OCTOBER 1987

Mini-Micro Systems®

THE MAGAZINE FOR SYSTEMS INTEGRATION

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The great graphics IC race

Plus:
PC fax boards
Minisupercomputers

KEEPING AMERICA COMPETITIVE

Pages 9, 23-30

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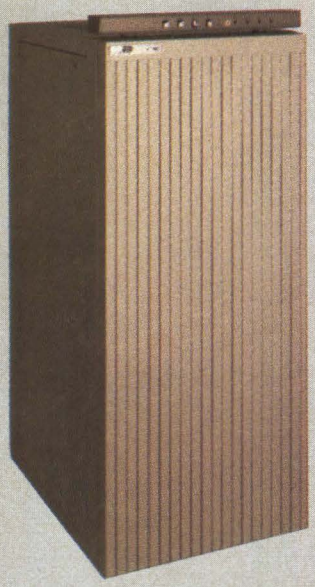

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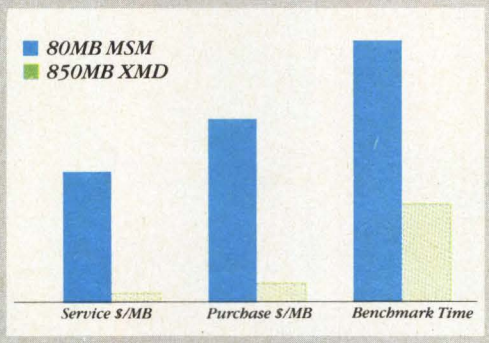

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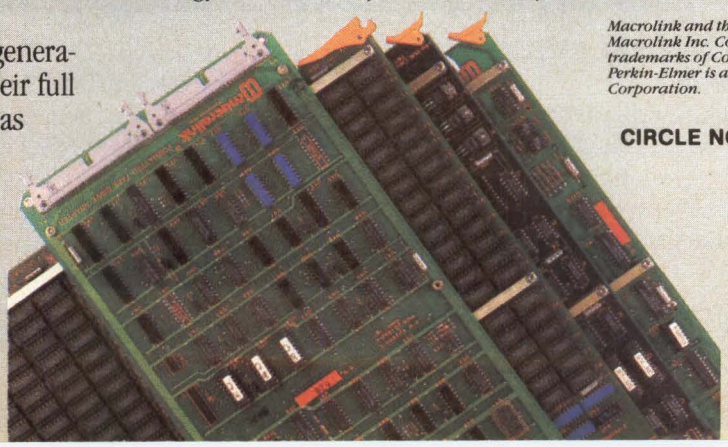

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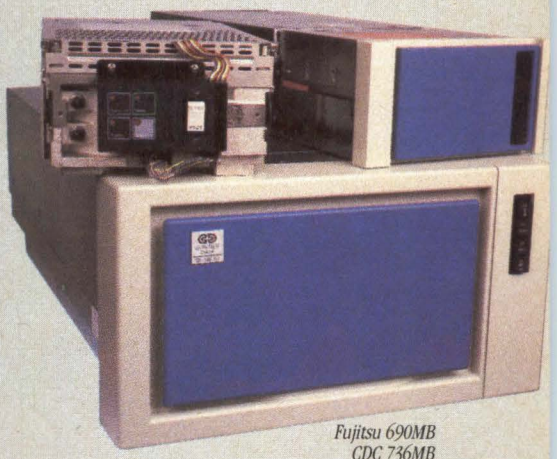

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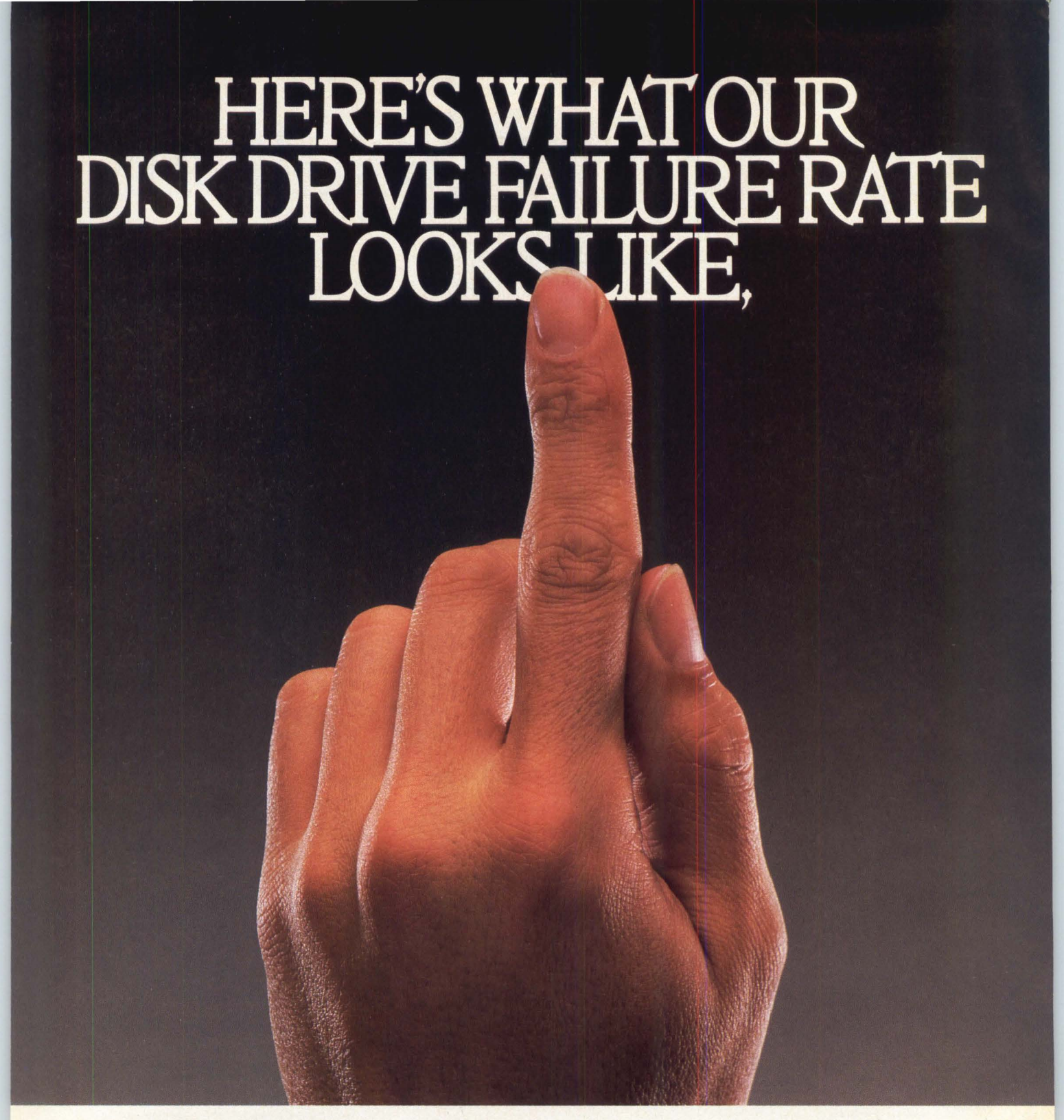

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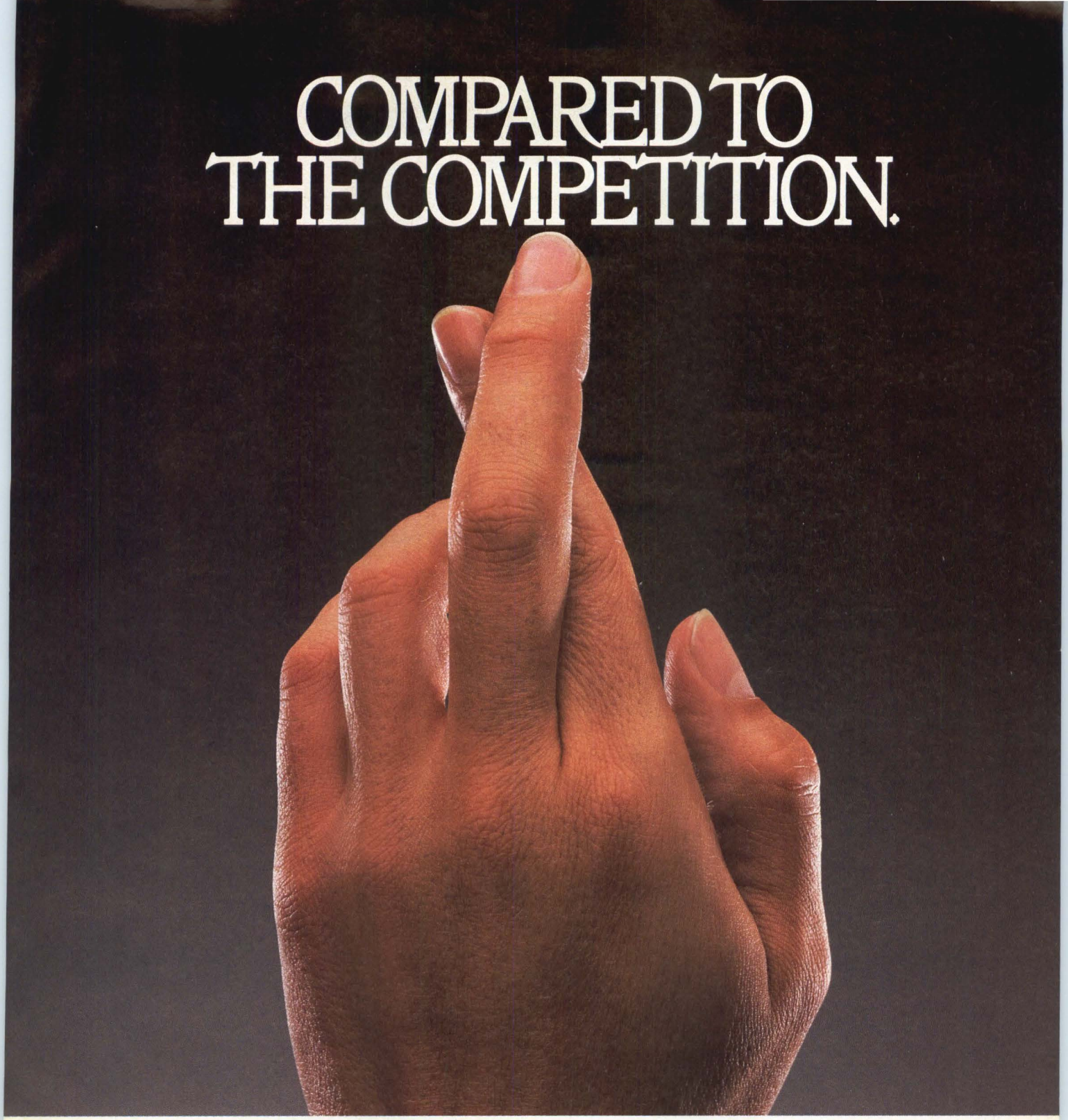

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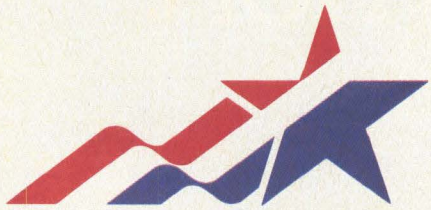

The Cahners magazines that serve the computer/electronics industry, namely, *Datamation, EDN, EDN News, Electronic Business, Electronics Purchasing, Electronic Packaging and Production, Mini-Micro Systems, Semindconductor International,* and *Test and Measurement World,* have established as an urgent priority the pledge to help U.S. companies restore their competitiveness. *Mini-Micro Systems* will present a series of "Keeping America Competitive" articles from October through March 1988. These technical articles will inform system integrators of the crucial product and technology trends, issues and strategies hat manipulate the computer marketplace.

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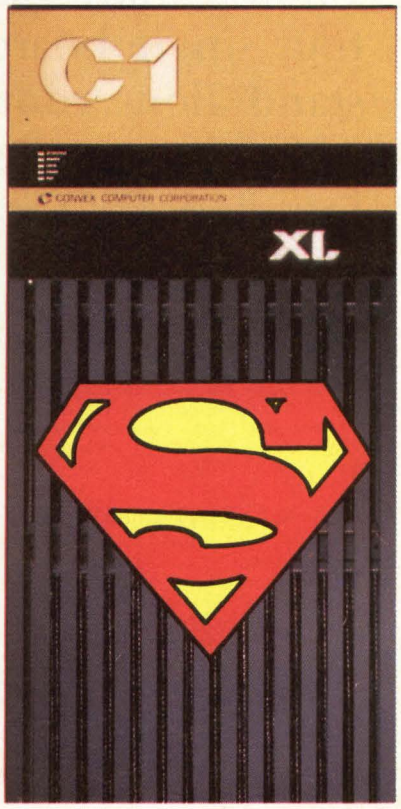

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19,200 bps

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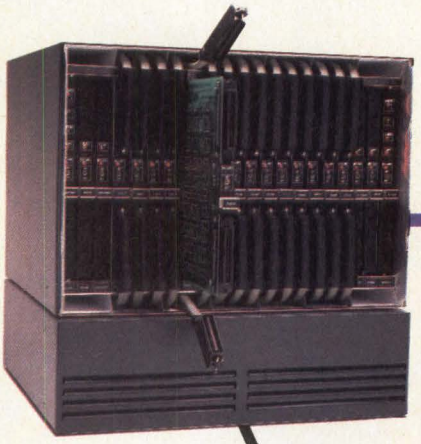

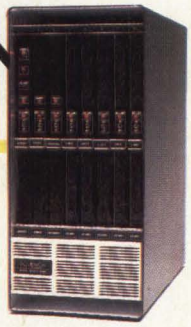

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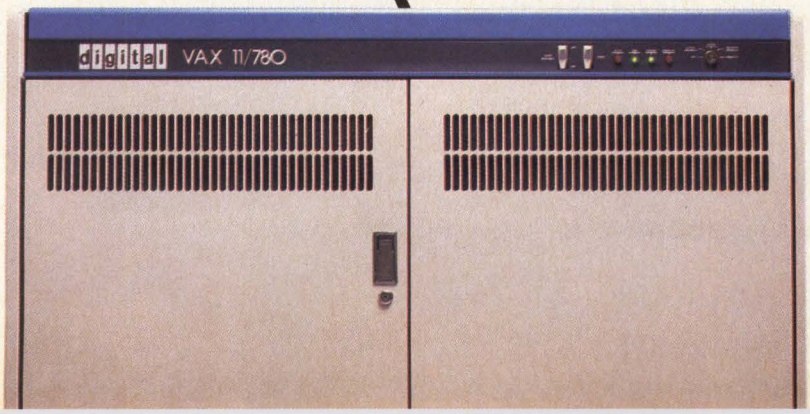

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CIRCLE NO. 6 ON INQUIRY CARD

EDITORIAL

KEEPING AMERICA COMPETITIVE

COMPETITIVENESS = COMMITMENT

In the worldwide marketplace, over the past few years, computer/electronic product competition has intensified. And, unfortunately, American-built products, in general, have been found deficient. A look at recent import/export data dramatically demonstrates this finding. Since 1984, American electronic products have posted negative balances. In 1985, imports exceeded exports by $6.5 billion; in 1986, the difference doubled to $13.1 billion.

Of course, much of the blame centers on questionable U.S. government trade policies, the mind-boggling $2 trillion federal deficit and the overvalued dollar. Some of the blame, though, must be shouldered by the U.S. manufacturing industry. U.S. companies have lost their competitiveness, claims Sony Corp. chairman Akio Morita, because they have pursued short-term profit at the expense of long-term planning and investment.

According to Mark Shepherd Jr., chairman of Texas Instruments Inc., the strategy to make the United States more competitive requires that companies adapt new technology, particularly information technology, into the manufacturing process. Such adaption would result in improved efficiency, reduced costs and higher quality.

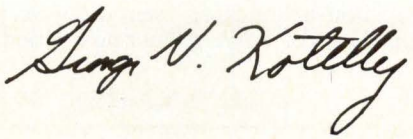
To obtain increased competitiveness, U.S. companies must treat manufacturing as an integrated system process. In the past, common practices for improving manufacturing methods have focused mainly on solving isolated problems. Now, however, global competition mandates an overall analysis that ties manufacturing into the company's total business planning strategy. Shepherd proposes that computer integrated manufacturing (CIM) will reduce the time it takes to get a product from the idea stage to the marketplace, and at improved profitability.

Business Week calls this approach "flexible manufacturing." It lets manufacturers customize one product line or shift quickly from product to product with nearly the same equipment. This approach differs radically from traditional mass production and assembly line techniques that don't allow variations.

The computer system equipment for upgrading and enhancing U.S. manufacturing is available now. CAD and CAM systems, when properly integrated and employed, can trim design, production, rework, inventory and labor costs by 50 percent to 85 percent, according to recent studies.

Although the need to implement new technology is recognized throughout the manufacturing industry, and is acknowledged to be critical to making and keeping the United States competitive, a recent Coopers & Lybrand study, "Made in America, a survey of Manufacturing's Future," reveals that U.S. manufacturers' use of advanced systems is still relatively modest. What's more, the survey observes, because of financial investment, U.S. manufacturers are reluctant to apply advanced technologies now, and they appear unlikely to do so in the near future.

In the light of those findings, therefore, what U.S. companies must do to be competitive is bold and revolutionary. They must make a total commitment to product quality control and to a willingness to change. They must overhaul their corporate culture, radically shift their managerial mind-set and educate their employees. With technology, equipment and expertise in place, smarter ideas will then more quickly and easily turn into better products.



George V. Kotelly
Chief Editor

LETTERS

SIMPLE ANSWERS

To the editor:

In "Bar code readers check out as 'most perplexing' automation tool," (MMS, June, Page 46), you list "the three impediments to efficient reading of bar codes . . . orientation, smudging and limits on length." There are some very simple answers.

1. It is true that bar code orientation is a critical limitation. However, a wide range of contact and non-contact (usually laser) scanners is available to meet most requirements, and careful attention to matching the scanner to its intended use will usually yield more than satisfactory results.

2. Smudging is quite often a problem when improper printing technology is chosen. Labels hastily generated by a dot-matrix printer and quickly pressed into service will naturally be prone to smearing. Alternate printing techniques, such as laser, thermal and photo-positive, can provide much more resistance to smearing, heat and solvents.

3. Bar code length limits are generally a problem imposed by unrealistic expectations. A bar code label is not meant to provide all the information about the item to which it is attached, just as a Social Security number cannot contain the life history of the card holder. Both are merely identifiers used to access more detailed information in some sort of database. A six-digit numeric label has one million possible variations, enough for most applications. An alphanumeric label has considerably more.

Joel Postman
Product Manager
TPS Electronics
Palo Alto, Calif. 94303

MORE ON SLANG

Editor's note:

In the "Letters" section of the June issue, a reader from France, Solveig Albrand, complained about the use of American slang in some articles in *Mini-Micro Systems*. The letter drew several responses. Here's another one.

To the editor:

I agree fully with Albrand. The need for clarity in written language is indeed important for questions of cross-cultural understanding. It is also significant to precise transmission of knowledge in a situation where an "explainer," a person, is simply not available. But the central issue is that clarity of expression represents underlying thinking. It is indicative of the fact that the writer takes the trouble to think at all, and it reflects the thoroughness with which the thinking takes place.

The distinction between written and spoken language is the distinction between completely controlled linguistic behavior and spoken, interactive transactions. The failure to maintain this distinction is important. It betrays an underlying sloppiness in thought that can rightly bring the reader to doubt that the writer has anything important to say. When we fall back on a spoken turn of speech to make a point in an expository context (e.g., a technical publication), we are making the additional statement that we really don't have to be taken seriously.

But more is at stake than the communication of some ideas. The organ also bears a social responsibility for some measure of intellectual leadership. The tone in which it publishes says something about its perception of this role.

Barney Milstein
Cherry Hill, N.J. 08002

UP THE UPS

To the editor:

In "The safe way to figure UPS specs" (MMS, June, Page 105), there were a few very important pieces of the puzzle omitted.

First of all, the quality of the AC power provided by the utility company is probably better than it's ever been. The bulk of the power problems we see at the computer today begins to unfold at the building distribution box: when we power elevators, air conditioners, fans, punch presses—creating noise, voltage spikes and sags, and a number of other power line disturbances.

The suggested solution to the problem is to add a UPS (Uninterruptible Power System). While this is true, you must be certain it is a properly designed UPS and, equally important, properly installed. All UPSes do not provide total protection, even to the point that many devices advertised as UPSes are in fact Standby Power Systems (SPS) with switch and start-up sequences.

What should a UPS do besides provide continuous power to the load? First of all, the power should be in the form of a sine wave and consistent with ANSI ADP range (110-125 VAC). Total harmonic distortion should be kept to a minimum: less than 5 percent THD is most desirable. It must also perfrom to these standards when operated with linear, non-linear, or combinations of these loads and across a wide range of power factors.

To further complicate matters, the UPS must provide all of the requirements across the spectrum of the UPS power capability: i.e., minimal load to full load and in normal and/or inverter mode (depending on design approach). It should also be UL approved.

An additional consideration, which is inherent to the design, is efficiency to 85 percent to 90 percent or better. Inefficiency of the UPS design is transformed into heat, which will contribute to premature failure of the UPS itself, plus create additional load on the air conditioning. In either case, energy is lost.

N.J. Geiger
Western Regional Sales Manager
AT&T Co.
Mesquite, Texas 75149

Without Compromise... The Modgraph GX-2000

A Quality High-Resolution Image...

The GX-2000 is the latest in Modgraph's series of high-resolution monochrome graphics/alphanumeric terminals. In a contemporary enclosure, it provides our field proven TEK 4010/4014 emulation and VT100/VT220 compatibility in a reliable low cost graphics terminal.

A 15″ anti-glare flat screen produces a crisp 1024×780 image with TRUE ZOOM capability. Optional features include: memory for three additional graphics screens, TEK 4631 hardcopy interface, composite video and mouse or data tablet.

Modgraph

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Digital Equipment Corp.–VT100, VT220

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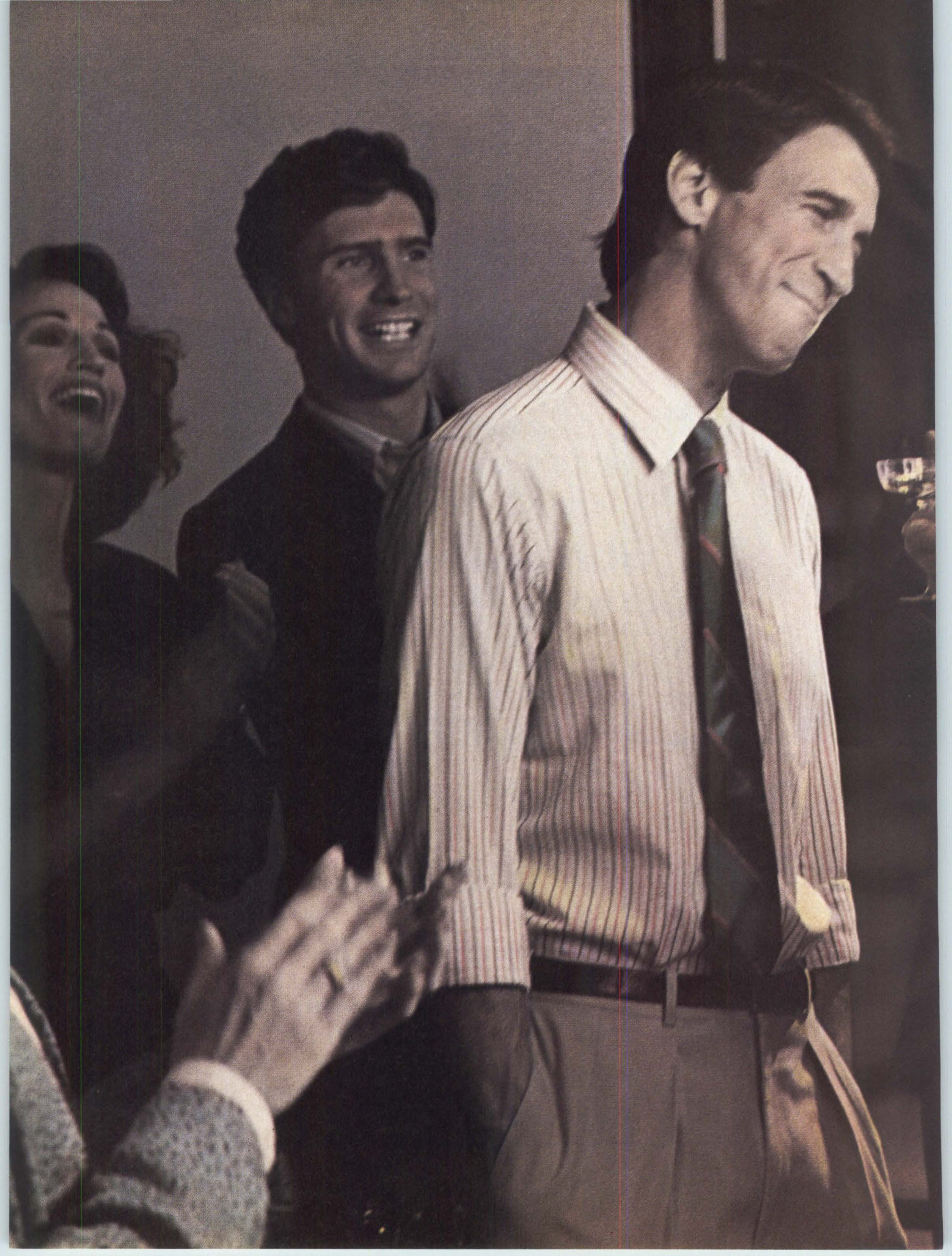
Image courtesy of Computervision Corp.

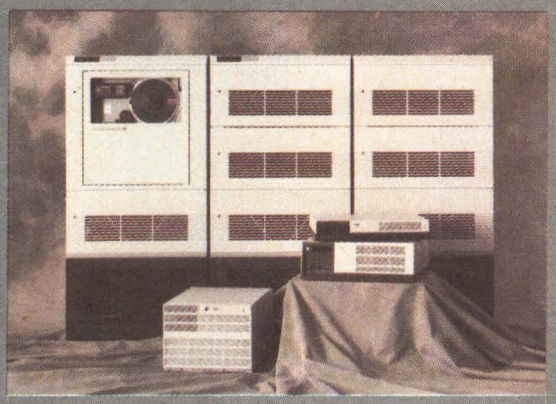
CIRCLE NO. 7 ON INQUIRY CARD



"I'm told they don't throw many parties down in DP.

So I asked Doug to come up to ours. Doug's the real brains behind our new 3B system. He's the reason our computers can now talk to the IBM in Accounting and the DEC in Manufacturing. If you know anything about DP, that amounted to doing business across the Berlin Wall. Doug had a brainstorm and suggested AT&T. Their approach is standardizing communications between different systems. I don't have to tell you that's opened some doors around here. We owe Doug a lot.

AT&T comes through."



The AT&T 3B Computers

AT&T now offers a full line of departmental workgroup computers serving up to 300 users. A rich library of system and applications software includes host connectivity, development tools, programming languages, database management, OA, and a world of other **UNIX**® System programs.

LAN standards: Interfaces to Ethernet*, AT&T ISN, STARLAN Network, DECnet** and more put different departments in touch.

Industry standards including IBM† 3270, SNA†, BSC and X.25 link mainframe, midrange and micro environments.

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From equipment to networking, from computers to communications, AT&T is the right choice.

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The right choice.

CIRCLE NO. 8 ON INQUIRY CARD

The people who offer you the best service now offer you a Dataproducts laser printer that may never need any.

At Kierulff, we've built our entire company around customer service.

Our technical design assistance program is an industry standard. Along with our ability to integrate systems to your specific needs. And provide you with complete testing services.

We also know that the best service of all is to provide you with a product that's designed not to need service. That's why we're offering the new Dataproducts LZR 1230 Printer.

For starters, the rugged construction of the new 1230 gives it an estimated 600,000 page life. Most personal laser printers are calling it quits after just 100,000 pages. In addition, the duty cycle is a staggering 10,000 pages per month.

You don't have to babysit this printer, either. The LZR 1230 can automatically feed up to 750 jam-free pages of various sizes. And you're not limited to just paper. You can get laser quality printing on envelopes, labels and transparencies too.

With three concurrent interfaces, the new 1230 can be used by three different systems simultaneously. Without constantly switching cables. Or adding any expensive hardware.

After all, when it comes to system solutions, Kierulff wrote the book. Our Systems Product Guide is the industry's most complete, single-source of product information available on twenty-two leading manufacturers of systems, peripherals, software and accessories. Contact us for your copy or look for Volume 3-KE of the Gold Book.

Call 1-800-FOR PROS. It'll connect you to the people who offer the best service.

And the Dataproducts laser printer that may never need any.

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Our people are the best part.

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CIRCLE NO. 9 ON INQUIRY CARD

BREAKPOINTS

MICROPOLIS OUT OF CHUTE WITH 760M-BYTE, 5¼-INCH WINCHESTER

Look for Micropolis Corp. to introduce a 765M-byte, 5¼-inch Winchester disk drive later this month. The eight-platter 1500 series, available in ESDI and SCSI versions, will be priced at about $2,300 in quantities of 2,500. Production is slated for April 1988. The announcement makes Micropolis, Chatsworth, Calif., the second vendor with such a drive. Maxtor Corp. of San Francisco introduced a similar drive last year. Micropolis will also this month unveil SCSI and ESDI versions of the Series 1600 180M-byte, half-height 5¼-inch Winchesters. They will be available in the first quarter of 1988 at about $800 in OEM quantities. —*Mike Seither*

SEIKO BRINGING OUT PS/2-COMPATIBLE COLOR MONITOR

In January, Seiko Instruments U.S.A. Inc., San Jose, expects to begin volume shipments of a $1,095 high-end color monitor for IBM Corp.'s PS/2. The CM-1430 multiple-frequency scanning unit operates in a variety of IBM Corp. PC graphics modes at resolutions of 320 by 200, 640 by 350 or 640 by 480 pixels. In the PS/2's video graphics adapter (VGA) mode, the monitor achieves a resolution of 1,024 by 768 pixels at a scanning rate of 43.5 Hz. The monitor features a separate video output for such peripherals as slave monitors or copiers to prevent signal degradation.—*Mike Seither*

TOSHIBA AIMS TO BE PRICE LEADER IN BIG WINCHESTERS

Toshiba America Inc. is banking on pricing to muscle in on the crowded 380M-byte, 5¼-inch rigid disk drive OEM market. The company's disk products division, in Irvine, Calif., is coming out with the MK250, a 382M-byte Winchester with an access time of 18 msec, for less than $1,700. That compares with about $2,000 for similar drives. Toshiba is also trying to differentiate itself from the crowd with hybrid tracking that combines dedicated and embedded servo systems. The MK250, with a data transfer rate of 15M bytes per second, will be previewed next month at COMDEX/Fall, Las Vegas. Sample units are expected in January, with production planned for the second quarter of 1988. —*Mike Seither*

MINISCRIBE TOUTS STABILITY WITH 'CLAMSHELL' DRIVE DESIGN

MiniScribe Corp.'s new high-capacity 5¼-inch Winchester disk drives, out this month, are nicknamed "the clamshells" due to their vertically split casting, in which one side holds the spindle and the rotary actuator. The Longmont, Colo., company claims the clamshell approach guards against shaft movement in cases where vendors stack as many as eight disks to increase capacity, as they can with MiniScribe's latest Series 9000 family. The high-end 382M-byte version, available with either SCSI and ESDI interfaces, will cost about $1,900 in OEM quantities.—*Mike Seither*

PARADISE UNVEILS VGA VIDEO CHIP, BOARDS

Paradise Systems Inc.'s PVGA1, a PS/2-compatible video chip made to surpass IBM Corp.'s VGA (Video Graphics Array), goes into full production this month. The key advantage of the PVGA1, as compared to other VGA chips, is its full hardware and software compatibility with the VGA, according to the South San Francisco, Calif., company. With a proprietary BIOS, the chip costs $60 in

100-unit OEM quantities. Next month, the company plans to begin shipping two board-level VGA products—the VGA Professional Card and the VGA Plus Card—both of which are based on the PVGA1 chip. Suggested retail prices are $599 and $399, respectively. All of Paradise's new products will be shown at next month's COMDEX show in Las Vegas.—*Dave Simpson*

DOUBLE-BARRELED SECURITY AT 9,600 BPS

Look for Cermetek Microelectronics Inc., Sunnyvale, Calif., to introduce next month at COMDEX/FALL in Las Vegas a V.32 modem fashioned with security in mind. The 9,600-bps device uses menu-driven software that requires eight-character passwords on both the sending and receiving ends. The passwords can be any combination of numbers and uppercase and lowercase letters, making it difficult for intruders using random dialing programs to break into a computer system. For additional security, the Cermetek model 9600S has a call-back feature that redials only users with authorized telephone numbers. Price is pending.—*Mike Seither*

CONTROL DATA PREMIERES FIRST G-BYTE 8-INCH WINCHESTER

Minneapolis-based Control Data Corp. expects to begin production before the year-end of the industry's first G-byte 8-inch Winchester. The Sabre 1230 has a capacity of 1.23G bytes and an average access time of 16 msec. Available with a SMD, SCSI or IPI-2 interface, the Sabre 1230 features a data transfer rate of 2.46M bytes per second. OEM pricing is $6,470. Samples are available.
—*Mike Seither*

LASERDRIVE WORM EMULATES MAGNETIC DISKS

Laserdrive Ltd., Santa Clara, Calif., this month introduces the LaserBank 800 WORM optical disk drive. The 810M-byte drive comes in a 5¼-inch form factor and, via software in its embedded SCSI controller, emulates standard magnetic disk drives. The company will show the drive at next month's COMDEX show in Las Vegas. Suggested retail price is $4,900; in OEM quantities, $3,200.
— *Dave Simpson*

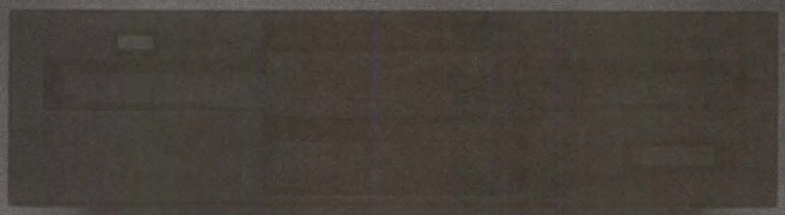
FUTURE DOMAIN DEBUTS PS/2 SCSI HOST ADAPTER

Future Domain Corp., Tustin, Calif., this month begins shipping evaluation units of its MCS-350 SCSI host adapter, which links SCSI devices to IBM Corp.'s PS/2 Models 50, 60 and 80. The adapter's transfer rate is 1.67M bytes per second, and the company claims full compatibility with the Micro Channel bus. Production quantities are slated for late in the fourth quarter, with prices pegged at $390 for single units.—*Dave Simpson*

HP BRINGS FIRST 'BUBBLEJET' THERMAL PRINTER TO MARKET

The first color printer to make it to the marketplace with "bubblejet" thermal-ink-jet technology is PaintJet from Hewlett-Packard Co., Cupertino, Calif. In bubblejet, heat forms a bubble in the reservoir, and that forces the ink through nozzles and onto the paper. The printhead has no tubes to clog and no moving parts to wear out. In addition, the ink and printhead are in a disposable cartridge, dispensing with reservoirs that need to be refilled. HP suggests you throw away the cartridges after producing 1,100 text pages with a black-ink cartridge or 180 graphics pages in color (cyan, magenta, yellow). That should reduce the clogging that comes with extended use. Color cartridges sell for $34.95; black cartridges for $27.95. PaintJet is priced at $1,395.
—*Jim Donohue*

Give Us an Inch.



FD-135 shown actual size.

The TEAC FD-135 Series of 3½-inch micro floppy disk drives need only one inch in height. A mere 25.4mm. But they're not short on capacity. Switchable from 1 to 2 megabytes of storage, the FD-135 Series fit in with today's emerging standard.

In addition, TEAC offers six different 3½-inch drives available in three different form factors. The FD-135 Series, the world's first one-inch high micro floppy disk drives. Next, our 40mm high FD-35 Series which set an industry record for quiet operation. Then there's our FD-35FN-23. It fits a standard 5¼-inch floppy disk drive opening and offers instant plug-in compatibility with 5¼-inch drives.

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CIRCLE NO. 10 ON INQUIRY CARD

COMPETITION DRIVES DOWN PRICES OF COLOR DOT-MATRIX PRINTERS

Six major vendors of color dot-matrix printers have reduced prices since the first of the year. They are Epson America Corp., Facit Inc., Fujitsu Ltd., NEC Informations Systems Inc., Okidata and Toshiba America Inc. For example, Fujitsu launched five color dot-matrix printers in the third quarter and cut the prices on three established models, including the DL 260 (from $1,795 to $1,695). The reductions range from 5 percent to 20 percent. Some of the cuts reflect competition among vendors and include spinoff effects from IBM Corp.'s announcement of its low-cost Proprinters.—*Charles LeCompte*

CALIPER SHIPS HI/TC-COMPATIBLE, 3480-STYLE TAPE DRIVE

California Peripherals Corp. (CaliPer) is scheduled to begin shipping the long-delayed, 240M-byte CP-240 tape drive next. The unit, held up for modifications, is compatible with HI/TC (half-inch tape cartridge) recording format standards and uses IBM Corp. 3480-compatible cartridges. In quantities of 500, the CP-240 costs $1,285. The Torrance, Calif., company will show the drives, which are manufactured by The Nakamichi Corp. of Tokyo, at next month's COMDEX/Fall in Las Vegas, where it will also introduce the 150M-byte, 18-track CP-150 quarter-inch tape cartridge drive.—*Dave Simpson*

ARETÉ TO BRING OUT MIDRANGE MULTIPROCESSOR SYSTEM

Areté Systems Corp., San Jose, plans to fill out its line of multiprocessor computers with the midrange model 825, to be announced later this month. Listing for about $40,000, the 825 comes with a single 25-Mhz Motorola Inc. MC68020 processor; 8M bytes of memory, expandable to 64M bytes; a 170M-byte Winchester disk drive; and a streaming tape drive. The system can accommodate an additional processing unit and enough I/O processors for 128 users. Areté is also taking the wraps off an expansion chassis that holds a nine-track tape drive, an 8-inch Winchester (337M bytes or 690M bytes) and a 12-inch optical disk drive. The 825 is available now and will be shown next month at COMDEX/Fall in Las Vegas.—*Mike Seither*

BIG BLUE TESTS OEM WATERS WITH 387M-BYTE, 5¼-INCH DISK DRIVE

The Systems Products Division of IBM Corp., White Plains, N.Y., is putting out feelers to OEMs in an attempt to sell its 387M-byte Winchester. IBM's model 671, with an access time of about 23 msec, uses thin-film media and ferrite heads. Price: $4 to $5 per megabyte. IBM officials say the drive will be available in production quantities in January.—*Mike Seither*

PLASMON PREPARES IBM 3363-COMPATIBLE OPTICAL DISKS

Reportedly, IBM Corp. has already shipped over 10,000 5¼-inch 3363 optical disk drives—the 200M-byte devices announced with the PS/2s in April. These surprisingly huge shipments are spurring demand for compatible media. At next month's COMDEX show, look for such media from Plasmon Data Systems, a San Jose subsidiary of Plasmon Ltd. of England. The company has already tested the disks and last month began cartridge packaging. Retail prices are expected to be about $65, with evaluation shipments due in the first quarter of next year.—*Dave Simpson*

TEK COLOR PRINTERS

ART IMITATES LIFE. IN ABOUT A MINUTE.

Introducing the Tektronix 4693D: The 300 dots-per-inch, 16.7 million-color printer. The flexible 4693D is fully compatible with Sun, Apollo and Tek workstations, plus the IBM PC and MAC II. Add the 4510A Color Graphics Rasterizer for support of ASCII and IBM hosts.

Use the 4693D's high-speed interface to download complex images in under five seconds. Then, the onboard Motorola 68020 drives ultra-fast intelligent image processing. The result: rich, vivid output in as little as ninety seconds.

What's more, the 4693D features up to 12Mb of memory. So you can offload and store three full color images of 1024 × 1280 pixels. The 4693D's multiplexing capability allows four users locally, or even more on a LAN.

And backing the 4693D is Tek's 67-country service and support network. For more information about Tek's complete 4690 Color Printer Family and OEM/VAR dealer programs, contact your local Tektronix representative. Or call 1-800-225-5434. In Oregon, 1-235-7202.

Tektronix

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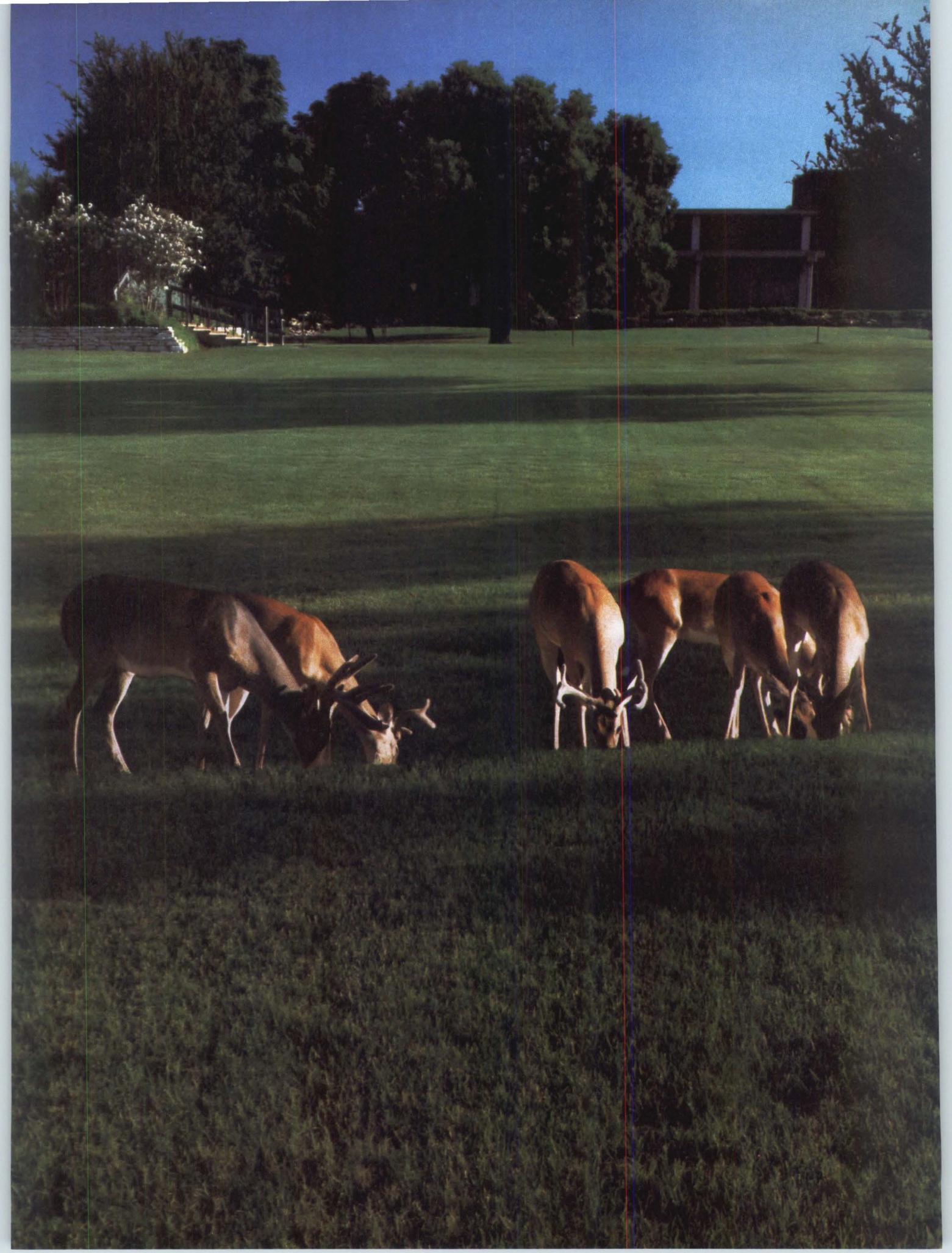
Cockpit image courtesy of Island Graphics Corporation.

CIRCLE NO. 11 ON INQUIRY CARD



To most computer vendors, VARs are just a way of doing business. To Texas Instruments, they're a way of life.

At Texas Instruments, we have a refreshingly simple approach to doing business. We sell our multi-user computer systems to VARs. Our VARs sell them to their customers.

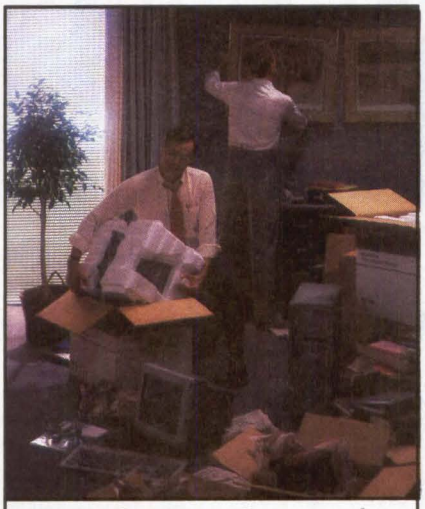
If this sounds straightforward to you, that's because it is. You see, unlike most vendors, we dedicate our selling effort to our VARs. So not only do we work harder than most to ensure our VARs' success, we completely avoid situations like cross-channel conflicts that can come between a VAR and a vendor.

