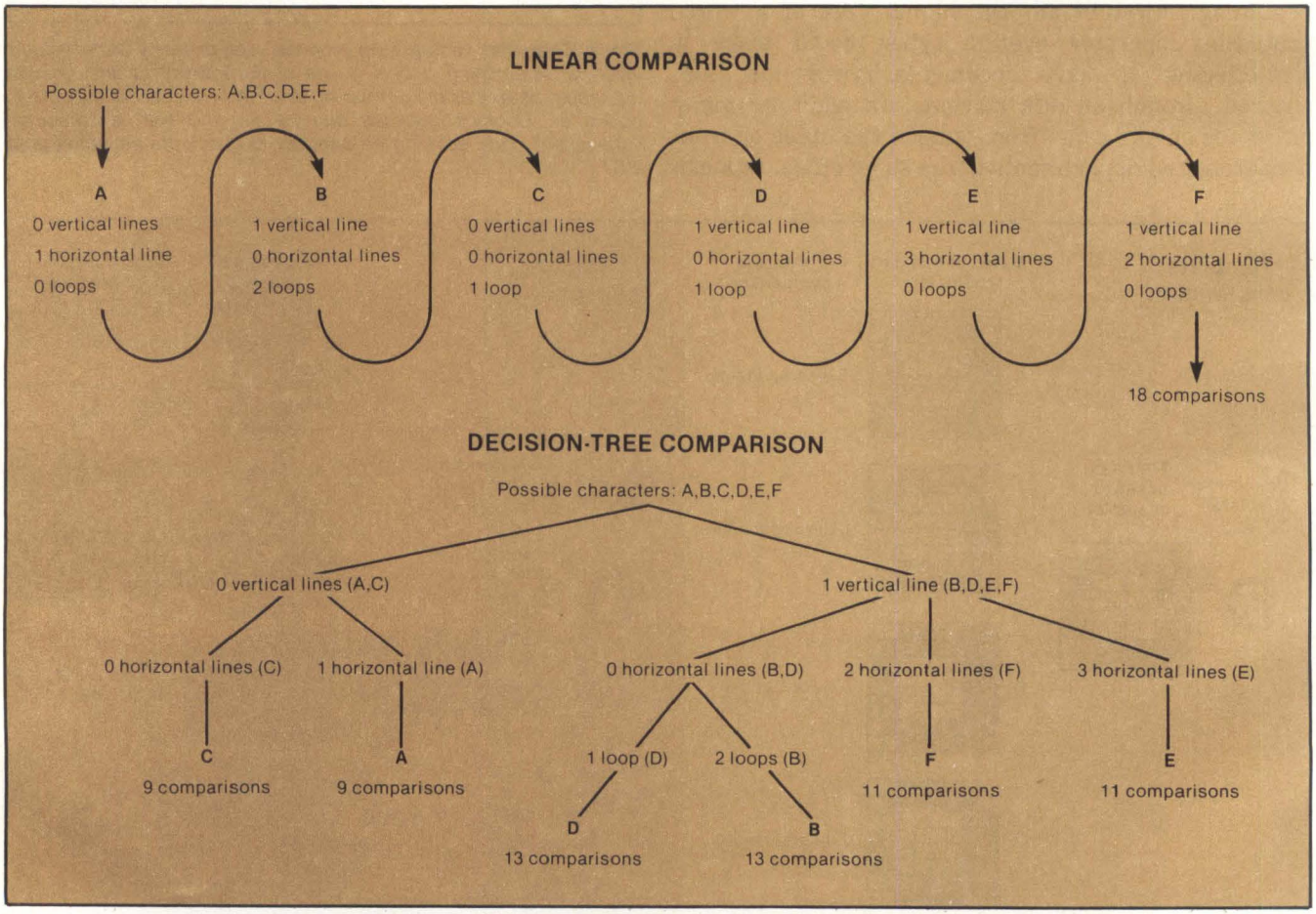

Fig. 3. Linear and decision-tree approaches to character comparison *are both used by OCR systems. The linear approach compares all information about the unknown character to all information about each standard character. The more sophisticated decision-tree techniques compare characters one feature at a time, eliminating unsuitable characters with each comparison and reducing the total number of comparisons necessary for identification. In the above example, which uses a 6-character set and three features for simplicity, a linear approach requires 18 comparisons, while a decision-tree approach needs as few as nine. Decision-tree techniques can also be applied to template construction, with characters being compared one pixel at a time.*

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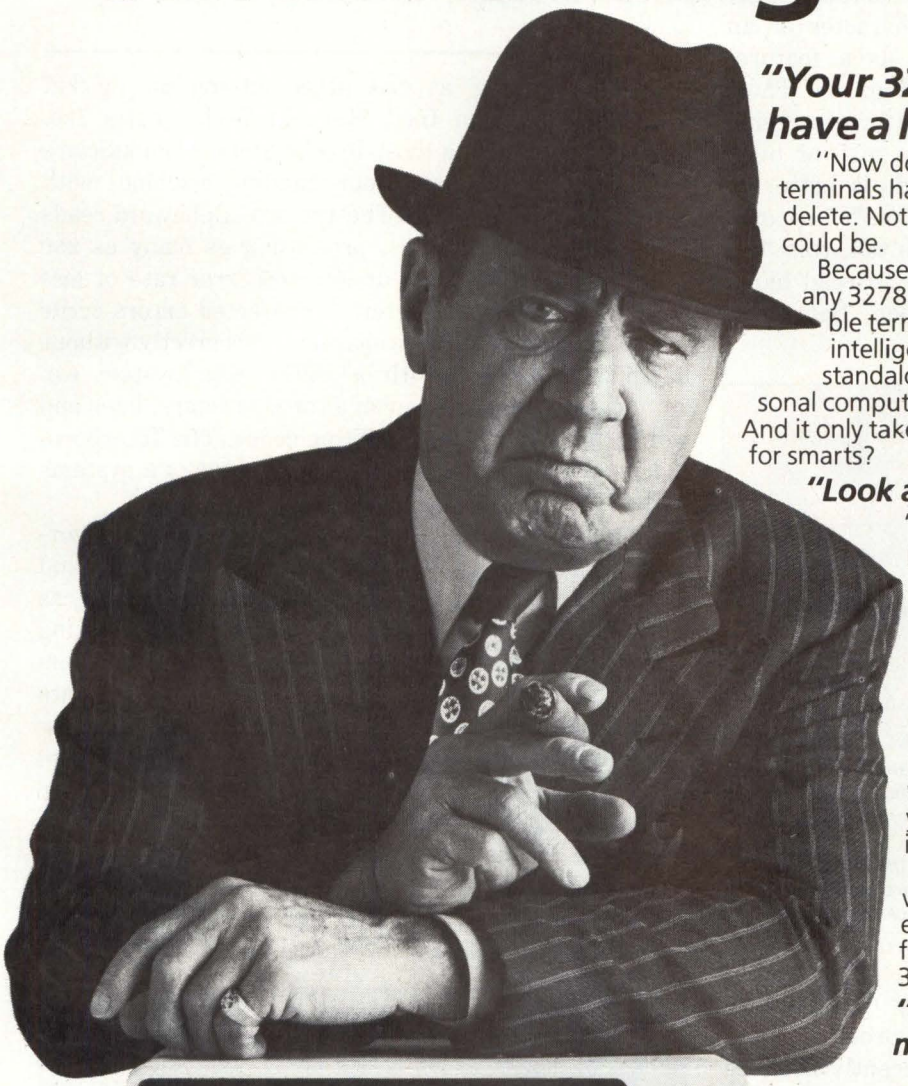

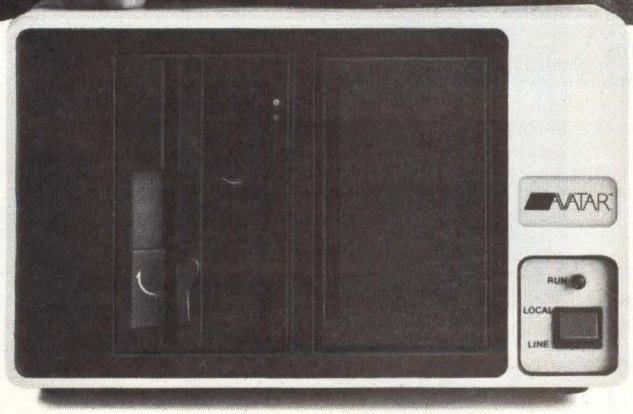

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template construction, this set of features is then compared to similar sets of features for each of a set of standard characters, and the best match is determined (Fig. 3).

Template construction is less sensitive to poor print quality and extraneous marks than feature extraction. As long as the basic character shape is intact, most of the pixels still coincide with those of the correct image. In feature extraction, a break in a character or an extraneous mark can be interpreted as a feature, throwing off the matching process (Fig. 4). Thus, template construction is often preferred for processing much-handled, "noisy" samples such as mail or bills. Feature extraction, on the other hand, is better at reading distorted characters: as long as an "o" appears as a closed loop, the system recognizes tall, thin "o"s and short, fat "o"s. Systems designed to read handwriting generally use feature extraction. Some machines combine both techniques.

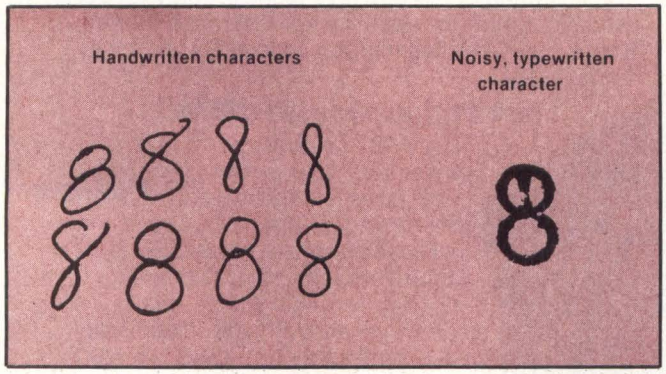


Fig. 4. Different character defects *are best handled by different recognition techniques. Distorted characters, typified by handwritten characters, can often be read by OCR systems using feature extraction, which ignores character shape in favor of simple geometric features. "Noisy" characters, such as those produced by defective typewriter slugs or copying machines, are most easily read with template-construction techniques, which look primarily for the overall character shape.*

After identifying a character, many OCR systems refer to a resident dictionary of words or word segments to determine if the most recently selected characters comprise a valid character group. Some systems also insert formatting codes compatible with those of popular word-processing systems.

OCR vendors

OCR systems are available from more than 20 U.S. vendors. Most of these vendors specialize in high-speed machines for forms processing, but many offer OCR products ranging from medium-speed document readers to hand-held wand readers.

The leader in OCR system sales is Recognition Equipment Inc., Dallas, with about one-third of the OCR market. REI's high-end systems, able to read more than 1500 forms per min., are too expensive to impact the office-automation market. REI also offers a $1500 hand-held wand system that reads a special character set. Designed for inventory control in point-of-sale applications, the Wand Reader has become a competitor of bar-code-reading systems. IBM Corp. is second in OCR sales, also marketing large forms-oriented systems.

OCR is available in desk-top units priced at nearly $5000.

Vendors aiming at the office-automation market include CompuScan Inc., Hendrix Technologies Inc. and Dest Corp. Like most text readers, CompuScan's Alphaword systems are floor-standing machines with automatic sheet feeders. The $27,000 Alphaword reads 30 type fonts at 120 cps, processing as many as 250 pages per hour with an undetected-error rate of less than 1 in 100,000 characters (undetected errors occur when a machine records a character incorrectly without flagging the error with a code). The system can automatically delete or even alter characters, lines and words through the use of editing codes. The Teterboro, N.J., vendor has installed more than 3000 OCR systems to date.

Hendrix, Manchester, N.H., offers a 150-cps, floor-standing machine that uses both template matching and feature extraction. The Typereader 3 stores as many as eight of 10 possible fonts, automatically recognizing acceptable fonts as it encounters them. Hendrix's Tom Jones claims the machine has an undetected error rate of 1 in 20,000 characters but points out, "Vendors' error rates are like EPA mileage figures: they depend on a lot of factors." The system is available in a Western Union-compatible version for message-processing applications.

Dest, San Jose, Calif., rocked the text-reading industry last year with the introduction of a $7000 desk-top OCR machine. The WorkLess Station reads at

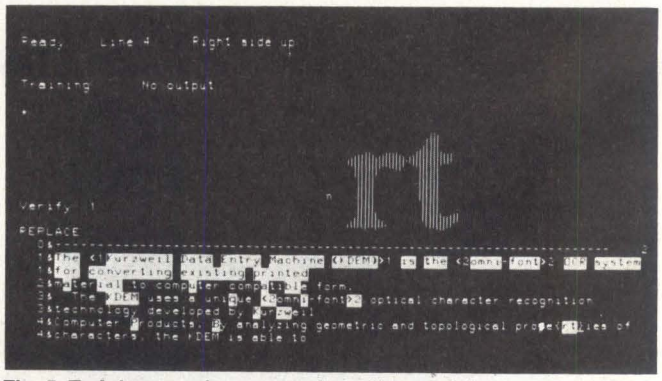
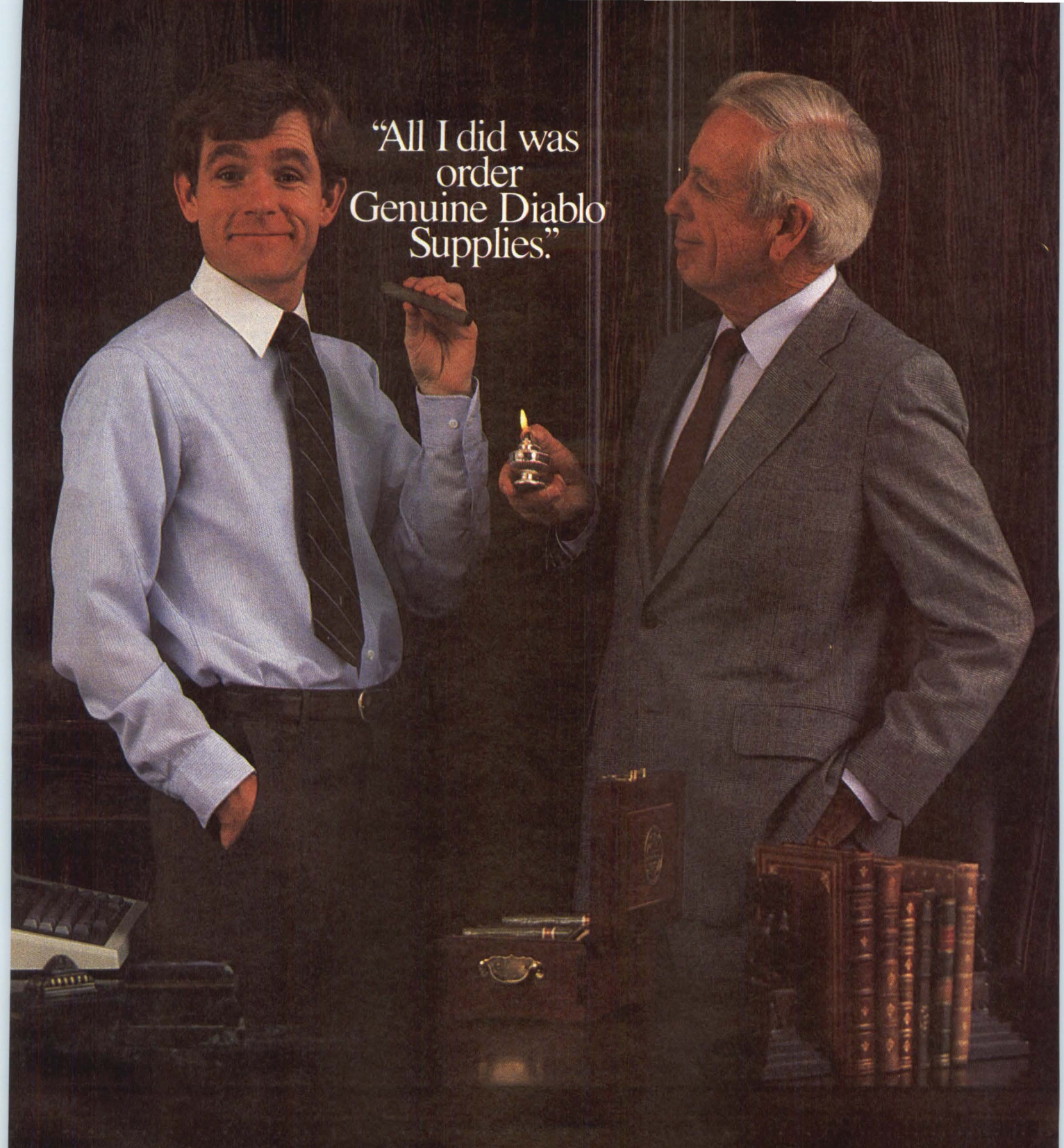


Fig. 5. Training-session screen from Kurzweil data-entry machine *shows a digitized image of characters requiring operator verification at center. As training session continues, the KDEM requires less and less operator verification, until a font has been "learned."*



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about 85 cps, or 145 pages per hour, with an undetected error rate of less than 1 in 30,000 characters. The machine selects the correct recognition font out of the possible eight it can store and automatically adjusts for page color and text contrast. Like most medium-speed machines, the WorkLess Station incorporates semi-custom VLSI technology and a photodiode array light detector under control of a resident 8085 microprocessor. However, its low price—about one-third that of most competing machines—and compact size could give Dest a lead in the office-automation OCR race.

One OCR vendor has managed to corner a segment of the market for itself. Kurzweil Computer Products Inc., Cambridge, Mass., offers the only available OCR system that is not font specific; that is, it can recognize any consistent typeface. Using principles of artificial intelligence, the Kurzweil data-entry machine "learns" a typeface in a 30-min. training session in which it guesses at characters and is corrected by an operator (Fig. 5). The KDEM is slower (35 cps), more expensive ($60,000) and has a higher error rate than other machines, but its ability to read typeset text (Fig. 6), as well as any typewritten font, has already won it about 125 installations.

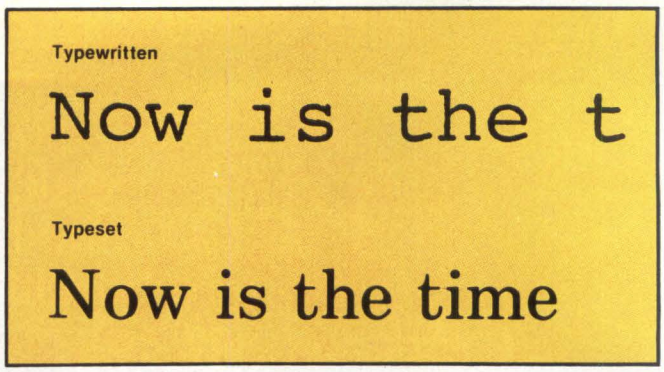

Fig. 6. Typewritten and typeset text *use different spacing techniques, preventing most OCR machines from reading typeset text. Typewritten characters, including spaces and punctuation, all receive the same amount of space in a line of text. Typeset characters use variable spacing, requiring sophisticated logic to locate characters. In addition, typeset characters are available in a wider variety of fonts than are typewritten characters. The only machine able to read most typeset text is the data-entry machine from Kurzweil Computer Products.*

Most experts agree that the next step for text readers is integrating OCR and facsimile equipment. This capability would allow machines to differentiate text from nontextual graphics on one page, storing the graphics as digitized images and the text as 8-bit characters. Such developments await the arrival of inexpensive, high-density storage, such as that promised by optical-disk technology, as well as reliable graphics-recognition algorithms. □

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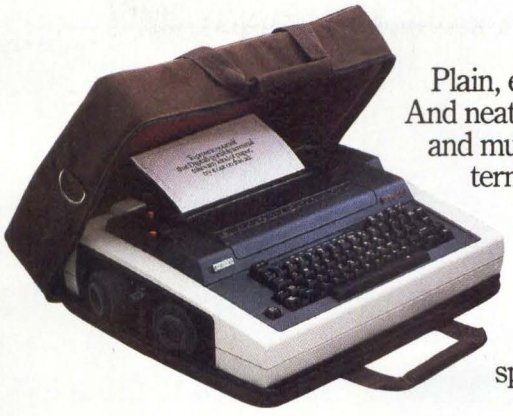

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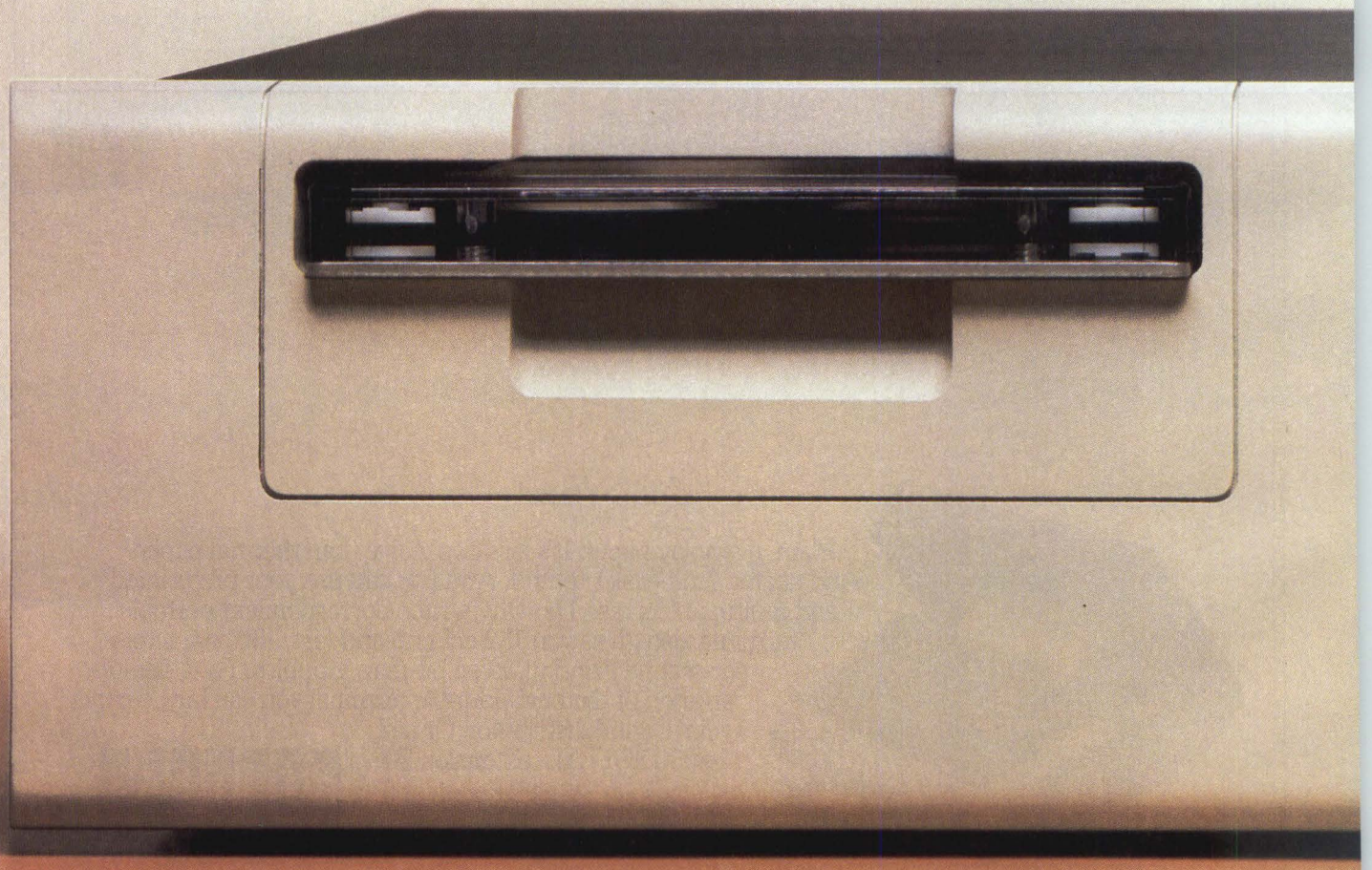

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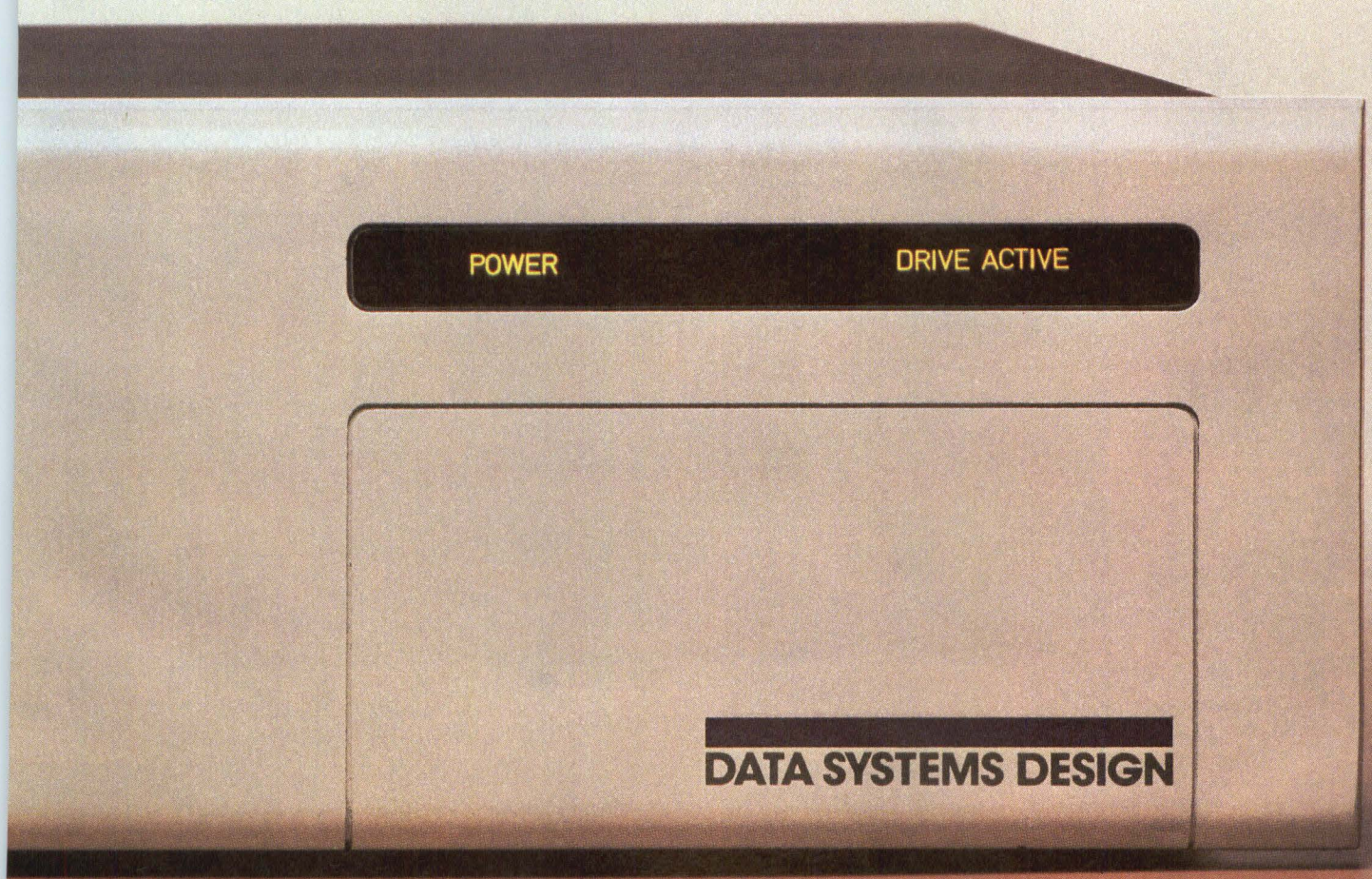

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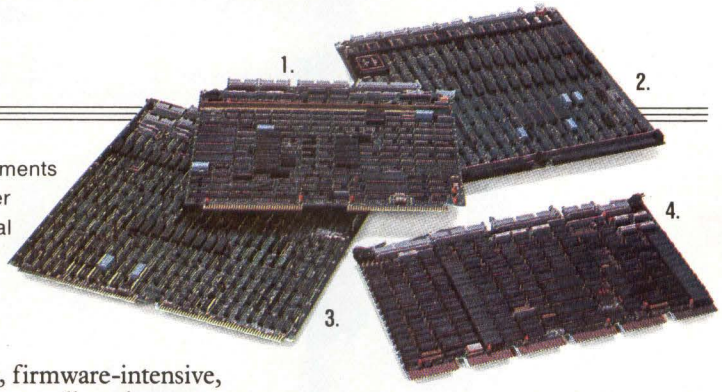

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CIRCLE NO. 123 ON INQUIRY CARD

MICROCOMPUTERS

68000-based supermicro uses distributed architecture

RON DeJOUNG, Onyx Systems Inc.

Intelligent I/O and memory management boost multi-user performance

Microcomputers with 16-bit architectures that operate with sophisticated multi-user operating systems such as UNIX need an internal design that can handle faster processing, rapid switching between tasks and strenuous memory-access requirements without degrading performance. An I/O channel-intensive architecture is one approach to these requirements, offloading system housekeeping and I/O manipulation from the main CPU.

One such "turbocharged" architecture is based on intelligent I/O channels and memory management. Onyx Systems Inc.'s 68000 system improves system performance by strengthening CPU-to-memory, CPU-to-I/O and CPU-to-disk throughput.

CPU to memory

CPU-to-memory data transfers in the Onyx 68000 system (Fig. 1) are aided by both the cache memory, which makes frequently requested data more accessible to the processor, and the memory-management unit, which maps data into and out of memory locations and divides main memory among simultaneous users.

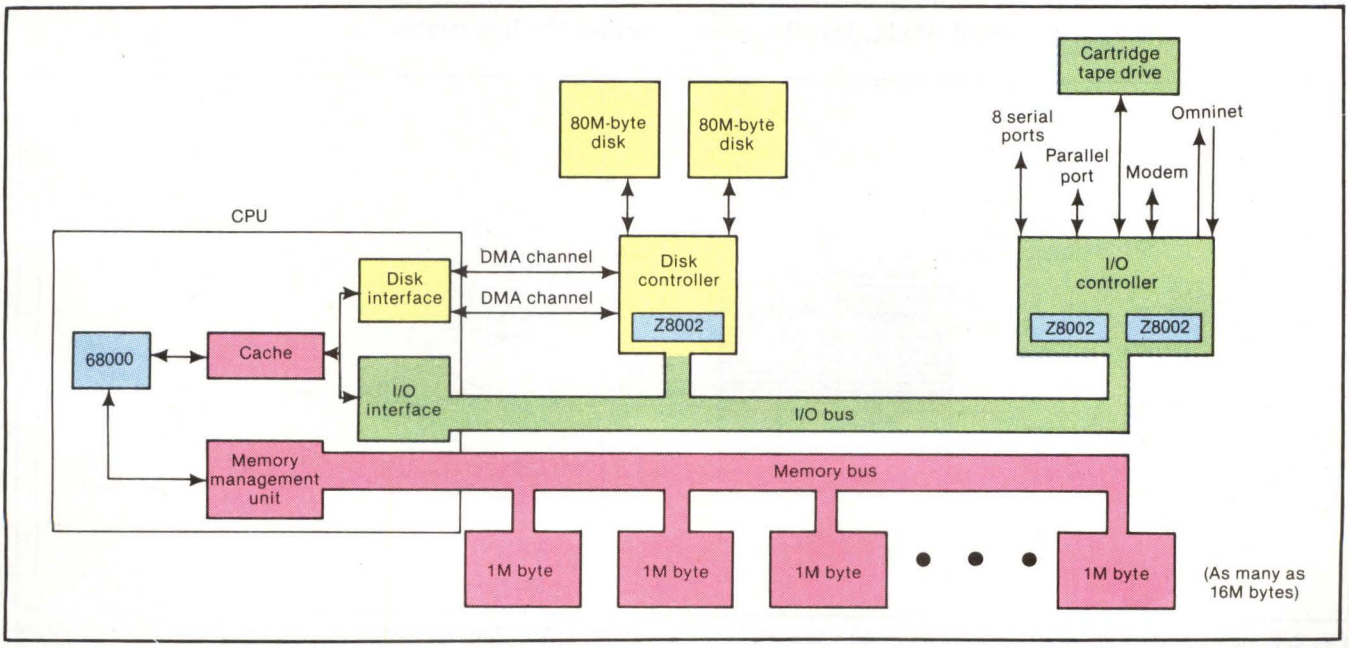

Fig. 1. Channel-intensive design. *The main CPU board contains a 12.5-MHz 68000 processor, a memory-management unit that governs memory accesses to cache and main memory, two intelligent disk channels with DMA and an I/O bus interface. The memory bus interface connects as much as 16M bytes of main memory with error-correcting code. Each of as many as four 8-in. Winchester disk drives has a dedicated 16-bit Z8002 control processor to optimize throughput. The I/O processor card houses dual Z8002A CPUs for support of as many as eight serial ports, a modem port, a parallel port and a cartridge-tape drive with as much as 12M bytes of storage.*

Cache. The Onyx 68000 system speeds memory access by using high-speed static RAM in an on-board cache memory residing between the MMU and the main memory. Main memory uses less costly dynamic RAM.

The cache memory is organized as a 1K- × 48-bit array. For each entry in cache, there are three separate fields: address, data and valid bit. When the processor or DMA master controller references main memory, it outputs a 24-bit virtual address and a 4-bit function code that specifies what type of memory access is desired, such as read, write, interrupt or supervisory (Fig. 3). The MMU compares bits 1 through 12 of the address against the address field contained in the selected cache entry. If they match, and the valid bit is set, a cache "hit" occurs, and the appropriate bytes from the data field of the cache are sent to the CPU. This cycle can be completed in less than 160 nsec.

If the desired data are not in the cache memory, a main memory cycle is initiated. When the data are ready, the cache address, data and valid bit are updated. In addition to the referenced word being loaded into cache, the 16-bit word with the next highest address is also loaded. This prefetch of the next word is useful because, during most sequential operations, the next program instruction is located in the next sequential address. This scheme considerably improves the hit ratio of the cache.

The cache is designed to operate as a write-through cache. The CPU checks the cache when writing to main memory; if a cache hit occurs, both the cache memory and the main memory are updated. If not, just the main memory is updated.

Memory management. The MMU maps the 1M byte to 16M bytes of main memory into as many as 16 segments. Each segment can be dedicated to one or more user processes and can be swapped quickly back and forth between memory and the disk. Main memory segments can be partitioned among as many as 31 concurrent user processes. Segments are allocated contiguous virtual address space even if contiguous physical memory is not available, and can be moved about the virtual memory space in 4K-word blocks.

To access main memory, the MMU looks at the first 4 bits of the 24-bit virtual address (Fig. 2). These 4 bits are used by a file called the "map RAM" to indicate which of the 16 segments are to be accessed. The second 8 bits in the virtual address are used by a "base address table" to specify one of as many as 256 pages comprising each segment. The last 12 bits of the virtual address select the appropriate word out of the 4K words in each page.

An 8K-byte block of the I/O processor memory can be selected to be in the 68000 address space.

If a segment were as large as its address space permitted, it would occupy 1M byte of physical memory. This would mean that even the smallest systems would require 4M bytes of memory to support a single user because the user and the system each require data and code segments. To avoid this excessive memory requirement, segment size can be limited by a file that specifies the last usable page in each segment.

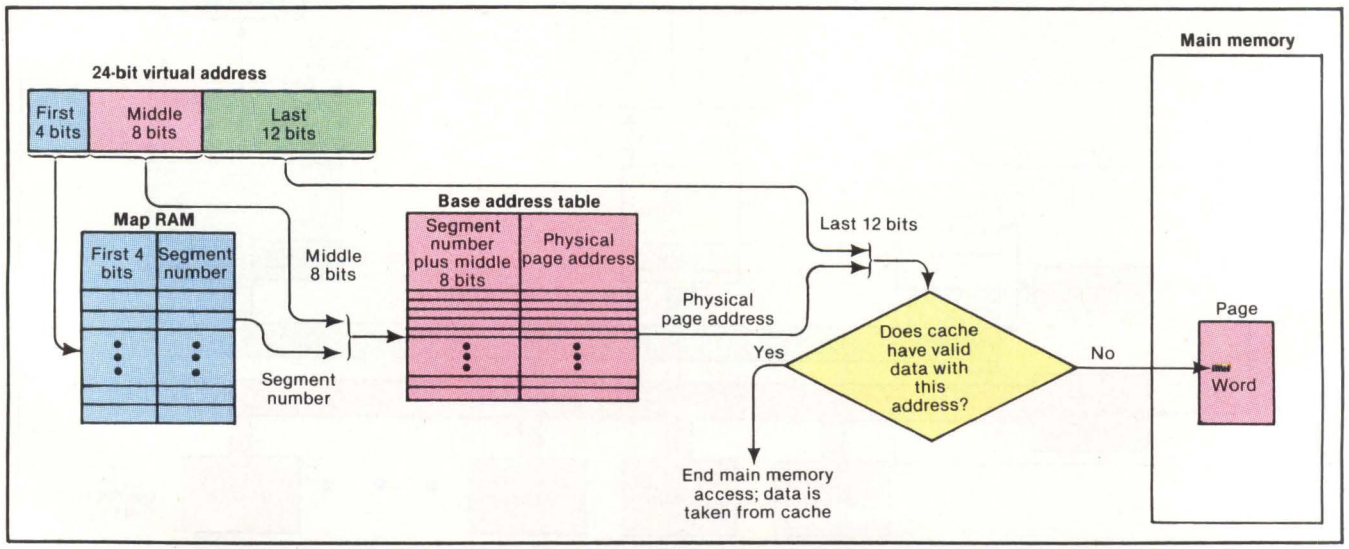

Fig. 2. A main-memory access *begins with a 24-bit virtual address issued by the CPU. The first 4 bits specifies a location in a file called the map RAM, which identifies one of 16 memory segments. This segment number is used with the next 8 bits of the virtual address to specify a location in a file called the base address table. The base address table returns the physical memory address of a 4K-word page within the selected segment (each segment comprises as many as 256 pages). The memory-management unit then checks to see if the required data are in cache. If they are not, then the last 12 bits of virtual address are combined with the page address to locate the required word in main memory. If a cache hit occurs, the data are taken from cache, and there is no main-memory access.*

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CIRCLE NO. 124 ON INQUIRY CARD

CPU to I/O

The I/O interface (Fig. 3) is controlled by two Z8002 CPUs and associated control circuitry. The interface is mated to the main 68000 bus via control, address and data lines. The I/O bus interface is a time-multiplexed bus consisting of 17 address lines and 16 bidirectional data lines. A subset of 68000 control lines is included so that the main 68000 CPU can selectively access as much as 128K bytes of I/O processor shared memory. A DMA channel for I/O transfers results in a memory bus usage of 23.4 percent and a data rate of 900K bytes per sec.

One of the Z8002s (CPU/A) controls the serial and parallel ports, and the other (CPU/B) controls the network and tape backup. Each Z8002 runs at 6 MHz and has 8K bytes of EPROM, 4K bytes of static RAM, 128K bytes of dynamic RAM and the I/O bus interface. A mapper allows each Z8002 to address more than the 64K bytes of RAM it normally can address. The bottom 32K bytes of the address space is the same as the physical memory. The mapper selects one of four 32K-byte segments when addressing the top portion of memory.

An external bank-select register and a communication register permit inter-CPU communications and control of the I/O memory. Both can be written and read by the 68000 or either Z8002. Using the bank-select register, an 8K-byte block of the I/O processor memory can be selected to be in the 68000 address space. The communications register has control bits that can be set to allow either processor to interrupt the other, to allow the 68000 to reset either Z8002 and to enable or disable parity checking on 68000 memory reads.

Memory segments can be dedicated to one or more user processes, and can be swapped quickly back and forth between memory and disk.

The two control registers are addressed as memory-mapped I/O ports in the 68000 and as I/O address space in the Z8002 I/O space. Rather than use two addresses out of the 8K-byte shared memory space, the hardware registers occupy part of another 8K-byte page. Thus, each Z8002 processor uses 16K bytes of the 128K-byte

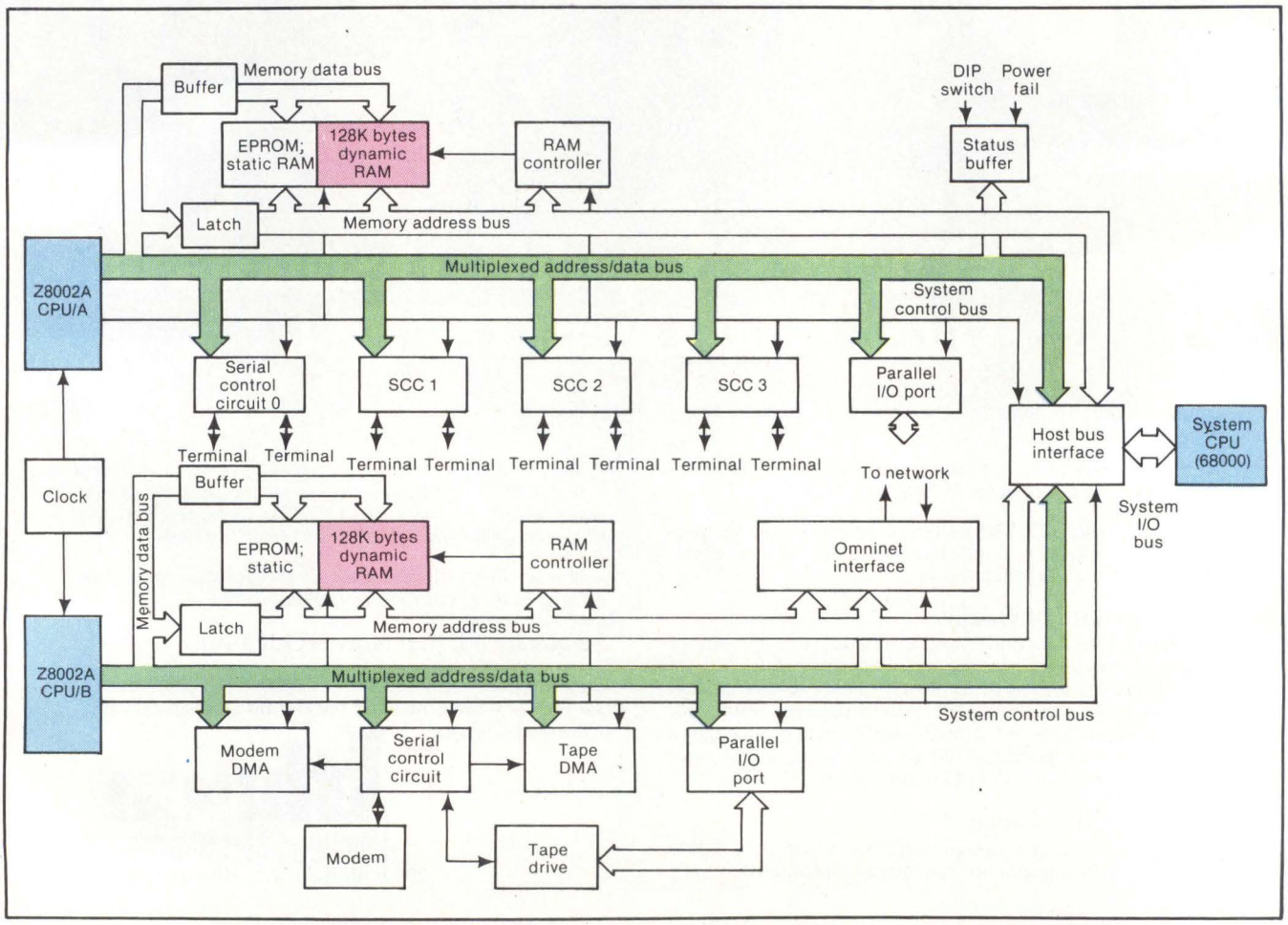


Fig. 3. The I/O interface *is based on two Z8002 CPUs, one (CPU/A) controlling eight serial ports and one parallel port, and the other (CPU/B) controlling modem and network interfaces. Each CPU has 128K bytes of local RAM, which is also accessible by the system CPU.*

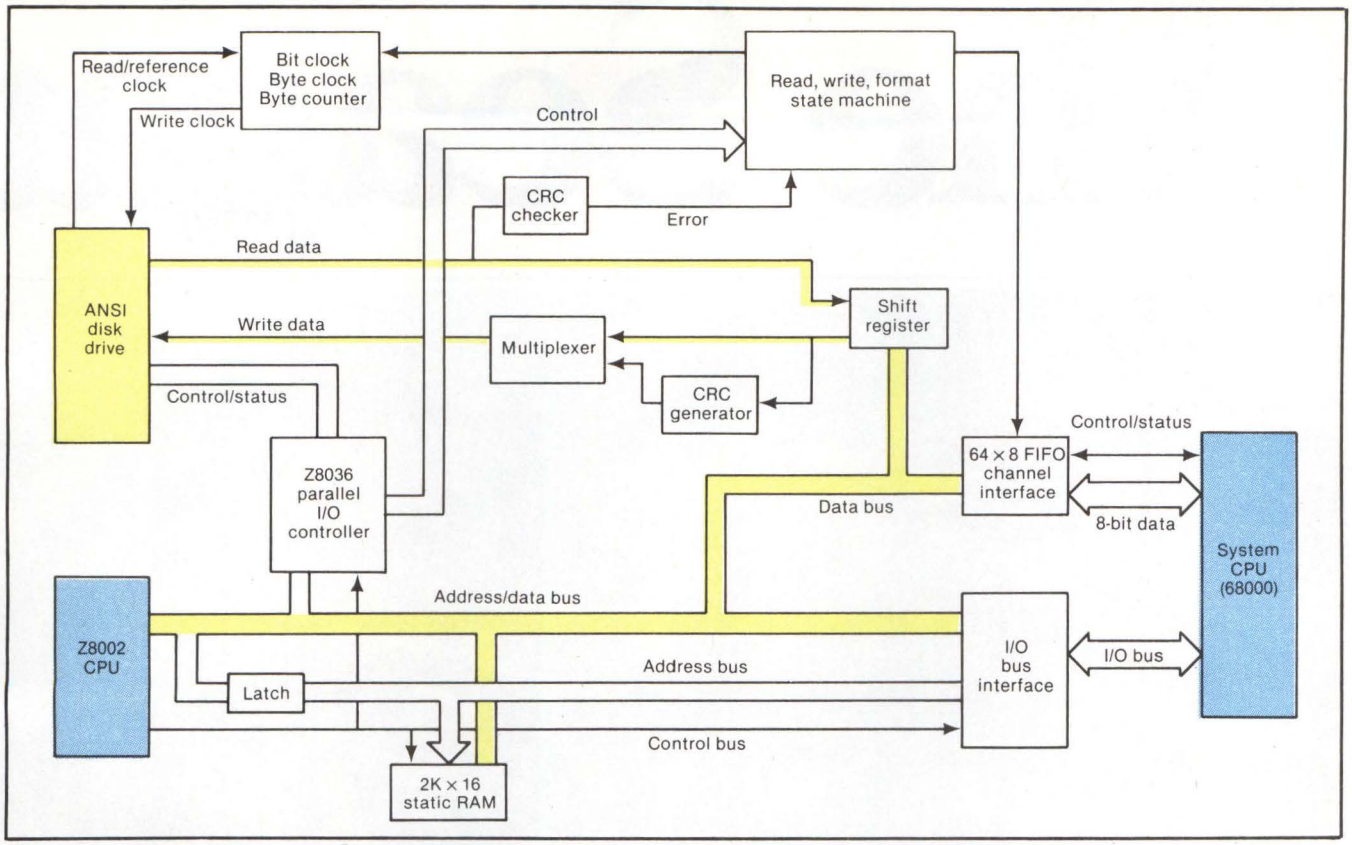


Fig. 4. The disk interface *incorporates a Z8002 CPU that receives commands and operating software from the system CPU. Data are transferred from the disk to the FIFO channel interface buffer in bytes, and then sent to the memory in a 32-bit DMA transfer controlled by the system CPU.*

I/O addressing range of the 68000. A DIP switch on the I/O board determines where the 16K-byte page will be located in the 68000 I/O space.

When the 68000 accesses the I/O bus, the Z8002 that is being addressed is bus requested. Once it has relinquished the bus, the 68000 will be allowed to read or write memory or the hardware registers.

CPU/A has four dual serial communications controllers, counter/timer circuits, parallel I/O and a calendar with battery backup. Each of the eight serial ports has its own programmable baud-rate generator. CPU/B has one dual serial communications controller, counter/timer circuits, two DMA chips for controlling the cartridge-tape drive and the modem port and a local network interface.

Interface

Like the I/O controllers, the disk controller (Fig. 4) uses a Z8002. The disk interface board also contains 4K bytes of static RAM, an I/O bus interface, a CPU DMA channel interface and the ANSI X3T9 disk interface.

Operating software and commands are sent to the Z8002 from the 68000 via the I/O bus. When a data transfer is to occur, the 68000 sets up its DMA channel and then signals the Z8002. The Z8002 then activates the disk control logic, and data are transferred through the DMA channel.

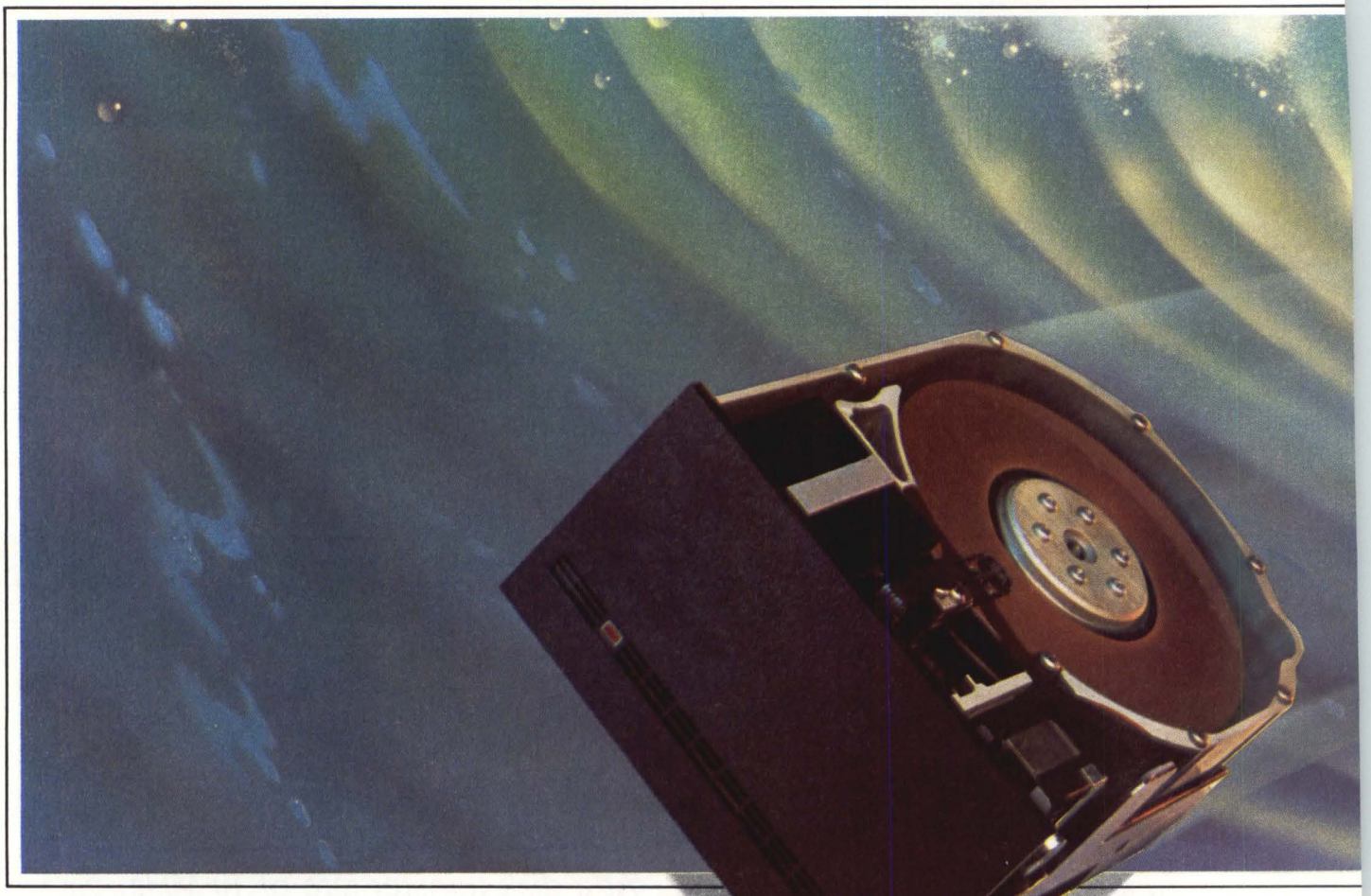
The disk I/O bus interface is similar to that of the I/O processor boards in that the 68000 CPU can access the local 4K-byte memory and all of the I/O ports. The Z8002 is held in a reset state while the 68000 is down-loading or controlling the hardware registers. These registers are memory mapped so that the 68000 can easily access them.

