

OCTOBER 1986

Mini-Micro Systems

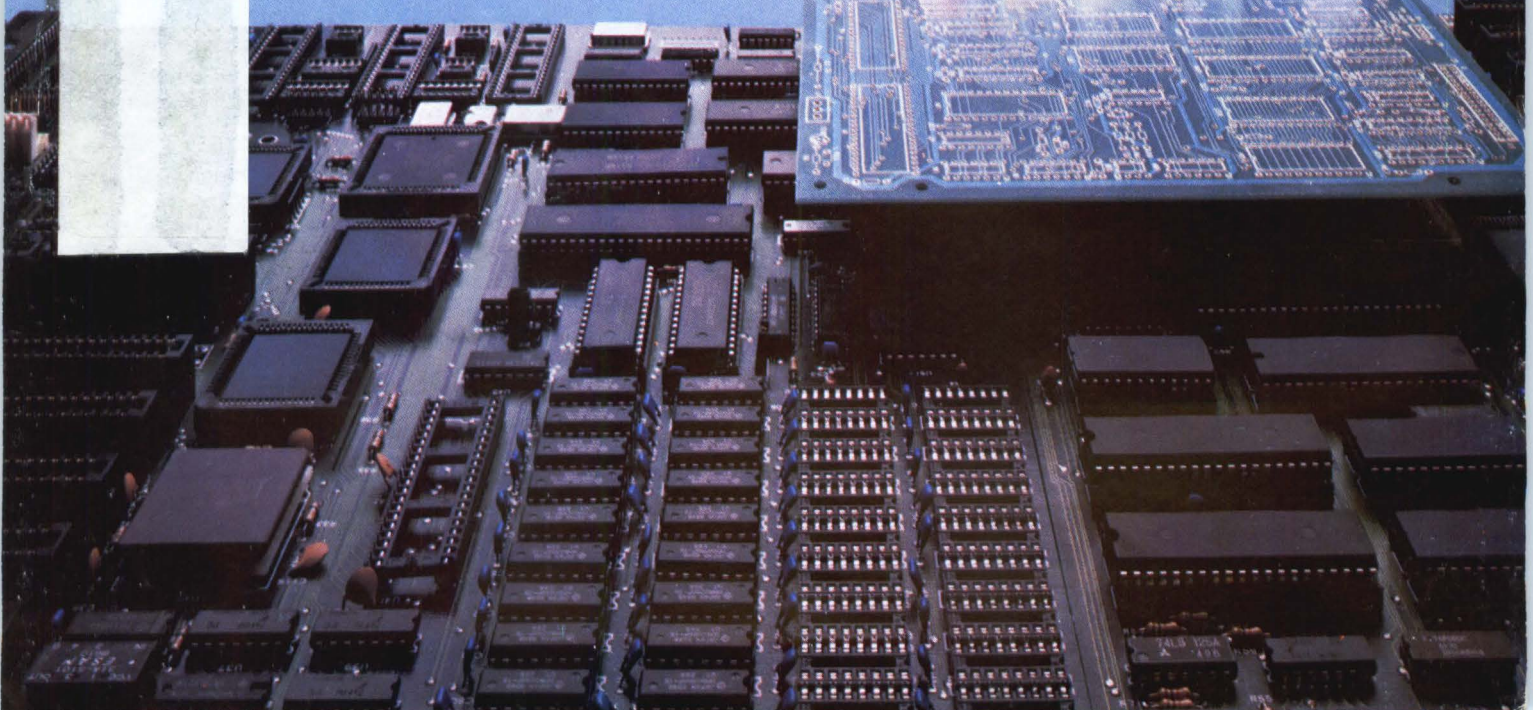
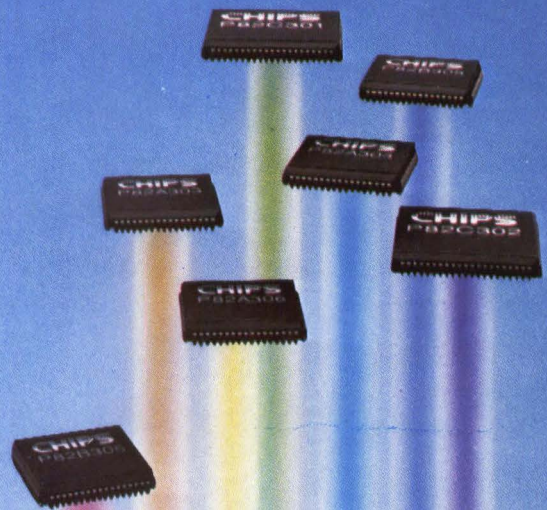
THE MAGAZINE FOR COMPUTER SYSTEMS INTEGRATION

A CAHNERS PUBLICATION

Chips and Technologies' AT386 ICs save parts, power and property

SPECIAL REPORTS:

- **Expanded memory**
- **Software integrates AI**
- **Laser printers**
- **Ada woos VARs**





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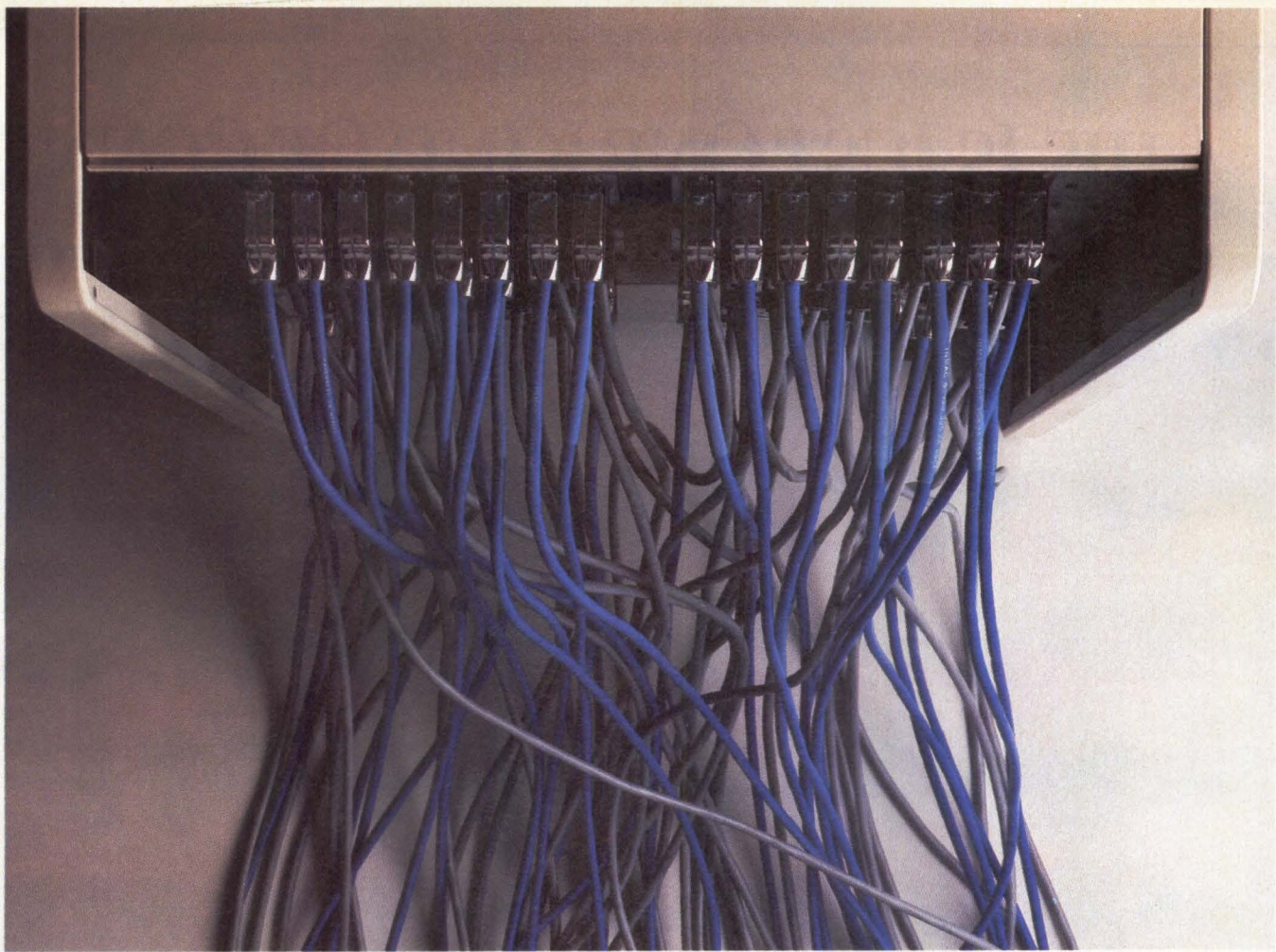


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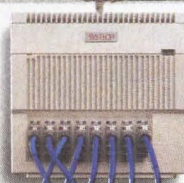
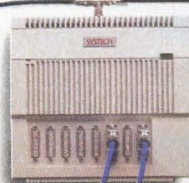
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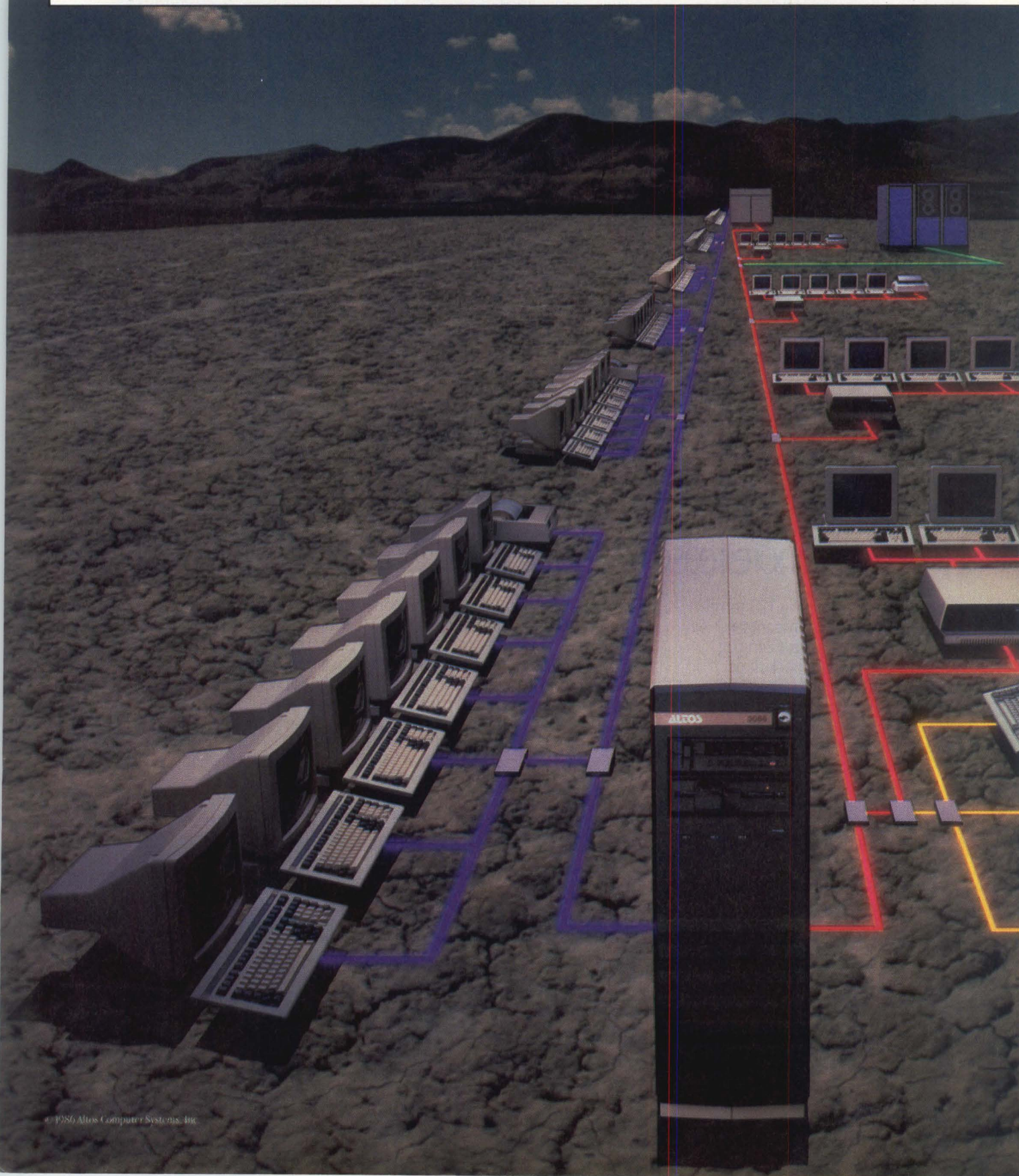
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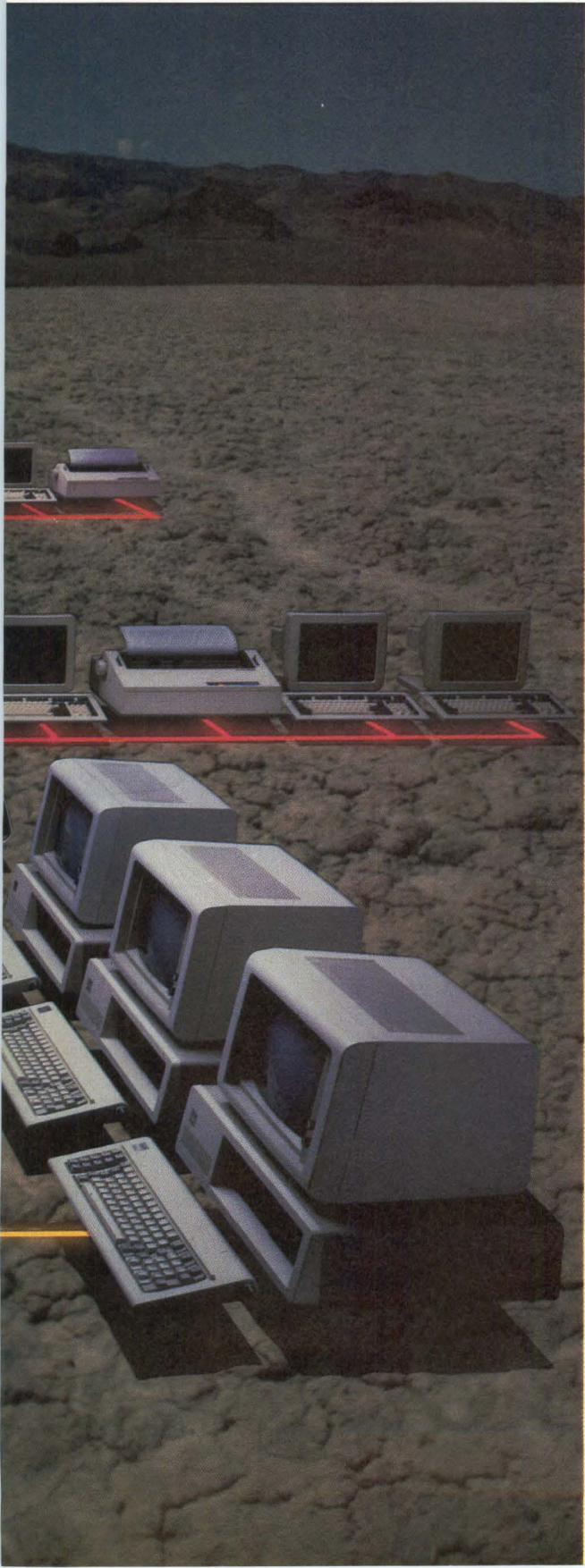
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To find out more about how Altos connectivity can help your business, call Rick Davis, vice president of OEM sales, at 1-800-ALTOS U.S.

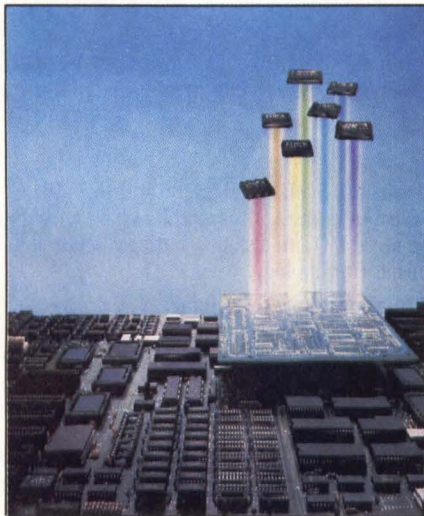
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p. 25 Chips and Technologies' AT386 ICs save parts, power and property. Art design by Stratagraphics. Photography by Stephen Marley with the participation of Gray Strayton International. Courtesy of Chips and Technologies Inc.

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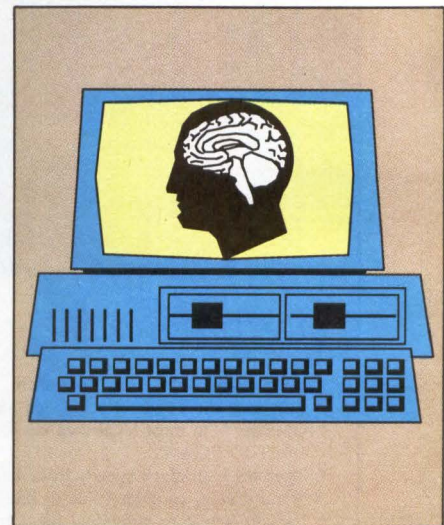
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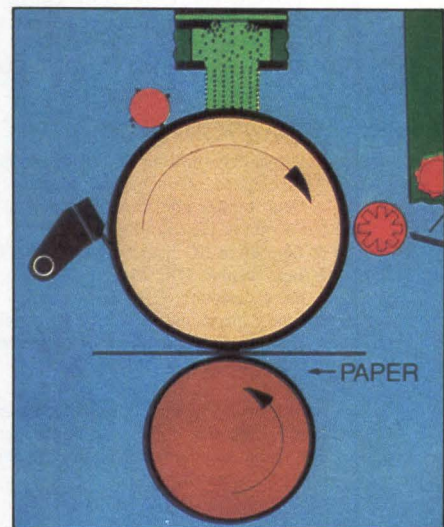
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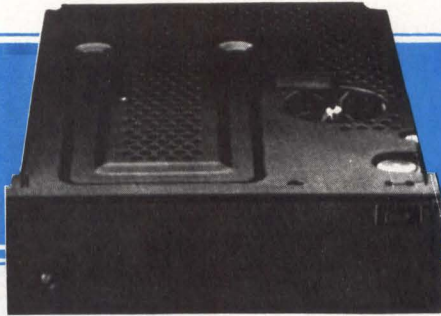
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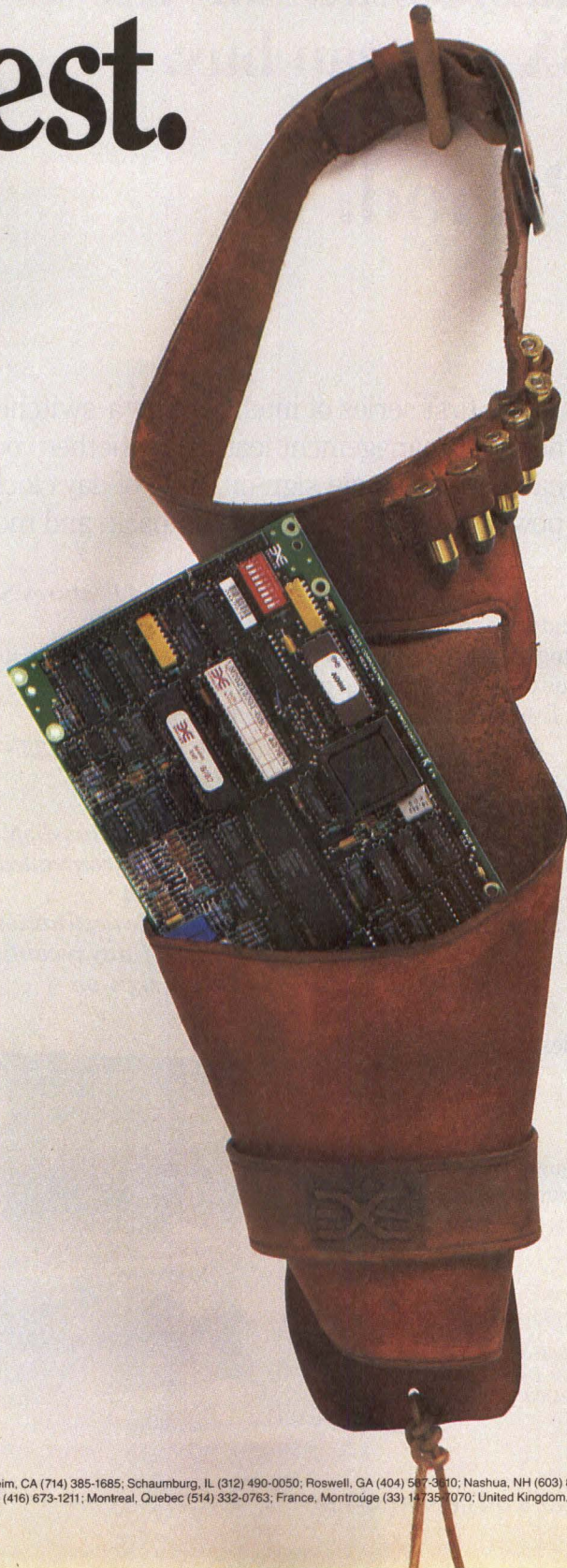
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LOGICAL BLOCK SIZE (Bytes)	256/512	256/512	256/512	256/4096	256/4096
CCS	N/A	N/A	NO	YES	YES
ECC	16-Bit CRC	16-Bit CRC	48-Bit	48-Bit	48-Bit
DRIVE INTERFACE SPEED	90 KBYTES	90 KBYTES	Up to 24 Mbits	Up to 24 Mbits	Up to 24 Mbits
DRIVES SUPPORTED	QIC-36 Type	QIC-44 Type	ST506	ESDI	ESDI

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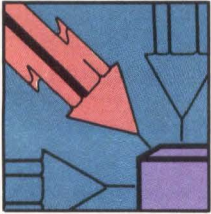
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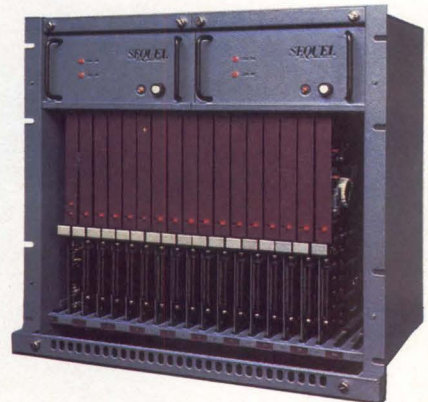
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- *Time-of-day reconfiguration*
- *Single sign-on*



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CIRCLE NO. 6 ON INQUIRY CARD

EDITORIAL



RIGID-DISK DRIVE INDUSTRY REBOUNDS

Devastated by the personal computer industry slump of the last year, manufacturers of 5¼-inch rigid disk drives have recently reversed their business climate.

According to a "Peripheral Periodical," authored by James Stone, a research analyst at New York's Shearson Lehman Brothers Inc., sales revenues for the eight leading vendors of rigid-disk drives (i.e., Iomega Corp., Maxtor Corp., Micropolis Corp., MiniScribe Corp., Priam Corp., Quantum Corp., Seagate Technology and Tandon Corp.) totaled \$401 million for the March 1986 quarter. This figure translates into a 65 percent gain over last year's \$305 million first quarter and an 18 percent increase over the December 1985 quarter's \$340 million value.

And several manufacturers have generated their outstanding financial results by addressing niche products and markets. For example, Micropolis experienced a 40 percent sales gain, mostly in the high-capacity 85M-byte drive market. Seagate jumped up 26 percent, which involved selling 20M-byte half-height aftermarket drives to value-added resellers and to value-added dealers. Maxtor leaped ahead by 23 percent from selling rigid-disk drives with capacities greater than 100M bytes. Tandon saw sales rise by 23 percent, mostly from European personal computer business. And MiniScribe moved upward by 14 percent via the sale of 50M-byte drives.

Sales figures are important, but earnings are more meaningful fiscal indicators. Not surprisingly, most suppliers showed significant quarterly increases in profits: Seagate, 152 percent; Tandon, 132 percent; MiniScribe, 90 percent; Micropolis, 66 percent.

And rigid-disk-drive sales should remain brisk throughout 1986. Revenues for the industry leaders for the June quarter are projected at \$419 million, up 4 percent over the previous quarter, but 47 percent greater than last year's quarter. Earnings are predicted to reach \$39 million, a staggering 325 percent above 1985's figure.

In stark contrast, just a year ago, 5¼-inch

rigid-disk-drive makers were sales-starved. But then, says Stone, three factors contributed to the industry's colossal turnaround.

First, the increasing use of personal computers continues unabated. Business personal computer unit shipments are moving at a 15 percent to 20 percent growth rate this year. More important, though, the number of personal computers shipped with installed rigid-disk drives has increased markedly.

Second, a personal computer aftermarket has emerged. Presently, some 3 million to 5 million flexible disk-drive-based systems are installed. These systems represent a potentially lucrative upgrade path to higher capacity rigid-disk drives.

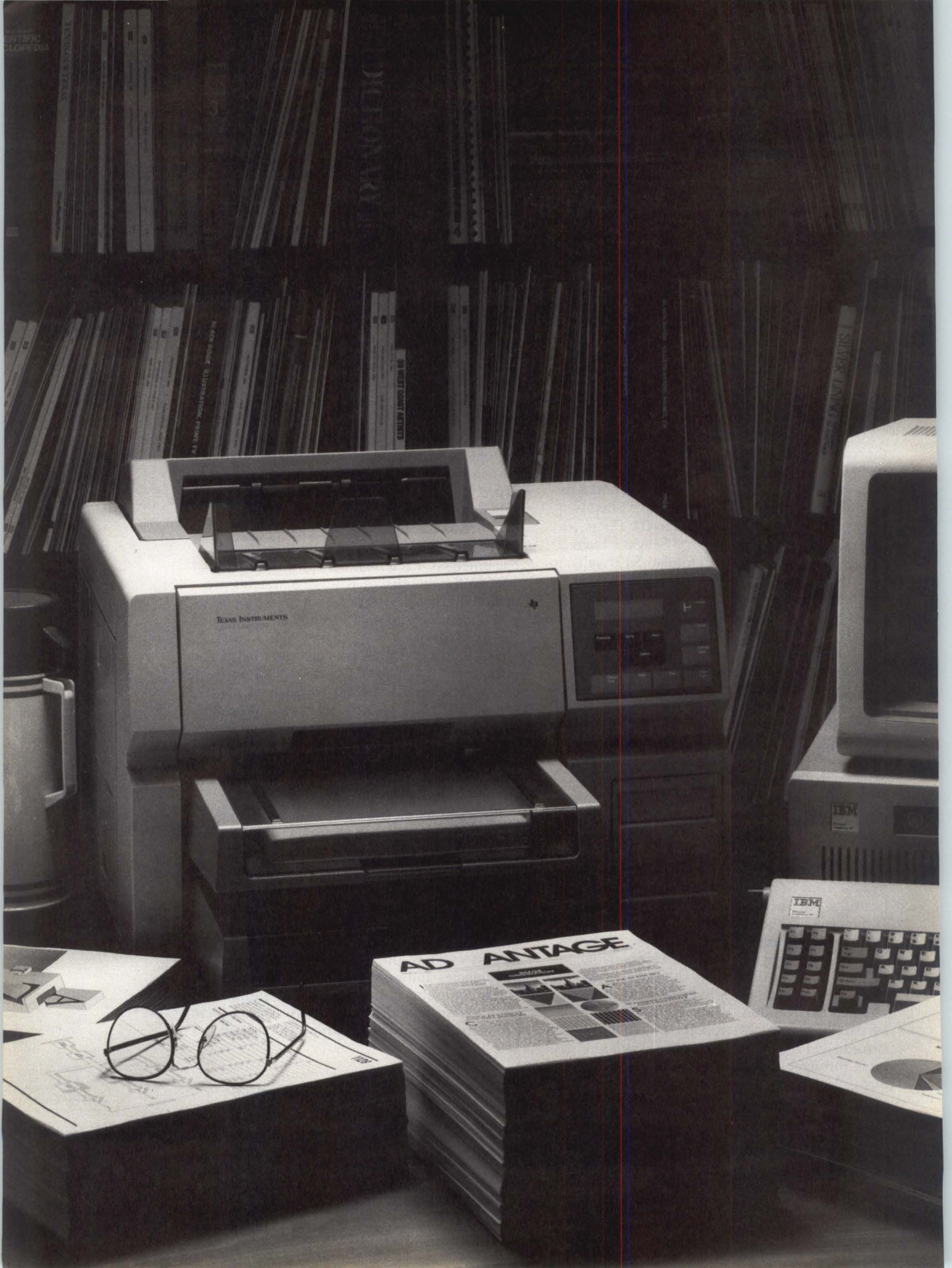
Third, 8-inch rigid-disk drives are being replaced by 5¼-inch units. Virtually all new computer systems, such as file servers; multi-user, multitasking microcomputers; and engineering workstations, are incorporating 5¼-inch, 40M- to 85M-byte rigid-disk drives. In 1985, shipments of these products were valued at \$150 million; in 1986, shipments should exceed \$400 million.

But what about the most important company influencing the rigid-disk-drive market—IBM? What most concerns the disk-drive industry are IBM's pricing tactics, possible new drive proprietary interfaces, and 3½-inch rigid-disk-drive policies.

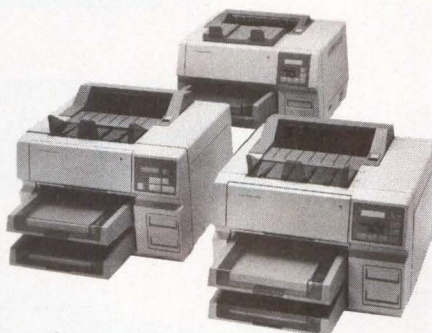
Nevertheless, rigid-disk-drive vendors unanimously agree that the industry has learned its lessons well and profited from past product deficiencies and poor marketing strategies. Other computer industry segments should similarly analyze their situations, correct their problems and provide products that satisfy users' needs.

A handwritten signature in cursive script that reads "George V. Kotelly".

George V. Kotelly
Editor-in-Chief



TI's new OmniLaserTM page printer can turn your PC into a desktop publishing system.



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The OmniLaser Series 2000 family from Texas Instruments is available in three desktop models designed to address workstation and shared-resource environments at 8 and 15 pages per minute, respectively. Both the 2108 and 2115 feature the

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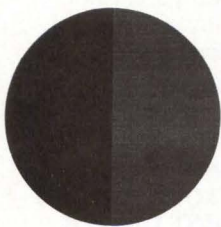
TI OmniLasers and the power of PostScript.

PostScript is the page-description language that drives OmniLaser Model 2108 and 2115 printers to their full

capabilities, including rotated type, textures, patterns, halftones, images in any size and shape, and a wide variety of typefaces. Each font has one definition that is used as the basis for any point size. You have complete control over the size and positioning of your text and graphics. PostScript also has built-in commands for point specification, circular arcs, curves, etc. You can perfect your text and graphics on your OmniLaser and PC, and then take your original to a high-quality production facility and skip all the headaches of mechanical assembly. Whether you're composing newsletters, product data bulletins, ad proofs, business presentations, technical manuals, or any type of document, you'll find that with the power of PostScript, you are only limited by your imagination.

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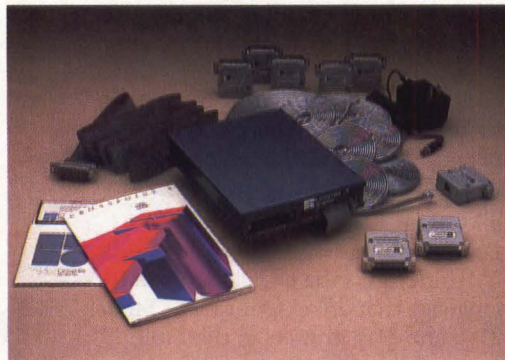
The Crosspoint 8 package includes all necessary hardware to interface PCs and peripherals—like easy-to-connect data phone jacks and cable. Compatible with IBM and other PCs, it allows file transfer, LAN, and simultaneous user access. Add peripherals or

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BREAKPOINTS

SCORING 5¼-INCH WINCHESTERS: MAXTOR 760M BYTES, OTHERS 380

Maxtor Corp. has again redefined the upper reaches of the market for 5¼-inch rigid disk drives with a 760M-byte model. The San Jose, Calif., manufacturer has just begun shipping evaluation units of its EXT-8760 to system integrators. When the drives go into production next year, Maxtor expects they will sell for about \$3,000 in OEM quantities. Maxtor reached 760M bytes by increasing track and recording densities. Meanwhile, Priam Corp., also of San Jose, and Micropolis Corp., Chatsworth, Calif., have both begun shipping sample units of 5¼-inch drives in the 380M-byte range. All three companies plan to make their drives available with either SCSI or ESDI interfaces.—*Mike Seither*

DEC DEFENDS VAXMATE'S PRICE TAG

The price of the eagerly anticipated VAXmate desktop microprocessor unveiled by Digital Equipment Corp., Maynard, Mass., caused some eyebrows to go up. The IBM Corp. PC/AT-compatible costs \$4,045, but DEC says a comparably equipped PC would cost at least \$6,000. VAXmate, which can run MS-DOS software, is powered by an 8-MHz Intel Corp. 80286 processor. At the same time, DEC announced PC All-In-1, an \$81,161 "packaged" hardware/software system which uses a VAX as server to join in an office network up to 30 DEC microcomputers, VAXmates, IBM PCs and clones. The price includes a MicroVAX II for the server.—*Jim Donohue*

BUBBLES SURFACE AT INTEL, HITACHI

Intel Corp., Folsom, Calif., recently introduced the iPCB-76 PC-Bubble Card, a memory-expansion board that fits into an IBM Corp. PC, PC/XT or PC/AT slot. The card packs 512K bytes or 1M byte of non-volatile storage using one or two 4M-bit bubble-memory devices, and an EPROM-based I/O driver that ensures compatibility with MS-DOS and PC-DOS. Prices are \$795 and \$1,445 in quantities of 100. Meanwhile, Hitachi America Ltd., Schaumburg, Ill., spearheaded its surge into the U.S. bubble-memory market with a small (40-by-44-by-9-mm), 4M-bit device—the PFC (Picture Frame Coil). The PFC is the first bubble-memory device to be hermetically sealed to improve reliability. Hitachi expects to be first to market with 16M-bit devices, which it will sample in mid-1987.—*Dave Simpson*

SONY READIES OEM VERSION OF MULTISYNCH TERMINALS

Sony Corp. of America has joined a growing number of suppliers making multiple-frequency PC monitors that handle the three IBM Corp. graphic standards: the Color Graphics Adapter (15.75 kHz), Enhanced Graphics Adapter (21.85 kHz) and Professional Graphics Adapter (30.5 kHz). Sony's component-product division, San Diego, plans to ship two such models in November. The CPD1390, with a 0.25-mm dot pitch, costs about \$750. The CPD1291, with a 0.37-mm dot pitch, runs about \$700. The two monitors

can ultimately be driven to resolutions of 900 by 560 pixels. NEC Corp., JVC Information Products Co. and Mitsubishi Electronics America Inc. also make multisynch devices, which allow the use of different graphics adapters without changing monitors.—*Mike Seither*

SOFTWARE LINKS PC APPLICATIONS TO DEC COMPUTERS

Look for shipments in November of software to link applications programs for the IBM Corp. PC and compatibles to Digital Equipment Corp. computers running either the VMS or ULTRIX operating systems. The program, called Multiplex, was developed by Network Innovations Corp., Cupertino, Calif. Since the first of the year, Network Innovations has supplied Multiplex to a number of manufacturers, including Altos Computer Systems, Convergent Technologies Inc. and NCR Corp. whose computers run UNIX. Multiplex resides on both the host and the PC and converts downloaded data into popular formats, such as Lotus Development Corp.'s 1-2-3 and Ashton Tate's dBASE, for personal computers.

—*Mike Seither*

WYSE-COMPATIBLE IBM TERMINAL PROMPTS PRICE CUTS

Wyse Technology has cut the price of its WY-50 ACSII terminal by \$100 to \$499. According to Wyse officials, the move is partly in response to IBM Corp.'s recent introduction of the 3162 Display Station. The 3162, priced at \$645, uses optional cartridges to emulate a number of other terminals, including the popular WY-50 and Digital Equipment Corp.'s VT220. IBM charges an additional \$50 for the WY-50 emulator. Under the former pricing structure, a \$100 difference was too close for Wyse's comfort, says a company official. The San Jose, Calif. company also trimmed pricing on its WY-350 color terminal from \$1,195 to \$999.—*Mike Seither*

DATAPRODUCTS SOLIDIFIES INK-JET PRINTING

A new solid ink-jet printer from Dataproducts Inc., Woodland Hills, Calif., is expected to be available in November. Priced under \$3,000, the printer will emulate the IBM Corp. Quietwriter II and print up to 400 characters per second in near-letter-quality mode with a 240-dot resolution. For high-quality (240 by 480 dots) solid-font-level output the unit slows down to 200 cps. The printer uses solid ink that is heated on drop demand and shot at the paper where it solidifies on impact. The print effect is similar to high-quality embossing.—*Carl Warren*

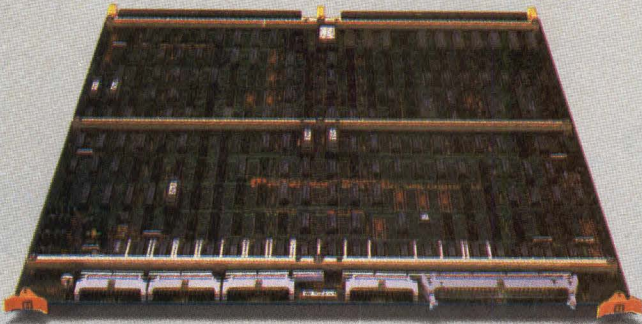
TOSHIBA EXTENDS PC STORAGE CAPABILITY WITH 3½-INCH ADD-IN

Users of laptop computers that have 3½-inch, double-density, double-sided (740K bytes) flexible disk drives will, beginning this month, be able to solve interchanges to and from 5¼-inch disks with a \$150 add-in drive from Toshiba America Inc., Tustin, Calif. The model ND354A 3½-inch disk drive kit comes with a bezel mount that allows the drive to be installed in a one-third height, 5¼-inch slot and plugged into the existing flexible disk controller, permitting users to read and write 3½-inch disks.

—*Carl Warren*

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Our **Solid State Disk** system offers ultimate performance — up to 20 times faster than conventional disks. No special drivers or software modifications are required for OS/32 or XELOS, so installation is easy. The SSD uses our standard 3200 series memory modules, supports up to 268MB, and can be dual ported.

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One of the most significant developments in IBM ASCII terminals is the one you may never use.

**Announcing an IBM first:
the three-year ASCII
terminal warranty.**

Here's how it works.

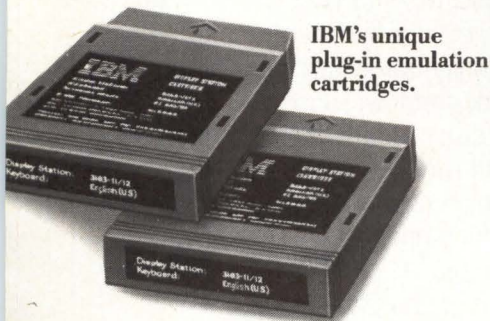
Should you have a problem with any of the three elements* of an IBM ASCII terminal purchased after June 15, 1986, just take the problem element to any

IBM Service Exchange Center or IBM authorized remarketer.

They'll exchange the non-working element for one that works. So you'll be on your way with a minimum of downtime.

How will you know which element isn't working properly? Our built-in diagnostics let you know quickly.

Of course, all this may well be academic. For given the reliability that's built into every IBM ASCII terminal, the three-year limited warranty is one feature you'll probably never need.



IBM's unique plug-in emulation cartridges.

Emulation	3161	3162	3163	3164
ADDS Viewpoint	X	X		
DEC VT220/100/52		X		
DEC VT100/52			X	
DEC VT220 w/Hot Key/3708		X		
Hazeltine 1500	X	X		
Lear Siegler ADM-3A	X	X		
Lear Siegler ADM-5	X	X		
TeleVideo 910, 910+, 912, 920, 925, 925E	X	X		
TeleVideo 950			X	
WYSE 50/50+		X		
IBM 3101	X	X	X	X
Enhanced IBM 3708 Attachment	X			

**Introducing the 132-column
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But our three year warranty isn't the only significant development in IBM ASCII terminals.

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It features a crisp, clear, readable 7 x 12 character matrix.

And it's available with our new amber-gold 14-inch screen. Or our new green 14-inch screen. Your choice.

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Our exclusive plug-in Emulation Cartridges allow all our ASCII terminals to operate in the most widely-used data streams. (Including the DEC VT 220 and WYSE 50+.) So that instead of changing terminals, you merely change cartridges.

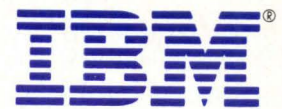
And, in addition to their changeable personalities, all IBM ASCII terminals share another trait. The ability to operate in their own function-rich native mode.

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Neither is the availability of financing from IBM Credit Corporation. Or the quality and support you'd expect from IBM.

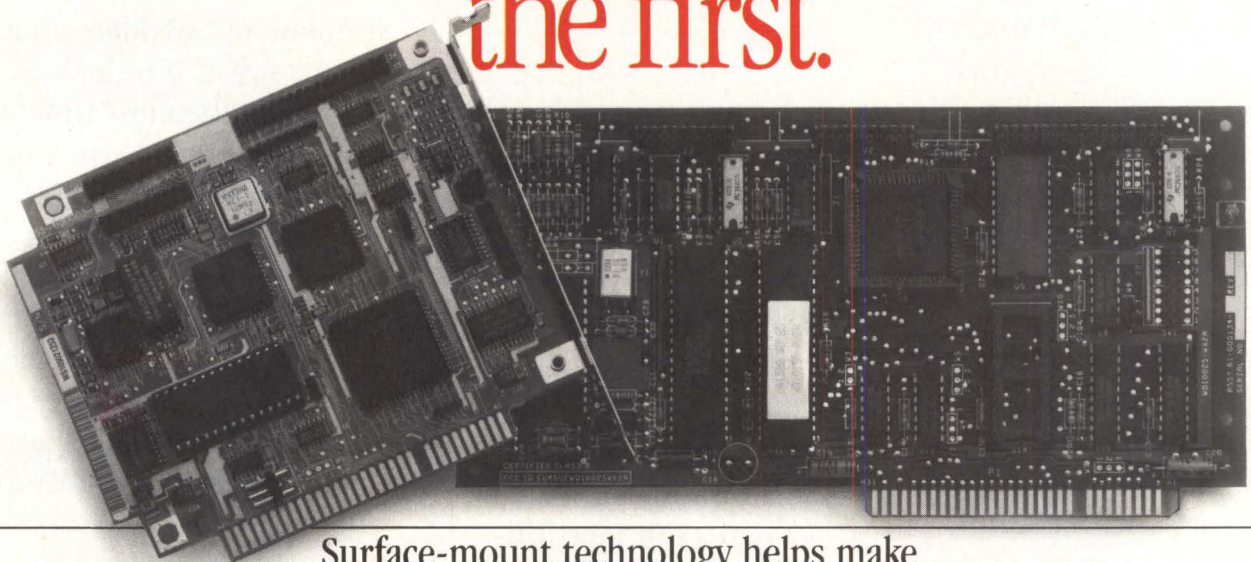
For more information, contact IBM or your marketing representative. Or call 1 800 IBM-2468, Ext. CM/96 for the IBM authorized supplier nearest you.