As a TI System 1000 Series VAR, you'll be working with a product family, designed using industry standards, that's expandable from two to 128 users. But just as important, you'll be working with a company that has over 15 years' experience in helping VARs succeed.

Take our field-based software migration support program, for example. It allows you to bring your applications software into the System 1000 Series environment without your normal heavy investment requirements. And with our product evaluations, leasing options, sales and technical training and our 25 nationwide service locations behind you, you'll find us very easy to deal with.

You'll also benefit from our focused marketing support programs and receive leads from our extensive advertising campaigns and trade shows. Once we've helped you find a customer, we'll also provide you with a hardware and software growth path that will help you provide superior protection for your customer's computing investment.

◀ *Pictured left: Texas Instruments, Data Systems Group Headquarters in Austin, Texas, home of approximately 2,500 employees and over 50 native white-tailed deer.*



TI's new System 1000 Series can take your customers from start-up to where they plan to end up, with unmatched protection of their hardware and software investment.

TI System V–The UNIX® operating environment for the business environment.

To help you satisfy almost any size application with common development tools, we've based our System 1000 Series on an enhanced version of the UNIX V standard, TI System V.* With source code compatibility, data file management, user interfaces, communications and languages common to our entire System 1000 Series family, TI System V provides you with maximum programming efficiency.

What's more, we've enhanced our TI System V capabilities to make it more suitable for the business environment, with features like interactive command menus, on-line help screens and a user-friendly command language.

Make our way of life a part of yours; become a TI VAR.

Add it all up and compare what we can offer with what you're getting from your present vendor. We think you'll find nobody works harder to help VARs succeed than TI. When you consider the wide sales appeal of our System 1000 Series, our full line of printers and terminals and our competitive margins, you can see what makes TI the vendor of choice in multi-user systems.

To find out more, call us toll-free at 1-800-527-3500. We'll explain how easy it is to get started with TI or one of our distributors, and how hard we'll work to help you succeed.

TEXAS INSTRUMENTS

*TI System V for the System 1100 and System 1300 incorporates the XENIX® V operating system; TI System V for the System 1500 is derived from the UNIX System V. UNIX is a registered trademark of AT&T. XENIX is a registered trademark of Microsoft Corporation.

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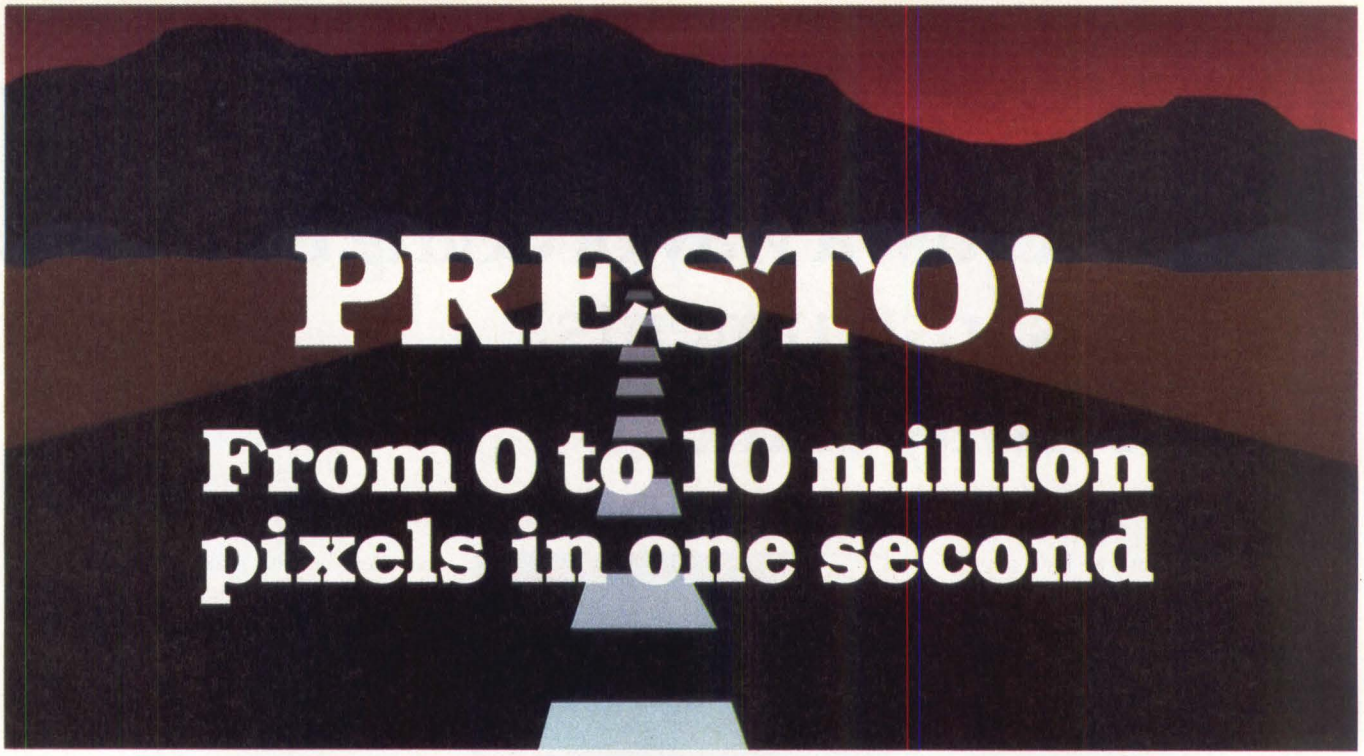

Finally a TI™-34010 graphics controller card in sync with your 286/386-based application

Vectrix matches your high-speed microprocessor with high-speed graphics. The PRESTO! graphics controller card utilizes a proprietary Digital Differential Analyzer (DDA), the TI-34010 graphics controller, 512K to 4.5 MBytes of on-board DRAM, and a unique organization of high-speed video shifter RAMS. The result — line drawing speeds in excess of 10 million pixels per second.

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SPECIFICATIONS

Resolution — 1280 x 1024 or 1024 x 768

Available in the following configurations:
16 colors
256 colors from a palette of 4096
256 colors from a palette of 16.8 million

Speed — 10,000,000 pixels per second
Average Block Move: 25 million bits/second
Horizontal line or fill: 50 million bits/second
DMA speed: matches host bus speed

Interface — 16-bit PC family

Video — 60 Hz non-interlaced

SOFTWARE DEVELOPMENT TOOLS

Industry-standard PGL Command Set Compatibility

PRESTO! TI-34010 Developer Toolkit

PRESTO! PGL Developer Toolkit

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CIRCLE NO. 12 ON INQUIRY CARD

FLEXIBLE DISK DRIVES

Brier Technology fields a first: a 20M-byte, 3½-inch flexible drive

Mike Seither, Senior Editor

San Jose start-up Brier Technology Inc. hopes to turn a few heads at the COMDEX/Fall show in Las Vegas next month when it introduces a 20M-byte, 3½-inch flexible disk drive. That's more than double the storage of the newest breed of high-capacity 5¼-inch flexible disk drives.

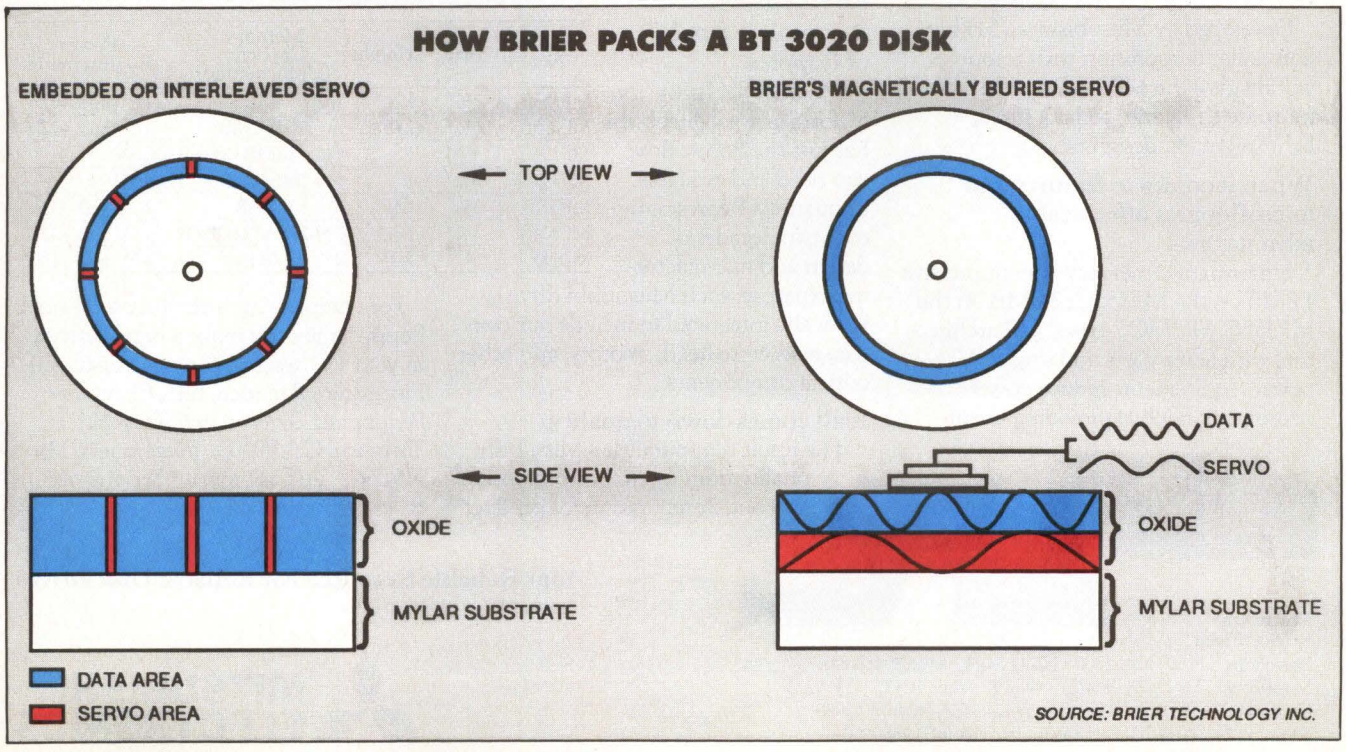
With an average access time of 35 msec, Brier's BT 3020 high-capacity product also rivals the performance of comparable-size Winchester disks and offers a removable media to boot. This is something that is attractive to OEMs and system integrators working in the engineering, scientific and military segments, where workstations are shared and the best way to protect one's data is to remove it.

Brier's first product uses a proprietary system that embeds continuous servo information into the magnetic oxide coating of a standard 3½-inch high-density disk. The company claims that it has been able to divide the disk's oxide media into two logical layers. Servo information in the deeper layer, recorded at a very low freqency, is used to keep the read/write head on track. The upper layer is dedicated solely to user data and is written at a much higher frequency than the servo information.

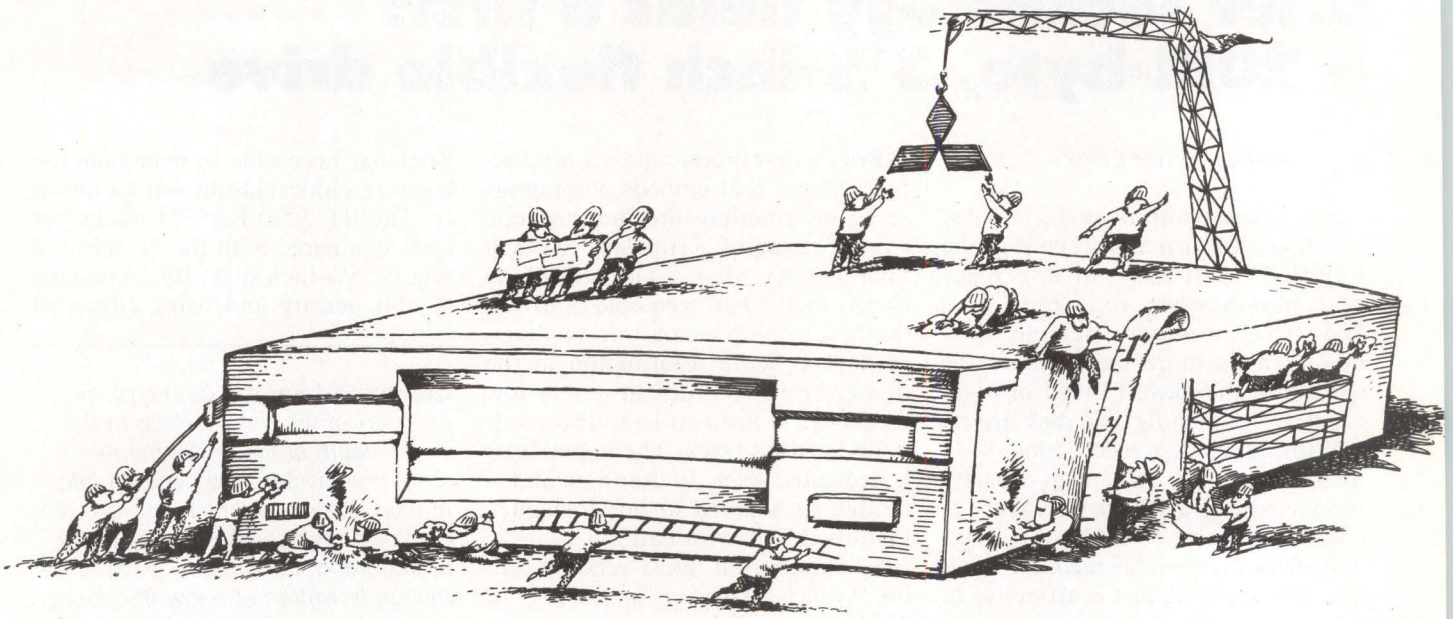
By comparison, most vendors selling 5¼-inch disk drives in the range of 4M bytes to 10M bytes embed servo information directly on the data surface. As a result, up to half the total data area is given up to servo.

Thanks to this buried-servo system, Brier has been able to overcome the biggest technical hurdle—track density. The BT 3020 has 777 tracks per inch, compared with the 96 tpi on a regular 5¼-inch disk. By increasing the bit density and using advanced

Embedded servos *(left) typically use part of the data surface to the entire depth of the oxide media to store read/write head tracking information. Brier horizontally divides the oxide into two logical layers (right). Prerecorded, continuous servo information is written at a low frequency onto the lower. Data is written over the entire upper layer at a high frequency. Brier's drive electronics sends data one way and head tracking information another.*



Introducing The Only 1″ High Microfloppy Disk Drive Big Enough To Be A Mitsubishi.



At just 1″ high, our new MF353C and MF355C 3½″ microfloppy drives are designed to give your system a giant edge in performance and reliability.

Developed by Mitsubishi—a $13 billion dollar corporation with resources worldwide—the MF353C and MF355C integrate easily into today's small, lightweight PC designs.

When it comes to features, our microfloppies offer sizable advantages.

Unformatted memory is an impressive 1.0MB on the MF353C; 2.0MB on the MF355C. HCMOS-based LSI architecture with fewer parts and single 5V power requirements reduce power consumption while providing unsurpassed dependability and longer product life. Another big advantage from Mitsubishi: The MF355C is downwardly compatible with the MF353C.

A complete family of floppies.

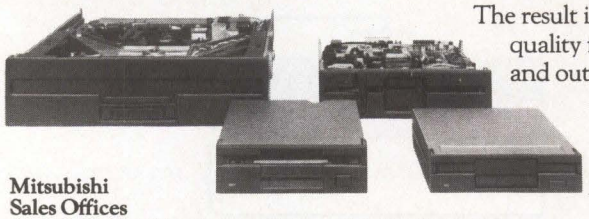
Whether 3½″, 5¼″ or 8″ form factor, Mitsubishi has just the floppy drive you need and available in quantity. Representing over two decades of design and manufacturing expertise, each Mitsubishi drive is vertically integrated to include our own ICs, read-write heads, motors, and other critical components.

It all comes down to quality.

The result is unparalleled Mitsubishi quality from top to bottom, inside and out. A reputation for product innovation, proven performance and reliable, on-time delivery has made Mitsubishi the supplier of choice among the biggest OEMs in the business.

Model No.	Size	Height	Memory Capacity (Unformatted)	Power Requirements
MF353B	3½″	1.26″	1MB	+5V and +12V
MF355B	3½″	1.26″	1MB/2MB	+5V and +12V
MF353C	3½″	1″	1MB	+5V
MF355C	3½″	1″	1MB/2MB	+5V
MF501B	5¼″	1.61″	0.5MB	+5V and +12V
MF504B	5¼″	1.61″	0.5MB/1MB/1.6MB	+5V and +12V
M2896	8″	2.25″	1.6MB	+5V and +24V

For complete information on how our floppy family can make a big difference in your PC designs, contact Mitsubishi Electronics America, Inc., Computer Peripherals Division, 991 Knox Street, Torrance, CA 90502. Telephone: (213) 515-3993, and ask for our Peripherals Sales Department.



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CIRCLE NO. 13 ON INQUIRY CARD

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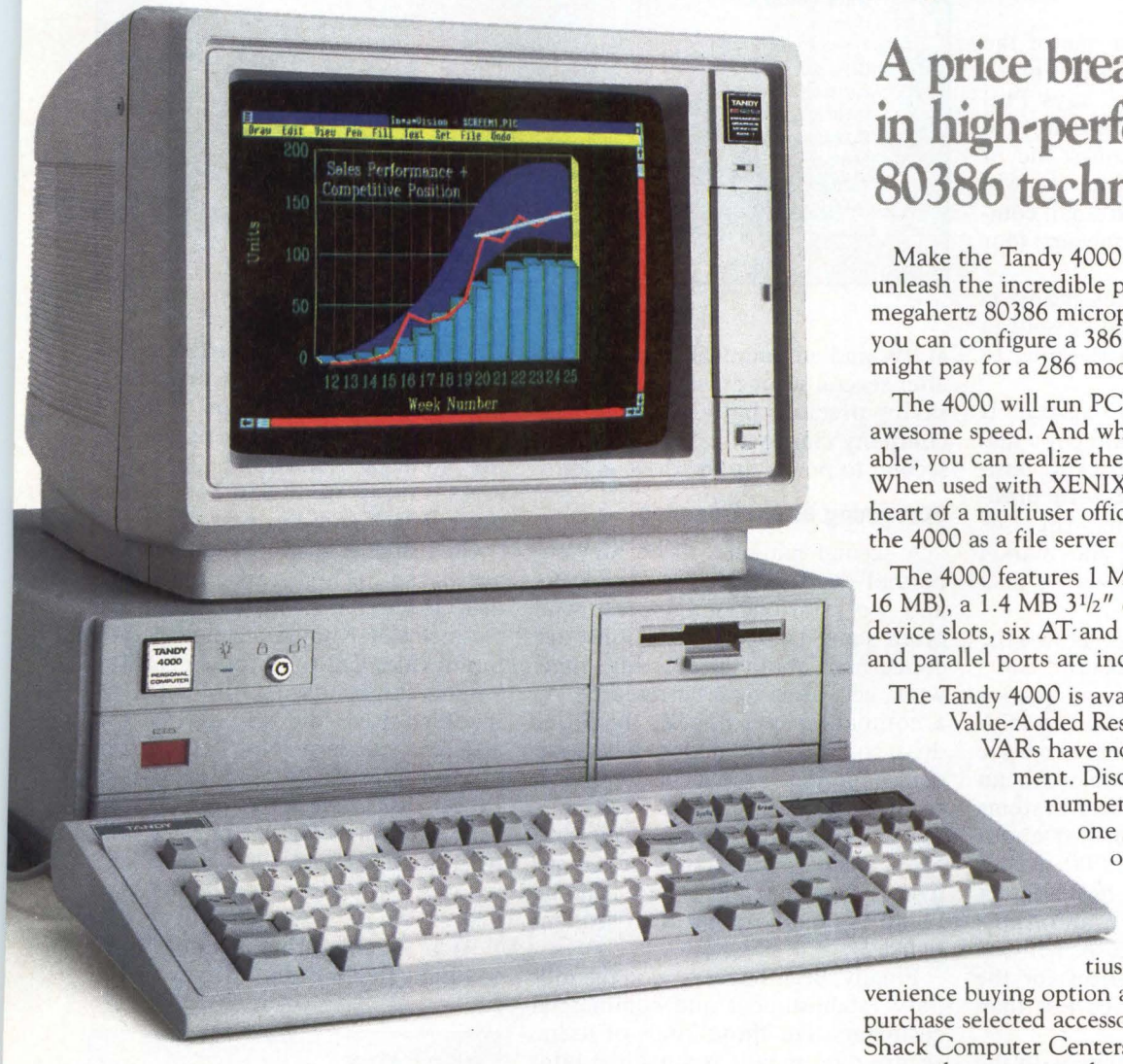

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The Tandy 4000 is available through the Tandy Value-Added Resale program. Tandy VARs have no annual volume commitment. Discounts are based on the number of computers ordered at one time, with bonuses based on quarterly purchases. There are extra incentives for leased orders and network and multiuser system sales. A convenience buying option allows Tandy VARs to purchase selected accessory items from Radio Shack Computer Centers at a discount. Call or return the coupon today.

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CIRCLE NO. 14 ON INQUIRY CARD

data-encoding schemes, company officials say, even a 40M-byte drive is not out of the question.

Cuts into tape backup

"Brier appears to have one of the most significant [mass storage] products in recent memory," says Phil Devin, director of the data-storage industry service for Dataquest Inc. of San Jose. "This kind of device will have a major influence on small computer systems for at least the next four years."

Devin forecasts that as many as 142,000 such drives could be sold in 1989, with shipments ballooning to 350,000 in 1990.

Other analysts tend to agree. "If marketed properly, it could cut a hell of a swath in the tape-backup business," says Bob Katzive, vice president of Disk/Trend Inc., the Los Altos, Calif., publishing and market research outfit that tracks the disk drive industry.

Brier president John Bizjak says the company will have evaluation units ready sometime in the second quarter of 1988, with full production by mid-year. Brier will manufacture two basic versions: An OEM model with an embedded small computer systems interface (SCSI) will sell for about $495 in quantities of 5,000. Retail drives, with add-in SCSI host adapter cards for IBM Corp.'s PC and Apple Computer Inc.'s Macintosh, will sell for about $995. User prices for the servo-written disks will be less than $20, Bizjak says.

Brier is not going it alone with the new BT 3020. The company has lined up tape drive vendor Irwin Magnetics Inc., Ann Arbor, Mich., as a second source to manufacture the drive and the servo-written disks.

Jack Taylor, Brier's vice president of marketing, says the drive ought to appeal to three distinct classes of OEMs. First are producers of laptop computers, who may use the drive as a primary storage device in favor of delicate Winchesters. A laptop's rigid disk drive typically requires 10W to 15W and runs continuously, draining the limited battery power of these small computers. Brier's drive is rated at 9W and automatically shuts down after several seconds when not in use, saving precious battery power. The company claims it takes about one second to power up the drive again.

LOOKING INSIDE BRIER'S BT 3020

Number of disks	1
Data surfaces	2
Heads	2
Tracks per inch	777
Bits per inch	26,000
Actuator type	linear voice coil
Interface	SCSI
Power dissipation	9W
Media	high density, 3½-inch disk
Dimensions (inches)	5.75×4.0×1.625
Weight (lbs)	1.6

Source: Brier Technology Inc.

Screaming after streaming

A second market will be for vendors of desktop systems, file servers and workstations. Engineers, who often share those workstations, are concerned about protecting their work, according to Brier research. As a companion peripheral, the Brier drive could be used both as a back-up device for another Winchester or as a secondary drive. Company officials say the 20M-byte flexible disk drive has a major performance advantage over streaming tape—data can be found randomly rather than sequentially.

Finally, Brier hopes to woo the military establishment and commercial customers. For those kinds of users, secure data means removable data; flexible disks, unlike most Winchesters, are easily removed and locked up. (However, Tandon Corp., Chatsworth, Calif., and Alps America USA Inc., San Jose, have recently introduced removable Winchesters.)

The move to 3½ inches

Of course, system integrators aren't exactly suffering from a shortage of choices when it comes to removable media. But nothing on the market seems to combine the compact packaging, Winchester-like performance and low-cost media that Brier intends to offer, analysts say. For example, a 20M-byte Bernoulli Box standalone subsytem from Iomega Corp., Roy, Utah, carries an OEM price tag of about $650. But volume pricing for the Iomega removable 20M-byte disks ranges from $50-$60, about twice Brier's end-user cost.

On a smaller scale, several vendors are marketing high-capacity flexible disk drives that fit inside a standard 5¼-inch slot. Konica Technology Inc., Sunnyvale, Calif., is just beginning volume shipments of a 10M-byte flexible disk drive, the KT510, that can also read standard 360K-byte personal computer disks, and 1.2M-byte PC/AT disks. The drive, with an average access time of about 75 msec, sells to OEMs for about $400. Servo-written disks will cost users about $20 to $25.

At least two other vendors have 5¼-inch flexible disk drives in the

FACT FILE

BT 3020

Brier Technology Inc.
2363 Bering Drive
San Jose, Calif. 95131
(408) 435-8463
Circle 473

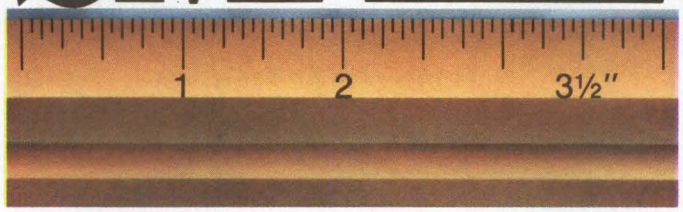
**A 3½-inch flexible disk drive with a formatted capacity of 21.4M bytes.

**Uses standard high density 3½-inch media with prerecorded servo information.

**Seek time averages 35 msec. Actuator type: linear voice coil motor.

**Available with embedded SCSI interface or SCSI host adapter kit for IBM Corp. PCs and Apple Computer Inc. Macintoshes.

THINK SMALL



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CONTROL DATA

CIRCLE NO. 15 ON INQUIRY CARD

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"...all computers that are integral to, physically a part of, dedicated to, or essential in real time to a performance of the mission of weapon systems...used for specialized training, diagnostic testing and maintenance, simulation, or calibration of weapon systems...used for research and development of weapon systems...Use of validated compilers is required...this directive is effective immediately."
—DoD Directive 3405.2, 3/30/87.

"...Defense computer resources used in intelligence systems, for the command and control of military forces...all major software upgrades...all other applications (some exceptions) in keeping with the long range goal of establishing Ada as the primary DoD higher order language... waivers to the policy...shall be strictly controlled and closely reviewed...this directive is effective immediately."
—DoD Directive 3405.1, 4/2/87.

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FLEXIBLE DISK DRIVES

10M-byte range: Data Technology Corp., Santa Clara, Calif., and Eastman Kodak Co., Rochester, N.Y. Although Kodak and Data Technology originally teamed up on development, both companies have gone their own way, to the point that their respective drives are not even compatible. Unlike Konica's, their drives do not use standard 5¼-inch disks (they use a rigid envelope), nor have they gained much market acceptance.

"There's been no real attempt by either [Kodak or DTC] to enlist the help of others to create a 10M-byte standard," says Disk/Trend's Katzive. "Then IBM came along and standardized on 3½-inch for floppies. That's done both some damage." Knica product marketing manager Maurice Webb admits that IBM's new standard will also hurt sales of the KT 510, especially for design awards for new computer systems. Konica will concentrate on the after market for add-in and subsystem products.

Brier officials believe that with a 20M-byte, 3½-inch drive that uses standard media, they are positioned to shake up the industry and take a leadership position.

Other manufacturers are sure to follow. Katzive says a few Japanese companies may announce similar products before year's end. And Data Technology's chairman David Lee says that his company is definitely working on a 3½-inch removable media drive. □

SOFTWARE ENGINEERING

Atherton, ATI make a CASE for fast software development

Tim Scannell, Senior Editor

Computers can be souped up with the latest microprocessors and memory architectures, and disk drives can take a turn for the better with more advanced bus structures. However, things are not so cut-and-dry for developers of large software programs.

While the programs themselves can be accelerated through the use of fourth-generation languages and modular programming, coding the initial software often remains an arduous and even mismanaged task. This is especially true in large-scale engineering or real-time software development, where hundreds of programmers may work in teams. Each team works on a single portion of the whole, with minimal interaction. The result is a little like the fabled blind men trying to describe an elephant: Each can visualize the part he touches, but none can picture the entire scene.

Enter computer-aided software engineering (CASE), a catch-all phrase that has come to describe types of software that are used to design, write, generate or maintain software in an assembly-line fashion. CASE might be described as a programmer's toolbox of sorts. Only the tools are software routines that make coding a little smoother and help programmers keep their bearings in a sea of code.

Recently, two companies have unveiled products that offer not only sophisticated CASE functions but also high degrees of integration and control. The first product comes from Atherton Technology Inc., Sunnyvale, Calif., and is called the Software Backplane. It debuted last month at a Computer-Aided Software Engineering Symposium in Boston.

X Window provides umbrella

Basically, it is a platform that lets inherently incompatible database management, programming and documentation CASE software coexist under the same operating umbrella. In this case, the umbrella is Massachusetts Institute of Technology's X Window operating environment, which has been adopted by most major workstation and minicomputer vendors.

"The Backplane provides a common user interface, allowing different programs to look and act the same," says Atherton vice president of marketing Alan L. Codkind. "This is important to third-party developers who are working with new hardware environments."

Atherton claims its Software Backplane can reduce software development time by up to 25 percent. It initially supports both Digital Equipment Corp. VAX/VMS systems and Sun Microsystem Inc. UNIX-based workstations, and it is designed for use with C and Ada language programming environments. By early November, the product will also support DEC UNIX environments, adds Codkind.

Atherton also unveiled a series of supplementary programs—called the SoftBoard Series Tools—that provide tracking, documentation and other programming aids. For example, there is a C SoftBoard, an Ada SoftBoard, a Document SoftBoard and a Project SoftBoard. The latter is a project planner that keeps track of everything that occurs in a typical software factory so that, if a programming team changes an item in its portion of a project, that change is reflected throughout the entire software development cycle.

The Software Backplane costs $8,000 in single quantities and $5,000 per copy in quantities over 25. Atherton also charges a 1 percent per month maintenance fee. The SoftBoard tools cost $3,000 each.

The second product, scheduled to

we never stop asking "What if..."

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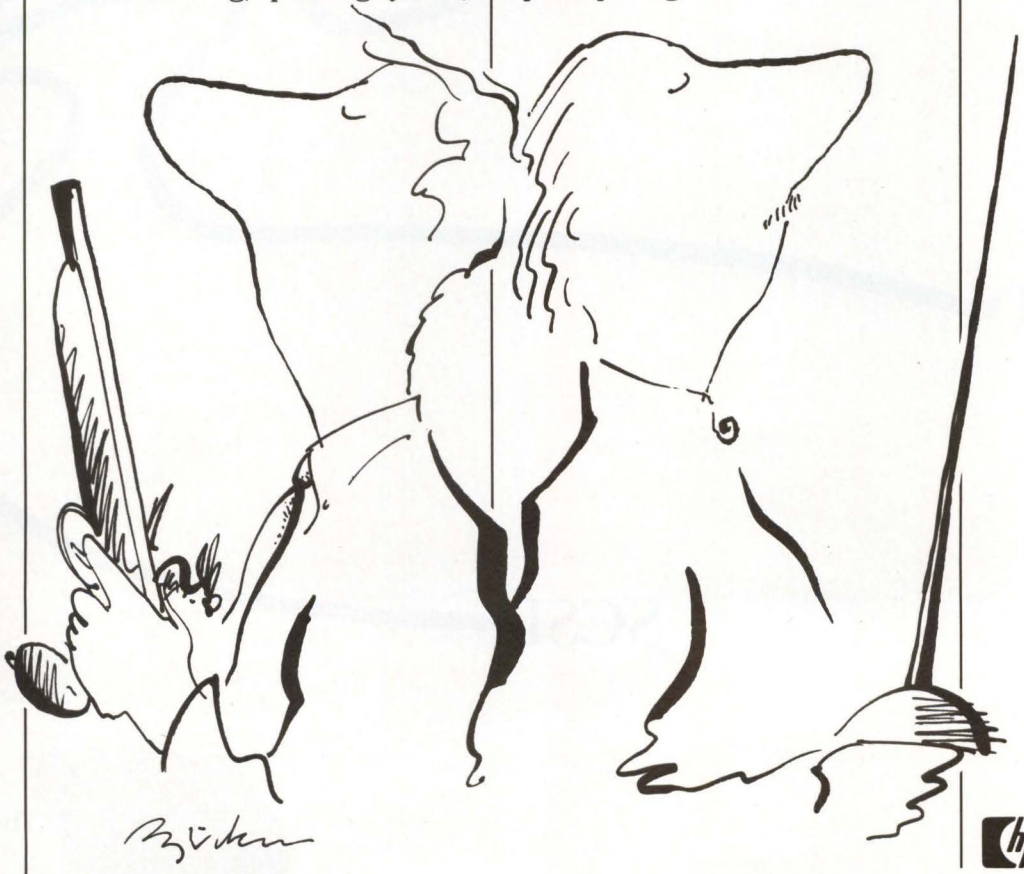

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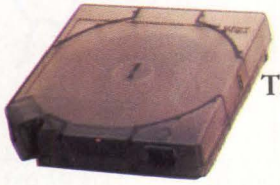
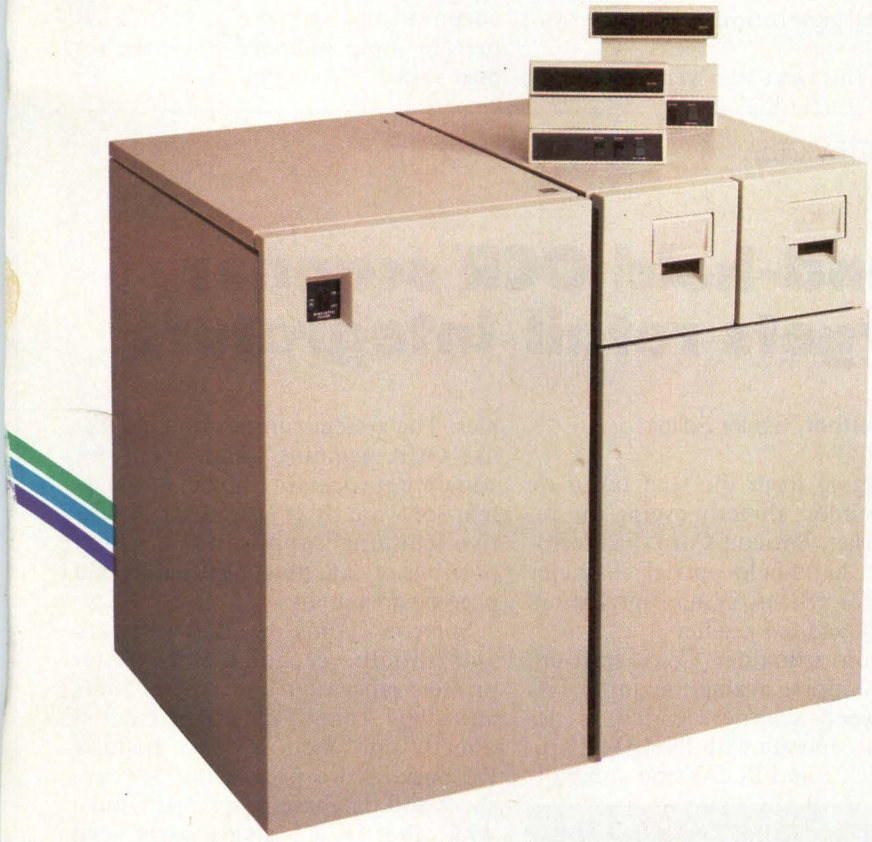


The 3480

Without the Wait.



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CIRCLE NO. 18 ON INQUIRY CARD

SOFTWARE ENGINEERING

be introduced this month by Advanced Technology International Inc., New York, is superCASE, an integrated software development environment that succeeds to the company's superPDL, an interactive design tool that debuted in 1983. In fact, superPDL is fully upward compatible with the new software via a conversion utility that will be supplied by ATI.

Like Atherton's product, superCASE provides full support for all software development phases, from design and coding to integration and maintenance. It is geared for the Ada language environment, but can generate code for non-Ada environments like C, FORTRAN and Pascal.

ATI's superCASE also provides a powerful editor, extensive data analysis—that can be called on-line at any point in the software development cycle—and full compatibility with Department of Defense programming standards for the Ada environment. Prices for superCASE vary for each system, but the typical cost for DEC system users is $21,000 for the MicroVAX II, or $45,000 for VAXcluster minicomputers. ATI also offers discounts of 20 percent for two to five packages, and 30 percent for more than six superCASE systems.

Weave to prevent errors

One of the key features of both superCASE and Atherton's products is their ability to provide extensive reports throughout the entire programming cycle and thereby pull together what could otherwise be a disjointed process. Tightly woven integration is something that has been lacking in most CASE products. That's the reason why up to 35 percent of shipped large software programs contain bugs that occurred during testing and maintenance phases, according to IBM Corp. (IBM is one of the largest developers of embedded software.)

Therefore, both Atherton and ATI designed their systems with heavy dollops of integration, and stress each system's reporting and tracking functions.

Is there a substantial market for such products? Yes, since the only real competition to companies like Atherton and ATI are the hardware developers who rely on their programming staffs to develop their own tools and shortcuts to writing embedded code, states Atherton's Codkind. However, they too may turn to off-the-shelf products like the Software Backplane and superCASE as more and more software is written into the microcode of newer-generation computer systems.

Over the next two years, embedded-software designers expect the length of their programs to increase by about 52 percent to well over a million lines of code per program. That's according to a report issued this year by the Technology Research Group of L.F. Rothschild & Co. Inc., Boston. Likewise, commercial software designers who develop packaged programs expect a 38 percent code hike; and management information system designers, working for specific corporations, will see at least a 20 percent jump in coded lines, the report said. □

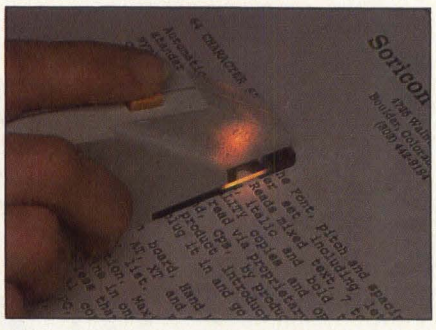
INPUT DEVICES

Hand-held OCR scanner targets retail integrators

Mike Seither, Senior Editor

Diverging from the lead taken by other vendors directly eyeing the retail market, Soricon Corp. has introduced a hand-held optical character reader for OEMs, system integrators and value-added resellers.

Soricon, a Boulder, Colo., start-up, is now shipping evaluation units of its DataSweep scanner, which is designed to operate with the IBM Corp. PC, PC/XT and PC/AT and compatibles. The system consists of a mouse-like OCR scanning wand, a full-slot add-in coprocessing board and system software. It is geared for "selective-scanning" applications, where portions of data must be lifted from a page or document.

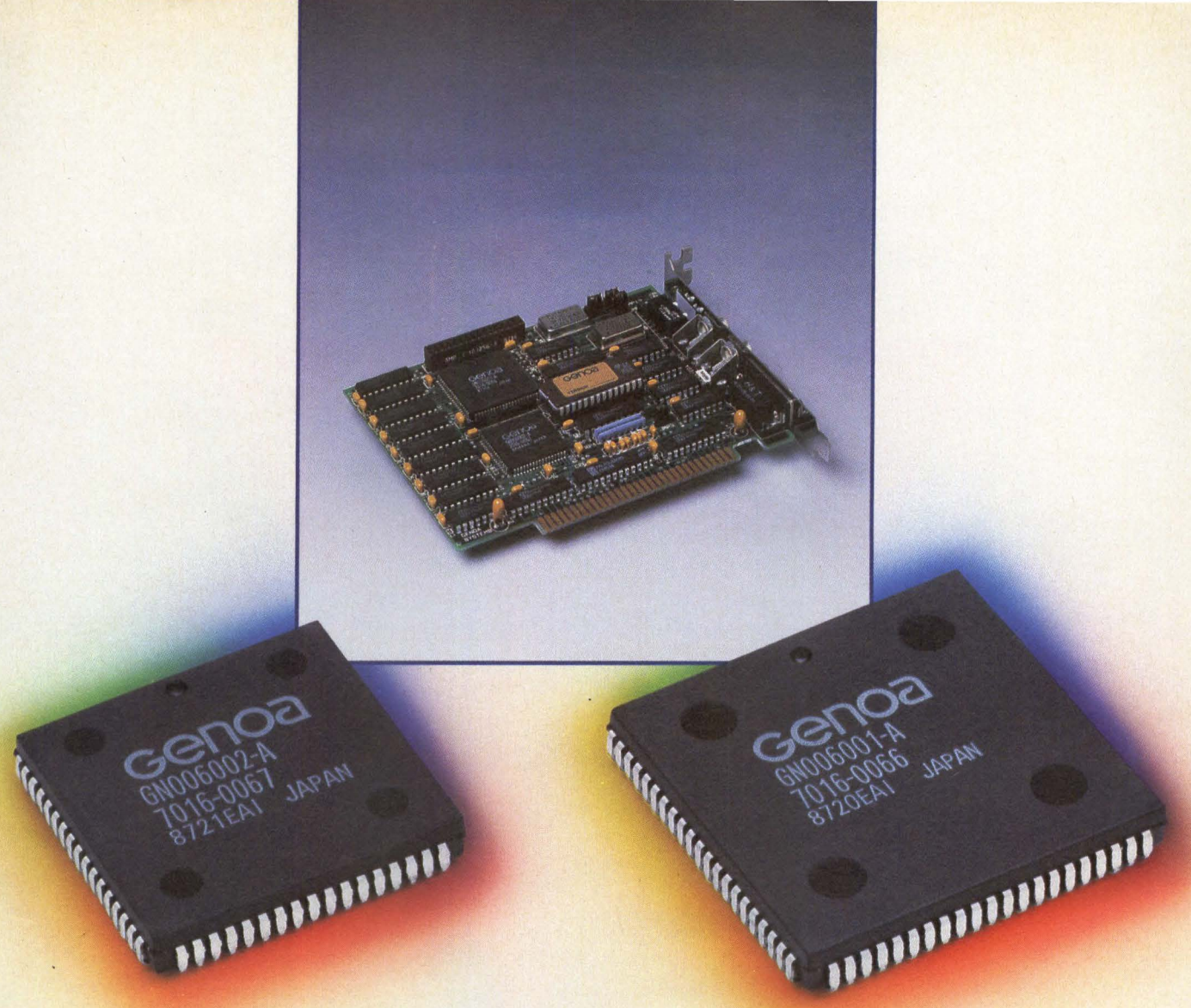


Soricon's DataSweep *selectively scans text within a document. Type sizes and font styles are automatically matched via software provided with the unit.*

Soricon claims its OCR software will initially recognize 50 common printer, typewriter and typeset fonts and allow scanned data to be entered directly into about a dozen popular PC-based word processing, spreadsheet and database programs. Unlike with other OCR systems, users need not know the type size or font style of the material they are scanning; information from Soricon's character library performs that job automatically.

OEM pricing for the DataSweep is $625 in quantities of 1,000. Soricon will show the scanner at COMDEX/Fall in Las Vegas in November. The scanner has been in a number of beta test sites since August, including a large insurance company, according to Soricon president Billy Anders. He says that Soricon expects to accelerate production by December.