At a disk transfer rate of 10 MHz, data arrive at the FIFO buffer at a rate of 1.25M bytes per sec.

The CPU channel interface transfers data from the disk to the CPU. As data are read from the disk, the data are first stored in a 64- × 8-bit first-in-first-out register file. The output of the FIFO is connected to an 8-bit data bus controlled by the disk interface logic on the CPU board. After 4 bytes have been transferred to the CPU board, the DMA controller transfers them into the main memory. At a disk transfer rate of 10 MHz, data arrive at the output of the FIFO at a rate of 1.25M bytes per sec. This sequence continues until all of the requested sectors are transferred. □

Ron DeJoung is product marketing specialist at Onyx Systems Inc., San Jose, Calif.

The Seagat



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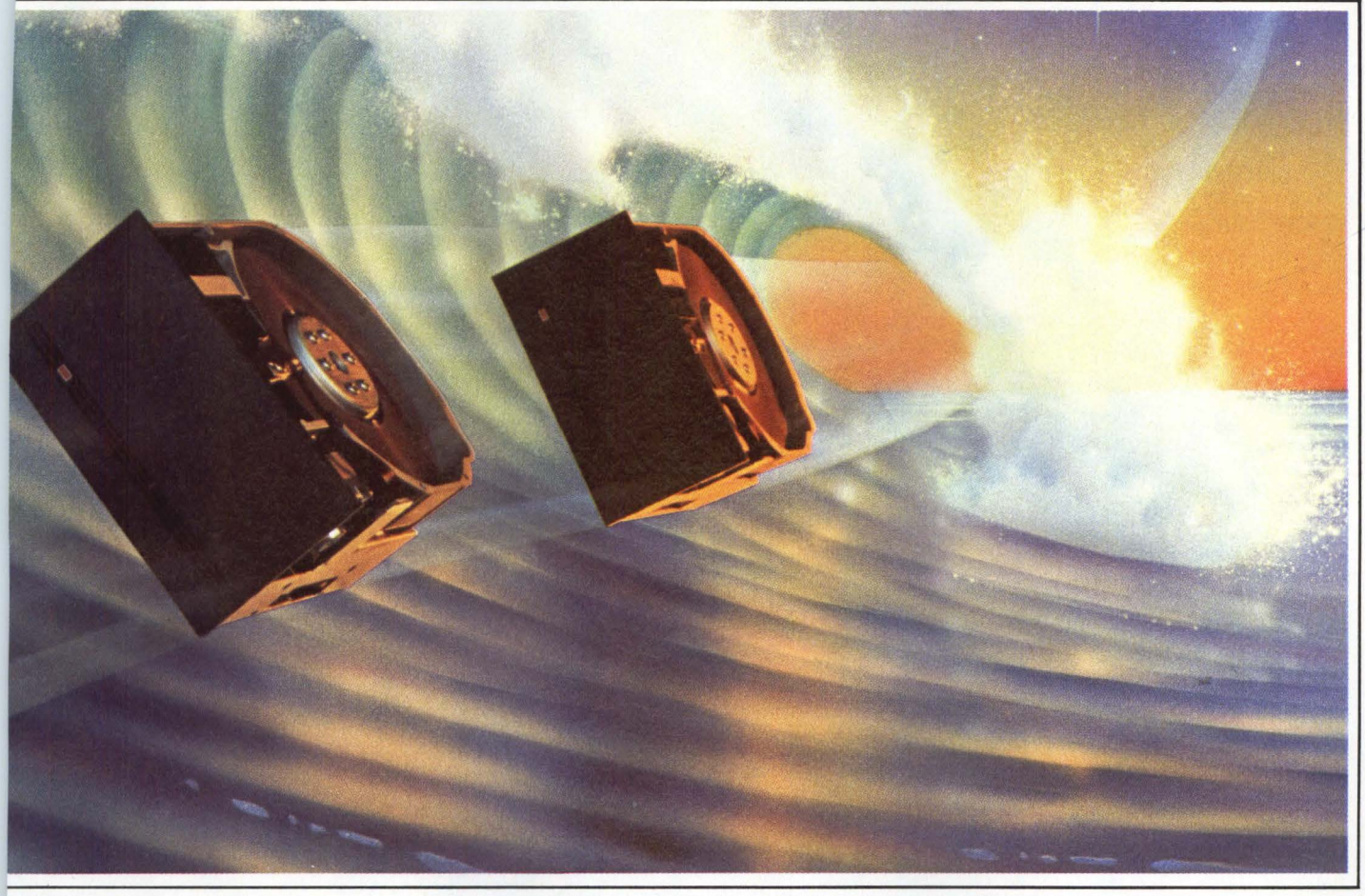

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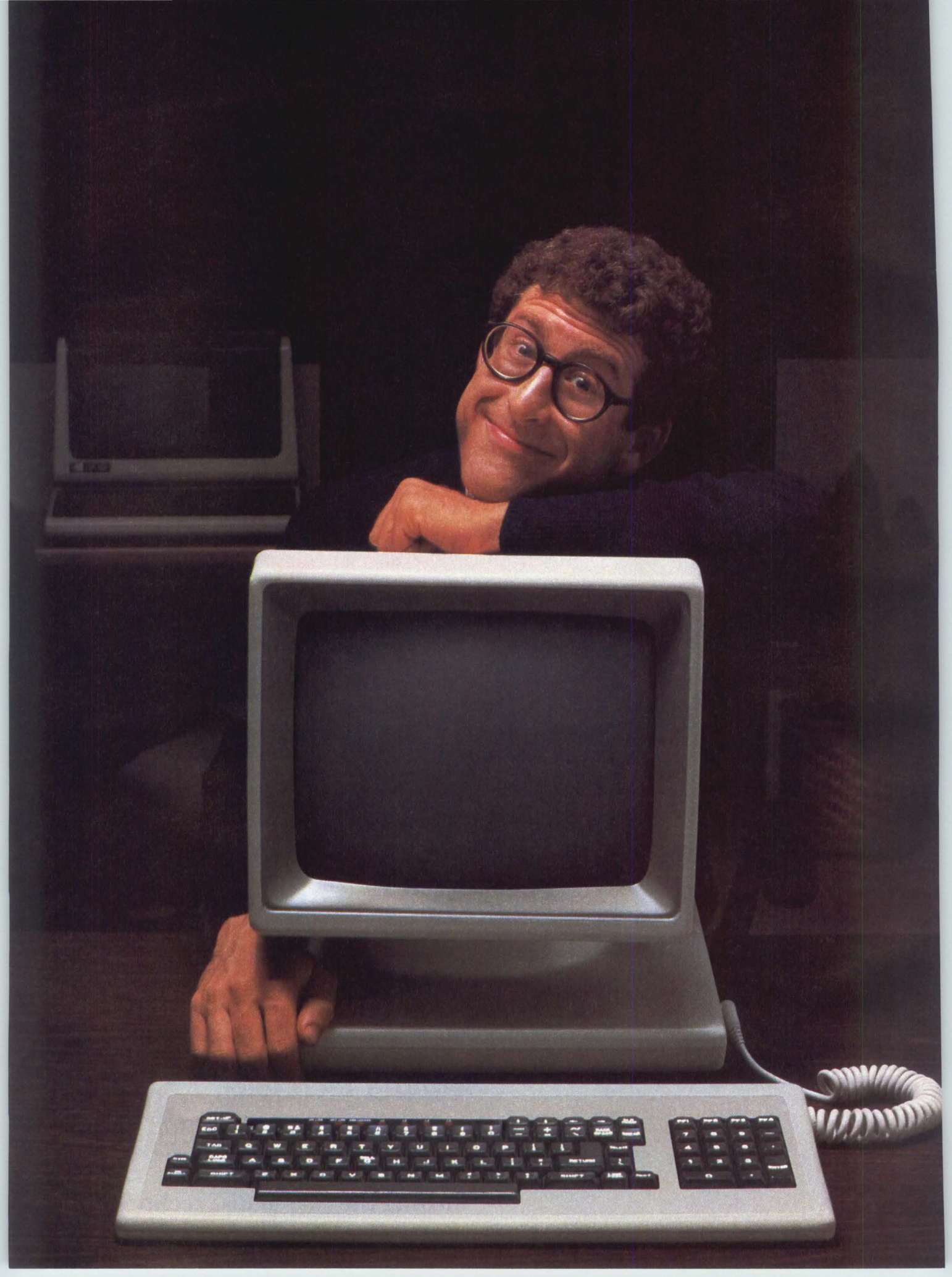

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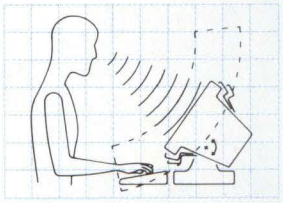

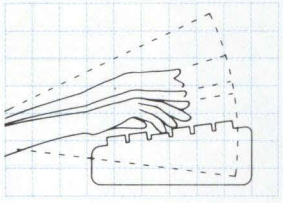

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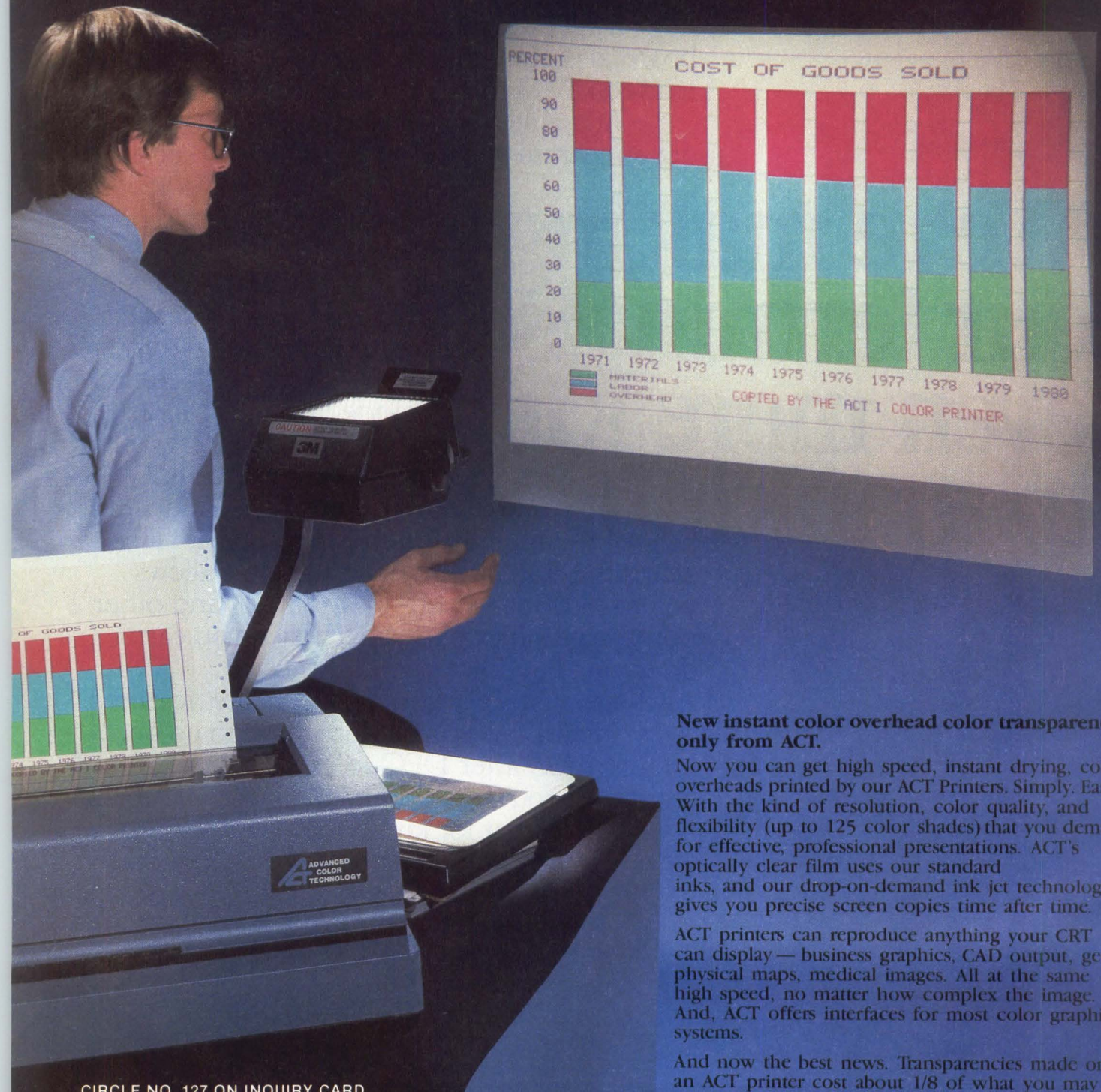

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DISK DRIVES

Thin film encroaches on both ends of disk market

DENNIS WAID, Peripheral Research Corp. and
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More large- and small-disk drive vendors looking to bolster storage capacities are turning to thin-film heads and media

Storage densities on magnetic media have increased from 2.5M bits of data per sq. in. in 1973 to 12M bits per sq. in. in 1981, and are forecast to grow to 50M bits per sq. in. in 1986. The density increases to date result both from improvements in recording techniques and from evolving Winchester disk technology. Additional density increases are now being realized through new materials that are supplanting conventional oxide disks and nickel zinc heads.

Most thin-film media will be introduced in low-end 5¼-in. and smaller products and then graduate to larger disk drives over the next few years. They will initially be used with manganese zinc heads, which are marginally more expensive than nickel zinc heads yet have significantly greater storage capacity. Thin-film media appeals to small disk-drive manufacturers because of its durability, increased signal-to-noise ratios and economics.

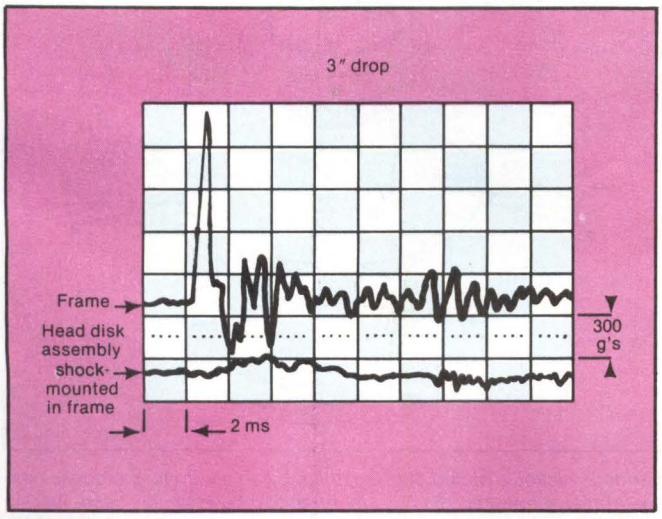

Fig. 1. A 5¼-in. disk drive dropped from 3 in. *causes a 1500g shock to the frame and a shock to the head disk assembly of at least 100g.*

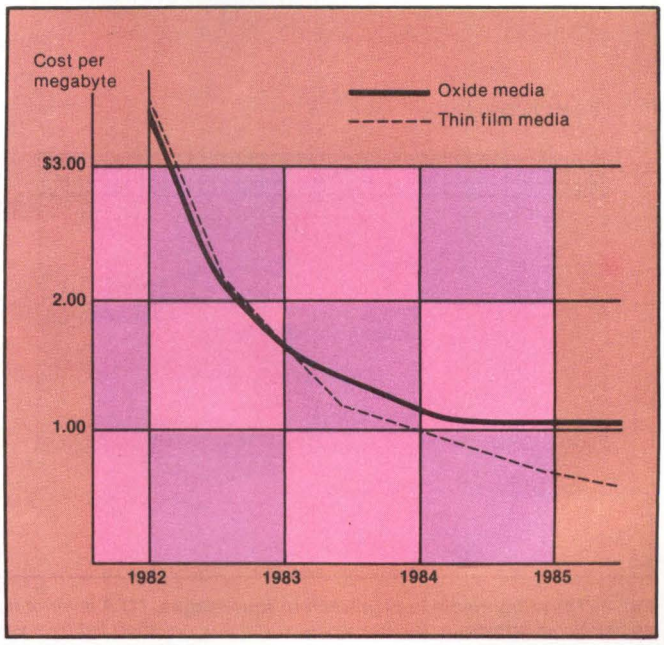

Fig. 2. Cost per megabyte on 5¼-in. thin-film media *will soon fall below that of oxide-coated media as more thin-film manufacturers improve production techniques.*

THIN FILM MEDIA PRODUCTS					
	DISK SIZE (INCHES)				
COMPANY	3.9	5¼	8	14	FUTURE PRODUCTS
AMPEX					X
BURROUGHS				X	
EVOTEK		X			
HI-TRACK			X		
INTERNATIONAL MEMORIES INC.		X			
IRWIN INTERNATIONAL		X			
NEW WORLD COMPUTER		X	X		
OLIVETTI		X			
SYQUEST	X				
TANDON		X*			
TEXAS INSTRUMENTS		X			

*Planned

Because of its hardness, thin-film media is less prone to damage during shipping and can handle the portability requirements of the personal and small-business computer markets. Media hardness can be measured by the impact on a drive when it is dropped 3 in. on its edge onto a desk top (Fig. 1). The outside frame will receive a ½-msec. shock impulse of approximately 1500g forces. Even if the drive were well-protected with properly designed shock mounts isolating the head disk assembly from direct impact, the head disk interface would be subjected to approximately 100g forces. To appreciate the impact, note that the standard 3350 flexure leaves the disk and slaps back at 40g.

When the head bounces on particulate media (oxide), particles are jarred loose, causing errors and often catastrophic head crashes. A thin-film coating can withstand many hundreds of gs, and thus the failure mechanism becomes the hardness of the disk's aluminum substrate, which "dents" at about 150g, with no debris generated. Because plated media is three to four times more shock-resistant than unplated media, it is less susceptible to head crashes, and the failures made will be only occasional data errors. Another advantage of thin-film media is its 2:1 higher signal-to-noise ratio over oxide media. As disk media decreases in diameter, the surface velocity of the data domains below the head is also reduced proportionally, which then lowers signal. Since 5- and 3-in. drives are exposed to relatively uncontrolled noisy environments, such as factories and offices, the increased signal-to-

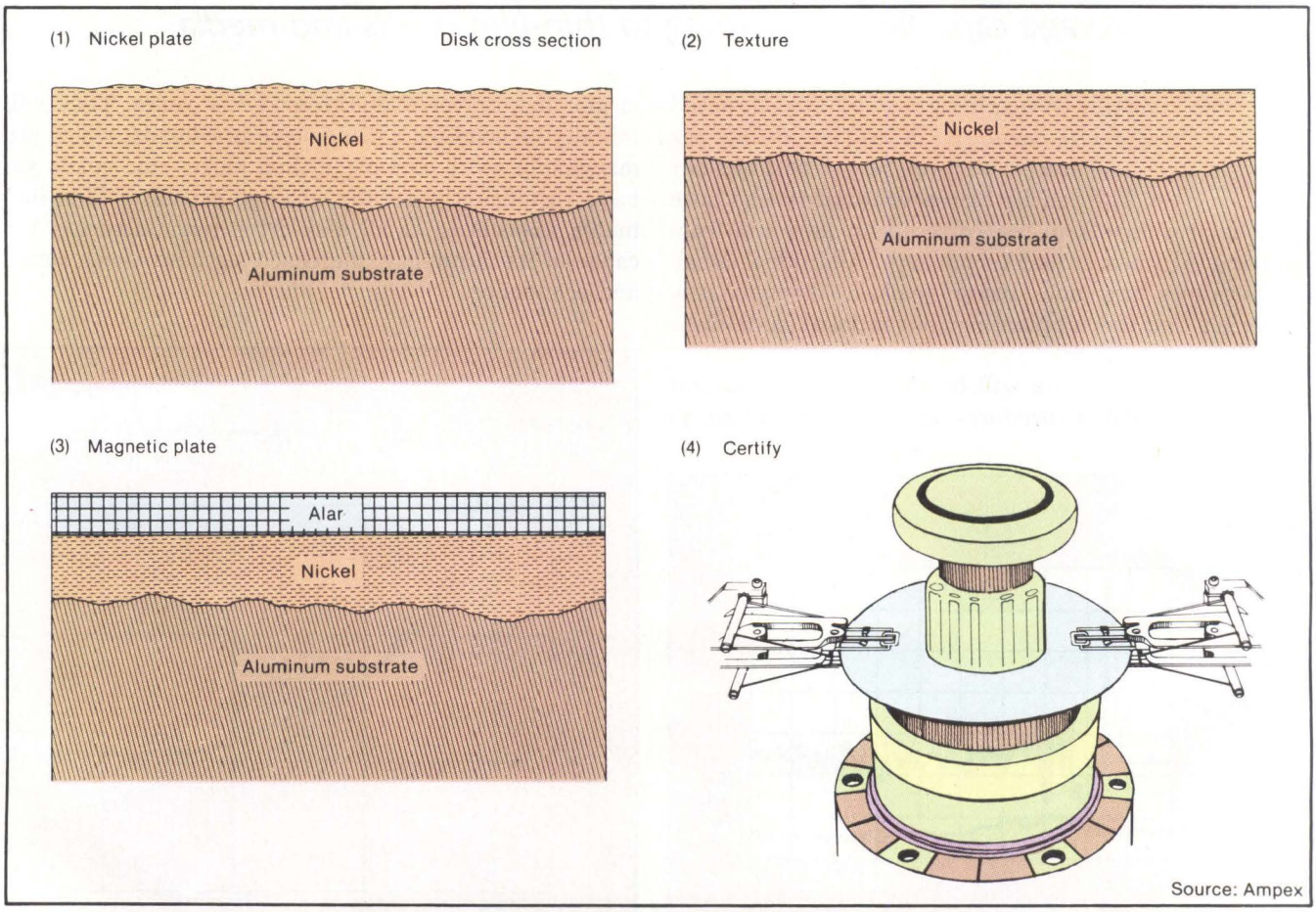

Fig. 3. Thin-film media is produced in four stages. *(1) A layer of nonmagnetic nickel is plated 800 μin. thick by an electroless process onto an aluminum substrate. (2) The nickel surface is polished flat by a very fine abrasive material. (3) A 3-μin. magnetic layer (in this case, Alar) is plated by an electroless process onto the nickel. This surface replicates any imperfections in the nickel. (4) The disk is then tested for high spots, defects such as drop-outs and drop-ins (missing or extra pulses), resolution and signal-to-noise ratio. Based on the number and types of defects, the disk is rated for commercial use.*

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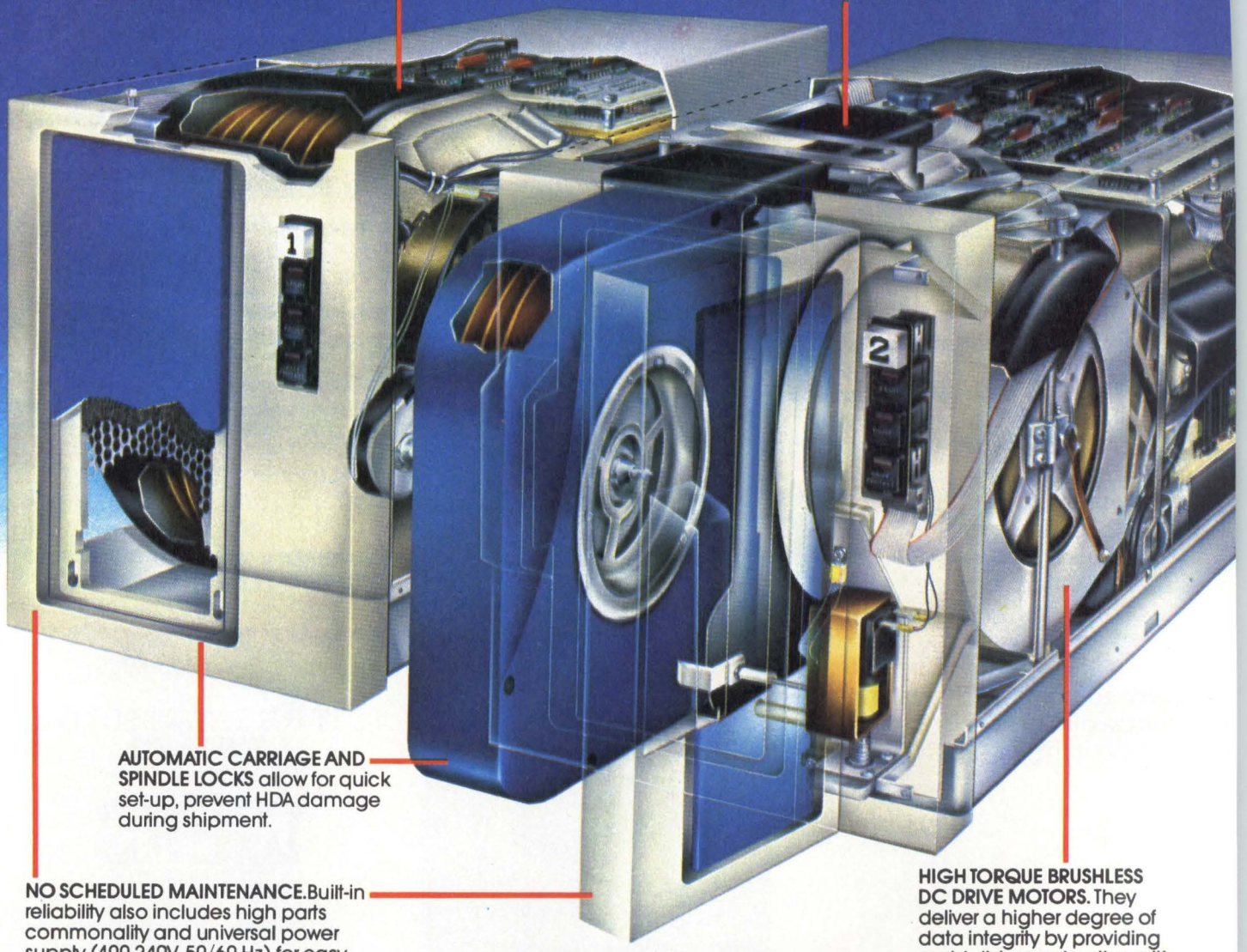

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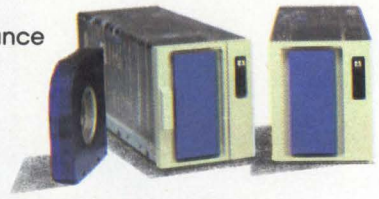

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CIRCLE NO. 129 ON INQUIRY CARD

noise ratio of thin film provides greater noise immunity.

The economics of plated media are also attractive. A 5¼-in., thin-film disk in low production volumes is cost-competitive with the equivalent oxide disk, and as the volumes build and the learning curves are realized, it should become less expensive (Fig. 2).

Despite its benefits, thin-film media has been hindered in the market by a lack of thin-film manufacturers. In the experimental stages since the mid-1960s, thin-film media was early evaluated by companies such as IBM Corp., Burroughs Corp. and NEC Information Systems, Inc. Until recently, however, there had been no reliable consistency coating in production volumes (Fig. 3). Ampex Corp. and Poly Disc Systems Inc. were initially the only suppliers, with Ampex being the early leader in volume production for the 5¼-in. disks. For this reason, Ampex appears to be the driving force behind the acceptance of the technology from the media manufacturers' standpoint. But other firms have since joined the fold, including AIM, Advanced Disk Technology, Datapoint, Fujitsu, Syquest, Tandon Computer Communications Technology Corp., IBIS Corp. and FCI Magnetics.

Because of its hardness, thin-film media is less prone to damage during shipping and can handle the portability required in the personal and small-business markets.

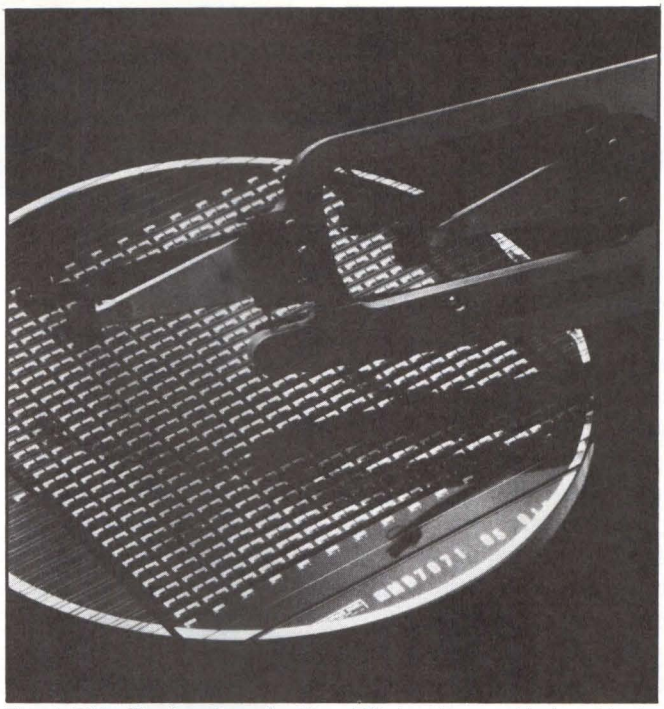
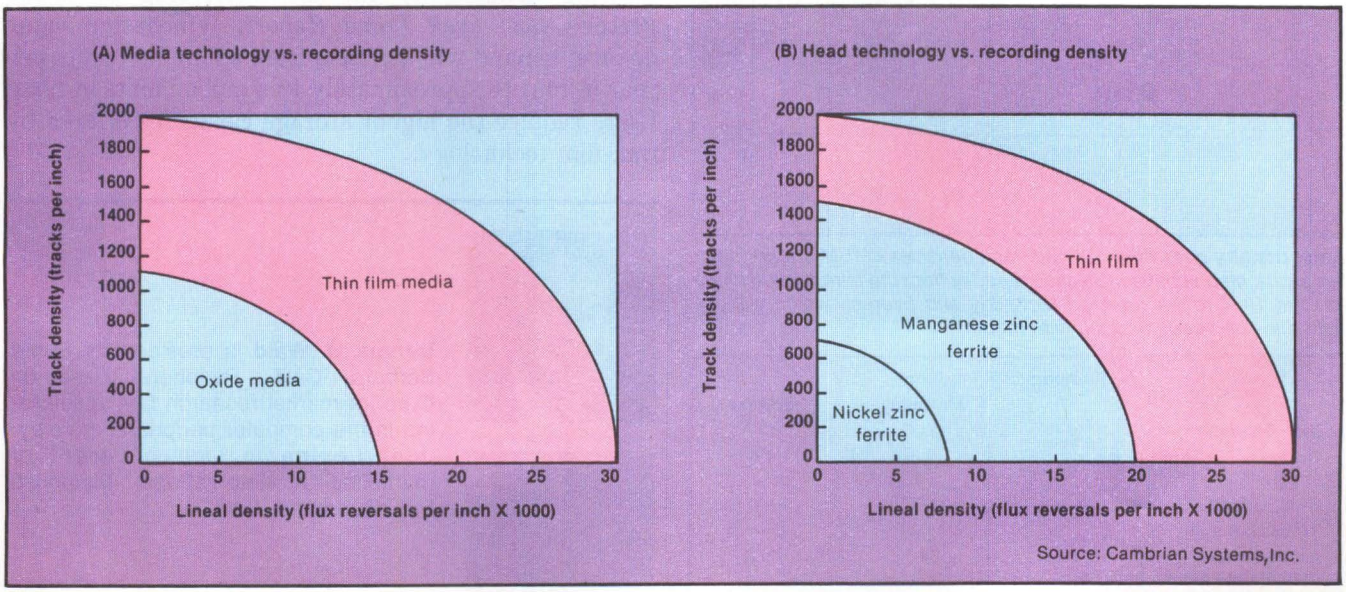


Fig. 4. Thin-film head production. *This head assembly (used in the 3380) has four sliders that are produced using semiconductor technology. Hundreds of magnetic circuits are deposited onto a wafer, which is then sliced and machined to form hundreds of one-piece integrated sliders.*

The first moving-head disk companies to use thin-film media are listed in Table 1. Of these companies, International Memories Inc. had more than 20,000 5¼-in. disk drives in the field at the end of 1982 using thin-film media from Ampex and Poly Disc. During the last 12 months, IMI has found thin-film media to be producible and consistently high in performance.



Thin-film versus other technologies. *(A) A comparison of bit and track densities for thin-film media (in this case, assuming thin-film heads) and conventional oxide particulate media shows the higher areal density of plated media. (B) Thin-film-head technology also achieves greater areal density than manganese zinc ferrite and conventional nickel zinc heads.*

Thin-film heads

Thin-film-head technology promises higher capacity per square inch than thin-film media and perhaps eventually lower cost. However, lower production volumes have limited price/performance, and consequently, thin-film heads are found only in high-technology 14-in. drive. With a $100,000, gigabyte-capacity drive, the premium cost of a thin-film head is affordable.

The anticipated advantages of thin-film technology are lower cost products because the manufacturing process is similar to the high-volume process used in the semiconductor industry (Fig. 4), a 4:1 improvement in bit and track densities and better and more consistent production yields.

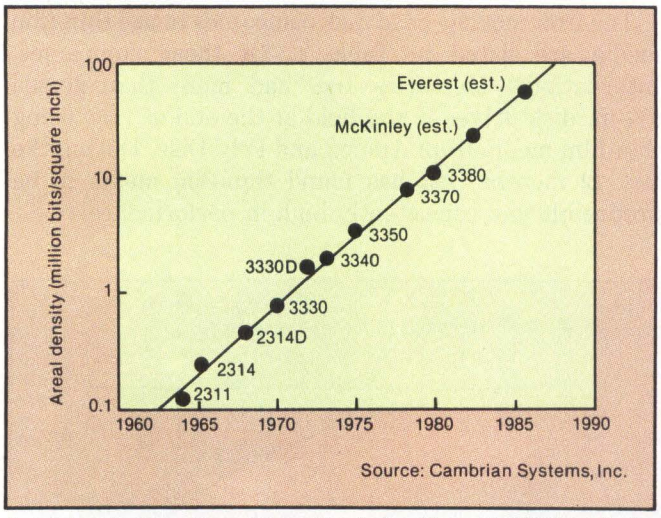
Industry concentration on thin-film magnetic-head technology began during the early 1970s with research by IBM Corp. and Cii Honeywell Bull. However, the technology has proved to be far more complex than anticipated, causing four- to six-year delays in volume productions and higher costs than originally forecast. IBM was expected to use thin-film heads in the mid-1970s and did not start delivery until 1979. Thin-film heads are available today in evaluation samples from independent manufacturers such as Applied Magnetics Corp. and Magnex Corp. at four to five times the cost of conventional manganese zinc technology.

Present or intended manufacturers of thin film heads	Disk drive manufacturers using or planning to use thin film heads
Applied Magnetics Corp.	Applied Peripheral Systems
Control Data Corp.	Control Data Corp.
Dastek	Cii Honeywell Bull
Magnex	Dastek
Memorex	IBIS
Cii Honeywell Bull	Memorex
Cybernex	Nippon Peripherals Ltd.
Infomag	Storage Technology Corp.
Advanced Recording Technology	

Several companies that are gearing up for thin-film-head manufacturing or are planning to use the technology in their products are listed in Table 2. With IBM taking the lead in thin-film-head technology, it is expected that the first independent applications will be for the plug-compatible 14-in. disk-drive market.

A 5¼-in., thin-film disk in today's low production volumes is cost-competitive with the equivalent oxide disk, and as volumes build, it should become less expensive.

Based on industry forecasts, it will be several years before thin-film production capabilities can support the growing demand for its use. According to James Porter's *1981 Disk Trend Report*, Winchester slider flexure demand will increase from 3.5 million units per year in 1981 to approximately 13.5 million units in 1985. Users require the higher storage capacities offered by thin-film technology. □



Areal density over time. *Bit and track densities of IBM entries in the large-disk market have increased steadily from the introduction of the 2311 in 1964 to the rumored McKinley and Everest, which will use both thin-film heads and thin-film media.*

Rumored IBM Products		
	McKinley	Everest
Disk Diameter	14″	14″
Capacity Per Spindle (gigabytes)	2.6	4.8
Bits per inch	24,000	—
Tracks per inch	1,000	—
Areal density (million bits per sq in.)	24.0	50.0
Head type	Thin film	Thin film
Media	Thin film	Thin film

Dennis D. Waid is president of Santa Barbara, Calif., Peripheral Research Corp., a market research firm specializing in the computer peripheral industry. **Joel Levine** is vice president of marketing at International Memories Inc., Cupertino, Calif.

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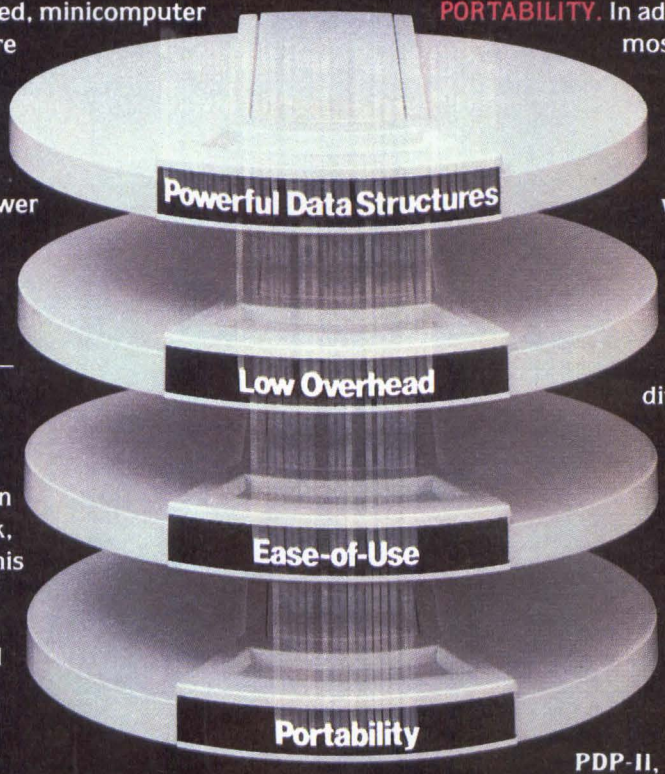

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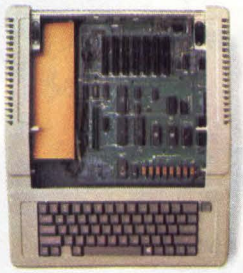
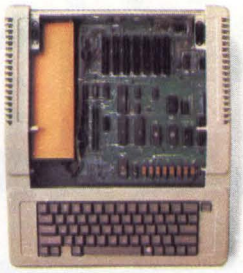
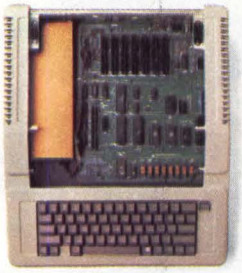


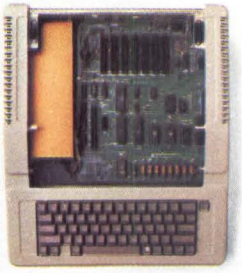
Advanced Information Systems
Computer aided drafting



Varian Associates, Inc.
UV Spectrophotometry

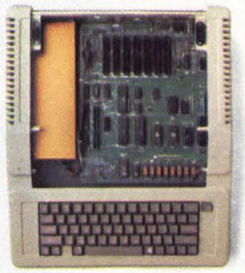


L&S Computers
Personnel profiling systems

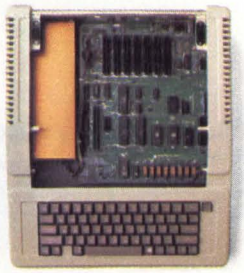


Rockwell International
Truck fleet management

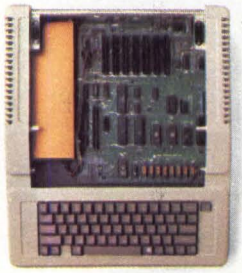
Gentech
Interactive video training



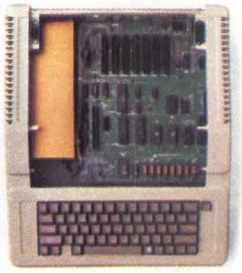
Farm Plan, Inc.
Agricultural software



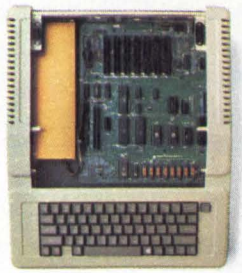
Core Technology
Burroughs terminal emulation



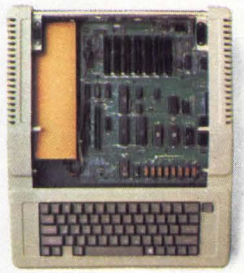
Gerber Scientific Products, Inc.
Computerized engraver



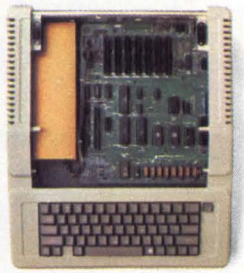
TSI Inc.
Particle sizer data analysis



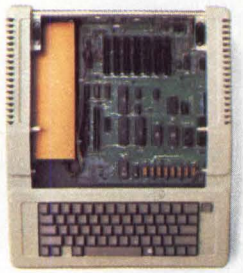
Enterprise Systems, Inc.
Hospital on-line inventory



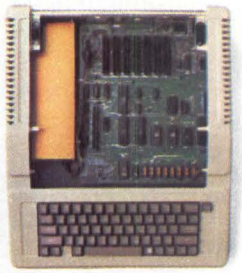
Sandu
Industrial robotics



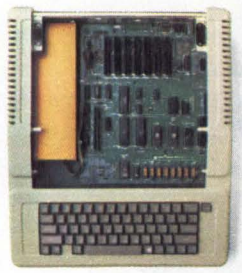
TCD, Inc.
Life insurance illustrations



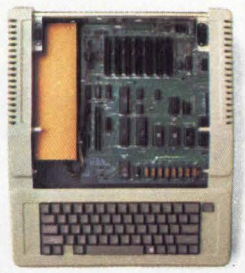
Cascade Graphics Development
Computer aided drafting



CompCoWare Inc.
Custom instructional software



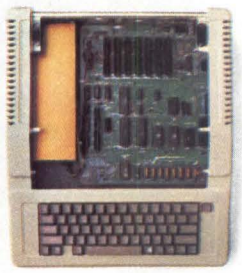
Autographix, Inc.
Designs, graph slides



Software Resources
Financial investment packages

American Zettler, Inc.
Hospital nursing station

Basic Computer Literacy
Courseware

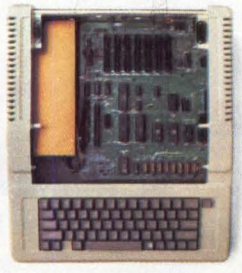


CPHA
Hospital data entry systems

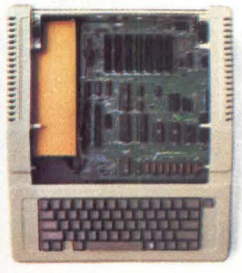
Transportation Concepts
& Services
Interstate tariff rates

Energy Management Service, Inc.
Residential/commercial
energy analysis

Vitalograph Ltd.
Pulmonary systems,
on-line spirometer



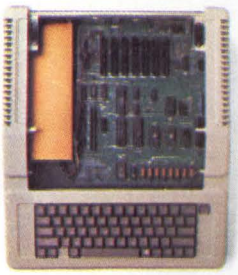
Fisher Scientific Company
Intelligent color console
for mass spectrophotometer



First Software Corp.
Computer work station
for children

guts to be successful.

Alltech
Scientific instrumentation

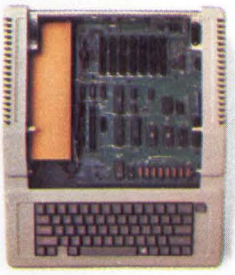


Kwik-Kopy Corporation
Computerized pricing

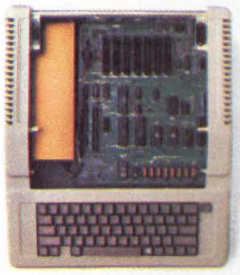
Warren E. Collins
Medical electronics

HCI Data
Agricultural software

Northwest Instrument Sys., Inc.
Digitizing oscilloscope



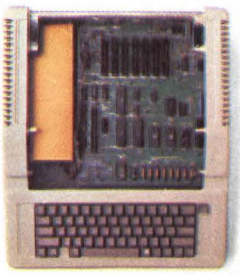
Federal Computer Systems Inc.
Pharmacy package



Cyborg Corporation
Lab data acquisition

Medical Graphics
Inhalation data analysis

Walman Optical
Opticians systems



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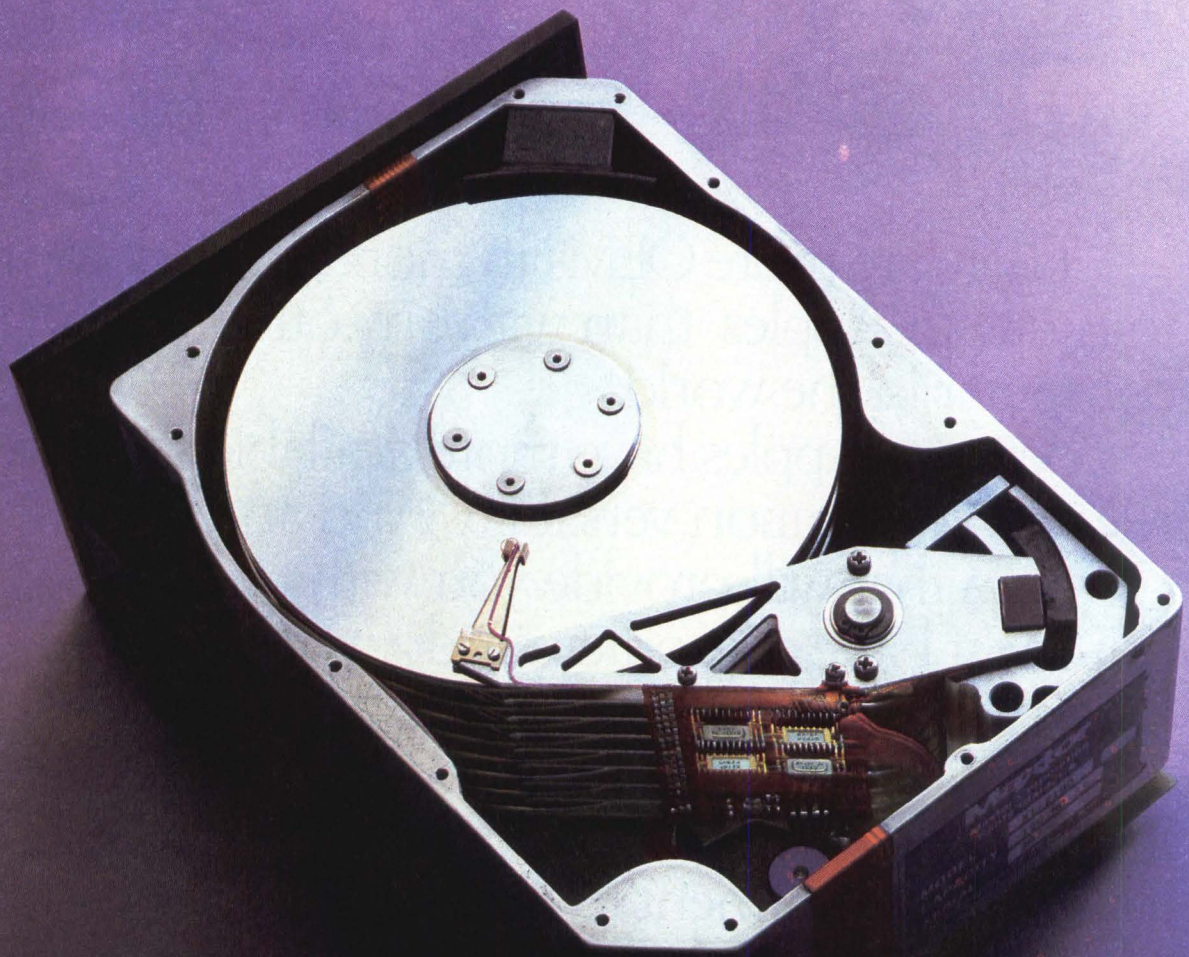

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EXT-4000 drives feature the new industry standard, ESDI (Enhanced Small Disk Drive Interface). The high-performance alternative to the ST506/412 interface. Permitting up to 100% more storage capacity. And twice the transfer rate.

XT-1000.™ XT-2000. EXT-4000. Take your pick. One of our 5¼" drives is bound to fit your current or future product plans.

If not, give us a few months. We're working on it.

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UNIX-based system runs real-time applications

R. KENT BLACKETT, MASSCOMP

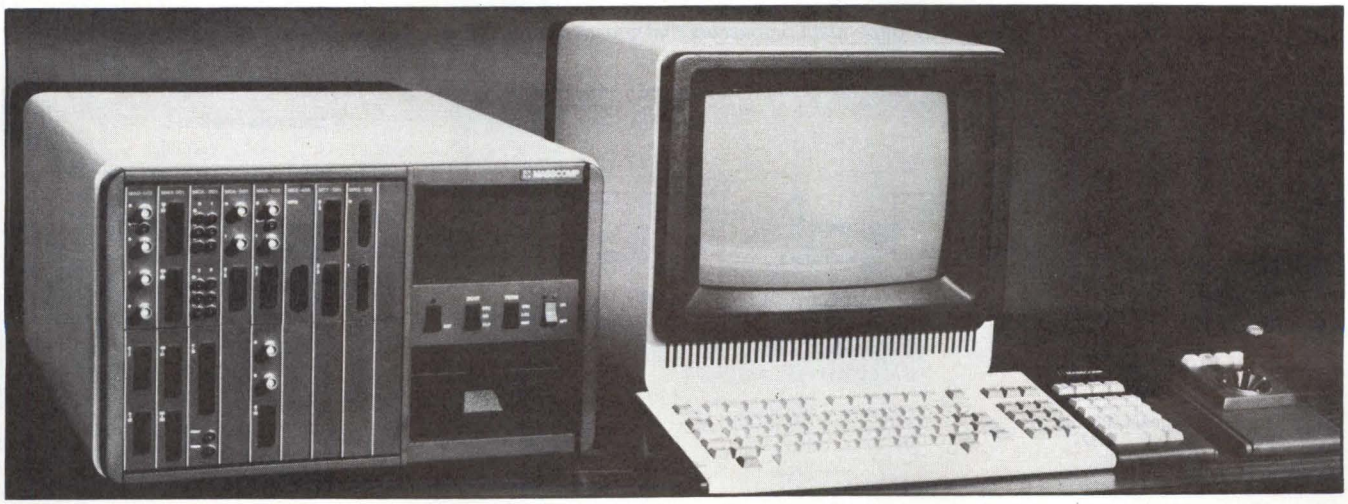
UNIX enhancements and three-processor architecture support real-time tasks in a multi-user environment

The frequent interrupts and data transfers associated with many real-time applications can place too large a burden on multi-user, minicomputer-based systems. In addition, popular multi-user operating systems such as UNIX often lack the process-scheduling and memory- and disk-management features required for such applications. A new multi-user system from MASSCOMP keeps up with both real-time and general processing tasks through three independent processors. The MC-500 also runs an enhanced UNIX supporting real-time-oriented features.

Multiprocessing handles real-time tasks

A real-time application is one in which the computer system must respond to an external event or generate an external signal within a prescribed period of time. This response period ranges from a few microseconds to a few hours, depending on the application.

Real-time response is defined as the time from the sensing of an external event to the moment the real-time process begins. Assuming the real-time task has been loaded into memory and is waiting for the event, real-time response depends only on interrupt latency within the operating system and context-switch time. Operating-system latency is most easily conceptualized as the longest time the operating system has the hardware interrupt system turned off or raised to its highest priority level. Operating systems must



MASSCOMP MC-500 system *runs an enhanced UNIX supporting real-time applications. A typical system including graphics and data-acquisition hardware and software is priced at $40,000.*

frequently disable the interrupt system in this way while internal data structures are being modified. Context-switch time is the time it takes the operating system to stop one process and begin another. Operations with longer context-switch times include saving the user's registers, saving the user's memory-management registers and loading a new user's memory-management and general registers.