This limited warranty applies only to ASCII terminal models 3161, 3162, 3163 and 3164 purchased from IBM or an authorized IBM supplier in the U.S. and Puerto Rico. A 3-month limited warranty is also available. For more information on the warranty, contact your authorized IBM supplier.

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Our success has been marked by a stubborn refusal to ever leave well enough alone. So we've taken our best-selling controller and changed it. For the better.

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CIRCLE NO. 10 ON INQUIRY CARD

CORTEX THINKS PICTURE PROGRAMMING

Cortex Corp., Waltham, Mass., announced this month a graphically oriented user interface for its business-application generator, the Applications Factory, which runs on Digital Equipment Corp. VAX-class machines. The new product, named CorVision, will run on the IBM Corp. PC and compatible machines and interactively link with the VAX-based Factory. With it, a system analyst can specify tasks with icon-like pictures, download the icons to the Application Factory and rapidly produce debugged, workable fourth-generation language code. Moreover, the Factory can update CorVision to reflect changes in code resulting from long-term maintenance. The CorVision could thus rival such products as DEC's own COBOL generator. —*Michael Tucker*

ORACLE SIGNS OVER MARKETING RIGHTS TO AT&T

Oracle Corp., Belmont, Calif., has signed a marketing agreement with AT&T Co. for its standard query-language-based relational database management system, fourth-generation language tools and decision-support software. AT&T is expected to market Oracle's products with its 3B mini-computer series, the AT&T PC 6300 and the UNIX PC. Under the OEM agreement, AT&T has obtained non-exclusive worldwide rights to the Oracle products only for current AT&T computers. The agreement follows two recent OEM agreements with IBM Corp. to market Oracle's SQL DBMS and other products on the IBM's RT PC and System 88 product lines.

—*Stephen Shaw*

TEKTRONIX DEBUTS LOW-COST COLOR GRAPHICS TERMINALS

Look this month for Tektronix Inc.'s new 4200 Series of intelligent color graphics terminals starting at \$2,495, less than half the price of the Tek 4107 Computer Display Terminal. The Beaverton, Ore., company expects that the price-performance ratio of the terminals will make the Tektronix graphics standard more accessible to users involved in applications such as computer aided design previewing, 2-D drafting and data analysis.

—*Megan Nields*

FUJITSU AMERICA TO PREVIEW HIGH-CAPACITY DISK DRIVES

Fujitsu America Inc., San Jose, Calif., expects to preview several high-capacity disk drives at Comdex Fall. The M2505 is a 5¼-inch write once, read many optical disk drive. The enhanced-small-device-interface drive with 600M-byte capacity uses two lasers to ensure read accuracy and features a small computer systems interface bridge. The M2344 8-inch Winchester drive, with SCSI and storage module device interfaces, stores 690M bytes. The company will introduce a series of 40-msec, 3½-inch Winchesters, models 2226, 2227 or 2228 depending on capacity (25, 38 or 51M bytes). —*Carl Warren*

THREE NEW SERIAL MATRIX PRINTHEADS SET SPEED RECORDS

Serial matrix printhead designs which claim rep rates of 2 kHz or higher have been announced by two European and one American company: Seitz S.A. of Switzerland (contact the U.S. distributor, American Laubscher, Farmingdale, N.Y.); Russet Instruments Plc, Reading, England; and Sanders SCI, Wilton, N.H. Rep rates of 2 kHz means that printing speeds in serial matrix printers could double in future products. SCI claims that a 24-wire version of its Intra-Dot Scanning printhead can produce up to six pages of letter-quality text per minute. C. Itoh Electronics Inc., Los Angeles, licenses printhead technology developed by Sanders SCI.

—*Jim Donohue*

CLEARPOINT SUN-COMPATIBLE CARD FURNISHES 12M BYTES

Clearpoint Inc., Hopkinton, Mass., has introduced SNXRAM, the first 12M-byte Sun 3-compatible memory card that, coupled with the system's 4M bytes, delivers a full 16M bytes of address space using a single slot. SNXRAM replaces up to three Sun Microsystems Inc. memory cards and frees two VMEbus slots for expansion. It has an OEM price of \$4,905.

—*Megan Nields*

MICROCOMPUTER BREAKS PRICE BARRIER

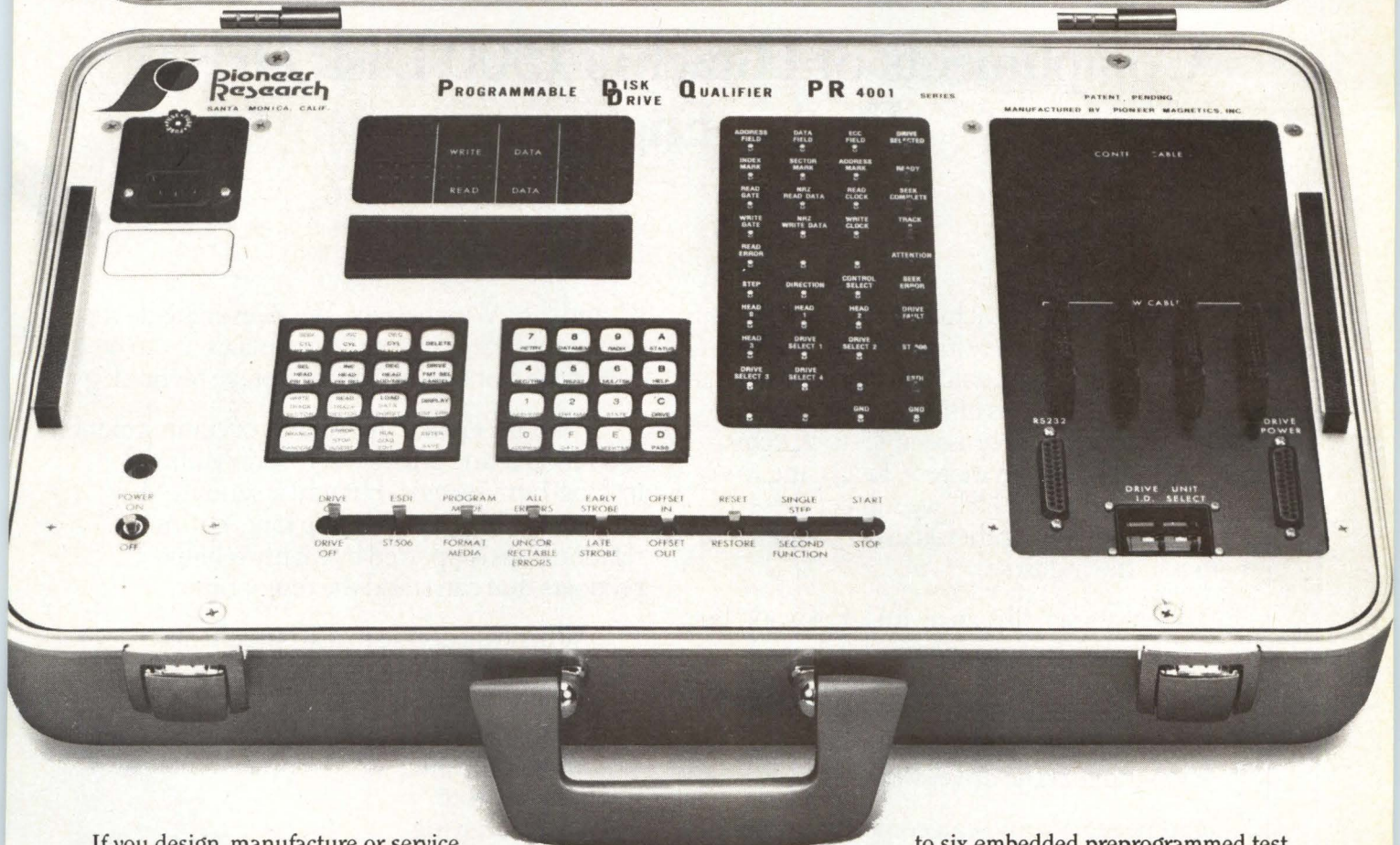
A microcomputer with everything needed to hook into a local area network at a price of \$600 (for machine and interface) should be available by January. The cost is said to be about \$300 less than anything comparable on the market today. The monochrome display computer, designed by Santa Clara Systems Inc., Santa Clara, Calif., is being built by Hyundai Electronics of Seoul, Korea. It will run under the NetWare operating system of Novell Inc., Orem, Utah. Preliminary reports say the unnamed diskless computer will contain 512K bytes of RAM and operate with an Intel Corp. 16-bit 8088 microprocessor with a clock speed of 4.7 MHz.

—*Jim Donohue*

WELTEC PUTS PC/AT STORAGE ON PC AND PC/XT SYSTEMS

For \$149 or \$99, end-users and system integrators can buy the Weltec Digital Inc., Irvine, Calif., model M16-P12, a 1.2M-byte, IBM Corp. PC/AT-compatible flexible disk drive for use on PC and PC/XT systems. The good news is that the drive can use the existing PC or XT controller. This is because the M16-P12 maintains a constant wavelength—i.e. constant linear velocity (CLV)—by changing the spindle speed as the drive steps every 10 tracks, thus maintaining the bit-packing density and transfer rate expected by 360K-byte disk controllers. The marketing goal, according to company president Philip Harding, is to allow users with older machines to read and write AT-compatible disks. —*Carl Warren*

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One size tests all.

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The PR4001 monitors and diagnoses drive problems. And all the readouts are in English. It pin-points errors to a specific media sector or byte. And can rerun tests continually to find intermittents in the output. It works with dedicated or embedded servos. Can test four drives at once. Operates remotely using a standard terminal and modem. And even gives you instant readout of drive configuration and unique vendor codes.

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A serious, historic commitment to the disk drive business.

Hitachi's involvement with memory peripherals goes back to the earliest days of mag tape. We still produce mag tape equipment. And, today we have one of the broadest lines of disk drives you'll ever find—including 3.5", 5.25",

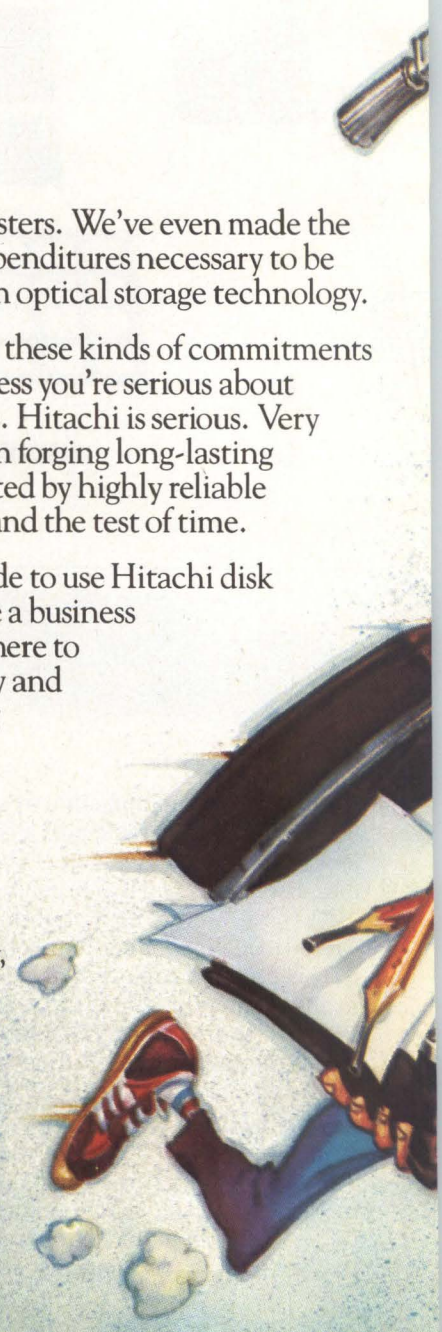
8", and 8.8" Winchesters. We've even made the enormous R & D expenditures necessary to be one of the pioneers in optical storage technology.

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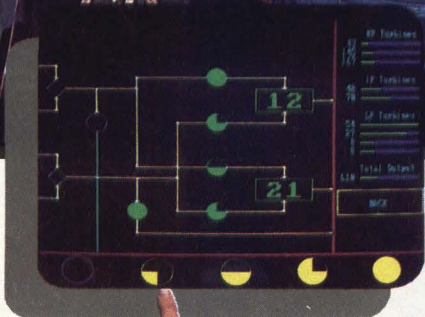
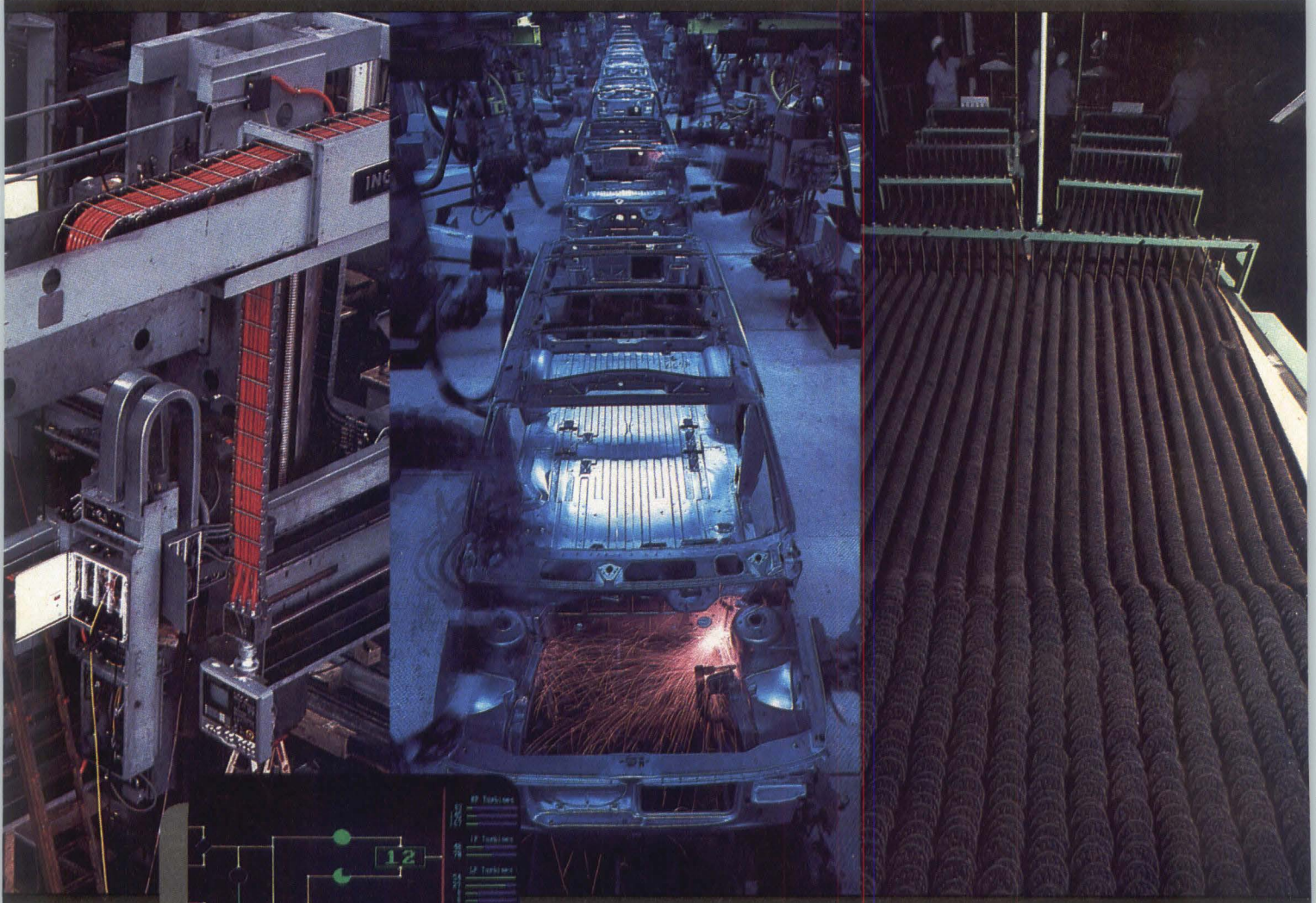


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CIRCLE NO. 13 ON INQUIRY CARD

INTERPRETER

Vendors fire first salvo of products for Intel's 80386

Mike Seither

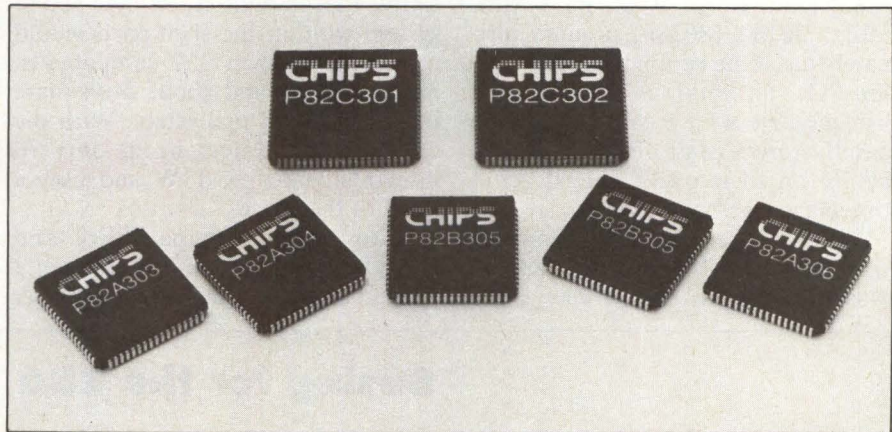
Associate Western Editor

The 80386, an intangible in a welter of speculation within the industry ever since Intel Corp. announced the 32-bit chip a year ago, is finally beginning to manifest itself in product reality.

In recent weeks a few of the 150 vendors whom Intel claims are evaluating the microprocessor have tipped their hand. Products aimed directly at OEMs, system integrators and software developers run the gamut from chips, workstations and network servers to supercharged add-in boards and full-blown desktop units—all compatible with the IBM Corp. PC/AT and lookalikes. As Comdex/Fall nears, more announcements are expected. Developments to date:

- Chips and Technologies Inc. has begun shipping samples of an AT-compatible seven-chip set for the 80386, with production set to commence in January. The AT386 CHIP-Set ought to produce numerous offspring, if the past performance of the Milpitas, Calif., semiconductor outfit is any indicator. When the company introduced an 80286 chip set last year, clone manufacturers jumped all over it as a way to get AT compatibles to market quickly and cheaply. The chips handle address and data functions for the 80386, as well as memory and bus control. Company officials say the high level of integration should help manufacturers bring products from the drawing board to market in as little as two months, compared to the normal nine months to a year. Chips and Technologies is quoting prices of \$210 in quantities of 100 and \$130 for 5,000.

- The first system-level 80386



Chips and Technologies has integrated more than 250 components into its seven-chip set for 80386-based PC/AT-compatible systems. A few vendors will show PCs and workstations designed around the chip set at Comdex/Fall.

products out of the chute came from Corvus Systems Inc., San Jose, Calif. The Series 386 can be configured as either a workstation or file server. Pricing ranges from \$13,000 to \$20,000, depending on mass-storage options. Servers come bundled with Novell Inc.'s local area network software.

- Houston-based Compaq Computer Corp. is also targeting technical workers with its recently introduced Deskpro 386. The workstation ranges in cost from about \$6,500 to \$9,000 and is touted as having three times the punch of the PC/AT (see "Compaq casts off clone label with its Deskpro 386," Page 28).

- Intel is readying two board-level products at its Hillsboro, Ore., plant to help manufacturers speed up development. One, the 386 PC, is a motherboard replacement for AT compatibles. Big OEMs evaluating the board include Data General Corp., Harris Corp. and Wang Laboratories Inc.

Intel is also producing a 16 Mhz 80386 accelerator card that fits inside an AT expansion slot. With piggyback boards it can hold as much as 3M bytes of memory.

- American Computer & Peripheral Inc., Santa Monica, Calif., has just made available to software developers its inexpensive 386 Translator. The \$895 board (\$395 without the 80386 chip) is also AT compatible.

- In November, AT&T Co. is expected to certify the UNIX System V Release 3 for the 80386. Intel, which contracted out the port to Interactive Systems Corp. of Santa Monica, Calif., says that more than 40 OEMs are now beta testing the operating system for 80386 applications.

All this activity has taken place without any signal from IBM about its plans for the 80386. And that's come as a surprise to some industry observers, who had predicted vendors would wait for IBM to move first. Conventional wisdom has it that IBM

will market an 80386 machine with some kind of proprietary design in order to lock out the clone manufacturers, who have cut so deeply into Big Blue's PC sales.

But that argument doesn't seem to carry much weight anymore. Most analysts agree it would be difficult for IBM to abandon a standard that has become so entrenched.

Says Michael Gross, director of semiconductor research for International Data Corp. West, Palo Alto, Calif.: "IBM's [80386] product ultimately has to be compatible with earlier PCs. So what, if they replace discrete logic with a chip most clone manufacturers can't afford to manufacture on their own? They'll get it someplace else."

With the presence of a company like Chips and Technologies, Gross adds, there is no reason why clone

manufacturers cannot stay in lockstep with, if not ahead of, whatever AT-compatible design IBM comes up with.

Chipping away at circuits

With its AT386 chip set, for example, Chips and Technologies claims it achieves as much as four times the performance of the AT-type machines. The company's product marketing manager, Sikander Naqvi claims that to build a 1M-byte 80386 system with off-the-shelf parts would require more than 350 components, 50W of power and about 240 square inches of board real estate. With the chip set, the system needs only 70 integrated circuits, 11W and uses a third of the space.

With its AT compatibility and enough horsepower to run between 3 million and 4 million instructions per

second (MIPS), Naqvi believes the 80386 cannot be ignored by workstation vendors. "If you have a 386 machine selling for half as much as a [32-bit Motorola Inc.] 68020, you're going to look at it, even if you don't care for DOS," says Naqvi.

Intel designed the 80386 to operate in two modes. In the "real" mode, it is bit-compatible with 8086/88 processors, which is to say the addressing mechanism, segment size and interrupt structure are identical. This will allow the 32-bit chip to continue to run the estimated \$6 billion worth of application software now in use on PC-, XT- and AT-compatible machines.

But the real potential for the 80386 is in its protected mode. There, the processor can directly address 4 billion bytes of physical memory and up to 64 trillion bytes of virtual memory.

Busing for the 386

Companies planning to employ the 32-bit Intel Corp. 80386 microprocessor face a set of problems: maintaining compatibility with existing PC/AT systems, creating a way of handling 32-bit transfers without inhibiting the functionality of the base AT and devising some compromise that provides full compatibility and still insulates their designs from IBM Corp. influences.

To this end more than 40 companies have banded together to form an *ad hoc* industry committee called the Personal Computer Extended Technology Bus Committee (PCET) to develop a draft specification to allow developers to create new generation machines.

Specifically, PCET is preparing a draft standard for developers working with extended technology designs (scheduled for release at Buscon/86-East in Woburn, Mass.). "Although the original goal of PCET was to develop 32-bit extensions for the AT bus, it quickly became evident that the industry wanted codification of the AT bus and extending the bus to 32 bits was of secondary importance," says a committee spokesman. Consequently, he says, the PCET draft proposal will define specifications for the AT bus operating at 8 Mhz, with appendices that offer suggestions to extend the bus to 32 bits.

Among the additions being proposed is the burst mode. This mode will allow faster transfers without multiple arbitrations. Rather, there is one arbitration phase and multiple transfers.

Extending the bus to 32 bits, however, is more complex. And several companies, including AST Research Inc., Irvine, Calif.; AT&T Co., Morristown,

N.J.; Bull Micral of America, Roseville, Minn.; Chips and Technologies Inc., Milpitas, Calif.; Faraday Electronics Inc., Sunnyvale, Calif.; NCR Corp., Liberty, S.C.; Olivetti Advanced Technology Center Inc., Cupertino, Calif.; Phoenix Technology Ltd., Norwood, Mass.; Quadram, Norcross, Ga.; Western Digital Corp., Irvine, Calif.; and Xerox Corp., Sunnyvale, Calif., are all working on defining the specification.

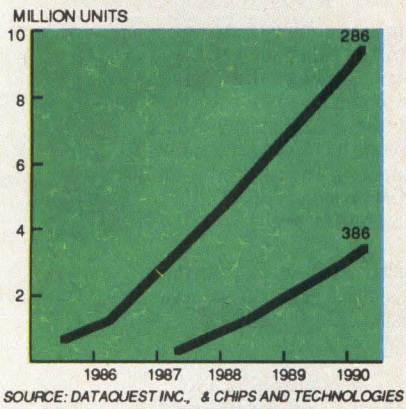
PCET wants to ensure that the 32-bit extended-technology bus will work with a host of processors including the Motorola Inc. MC68020 and the National Semiconductor Corp. NS32000 series, while maintaining AT signal compatibility. To this end, extended-technology bus architects have elected to employ techniques similar to those used by IBM in the RISC (reduced instruction set computer) technology-based (RT PC) system.

Besides adding additional address and data lines, the specification defines the mechanical aspects including the additional extended-technology connector and the proper ET add-in board geometries.

Electrical and mechanical aspects aside, PCET is also dealing with the necessary bus protocols and byte-to-word transfers relative to different memory types. The committee is considering establishing a 16-bit or 32-bit bus master definition and determining the transfer based on that. According to a spokesman, "There doesn't appear to be a need for 8-bit masters and our concern is really with next generation extended systems."

—Carl Warren

**HOW 80386 SYSTEMS
WILL FARE AGAINST
AT COMPATIBLES**



out before the end of the year, lets a single DOS application run under UNIX. A multitasking version will be

available in the first quarter of 1987, according to Phoenix officials.

Meanwhile, Softguard Systems Inc. is staying away from UNIX with its 80386 multitasking package called VM/386. The Santa Clara, Calif., company claims its "virtual operating system" takes up only 1M byte of rigid disk space, a fraction of that required by UNIX. Not only will VM/386 run different operating system at the same time—DOS 2.0 and DOS 3.2, for example—but it also will run the same application package in different virtual 386 machines. A database package could be printing a report in one virtual machine while running a sort in another. Softguard plans to market the package to OEMs who make 80386 systems and accelerator boards. □

system board with socketed expansion boards (each 4M-byte expansion costs \$2,699). The static RAM chips used by Compaq require fewer refreshes per cycle and, as a result, they speed processing. An optional Intel 80287 math coprocessor accelerates the Deskpro's number-crunching speed.

The onboard memory, managed by a software utility provided on the operating system disk, complies with the LIM standard, a specification promulgated by Lotus Development Corp., Intel and Microsoft Corp. that handles memory in the rarefied reaches above the 640K-byte limit of MS-DOS. The memory-management scheme also ensures compatibility with programs written to the specification: for example, Lotus 1-2-3 Release 2 and Autodesk Inc.'s AutoCAD version 2.5.

The model 40 has a 40M-byte, half-height fixed disk drive (access time under 30 msec), leaving room for another rigid disk drive or for a 360K-byte flexible disk drive. Model 130 forsakes these options in favor of one full-height, 130M-byte rigid disk drive (access time under 25 msec).

Because add-in memory nests on the system board, expansion slots are left free. There are five expansion slots on the model 130: two for the 16/8-bit board and three for the 8-bit board. The model 40 has six slots: three for each board. Each model is equipped with a 1.2M-byte flexible disk drive and a 40M-byte tape-cartridge drive backup (transfer rate 400K bits per second) with a write-to time of about 40 minutes and a 20-minute read time.

Accentuate the positive

But the real power behind the machine, the 80386 CPU, gives the Deskpro 386 "two to three times the performance of the (IBM) PC/AT," says Compaq.

Jeff Stives, Compaq's director of corporate relations, notes that Intel claims the 80386 chip (at a clock speed of 16 MHz) can spew out 4 million instructions per second with UNIX System V and 2 MIPS with XENIX System V/286 and the DOS operating system. But, he adds that Compaq is claiming only 2 MIPS,

Compaq casts off clone label with its Deskpro 386

Douglas Pryor, Senior Editor

Compaq Computer Corp. has exchanged its clone garb for '386 glad rags. Always sensitive to being lumped with other cloners of IBM Corp.'s family of personal computers, Compaq got the jump on Big Blue by beating it to market with a machine driven by what industry analysts are hailing as the next-generation microprocessor, Intel Corp.'s 80386.

Dubbed by Compaq insiders the "St. Estephe," after a Bordeaux wine, the Deskpro 386, a 32-bit workstation with a 32-bit bus, will sport another first for Compaq: an optional color display. But, no matter how colorful, being early in the 80386 sweepstakes may not be enough to loosen the purse strings of users and system integrators still scrambling to absorb iron. It will take a blend of cost-effective technology and solutions-oriented applications to attract customers—except for those few enamored of leading-edge technology.

The first Deskpro 386s off the assembly line come in two flavors priced from \$6,499 for the basic 40M-byte fixed disk drive model 40 to



The Deskpro 386, dubbed the St. Estephe, is Compaq's early entrant into the 80386 CPU arena. It is a 32-bit workstation with a 32-bit bus and comes in two models with a color graphics option.

\$8,799 for the 130M-byte model 130. Early production models were shipped with a new Compaq keyboard with separate cursor controls, numeric keypad and extra function keys.

Housed in 19.8-by-16.8-by-16.5-inch gray boxes, both configurations come with 1M byte of memory (expandable to 2M bytes by adding 100-nsec, 256K-byte static RAM chips). Up to 10M bytes can be added to the

"for the present."

The XENIX/DOS, published by Compaq under a license agreement with Microsoft, will give users true multiuser, multitasking capability. But a XENIX version that fully exploits the 80386 chip will not be available until the second half of 1987, according to a Compaq representative. Microsoft is presently selling software development kits for the future XENIX System V/386.

All this and color, too

Compaq maintains that its color graphics monitor (\$799), driven by an optional, \$599, enhanced graphics card, is compatible with IBM's EGA (enhanced graphics adaptor) and CGA (color graphics adaptor). It has a 640-by-350-pixel resolution and displays 16 colors out of a palette of 64. The monitor can be substituted for Compaq's Dual Mode Monitor with both text and graphics capability and a resolution of 720 by 350 pixels.

Given its menu of features and options—open stretches of memory, a UNIX derivative multitasking/multiuser operating system, math coprocessor, hefty fixed-disk capacity and high-resolution color monitor—the Compaq seems destined for niche, as well as general, markets. According to the company, those niches will include the engineering workstation and file-server markets.

Investigate the negative

Stives says of the Deskpro 386: "This is true engineering workstation capability in a workstation running DOS and XENIX. We say we're going to make severe inroads into the UNIX environment. We're targeting the person who says, 'I need more performance than I get with my AT.'"

Stives sees the Deskpro 386 as competitive with the AT, the IBM RT PC, the AT&T Co. PC 6300 or any other 80286-based desktop machine. Compaq also expects the Deskpro 386 to compete with offerings from Apollo Computer Corp., Convergent Technologies Inc. and Sun Microsystems Inc.

But, in the fiercely competitive engineering market, Compaq's hopes could be dashed by the dynamics of reality.

FACT FILE

Deskpro 386
Compaq Computer Corp.
 20555 FM 149
 Houston, Texas 77070
 (713) 370-0670
Circle 418

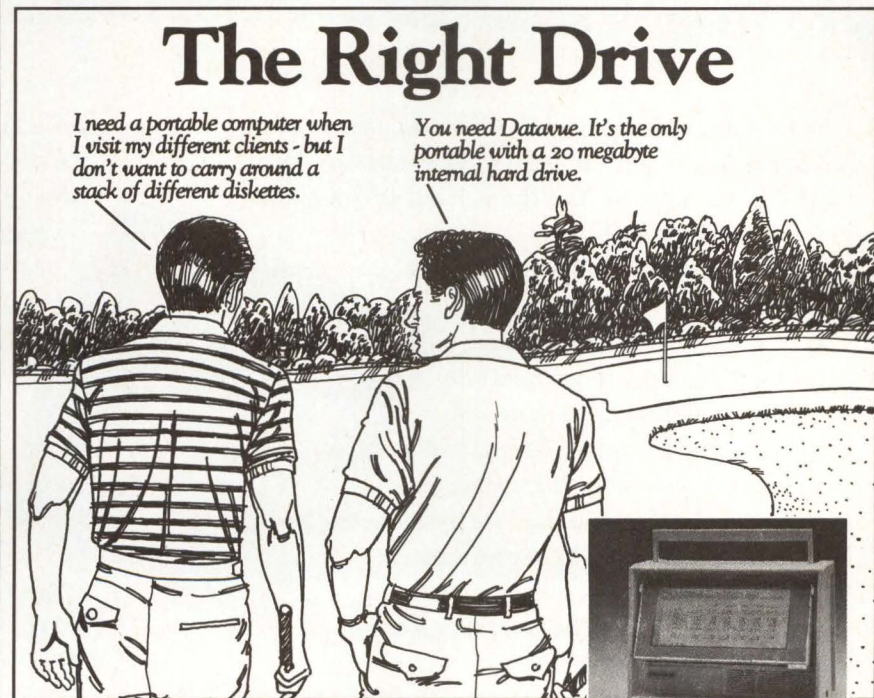
- *Intel Corp. 80386 CPU
- *32-bit bus
- *1M-byte memory, expandable to 2M bytes
- *1.2M flexible disk drive
- *40M-byte tape-cartridge drive
- *16 MHz
- *2 MIPS
- *Model 40: 40M-byte fixed disk drives or one 40M-byte drive and 360K-byte flexible disk drive
- *Model 130: 130M-byte rigid disk drive
- *\$6,499, model 40
- *\$8,799, model 130
- *Technical reference, \$179
- *Graphics technical reference, \$49

"Compaq's machine may steal a few seats at the very low end, the personal computer CAD/CAM [computer aided design/computer aided manufacturing] end, of the worksta-

tion market, but the system will not migrate upward," says engineering workstation watcher, Bruce Jenkins, editor with market-research publisher Daratech Inc., Cambridge, Mass. "It's just not ready to compete with the likes of Sun and Apollo either graphically or in systems software." Jenkins suggests that augmenting the brain of the Compaq 80386 with enough graphics brawn for demanding applications would make the system less than cost effective.

Compaq could find more receptive users and integrators in the file-server market. "What users want is a machine that can be both a file server and workstation at the same time," says Mitch Geier, president of Computer Education and Consulting Group, an Old Bridge, N.J., value-added reseller. "They don't want a computer dedicated to file service."

Although the Deskpro 386 fits Geier's profile, he and many users and integrators have profited from



The Right Drive

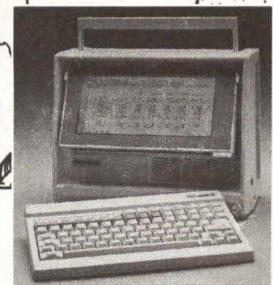
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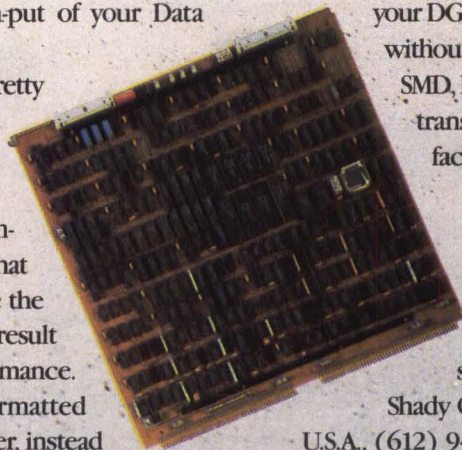
ARZ-1 isn't just another pretty interface. It is the most intelligent controller ever designed for the DG world. It acts as a co-processor, off-loading the data command functions from the CPU so that your MV can do other tasks while the controller manages the disk. The result is significantly faster system performance.

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CIRCLE NO. 18 ON INQUIRY CARD

other configurations. For example, PC/ATs and compatibles wired to fixed disks such as Maxtor Corp.'s 1140, supported by the AT basic input/output system, offer high performance for the dollar, according to Richard Glidewell, a Westminster, Mass., systems consultant.

"The 80386 chip is evolutionary, not revolutionary, because network and computer operating systems are still running in real mode," says Craig

Burton, vice president of corporate marketing and development at Novell Inc., Orem, Utah. Burton points out that software developers will now have to catch up with hardware. (see "Vendors fire first salvo of products for Intel's 80386," Page 25).

Until local area network software and computer operating systems offer efficiencies that no one can refuse, modified ATs and compatibles will remain strong competition.

But industry watchers know not to bet against Compaq. From deep in the heart of Texas, the Houston company has lassoed profits in the worst of times for the personal computer market. The company netted \$9,600,000 on gross sales of \$147,100,000 in the second quarter, the last period for which figures are available. Compaq reported a net of \$5,700,000 on sales of \$118,900,000 in the second quarter of 1985. □

Datacopy builds scanning system for desktop-publishing vendors

Mike Seither

Associate Western Editor

Datacopy Corp. has developed an image-processing system that it claims will bring to desktop scanners capabilities now found only in high-end machines.

The Mountain View, Calif., company, producers of scanners and digitizing cameras, plans to market the system, called PreScript, to software developers and hardware manufacturers selling publishing products for personal computers.

PreScript is a two-part product. First is a high-level language, which Datacopy sells to software developers working on desktop publishing programs. They embed the non-procedural imaging commands directly into their applications. The com-

mands cover the three basic processes of scanning: capturing the image as a bit map, modifying it for the target application (for example, scaling it for resolution or enhancing jagged edges on a line) and transforming the data into a final form (for example, text would be converted into ASCII

code).

The other half of the combination is a firmware interpreter that translates the commands for the processor doing the actual image processing. The Datacopy interpreter can be implemented with a conventional CPU, or with one of the new breed of pro-

FACT FILE

PreScript

Datacopy Corp.
1215 Terra Bella Ave.
Mountain View, Calif. 94043
(415) 965-7900

Circle 420

*Embedded high-level commands for scanning text, drawings and photographs in desktop publishing programs. Available to developers for a nominal fee.

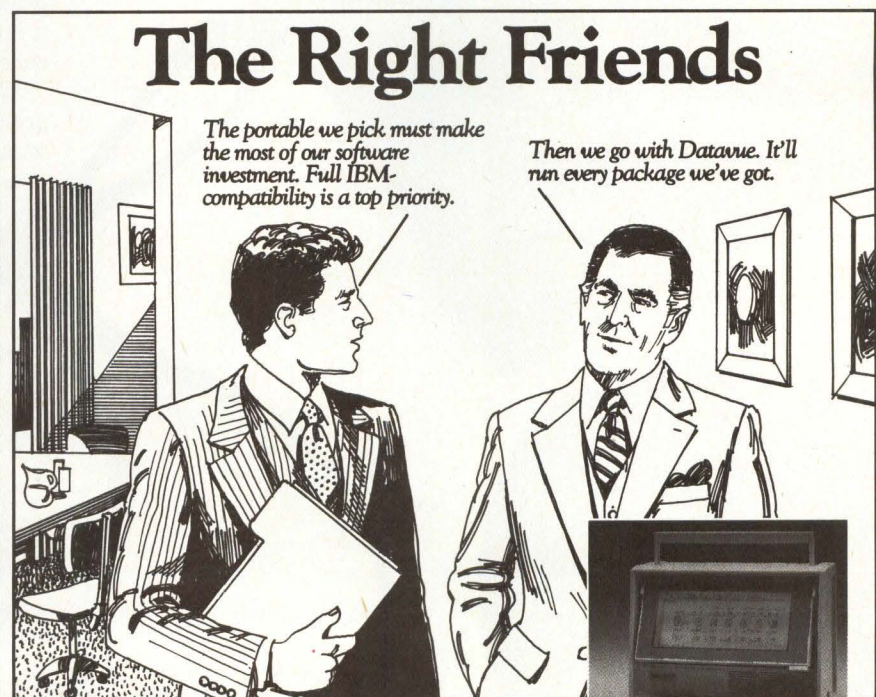
*Firmware interpreter, resident in scanner or other control device, executes PreScript commands in concert with image processor. Datacopy licenses firmware to hardware vendors.

*Choice of six algorithms for producing halftone patterns.

*Scan rate of 8 bits per pixel creates 256 levels of gray scale.

*Up to eight preset windows allow documents to be scanned selectively.

*Up-front licenses, between \$1,000 and \$2,000.



The Right Friends

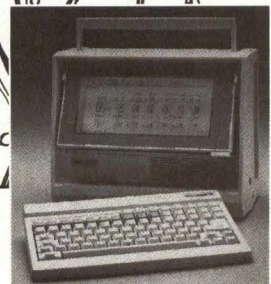
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CIRCLE NO. 19 ON INQUIRY CARD



To a scanner, gray is gray is...

Electromechanical eyes such as cameras or digital scanners rely on gradations of gray to provide contrast between one object and another, among objects in relief and within backgrounds.

Although a skilled photographer can use filters to adjust gray scale to manage shadows and image edges properly, capturing an image with a digital scanner is more complex. Typically, a scanner is a charged-coupled device that senses changes in light

but is unable to manage subtle shades of gray. However, by using better and movable lenses in the scanner and algorithms burned into the scanner's firmware each scanned pixel can be adjusted.

These adjusting algorithms essentially interpret how bright the light coming from the surface is, adjust the lens and store the pixel with the proper display attributes.

—Carl Warren

processors specifically designed for graphics applications—for example, Intel Corp.'s 82786 or Texas Instruments Inc.'s TMS34010.

Datacopy plans to license the firmware interpreter to scanner manufacturers, as well as to other interested vendors, who could design a coprocessor as an add-in card for personal computers or as a standalone image-processing box that connects to a host system.

Datacopy will charge an up-front fee of \$1,000 to \$2,000 for use of the firmware. The final licensing fees will vary depending on the number of units to be produced and the degree of functionality a manufacturer wants (for example, edge enhancement, scaling, halftoning algorithms). Look for more complete pricing information in November.

Datacopy officials say that PreScript will bring to desktop scanners capabilities typically available only in high-end dedicated devices costing \$30,000 and more. Intelligent scanners using PreScript could not only incorporate optical character recognition (OCR) for reading text but also convert graphics and continuous-tone art, such as photographs or rendered drawings, into gray scale information and halftones. (Halftoning is the process by which continuous tones—black-and-white photographs, for example—are converted into binary black and white information that printers can reproduce.)

Users define algorithms

PreScript will capture images at 8 bits per pixel, allowing for 256 levels of gray scale. Industry observers say that magazine-quality halftones show at least 64 levels of gray per halftone

dot. Although Datacopy provides six algorithms for halftoning, users may define their own. Resolution can be controlled at 100, 150, 200 or 300 dots per inch.

PreScript allows a document page displayed on a screen to be broken up into as many as eight segments, or "windows." Imagine a document that contains a photograph, a line drawing and text (see diagram). Information in each window can be captured in the most efficient or appropriate

way—as a halftone or gray scale or, for written material, in ASCII code.

In a database, the text portion could be used to find the document through a key-word search. Yet the whole document—drawings and text—would be a single file.