At least two other companies are



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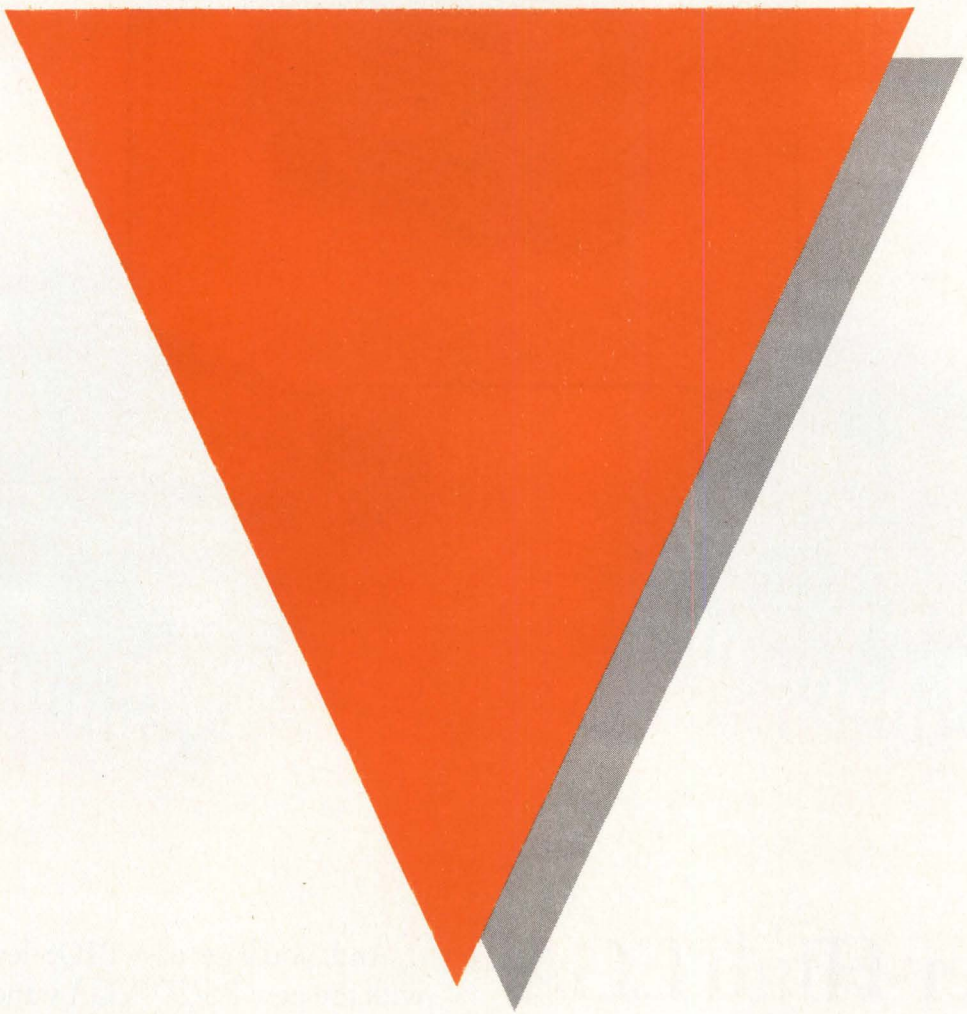

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CIRCLE NO. 20 ON INQUIRY CARD

INPUT DEVICES

peddling similar PC-based scanning devices through dealers. In April Saba Technologies Inc., Beaverton Ore., brought out the Handscan, which lists for about $650. TransImage Corp., Sunnyvale, Calif., introduced its $2,595 TransImage 1000 scanner at the PC Expo show last month in New York.

Soricon, like Saba and TransImage, is targeting users such as accountants, lawyers and insurance underwriters who need to selectively enter information into a computer system. According to some observers, there's a demand for such products.

"You'll never eliminate the keyboard totally," says Soricon president Anders, "but when information is already typed, printed or typeset, this kind of scanning gives the user a clear alternative to input data."

Edward Wong, an analyst who follows the electronic publishing industry for Dataquest Inc. in San Jose concurs, adding: "There are times when you don't need to scan an entire document. You may want only key database information like an account number or date of birth."

Scan selectively

Hand-held scanners, which sweep across individual lines of type, offer distinct advantages over flat-bed or sheet-fed scanners. Wong points out that those kinds of scanners digitize an entire page and typically accommodate only standard paper sizes. Scanning books, magazines or wide printouts is impossible on sheet-fed scanners and is awkward, at best, on flat-fed models.

Unlike its competitors, Soricon plans to stay out of direct contact with the retail business. Instead, the company will use manufacturer's representatives to sell the standard PC-based scanner to VARs and system integrators. But Anders emphasizes that Soricon is prepared to customize this device for OEMs.

For example, he says that Soricon's technology can be adapted to work with a variety of terminals from IBM's 3270 to Digital Equipment Corp.'s VT100 and VT220, as well as those from other vendors. In that kind of configuration, the scanner would work in conjunction with a keyboard. Another possibility would be to integrate Soricon's OCR capability with a mouse, combining two functions in one peripheral. Anders says it is also possible to produce a scanner that simultaneously reads multiple lines on, say, a customer's forms. Finally, the scanner can be used to read bar codes. □

FACT FILE

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COMPUTER SYSTEMS

IMPACT PS/2

IBM's PS/2 won't stall competing systems makers

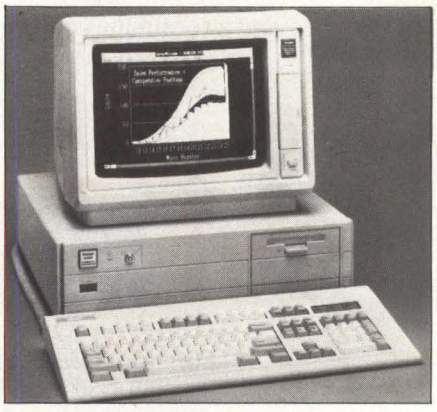
Tim Scannell, Senior Editor

The dust has finally settled following IBM Corp.'s rapid-fire set of Personal System/2 announcements, and at least two things are suddenly clear —or at least a little clearer than they were a few months ago.

One is that IBM's PS/2 and Microsoft Corp.'s OS/2 operating system will become standards in the business-computing marketplace, despite what the PC-compatible systems manufacturers and third-party developers say about protecting and serving the installed base of previous-generation systems and software. Developers who hope to survive in the business personal computer arena would be crazy not to write their software for OS/2, and at least adapt their board-level products to accommodate IBM's Micro Channel bus architecture.

"Most major players are capable of implementing Micro Channel without infringing on IBM's copyrights," says Alan D. Kraemer, vice president of systems engineering for AST Research Inc., Irvine, Calif.

The other revelation is that while PS/2 and OS/2 eventually will be standards, they won't necessarily be the only standards in town. System integrators and value-added resellers may see more gain in pursuing prod-



The Tandy 4000 personal computer *has a 16-MHz microprocessor, up to 16M bytes of memory and a 1.44M-byte, 3½-inch flexible disk drive. The system can run both industry-standard MS-DOS and OS/2 software, claims Tandy.*

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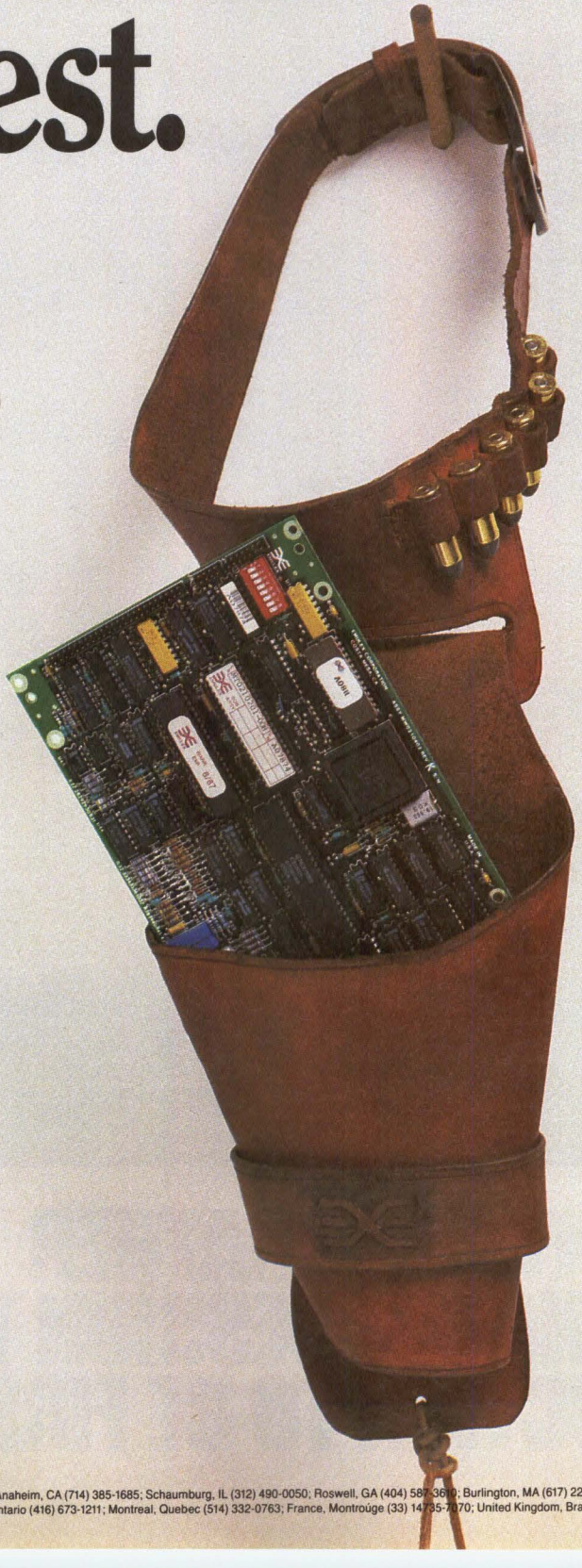

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CCS	Yes	Yes	Yes		
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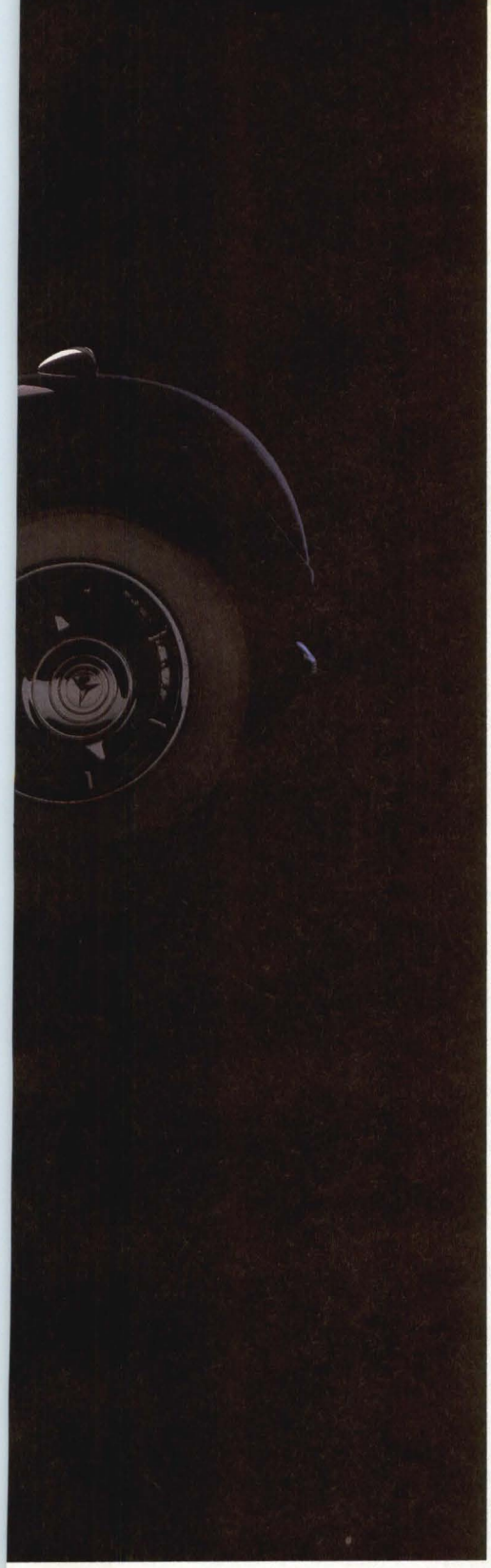

Call it a manifestation of German pride, but we took our time to introduce the MT330 for good reason: We wanted to think it through to a superior conclusion.

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CIRCLE NO. 22 ON INQUIRY CARD

ucts for the 13 million personal computers already installed, than ramping up for a whole new technology chapter.

"What IBM has yet to realize is that, if they go off and do their own thing, a large piece of the market will not follow them," says Aaron Goldberg, a vice president and analyst with International Data Corp. in Framingham, Mass.

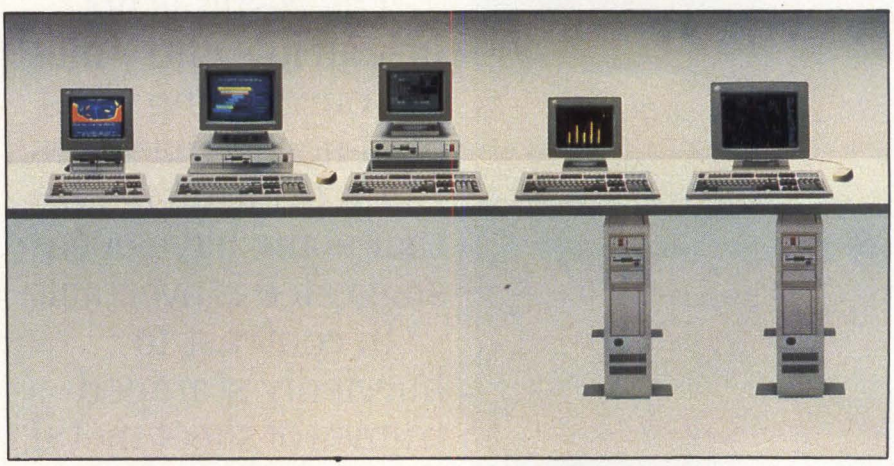
IBM OS/2 slow to arrive

OS/2 has been slow in coming. Also, the eccentricities of the PS/2's Micro Channel architecture are forcing hardware developers to virtually retool to manufacture larger boards and skirt its proprietary architecture —at no small expense. So, most hardware development for the next year or so will probably occur at the IBM PC/AT level, says AST's Kraemer.

As a result, board manufacturers will develop products that either add the Intel Corp. 80386 as a coprocessor to boost the performance of a PC/AT or compatible, or they will create hardware or software bridges to the 80386-based OS/2 world. And system manufacturers—including AST Research, which makes both boards and complete systems—will offer 80286 and 80386 machines with PS/2 performance, without the restrictions of the Micro Channel.

"Despite the major standards, you will have variations on these standards," AST's Kraemer maintains.

Software developers, on the other hand, will continue to push MS-DOS products and links to OS/2, but are concentrating new development on creating totally dedicated OS/2 applications to accommodate what eventually will be the business-computing standard.



IBM's growing family *of Personal System/2 computers now includes the entry-level Model 25, which can be used as an intelligent terminal in corporate networks, and a beefed-up Model 80 with more disk capacity.*

"We're in the business of giving users what they want, and what they want is the ability to choose what is right for them," said James Manzi, president and CEO of Lotus Development Corp., Cambridge, Mass., at an OS/2 press conference in July. Lotus plans to unveil soon a new version of its 1-2-3 spreadsheet that will run in both the protected and real modes of MS-DOS and OS/2, he stated.

IBM, meanwhile, is not content to just sit back and watch hardware and software vendors scramble to take advantage of an apparent lull in its momentum. At the moment, the company is busily trying to attract developers to its camp by shoring up its third-party relationships and providing IBM-tested and validated products through its SolutionPac program. These products target specific markets—such as CAD, medical, legal and personal publishing applications—and can only be sold by dealers who have demonstrated a certain degree of expertise in these respective areas.

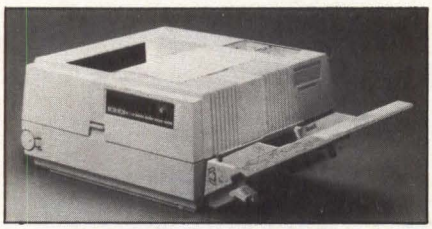
IBM also has not abandoned those who may not want to immediately make the switch to OS/2 and abandon their MS-DOS-based hardware and software environment. The top two systems in the PS/2 line—the 80286-based Model 60 and the 80386-based 32-bit Model 80—aim at high-level applications and serve as the flagships in the OS/2 armada. The other two PS/2 systems—8086-based Model 30 and the 80286-based Model 50—maintain a link to MS-DOS developers and are presently the biggest sellers.

A classroom/business tool

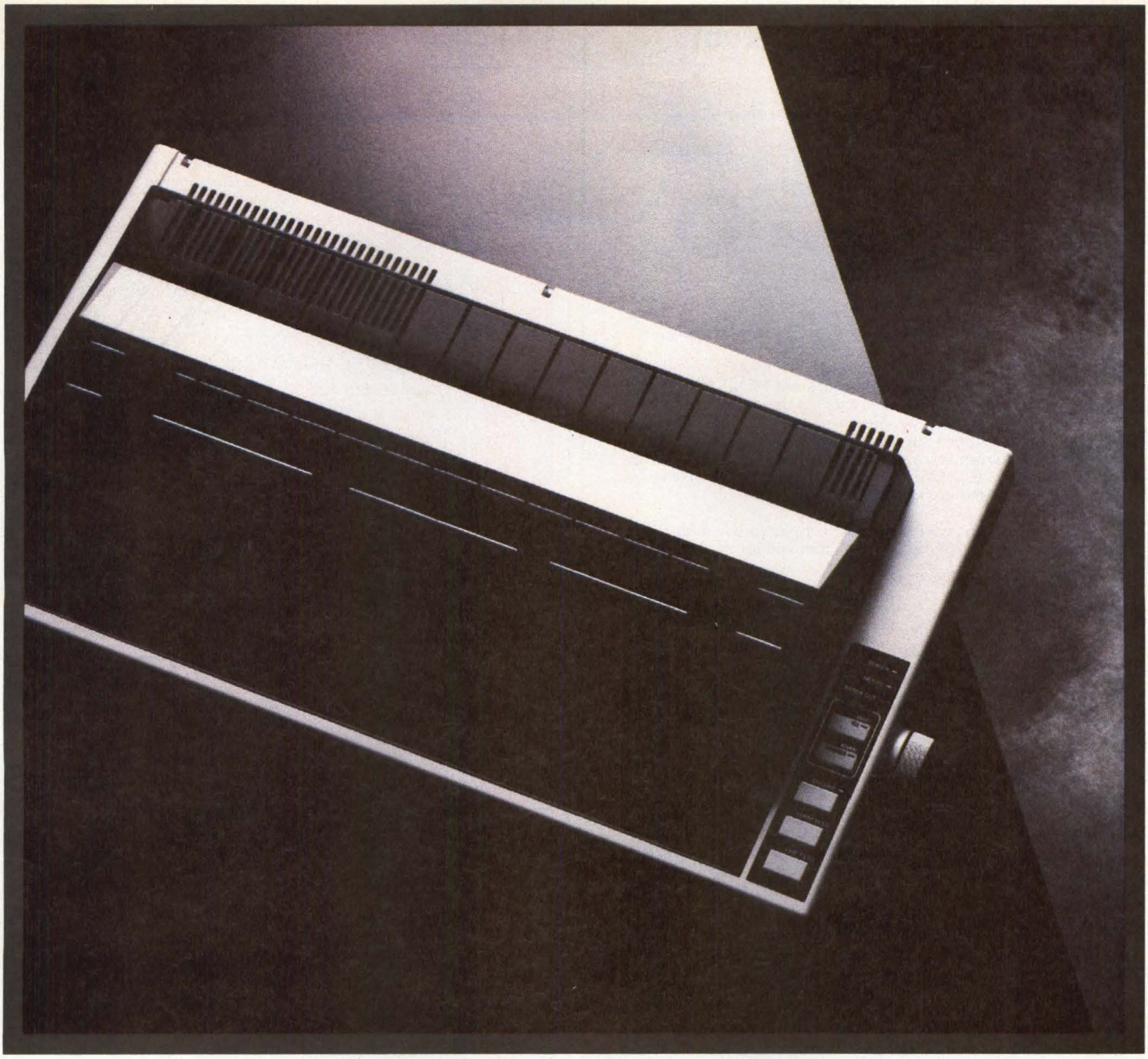
Recently, IBM disclosed the Model 25—an Intel 8086-based machine—that has the advanced graphics capabilities of the Model 30 at prices starting at $1,350. Although the Model 25 is aimed at the education market, many dealers also see it as an inexpensive intelligent terminal for small business networks. (Interestingly, IBM's new model borrows the all-in-one design of Apple Computer Inc.'s Macintosh, containing the processor, disk drives and CRT in a single unit.)

Clearly, IBM is out to parlay its PS/2, and especially OS/2 Extended Version, into standards that provide across-the-board functionality and flexibility for VARs and system integrators.

While IBM's view of the world will



The LP 1000 is Tandy's *first laser printer and features a 300-by-300-dot-per-inch resolution at a speed of 6 pages per minute. The unit includes 1.5M bytes of internal memory for full-page graphics capabilities.*



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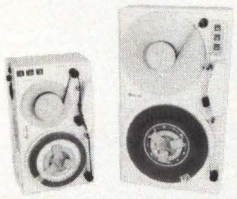

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IMPACT PS/2

VAR views on the PS/2

What do system integrators and value-added resellers think of IBM Corp.'s Personal System/2, now that they've had some time to weed fact from fancy? Some like it, some don't. But, all have an opinion.

"Everybody is confused about PS/2. OS/2 is the real issue—the hardware isn't much good without the software. PS/2 is like the Macintosh when it first came out—a lot of talk and not a lot of action. A lot of people won't change systems, so expansion and enhancement products will become really popular. The clone market will not just go away."—*Mark Lowenstein, vice president of sales and marketing, Fidelis Group, Newton, Mass.*

"PS/2 hasn't had that much of an impact. I don't know where they're going with it. There are too many machines out there and not enough demand for PS/2—especially when the clone guys get going. In six or nine months all kinds of interesting things will hit the market, making current systems compatible with IBM. People won't chuck their old PCs."—*Ken Kelly, president, A-Z Business Systems, Wilmington, Del.*

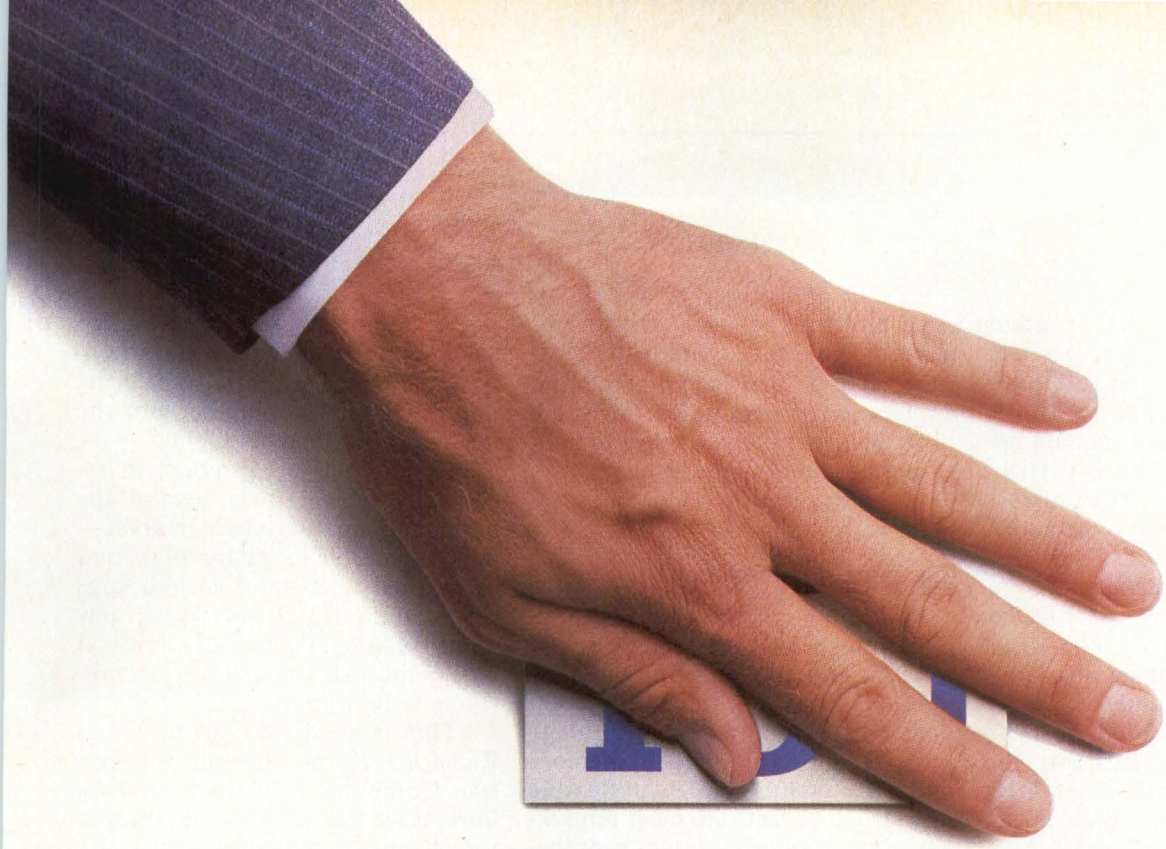
"If products don't surface soon, PS/2 won't be 'the standard,' just one of many. IBM is playing ball with the clones—this will make PS/2 and OS/2 technology more affordable to end users. Clones just became respectable recently. People will buy PS/2."—*William Casey Jr., Value-Added Systems Division marketing manager, Sumitronics Inc., Sunnyvale, Calif.*

"We've looked at the systems and don't see anything worth getting excited about except the advertising. More and more people are becoming computer-sophisticated. They're making their own choices, rather than blindly buying a new big-name system. Why should people bother with new clones when the 'old' ones are so good?" (meaning Intel Corp. 80286-based, and IBM PC/AT-compatible products).—*Bob Delamar, president, Lynk Systems, Grand Rapids, Mich.*

"The effect of the PS/2 is mediocre to poor. This is IBM's obvious move to go back to a proprietary machine—they're trying to protect their own market. The PS/2 doesn't do anything other machines can't also do. Yuppies might buy it, but people who know what they're doing won't."—*Jim Hargreaves, president, CIN Inc., Cincinnati.*

"Most people, except for those in really large corporations, feel more comfortable with the old IBM standard. Right now, the PS/2 just doesn't make sense in terms of value for your bucks. It won't work until all the pieces are there. There will be a lot of interest then."—*Bruce Bohuslav, president, Systems Integration Associates, Chicago.*

— Megan Nields



The People Who Created the Next Industry-Wide Tape Standard Can Be Named in Just Three Letters.

be a standard, however, the rub is that it will not be the only perspective. Competing computer makers have been quick to capitalize on IBM's split-level standards and shotgun approach to marketing. This is particularly true of their efforts to attract systems integrators and value-added resellers.

Two of the other top personal computer makers—Tandy Corp. of Dallas and Apple of Cupertino, Calif.—have already unveiled systems that compete with IBM's PS/2 line.

In July, Tandy debuted its 1988 computer line. One system, the Model 4000, includes a 16-MHz 80386-based system that can run MS-DOS 3.3, OS/2 and UNIX 5.3 operating systems and use Microsoft Corp.'s Windows operating environment. Since the Tandy 4000 has a memory controller with a page mode feature—offering close to zero-wait-state performance—as well as improved DeskMate windowing software, it can also load up to nine application programs at the same time. This makes it attractive to both corporate and government users, says Dr. John Patterson, a senior vice president with Tandy.

The price tag challenge

Aside from incorporating eight application-specific integrated circuits (ASICs) and single-in-line memory modules (SIMMs), the Tandy 4000 does not blaze any new technology trails. It sports 16M bytes of memory and a 3½-inch, 1.44M-byte flexible disk drive. In fact, the most remarkable thing about the system is probably the low price—$2,599 for the basic system with 1M-byte RAM and a dedicated 32-bit expansion slot.

"It will be difficult for IBM to compete cost effectively," notes IDC's Goldberg. "They'll have to go back to selling FUD [fear, uncertainty and doubt], essentially offering non-tangibles to compete with the tangibles that Tandy is selling."

Tandy is making an effort to expand its sales efforts beyond the home and small-business market—now responsible for up for 90 percent of its total sales—and go into large corporations. To do this, it will rely on its traditional direct-sales force, as well as the VAR channel it is just now trying to beef up.

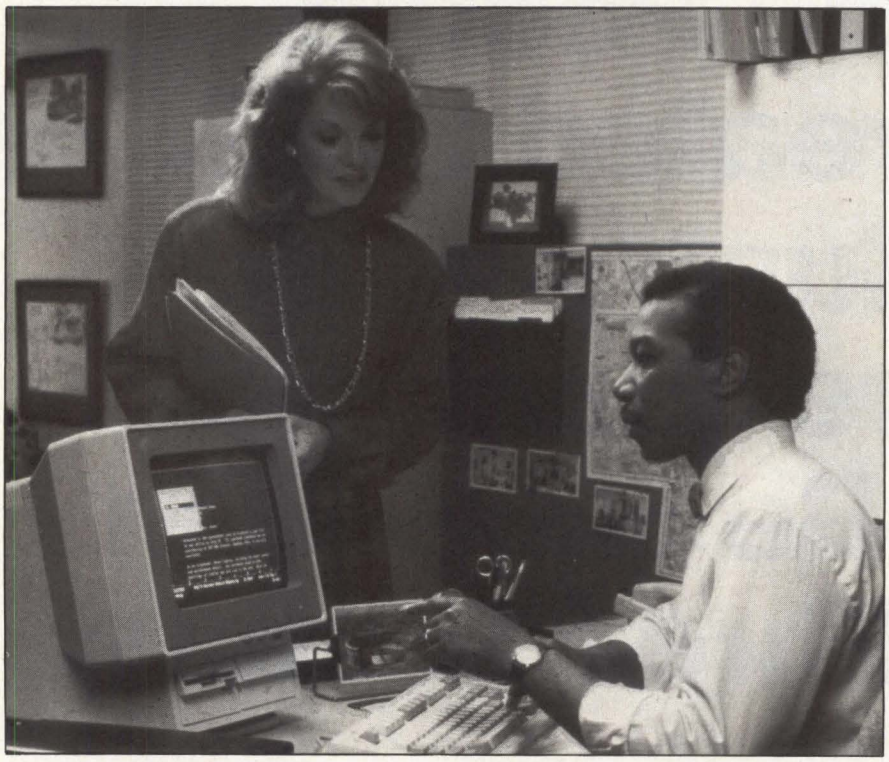
"This is good news to us," says Richard J. Horan, director of Executive Computer Inc. (ECI) in New York, a leading supplier and integrator of laptop computers to the Fortune 2000 companies. ECI presently sells about 400 Tandy machines per month to such corporate customers as Warner Communications and the American Broadcasting Co.

Leans on publishing, LANs

Unlike most other computer companies, Tandy controls distribution of its products through its nationwide Radio Shack stores and 500 Radio Shack Computer Centers. But, it is now in the process of retraining its 1,500 sales representatives to become more savvy about the needs of medium-to-large-size businesses where it would like to make an impact.

To this end, Tandy is trying to get away from its high-tech toy image, and offer products that appeal to business tastes, such as desktop publishing and networking. For example, Tandy signed an agreement with Aldus Corp. of Seattle, Wash., the leading supplier of desktop publishing software, to provide packages for Tandy's first laser printer. The $2,199 LP 1000 prints six pages a minute with a 300-by-300-dot resolution.

Tandy also signed an agreement with 3Com Corp. in February to sell its networking products along with Tandy computer systems. At present, 3Com has about 33,000 Ethernet networks installed, with more than 400,000 computers networked. The company's goal is 1 million networked personal computers by 1990.



The Personal System/2 Model 25 *is touted as a personal workstation that can be connected to an off-site mainframe to download information. It is available with either a color or monochrome display, and two types of keyboards, one compact and the other enhanced for use with other members of the PS/2 family.*

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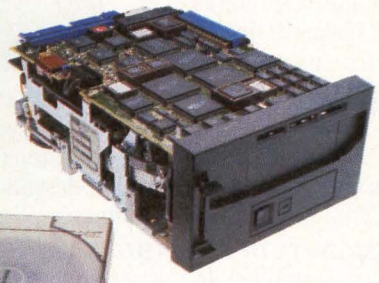

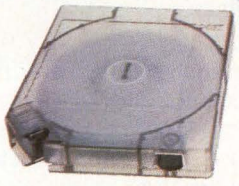

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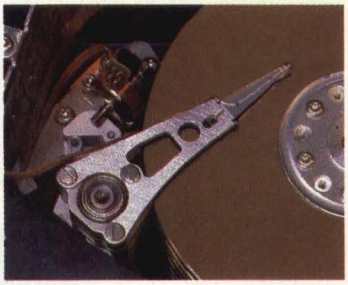

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Model	Capacity (Mbytes)	Avg. Seek (ms)	Interface	Transfer Rate (MHz)
Wren V	550	16	SCSI	10-15
Wren V	442	16	ESDI	10
Wren V	382	14.5	ESDI	10
Wren V	345	16.5	SCSI	10-15
Wren V H.H.	190	18	SCSI	10-15
Wren IV	307	16.5	SCSI	10-15
Wren III	182	16.5	ESDI	10
Wren III	160	16.5	SCSI	10
Wren III H.H.	106	18	ESDI	10
Wren III H.H.	91	18	SCSI	10
Wren II	96	28	ST506,ESDI	5
Wren II H.H.	51	28	ST506	5

H.H. = Half High Models
SCSI models list usable capacity formatted in 1024 Byte sectors.
Wren III, IV, V-345 Mb SCSI models have 40,000 Hr. MTBF (others: 30,000 Hr. MTBF).

CONTROL DATA

CIRCLE NO. 26 ON INQUIRY CARD

The agreement ties in nicely with Tandy's OS/2 and business mind-set. 3Com recently inked a codevelopment agreement with Microsoft in early July to produce a LAN Manager for Microsoft's OS/2. Such a LAN product is a missing link in the whole OS/2 strategy.

The Microsoft-3Com LAN Manager will reportedly be shipped sometime in the first half of next year. IBM—at press time—had yet to announce plans for a LAN product. Meanwhile, Novell Inc., Provo, Utah, is at work tweaking its own NetWare LAN product to accommodate OS/2 environments, offering yet a third possible networking alternative.

"Clearly networking is the key to the future, and we believe it should be easy and affordable," remarked Tandy president and CEO John V. Roach at the New York unveiling of the company's new products.

Knifing with the Mac

Apple Computer, which has always been unabashedly anti-IBM, is moving to push its Macintosh environment as a business standard and cut into IBM's corporate segment. Recently, Apple unveiled two software products that are expected to have a lot of appeal to the business user. One is HyperCard, a personal programming environment that lets users easily build relational databases and tie together data, voice, graphics and animation. The other, MultiFinder, is a multitasking operating system—similar in operation to the yet to be delivered OS/2—that can handle up to 30 applications at the same time, depending on the amount of available RAM.

One recent entry *in a rising number of PS/2 alternatives is the Premium/386 from AST Research. This system features a 20-MHz 80386 microprocessor, up to 13M bytes of 32-bit static-column RAM, and a 32-bit expansion slot dedicated to memory devices.*

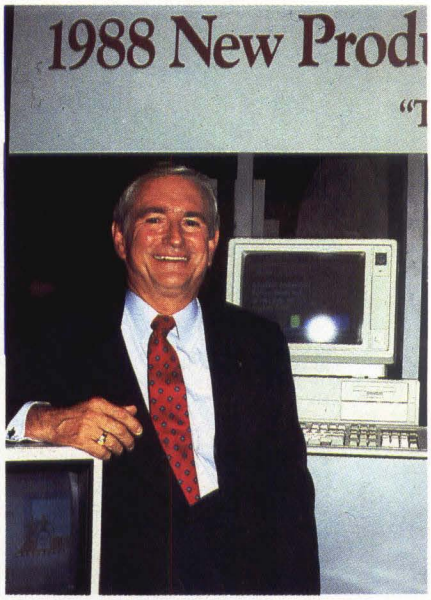
Both HyperCard and MultiFinder are available for $49 each for current Macintosh users, and will be bundled into new systems, according to John Sculley, Apple chairman and CEO.

At MacWorld Expo in Boston, Sculley described the Macintosh SE and Macintosh II as platforms for "inter-personal computing"—whereby powerful computers will be accessible and connectable by both technical and non-technical users. "We're not just trying to connect computers, but to inter-connect people," he said.

A big part of Apple's connectivity plan is to plug into disparate systems, particularly those that are not IBM. Sculley maintains that, although there is no formal agreement, Apple is presently zeroing in on Digital Equipment Corp. computer users, basically because they have already decided not to buy IBM and are a much easier sell. Also, DEC's across-the-board connectivity style is more in tune with Apple's networking philosophy. Presently, there are about 130,000 Apple networks installed worldwide, connecting more than 400,000 computers, Sculley said.

Builds a third-party platform

Unlike Tandy, Apple already has an established VAR and third-party network, selling a lot of equipment through these channels to the business market. In fact, since the Macintosh II is a system that can be easily customized and expanded—and can even be made IBM PC software-compatible with the addition of a plug-in board—it is being targeted to sell mainly through VARs and system integrators.



A beaming John Roach, *Tandy chairman and CEO, stands flanked by two new systems in his company's 1988 line: (from left) the 8088-2-based 1000 HX personal computer and 80386-based Tandy 4000.*

"Apple's role is to supply the developer platform, and for others to supply the solution," points out Sculley.

At present, there are more than 3,000 software applications designed to run on the Macintosh, says Apple VAR channel manager, Erna Arneson. And, contrary to what any believe, the most popular applications for Apple Macintoshes are not in desktop publishing, but are general business programs. Right now, many developers are working on programs for the Macintosh II, Arneson notes. However, the bulk of this development concentrates on scientific and engineering applications, followed by medical, manufacturing and education applications.

Up to 40 percent of Apple VARs do some sort of modification to the system, from adding third-party boards to ruggedizing the system for government applications, Arneson added.

Although Apple's VAR program is only a few years old—and really didn't get off the ground until Arne-

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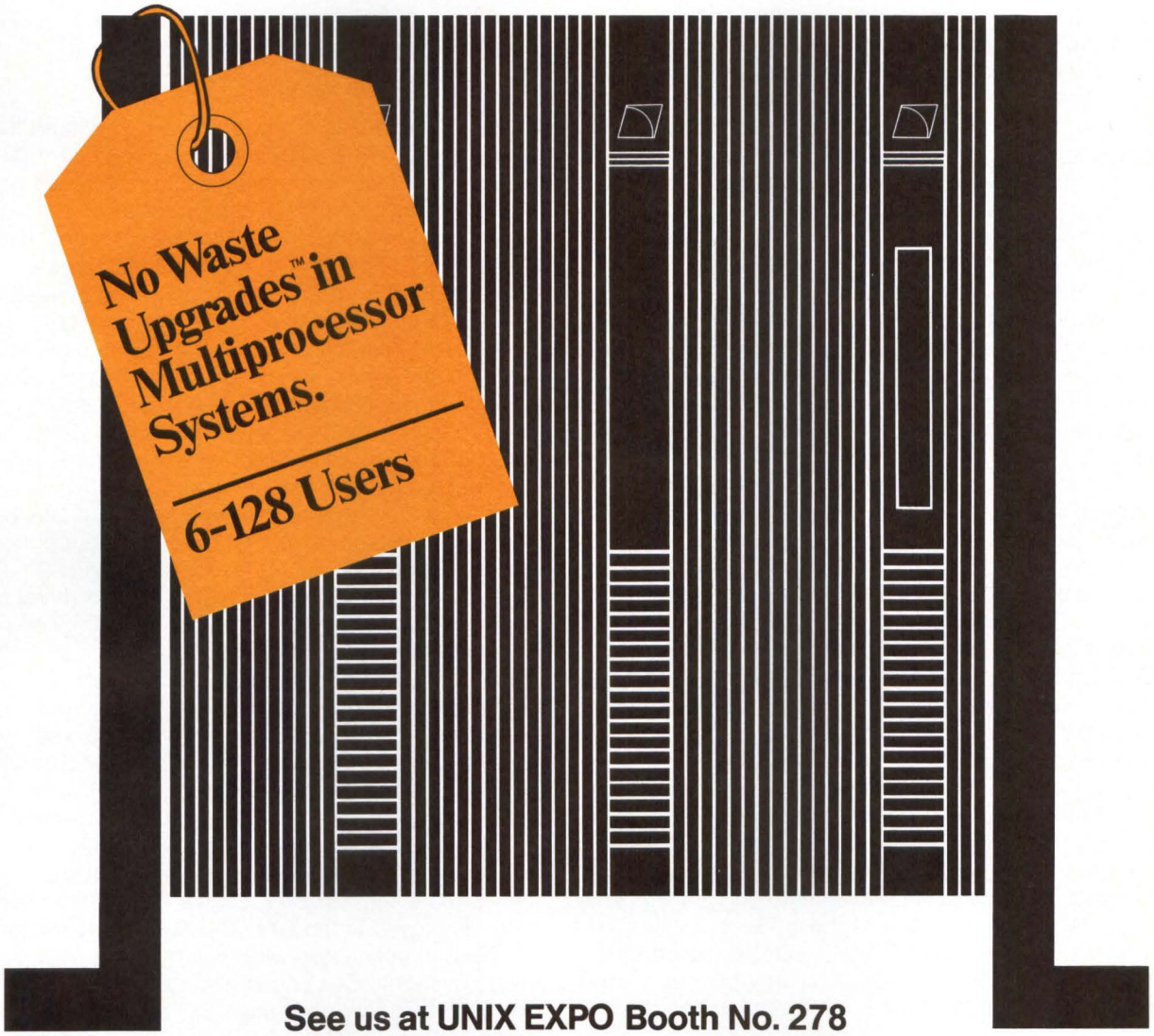

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CIRCLE NO. 27 ON INQUIRY CARD

Compaq lures high-end buyers with 'mini-class' Deskpro

There is no doubt that Compaq Computer Corp. has a lot to do with the success and acceptance of Intel Corp.'s 80386 chip architecture.

The Houston company was, after all, the first to use the, then innovative, microprocessor in its Deskpro 386, introduced last year. Consequently, it was also the first personal computer maker to use a built-in tape backup system, acknowledging both the coming wave of high-capacity rigid disk drives and the processing power of the 80386 chip. Microsoft Corp. chairman William Gates also admits that much of the development work for the OS/2 operating system was done on the Deskpro 386—making it, if not the father, then at least the first cousin of this new-generation operating environment.

Demand for the Deskpro 386 has been solid, according to Compaq director of corporate relations Jeff Stives. But, sales have been slipping with the advent of low-cost 386-based system clones and will continue to slide as vendors of clout come into the market.

This month, however, Compaq will again try to make a stab in new directions by introducing two 80386-based systems: the Portable 386/20 and the Deskpro 386/20. The Portable 386/20 physically resembles the company's 80286-based Portable III but offers a 20-MHz processor speed and a full 32-bit data path. The Deskpro 386/20, an 80386-based desktop system, has a built-in 32K-bit cache memory, one-to-one interleaving, and an Expanded Memory Manager to boost performance to midrange minicomputer levels.

The Deskpro 386/20 is also the first MS-DOS personal computer to use static-column RAM (SCRAM) in its cache-memory controller. SCRAM, together with other enhancements, results in a 50 percent performance improvement over 16-MHz 386-based systems, says Michael Swavely, Compaq's director of marketing. SCRAMs were first used by Compaq in its Deskpro 386, and are now being used by such competitors as AST Research Inc. in the design of their 386-based systems.

The Deskpro 386/20 incorporates a modified enhanced small device interface (ESDI) disk interface rather than the standard and much slower Storage Technology Corp. ST506 bus. It also can be outfitted with an optional Weitek Corp. graphics co-processor—the same one included in Sun Microsystems Inc. workstations and considered necessary for CAD/CAM and scientific/engineering applications.

Both systems are available as of October 1, although the Deskpro 386/20 will initially be in limited supply. The Portable 386/20 will sell for about $7,000 with a 40M-byte disk drive and $10,000 with a 100M-byte drive. Prices for the Deskpro 386/20 were not available at press time, but were expected to start at about $1,000 more than Compaq's Deskpro model 40, which is priced at $6,499. The three models in the new line—the Deskpro 386/20 models 60, 130 and 300—replace the Deskpro 286 models 70 and 130, which have been discontinued.

Reaches for new heights

The Portable 386/20 targets users who need the power of the 386 architecture, and eventually full access to the OS/2 operating system, in a compact package. Basically, it is a system for the pick-up-and-go power user. However, the desktop Deskpro 386/20 seems to be the cornerstone in Compaq's bid to attack the top high-end markets of CAD/CAM, and even of real-time processing.

In fact, market director Swavely maintains the new Deskpro series will further attract workstation buyers away from such companies as Apollo Computer Inc., Digital Equipment Corp. and Sun Microsystems Inc. Still, Compaq's traditionally higher price tags may turn off buyers, because most workstation manufacturers are either severely cutting prices or coming out with lower priced models. The top models in the Deskpro 386/20 line—models 130 and 300—are expected to sell for $10,000 and more, especially when you add $2,000 to $3,000 for the optional Weitek graphics coprocessor.

Presently, half of Compaq's Deskpro 386 systems shipped—which amount to about 5 percent of the company's total computer shipments—are used in general business applications, such as for databases, spreadsheets and the like. Roughly 20 percent of the 386 systems are used in CAD/CAM applications, 15 percent in local area network environments, and the remainder in other specialized areas. With the Deskpro 386/20, however, Swavely expects to see more employed in the CAD/CAM and LAN areas.

Although concerned with maintaining a beachhead in 386 systems, Compaq is also busily trying to convince the world that the OS/2 operating system and IBM Corp.'s PS/2 systems are not inseparable partners. In a survey of its own user base, Compaq found that fully 37 percent thought OS/2 and PS/2 were an undeniable duo, which is why Compaq and other companies have been stumping to push OS/2 as a standard, but not the PS/2, Swavely says.