In most computers, real-time response (interrupt-latency plus context-switch time) ranges from several hundred microseconds to a few milliseconds. If a real-time device needs processor attention from such a system a few thousand times per second, the system spends nearly all of its time switching to the real-time process designated to handle the interrupt. Real-time tasks thus often run as stand-alone jobs on small computers to avoid tying up larger systems.

For example, assume a photocell is connected to a device under test. The sensor generates a small voltage proportional to the light intensity it measures, and that voltage is sampled through an analog-to-digital converter every 5 μsec., or 200,000 times per sec. For the

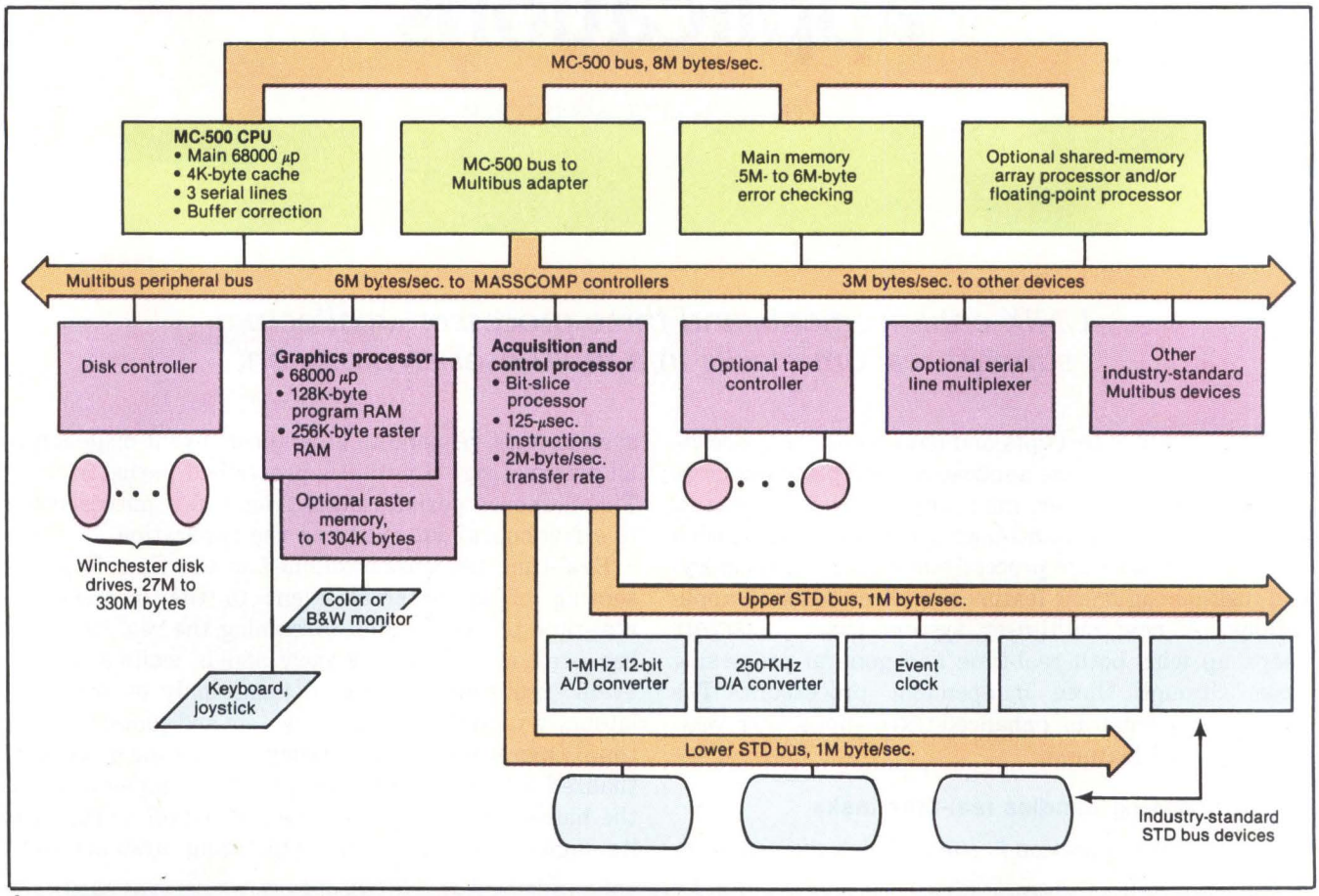


Fig. 1. MC-500 architecture *includes three independent processors that communicate with each other and with system components through three separate buses.*

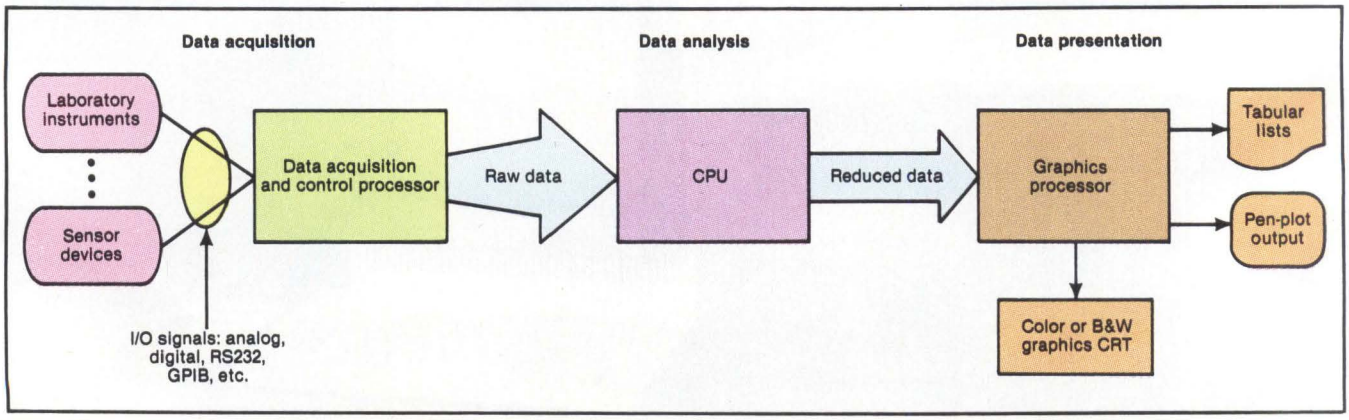


Fig. 2. The three real-time processing tasks, *data acquisition, data analysis and data presentation, are handled by separate processors in the MC-500.*

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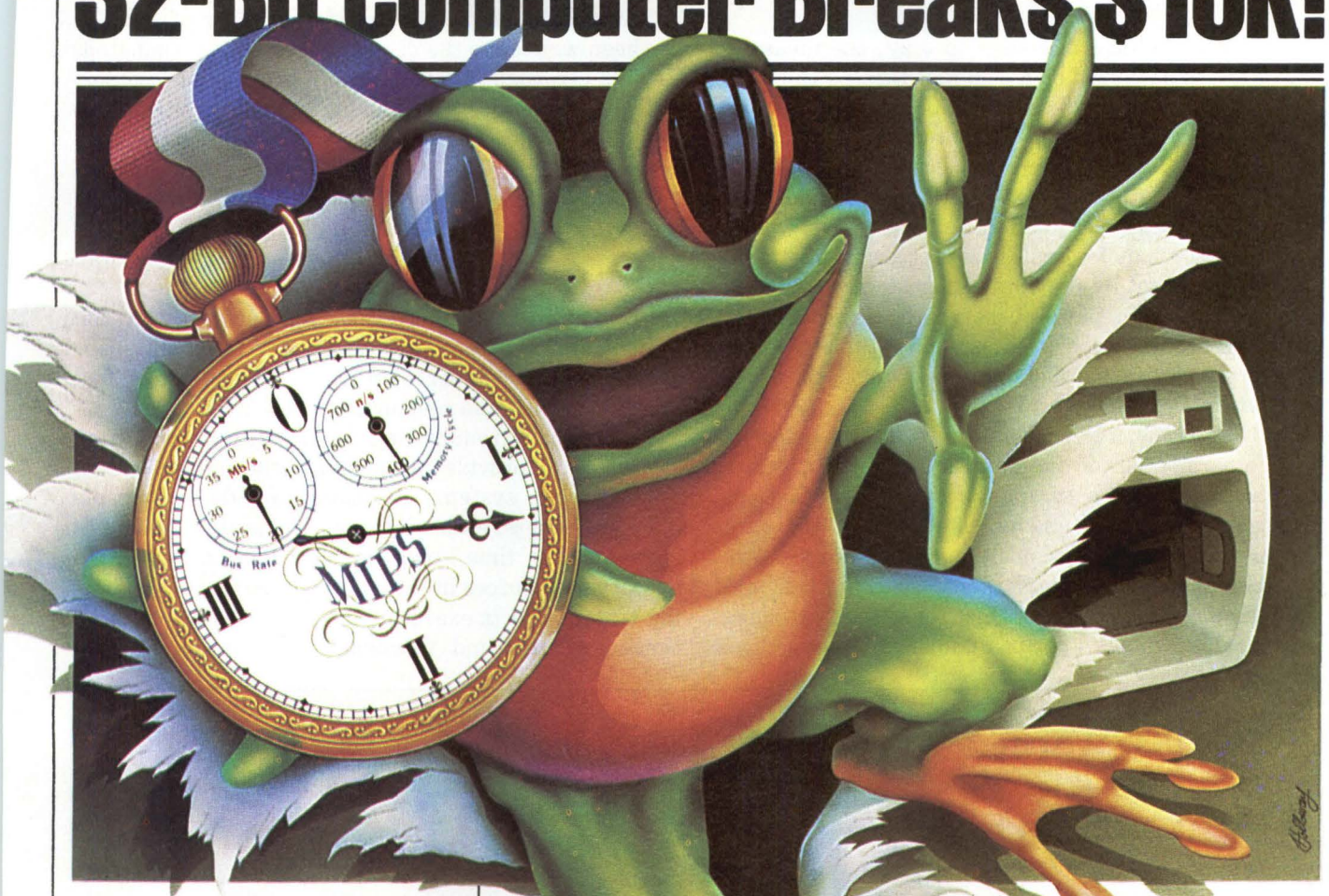

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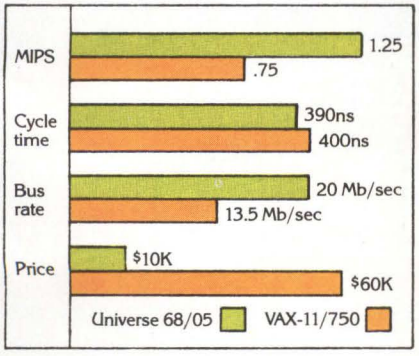
The new Universe 68/05 is the first true 32-bit computer priced under $10,000 (OEM quantity one). "True" because, unlike other 68000-based systems, the Universe 68/05 handles 32 bits in parallel on its VERSAbus.

Outperforms VAX*

Its *price* is even more impressive when you look at Universe 68/05



performance versus that of 32-bit "superminis" several times more expensive, like the VAX-11/750.

High-Speed 68000, 4Kb Cache, 32-Bit Bus

The key to that performance is a 4Kb cache that eliminates processor wait-states and takes full advantage of a 12.5MHz 68000 processor. Also included are a separate 68000 I/O processor, four serial I/O ports (expandable to 64), 256Kb RAM (expandable to 3Mb), 20Mb/sec, 32-bit VERSAbus, 10Mb Winchester, 1.25Mb floppy disk, and 5-slot card cage. All in a 7-inch enclosure.

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30 sec. after voltage increases to 0.2V, the measured values are to be stored on a disk file. Using a 12-bit A/D converter and storing each sample in 2 bytes, the process results in a data file of approximately 12M bytes on the disk. This real-time process would bog down most minicomputer-based systems using a multi-user operating system.

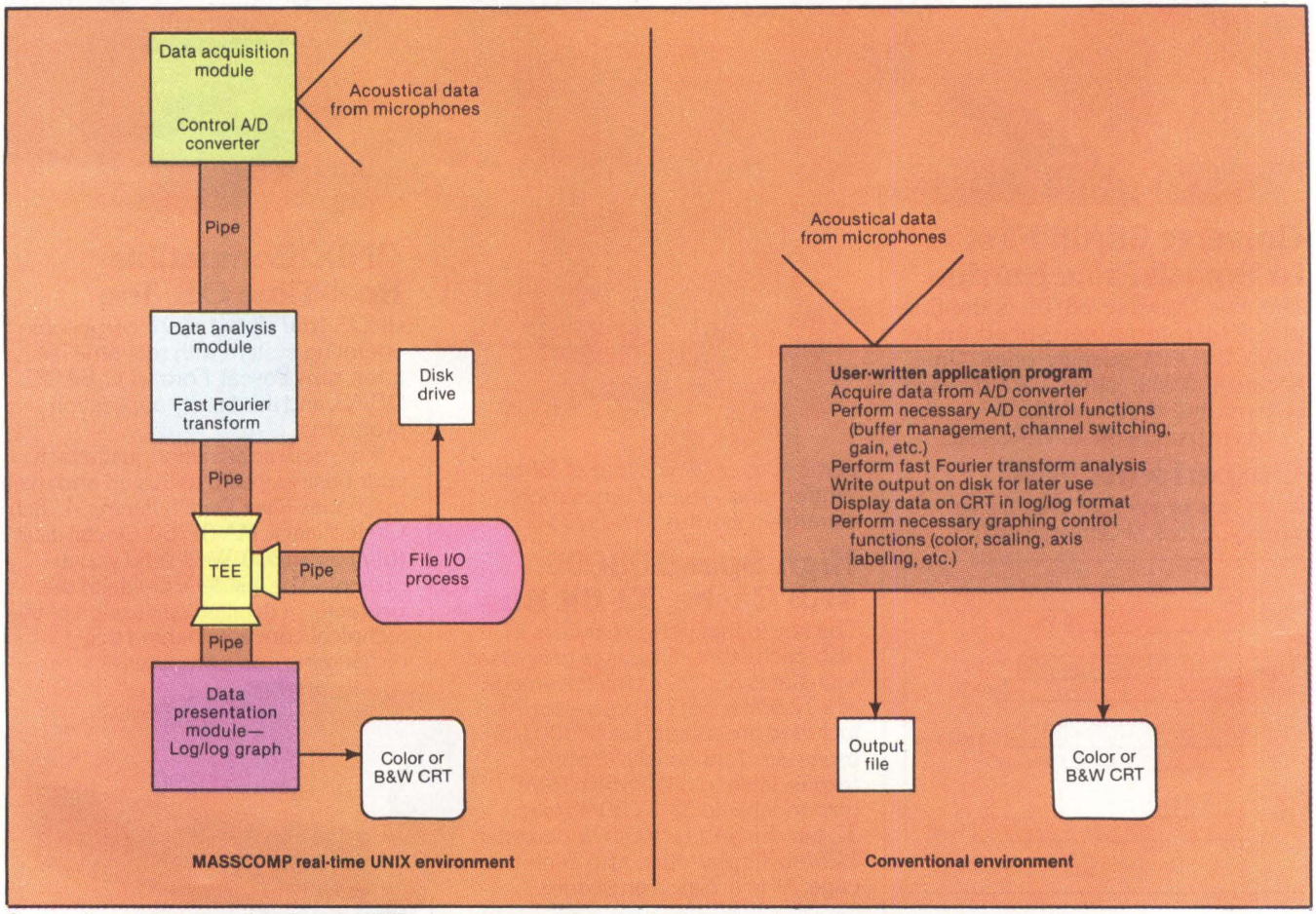
The MC-500 handles real-time processing in a multi-user environment by providing separate processors for data acquisition, general-purpose processing and data display (Fig. 1). Each processor is optimized for its role, operating in parallel with the others on a user application.

On the MC-500, the user enters menu items specifying the parameters of the data-acquisition job, such as A/D channel numbers, sampling rates, threshold value, duration and disk-file name. The first of the three processors—the data-acquisition/control processor—then begins sampling the data and checking it against the threshold value (Fig. 2). Once the threshold value is passed, data values are DMA-transferred to multiple buffers in the memory of the second processor, the CPU. The CPU is interrupted only upon a buffer-full condition. The buffers are transferred to disk as each is filled by the DA/CP. When the specified number of samples has been written to the disk, the process is terminated. Results can then be displayed by the third processor, the graphics processor. During data acquisition, the MC-500 CPU is essentially idle and available to execute other programs. The system buses permit high-speed transfers while retaining sufficient bandwidth to allow the CPU to continue execution.

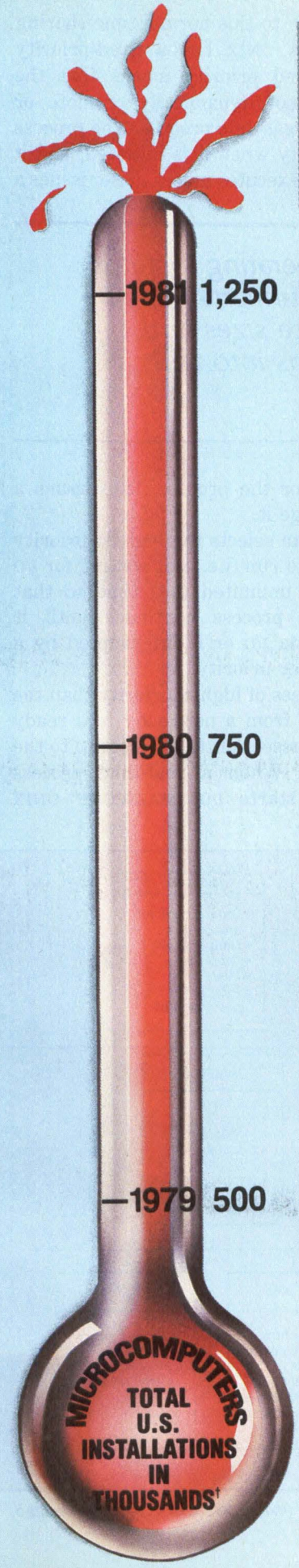
Enhanced UNIX

In addition to its hardware approach, the MC-500 incorporates software for both real-time and multi-user applications. It supports an enhanced UNIX, modified for fast, predictable responses to real-time tasks.

The primary requirement of a real-time operating system is to provide predictable program execution. Time-sharing systems normally provide a variable number of users, each with a share of system resources such as CPU time, memory and disk accesses. In allocating resources in this way, a time-sharing operating system injects execution uncertainties by changing time-slice sizes and frequencies and swapping pro-



Comparison of conventional and UNIX pipe programming environments *shows that pipes allow use of program modules, while conventional approach often requires monolithic programs. In this example, acoustic data from microphones are acquired and analyzed, with results stored or displayed. This application can be run in MASSCOMP's real-time UNIX environment largely through easily modified pre-written program modules: a user need only specify instructions through a menu. The same application on a conventional system generally requires writing or modifying a longer, more complex program.*



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grams into and out of memory. MASSCOMP's real-time enhancements to UNIX remove these execution-time uncertainties when running a real-time program. The normal time-sharing capabilities of the system have not been removed. Instead, real-time features have been added, ensuring the system's ability to process both real-time and time-sharing jobs.

The MC-500 enhanced UNIX emphasizes speed over memory conservation, which differs from other UNIX systems. This emphasis is acceptable because the 68000 microprocessor on which the MC-500 is based addresses as much as 16M bytes of memory, and because memory prices have declined dramatically as a result of 64K-bit chips. The 0.5M to 6M bytes of memory offered by the MC-500 enable facilities such as inter-process communication to run at much higher rates than similar facilities on more powerful systems.

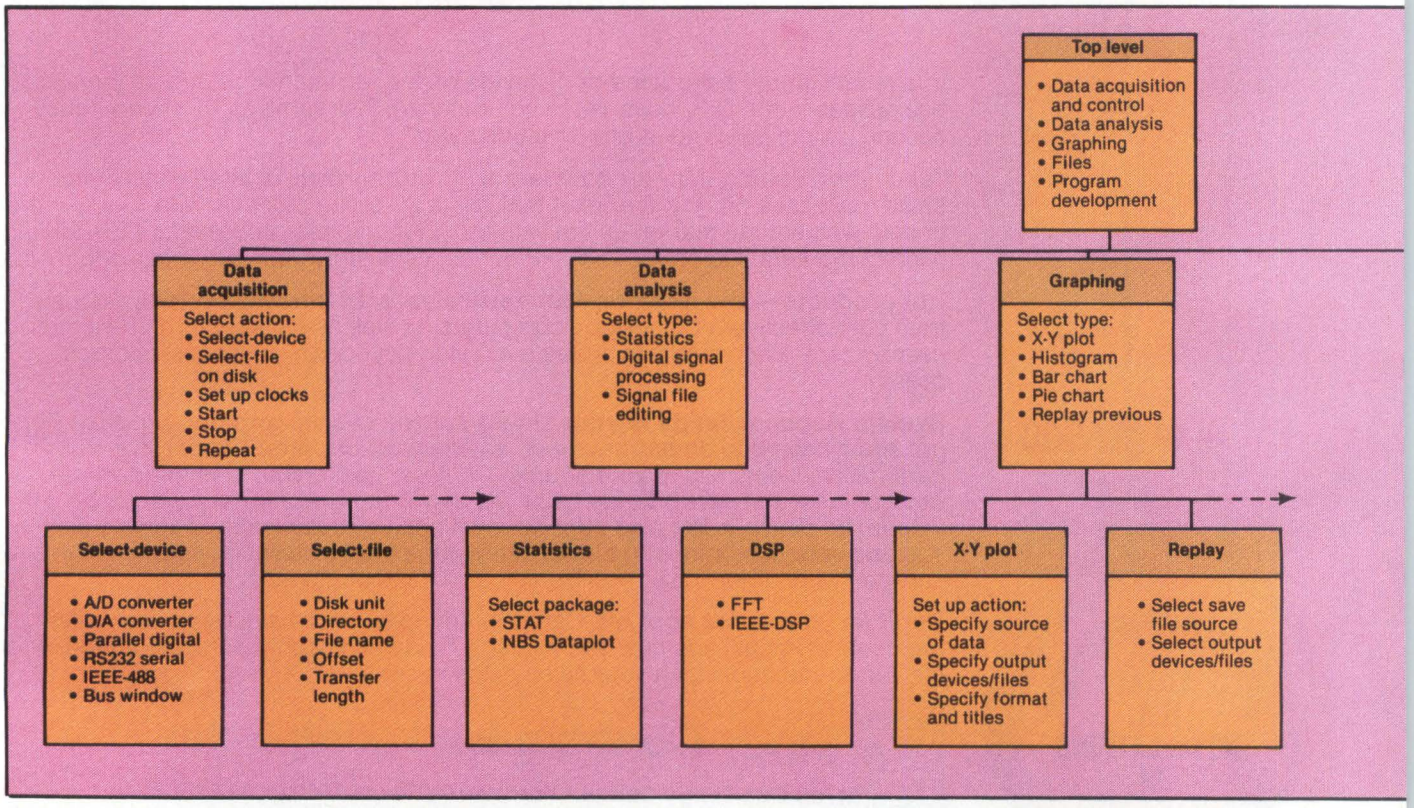
MASSCOMP's enhancements cover general UNIX performance as well. Areas of the system with traditionally high overhead, such as context switching, process scheduling and system service calls, have been recoded for efficient execution.

The most important resource that an operating system distributes is CPU time. The conventional UNIX scheduler features a time quantum mechanism, which gives each process a time slice of specified duration. At the end of the slice, another job is selected to receive the next slice. In addition to this normal time-sharing mechanism, the MC-500's UNIX has a fixed-priority real-time scheduler. Fixed priority means that the operating system does not dynamically promote or demote the priority of a real-time process. The process is endowed with a priority when it is initiated, and it retains that priority as it executes unless a user issues a command to change it, or the process itself issues a system directive to change it.

A time-sharing operating system injects execution uncertainties by changing time-slice sizes and swapping programs into and out of memory.

At any time, the system selects the highest priority real-time process ready to run (i.e., not waiting for I/O to complete) and gives unlimited CPU time to that process. The real-time process continues until it terminates, pauses, starts I/O or is interrupted by a real-time process of higher priority.

When a real-time process of higher priority than the current process changes from a not-ready to a ready state, MASSCOMP UNIX passes control of the CPU to the newly readied process. When a real-time process terminates, pauses or starts I/O, MASSCOMP UNIX



Hierarchical menu provided by MC-500 *aids users in specifying command strings. Menu selections (excerpted above) can be executed, modified or saved.*

examines the list of processes to determine the process of next highest priority. If no real-time processes can be run, normal time-sharing scheduling resumes. By this method, normal time-sharing functions such as program development can proceed as a background activity to higher priority real-time functions.

Memory and file management

Execution-time indeterminacy is largely related to operating-system memory management. In a heavily loaded system, there is usually a demand for more memory than that available. UNIX System III handles this by swapping processes to and from the disk. MASSCOMP UNIX has more efficient virtual-memory demand paging, supporting programs as long as 16M bytes.

Because a real-time process might idle for a considerable time waiting for an external event, a conventional operating system would outswap or outpage the process. When the event did occur, the real-time process could be delayed for a significant fraction of a second while the system swapped it back into memory. MASSCOMP UNIX avoids this problem by adding system directives that allow a real-time process to declare itself ineligible for paging or swapping (Fig. 3). The real-time program can also lock itself into physical memory for only certain times, so that it can be swapped or paged when the highest possible response is not required.

In the early years of computing, disk files were allocated contiguously. As operating systems matured, files were more often allocated as linked structures, for

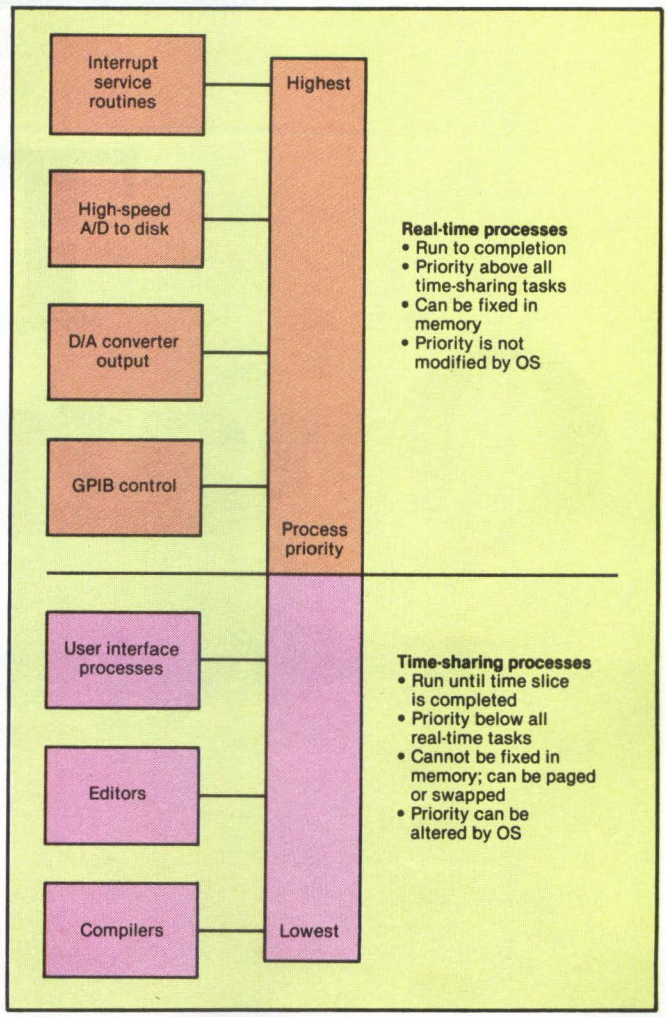
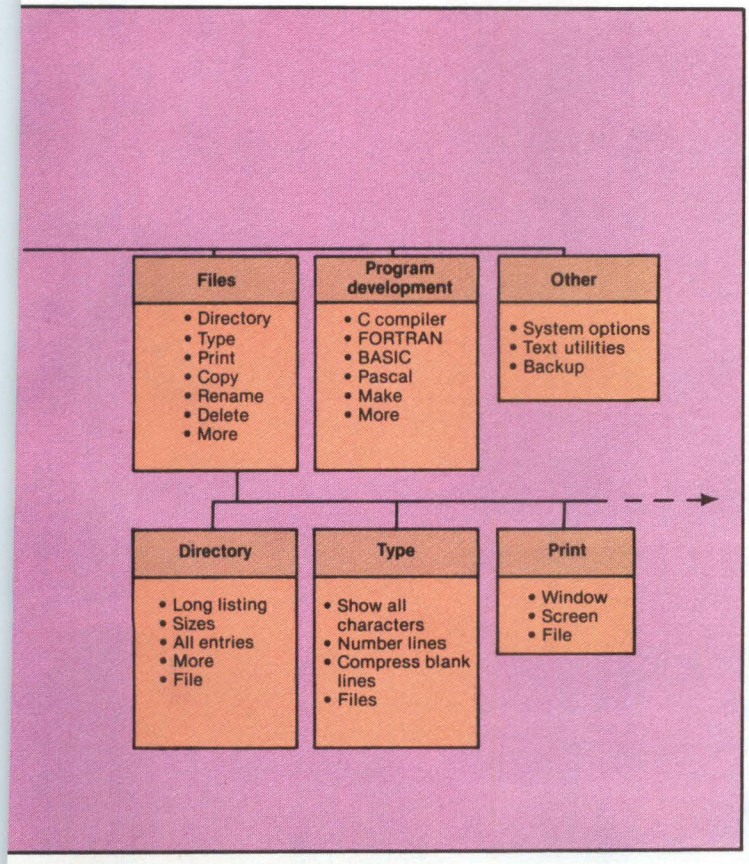


Fig. 3. Task priorities in the MC-500 *allow real-time programs to remain fixed in memory and run without interruption. Lower priority time-sharing processes can be paged or swapped out of memory and interrupted by real-time tasks.*

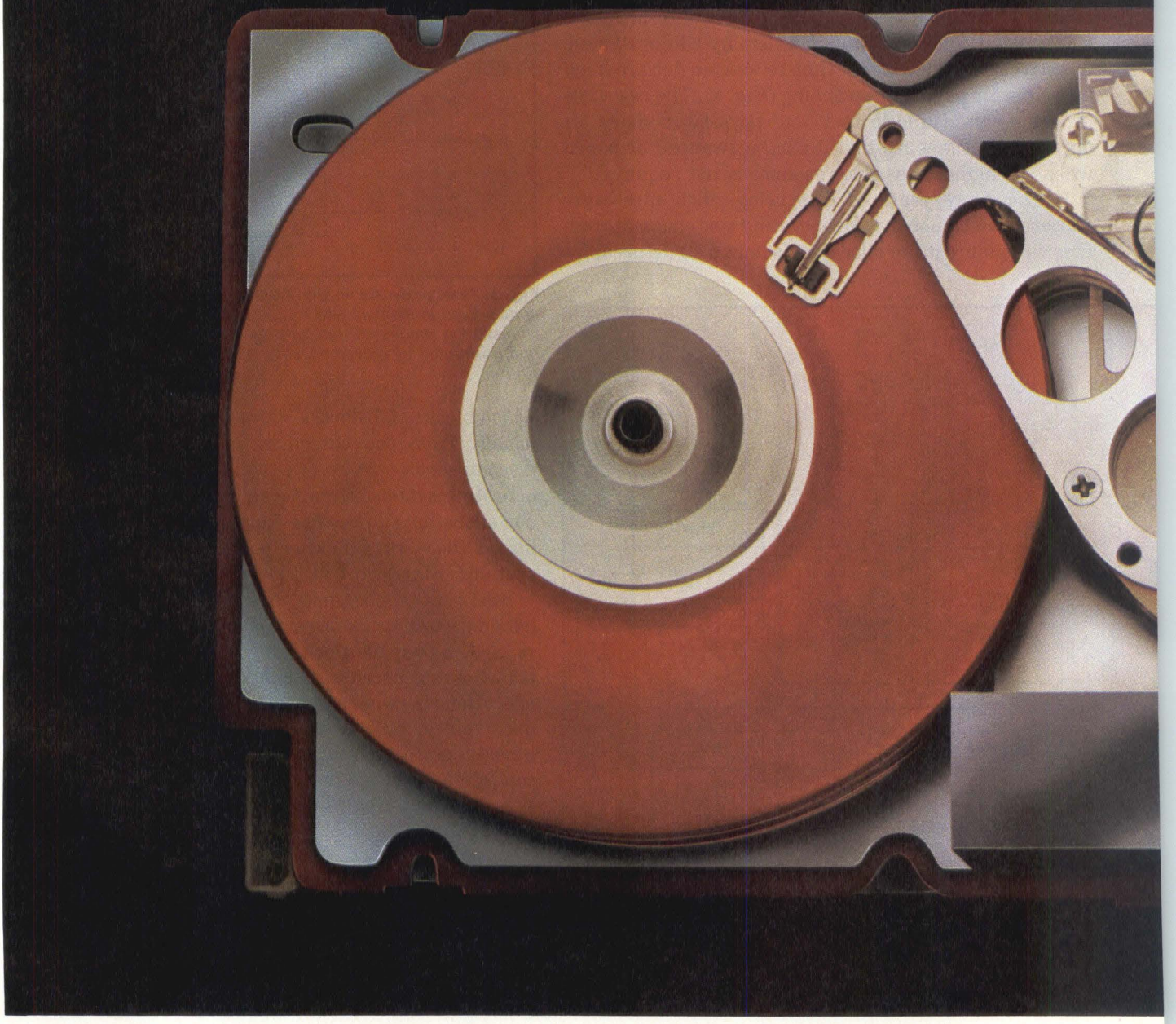


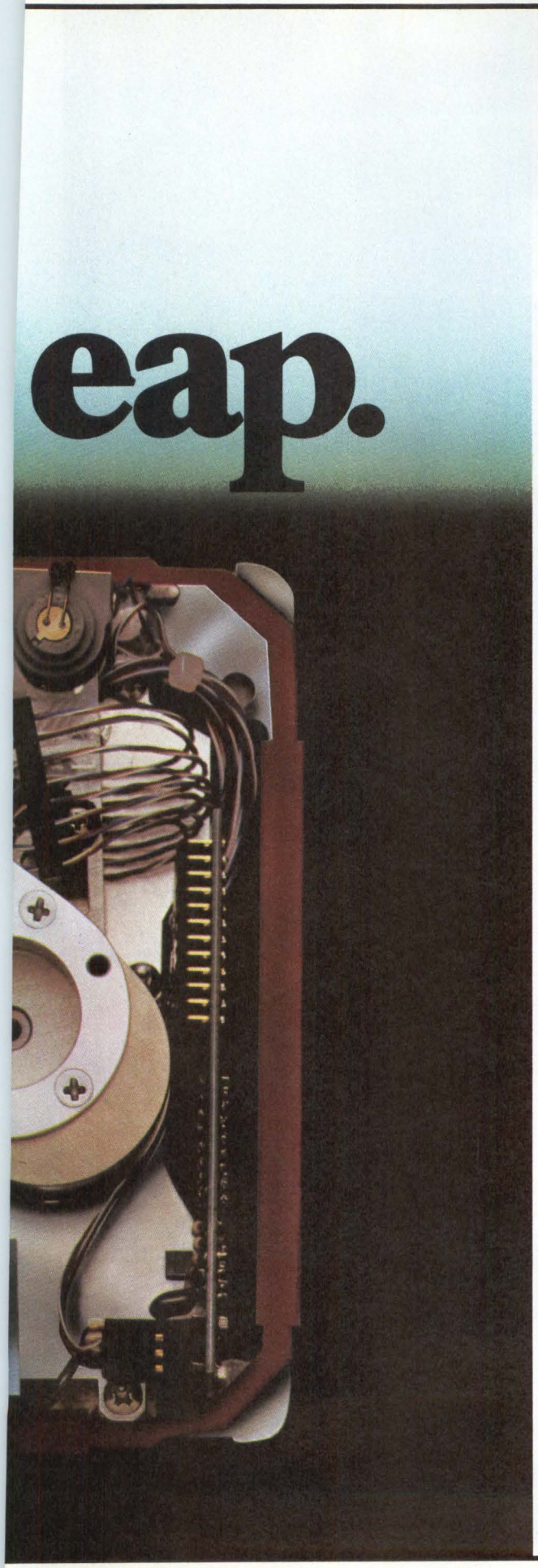
which blocks of disks are allocated as they become free, usually from the outermost cylinder inward. These discontiguous sectors are then logically linked by the operating system. Because a disk managed by contiguous allocation can become fragmented and poorly used, linked files are generally preferred for time-sharing systems. Standard UNIX uses linked files.

Real-time applications, however, use data from the outside world transferred to disk files at a high data rate. A linked file does not provide a consistent data transfer rate because an unknown number of disk seek operations is required to access the file. To remove this uncertainty, MASSCOMP UNIX allows a user to specify contiguous disk storage for a data file. Such a contiguous disk file provides a consistent data transfer rate so that real-time processes can be handled predictably. □

R. Kent Blackett is software development manager at MASSCOMP, Littleton, Mass.

The 5¼" Quantum L





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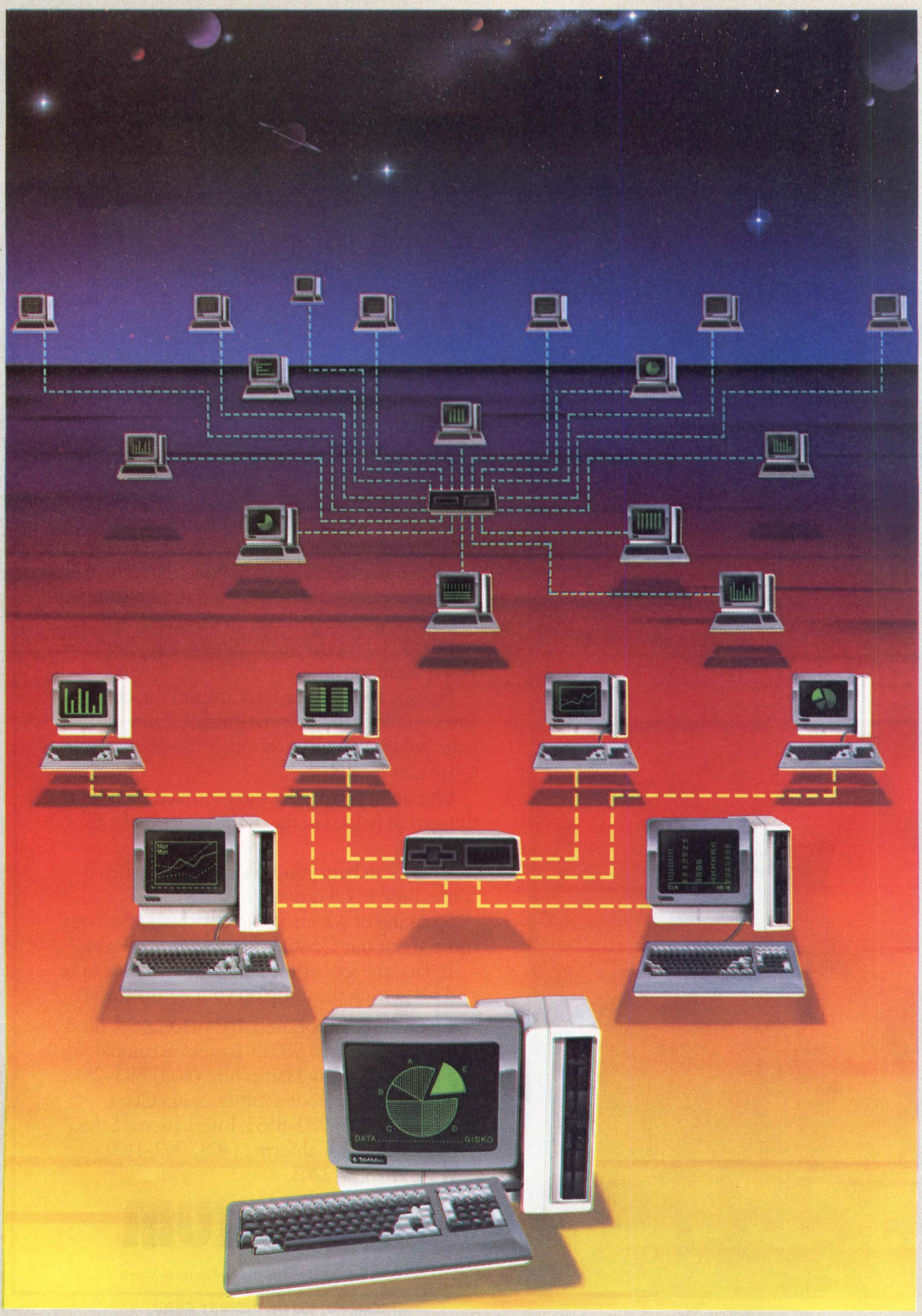
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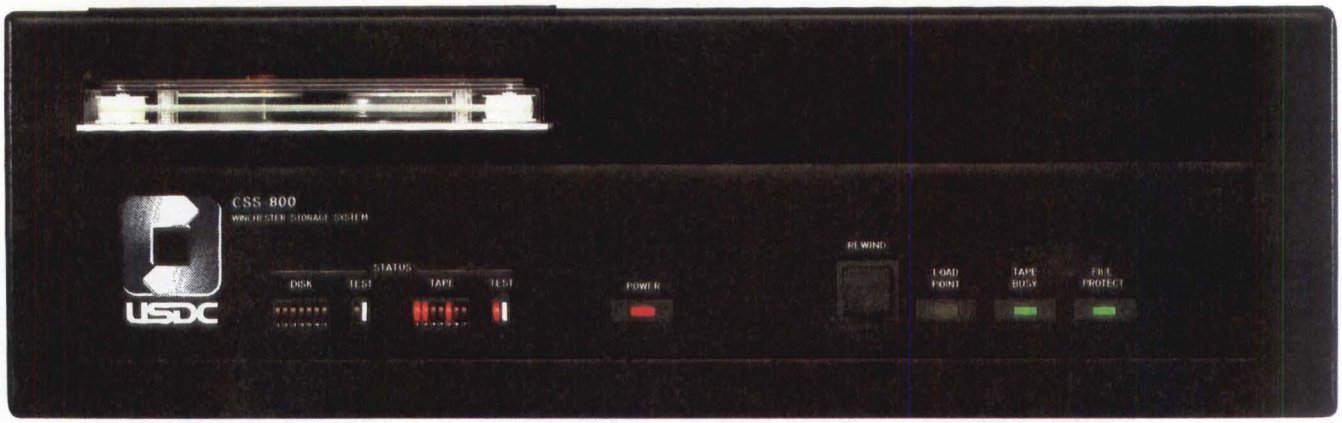

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Streaming-tape drives emulate start/stop machines

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Streaming drives with cache buffer give higher throughput without special software

The predominant method for archival backup of data stored on medium- to large-capacity Winchester disks is ½-in. streaming-tape drives using reel-to-reel tape. But streaming tape has not achieved complete penetration of the disk backup market because streamers require extensive software development.

This problem may be solved with the advent of a new type of streaming-tape drives that employ a cache memory to make the streamer appear to the computer as if it were a start/stop drive. This approach eliminates the need for special streaming software and improves drive performance beyond that of existing start/stop machines.

Conventional tape drives

There are two major types of tape drives: start/stop drives and streaming drives. Start/stop tape drives are designed to stop and start within a fixed distance as they read or write data transferred from a computer. Data records on conventionally formatted recording tape are separated by inter-record gaps measuring from 0.3 to 0.6 in., depending upon the recording format being used. The start/stop drive performs a

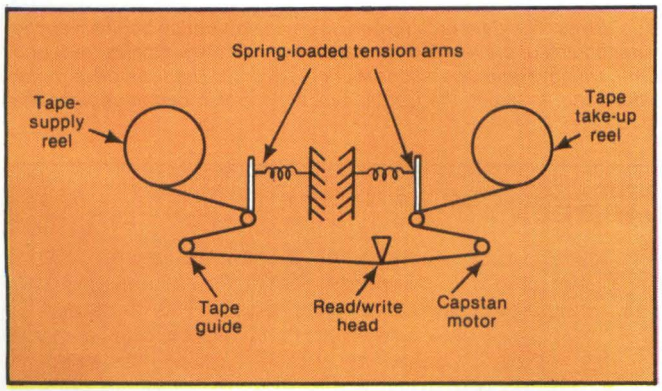

Fig. 1. Start/stop tape drives *use spring-loaded tension arms (or vacuum columns) to buffer the tape against the pull of the reels during acceleration and deceleration. The buffering mechanisms allow quicker stops and starts than a streaming drive, but limit maximum tape speed and increase drive costs.*

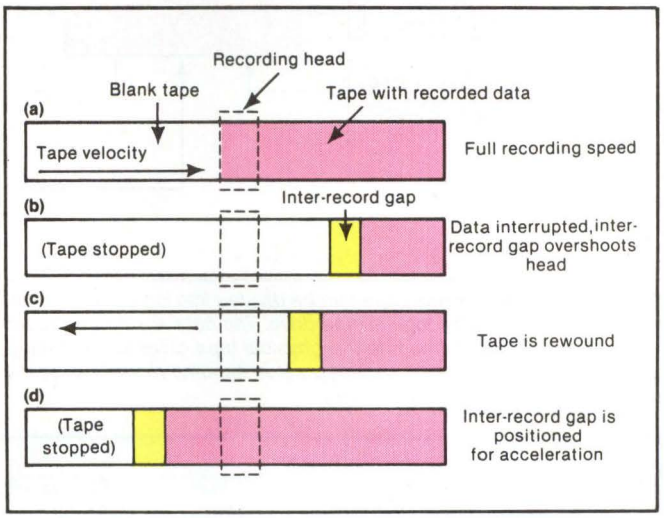

Fig. 2. Streaming-tape repositioning *is necessary due to the inability of streaming mechanism to stop within a narrow inter-record gap when the data stream is interrupted. When tape is moving at full speed (a), the interruption of data causes the tape to slow, but not quickly enough to stop the tape with the inter-record gap underneath the head (b). The tape is then rewound (c), until the inter-record gap is positioned far enough behind the head (d) to allow acceleration to full speed when the data stream is resumed. Buffering mechanisms in start/stop drives make repositioning unnecessary, and thus improve performance in applications in which the data stream is frequently interrupted. Relative distances above are arbitrary.*

read-after-write data verification, comes to a complete stop and accelerates to operating speed within an inter-record gap.

The mechanics of handling start/stop drives have always been complex. Stopping and starting the tape require mechanisms to maintain proper tape tension and limit torque requirements in reel servo motors (Fig. 1). Most tape drives use tension arms or vacuum columns for this purpose. Both schemes, however, limit tape speed. Typically, the fastest a tension-arm drive can move tape and still be able to stop on the inter-record gap is 45 in. per sec. Vacuum-column drives move tape as fast as 125 ips due to the reduced mass of the vacuum column in comparison to the compliance-arm devices.

Streaming-tape drives offer an alternative to start/stop drives. These drives were designed specifically for disk backup and take advantage of the fact that most disk dumps are continuous in nature. By reading continuous data at high speeds, a streaming drive can replace the complex mechanics of a start/stop drive with microprocessor-controlled servo systems. The simplicity of the streaming drive lowers costs, but streamers require a constant data stream to maintain their performance level.

Unlike start/stop drives, streaming-tape drives do not stop on each inter-record gap. Instead, streamers record inter-record gaps "on the fly." But if the data stream is interrupted, a streamer overshoots the last inter-record gap, and must back up the tape to before the last inter-record gap to prepare for additional data (Fig. 2). This repositioning scheme is slow compared to a start/stop drive, but streaming drives simply cannot

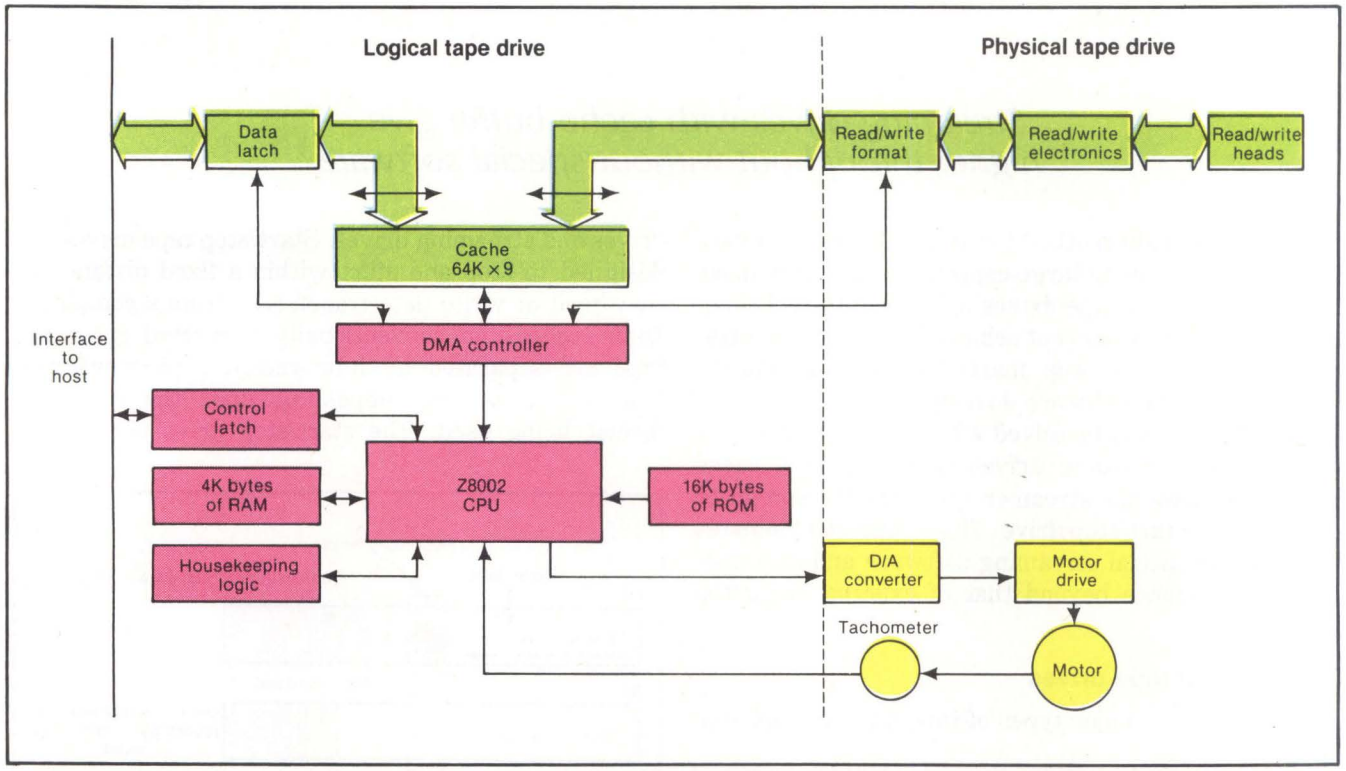

Fig. 3. CacheTape architecture *can be divided into logical and physical tape drives. The data path (green) in a write operation begins with the host sending data to the logical tape drive. The data are stored in cache under control of the resident* CPU *and associated electronics (red) and then sent in a steady stream to the physical tape drive for formatting and recording. Read operations work in reverse. The tape drive motor asembly (yellow) uses a closed-loop servo scheme monitored by the resident* CPU. *In effect, the CacheTape's electronic buffers replace the pyhsical buffers of start/stop drives.*

INCREASING STANDARD DENSITIES

Start/stop requirements are not the only limitations on tape-drive performance. Capacity and throughput both depend on data density, but potential increases in the density of ½-in. tape have been hampered by the American National Standards Institute's standards, currently set at 1600 and 6250 bpi. Vendors are free to use non-ANSI densities, but risk losing business with users concerned with compatibility between drives.

One approach to this problem would be to make the current top of the standards range, the 6250-bpi Group Code Recording format, the bottom of a new range of ANSI standards that take advantage of modern electronics. This approach could also boost the performance and capacity of ¼-in. cartridge streamers to roughly the level of today's standard 75-ips ½-in. start/stop drives.

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come to a stop or accelerate to speed in 0.003 sec. as can a 125-ips vacuum drive. To minimize repositioning, OEMs must often write special drivers so that the CPU supplies data in a constant flow and streaming operations are not disrupted.