"The ability to intelligently isolate graphics, text or pictures is very important," says Ajit Kapoor, director of the electronic-publishing service for Dataquest Inc., a San Jose, Calif., market-research concern. "That's ul-

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Max Disk Storage*	80 MB	140 MB	280 MB	4.0 GB	4.0 GB	6 GB
Technology	10 MHz 68010 CPU	12.5 MHz 68020 CPU	12.5 MHz 68020 CPU	12.5 MHz 68020 CPU	25 MHz 68020 CPU	4x16.67 MHz 68020 CPU
MIPS	.75	2.0	2.0	2.0	4.25	8.8

*storage listed in unformatted capacities

Convergent

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PUTTING PRESCRIPT TO WORK SCANNING

PreScript commands

1 Device___Select___

What's executed

Loads maximum frame for device 1

1 Window___Select___

Selects window 1

10 10 200 200 Window___Frame

Set X and Y coordinates for window 1

2 2 Scaling

Doubles scale of image in window 1

Mask Halftone

Screens image in window 1

2 ___Window___Select

Selects window 2

40 40 300 300 Window___Frame

Set X and Y coordinates for window 2

0.5 0.5 Scaling

Halves scale of image in window 2

128 Mask Convolution

Enhance edges of image in window 2

3 Window___Select

Select window 3

200 100 145 300 Window___Frame

Set X and Y coordinates for window 3

Cour 10 OCR

Optically read 10-point Courier text

Scan

Scan entire document

The diagram shows a green rectangular area representing a screen. Inside, there are three distinct windows. The top window, labeled 'WINDOW 1 PHOTOGRAPH', shows a grayscale image of a human eye. The middle window, labeled 'WINDOW 2 LINE DRAWING', shows a simple line drawing of a printer. The bottom window, labeled 'WINDOW 3 TEXT', contains a block of text. To the right of the screen area is a text box with a white background and a black border, containing information about the scanner's capabilities and pricing.

Datacopy plans to demo own scanner based on Pr Comdex Fall in Las Vegas, November. Jim McNaul, D vice president of strategic says the model 735 Intelling System, which will be tured for Datacopy by Rico Japan, will be available i quarter of 1987. It will car of less than \$5,000, he say

The model 735, a flatbe will have a small compu interface (SCSI), use a Mo MC68000 as the image pro have up to 4M bytes of will be sold for use with Corp. PC and compatibles

PreScript can selectively scan up to eight segments, or "windows," on a document page displayed on a screen. (Three windows are shown here.) Each segment may be stored in the most efficient and least memory-consuming way. The photograph in window 1, for example, would be stored as a gray-scale bit map. The line drawing in window 2 would be stored as vector data. The text in window 3, as ASCII code.

timately where the market is headed."

A key benefit, Kapoor says, is a reduction in data storage requirements. A page of text, stored as bit-mapped information, consumes about 1M byte of memory. Stored as ASCII code, the same page would need 4.5K bytes.

Datacopy plans to demonstrate its own scanner based on PreScript at Comdex Fall in Las Vegas, Nev., in November. Jim McNaul, Datacopy's vice president of strategic planning, says the model 735 Intelligent Scanning System, which will be manufactured for Datacopy by Ricoh Corp. of Japan, will be available in the first quarter of 1987. It will carry a price of less than \$5,000, he says.

The model 735, a flatbed scanner, will have a small computer system interface (SCSI), use a Motorola Inc. MC68000 as the image processor and have up to 4M bytes of memory. It will be sold for use with the IBM Corp. PC and compatibles, as well as with the Macintosh from Apple Computer Inc.

McNaul says that Datacopy also plans to bring out two other versions



of the scanner, one with less memory, and another that will use a dedicated graphics processor rather than the 68000. Also on the drawing board is a separate PreScript image-processing box designed to work between Datacopy's series 600 digitizing camera and a host computer.

Moving toward \$4 billion

According to CAP International, a Marshfield, Mass., market research outfit, about 40,000 computer-based publishing systems, valued at \$1.3 billion, will be shipped in 1987. By 1990, shipments of hardware and software for publishing applications will exceed half a million units and be worth \$4 billion. PC-based publishing systems are expected to account for about a quarter of that: \$930 million.

"People are now doing complex layouts and printing them on low-cost laser printers. But they are using simple graphics, usually line drawings," says Datacopy's McNaul. "As they use these systems more, they'll want more complex drawings and pictures."

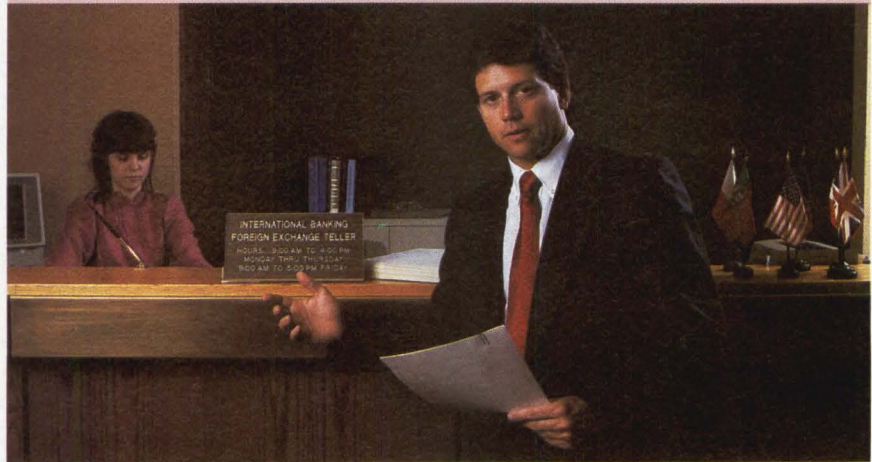
Although scanners for desktop publishing applications are only beginning to come into their own, industry analysts are forecasting quick growth in the coming years. This year, for example, Dataquest expects about 8,700 desktop scanners to be shipped. That's about one for every 10 PCs used for publishing applications. Dataquest forecasts a \$1.2 billion market for scanners in 1990, with annual shipments of more than 600,000 units. That works out to one scanner for every three PCs sold for publishing.

Chain reaction ahead

Datacopy is one of about two dozen scanner manufacturers vying for a piece of the action. So far each has taken a different approach to the market.

DEST Corp. of Milpitas, Calif, for example, sells its \$2,800 PC Scan for the IBM PC. Although the initial version enters text only through optical character recognition, DEST is ex-

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pected to introduce graphics capability soon.

At the other end is Microtek Inc., San Diego. Its MS-300 for the IBM PC and Apple Macintosh until recently only scanned simple graphics, producing halftones at 1 bit per pixel. However, Microtek plans to offer OCR capability for the MS-300 PC model this month.

One company competing with Datacopy for graphics performance is Truvel Corp., Gardena, Calif. In July it introduced the Z-Comp family of scanners. The high-end model, Z-Comp 3600, costs \$3,450 and, like Datacopy's model 735, can sense 256 levels of gray scale at 8 bits per pixel. A \$995 direct-memory access (DMA) interface card allows data to be transferred at 1.5M bits per second into the PC/AT's extended memory or disk space.

President Richard Gerlach says that, although Truvel does not provide an OCR package with the Z-Comp 3600, the company is selling the scanner to an OEM who will provide text-recognition software. He says the scanner will be marketed with a VMEbus system to replace microfiche archives in the legal market.

It is at the application level that Datacopy hopes to make the biggest dent in the market. Because PreScript commands already contain image-processing commands, applications developers will be relieved of having to worry about writing complex code for tasks like halftoning, claims McNaul.

"Programmers won't need to have a knowledge of how image processing works, but only what they want," says McNaul. Dataquest analyst Kapoor agrees, saying that the Datacopy approach could be important because it could lead to standardization.

"Philosophically," says Kapoor, "it's the right approach toward some kind of standard. I think you'll see a chain reaction as others follow their lead." □

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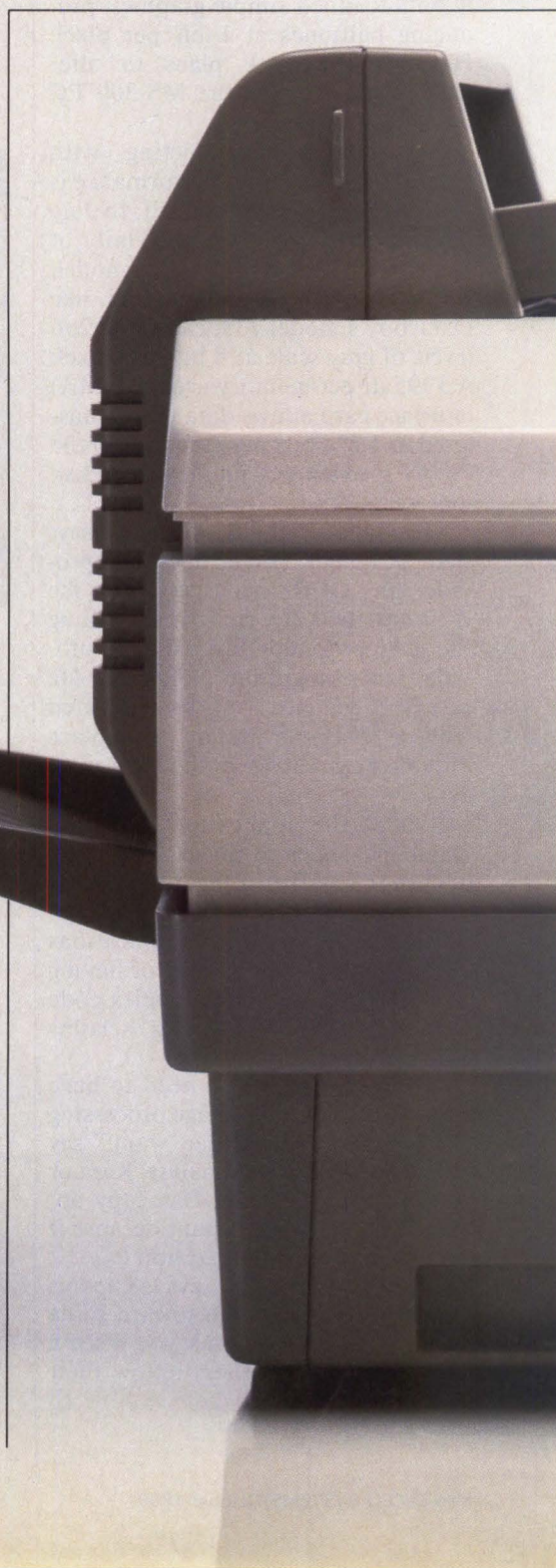
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CIRCLE NO. 24 ON INQUIRY CARD

You may not like all that DEC and DG are up to

James F. Donohue
Managing Editor

Digital Equipment Corp. and Data General Corp., those feuding cousins who are neighbors in Massachusetts, appear to be veering off in new directions. System integrators may not like the results: Some prices on DG products already have gone up, and the number of vendors of DEC-compatible peripherals may be going down, reducing competition.

To its credit, DEC now appears to have put together a complete line of workhorse office computers. And DG has become reborn as a provider of engineering and technical computer applications, unveiling two software products that ride on its Technical Electronic Office (TEO) software.

Since midyear, DEC has

- Filled in the upper reaches of its VAXBI series with two machines, each rated (not by DEC) at 6.1 million instructions per second (MIPS).

The 8550 (\$364,000 starting price) and the 8700 (\$433,000 starting price) are aimed at the office.

- Announced it would keep proprietary the VAXBI architecture and license only a selected few manufacturers to interface peripherals to it.

- Unveiled the VAXmate which, powered by an 8-MHz Intel Corp. 80286, brings distributed processing to the desktop; the main target: networked offices.

Meanwhile, DG has

- Brought out the first two applications programs for its TEO software platform, in marking the company's return to the technical/engineering arena.

DEC will 'reduce the choice of equipment' ...DG 'has a bit of an edge'

Recent product and pricing announcements have rekindled debate over the strategic directions of

David C. Moschella, vice president, International Data Corp., Framingham, Mass.

MMS. What do you make of DEC's refusal to license VAXBI?

It will hurt vendors like Emulex [Corp.] and System Industries [Inc.] that are major suppliers to DEC systems. There may be some legal problems with it, because DEC is trying to lock out selected third-party vendors from making peripheral equipment that can work with the VAXBI series. That's what the courts won't let IBM Corp. do [with its equipment and third-party vendors]. But DEC is smaller than IBM, and maybe they can get away with it.

MMS. How long will DEC lock up VAXBI?

There are already reports that DEC is considering softening this policy. If they do, it probably won't be before late 1987. It's clear that what DEC wants is a headstart in attaching their own disk drives to their own systems. After all, it's in their interest to get as high a share as possible of their own revenue base.

MMS. The VAXBI series targets office applications. That means DEC is moving away from its traditional markets in technical and scientific applications and going head to head against IBM. How risky is that?

If DEC is going to grow, that's the area they're going to have to grow in. DEC is going through the same thing that DG [Data General Corp.] went through about five years ago. DG went after the office market, and they lost ground in the technical side. That's a risk for DEC, too.

these two major computer companies. *Mini-Micro Systems* asked two analysts for an assessment.

Frederic G. Withington, vice president, Arthur D. Little Inc., Cambridge, Mass.

MMS. How do you think Data General Corp.'s price increase will fly?

The machine price increases were on older models. I think Data General would just as soon get those machines out of the inventory and move the customers to newer ones. And CEO (Data General's all-purpose office automation software package) was probably badly underpriced anyway.

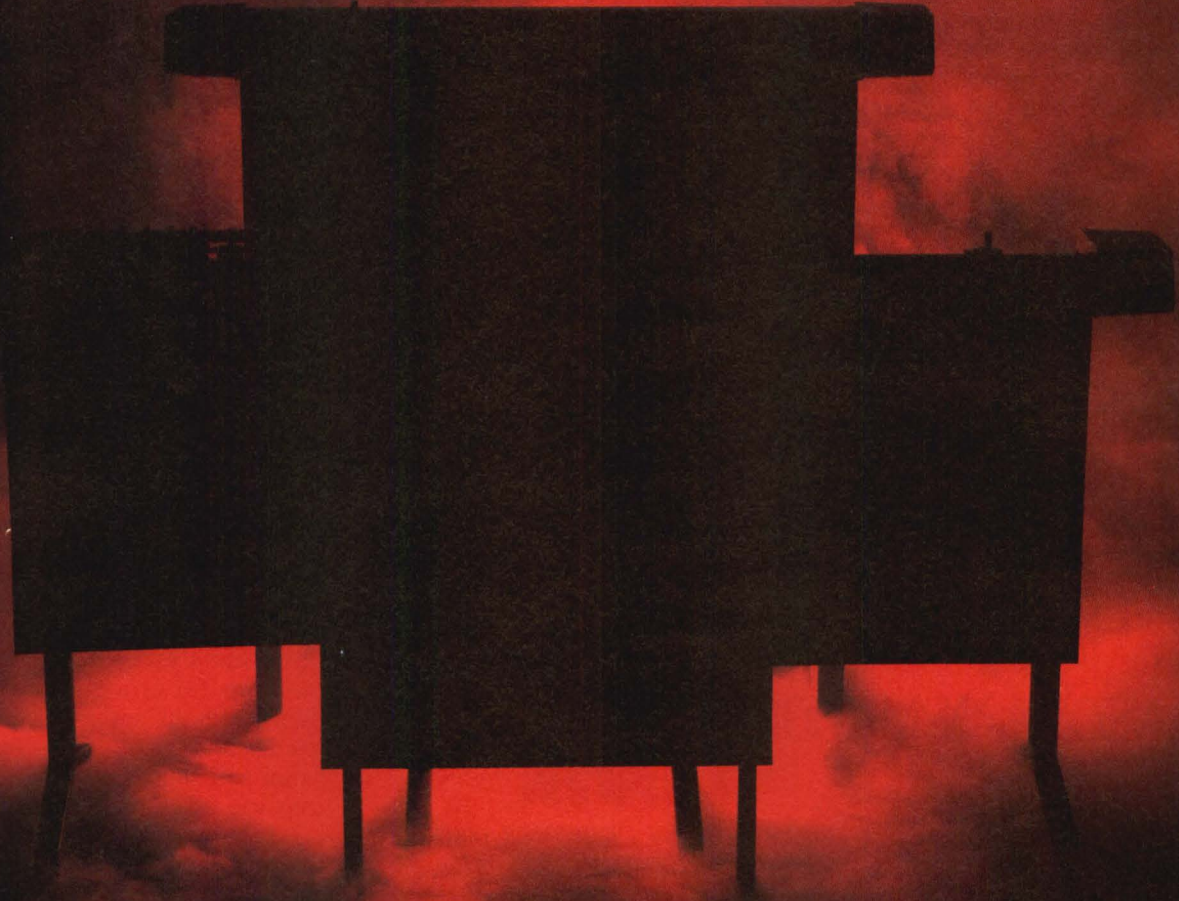
MMS. How do you compare Data General and Digital Equipment Corp.?

In our opinion, the DG product is directly competitive with DEC and just as good. In terms of price/performance, Data General usually has a bit of an edge. But for some reason, they don't seem to be able to realize the value of these products in the market.

MMS. Is office automation a good market to be in?

Two things have to take place. First, the users have got to get their transaction-processing applications converted from batch to database or fast-response mode. Second, the vendors have to provide the proper tools, including standard protocols. I think that all will start happening soon, and then slowly accelerate. I see office automation becoming a major market in 1988 and thereafter.

**THE
SECRET
BEHIND
THE PLOT.**



• Raised prices on about half of its product line, including on Comprehensive Electronic Office (CEO), its office-automation software product.

DEC, of Maynard, Mass., always a force among vendors of scientific and technical computers, has decided it wants a much bigger hunk of the networked office, where archrival IBM Corp. holds sway. To get it, DEC

seems intent on employing patents to lock up its proprietary VAXBI architecture. By eliminating competition, that strategy could push up prices.

As to DG, Westboro, Mass., its decision to put renewed product emphasis on engineering applications answers charges that it has neglected technical users—especially users of low-end engineering workstations—

while it battled for sales in the white-collar office. But, while pursuing chip designers and architects, DG has raised prices on much of its existing office-automation product line, including a 10 percent jump for CEO.

Although the two companies have a family relationship—Edson D. de-Castro quit DEC in the late 1960s to found DG, which he still heads as president—they are not “kissin’” cousins. DG has made a good living selling computer equipment and software primarily against DEC at prices DEC has been unwilling to match.

At the moment, their fortunes are far apart: DG is struggling and DEC seems to be enjoying a boom, after experiencing hard times in the early 1980s. In the 1986 fiscal year, DEC reported a 38 percent increase in income, to \$617.4 million. DG, after completing nine months of its fiscal year, says it has lost \$2 million.

Two at the crossroads

Many analysts believe both companies stand at a crossroads. DEC, in looking for office-automation business with its seven-machine VAXBI series and its All-In-1 office automation software, has put itself squarely up against IBM. There are obvious dangers in doing that: DEC is a \$6.7 billion mouse going against IBM, a \$50 billion elephant.

DEC is going after IBM by touting ease of networking through its VAXBI architecture and VMS operating system which, it says, enable it to swiftly unify an office network even when the machines of many different vendors are on it.

DEC has its problems, however. It still ranks second to IBM in the hearts of most office automation managers. And, by refusing to license the VAXBI bus architecture to third-party vendors, it is making enemies and will probably face law suits.

And DG is burdened by the fact that both CEO and TEO run for now only on its proprietary operating system, Advanced Operating System/Virtual Storage (AOS/VS). That appears to limit sales to DG's 150,000 CEO-user sites, a small base upon which to build what it hopes will be a major product line. □

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Sunnyvale, CA Daisy Systems' Vic DaGragnano says, "The California Computer Show always generates the CAD/CAM systems designer crowd we typically try to reach."

San Jose, CA NEC Information Systems' Tom McQuillan states, "We've been bringing our printers and disk drives to the California Computer Shows for five years consistently drawing well-qualified leads."

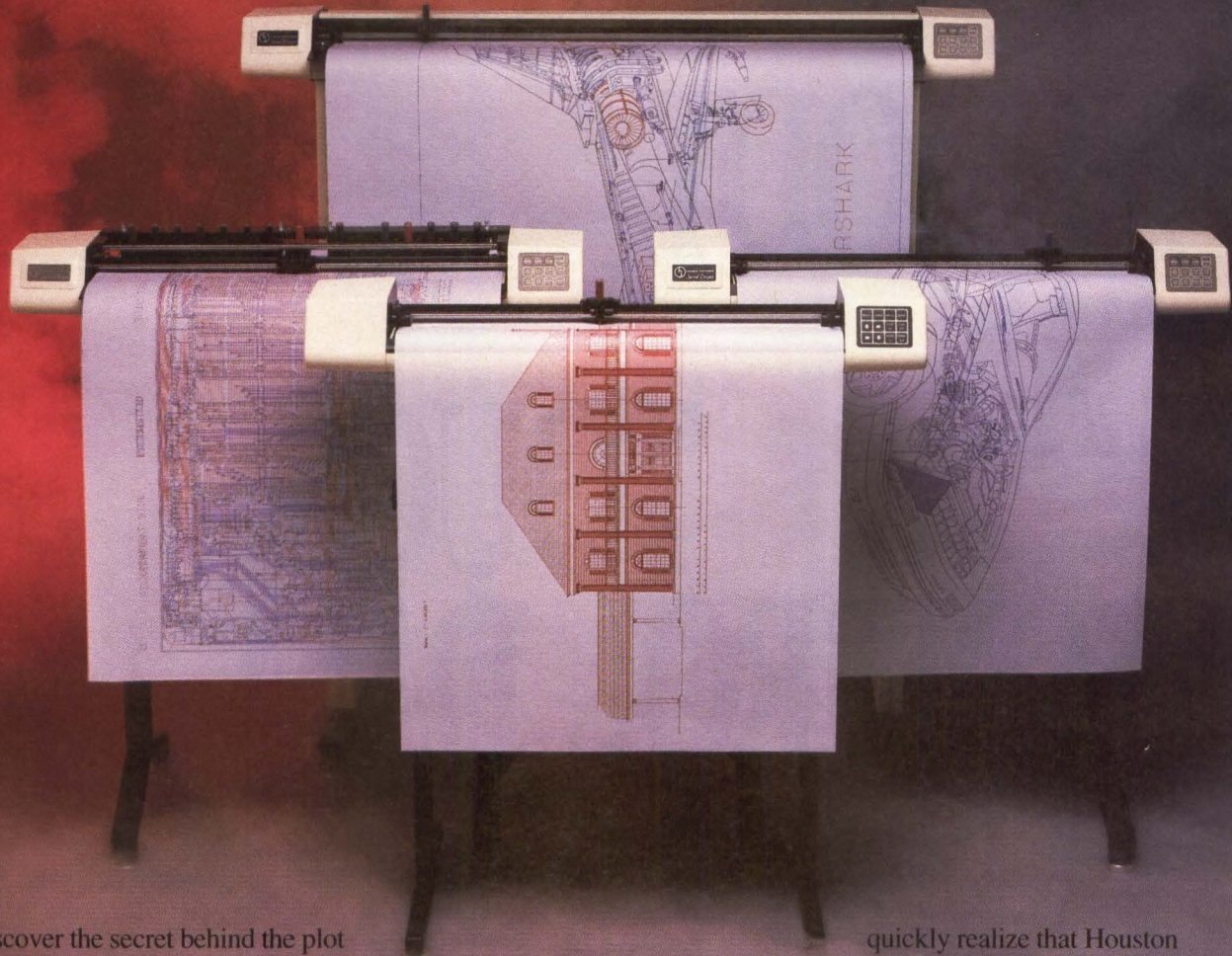
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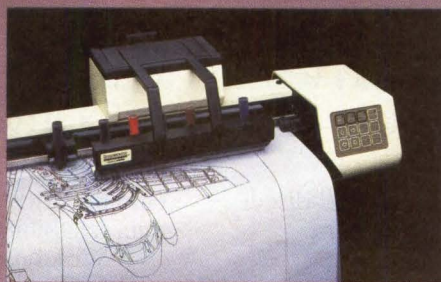
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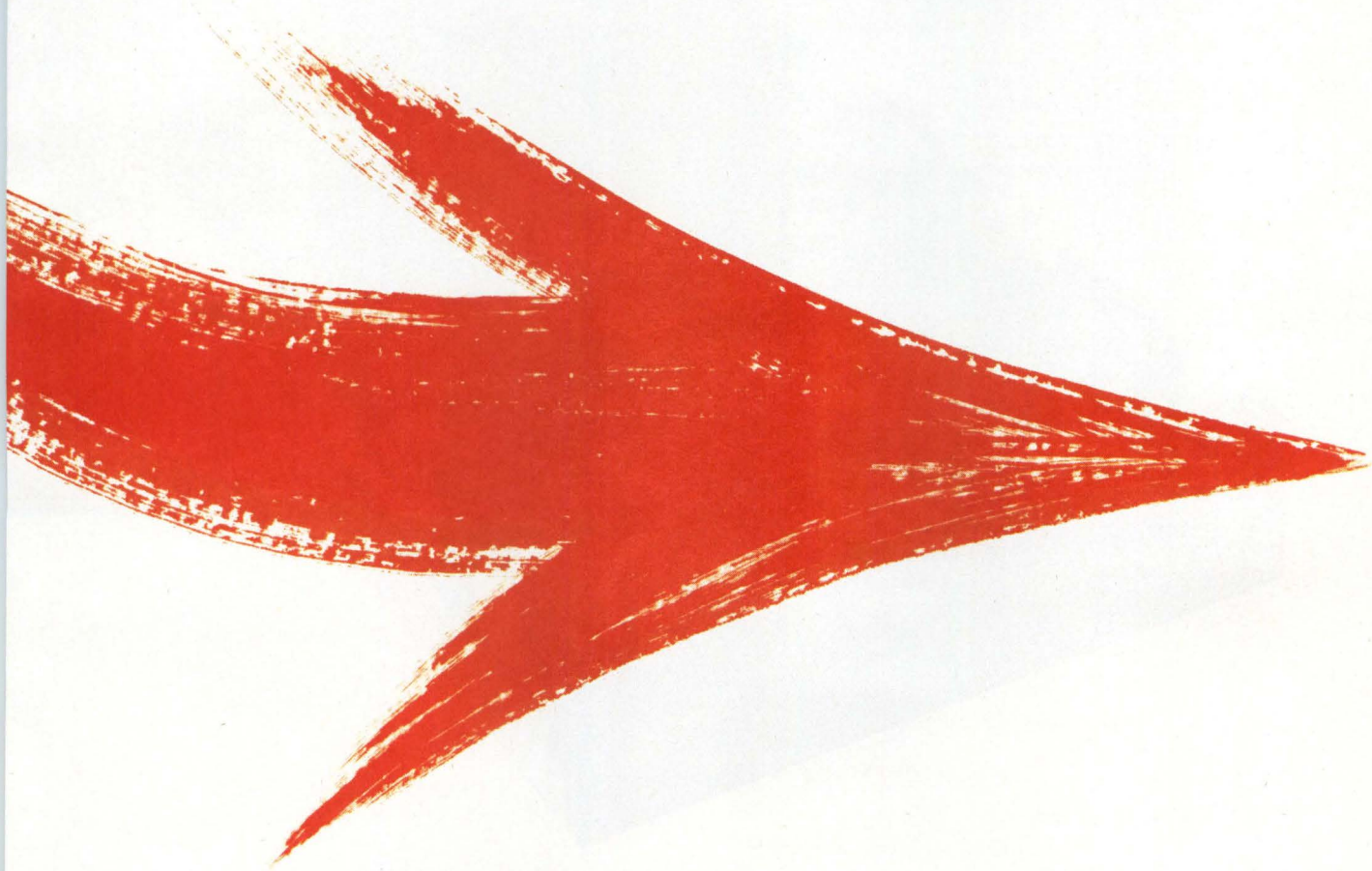
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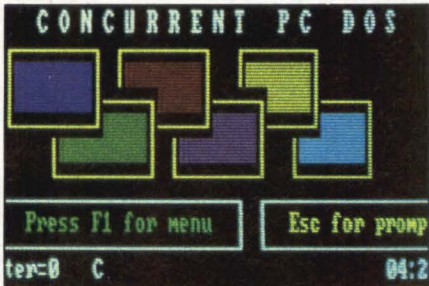
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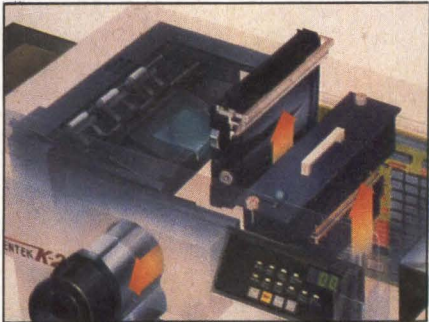
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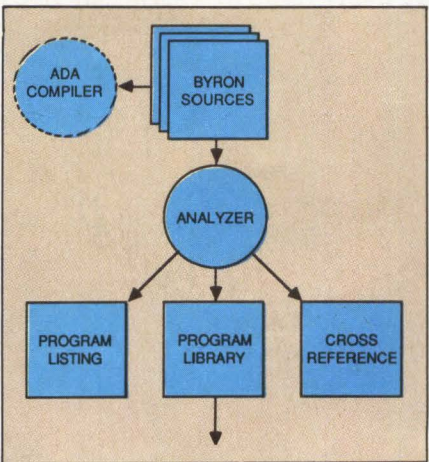
FEATURE HIGHLIGHTS



p. 51 Enhanced capabilities



p. 87 The newest in technology



p. 101 A viable option

EXPANDED MEMORY BROADENS PC CAPABILITIES 51

By breaking the 640K-byte barrier imposed by MS-DOS and PC-DOS, expanded-memory boards open up megabytes of memory for a variety of RAM-hungry applications. Among other benefits, the boards enhance multi-tasking and high-resolution graphics and permit protected-mode operations. But controversy surrounds the two prevailing "standards": Lotus/Intel/Microsoft's Expanded Memory Specification (EMS) and AST/Quadram/Ashton-Tate's Enhanced Expanded Memory Specification (EEMS).

SOFTWARE INTEGRATES AI, STANDARD SYSTEMS .69

In an effort to boost acceptance of artificial intelligence in the commercial world, a variety of vendors are offering techniques and tools that integrate knowledge systems with conventional processing engines. In this second part of a special report on AI (the first article ran in the August issue), MMS looks at the principal methods of achieving that integration.

LASER PRINTERS DRAW FROM COPIER TECHNOLOGY87

Despite strong sales in laser printers, they still have serious drawbacks, such as often-inadequate resolution, lack of software support, rudimentary paper-handling and the absence of color. However, all that is changing. Our survey examines recent improvements and profiles over 60 laser printers from 30 vendors.

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Why Bizcomp for Your Company

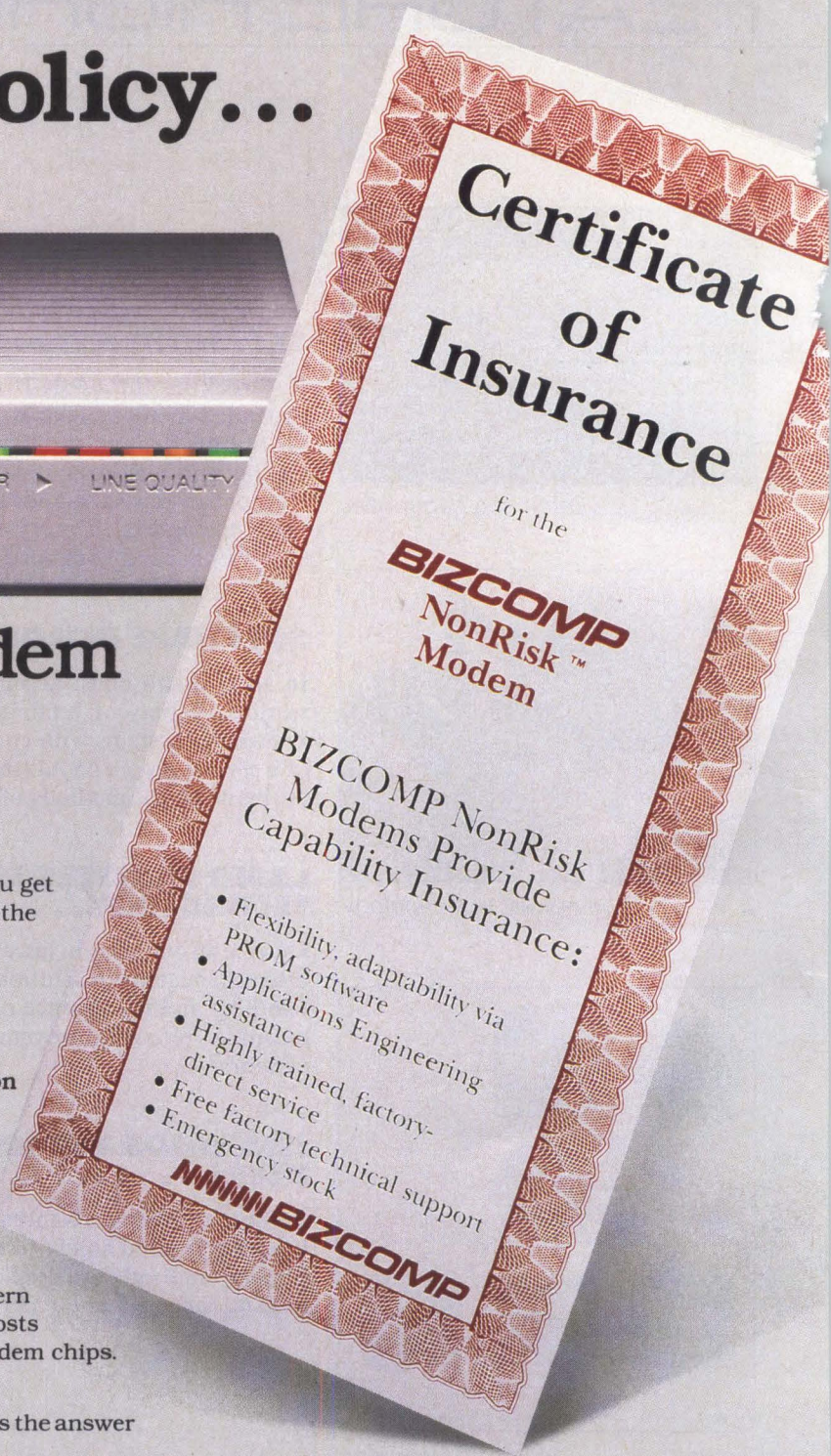
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EXPANDED-MEMORY BROADENS PC CAPABILITIES

Configured as PC plug-ins, expanded-memory boards enhance multitasking, furnish high-resolution graphics, add RAM disks and printer spoolers and permit protected-mode operations

Jesse Victor, Associate Editor

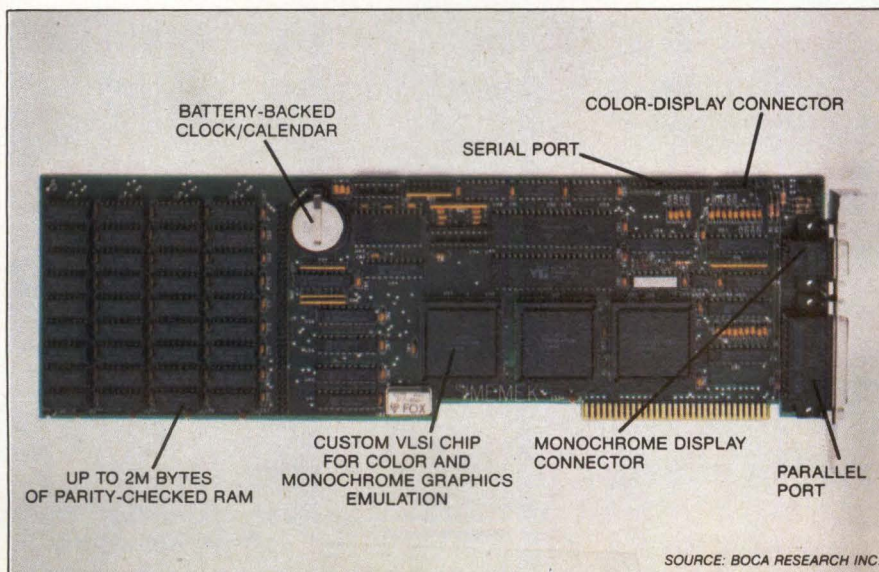
First there was add-in memory, then multi-function memory boards. Now there are expanded-memory boards and software. Expanded-memory products are gaining converts among both system integrators and end users. Displacing their plain-vanilla add-in and multi-function predecessors, they are emerging as the methods of choice for unleashing the capabilities of IBM Corp. PCs, PC/XTs and PC/ATs by breaking the MS-DOS/PC-DOS-imposed 640K-byte addressing barrier. They thus open up megabytes of memory to larger spreadsheets and databases, to popular RAM-resident personal-productivity packages and to higher resolution images and graphics for computer aided

design and desktop-publishing applications.

But expanded-memory products are also facilitating and speeding multitasking under PC-based windowing environments and making their first, tentative steps toward enabling the PC/AT to run in protected virtual-address mode.

Although 8088 microprocessor-based microcomputers such as the PC and PC/XT have 1M-byte physical-address spaces, large chunks of that space above 640K bytes are occupied by video RAM, hard disk ROM or the basic input/output system. Therefore, this memory space is normally inaccessible to MS-DOS/PC-DOS programs. Expanded-memory add-in boards and software use bank-switching techniques to move 16K-byte banks, or logical pages, of

Expanded-memory products are facilitating and speeding multitasking under PC-based windowing environments.



The MEMEK expanded-memory board from Boca Research uses a custom VLSI chip to emulate a variety of color and monochrome graphics modes, and comes with 2M bytes of parity-checked RAM, serial and parallel ports and a battery-backed clock/calendar.

SOURCE: BOCA RESEARCH INC.

memory into and out of set-aside portions of address space (address windows), when required by application programs—an action completely transparent to the system user.

Most expanded-memory boards and software follow either the Lotus Development Corp./Intel Corp./Microsoft Corp. (LIM) Expanded Memory Specification (EMS) or the alternative AST Research Inc./Quadram Corp./Ashton-Tate (AQA) Enhanced Expanded Memory Specification (EEMS), a superset of LIM. The latest versions of popular application packages, such as Lotus 1-2-3 Release 2.0, Lotus Symphony Release 1.1, Ashton-Tate's Framework II, Living Videotext Inc.'s ThinkTank 2.1 and Computer Associates International Inc.'s SuperCalc3 Release 2 or SuperCalc4, have all been modified for EMS. All programs designed for the EMS spec can run with EEMS boards, but EEMS modified packages cannot run with EMS boards, unless they include a special EMS mode.

EMS and EEMS define hardware and soft-

ware standards for bank switching, require the rewriting of application-program memory-address routines and use a special device driver—the expanded-memory manager. This management program loads into the PC's CONFIG.SYS file when the PC is booted and acts as an interface between applications and expanded memory.

Expanded-memory boards can supply memory to PCs in three ways: They can supplement conventional RAM below 640K, expand memory to 8M bytes or, with 80286 processor-based machines such as the PC/AT, to 16M bytes. Expanded-memory board vendors are thus aiming their products at system integrators and end users who want more bang for the buck. Expanded-memory products fulfill that desire by satisfying PC-based applications' insatiable need for more RAM storage and expanded functionality in a cost-effective manner without tying up valuable expansion slots.

"We are increasingly being asked for multifunction boards with expanded-memory capa-

Replacing conventional add-in memory and multifunction memory cards with expanded-memory boards is a cost-effective solution for PC-based applications' need for megabytes of memory.

EXPANDED-MEMORY CARDS CUT COSTS OF MULTIPLE FUNCTIONS				
	Typical cost of separate functions (\$)	Typical total cost of separate functions (\$)	Cost of multifunction card (\$)	Cost savings with multifunction card (\$)
All Aboard card with CGA and without expanded memory				
Disk controller	200	675	545	130
Serial, parallel, clock	225			
CGA graphics	250			
All Aboard card with EGA and without expanded memory				
Disk controller	200	975	795	180
Serial, parallel, clock	225			
EGA graphics	550			
All Aboard card with CGA and EMS expanded memory				
Disk controller	200	945	745	200
CGA graphics	250			
EMS with I/O functions	495			
All Aboard card with EGA and EMS expanded memory				
Disk controller	200	1,245	995	250
EGA graphics	550			
EMS with I/O functions	495			

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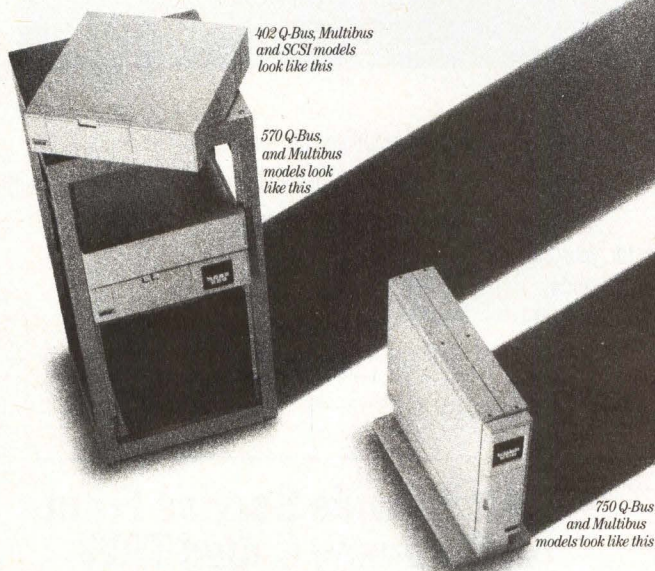
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bility, now that you can count on more than two hands the software packages available that support the spec," asserts Nora Gildea, director of marketing at EMS board vendor IDEASociates Inc. "Twenty-five percent to 30 percent of PC/XTs and ATs are now sold with an expanded-memory product."

Boards add graphics functions

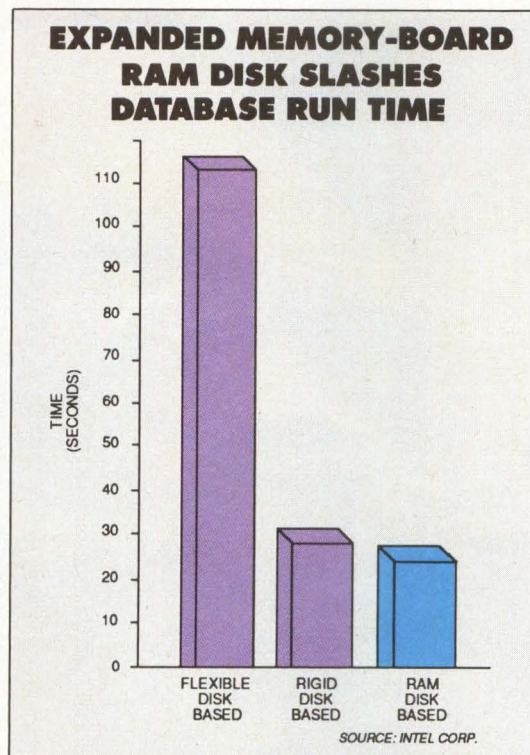
Because expanded-memory boards can be more cost-effective than standard multifunction cards, they are replacing them for most PC-based applications, Gildea says. For example, IDEASociates' 2M-byte All Aboard card uses surface-mount technology to cram onto one card EMS functions, IBM monochrome and color graphics adapter (CGA) or enhanced graphics adapter (EGA) modes, a controller for an internal hard disk and serial and parallel I/O ports. It sells for about \$250 less than the cost of buying equivalent functions on separate cards.