At the moment, 45 percent of Compaq's computer shipments are 286-based machines, with the remaining comprised of old-technology 8088 and 8086 systems. But, Swavely sees this balance shifting in favor of 286 systems and 386 systems by the end of next year. By the beginning of 1989, however, Swavely predicts shipments of 8088 and 8086 systems from all computer manufacturers should drop to less than 3 percent. □

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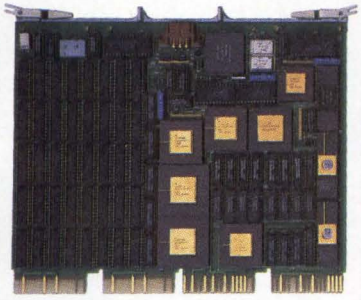

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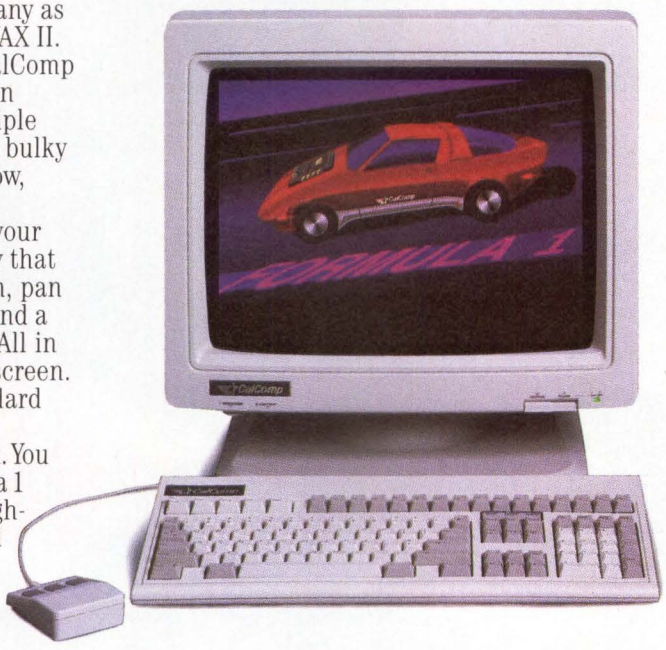

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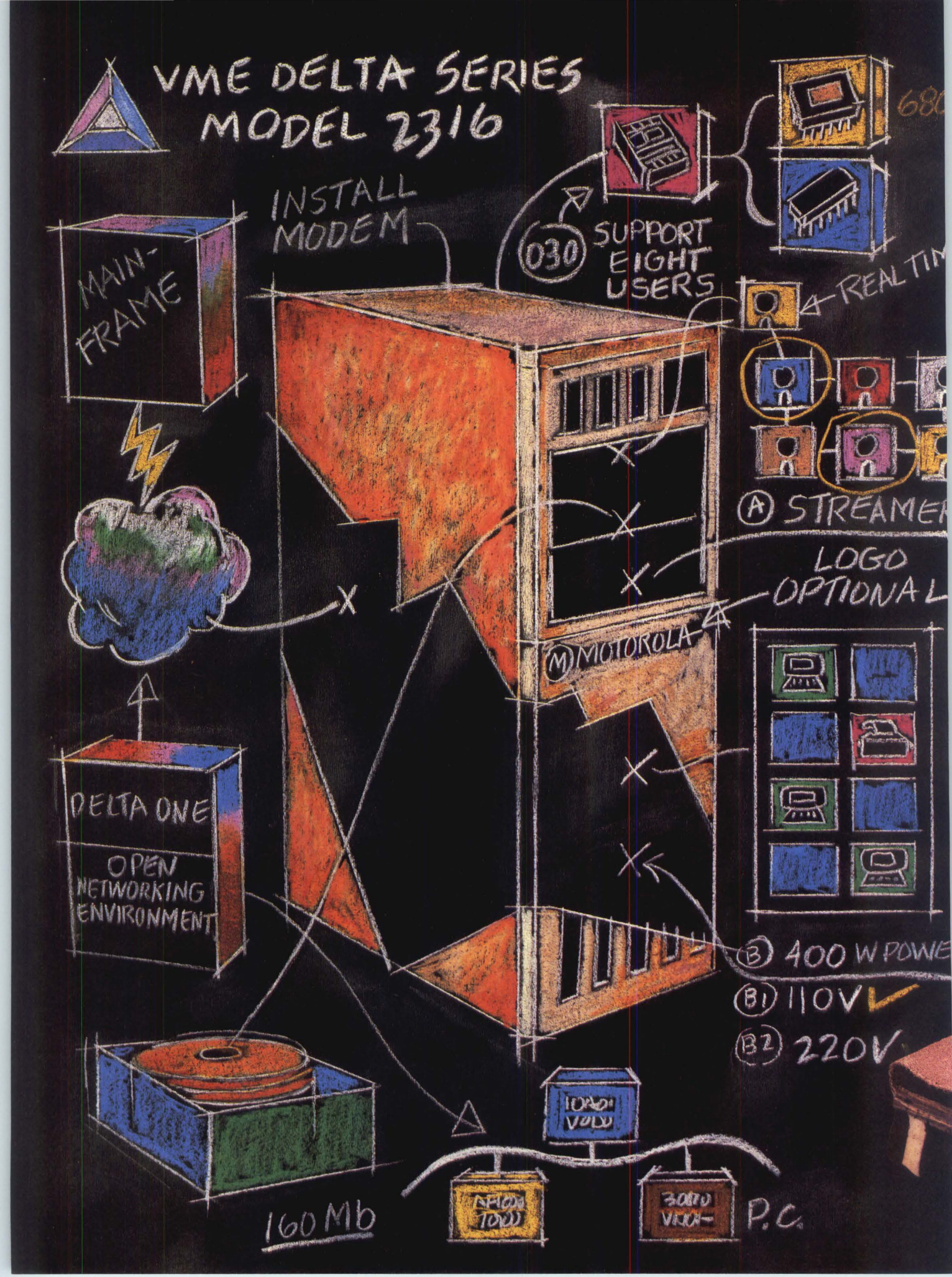
CIRCLE NO. 28 ON INQUIRY CARD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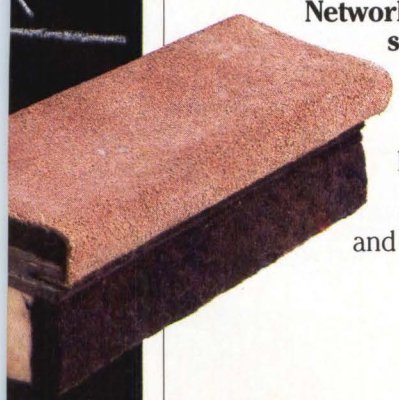

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CIRCLE NO. 29 ON INQUIRY CARD

son was named channel manager last year and the Macintosh II was announced last March—Macintosh VARs are a dedicated lot and optimistic about competing against IBM in the business market.

For example, Michael B. Edwards, president of Health Care Communications Inc. in Lincoln, Neb., and an Apple VAR since 1984, believes the vertical market is wide open for the Macintosh. In the past 2½ years, his company has sold $8 million to $9 million in hardware and software to more than 600 clients worldwide. Likewise, John DiBiasi, president of Softworks Inc. in Huntington, Conn., and an Apple VAR since last year, has been having success selling Apple systems into the real-estate market.

However, as Apple strives to increase its VAR momentum, some problems do crop up, mostly centering on training and support. DiBiasi, for instance, would like to see more support from Apple and is even trying to drum up interest in establishing a VAR association whose members could lean on each other to solve problems and offer advice.

Earlier this year, Apple also had a problem with non-certified VARs who were selling equipment without official Apple blessing and technical support. Apple solved this problem in April, however, when it decided that all VARs would automatically become certified developers and be entitled to field service, training classes and connection to company representatives through its AppleLink electronic mail service.

Now, Apple is in a position to make some major coups in the VAR community. In August, it reached a VAR agreement with Dow Chemical Co., Midland, Mich., to provide Macintosh II systems for chemical applications, and was expected at press time to formalize a similar deal with Dupont Chemical Co.'s Medical Products division in Troy, Mich., according to reports.

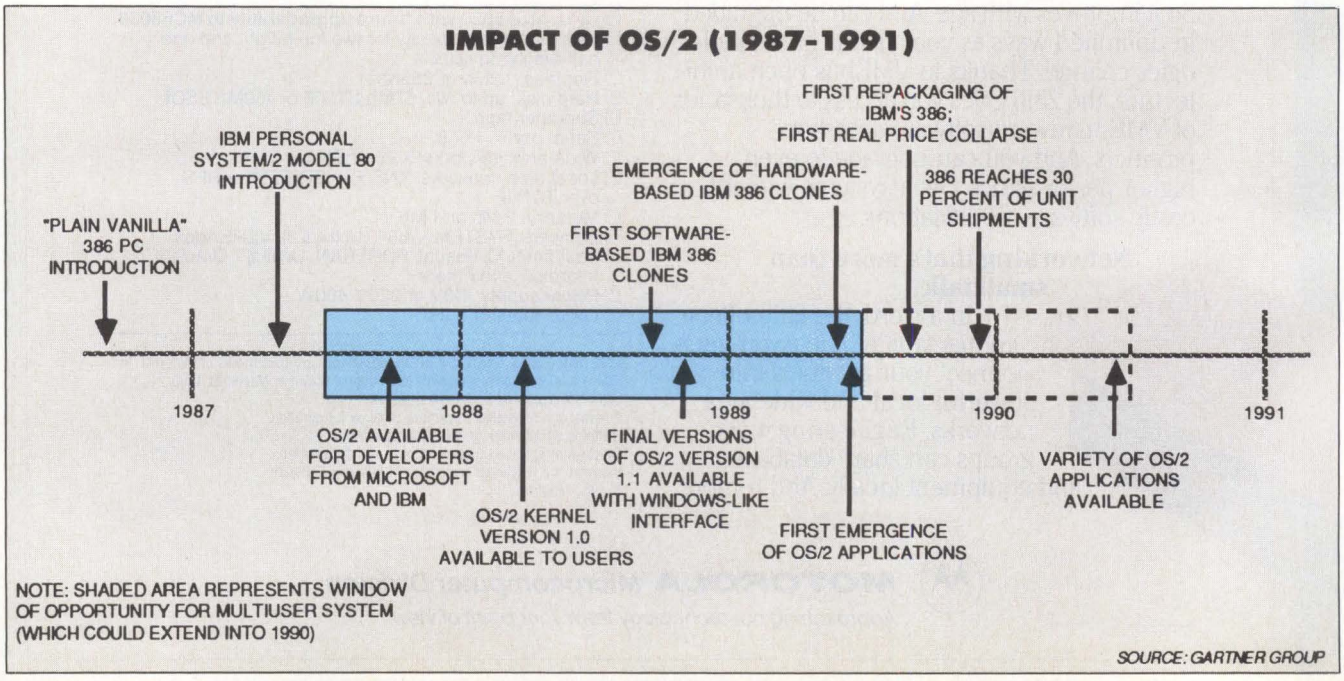
Adds to the alternatives

Apple is not alone in its quest to convince system integrators and VARs that that there are alternatives to the IBM PS/2 in business applications. At COMDEX/Fall in Las Vegas, AST will be showing its Premium/386—a PC/AT-compatible that runs at 20 MHz, has up to 130M bytes of storage and a variety of expansion slots that can accommodate 8- and 16-bit PC/XT and PC/AT cards. In addition, the system has a 32-bit slot that is dedicated to memory, which is expandable to 13M bytes. Like the Tandy 4000, the Premium/386 features SIMMs and has a zero-to-one wait-state operation.

"We see the machine as a platform that will take us into more minicomputer-like applications," says AST vice president Kraemer.

AST is marketing its system to VARs and system integrators as a more expandable alternative to the PS/2. Unlike IBM's high-end systems in that line, which require large-size add-in and expansion boards, the Premium/386 and its PC/AT architecture can accommodate standard-size boards. Therefore, resellers can add products and customize systems without having to build new products, Kraemer explains.

No one is in a better position to know how strongly developers will shy away from IBM's proprietary PS/2 architecture than AST. Before it went into the IBM PC-compatible systems business earlier this year with the introduction of the Premium/286 (of which it now ships from 8,000 to 10,000 units per month) it was, and still is, a major supplier of board-level products for IBM PC-compatibles



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CIRCLE NO. 31 ON INQUIRY CARD

For Apple, third-party activity is in the cards

It is ironic that what eventually should be one of the most innovative and appealing products ever developed by Apple Computer Inc. almost did not come from the Cupertino, Calif., company.

It is even more ironic that it was Apple Computers' reluctance to step on the toes of its third-party software developers—which are to a large extent responsible for the company's overall success—that nearly prevented the product from coming out.

When Apple Fellow William Atkinson first decided to develop a new Macintosh programming environment—known today as HyperCard—it "was at a point in his career when his relationship with Apple was "going downhill fast," he says in *The Complete HyperCard Handbook* by computer-writer Danny Goodman. Apple had unbundled and was selling separately the MacPaint program he had designed with the understanding it would be included with the Macintosh. Atkinson also felt Apple was not giving enough support to his work and the efforts of other programmers.

More important, Atkinson was concerned that Apple might not want to back his new programming environment, because it contained some elements of application programming. Apple was under pressure from third-party software developers not to compete with them by developing and selling its own application products. The solution, thought Atkinson, was to leave the company and develop HyperCard as a third-party product. However, Apple Chairman and CEO John Sculley had other ideas.

Upon hearing of Atkinson's concern, Sculley elected to bend the rules and quickly established a HyperCard "task force"—jokingly called the Acme Dot Co.—spearheaded by Atkinson to develop the new product. The task force's main objective was to get HyperCard and HyperTalk—the object-oriented programming language used to write the environment—off the ground, along with all of its visual and sound eccentricities. Three years later, in August of this year, HyperCard was unveiled with other products at the MacWorld Expo in Boston.

Apple Fellow Bill Atkinson, *creator of HyperCard, talks about the programming environment at the August MacWorld Exposition in Boston.*

From Software to StackWare

Basically, HyperCard is a writing tool that lets users organize information by building related stacks of data. This data can be in the form of text, graphics, pictures or sound. It can also be related by a single word in a document or by a small portion of a large graphics image.

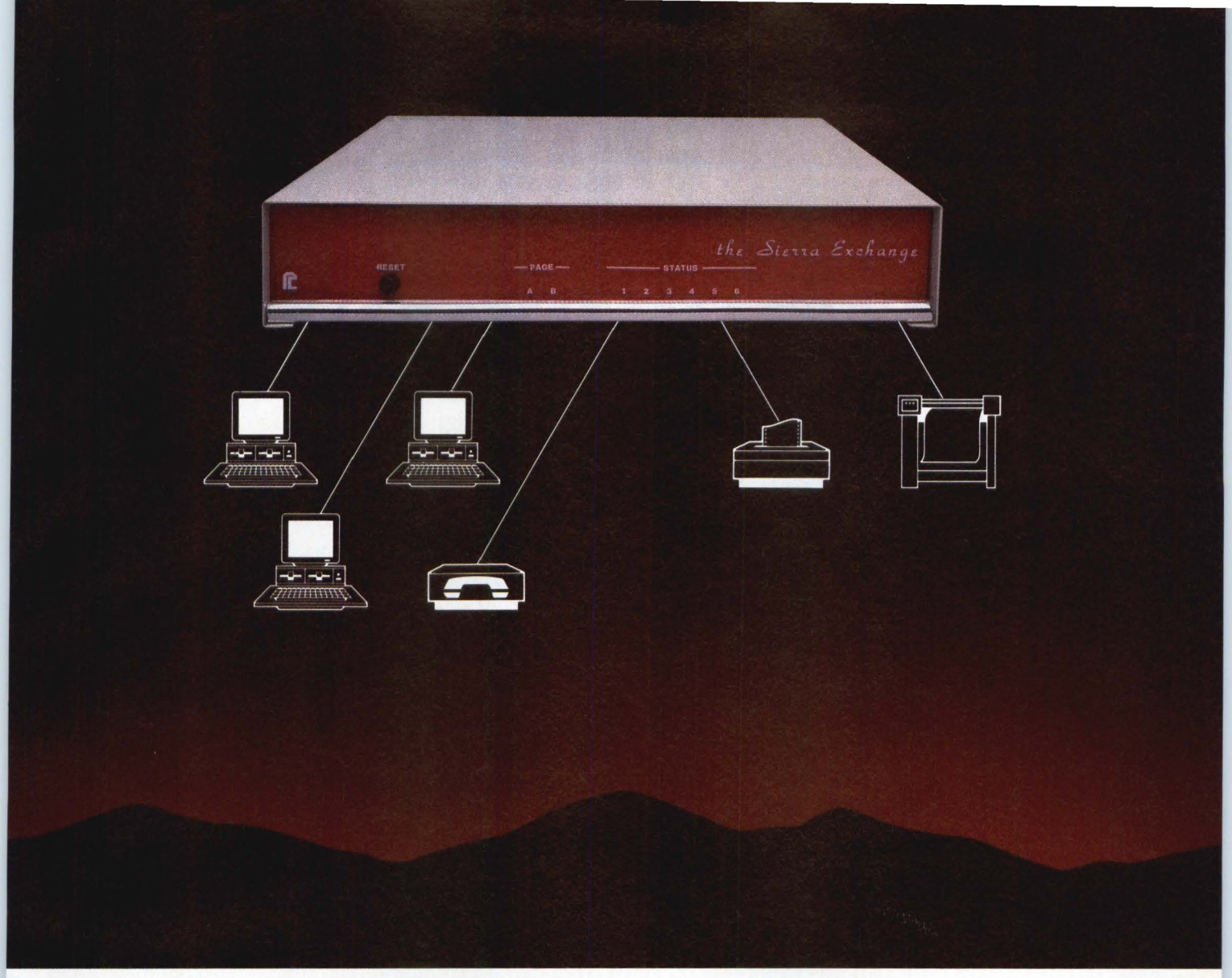
Third-party software developers can easily build HyperCard applications—called StackWare, since each application is actually a collection of graphics cards—by using HyperTalk to identify "buttons," fields, cards, backgrounds, stacks and the all-important Home Stack; the anchor to the entire organizational pyramid. Buttons initiate actions within an application, such as going to the next card in the stack or finding a related image or word in other stacks.

Already, a number of Apple's third-party software developers have released StackWare products for the Macintosh. They include Optical Data Corp., Florham Park, N.J., which announced LaserCards, and Data Desk International, Van Nuys, Calif., which developed an automatic telephone dialer.

Not surprisingly, Apple is hoping HyperCard will open up systems like the Macintosh II to non-programmers and spur more software development for Apple machines. The company is also hoping the new environment will boost sales of the Macintosh II and other new products, from which Apple derives up to 50 percent of its annual revenue.

Other key products announced by Apple at MacWorld Expo included:

- MultiFinder, a multitasking operating system that allows users to concurrently operate and integrate information in applications running on different operating systems—including MS-DOS. It is bundled with all Macintosh computers, or sold separately to current users for $49.
- Macintosh EtherTalk II, a communications card that lets Macintosh users connect to Ethernet-based networks for speedier transmissions. It will be available in the fourth quarter of this year.
- AppleFax Modem, a device that lets users send and receive facsimile files from Group II and III fax machines. It also will be available sometime this year, for $699.



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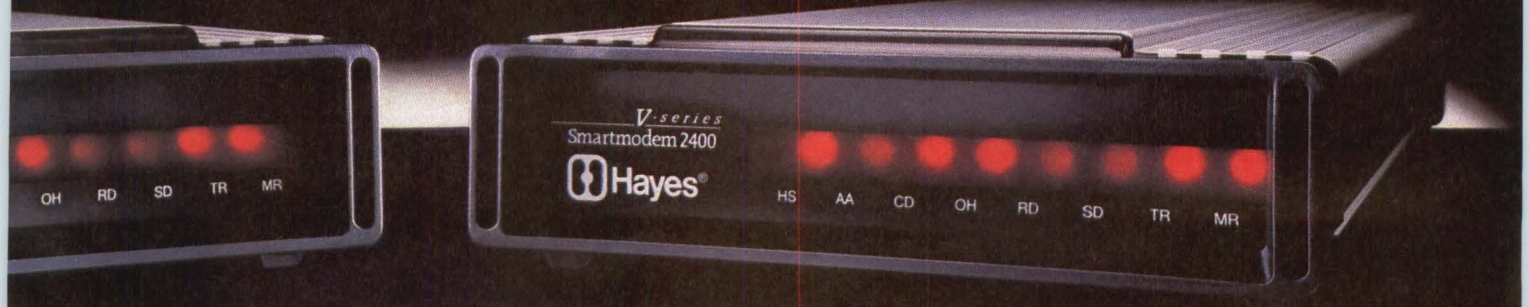

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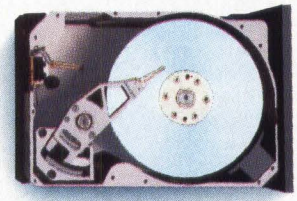
WHAT DRIVES  A LEADER?

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Maxtor

A TOP-DOWN LOOK AT THE TOP THREE SYSTEMS: TANDY, IBM AND COMPAQ

Features	Tandy 4000	IBM 80-041	Compaq Model 40
Microprocessor	80386	80386	80386
Clock speed (MHz)	16	16	16
Coprocessor (optional)	80287	80387	80287
Standard memory (M bytes)	1	1	1
Maximum onboard memory (M bytes)	2	2	2
Maximum 32-bit memory (M bytes)	16	16	10
Expansion slots			
8-bit	2		3
16-bit	6	4	4
32-bit (dedicated)	1	3	1
Bus architecture (type)	AT	Micro Channel	AT
Flexible drive	one 3½-inch	one 3½-inch	one 5¼-inch
Flexible drive capacity (M bytes)	1.44	1.44	1.2
Rigid drive average access time (M bytes/msec)	optional	44-40	40-28
Serial/parallel port	included	included	included
Power supply (watts)	192	225	192
Retail price ($)	2,599	6,995	6,499

Source: Tandy Corp.

and Apple Computer systems. In fact, AST makes a coprocessor for the Macintosh II, called Mac286 that brings that Macintosh up to snuff in the MS-DOS world.

AST does not intend to abandon those business segments while taking a stab at the PS/2 market, by providing a systems alternative and by manufacturing expansion boards for the PS/2 and its Micro Channel architecture.

The board and systems manufacturer also will not be alone in its efforts to derail, or at least cause some problems, for IBM's PS/2 push. Compaq Computer Corp., Houston, Texas, just this month introduced an 80386-based portable that is similar to Compaq's 80286-based Portable III but operates at a 20-MHz clock rate and can accommodate up to 10M bytes of RAM on the system board. Compaq director of corporate relations Jeff Stives claims the system—called the Portable 386/20—has a 25 percent or better performance advantage over IBM's PS/2 Model 80.

Compaq also extended its Deskpro 386 series by announcing three systems that incorporate memory caching, an expanded memory manager and other tricks common to the mini-computer world. The systems not only target high-end general business applications, but can be supplemented with an optional Weitek Corp. graphics coprocessor to deliver performance on the level of midrange Apollo and DEC computer systems, says Compaq director of marketing Michael Swavely.

Newcomer IDR Inc., a U.S. subsidiary of Reuters based in Hauppauge, N.Y., has also unveiled a PC/AT-compatible system that is built around Intel's 80386 microprocessor and is being marketed solely through VAR and reseller channels. The IDR 386 workstation prices start at $4,495, with considerable discounts for quantity OEM and VAR purchases. It offers 16-MHz speed and a 32-bit bus on a single board.

Finally, Chips and Technologies Inc., which made its name by producing microprocessor backbones for many of the IBM PC clones in existence, has recently unveiled a VLSI chip set for designing PS/2 Model 30-compatible microcomputer systems. The chip set will reportedly let manufacturers design desktop and laptop computers with up to 25 percent more performance than IBM's Model 30 system. □

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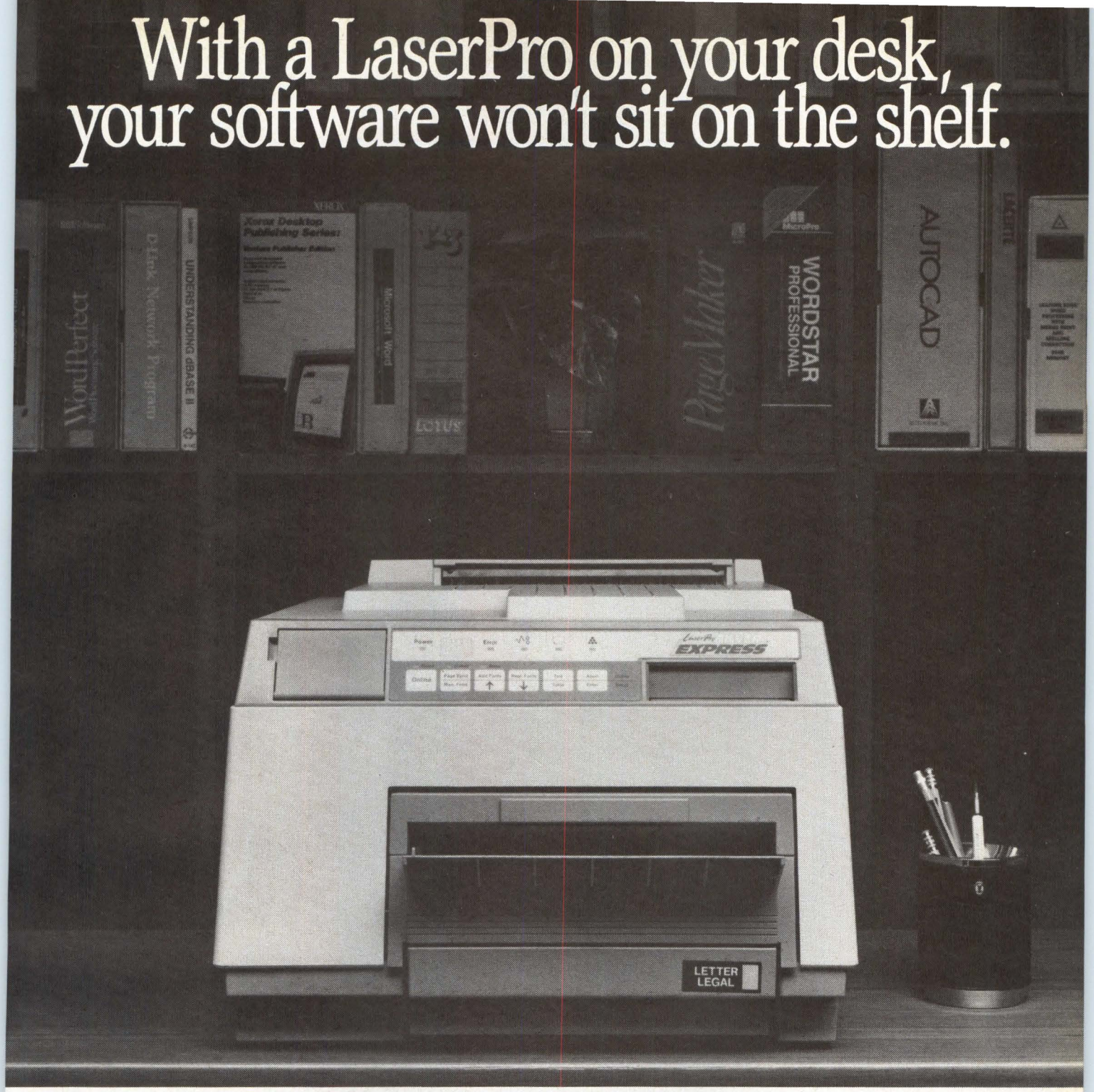

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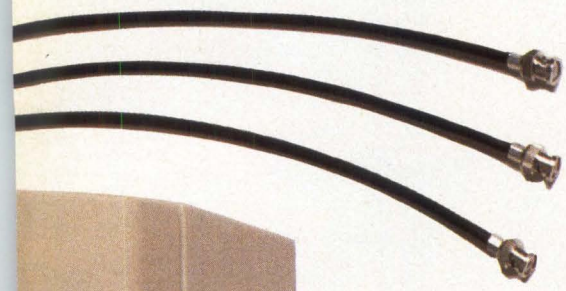
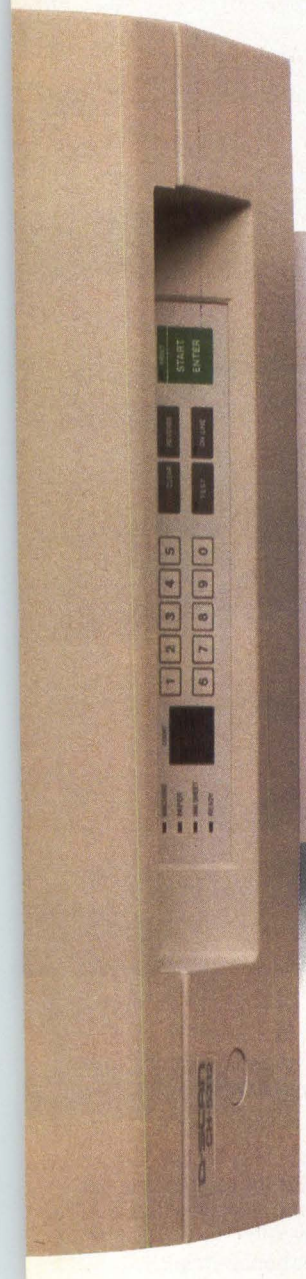
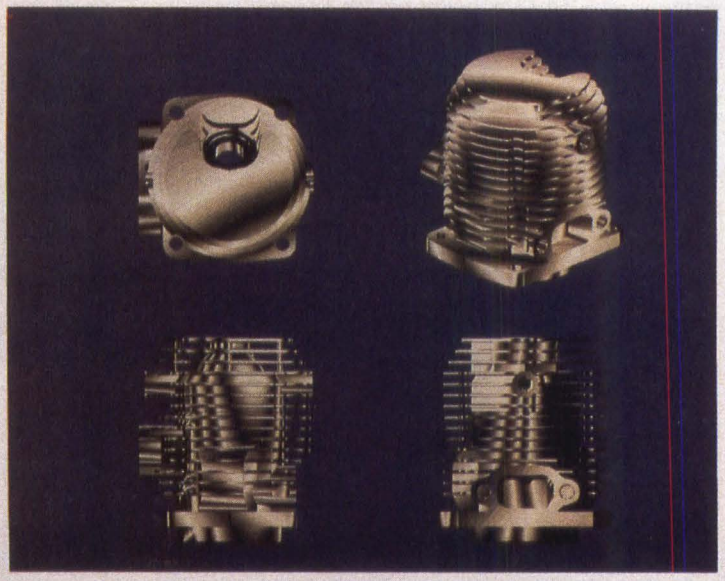
- Both parallel and RS-232 interfaces are supported by a wide selection of software.

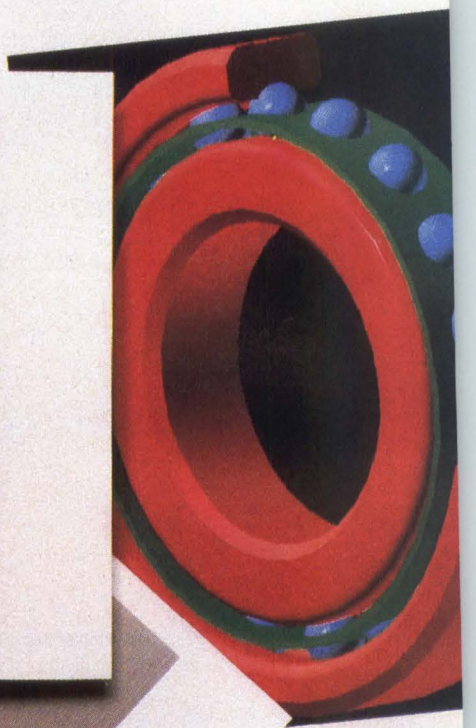


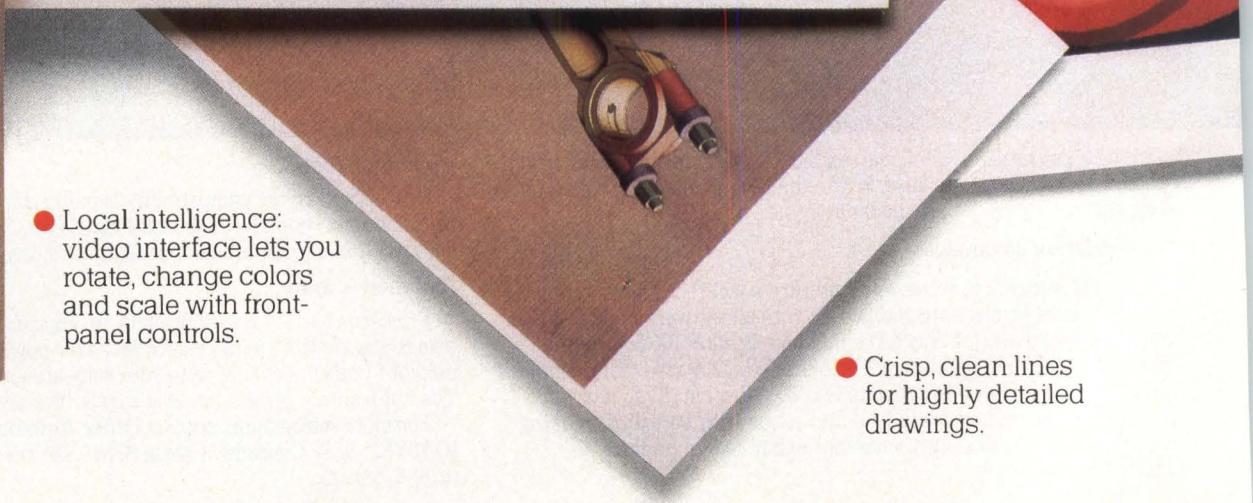
- Easy video interfacing—over 150 interfaces are supported. No need to write software.

- Accurate shading for realistic, detailed solids; work with 4,912 colors.









- Local intelligence: video interface lets you rotate, change colors and scale with front-panel controls.

- Crisp, clean lines for highly detailed drawings.

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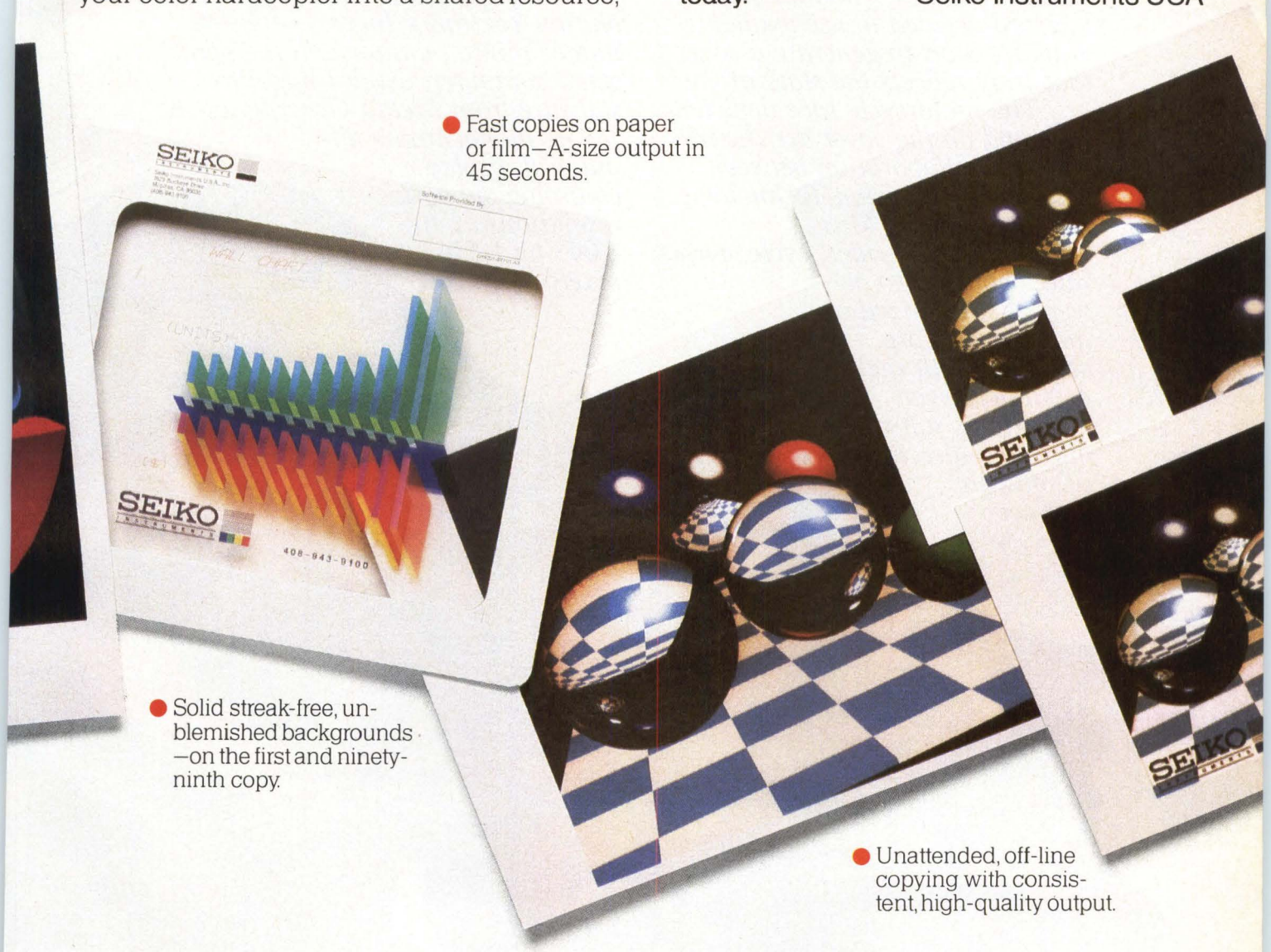

- Fast copies on paper or film—A-size output in 45 seconds.
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Visuals courtesy of Ramtek Corporation, Matra Datavision, Computer Design Equipment Incorporated.

GAUGING THE GREAT

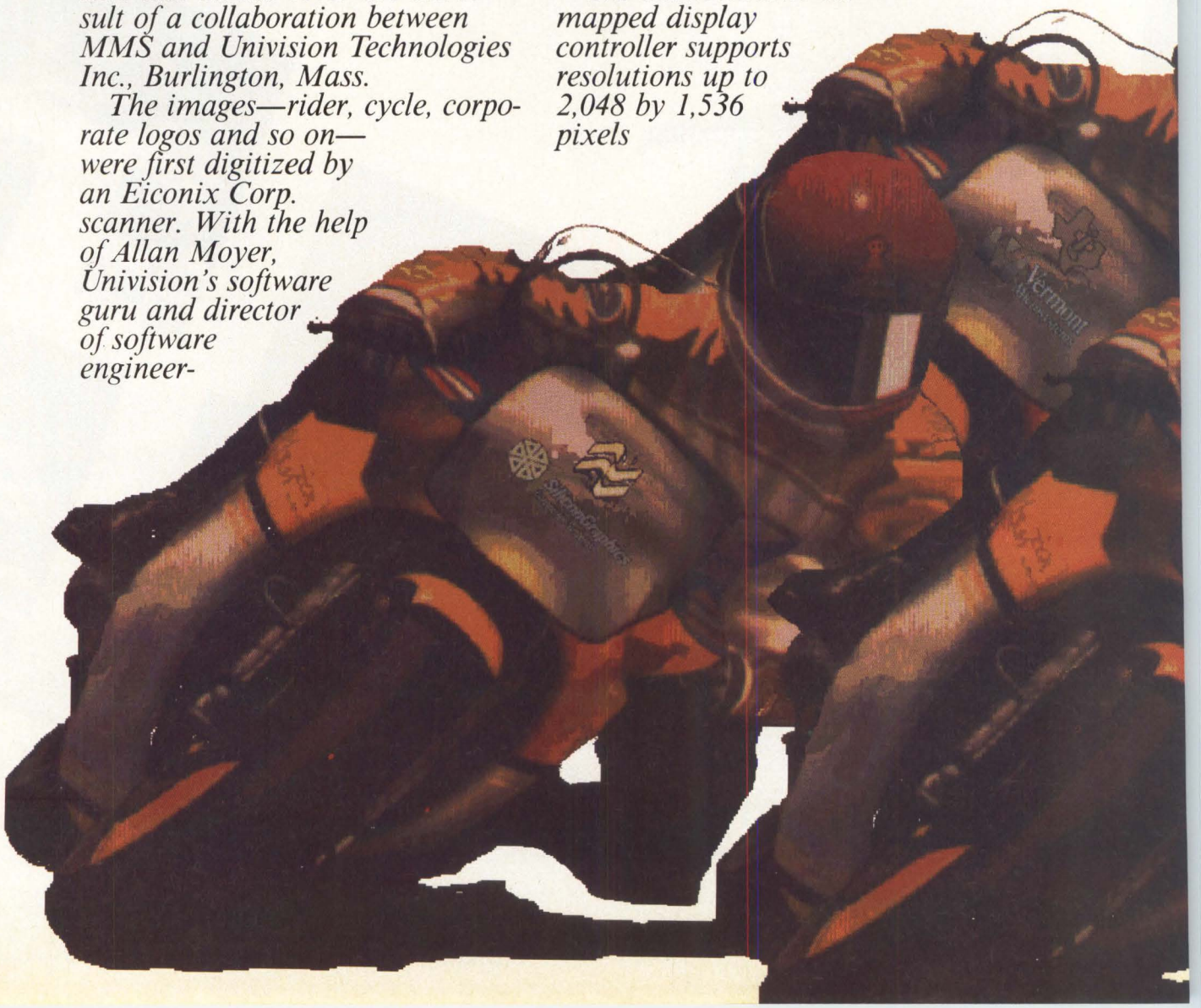
New chips serve as platform for system integrators and OEMs looking for versatile graphics subsystems

Would-be graphics users confront a dilemma. The promise of powerful image-handling systems is clear, but low-cost platforms and easy-to-use tools are only beginning to emerge.

When Mini-Micro Systems *editors began to plan this month's special report on graphics chips, the staff decided to use available graphics tools to generate a cover that truly reflects the state of the art. The motorcycle race depicted here and on the cover are the result of a collaboration between MMS and Univision Technologies Inc., Burlington, Mass.*

The images—rider, cycle, corporate logos and so on—were first digitized by an Eiconix Corp. scanner. With the help of Allan Moyer, Univision's software guru and director of software engineering, these images were transferred as blocks into a PC's Limited AT-compatible outfitted with Univision UDC-800 series add-in graphics boards built around an Intel Corp. 82786 graphics chip. MMS editors and Univision engineers did the editing (pixel-by-pixel manipulation) on a high-resolution Tektronix Inc.'s monochrome monitor and the personal computer, using ImagePro software from Media Cybernetics Inc.

The monochrome bit-mapped display controller supports resolutions up to 2,048 by 1,536 pixels



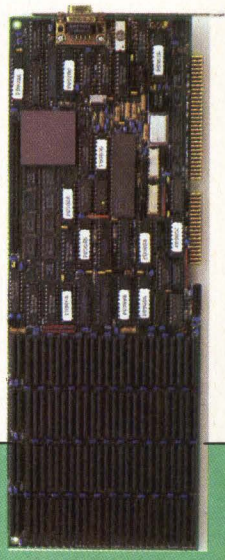
GRAPHICS IC RACE

by 8 bits with 256 gray levels. To double-check each editing stage for color, we switched to a UDC-803 controller—with resolutions of up to 1,600 by 1,280 by 8 bits with 256 colors—and a Monitronix Corp. monitor, an engineering prototype of the tube introduced at this year's SIGGRAPH show. (The cover image is a photograph of the screen.) Both boards support flicker-free 60-Hz non-interlaced displays.

In order to upload the digitized images directly into the processing equipment of our color-separation supplier, we had to put the bikers on this page through several more translations. Because red, green and blue images and 8-bit planes are not the province of color separation suppliers, the color separations supplier had to translate these images into cyan, magenta, yellow and black—the four colors printers use—and 24-bit planes. But now the bikers are off and racing after we cranked out more than 20 image files, each containing approximately 1.7M bytes.

What does it all mean? First, it demonstrates that high-quality images can be produced with personal computers. Second, it demonstrates there is a crying need for easy-to-integrate image handling software and hardware. And last, it demonstrates that the newest generation of graphics-processing chips could initiate a booming personal computer imaging business.

— Doug Pryor



Read all about the image makers

OEMs, system integrators and value-added resellers hoping to capture a share of the fast-track image and graphics add-in business will find this special report, coordinated by senior editor Joe Lerro, indispensible. In Part I, Intel Corp. explains how its chip tranlates bits into images; in Part II, Texas Instruments Inc. examines the importance of programmability; and Part III lays out the key specs of six other chip offerings.