Electronic buffering

The new CacheTape streaming-tape drives from Cipher Data Products Inc. incorporate a cache buffer that adds start/stop performance and software compatibility to the streamer's mechanical simplicity. These drives employ a microprocessor, firmware and a cache memory to make a streaming drive appear to the computer as if it were a start/stop drive. The drive can read and write data in the streaming mode without special software drivers, even if the CPU data stream is not constant. In effect, the cache memory acts as an electronic tension arm, buffering the tape against starts and stops. The cache front end concatenates data records in its semiconductor memory, eliminating inter-record gaps. In addition, the memory's read and write rates are adjustable. Thus, the tape operating speed need not be matched to the host-computer transfer rate, and burst operation is possible.

The logic contained in the CacheTape electronics simulates a start/stop drive with a read/write "head" able to read or write to an electronic "tape"—the cache memory (Fig. 3). The physical tape drive transfers the data between the tape and the memory at 100 ips. Automatic error correction and read-after-write checks are performed in the logical tape drive, independently of the physical tape drive. The logical tape drive provides all interface operations.

The cache front end concatenates data records, eliminating inter-record gaps.

Cipher Data Products' CacheTape streamers are not the only products to incorporate tape buffering. Storage Technology Corp. has announced a cache memory system for its 125-ips start/stop drives, to approximate the data-transfer rate of disk drives. Some controller manufacturers have also announced nonintegrated controllers that provide intelligence to buffer data to and from standard tape drives.

Increased performance

The use of electronic buffers means that transfer rates are no longer limited by tape speed, data density and the ability to start and stop the tape. CacheTape transfer rates are selectable from 40K to 380K bytes per sec., regardless of the actual tape speed. A 1600-bpi start/stop drive writing a 256-character block every 10 msec. would require approximately a 650-ips tape speed to provide a 380K-byte-per-sec. transfer rate; no 650-ips start/stop drives exist.

This sort of performance can be improved even further in an electronically buffered tape drive. Because inter-record gaps are used mainly to facilitate starting and stopping, they can be reduced or eliminated in streaming drives, as long as interchangeability with start/stop drives is not required. All that is required is a means of separating consecutive data blocks, which can be accomplished with inter-record gaps much smaller than those currently used. Reduction of the inter-record gap in phase-encoded tape raises tape usage efficiency from 35 to almost 100 percent. Even more important is the corresponding throughput increase achieved with smaller inter-record gaps. Such methods are already in use with some ¼-in. cartridge drives. For now, the Cache Tape drives read and write ½-in. IBM- and ANSI-compatible tape data formats, contributing to the ease of integration for this new class of tape drive.

The mechanical limitations of tape drives are being overcome by electronics. Many industry watchers predicted 10 years ago that magnetic tape as a storage medium would be a dead issue by the 1980s. New approaches have made these predictions incorrect. □

Kim Kelly is product manager at Cipher Data Products Inc., San Diego, Calif.

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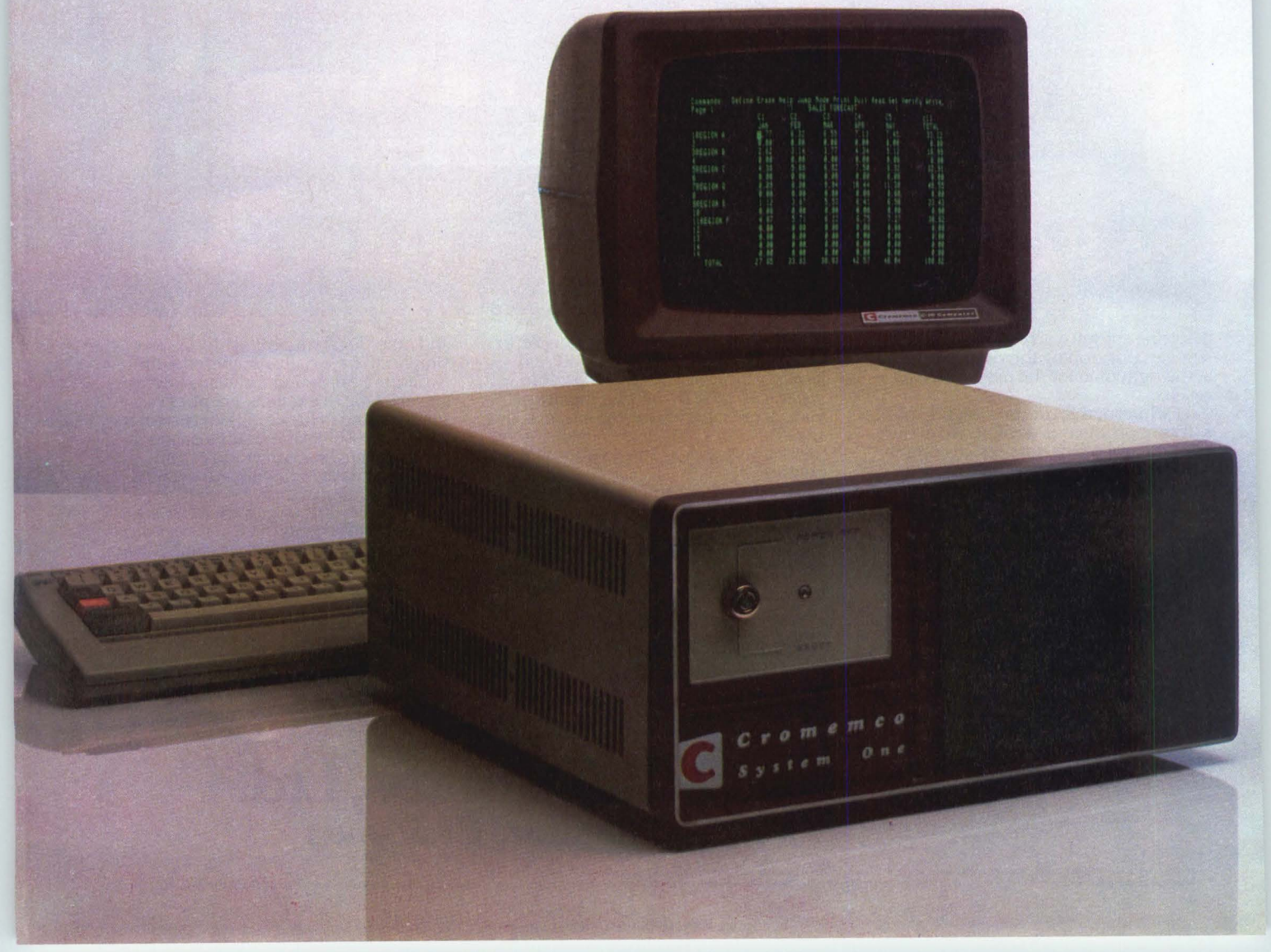

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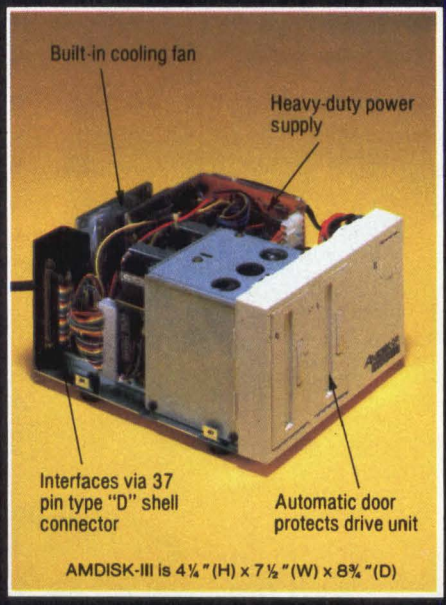
9	Drive select C	17	Read data
10	Motor enable D	18*	Select head 1
11	Direction	19	GND
12	Step pulse	20-37	GND

*drives are single head



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Venture capital demystified

RICHARD LOFTIN, Financial Data Corp.

The venture capitalists are looking for a few good businesses

You're an entrepreneur with an exciting new computer business—a business that could make you rich and, not incidentally, fulfill an important commercial need. But you need money to get your idea off the ground, and your bank says "no dice" to any venture riskier than AT&T. You've heard that venture capital is abundant these days, but is it really? How much do you really know about what venture capital is, whether it's appropriate for your business, what it will cost you and how to go about raising it?

Venture capital defined

To understand what venture capital is, start by understanding what it is not. First, it is not a loan—at least not in the conventional sense. The venture capital investor almost always wants some form of equity in the company. The most favored forms of investment are common stock and debt that can be converted into stock. Preferred stock (often convertible to common) and stock warrants are also popular. Regardless of what form the transaction takes, if you are not prepared to give up a portion of your ownership in the company, venture capital is not for you.

Will venture capitalists finance R&D? Suppose you're working on a microcomputer system that uses artificial intelligence and an expert system to replace paralegals in a law office. You have the specifications written, but the systems design and programming have yet to begin. Can you count on venture capital to finance this phase of the project? Or must you wait until the system is up and running before asking the venture capitalists to come in?

The answer depends on the venture capitalist you're talking with. In a survey I recently conducted of 145 of the nation's leading venture capitalists, 35 percent said they would finance a product that exists on paper only, while only one out of five said the product must be in production before they will commit funds. The less developed your product is, the riskier the investment. To compensate for the possibility that the finished product never will see the light of day, other aspects of your project should be especially appealing, such as an unusually large market potential or a superior management team.

If your product is still in development, your company may also want to consider an R&D limited partnership. The partnership funds the development of your product and in return "owns" the product once it's completed. Investors get tax benefits, because developmental expenses are passed on to the partnership as tax losses. Once the product begins to generate income for your company, the partnership receives a royalty on sales through a licensing arrangement between your company and the partnership.

Funding for R&D limited partnerships traditionally has been provided through private underwritings by investment bankers and others who charge a commission based on the amount raised (usually 7.5 to 10

percent). Venture capitalists are beginning to jump on the limited-partnership bandwagon, however. One-fourth of the venture capitalists queried in my survey would consider investing in this relatively new form of financing.

Who are the venture capitalists? They are the professional managers of funds created specifically for investment in young, high-risk companies that have the potential for producing a handsome return on investment. Venture capital funds are supported by insurance companies, pension funds, high-tech corporations, wealthy individuals and other investors who are willing to assume risks that banks wouldn't even consider—in return for the possibility of being on the ground floor of the next Qume Corp., Apple Computer, Inc., or Digital Equipment Corp.

The types of organizations that invest in venture capital situations generally fall into one of four categories. The largest category is private venture capital firms, which invest from a pool of privately raised capital. The next largest category is small business investment companies, which are licensed by the Small Business Administration and can borrow from the federal government as much as four times the amount of their private capital.

Other categories include investment bankers, who usually underwrite public or private offerings as well as invest in venture capital deals, and venture subsidiaries of major corporations, which often provide venture capital money as a way to acquire new technologies.

Who gets venture capital?

You may be proud of the CAD/CAM system you've perfected, but is it good enough to attract venture capital? Most venture capitalists look for a product that is unique in the market. If your system is like everyone else's, competition will be keen. But if your CAD/CAM system is the first to address the needs of a user group (such as video-game designers, for example), you will have no direct competition, and that's what investors like to see. If you can't establish competitive advantage, your ability to attract venture capital will be greatly diminished.

Besides being unique, your product should be in a market that is big enough to generate a high volume of sales. Capturing 100 percent of a tiny market is not nearly so impressive to an investor as grabbing a healthy fraction of a larger, rapidly expanding market. Fortunately, computer-related ventures are in favor among the venture capitalists because most markets for computer technology are growing at a rate that makes even conservative investors drool.

But some markets get drooled over more than others. My survey of the venture capitalists revealed that the computer-related technologies most likely to attract an investor's attention are telecommunication products and computer peripherals. The least exciting computer technology is mainframe computers. As you might have expected, microcomputers win out over minicomputers. Fig. 1 shows the relative preferences of venture capitalists for various computer-related technologies.

Even more important than the market or product, however, is the entrepreneur and the rest of his management team. Are they good managers? Do they have a track record in their field? No matter what they're selling, they must convince an investor that they know how to sell it profitably. Believe it or not, most venture capitalists would rather finance a mediocre product with superior management than a superior product with mediocre management. The entrepreneur should assemble a competent management team before getting serious about venture capital.

Is it easier to raise small amounts of venture capital than large amounts? In general, it is not. Most venture capitalists won't fool with investments below $50,000

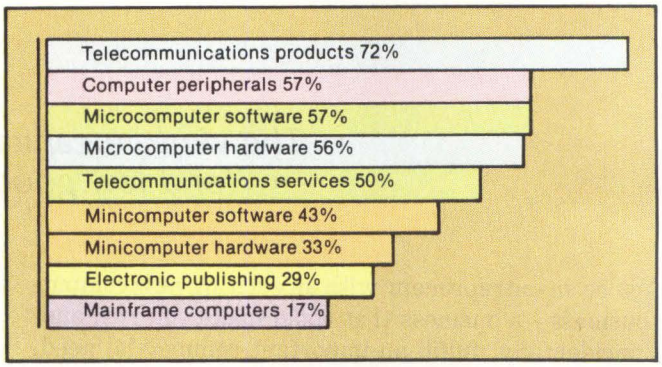

Fig. 1. Attractive areas for venture capital investments in the computer industry. *The graph above summarizes the percentage of 145 recently surveyed venture capital firms that were "especially interested" in each technology.*

because small investments just don't provide enough return to justify the effort required to evaluate them.

Amounts of $250,000 or more, on the other hand, are not difficult to find. But before you start making grandiose plans, there's something else you should know: if your company needs more than $5 million, you'd better offer investors a very good deal to offset the risk of funneling such a large sum into a single enterprise.

The quid pro quo

You've decided that you're willing to give up equity in your company, but just how much will the venture capitalist want? Will management lose control of the company? Will the investors take over the board of directors?

The amount of equity sought by a venture capitalist depends on the earnings potential of a company. A venture capital investor expects to "cash in" in five years (more or less) by selling his equity in the company. The value of his stock is a function of the

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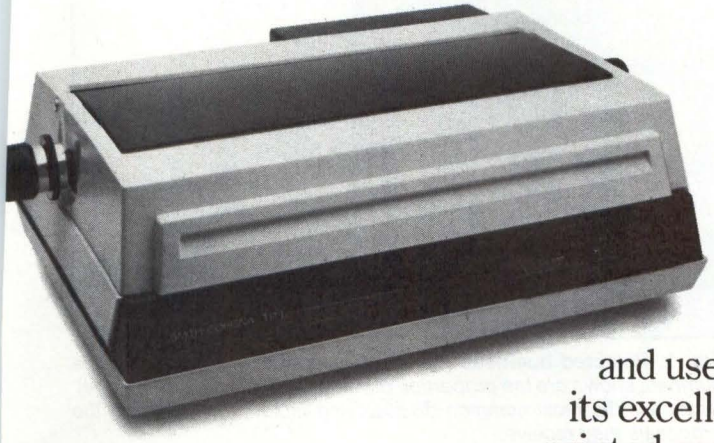

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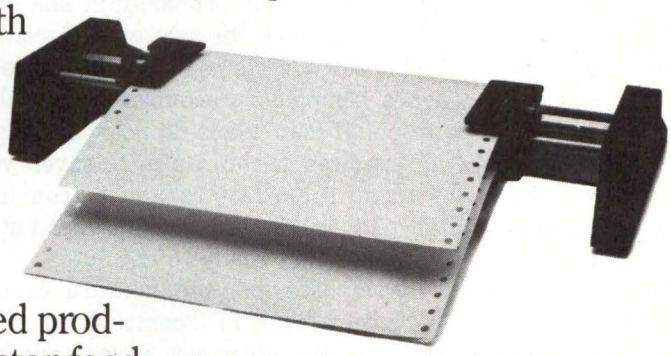

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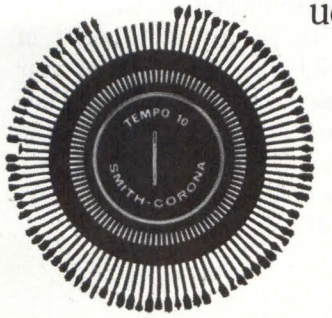

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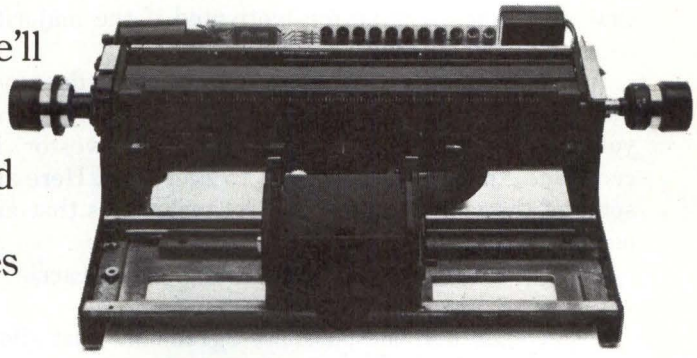

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earnings of your company at the time the sale takes place.

Thus, when his money goes into your company, the venture capitalist will estimate what the company will be worth at the time he plans to sell out. His goal is an annual return on his investment of 20 to 100 percent or more, and he wants enough equity to assure this return. (In my survey, the average venture capitalist said he seeks an ROI of at least 30 percent per year for the "most conservative" deal he will consider, while the "riskiest" deal demands an annual ROI of 60 percent or more.)

Venture capitalists sell out primarily in one of two ways: they offer their stock for sale when a company goes public, or they trade their stock for marketable securities when a company is acquired by a publicly traded corporation. If your plans do not call for going public or being acquired within three to seven years, you will have to do some fast talking to convince a venture capitalist that there will be a market for your company's stock when he's ready to get out.

To protect his investment, the venture capitalist usually wants some form of "control" over your company. Having control does not necessarily mean owning 51 percent of the stock. Giving away a majority of your stock clearly is inappropriate when 10 or 20 percent is enough to give the investor the ROI he wants. Besides, venture capitalists often do not want to acquire more than half the stock because they believe that management is better motivated if the majority ownership remains with the founders.

Avoiding a controlling interest, however, does not mean avoiding control. Although owning a majority of your company's stock would put the investor in command, there are many ways to skin a cat. Here are some of the more "subtle" control techniques that are used:

- two classes of stock, only one of which carries a vote;
- convenants in the purchase agreement that allow the investors to take over the company if certain events happen, or do not happen; and
- voting trusts, which transfer voting rights to the investors until certain milestones are reached.

Because there are so many ways to give an investor the control that he seeks, this issue by itself should not be a barrier to striking a deal. But you or your attorney may have to do some negotiating before you hit upon the control device that's right for both you and the investor.

Giving up equity and control is the price you pay for venture capital. But what you're getting is more than just money. Once a venture capitalist decides to invest in your business, you usually can count on a helping hand in running the company. Most venture capital investors participate in the major decisions made by your company's management, and the guidance they provide can be invaluable. They can be helpful in other ways as well, such as finding additional members for your management team or introducing you to key business contacts.

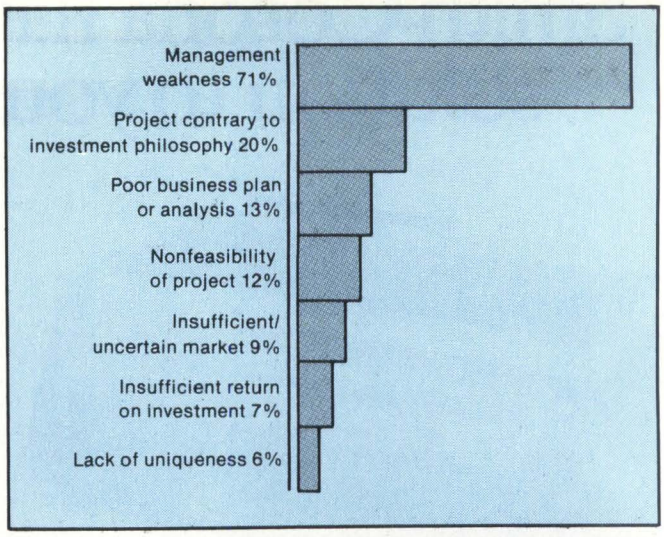

Fig. 2. Rejected business plans share common symptoms. *The numbers shown are the proportion of venture capital firms citing that factor as "the most common disqualifying factor" found among the proposals they receive.*

To keep a finger on the pulse of your business, the investor usually will want to sit on your board of directors. (My survey showed that three out of four venture capitalists want seats on the board.) Your backer probably will not want majority control of the board, however, unless your company subsequently gets into trouble, and one of the control devices mentioned above is triggered.

Approaching an investor

The first step in locating a venture capital investor is to prepare a business plan. Without a well-reasoned and well-constructed plan, raising venture capital is impossible.

A good business plan has four key elements: a description of your company and product; a discussion of key management personnel; a detailed marketing plan; and past and projected financial statements along with a brief description of the deal being offered the investor. Thoroughness is important, but you should also be concise. A long, tedious proposal is worthless if no one takes the time to read it.

As a consultant who has reviewed numerous business

The Databook of Venture Capital Sources for High Technology Companies is a 576-page directory that contains full-page listings for each of nearly 300 venture capital firms with funds available for high-technology investments. The book is available for $115.00 from Financial Data Corp., Drawer L, P.O. Box 9524, Washington, D.C. 20016.

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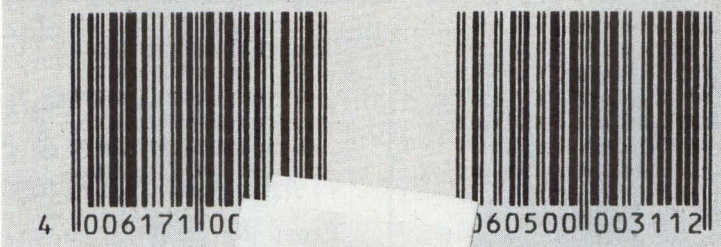

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plans, I have found that the mistake most often made by entrepreneurs in formulating their plans is failing to develop fully the section containing the marketing strategy and projections. One reason is that this section is the most difficult to prepare. How do you project sales for your industry three or more years in advance? How do you determine your product's share of the market when the market itself is so unpredictable? And how do you get data on your competitors when they are just as secretive as you are?

If your product is still in development, your company may also want to consider an R&D limited partnership.

Yet, as tough as it may be to quantify, the market potential for your product is a crucial factor in an investor's evaluation, and your strategy for achieving your marketing goals could spell the difference between success and failure. It's not surprising that the venture capitalist wants to know as much about this aspect of your project as possible.

The other elements of your business plan are also important. To score a home run, you must touch all the bases. Once you've presented your proposal to an investor, what are the chances that he will give it the time of day? Most venture capitalists seriously consider only 10 percent of the proposals they receive, and they actually fund a mere 2 percent. As these numbers suggest, venture capitalists are extremely selective when it comes to reaching into their pocketbooks.

The causes for rejection are numerous, but "weak management" is the deficiency cited most by the venture capitalists participating in my survey: 70 percent said this was the main problem with the business plans they receive. Only 25 percent said they most often reject proposals for product-related reasons. Fig. 2 shows the leading causes for proposal rejection by venture capital groups.

But don't let the high rejection rate discourage you. Venture capitalists all over the country are actively looking for good investments, and they'll fight to grab a good deal when it comes their way. If venture capital is appropriate for your company, chances are good that you'll be able to find some—on terms that even your banker might be able to appreciate! □

Richard Loftin is a Washington, D.C., consultant and lawyer specializing in venture capital and microprocessor software marketing. He is also the editor of *Databook of Venture Capital Sources for High-Technology Companies.*

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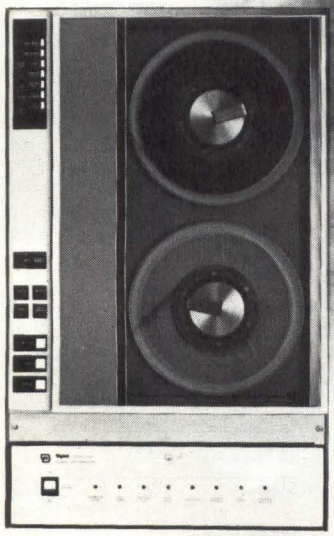

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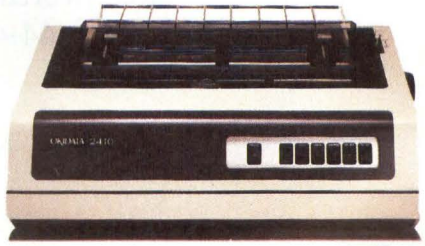

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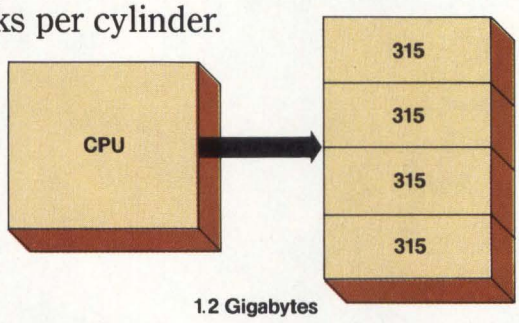

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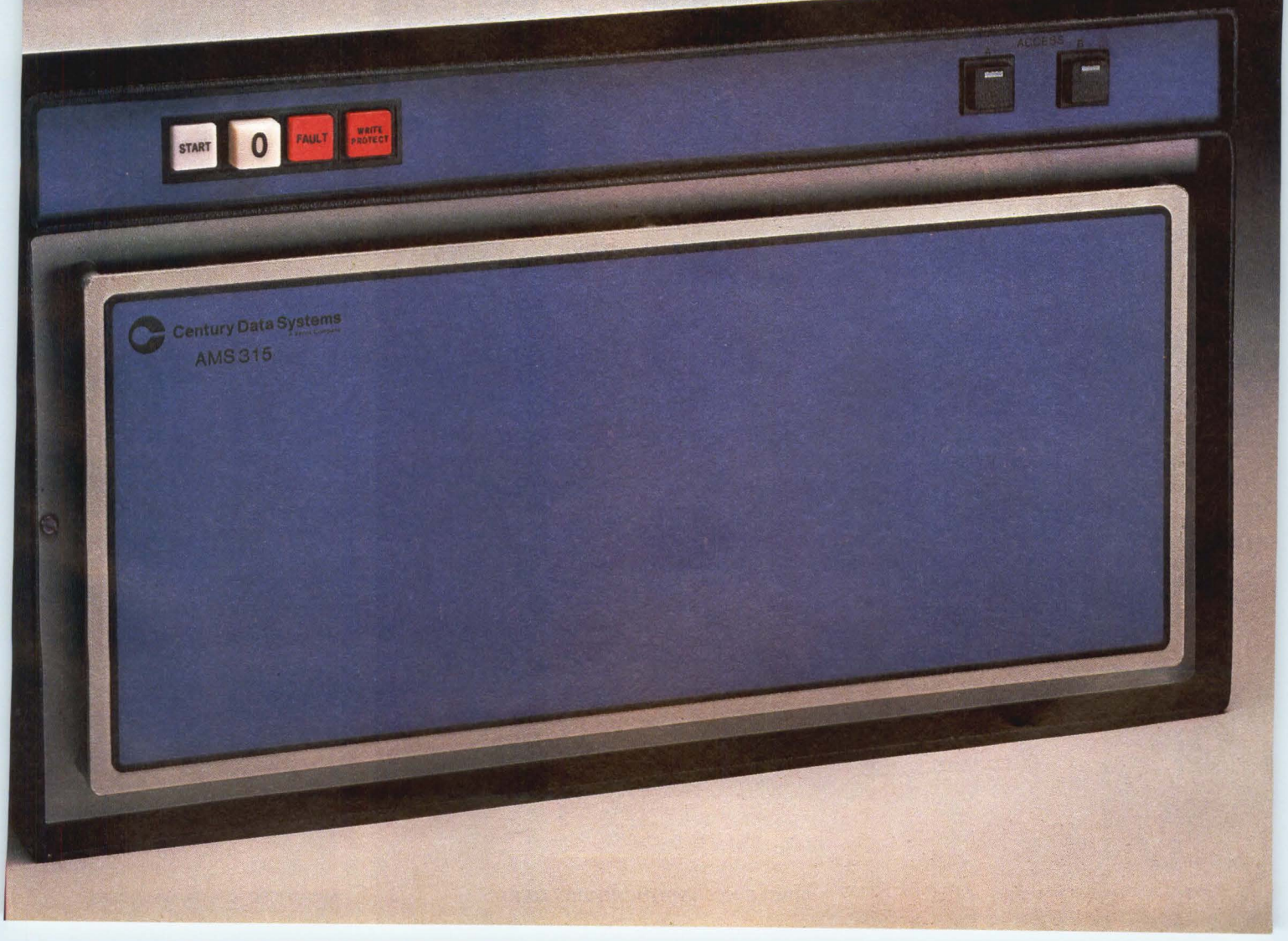

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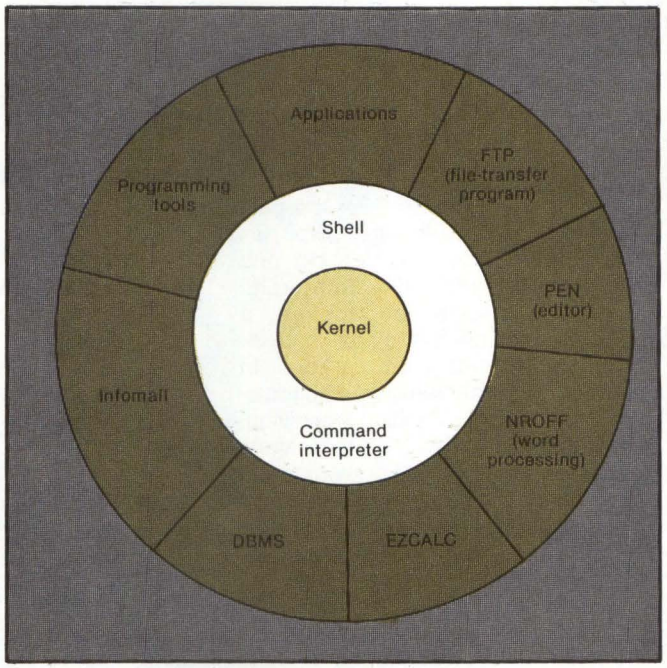
Developing programs with UNIX

CURTIS SANFORD and DAVID WALDEN, BBN Computer Corp.

Tools, pipes and testing capabilities make this operating system a powerful one for programmers

UNIX is a modern time-sharing operating system along the lines of the SDS940 time-sharing system from the University of California at Berkeley, Multics from the Massachusetts Institute of Technology, TENEX from BBN Computer Corp. and Digital Equipment Corp.'s TENEX-based TOPS-20. It is the first widely available operating system to have most of the facilities that members of the computer-science research community in the U.S. have had for years. In terms of power, convenience and most other program-development criteria, it is in a different league from most other operating systems, and particularly superior to other modern time-sharing systems for building development tools and combining tools or parts of tools into new ones. UNIX software includes a vast body of various tools, and new tools are being written all the time. When combined with UNIX's "pipe" feature and program analysis and testing capabilities, these tools make UNIX ideal for program development.



The UNIX application environment *comprises three levels: kernel, shell and applications/utilities. Programmers work from the shell, accessing tools and utilities in the outer level to build application packages. The kernel provides major operating-system functions.*

Programming advantages

The features UNIX provides for program development include support of the RATFOR programing language, useful programming utilities and a powerful file system. For a program to be portable, it must be written in a widely available programming language. UNIX software includes not only an excellent version of FORTRAN 77, but also the RATFOR pre-processor, which supports structured programming, eliminating many of the disadvantages of FORTRAN. There are also COBOL, BASIC and Pascal processors for UNIX.

The high-level language RATFOR (Rationalized FORTRAN) is one of the best-known of a number of FORTRAN pre-processors that shield a user from many of FORTRAN's deficiencies while keeping its chief advantages. RATFOR permits a FORTRAN programmer to use structured programming, including commands such as WHILE, FOR, IF/ELSE and SWITCH, and long, mnemonic names for variables and routines, speeding program development. RATFOR also performs type checking between separately compiled programs.

UNIX offers program "beautifiers," such as CB, which mechanically converts a piece of unstructured source code into a consistent structured-programming format. Other programs compare source files and flag differences, such as DIFF, while cross-reference tools such as CREF produce conventional symbol cross-reference

lists. Symbol-table analysis tools such as NM provide symbol tables in forms easily manipulated by SORT and GREP. UNIX also supports symbolic debugging, a feature whose great usefulness will be attested to by any programmer who has used core dumps to debug software.

UNIX "shell" files enable programmers to make the most effective use of UNIX's wealth of tools. Programmers can define complex sequences of commands in a shell file; then, each time one of these tasks is to be performed, the user need invoke only the name of the corresponding shell file, in effect executing the entire sequence of steps with one command. Because these shell files can take arguments, include conditional actions and contain referenees to other shell files, users can build a library of increasingly complex sequences that are executed with a single command.

Pipes and file structure

Another way in which existing tools can be combined to build new tools is by use of the UNIX "pipe" feature, which directs the output of one program to be the input for the next program. Conventional operating systems approximate this capability by putting the output of the first program in a file, then passing that file to the second program, which cannot run until the first program completes; later programs in the sequence do not see any data until each earlier program has processed the whole batch. Under the UNIX system, however, a stream of data can flow through a "pipeline" of programs as if each program had been written as a specialized co-routine to call the next program for each unit of data in succession.

A simple example of the use of a pipe is the statement:

cat abc / more

The UNIX command "cat abc," when used alone, prints the entire contents of the file "abc" to the user's terminal; the file, however, may be more than a screenfull. The vertical bar is the UNIX pipe command

COMMERCIAL APPLICATION DEVELOPMENT ON UNIX

While the UNIX operating system is widely used as a system-development environment, its suitability for developing commercial application packages is less well known. Over the past two years, BBN Computer Corp. has used UNIX to design, develop and support the InfoMail commercial application software package, a sophisticated electronic-mail and information-manangement package. In addition to such familiar electronic-mail functions as sending, receiving, forwarding and answering messages, InfoMail retrieves, manipulates and files documents. Most of InfoMail's development was done under BBN-UNIX, an enhanced UNIX operating system, on a BBN C/70 minicomputer.

The InfoMail package had to be portable to maximize the return on its large financial investment. And because InfoMail usually has many simultaneous users on any given computer system, it was important that a reentrant version of the InfoMail program be available. This allows all simultaneous InfoMail users on a computer to share a copy of the program. These needs were met by writing InfoMail in a BNN-UNIX version of RATFOR, which generates both PL/1 code for IBM Corp. machines (IBM's PL/1 is the only IBM language to generate reentrant code) and FORTRAN for non-IBM machines (Figure).

The UNIX program GREP was used in InfoMail development to build a tool that searches the entire InfoMail source system for a construction in seconds. GREP can be used to find all occurrences of a call to the log-in subroutine in which its argument is zero.

UNIX's powerful string-manipulation tools, SPL, AWK and SED are useful for building complex data structures. These tools were combined in hours to read a simple list of messages and then to create FORTRAN or PL/1 code for initializing the InfoMail message database.

An example of how the UNIX pipe facility was used in InfoMail development involved the command "GETNAMES md," which invoked the following shell file:

FGREP $1 : AWK ' [PRINT $1]' / SORT.

Here, FGREP finds all the uses of the string "md'" in the input stream to the GETNAMES shell command and pipes its output to AWK. AWK extracts the first word from each line passed to it by FGREP and pipes its output to SORT. SORT sorts the words passed from AWK into alphabetical order. This shell file thus produces a sorted list of all the first words of lines in a program containing "md."

The development of InfoMail was a team effort, supported by the UNIX hierarchical file structure. The system users directory contains directories of InfoMail developers, of configuration-control files maintained for each InfoMail customer and of all the InfoMail development files used by all of the InfoMail developers. A high-level file directory contains all common InfoMail and other definition files, as well as file directories for each major cluster of program modules. In this way, related program modules are kept in one subdirectory. Also within the directory is a separate file directory for each set of program changes that a member of the programming team is making. A shell file called Install sets up a new version of InfoMail, makes a backup copy of the old version and sets the file protection of the new version so that it cannot be accidently overwritten.

UNIX's analysis and testing tools were useful in InfoMail's development. At an early stage, it became apparent there was a performance problem. Analysis by the PROF (profiling) tool indicated tens of thousands of calls to a symbol table look-up routine. By changing the program to look up all the symbols once in the beginning, and thereafter to use the results of that look-up, a 7:1 increase in speed was made in that part of the program.

UNIX partioning features keep proprietary InfoMail files safe from unauthorized access. InfoMail is regularly demonstrated to potential customers on the same UNIX system on which development is done, but these prospects cannot access any of the development files, even when allowed to experiment freely with InfoMail.

and indicates that the output of the "cat" program is to go into the "more" program instead of going directly to the terminal. The "more" program prints one screenfull of its input text on the user's terminal and then waits for the user to indicate that the next screenfull should be printed. Thus, the above compound command, or pipe, prints a file on the user's screen, with the user specifying when successive screenfulls should be printed.

While a special "catmore" command could have been developed under UNIX for the above function, the pipe facility permits the user to create the function by defining a shell file, "catmore," which has as its contents the above compound command.

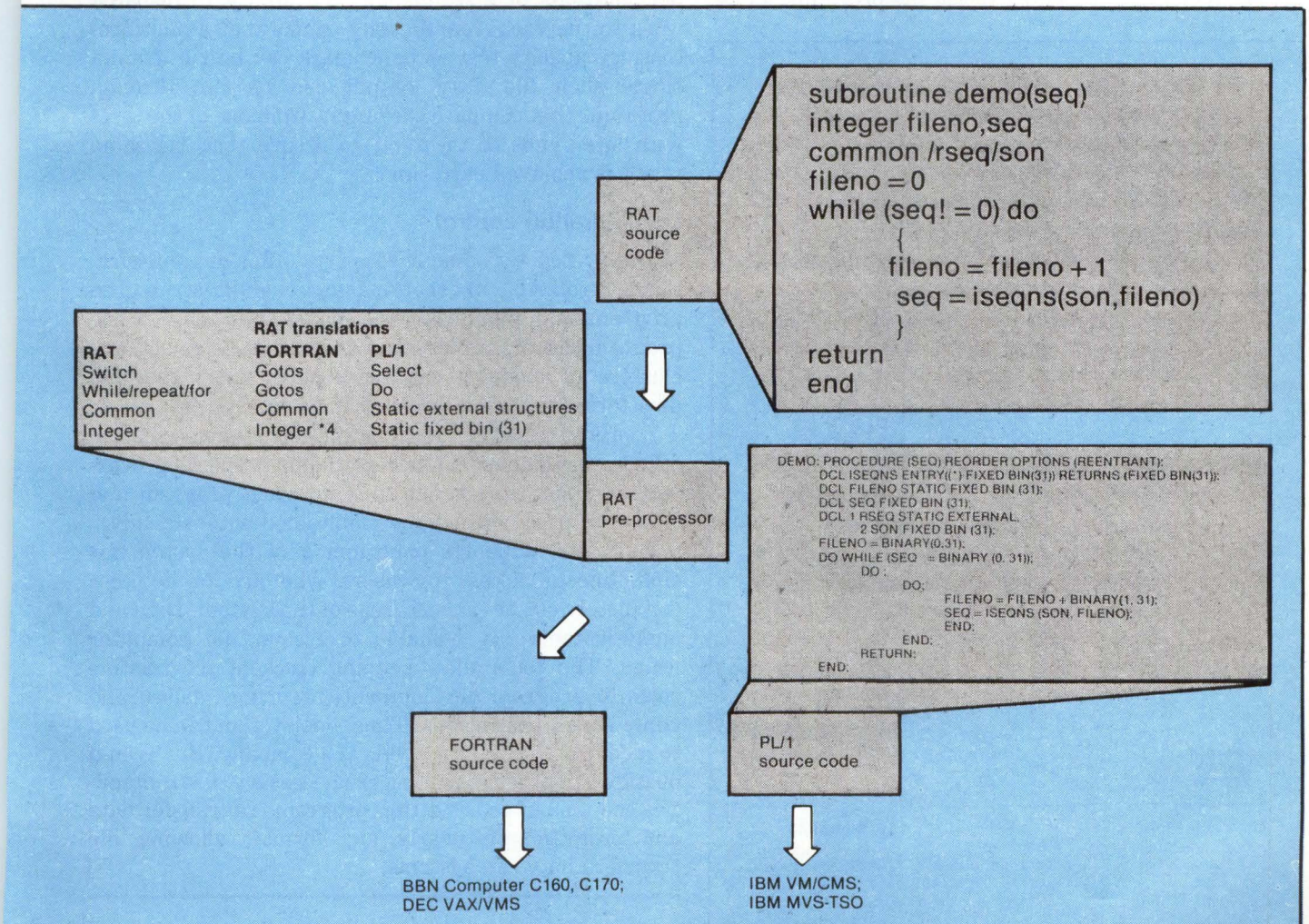
UNIX provides a hierarchy of file directories, in which each file directory contains files or other file directories (Fig. 1). A top-level directory, called the root directory, contains system directories such as directories of compilers, system utilities and all of the directories of users of the system.

The usual documentation available with an operating system does not provide sufficient details to meet the developer's needs. Because the source files for the UNIX operating system are written in the high-level C programming language, they are readily available and readable, providing an unambiguous documentation of tools. With the source programs available, programmers can easily modify programs to suit their needs, without changing the program from other users' viewpoints. Modified programs are visible only to a modifying user.

UNIX supports a uniform I/O model for device-independent programs. The UNIX user need not be concerned about whether the output device is the terminal, tape, disk or printer. The basic program is written for "standard output," usually the terminal. At execution time, a parameter selects the actual output device.

Analysis and testing

Even a well-designed program will not be completely understood until the program is compiled or run. Several UNIX tools facilitate this analysis and help implement necessary changes.



RAT source code translation for InfoMail *is handled by pre-processor, which generates either FORTRAN or PL/1 source code acceptable to various computers. RAT is a more standardized, structured version of FORTRAN.*

UNIX's C and FORTRAN compilers are integrated with profiling tools that provide immediate analysis of dynamic program behavior. On the basis of this analysis, modifications can be made to improve program performance. The load maps and subroutine-dependence graphs available from the compilers can be processed using UNIX sorting tools and passed to the loader. This allows generating a run-time module with improved page-faulting characteristics.

Internally, the UNIX operating system maintains counters of a variety of system and program-wide statistics, such as memory and CPU use and disk and terminal I/O. Programs are available to monitor these counters in real time, providing valuable information on how the programs run. UNIX also includes excellent tools for program testing. When a programmer first tests a new module by typing various commands to the program, the UNIX "tee" feature saves the input, forming a typescript against which the program can be retested (Fig. 2). Over time, these scripts can be modified and extended to test the program in increasingly comprehensive ways.

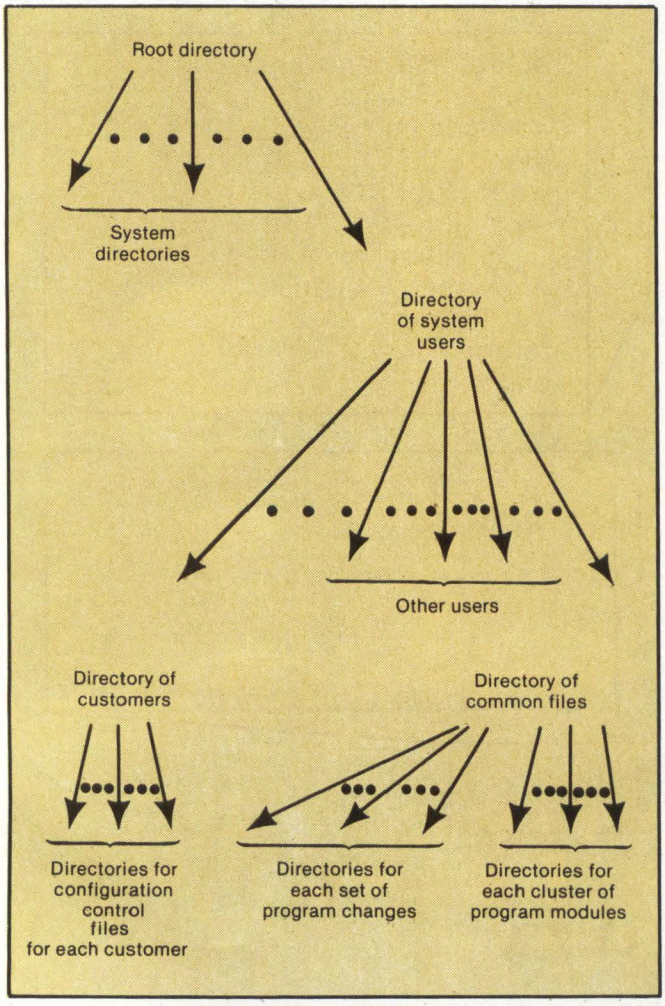


Fig. 1. The UNIX hierarchical file system *starts with a single root directory that branches into other directories. Each directory can branch into any combination of files or other directories, and files can be listed repeatedly in different directories under the same name.*

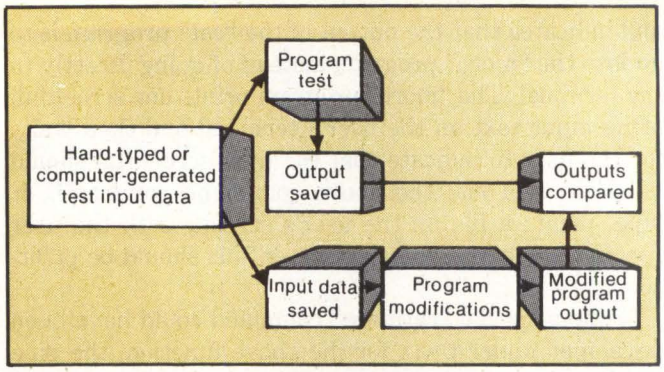


Fig. 2. The UNIX program-testing facilities *allow a programmer to keep track of how program modifications affect test results. One set of typed or computer-generated test input data can be saved while another set is tested against the program; the test output is then saved. After program modifications are made, the modified program output is compared with the original program output.*

Other UNIX tools facilitate inputting large amounts of data to test a program, such as iterating through the permutations of a command. The ability to dispatch work to the background easily means that a multiprocessing capacity test or benchmark can be run from a single shell file. Test output can be run through programs that compare the output from one of the tests with later runs of the test, to assure that the same result is achieved each time.

Configuration control

The UNIX environment supports efficient configuration control. All UNIX tools support modular structured programming, minimizing the chance of a change to the program causing problems in another area. Functional clusters of modules can be kept in their own file directories in the hierarchical UNIX file system.

A programmer can reserve these clusters so that no other programmer can access them, preventing overlapping changes. Change logs for each program and cluster of programs can be maintained automatically.

UNIX also supports partitioning of the system for simultaneous access by users who are to be kept completely out of various areas of the system. Data and analysis tools are available to account for computer usage. The tools allow keeping track of the relative costs of program development, assuring quality, and running demonstrations. Thus, one system can be used to meet many different needs of a company. But even if outside computer resources are necessary, UNIX simplifies the task of constructing programs to transfer data and programs in nearly any format, allowing file transfers between systems. □

Curtis N. Sanford directs the InfoMail development program, and **David Walden** is executive vice president at BBN Computer Corp., Cambridge, Mass.

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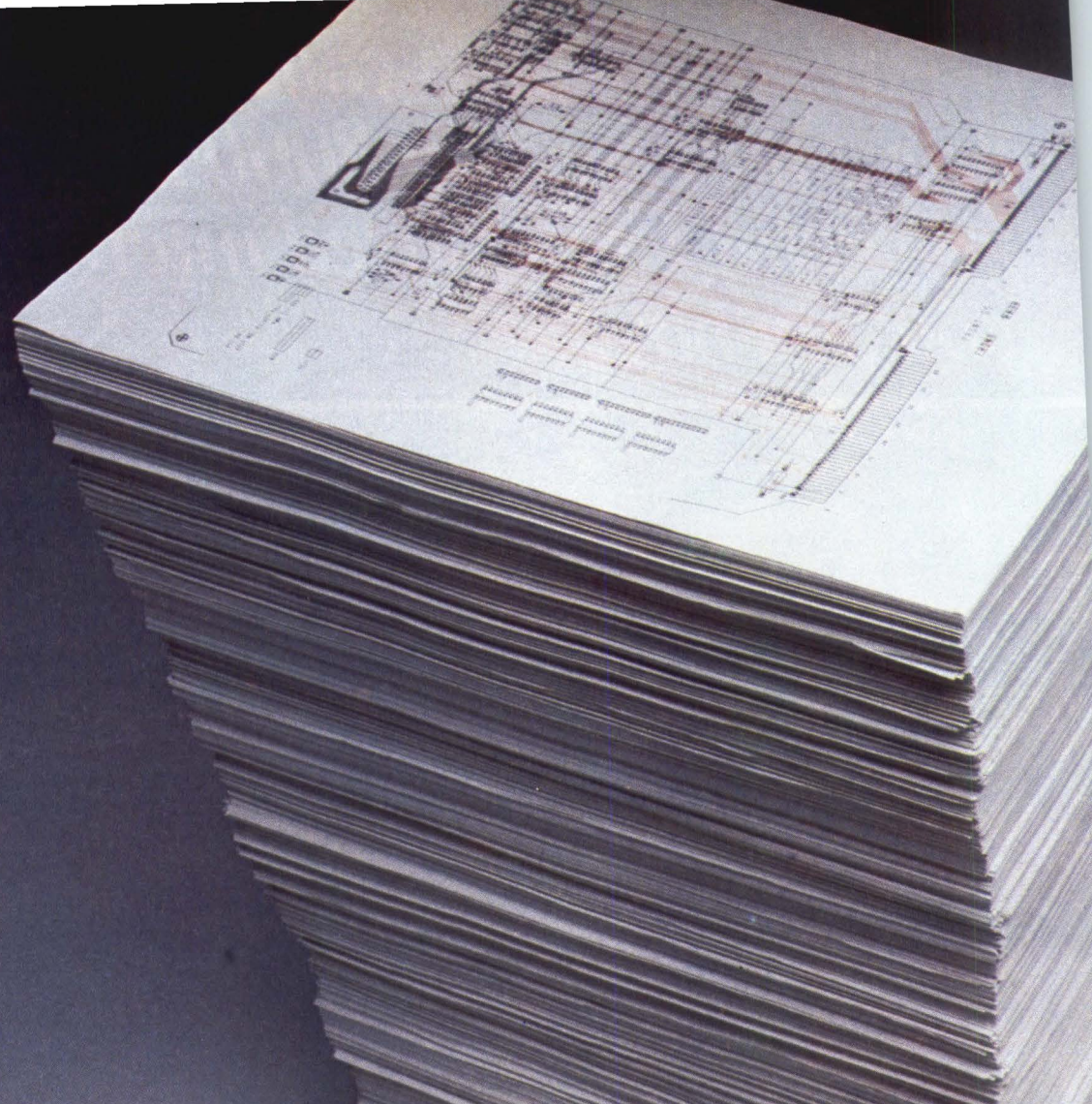

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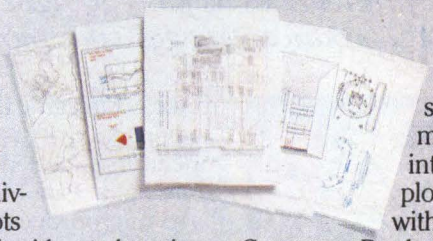

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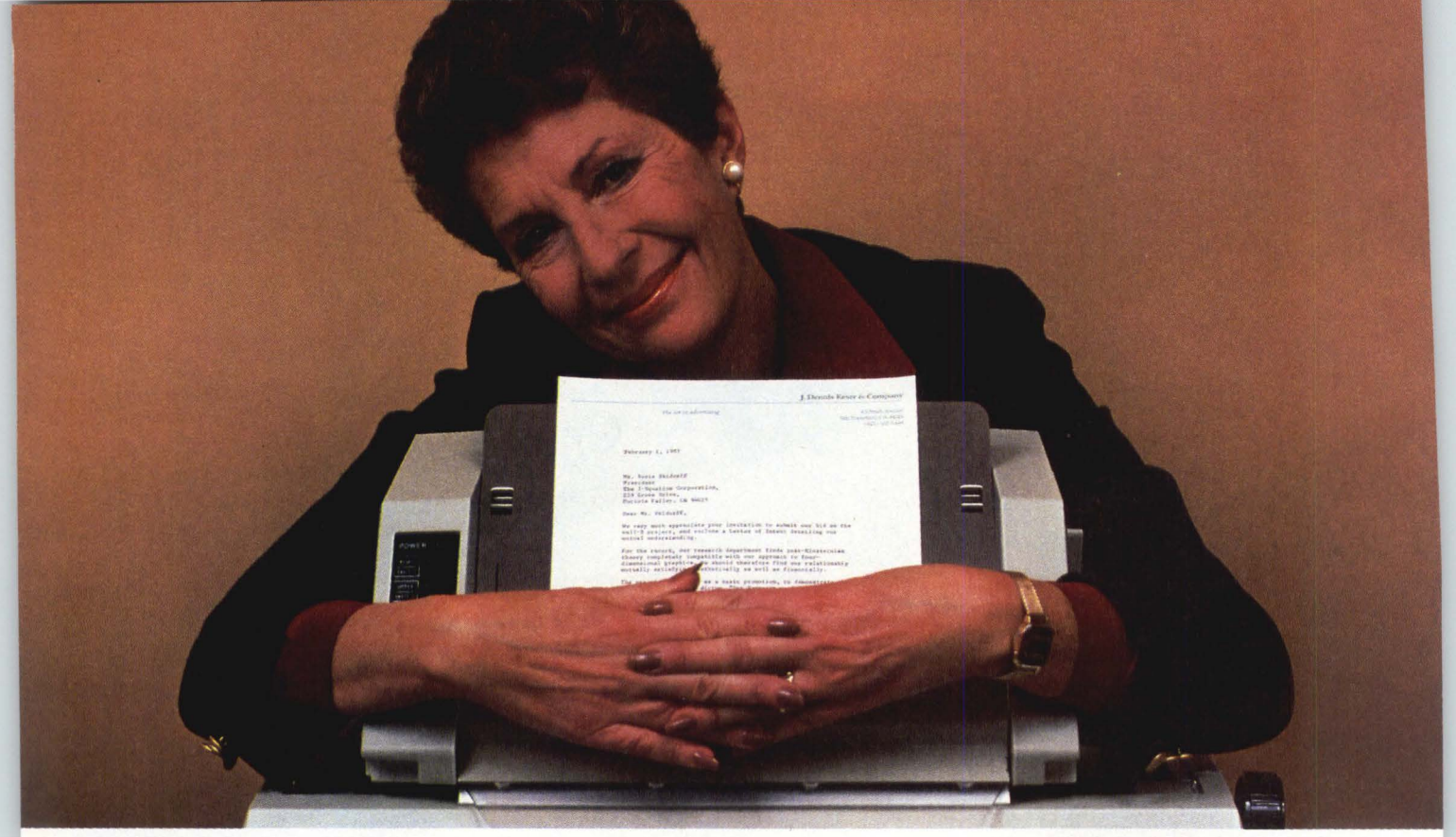

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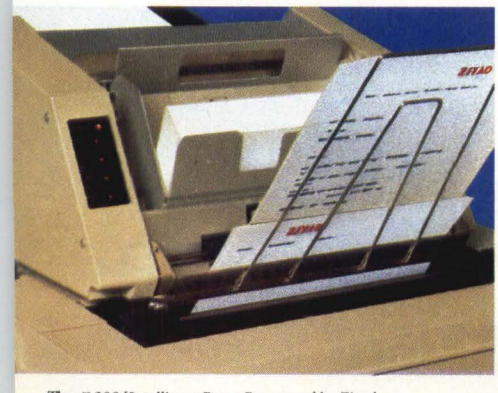

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Micro integrates development and testing functions

DR. OLAF KAESTNER, Siemens AG

Siemens PMS combines capabilities of cross systems and field testers in a portable, modular unit

The evolution of a microcomputer system, from hardware configuration and software writing to installation, testing and debugging, can be a lengthy and complex process requiring tools that complement a system integrator's expertise. The ideal tool should provide flexibility for both development and testing. Siemens's portable microcomputer system (PMS) addresses this goal of flexibility and fills the gap between high-end systems such as Intel Corp.'s MDS and simple cross systems and field testers. PMS has a portable, modular design that allows it to perform in the lab as well as in the field.