Boca Research Inc.'s new MEMEK board similarly offers a wide range of graphics capabilities. In addition to supplying CGA, EGA and 2M bytes of expanded memory, it uses a custom VLSI chip set to emulate a Hercules Computer Technology card's monochrome graphics and the extended color graphics of a Plantronics/PC+ Products Inc. ColorPlus. The board, which has serial and parallel ports and a battery-backed clock/calendar, can display 16 colors with 640-by-400-pixel resolution and can display video memory sequentially and rapidly for animation.

Vendors are boosting expanded-memory functionality in other ways to add value to their products. The MEMEK board, for example, does not require settings for dual-in-line-package (DIP) switches or jumpers to configure system-memory allotments. The menu screen also helps configure display and I/O functions, and erasable programmable ROM saves settings when the computer is turned off. Similarly, Intel's Above Board products have menu-driven installation screens provided by the SETUPAB program to configure the boards for popular application programs such as Lotus 1-2-3.

RAM disks storing as much as 16M bytes can speed the execution of PC-based application packages requiring frequent disk access. They prove especially useful with programs like Ashton-Tate's dBASE or word-processing packages that do not support expanded memory. Running applications from the RAM disks offered by many expanded-memory boards slashes operating time when compared with flexible- or rigid-disk-based tasks (see graph).

STB Systems Inc.'s Memory Companion/PC



board, for instance, allows the creation of as many as 10 RAM disks of any capacity and three printer buffers using the board's 2M bytes of parity-checked memory. The board retains printer-buffer or disk-emulator data after a warm reboot when the system is reset from the keyboard.

Mega-Omega Systems Inc.'s The Companion Card Plus provides optional battery backup for creating non-volatile RAM disks. It also offers a memory-diagnostics function, that checks for, notifies the user of and bypasses defective memory chips.

If users want to speed printing of high-resolution graphics images, they should consider Tall Tree Systems' J Laser printer interface module. Piggybacking onto the company's 2M-byte JRAM-3 or JRAM-AT-3 expanded-memory boards, the module sends bit-mapped, full-page, 300-dot-per-inch graphics with multiple type fonts directly to Canon U.S.A. Inc.'s LBP-CX or equivalent laser printers, bypassing the printer's buffer.

For those concerned about unauthorized access to all that extra expanded memory, Tecmar Inc.'s 2.5M-byte Maestro AT board will prove useful. It furnishes an optional software lockout chip with password protection for application programs. The Underwriters Laboratories-listed board also supplies 20 application programs, including mailing-list and forms gen-

Running application packages from the RAM disk offered by many expanded-memory boards slashes operating time when compared to flexible disk- or rigid disk-based tasks. The graph compares the time required to index on a seven-character field a 244K-byte dBASE II Plus database file containing 1,500 records, using a PC/XT with 640K bytes of RAM, two flexible disk drives and an Intel Above Board-based 1.5M-byte RAM disk.



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Creating large spreadsheets in the megabytes of memory available on one or more expanded-memory boards may not be the panacea many integrated-program addicts expect.

erators, inventory control and a memo writer. Thesys Memory Products Corp.'s FASTCARD IV similarly furnishes password protection plus disk-caching software, a feature offered by several other boards.

Creating very large spreadsheets in the megabytes of memory available on one or more expanded-memory boards is a boon to "power" users but may not be the panacea many integrated-program addicts expect. Lotus' 1-2-3, Symphony and Symphony Spelling Checker and Text Outliner can store labels or words typed into the spreadsheets, formulas and floating-point numbers in expanded memory above 640K bytes. Everything else, however, including the pointers that locate data in expanded memory, is stored below 640K in conventional memory, which can quickly fill up.

Multitasking comes to the fore

In spite of leviathan spreadsheets, most of the excitement in the expanded-memory arena centers on enhanced support for multitasking on the PC. Thus, both Intel with its EMS Above Board cards and AST Research with its EEMS RAMpage and SixPakPremium boards supply windowing environments with their expanded-memory products—Microsoft's Windows and Quarterdeck Office Systems' DESQview, respectively.

AST Research and other EEMS board vendors claim advantages for multitasking with EEMS-based compared with EMS-based bank switching: specifically, faster execution of multiple applications from completely RAM-resi-

dent programs and the ability to store both code and data in memory locations above 640K bytes. In contrast to EMS' four 16K-byte fixed-address windows for expanded-memory paging, EEMS can allocate as many as 64 16K-byte windows over any portion of the PC's 1M-byte address space not used by video memory or other resident PC functions. (EEMS also assigns the same four windows as does EMS to ensure compatibility with programs supporting that standard.)

"EEMS is much better adapted for multitasking. It has a lot more capability and flexibility than the original EMS spec," asserts Tony Paradiso, director of marketing for multifunction products at AST Research. "With DESQview and flexible disk-based applications, you can 'hot-key' between multiple tasks because EEMS provides sufficient memory to store everything directly in RAM."

EEMS' 64 16K-byte windows, Paradiso emphasizes, enable resident multitasking programs to page directly into conventional memory below 640K bytes. In contrast, EMS brings 64K bytes of an application at a time into the upper memory range and then moves it down into conventional memory. "This is a two-move operation that takes seconds instead of milliseconds," Paradiso adds.

With DESQview, AST's SixPakPremium board can run nine RAM-resident application programs simultaneously in separate windows, including several Lotus 1-2-3 sessions, and transfer data between them. Menu screens and utilities allow users to write and execute macro-

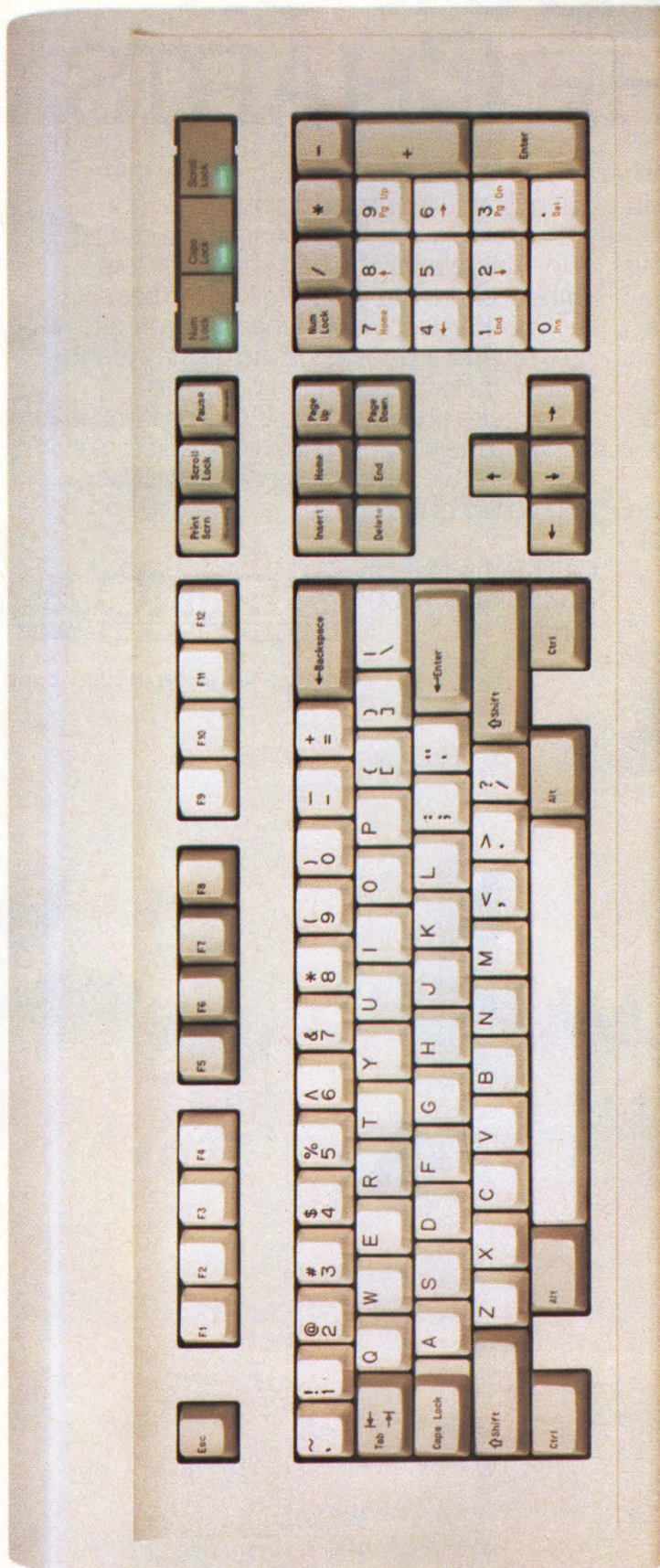
Supplied with Quadram's expanded-memory boards, Digital Research's Concurrent PC-DOS XM operating system is compatible with both EMS and EEMS specifications. It runs up to six concurrent DOS sessions, such as the 1-2-3, Wordstar, File Manager and Menu System applications shown here.

The screenshot displays a multitasking PC-DOS environment with several windows open:

- Top Left Window:** A menu titled "MAIN" with options: "Cursor Movement" (AS char left, AH word left, AL line up, AZ line down, AC screen up), "Delete" (AG char, DEL chr l, AT word r, AY line), and "Scrolling" (AM line up, AR screen down).
- Top Right Window:** A spreadsheet titled "Variable Costs/Unit" with columns "Description" and "Cost/Unit".

Description	Cost/Unit
Materials	\$3.26
Contract Labor	\$3.75
Energy	\$1.45
Sales Commissions	\$2.21
Freight	\$0.32
- Bottom Left Window:** A file manager window titled "CONCURRENT PC DOS" showing a list of files: DSKMAINT.CMD, FDSTART.1, FSET.CMD, HDMAINT.DOC, HELP.HLP, LETTER.TXT, LSN.EDX.
- Bottom Center Window:** A menu titled "Run a Program" with options: Copy Diskette, Format Diskette, Free Memory, Size/Date ON, Set Up System.
- Bottom Right Window:** A status bar showing "Press F1 for menu" and "Esc for prompt".
- System Information:** At the bottom, it shows "LOTUS FM", "Printer=B C", and the time "04:20".

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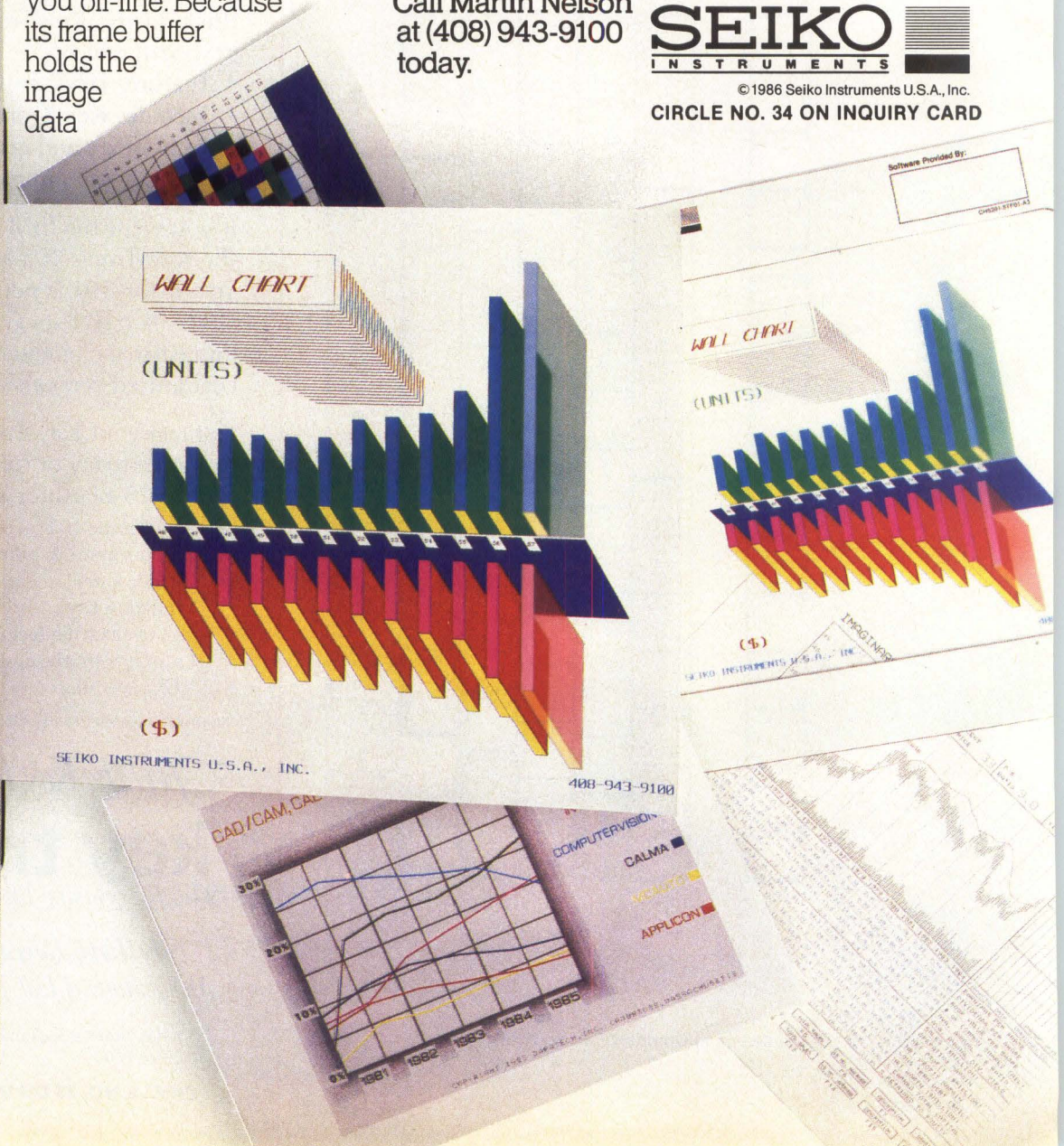
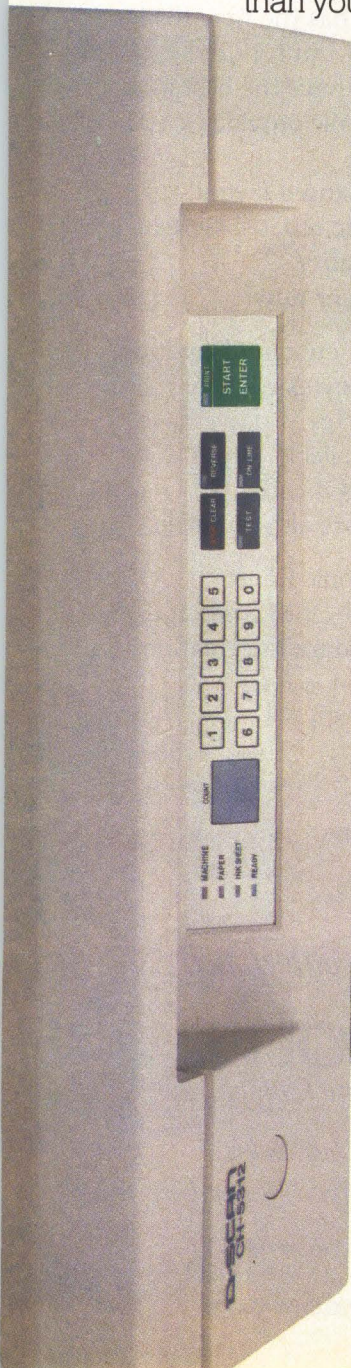
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instructions, redefine keys, automatically log on and transfer data from external databases, run DOS services directly and preconfigure the system for more than 70 application programs.

One software vendor that plans to take advantage of the EEMS spec is Oracle Corp., in Version 5.1 of its Oracle database management system. Support for EEMS will speed and enhance Oracle's new forms-generation, report-writing and graphics capabilities, according to Oracle technical analyst, Mike Wallace. "With only 640K, we didn't have a lot of room to work with. Using EEMS, we can store both code and data above 640K." A new version of the Paradox DBMS from ANSA Software will also support EEMS, says AST's Paradiso.

Software accesses extended memory

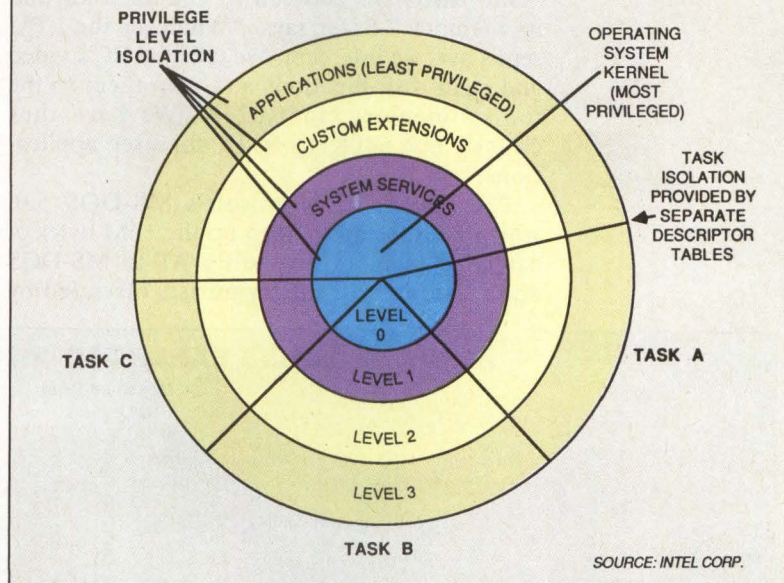
The 1M byte to 16M bytes of extended-memory addressing provided by the PC/AT's 80286 processor is currently accessible only by the XENIX operating system, and under PC-DOS/MS-DOS, only by the MS-DOS 3.0 VDISK RAMdisk utility, which can create up to 2.5M bytes of semiconductor storage. However, system integrators and end users are not confined by the limitations of PC-DOS and MS-DOS in utilizing this alternative to expanded memory.

For example, The Extender for Lotus 1-2-3, from Uniform Software Systems Inc., allows ATs with PC-DOS 3.1 to address more than 960K bytes of RAM under the 80286's protected virtual-address mode without an expanded-memory card. The Extender also accommodates older versions of Lotus not modified for expanded memory, i.e., Release 1A. Uniform Software is a division of Locus Computing Corp.

Developed under contract with IBM for that company's 4680 point-of-sale system, Digital Research Inc.'s Concurrent DOS 286 is a real-time, multiuser, multitasking operating system. It also permits the PC/AT to run applications in protected mode. Four hierarchical privilege levels for each task within each user's virtual-address space protect the operating system from application programs or one task from interfering with another task's programs or data. A program can access data or call services only at the same or at a less privileged level.

If you can't wait for Microsoft's MS-DOS 4.0, which is expected to support expanded memory, consider Digital Research's Concurrent PC DOS XM (Expanded Memory) multiuser and multitasking operating system. Bundled with Quadram's expanded-memory boards, it supports both EMS and EEMS specifications and provides windows for simultane-

PC/AT PROTECTED-MODE PRIVILEGE LEVELS SAFEGUARD CODE AND DATA



ously running as many as six PC/MS-DOS, CP/M-86 and Concurrent DOS 86 applications on a PC, XT or AT. It can work either with programs that are unmodified for expanded memory or those specifically designed to work with expanded-memory boards. Alternatively, multiple users on one main computer and two RS232-connected terminals can share disks, files and printers with record-lockout protection.

MMU opens up protected mode

All Computers Inc. thinks it has a better idea than do vendors of conventional expanded-memory boards. Its new All Card provides a proprietary memory-management unit (MMU) that enables PCs, PC/XTs and PC/ATs to run MS-DOS programs in protected mode. The All Card 286 module plugs into the 80286 socket and replaces that chip's MMU.

"The 8088 CPU puts out 20-bit addresses. The AT puts out 24-bit addresses, but in that mode you lose DOS compatibility," explains All Computers' marketing manager, Shelly Sofer. "Our MMU turns the 20-bit addresses into 24-bit addresses and preserves DOS compatibility. When protected-mode DOS comes out, we believe you will be able to run unmodified application programs with our board under it."

Supporting both EMS and EEMS specs as well as IBM's XMA adapter, the up-to-6M-byte (with piggyback module) All Card board is

Four hierarchical privilege levels in each user's virtual-address space, as well as separate descriptor tables, provide protection for programs, data and the operating system kernel when 80286-micro-processor-based computers run in protected virtual-address mode.

innovative in that it opens up the PC's entire 1M-byte address space for expanded memory. "Our MMU sits between CPU addressing and its memory," Sofer says. "Whatever the CPU sends out, we intercept. We take the PC's video and rigid disk functions and map them to the top of memory, to 1,024K. We have thus cleaned out 640K to 952K for user applications."

The advent of Microsoft's MS-DOS 5.0, which is expected to open up the 16M bytes of extended memory on the PC/AT to MS-DOS applications, will satisfy purists offended by

the inelegance of bank switching. It may also cause problems for future sales of expanded-memory boards. Will system integrators and end users dispense with expanded-memory boards to jump on the extended-memory bandwagon? Or will they bypass extended memory on the AT to go directly to future 80386-microprocessor-based machines? The 80386's two- to four-times speed advantage over the 80286, six-stage pipelining, segmented and paged addressing and 64 terabytes of virtual memory may be a powerful lure.

But because today's application programs

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All Computers																				
All Card	✓	✓	✓	✓	✓			1	5		✓	✓						✓	✓	✓
All Card 286	✓	✓	✓			✓					✓	✓								
AST Research																				
RAMpage	✓	✓		✓	✓			2			✓			✓				✓	✓	✓
RAMpage AT	✓	✓	✓			✓		2			✓	✓		✓				✓	✓	✓
SixPakPremium	✓	✓		✓	✓			1	1		✓	✓		✓				✓	✓	✓
Boca Research																				
BocaRAM	✓			✓	✓	✓		1	1		✓	✓								
MEMEK	✓			✓	✓			1	1	✓	✓	✓						✓	✓	✓
Emulex																				
Stretch	✓			✓	✓	✓	✓	2			✓	✓								
IDEAssociates																				
All Aboard	✓				✓				2	✓								✓	✓	✓
IDEA Supermax/EMS	✓		✓			✓		1.5	2.5		✓	✓						✓	✓	
Intel																				
Above Board/PC	✓			✓	✓			2	2		✓	✓	✓							
Above Board PS/PC	✓			✓	✓			1.5			✓	✓	✓					✓	✓	✓
Above Board/AT	✓		✓			✓		2	2		✓	✓	✓							
Above Board PS/AT	✓		✓			✓			2		✓	✓	✓							
Mega-Omega																				
The Companion Card	✓			✓		✓		2			✓	✓								
The Companion Card Plus	✓			✓		✓		2			✓	✓						✓	✓	✓
Quadram																				
Liberty-PC	✓			✓	✓			2							✓					
Liberty-AT	✓		✓			✓		2	2						✓					
Quadboard-AT	✓		✓			✓		1.5	2									✓	✓	
QuadEMS+	✓	✓		✓	✓			2												
QuadEMS+I/O	✓	✓		✓	✓			1	1							✓		✓	✓	✓
STB																				
Memory Companion/PC	✓		✓	✓	✓	✓	✓	2			✓	✓								
Tall Tree																				
JRAM-3	✓			✓	✓			2			✓	✓						✓	✓	✓
JRAM-AT-3	✓		✓			✓		2			✓	✓						✓	✓	✓
Tecmar																				
640 Plus	✓			✓	✓	✓	✓	2			✓									
Maestro AT	✓			✓		✓		2.5			✓	✓					✓	✓	✓	
Thesys																				
Fastcard III	✓			✓	✓			2			✓	✓								
Fastcard IV	✓			✓	✓			1	1		✓	✓						✓	✓	✓

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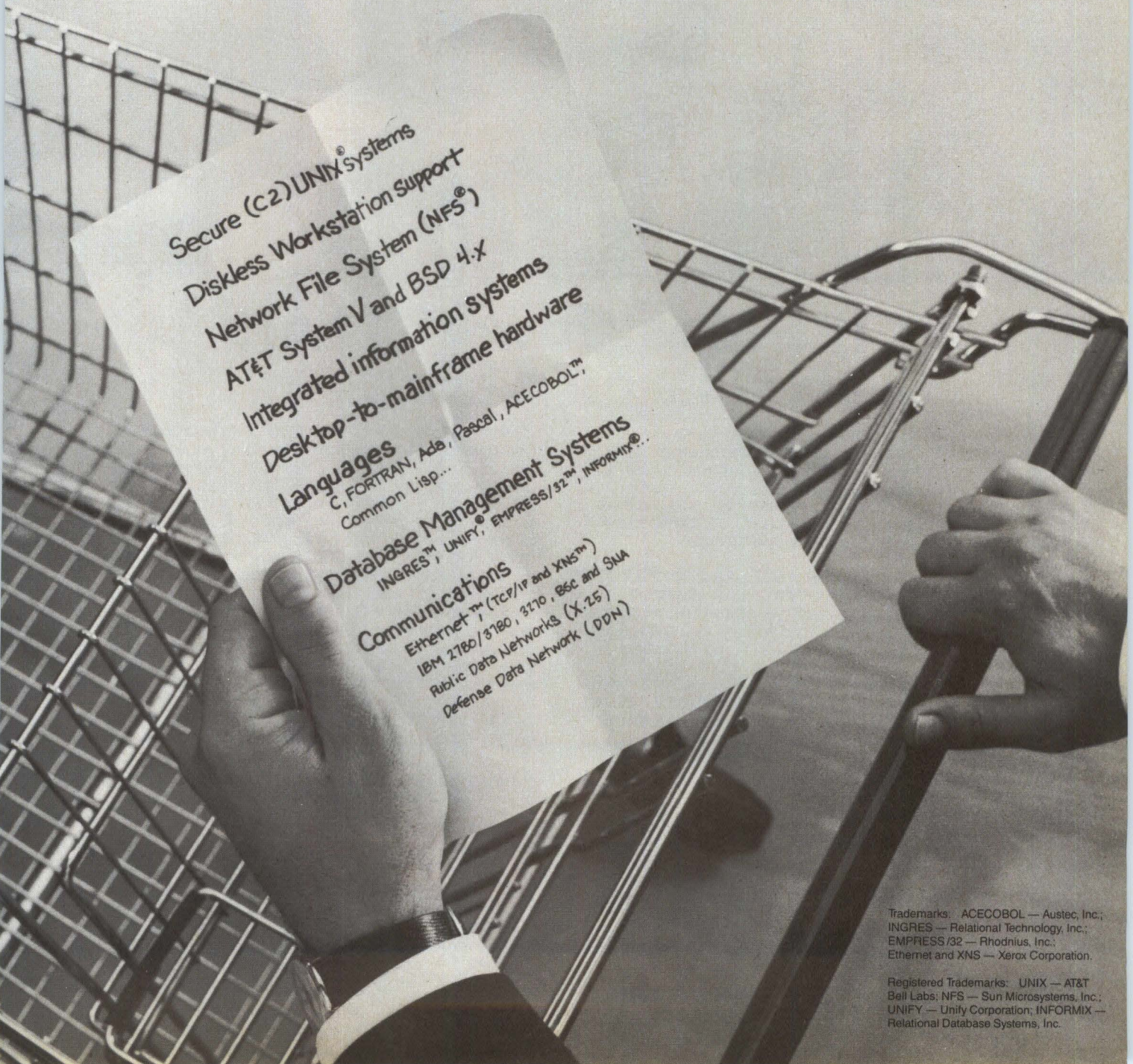
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will probably require extensive modifications to run under extended-mode DOS, analysts don't see it as signaling the demise of the expanded-memory-board market. In any case, the vast installed base of PCs and PC/XTs will

still have to be served—by expanded-memory boards and software.

Thus, the leaders of both the EMS and EEMS expanded-memory-board camps, Intel and AST Research, are optimistic about the future of their products.

"There is no question of obsolescence," contends Intel's Above Board product marketing manager, Anita Johnson. "Users should realize that when protected-mode DOS appears, their Symphony program is not going to instantly run to 8M bytes. There will be a greater market for expanded-memory products when users become aware of what protected-mode won't do for them."

"If you want to wait two years [for extended-mode MS-DOS], it may be worth it," says AST Research's Paradiso. "But it is a gamble even then. Our expanded-memory products provide that same functionality today." □

The advent of protected-mode MS-DOS may cause problems for future sales of expanded-memory boards.

Companies mentioned in this article

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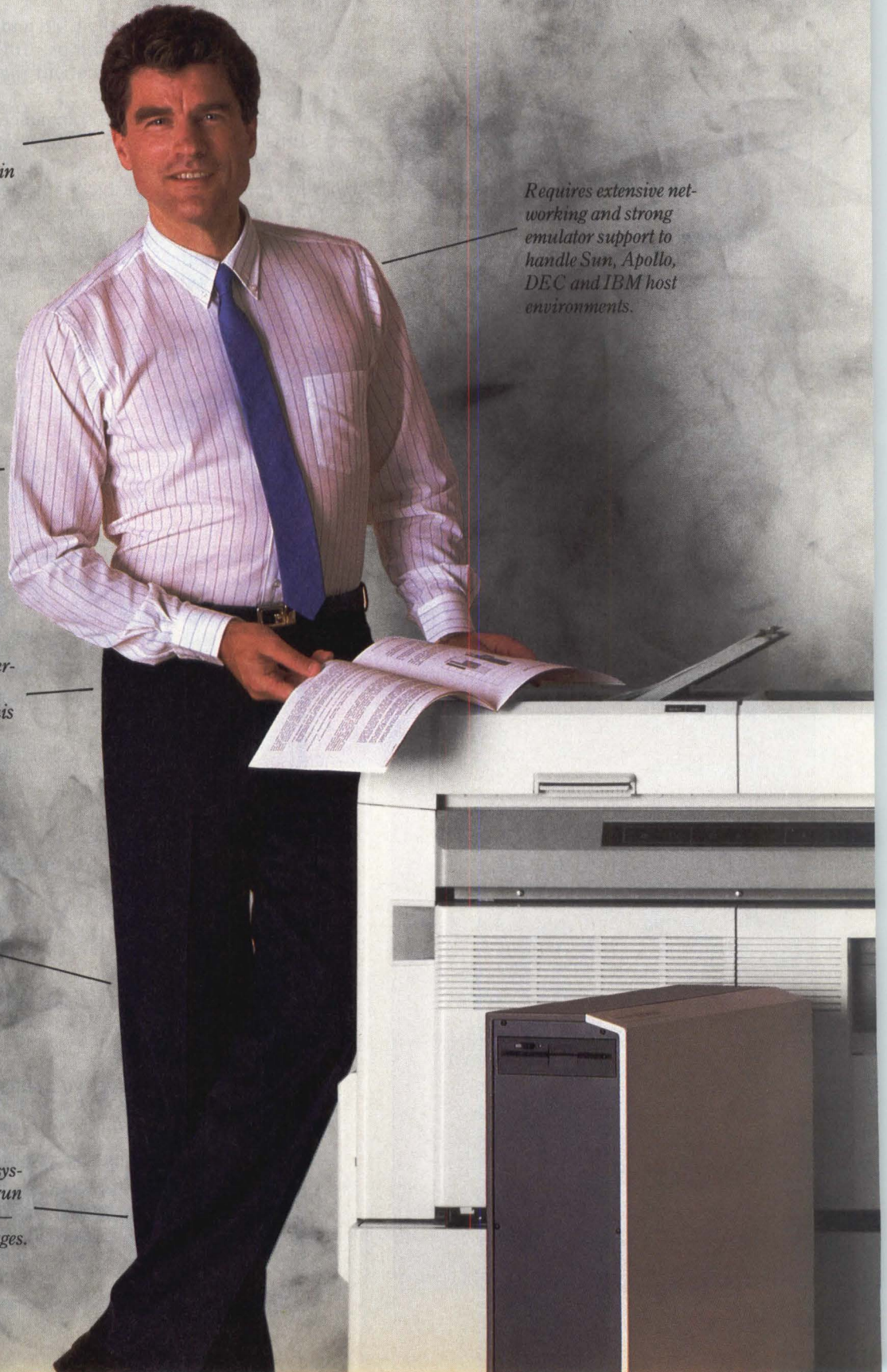
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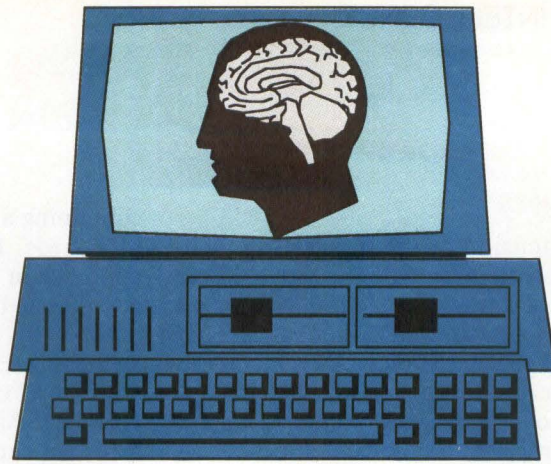
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SOFTWARE INTEGRATES AI, STANDARD SYSTEMS

A range of techniques and tools integrates knowledge systems with existing conventional systems and simplifies their development

Wendy Rauch-Hindin
Special Features Editor

Although short-staffed, Delco Products needs to come up quickly with design and production drawings for DC motor components. First Financial Planner Services is anxious to maintain qualified staff with sufficient time for comprehensive financial planning so the company needn't lose or turn away clients. In still another situation, some geographically spaced IBM Corp. customers are upset because IBM takes 10 days to quote prices to move computers from one site to another. These companies joined the growing number that have solved such problems with the help of knowledge-based systems.

In the last few years, knowledge-system tools and prototypes have become widespread in business and industry. Moving these tools and prototypes to production environments where they can be used in an organization's everyday operations is this year's challenge.

Cost is currently the biggest barrier to fielding knowledge systems. To reduce artificial-intelligence costs, companies are introducing less expensive versions of LISP machines, as well as tools and languages to run AI systems on conventional computers (MMS, August, Page 57).

Second only to the problem of cost is that of the need for integration with standard (i.e., non-AI) systems. "A standalone knowledge system is a temporary phenomenon—a stage

probably necessary to go through—as people are learning and experimenting with the capabilities that knowledge systems can provide," says Richard Ten Dyke, assistant for business-analysis products and technology at IBM, White Plains, N.Y. "But these programs cannot exist in a vacuum. Ultimately, the goal will be to integrate knowledge systems into standard business systems."

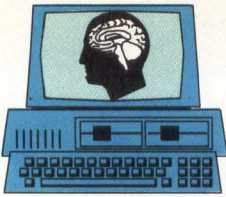
The problem of integration is bigger than just applying AI technology. Various levels of integration exist. They can be classified in two major categories, each of which uses many methods: Knowledge-system applications can access or interact with standard applications and databases, or they can be embedded in a conventional program.

Focus on integration

The simplest and most common integration method relies on AI and traditional software operating on a single processor. AI programs running on minicomputers, mainframes and workstations are examples. With this approach, traditional programs and databases that run on the processor are callable from knowledge systems and vice versa.

Going one step further, Hewlett-Packard Co. has tightly integrated LISP with FORTRAN, C, Pascal and HP-UX (HP's version of UNIX). As a result, programmers can edit, compile, test and debug FORTRAN, C and Pascal programs incrementally and interactively, using LISP or UNIX techniques without ever leaving the

Cost is currently the biggest barrier to fielding knowledge systems.



LISP editor.

Another extension of the integration technique is illustrated by Silogic Inc.'s Logic Workbench, a knowledge-system development tool that interfaces to UNIX databases. That the Logic Workbench is Prolog-based facilitates integration because Prolog has many characteristics of relational databases, including query- and database-representation capabilities.

Software communicates

Another approach is to have the software operating on different processors. LISP Machine Inc. (LMI), for example, runs LISP software on LISP processors that reside in the same box as UNIX running on a Motorola Inc. MC68010 processor. Software on the UNIX and LISP processors communicate. This architectural feature has supported LMI's development of real-time knowledge-based systems, in which the UNIX processor performed data acquisition and passed the data to the LISP processors, which, in turn, performed knowledge-based analysis and diagnostic tasks.

In addition, Xerox has designed a new LISP chip without an embedded bus in VLSI so that coprocessor LISP boards containing the chip can be targeted at various industry-standard buses.

Gould Inc., Texas Instruments Inc. and Xerox Corp. also have or are working on integration through coprocessor techniques. Gould plans to incorporate LISP system boards in its programmable controllers. TI plans to install the UNIX boards from its Business System 1500 minicomputer in its Explorer LISP machine to support integrated systems. Xerox supports an Intel Corp. 80186-based MS-DOS coprocessor board in its 1185 and 1186 systems. The LISP and MS-DOS boards can communicate and exchange data.

A bus coupler represents another integration technique. Flavors Technology Inc., for example, makes a bus coupler that couples the backplane of either LMI's or Symbolics Inc.'s LISP machines to the backplane of the Gould PowerNode 9000 superminicomputer. This level of integration allows LISP machine users to access data, applications and work that has been performed by the Gould computer.

LMI's Lambda OEM box extends the bus-coupling approach to integration. LMI is selling the system to large end users and value-added resellers who want to embed AI processing within their computers.

The Lambda OEM box is basically the Lambda chassis with the LISP processor but without peripherals. LMI sells it as a chassis

containing a backplane with a board or as a set of boards. It differs from the bus-coupling approach in that, after integration, the Lambda is only one box.

Typically, a user such as Gould might buy the Lambda OEM box to provide its computers with an AI option. However, LMI says that its OEM LISP processor boxes will not come in standard configurations. Instead, LMI will define the pin sockets and custom embed the boards for each vendor. LMI estimates the price for a custom configuration at \$15,000 to \$30,000 in large quantities.

Integrate via networking

Networking is the second most common method of integrating AI systems with data and traditional programs. LMI supports the General Motors Corp. Manufacturing Automation Protocol (MAP). Xerox, Symbolics and TI are working on these protocols. The LISP machines also generally support Ethernet, Transport Control Protocol/Internet Protocol (TCP/IP) and, lately, Systems Network Architecture (SNA).

More recently, TI signed separate networking agreements with Apollo Computer Inc. and Sun Microsystems Inc. The Sun agreement is to install Sun's Network File System (NFS) in the TI Explorer. The NFS implementation provides transparent access to files on Sun's UNIX workstation and TI's Explorer.

The other agreement calls for an Apollo Domain communications board to be plugged into the TI Explorer, making the Explorer part of the Domain network. The Domain communications board contains microprocessors, memory and software to execute the Domain communications protocols, recognize the Domain and LISP operating systems and extend the Domain's virtual demand-paged memory techniques across the LISP machine as well as across the Explorer computers. Domain's virtual demand-paged capabilities allow any computer on the network to store, access or execute information on any other Domain-network computer as if it were on its own.

Embed value-added AI

The second generation of integrated AI and conventional systems embeds value-added AI capabilities in conventional programs. Users see a single application instead of separate programs, and users may not be aware that they are dealing with AI.

One such application, Guru, from Micro Data Base Systems Inc., embeds knowledge-system techniques in an environment that sup-

Using knowledge-system development tools is as easy as learning a programming language.

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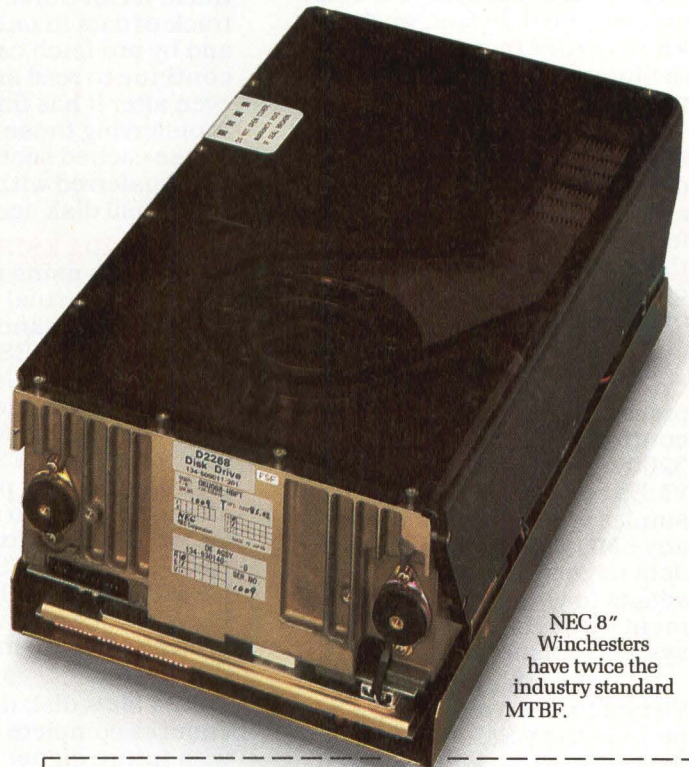
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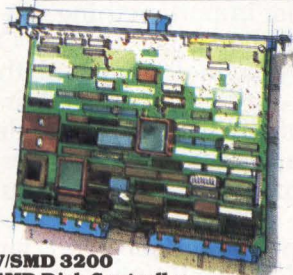
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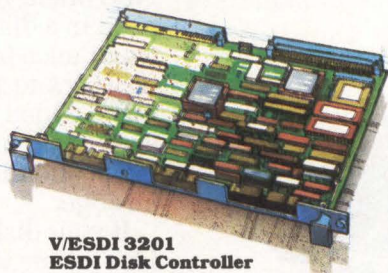
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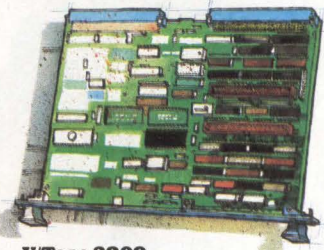
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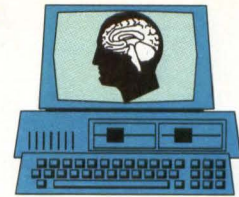


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ports integrated spreadsheets, text processing, relational database management, report generating, graphics, communications and business computing. Guru users and developers can use a simple English-like language and a knowledge-system development tool to develop a rule-based knowledge system employing backward chaining—a reasoning technique in which a knowledge system hypothesizes that a solution is true and then links backward through rules to find evidence to support the hypothesis. Guru-developed knowledge systems differ from traditional knowledge systems in that Guru's rules are more versatile.

In most knowledge systems, the premise, or "IF" part, of a rule refers to working variables; the conclusion of a rule supports assignment statements, advice or procedures. Guru, however, also allows rule premises and conclusions to refer to spreadsheet cells; perform spreadsheet processing; create, access or update databases; handle graphics generation and remote communications; and perform a variety of built-in functions for business processing (Fig. 1).

Guru also allows users to define a cell of a spreadsheet to be a knowledge-system consultation: When the user re-evaluates the spreadsheet, the value of that cell is determined not by an arithmetic formula but by the result of the rule-based consultation.

Simplify the complicated

The greatest technology is useless if few people understand it. Tools make technology transfer easier. The power of knowledge-system development tools lies in their ability to be used by people with no AI experience.

Knowledge-system development tools con-

tain an inference mechanism—an easy-to-use user interface, shell or template—to which knowledge engineers add application-specific information for a knowledge base and also a control mechanism to control the order of a consultation. To develop a knowledge-based application, knowledge engineers interview experts in the application field. They then use the tools' user interface to encode the knowledge and some control information and enter them in the knowledge base. When the application executes, it uses the inference mechanism supplied with the tools.