The report provides product planners, equipment buyers and system integrators the insights they need to create graphics-operating environments that satisfy customer demands. And these demands are wide ranging:

- Faster screen response, higher resolution, more colors and advanced graphics in personal workstations;
- Fast, flexible text handling and efficient spline curves for geometric fonts in electronic publishing;
- Fast image compression and decompression in low-cost imaging systems;
- Emulation of all the popular hardware standards in graphics terminals.

And for in-house, high-volume end users, the chip wizards supply the technology grit to help them make informed graphics decisions.

PART I

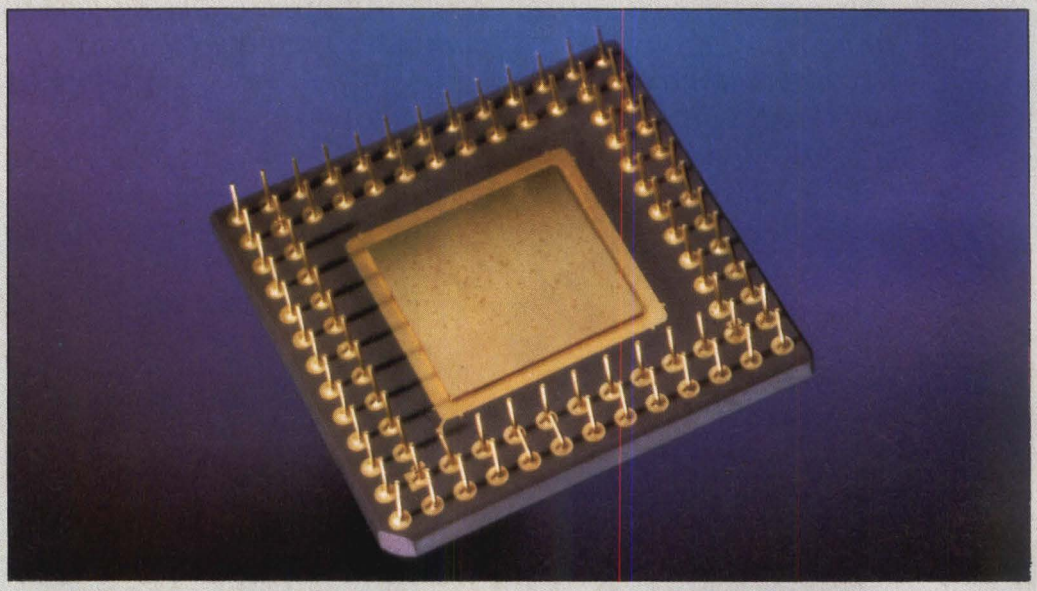
COPROCESSOR REVS UP GRAPHICS PERFORMANCE

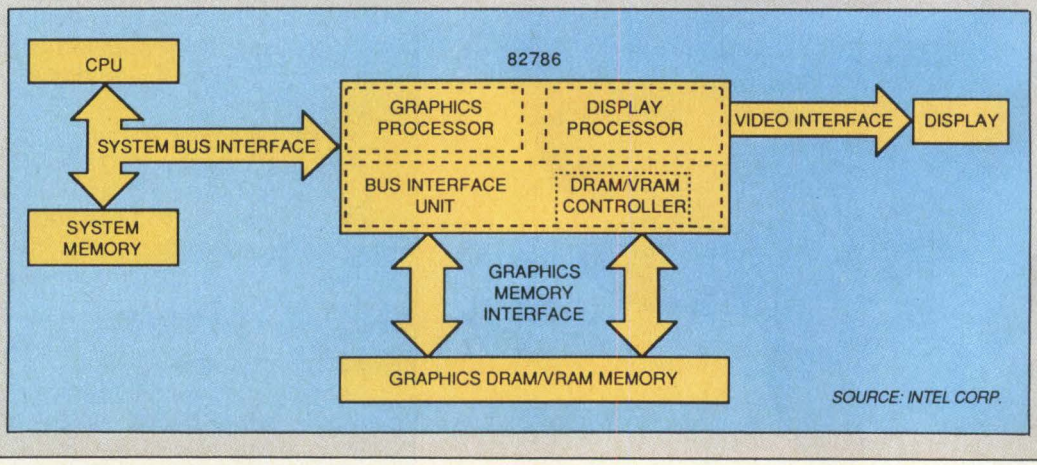
Mounted on a single VLSI chip, two independent processors respectively manipulate graphics and text, and execute multiple windows in hardware

Ray Torres and Richard Shankman
Intel Corp.

A standard VLSI part, the Intel Corp. 82786 graphics coprocessor, provides engineers with a foundation for their designs and serves as a ready alternative to custom graphics approaches. Where separate integrated circuits (ICs) are needed to supply basic graphics requirements, and several additional ones are required for more sophisticated systems, engineers can instead rely on this graphics chip as the standard platform for varied designs.

THE GP-DP ONE-TWO PUNCH





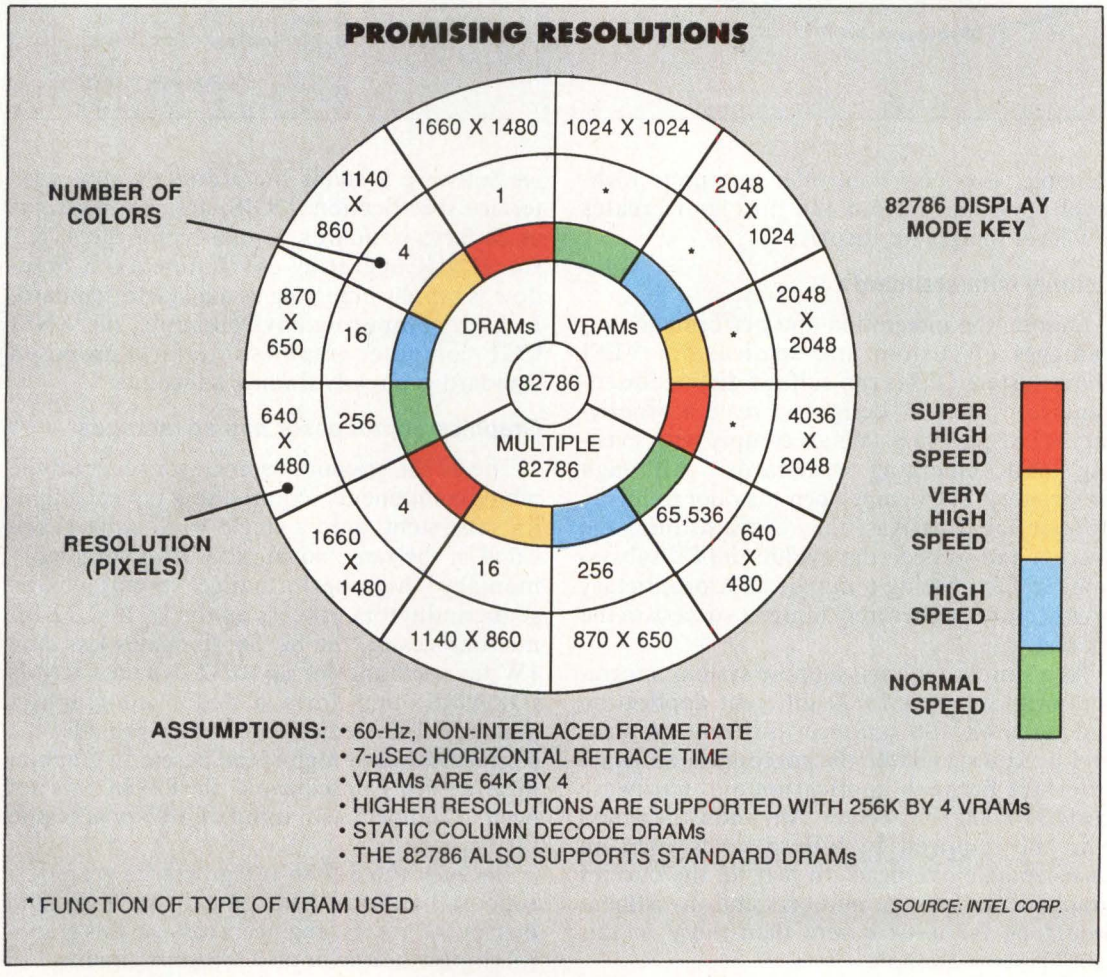
Key to the 82786 graphics *coprocessor's performance is a pair of on-chip processors—the graphics processor (GP) and the display processor (DP). The GP provides graphics primitives for lines, rectangles, arcs and circles, which it executes in silicon. The DP provides hardware to support multiple windows and instantaneous smooth panning and scrolling.*

Although the approaches for graphics hardware design differ in detail, they all rely on a similar architecture. That includes, at a minimum, a video display interface, some memory dedicated to graphics and a host interface.

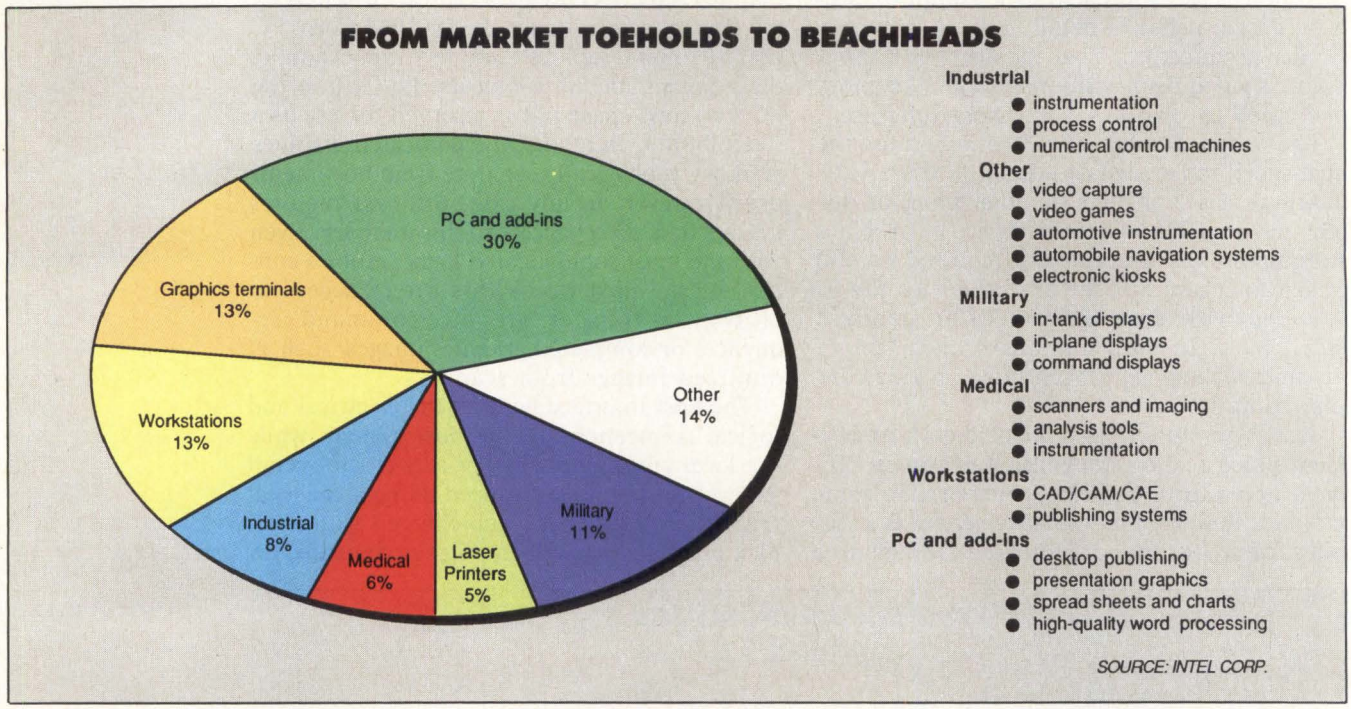
The video display interface generates the high-speed video signals needed to drive CRT monitors, laser printers or other types of display devices. The video hardware of graphics subsystems has traditionally required careful design to ensure that the display device can be supplied with data (refreshed) at standard video rates. In fact, some early advances in graphics technology concentrated on video display control.

Just as graphics requirements dictate an efficient video section, they also demand an efficient access to a dedicated memory. In some graphics designs, this memory serves as a display frame buffer—a dedicated storage area that holds the specific data representing exactly the current screen image. In the IBM Corp. PC CGA (Color Graphics Adapter), for example, the graphics memory logically lies within the PC's address space but is reserved for use as a frame buffer. In others, the dedicated graphics memory is physically separate from host memory. However, in any case, the host requires unimpeded, direct access to this memory. Even with the most sophisticated local graphics controller, the host needs this direct access to efficiently transfer graphics-command sequences or completed graphics images, such as digitized images from scanners.

The host interface handles the electrical and logical connections to the host system, while the local graphics controller acts as an overall supervisor. In more advanced designs, the local graphics controller is often charged with complex tasks. In "smart" graphics peripherals, for



Using combinations of DRAMs, *VRAMs and multiple graphics coprocessors, designers can address a broad spectrum of resolutions for 60-Hz, non-interlaced display devices. The 82786's accelerated mode trades bits per pixel for higher transfer rates.*



Because of its versatility, *the 82786 graphics coprocessor can be effectively used in diverse applications.*

example, the local controller interprets high-level commands from the host and creates low-level images for display.

Comply with standards

Despite the integration and performance advantages of custom and semicustom VLSI chips, system OEMs can suffer a distinct disadvantage if their IC designers create a proprietary VLSI part that fails to comply with existing and emerging standards. Although proprietary VLSI chips open the door to highly differentiated designs, they can also limit the success and impede the evolution of a subsystem. In fact, basing a design on a proprietary architecture can severely limit its success in the market.

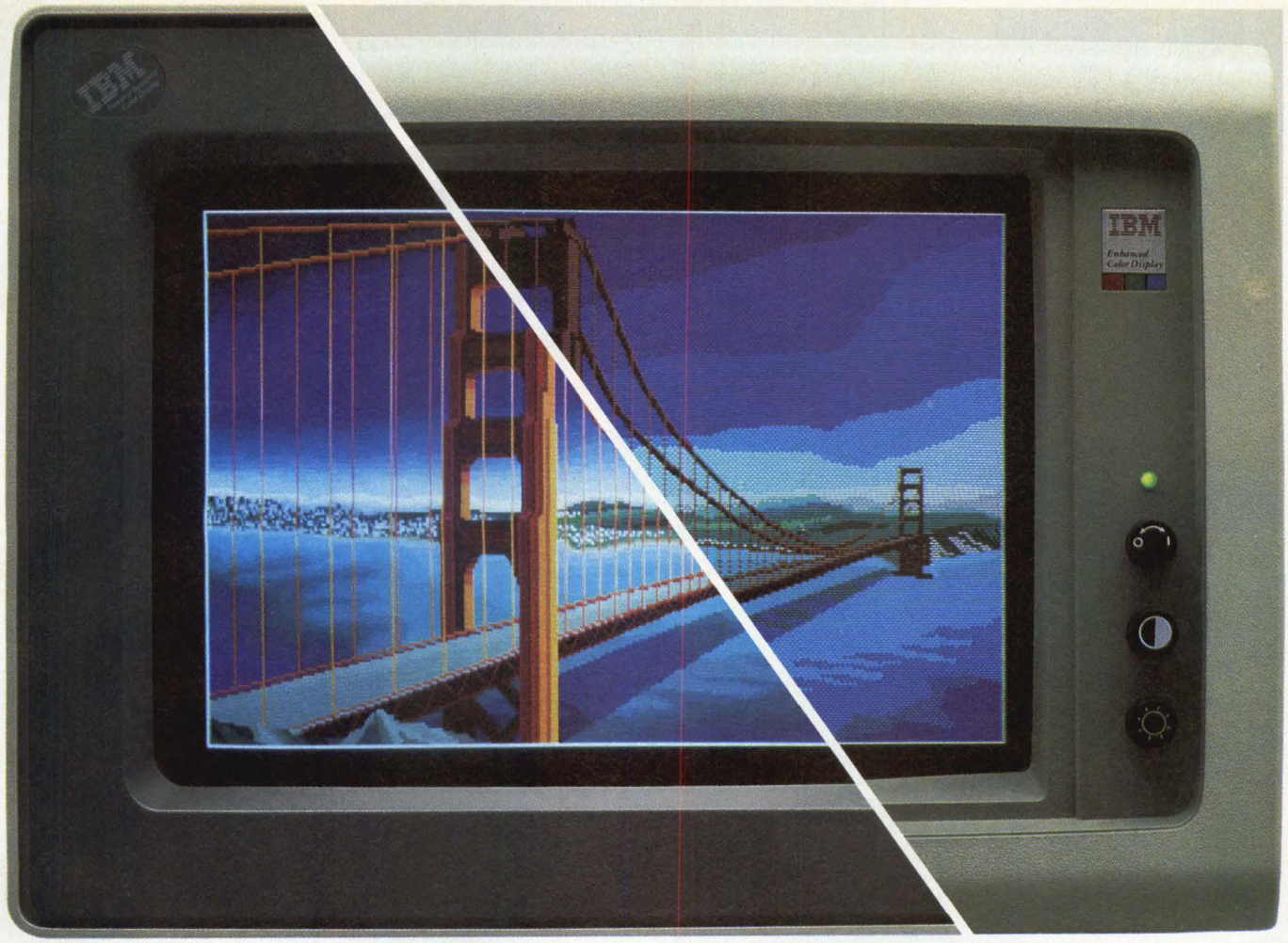
As a simple analysis, suppose system integrators must support 1,000 different application programs on 100 uniquely different graphics architectures, and that the appropriate software interface between application and hardware costs $10,000 to generate. Any industry would find the required $1 billion investment an unacceptable overhead. In fact, in the current graphics market, the numbers and investment would be far more severe than those in this conservative example.

However, standards limit the number of distinct architectures that must be supported. In the graphics arena for PC-DOS systems, graphics protocols such as Digital Research Inc.'s GEM, Microsoft Corp.'s Windows, and Graphics Software Systems Inc.'s direct graphics interface specification (DGIS) are earning status as de facto standards. Similarly, for the AT&T Co. UNIX operating environments, X-Window is rapidly emerging as a de facto standard. In both computing environments, the ANSI CGI (computer graphics interface) proposed standard is already finding adherents.

Graphics coprocessor has advantages

The 82786 graphics coprocessor squeezes the major components required in a typical graphics subsystem, onto a single VLSI chip. Fabricated in the same advanced CHMOS (complimentary high-performance metal oxide semiconductor) process as the 80386, 32-bit microprocessor, the 82786 dissipates less than 1W for itself and for up to 32 dynamic RAMs (DRAMS) that form a dedicated graphics memory. This dedicated memory provides the coprocessor with high-speed access to graphics information. Consequently, the 82786 does not need to compete with its host CPU for access to system memory.

Because the 82786 integrates its graphics-support hardware with on-chip memory and display interfaces, engineers can use this graphics chip with little or no additional circuitry. In fact, the simplest 82786-based configuration comprises only the coprocessor, the host CPU, a CRT display device and graphics memory, which the host CPU can share for its system memory.



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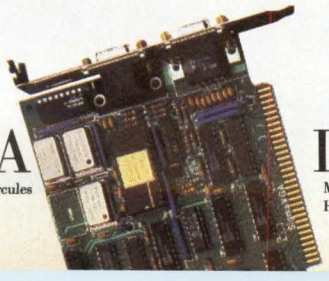

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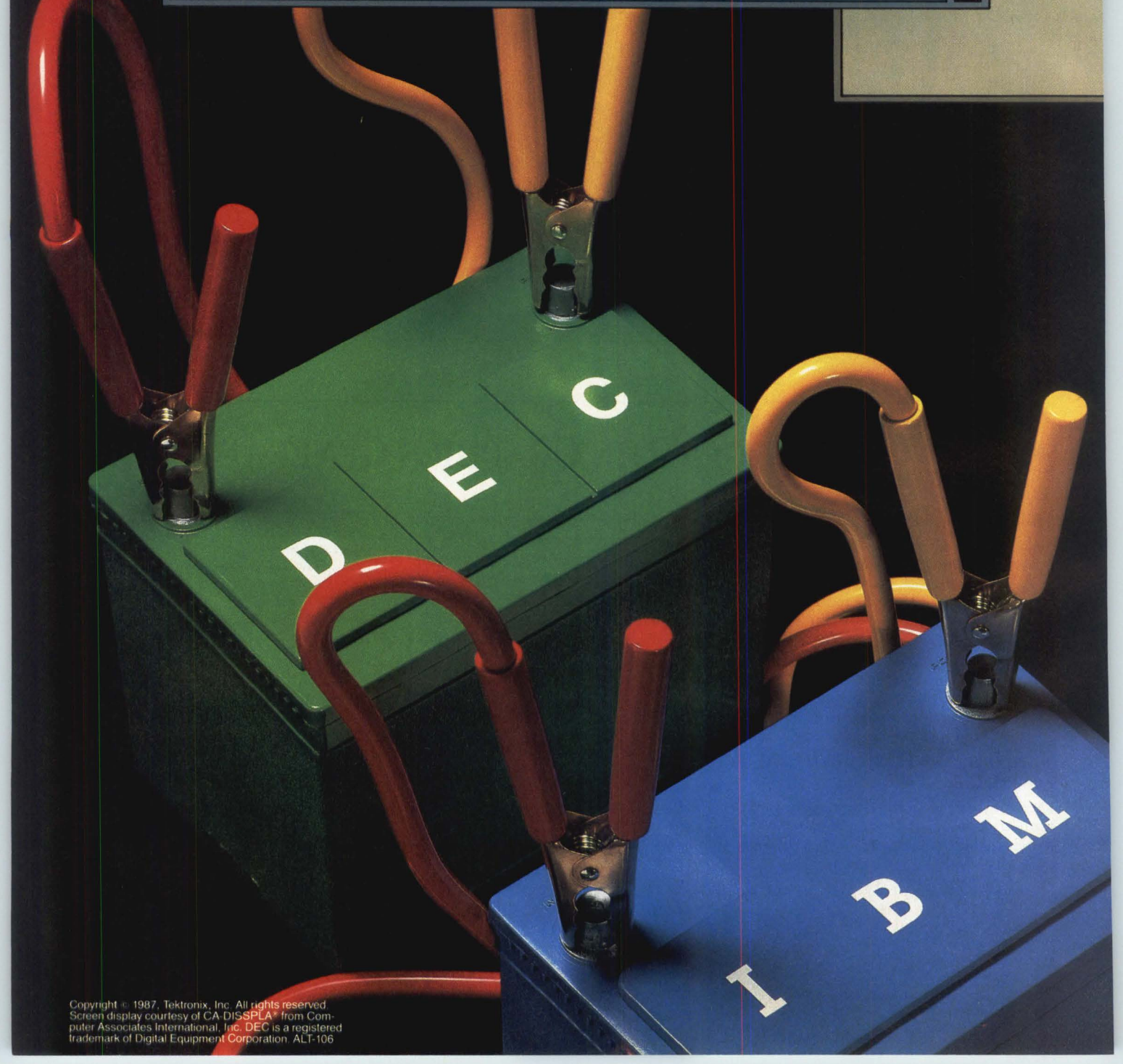
TEK 4200 SERIES TERMINALS

HOW TEK CONNECTS YOU TO BOTH HOSTS, EVEN THOUGH THEY'RE POLES APART.



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Typically, one host serves your business applications while another serves your engineering and database needs. Now Tek's 4200 Series gives you one window to them all.

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The host processor requires unimpeded, direct access to the graphics memory.

An on-chip component, the BIU (bus interface unit), supports this simple design capability through its programmable host interface and integrated DRAM controller. The controller performs DRAM refresh cycles and mediates access to the dedicated DRAM array. In turn, the host CPU has extensive programmable control of the graphics coprocessor's resources through a 128-byte block of internal control registers.

Using a 25-MHz video clock and conventional DRAM, a 20-MHz 82786 can support drawing rates up to 2.5 million pixels per second and up to 25,000 characters per second. The graphics coprocessor's performance derives from an architecture in which a pair of on-chip processors—the GP (graphics processor) and DP (display processor)—independently handle graphics and display tasks.

The GP manipulates graphics and text in bit-maps—rectangular drawing areas that comprise a specific number of pixels. Logically, a bit-map serves as the canvas for a set of graphics operations, such as line drawing, color filling or polygon creation. Physically, the display screen (frame) can show a window or several overlapping windows as in multiwindow graphics interfaces. In turn, each window corresponds to a bit-map or part of a bit-map. The GP manipulates several individual bit-maps independently of their actual display.

In turn, the DP controls the display of video data on a CRT, laser printer or other output device. In this role, the DP extends support for display operations beyond conventional features like cursor support and video interfaces. The DP is optimized to display data in the form of packed bit-maps, and provides a number of related features that directly support multiple display windows. In fact, the DP's ability to dynamically assemble a display frame obviates the need for the frame buffer of traditional graphics architectures.

Memory makes demands

Graphics applications are perhaps the most memory-intensive. In fact, with their requirements for a frame buffer, traditional hardware designs exacerbate the memory demand for graphics. Even without a separate frame buffer, graphics is inherently memory intensive: Character generation requires memory for storage of font bit-maps, and graphics images require their own bit-maps. To manage this demand, the 82786 can support a dedicated graphics memory as large as 4M bytes. All of the graphics coprocessor's internal subsystems access memory via a 22-bit address space, which can be mapped into both graphics and main-system memory.

However, not all application areas require a full 4M-byte complement of graphics memory. In those cases, the 82786's address space can be divided between external system memory and local, dedicated graphics memory. Thus, the graphics coprocessor can access system memory through the remaining memory-address space.

In a 82786-based subsystem, the dedicated graphics memory holds display data, character fonts and programmed instructions for use by the graphics coprocessor's internal processors. In addition, graphics memory holds separate bit-maps, which can be displayed by the DP in separate windows. Bit-maps may range up to 32,000 pixels on a side, with individual pixel depth (bits per pixel) ranging from 1 to 8 bits of color or gray scale. Logically, each bit-map represents a self-contained drawing area, with its own coordinate system defined as starting at the upper left-hand corner of the rectangle. Physically, bit-maps may start on any even address in the 4M-byte graphics memory space and may number up to the limit permitted by available graphics memory.

The 82786 supports a variable number of bits per pixel, and permits the use of various combinations in different bit-maps within the same system. For example, several bits per pixel would be used for color graphics applications, while only a single bit per pixel would be needed for text in a different bit-map.

The 82786 is fabricated in the same advanced CHMOS process as the 80386, 32-bit microprocessor.

Starting from the even byte that represents a bit-map's origin, each 16-bit word in memory is packed with as many pixels as possible. If the minimum number of bits store information, less memory and lower bandwidth are needed to refresh the display.

Because memory design is critically important to the throughput of a graphics subsystem, the 82786's DRAM controller supports a wide range of memory configurations and device types. For example, designers can use the graphics coprocessor page mode or fast-page-mode DRAMs. With these types of memory devices, the 82786 sets up the row addresses and quickly scans in the column addresses for several burst accesses to the same page.

With the graphics coprocessor, fast-page-mode bursts operate at twice the speed of page mode. For example, in non-interleaved opera-

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tion, the 82786 manages burst-access rates of 10M bytes per second and 20M bytes per second for page-mode and fast-page-mode access, respectively. By exploiting the 82786's support for interleaved memory in two separate banks, these rates can be doubled. Here, after DRAM cycles for both banks are initiated, the graphics coprocessor can alternate access between the two banks, thus cutting the effective access time in half.

Besides its support for DRAM, the 82786 can similarly support dual-ported VRAM (video RAM). For the most demanding applications, VRAM provides a highly efficient mechanism for the transfer of pixels to a display device. As the graphics coprocessor uses

The 82786 gives *system integrators a standard platform to face proliferating graphics architectures and different applications. This facilitates creation of advanced graphics subsystems economically.*

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Company	Product/Resolution (pixels)	Applications	Software support
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Number Nine Computers Corp.	Pepper SGT 1,280×480×4 800×600×4 640×350×8	CAD/CAM, desktop publishing, graphics	AutoCAD, GEM, HALO, Lotus, MS-Windows, Software Publishing, VersaCAD
Bell Technologies	Blit Express 1,660×1,200×1 640×480×8	CAD/CAM, desktop publishing, graphics	GEM, MS-DOS, MS-Windows, Sun NeWS, UNIX V/386 Rel. 3.0, X Window
Vista Computer Systems	VCS-2000 1,728×2,200×1	CAD/CAE, desktop publishing	proprietary
Univision Technologies Inc.	UDC-800 2,000×1,600×8 UDC-803 1,600×1,280×8	CAD/CAE, image processing, medical imaging, surveillance	AutoCAD, MS-DOS, UNIX, X Windows
Systems:			
International Software Technology Inc.	ViewMATE 1,240×950×1	multitasking/multipurpose workstations	Ethernet, Gould/MPX-32, MS-DOS, UNIX, VAX/VMS
MAD Intelligent Systems Inc.	RDS 3000	AI, CAD/CAE, workstations	AutoCAD, Common Lisp, Kyoto Common Lisp, Lucid, MS-DOS, UNIX V/386, XENIX, X Windows
Taxan USA Corp.	Crystal series 1,280×960×1	desktop publishing	AutoCAD, GEM, MS-Windows, Pagemaker, Ventura Publisher
Vermont Microsystems Inc.	Page Manager 100 1,024×1,024×1	desktop publishing	Ventura Publisher
Verticom Inc.	Desktop 1280 1,280×960×1	desktop publishing	AutoCAD, GEM, MS-Windows, Pagemaker, Ventura Publisher

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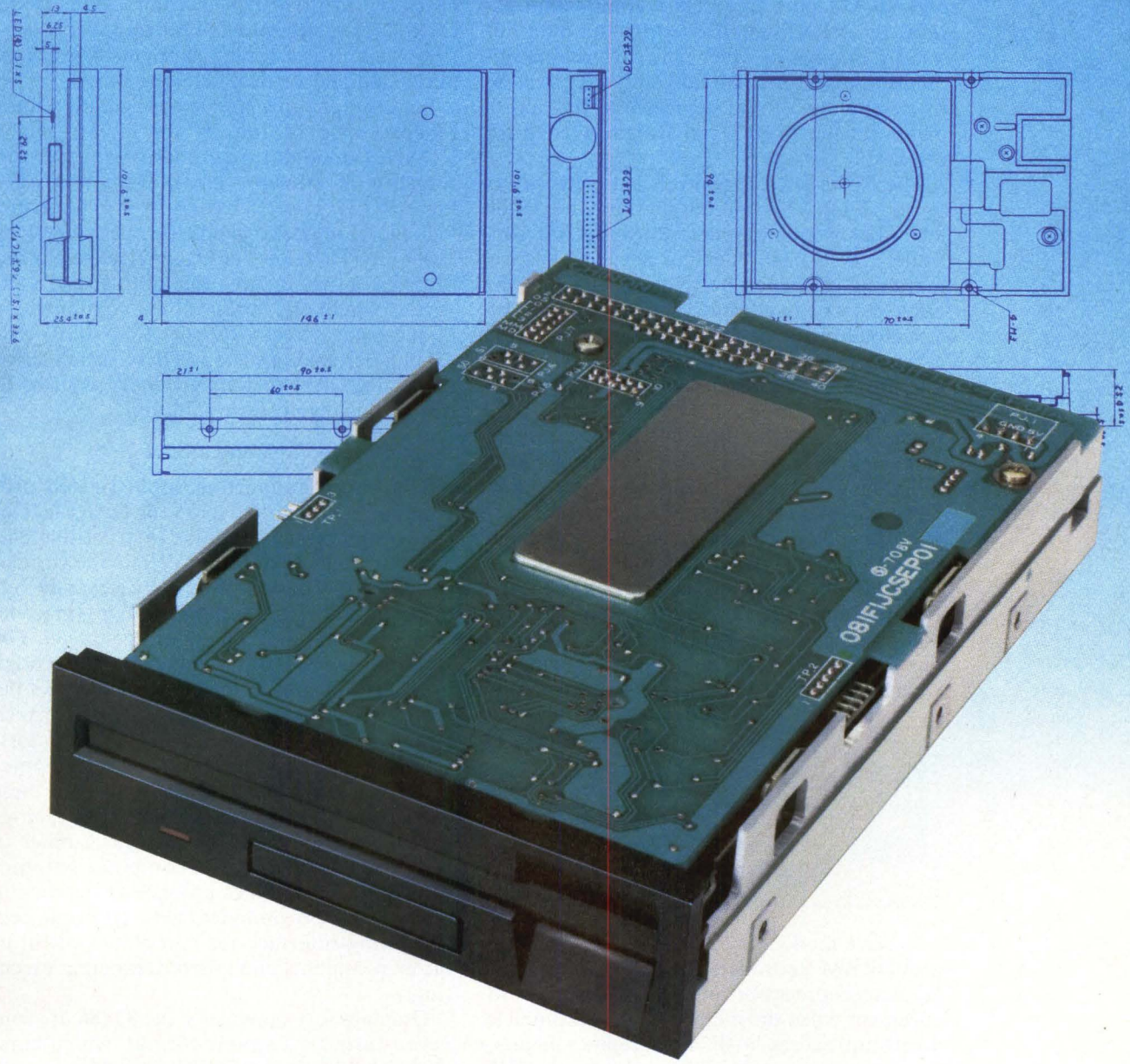

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one VRAM port to access graphics information, the VRAM rapidly shifts the data out serially through its other port. External multiplexers convert the individual bit data streams from separate VRAM devices into the appropriate bit-per-pixel serial stream needed for display.

The BIU's DRAM controller directly drives up to 32 DRAMs without additional external logic. For example, unlike most DRAM controllers, the 82786 does not need impedance-matching resistors between itself and the DRAM array. In addition, the DRAM controller automatically performs the required refresh cycles needed for DRAM arrays, at a refresh rate programmed through a BIU register.

Besides its support for DRAM and VRAM memory arrays, the BIU supports memory access itself by providing all the control signals required to arbitrate 82786 access to system memory (master mode) and CPU access to graphics memory (slave mode) during separate bus transactions. When it is configured in master mode, the 82786 looks like another (potential) bus master in the system: The graphics coprocessor requests bus control, takes over the bus when the CPU permits and releases the bus when it has completed its system-bus cycles.

The graphics coprocessor's DRAM controller supports a wide range of memory configurations and device types.

In slave mode, the 82786 acts like an intelligent DRAM controller: The CPU can select the graphics coprocessor and receive an acknowledgement when the memory cycle is complete. To arbitrate access to 82786's graphics memory from various potential requestors, the BIU maintains a programmable priority level for each potential source of bus requests.

The 82786's support for master mode or slave mode operation provides designers with the flexibility needed for a variety of graphics applications. In addition, the graphics coprocessor supports both synchronous and asynchronous interfaces with the system CPU. For example, as the core of a graphics board for an 80186-based system, the 82786 uses an asynchronous CPU interface, with the graphics coprocessor operating only in slave mode. Much the same design would apply in a simple add-on board for personal computers.

Finally, the 82786 includes on-chip video hardware that generates all the video signals necessary to drive typical color CRTs. Dedicated DP registers provide programmable control of all critical timing parameters—such as horizontal and vertical blanking times.

For example, in a simple configuration for a 16-color display, four of the 82786's eight VDATA (video data) outputs would provide four bits of color per pixel. Many relatively low-cost CRTs use TTL (transistor to transistor logic)-level inputs to handle this basic graphics capability. However, for higher pixel-resolution displays, a set of three digital-to-analog converters would convert specified combinations of the eight VDATA outputs into RGB (red-green-blue) analog signals. These signals drive the analog CRTs that are generally required to handle this high-color resolution.

Supports programming model

The 82786 supports a sophisticated programming model that relies on linked lists of user-programmed graphics instructions and their associated parameters. While the GP manipulates the data within these separate bit-maps, the DP retrieves these bit-maps (in whole or in part) and draws them on the screen. The host CPU orchestrates this activity through lists of commands to the GP, and specifies the required arrangement of bit-maps on the screen by providing the DP with a list of descriptors.

In a typical system, a high-level graphics package would cause the CPU to write these command lists of instructions into graphics memory for execution by the GP. Similar to those in the ANSI CGI (computer graphics interface), the graphics processor's instruction set provides programmers with a flexible programming interface for complete control of bit-map contents and graphics program execution.

Graphics instructions for the 82786 are conveyed through a simple format, which comprises an 8-bit opcode, GECL (graphics-end-of-command-list) flag and associated parameter list. The parameter list often contains 22-bit pointers to reference the graphics memory. These pointers are allocated 32 bits of space in the instruction set to allow for future expansion, thus using more of the graphics coprocessor's inherent 32-bit internal architecture.

Typically, the host CPU builds a command block of these instructions by placing several of them sequentially in graphics memory. In turn, the GP fetches these instructions directly from graphics memory and executes them—just as the CPU executes its own instructions from system memory. After it fetches a command, the GP checks the GECL bit to determine if more commands need to be executed. If the GP

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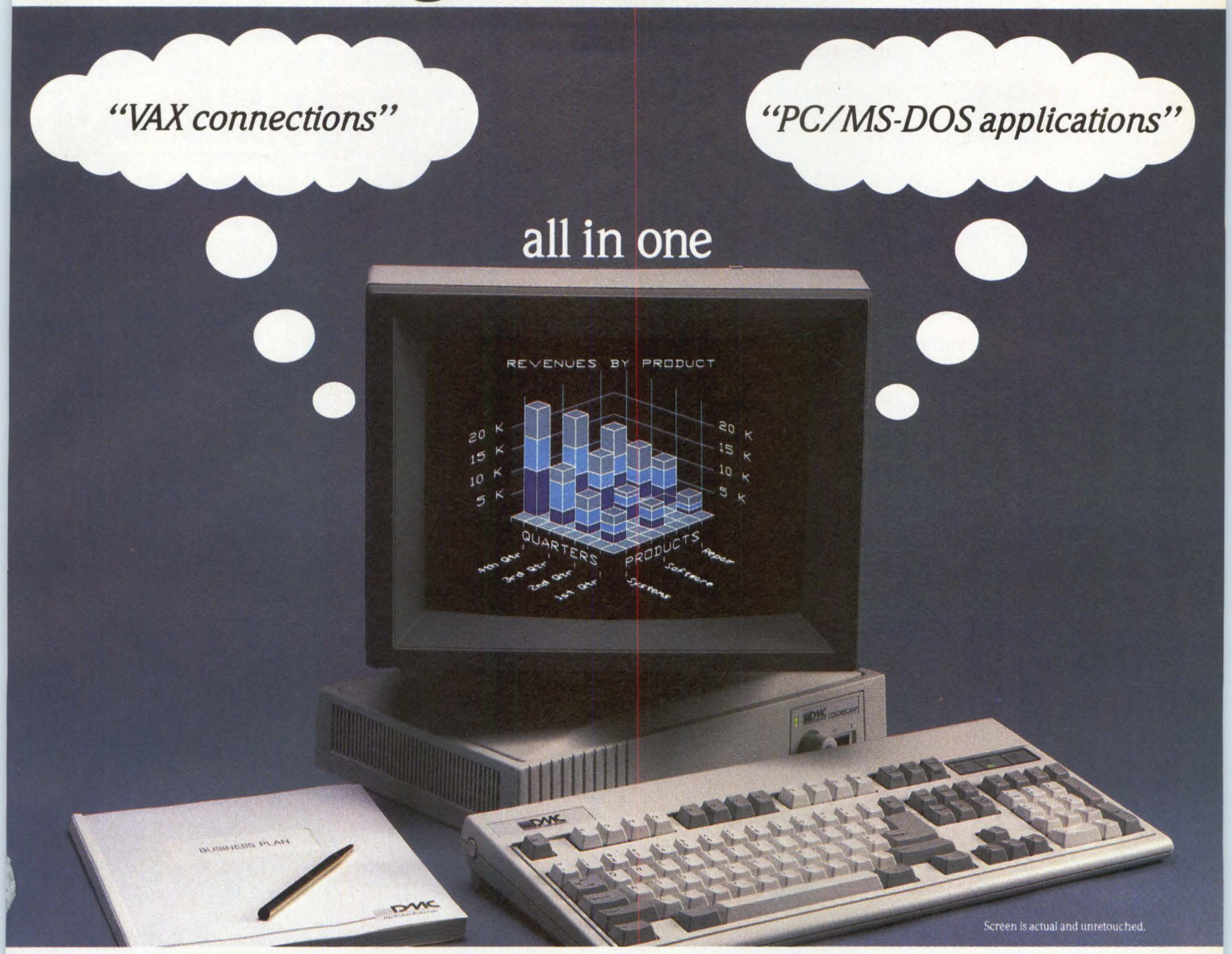

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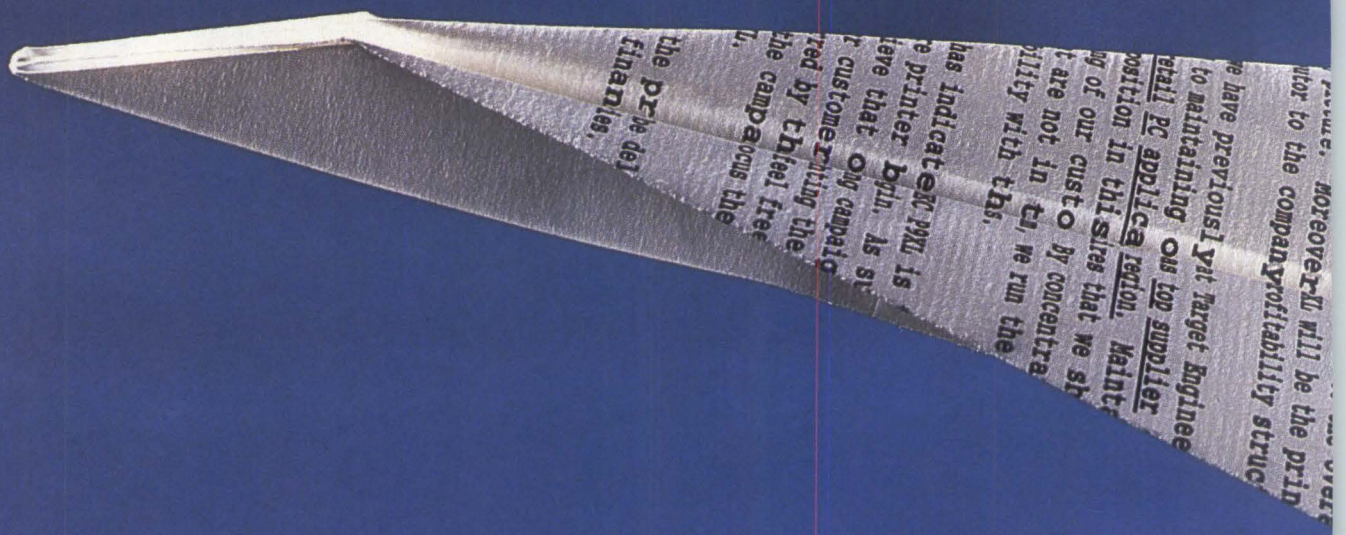

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Graphics instructions for the 82786 are conveyed through an extremely simple format.

finds that the GECL bit is set, it does not execute the command, but instead enters the "poll" state. While in the poll state, the GP checks the GECL bit in one of its internal registers and begins executing the command list specified in other internal registers when the GECL bit is reset.

Similarly, the CPU controls the display itself by loading graphics memory with a display command, which the DP subsequently executes during the vertical blanking period. At the beginning of each vertical blanking period, the DP checks the ECL (end-of-command-list) bit in its opcode register. It executes the instruction in the opcode register only if the ECL bit is reset (0). In turn, after it executes the instruction, the DP sets the ECL bit, which indicates to the CPU that it may load a new instruction.

This simple handshake mechanism ensures that the DP has time to complete execution of a particular instruction before the CPU issues a new one. Consequently, parameter updates are synchronized with display refresh, providing for clean and flicker-free displays. In addition, the DP can be programmed to issue a frame interrupt on a specified multiple of frames—providing a mechanism for frame-oriented display features like scrolling or panning.

Cooperates with the host

As a graphics coprocessor, the 82786 cooperates with the host microprocessor to speed graphics operations. Because it is not a microprogrammable processor, the 82786 does not need a separate development environment. Instead, it works within the existing development environments. Consequently, the same development tools used for microprocessor design are available, as are a variety of support tools specifically for the graphics processor. For example, an IBM PC/AT can serve as a suitable development host for 82786 design.

In fact, the 82786 could easily fit into an 80286-based system, such as the PC/AT, by means of an add-on board. In this case, because the graphics coprocessor has been designed with the 80286 in mind, the interface logic needed is minimal: The graphics coprocessor and CPU can virtually be directly connected. In a system where the 82786 is connected synchronously to an 80286, much of the logic can be shared by the rest of the 80286 system. In this particular configuration, the graphics coprocessor can run either as a master or a slave. Data transceivers permit the 80286 to access the 82786 and its graphics memory, and the graphics coprocessor to access system memory. Furthermore, although the 82786 always uses 16 bits, engineers can program it to work in systems that use a microprocessor like the 8088, which uses an 8-bit bus.