Portable, modular design

PMS has a small, compact construction that makes the system genuinely portable (Fig. 1). It also fits into a standard 19-in. rack. The keyboard serves as a protective cover for the CRT and floppies during transport and folds down during operation. The keyboard can also be detached from the housing and moved to the most comfortable working position. The 9-in. screen is larger than is common in portable systems.

PMS is configured from standard microcomputer boards rather than being a special purpose design (Fig. 2). The system consists of five basic boards from the SMP family (see "What is SMP?" p.288). The five basic boards fit a motherboard with connectors for eight additional SMP boards selectable by a user.

The system's power supply powers all components including CRT and floppies, and has ample reserve for system extension. The power supply can easily be changed for the voltage requirements of different countries.

PMS's software is based on the popular CP/M operating system. All devices are coordinated by an interrupt controller on the general interface board. The software device drivers are standard SMP products allowing the interrupt system to be extended by the user.

Dual-mode capability

PMS addresses two long-standing objectives of system integrators: to develop an application on the target system and to test and to debug on-site. Development and testing have always been undertaken with support tools, but, in general, each of these functions requires a different tool. The usual development tool is a "cross system," in which the application software is developed away from the target machine. Common testing tools are oscilloscopes, logic analyzers and in-circuit emulators. These devices, called field testers, usually are listening devices: they pinpoint the trouble spots but do not permit immediate correction of the problem. PMS

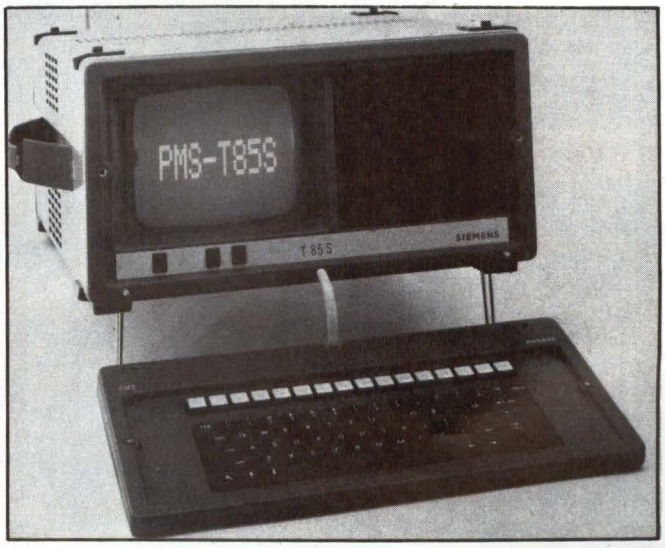

Fig. 1. The Siemens portable microcomputer system *features dual minifloppy disks, a 9-in. CRT display and a detachable keyboard.*

combines the functions of cross systems and field testers and possesses additional capabilities of its own.

In its development function, PMS can behave as a traditional cross system. It is a stand-alone system with utilities to write, edit, compile and debug application software. However, an application system can be developed by an entirely different method: using PMS as the kernel around which the application is configured (Fig. 3). To use this method, a system integrator must choose SMP interface and controller boards appropriate for an application. Among the devices that can be configured are terminal cluster multiplexers, IEEE-488 controllers, data loggers and graphics subsystems. The list of choices is almost unlimited. Hardware in the form of SMP boards and software in the form of drivers, monitors and operating systems are all in the available tool box.

PMS addresses two long-standing objectives of system integrators: to develop an application on the target system and to debug on-site.

In its testing function, PMS provides another choice:

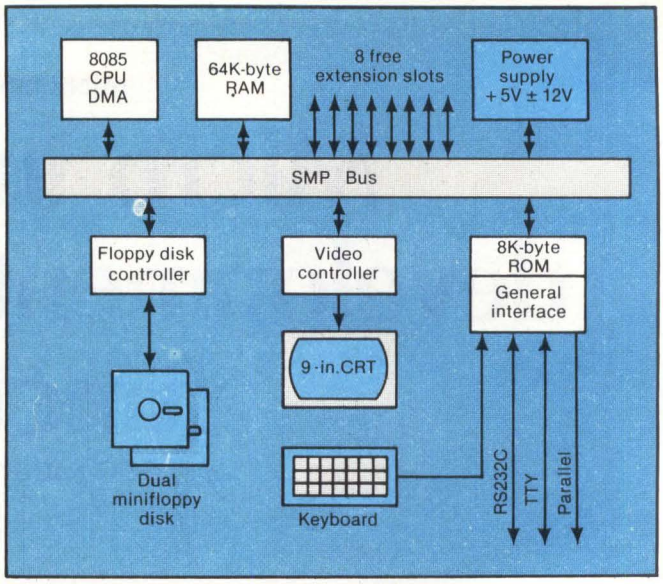

Fig. 2. PMS configuration. *The system contains five basic microcomputer boards. The processor board includes an 8085 CPU and a four-channel DMA controller; a general interface board provides a boot ROM and connections to the keyboard, the printer, the modem and the terminal. The user can substitute other boards to reconfigure the system for larger memory or for other processors from the 8080/8085/8088 family.*

WHAT IS SMP?

SMP is a family of more than 70 basic types of microcomputer boards. Also available are backplane modules, extenders, prototyping boards, preassembled card cages and power supplies. SMP products are available in the U.S. from Western Digital Corp. and many independent suppliers.

The SMP family is characterized by its Eurocard form factor and use of microprocessors from the 8080/8085/8088 family. The processor boards include DMA controllers and arithmetic units. RAM can be static, dynamic or CMOS with on-board battery backup. Mass-storage controllers are available for magnetic bubbles, floppy and hard disks and cassettes. System support includes interrupt controllers, timers, a real-time clock, boot EPROM and a system monitor. Interfaces are parallel (TTL or 24V), serial (TTL, TTY or RS232C) or analog (voltage or current) with optional optical decoupling.

Software tools are available for writing and debugging application programs. Software drivers support peripheral controller boards, making it unnecessary for the user to handle the details of devices and controller LSIs. Real-time operating systems allow multitasking. Run-time support is available for BASIC and FORTRAN.

SMP BUS SIGNALS

The basic SMP bus occupies 64 pins (rows a and c) of a standard VG connector. Additional lines for special extension are placed in row b of a 96-pin connector.

Signals of rows a and c:

Number	Description
17	Address lines, memory-mapped I/O indicator
8	Data lines, bidirectional
4	Command lines
3	Clock and synchronization
2	Interrupt handshake
6	DMA bus handshake and extension
8	DMA device handshake
9	Power supply
7	Processor specific
64	Total

Signals of row b:

Number	Description
4	Reserved bus lines
4	Additional power supplies (free for user)
24	Non-bused signals (bank selects, interrupts)
32	Total

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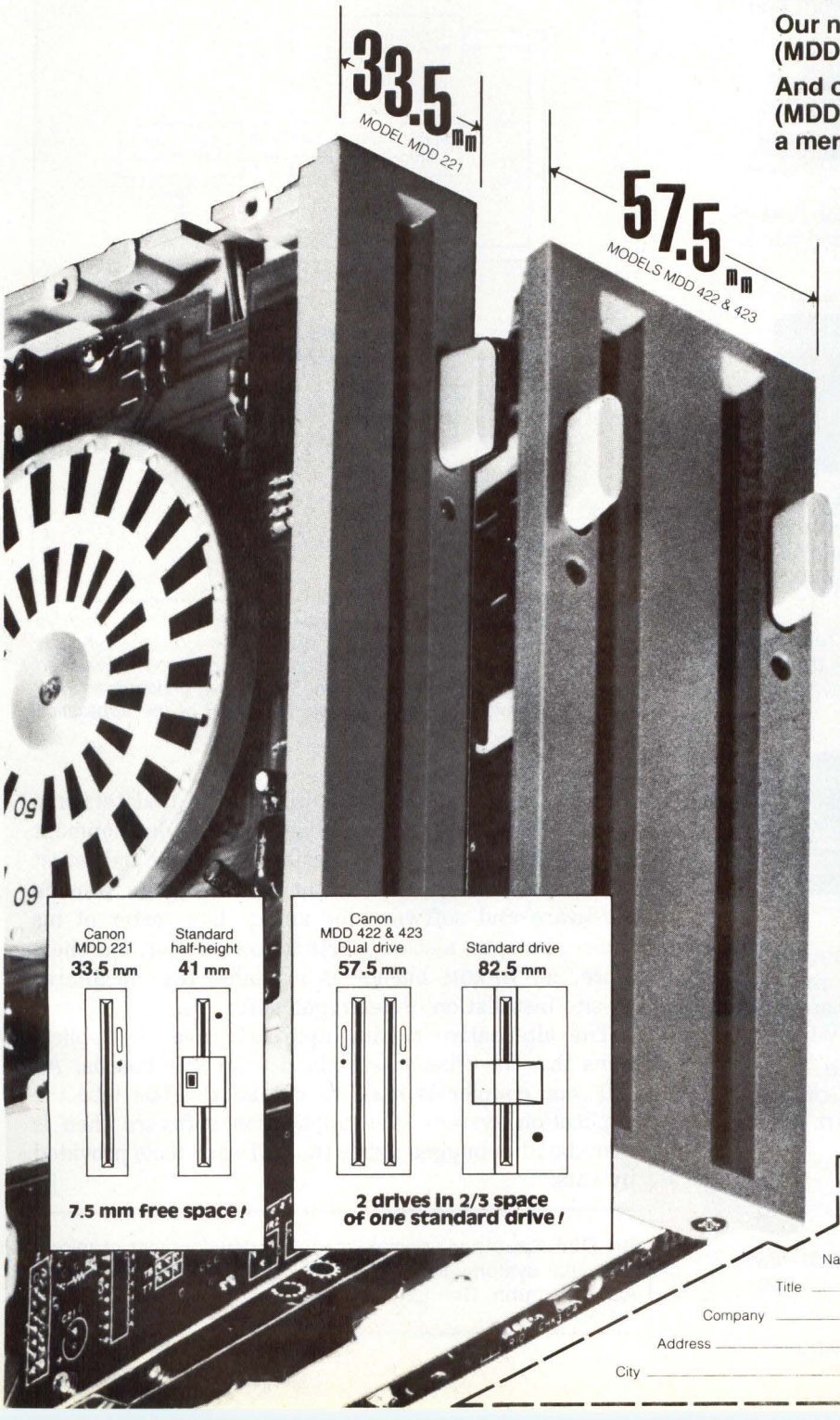

User convenience

- Single-pushbutton media locking and ejection. Anti-crunch mechanism prevents damage to improperly inserted media. Pushbutton is locked while drive is in R/W operation.

Reliability

- Wear and shock resistant thin head — *designed and manufactured by Canon.*
- Soft-landing head mechanism eliminates tap damage.
- Brushless direct drive motor.
- Low parts count.
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- Space savings.
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- Available with standard half-height panel as option.
- Industry compatible interface.
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- Two drives equal only ⅔ the height of standard 5¼″ floppy drive.
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- Power savings: two drives require approximately the same power as only one drive.
- MDD 422 has one stepper for both drives; MDD 423 has separate stepper for each drive.

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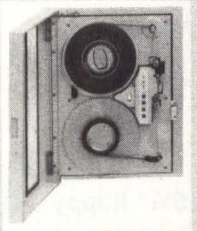


Series 1012 TMS "Virgo" Streaming Tape Transports

TD 1012-1

Basic vertical transport with reels up to 10½", 9-track, IBM compatible, Read-after-Write; 100 ips streaming, 12.5 ips start-stop. Integrated industry-standard formatter, 1600 cpi (P.E.). Rack mountable. Available without front door.

TD 1012-2

Drawer mounted version of the TD 1012-1, incorporating identical specifications and performance, with drawer slides.

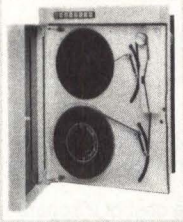
TD 1012-3

Table-top mounted version, including same specifications and performance of TD 1012-1.

Series 1050 Magnetic Tape Drives and Subsystems

TD 1050

Basic tension arm magnetic tape subsystem with up to 10½" reels, speeds from 18.75 to 45 ips, 9-track, P.E. (1600 cpi) and/or NRZI (800 cpi). Available in 21 separate models which are compatible with a variety of host systems, for example: GPIB, RS232C, parallel I/O, Multibus and others.



TD 1750

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using a field tester or extending PMS into the application system. The first approach takes advantage of the RS232C interface available on most field testers. This interface usually is dedicated to a terminal for interactive user control. Since PMS also features an RS232C

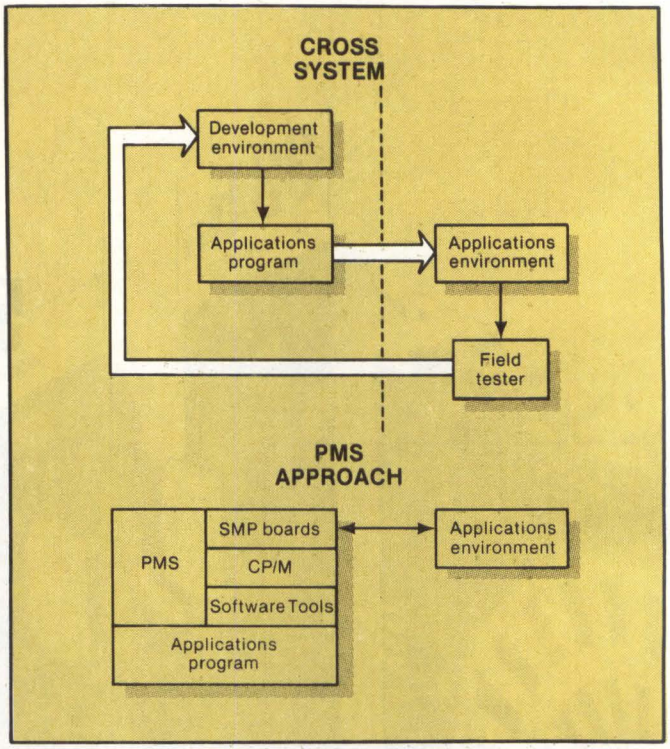

Fig. 3. Two development approaches. *The PMS approach is more integrated than the traditional cross system in which development is separate from the application environment. Applications developed using PMS can be configured from the same family of boards as PMS itself. This allows PMS to serve as the kernel of the application system.*

interface, it can be connected instead of that terminal and achieve the added intelligence of a development system. In this case, it is possible to modify and retest the software on-site. A user currently can provide hardware and software for an ICE-like tester of his choice, but PMS also supports its own tester. Furthermore, an EPROM burner is available that facilitates on-site installation of debugged software.

The alternative testing approach involves applications that have been assembled from SMP boards. An SMP bus coupler is used to extend the bus into the application system. The application software then is tested and debugged using the software tools provided by PMS. □

Dr. Olaf Kaestner specializes in the development of microcomputer systems for the semiconductor division of Siemens AG, Ottobrunn, Germany.

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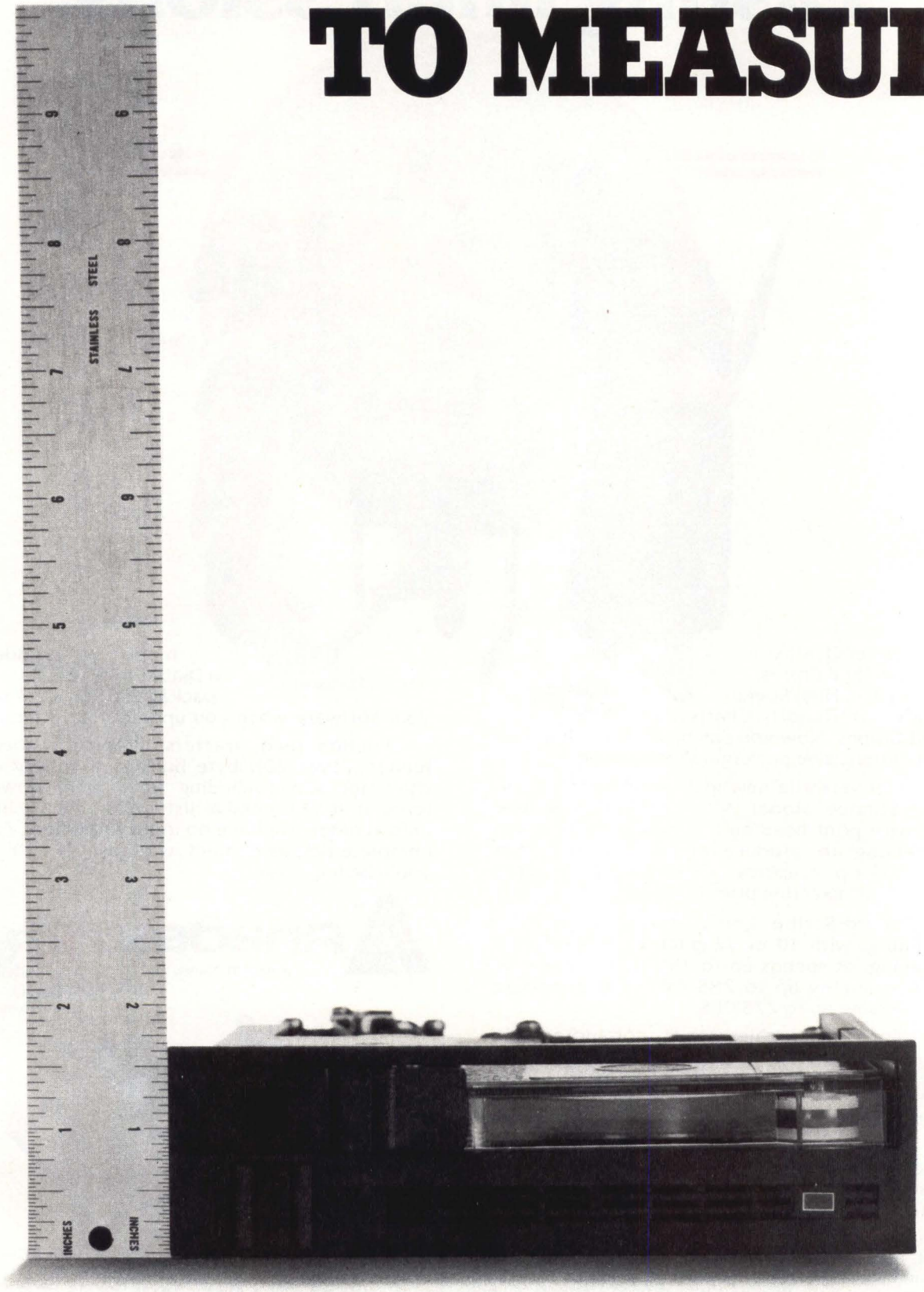

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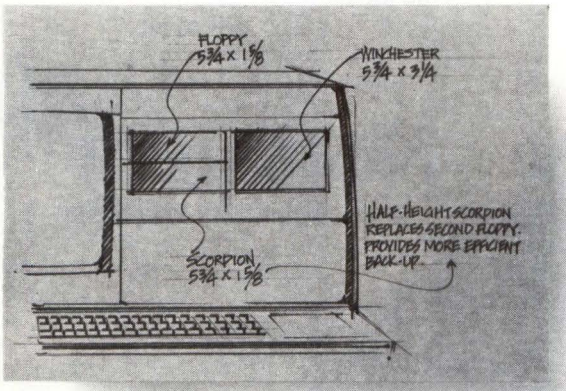

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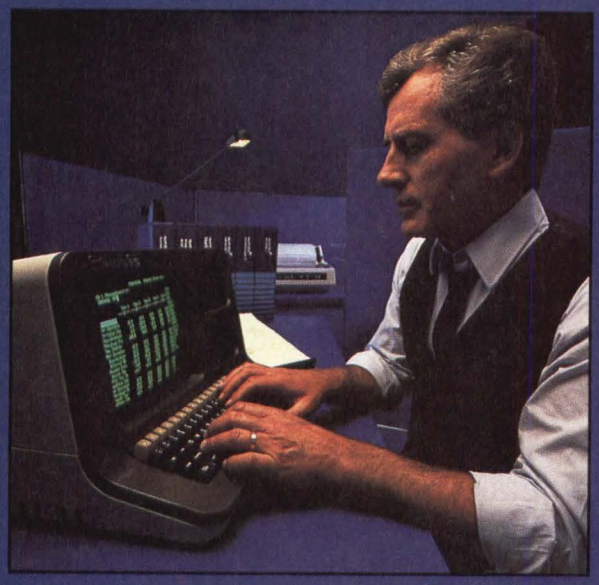

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CIRCLE NO. 159 ON INQUIRY CARD

Plotters keep tire design rolling

JOSEPH ELLIS, General Tire and Rubber Co.

CADD system cuts drafting costs and development time in tread design

By 1968, it was clear to General Tire and Rubber Co., Akron, Ohio, that computer-aided design and drafting was the only long-term, cost-effective way to improve product quality while responding to competitive pressures to speed new tires to the market. Since then, the company has updated its capabilities. CADD has reduced from two months to two weeks the time required from initial design to production drawings for a new line of tires.

A major factor in the time reduction has been the use

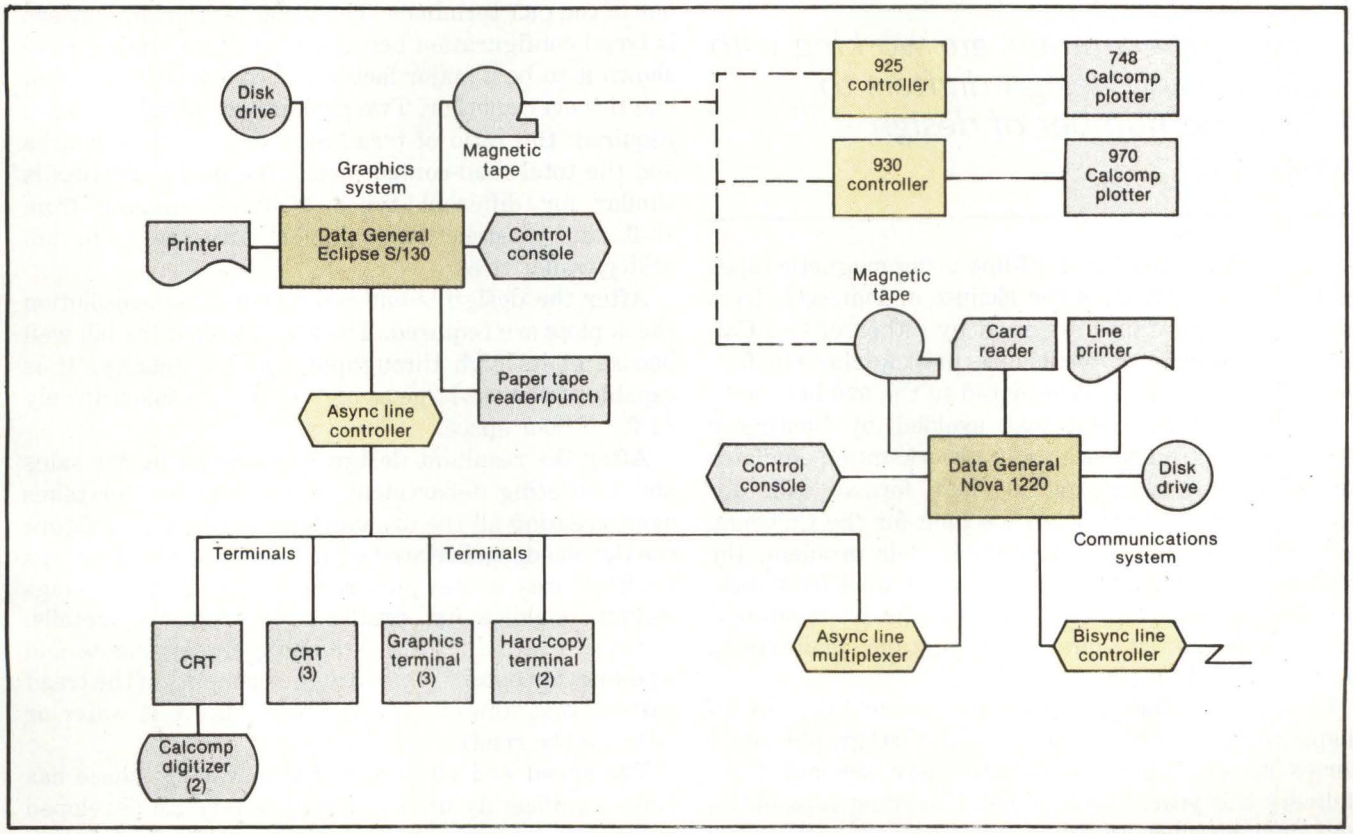

Fig. 1. General Tire's CADD system configuration *is based on two Data General Corp. minicomputers and CalComp peripherals. Most application software programs reside in the Eclipse, which has 0.5M bytes of main memory and 40M bytes of on-line storage. Large-scale number-crunching programs are located in a remote IBM 3033.*

of two pen plotters from California Computer Products (CalComp), Anaheim, Calif., to generate productin drawings. Drawings for a new tire design that would typically take a drafter 40 hours now take just 4 hours using a model 748 flatbed plotter or a model 970 belt-bed unit. And by reducing drafting costs, the plotters save the company an estimated $1 million a year.

How the system works

General Tire's system (Fig. 1) revolves around a Data General Corp. Eclipse computer supporting interactive input through two CalComp 6000 series digitizers, three interactive graphics displays and a number of alphanumeric terminals. A DG Nova minicomputer serves as a remote-job-entry terminal, handling communications to and from an IBM Corp. 3033. By replacing IBM 2780 and 3780 terminals with the Nova, the company saves on rental costs and, more importantly, the Eclipse communicates with the 3033 through the Nova, considerably improving throughput. The 3033 performs complex computations such as finite-element analysis and is used to generate drawings that can be run in batch rather than interactive mode.

Graphic programmers are working with engineers and design drafters to reduce the number of design iterations.

All output is generated off-line using magnetic tapes generated directly from the Eclipse or indirectly from the 3033. These tapes are read by either of two CalComp controllers—a model 925 driving the 748 flatbed plotter or a model 930 mated to the 970 belt bed.

A data output hitch was avoided by writing a subroutine for the Nova's HASP II workstation emulator program. The standard DG data format calls for 512-byte records, which are too long for the CalComp controllers to read. To circumvent this problem, the 3033 is programmed to send data intended for punch-card output using 80-byte records. The Nova subroutine directs the data onto magnetic tape, maintaining 80-byte record length.

General Tire has upgraded its interactive graphics displays by installing a CalComp Vistagraphic 3000 series raster display, with two more scheduled for delivery this year. The intelligent zooming capabilities and dual bit-slice microprocessor architecture of the Vistagraphic displays provide the positioning accuracy required for the design applications.

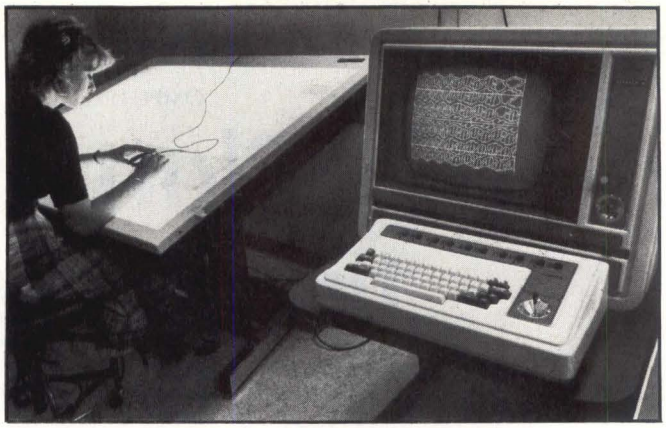

Fig. 2. Tread-design digitization *involves entering a rough sketch through a CalComp 6482 digitizer into an Eclipse processor over a 4800-baud RS232 line. The Eclipse echoes the data serially at 9600 baud to the CRT display, and the designer modifies the tread configuration by using the keyboard to select functions and the joystick to identify segments of the image to be manipulated.*

Graphic programmers are working with engineers, designers and design drafters to reduce the number of design iterations, and to program the Eclipse to construct design parameters with appropriate prompts to the various users.

Using the CADD system

The initial tread design is entered into the CADD system by digitizing a rough sketch onto one of the interactive displays (Fig. 2), or is created directly on one of the CRT terminals. The designer's prime concern is tread configuration because marketing studies have shown it to be a major factor in a consumer's selecting one tire over another. Two preliminary calculations are required: the ratio of tread area to road-contact area and the total road-contact area. The design process is similar for different types of tires, ranging from 10-ft.-tall construction-equipment tires to 10-in.-tall utility-trailer tires.

After the design is entered, several high-resolution check plots are required. The 970 has filled the bill well becuse of its high throughput and line quality. It is capable of plots as large as 51 × 80 in., yet takes up only 12 ft. of floor space.

After the resultant design is approved by the sales and marketing department, the design drafter takes over, creating all the drawings needed to manufacture the tire molds and related equipment, and the drawings to check tires as they go through production. Drawings include mold-cavity profiles, tread-groove details, cured-tire layouts, letter-stamping arrangements and sipe-location details (sipes are the elements of the tread pattern that improve traction when there is water or snow on the road).

The speed and efficiency of the drafting phase has been significantly improved by an in-house-developed software program that uses parametric geometry, shapes with variables rather than numbers. The design drafter enters the values of the key independent

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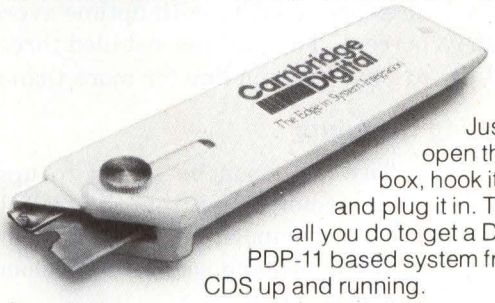

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variables, and the program automatically calculates the associated geometry for a new tire size.

The final drawings (Fig. 3) are usually liquid ink or mylar and are produced on the 748 flatbed plotter. Because the 970's liquid-inking capability and resolution approximate those of the flatbed, it can back up the 748 to flatten out peaks in the liquid-ink work load. Both devices are reliable, with uptime averaging more than 95 percent. The 748 was installed three years ago, and the 970 has been on-line for more than a year.

Plotting the future

General Tire will soon be forced to upgrade to a 32-bit virtual memory mini from the traditional 16-bit architecture to manipulate increasing complex databases and handle ongoing software development without system degradation.

Computer output microfilm plotters wll also play an important role in further reducing turnaround time. While there will always be a need for hard copy from pen plotters, the high throughput and accuracy of COM plotters will make them indispensable in the near future.

The rapid growth of computer-graphics technology, coupled with such uncertainties as the economy, makes long-range hardware and software planning an inexact science. The one conclusion that does not require a crystal ball is that CADD will play an ever-greater role in supporting engineers and drafters. □

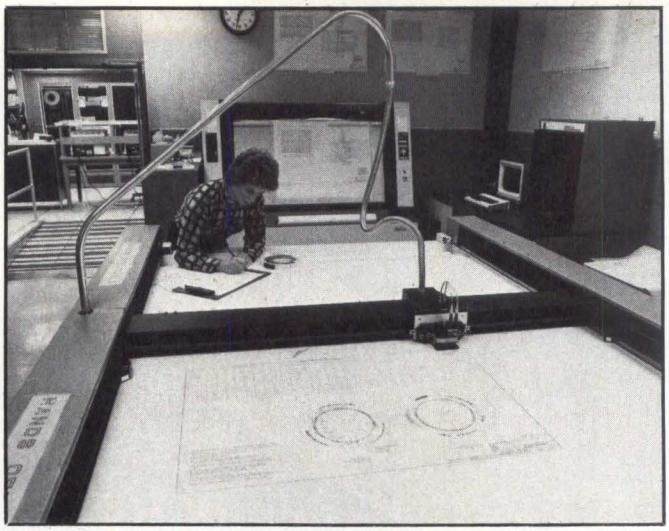

Fig. 3. Final drawings *are produced by the model 748 flatbed (front) and the model 970 belt-bed plotters using liquid ink on mylar. Drawings can be reproduced in blueline or sepia.*

Joseph Ellis is engineering systems manager at General Tire and Rubber Co., Akron, Ohio.

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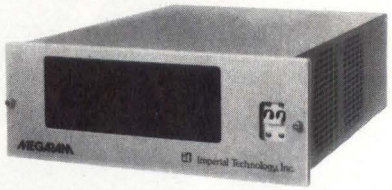

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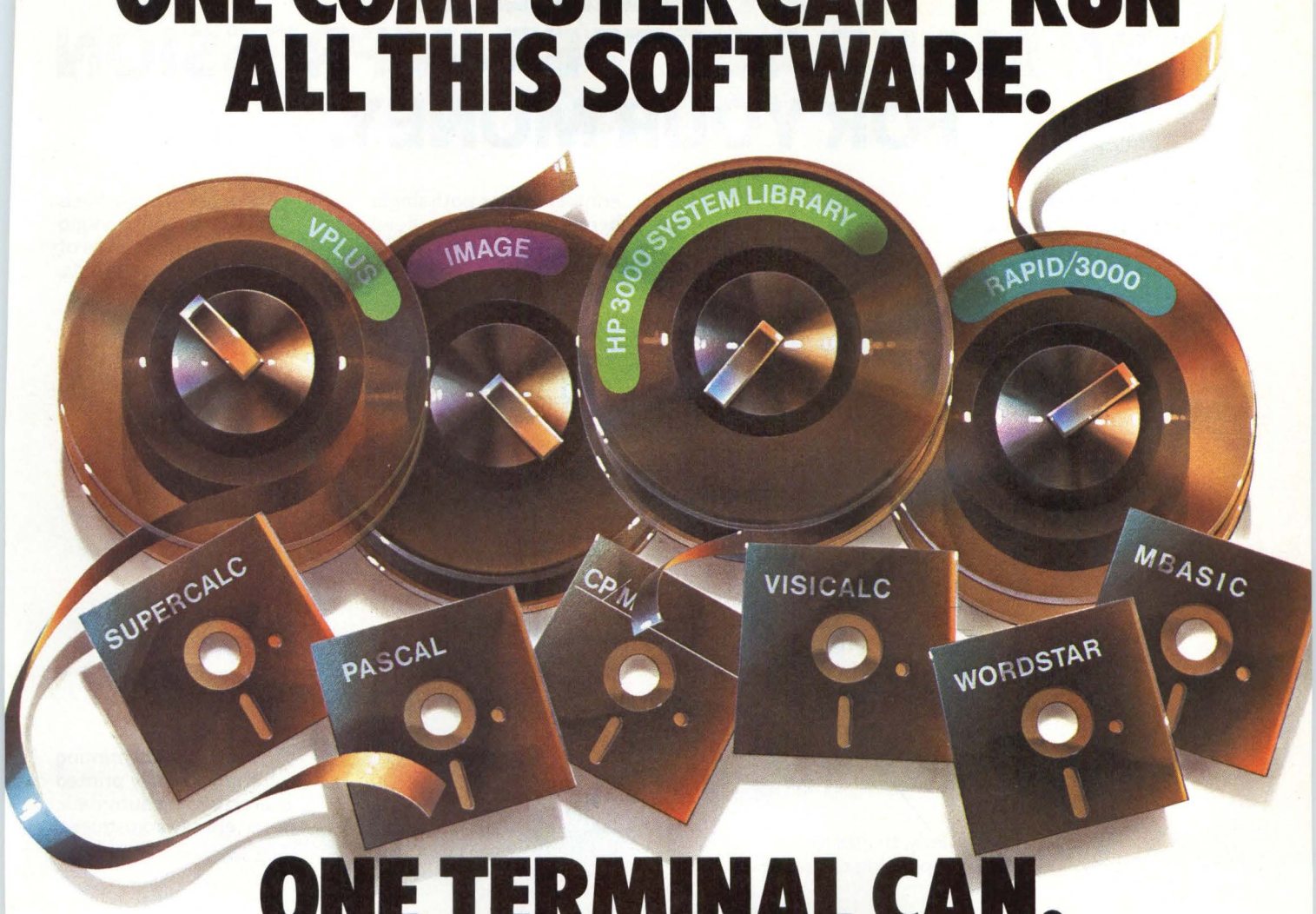

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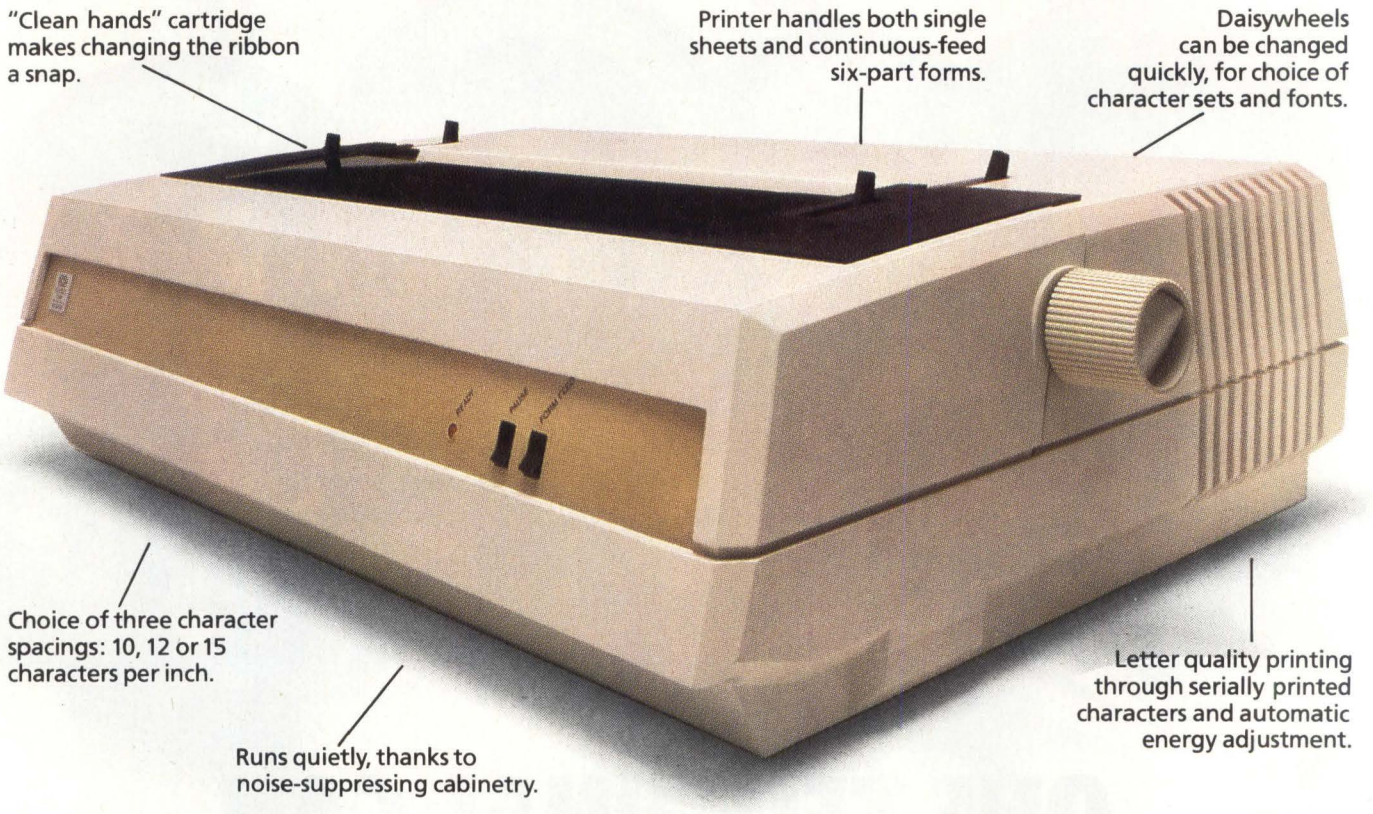

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APPLICATIONS

Microcomputer-based lathe cuts precision lenses

Contact-lens cutting system uses laser and microcomputer to keep on track

A contact lens manufacturing system controlled by a Hewlett-Packard Co. microcomputer and laser interferometer turns out complex, accurate lenses in two minutes.

The system, developed by Automated Optics, Clearwater, Fla., uses a dual-axis contouring lathe to produce hard or soft lenses. The material to be cut is mounted in a spindle on the Y-axis slide of the lathe, facing two diamond-turning tools on the X-axis slide. By simultaneously controlling movement along each axis, an HP 9825 desk-top computer can make the lathe follow any preprogrammed path. The X and Y slides are monitored by an HP 5501A laser transducer interferometer, which informs the computer of their precise positions (Fig. 1). The interferometer uses the interference fringes of a split light beam to measure changes in distance of millionths of an inch (see "Using light as a ruler," p. 302).

The computer corrects any deviation from the programmed path with commands sent through comparator cards to a digital-to-analog converter. The D/A converter provides the analog signals necessary to control the servo motors that drive the X and Y slides. Lenses do not require hard polishing after cutting, and are produced with a near-zero rejection rate.

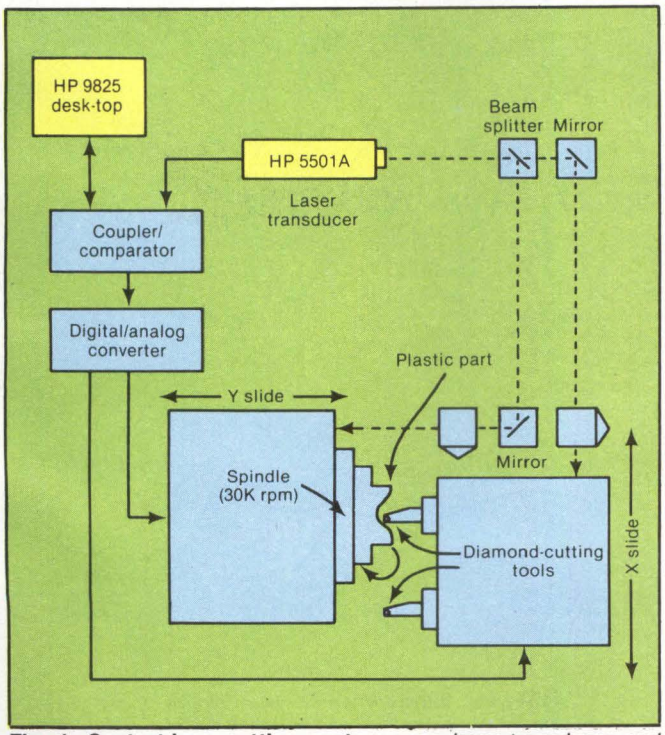
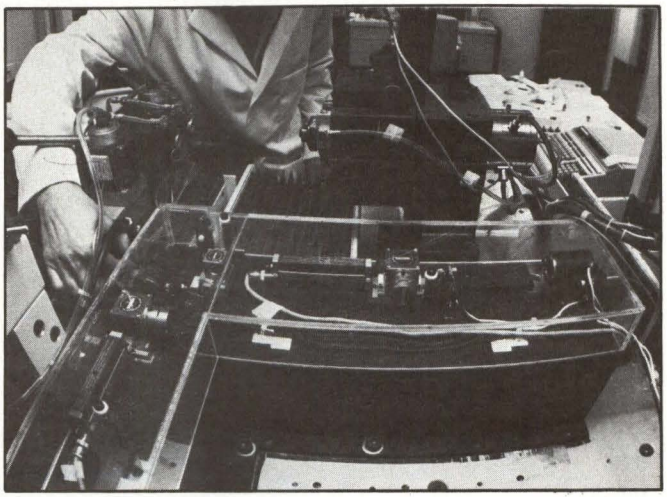


Fig. 1. Contact-lens cutting system *uses laser transducer and microcomputer to monitor and control dual-axis lathe. Transducer reports deviations in cutting path to microcomputer, which corrects lathe motion.*



Laser transducer interferometer *(foreground) uses split laser beam to detect displacements as small as 0.008 μm., allowing lathe (background) to produce lenses with near-zero rejection rate.*

Other features of the new system include a spray-mist cooling system, a venturi-type chip extractor and friction-reducing fluid bearings to support the lathe's two moving slides and 30,000-rpm spindle. The lathe is

mounted on a 2-ton, 12-in.-thick granite slab to reduce vibration.

The HP 9825 desk-top computer is programmed in the HPL high-level, formula-oriented language, and features a 32-character LED display, a built-in 16-character thermal printer and a 25M-byte data cartridge.

The key to the lens-generating system's accuracy (as high as 0.008 μm.) lies with the HP 5501A laser transducer. This interferometer uses a single helium-neon laser source and simultaneously monitors as many as four axes of motion. Output devices offer the choice of feedback control or digital display.

The Automated Optics machine can make a lens in two minutes to any optical configuration prescribed. Lenses are automatically corrected for spherical aberration, and can be used for people with vision previously uncorrectable by conventional contact lenses.

The firm is considering making lenses for nationwide distribution and selling the rights to lens-making on the system. The system could also be adapted to cut metals, plastics or other material, bringing its speed, flexibility and accuracy to different applications. □

USING LIGHT AS A RULER

An interferometer uses a split beam of light to measure extremely small changes of position. The technique was developed by A.A. Michelson in 1880 to detect the motion of the earth through "absolute" space by measuring changes in the speed of light. The experiment failed to find any variation in the speed of light, leading a young Swiss patent office clerk named Albert Einstein to propose the Special Theory of Relativity.

The interferometer works on the principle of light-wave interference. A half-silvered mirror splits a beam of light (Fig. 2), sending one beam along a path of fixed length, and the other along an adjustable path (by bouncing it off a mirror mounted on a piece of moving machinery, for example). The two beams are then reunited. If the resulting image is bright, the two light waves are "in phase," and are reinforcing each other (Fig. 3). If the image is dark, they are "out of phase," and cancel each other. The same principle applies to sound waves, making speaker placement important in stereo systems.