Using knowledge-system development tools is as easy as learning a programming language. After one week, system developers can do something useful. After three months, they become facile with the tool. But it takes six months to a year for them to become virtuosos.

The tools practically automate the coding of a knowledge system. But system developers should not let this automation lull them into false confidence about how easy it is to build knowledge systems. As with any complex software development, the analysis, planning and design steps that occur before writing the program and the testing and debugging that occur afterward are far more difficult and time-consuming than is coding.

The 'Four Musketoools'

A variety of tools exist for LISP machines, minicomputers, mainframes, workstations and personal computers. The "Four Musketoools"—the most commonly known large-scale tools—are Knowledge Craft, from Carnegie Group Inc.; Knowledge Engineering Environment (KEE), from IntelliCorp; Automated Reasoning Tool (ART), from Inference Corp.; and S.1

```
RULE: R782
If: Sum (#B18, #B31) > 4200
Then: Select prodname, qtrnum, quota, sales from thisyr\
      Where prodname in ["computer", "scifi", "reference"] & repname=#B17\
      Order by prodname, qtrnum
Comment: Select a sales rep's performance data for certain product
         lines from the integral THISYR table in the event that cells
         B18 through B31 in the integral advertising budget spreadsheet
         exceeds 4200.
```

TRANSLATION

```
If: The sum of spreadsheet cells B18 through B31 exceeds 4200
Then: Select product name, quarter number, quota, sales from the
      "This Year" table
      Where the product name is "computer" or "scifi" or "reference"
      and whose rep name is the same as the name appearing in cell
      B17 of the spreadsheet.
The results are dynamically sorted by product name, and within
that grouping by quarter number.
```

Fig. 1. A knowledge-system rule integrates spreadsheet processing and a structured-query language (SQL) query of a relational database. (Based on the quota advisor example in Manager's Guide to Expert Systems Using Guru, Dow Jones-Irwin, Homewood, Ill., 1986.)



from Teknowledge Inc..

Of these tools, S.I is the simplest to learn to use. It is primarily a rule-based, backward-chaining tool that also features a block-structure language. It has sometimes been accused of being limited in techniques and useful only for diagnostic applications, but S.I users have revealed in interviews that they were never at a loss. Delco Products used S.I to build its design systems for DC motor components.

KEE and ART—especially the newer versions—are similar to each other in functionality and capabilities. In their new versions, KEE 3.0 implements viewpoints, previously one of ART's most popular features, while ART 3.0 implements object-oriented programming, a popular feature in KEE.

Babcock & Wilcox Co., New Orleans, have used KEE to build a welding scheduler, and Lawrence Livermore Laboratories has used it to build an intelligent interface to instrumentation. In addition, the Electrical Power Research Institute has used KEE to build a crisis-management system for a nuclear-power plant. Of the tools that support multiple AI paradigms, KEE is the simplest to use. One reason is its dramatically graphical, well-thought-out user interface.

KEE supports both rules and frames for knowledge representation, backward and forward chaining, object-oriented programming, an active-values mechanism and viewpoints, which Intellicorp calls "worlds." KEE's active-values mechanism provides a straightforward way to attach procedures to frame slots so that when these slots are accessed or changed, specified procedures execute. For example, if the temperature represented in a frame slot is increased, it might trigger a procedure that actuates a thermostat or causes the temperature in an image of a thermometer to change accordingly.

KEE worlds allow users to hypothesize various situations and reason about them in parallel. For example, a distribution knowledge system that matches trucks, drivers, routes and products—using knowledge like "milk must be shipped in refrigerator trucks over a route that doesn't require too many stops"—might hypothesize various itineraries of different routes, stops, trucks and drivers (Fig. 2). Rules would then reason about each itinerary, eliminate the poor ones, shown by crossed-out squares in Fig. 2, and eventually reason their way to the best itinerary.

Creating hypothetical worlds is simple in

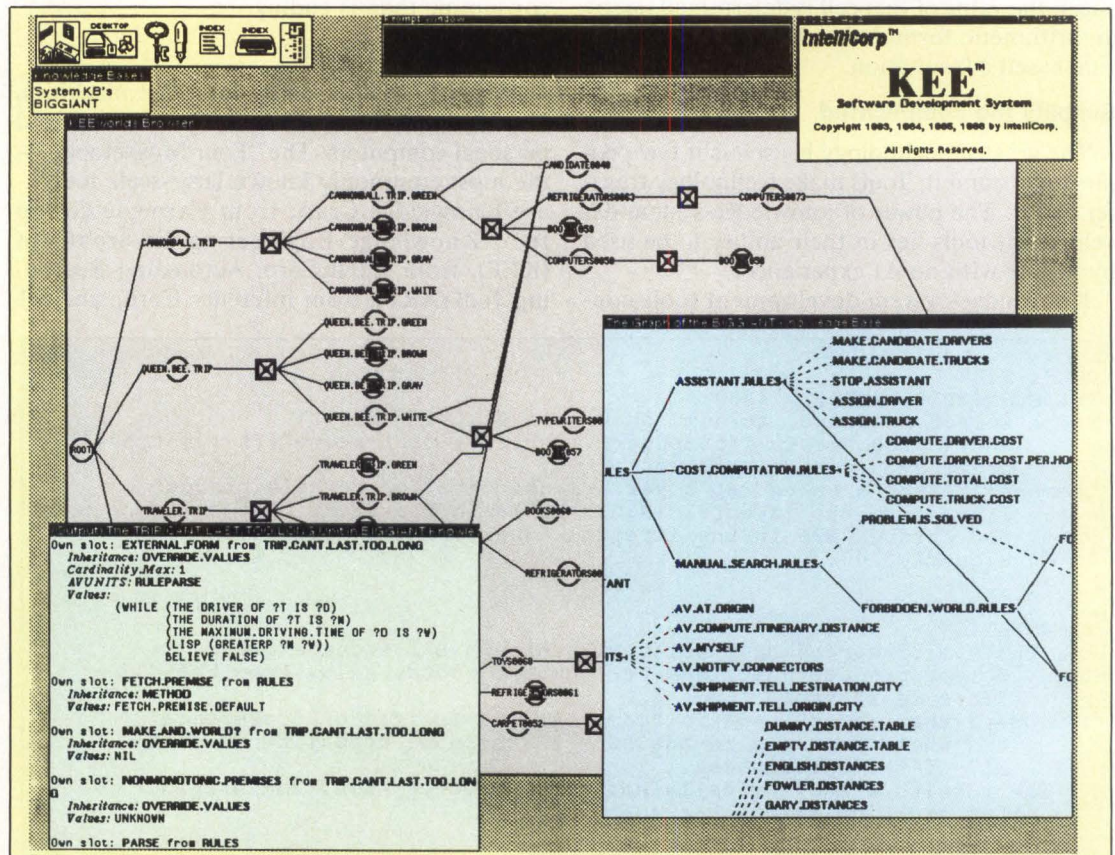


Fig. 2. KEE worlds provide a simple graphical interface for users to create and reason about several hypothetical situations simultaneously.

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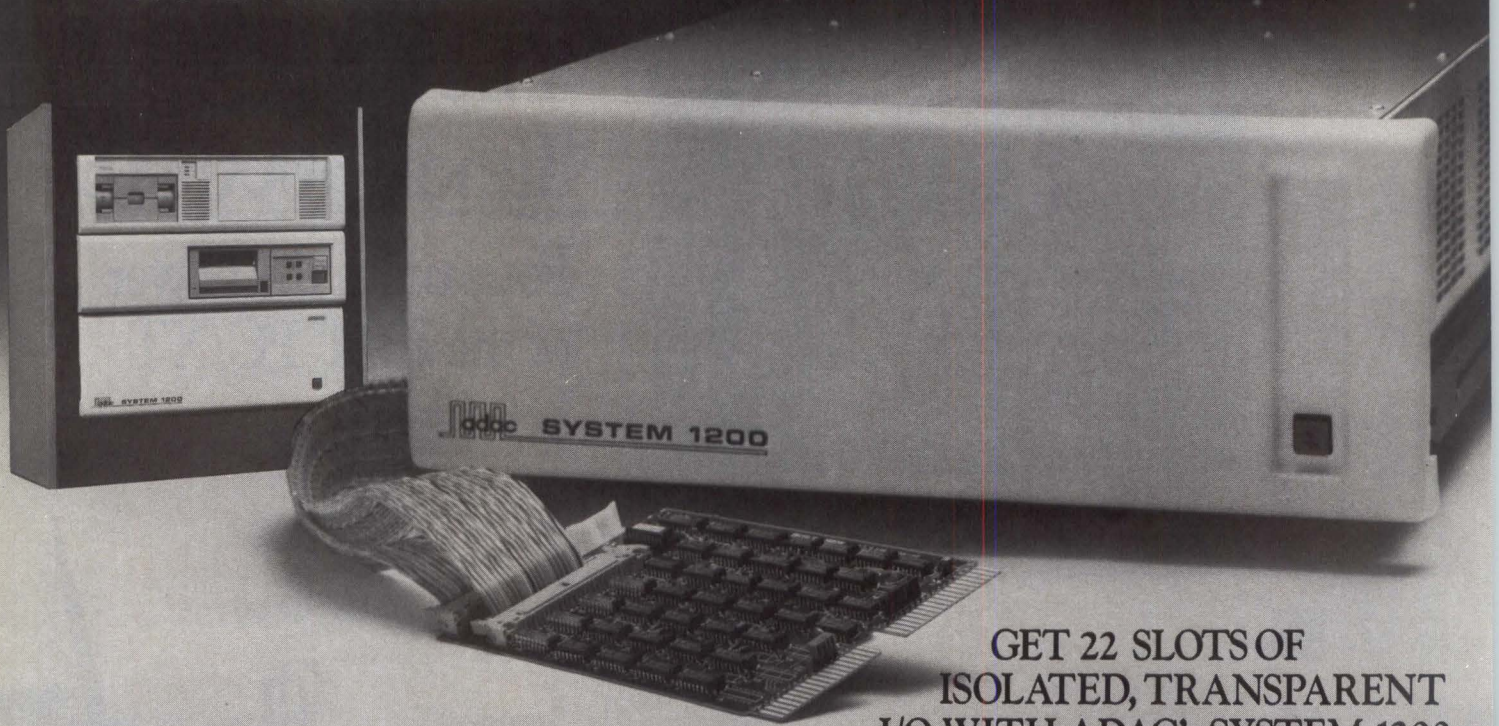
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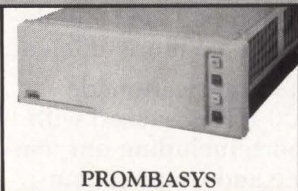
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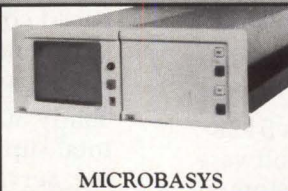
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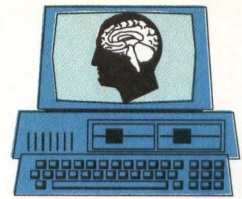
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KEE because of KEE's graphical interface. Users can merely display a hierarchy of objects in the trucking system, shown on the right side of the figure, use the mouse to indicate an object in the hierarchy, select the option to add a "child-link" and create the "child." Alternatively, a program can create the child during the program's execution.

'Objects d'ART'

In the past, ART was considered a higher end—but more difficult-to-use—tool than KEE. Proof of ART's capabilities is found in the Hughes Radar Systems Group's circuit-board-diagnosis system, Composition Systems' electronic-typesetting and editorial-layout knowledge-based software and Eastman Kodak Co.'s knowledge-based document-management and -updating system for the F-14 aircraft documentation.

ART supports rules, frames, integrated backward and forward chaining and viewpoints for reasoning about hypothetical worlds. Inference emphasizes ART's optimization for high performance. ART's latest release adds two major features: object-oriented programming capabilities and the elimination of "garbage collection."

Object-oriented programming facilitates exploratory programming and rapid prototyping in AI systems. It allows code changes to be easily made without disturbing the rest of the program because it encapsulates specific procedures with objects—anything that can be given a name, such as a document, a file or an ASCII terminal. Object-oriented programming also supports reusable code because the objects and their associated procedures are arranged in an "inheritance hierarchy." "Child" objects at lower levels of the hierarchy "inherit" attributes and procedures from "parent" objects higher in the hierarchy. Therefore, the only procedures and attributes that need to be written for objects at the lower levels of the hierarchy are those that make the objects unique; the others are inherited.

Some conventional programs embed object-oriented programming. For example, in Syntactics Inc.'s CrystalWriter, a word- and document-processing program, an object-oriented implementation allows VARs to rapidly prototype and develop complex functions, such as those used in publishing.

In object-oriented programming, procedures are called methods, and ART's version of methods is called "multimethods." Multimethods allow users to send a message—a procedure to be executed—to a generalized group of closely

linked objects instead of to only a single object. This, in turn, allows for fewer procedures to be written because each one handles more objects.

For example, a factory system might be divided into subsystems, and each subsystem might be divided into machines. During production, certain groups of machines, such as a feeder, a milling machine and a transporter, must be periodically synchronized. With multimethods, a single generic synchronization procedure can be written for these machines. The message "synchronize" is then sent to the generalized class that contains the machines to be synchronized. This synchronization procedure would differ from the procedures used to synchronize other groups of machines.

Eliminates 'garbage collection'

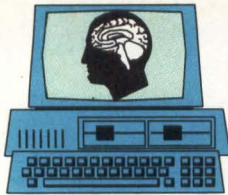
Programmers writing knowledge systems write rules that assert and retract facts. When a fact is asserted, LISP allocates the memory needed. Normally, when the fact is retracted, the operating environment drops the pointer to that area of memory and then waits for a LISP garbage-collection program to reclaim the memory and add it to the free-memory table.

Identifying and reclaiming "garbage" is a high-overhead operation. Some LISP machines collect garbage incrementally so that the garbage-collection program does not bring the AI program to a halt while it completes its job in batch mode. Other LISP machines speed garbage collection by handling it in hardware. ART 3.0 eliminates garbage collection by employing intelligent memory management to avoid generating any garbage.

Toward this end, ART 3.0 maintains its own database of allocated and deallocated memory. When a fact is retracted, ART instantly reclaims that fact's allocated memory and adds it to the free list, instead of letting it become garbage. Allocating and deallocating memory is internal to ART and hidden from the user. Inference describes the memory-management software as more complex and more difficult to develop than garbage-collection programs. But it balances these drawbacks against significant performance advantages.

The memory-management software improves performance by eliminating random pauses during which the program performs batch garbage collection or by avoiding the reduced virtual-memory space and poor swapping performance associated with incremental garbage collection. Programmers using ART 3.0 also gain more control over their programs' performance. They can do timing and sizing analyses that they cannot do in normal LISP.

Object-oriented programming facilitates exploratory programming and rapid prototyping in AI systems.



ARTIFICIAL INTELLIGENCE

Many people consider Knowledge Craft to be the high end of all AI tools but the most difficult to use. It both suffers and benefits from its history and its newness.

Knowledge Craft is an outgrowth of Schema Representation Language (SRL), a tool developed at Carnegie-Mellon University (CMU). In its precommercial days, Knowledge Craft was used to build ISIS—a CMU-Westinghouse Electric Co. factory-scheduling system—and various other planning, factory-management and monitoring systems for Westinghouse, Digital Equipment Corp., the U.S. Air Force and the Aluminum Company of America (ALCOA).

CMU researchers formed the Carnegie Group two to four years after the formation of the other Musketool companies. The Carnegie Group's founding fathers brought with them several years of experience in building operational knowledge-based manufacturing systems. However, because researchers built these systems, their prime concern was functionality rather than user interfaces for development tools. Consequently, Knowledge Craft is an amalgam of knowledge-representation methods, languages and specialized features that help it to model organizations at various levels of abstractions—from machines, materials and people, to tasks, goals, time and beliefs. Meanwhile, Carnegie Group knowledge-system developers are working to sugarcoat the system to provide a friendlier interface.

Knowledge Craft features rules and frames for representing knowledge. It supports three languages: OPS5, Prolog and CRL—a frame-based language. Another feature, an agenda mechanism, tracks multiple queues of events and manages scheduling of the events for execution—useful for such applications as simulation and scheduling. The agenda mechanism can also track multiple contexts—subdivisions of a problem—sprouted by rules, thus creating, in effect, a viewpoint mechanism.

Recently, Carnegie Group developers have integrated the OPS5, Prolog and CRL languages, and added a consistent knowledge-programming interface. In addition, they have introduced a family of upward-compatible versions, including a streamlined version with C object-code output for embedding AI in conventional applications, and subsets for delivery systems. In any case, after initial development, users can add knowledge through menu-driven interfaces without using any of the Knowledge Craft languages.

A unique attraction of Knowledge Craft is a natural-language interface, the result of inte-

grating Knowledge Craft with Language Craft—a Carnegie Group natural-language system. The integration allows Knowledge Craft-based systems to obtain natural-language input. The ultimate goal is to allow knowledge engineers to use natural language to acquire domain knowledge and develop knowledge systems.

Good things come in small packages

The four granddaddy knowledge-system development tools have been followed by countless others that run on minicomputers, workstations and personal computers; in LISP and Prolog; and under UNIX and MS-DOS. KES, for example, from Software Architecture & Engineering, is primarily a rule-based system that supports backward chaining and Bayesian statistical methods. It runs under UNIX, Aegis, VMS and MS-DOS. KES-based knowledge systems can be embedded as subroutines in larger applications.

RuleMaster, from Radian Corp., runs under UNIX and MS-DOS. It integrates two components. One induces decision trees from examples of situations and actions represented in tables. The other is a block-structured, recursive-procedural programming language. The solutions produced by RuleMaster-based knowledge systems can be executable procedures, advice or data.

Another tool, ADS (Aion Development System), from Aion Corp., runs on personal computers under MS-DOS and on IBM mainframes under MVS. The personal computer and MVS versions are compatible, thus allowing applications to be moved between the two environments. Designed for commercial data-processing environments, ADS sports rules, graphics and report generation, and it interfaces to Ashton-Tate's dBASE, Lotus Development Corp.'s 1-2-3 and Microrim Inc.'s R:base. The personal computer version supports demand paging—unusual for personal computer-based systems.

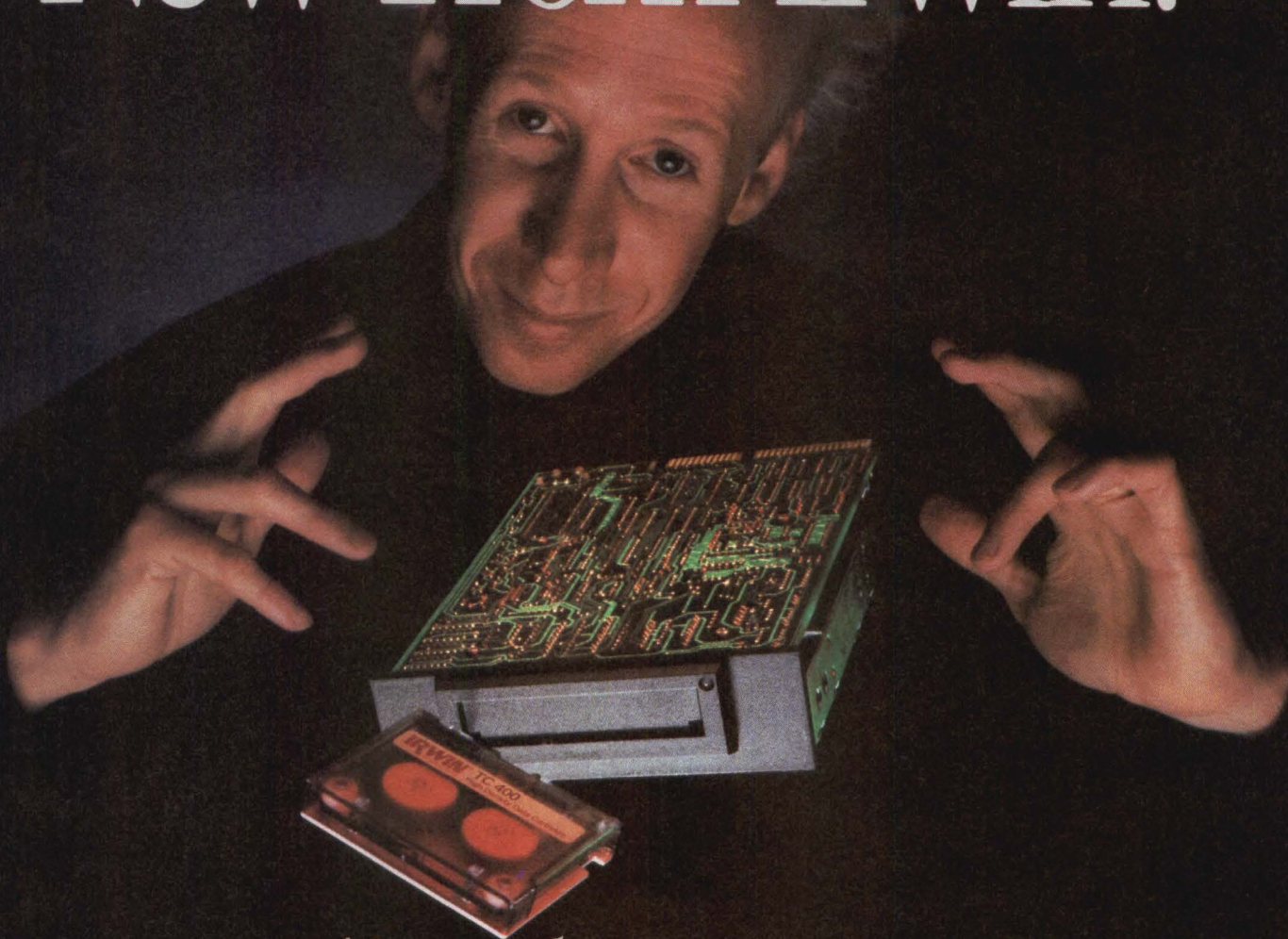
Caveat emptor

A huge number of personal computer-based AI tools have been introduced. Some, such as M.1 from Teknowledge and the Personal Consultant from TI, are scaled-down versions of large-scale tools (Fig. 3). They differ from large-scale tools in that they contain only one knowledge representation method—usually rules—contain only one inference strategy—usually backward chaining—and lack the specialized features of the large-scale tools.

Tools such as these have been used to write small commercial applications that many com-

Within the last year, several companies have translated their LISP-based knowledge-system development tools into C.

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panies find useful. Because they are scaled-down, less expensive versions of larger tools, they also may make good entry-level tools that would-be knowledge-system developers and users can test to explore AI techniques and the applicability of AI to their problems.

To help users graduate from entry-level to large-scale applications, TI now has three compatible versions of the Personal Consultant: a low-end version called Personal Consultant Easy, a higher end version called Personal Consultant Plus and a version of Personal Consultant Plus that runs on the Explorer and takes advantage of the LISP machine's environment. Because the systems are compatible, knowledge bases developed with the low-end product can be expanded under Personal Consultant Plus. Also, knowledge systems developed on the Explorer can be delivered, sans the Explorer environment, to execute under Personal Consultant on a personal computer. An interface on the personal computer integrates both personal computer versions of the Personal Consultant with dBASE II and dBASE III.

There are too many personal computer-based knowledge system tools to discuss here. However, users should be aware that, while some of them are useful for a variety of applications, a number of them are not inexpensive AI tools but overpriced toys. These tools might have cute user interfaces but inadequate methods for

representing knowledge and limited methods of reasoning. They frequently lack an explanation facility and the ability to handle uncertain heuristic knowledge. Often they bear too little resemblance to AI tools to be even suitable for learning.

Users deciding on one of these tools must view the applications they can solve in light of three questions. First, are they useful? Second, are the applications so trivial that they could be designed in a conventional language such as BASIC? Third, do they really educate the users in AI capabilities?

Within the last year, several companies have translated their LISP-based knowledge-system development tools into C. Teknowledge, for example, wrote both a delivery and a development version of its S.1 tool in C, in addition to a C version of M.1, its scaled-down personal computer-based tool. Inference has translated ART, including its development environment, into C. And Carnegie Group plans to develop a C version of its next-generation Knowledge Craft tool.

Translating the tools involves writing the compiler and the environment in C. This underlying C, however, is transparent to users. They see the same syntax, environment, rules and so on as they did previously.

The value of these translations from LISP to C is controversial. Some vendors are implying

EVENTS	CONCLUSIONS
<pre> Seeking result-of-field-arc-test Found result-of-field-arc-test Found cause-of-fault-in-charging- system </pre>	<pre> cause-of-fault-in-charging- system = alternator-casing-has- a-short </pre>
REASONING	OPTIONS
<pre> Invoking kb-2 if result-of-oscilloscope-test = straight-line and result-of-field-arc-test = hot-yellow then cause-of-fault-in-charging-system = alternator-casing-has-a-short kb-2 succeeded </pre>	<pre> none blue hot-yellow </pre>
<pre> Please perform a standard oscilloscope test. What type of pattern do you see? >> straight-line. Turn on the ignition and pull out the filed connector to the alternator. What type of flash do you see? >> hot-yellow. cause-of-fault-in-charging-system = alternator-casing-has-a-short (100%) because kb-2 </pre>	

Fig. 3. The M.1 knowledge-system development tool, which runs on personal computers and the IBM PC-AT, is a scaled-down version of Teknowledge's S.1 tool (from Rauch-Hindin, Artificial Intelligence in Business, Science and Industry, Volume I: Fundamentals, Prentice-Hall, N.J., 1986).



that the translations increase performance, as though this were an attribute of C vs. LISP. But this is not necessarily true—Carnegie-Mellon's Scott Fahlman, senior research computer scientist, bristles at the suggestion—and it may be less true in the future. If the LISP on a machine is fast and efficient, which many of the new workstation LISPs are, the chief advantage of conversion to C is the wider market opened up for vendors' AI products.

Fahlman claims that the best C compiler probably outranks the best LISP compiler by 20 percent to 30 percent on any given machine. The reality is that some machines have fast C compilers and slow LISP compilers, while others exemplify the reverse.

For example, VAX LISP is not considered fast, and, therefore, translation from LISP to C offers performance improvements on the VAX. However, the portable C compiler that runs on the IBM RT PC is rather slow, and the Common LISP at Carnegie-Mellon regularly trumps it on benchmarks. Lucid Inc.'s Common LISP for the Intel Corp. 68000 family is another

example of a new LISP that has proved quite fast in benchmarks.

In cases like these, Fahlman sees little benefit in C conversions. He recommends leaving the complicated functions, interfaces and environments in LISP but calling specific C subroutines for better performance. By not converting the rest of the system, both users and developers retain the advantage of LISP's ability to be extended.

PCs: a horse of a different color

LISP systems on personal computers are a different story. Personal computers have limited physical memory and lack virtual-memory capabilities. LISP consumes a large amount of memory because the entire LISP environment must be loaded into memory. So a particular program may require 250K bytes of space for itself but 4M bytes to load all known LISP functions. This memory requirement prevents the porting of LISP-based systems to personal computers as a delivery vehicle.

In addition, neither LISP nor Prolog allows

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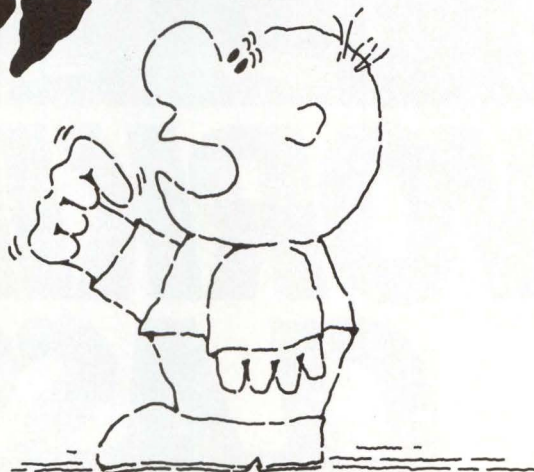
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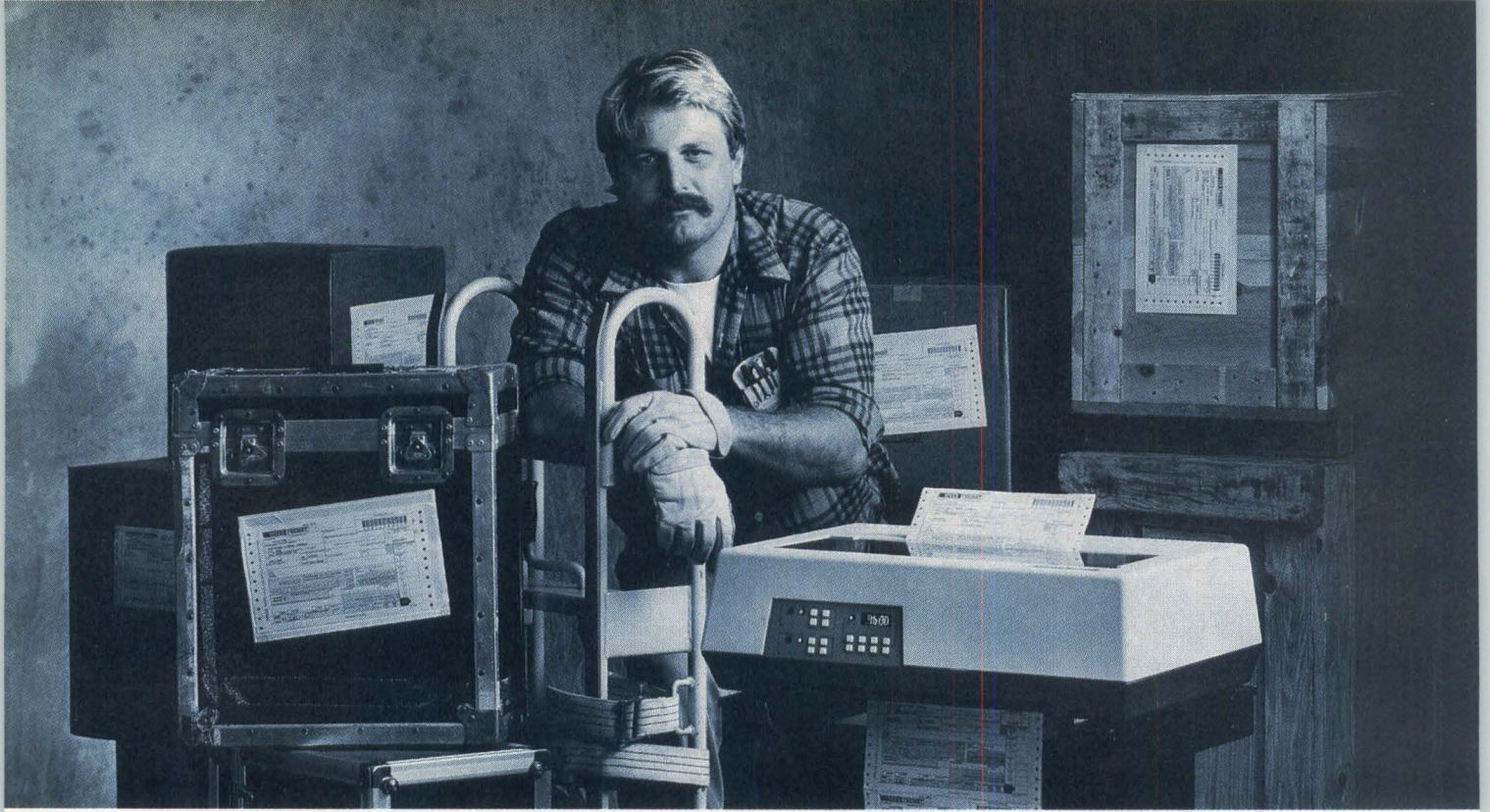
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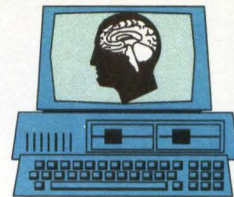
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programmers to manage their memory because the compiler handles memory management. This takes a burden off program designers, but it also prevents them from loading only the functions that an application needs. It also prevents them from specifying the size of an address in order to use extra personal computer memory.

The problem is that LISP and Prolog handle all data via pointers, which are simply addresses in memory. Most Prolog and LISP implementations for personal computers use a 16-bit address for pointers because 16 bits make up the natural word size of the machine. With 16 bits, the language can address a maximum of 64,000 addresses—not sufficient for many AI applications.

Translating personal computer-based LISP or Prolog programs to C means that programmers must allocate their own memory and write more code. In return, they have control over the program and can make it run faster and in considerably less space. The need for C-based memory management disappears on 32-bit machines. In those machines, program-

mers can address 2^{32} , or 4 billion, addresses. Practically speaking, this eliminates memory restrictions.

AI still evolves

All things considered, commercial AI is evolving in production environments. A range of machines is available, and a standardized AI programming language and several tool kits exist.

Some companies have demonstrated that the use of AI technology in production operations saves them money. DEC, for example, says it saves \$18 million per year just for XCON, its knowledge-based computer-configuration system, not to mention several other routinely used knowledge-based systems. It is now up to users to become aware of what AI can do. If they expect more of AI than it can deliver, they will surely be disappointed. □

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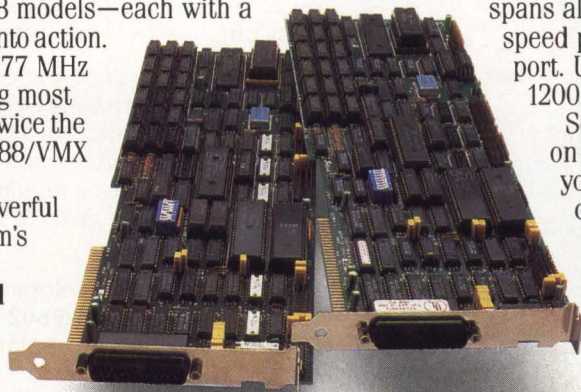
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Carl Warren, Western Editor

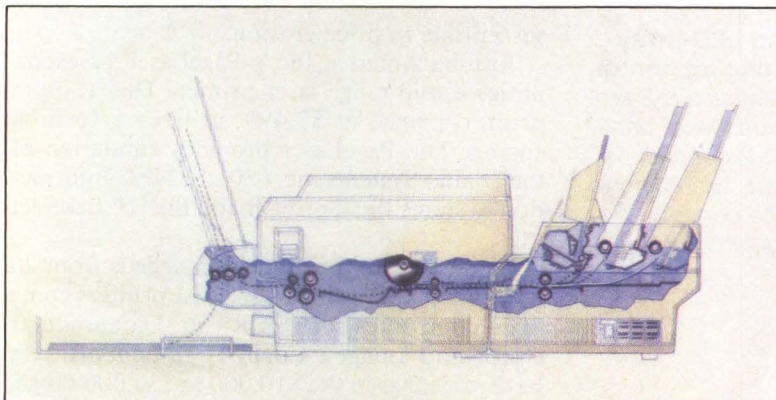
Blazing speeds, color, automatic adjustment of print density—as well as standard features such as collating, stapling and stacking—are just some of the capabilities office photocopier manufacturers are offering in their latest laser-enhanced machines. The leading vendors include Canon U.S.A. Inc., Mita Copy Star America Inc., Ricoh Corp. Ltd. and Xerox Corp.

However, the real news isn't with the copiers, but, rather, with the impact these photocopier enhancements are having on non-impact printers, particularly laser printers.

For example, Hewlett-Packard Co., which has more than 70 percent (over 200,000 units) of the laser-printer market with its LaserJet series, is enhancing its existing products with features found on office copiers. To illustrate, HP has added multiple paper bins and collating to its LaserJet Plus model 500. In addition, the company boosted memory from 128K bytes on the original LaserJet to 512K bytes on the LaserJet Plus to better accommodate business graphics.

All HP models use the Canon LBP-20 print engine, and employ both built-in and plug-in firmware font modules. However, system integrators and end users aren't stuck with fonts welded into firmware. HP's printers also permit downloadable character sets (font definitions transmitted from the host computer to the printer), thus treating users to a large library of character sets.

As the front-runner, HP has established the de facto standard for relatively low-cost laser printers. So, most other laser-printer manufacturers offer, if not exact emulation, capabilities



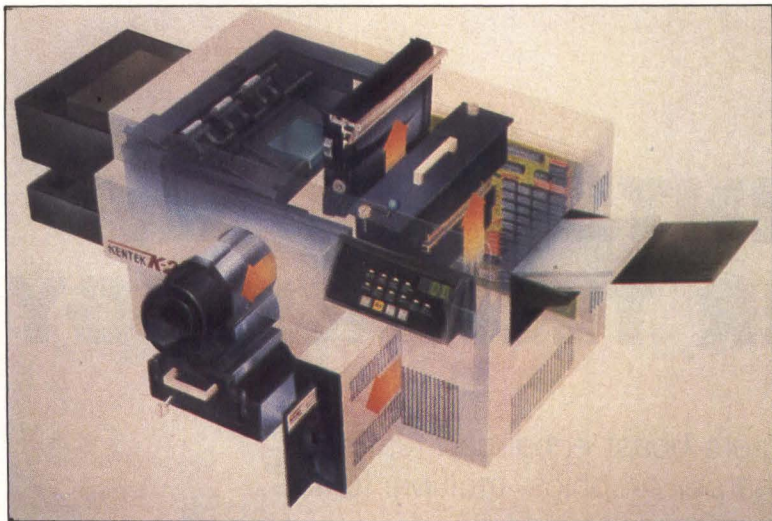
Providing photocopier features for laser printers, BDT's add-ons include multiple paper bins and collating. The system has up to six bins—five for paper and one for envelopes—plus a collator on the end.

similar to those of the LaserJets—including downloadable fonts.

Three categories emerge

Three categories of laser printers are emerging. Typical low-end units are exemplified by Office Automation Systems Inc.'s (OASYS) 8-page-per-minute (ppm), \$1,895 LaserPro Express—built around the Mita LP-X1 engine—and Quality Micro Systems Inc.'s (QMS) 6-ppm, \$1,995 KISS printer—built around Canon's LBP engine.

The mid-range units include models from HP, OASYS, QMS, Ricoh, AST Research Inc., Cordata Inc. and Quadram Corp. These mid-range printers typically provide output of 10 to 12 ppm and cost between \$2,000 and \$4,000. However, this price class may be the most



An LED-array imaging printer, Kentek's K-2 provides laser printer-like functions but, according to the company, greater reliability.

susceptible to price erosion.

Toshiba America Inc.'s PageLaser 12 exemplifies a mid-range laser printer. This 12-ppm printer, priced at \$3,499, utilizes a Toshiba engine. The PageLaser provides emulation of the Diablo Systems Inc. 630, the NEC Information Systems Inc. Sprint II and the HP LaserJet Plus.

High-end laser printers offer speeds from 20 ppm to 40 ppm. These superfast printers come from companies such as Ricoh, Dataproducts Corp. and Imagen Corp. High-end printers have price tags in the \$10,000 to \$30,000 range, and are aimed at the shared-resource market where the cost can be spread across several users.

Taking a different tack, Kentek Information Systems Inc.'s K-2 electronic page printer fits into a unique category. This \$7,995 printer contains 1.8M bytes of memory, delivers 12 ppm in text mode and handles full 8½-by-14-inch bit-mapped graphics. What makes K-2 unique, besides price, is that it uses laser-printer techniques but with a light-emitter diode (LED) array light source, which the company claims is more reliable than laserography. But the printer does require a powerful controller—based on Motorola Inc.'s MC68000 and 6809 microprocessors. A built-in flexible disk drive accommodates down-loadable fonts and special software controls.

How fast are they?

Most laser printers generate 8 ppm to 40 ppm. But quoted print speed affords a poor measure of the real performance of a laser printer, claims Philip Lieberman, president of interface manufacturer Zvert Corp. "More expensive laser printers, such as the Xerox 4045,

appear to be nearly equivalent to the HP LaserJet Plus in performance, but when a complex page is thrown at both of them, the more sophisticated controller in the Xerox holds the print speed to 10 pages a minute while the LaserJet Plus deteriorates rapidly," says Lieberman. He suggests the best way to benchmark a laser printer's performance is to use a program such as Microsoft Corp.'s Word (a word-processing program that supports many types of laser printers) and try printing a long document on both. "In one case," says Lieberman, "we found that the Xerox 4045 performed at twice the speed of the LaserJet Plus." The 4045 costs \$4,995, the LaserJet Plus, \$3,995.

In its marketing approach, Cordata touts speed. Its LP-300X, priced at \$3,895, offers 1.25M bytes of internal memory, making it possible to print a full page of 300-dot-by-300-dot graphics in about 18 seconds—which may be arguably the fastest in the industry among low-cost laser printers. Other printers provide faster speeds, but at significantly higher prices.

In specifying a laser printer, consider speed and price as only the first considerations. Other key aspects exist, many of which center on compatibility and performance:

- Available printing area
- Paper sizes supported (some only support letter size)
- Emulation completeness
- Availability of a manual paper input slot
- Number of font cartridges available
- Cost and availability of downloadable fonts
- Print quality
- Size of paper bins (number of pages).

Additionally, end users are particularly interested in maintenance and page costs. Obviously, there are many ways to define the operational cost per page. For example, HP claims that the LaserJet Plus has a use cost of three-tenths of a cent per page, which is 2 to 5 cents less expensive than a photocopier and about 4 cents cheaper than a daisywheel printer. But this calculation doesn't take into consideration paper, maintenance and toner cartridge costs—which vary depending on the supplier.

Add-ons sharpen operation

A variety of companies add value to existing laser printers with products that are usually associated with photocopiers. One example is BDT Products Inc., which makes a line of paper trays, stackers and collators. The BDT system permits printing one- to six-page documents, as well as envelopes. This system, called

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LaserFeeder, relies on software control from the host rather than on master control from the laser printer. It has dual paper bins and an envelope bin and handles paper sizes from 4 inches to 8½ inches wide and up to 14 inches in length. It costs \$1,895. The BDT \$4,495 Laser Multifeder handles similar paper sizes but increases the number of paper bins from three to six (five for paper, one for envelopes).

BDT also offers the \$149 Flipper, which fits on the output side of the printer. This device, made specifically for 8-ppm printers like HP's LaserJets and other printers based on the Canon LBP engine, collates printed sheets in a 400-sheet bin.