Although the 82786 uses packed bit-maps that combine efficient memory utilization with high flexibility, the chip nevertheless protects the large installed base of existing PC graphics software applications. The graphics coprocessor provides an environment compatible with existing graphics subsystems like IBM's monochrome and CGA interfaces, as well as the Hercules Computer Technology interface. In fact, the DP provides a special provision for displaying IBM PC-compatible windows. By setting a bit, engineers can specify that a particular window is being displayed from the bit-map created in the IBM PC format. The DP supports the CGA bit-map format in which the least significant byte of a word appears on the left of the most significant byte on the screen—as opposed to the 82786's format, in which the least significant byte appears to the right of the most significant byte.

In addition, the two-bank and four-bank bit-maps used in IBM PC and PCjr systems are also supported. These different modes permit the bit-maps created by systems compatible with the PC or PCjr to be upwardly compatible with 82786 displays. Thus, existing applications using these interfaces can coexist on a display screen with newer applications using bit-maps created with the graphics coprocessor.

Encompasses the high-end

With the availability of more sophisticated operating environments, the 82786's hardware support for graphics windows offers opportunities for versatile user interfaces. For example, in a multitasking environment, such as that of OS/2, the graphics coprocessor can support graphics requirements of several concurrently executing tasks. The GP could update bit-maps for different tasks, while the DP draws only those of most interest to the user. Thus, a spreadsheet task could fill the display screen, while the graphics for a concurrent electronic mail task could be updated in the background and shown only when the user requests it. In this case, the switch between displayed windows would occur nearly instantaneously, because the graphics information would already

The graphics coprocessor can support graphics requirements of several concurrently executing tasks.

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be available in memory. All of this activity can occur without detracting from the CPU's ability to execute application programs, because the 82786 operates as an independent coprocessor.

As users demand higher resolution, OEMs can continue to draw on more of the 82786's features. The graphics coprocessor's flexible modes of operation let designers meet higher data-transfer requirements by trading bits-per-pixel resolution for higher transfer speed. Through a special mode, called accelerated mode, the 82786 can support a 50-MHz external video clock rate with a resolution of 4 bits per pixel; at 100 MHz with 2 bits per pixel; or even at 200 MHz with a 1 bit-per-pixel resolution. Designers can put the graphics coprocessor in this accelerated mode by setting dedicated bits in the DP control register.

Besides setting these bits, designers need to add some additional external circuitry to the output of the 82786 in order to implement accelerated mode. For example, to handle 4 bits per pixel in accelerated mode, only an additional multiplexer is required. In this case, when the 82786 transmits its 8-bit VDATA output signal, the external multiplexer switches the 4-bit output between the low-order four bits and the high-order four bits at 50 MHz—twice the video clock frequency.

Still, the use of accelerated mode does not have to limit the color resolution of the displayed data. Engineers can use high-speed video palette RAMs (color-lookup tables) to restore higher color resolution from information stored at a lower resolution. For example, a color-lookup table could translate the 4-bit information from the previous example into 8-bit color data for a 256-color display. In fact, the use of color-lookup tables provides a highly efficient use of graphics memory. Because data is maintained internally at a lower color resolution, less display memory is required for this approach. For example, rather than use 8 bits per pixel for a 256-color display, designers can achieve a similar effect—and save memory—by manipulating 4 bit-per-pixel data internally and accessing the color-lookup table to select a set of 16 different colors from the complete palette of 256. Here, the 82786 uses its 4-bit data as an address to the color-lookup table. In turn, the color-lookup table passes along the higher resolution color data (through digital to analog converters) to the CRT.

When display requirements dictate a different set of 16 colors, the host CPU loads a new set into the color-lookup table. In fact, to load a new color into a specific location in the color-lookup table, the DP can be programmed to output the 4-bit address on four VDATA pins during the horizontal and vertical blank times. The CPU can then load the 8-bit color information through external logic, directly into the color-palette memory array.

For ultra high-resolution graphics subsystems, engineers can use multiple 82786s. For example, two graphics coprocessors could support a 1,144-by-860-pixel, 16-color, 60-Hz, non-interlaced display. Here, the two graphics coprocessors—using 2 bits per pixel at 100 MHz—would each handle half of the 4 bits per pixel information needed by a color-lookup table. Each 82786 would manipulate a 2-bits-per-pixel bit-map in memory, and combine their separate 2-bit outputs into a single 4-bit value. As previously mentioned, such a design could also include a color-lookup table to provide even higher color resolution to the display device.

To function correctly, the video signals from multiple 82786s must be synchronized. In this case, one of the graphics coprocessors would be normally programmed to generate the master video horizontal and vertical synchronous signals. The other graphics coprocessors would be programmed to be slaves; their horizontal and vertical synchronous pins would become inputs. All slave 82786s will then automatically synchronize their video output to the master graphics coprocessor. Although this configuration would more likely be used for high-performance, non-interlaced displays, the 82786 supports similar configurations for interlaced displays.

The 82786's slave-video interface extends the suitability of the graphics coprocessor into areas outside of conventional CRT display graphics. For example, in laser printers, the internal laser engine generates synchronous signals for its data source. Thus, in a laser-printer design, the 82786 could use the laser engine's synchronous signals. Also, the graphics coprocessor's ability to support a 4M-byte dedicated memory would prove essential in managing the various memory areas of a high-resolution office laser printer. □

Ray Torres, a senior software application engineer for the 82786, received his bachelor of science degree from Louisiana State University. **Richard Shankman,** a senior hardware application engineer for the 82786, received his bachelor of science degree from San Jose State University in California.

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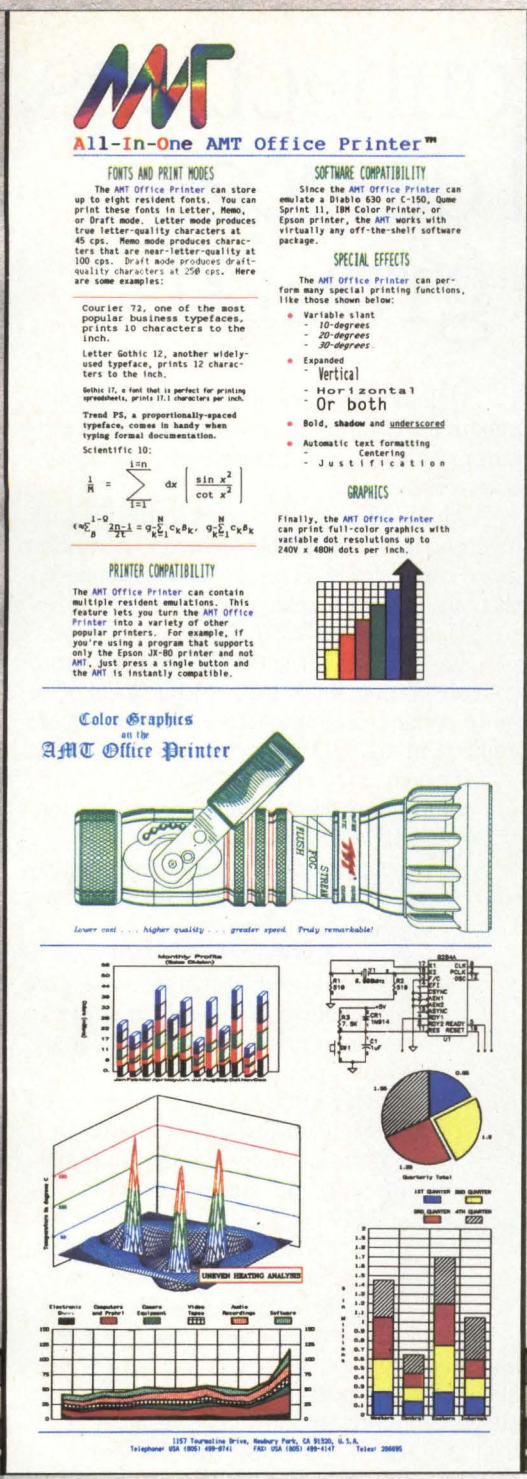

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Most importantly, the AMT Office Printer is fully compatible with software that drives the Diablo 630™, Diablo C-150 Ink-Jet Printer™, IBM Model 5182 Color Printer™, or Epson JX-80™. So just plug the printer into your computer's serial or parallel port, load your favorite software, and begin printing.

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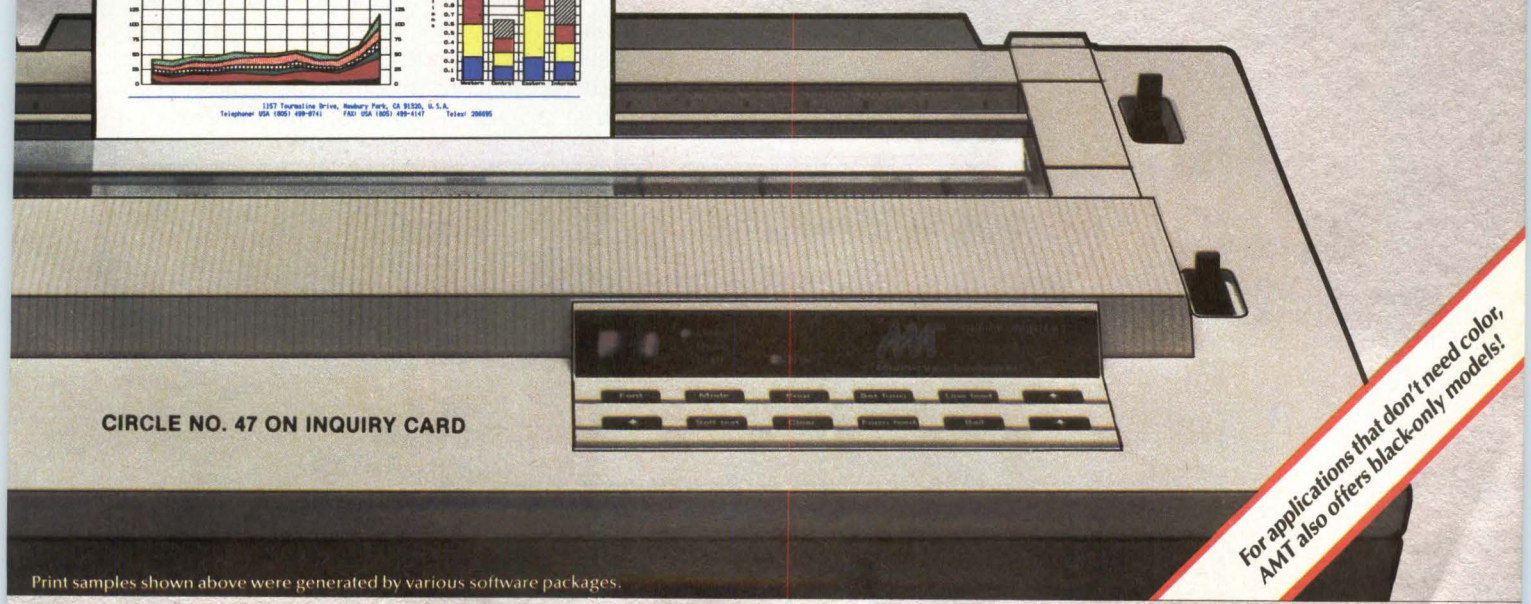

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For applications that don't need color, AMT also offers black-only models!

Print samples shown above were generated by various software packages.

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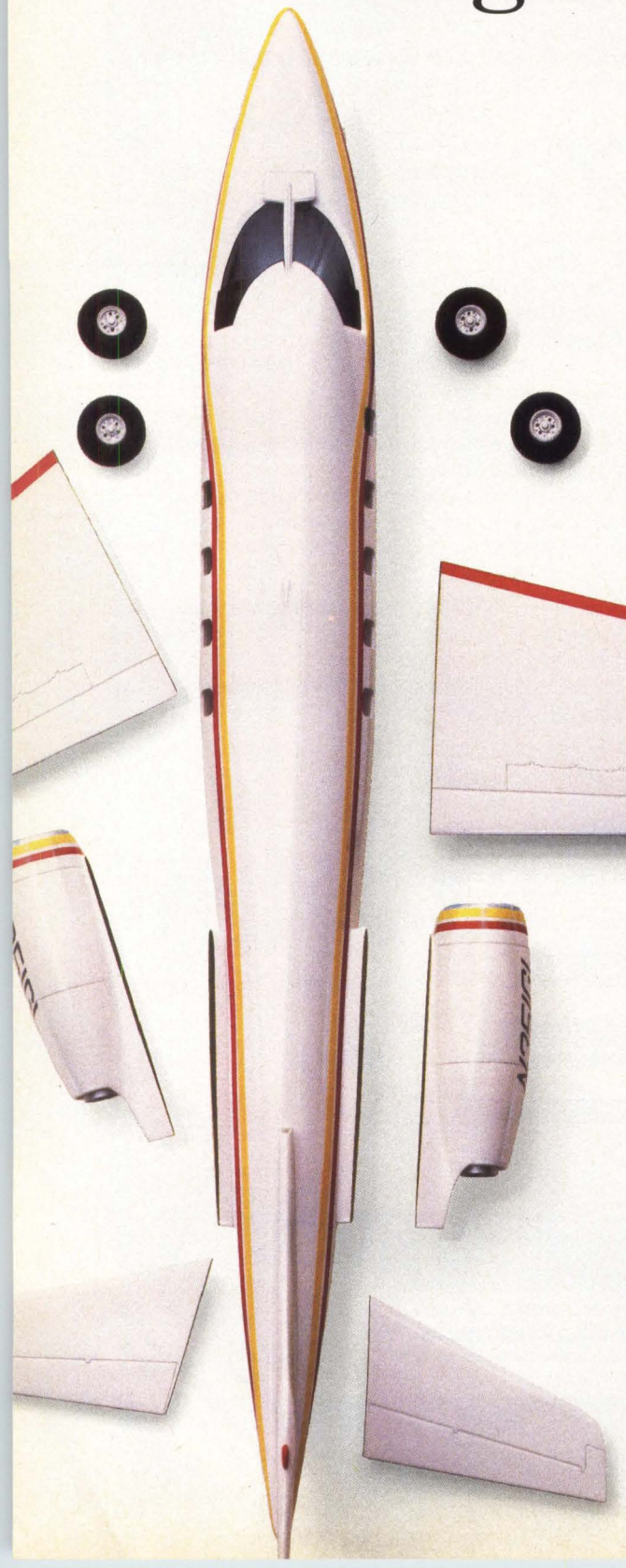

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PART II

PROGRAMMABLE CHIP CLEARS GRAPHICS JAM

Acting as a general-purpose microprocessor with field-management capabilities, this graphics processor optimizes system applications by off-loading the host

Scott Huckaby
Texas Instruments Inc.

With most graphics-systems, the host CPU is burdened with graphics intensive operations that cause a processing bottleneck. Graphics operating environment standards, such as CGI (computer graphics interface), DGIS (direct graphics interface specification), GKS (graphical kernel system) and Microsoft Corp. Windows, impose even more overhead on the host processor. That's the main reason why these standards have not achieved widespread use. For these standards to become a reality, the processing burden must be off-loaded from the host processor.

Traditional graphics chips do not solve the problem. Most are hardwired controllers that must operate peripherally to a general-purpose processor. These controllers support only a few basic graphics operations, such as block transfers, line drawings and circle drawings. The host processor must interpret all other drawing operations so that the controller can effectively perform these tasks. In many cases, using the hardwired controller is not the most efficient way to perform an operation, so the host processor ends up doing all the work.

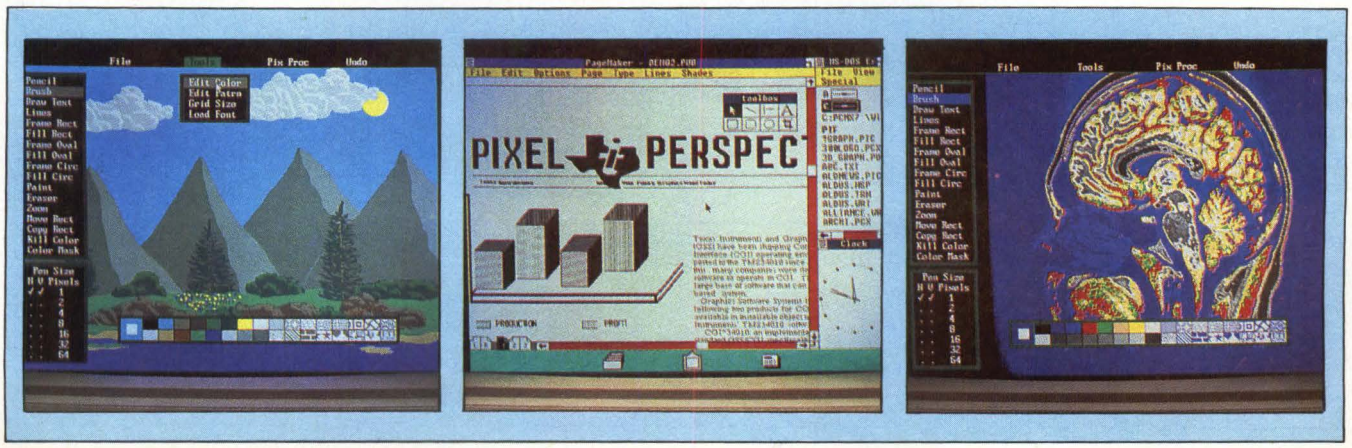
When hardwired controllers are used in a system, application development is done on the host processor with a high-level language compiler and assembler-development tools. However, a true graphics processor does not depend on the host processor for any graphics operations and has its own high-level language compiler.

Provides programmable approach

The Texas Instruments Inc. TMS34010 graphics processor, an advanced 32-bit, CMOS (complimentary metal-oxide semiconductor) microprocessor, is optimized for graphics systems applications. Its general-purpose programmability, augmented by special graphics operations implemented in hardware, give it advantages over hardwired graphics controllers and general-purpose microprocessors.

The 34010 processor has both RISC (reduced

These images were created *on a 34010-based, TI software development board operating in an IBM PC. The board is driving an analog RGB monitor with 640-by-480-by-4-pixel resolution.*



instruction set computer) and CISC (complex instruction set computer) features. The RISC instructions include single-cycle operations of general-purpose microprocessor functions like "Jumps and Calls," "Shifts and Rotates," "Integer and Boolean Arithmetic" and "Moves." The CISC functions provide hardware support for important fundamental graphics operations like pixblts (pixel-block transfers), line drawing and fills.

Because of its general-purpose programmability, the 34010 boosts system performance by off-loading from the host the processing burden imposed by advanced drawing algorithms, graphics operating environment standards and the emulation of graphics hardware standards. The host processor is now free to perform important system functions like memory and file management, I/O and peripheral-device and keyboard control. Also, application performance is increased by introducing more parallel processing into the system.

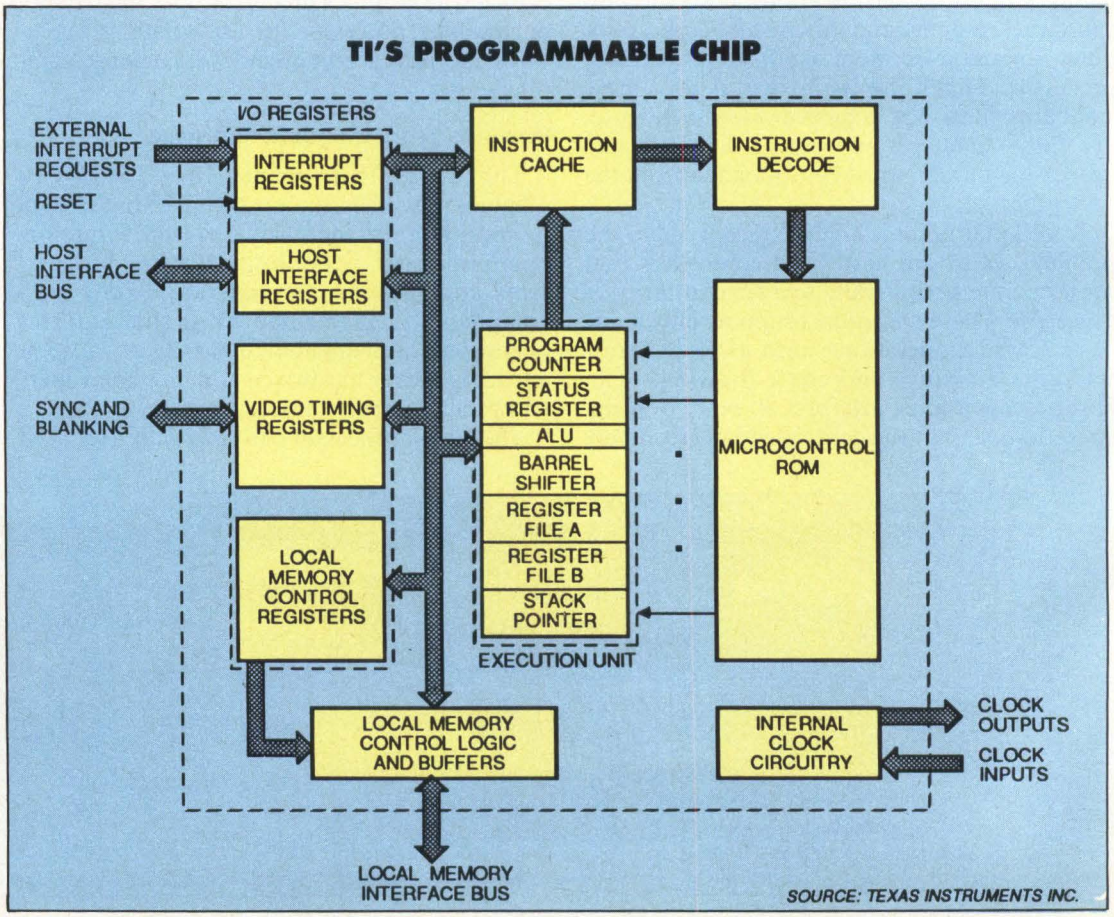
The general-purpose microprocessor features of the 34010 make possible standalone operation without a host processor. This situation reduces the cost of terminals, page printers, arcade games, etc., and allows the graphics processor to be easily programmed in high-level languages.

Renders hardware support

The 34010 interfaces directly to DRAMs (dynamic RAMs) and VRAMs (video RAMs), and supports instruction fetch and data manipulations at 6M bytes per second. It also generates the CRT control signals needed by most display systems. The graphics processor's high level of integration reduces a graphics system's chip count.

Other processors can communicate with the 34010 via the host interface at sustained maximum data rates of 5M bytes per second. The host interface is configurable for 8-bit or 16-bit buses and provides bidirectional, pipelined DMA (direct memory access) between local memory and the host-interface registers.

The host interface also enables communication with other 34010s. Partitioning tasks among multiple graphics processors is an advanced design technique that further increases performance. At least one company is designing multiple 34010s into a system that organizes



TI's 34010 graphics processor's *major internal functions and external interfaces enable it to relieve the host of graphics tasks. It has 32-bit internal data paths, a 32-bit ALU and a large address space.*

the display memory in a planar approach, as opposed to the packed-pixel organization that single-processor systems use.

The 34010 supports the most important data structures needed for graphics: bits, bytes, pixels, fields and 2-D arrays. There are two addressing modes for graphics data: linear and X-Y.

The graphics processor's instruction set incorporates numerous mechanisms for manipulating single pixels or arrays of pixels. The 34010's pixblt operations provide hardware to support windowing, plane masking, transparency and binary-to-color expand operations.

Color graphics systems require special capabilities when transferring a pixel array from one location to another where image data already exists. The 34010 supports 16 Boolean and six arithmetic, color-pixel processing operators. This raster-operation hardware enables applications to have transparency when moving blocks of colored pixels. Support for transparency makes the overlaying of text on graphics a simple task.

To increase programming efficiency, the 34010 has two register files, each containing 15 32-bit, general-purpose (both address and data) registers. Including a dedicated stack pointer, the graphics processor has a total of 31 user-programmable registers. Having this many user registers enables graphics algorithms to be more efficient by reducing the number of data moves that have to be made.

Parallel and pipeline support

The 34010 has a high degree of internal parallelism with its instruction cache, barrel shifter, ALU (arithmetic logic unit) and local memory interface.

The 256-byte instruction cache supports simultaneous access to memory and registers. The cache reduces the number of instruction fetches the graphics processor has to make, by enabling subroutines to be resident on the chip. This allows graphics algorithms, which have many iterative instruction loops, to be accelerated. Also, when executing from cache, instruction decode occurs while the preceding instruction is executing. Instruction blocks of 8 bytes are replaced in the cache on a least recently used basis.

The barrel shifter can rotate any field up to 32 bits, in a single, 160-nsec operation cycle. The barrel shifter speeds up many bit-field manipulation tasks that are needed in graphics.

The 32-bit ALU is splitable in width to process several pixels in parallel. When the pixel size is programmed, the ALU is configured as a series of smaller ALUs, which then perform simultaneous Boolean and arithmetic operations upon the pixels.

The local memory interface improves instruction times during write operations by decoupling the execution unit from the bus with a 32-bit write queue. Instructions can write from one to 32 bits into the queue. The memory controller automatically performs the bit-alignment and data-field insertion/extraction needed for data transfer operations.

Pipelining further increases system performance. During a single cycle, the 34010 can read from two registers, write to one register, decode one instruction, execute the current instruction and initiate or complete a local memory cycle. This makes it a fast general-purpose processor, given that it can execute instructions at sustained rates of 6 MIPS (million instructions per second) when it is clocked at 50 MHz and executes out of the cache.

Traditional graphics chips do not solve the processing bottleneck problem.

Applications vary widely

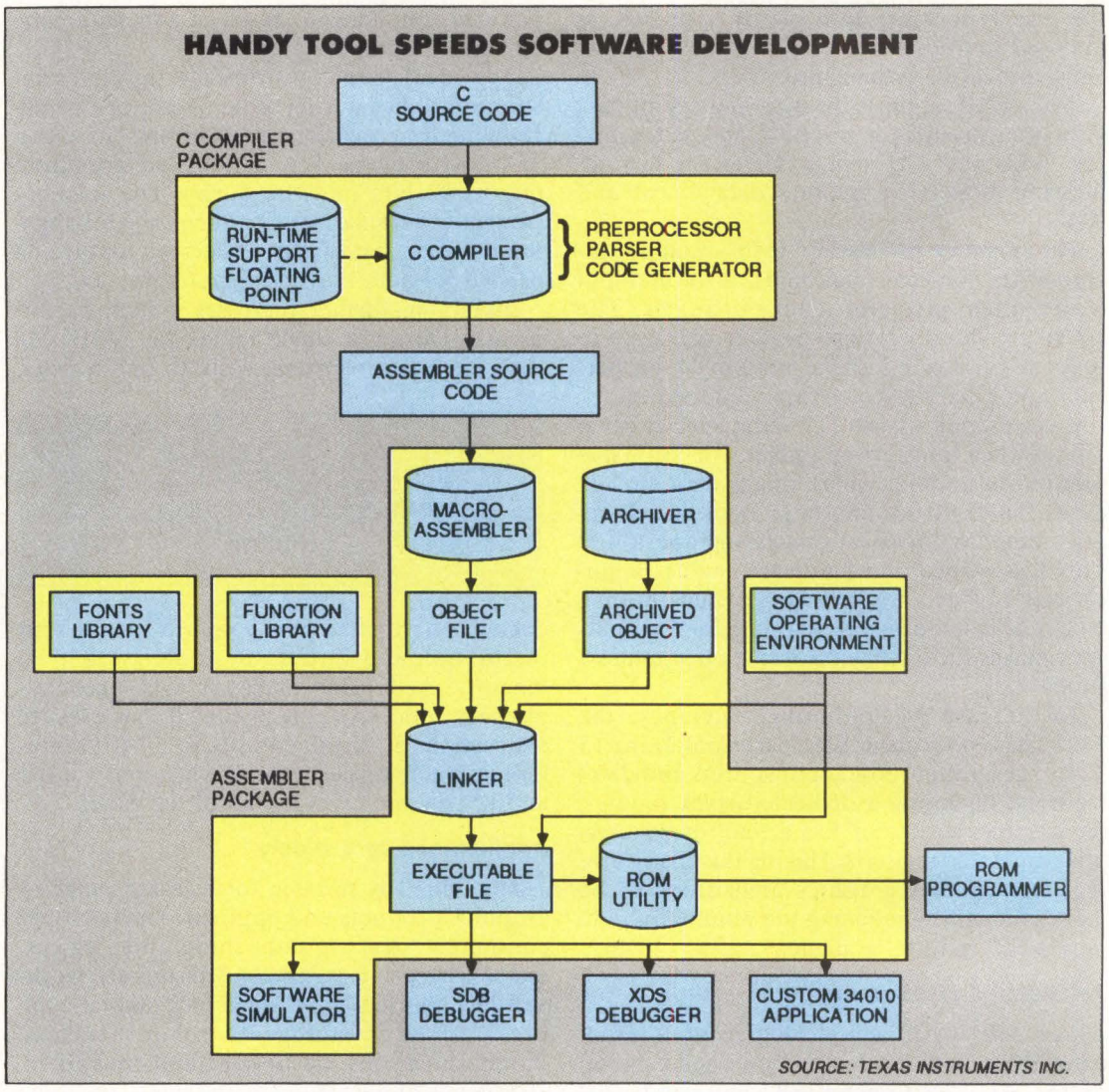
The 34010 is suitable for a broad range of graphics products and applications: personal computers, desktop publishing, imaging systems, laser printers, graphics terminals, workstations, plotters, FAX machines, digital copiers, mass storage, robot vision, communications, dashboard and cockpit instruments, and consumer products.

Currently, the fastest growing segment for 34010 designs is personal computers, because there is a universally perceived need for improved graphics. User tolerance of a graphics application is stretched thin when screen response times are longer than about a third of a second. The 34010's 50-million-bit-per-second (bps) fills and 25-million-bps pixblts enable most images to appear nearly instantaneously.

Higher resolutions for personal computer displays are also in demand. This fact has prompted IBM Corp. to stretch its EGA (Enhanced Graphics Adapter) resolution to 640 by 480 pixels when they announced their VGA (Video Graphics Adapter)—the graphics standard for their new PS/2 computer line. Desktop publishing and imaging system needs start at resolutions of 1,024 pixels by 768 pixels. Likewise, the most common number of bits per pixel used in new designs has increased from four to eight, giving 256 colors instead of 16.

The graphics processor effectively processes spline curves.

The software development tools *operate on IBM PC, PC/XT, PC/AT and compatibles or on DEC VAXs. The minimum tools a software designer needs is a C compiler, a software development board and an assembler package. These tools speed graphics system design and development.*



Several PC add-in board manufacturers have produced 34010-based systems that either emulate EGA or allow existing graphics boards to work with them. This enables users to benefit from the broad base of application software that exists for these hardware standards.

IBM's announcement of its new direction in personal computers has done much to relieve other companies' hesitation about introducing new graphics products. The "Let's wait to see what IBM does next" syndrome is gone. IBM's PS/2 bus architecture encourages manufacturers to develop add-in boards by putting VGA on the motherboard. Furthermore, IBM's new Micro Channel bus permits VGA to be passed through to the add-in graphics card. Board manufacturers do not have to be concerned about emulating it.

IBM also announced a 1,024-by-780 pixel high-resolution board, the 8514A, which has either four color planes or eight color planes. A number of companies are planning to use the 34010 to emulate the 8514A.

The PS/2 operating system, OS/2, will also have a positive impact on the 34010. OS/2 emphasizes software, not hardware interfaces. The graphics processor suits these flexible software interfaces and will be compatible.

Another reason the 34010 appeals to personal computer add-in board manufacturers is that it facilitates product differentiation. Using hardwired controllers for personal computer add-in boards has resulted in a few hardware standards, such as EGA, CGA (Color Graphics Adapter) and Hercules, but the specifications for the software have to be so rigid that competitive products are essentially the same.

Desktop publishing use grows fast

Desktop publishing is the fastest growing application area for personal computer graphics. A typical desktop publishing system has at

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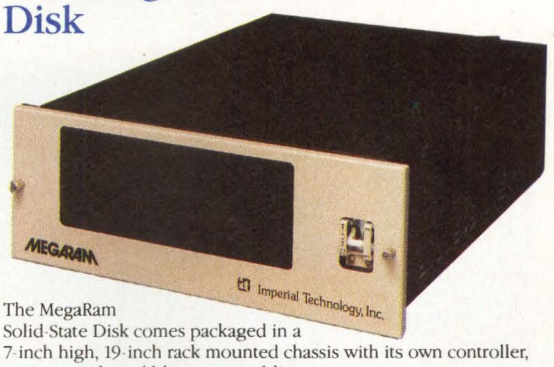

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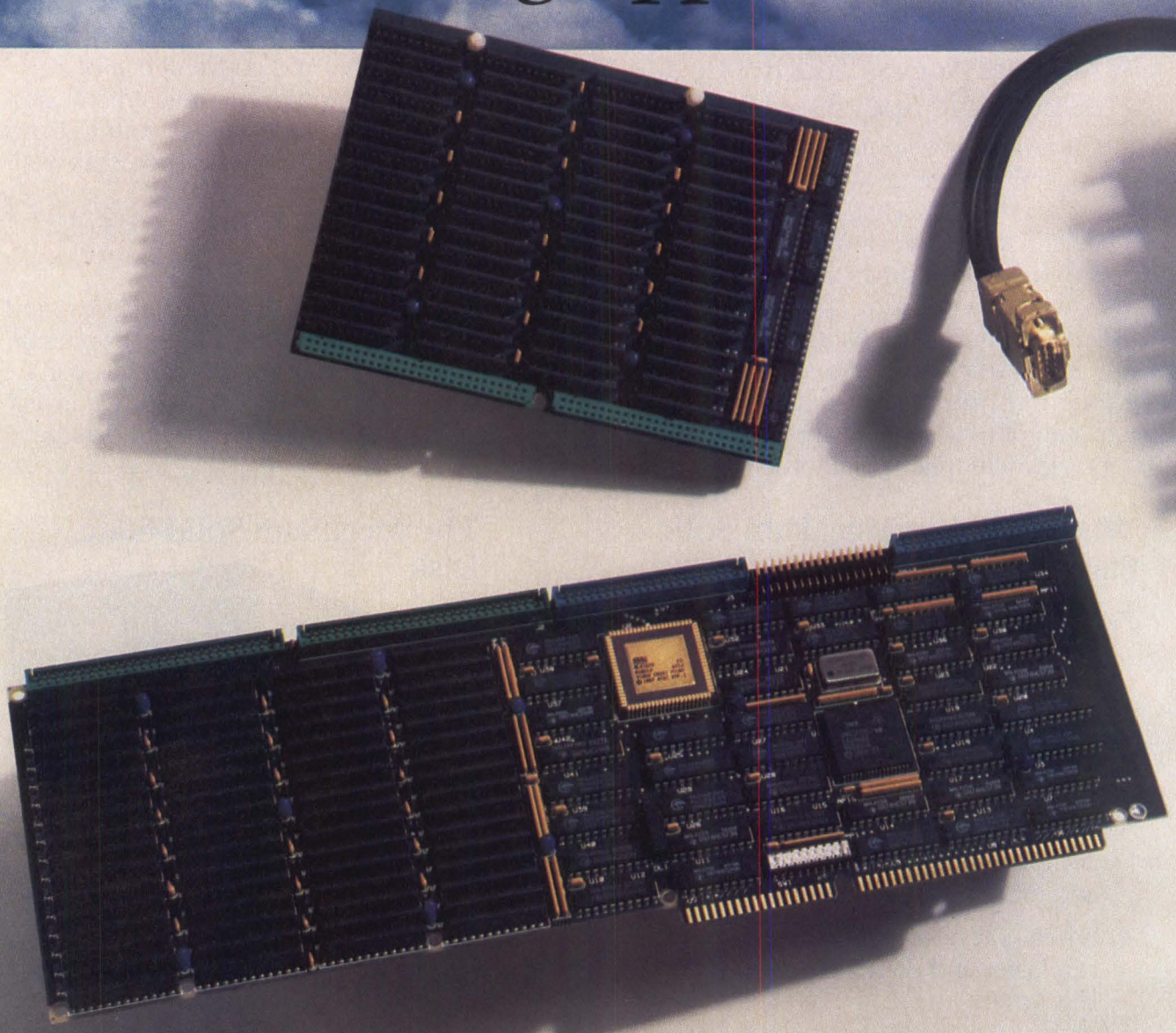
Now Taking Applications.



Take a look at the specs on VISTA™, a good look. Notice the processing, programming, and video capabilities? Now think real hard about what *you* could do with the power of VISTA and a microcomputer. Incorporate it with your system to create a digital pre-press proofing station for publishing. Design a graphics workstation which outputs both colorful hi-resolution slides and broadcast-quality animated images. Construct a CAD system which merges computer generated images with real-life backdrops for architecture, packaging or other industries. And, after you've brainstormed your way to new horizons of videographics possibilities, get your own VISTA and start working.

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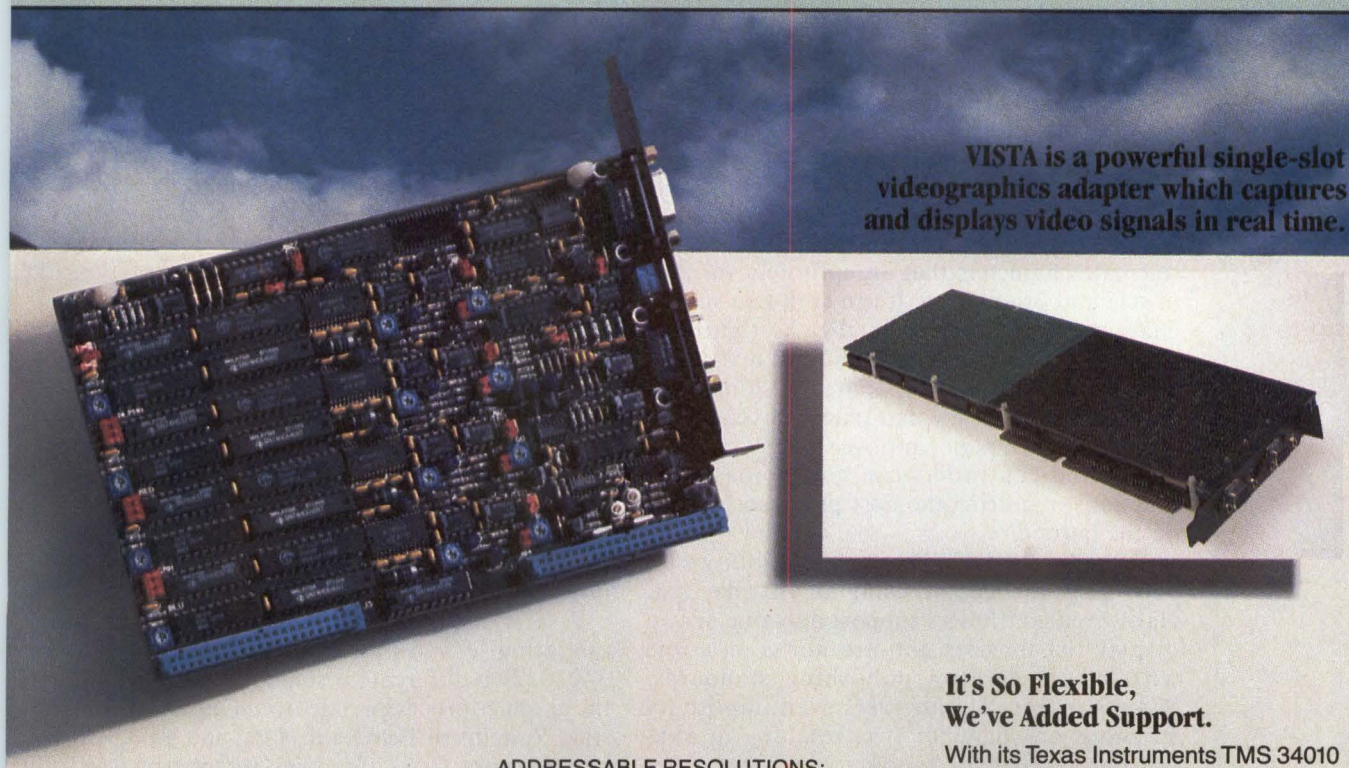

VISTA is a powerful single-slot videographics adapter which captures and displays video signals in real time.

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FEATURES:

- 4Mbytes of Video RAM on-board
- Texas Instruments' TMS 34010 GSP
- Flexible, programmable resolutions
- NTSC and PAL compatible
- Four 8-bit channels for real-time capture
- Fully integrated genlock
- Processor memory expandable in 2Mbyte increments to 12Mbytes
- Four 2K x 8-bit CMOS static RAM LUTs
- Display can be color-mapped, RGB, or a versatile combination of both
- Interlaced and non-interlaced display
- Binary and fractional programmable zoom capability, creates horizontal and vertical magnify or minify
- Smooth horizontal and vertical programmable panning, includes wrap-around and split screen
- Suggested Retail Price: $5995.

ADDRESSABLE RESOLUTIONS:

32 bits/pixel	16 bits/pixel	8 bits/pixel
1024x1024	2048x1024	4096x1024
512x2048	1024x2048	2048x2048
256x4096	512x4096	1024x4096

CAPTURE RESOLUTIONS:*

NTSC	PAL
(RS-170A)	(CCIR-624)
756x486	738x576
604x486	590x576
504x486	492x576
432x486	422x576

**Resolutions are programmable; these are nominal ones for interlaced NTSC and PAL compatible.*

DISPLAY RESOLUTIONS:*

NTSC	PAL	Interlaced	Non-Interlaced
(RS-170A)	(CCIR-624)		
1512x486	1476x576	1024x768	768x576
1008x486	984x576	(60 Hz)	(50 Hz)
756x486	738x576		
604x486	590x576	768x768	756x486
504x486	492x576	(80 Hz)	(60 Hz)

**Resolutions are programmable; these are nominal ones.*

COMPUTER REQUIREMENTS:

Host Type:	IBM PC AT and 100% Compatibles, Compaq 386, Apollo DN 3000-single-slot board
Data Bus:	16-bit or 8-bit (self-configuring)
Bus Clock:	6MHz to 12MHz
Power Consumption:	15 Watts

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The fastest growing segment for 34010s designs is personal computers.

least a 1,024-by-1,024-pixel resolution and drives both a page printer and a monochrome monitor to provide a WYSIWYG (what you see is what you get) display.

The 34010 effectively processes spline curves to create characters that are infinitely variable in size and orientation. It can kern text so that characters are spaced together as tightly as possible, thus providing the uniform text densities necessary for professional publishing. Support for transparency and plane masking enables text to be superimposed over graphics. Hardwired controllers can not do these text functions, requiring the host processor to take on the burden.

Also, the 34010 facilitates compatibility with peripheral devices by using any display list. Hardwired controllers support only one or two display list formats and are not compatible with newer desktop publishing standards. Some hardwired controllers even impose restrictions on character size, resulting in awkward procedures for handling larger fonts.

Imaging is an application area that is rapidly migrating to personal computers. The 34010 permits custom imaging algorithms to be used. It also performs the data compression and expansion operations that are needed for economically storing and transmitting the large amounts of data associated with imaging systems.

Hardware fails laser printers

A laser printer is an integral part of a desktop publishing system. Hardwired controllers are not desirable for this application because of their limited set of graphics functions. At the typical 4,000 pixel-by-4,000 pixel resolution of a laser printed page, the 1-pixel-wide lines that hardwired controllers draw can not be seen. They would need an additional general-purpose processor, like Motorola Inc.'s MC68000 or MC68020, to help them draw the thin polygons.

Another application area in which the 34010 is making an impact is graphics terminals. The graphics processor can emulate most standards in software and operate without a host CPU, thus reducing system cost. Of course, the 34010 may not be able to give a real-time emulation of the hardware standard by itself, but external hardware can be interfaced to accelerate certain functions and speed up the emulation.

Examples of 34010-based systems emulating hardware standards are produced by Tektronix Inc. of Wilsonville, Ore. and GraphOn of Campbell, Calif. Tektronix produces a personal computer add-in board that emulates its own color terminals. GraphOn produces a family of color terminals that emulate both Tektronix and Digital Equipment Corp. systems. The TI processor is used in these products because it adds more than just an emulation—it provides a base for other applications and improvements. For example, anti-aliasing algorithms can be implemented to produce jag-free images.

Graphics operating environment standards enable application packages to work on systems that have different resolutions and color contents. These standards have been slow to achieve widespread acceptance because they impose another layer of software, and that situation reduces application performance. The 34010 improves the situation by off-loading some of the processing burden from the host processor.

Several companies have developed graphics operating environment standards for the 34010. Two different versions of CGI exist for the graphics processor: one from Graphics Software Systems of Beaverton, Ore. and an ANSI version from Nova Graphics International of Austin, Texas. Other graphics operating environment standards supported by the graphics processor are GKS, DGIS and both color and monochrome Microsoft Windows. Additional noteworthy graphics operating environment standards are available for the 34010 from Number Nine Computer Corp. (Cambridge, Mass.); Metagraphics Software Corp. (Scotts Valley, Calif.); Micrografx Inc. (Richardson, Texas); Microstar Software Ltd (Nepean, Ontario, Canada); and Vermont Microsystems Inc. (Winooski, Vt.).