As the adjustable path length changes with the machinery's movement, the image changes from bright to dark to bright, and so on. Each change in brightness represents a change in path length of one-half wavelength, or less than $^{1}/_{100,000}$ in. for red light. Thus, a light meter aimed at the image can detect minute changes in position. Lasers are used as interferometer light sources because of their brightness and precise wavelength. —*DHF*

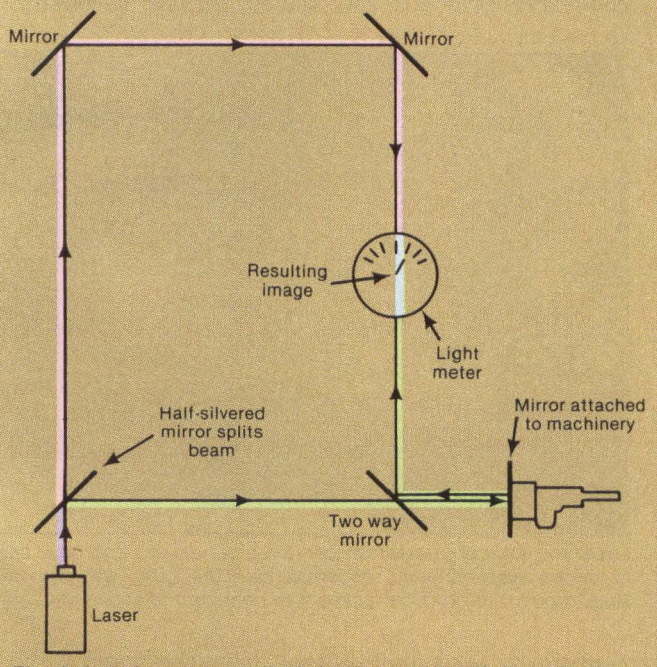


Fig. 2. Interferometer *splits light beam with half-silvered mirror, sending one beam on a fixed-length path, and the other along a path whose length changes with motion of a piece of machinery. The two beams join at a light detector, which measures the machinery's motion through the brightness of the resulting image. Colors above represent different light paths, not different wavelengths.*

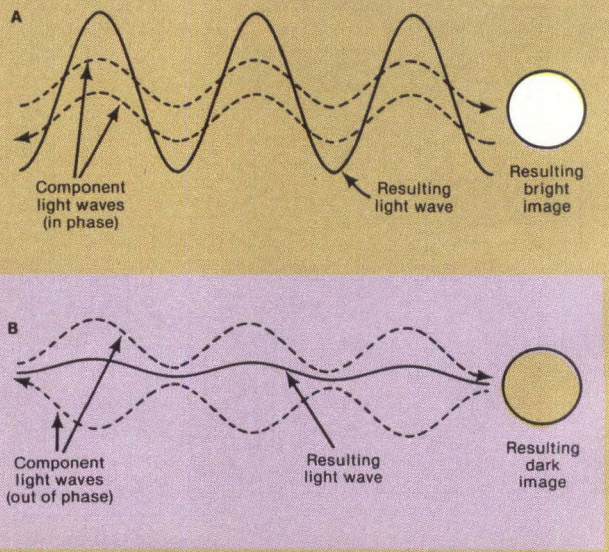
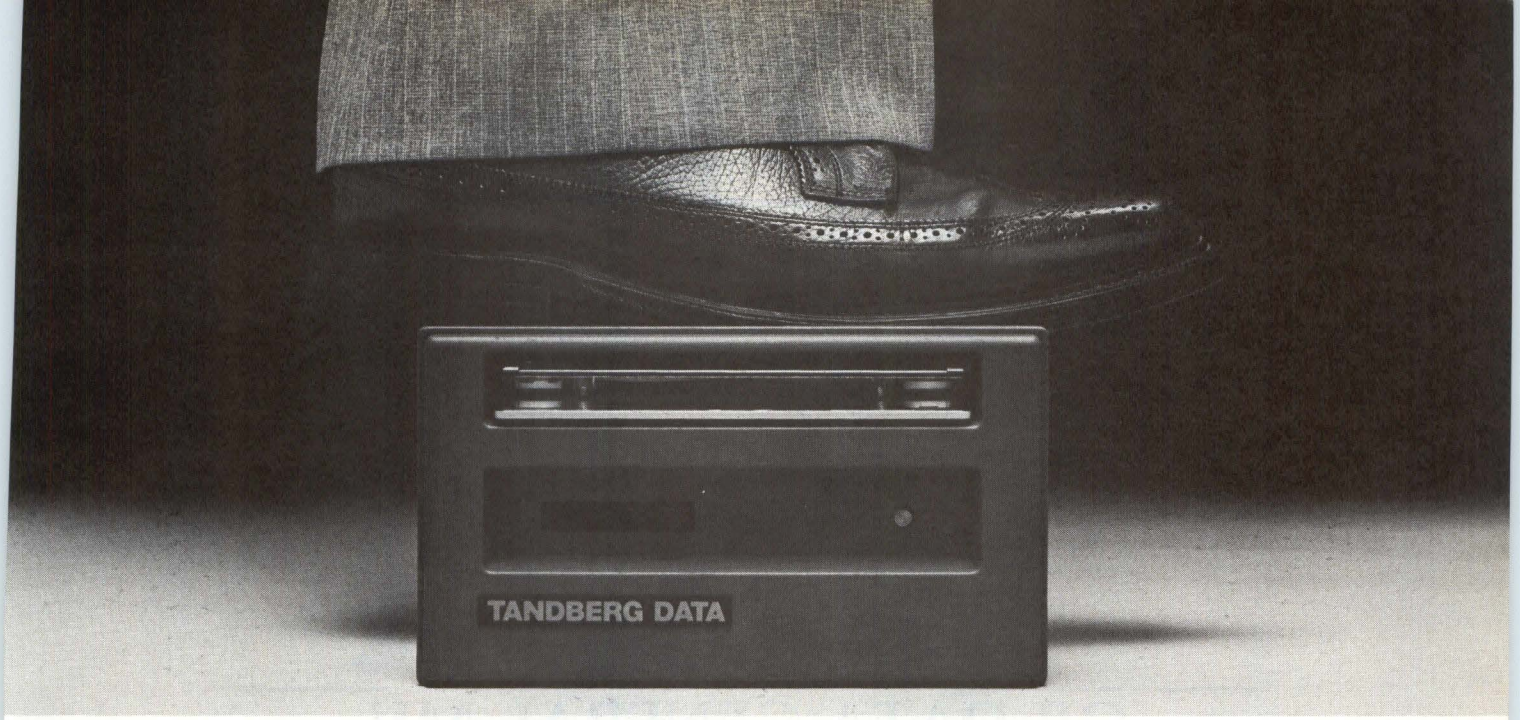


Fig. 3. Light-wave interference *involves relative phase of two light waves. If waves are in phase (A), they reinforce each other and a bright image results. Out-of-phase waves (B) cancel each other out, producing a dark image.*



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CIRCLE NO. 166 ON INQUIRY CARD

RTFILE: A database for low-end DEC machines

HARVEY M. WEISS, Weiss & Associates Inc.

Report-writing and forms-design features make the RTFILE database-management system suitable for small-computer, multi-user environments

Eighth in a Series

RTFILE is almost relational. It is "relational" in the sense that it stores records sequentially and creates indexes to retrieve them. Yet it is not truly relational because its JOIN command is not dynamic and does not result in new tables. RTFILE can JOIN (link) fields to create new databases, but that is a utility function, not part of a STORE command (see "What is a relational database?" p.308). RTFILE provides an OEM, a system developer or a user with the potential to structure data as data are used. The database can be logically constructed, loaded with data and manipulated without the typical program-development process.

RTFILE's most important features are its report writer and forms designer, which allow a non-data-processing person to manipulate and present data stored in an RTFILE database. Although not as easy to use as their counterparts in similar products, such as Relational Technology Inc.'s INGRES (MMS, January, 1982, p. 231), the report writer and forms designer give the low-end computer user tools not normally found in products offered in this market. However, RTFILE is missing some very important components, including system-development tools, DBMS utilities and a more powerful data dictionary.

This is the eighth in a series of evaluation reports on database-management systems for minicomputers and microcomputers. The first, on the ORACLE system, appeared in the August, 1980, issue, and the second, which ran in October, reviewed SEED. Other articles reviewed QDMS in February, 1981, TAGS in March, MDBS in April, DRS in August and INGRES in January, 1982. These reports are intended to provide sufficient information about a DBMS to enable potential users to determine if they want additional information about a system. Each article surveys the features of a DBMS and evaluates it against a standard set of criteria. If there is a system you would like to see reviewed, please send its name and the address of its supplier to: Editor, Mini-Micro Systems, *221 Columbus Ave., Boston, Mass. 02116. For more information on systems that have been reviewed or on how to evaluate other systems, Weiss & Associates is in business to help.*

RTFILE environment

RTFILE is designed to run on Digital Equipment Corp.'s LSI-11 series microcomputers and PDP-11 series minicomputers. It builds on the flexibility, speed and enconomy of RT-11, DEC's low-end operating system. A version is also available for the VAX operating system, as well as for UNIX (with RT/EMT), RSTS/E (with RT/RTS), RSX-11M and VAX/VMS (with RTEM-11).

Most RTFILE sites are multi-user installations. Several operating system adjuncts exist to transfer the advantages of RT-11 to a multi-user environment. They include TSX-plus, a time-sharing monitor that allows as many as 20 interactive terminals to be connected to RTFILE.

RTFILE components

The RTFILE "system" comprises several components, each designed to meet a specific database function (Fig. 1). All components are menu driven and can be invoked from an interactive environment.

The general menu is the mechanism for entering the world of RTFILE. It provides the access route to the other components needed to define a database, load it with data and produce output.

The device that links all components is the RTFILE dictionary/directory, an on-line dictionary in that it provides the vehicle not only to define data and their relationships, but also to control data storage and retrieval. The data dictionary program resides in memory at execution time. All access to and from the database is checked by the dictionary/directory. Fields are edited for completeness, value ranges are checked, and access rights are checked before access. This makes it seem that RTFILE can secure accessibility to the database via the dictionary, but it doesn't. Security is left to DEC's operating system and the screen-definition function (CRT display manager). Accessibility is con-

trolled by establishing password equivalents by terminal and screen "views," the way it's done on an IBM Corp. System 38. This appears to be a sound approach, but a better way is to secure data access by data values noted in the dictionary.

The dictionary does not provide evaluation facilities that could help design databases or report functions to give a database administrator statistics about the RTFILE databases. Some support can be "programmed," but all the raw data required in a dictionary analysis are not captured by RTFILE's dictionary.

Using RTFILE

RTFILE can be used as a stand-alone product or incorporated in "user-written" applications. In the former, a user logs on and then invokes the main menu. The user can then create databases or access data stored in databases.

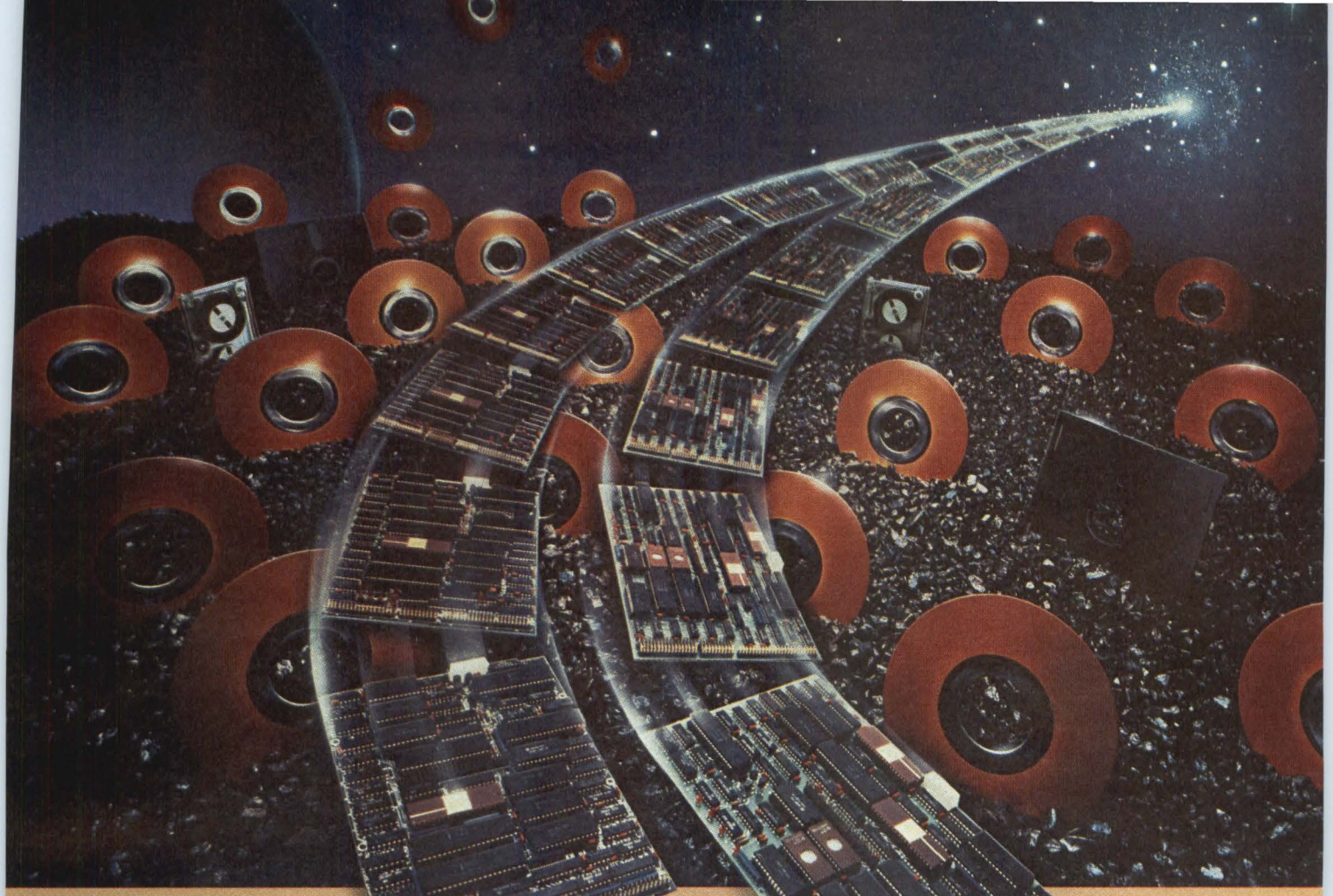
To create a new database, the file manager is used to define the physical space for the new database and the logical "picture," or view, of the data to be stored. The database's name and record format are established using a series of screen prompts. Each field in the record is defined relative to its name, size and edit criteria.

RTFILE can JOIN (link) fields to create new databases, but that is a utility function, not part of a STORE command.

The user can incorporate an existing non-database file, defined under the RT-11 operating system, through an "adoption" function. Again, the record's format must be defined, physical space must be allocated, data

EVALUATION MATRIX—VENDOR RATING: RTFILE

SELECTION CRITERIA	VENDOR SCORE
1. DBMS manipulation process:	
1.1 Data/record generation	8
1.2 Database-update process	8
1.3 Database-deletion process	8
1.4 Security techniques	4
1.5 Privacy-control techniques	4
1.6 Data-integrity controls	8
1.7 Data-format translation	8
1.8 Error-processing techniques	6
1.9 Data-redundancy controls	8
1.10 Data-compaction process	6
1.11 Data/file convertibility	10
1.12 Program/data independence	10
1.13 Data-manipulation language	6
Possible: 130	94
2. DBMS physical structure:	
2.1 Record structure (logical/ physical) supported	6
2.2 Record-creation process	8
2.3 Record-modification process	6
2.4 Physical-storage processes	8
2.5 Record-indexing mechanisms	8
2.6 Data-space management	8
2.7 DBMS structure	8
2.8 File growth	6
Possible: 80	58
3. DBMS tools:	
3.1 Data-query facility	
3.11 Availability of tool	10
3.12 Ease of use	6
3.13 Capabilities	6
3.2 Report-writer facility	
3.21 Availability of tool	10
3.22 Ease of use	8
3.23 Capabilities	8
3.3 Data-Dictionary facility	
3.31 Type	8
3.32 Ease of use	6
3.33 Program/operation interface	6
3.34 Reports capability	2
3.4 Data-communications facility	
3.41 Protocols supported	6
3.42 Ease of use	6
3.5 System-development tools	
3.51 System-design tools	0
3.52 Program-development tools	8
3.53 Database-design tools	0
3.54 Screen-design tools	8
Possible: 160	98
4. System implementation	
4.1 Hardware requirements	10
4.2 Database-loading facility	8
4.3 Data-definition language	6
4.4 Vendor support	6
Possible: 40	30
5. Secondary features	
5.1 DBMS utilities	
5.11 Performance statistics	0
5.12 Simulation facility	0
5.2 Vendor response to hardware/ software changes	10
5.3 Ease of installation	6
5.4 DBMS maintenance policies	10
5.5 Customer experience	8
5.6 Documentation	6
5.7 Training availability	6
5.8 System performance	8
Possible: 90	54
Total Possible: 500 RTFILE: 334	



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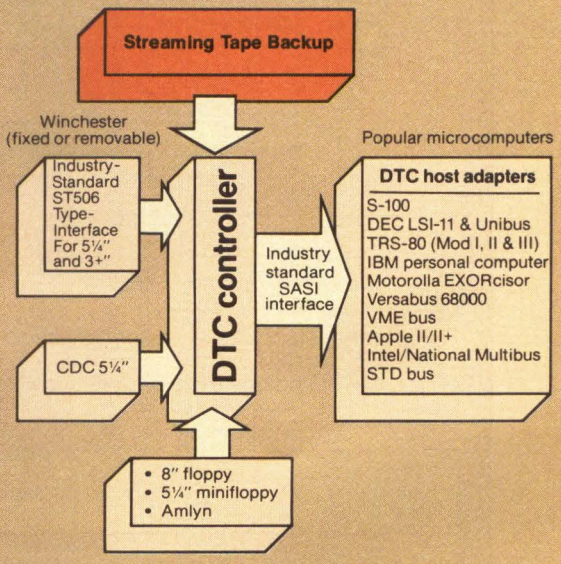

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CIRCLE NO. 167 ON INQUIRY CARD

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blocks must be determined, and RTFILE control blocks must be established.

A linking function in the index manager component is used to JOIN data from several database files. Linking several files requires that the fields used in the link process are in both files and that the values in each field are the same. Thus, total linking, or JOIN, is not possible in RTFILE.

Once a database structure is defined, the CRT display manager is used to "paint" screen forms to store and retrieve database records. Reports are defined using the report generator component. Users cannot access an RTFILE database except through a system-created screen display. A designer of a screen must pass access rules first. Screen development is required for data entry as well as inquiry. To document the design, the report writer must be used since the screen designer has no documentation capability.

The report writer can interactively define report layouts, edit rules, control rules and the items to be printed. If the fields are not in one database, these databases must be linked first for the report writer to function properly. All calculation functions must have been defined in calculation modules before executing the printing activity. If a sort is required, it also must be defined through another RTFILE component. Once these actions are completed, data can be loaded into the database via the transaction-processor component.

Calculation functions are defined by invoking the data-manager component. These functions must be pre-defined and are stored by RTFILE. Users should document the functions, since RTFILE does not display the source function or command. The sort and selection manager can be used to select records and recognize them as desired.

An alternative to using RTFILE for system development is to develop one's own system and incorporate RTFILE within it. RTFILE supports program calls from the FORTRAN, Pascal and Macro languages. Interfaces to C, DIBOL, COBOL and BASIC are likely to be available soon.

Thus, programs can be written with access to data stored in an RTFILE database obtained through a language's subroutine call feature. This feature provides a significant level of control and independence

WHAT IS A RELATIONAL DATABASE?

For some time, Weiss & Associates has received documentation describing relational database products. Few, if any, are what they profess to be. Some clarification must be made for both potential buyers and developers.

Today, there are three basic database structures, which are implemented in many versions. The first is the CODASYL structure, named for the government committee that created it. This structure stores records, called record types, and links them via internally defined "pointers." The CODASYL structure supports the hierarchical or network types of databases (Figs. 1 and 2).

The terms "hierarchical" and "net-

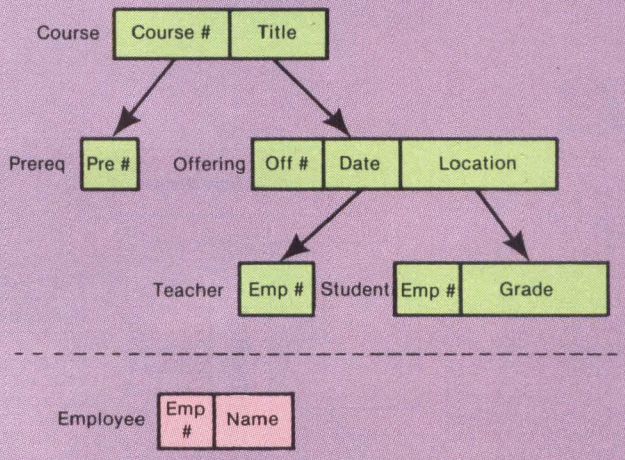


Fig. 1. Hierarchical view of an education database containing two files. Access to records is gained via the course record and proceeds unidirectionally through other linked records.

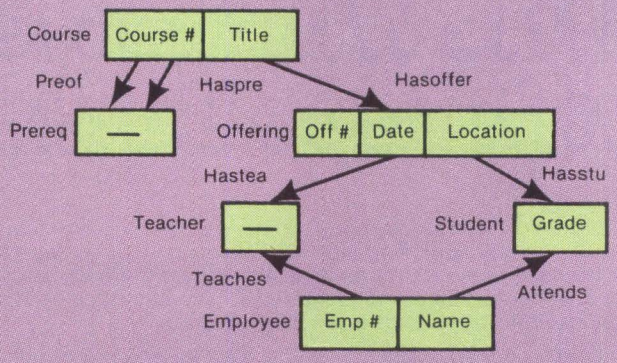


Fig. 2. Network view of an education database (1 file). Access to records is gained through either the course or the employee record.

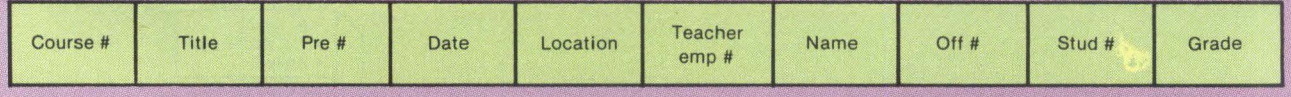
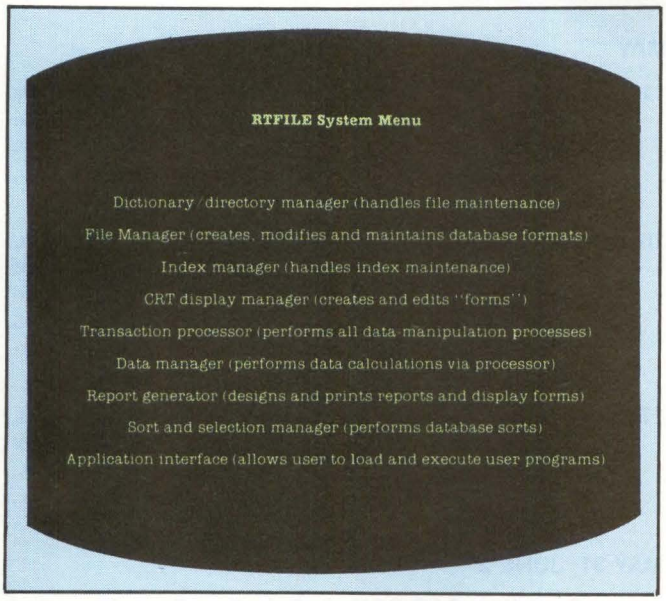


Fig. 3. Inverted view of an education database *(1 file). The user accesses records via indexes built to hold values of the fields in a file. Indexes can be on one or several fields.*

CONTEL: A COMPANY OVERVIEW

Continental Telephone Corp. acquired International Computing Co. in 1982, then merged ICC with Network Analysis Corp. to form ConTel Information Systems. ConTel has more than 300 employees. RTFILE was announced in 1980, and as of May, 1982, there were some 300 users of the product. The company is located at 4330 East-West Highway, Bethesda, Md. 20814, (301) 654-9128.



over the data versus the program.

A component missing from RTFILE is a database design tool. RTFILE offers no automated assistance to a database designer relative to the best way to create files and link them. To a low-end user or user new to the database, this assistance is paramount. Such products identify problems that could occur that would affect storage use, performance, security and total processing time. □

Harvey M. Weiss, principal consultant at Weiss & Associates, Aurora, Colo., has more than 20 years of experience in data processing. He is known internationally as a speaker and author of articles on database, security and data-processing planning. Weiss & Associates serves clients in industry, education and government with DBMS development and evaluation/selection.

work" describe how records are related. In a hierarchical structure, records are identified very similarly to a company's organizational chart, that is, a pyramid approach. For example, functional access to the vice president of marketing record, the vice president of finance record and the vice president of corporate relations record all would be through the president record. To talk to the vice president of corporate relations, the vice president of marketing would have to go through the president. In a network approach, the records are related based on relationship to each other, rather than on the pyramid structure. In the example, the records on the vice president level could communicate with each other without going through the president record.

A second basic structure is the inverted or partially inverted structure, wherein data are stored in a file, and indexes are used to locate the data. A separate set of indexes is created for each type of access (Fig. 3).

The third structure-type is the relational model, which stores data in records in the form to be used and links them with indexes. The difference between the second and third types of structures is in how much data are contained in each record. The relational structure is said to be normalized; that is, duplicated values are not allowed in any one file (Fig. 4).

The relational model allows storing data in separate files called tables and linking the data in these tables. This linking process is called JOINing and can be done on an equal or unequal condition. The key is how the JOINing occurs.

Relational databases link using indexes; they create indexes to show data relationships, but do not actually create a new table. True relational database systems actually create a new table at the time the data relationship is established. Although the difference seems slight, it is significant when one expects new files rather than just indexes. Thus, users evaluating the capability of a DBMS product thought to be "relational," should check out its JOIN command first.

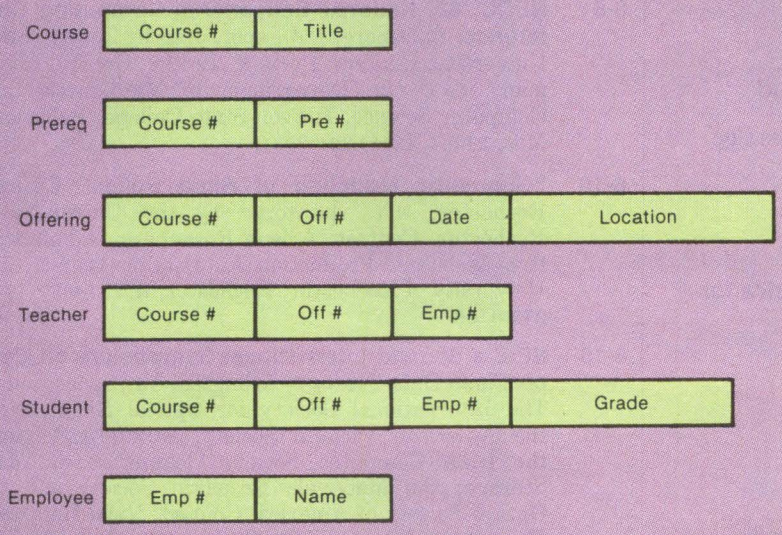
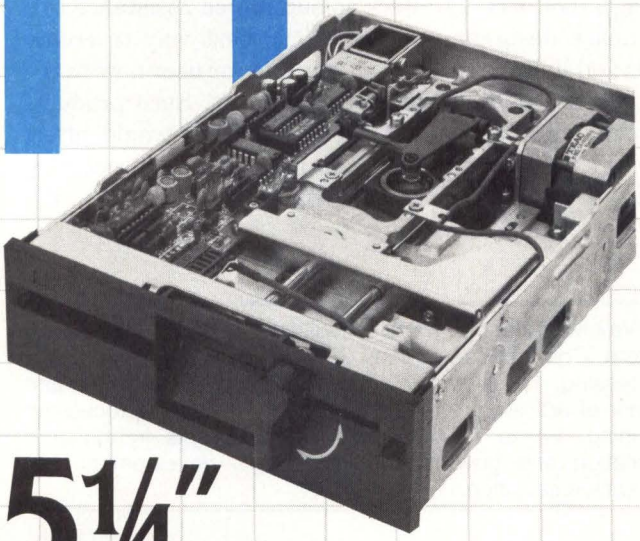


Fig. 4. Relational view of an education database *(contains 6 tables). Records are accessed through indexes or fields that can be built from different files (tables).*

HALF HIGH



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CIRCLE NO. 170 ON INQUIRY CARD

Calendar

MAY

11-15 COMPUTA '83 International Computer Technology Exhibition, Singapore, sponsored by the National Computer Board of Singapore. Contact: Kallman Associates, 5 Maple Court, Ridgewood, N.J. 07450, (201) 652-7070.

16-19 1983 National Computer Conference, Anaheim, Calif., sponsored by the American Federation of Information Processing Societies Inc. Contact: Ann-Marie Bartels, American Federation of Information Processing Societies Inc., 1815 N. Lynn St., Arlington, Va. 22209, (703) 558-3612.

17-19 National Aerospace and Electronics Conference, Dayton, Ohio, sponsored by the Institute of Electrical & Electronics Engineers. Contact: Dan Synder, NAECON '83, 2046 Northern Dr., Dayton, Ohio 45431, (513) 255-4709.

MAY 31- JUNE 2

Canadian CAD/CAM & Robotics Exposition and Conference, Toronto, sponosored by the Canadian Institute of Metalworking, Robotics International of the Society of Manufacturing Engineers and the Computer and Automated Systems Association of SME. Contact: Hugh F. Macgregor & Associates, 662 Queen St. W., Toronto, Canada, M6J 1E5, (416) 363-2201.

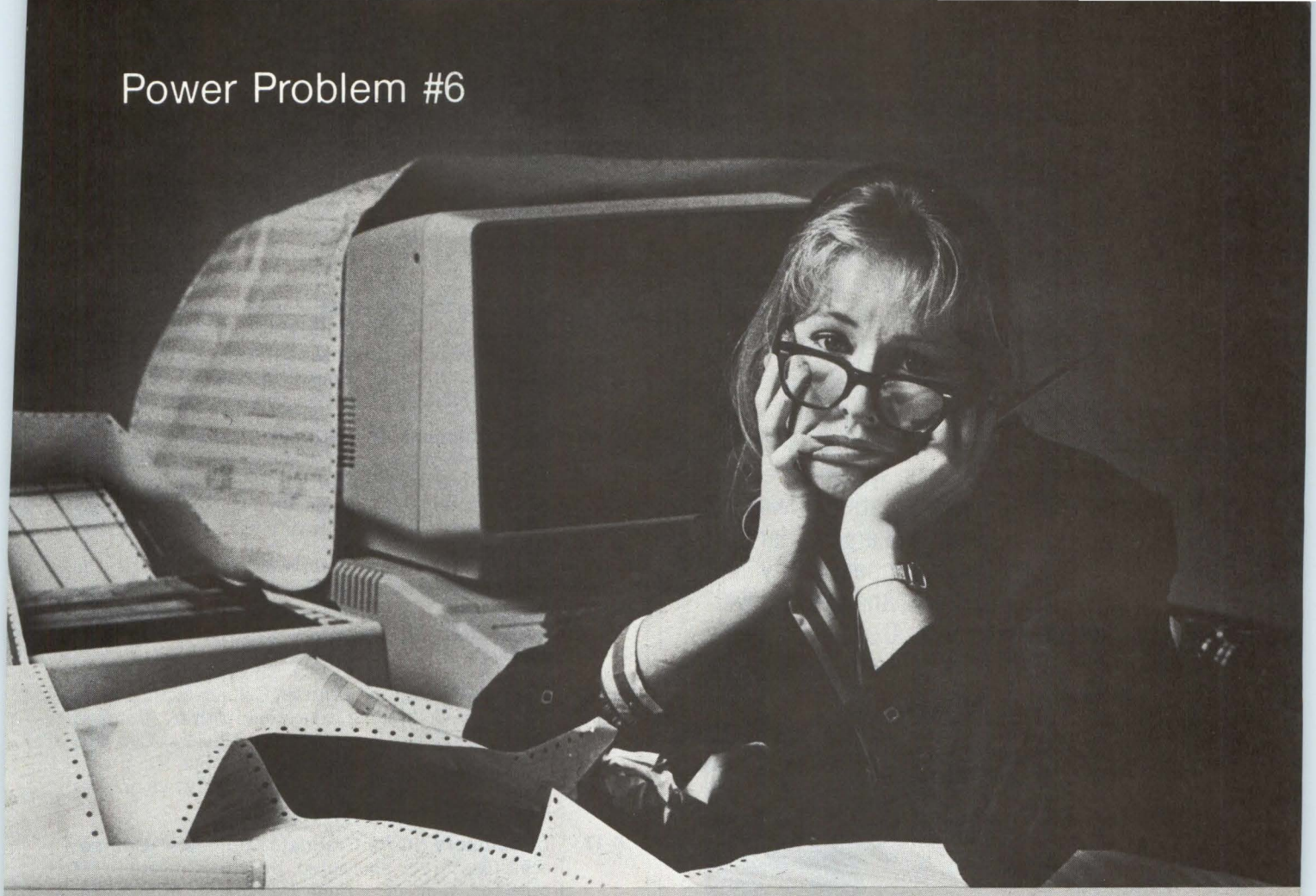
JUNE

2-4 Personal Computer Interfacing and Scientific Instrument Automation Workshop, Charlotte, N.C., sponsored by the Virginia Polytechnic Institute and State University. Contact: Dr. Linda Leffel, C.E.C., Virginia Tech, Blacksburg, Va. 24061, (703) 961-4848.

6-8 NECC '83, National Educational Computing Conference, Balitmore, Md., sponsored by Towson State University. Contact: Doris K. Lidtke, General Chairman, NECC '83, Department of Mathematics and Computer Science, Towson State College, Balitmore, Md., 21204, (301) 321-3091.

6-10 "Geometric Modeling of Rigid Solids" Course, Rochester, N.Y. sponsored by the University of Rochester. Contact: Arlene Rosenberg, Administrative Assistant, Production Automation Project, The University of Rochester, Rochester, N.Y. 14627, (716) 275-3106.

6-10 SPIE's Second International Symposium on Optical Mass Data Storage, Arlington, Va., sponsored by The International Society for Optical Engineering, the American Vacuum Society, EUROPEA/Belgium, the IEEE Computer Society Committee on Mass Storage, the Materials Research Society and the Optical Society of America. Contact: Vicki Hall, SPIE Exhibit Coordinator, SPIE/Optical Mass Data Storage '83 Program Committee, P.O. Box 10, Bellingham, Wash. 98227-0010, (206) 676-3290.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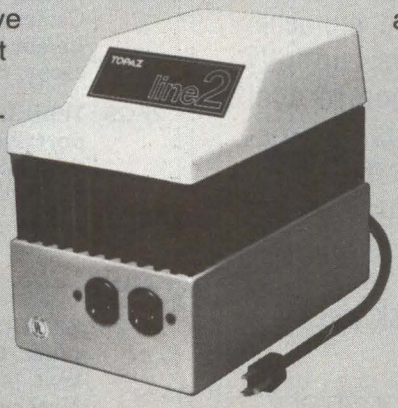

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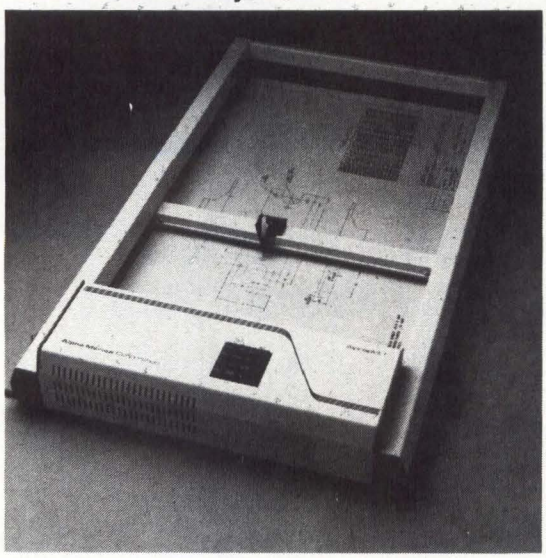

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Calendar

7-10 **Hong Kong Computer '83,** Hong Kong, sponsored by Industrial and Trade Fairs International Ltd. Contact: Terry Hill, Industrial and Trade Fairs International Ltd., Radcliffe House, Blenheim Court, Solihull, West Midlands, B91 2BG, England, (02) 705-6707.

13-15 **"An Introduction to PADL-2" Course,** Rochester, N.Y., sponsored by the University of Rochester. Contact: Arlene Rosenberg, Administrative Assistant, Production Automation Project, The University of Rochester, Rochester, N.Y. 14627, (716) 275-3106.

13-16 **Syntopican XI,** San Francisco, sponsored by the International Information/Word Processing Association. Contact: IWP Conference Planning Department, 1015 N. York Rd., Willow Grove, Pa. 19090, (215) 657-6300.

15-17 **"Computed Imaging" Course,** Columbia, Md., sponsored by the Continuing Education Institute. Contact: Continuing Education Institute, Oliver's Carriage House, 5410 Leaf Treader Way, Columbia, Md. 21044, (301) 596-0111. Also to be held July 27-29 in Los Angeles, (213) 824-9545.

16-17 **"Introductory NC for Graduate Engineers" Course,** Rochester, N.Y., sponsored by the University of Rochester. Contact: Arlene Rosenberg, Administrative Assistant, Production Automation Project, The University of Rochester, Rochester, N.Y. 14627, (716) 275-3106.

22-24 **"Machine Vision/Image Understanding" Course,** Los Angeles, sponsored by the Continuing Education Institute. Contact: Continuing Education Institute, (213) 924-9545. Also to be held July 13-15 in Columbia, Md. (Oliver's Carriage House, 5410 Leaf Treader Way, Columbia, Md. 21044, (301) 596-0111).

23 **22nd Annual Technical Symposium,** Washington, D.C., sponsored by the Washington, D.C., Chapter of the Association for Computing Machinery. Contact: Lorraine Lynch Nagy, (202) 676-0037.

26-30 **NCGA '83,** Chicago, sponsored by the National Computer Graphics Association. Contact: Nancy Lefebvre, NCGA, 8401 Arlington Blvd., Fairfax, Va. 22031, (703) 698-9600.

27-29 **Third International Conference on Decision Support Systems,** Boston, sponsored by The Institute for the Advancement of Decision Support Systems. Contact: Pat Van Cleve, DSS-83, P.O. Box 10001, Austin, Texas 78766, (512) 345-7948.

JULY

25-29 **SIGGRAPH '83, 10th Annual Conference on Computer Graphics and Interactive Techniques,** Detroit, sponsored by the Association for Computing Machinery's Special Interest Group on Computer Graphics. Contact: SIGGRAPH '83 Conference Office, 111 E. Wacker Dr., Chicago, Ill. 60601, (312) 644-6610.

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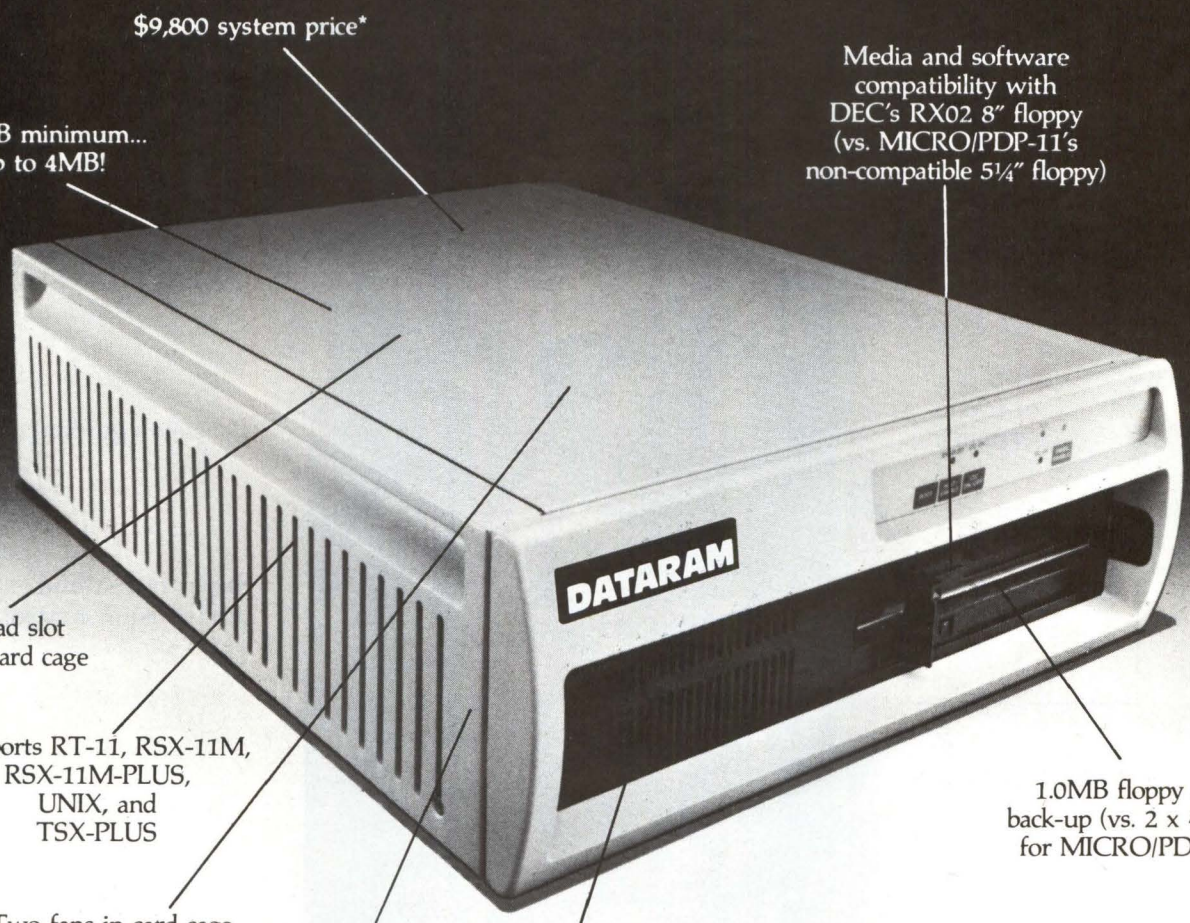

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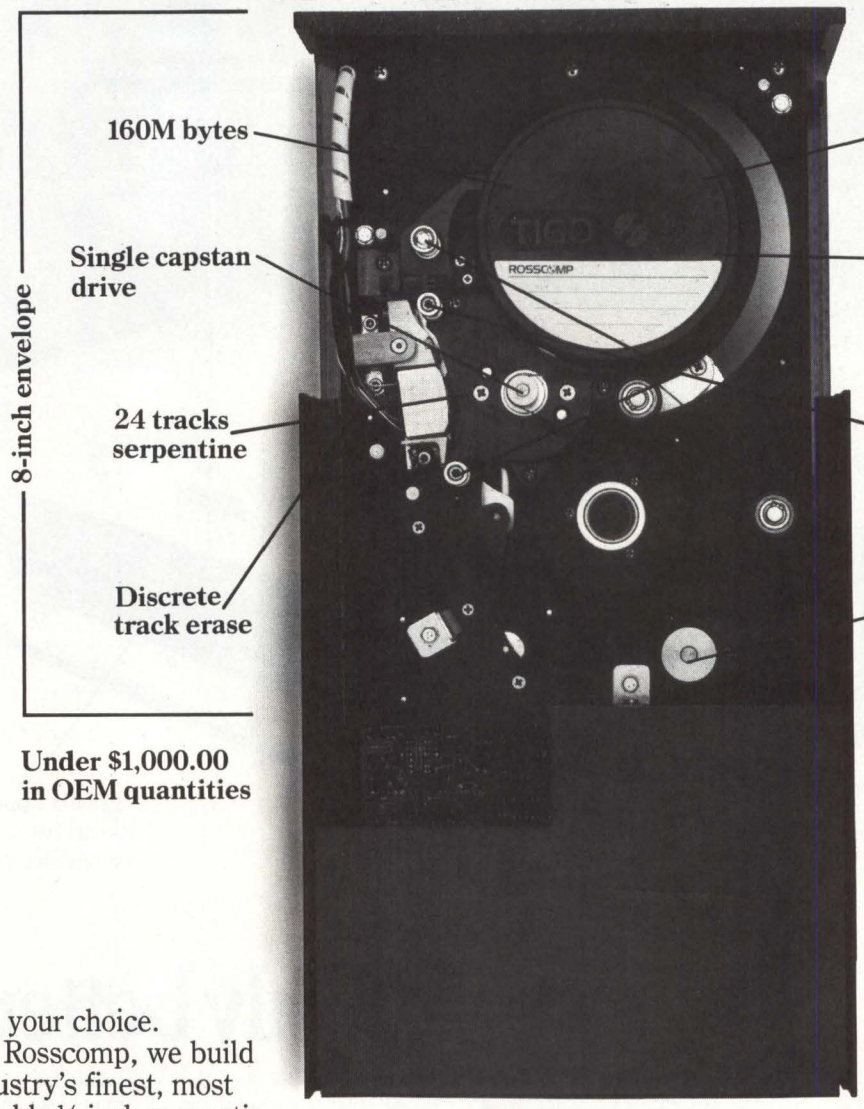

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CIRCLE NO. 198 ON INQUIRY CARD

Multifunction development station is expandable

Kontron Electronics' KDS configurable development system/EE workstation *features modular, ergonomic design with separate adjustable CRT and detached keyboard, computing and mass storage, universal in-circuit emulation, timing and state logic analysis, a Z80 CPU and the CP/M operating system.*

The KDS system is a modular, integrated, multifunction workstation that provides all the tools needed for hardware and software development. The KDS features CPU/mass storage, in-circuit emulators and logic analyzers in separate, stackable modules that are also card-configurable and card-serviceable.

The CPU and mass-storage module contains seven card slots. Three slots accommodate a Z80A CPU, 256K bytes of paged RAM and system I/O. The four remaining slots are reserved for expansion including items such as a 68000 CPU and 1M byte of RAM. The module provides four RS232 ports, an IEEE-488 port and a Centronics-compatible printer port.

Standard mass storage is provided by dual 5¼-in., double-sided, quad-density floppy disk drives with a formatted storage capacity of 616K bytes per drive. An optional 10M-byte hard disk is available to plug into the computer module.

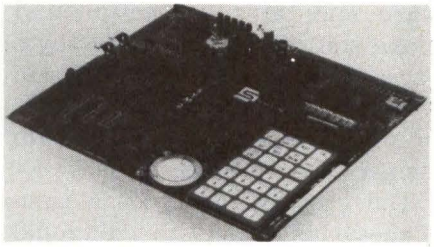
The KDS computer module supports as many as four KSE series in-circuit emulator modules and one KSA timing and state logic analyzer module. These units operate as a fully integrated instrument package for microprocessor hardware debugging and software/hardware integration.

The Z80 version of the KDS uses CP/M 2.2 as its operating system. With the addition of the 68000 CPU and memory modules, the KDS operates under UNIX. In this configuration, the Z80 becomes the I/O interface processor for the 68000 CPU. Pascal assemblers and compilers are available from the vendor for a wide range of 8- and 16-bit microprocessors.

The KDS's ergonomically designed workstation features a separate, adjustable CRT and a detached keyboard. The keyboard features a full ASCII keyset with 25 special-function keys. The 15-in. green CRT displays 24 lines of 80 characters.

The KDS system including 256K bytes of RAM and two floppy disk drives is priced at $12,500. **Kontron Electronics,** 5730 Buckingham Parkway, Culver City, Calif. 90230. **Circle No** 300

Single-board computer is designed for classroom use



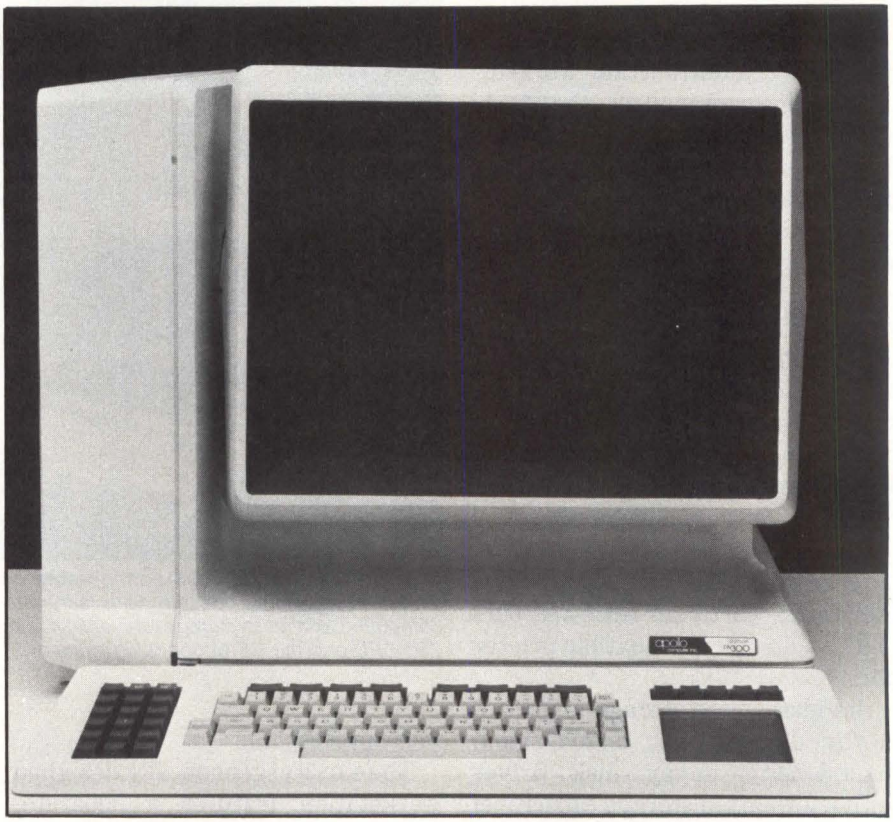
Designed for classroom and education use, the model SYM-2 single-board microcomputer is built around the SY6502 8-bit microprocessor. The SYM-2 can be programmed using its built-in 28-key keypad, six-digit display, eight-LED output and eight-toggle-switch input. On-board, a user has access to 1K byte of RAM, a 4K-byte resident monitor and a ROM/EPROM socket for BASIC, an editor/assembler or custom firmware. Also included are a cassette interface jack and an RS232C interface. Price for the assembled, tested and ready-to-use SYM-2 is $245. **Synertek,** 3001 Stender Way, Santa Clara, Calif. 95054. **Circle No** 301

Desk-top computer offers 32-bit, supermini performance

The DN300 computational node is a desk-top computer system that offers performance comparable to mid-range, 32-bit superminicomputers for a large-quantity price of approximately $10,000. It is intended for engineering, scientific, CAD/CAM, computer-aided software engineering, document-processing and financial-modeling applications. It can be used as a stand-alone professional workstation, as part of a network with the vendor's other Domain nodes or as part of an all-DN-300 network system.

The DN300 is built around two PC boards that contain the CPU with 512K bytes of main memory, memory-management hardware, a display controller with 128K bytes of additional memory and an interface to the vendor's Domain network. The DN300's CPU is based on a 32-bit VLSI processor that supports as many as 15 concurrent user processes. A per-process virtual-address space of 16M bytes results from an integral memory-management unit that dynamically maps 24-bit virtual addresses into a 22-bit physical memory address space. Memory-management hardware maintains protection and usage statistics for each 1024-byte page of data. The DN300's main memory is expandable to 1.5M bytes in 0.5M-byte increments; main memory uses 64K-byte RAMs.

The graphics display is a landscape-oriented, 17-in. diagonal black-and-white monitor with 1024- × 800-pixel resolution using bit-mapped raster-scan technology. A dedicated 128K-byte, dual-ported display memory performs interlaced refresh at 80 cycles per sec. and features a block transfer rate of 12M bits per sec. The monitor has adjustable tilt.



Apollo Computer's DN300 *desk-top mainframe puts 32-bit virtual memory computing power into the hands of engineers, scientists and designers for approximately $10,000 in quantity.*

The DN300's detachable, low-profile keyboard has 32 programmable function keys. The node includes two RS232C asynchronous I/O ports for communication rates from 50 to 19.2K bps.

Standard software with the DN300 is the AEGIS virtual-memory operating system. Optional software includes FORTRAN 77; Pascal; C; the SIGGRAPH CORE graphics library; AUX, a software environment based on UNIX System III; D3M, a distributed data-management system; and support for the X.25 international packet-switching communications protocol.

In addition to the memory expansion, hardware options include floppy and hard disk drives and a touchpad cursor control. A DN300 with 32-bit virtual memory processor, 512K bytes of main memory, an MMU, a Domain network interface, a display, two I/O ports and a license to the AEGIS operating system is priced at $10,449 in 50-unit quantities. **Apollo Computer Inc.,** 15 Elizabeth Dr., Chelmsford, Mass. 01824.

Circle No 302

"Racal-Vadic's Invisible Modem Gives Grid's Ultra-Portable Computer Access to a Whole World of Data!"

Dave Hanna — V.P. Marketing and Sales, Grid Systems, Inc., Palo Alto, California

One of the hottest personal computers on the market is the new Grid Compass. It weighs about 10 pounds and takes up less than half of a standard briefcase.

Business Week calls Compass "a Porsche for top executives."

A custom Racal-Vadic modem is behind the smashing success of Compass. This VS212A/103 modem — complete with auto dial and auto answer — is built on a 6" by 6" PC board. "Without this built-in modem we couldn't have made the product," says Glenn Edens, V.P. of Development for Grid Systems, Inc., Palo Alto, California.

Racal-Vadic's incredibly small modem is vital because it gives Compass a unique communication capability, setting it apart from other portable computers. For example, Compass can "talk" to another Compass... or to Compass Central, a user-owned, 240 Mbyte desk-top computer, which is designed to support a number of Compass computers in the field. It can also access Grid Central, a Grid-owned mainframe which distributes new software and provides data storage for its users. And there's more! The ultra-portable Compass can access corporate mainframes and public data bases.

Imagine... a Fortune 500 executive in a hotel room with the whole wide world of data at his or her fingertips — using the dial-up telephone.

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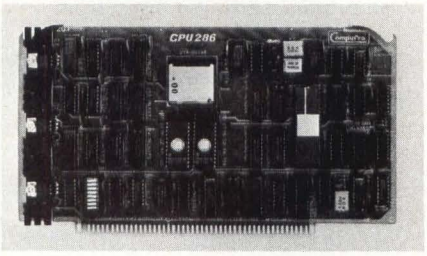
RACAL

CIRCLE NO. 171 ON INQUIRY CARD

iAPX CPU board is software-compatible with 8086/8088 processor code

The model CPU 286 is an IEEE 696-standard CPU board based on Intel's iAPX 286/10 microprocessor featuring code compatibility with 8- and 16-bit software. Standard features include sockets for an 80287 math co-processor and as much as 16K bytes of EPROM for system development and multi-user business applications. To protect memory and software investments, the board is software compatible with code written for Intel's 8086 and 8088 processors.

Clock rate for the CPU 286 is 8 MHz for the standard version and 10 MHz for the high-reliability version. A clock-switching circuit permits 8- or 16-bit slave processors to run on the same bus at various clock rates without timing conflicts, enabling users to execute alternate software libraries.