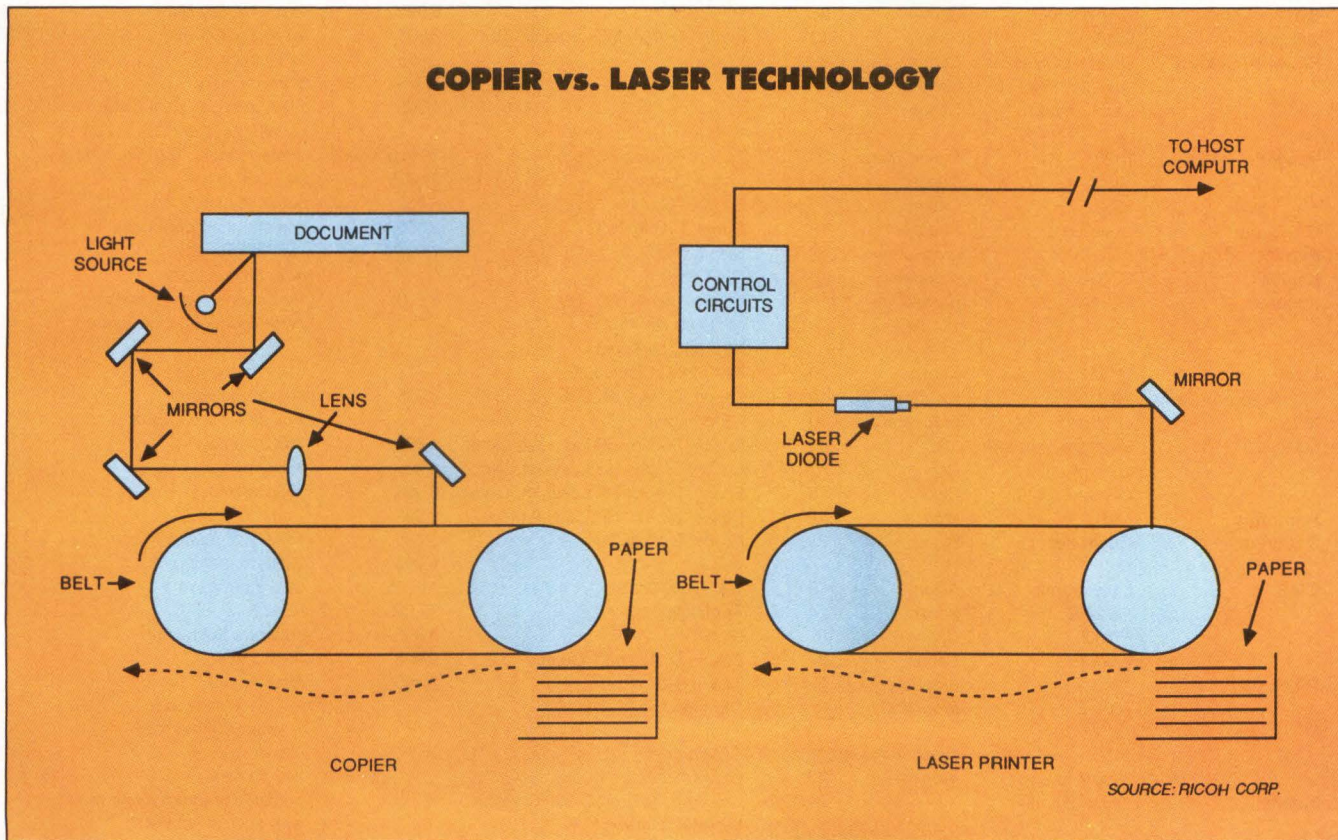
Zvert produces a line of interfaces that provide hardware and software to connect dedicated word-processors to laser printers. The Zvert interfaces sell for \$1,200 to \$2,700, depending on the type of word processor and laser printer.

The conversion process handled by the interfaces involves translating the proprietary parallel transmissions used by word-processor manufacturers into industry-standard RS232C serial or Centronics parallel format. This process also requires firmware to map print commands into the laser printer's control set.

Lexi Data & Communications has a similar box, called the Print Mate. This \$495 interface allows Digital Equipment Corp. computer users to connect to any laser printer, without software modifications.

Emulation is essential

Laser-printer manufacturers are catching on to the need for emulation. A number of companies not only emulate HP printers, but also emulate dot-matrix units from Diablo, NEC, Epson America Inc. and ITT Qume Corp. Emulation allows users to take advantage of existing software even after they've upgraded to



Although based on photocopier, or xerography, techniques, laserography differs significantly. A photocopier (left) uses mirrors to translate the image to a photosensitive belt, which in turn picks up toner and transposes the image to paper. With laserography (right), a laser diode creates a modulated beam of light that reflects off

a moving mirror to scan a photoreceptor belt or drum to create a latent image that attracts toner from the developer unit. An electrostatic charger transfers the toned image to paper where it is fixed by heat and pressure at a fusing station.

NON-IMPACT PRINTERS

REPRESENTATIVE LASER PRINTERS

Company	Model	Engine	Speed (ppm)	Emulation	Price (\$)	Notes
Apple	LaserWriter	Canon	8	Appletalk, IBM PC, Diablo 630	5,995	supports Postscript
	LaserWriter Plus	Canon	8	Mac XL, MacPlus, Diablo 630	6,995	extra fonts
AST	Turbolaser	Ricoh	8	Epson, HP Plotter	4,995	1.5M bytes RAM
Blaser	Blaser series	Canon	8	IBM graphic	2,395-2,995	64K memory, 1-5 users
C. Itoh	LIPS-10	Konica	10	HP LaserJet Plus	3,495	dual input cartridges
Canon	LBP 8A-1/2	Canon	8	Epson, Diablo	3,000/4,000	128K-/1.25M-bytes
	LBP 20	Canon	8-12	Epson, Diablo		OEM model
Centronics	Pageprinter 8	Sharp	8	Centronics, Epson	2,495	memory expansion option
Cordata	LP-300	Canon	8	Epson	2,995	PC-compatible interface
	LP-300X	Canon	8	Epson	3,895	1.25M-byte memory, 32 fonts
Dataproducts	LZR-2600 series	Toshiba	26	line printer, Centronics, Diablo	13,900-19,900	up to 3M-bytes, supports Postscript
	LZR-1230	Toshiba	12	Epson, Diablo, HP LaserJet	3,495	uses plug-in profile cards
Digital Equipment	LNO1		12	DEC, Centronics, Tektronix	19,995-29,995	
	LNO3		8	DEC	4,195	
Facit	Opus-1	Ricoh	12	line printer	9,500	bar code rotation
GBT	GBT 6635XP	Canon	8		6,995	forms overlay buffer
Genicom	5010	Hitachi	10	Epson, Diablo, HP LaserJet, IBM	2,995	up to 1,500 fonts
Hewlett-Packard	LaserJet Classic	Canon	8		2,995	128K memory
	LaserJet Plus	Canon	8		3,995	512K memory
	LaserJet 500	Canon	8		4,995	512K memory, dual paper handling system
Imagen	7320	Canon, Xerox	20, 24	Epson, Tektronix	29,950-32,950	duplex 11x17, 6M-byte memory
	3320	Canon	20	Epson, Tektronix	21,875	two bins
	2308	Canon	8	Epson, Tektronix	8,950	auto collation
ITT Qume	Laserten	Hitachi	10	Qume, Diablo, NEC	3,395	non-standard cartridges
Kentek	K-2	proprietary	12	Diablo 630	7,995	LED technology
Konica	LP-310	proprietary	10	OEM engine		helium neon laser
Kyocera	FBP-01	proprietary	10	Epson, Diablo 630, IBM, HP LaserJet Plus, NEC, Qume Sprint	3,900	1M-byte memory, has own page description, 60 fonts
Lexi	M5311	Xerox	20	IBM 52XX, Diablo 630		SNA-compatible
Mannesmann Tally	MT910	Kyocera	10	Epson, Diablo, HP LaserJet, IBM	3,695	new introduction
Mita	LP-XI	proprietary	10	OEM model		includes video interface
OASYS	Laserpro Express	Mita	8	Epson, Diablo, HP LaserJet, Qume	1,895	368K memory
	Laserpro 810	Canon	8	Epson, Diablo, HP LaserJet, Qume	4,995	368K memory
	Laserpro 1510	Ricoh	15	Epson, Diablo, HP LaserJet, Qume	6,995	368K memory
Printronix	L1012	Mita	12	Epson, Diablo, HP LaserJet Plus	2,995	
Quadram	Quadlaser	Ricoh	8	Epson, Diablo, Qume	3,795;	1.5M-byte memory;
			4,295		2M-byte memory	
QMS	Lasergraphix 1500	Ricoh	15	Tex, Troff, Scribe	11,995	dual input trays
	PS-2400	Xerox	24	Appletalk	29,995	RS422
	PS-800	Canon	8	Diablo	5,895	supports Postscript
	BIG KISS	Canon	8	Epson, Diablo 630, Qume	2,995	ANSI x3.64
Ricoh	4080 R	proprietary	8	Diablo 630	3,495	retail model
	4080 E, I	proprietary	8	OEM models		E—external interface, I—internal interface
	4150	proprietary	15	OEM model		300 dpi
Talaris	3400/4400/5400	proprietary	40	OEM models		240-400 dpi
	2400/1200/800	Xerox/Xerox/Canon	24/12/8	Calcomp, Tektronix, IBM Selectric, Versatec plotters		primarily graphics systems with special firmware, FORTRAN subroutines
Texas Instruments	2015	Ricoh	15	HP LaserJet, TI855	3,995	
	2108	Ricoh	8	HP LaserJet, plotter	5,995	2M-byte memory
	2115	Ricoh	15	HP LaserJet, plotter	7,995	3M-byte memory
Toshiba	Pagelaser	proprietary	12	P35, HP LaserJet	4,995	512K-byte memory
Xerox	4045	proprietary	10	Epson, HP LaserJet	4,995	

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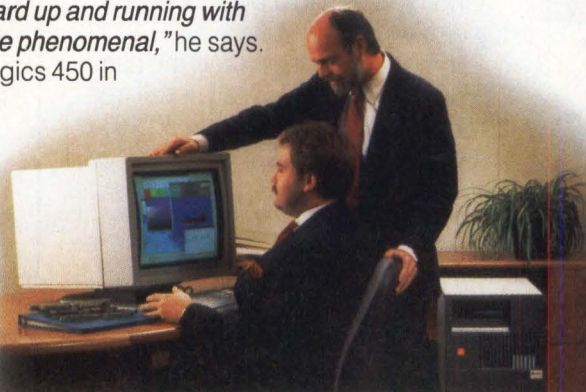


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Kevin Gonor, Xylogics and Jon Garman,
Sun Microsystems, with Sun-3/160 C
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CIRCLE NO. 52 ON INQUIRY CARD



a laser printer, a situation that didn't exist just a few months ago.

Emulation of popular printers and plotters is especially important to users who want to replace a worn-out or slow plotter with a laser printer. For example, AST's Turbo Laser uses the HP Plotter command set, thus allowing users to take advantage of existing software.

Kyocera's FBP-01 includes the PRESCRIBE page-description language, which assists page layout and to handle virtually any emulation desired. The software also allows the creation of new fonts.

But emulation is not as straightforward as it may seem. In all cases, a special driver must be installed and, frequently, special dot commands.

A popular word-processing program, MicroPro International's WordStar, is typically installed with a generic printer driver. Then users add patches to the user areas of the WordStar code to activate laser-printer functions.

James Cavuoto, publisher and editor of the industry newsletter *Micropublishing Report*, Redondo Beach, Calif., says that right now emulation is high on users' lists, but that they have other demands for future designs. "The 300 dots per inch is low quality. Right now, laser printers can't really manage a half-tone properly," says Cavuoto. He also agrees that greater speed is essential, as is a richer library of fonts.

Although most printers currently use RS232C or RS422 serial or Centronics parallel

Ion-deposition printers offer speed for a price

Laser technology isn't the only method that is intriguing print-engine builders. One of the more exciting is ion-deposition. This method, developed by Delphax, achieves print speeds in the 30-to-90-ppm range. But these printers are expensive. For example, the C.I.E. 3000 from C. Itoh Electronics Co., which uses the Delphax technology, starts at \$12,990 for a 30-ppm model and \$15,450 for a 45-ppm-model.

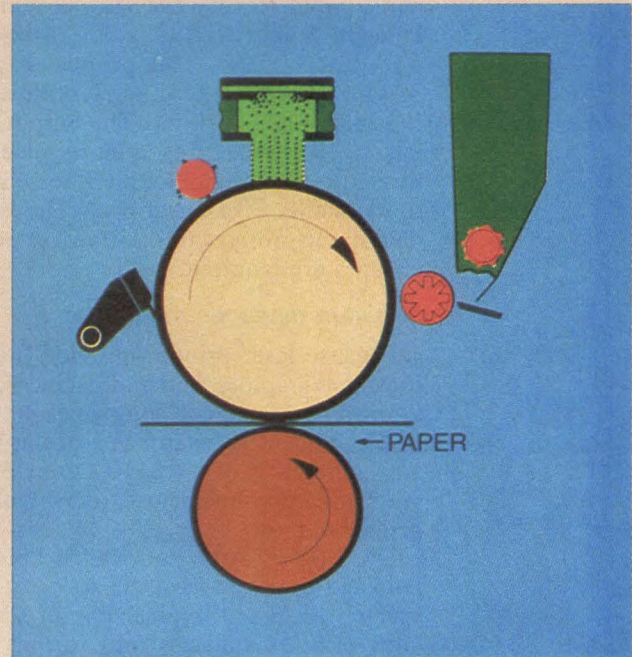
But C. Itoh doesn't expect to sell the printer to users of low-cost computers. Rather, the company targets the line-printer replacement market where draft speed counts more than cost.

Typically, line printers operate with 15-inch-wide green-bar computer paper. The ion printer, however, uses letter or legal-size cut-sheet paper. However, C. Itoh doesn't believe that poses a problem because the printer can handle a variety of type sizes and page formats. According to C. Itoh group vice president J. David Callan, the model 3000 suits high-volume users where 75,000 to 150,000 pages per month are standard. "You can't compare this printer with a laser printer. The laser printer is for the workstation-type environment where the creative process takes place. The high-speed ion printer is a production machine where moving paper is paramount," says Callan.

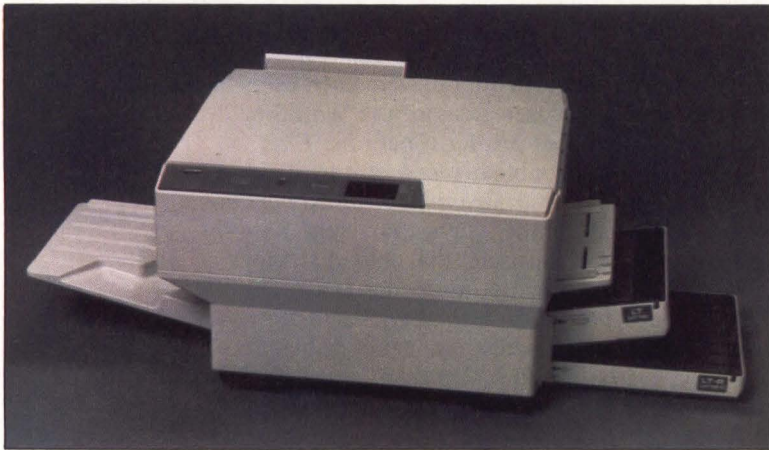
Ion-deposition printers carry a cost of ownership that is usually higher than desktop laser printers but lower than the high-speed impact printers that they replace. For example, a toner cartridge costs about \$25 and typically yields 7,500 pages, depending on the amount and density of the black space printed.

To ease the use of the printer, many of the setup commands to set page format and font size can be entered via the front panel. And, like most printers today, it also handles downloadable commands.

Although the quality of C. Itoh's printer's output is good, it still isn't on a par with most laser printers. However, that may be only a short-term drawback: C. Itoh is developing new controls and firmware to pit the ion printer firmly against high-end laser printers in the desktop-publishing market.



Ion-deposition printers, such as C. Itoh's C.I.E. 3000, use an ion cartridge to generate an image on a rotating drum. The latent electrostatic image imprinted on the drum attracts toner. The toned image is then transfixed to paper via cold high-pressure fusing rather than using heat as with laser printers.



A high-end laser printer, *Dataproduct's LZR-2600 prints at 26 pages per minute, and is intended for the shared-resource market where the cost can be spread across several users.*

interfaces, many laser-printer manufacturers plan to incorporate the small computer systems interface (SCSI). This interface, while primarily used for disk storage, is well-defined for printer and local area network operation as well. Reportedly, HP and IBM may be the first companies to introduce printer products using this interface. Several Japanese companies also claim to be preparing SCSI-compatible ports.

In the meantime, owners of IBM Corp. PCs and compatibles can use a low-cost unit such as Henson Scientific Inc.'s The Missing Link, priced at \$189.95. This printer adapter occupies a short slot in a PC and is addressed by the PC as a parallel printer. The output, however, is serial RS232. Consequently, users get the throughput of a parallel interface but with the functionality of a serial port. The board handles all the protocol translations, so no software changes are required.

Software manages the printer

Because laser printers provide flexibility in fonts and graphics, and approach typeset-quality printing, numerous companies provide easy-to-use control software. For example, Insight Development Corp.'s \$150 LaserControl program uses pop-up menus to give control over printer output.

QMS offers a program called Popset, a \$59 package that allows users to create printer-specific scripts. A typical Popset script translates escape sequences into various functions for setting the font and the print format, i.e., portrait (vertical) or landscape (horizontal). Users can also program other operational functions, such as switching paper bins. Popset code resides in memory and is activated by depressing the ALT and print-screen keys on an IBM PC. The displayed menu then lets users enter the choice of functions.

An easy approach to controlling a laser printer is to write a BATCH command file, which lets users choose fonts and formats. But for greater functionality, such as capturing graphic images and sophisticated merging features, consider a more full-featured product, such as those mentioned above or Polaris Software's Ram-Resident PrintMerge. For \$149, users can employ their favorite word-processing software to create typeset-like documents on an HP LaserJet Plus, including drawing boxes, adding shading and merging graphics. The software manages the translation of an easy-to-use single command to the more complex HP command language.

Talaris Systems Inc., an OEM of QMS, takes a value-added approach by changing the firmware and adding fonts in the QMS model 810. Talaris also provides powerful software-development tools. One such tool is Laserplot. This package provides subroutines that allow developers to emulate plotter functions, as well as manage shading and gray scaling.

Creating the software—especially for a wide variety of printers—isn't a trivial pursuit, because manufacturers have chosen their own way of implementing laser control. Thus, a multiple escape sequence used by HP to create a line may mean something entirely different in another manufacturer's machine. This problem is handled by Studio Software Corp. with its Front Page desktop publishing page make-up program. Because Front Page is a graphics-based product, the company implemented the virtual device interface (VDI) to ease integration. Peter J. Clarno, vice president for product planning, says that to ensure full compatibility of the product, Studio Software wrote more than a dozen device drivers: "And most are native to the device rather than a VDI generic-type approach. Otherwise we couldn't take advantage of all the features and functions a printer or typesetter offers," says Clarno.

Put a price on speed

Print speed is a major consideration to users, especially if they process large volumes of information. One approach to meeting high-speed requirements is to employ line-printer replacements products, such as ion-deposition printers (see "Ion-deposition printers offer speed for a price," Page 95). Ion-deposition printers can achieve speeds as high as 90 ppm.

Dataproducts' LZR-2600 series laser printers manage a fast 26 ppm, but these units range in price from \$12,900 to as high as \$22,000, depending on paper-handling capabilities and internal-memory size.

The TeleVideo 955. Seeing is believing.

WYSE WY-50
(Unretouched photo)

TELEVIDEO 955
(Unretouched photo)

SALES ANALYSIS

LATEX SPECIALTY PRODUCTS INC.

PERIOD: Q3, 1985

PERSON	ID NUMBER	TERRITORY	CUSTOMER	CUST. NUMBER	PART NUMBER	ITEM	SHIPDATE	WAREHOUSE	SHIPDEST	CARRIER	CUST. T
	181000000	NEW YORK	APEXINC	33333888899	KL23487654	200	10/02/85	NYPHILIDE	NEW YORK	ACMETRS	25
	162277754	BOSTON	ZINCINC	33388990044	KL23450987	007	12/01/85	CENTRALLA	BOSTON	ATAIR	15
	100000456	CHICAGO	AASEHER	98750372378	KL23090867	999	ONHOLD	WOODLAWN	CHICAGO	DUMAIR	10
	100057363	ATLANTA	TUSINC	77493887549	KL23999999	808	11/19/85	ATLANTANW	AUGUSTA	EUFRT	50
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FEATURES	TVI 955	WY-50	WY-50+
Screen Color	Green or Amber	Green Only	Amber Only
Optional Graphics model	Yes	No	No
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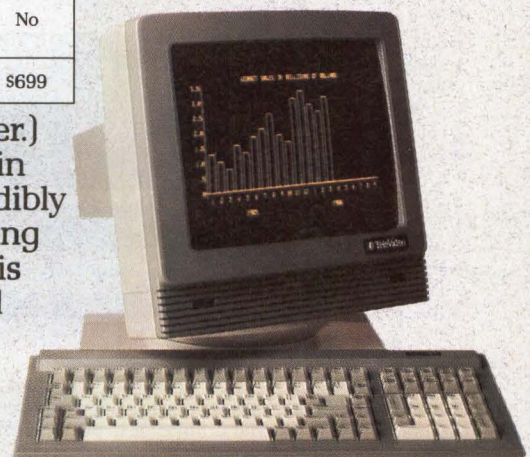
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Ricoh's LP3400, 4400 and 5400 printers provide resolution from 240 dpi to 400 dpi with a 40-ppm print speed. Because these printers are OEM products, the company prefers not to release pricing information.

Add color!

One of the more exciting possibilities in laserography is the addition of color. Many copier companies are experimenting with color; in fact, Canon has demonstrated a color copier. But Koichi Kadokur, product marketing manager, says that a commercial product is still some time off.

But QMS, part owner of Colorocs Corp., is more optimistic. It expects, in about a year, to sell color printers based on a Colorocs print engine.

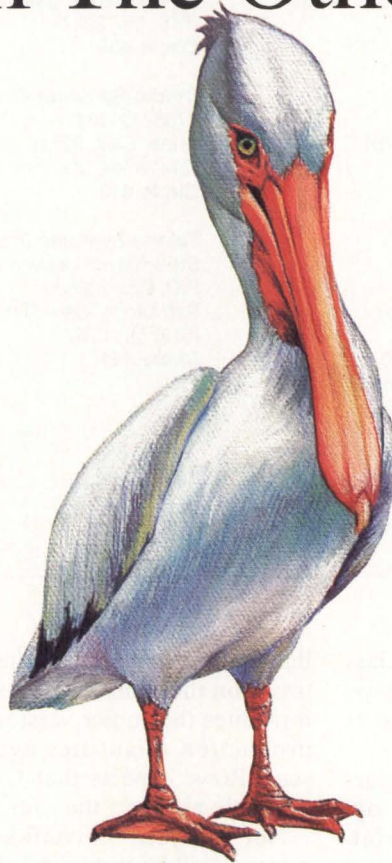
Frank Rowe, executive vice president for Colorocs, says that the first Colorocs machine will be a copier, possibly in the \$15,000 to \$18,000 range. The 300-dpi Colorocs raster print engine will operate at 6 to 14 ppm, and use yellow, magenta, cyan and true black. It will employ either laser diodes or LEDs as the

light source and a shutter technique to scan the image on the transfer drums. Colorocs plans to introduce the copier version in mid-1987, with production quantities available later in the year. Rowe expects that QMS' printer will be available at about the same time.

Not everyone is confident that color laser printers will be successful. *Micropublishing Report's* Cavuoto notes that a color printer will be one-half to one-quarter as fast as a black-and-white printer: "If you can do it fast in color, you can do it faster in black and white, and speed is important," says Cavuoto. He also points out that 300-dpi output is still too rough for many publishing applications, which would still need four-color separations. "The color printer may be good for graphics proofing, or possibly single-copy presentations. Those are about the only applications I can think of. What people want is X-ray quality—lots of gray scaling, that will give the ability to properly handle half-tones, something no laser printer presently does. That's far more important than color." □

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ADA WOOS VAR HEARTS, WINS MAINSTREAM USERS

The Ada language, long relegated to mainframes and military projects, blossoms into a viable option for value-added resellers

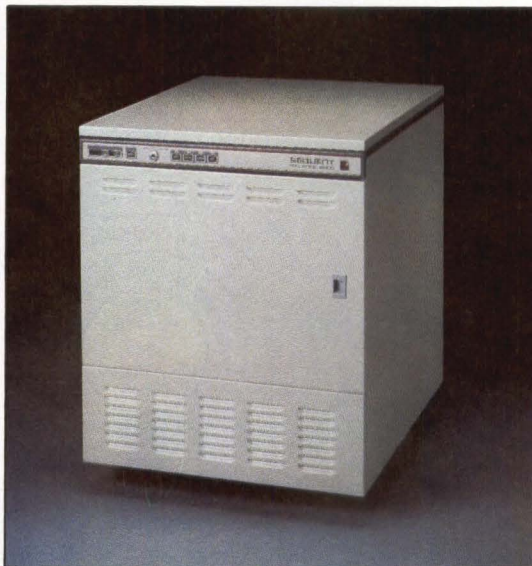
Michael Tucker, Associate Editor

Ada, the programming language developed to the specifications of the U.S. Department of Defense, is starting to have commercial importance in the minicomputer and microcomputer worlds. Traditionally regarded as too large and complex for machines smaller than full-scale mainframes, Ada is showing up even on personal computers as a result of advances in both compiler and computer technology. This means that value-added resellers and independent software developers can exploit the advantages of a language designed for very large, very complex applications.

In the late 1970s, the DOD wanted its own language for a number of reasons, among them a serious concern about its own software investment. The department owns one of the largest collections of software in the world. In the 1960s, the DOD realized that this immense investment in code was aging. Larger and larger percentages of the military software budget were being expended just to maintain code.

The DOD decided it would create a language that would be heavily biased toward software engineering. The result was Ada, an immensely capable programming language named after Lady Ada Byron, the 19th century mathematician who has been called the first programmer. Ada's very syntax encourages structured code. It forces the programmer to write in semiautonomous modules of code that can be documented, managed and maintained over long periods of time.

Moreover, Ada is extremely standardized. Every Ada compiler must be validated by the



A multiprocessor machine, the Balance 8000 from Sequent recently acquired an Ada capacity. Ada is one of the few languages that truly support multiple processors.

government before it can carry the name "Ada," and the validation process is one of the most rigorous testing programs ever devised for software. This, in turn, means that individual modules of code can be pulled out of existing programs and inserted into new ones with little or no modification.

Ada comes of age

"The thing we've noticed is the increasing maturity of Ada compilers," notes Benjamin Brosgol, vice president and technical director of Ada compiler maker Alsys Inc. "For the first time we're seeing Ada compilers that can match benchmarks with C compilers."

And, at the same time Ada compilers are

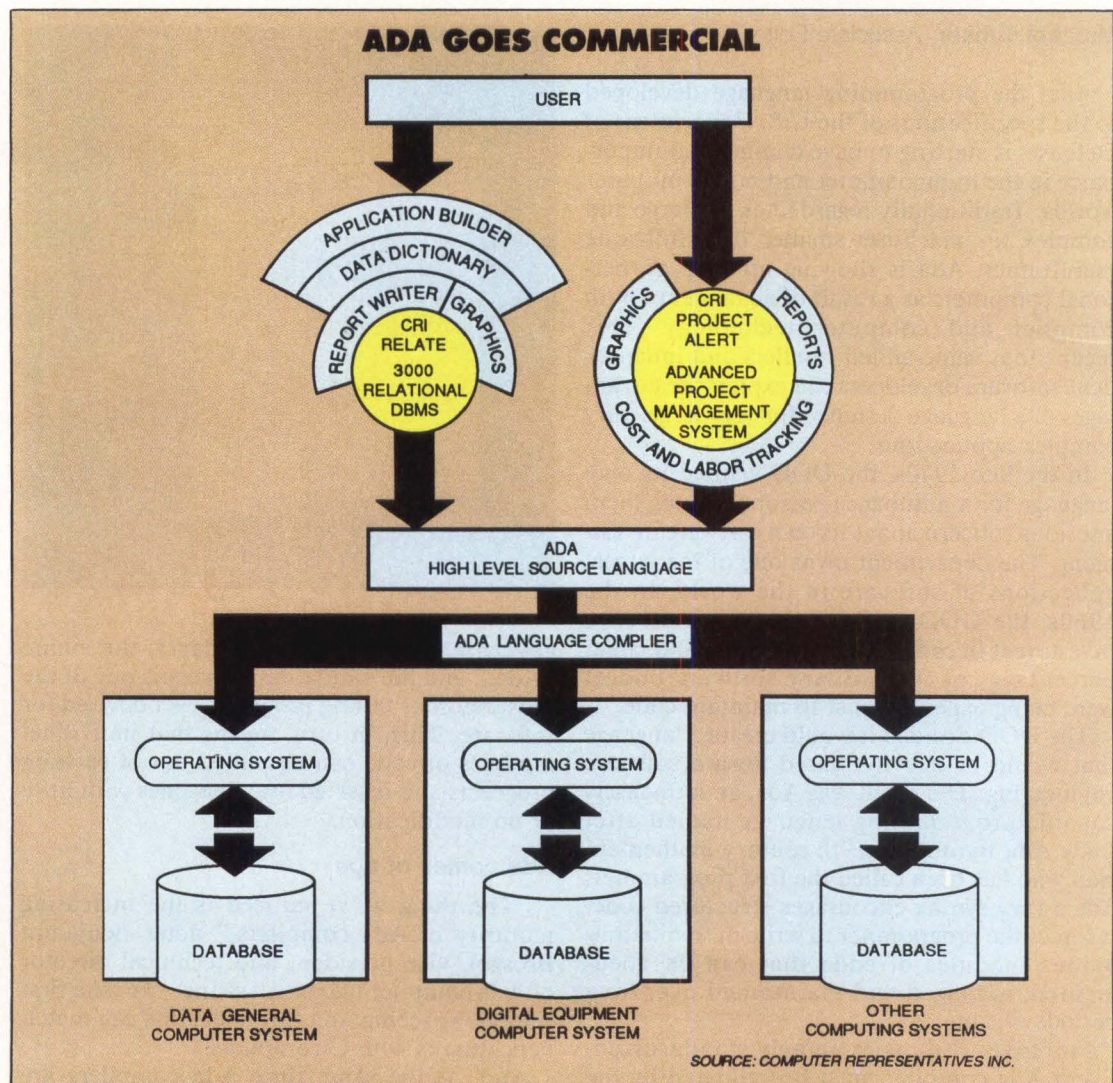
getting faster, they're also becoming more common. In 1980, there were no commercially available, validated Ada compilers. However, by May 1986, the Ada Information Clearinghouse (the organization maintained by the government to promote information about the language) reported that fully 19 validated compilers were up and running.

Telesoft Inc., for instance, was one of the first Ada compiler vendors to go commercial. This year the company released its second-generation Ada compiler, Telegen 2, which includes an integrated DBMS that allows developers to keep track of modifications of code in large programming efforts. Verdix Corp., another early Ada participant, markets a similar product known as the Verdix Ada Development System. VADS includes an Ada compiler, a library manager, assorted libraries of development tools and a debugger.

If there's an Ada theme in 1986, it's that the

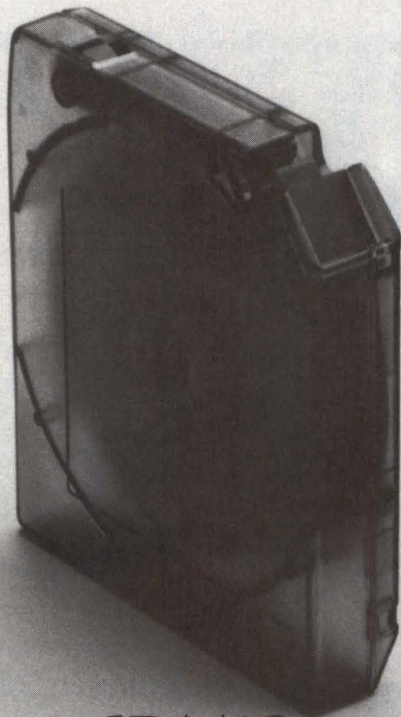
language is becoming less exotic by the hour. "Validation is simply becoming more and more commonplace," says Bruce Sherman, Telesoft's director of marketing. "Passing the test suite is just no longer the unheard-of event it once was. And, I'll predict that in the next year, every major computer vendor will offer an Ada capacity of some kind." Already, Telesoft this year announced that Prime Computers Inc. signed an agreement to adapt Telegen 2 to its commercially oriented Prime 50 series machines.

The real kicker, though, is that vendors of small machines are also becoming Ada-literate. Where once an Ada compiler was a rarity even on mainframes, now several companies offer Ada for microcomputers. RR Software Inc., for instance, markets Janus/Ada, a powerful Ada-based language for the IBM Corp. PC. Alsys, meanwhile, recently brought out a validated Ada compiler for the PC. "We call it 'Ada for



Commercial applications of Ada include *Relate 3000*, a relational DBMS, and *ProjectAlert*, a project manager, both from CRI. *Relate 3000* includes *Builder*, an applications generator.

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There's nothing new about 1/2 inch tape cartridge drives. IBM introduced the 3480 back in 1984. Unfortunately, its \$100,000 price tag to end-users, coupled with its 3 megabyte per second transfer rate, relegated its use to mainframes.

But the idea of a 1/2 inch tape cartridge caught on. Its potential as a low cost, high capacity back-up for Winchester disk drives excited the industry and by 1985 there were half a dozen companies offering 1/2 inch tape cartridge drives for minis and micros. But there was no standardization of cartridge design, recording formats, interfaces or form factors. In fact, the industry was characterized as "a potpourri of incompatible products"

Realizing that there would never be full acceptance by the OEM community until there were industry standards, many of the leading tape drive manufacturers met in November 1984 and formed an organization called HI/TC (Working Group for Half-Inch Tape Cartridge Drive Compatibility). While seven companies form the nucleus of the organization, over 70 companies have attended HI/TC meetings as observers or active participants.

Working in an atmosphere of cooperation that is unprecedented in the industry, HI/TC has generated and adopted development standards for both a 240 and a 480 megabyte class of 1/2 inch tape cartridge drives. These development standards specify two-track serpentine recording on a total of 24 tracks, ESDI and SCSI interfaces, and a dump time of 17 minutes for either capacity.

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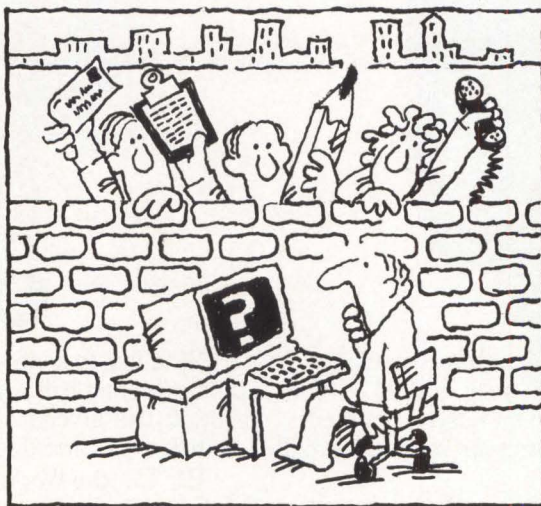
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the masses,'" says Alsys' executive vice president, Chuck Patrick.

However, despite these improvements, the developer who works with Ada runs some real risks. This year, many leading companies in the Ada compiler business suffered serious financial setbacks and had to undergo widely publicized staff cutbacks.

The illusion of a market

Even those Ada vendors who've been unaffected by this year's shock treatment warn that the language conceals a particularly diabolic trap for the unwary developer—the illusion that Ada is itself a market, and that customers will buy products simply because they happen to have been written in Ada. "First, let's make it clear there is no such thing as an Ada market," insists Michael Ryer, director of the Ada systems division for software developer Intermetrics Inc. "When people buy software, they buy an application, not a language. They couldn't care less if it were written in Sanskrit, so long as it does the job."

But, says Ryer, for some vendors, Ada is worth its risk, "I would say that VARs ought to be using Ada if their software is large, if they intend to maintain it themselves over the long haul and, finally, if they can get hold of a very good Ada compiler."

Intermetrics does have a very good compiler. In fact, the company was involved in the original design team that invented Ada. But, Intermetrics' main lure for Ada developers is "Byron," an Ada development environment comprising an Ada compiler and a host of support facilities. Of these, the Byron PDL (program description language) may be the most indicative of the larger importance of Ada.

When the DOD mandated Ada, it also became interested in PDLs. These are not pro-

gramming languages in themselves, but, rather, subsets of English (and other natural languages) with exact syntax, vocabulary and methods of representation. PDLs are used to describe in precise terms exactly what a program is going to do in any module or subunit of code.

PDLs are not unique to Ada, but the language is heavily biased toward their use. Because Ada assumes that code is written as semiautonomous modules, and that the modules themselves are structured into smaller units, a programmer can use a PDL to achieve a level of documentation impossible with almost any other language. "The idea," says Ryer, "is that you'd describe your project so exactly that you could drop specifications to any programmer—even the guy in the back room who graduated from a tech school that advertises on matchbook covers—and that programmer could produce workable code."

Byron PDL is such a language. What makes it unique is that Ada statements may be embedded within it. A programmer, or a systems analyst, could do a PDL description of a piece of proposed software, include chunks of Ada code in the work, and, says Ryer, "If the Byron program is complete enough, you could actually compile it and run it."

Ada urgently seeks software

In other words, a programmer may do documentation and prototype coding at the same time—and virtually every line of code can have some record, in English, of its purpose and history. "When, five years down the line, the code has changed 500 times or so, and all the original programmers have long ago disappeared, Byron PDL can help you track down what the program is doing."

But, the single most disconcerting thing about Ada is that no one has written in it much. "The big advantages of Ada," jokes Ryer, "is its

'We're seeing Ada compilers that can match benchmarks with C compilers.'

How to make money in Ada

What is the most effective way to make a profit from Ada? *Mini-Micro Systems* put that question to a number of individuals interviewed for this article. The following are some of the responses:

- Bill Brykczynski, research staff member, Institute for Defense Analyses: "If you have an existing application on one machine, I'm not sure you should rewrite it in Ada. If it's not broke, don't fix it. But, for new products your readers should exploit Ada's portability. They can have their products on more and more computers."

- Paul Fuller, vice president of marketing and sales, Computer Representatives Inc.: "I cannot think

of an application that wouldn't benefit from being in Ada."

- Dave Quigley, VAX Ada product manager, Digital Equipment Corp.: "I believe there is a tremendous business to be had in developing tools to support Ada programming."

- Bruce Sherman, director of marketing, Telesoft Inc.: "The major market for Ada right now is the military. If I were a developer, I'd write components—not even complete applications—that I would take first to the government and then to the commercial sector."

maintainability and the reusability of existing code—the trouble is, there isn't any existing code." Until recently, there were no completed Ada applications for a developer to go look at—whether to seek inspiration or to learn from someone else's mistakes or to find a product to add value to and remarket.

That too, however, is starting to change. Commercial vendors of software for developers are beginning to enter the field. This is particularly true on the components level. Components are chunks of code ranging from simple keyboard subroutines to complete applications that may be purchased and installed in larger programs (MMS, June, Page 95).

Because component libraries may vastly reduce the amount of time spent in coding, Ada was designed with libraries in mind. A number of different companies sell Ada components. EVB Software Engineering Inc., for example, markets a large package known as GRACE (Generic Reusable Ada Components for Engineering). Originally, GRACE was a subscription service—buyers received so many functions a month—but it's now being sold as a completed package of 133 Ada components. These include everything from device drivers to stack handlers. "GRACE contains very basic functions," notes Brad Balfour, EVB's software engineer. "They're the sort of data structures

that you'd find in just about any application—engineering, technical, database or whatever."

Another participant in the Ada library business is Atech. This recent start-up markets a package for professional developers that includes such things as screen handlers, terminal controllers, menu handlers, screen formatters and so forth. "Ada allows a true components industry," notes Peter Hacker, Atech's founder and CEO. "With it, you can write a piece of code, hide the details and hand the whole package to a programmer."

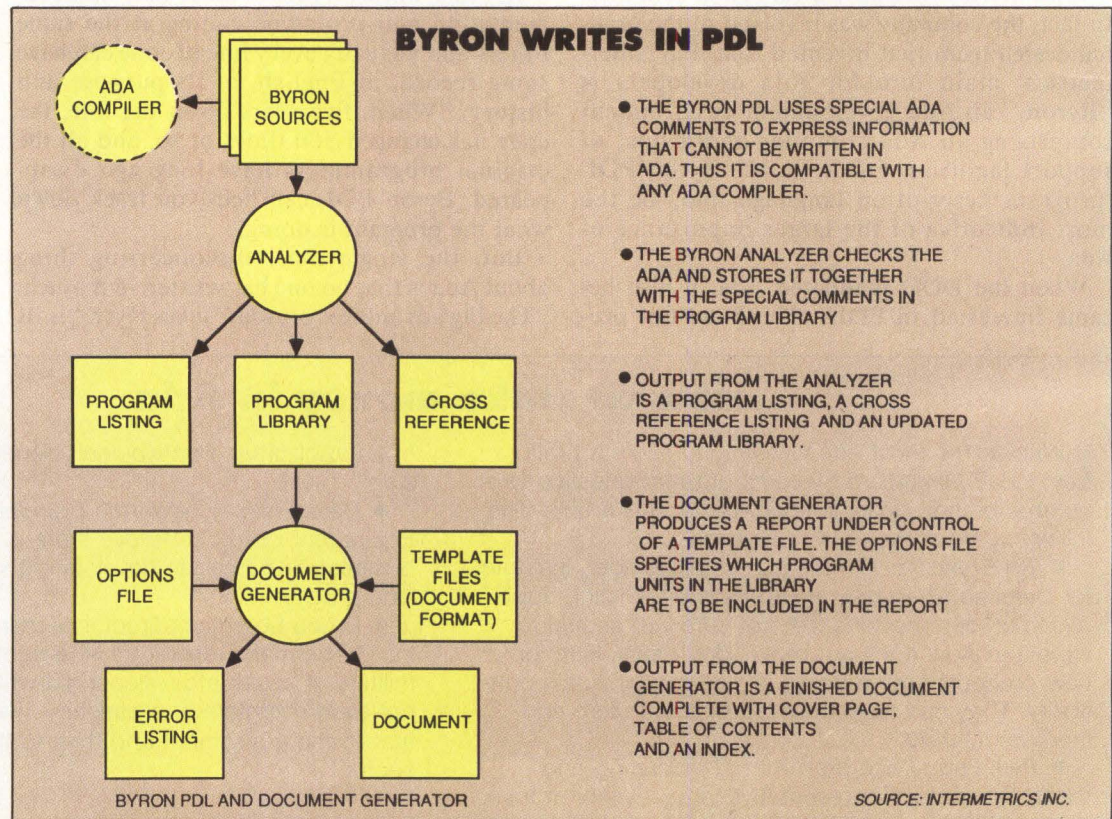
Ada is also starting to gain libraries of math subroutines, some of them neatly lifted from other languages. Quantitative Technology Corp., for instance, recently translated its existing package of C and FORTRAN math functions to Ada.

Ada gets some support

But, Ada's ability to woo the commercial world will depend on completed applications. Specifically, if it is to appeal to VARs, Ada needs applications that can be quickly and easily modified for vertical markets. It needs, for example, database management systems, and fourth-generation languages (4GLs) based on them, which have become commonplace in the C and UNIX worlds.

Some companies have begun to offer such

A Program Description Language, Byron PDL from Intermetrics can both describe and contain Ada programs. With it, developers can obtain a level of documentation almost impossible outside of Ada.





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Ada-based DBMSes and DBMS languages. Computer Representatives Inc. was, until recently, a software developer exclusively for Hewlett-Packard Co. machines. Then, in November 1985, CRI announced it had converted its relational DBMS and associated products to Ada.

"We decided to get into other markets, and we needed a very portable language," explains Paul Fuller, CRI's vice president of marketing and sales. "And we saw we had two options—we either rewrite our software in C or in Ada. We decided on Ada because it is a strict, very rigid language, where C tends to be loosely structured and there are no firm guidelines to follow."