X-Window is a graphics operating environment standard, developed by Massachusetts Institute of Technology for DEC, which provides for the efficient transfer of graphics over a network. There is interest in using the 34010 for X-Windows, because its graphics images are passed in the form of drawing commands rather than as bit-maps. Thus, local drawing intelligence, as provided by the 34010, is required to translate these commands into images. Additionally, the 34010 provides hardware support, like plane masking, for many of the raster operations required by X-Window.

Windows run by software

Windowing is being incorporated in most new graphics operating environment standards and applications. The 34010 allows programmers to control windowing with software. This is necessary for the virtual device interface that Microsoft Windows requires.

The 34010's hardware support for windowing is in the form of "Compare Point to Window" and "Pixel Block Transfer" instructions. Preclipping is used so that portions of images

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outside the windows are not drawn into the frame buffer, thus saving processing time.

Most products based on the 34010 support some graphics operating environment standard and/or emulate a hardware standard. This enables users to benefit immediately from performance improvements, because they are working with familiar applications.

The 34010 supports 16 Boolean and six arithmetic, color-pixel processing operators.

Many existing applications require a certain amount of processing to be performed by the host processor. In these cases, the 34010 speeds up the application because drawing into the frame buffer is faster and VRAMS can be used. However, the full processing potential of the 34010 is not being tapped.

Since 34010-based hardware systems have recently become available in large quantities, software developers are now developing applications that run directly on the graphics processor. These applications can be ported easily between different 34010-based systems, because they are usually written in either C language or in 34010 assembly language.

TI has a variety of hardware and software development tools for the 34010. The software tools operate on IBM PC, PC/XT, PC/AT and compatibles or on DEC VAX systems. The minimum set of tools a software developer needs is an assembler package, a C compiler and a software development board that contains a debugger.

The assembler package consists of a linker, an archiver, ROM utilities, and a simulator for PC versions. The software development board enables programmers to directly modify 34010 register contents and to single-step through code. Software written in C language can call routines written in 34010 assembly language.

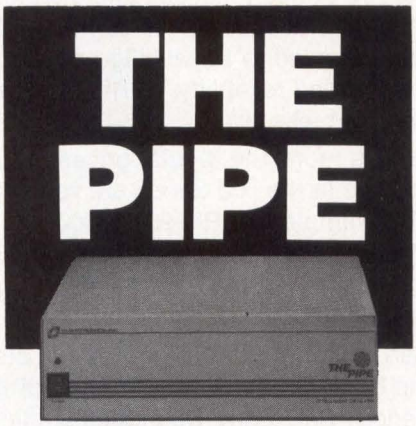
A graphics-math function library accelerates application development. It includes high-level-graphics drawing routines as well as floating-point math and transcendental operations. The drawing routines were written in C language and 34010 assembly language and are supplied as a source code that can be modified to create custom algorithms. There is also a bit-map font library, which has 19 different character styles and over 100 different sizes. Unlimited copies of executable derivations of the code can be distributed without payment of royalties.

To assist hardware designers with product development and integration, TI has a 34010 XDS in-circuit emulator. This development system works with a PC and offers such capabilities as breakpoint and trace, machine-state manipulation and reverse assembly.

Another development tool is the PC Debugger Development Package. It enables PC add-in board manufacturers to port TI's Software Development Board Debugger to their own board —a quick way to make their board a software development system. This enables independent software developers to develop applications directly on the target PC add-in board. □

Scott Huckaby, the marketing communication manager for the 34010, holds a bachelor of science degree in electrical engineering from the University of Cincinnati.

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



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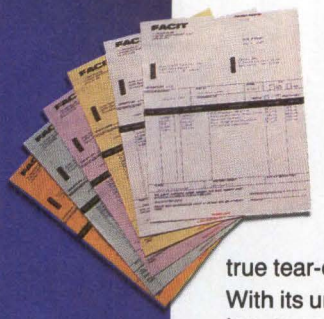

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A Bar Code Shouldn't Make Waves.

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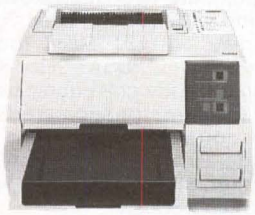
Facit P7080—A Laser Printer—For high-volume workloads with multiple emulations, face-down stacking, and optional PostScript emulation and bar codes.



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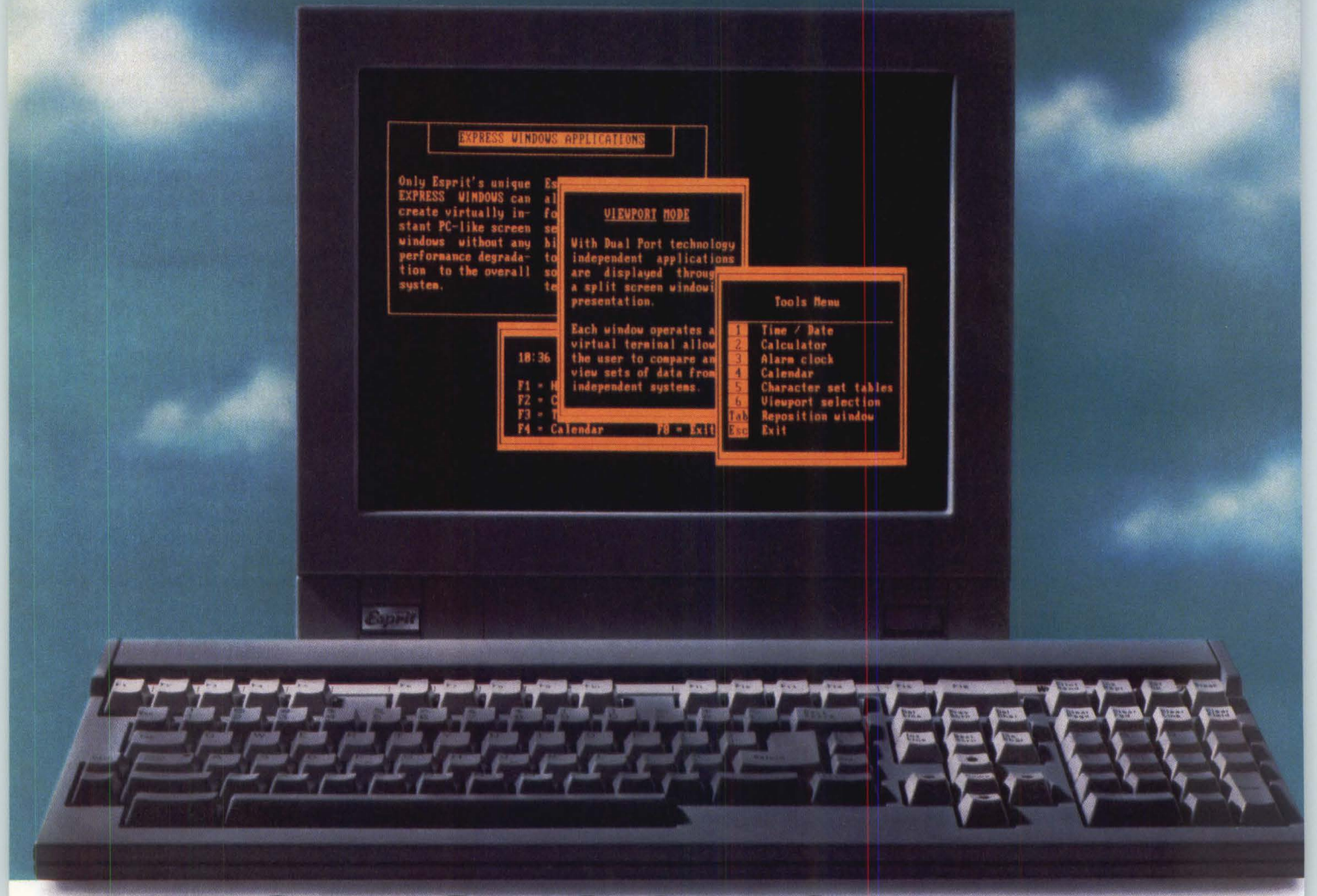

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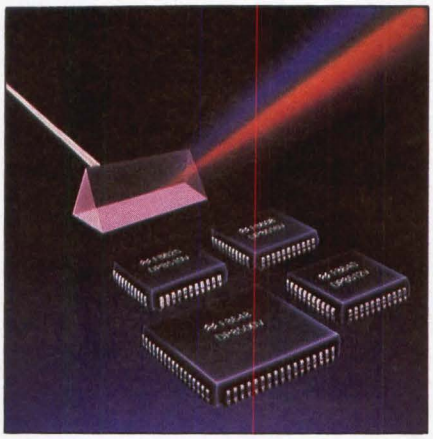
CIRCLE NO. 53 ON INQUIRY CARD

PART III

OTHER CONTENDERS IN THE GRAPHICS RACE

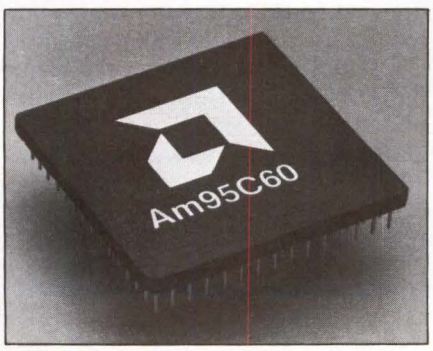
National Semiconductor Corp.

The RGP (Raster Graphics Processor) is a fully programmable, 20-MHz, CMOS microprocessor designed for graphics rendering. It contains dedicated-state machine logic to maximize the performance of graphics primitives. In addition to its general-purpose instruction set, the RGP contains primitive instructions for generating patterned lines and polylines, BitBLTs (bit block transfers), filled polygons, and direct support for bit-mapped fonts. The RGP can provide extremely high rendering rates: 10 million pixels per second for patterned lines; 160-million-pixel-per-second fill; 80-million-pixel-per-second BitBLT and 100,000 characters per second for bit-mapped fonts. Due to the planar-pixel architecture, this performance is independent of the color depth. All drawing operations are performed in X-Y coordinates—the RGB automatically converts to linear addresses when accessing the frame buffer. The RGP also contains hardware clipping, which operates with no impact on performance. Screen refresh, if required, is also handled by the RGP.



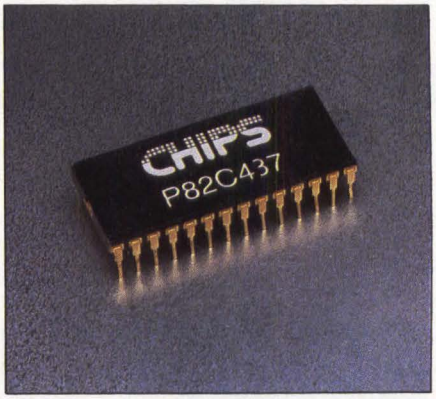
Advanced Micro Devices Inc.

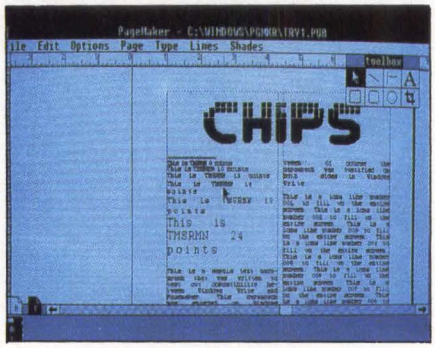
The Am95C60 QPDM (Quad Pixel Dataflow Manager) is a CMOS graphics processor that drives four bit-mapped memory arrays. Featuring a maximum clock speed of 20 MHz, the processor can interface to any 8- or 16-bit system bus. It can draw vectors up to 3.3 million pixels per second or place text at a rate of 45,000 characters per second. This performance allows users to efficiently mix text and graphics within the bit-map. The Am95C60 contains graphics primitives that smoothly interface with GKS, NAPLPS and VDI (virtual device interface) software standards. The processor is fully cascadable and can manage up to 256 memory planes with no degradation in system performance. Other features include windowing; independent X and Y zoom factors; pan and scroll; and picking, clipping and logical pen size. The Am95C60 is packaged in a 144-pin PGA (professional graphics adapter), and supports the drawing of anti-aliased vectors, circles and arcs using various, user-definable line styles.



Chips and Technologies Inc.

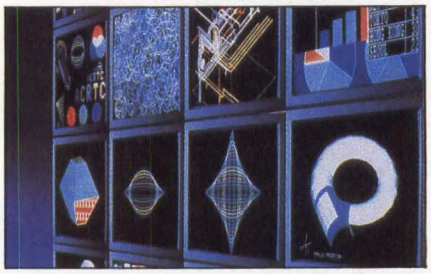
The SharpScan EGA is a high-performance enhanced graphics adapter designed to meet the high-resolution requirements of desktop publishing, presentation graphics and spreadsheet software applications. It provides a 300 percent resolution improvement over IBM Corp.s EGA by trading off a number of colors for resolution, while maintaining 100 percent EGA compatibility. The SharpScan chains the EGA memory planes together to provide a larger bit-map at 2 bits per pixel, giving users four simultaneous colors on the screen instead of the normal 16 colors with EGA. For some business applications, resolution can be more important than the number of colors. The SharpScan does not require additional software or set-up changes to coexist with regular EGA. Users can easily switch back and forth between high resolution and normal EGA, depending on their application requirements. Also, 60-MHz dot clock frequencies are possible when using this chip.





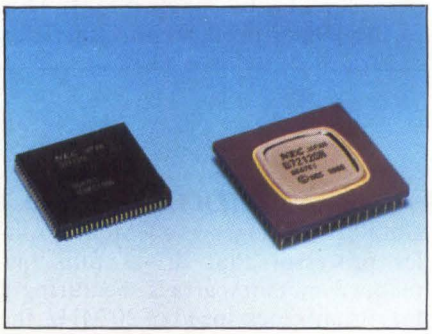
Hitachi America Ltd.

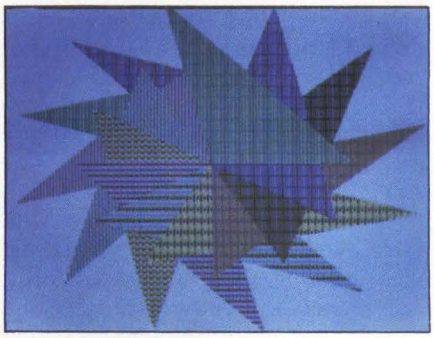
The HD63484 16-bit ACRTC (Advanced CRT Controller) uses 2-micron VLSI, all-CMOS technology to integrate CRT and graphics functions on a silicon chip. This bit-mapped controller has three on-chip, 16-bit processors to relieve the CPU from the burden of graphics processing. A timing control processor creates signals that synchronize the ACRTC with the horizontal and vertical raster-scanning operation of the CRT. A display control processor transfers frame-buffer data to an external dot shifter, which in turn converts the data to a format used by the CRT. A drawing processor interprets commands from the CPU by performing calculations and updating the frame buffer, which will ultimately be displayed on the CRT. The ACRTC has 38 high-level commands, including 13 graphics drawing commands. Because the ACRTC maps drawings to frame-buffer addresses, and then to CRT pixels, users are able to work with simple X-Y coordinates instead of linear addresses.



NEC Electronics Inc.

The AGDC (Advanced Graphics Display Controller) is a single, VLSI, high-performance graphics coprocessor. Its high-speed graphics drawing functions include painting, BitBLT operations, inquiry commands, logic operation within and/or between planes, clipping and picking. Drawing speeds are 500 nsec per pixel at 8 MHz, 400 nsec per pixel at 10 MHz, with BitBLT at 32M bits per second. The system's high throughput performance is achieved through three-stage pipeline processing of commands from the CPU to the drawing processor by using a preprocessor. Also, the AGDC can simultaneously access pixels from the graphics buffer when they are in pixel mode and plane mode configurations. The AGDC can be used in the following applications: high-end personal computer graphics including CAD/CAM and desktop publishing, laser printers and non-impact printers, low- and medium-end workstations for office automation and engineering, graphics terminals and image processing.





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CIRCLE NO. 54 ON INQUIRY CARD

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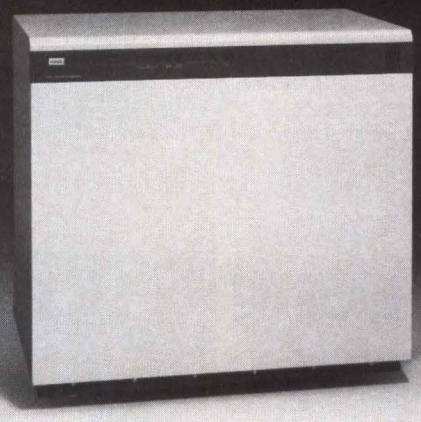

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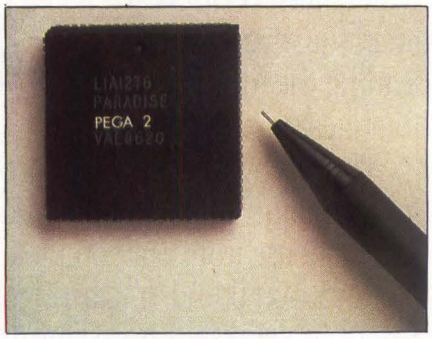
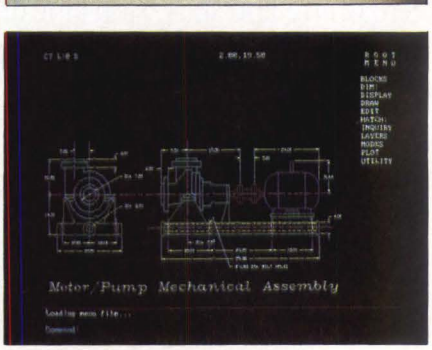
GRAPHICS CHIP TECHNOLOGY

Paradise Systems Inc.

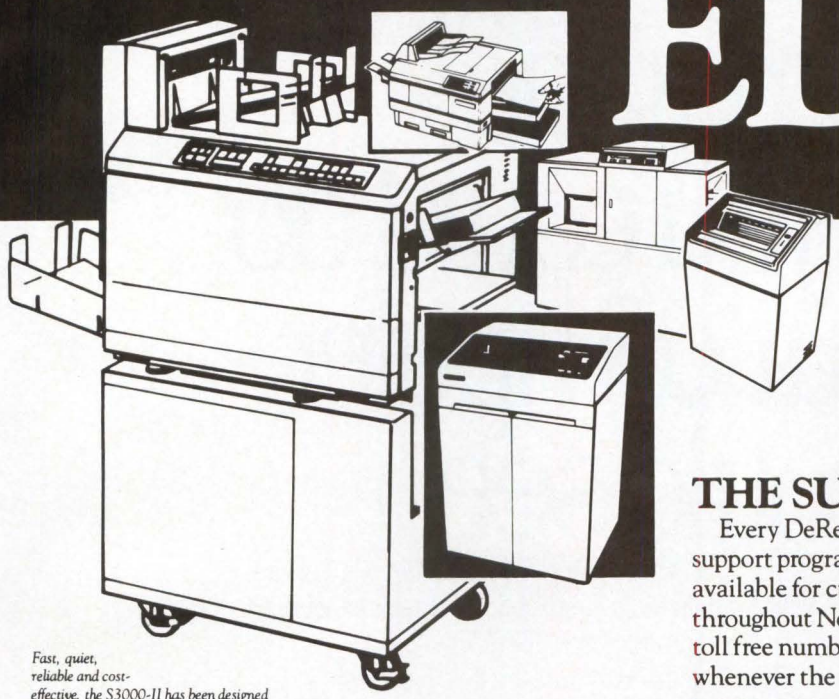
The PEGA 2 is a single-chip video controller that is ASIC (application-specific integrated circuit)-designed to support IBM Corp.'s EGA, CGA and MDA; Hercules monochrome; and AT&T Co. video modes. Its specifications include 30.2-mm-by-30.2-mm dimensions, an 84-pin plastic leaded-chip carrier and a 2.0-micron CMOS gate array. It has a high-resolution mode of 640 by 480 pixels, with 16 colors appearing on the screen simultaneously out of a 64-color palette. The color palette is on the chip, and color simulation support is provided for 16 shades of gray on monochrome monitors. Also, the PEGA 2 features a 132-column, alphanumeric mode light-pen interface, 26-MHz maximum pixel frequency, flat-panel display and provides all signals for 256K bytes of DRAM. The PEGA 2 benefits include low-cost implementation of EGA, low power consumption, reduced real estate and high reliability. Typical applications include motherboards and add-in boards.





CIRCLE NO. 55 ON INQUIRY CARD

THE PRINTING EDGE.



Fast, quiet, reliable and cost-effective, the S3000-II has been designed specifically as a high volume (30 ppm, up to 150,000 per month), high resolution printer. And it is thoroughly backed by the expertise, technical support and nationwide service of DeRex.

In today's economy you can't afford to simply keep up with the competition. You must stay a step ahead in every aspect of your business.

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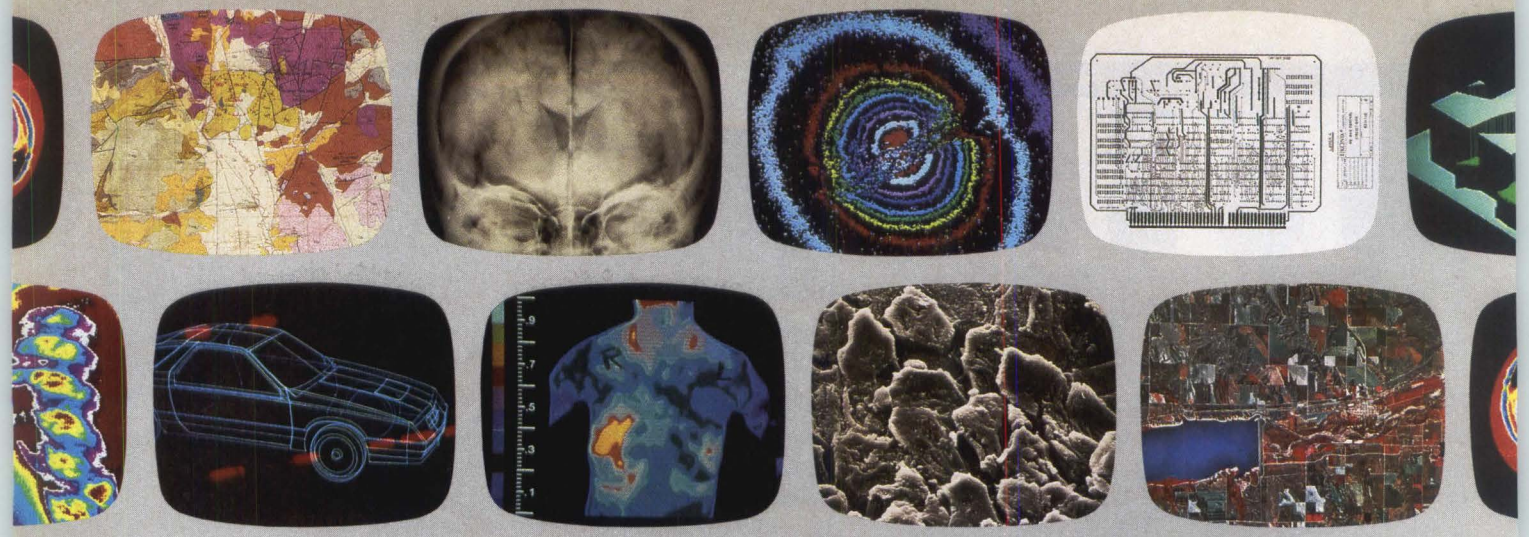

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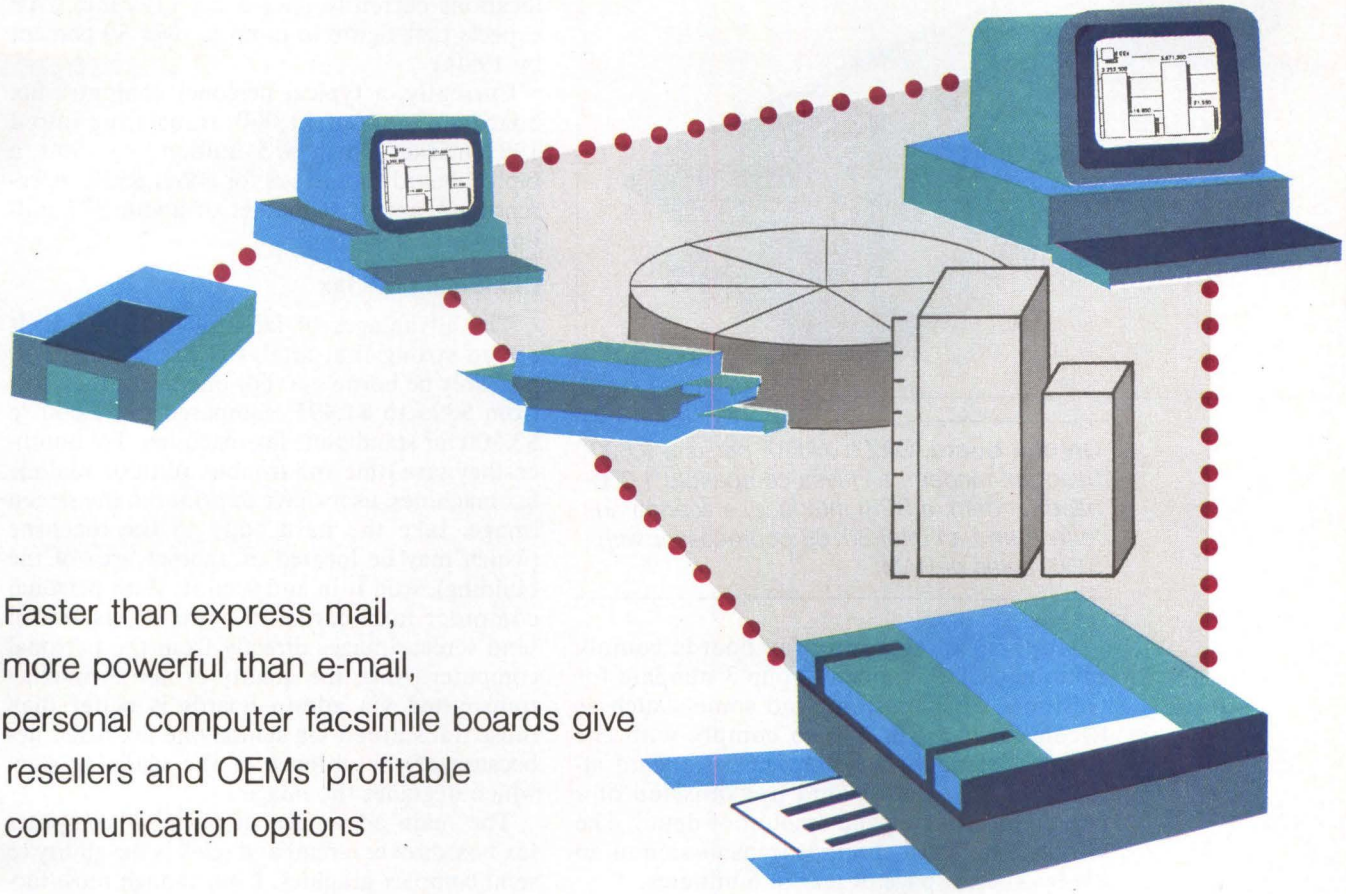
CIRCLE NO. 57 ON INQUIRY CARD

HOW TO SEPARATE PC FAX FROM VENDOR FICTION



Faster than express mail, more powerful than e-mail, personal computer facsimile boards give resellers and OEMs profitable communication options

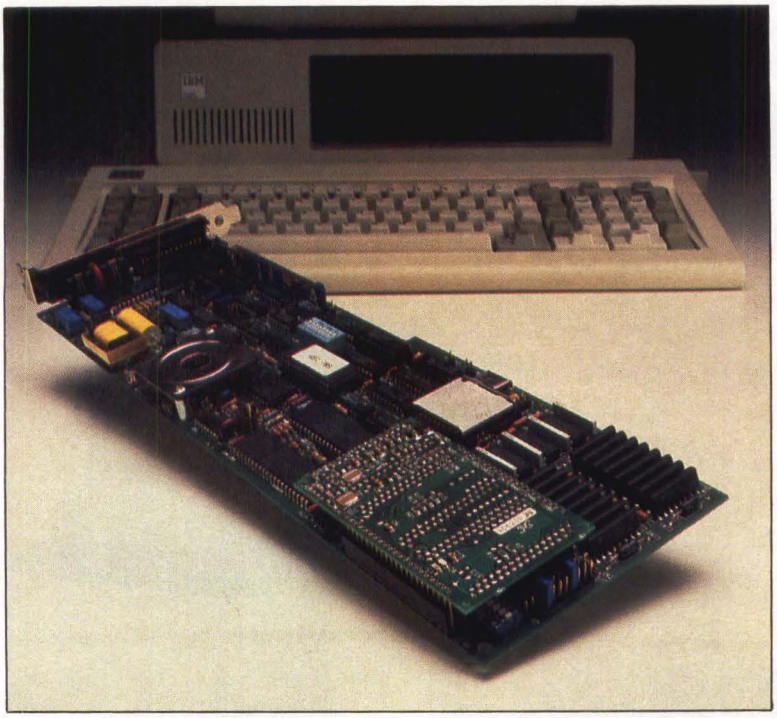
David Simpson, Senior Editor

Combining two of the personal computer's strongest suits—graphics and communications—add-in facsimile boards prove ideal profit vehicles for value-added resellers and OEMs. Why? Because they often need to be teamed with scanning equipment, graphics boards, image-editing programs, optical character recogniton (OCR) software and high-capacity—perhaps optical—disk drives. As more documents trip the fax fantastic, end users will be asking value-adding specialists for help in uniting those disparate devices.

Personal computer fax add-in boards, also called fax modems, give facsimile capabilities to personal computers. A fax-equipped personal computer can send and receive documents to or from standalone fax machines or other personal computers outfitted with similar cards.

The cards themselves usually include a 9,600-baud fax modem (more often than not based on the Rockwell International Corp. R96F chip set) and related software that converts ASCII files, screen captures and graphics files into bit-mapped images. The system compresses the bit map and converts the digital facsimile image to standard fax format for transmission over the phone lines as an analog signal. At the receiving end, the standalone fax machine or fax-equipped personal computer decompresses the image, converts it from analog to digital form, and either prints it out, displays it on the screen, or stores it on disk.

The quality of fax documents transmitted via add-in boards is better than those transmitted via standalone machines.



On one board, *OAZ's XAFAX packs a 9,600-baud fax modem, a Hayes-compatible 1,200-baud modem, a SCSI interface, a scanner interface and an Intel 80188 coprocessor with 512K bytes of RAM.*

All personal computer fax boards comply with the CCITT-defined Group 3 standard for facsimile transmission. And some—such as Ricoh Corp.'s FB-1—also comply with the Group 2 standard. The Group 3 standard allows for 30- to 60-second transmission of a page, depending on the amount of detail. The Group 2 standard specifies transmission of an 8½-by-11-inch page of text in 6 minutes.

Despite stiff competition from electronic mail (e-mail), telex, express mail services, and even standalone fax machines, personal computer fax board sales will surge, according to market analysts. For example, Don Ryan, director of the image-communication systems market requirements service at CAP International Inc., Marshfield, Mass., reports that 2,500 personal computer fax boards were shipped last year. That number will reach 15,000 this year and over 150,000 in 1990. (Interestingly, about 10 percent of all business locations currently have a fax machine; CAP expects that figure to jump to over 30 percent by 1990.)

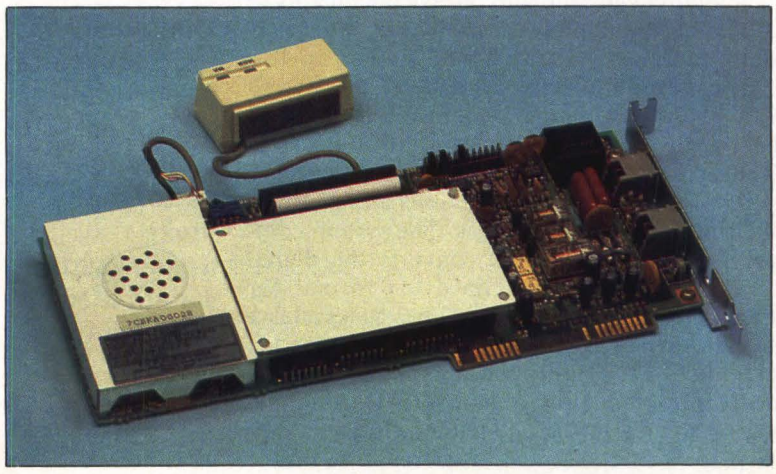
Currently, a typical personal computer fax board costs about $1,000, translating into a 1987 market worth $15 million. By 1990, a typical board should sell for about $500, representing a potential market of about $75 million.

Confirming the fax

The advantages of facsimile add-in boards are so strong that analysts' predictions will probably be borne out. For one thing, they cost from $395 to $1,495, compared to $2,000 to $3,500 for standalone fax machines. For another, they save time and trouble. With standalone fax machines, users have to print out the screen image, take the hard copy to the machine (which may be located in another area of the building), scan it in and send it. With personal computer fax boards, in contrast, users can send screen images directly from the personal computer. Also, the quality of fax documents transmitted via add-in boards is better than those transmitted via standalone fax machines because of the absence of the scanning step, which degrades the image.

The main advantage of personal computer fax boards over e-mail and telex is the ability to send complex graphics. Even though most facsimile devices are limited to Group 3's 200-dot-per-inch standard, they can transmit fancier graphics than typical e-mail setups. Also, the facsimile industry is blessed with long-standing standards; thus users don't have to worry about varying transmission speeds and confusing communications parameters that often characterize e-mail.

A disadvantage of facsimile relative to e-mail is that fax files, not being in ASCII format, are not easily edited at the receiving end. If editing the fax documents is necessary, system integrators will have to incorporate graphics editing



Panasonic's Fax Partner, *bundled with a customized PC Paintbrush, includes an Intel 80188 processor and 256K bytes of memory.*

programs or OCR software into the systems, which adds cost and complexity.

Currently, more than a dozen companies sell, but not necessarily manufacture, personal computer facsimile boards (see Table); and no doubt many more will emerge at next month's COMDEX show (Nov. 2-6, Las Vegas). Most of the boards were introduced this year, although GammaLink, the original personal computer fax board manufacturer, started the market over 2½ years ago. Although the various products share similarities, there are key differences that don't show up in product brochures or in quick calls to sales representatives. To evaluate the crop of offerings, prospective buyers have to look at a variety of specs, but only a hands-on evaluation will uncover the best board for a buyer's or a customer's application needs (see "Three boards pass the fax check").

Most personal computer fax boards can perform ASCII-to-fax format conversion; broadcasting (sending documents to multiple locations); polling (requesting data from a remote, perhaps unattended, station); automatic logging (also called activity journal or fax journal); and automatic dialing/sending and answer/receiving.

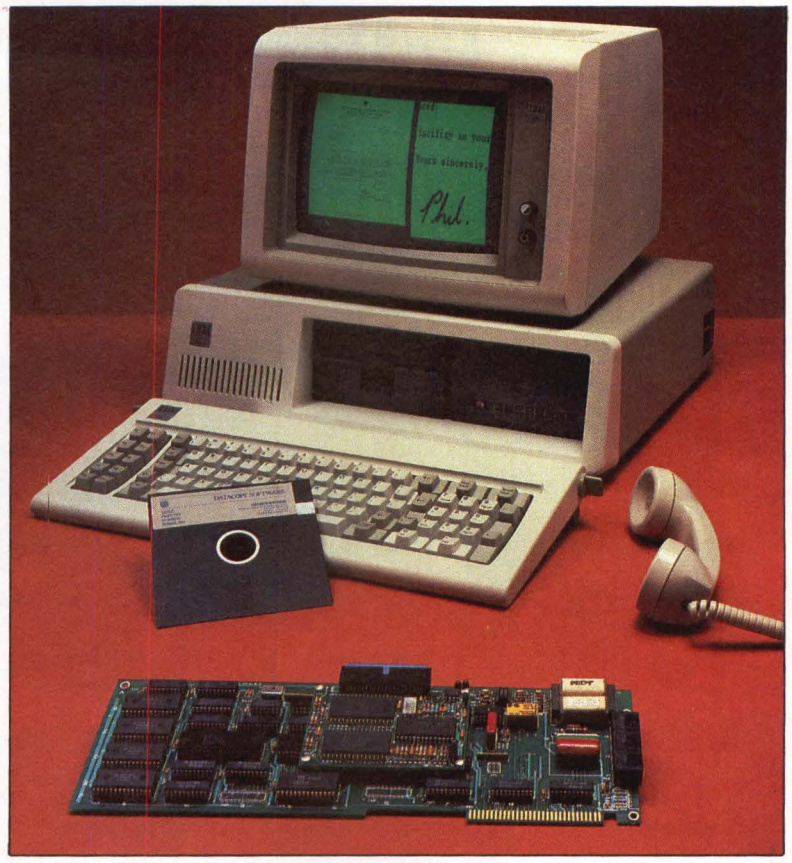
Many fax-board vendors advertise "background operation." (Ordinarily background operation means that the system performs its chores without interrupting a foreground application.) But most of the boards must "freeze," or pause, the foreground application when a fax comes in, or when the user wants to send a fax document. Some vendors use the terms "terminate-and-stay-resident" or "quasi background" operation to describe this function.

For true background operation, in which users can transmit or receive fax files without interrupting or slowing down the foreground application, it's generally necessary for the fax board to be equipped with an onboard microprocessor and its own RAM. This coprocessor offloads fax-related processing from the personal computer's processor. The most commonly employed coprocessor in fax cards is the Intel Corp. 80188.

Manufacturers with onboard microprocessors include Brooktrout Technology, Datacopy Corp., Gulfstream Micro Systems Inc., OAZ Communications Inc., Panasonic Computer Products and Spectrafax, which OEMs the Panasonic board.

Tie on the bundles

Another key question in evaluating personal computer fax boards is whether the board's software includes a graphics, or image, editor. Most boards will work with programs such as Dr. Halo from Media Cybernetics Inc., PC Paintbrush from ZSoft Corp., or various desktop publishing packages. But an easy-to-use integral graphics editor eliminates the need to buy an extra package. Only a few companies bundle image editors—and most of these are rudimentary. Panasonic, however, bundles a customized, full-function version of PC Paintbrush with its Fax Partner system, as does Spectrafax.

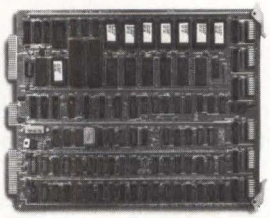


Datacopy's MicroFax *add-in board displays text converted from ASCII to fax format and its status screen lets you monitor fax transmissions.*

Some companies, such as Gulfstream, OAZ and Microtek Lab Inc., put scanner interfaces onboard, saving users the added cost and hassle of buying a separate board and taking up another slot. The down side of an integrated scanner interface is that users might be tied to that company's particular scanner, if the company doesn't offer drivers for other units.

Major scanner manufacturers such as Microtek and Datacopy were quick to capitalize on the personal computer fax market, offering bundled scanner/facsimile solutions. And DEST Corp., another major scanner vendor, entered the market via its acquisiton of Gulfstream this year. However, CAP Internation-

Follow this line.



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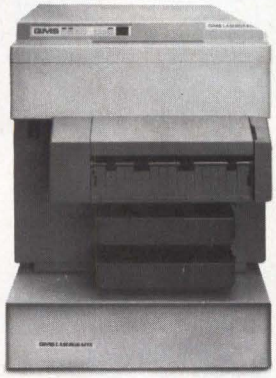

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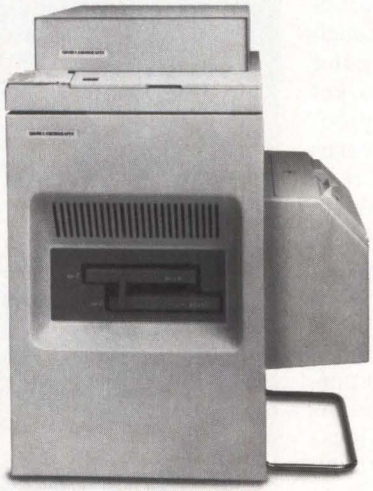

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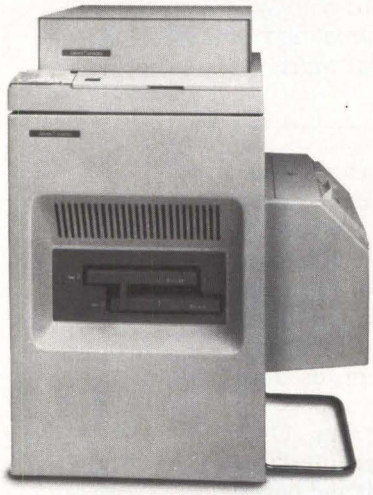

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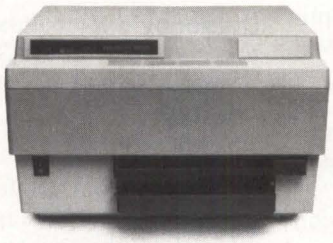

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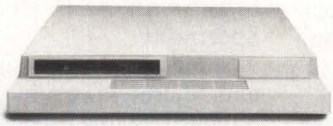

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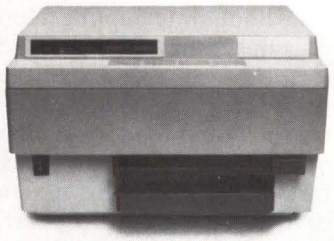

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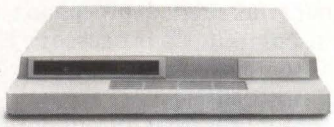

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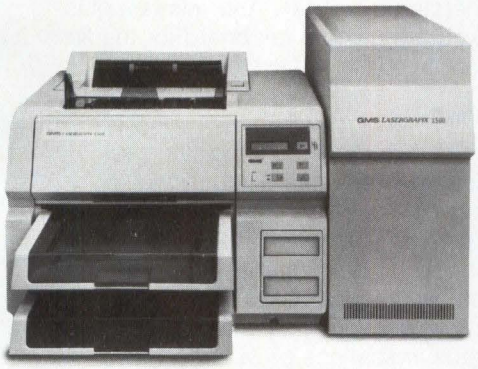

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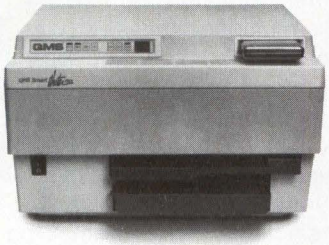

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al's Ryan estimates that less than 25 percent of all fax boards are sold with scanners.

Another advantage to look for in fax boards is an integrated, asynchronous, Hayes Microcomputer Products Inc.-compatible modem for ASCII transmission or e-mail. Carterfone Communications Corp., which OEMs GammaLink's board, includes a Hayes-compatible modem, as do Datacopy, GammaLink (in its newer GammaFax Plus board), and OAZ.

Three boards pass the fax check

Edward Teja, Contributing Editor

Prospective buyers of personal computer fax boards should expect some discrepancies between the features the vendors tout and those the boards deliver. To find out how good a job the fax-board designers have done, boards from three vendors—Panasonic Computer Products, Datacopy Corp. and OAZ Communications Inc.—were given a hands-on comparison. The tests were restricted to sending ASCII text and predigitized images; the image-conversion software was not tested with a scanner.

Installing each of the boards was simple. Panasonic's Fax Partner offered the slickest packaging of the three. The documentation clearly spells out the hardware and software installation. The other two boards had less adequate documentation. However, the installation was still quick and easy. In fact, each board was installed and sending messages within 15 minutes. Panasonic supplies diagnostics that verify that the Fax Partner works properly; this was the only board that came with diagnostics.

The key differences in the boards are in the application software. Panasonic, for instance, makes good use of the special function keys to make sending a fax as easy as: hit F1, point to a file, point to a phone number and hit the carriage return. The first fax messages crossed state lines on a voice-grade line replete with call waiting—the most difficult conditions, as befits a test.

Datacopy's MicroFax' operation was surprising. By comparison to the Fax Partner its software at first seemed awkward. It doesn't use function keys and the documentation isn't thorough. However, it turns out that Datacopy's software tells what is going on with the fax transmission. A "Display Status" screen, unique to Datacopy (of the three), tells you if the board is running, at what baud rate, and what page is currently being sent. The handshaking ("waiting for response," etc.) displays in the upper right-hand corner. And, if you wonder what the fax looked like after it was converted from ASCII to fax, you can view it on the screen or print it out. With an enhanced graphics adapter (EGA) board installed, the fax image looks good.

These features mean that there's never any question about the status of a fax. And this is a plus, especially when you are using a fax board for the first time—it builds confidence in the system.

Fooled by a modem

And confidence is important. Sending fax messages revealed an interesting glitch in the Panasonic Fax Partner's monitoring and error logging that undermines confidence: the board didn't always know when the fax didn't go. When sending long fax messages, the journal would record that, say, nine pages were sent, but only one-and-a-half might arrive. The only user status indications provided are two LEDs (light-emitting diodes)—one for SEND, one for RECEIVE. This same error-reporting phenomenon occurred when sending locally to two different standalone facsimile machines (different brands) and to another Panasonic card in another state. In this last case, it was discovered that, although the board at the transmittig end said a multipage message was successfully sent, the board at the other end wasn't even turned on—a modem had answered the phone.