CompuPro's CPU 286 board *incorporates a large addressing capacity for multi-user, multitasking applications.*

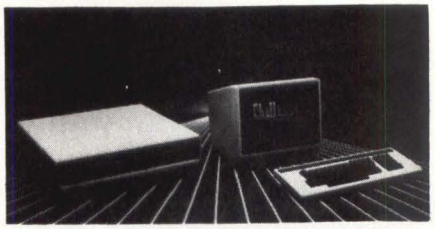
With a 24-bit-address and a 16-bit data bus, the CPU 286 can access as much as 16M bytes of on-line system memory without segmentation. The unit's on-board logic can also read or write 2 bytes serially to simulate 16-bit operation in the presence of 8-bit memory or I/O.

The board also incorporates a memory-management unit that permits high-speed, multi-user, multitasking operation as well as memory protection for each workstation. Single-unit price is $1595. **CompuPro,** Building 725, P.O. Box 2355, Oakland Airport, Calif. 94614.

Circle No 303

CAE system features menu-driven software

The model 2000 CAE workstation addresses the chip, circuit and systems design cycle from behavioral definition through physical layout and testing. The system is based on the Apollo Domain minicomputer and the UNIX virtual-memory operating system. Pop-up menus are provided for frequently used commands and can be displayed temporarily as command pallets anywhere in the data area. A mouse guides the cursor and minimizes the amount of keyboard entry. The vendor's proprietary software is written in the C programming language and features schematic capture, a modeling capability for customizing interfaces to mainframes, analyses and simulation programs, an electronic spread sheet for what-if analysis, an engineering notebook, circuit connectivity and consistency checking, an interactive, nine-state logic simulator and timing verification and analysis. The software allows an engineer to use top-down, bottom-up or flat-array design philosophies. The Apollo Domain minicomputer on which the model 2000 is based features dual 68000 microprocessors, 1M byte of main memory and 34M bytes of local Winchester disk storage. The system includes a 17- or 19-in. display, keyboard and graphics tablet; printers, plotters and tape transports are optional. Software is also provided for outputting to plotters and printers. The model 2000 is available in several configurations with prices starting at $39,990 in single-unit quantities. **CAE Systems Inc.,** 1333 Bordeaux, Sunnyvale, Calif. 94086. **Circle No** 304



Small-business computer uses dual microprocessors

Designed to process proven business software at high speeds, the CS1000 small-business computer system features dual 8-bit microprocessors that share the code processing and I/O workload and are connected by a proprietary, high-speed data link. A standard disk buffer and a 32K-byte print buffer also increase the machine's performance. An entry-level CS1000 includes 64K or 128K bytes of RAM, a CRT display, a detached keyboard and two 8-in., double-sided, double-density floppy disk drives with a total storage capacity of 2M bytes. The basic system can be expanded to support three terminals, a printer, a serial communications channel and as much as 384K bytes of memory. The CS1000 uses CP/M or the CP/M-compatible I/OS operating system. Microsoft BASIC, COBOL, Pascal and assembly languages are available. A CS1000 with 64K bytes of RAM and CP/M is priced at $4987 in single-unit quantities. **Systems Sales International Inc.,** 509 W. 18th St., Austin, Texas 78701.

Circle No 305

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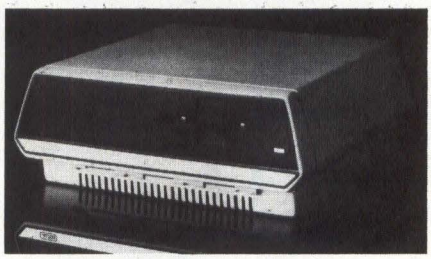
Just plug it in your computer system. No additional hardware or software is needed. Transfer data to a 17.2 megabyte tape cartridge. Perform file search, update records, edit and reformat data. Use it for Winchester backup, data logging, or archival storage applications. Interfaces are built-in for RS-232, Multibus, S-100, 8-bit parallel, or Ohio Scientific. For full details on the Model 150 contact: **North Atlantic Qantex,** 60 Plant Avenue, Hauppauge, NY 11788 (516) 582-6060

See us at NCC, Booth W6240

CIRCLE NO. 172 ON INQUIRY CARD

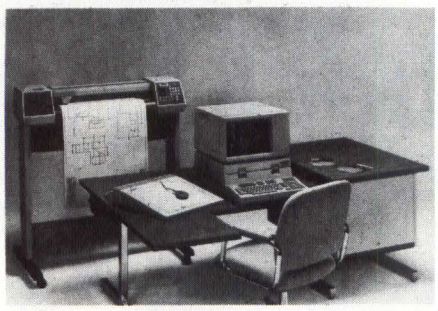


Z80-based microcomputer has hard disk storage

The model 580-10 microcomputer features an 8-bit Z80 microprocessor, a 5¼-in. double-sided, double-density floppy disk drive that stores 1M byte and a 5¼-in. Winchester disk that stores 10M bytes. The system includes 192K bytes of RAM, four serial ports and one parallel port and can support three simultaneous users with its standard MP/M II multi-user operating system. Price is $6490. **Altos Computer Systems,** 2360 Bering Dr., San Jose, Calif. 95131. **Circle No** 306

CAD system aids users with command tracking

Designed for architectural, mechanical engineering and schematic work, the EasyDraf^2 computer-aided drafting system includes an HP 9836 computer, two 264K-byte, 5¼-in. floppy disk drives, an HP 7580 D-size plotter, a desk and a chair. At the heart of the system is the HP 9836 computer featuring an 8-MHz MC68000 microprocessor, a 12.2-in. CRT with a 512- × 390-dpi graphics resolution and an interactive, standard ASCII keyboard with numeric keypad and special function keys. Software highlights include command tracking to facilitate communication between the computer and a user. The system displays the command options in short or long form and, when an option is selected, walks the operator through the steps needed to complete that command. A track of the drafter's input is displayed, so he always controls the computer's actions. Price is $57,700 including installation and training. **Bruning,** 1800 Bruning Dr. W., Itasca, Ill. 60143. **Circle No** 307



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Telecommunications Industry Market Research Reports

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☐ ***1091 Videotex & Teletext (U.S.)***
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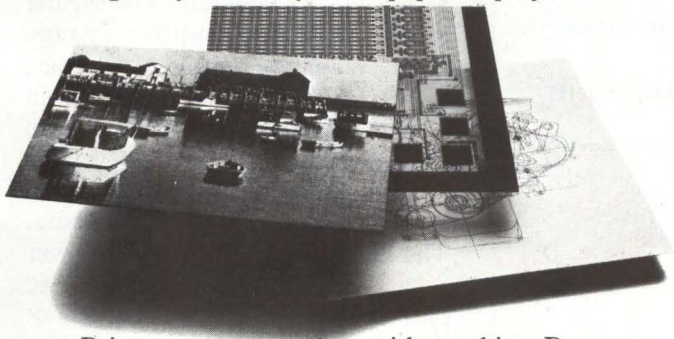

Print reports, complete with graphics. Draw complex plots that would take hours on a pen plotter, in just seven seconds. Even produce transparent overlays, overheads, and photocopy masters direct from computer or display terminal.

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V-80 delivers output worth sharing. It prints with three times the character definition of comparably priced impact printers. And with 40,000 points per square inch resolution, it's the choice of leading CAD and graphics workstation suppliers for high speed graphics.

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Database subsystem serves as auxiliary

Serving as an auxiliary processor to one or more host computers and driven by a host-resident high-level query language, the IDM 500/2 intelligent database machine performs relational database processing tasks and manages dedicated database disks. Appropriate for DBMS applications with an average 900 to 1500 transactions per min., the IDM 500/2 features a database accelerator processor that can execute database instructions at 10 MIPS. A single IDM 500/2 can manage as much as 10G bytes of data, accommodate as many as 4096 users and interface to as many as 64 host systems. A base IDM 500/2 configuration includes a 16-slot chassis, front panel and power supply; a database processor; a database accelerator; a memory timing and control module; 2M bytes of main memory; a disk controller that supports as many as four SMD-compatible disk drives and an RS232C or IEEE-488 host interface module that supports as many as eight host devices. Prices start at $85,000. **Britton Lee Inc.,** 90 Albright Way, Los Gatos, Calif. 95030. **Circle No** 308

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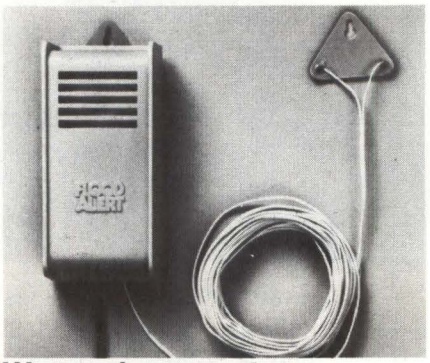

Water alarm system features remote sensor

A water alarm system with a sensor that can be mounted as far as 30 ft. from the control box provides protection for computer rooms, file rooms and other sensitive storage areas. When the unit detects water, it triggers a high-pitched, 85-dB warning that sounds until the alarm is disengaged. The sensor can be mounted to detect water intrusion anywhere from ceilings to subfloors. The alarm box has a 6-ft. power cord, plugs into any standard AC outlet and measures 5⅛ × 2⁵⁄₁₆ × 1⅞ in. Price is $42.50, with quantity discounts available. **Devoke Data Products,** 1500 Martin Ave., Santa Clara, Calif. 95050. **Circle No** 309

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Circle 194 for LSI-11 Circle 195 for PDP-11

Portable computer includes application programs

The Kaypro II portable personal computer features a 9-in. green screen that displays 24 rows of 80 characters each. Its keyboard features a standard typewriter layout plus a 14-key calculator-style keypad, four separate, individually programmable cursor control keys and control, delete and escape function keys. A standard RS232 port allows a user to connect the Kaypro II to a printer or a modem.

Other features include a Z80 processor, two built-in 5¼-in. floppy disk drives that store 191K bytes each and 64K bytes of RAM. The Kaypro II uses the CP/M 2.2 operating system and includes word-processing, spelling-checker, mail-list and electronic spread-sheet application programs as well as the S-BASIC and M-BASIC programming languages. Single-unit price is $1795. **Kaypro Division, Non-Linear Systems Inc.,** 533 Stevens Ave., Solana Beach, Calif. 92075.

Circle No 310

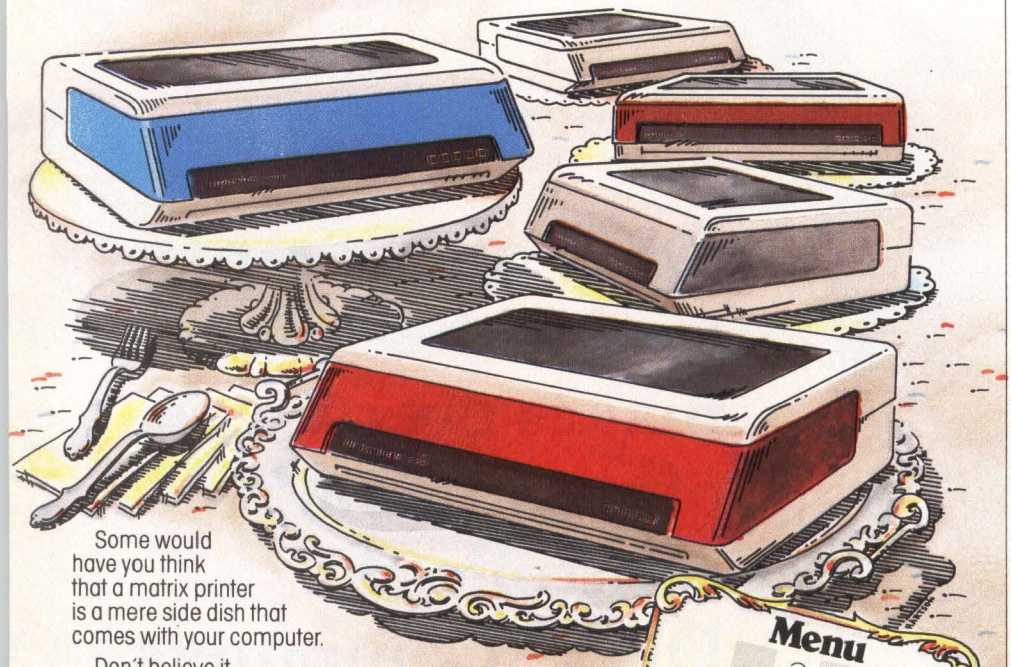
Single-board computer is STD bus compatible

Suited for robotics, controls and small-computer applications, the STD bus-compatible model SCMT-88 single-board computer includes an 8088 CPU and 128K bytes of on-board memory capacity. The 8088 CPU can operate at 4.7 MHz and executes 8086 microprocessor instructions. Each of the board's eight 28-pin sockets is compatible with JEDEC 28-pin dual-in-line pinout and can be configured to accept from 2K- to 16K-byte-wide ROMs/EPROMs or from 2K to 32K-byte-wide RAMs. The SCMT-88 with 32K bytes of RAM is priced at $475 in single-unit quantities. **Solarcom Technology Inc.,** P.O. Box 4715, Hayward, Calif. 94544. **Circle No** 311

Information processor can be stand-alone system

The WorkSaver WS-150 word- and information-processing system functions as a stand-alone system, a

Soup to Nuts.



Some would have you think that a matrix printer is a mere side dish that comes with your computer.

Don't believe it.

What you get out of your printer is what you get out of your computer. If your printer is small, slow, noisy or unreliable, your computer will be limited, sluggish, irritating, or inoperable. Just telling it like it is.

That's why Infoscribe has come up with a gourmet line of multifunction matrix printers specifically for business and professional users.

You can switch from high-speed data processing to business letters, at will; handle up to 16-inch-wide paper; make up to five crisp carbons; generate gorgeous graphics in up to eight colors; and enjoy truly elegant and incredibly quiet operation, day-in and day-out.

Menu

MODEL	DRAFT (CPS)	CORRESPONDENCE (CPS)	LETTERS (CPS)	GRAPHICS (72 x 72)	GRAPHICS (144 x 144)	PROGRAMMABLE FONTS	COLOR
500	150	75					
1000	200	100					
1100	200	100		X		X	
1200	200	100	40	X	X	X	
1500	400	200	40	X	X	X	X
				X		X	

Check the menu for the printer that meets your exact needs. Why go with the computer manufacturer's combo plate when the same money will let you buy Infoscribe, a la carte?

Your favorite computer dealer or systems specialist will be delighted to arrange a demonstration for you. Or contact the *matrix d'*: Infoscribe, 2720 South Croddy Way, Santa Ana, California 92704, USA, Phone (714) 641-8595, Telex 692422.

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CIRCLE NO. 175 ON INQUIRY CARD

cluster station or a master station that can support four additional workstations. The WorkSaver WS-150 includes an 8-MHz, 16-bit Intel 8086 microprocessor, 384K bytes of RAM, a 5¼-in., dual-density, double-sided floppy disk drive and a 5¼-in., 16M-byte, triple-platter, sealed Winchester disk drive, all housed in a desk-top cabinet. Other features include a 15-in. screen, a detached keyboard with a 10-key numeric keypad, two RS232C ports, one RS244 cluster communication port and one Centronics parallel port. The WorkSaver WS-150 supports WordReady I and II software, record processing, WordCheck, CP/M-86, Multiplan, BASIC, COBOL, Pascal and asynchronous TTY, bisynchronous 2780/3780 and 3270 communication protocols. Price is $10,995. When used as a master station, the WorkSaver WS-150 requires a master operating system software program available for a one-time licensing fee of $2700 or an annual license fee of $1080. **NCR Corp.**, Dayton, Ohio 45479.

Circle No 312

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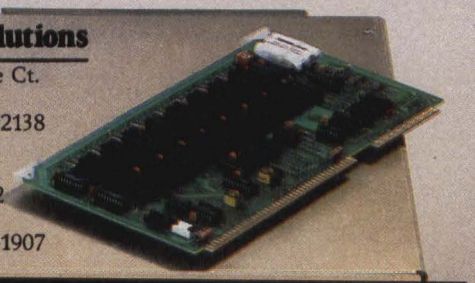


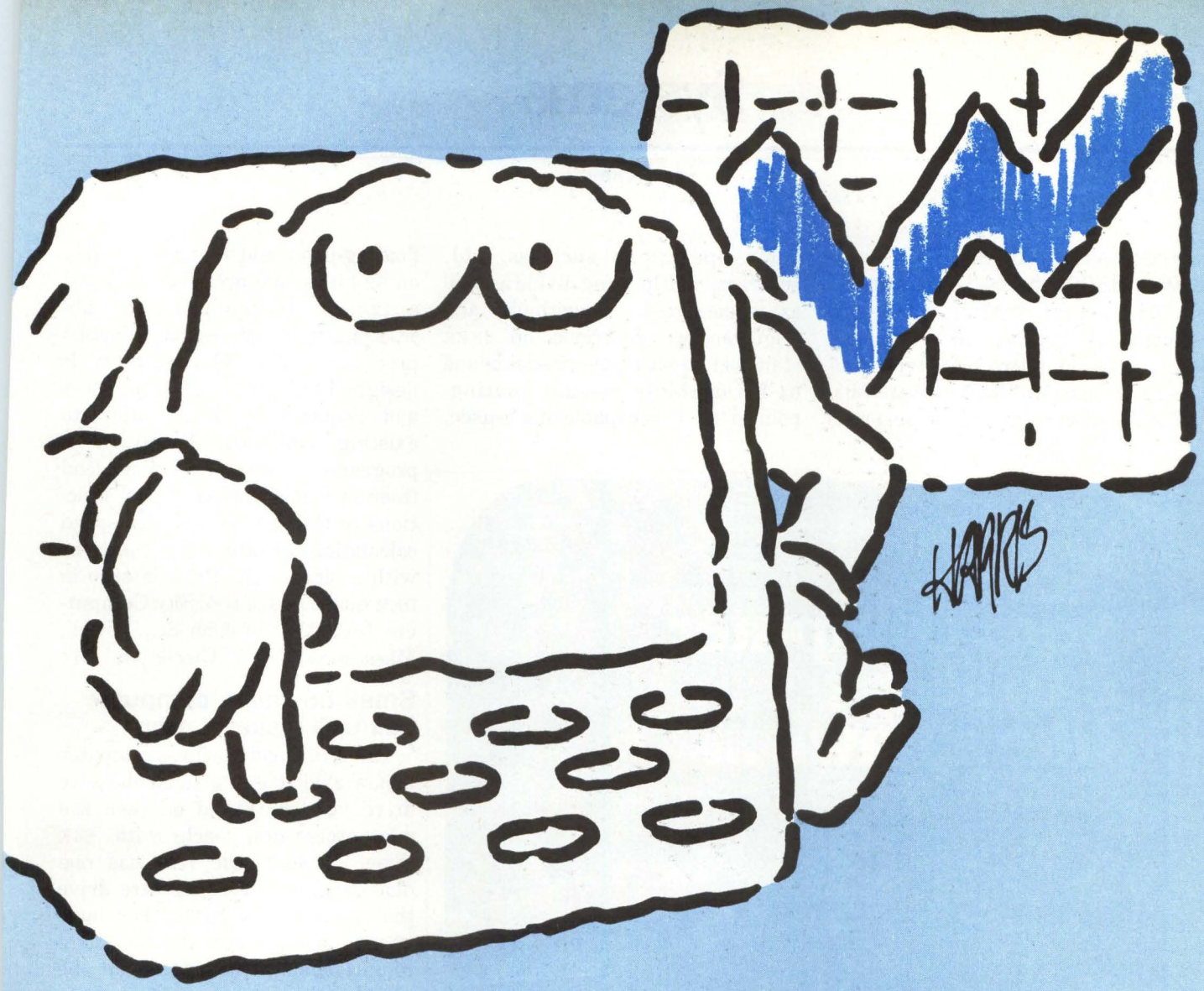
*Multibus is a Trademark of Intel Corp.

CIRCLE NO. 176 ON INQUIRY CARD

Single-board STD computer features 16-bit CPU

The model RSD-8088 single-board computer for the STD bus features a 16-bit 8088 CPU, an RS232 serial I/O channel with software-programmable baud rates from 110 to 19.2K baud, 20 programmable parallel I/O lines usable with or without handshaking, five 28-pin, byte-wide memory sockets and 256 bytes of on-board RAM. The 28-pin memory sockets can be jumpered to used any of the common 24- or 28-pin, byte-wide memories including 2716 to 27128 EPROMS and 8K-, 16K- or 32K-byte RAMs. The sockets also support nonvolatile EEPROMs. The 8088 CPU runs at 4.77 MHz with 450-nsec. memory with no wait states. An on-board wait-state generator allows use with slower memories and provides an increased interrupt-acknowledge time for slow peripherals. A memory and I/O map decoder enables a user to select one of four factory-programmed memory maps to allow for different-sized memories and different locations of the memory in the 1M-byte memory map. Single-unit price is $390. **Robotrol Corp.**, 1250 Oakmead Parkway, Suite 210, Sunnyvale, Calif. 94086.

Circle No 313



The Business Computer

Business Computer Systems is the first publication to view the business computer market as a whole—not just a microcomputer market, not just a personal computer market, not just a small computer market—but all of these when used in business applications.

The business computer is more likely to be upgraded with additional capacity, peripherals and software and to require more services and supplies than any other computer.

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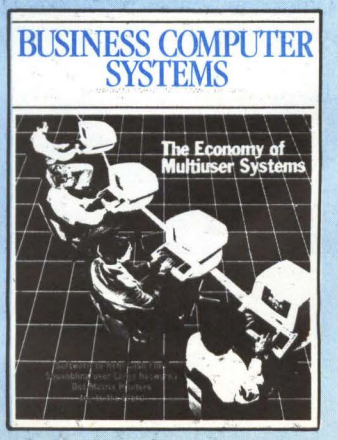
Business Computer Systems—Our circulation *is* the market



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Processor works with 68000-based systems

The model SKYFFP hardware floating-point processor is designed for MC68000 microcomputers running on the Multibus or VME-bus. The single-card processor performs basic operations such as add, subtract, multiply and divide as well as square-root, logarithmic and trigonometric functions on IEEE standard 32-bit single-precision and 64-bit double-precision floating-point data. It is capable of a 3-μsec. floating-point add/subtract/multiply on 32-bit, single-precision data and a 12-μsec. floating-point add/subtract/multiply on 64-bit, double-precision data. The SKYFFP is designed to be transparent to users and requires no modification to existing FORTRAN, Pascal or C programs. Users can down-load their own microcoded special functions to the SKYFFP for high-speed calculations of often-used functions with a single call. Price is $890 in OEM quantities of 500. **Sky Computers Inc.,** Foot of John St., Lowell, Mass. 01852. **Circle No** 314

Datacube boards give your CPU video I/O capability... economically.

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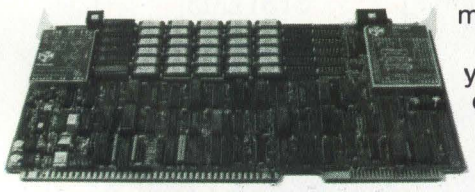

See how easy it is to make your computer see like a hawk. Call or write Datacube Incorporated, 4 Dearborn Road, Peabody, MA 01960, Telephone: (617) 535-6644.

Datacube

CIRCLE NO. 178 ON INQUIRY CARD

Small-business computer has one diskette drive

The S/10 small-business computer is now available in a single-diskette drive version. Based on twin Z80 microprocessors, each with 64K bytes of RAM, the S/10 has one dual-density, 5¼-in. diskette drive that stores 630K bytes. For businesses with large data-storage requirements, the S/10 can be combined with the vendor's 10M- or 20M-byte Winchester disk drive. The single-drive S/10 can also be used as an add-on terminal for larger Basic Four systems. The S/10's software is compatible with software written for the larger systems and includes standard accounting programs such as general ledger, accounts payable, accounts receivable, payroll and many other application programs written in Business BASIC, the language that runs under the multitasking Business BASIC/Micro operating system. The S/10 can also run the CP/M operating system. Other features include a 132-column display screen and special function keys. Options include communication interfaces and printers. Single-unit price is $3995. **MAI/Basic Four Business Products Corp.,** 601 San Pedro N.E., Albuquerque, N.M. 87108. **Circle No** 315

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A standard that changed the way users think about dot matrix line printers.

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Microcomputers feature multiprocessor architecture

The X series of combined 8- and 16-bit multi-user microcomputers includes the Supermicro 32X and the Supermicro 64X. The Supermicro 32X supports as many as 32 concurrent users and has an 8-in. Winchester disk drive that stores 60M bytes expandable to 240M bytes. The Supermicro 64X supports as many as 64 concurrent users and has a 14-in. Winchester disk drive that stores 136M bytes

expandable to 272M bytes. Both systems feature an 8-bit, 6-MHz Z80B-based file processor with 256K bytes of RAM and bus-transfer rates of 400K bytes per sec. Each Supermicro X series user has an X series application processor featuring a Z80A microprocessor, 64K bytes of RAM, two RS232 ports and switch-selectable addressing. A shared 16-bit processing capability is available through optional AP/86 performance accelerators. Based on the Intel 8086 microprocessor, the performance accelerator features memory expandable to 1M byte in 256K-byte increments. Application processors are linked to each other and to the file processor by a proprietary, high-speed bus, the m/Bus inter-processor link. Operating under its own proprietary n/STAR network operating system, the Supermicro series is compatible with CP/M and CP/M-86 application software packages. A basic Supermicro 32X with a 60M-byte hard disk drive, a 500K-byte floppy disk drive and 32 application-processor slots is priced at $18,995. A basic Supermicro 64X with a 136M-byte hard disk drive, a 500K-byte floppy disk drive and 32 application-processor slots is priced at $22,995. Each X series application processor is priced at $995. An AP/86 performance accelerator with 256K bytes of RAM is priced at $2795. **Molecular Computer,** 251 River Oaks Parkway, San Jose, Calif. 95134.

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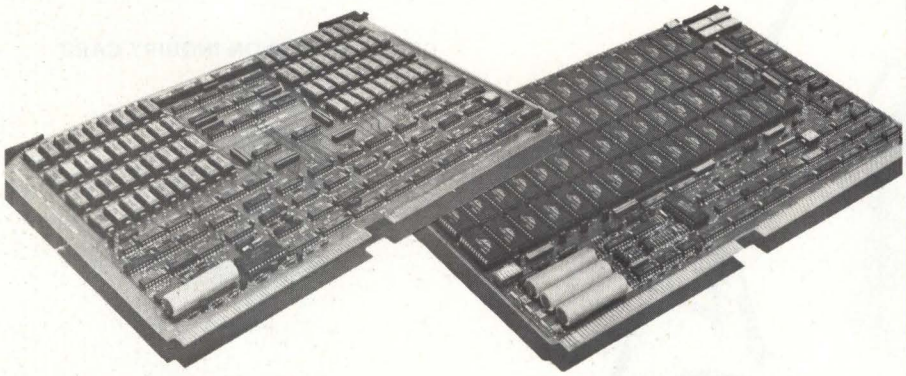

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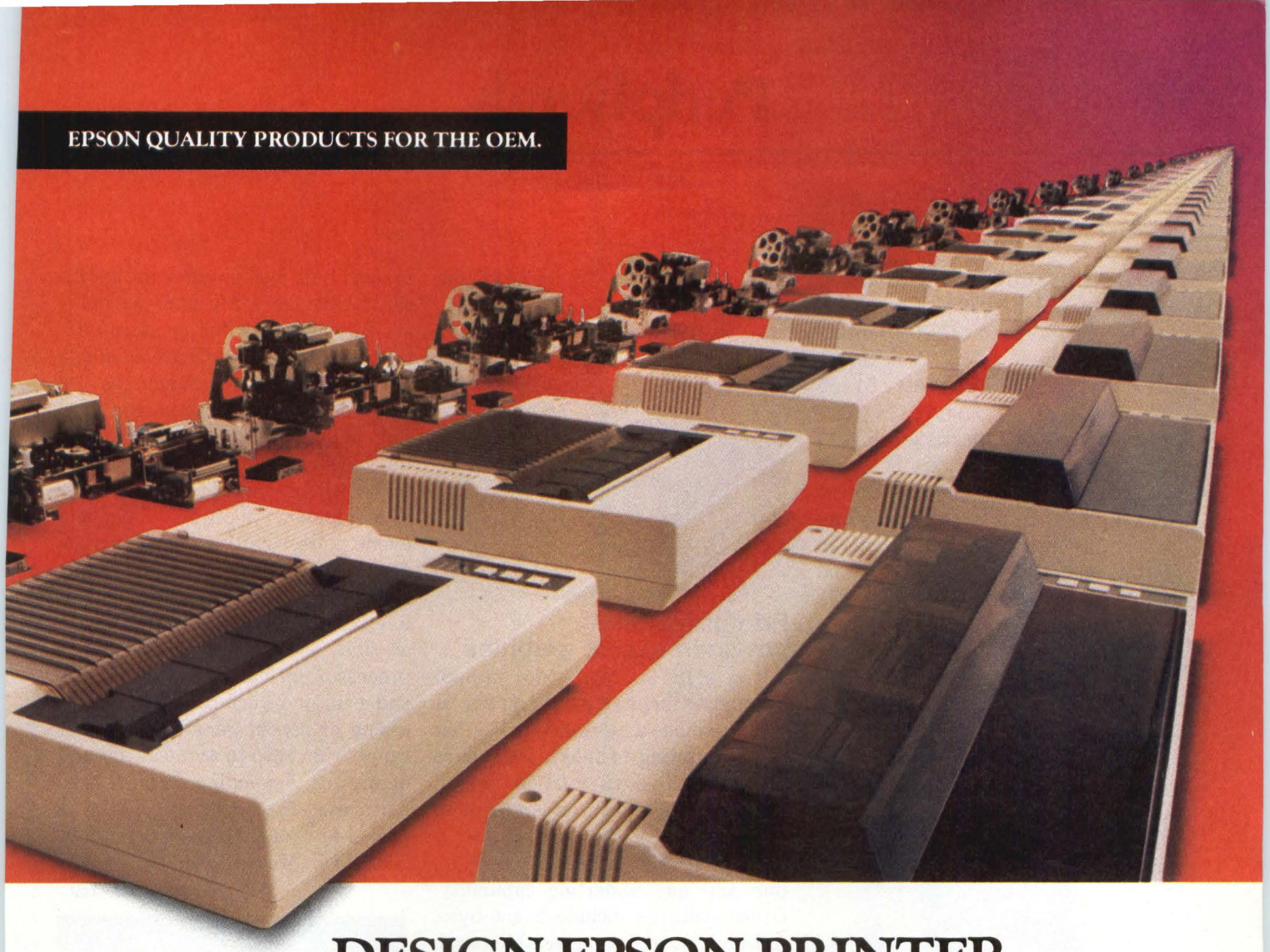

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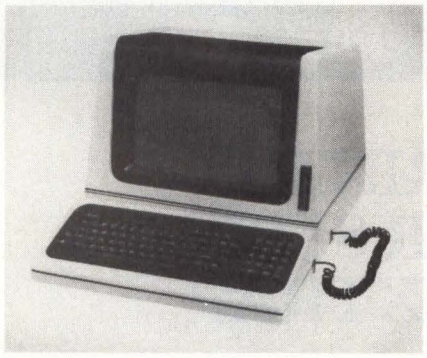
CIRCLE NO. 181 ON INQUIRY CARD

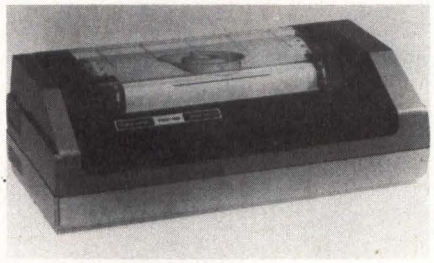
SMD-compatible Winchester stores 513M bytes

The model AMS 513 SMD-interface-compatible 14-in. Winchester disk drive stores 513M bytes (unformatted). It features a five-disk platter configuration using 19 data heads. Transfer rate is 1208K bits per sec., and average access time is 25 msec. The AMS 513 has an MTBF of more than 10,000 hours, an MTTR of less than ½ hour and requires no scheduled preventive maintenance. It includes a basic drive, a power supply and a desk-top enclosure and is priced at $7900 in OEM quantities of 50 to 99. **Century Data Systems Inc.,** 1270 N. Kraemer Blvd., Anaheim, Calif. 92806. **Circle No** 317



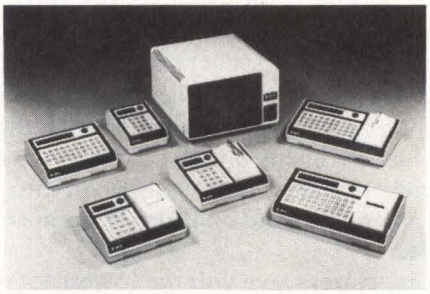
Video terminal emulates Burroughs TD830/MT983

The model 3830 video display terminal is plug- and command-sequence-compatible with Burroughs TD830/MT983 terminals. The terminal's 15-in., non-glare, green phosphor screen displays 24 lines × 80 or 132 columns and a 25th status line. Other features include keyboard-controlled terminal attributes, 14 programmable function keys, serial printer ports and selectable RS232C/BDI/TDI interface. The terminal's detachable keyboard features a Selectric-style alphanumeric section; a numeric keypad; seven status indicators; and setup, edit, function and control keys. Options include a white or amber phosphor screen. Unit price of the model 3830 is $1995. **Cobar Inc.,** 1181 N. Fountain Way, Anaheim, Calif. 92806. **Circle No** 318



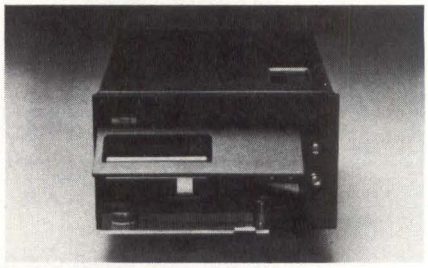
Printer features dot-addressable graphics

The TRS-80 DMP-100 impact dot-matrix printer prints 50 cps at 10 cpi and has a bit-image mode that allows printing of fully addressable graphics with a 60- × 63-dot-per-in. resolution. The printer can print 80 upper- and lower-case, 5 × 7 dot-matrix characters on an 8-in. line and has underline capability. Other features include a 480-byte, full-line dot buffer, selectable parallel and serial interfaces and a 4½- to 9½-in. adjustable tractor. Single-unit price is $399. **Tandy Corp./ Radio Shack,** 1800 One Tandy Center, Fort Worth, Texas 76102. **Circle No** 319



Entry terminals available in a variety of models

Suitable for data-collection, -control and -processing applications, the Data Transaction Equipment series of entry terminals features a variety of models and options including key entry, card entry, receipt printers, external device control and a disk data-processing system. All models offer an RS422-compatible interface and can operate in character, line or store-and-forward mode. Models are available with LCDs of as many as 16 characters and 12-key numeric or full alphanumeric keypads using touch-sensitive switches. An optional control interface provides auxiliary equipment on/off switching and event pulse counting. A companion data recorder and processor accepts DTE input, executes CP/M-compatible software and records on single or dual 5¼-in. floppy disks. The processor includes communications and printer interfaces for teleprocessing or report generation. Prices range from $690 to $1150 in 100-unit quantities, depending on model and features. The disk processor is priced at $1995. **Danyl Corp.,** 1509 Glen Ave., Moorestown, N.J. 08057. **Circle No** 320



Tape drives feature end- or side-loading cartridges

Members of the Microtape family of ¼-in. digital cartridge-tape drives fit the same package dimensions as a 5¼-in. Winchester or floppy disk drive. Available in end- or side-loading configurations, they offer OEMs design flexibility resulting from the alternate package configurations. The first member of the family is a 17.3M-byte, four-track, start/stop drive that is both media and interface compatible with the "Funnel," a high-density, digital cartridge-tape drive. The second member of the family is a serpentine version of the Funnel-equivalent described. It features bidirectional

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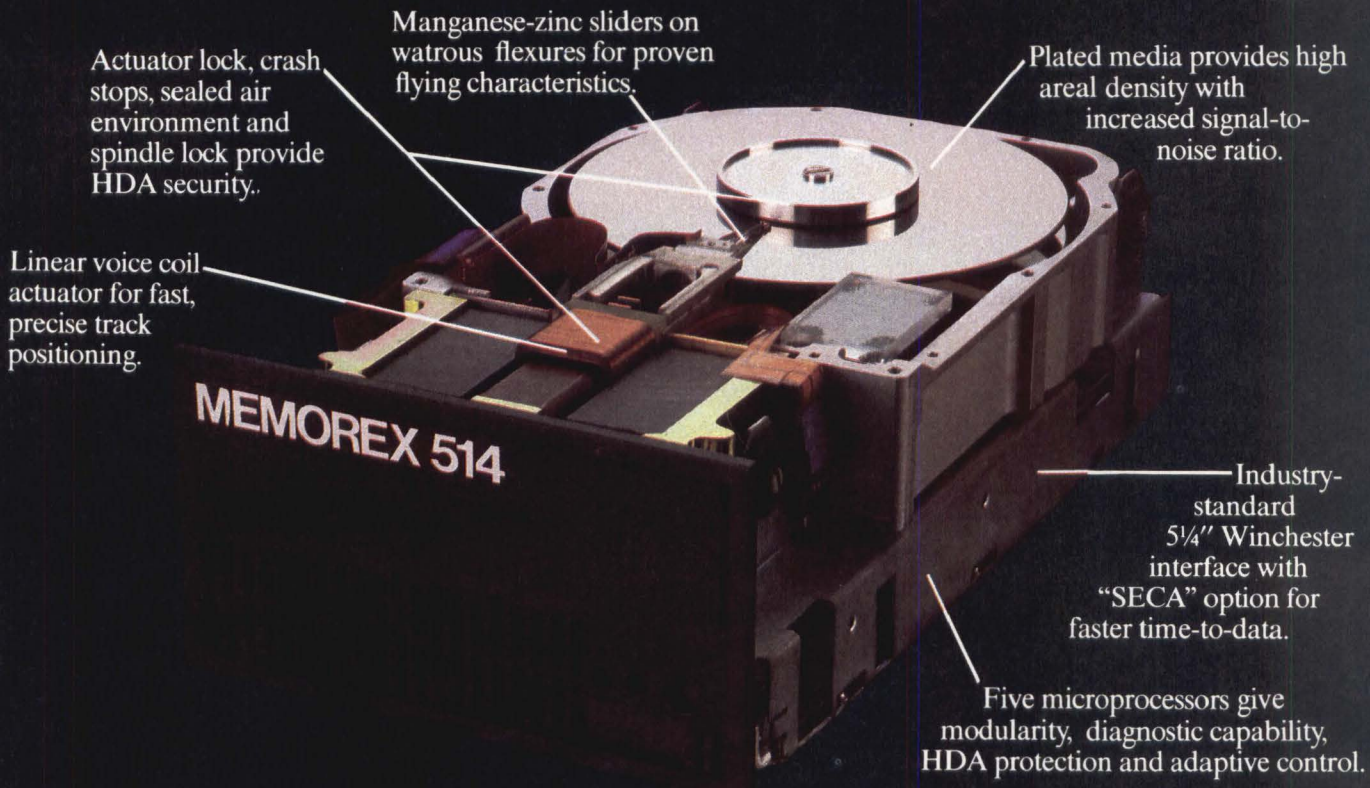

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Above all else, reliability and quality are key to the 500 Family design. By choosing a base design with capabilities well beyond the current series, our drives feature servo and read channels with extremely wide operating margins. And by using an advanced electronic architecture with five interconnected microprocessors, we provide adaptive control systems which continually monitor critical parameters throughout the life of the drive and make dynamic adjustments to compensate for wear and component aging. In this way we obtain and retain true reliability throughout the life of the system.

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serpentine recording heads that eliminate the requirement for rewind time between tracks. Streaming members of the Microtape family are available with operating speeds of 30, 60 or 90 ips. Streaming models that operate at 90 ips can transfer 10M bytes of data in less than 3 min. at a transfer rate of 90K bytes per sec. Prices in 1000-unit quantities range from less than $400 to approximately $870, depending on model. **Data Electronics Inc.,** 10150 Sorrento Valley Rd., San Diego, Calif. 92121.

Circle No 321

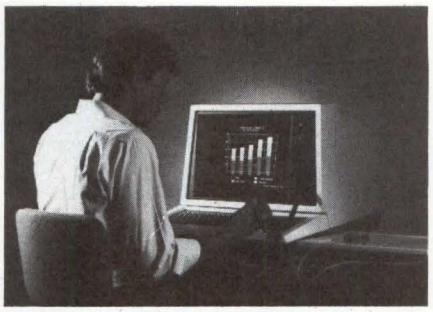
Thin-film heads operate at 8000 to 15,000 fcpi

The Cyber 100 series of thin-film read/write heads are designed for use in 5¼- or 8-in. Winchester disk drives. The dual-layer, 23-turn heads operate at inner-track flying heights of 13 μin. and at flux densities ranging from 8000 to 15,000 flux changes per in., depending on the drive's read-channel electronics and media used. At these spacings and densities, the Cyber 100 heads give signals of 250 μV or more with a resolution of more than 80 percent. The series supports track densities of 800 to 1200 tpi. Prices range from $35 to $65 per head in OEM quantities, depending upon specifications. **Cybernex Corp.,** 6580 Via Del Oro, San Jose, Calif. 95119.

Circle No 322

Color terminal features long-persistence phosphor

Three new versions of the vendor's 6211 family of interactive color graphic terminals offer rack-mount capability, long-persistence phosphor and DEC VT100 compatibility. Designed for process-control and command and control environments in which equipment is typically rack mounted, the model

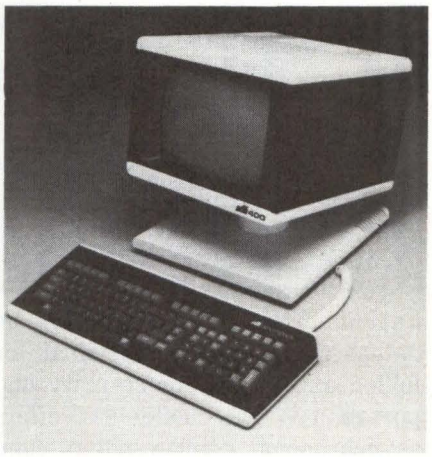


R6211 is priced at $3995 without a monitor. Priced at $4995, the model 6211-03 is a 40-MHz, interlaced, long-persistence phosphor version of the model 6211. The models feature resolution of 640 × 480/512 pixels, simultaneous display of as many as 16 colors from a palette of 64 and communications with any host computer via an RS232 interface at baud rates from 110 to 9600 baud. The model 6221, priced at $5995, offers DEC VT100 compatibility. Configured to emulate the 83-key VT100 keyboard, the model 6211's low-profile, ergonomic keyboard has 20 programmable function keys, 12 control keys, 10 LED displays and an audible alarm. The model 6221's screen display features 24 lines × 80, 132 or 160 characters, smooth or jump scroll, a user-defined scrollable region and character attributes such as reverse, color, underline, bold and blink. **Ramtek Corp.,** 2211 Lawson Lane, Santa Clara, Calif. 95050.

Circle No 323

Daisy-wheel printers feature modular interface capability

The Sprint 11 Plus family of daisy-wheel printers features an interchangeable communications module that plugs into the back of the printer. The module makes the printer compatible with any standard word-processing application software on many computers including IBM, Hewlett-Packard, Xerox, Commodore, Tandy and North Star. The Sprint 11/40 and Sprint 11/55 offer automatic bidirectional printing at 40 and 55 cps, respectively, using standard Qume 96-character print wheels. The Sprint 11 Plus printers feature Intel 8085, 8-bit microprocessor-controlled, single-board electronics and MTBFs of 5500 hours. The Sprint 11/40, with choice of serial, parallel and IEEE-488 modular interface, including a 2m. cable, is priced at $1776 in single-unit quantities. **Qume Corp.,** 2350 Qume Dr., San Jose, Calif. 95131. **Circle No** 324



Terminal replaces Data General D400

The model 400 CRT terminal emulates Data General Corp.'s Dasher D400 and features two pages of memory, horizontal scrolling, vertical soft scrolling, screen windowing, split screen and a 64K-byte RAM expansion. Its standard 12-in. and optional 15-in., black-and-white, green or amber CRTs display 81 or 135 characters per line. The terminal's ergonomic features include a detachable, low-profile keyboard and a CRT that rotates 90 degrees and tilts 22 degrees. RS232 and current-loop interfaces are standard. Price is $1650 in single-unit quantities, with quantity discounts available. **Dentronix Systems Inc.,** 2635 Croddy Way, Santa Ana, Calif. 92704. **Circle No** 325

Block-mode terminal is Z80-based

The DEC VT100-compatible model 831 block-mode terminal for VAX system environments features a 16K-byte display memory, local editing capabilities, field definition and data-entry checking routines. Its white or green, 12-in. CRT features a switch- and program-selectable 80- or 132-column format. The keyboard features an IBM-Selectric-compatible layout, a 14-key numeric keypad and 16 programmable function-key combi-

nations. The keyboard can be detached from the terminal or folded and locked for security and portability. The model 831 offers asynchronous point-to-point communication in full and half duplex, with separate keyboard-selectable transmit and receive rates from 50 to 19.2K baud. The terminal can be upgraded to a CP/M-based 8-bit microcomputer. Price is $1395 in single-unit quantities, with volume discounts available. **Direct Inc.,** 4201 Burton Dr., Santa Clara, Calif. 95050. **Circle No** 326

DEC terminal substitute features 132-column format

The model TS-132 video display terminal emulates the DEC VT132 terminal and features two RS232C ports including a printer port, block-mode capability for local editing and a 128-character set to produce business graphics. Its 12-in., green screen features an 80- or 132-column display format and 6

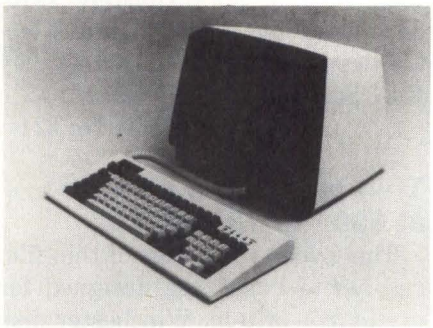
× 10 characters in an 8 × 12 dot-matrix cell. White and amber screen colors are optional. Special function keys, baud rates for the two ports, parity checks, conversation modes, protocols, scrolling, screen brightness, cursor type and line length are software selectable. These parameters are retained by CMOS circuitry even when the power is off. Price is $1650 in single-unit quantities. **Falco Data Products Inc.,** 1286 Lawrence Station Rd., Sunnyvale, Calif. 94086.

Circle No 327

Low-cost alternative emulates VT100

The model SW10 terminal emulates DEC's VT100 terminal and features a small footprint, low weight (26 lbs.), a movable keyboard with 12 programmable function keys and direct access to all terminal operating characteristics via the keyboard. Its green or white screen displays 24 lines of 80 characters and a 25th status line. The SW10 incorporates a simulated block-mode transmission that allows a user to go off-line, fill the screen and edit text and then go back on-line to transmit the data. Two RS232C interfaces are standard. Single-unit price is $899, with OEM quantity discounts available. **General Terminal Corp.,** 14831 Franklin Ave., Tustin, Calif. 92680.

Circle No 328

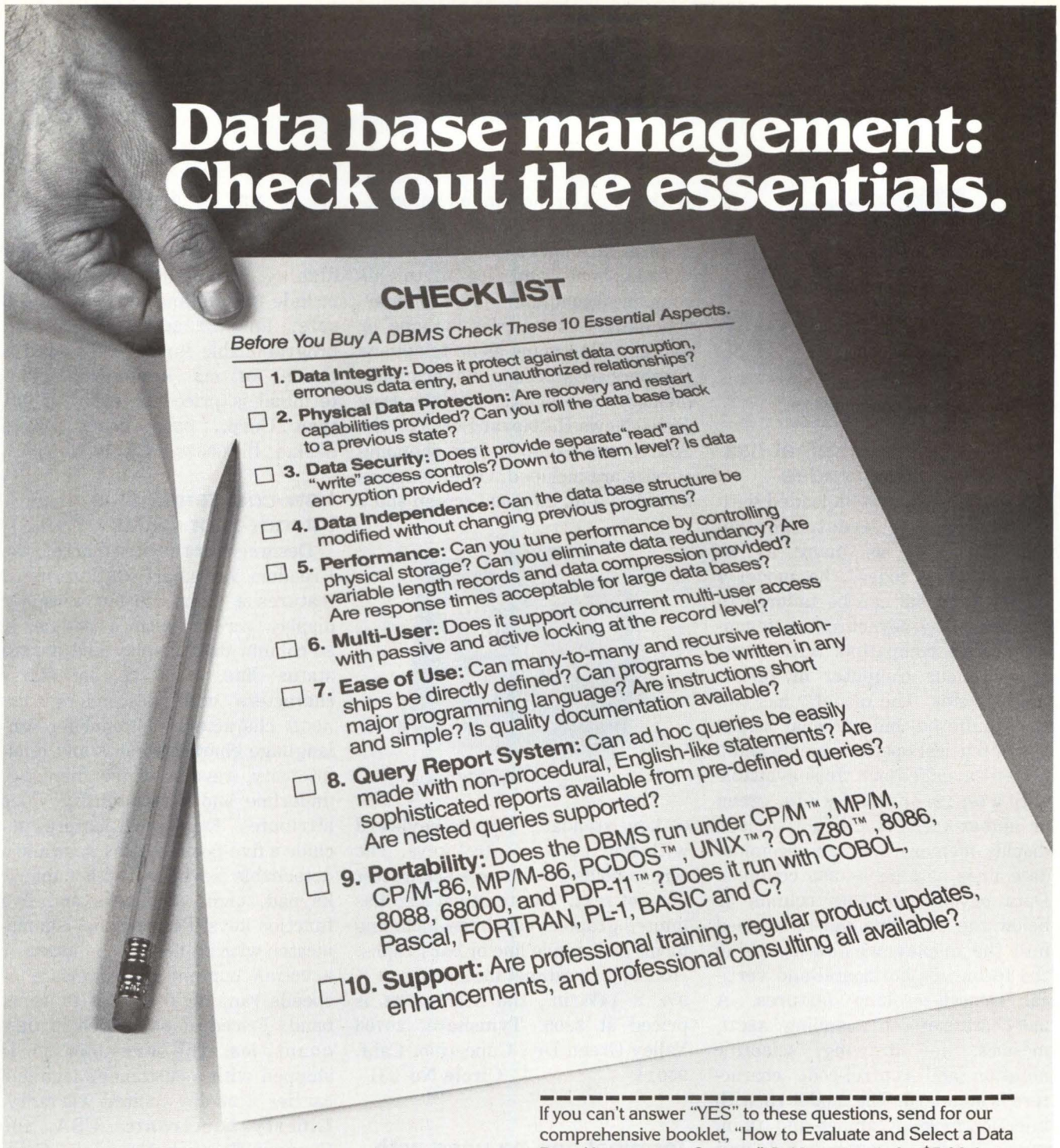


Smart terminal features variable page size

The model SW80 smart terminal features a 12-in., green screen, a detached keyboard with 100 sculptured keys, 12 programmable function keys, hidden video attributes that can be changed on a character-by-character basis and asynchronous data transmissions on a character, line or block basis in full- or half-duplex modes at baud rates as high as 19.2K bps. The display is arranged in a 24-row × 80-column format with a 25th status line that can also be used as a host message line. The terminal displays 128 ASCII characters and 96 additional line-drawing and block-graphics characters. A page of data can be as large as 3840 characters. Horizontal and vertical scrolling allows the display window to move up, down, left or right around the page. Single-quantity price is $995, with OEM discounts available. **General Terminal Corp.,** 14831 Franklin Ave., Tustin, Calif. 92680.

Circle No 329

Data base management: Check out the essentials.



CHECKLIST

Before You Buy A DBMS Check These 10 Essential Aspects.

☐ **1. Data Integrity:** Does it protect against data corruption, erroneous data entry, and unauthorized relationships?

☐ **2. Physical Data Protection:** Are recovery and restart capabilities provided? Can you roll the data base back to a previous state?

☐ **3. Data Security:** Does it provide separate "read" and "write" access controls? Down to the item level? Is data encryption provided?

☐ **4. Data Independence:** Can the data base structure be modified without changing previous programs?

☐ **5. Performance:** Can you tune performance by controlling physical storage? Can you eliminate data redundancy? Are variable length records and data compression provided? Are response times acceptable for large data bases?

☐ **6. Multi-User:** Does it support concurrent multi-user access with passive and active locking at the record level?

☐ **7. Ease of Use:** Can many-to-many and recursive relationships be directly defined? Can programs be written in any major programming language? Are instructions short and simple? Is quality documentation available?

☐ **8. Query Report System:** Can ad hoc queries be easily made with non-procedural, English-like statements? Are sophisticated reports available from pre-defined queries? Are nested queries supported?