CRI's Ada product is Relate 3000, a relational DBMS. In addition, CRI markets a 4GL, Builder, which allows even non-technical personnel to rapidly develop screen-based applications running on top of Relate. CRI will also supply a host of other options, including a report writer, an interactive graphics package, a data dictionary and a menu-driven user interface. CRI also sells ProjectAlert, a project-management system written in Ada.

Fuller says CRI has found Ada's biggest advantage is its transportability. "Our ISDs (independent software developers) enjoy an opportunity that not many VARs have. They can

learn Ada and know their systems are going to work on any machine. We've been able to add three hardware lines in just the last two years, without an increase in support costs."

CRI does this by making the vast majority of its code wholly device-independent. What little software is hardware-dependent (not even Ada is perfect) consists of small modules of code that, because of the nature of the language, can be easily swapped out and replaced. If users have Relate 3000 running on one machine and want to bring it up on another, all they need do is purchase an additional module from CRI. In fact, CRI claims to have ported the products between machines with nearly insulting ease. "Because of Ada, we can go from a Data General Corp. to a DEC (Digital Equipment Corp.) in an hour," says Fuller. "I don't believe that's possible with any other language."

Meanwhile, Ada is gaining the ability to deal with other real and emerging standards in software. For instance, Ada has recently begun to woo structured query language, the de facto standard in database query languages. As an interim measure, several vendors of SQL-based DBMSes—notably Relational Technology Inc.—have given their products Ada interfaces. But, some analysts have said that such interfaces are expensive in terms of software efficiency. So, several Ada developers have looked

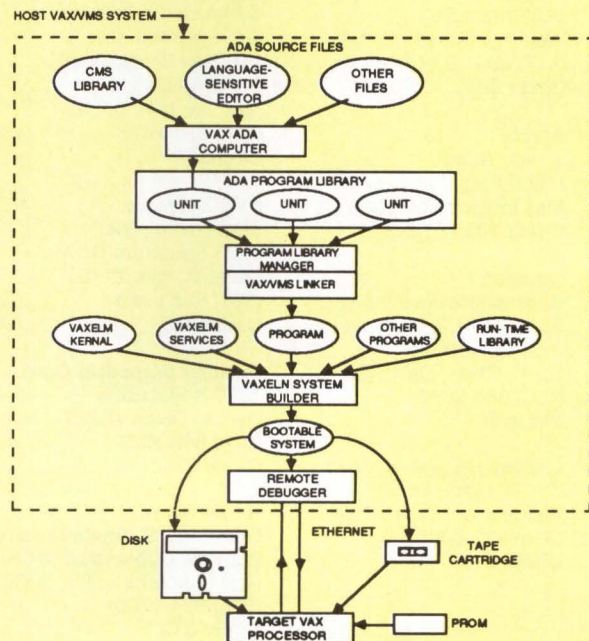
VAXELN Ada means real time

VAXELN Ada is a real-time application development and operating environment from Digital Equipment Corp. It combines an extensive set of programmer's tools—debuggers and the like—with system functions. Developers can put together applications using VAXELN Ada and drop them into an embedded system, where they will run without another operating system.

With VAXELN Ada (see diagram), a developer can start with such tools as a code management system (CMS) library and a language-sensitive editor, and then drop completed Ada source code into DEC's Ada compiler. The programmer's own efforts can be supplemented with modules of Ada code from VAXELN Ada's own Ada program library.

The developer can further refine code with VAXELN Ada's set of support tools. These include the VAXELN Kernel, an extensive run-time library, device drivers and file and network servers.

The completed application can then be transferred to a target VAX-compatible machine via disk, tape, or direct connection. VAXELN Ada also offers a remote debugger, so any code problems can be weeded out on a host system.



SOURCE: DIGITAL EQUIPMENT CORP.

into the problem of opening interfaces to SQL from Ada.

Atech is doing some work in the field, as is the Institute For Defense Analyses. IDA is a non-profit Federal Contract Research Center with connections to the DOD. It has been associated with Ada since its beginnings. Recently, IDA was commissioned to link Ada with SQL. Explains research staff member, Bill Brykzynski, "We're working on something called Ada/SQL...this is an interface between the language and SQL-based database systems. Basically, it allows an Ada program to talk to a DBMS without being concerned about whose DBMS it is."

Ada finds its hardware

However, if applications in Ada can be easily ported to almost any machine, the real measure of the language's success, or lack thereof, will be the number and type of machines to which developers are actually doing the porting. Given Ada's unique characteristics, it probably isn't surprising that the language is showing up most frequently on systems that are themselves somewhat exotic.

For example, the so-called "Crayette" mini-computers, that use advanced architectures to approach supercomputer performance, have

proved particularly fertile ground for Ada compilers. One such example is Convex Computer Corp., whose C-1 was arguably the first Crayette on the market. Last year Convex announced that it would acquire VADS from Verdix. Essentially, Convex is grafting the VADS' front end onto its own vectorizing compiler technology to produce what may be the world's first vectorizing Ada.

There are significant advantages to running Ada on the C-1. "Ada contains a number of routines that lend themselves to vectorizing technology rather well," says Stephen Campbell, Convex's director of marketing. But the chief advantage of having Ada on the C-1 may have more to do with its users. Crayettes are frequently employed by government contractors, and because the government is beginning to demand Ada in its software specifications, Convex's customers are doing the same.

There are, though, machines for which Ada might actually prove the best of all possible languages. When Ada was designed, the government assumed that parallel and multiprocessing machines represented the future of computing. These are, of course, computers that contain multiple CPUs and attempt to solve large problems quickly by breaking them into subtasks that can be farmed out to individual

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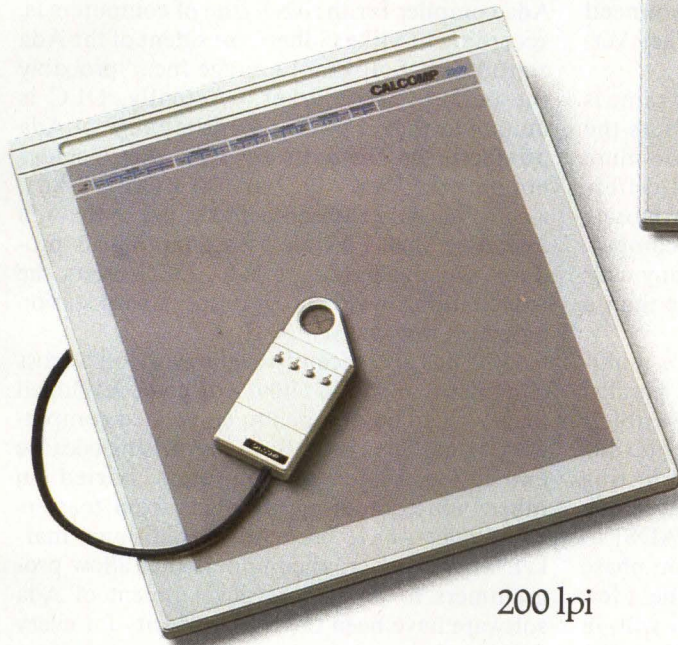
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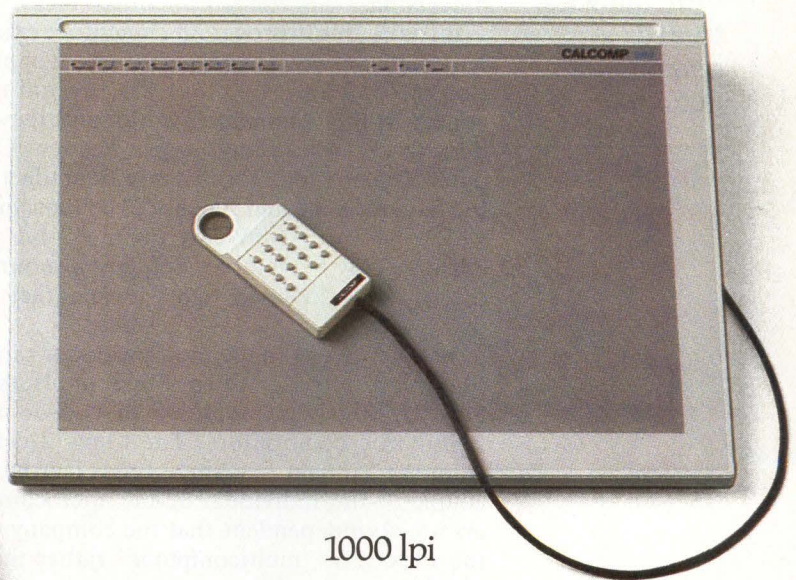
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processors. Ada is one of the few languages that is undeniably talented in the art of parallel processing.

Initially, multiprocessing machines existed only in university labs and government applications. Now, however, they are beginning to appear in the commercial world, and they are discovering Ada in the process. Sequent Computer Systems Inc., for instance, manufactures the Balance 8000 and Balance 21000 machines, which contain from two to 32 32-bit processors. Last November, Sequent announced that it had purchased rights to remarket Verdix's VADS.

Another player in the multiprocessor game is Flexible Computer Corp. Flexible offers the Flex/32, which is composed of two or more 32-bit microcomputers. The Flex/32 differs from the Sequent machine in that it is loosely coupled—the individual 32-bit microcomputers are so independent that the company calls the Flex/32 a "multicomputer" rather than a multiprocessor.

But, the Flex/32 is still very much a multiprocessing machine, fully capable of parallel operations, and, says Ray Naeini, Flexible's vice president of software engineering, Flexible is considering a broad Ada strategy lasting several years. "The first phase is pretty much completed and consists of porting [VADS] to the Flex/32. But, we're really betting on phase two, which will be happening over the next few years." Under phase two, the company will, in effect, produce an Ada-based executive that will run together with the Flex/32 UNIX-based operating system.

On most machines, Ada is like any other high-level language and runs as a task under the native operating system. But, says Intermetrics' Ryer, "Ada is a very curious language: It takes on aspects of an operating system. In fact, when we're doing software for embedded systems, we'll very often run the hardware without an OS and just let the Ada application operate the machine."

Flexible's phase two is a plan to apply this principle on a grand scale. The company hopes to produce a real-time executive—a streamlined, speedy operating system—based on Ada. Applications in Ada would run over this executive more efficiently and quickly than they could as tasks of an operating system.

But, as impressive as Ada's achievements in parallel processing may be, the real sign of its commercial success will be its adoption by mainstream computer market heavyweights. There are signs that that may, in fact, be happening. Harris Corp., for instance, announced this year a validated compiler that will

use the Verdix VADS as a front end and Harris' own code-generation technology as a back end. The Harris compiler could be significant because, traditionally, Ada compilers have not done much in the way of optimizing code. In contrast, however, the Harris code generators have been noted for superb code optimization. The combination may prove extremely formidable.

But it is DEC that may be the best symbol of Ada's success as a commercial product. DEC's Ada compiler for the VAX line of computers is, according to Mike Gilbert, president of the Ada consultancy Software Leverage Inc., "probably the best on the market." Actually, DEC is unique in that it offers an entire range of Ada products. On the software side, this includes not only the VAX Ada, but also VAXELN Ada, a run-time Ada environment similar to the Ada executive that Flexible is attempting to produce. On the hardware side, DEC offers the Ada Station, an Ada programmer's workstation based on the MicroVAX II.

DEC has also recently begun work on a cross compiler that would allow Ada code developed on a VAX to be dropped to embedded computer systems. The "recently" is surprising because embedded systems—computers buried in other, non-computing, products from toasters to missiles—have been Ada's traditional market. Therefore, cross compilers that allow programmers to do remote development of Ada software have been the No. 1 priority for every Ada vendor.

Every Ada vendor, that is, except DEC, which bet instead on commercial non-embedded applications. "We positioned our Ada product for the commercial market," explains Dave Quigley, DEC's VAX Ada product manager. "We believed that the commercial market was larger than it actually was. We also discovered that the embedded systems were still where Ada was doing its business."

But, DEC is sticking to its guns. While the company is getting into the cross-compiler business, it has not abandoned a longer term strategy of standalone Ada. "We're getting a lot of interest from MIS shops," says Quigley.

Indeed, when asked whether Ada has a commercial future, DEC—like virtually everyone else involved with the language—points out that only once before has the DOD standardized on a language. That was in the 1960s, and the language was the ubiquitous COBOL. □

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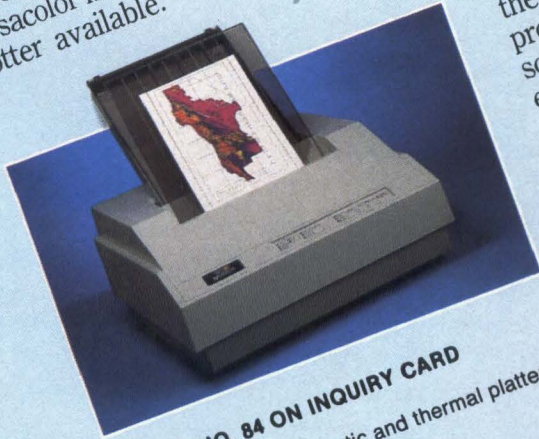
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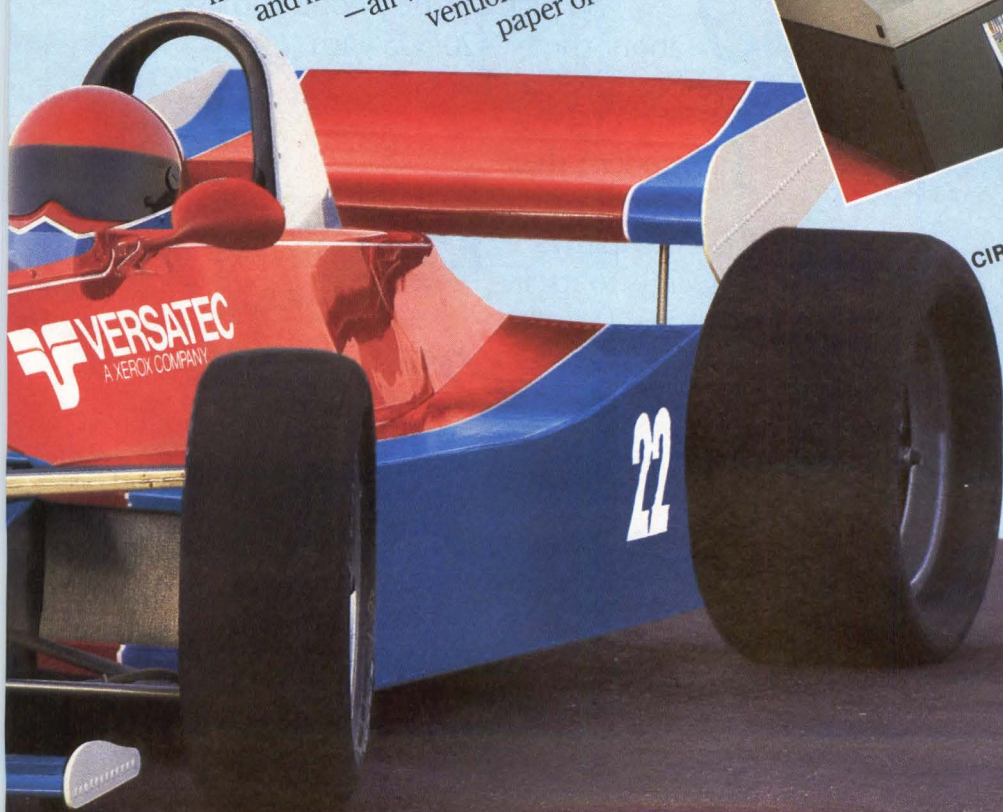
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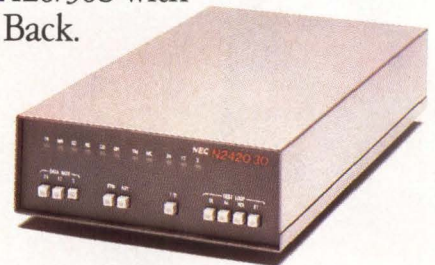
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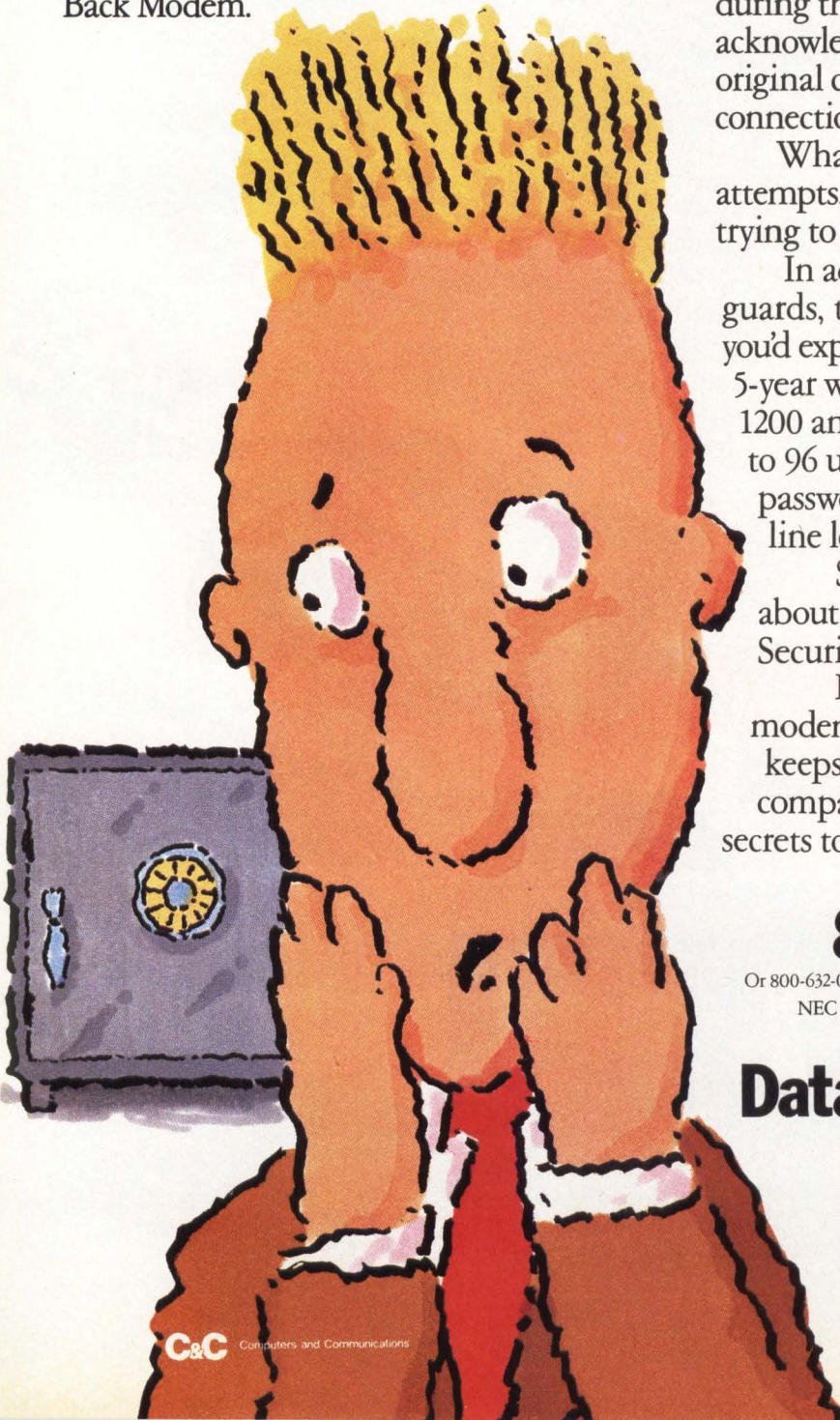
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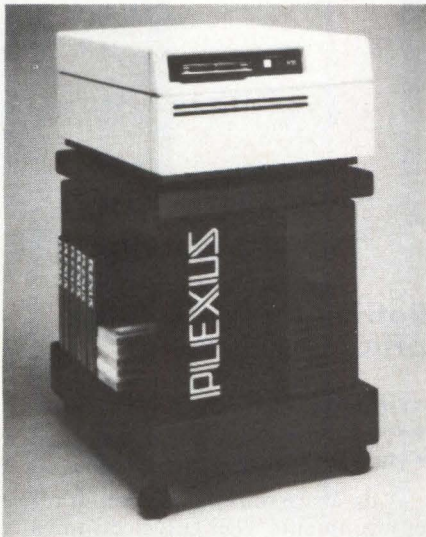
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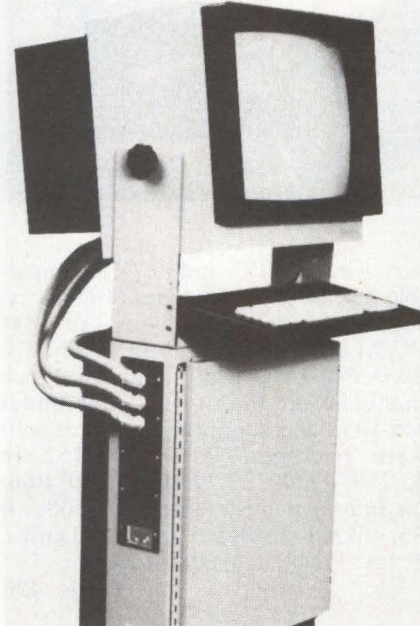
The P/55 multiuser computer supports up to 32 users. The system incorporates a 68020 processor, a 72M-byte disk drive and a 60M-byte cartridge tape drive. Memory capacity ranges from 1M byte to 8M bytes. Features include an optional 68881 floating-point coprocessor and up to 435M bytes of disk storage. Units can be linked in a LAN by adding an Ethernet controller and a proprietary network operating system. \$25,250 and higher. **Plexus Computers Inc.**, 3833 N. First St., San Jose, Calif. 95134, (408) 943-9433.

Circle 421

Computer offers eight expansion slots

- 640K bytes of RAM
- 16 colors
- 640 by 350 pixels

Supplying eight expansion slots, the EXPERT-AT is an IBM PC/AT-compat-



ible computer. The ruggedized system offers 640K bytes of RAM and a 200W power supply. A 19-inch RGB monitor displays 16 colors with a 640-by-350-pixel resolution. Ten function keys are included. \$6,495. **Comark Corp.**, 93 West St., P.O. Box 474, Medfield, Mass. 02052, (617) 359-8161.

Circle 422



Computer furnishes dual disk drives

- 640K bytes of memory
- 80C86 processor
- I/O bus

An IBM-compatible laptop comput-

er, the T1100 Plus is equipped with two 3½-inch, flexible disk drives. The unit supplies 256K bytes or 640K bytes of memory, parallel and serial ports and an RGB color monitor. It utilizes an 80C86 16-bit processor. An I/O bus is included for an optional expansion chassis with five slots. An optional 300- or 1,200-bps modem is available. \$1,999, 256K bytes; \$2,399, 640K bytes. **Toshiba America Inc.**, Information Systems Division, 2441 Michelle Drive, Tustin, Calif. 92680, (714) 730-5000.

Circle 423

Workstation features three CPUs

- 8M bytes of RAM
- I/O processor
- Six-channel multiplexer

Part of the HP 9000 series 500 line, the model 560 technical workstation provides three CPUs and 8M bytes of RAM. The system supports six to 32 users. It offers an I/O processor, a proprietary interface and a six-channel multiplexer with modem support. FORTRAN, C, Pascal and graphics libraries are supplied. \$44,950. **Hewlett-Packard Co.**, 1820 Embarcadero Road, Palo Alto, Calif. 94303. Phone locally.

Circle 424

Micro aims at VARs, OEMs

- IBM PC/AT compatible
- 640K bytes of RAM
- Eight expansion slots

An IBM PC/AT-compatible micro-computer, the WYSEpc 286 targets VARs and OEMs. The unit can be configured with a 1.2M-byte flexible disk drive, a 20M-byte, half-height rigid disk drive or a 40M-byte, full-height rigid disk drive. Standard features include 640K bytes of RAM, eight full-size PC/AT expansion slots, an RS232C port and a parallel port. \$2,499 to \$4,199. **Wyse Technology**, 3571 N. First St., San Jose, Calif. 95134, (408) 433-1000.

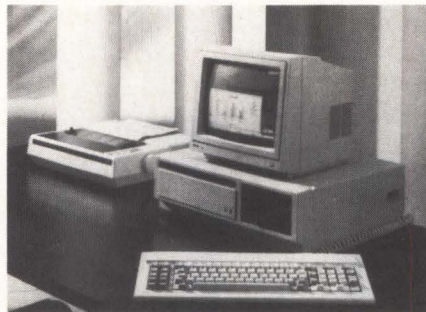
Circle 425



Personal computers offer graphics

- 12-inch monitor
- IBM compatible
- 640 by 400 pixels

The P3102 and P3200 personal computers supply color and monochrome graphics, respectively. The first model runs off-the-shelf software designed for color configurations via an emulation mode. Color is imitated on a 12-inch monitor with a 640-by-400-dot resolu-



tion. The IBM PC- and PC/XT-compatible unit offers 512K bytes of memory, expandable to 640K bytes. An IBM PC/AT-compatible unit, the P3200 displays 640 by 200 pixels on a 12-inch monochrome monitor. It runs under MS-DOS and supports a range of software packages. P3102, \$1,752 to \$2,750; P3200, \$3,795 to \$4,650. **Philips Information Systems**, Suite 300, LB 35, 15301 Dallas Parkway, Dallas, Texas, 75248, (214) 980-2000.

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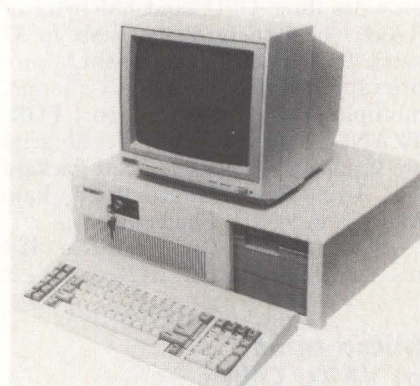


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- Color graphics

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Circle 428

System targets OEMs

- 80286 CPU
- 1M byte of RAM
- Flexible disk drive

An IBM PC/AT-compatible computer, the TPI 861-T targets OEMs. The unit runs under a 6-MHz or 8-MHz 80286 CPU. It provides 1M byte of RAM, a 1.2M-byte flexible disk drive and a 12-inch monochrome monitor. One serial port and one parallel port are standard. Software is MS-DOS 3.1 with GW BASIC. Options include a 60M-byte removable cartridge tape backup

Micros target system integrators

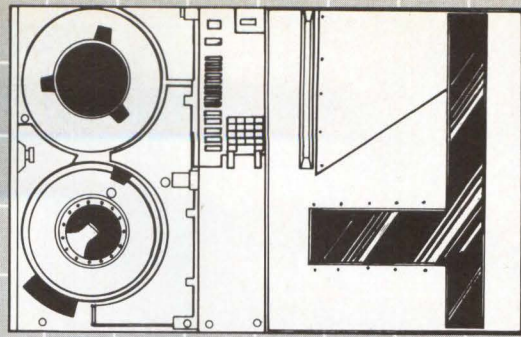
- MC68020 processor
- Two models
- 16K bytes of memory

Available in two models, the System 8000 supermicrocomputers target system integrators and VARs. The units feature an MC68020 microprocessor and VMEbus architecture. They address up to eight and up to 32 users, respectively. The model 400 supplies 16K bytes of cache memory. \$15,690, model 200; \$22,335, model 400. **Motorola Computer Systems Inc.**, 10700 North De Anza Blvd., Cupertino, Calif. 95014, (408) 864-4122.

Circle 430

Storage Technology's
New 2925
Tape Accelerator.

*It goes with unsurpassed speed.
It comes with unsurpassed features.*



TAKE THE PERFORMANCE DRIVE.

StorageTek's Model 2925 gives you the speed you need, and the features your customers demand. The 2925's Accelerator (Cache) feature dynamically adapts to system requirements and the host's capability ... at transfer rates ranging from 100 kilobytes per second up to 1.25 megabytes per second. The 2925 goes with speed indeed; but what it comes with is even more remarkable.



AT A GLANCE

Series Standard Features

Dual-speed 50 ips Start/Stop and 100 ips Streaming with Buffered or Synchronous mode

ANSI Standard 1600 bpi/6250 bpi formats

Convenient Auto-Threading

Integrated Formatter/Controller

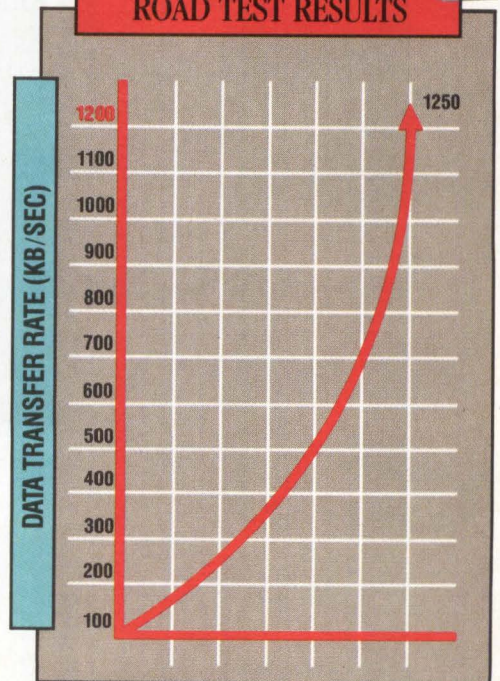
Service Panel with Alpha/Numeric Display

Resident Diagnostics

Host-optimized Data Transfer Rates

Error correction codes are built into the cache's 256k of multi-record memory; so your data is checked both as it enters cache and as it is written onto tape. Data should defective media be encountered. The 2925 allows OEM systems integrators to attach ANSI-compatible 1600/6250 bpi capability to systems ranging from micros to minis... without software modification. For ease of integration, the 2925 is available with either

ROAD TEST RESULTS



StorageTek- or Pertec-compatible interfaces.

That's still only the beginning—be sure to read the accompanying list of features. You'll understand at a glance that 2925 performance is not only *speed*... but *reliability, flexibility and ease of operation*. StorageTek's experience with GCR 6250 bpi technology includes a full 11 years of pioneering, proving and perfecting. Our 2920 Series includes the 2921 (50 ips start/stop), the 2922 (50 ips start/stop with 100 ips streaming) in addition to the 2925 subsystem.

Take a drive in our 2920 Series...

and experience performance you'll be proud to call your own.

Storage Technology. It's More Than Our Name... It's Our Commitment.

CIRCLE NO. 65 ON INQUIRY CARD

StorageTek

OEM MARKETING/3N, Louisville, Colorado 80028-0001 USA (303) 673-4066

OUR ADVANTAGE IN MIGRATION IS CLEAR.

NCR's nit-picking fanatics took a clear-headed approach in designing the NCR Tower® systems. By making Towers fully compatible, from the MiniTower (1-8 users) to the Tower XP (1-16 users) to the Tower 32 (1-32 users), they've provided a clean, clear upward growth path for your customers.

Compatibility across the Tower family lets you easily move your software from one Tower to the other with little alteration. So you can upgrade your customers' systems with a minimum of software maintenance and support.

And just as the Towers communicate fluently with each other, they talk to a host of standard protocols including Ethernet, 2780/3270, SNA and X.25. In fact, industry standards such as UNIX®, Multibus™, SCSI, RS-232 and others are built into every Tower to allow VARs the flexibility they need.

For your customers, it's the path to greater productivity. For you, it's a road to bigger, more lucrative accounts.

And that's just the beginning.

As your business grows, our comprehensive support programs give you the flexibility you need to keep growing. With everything from lead referral programs and single-source service to technical training and financing for you and your customers. And all the strength of a \$4.3 billion corporation at work for you.

Of course, all of this should come as no surprise. It's just another example of our towering commitment to VARs.

At NCR, we've always had your needs clearly in focus.

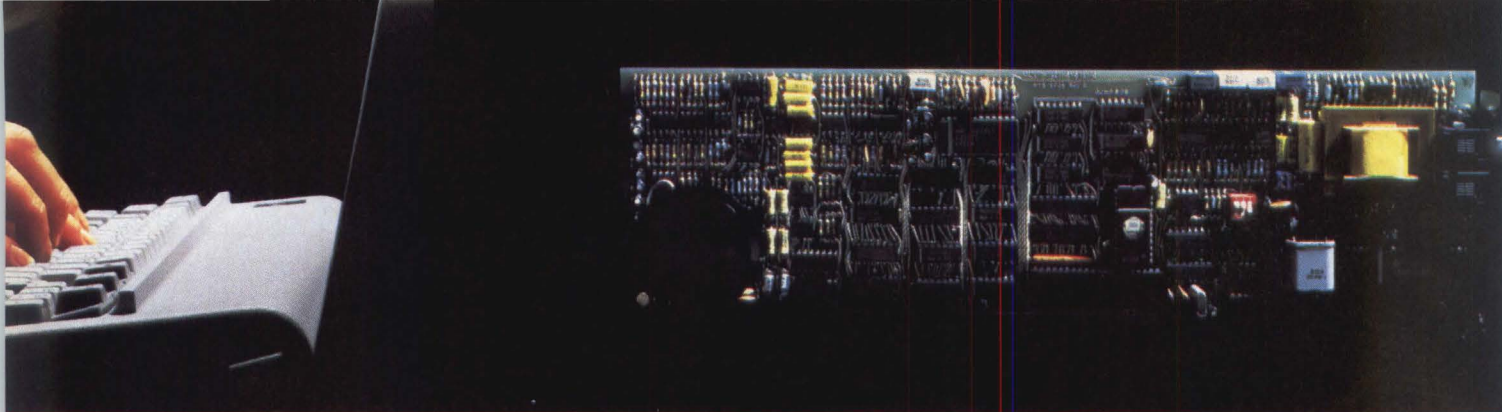
**THE TOWERS.
BUILT FOR SYSTEMS BUILDERS
BY NIT-PICKING FANATICS.**

CIRCLE NO. 66 ON INQUIRY CARD



OEM Systems Division, NCR Corporation, U.S. Data Processing Group, USG-1, Dayton, OH 45479. Nationwide (800) CALL-NCR.

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Error-Correcting 2400 bps Modems from Multi-Tech Systems:

When it has to be as good as it is fast

● Dial-up 2400 bps modems have arrived. More datacomm users are upgrading from 1200 to 2400 than ever before. But there can be a flip side to increased speed: More transmission errors.

● That's why our MultiModem224E™ offers MNP™ error correction. Available in our 2400 bps desktop, internal and rack-mounted modems, MNP gives you 100% error-free transmissions. No matter how bad the phone line. And MNP does it without the speed degradation of the less efficient, software-based protocols.

● Another important point: MNP Class 3 has emerged as an industry standard. It's now in the public domain, and has been implemented in virtually all 2400 bps modems that offer error-correction.

● So, why buy error-correcting modems from Multi-Tech? There are lots of good reasons, including:

1. Multi-Tech modems are 100% Hayes-compatible (more so than Hayes' own 2400 bps modems*). And our MultiModem224E with error-correction costs less than a Hayes Smartmodem 2400™ without error-correction.
2. Bonus features, like speed conversion. Both synch and asynch operation. And battery-backed option settings and phone number memory.
3. Versatility. The auto-dial/auto-answer Multi-Modem224E modems run at 2400, 1200 or 300 bps, with or without error-correction, and do so automatically.
4. A two year warranty that means something. Since Multi-Tech modems are designed and manufactured at our Minnesota headquarters (as they have been for the last sixteen years), you know we'll be here when you need us.

● Please call us toll-free, at **1-800-328-9717**, to get the rest of the reasons. And get a modem that's as good as it is fast.

**InfoWorld-8/5/85-reprints available*

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Smartmodem: Hayes Microcomputer Products, Inc.

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MultiTech
Systems

MultiModem224E

2400/1200/300 BPS Error Correcting Modem

SD

Transmit

RD

Receive

CD

Carrier

24

2400 bps

12

1200 bps

OH

Off Hook

TR

Term Rdy

1200
300
2400

Data
Rate

Ans
Org

Voice/
Data

NEW PRODUCTS SOFTWARE

DBMS accesses dBASE III Plus

- IBM PC compatible
- 26 report formats
- Form-letter generator

A DBMS package for the IBM PC and compatibles, Alpha/Three directly accesses dBASE and dBASE III Plus data. The software offers a report writer that accommodates up to 26 custom-designed reports, each with three sub-grouping levels. Features include a form-letter generator, a built-in editor and relational manipulation of data. \$395. **Alpha Software Corp.**, 30 B St., Burlington, Mass. 01803, (617) 229-2924.

Circle 431

LAN operating system supports DOS 3.1

- NETBIOS
- 16 users
- Menu driven

Network-OS is a LAN operating system for the IBM PC, PC/XT, PC/AT and compatibles. It requires 512K bytes of RAM and a 10M-byte rigid disk drive. The menu-driven software supports DOS 3.1 and NETBIOS. It accommodates four users per PC/XT and 16 users per PC/AT. Multiple file servers are employed when more workstations are required. \$995. **CBIS Inc.**, 2323 Cheshire Bridge Road, Atlanta, Ga. 30324, (404) 634-3079.

Circle 432

Graphics package runs on IBM PC, PC/XT, PC/AT

- 2,000 symbols
- 15 fonts
- 64 colors

A graphics package for the IBM PC, PC/XT and PC/AT, Concorde supports multiple medium and high resolution modes. It provides full painting capability with multiple-level zoom, 64 colors, unlimited patterns and scaling. The package features a database of over 2,000 symbols, icons and images. Up to 15 high-resolution and 15 medium-resolution fonts are available. Mouse support is included. \$695. **Visual Communications Network Inc.**, 238 Main St., Cambridge, Mass. 02142, (617) 497-4000.

Circle 433

Software targets system integrators

- IBM PC compatible
- PC-DOS 3.1
- Network processor

A TurboDOS-based software package, MS-1000 runs monochrome PC-DOS and MS-DOS on a proprietary network processor. The package emulates the IBM PC and includes an IBM-compatible terminal, PC-DOS 3.1, a CPS-16F board and TurboDOS/PC software. It is geared toward VARs and system integrators. \$1,995. **InterContinental Micro**, 4015 Leaverton Court, Anaheim, Calif. 92807, (714) 630-3714.

Circle 434

Software performs multiple applications

- XENIX support
- Electronic mail
- Computer conferencing

A multiuser software tool, TEAMate performs multiple functions. The package can be used for information management and retrieval, electronic messaging and computer conferencing. It supports XENIX editors and word processors and DBMS software. Features include a full-screen interface with cursor control, XMODEM support, transparent PC upload and download and integrated backup. Mappable keys for non-standard terminal support are supplied. \$1,995 and higher. **MMB Development Corp.**, 753 Deep Valley Drive, Rolling Hills Estates, Calif. 90274, (213) 541-4504.

Circle 435

Software runs on IBM PC

A communications software package, Smartcom II for the IBM PC Network allows it to share modems and asynchronous communications ports. Smartcom II is compatible with MS-DOS 3.10 and the NETBIOS interface. The program features proprietary error-correcting file-transfer protocols and remote access with password protection. \$599. **Hayes Microcomputer Products Inc.**, P.O. Box 105203, Atlanta, Ga. 30348, (404) 449-8791.

Circle 436



DIGILOG 300

PROTOCOL ANALYZER

SETS THE NEW STANDARD

\$3,995

INCLUDES 800K BYTE DISK



Digilog 300 sets the new standard for performance in network service applications. It sets up fast . . . automatically. Built-in tests and decodes speed you to a fast fix . . . so service engineers don't

need to know all the protocol details to be effective. Think of the training savings.

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Digilog ready-to-use software does the job when your needs go beyond protocol monitoring, trapping, and recording. Easy-to-run analysis, test, and emulation packages are available for SNA, SDLC, X.25, and the other protocols. They're easy to load, run, and understand.



Performance you want

- Full remotely-controlled operation
- 800K byte diskette storage
- Built-in automatic protocol decoding for SDLC/SNA, HDLC/X.25, Bisync, etc.
- Real-time graphic display
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- RS-232 Interface Lead Breakout
- Logging printer control port
- Extensive trap/trigger facilities
- Library of test/emulation programs

3-Year Warranty

Unmatched Digilog warranty protects you.

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Get full details on the Digilog 300 and all the other protocol analyzers in the Digilog family.



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DIGILOG

Leading in Data Communications Test and Control

CIRCLE NO. 68 ON INQUIRY CARD

123

PCOX The Micro-To-M Mainframe

Now PCs on your LANs can talk to your mainframe as easily as they talk to each other.

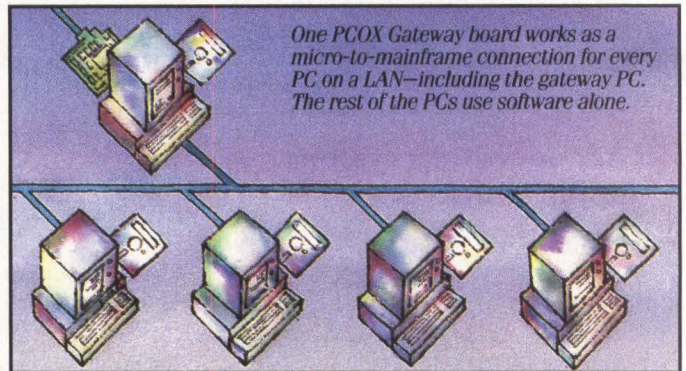
Talk about resource sharing. All it takes is one PCOX Gateway to deliver full mainframe privileges to all the PCs on a LAN.

And talk about resource *saving*. A PCOX Gateway can save you all kinds of modems, controllers, terminal emulators and line costs.

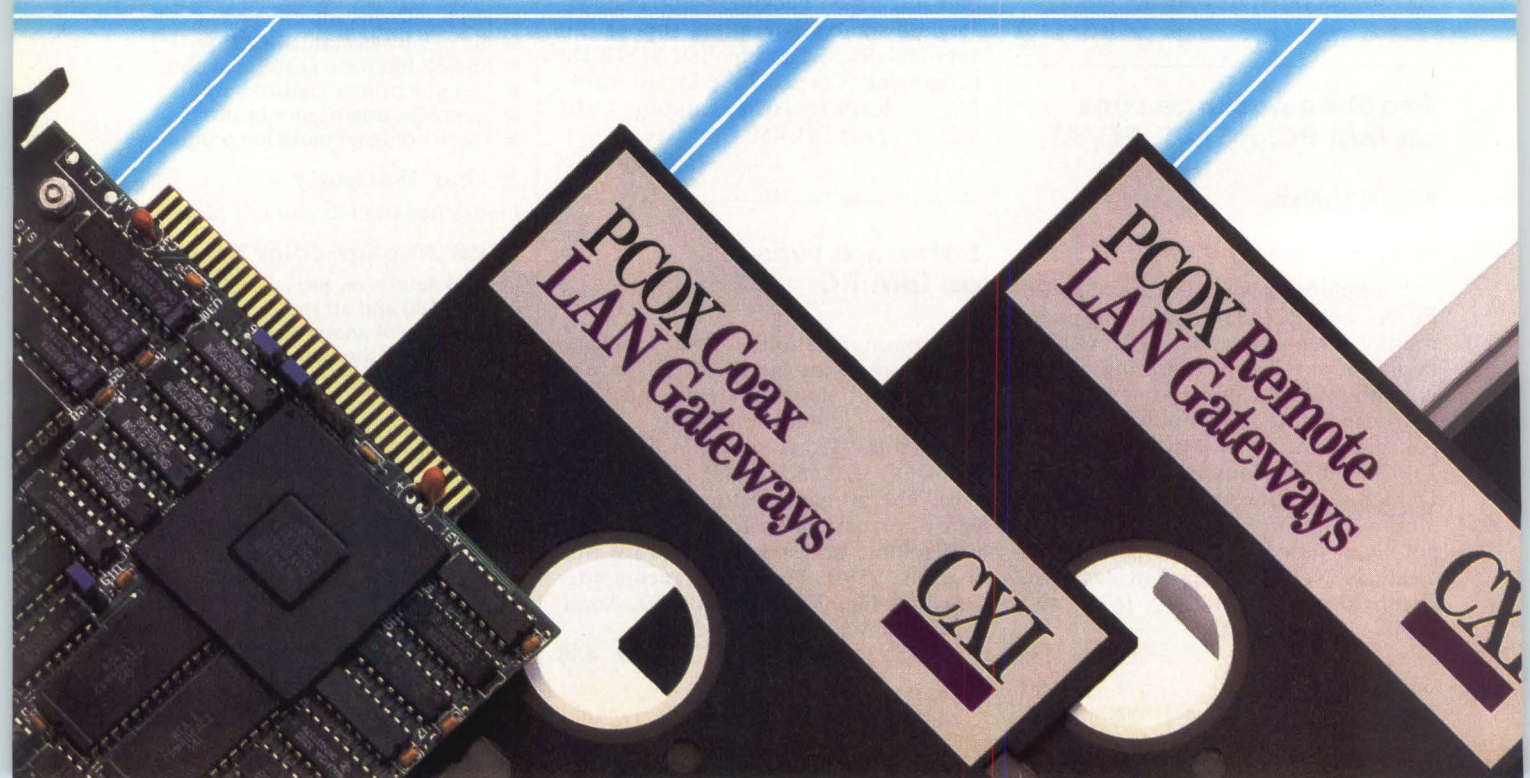
Each PCOX Gateway is a single board that plugs into a single slot on a single PC on the LAN. And unlike other gateways, PCOX Gateways let *every* PC on the LAN

talk to the mainframe, using software alone.

In fact, PCs can talk through more than a single PCOX Gateway. They can automatically seek mainframe sessions through multiple PCOX Gateways on a LAN. Then they can carry out 3278/79 emulation, 3270 PC emulation, send-receive file transfers, or even 3287 host printer emulation with their PC printers.



PCOX Gateways work in all NET- BIOS-compatible LANs, including IBM's own Token Ring and PC Network; plus LANs from AST, AT&T, Novell, Sytek, Ungermann-Bass and others.



Gateways: Micro-To-Micro-To- Connections.

PCOX/GATEWAY COAX connects directly to a 3274 cluster controller, and supports up to five concurrent host sessions. In fact, you can even make a PCOX Gateway Coax out of your existing IRMA™ board.

PCOX/GATEWAY-16 and PCOX/GATEWAY-64 each connect to a mainframe communication controller over modems and phone lines, and support up to 16 or 64 host sessions.

You can also put any number of PCOX Gateways on any size LAN, and control access to the mainframe through configuration and

security features built into the gateway itself.

PCOX Gateways are products of PCOX Technology, a modular system of advanced micro-to-mainframe connections that helps manage PC demands for mainframe access.

And PCOX Gateways are at the top of the PCOX product migration path. Which means all you need is software to turn any existing PCOX micro-to-mainframe link—coax or remote—into a PCOX Gateway.

So find out how PCOX Technology can help connect any number of micros to your mainframe. Call

now for more information about PCOX Gateways. And ask for the name of your nearest CXI distributor.

800-225-PCOX

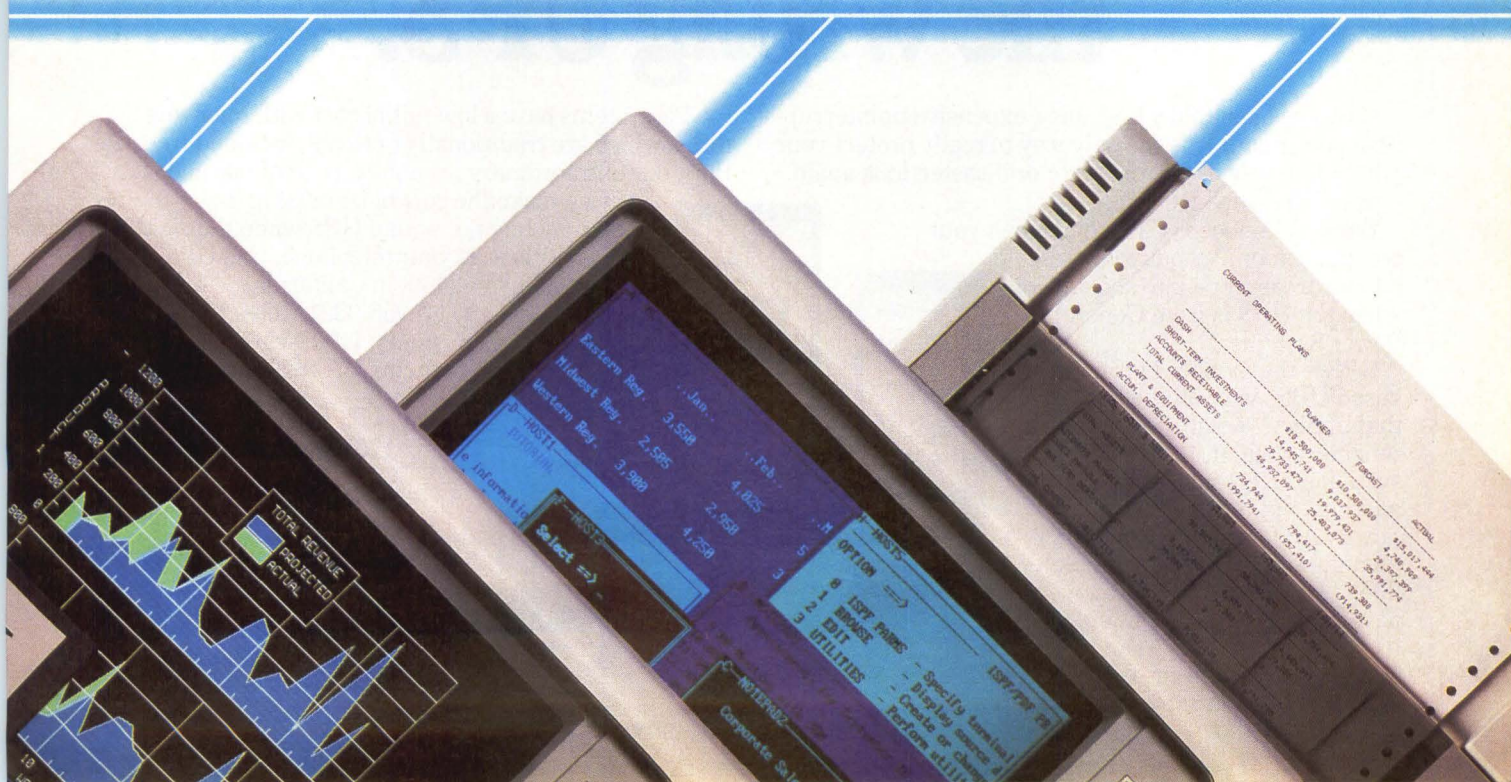
In California, call 415-424-0700.

CXI

CXI, Inc., 3606 West Bayshore Road
Palo Alto, CA 94303. Telex: 821945

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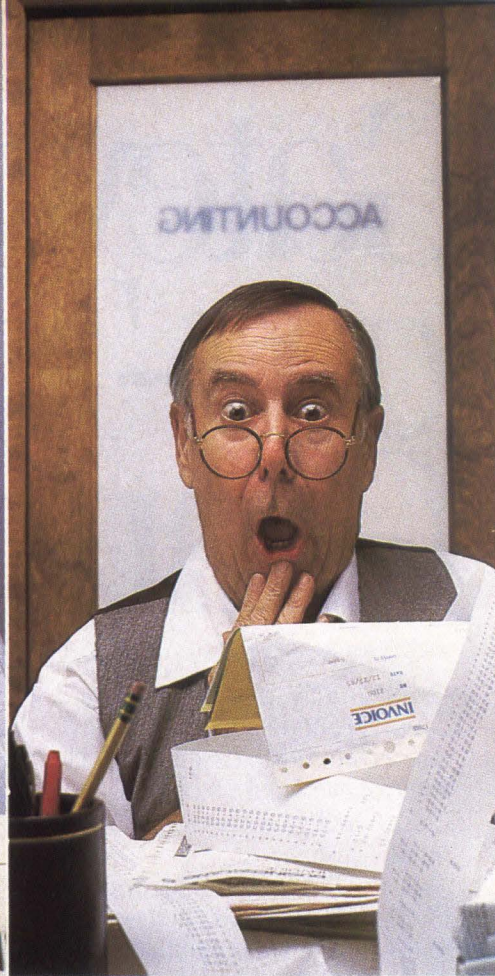




Too big.



Too noisy.



Too much.

How to keep from buying the wrong UPS.

If you've been told a big, noisy, expensive uninterruptible power supply is the only way to really protect your power-based system from error or disaster, look again.

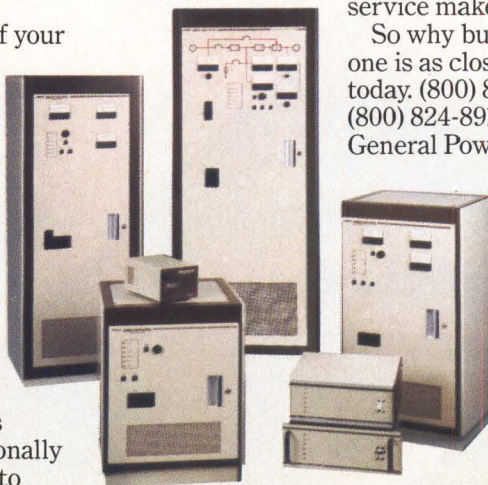
Yes, you do need a UPS.

But a UPS doesn't have to hog half your computer room, or put your staff—or your treasurer—into shock. Not when the UPS is from General Power Systems.

GPS is the pioneer in transistor-based UPSs with all the benefits that implies—small, quiet, cool, reliable, efficient. In fact, a GPS system is often half the size of another supply of comparable power. And because GPS manufactures the most complete line of UPSs on the market, we have what you need—on-line models from 500VA to 50KVA, and exceptionally small standby systems from 200VA to 2000VA with transition times as low as 2ms.

GPS systems have a low initial cost with many features, which are traditionally optional, included free. Plus, our extraordinary reliability, ease of use and service make the cost of ownership low.

So why buy the wrong UPS when the right one is as close as your telephone. Call GPS today. (800) 854-3469, in California (800) 824-8912, (714) 956-9321, Telex 182283. General Power Systems, 1400 North Baxter St., Anaheim, CA 92806-1201.



**Now, UL Listed models
1KVA-10KVA.**

GENERAL POWER SYSTEMS

A Division of ALS Corporation

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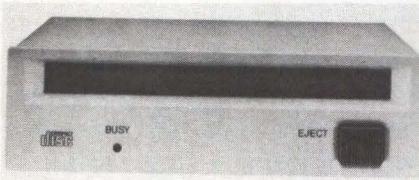
DISK/TAPE

Winchester drive provides 40M bytes

- 40-msec access time
- 13,171 bpi
- 20,000-hour MTBF

A 3½-inch Winchester disk drive, the 3540 provides a 40M-byte formatted capacity and a 40-msec average access time. Track-to-track access time is 9 msec. The unit supplies a 13,171-bpi recording density and 1,019 tracks per inch. MTBF is 20,000 hours. Under \$700, OEM quantities. **C. Itoh Electronics Inc.**, 5301 Beethoven St., Los Angeles, Calif. 90066, (213) 306-6700.

Circle 437

**CDROM disk drives access 540M bytes**

- 650-msec access time
- Half-height
- 1M-byte transfer rate

The models SQ-D1 and SQ-D101 are, respectively, a built-in, half-height disk drive and a standalone disk drive. The first unit is installed in a personal computer's flexible disk drive slot. It measures 1.63 by 5.75 by 8 inches. The second unit, measuring 6.1 by 3.78 by 13.6 inches, is an external subsystem. Each drive accesses up to 540M bytes of data from compact disks. Data transfer rate is 1M byte per second, and the average access time is 650 msec. \$1,495, SQ-D1; \$1,795, SQ-D101. **Panasonic Industrial Co.**, 1 Panasonic Way, Secaucus, N.J. 07094, (201) 348-7000.

Circle 438

Disk drive stores 689M bytes

- 18-msec access time
- Five-channel transfer
- 10½ inches

A 10½-inch disk drive, the M2360A stores 689M bytes. The parallel transfer unit furnishes a 12.29M-byte-per-second transfer rate, an 18-msec average access time, a one-, four- or five-channel data transfer and an SMD interface. As many as eight drives can be connected in a daisy-chain configuration. Data is transferred in single-channel or parallel-channel mode. \$19,000. **Fujitsu America Inc.**, 3055 Orchard Drive, San Jose, Calif. 95134, (408) 945-1318.

Circle 439

Disk drive suits IBM PC, PC/XT, PC/AT

- 40K-byte disk cache
- Single or dual drive
- 1.14M-bps transfer rate

A portable storage solution for the IBM PC, PC/XT, PC/AT and compatibles, the Sentinel measures 2½ by 19 by 16 inches. The unit comes with fixed or removable, single or dual, internal or external drives in 10M-byte to 30M-byte capacities. Features include a 40K-byte disk cache, a 16-bit transfer path from disk to CPU. Data transfer rate is 1.14M bps. \$1,495. **Magna Computer Corp.**, 735 E. Industrial Park Drive, Manchester, N.H. 03103, (603) 622-3699.

Circle 440

Tape controller aids Multibus II

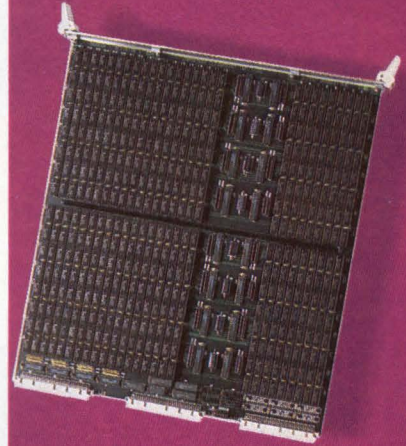
- 64K-byte FIFO
- Software-driver support
- 1.5M bytes per second

The Tapemaster 2000 is a half-inch tape controller for the 32-bit Multibus II. A 64K-byte FIFO allows the unit to handle data rates up to 1.5M bytes per second. Features include Read/Gather Write commands, unlimited record length support and complete software-driver support. \$2,795. **Ciprico Inc.**, 2955 Xenium Lane, Plymouth, Minn. 55441, (612) 559-2034.

Circle 441

Clearpoint

High Density System and VMEbus Peripheral Local Memory

**■ The Sun 3-Series**

The SNXRAM is the first 12 MB Sun 3-compatible memory card that delivers the full 16 MB address space using a single slot. Replacing up to 3 Sun memory cards, it frees two VMEbus slots for expansion.

- Available in 2, 4, 8, or 12 MB capacities.
- No Dip Switches, it comes factory configured for correct starting address and memory sizing.
- Using the 32-bit wide private memory bus, the SNXRAM frees the system bus from processor-memory transfers.

The VMERAM provides 4 MB of local memory for the VMEbus. This highly reliable EDC memory can be used to support peripherals such as array processors operating in parallel with the main processor.

Write or call for our new designer literature packages.

Sun is a trademark of Sun Microsystems

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CIRCLE NO. 71 ON INQUIRY CARD

THE TIME MACHINES



The Facit "C-line" includes the 400 cps, 15-color C7500 and the 250 cps, 7-color C5500

The 400 cps report is finished. You press a button and the printer is ready for a single sheet, 15-color business graphics. Then you change to a multi-font NLQ printout from a second connected computer. At the same time, you also change the paper path for document-on-demand. Then you...

The Facit C7500 and C5500 Matrix Printers not only handle a multitude of different applications. They permit instant switching from one application to another.

Printout options (including NLQ, multi-fonts and graphics), paper handling and all set-up parameters are changed in a matter of seconds using the "Yes" and "No" keys. Two entire parameter sets can even be pre-defined for instant selection.

All at the touch of a key.

IBM and Epson are reg. trademarks

INSTANT PAPER LOADING AND SWITCHING

To save more time, paper loading is fully automatic with a choice of three different paper paths. This enables accurate feed of multi-part invoices and paper tear-off without losing a single form. You can even hold a continuous form in stand-by while cut-sheets are printed.

To facilitate easy integration in your system, both parallel and serial interfaces are provided as standard along with Epson FX/JX or IBM Graphics Printer emulation. You can use the pre-defined set-ups to alternate between different hosts, if required.

For a demonstration of how the Facit C7500 and C5500 boost the efficiency of your computer system, contact your nearest Facit representative. It will be a real timetrip.

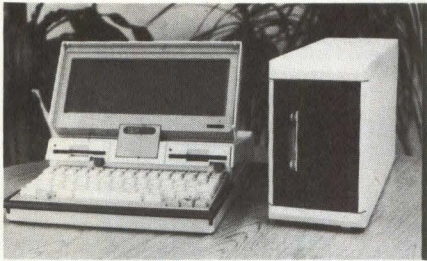
FACIT

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CIRCLE NO. 251 ON INQUIRY CARD

NEW PRODUCTS
DISK/TAPE

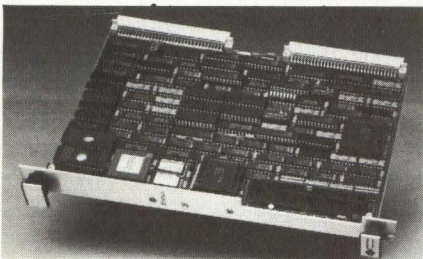


Subsystem agrees with IBM Convertible

- 360K-byte disk drive
- 40M-byte tape backup
- Parallel printer port

StarBase III is a storage subsystem that allows data to be exchanged between the IBM PC Convertible and the IBM PC and compatibles. The unit includes a 5¼-inch, 360K-byte flexible disk drive; a 20M-byte Winchester disk drive for storage on the convertible, a 40M-byte, 3½-inch cartridge tape backup device and a parallel printer port. It measures 9 by 5 by 16 inches. \$1,495. **Alloy Computer Products Inc.**, 100 Pennsylvania Ave., Framingham, Mass. 01701, (617) 875-6100.

Circle 442

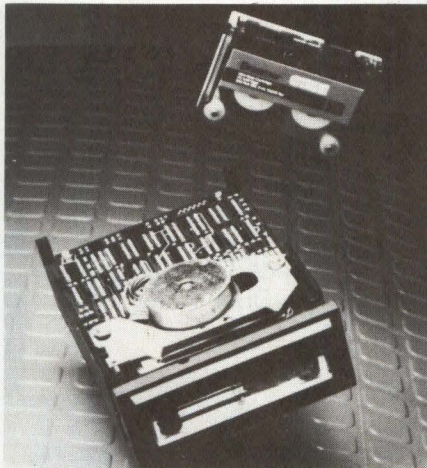


Controller boosts VMEbus throughput

- 30M bytes per second
- 128K-byte cache memory
- Proprietary interface

The V/SMD 4200 Cheetah disk controller boosts VMEbus throughput to 30M bytes per second via a proprietary interface. The device features zero-latency reads and writes and 128K bytes of multitrack cache memory. It is compatible with proprietary software. \$2,350. **Interphase Corp.**, 2925 Merrell Road, Dallas, Texas 75229, (214) 350-9000.

Circle 443



Tape drives store 60M bytes

- IBM compatible
- 75 ips
- 750K-bps transfer rate

The QicBac 350 and QicBac 525 quarter-inch cartridge tape drives supply a 75-ips read/write speed and a 750K-bps data-transfer rate. Data capacity is 60M bytes, unformatted and 48M bytes, formatted. Features include an IBM PC-, XT- and AT-compatible host adapter card and an optional SCSI interface that resides on the drive. Software subroutines allow the tape to be written in a single pass. \$300 (OEM quantities) **Braemar Corp.**, 11400 Rupp Drive, Burnsville, Minn. 55337, (800) 328-2719.

Circle 444

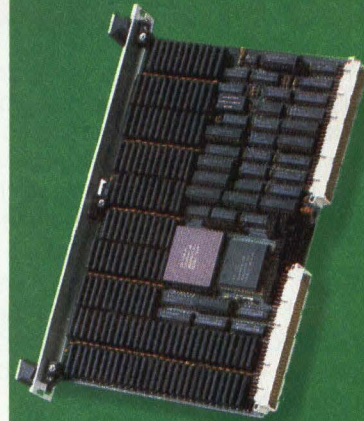
Subsystems control four start/stop drives

- SCSI interface
- 1.25M-byte transfer rate
- 800, 1,600 bpi

Controlling up to four start/stop disk drives via a SCSI interface, the models TDX 45 and TDX 75 are nine-track, half-inch tape drives. The units supply 64K bytes of buffer memory with parity and a buffered data transfer rate of up to 1.25M bytes per second. They offer ANSI-compatible support of 800 and 1,600 bpi. Features include self-test and 21 commands. \$4,495, TDX 45; \$6,495, TDX 75. **Telebyte Technology Inc.**, 270 E. Pulaski Road, Greenlawn, N.Y. 11740, (516) 423-3232.

Circle 445

Clearpoint
Combining High Density with Error Detection and Correction



■ The VMEbus

With the VMERAM, Clearpoint presents the ultimate memory for the VMEbus. Our first entry into this growing market, the VMERAM offers the highest density—an incredible 4 MB capacity on a standard dual-high VME card containing 256K ZIP DRAMs. Using Clearpoint's custom EDC chip set, the VMERAM features full single-bit correction and double-bit detection. Because of the chip set caching feature, the VMERAM benchmarks favorably with parity memory. It also supports block mode transfers (BMT) and unaligned transfers (UAT).

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- Clearpoint's 80-page **Designers Guide to Add-in Memory**
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CIRCLE NO. 72 ON INQUIRY CARD

A Comprehensive Analysis of the Computer Magnetic Tape Marketplace

The shift from removable disk drives in the seventies to fixed disk drives in the eighties has created a growing demand for tape transports to be used for back-up in addition to their established roles as data interchange and archival storage devices. "Tape Storage Technology" analyzes these and other forces which are shaping the OEM market for tape transports and forecasts both technology and market demand on a quarterly basis.

"Tape Storage Technology" has been prepared with the needs of both suppliers and integrators carefully considered. It is a comprehensive yet focused planning tool for product planning, engineering, marketing, and general management personnel.

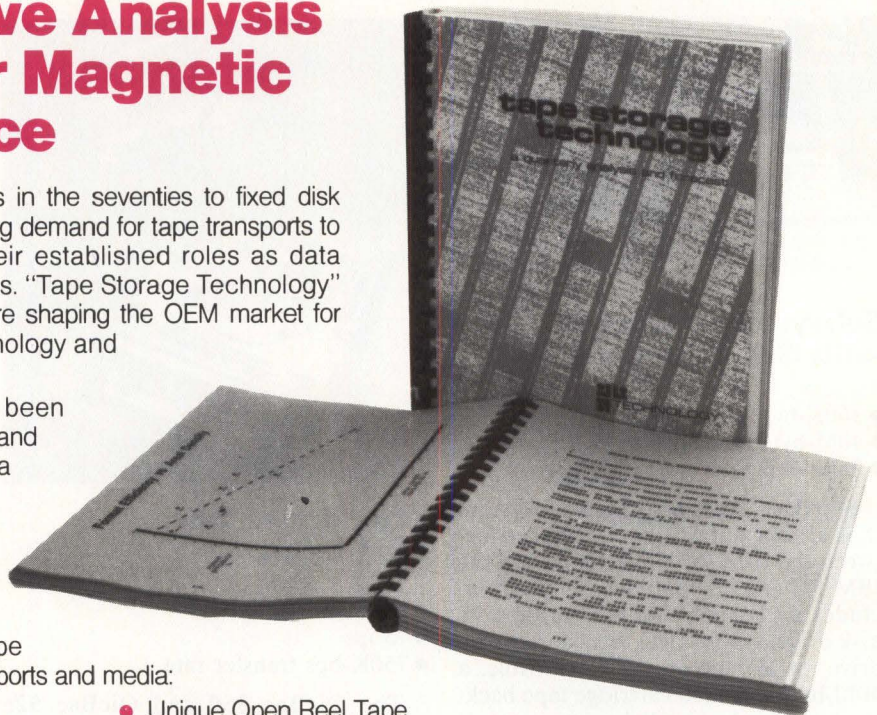
"Tape Storage Technology" covers all computer digital magnetic tape products, including the following tape transports and media:

- IBM Tape Cartridge
- Quarter-Inch Cartridge
- Standard Half-Inch Open Reel Tape
- Quarter-Inch Mini-Cartridge
- Unique Open Reel Tape
- Data Cassette
- Mini-Cartridge
- Unique Cartridges and Cassettes

The dynamics of the peripheral storage marketplace often render annual reports on magnetic tape transports out-of-date well before their next publication date. By updating and publishing quarterly, clients who subscribe to "Tape Storage Technology" will always have access to the latest data on technology, forecasts, specifications, standards, and other important subjects. Single copies of "Tape Storage Technology" are priced at \$995. Clients who subscribe on an annual basis will receive one current copy for each quarter of their annual subscription period at an annual price of \$2495.

In order to coherently assess all of the complex interrelationships between technology, pricing, suppliers, products, and applications, "Tape Storage Technology" is conveniently presented as one comprehensive and integrated report on all digital magnetic tape transports and media used for computer auxiliary storage.

In less than one year, "Tape Storage Technology: A Quarterly Analysis and Forecast" has become the definitive source of information on digital magnetic tape transports. Join the over 75 companies now relying on "Tape Storage Technology" for the most up-to-date data and analysis of tape transports and media by completing the order form below.



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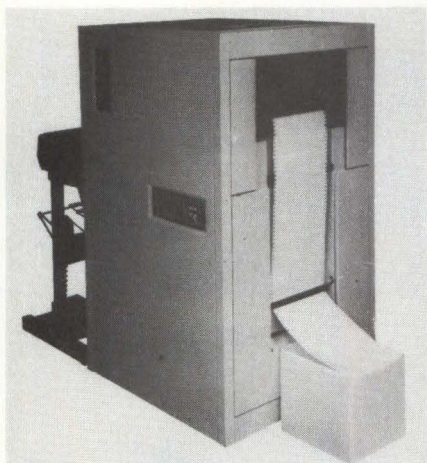
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CIRCLE NO. 76 ON INQUIRY CARD

NEW PRODUCTS

PRINTERS

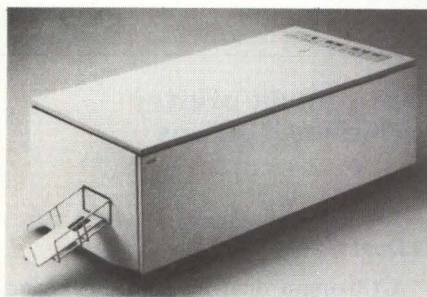


Printer handles 90 ppm

- Ion deposition
- 240 by 240 dpi
- IBM 3211 emulation

The 3801 ion deposition printer handles 90 ppm with a 240-by-240-dpi resolution. It provides a standard parallel interface or plug-to-plug compatibility and emulation of the IBM 3211 printer. Features include variable line spacing, two fixed fonts and two variable fonts. The unit accommodates continuous fan-fold and tractor-feed paper. \$4,000. **Miltope Business Products Inc.**, 1770 Walt Whitman Road, Melville, N.Y. 11747, (516) 420-0200.

Circle 446



Plotter suits CAD usage

- 200 dpi
- Versatec processor
- Laser imaging

The 4300 CAD/COM plotter records a digitized image directly from a CAD workstation onto an aperture card. Laser imaging provides a 200-dpi resolution. The unit interfaces to systems

via a Versatec processor. Drawings are imaged, processed and indexed in less than three minutes. \$38,000 to \$45,000. **NCR Corp.**, Micrographic Systems Division, 520 Logue Ave., Mountain View, Calif. 94043, (415) 965-3700.

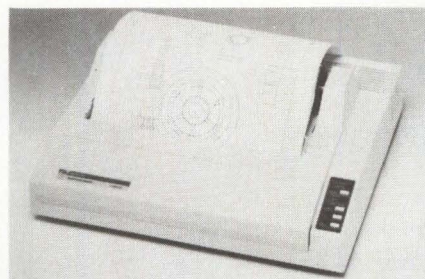
Circle 447

Laser printer supplies two controllers

- 17 fonts
- 8 ppm
- Three interfaces

A laser printer with two intelligent controllers, the QMS SmartScript 800 produces 8 ppm. The unit emulates Qume, Diablo and Epson printers. It can access 17 resident fonts. ANSI X3.64 escape sequences are used to draw lines, boxes, charts and tables. RS232C, RS422 and AppleTalk interfaces are standard. Features include automatic or manual paper feed and 16- to 24-pound paper handling. \$8,995. **QMS Inc.**, P.O. Box 81250, Mobile, Ala. 36689, (205) 633-4300.

Circle 448



Plotter prints in 30 seconds

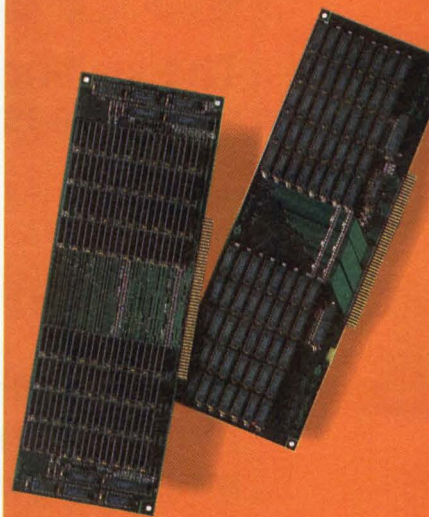
- 200 dpi
- 500 cps
- CAD/CAM applications

Utilizing a vector-to-raster conversion system, the MS 8603 thermal plotter prints copy in 30 seconds. The unit supplies a 200-dpi resolution and prints 500 cps. Duplicate plots are obtained by pressing the COPY key. The device operates with any type of computer and is geared toward CAD/CAM applications. It is available with an RS232C, Centronics or IEEE interface. Proprietary protocols and Hewlett-Packard emulation commands are supported. \$2,950. **Western Graphtec Inc.**, 12 Chrysler St., Irvine, Calif. 92718, (714) 770-6010.

Circle 449

Clearpoint

The Full 16 MB Address Space with 4 or 8 MB Expansion Cards



■ The IBM PC/RT

Another memory design first: the RTRAM is the first 100% PC/RT compatible memory. This Clearpoint memory comes fully tested with soldered-in memory devices.

The 4 MB card offers twice the density of comparable memories from IBM by using 256K ZIP DRAMs. The 8 MB RTRAM uses megabit DRAMs to quadruple the capacity per slot. Other features are on-board interleaving and low power consumption. Fully-populated testing ensures the highest reliability and full functionality.

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CIRCLE NO. 73 ON INQUIRY CARD

DEC Users

The waiting for disk response is over

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If your system is I/O bound because of disk intensive applications, the MegaDSC-11 can significantly increase your system's performance.

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The MegaDSC-11 intelligent disk caching system anticipates the data most likely to be needed by the CPU and holds that data in high-speed cache memory. Many read responses come directly from the cache memory, thereby eliminating mechanical motion as a factor in disk access time. Extra performance is gained by off-loading storage management functions from the CPU.

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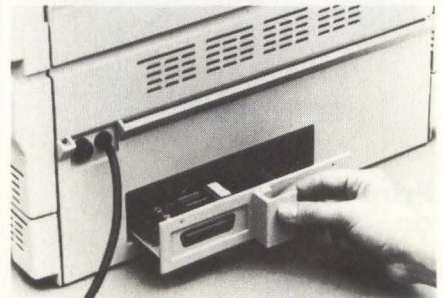


Imperial Technology, Inc.

831 S. Douglas Street • El Segundo, CA 90245
Telephone: (213) 536-0018 • Telex: 664469

CIRCLE NO. 77 ON INQUIRY CARD

NEW PRODUCTS PRINTERS



Laser printer produces 10 ppm

- 300 by 300 dpi
- IBM, Diablo emulation
- 80186 processor

The 5010 laser printer produces 10 ppm with a 300-by-300-dpi resolution. It includes an 80186 processor and a proprietary image processor. Two cartridges are provided for IBM Graphics Printer and Diablo 630 emulation. Up to four font cartridges can be inserted into available slots. \$3,000 and higher. Genicom Corp., Genicom Drive, Waynesboro, Va. 22980, (703) 949-1188.

Circle 450

Dot-matrix printer achieves 400 cps

- 8K-byte buffer
- Two software packages
- Dual nine-pin printhead

Utilizing a dual nine-pin printhead, the Microline 294 dot-matrix printer achieves a 400-cps speed in utility mode. NLQ speed is 100 cps. The unit offers IBM character sets, a built-in menu, bit-image graphics and an 8K-byte data buffer. It accepts continuous forms or cut sheets up to 16 inches wide. Features include two software packages and color printing. MTBF is 4,000 hours. \$1,499. Okidata, 532 Fellowship Road, Mt. Laurel, N.J. 08054, (609) 235-2600.

Circle 451

NEW PRODUCTS TERMINALS



ASCII terminal targets OEMs

- 16 function keys
- 14-inch screen
- 8K bytes of memory

An ASCII video display terminal, the ADM 2000 is geared toward OEMs. The unit supplies 16 function keys, 8K bytes of non-volatile memory and dual host ports. A 14-inch screen displays 80 or 132 columns by 26 lines. It is compatible with the Wyse WY-50, ADDS Viewpoint A2, TeleVideo 925 and 950 and the Esprit III and 6310. \$699, OEM discounts available. **Lear Siegler Inc.**, Data Products Division, 901 E. Ball Road, Anaheim, Calif. 92805, (714) 778-3500.

Circle 452

Terminal supplies bit-mapped graphics

- 14-inch screen
- 720 by 348 pixels
- 25 lines by 80 columns

Supplying bit-mapped graphics emulation, the PCST/G graphics terminal is compatible with software such as Lotus 1-2-3, Symphony and Framework. The unit includes a 14-inch, amber monitor with a text resolution of 25 lines by 80 columns and a graphics resolution of 720 by 348 pixels. It is used with a proprietary coprocessor card. \$995. **Alloy Computer Products Inc.**, 100 Pennsylvania Ave., Framingham, Mass. 01701, (617) 875-6100.

Circle 453

CG unit executes 4,500 vectors per second

- 1,024 by 780 pixels
- 14-inch screen
- Color graphics

A color graphics terminal, the GR-1105 executes 4,500 short vectors per second from display-list memory. The unit utilizes an 8086/8087 processor combination running at 8 MHz. A 14-inch screen displays 1,024 by 780 pixels. Features include 512 colors, multiple view ports and local pan and zoom capabilities. \$4,995 and higher. **Seiko Instruments USA Inc.**, 1623 Buckeye Drive, Milpitas, Calif. 95035, (408) 943-9100.

Circle 454



Terminal features windowing capabilities

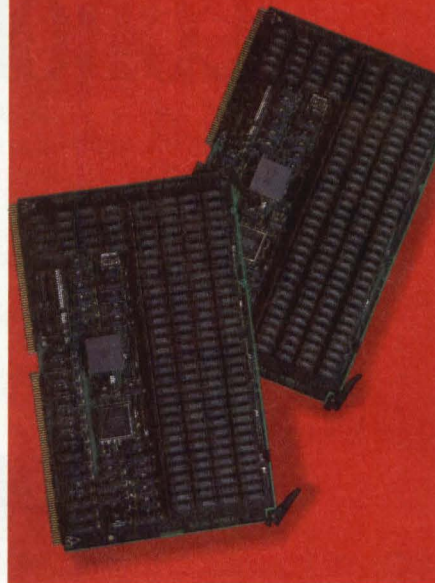
- 14-inch screen
- 38 programmable keys
- Horizontal scrolling

Generating windowing capabilities and horizontal scrolling, the P411 terminal emulates the DG D410 and D411. The unit displays 162-character lines on a 14-inch, green or amber screen. Features include 38 programmable function keys and an optional current-loop interface. \$795. **Perfect Terminal Inc.**, 3319 Seldon Court, Fremont, Calif. 94538, (415) 656-8383.

Circle 455

Clearpoint

High Reliability and High Performance in 4 or 16 MB Capacities



■ The VERSAbus

Using megabit DRAMs, the **VERSARAM** demonstrates Clearpoint's commitment to the most advanced technology for the VERSAbus. With a capacity range of 512 KB to 16 MB, the **VERSARAM** offers maximum capacity combined with maximum flexibility. Clearpoint's custom EDC chip set provides single-bit correction, double-bit detection, error scrubbing and the high performance of 64-bit caching.

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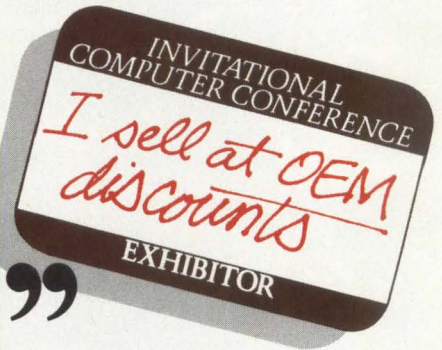
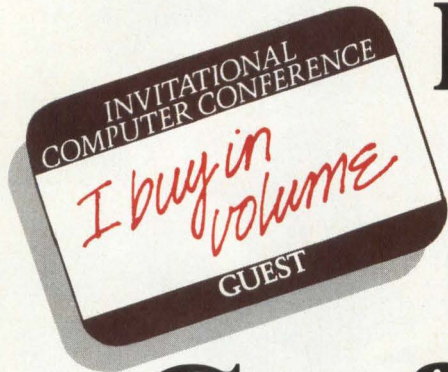
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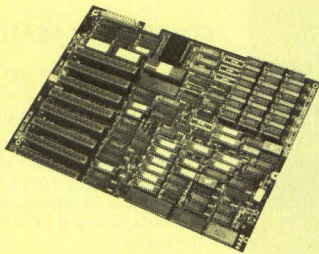
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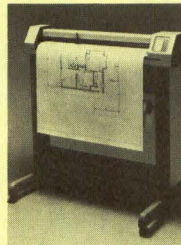
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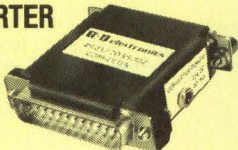


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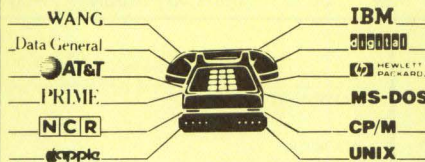
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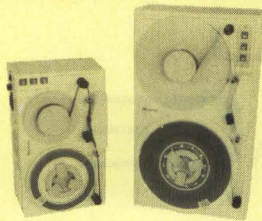
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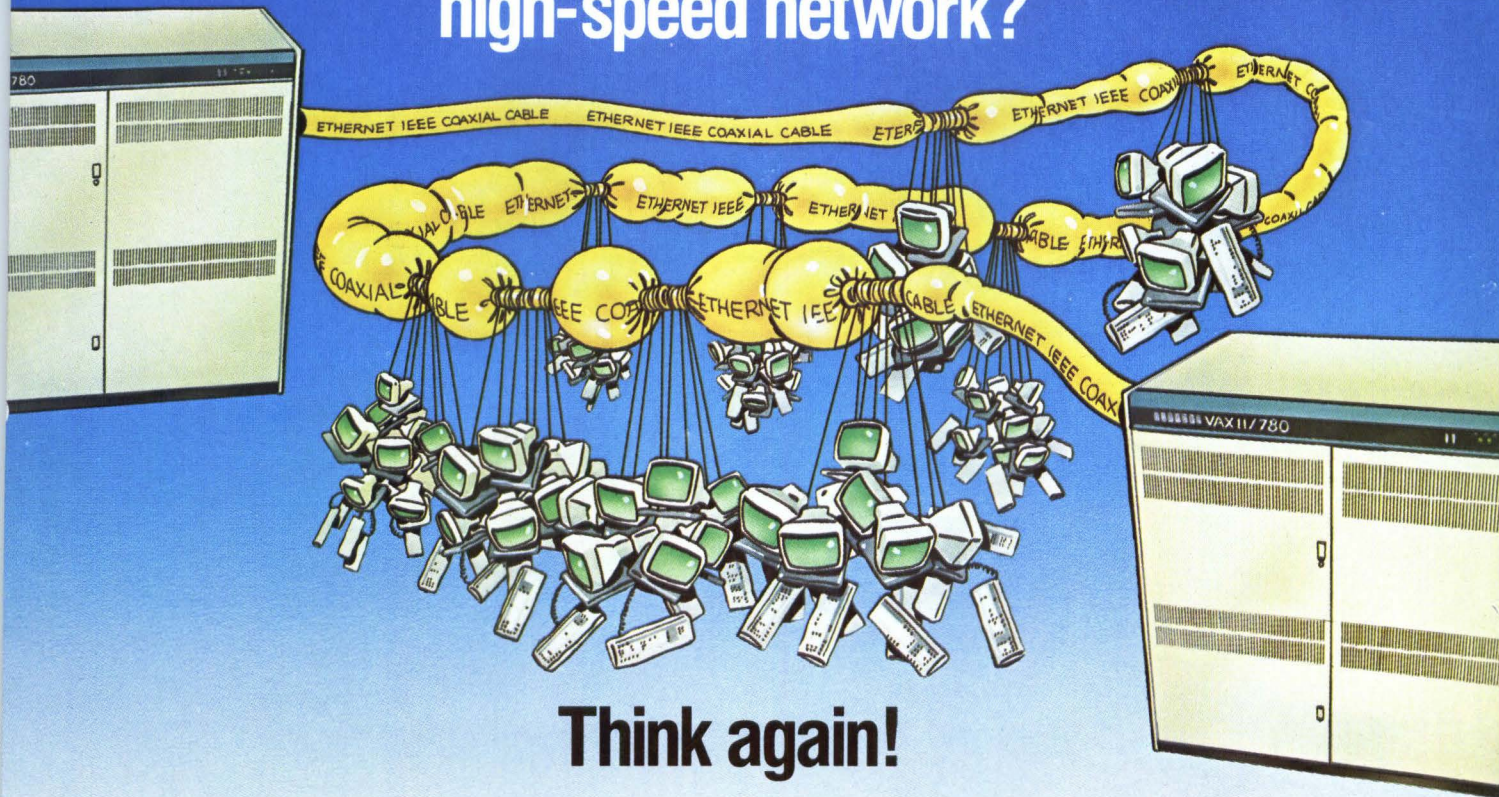
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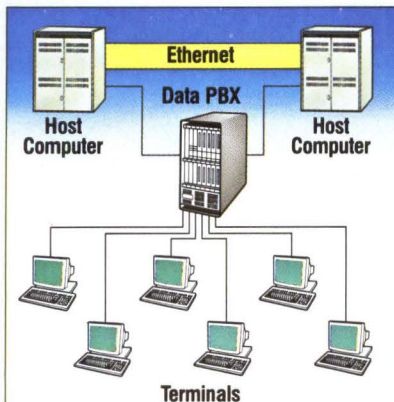
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