☐ **9. Portability:** Does the DBMS run under CP/M™, MP/M, CP/M-86, MP/M-86, PCDOS™, UNIX™? On Z80™, 8086, 8088, 68000, and PDP-11™? Does it run with COBOL, Pascal, FORTRAN, PL-1, BASIC and C?

☐ **10. Support:** Are professional training, regular product updates, enhancements, and professional consulting all available?

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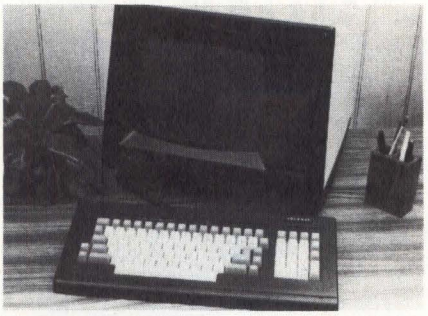
CIRCLE NO. 184 ON INQUIRY CARD

Peripherals

NEW PRODUCTS



Code-loadable terminal has 64 alternate key codes

With its ability to be loaded with 100 or more alternate control sequences and as many as 64 alternate key codes, the model 7 editing terminal can be tailored to emulate many asynchronous terminals or be compatible with many asynchronous computer or operating systems. The model 7 has two fully buffered bidirectional RS232 ports, musical operator alerts and a screen-saver feature. It is available with a 9-, 12- or 15-in. white, green or amber CRT. It has a two-page display memory and can accommodate lines as long as 255 columns. Data beyond the 80th column or below the 24th line can be panned into the display window by using the terminal's horizontal and vertical smooth-scrolling features. A 256-character set including ASCII, mosaics, line drawing, scientific notation and control-code characters is standard. The model 7N with injection-molded cabinet and 12-in. CRT sells for $1295 in single-unit quantities. Substantial discounts are available for volume purchases. **Teleray Division of Research Inc.,** P.O. Box 24064, Minneapolis, Minn. 55424. **Circle No 330**

Personal info terminal includes built-in telephone

Designed to access rather than input data, the Scanset XL personal information station includes a telephone and a computer terminal. With a built-in modem, an automatic dialer and computer log-in, the Scanset XL allows a computer novice to telephone and log-in to his company's computers or to commercial databases by pressing one or two keys. As many as 36 telephone numbers are stored in the terminal's memory. Subscriptions to the Dow Jones News/Retrieval Service, the Source and Comp-U-Star shopping service are included. Other features include a 9-in. diagonal screen and a

69-key standard layout keyboard with four cursor-control keys. The screen holds 24-, 40- or 80-character lines of text. The terminal also has limited graphics capability including forms and simple line or bar graphs. Housed in a cabinet measuring 14 × 9½ × 14½ in., the Scanset XL is priced at $895. **Tymshare,** 20705 Valley Green Dr., Cupertino, Calif. 95014. **Circle No 331**

Terminal can be used with under-carpet cabling

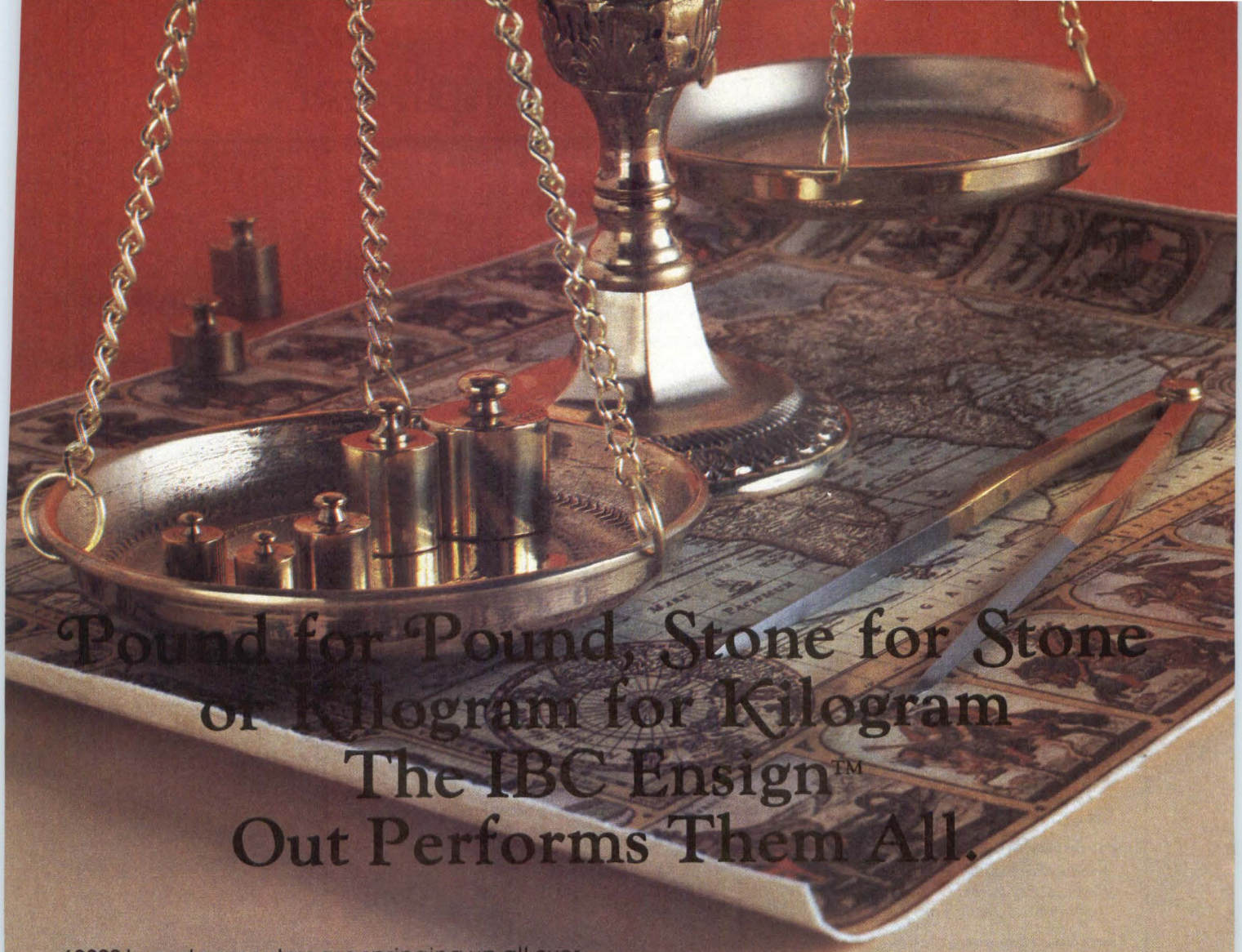
The model 4540 terminal can operate in system configurations using flat, under-the-carpet cabling. Under-carpet communication cable consists of thin parallel wires enclosed by a durable outer jacket. The cable can be placed directly on office underflooring and then covered with carpet tiles. Use of the cabling can reduce costs in new building construction or when remodeling. The model 4540 terminal is IBM 3270 compatible and features a 13-in., black-and-white CRT with an 80-column × 24-line display format. Other features include EBCDIC and ASCII character sets, an RS232C interface, 24 programmable function keys and a choice of six keyboards. The terminal is priced at $2627. **Teletype Corp.,** 5555 Touhy Ave., Skokie, Ill. 60077. **Circle No 332**

Low-cost terminal is intended for OEMs

Designed for the OEM market, the Freedom 50 smart CRT terminal features a 12-in., green phosphor display screen with a 24-line × 80-column data display and a 25th status line, 7 × 9 dot-matrix characters with descenders, 128 ASCII characters, optional foreign-language character fonts and dual-intensity, reverse video, blinking, underline and zero-intensity video attributes. Ergonomic features include a five-position tilt screen and a detachable keyboard with numeric keypad, eight edit keys and five function keys. The terminal communicates with its host via an RS232 or a 20-mA current-loop interface at speeds ranging from 110 to 19.2K baud. Priced at $395 each in OEM quantities, the Freedom 50 is shipped with a customer's logo and carries a 90-day limited warranty. **Liberty Electronics USA,** 100 Clement St., San Francisco, Calif. 94118. **Circle No 333**

Display terminal features window to memory access

The model ADM 23 microprocessor-based video display terminal features a window-to-memory access technique that allows the display screen to act as a 24-line window through which an operator can view any 24 successive lines of the terminal's 51-line display memo-



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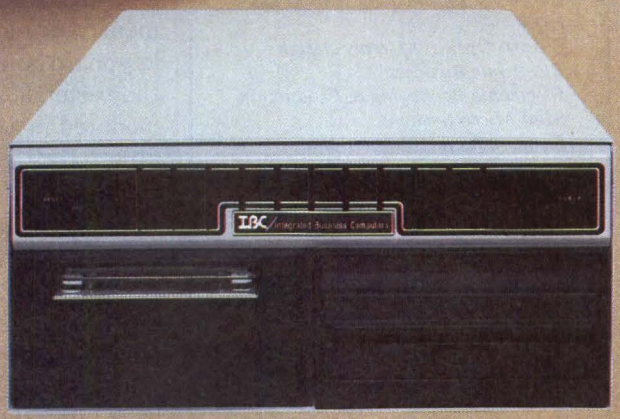

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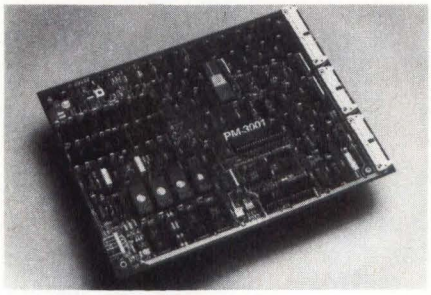
ry. The terminal also features conversation and block-mode operation, an auxiliary port, character and line insert, delete and erase editing, protected fields and five video attributes. It also offers a non-glare, 12-in. green or white phosphor screen, a numeric keypad and eight function keys. U.K., French and German character sets are optional. Price is $795 in single-unit quantities. **Lear Siegler Inc., Data Products Division,** 714 N. Brookhurst St., Anaheim, Calif. 92803. **Circle No** 334

Text terminal is intended for Teletex subscribers

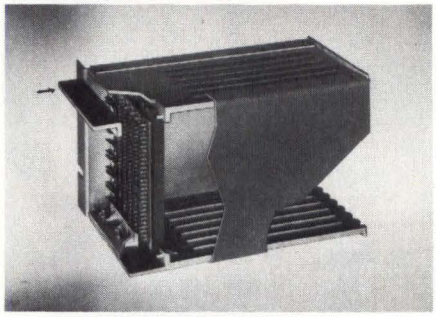
The Text Terminal T4200 functions as a memory typewriter, a Telex teleprinter and a terminal for the international Teletex service. It features a keyboard, a printer, a display unit, at least one minifloppy disk drive, a CPU, main/program memory, control electronics for peripherals, a communication module, data circuit-terminating equipment and a power supply. The keyboard and all function keys for the terminal's operation are accommodated in a self-contained, detachable, flat enclosure. All other modules are installed in another compact housing. The terminal's daisy-wheel printer prints 10- or 12-pitch characters at 40 cps. The terminal's black-and-white CRT displays 21 lines of 82 characters each. Synchronous transmission speed is 2400 bps. Four models are available, with prices ranging from $7087 to $8998. **Siemens Communication Systems Inc.,** 186 Wood Ave. S, Iselin, N.J. 08830. **Circle No** 335

Disk controller features 32K-byte cache memory

The PM-3001 single-board floppy disk controller system has 32K bytes of on-board I/O paging RAM and a ROM-based paged file-management



system. All PFMS files appear to a user as 2M bytes of byte-addressable virtual-memory space. Actual disk space is dynamically allocated and deallocated by PFMS during and between disk accesses. With an appropriate bus adapter card, the PM-3001 can control as many as four 8-in. disk drives and three minifloppy drives. Price is $733 in OEM quantities. **Distributed Processing Technology,** 132 Candace Dr., P.O. Box 1864, Maitland, Fla. 32751. **Circle No** 336



STD bus-compatible card cage holds eight cards

The model BPR-6001-65R STD bus-compatible card cage mounts as many as eight boards in a modular set of molded ABS guides, slotted for ventilation and with alignment studs on the connector mounting shelf to simplify correct assembly. The guides can be installed in the flanged aluminum end plates so that cards can be inserted front to back or back to front. Price is $16.35 in one- to 11-unit quantities. **Buckeye Stamping Co.,** 555 Marion Rd., Columbus, Ohio 43207. **Circle No** 337

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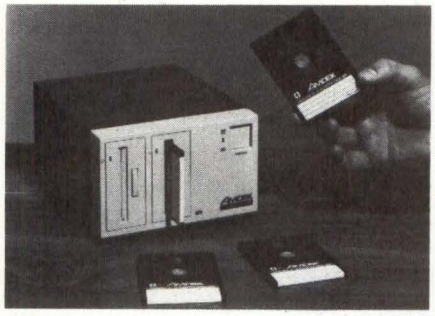
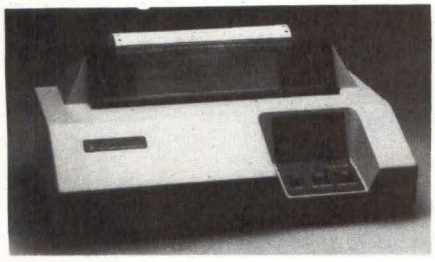


Floppy disk drive uses 3-in. diskette cartridge

The 3-in. Micro-Floppydisk drive system has a built-in power supply and accommodates two 3-in. Micro-Floppydisk cartridges. The recording format, data-transfer rate and disk-rotation speed are compatible with standard 5¼-in. floppy disk drives. The hard-plastic cartridges measure 0.179 × 3.15 × 3.94 in. and feature a flip-type, hinged head cover that protects the 3-in. diskette from dust, scratches and fingerprints. The hinged cover automatically opens when inserted in the drive unit. Single-side recording capacity is 125K or 250K bytes for both sides. A write-project mechanism is available to assure read-only status for recorded data. Evaluation samples of the drive, including four cartridges, are priced at $480/ each. **Amdek Corp.,** 2201 Lively Blvd., Elk Grove Village, Ill. 60007. **Circle No** 338



Low-cost dual-mode printer prints at 100 cps

The model D-92 dual-mode impact dot-matrix printer offers 100-cps bidirectional printing, short-line-seeking logic, friction paper feed, a parallel interface, an 800-character buffer and six character sizes with the data-processing or near-letter-quality printing modes. With a full ASCII character set, the printer is capable of uppercase and lowercase printing at 40, 48, 66, 80, 96 or 132 characters per line on 8½-in.-wide paper. Operator controls include power, select/de-select, line feed, top of form, self-test and variable vertical form-length setting. The printer's modular design enables a user to upgrade it with options such as an RS232C interface, an adjustable tractor feed, dot-addressable graphics, 9600-baud operation, a 2K-byte buffer, x-on/x-off, control x/y and a single-sheet feeder. Price is $399 for single-unit orders. **Data Impact Products Inc.,** 745 Atlantic Ave., Boston, Mass. 02111.

Circle No 339

Dot-matrix printer meets data-processing needs

The Microline 92 impact dot-matrix printer provides three print modes: bidirectional data processing with short-line-seeking logic at 160 cps, emphasized and enhanced mode at 80 cps and dual pass, high resolution, correspondence quality at 40 cps. It prints as many as 136 columns per line with a condensed character set and offers dot-addressable, 72- × 72-dpi resolution graphics and an alternate down-line-loadable 96-character set. The ML92 is offered with a Centronics-compatible parallel or an RS232C interface. Single-unit price is $699. **Okidata Corp.,** 111 Gaither Dr., Mount Laurel, N.J. 08054.

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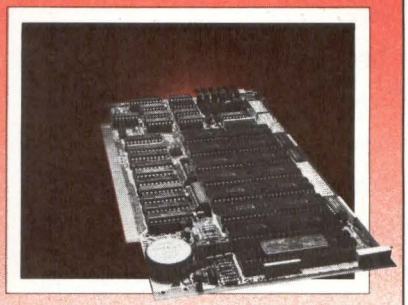

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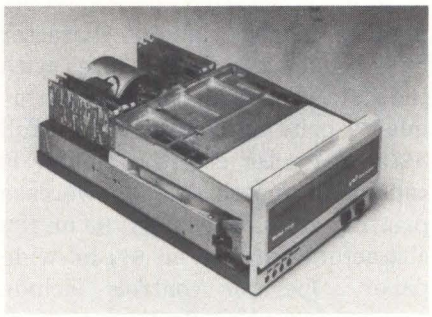

Removable drive features Whitney technology

Featuring Whitney head-suspension technology, the Arapahoe 7110 is a fixed/removable disk drive with 25M bytes of data storage fixed in a sealed enclosure and 25M bytes in an ANSI-standard removable cartridge. The 8-in. drive is interface and performance compatible with Control Data Corp.'s Lark II fixed/removable drive. Featuring an on-board microprocessor that reads embedded servo blocks in each data track, the 7110 eliminates head/disk alignment and cartridge interchangeability problems. Average access time is 35 msec., and the data-transfer rate is 1.2M bytes per sec. For further reliability, the 7110 features a ramp-loading system in which the heads are held off the disk until the cartridge is positively pressurized and purged to a clean-room atmosphere and the spindle reaches its 3600-rpm operating speed. The heads are then loaded onto the disk on an established air bearing. Unit price is $3215 in quantities of 100. **Amcodyne Inc.,** 805 S. Lincoln St., Longmont, Colo. 80501.

Circle No 341

Peripherals are designed for use with HP computers

Designed for use with HP 9000, HP 3000, HP 1000 and all HP-IB and IEEE-488 desk-top computers, a family of ½-in. magnetic-tape systems can store as much as 40M bytes of data on a single reel of ½-in. magnetic tape. The nine-track systems are available in a variety of system configurations with reel sizes from 7 to 10½ in., tape speeds from 25 to 125 ips, recording densities of 800 cpi NRZI, 1600 cpi PE, dual-density 800 cpi NRZI/1600 cpi PE or 6250 GCR and data-transfer rates as high as 200K bytes per sec. Prices range from approximately $6000 to approximately $35,000. **Dylon,** 9561 Ridgehaven Court, San Diego, Calif. 92123. **Circle No** 342

Tape drive fits in half-height drive space

Measuring 1.62 × 5.75 × 8 in., members of the Series 5000 streaming ¼-in. cartridge-tape drives have the same dimensions as a half-height 5¼-in. floppy or Winchester disk drive. Featuring 8000-bpi recording densities, the Series 5000 stores 20M bytes on four tracks or 45M bytes on nine tracks and has a data-transfer rate of 30K bytes per sec. when operating at 30 ips, or 90K bytes per sec. when operating at 90 ips. For tape interchangeability, the drives conform to the ANSI standard for three-point-datum positioning. They are also compatible with the QIC02 interface and can replace Archive Sidewinder or Supersidewinder and Cipher Quarterback streaming ¼-in. cartridge-tape drives. In OEM quantities, the Series 5000 is priced at $800. **Wangco,** 5835 Uplander Way, Culver City, Calif. 90230.

Circle No 343

DEC-compatible terminal has 43 programmable keys

The Concept AVT display terminal conforms to the ANSI X3.64 standard and is software compatible with DEC VT100/VT52 terminals. Its tilt-adjustable 12-in. amber screen displays a 128-character ASCII set on 25 lines × 80 or 132 columns. Other

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features include 43 programmable function keys, windowing and four pages of memory. The detachable keyboard features matte-finish keytops, click positive touch, n-key rollover and separate numeric, cursor control and function-key keypads. Price is $1295 in single-unit quantities, with OEM discounts available. **Human Designed Systems Inc.,** 3440 Market St., Philadelphia, Pa. 19104. **Circle No** 344

Mass-storage device has two drives

The 7300 series of disk subsystems are available with one or two 5¼-in. floppy drives, one 5¼-in. Winchester drive or one floppy and one Winchester. Floppy disk units are double-sided, double-density drives that have an unformatted capacity of 500K bytes. The floppy disk drives feature a 250K-bit-per-sec. transfer rate and a 298-msec. average access time. Winchester drives are available in 3.3M-, 6.6M- and 10M-byte unformatted capacities. The Winchester drives feature a 5M-bit-per-sec. transfer rate and a 75-msec. average access time. The 7300 series drives can be used as a desk-top or tabletop system. They are also available with brackets for standard 19-in. racks. In 50-unit quantities, prices range from $1297 for the model 7312 with two floppy disk drives to $4145 for the model 7342 with one floppy disk drive, one 10M-byte Winchester and a rigid-disk controller. **Cybersystems Inc.,** 7540 S. Memorial Parkway, Huntsville, Ala. 35802. **Circle No** 345

Winchester drives upgrade Q-bus systems

The MDS family of Winchester disk mass-storage subsystems is compatible with LSI-11/2, 11/23 and 11/23-Plus processors. Featuring storage capacities of 5M, 10M, 15M

and 20M bytes, a complete MDS package includes the vendor's WDC11 dual-width controller card, a 6-ft. cable and the MDS drive chassis. The WDC11 controller emulates RK05, RL01/02 and RP02 disks and features an intelligent bootstrap for start-up. Future system growth is supported by use of RLV12-compatible 22-bit direct memory access for all DEC device emulation. Measuring 15 × 7 × 4 in., the chassis can be placed on a desk top or mounted behind the host system. Prices are $3995, $4700, $5300 and $5700 for the 5M-, 10M-, 15M- and 20M-byte configurations, respectively. **Andromeda Systems Inc.,** 9000 Eton Ave., Canoga Park, Calif. 91304. **Circle No** 346

Line printer prints at 2000 lpm

Two high-speed band printers, the models BP-1500 and BP-2000, print at 1500 and 2000 lpm, respectively, using a 48-character set print band. The line printers handle one- to six-part forms from 3½ to 18¾ in. wide. They feature a swing-open gate that facilitates paper, band and ribbon changing, a paper puller and four tractors. Standard interfaces are Dataproducts parallel with full-line buffers. An optional visual alert system automatically raises the printer hood when a fault condition such as paper out, paper jam or ribbon fault occurs. Single-quantity OEM prices are $24,000 and $17,500 for the models BP-2000 and BP-1500, respectively. **Dataproducts Corp.,** 6200 Canoga Ave., Woodland Hills, Calif. 91365. **Circle No** 347

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Development System	• Compiles • Edits • Assembles • Programs Proms • Uploads/downloads to host machine • Emulates	$30–50,000
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You can buy four Icebox development stations for the price of one development system. So, the Icebox can be used in the lab to develop systems, in production to debug and test, and for field servicing. This allows R&D, production and field service to coordinate activities when they have a common problem.

The Icebox weighs about 25 pounds, and measures less than 9″×11″×17″. It includes 256K of emulation RAM, four serial I/O channels for synchronous and asynchronous communications, with RS-232C and RS-422A connectors. It also supports IEEE-796, IEEE-488 and centronics parallel line printer interface standards. The Icebox is also self-diagnostic and has a prom programmer interface.

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- Personal computer operation with no time wasted waiting for print completion.
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Software

NEW PRODUCTS

Screen editor runs under UCSD Pascal

The Advanced System Editor runs on microcomputers under the UCSD Pascal operating system. Features include the ability to edit large files, user-programmable function keys, menu-driven file selection and "nested" editing (the capability to edit one file while engaged with another). File size is limited by disk space, not by main-memory size; a single file can fill an entire disk volume. Single-keystroke commands are used for cursor positioning and for recall of search or replacement strings. Columns of text can be moved horizontally relative to one another. Dated lots of editing sessions can be kept for documents with multiple authors. Price is $175. **Volition Systems,** P.O. Box 1236, Del Mar, Calif. 92014. **Circle No** 348

Text file indexes for CP/M micros

Superfile is intended to index and retrieve information from free-form text files created on a microcomputer running under the CP/M operating system, using any CP/M-compatible text editor. The menu-driven package creates indexes to files based on user-furnished key words or phrases. The index file stores the disk and file name where each key word is located. Searches with logical AND, OR and NOT operators can use as many as 64 key words, each as much as 64 characters long. If an exact match is not found, the program displays keywords in the index file that are "close" alphabetically to the specified string. Routines for sorting, merging and splitting records and files are included. Price is $195. **Elliam Associates,** 24000 Bessemer St., Woodland Hills, Calif. 91367. **Circle No** 349

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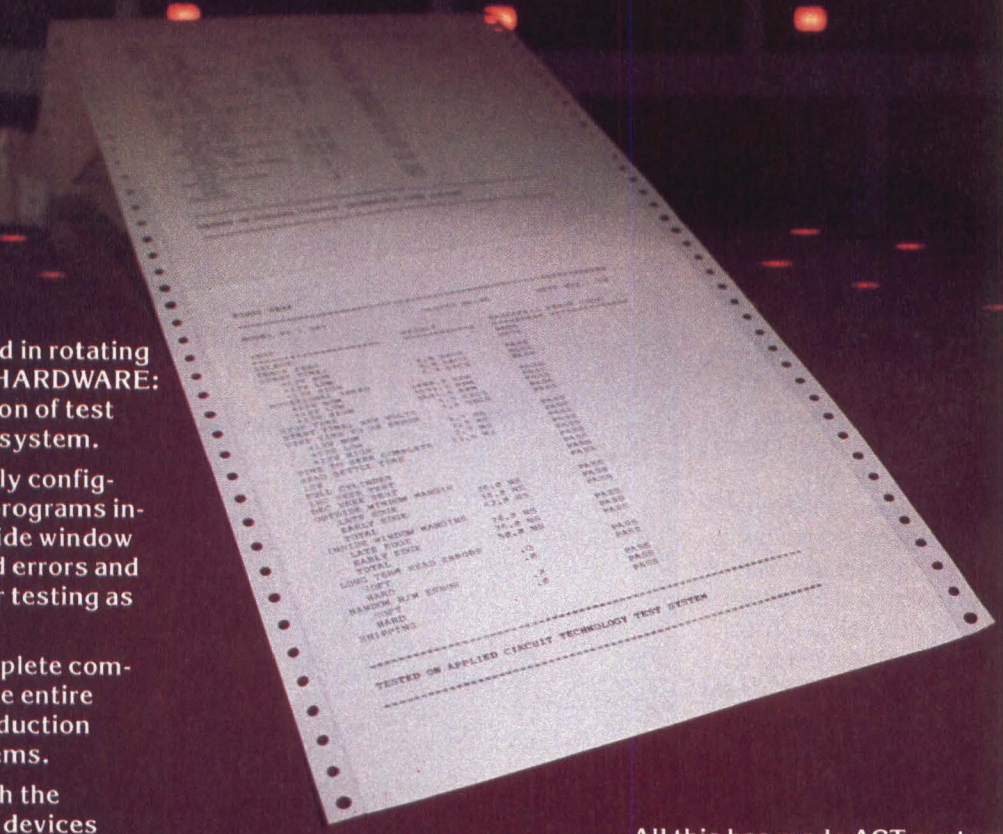

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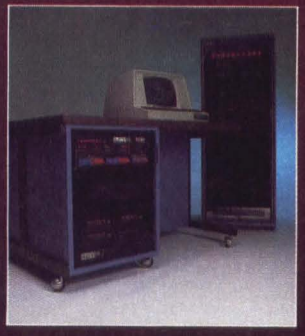

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ACT Applied Circuit Technology

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Text compressor also encrypts

Slim/1 is claimed to compress disk and tape files by a factor of three to four. The package also encrypts data during transmission, and includes a dictionary of words in a language to be compressed. An English-language dictionary is standard; optional dictionaries are available for foreign languages and programming languages including COBOL, FORTRAN and Pascal. A utility permits a user to create a specialized dictionary. Slim/1, written in the C language, runs on DEC PDP-11, VAX-11 and Professional 350 computers. Single-CPU licenses with English dictionary sell for $900. Additional dictionaries sell for $100 each. **Lime Trea Computer Systems,** 1 Penn Plaza, New York, N.Y. 10001. **Circle No 350**

Package provides commands for CP/M microcomputers

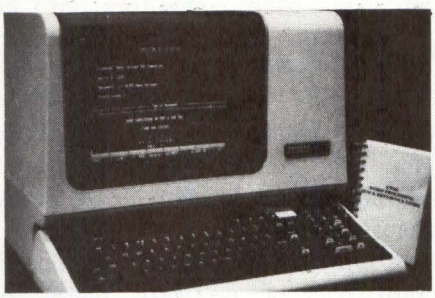
CP+ replaces CP/M 1.4 and CP/M 2.2 commands with English-language menus and directions and provides Help commands to assist beginners. The package includes a routine not available in CP/M for cataloging and describing files. Printing tasks are queued automatically, permitting use of the terminal while the printer is running. The package also verifies all copying operations. Price is $150. **Taurus Software Corp.,** 870 Market St., Suite 817, San Francisco, Calif. 94102. **Circle No 351**

Data-entry utility intended for PDP-11, LSI-11

SCREEN is a utility intended for data-entry operations on DEC PDP-11 and LSI-11 computers running under the TSX or TSX-Plus operating system. Formatting restrictions prevent entry of alphabetic data into numeric fields or entry of character strings that exceed field lengths. Slashes are automatically inserted in dates, parentheses around area codes and hyphens in local phone numbers. Dollar signs and decimal points are also inserted where appropriate. Illegal dates, such a Feb. 30, are rejected. Programming features include automatic entry of leading spaces and trailing zeros and data justification. Price is $1500 in single-unit quantity, with OEM discounts available. **Glenn A. Barber & Associates,** 15010 Ventura Blvd., Sherman Oaks, Calif. 91403. **Circle No 352**

Electronic mail works with CT*OS word processing

The CT*OS spelling corrector and Exectronic Mail electronic-mail system are companion products to the vendor's DEC-compatible CT*OS word-processing package. They run under RSTS/E, RSX-11/M, RSX-11/M+ and VAX/VMS. Using an 80K-word dictionary, the spelling corrector



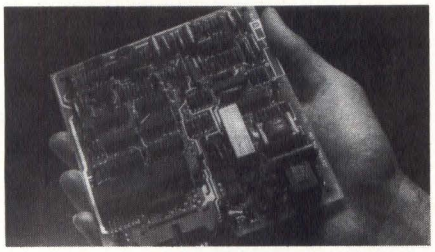
provides 80-word-per-sec. checking of spelling in documents several thousand words long. Exectronic Mail features a routing-slip format and requires an active response from a sender and a receiver. Exectronic Mail accommodates names and titles as long as 53 characters and can store on-line messages as long as 1K byte per user. Inter-CPU transfers are by DECnet. Price for the spelling corrector is $500 for a single-CPU license, and base price for Exectronic Mail is $18,000 including CT*OS word-processing software. **Compu-Tome Inc.,** 234 E. Colorado Blvd., Pasadena, Calif. 91101. **Circle No 353**

Data analysis package runs on VAX computers

The Integrated Data Analysis System, which runs on DEC VAX-11 computers under the VMS operating system, integrates several data-manipulation functions. A relational database facility provides sort, merge, update and join operations. A structured programming language handles numeric and character data types and permits the selection, merging and joining of data sets. A separate matrix-manipulation language provides scalar and matrix multiplication, transposition and horizontal and vertical concatention. Statistical routines perform analysis of variance and co-variance, regression analysis and multivariate analysis. Prices range from $4000 to $5000. **S&H Computer Systems,** 1027 17th Ave. S., Nashville, Tenn. 37212. **Circle No 354**

Program prints wide spread sheets

Sideways enables an IBM Personal Computer user to print wide spread sheets, other wide text or graphics. It rotates the page 90 degrees; the output can be hundreds of columns wide, limited only by the length of the paper. As many as 51 rows can be printed on 8- × 5-in. stock. Sideways is configured to work with Epson MX-80 or MX-100 dot-matrix printers equipped with the GrafTrax graphics option. It offers a choice of two character fonts, a double-strike option for increased print density and control over margins and character spacing. Price is $60. **Funk Software Inc.,** P.O. Box 1290, Cambridge, Mass. 02238. **Circle No 355**

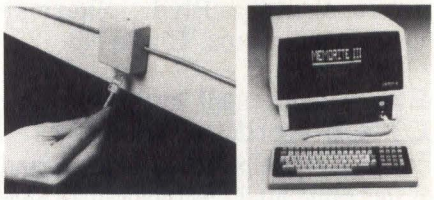


Direct-connect card modem operates at 1200 bps

The model CM2020 is a Bell 202S-compatible, integral PC-board modem that operates asynchronously in half-duplex mode at speeds as high as 1200 bps on the direct-distance-dial network. Measuring 30 sq. in., the device features self-testing, on-board auto dialing and auto answering. The on-board auto dialer provides automatic calling without the need for external automatic dialing units. The CM2020 can be connected directly to the DDD network via an RJ11C receptacle. Price is $180 in 100-unit quantities. **Intertel,** 6 Shattuck Rd., Andover, Mass. 01810. **Circle No** 356

1200-bps modem works with Apple II computers

Designed for use with an Apple II, Apple II Plus or Bell & Howell computer, the Multi-Modem II provides full- or half-duplex communications at 110, 300 or 1200 bps over standard dial-up telephone lines. With menu-driven firmware, the Multi-Modem II provides a self-contained communications system using only the base computer. It features user prompts at all levels of command entry and has auto dial, auto answer and keyboard dialing. Also provided is the ability to answer or originate transmissions manually using the software voice/data switch. With 10 LED indicators to check transmission status, the Multi-Modem II features diagnostics for analog loop, remote digital loop and automatic self-test. It also has a built-in speaker to monitor call progress. Price is $750 in single-unit quantities. **Multi-Tech Systems Inc.,** 82 Second Ave. S.E., New Brighton, Minn. 55112. **Circle No** 357



LAN connects workstations using telephone wire

The LINC low-cost, easy-to-install local-area network uses standard dual twisted-pair telephone wire to connect the vendor's Vector 4 family of single-user computers into a flexible and expandable multi-user system. This high-speed, token-passing network uses a distributed-control technique that eliminates the need for a dedicated master station or file server. A Vector 4 becomes LINC-compatible by installing a SABER-Net controller board into one of its card slots. A LINC-enhanced version of the Vector 4 CP/M operating system is also required. The Vector 4 is then connected to the network by plugging it into a wall-mounted LINC modular socket. The network can accommodate a maximum of 16 Vector 4 computers placed as far as 2000 ft. apart. Each workstation can support a printer. LINC uses a modified SDLC protocol. Data move along the network at 750K bits per sec. using RS422 transmission standards. Error detection and recovery is provided. The LINC upgrade kit is available as an option for the Vector models 4/20 and 4/30 and is priced at $750 including the basic LINC network software. A Vector 4 intelligent workstation including the SABER-Net controller board is priced at $3750. **Vector Graphic Inc.,** 500 N. Ventu Park Blvd., Thousand Oaks, Calif. 91320. **Circle No** 358

Interface enables communications with System 34/38

The model PCI 1051X protocol-conversion unit allows ASCII CRT terminals and printers to communicate with IBM System 34 and 38 computers via the X.25 public packet network. The conversion package consists of a pair of units, the model 1051X and the model 73SX. The 1051X interfaces between ASCII terminals and the X.25 node and provides the ASCII-to-SNA/SDLC-to-X.25 conversion. The 73SX performs the SNA/SDLC-to-X.25 conversion on the System 34/38 host side of the network. The PCI 1051X package permits a maximum of 56 ASCII devices to function simultaneously through the X.25 network emulating IBM's model 5251 CRTs and model 5256 printers. The 73SX supports as many as eight virtual circuits, with each circuit supporting one 1051X. Each 1051X supports a maximum of seven ASCII devices in any combination on its seven physical ports. Physical connection of the 1051X and the 73SX to the X.25 node, the host and ASCII devices can be direct or remote via leased or dial-up lines using synchronous modems on the host side or asynchronous modems on the ASCII side. The units are priced separately. The model 1051X starts at $4500 for the one-port model; a seven-port model is priced at $8500. The model 73SX is priced at $5500. **Protocol Computers Inc.,** 6150 Canoga Ave., Suite 100, Woodland Hills, Calif. 91367. **Circle No** 359

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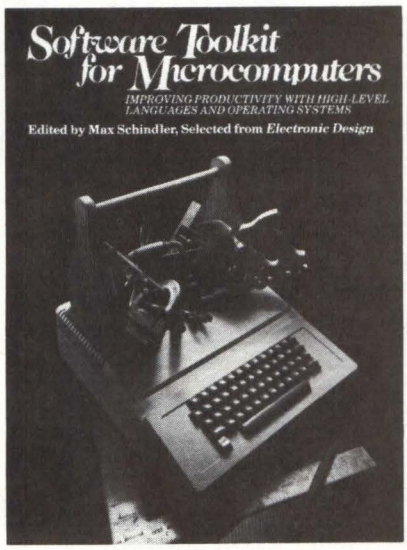


Software design aids compiled in book

The 348-page *Software Toolkit for Microcomputers,* edited by Max J. Schindler, is a compilation of 43 articles from *Electronic Design* magazine that provides a detailed analysis of how to use high-level languages and operating systems to speed software design. The book covers FORTRAN, COBOL, BASIC, Pascal and other high-level languages. A featured section on Ada explores the opportunities available to programmers. Sections included are Software Tools—The Key to Productivity, High-Level Languages Take Over Microcomputers, Pascal's Progeny Challenges the Parent, Operating Systems—Gateway to Efficiency, Pick the best Operating System for Your Needs and Software Impacts Hardware Design. Single-copy price is $14.95. **Hayden Book Co. Inc.,** 50 Essex St., Rochelle Park, N.J. 07662. **Circle No** 360

Communications tutorials contain 37 articles

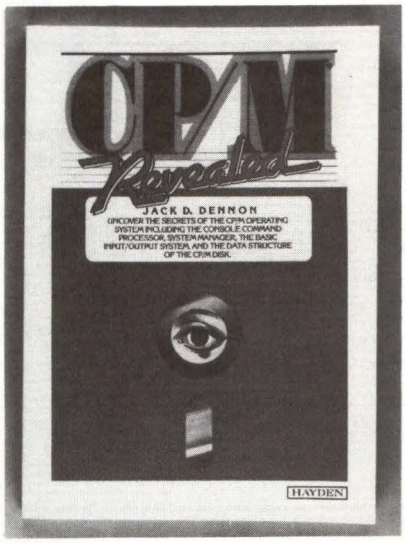
Intended to help communication engineers keep up with the rapidly changing communications field, *Tutorials in Modern Communications* contains 37 articles originally published in the IEEE Communications Society magazine. The 348-page book, edited by Victor B. Lawrence, Joseph L. LoCicero and Laurence B. Milstein, groups the articles into six sections including quantization and switching, data and modulation techniques, computer communications, transmission systems, signal processing and secure communications. Each section is preceded by an introduction. Single-copy price is $33.95. **Computer Science Press Inc.,** 11 Taft Court, Rockville, Md. 20850. **Circle No** 361

CP/M software directory lists 500 products

Spectrum: CP/M edition, volume 1, is a 64-page CP/M software directory that describes more than 500 software products for use on more than 100 microcomputers. All software products in Spectrum are categorized alphabetically according to the occupation or industry served most directly by the product, such as accountants, engineers and veterinarians. The products are grouped according to software application or system type, such as accounts receivable, client write-up and Pascal programming language. Two general categories separate products suited to business from those for entertainment, home or hobby activities. Price is $3.95. **The Software-X-Change,** 12032 Wilshire Blvd., Los Angeles, Calif. 90025. **Circle No** 362

Report details printer performance

Details on the rate of printer introductions and the competitive environment in performance/technology niches are provided in the 40-page *Datek Printer Database Service* report. The publication categorizes all printers by the technology they use (impact or non-impact; dot-matrix or full-character; serial, line or page) and lists them in ascending order of speed within each category. The report lists printers only as they are identified by the printer manufacturers and does not include the many OEM designations for the same printers. The publication also gives information on print width, introduction year and identification numbers of ribbons that a printer uses. By analyzing the date of product introductions in the various technology/performance categories, a reader can identify competing areas of the printer market. Single-copy price is $50. **Datek Information Services Inc.,** P.O. Box 68, Newtonville, Mass. 02160. **Circle No** 363



Book explores CP/M operating system

The 180-page *CP/M Revealed,* by Jack D. Dennon, details the CP/M operating system. The book explains technical aspects of CP/M, including the console monitor (CCP), the system manager (BDOS) and the input/output driver package (CBIOS). The data structure of the CP/M disk is also described. Details of booting up, logging in, changing memory size, mapping disk space, calling programs, file handling and interfacing techniques are included for advanced users. The book also includes CP/M utilities and programming exercises that a reader can use with any CP/M-based system. Single-copy price is $13.95. **Hayden Book Co. Inc.,** 50 Essex St., Rochelle Park, N.J. 07662. **Circle No** 364

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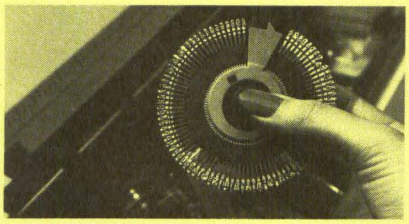

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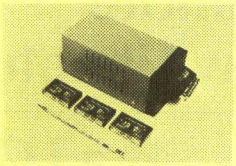

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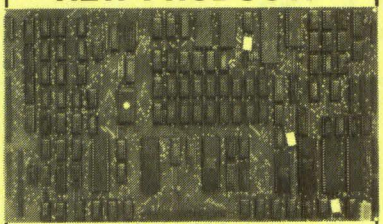

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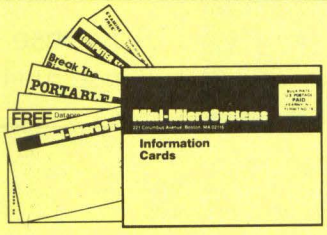

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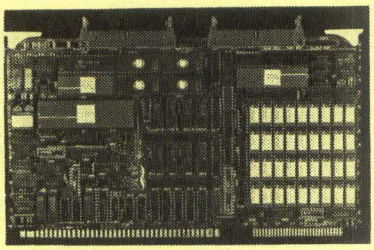

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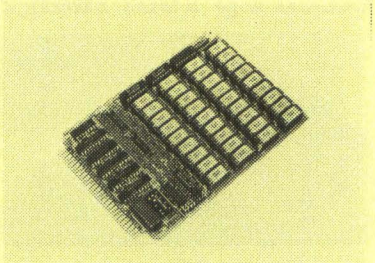

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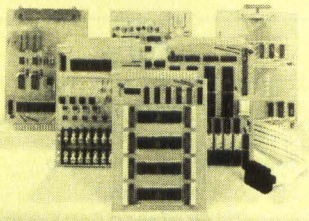

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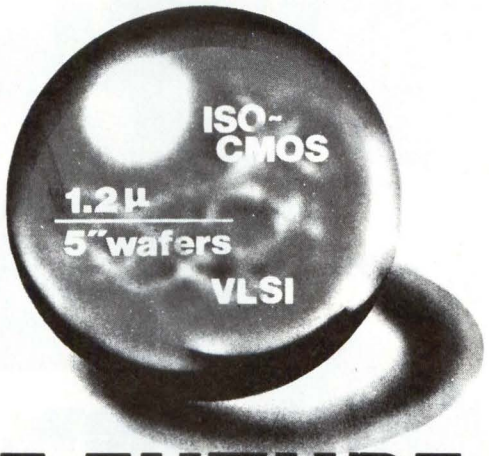

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In our new Survey, you'll get answers to these questions and much more.

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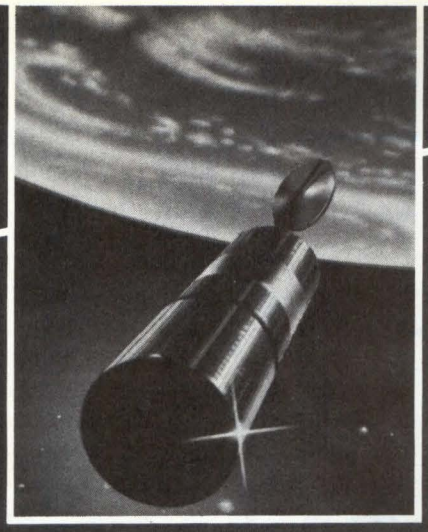

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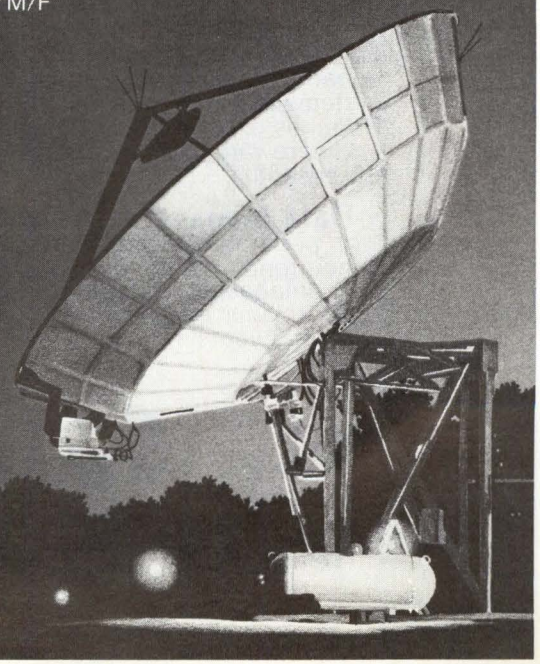

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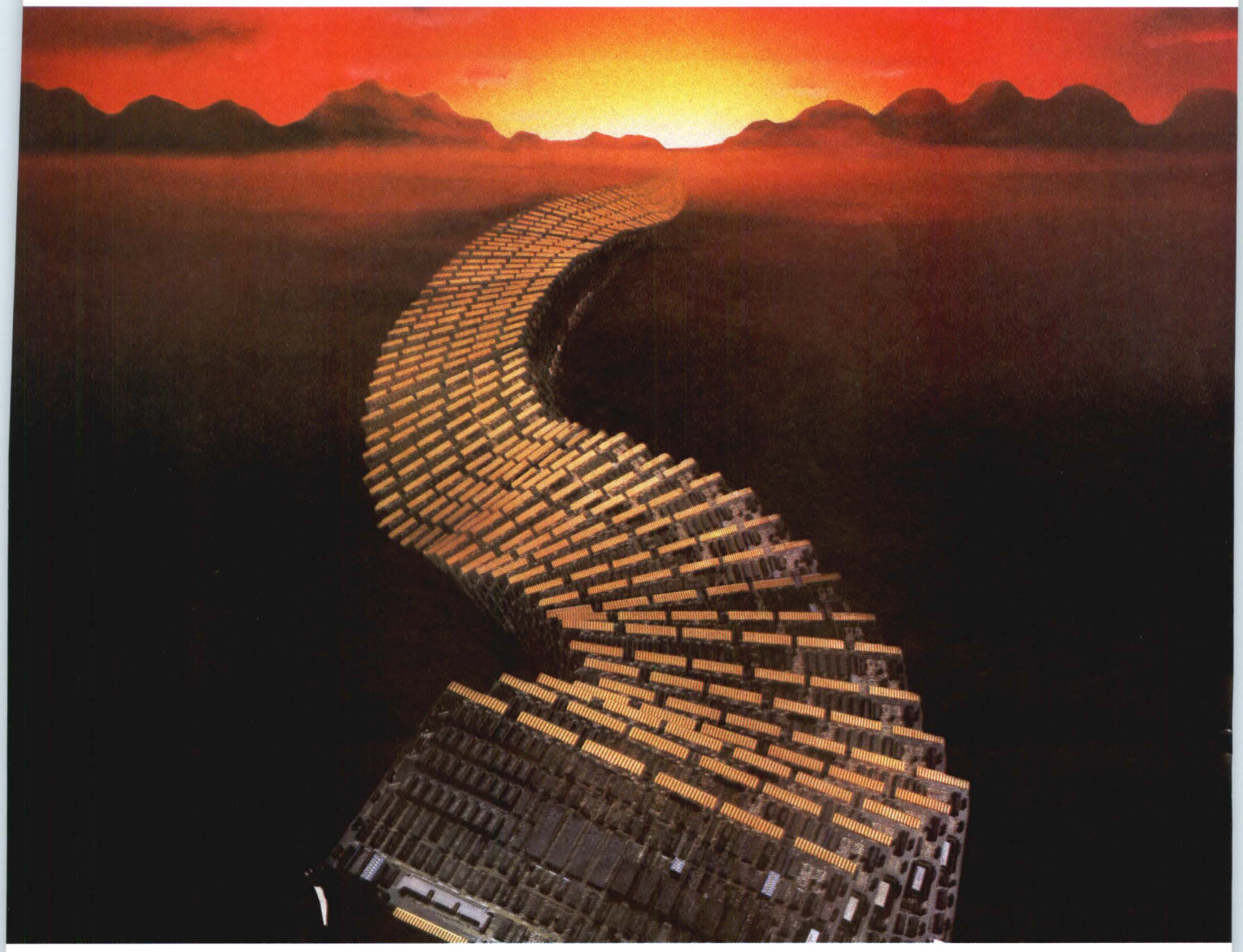

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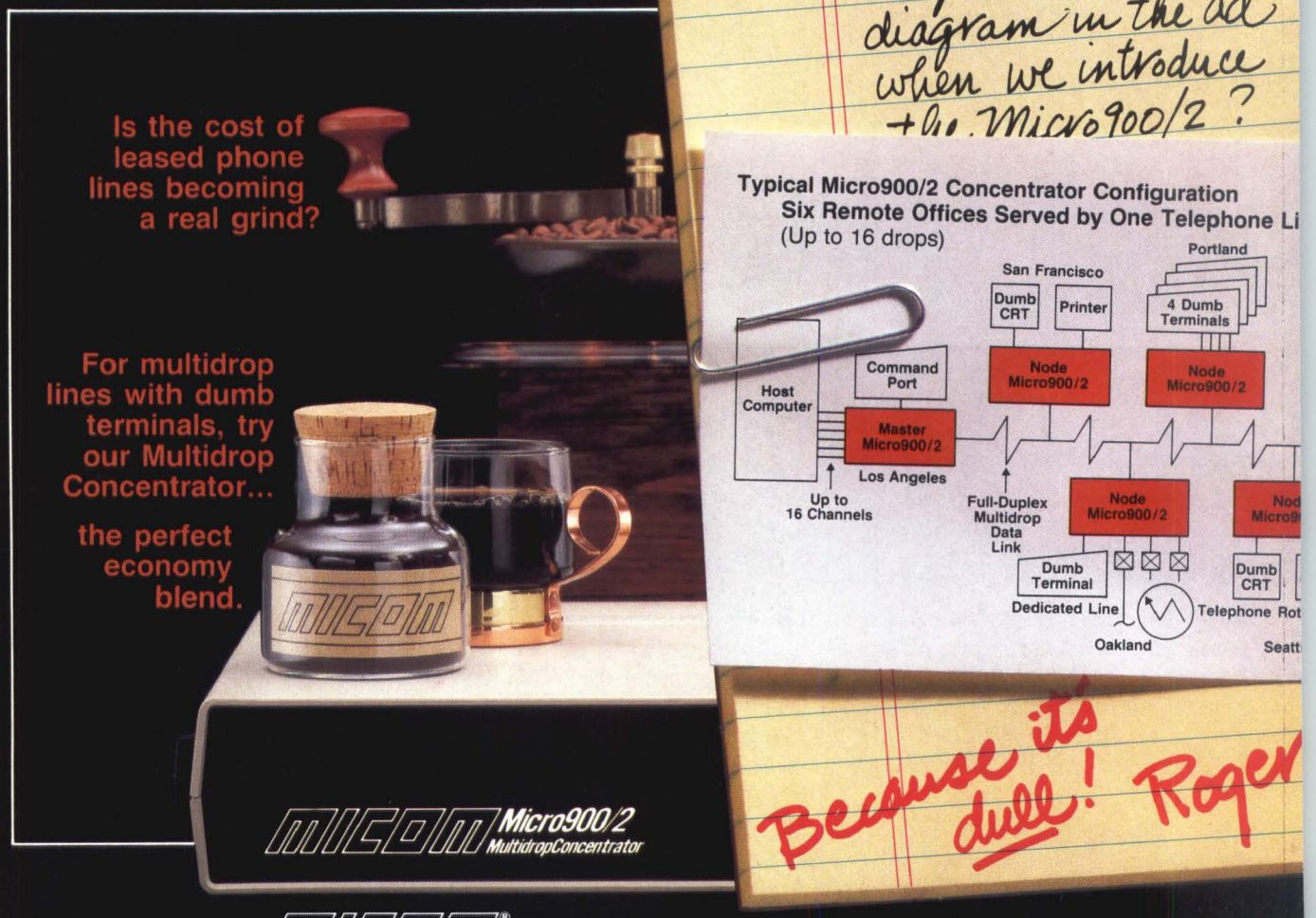

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