Panasonic suggested that the phone lines might be the problem. But the fax system calls for a handshake after each page—one page could indicate a mistake, multiple pages had to suggest something else. It turns out that there is a single hardware bit that the software polls—handshaking sets the bit, the board polls the bit. If the bit were stuck, . . .who knows?

Panasonic sent a new board, but the problem remained. This isn't to say that the board won't send long fax messages. It does. Messages as long as 32 pages were successfully sent. It just means that a journal entry saying "sent" is dubious.

Panasonic has a direct approach to sending fax messages: When you say go, it converts text files as it sends them. On the Datacopy board, however, ASCII-to-fax conversion software works offline. The entire document is converted with each page stored as a viewable .FAX file. Sending a document once takes longer with this approach, but if you want to send files more than once (except in the broadcast mode), or resend already-converted files, the Datacopy board is faster.

The OAZ board, XAFAX, walks a middle ground. It begins the calling and conversion processes together, but converts one page before sending, then keeps its on-board 30K-byte buffer filled with the next page;

In fact, OAZ aims to be the ultimate in one-stop shopping with its XAFAX. On a single board, the company packs the Hayes-compatible modem, an 80188 with 512K bytes of RAM (64K of which is dual-ported), a SCSI (small computer system interface) interface for adding other peripherals, and a scanner interface for the company's scanner. The board also includes a multitasking operating system that provides an event-driven environment, rather than the

thus it sends the first page slowly and the rest of the document proceeds at less than 30 seconds per page. And the connect time only begins once it has started its high-speed operation.

You might expect the boards to try to send a message again if it fails the first time. The Fax Partner doesn't, but the others let you specify the number of retries and how long to wait before trying again. The only difficulty with Datacopy's approach is the strategy of its re-try capability. If you send a multiple-page document and one of the middle pages, say Page Two, doesn't get sent properly, the program puts that page on its "to do" stack and moves on to Page Three. Later, after the rest of the document has been sent, it tries Page Two again. This can cause confusion at the receiving end.

Trim the page for numbering

And that leads to page numbering. There isn't any. Of course, you can use a word processor to put them in. For example, you can use Framework II, creating a *.PRT file all nicely formatted and numbered, rather than use the export-to-ASCII utility.

Ostensibly, the ASCII documents Datacopy's board converts are 66 lines long, at least according to the manual supplement. The word processor had to make them 58 lines long in order to get the page number on the right page. But the only way you can tell is to look. Unfortunately, the Panasonic board doesn't store the converted files; the only way to tell what is actually being sent is to look at a received fax that someone mails back.

OAZ gives you a choice—you can store the converted message or not. The OAZ board is also the only one to offer the explicit ability to convert and store a file without sending it. This is desirable when you want to see, for instance, if ASCII text-generated page numbers are being placed on the correct fax page. The Datacopy board, in contrast, must be tricked into thinking that you intend to send a fax, and then you abort the process.

The last board tested—OAZ's XAFAX—was the newest. When tested, it wasn't even a beta site product. In fact, the board came with its Rockwell International Corp. fax chips labelled "Engineering Sample." Volume shipments were scheduled for mid-August.

The software wasn't fully implemented, so the analysis is only partial. But the system does use function keys, and it does have some status reporting (page number and baud rate). Journal and manual calls hadn't been implemented at the time of the review.

A great deal has been made of background capability. All of these boards have it, and it appears to work. The question is how useful is it? It seems reasonable to assume that a fax is used because time is of the essence. After the fax has been sent, therefore, the user must go into the program to make sure it transferred successfully. It makes more sense to keep the fax program in foreground for the 5 minutes it might take to send a 10-page document. The exception to this reasoning is the OAZ board. This board keeps its software RAM-resident, and a simple ALT-SHFT takes the user into the main program to send a fax or check on message status, without interrupting whatever program is executing.

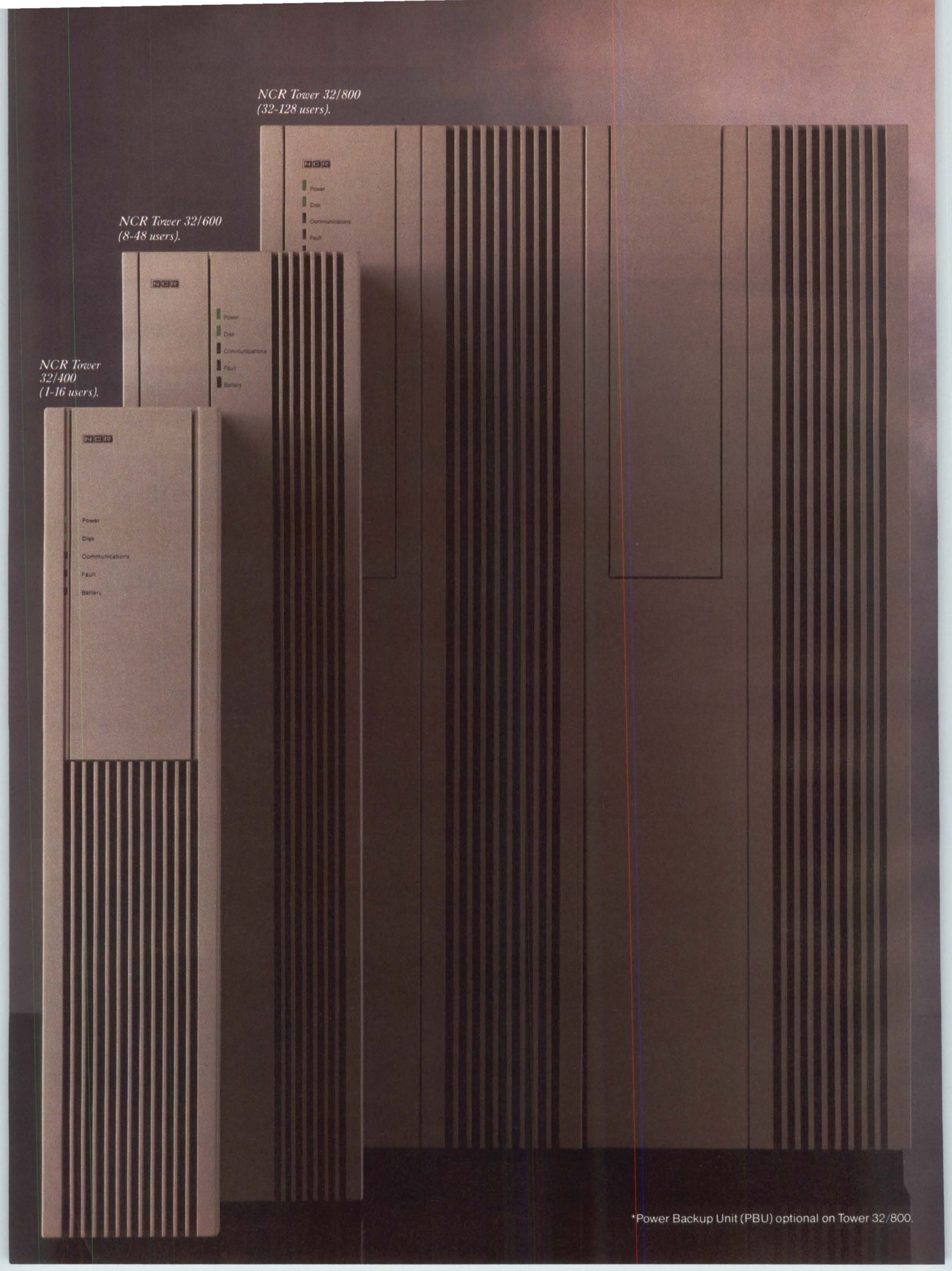
The final comparison

Each of the three software programs offers an activity journal. Both the Panasonic and Datacopy approaches record the file sent, who it was sent to (by phone number only, in the case of Datacopy), how many fax pages the message required and what time it was sent. For business purposes, the length of time it took to send should be included. Standalone fax systems typically provide that information. The OAZ journal promises that additional feature, although it had not yet been implemented when tested.

The Datacopy board also maintains a call journal that tells what messages it has left to send. This is important because it allows the user to cancel messages before they are sent, with the stroke of a delete key.

It was found that all three boards worked, more or less, as advertised, but because of the problems with error reporting, the Panasonic board didn't provide the confidence to start a fax and then pop into some other program. The OAZ board, being incomplete at the time of the review, remains somewhat of an unknown. But it promises to be a reasonable implementation, because of its ability to toggle between background and foreground and its use of special-function keys.

The Datacopy board was by far the most thoroughly developed product of the three at the time of the review. It does have a slightly longer learning curve, but it is a solid product that really made upgrading the computer to fax capability a pleasant experience.



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polled environment common on other boards.

Prospective buyers should also determine which peripheral devices a fax board supports. If it doesn't support the customer's particular laser printer, for example, either the vendor, the reseller or the customer will have to write the appropriate software driver.

Buying the right fax board is not one of a

SELECTED PC FAX BOARDS

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Advanced Vision Research	Megafax	N	Y	PageMaster	N	N	N	distributors	$1,495	OEM version of GammaLink board; designed for use with PageMaster desktop publishing system
America Data Technology	SMARTFAX	receive only	Y	PC Paintbrush, Dr. Halo	N	N	N	distributors, OEMs, dealers	$1,195	limited cut-and-paste capabilities in graphics editor
Asher Technologies	JT Fax	receive only	N	PC Paintbrush, Dr. Halo, Lotus graphics	N	N	N	OEMs (including Quadram), distributors, direct sales	$395	resident program; freezes foreground program when transmitting; Macintosh version available ($695)
Brooktrout Technology	Fax-Mail	Y	N	PC Paintbrush	N	8681, 8K bytes	N	OEMs	$595 (2,400 bps), $795 (4,800 bps), $995 (9,600 bps)	
Carterfone Communications	DATAFAX	N	N	PC Paintbrush, AutoCAD, Dr. Halo	N	N	Y	direct sales	$1,295	OEM version of GammLink board
Datacopy	MicroFax	Y	N	PC Paintbrush; PCX and TIF files	N	8088, 64K bytes	Y	distributors, OEMs	$1,195	available with OCR Plus software
Electronic Information Technology	pc-FAX	receive only	Y	PC Paintbrush	N	N	N	OEMs, distributors, dealers	$1,095	freezes foreground program when transmitting; upgrade board planned for COMDEX
GammaLink	GammaFax Plus	Y	N	PC Paintbrush, Dr. Halo, AutoCAD, TIF files	N	N	Y	OEMs, dealers, direct sales	$1,195	includes company's batch programming language for OEM customization; background operation via software
Gulfstream Micro Systems	EZ-Fax	Y	N	PC Paintbrush, Dr. Halo	Y	6802, 8K bytes	N	distributors, OEMs	$1,495	software available that allows a personal computer attached to a LAN server to be used as a facsimile gateway
Microtek	MFAX96	N	N	scanner software includes graphics editor	Y	N	N	dealers	$995	designed for use with Microtek scanners
OAZ Communications	XAFAX	Y	N	Dr. Halo	Y	80188, 512K bytes (64K bytes dual-ported)	Y	distributors, OEMs	$1,195	SCSI interface onboard; includes multitasking operating system; started shipping in August
Panasonic Computer Products	Fax Partner	Y	Y	PC Paintbrush, PCX and PIC files	N	80188, 256K bytes	N	distributors, dealers, OEMs	$999	software includes a customized version of PC Paintbrush
Pitney-Bowes	PATH II, PATH III	N	N	PC Paintbrush, Dr. Halo	Y	N	N	direct sales	$995 (PATH III); $2,795 (PATH II)	PATH II includes built-in OCR and text-graphics merge software
Ricoh	FB-1	N	N	PageMaker, PC Paintbrush, Dr. Halo, PIC files	N	N	N	direct sales, dealers, OEMs	$995 (est.)	started shipping in September; Group 2 and Group 3 compatible; onboard compression via firmware.
Spectrafax	FAXCARD	Y	Y	PC Paintbrush, PCX and PIC files	N	80188, 256K bytes	N	direct sales	$995	OEM version of Panasonic board; software includes customized version of PC Paintbrush

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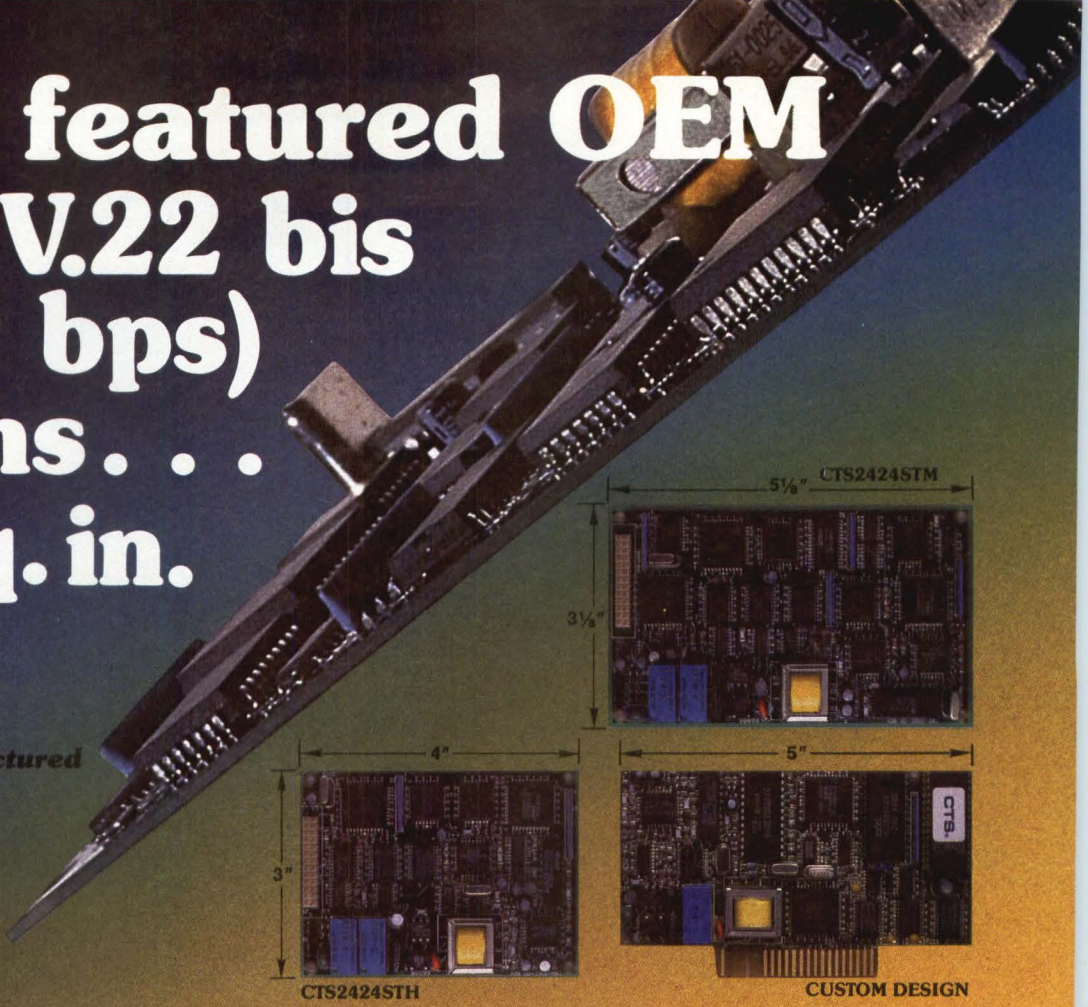

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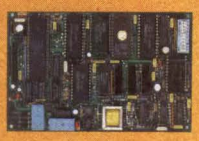

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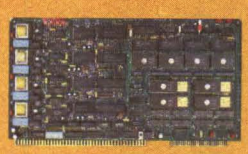

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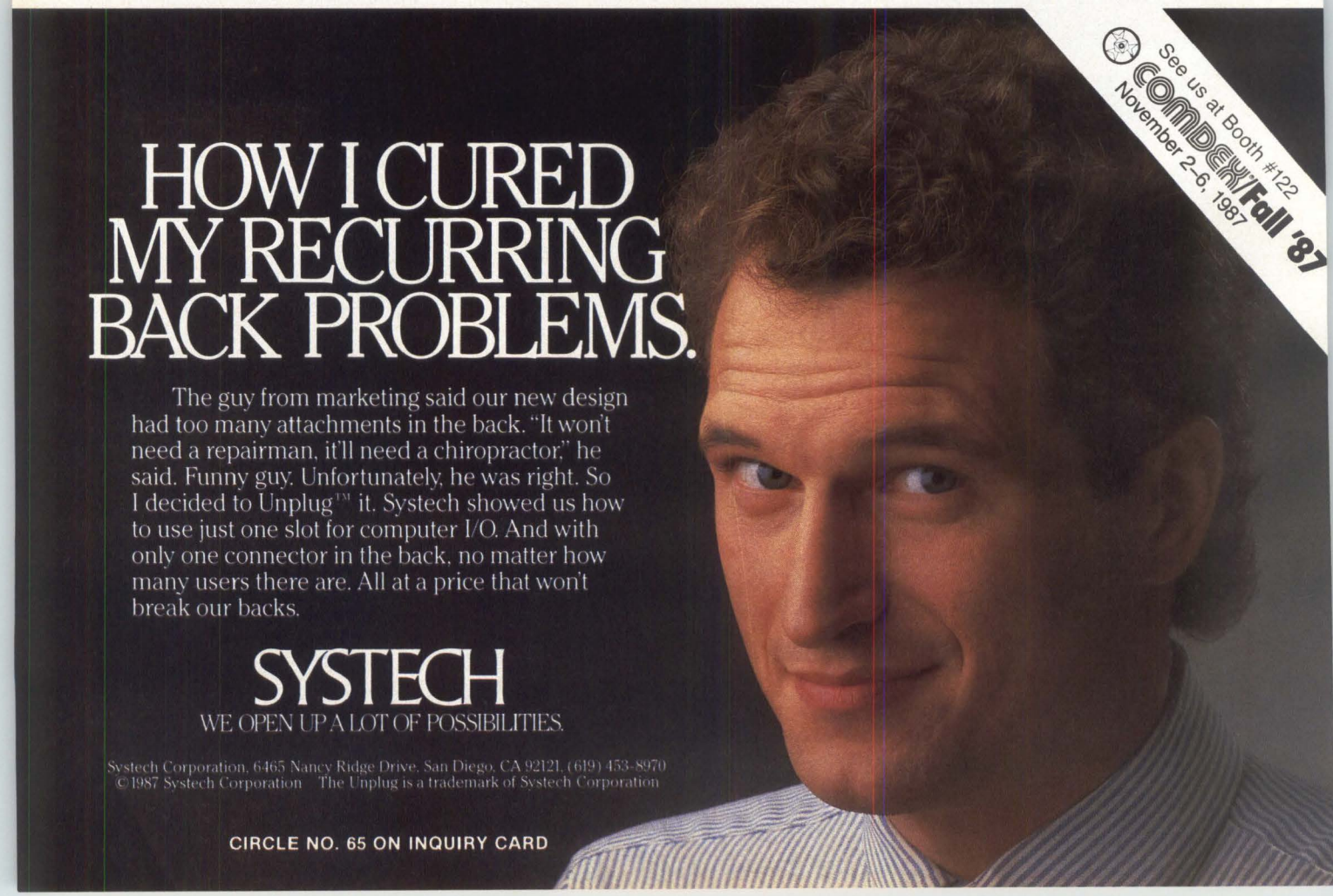

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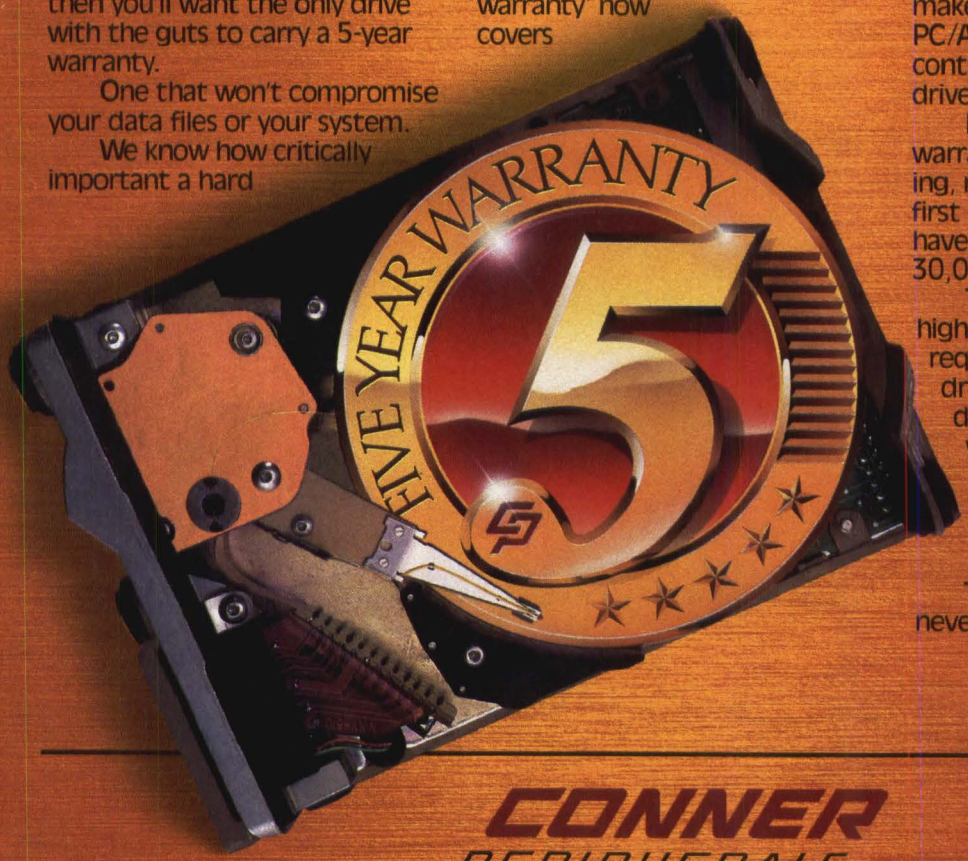

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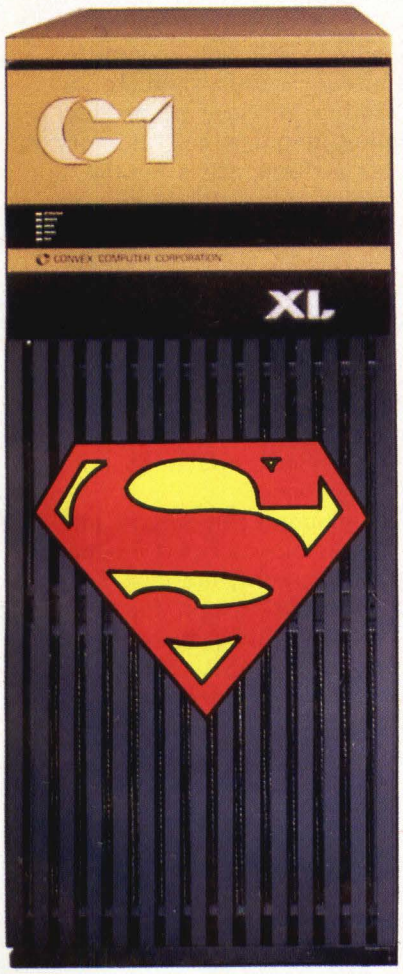
POWERFUL NEW MACHINES FIND A NICHE

Smaller than supercomputers, younger than superminicomputers, minisupercomputers offer system integrators good price/performance alternatives in key applications

Andrew Allison, Contibuting Editor



Minisupercomputers are differentiated from array processors on the basis of 64-bit arithmetic units.

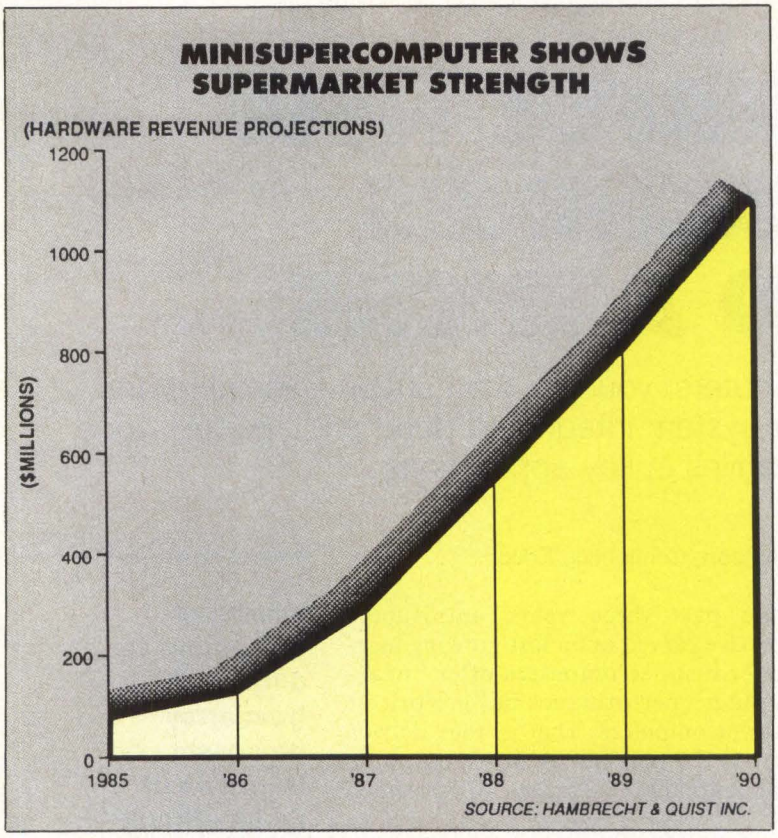
Over the past three years, minisupercomputers have carved out a fast-growing market niche. Minisupercomputers offer "near-supercomputer" performance but are priced like superminicomputers. That is, they deliver 10 percent to 25 percent of supercomputer capability but at only 5 percent to 10 percent of the cost.

Although minisupercomputers can't compete with supercomputers for problems that require all of the latter's power, they do fill a role as cost-effective, high-performance departmental processors, compute servers and workstations. Moreover, product proliferation and attractive pricing are creating exciting new opportunities for third-party participants to market powerful value-added systems.

Supercomputers and minisupercomputers currently are used almost exclusively in 64-bit arithmetic-intensive, FORTRAN-coded, scientific and engineering applications like modeling, simulation, finite-element analysis, matrix manipulation, and numerical solution and approximation.

The earliest method of achieving minisupercomputer performance was through the use of special-purpose attached processors, an approach pioneered by Floating Point Systems Inc. (FPS) in 1975. Increased functional density at the component level and rapid development of ASIC (application specific integrated circuit) design tools led first to board-level and then to chip-level implementations and finally to the development of the more powerful minisupercomputer.

The term array processor has now begun to be restricted to 32-bit scalar machines performing high-speed math over streams of data as



firmware subroutines called by the host. They are widely used in value-added signal- and image-processing applications. Minisupercomputers are differentiated from array processors on the basis of their 64-bit arithmetic units, their ability to execute entire programs rather than just subroutines, and their vector-processing capability.

From attached processors to CPUs

Attached processors such as those offered by FPS, CSP Inc. and Numerix Corp. add minisupercomputer capability to installed systems, typically Digital Equipment Corp. VAXs, while maintaining a familiar and well-supported operating environment—frequently for less than the price of a standalone minisupercomputer system. The three named suppliers also offer packaged systems including VAX processors. Board-level implementations and chip sets allow somewhat lesser capabilities to be incorporated into a broad range of systems. For instance, Sky Computers Inc.'s VORTEX board is used in Intel Scientific Computers' iPSC and Elxsi Inc. systems, and Weitek Corp. chip sets are widely used.

Geoff Cohler, director of Customer Support at CSP points out that: "Since communication with a host is relatively slow, the trend is towards executing more code with the attached processor. This means that it no longer is a subroutine box but has its own compiler, and the entire program runs within the unit." This calls for large, fast memories (e.g. 64M bytes for 5- to 10-thousand line FORTRAN programs). Furthermore, host processor I/O bandwidth limitations make integral I/O ports advantageous. As a result, a full-function attached processor contains all of the features of a CPU.

This led to the development of standalone minisupercomputers that eliminate the need for a host system, at the cost of introducing a new operating environment. The first standalone minisupercomputer, Convex Computer Corp.'s C-1, was introduced three years ago, and the trickle of additional suppliers has become a torrent during the past year. The degree of compatibility with existing software environments (in practice, those of DEC-FPS or Cray Research Inc.) is the key consideration in evaluating competing minisupercomputers.

The next step, namely minisupercomputer workstations, is already within sight. In the words of Mike Gallup, director of product marketing at Apollo Computer Inc., "It's very clear that minisuper performance is coming to the workstation market, and Apollo is working on workstation products with performance at the high end of the present minisuper performance spectrum." Replacement of the 1-to-5 MIPS (million instructions per second) merchant-market microprocessor engines (i.e. the ubiquitous Motorola Inc. MC68020) with 10-to-50 MIPS RISCs (reduced instruction set computer), as employed in Sun Microsystems Inc.'s Sun 4 and MIPS Computer Systems Inc.'s M/1000, is under way.

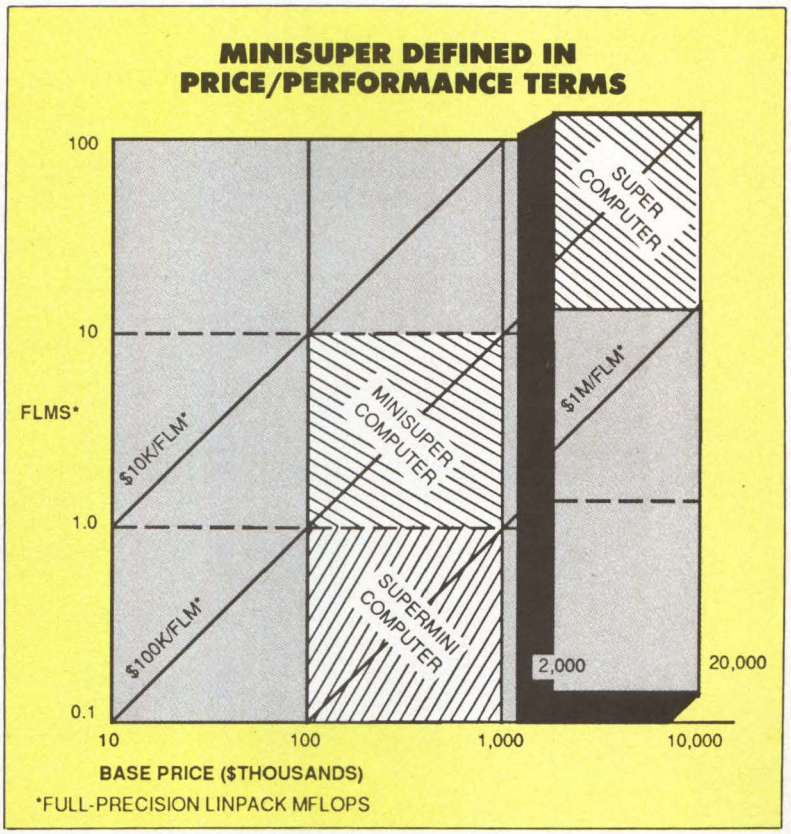
Off-the-shelf floating-point chip sets are putting low-end minisupercomputer performance into deskside and desktop configurations. Such chip sets are, notably, the Weitek products that drive almost half the currently available minisupercomputers. Proprietary ASICs drive most of the rest. Graphics-oriented personal minisupercomputers are under development at start-ups like Dana Computer Inc. and Stellar Computer Inc. And Sun entered the high-performance graphics market with the July introduction of a two-board graphics accelerator capable of 180,000 3-D vectors per second. This 20,000-polygon-per-second subsystem, which employs Weitek's XL-8000 and 32-bit WTL3032 in its two-stage pipeline, is a prime candidate for "ASICification." Weitek's 64-bit XL-8064, now being sampled, will facilitate highly integrated minisupercomputercomputer implementations.

Application-specific processors will cause a dramatic change in the rate of increase in minicomputer performance, historically an order of magnitude about every seven years. Bill Joy, vice president of R&D at Sun suggests that, "Sun and others will quickly migrate the performance to the limits of semiconductor technology." He offers "Joy's Law" of single-chip microprocessor performance, i.e. MIPS=2 (y-1984), or 2 to the power of the number of years since 1984.

In support of Joy's argument, Sun's initial 20,000-gate-array, 1.5-micron implementation of its SPARC (scaleable processor architecture) will be followed next year by a 0.8-micron chip set. It will include integer and floating-point processors, memory management, cache controllers jointly developed with Cypress Semiconductor, and ECL (emitter-coupled logic) from Bipolar Integrated Technology—with GaAs implementations to follow.

Minisupercomputer performance can also be attained by multiprocessor implementations (see "Multiprocessors boost system power," MMS, May Page 105). In fact, the recently introduced Sequent Computer Systems Inc. Symmetry multimicrocomputer system exceeds the 10-LINPACK-MFLOP threshold of supercomputer performance when equipped with an optional Weitek WTL1167 arithmetic coprocessor (a WTL114/65-based daughterboard replacement for the Intel Corp. 80387).

Parallel 32-bit microprocessor systems with board- or chip-level attached processors like Intel Scientific Computers' iPSC/2 are also capable of supercomputer performance, although the amount of suitable application software available is limited.



Minisupercomputers have carved *a price/performance market niche of their own between superminicomputers and supercomputers.*

Architectural issues

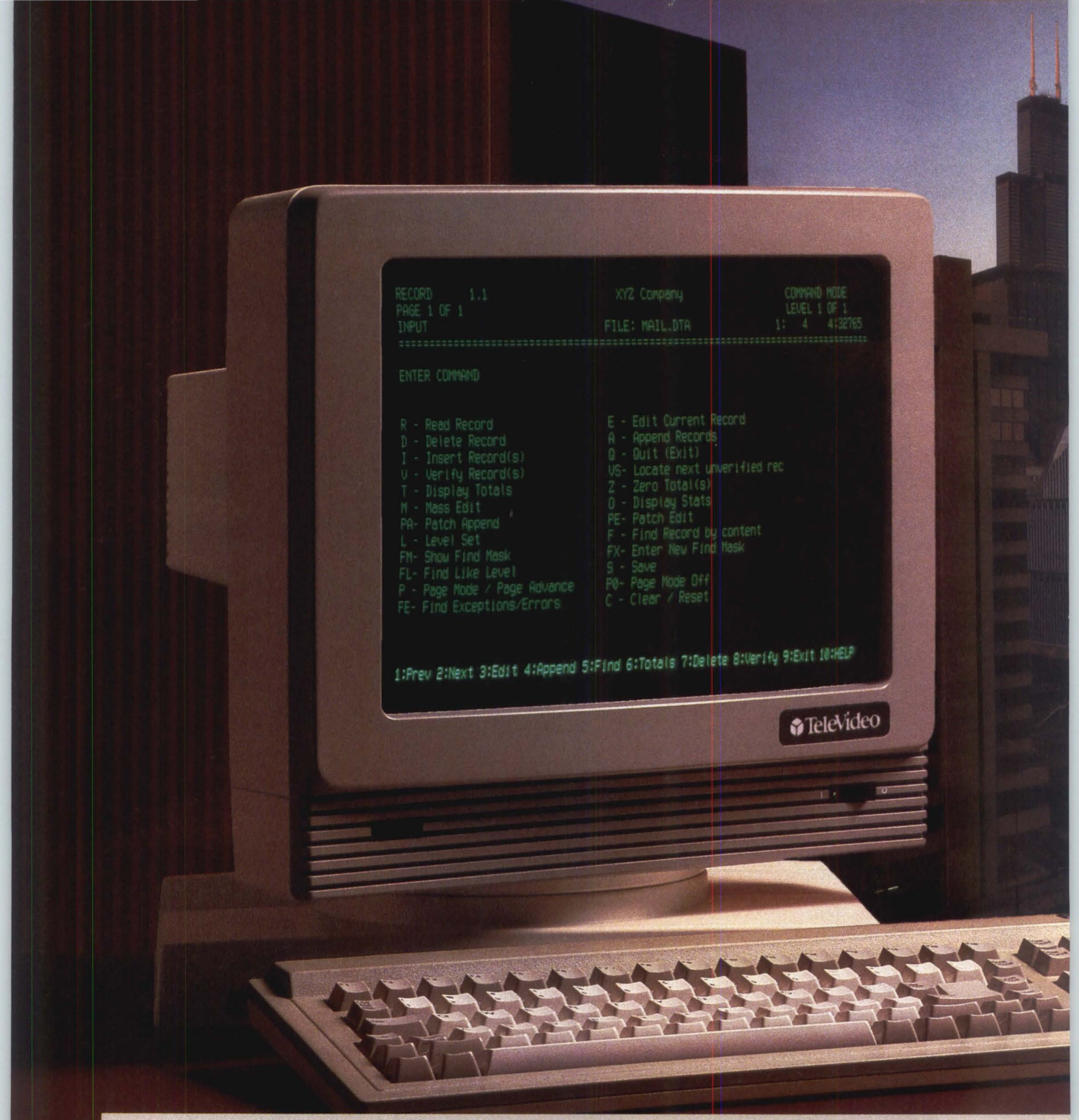
Scientific-processor architecture is in a state of flux. Some systems are modeled closely on the Cray supercomputer architecture, with scalar- and I/O-processing capability being added to what is essentially a vector-processing architecture. Scientific Computer Systems Corp.'s SCS-40 systems, which are directly compatible with Cray software, are the leading examples of this approach. Most, however, come from the other direction, adding vector-processing capability to scalar architectures.

Because available, or "dusty deck," software handles such an important part of the application workload, and are typically not highly vectorized, architectural balance is extremely important. Frank McMahon, computer scientists with the Lawrence Livermore National Laboratory in Livermore, Calif., says that, "The effect of unbalanced architecture is to make performance very dependent upon the application. Depending upon the particular application, balanced architectures (those in which all operations execute in about the same time) may exhibit a 4- or 5-to-1 [performance] range, as opposed to two orders of magnitude for unbalanced."

Since one of the fundamental goals of RISC architecture (see "RISCs challenge mini, micro suppliers," MMS November 1986, Page 127) is to execute instructions in a single cycle, balanced minisupercomputer implementations tend to be RISCs. The nature of scientific computation also encourages parallelism, which appears both in the form of multiple processors (vector, scalar and/or both) and internally through use of very long instruction word (VLIW) architectures.

A key to better performance

This latter approach seems likely to predominate. Pioneered by FPS over a decade ago, it has been given new impetus by Weitek's XL-series chip sets and by Multiflow Computer Systems' TRACE architecture. TRACE packs up to seven operations into a 256-bit instruction word and is intended to offer two and four times that capability in future implementa-



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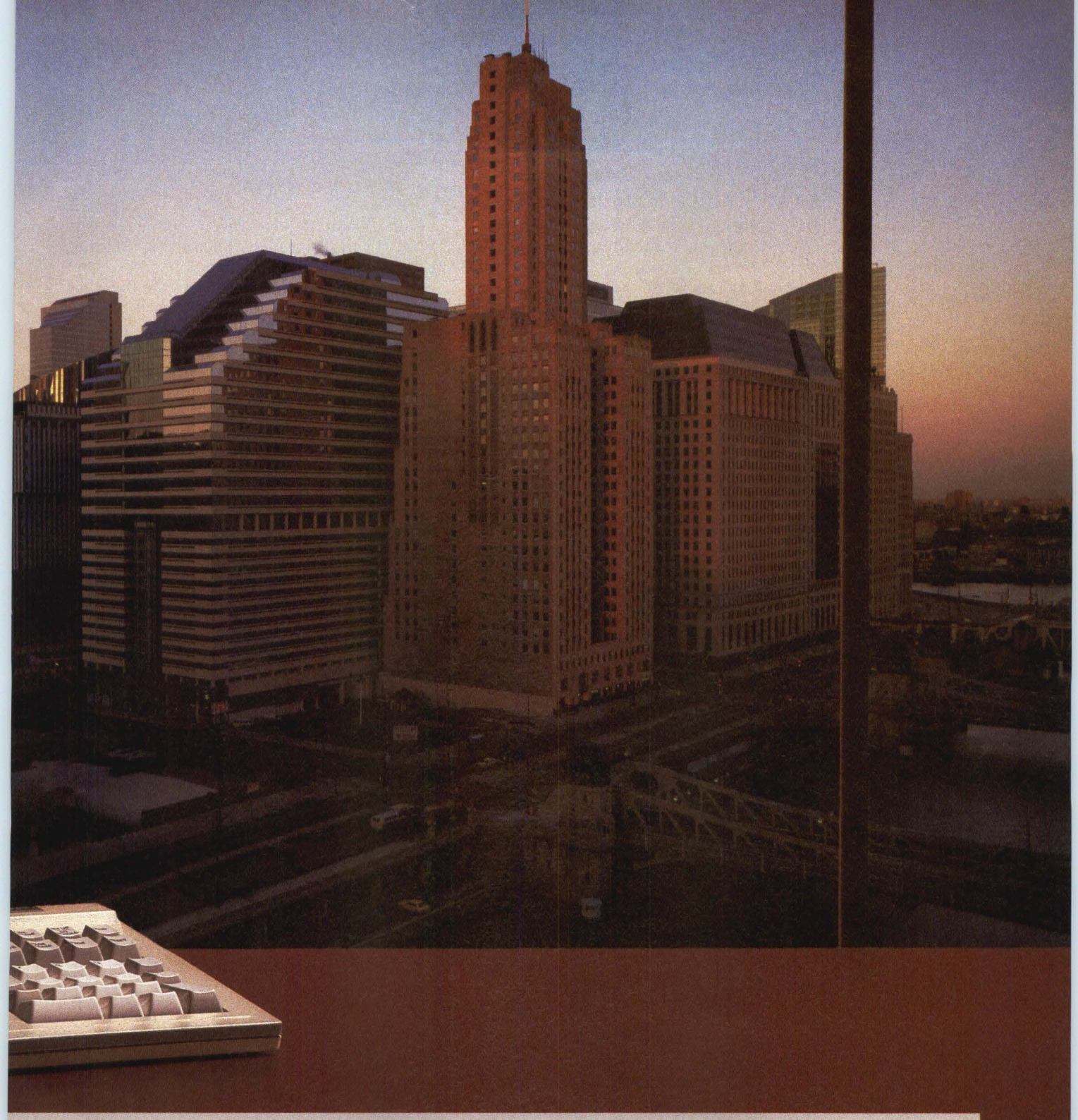

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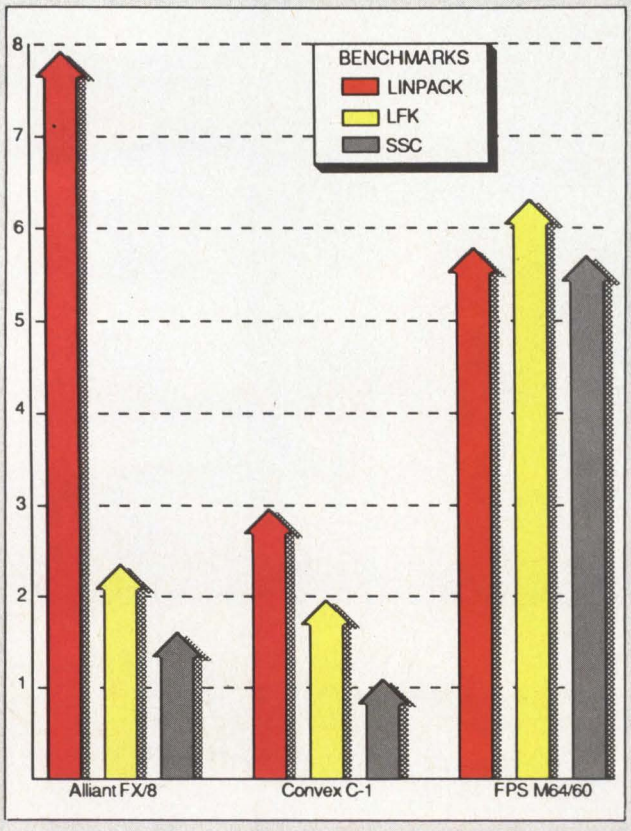
tions. In addition to the three current suppliers, start-up Cydrome Inc., Milpitas, Calif., is working on an ECL wide-word implementation. As with all forms of parallelism, the ability of compilers to convert existing application software into executable code that can take advantage of VLIW architectures holds the key to realizing performance benefits.

In the context of scientific processing, vector-processor performance depends highly upon the extent to which the application is, or can be, vectorized and on the match between the compiler and the processor architecture. Most suppliers have developed vectorizing FORTRAN compilers that attempt to convert scalar to vector operations where possible. Multiflow

Bench-pressing the benchmarks

The full-precision version of the well-known Argonne (Ill.) National Laboratory LINPACK benchmark provides a widely available approximation of computer performance in scientific and engineering applications. A range of 1-to-10 full-precision LINPACK MFLOPS (million floating point operations per second) adequately defines the capabilities of the present generation of minisupercomputers. Supercomputers offer more than 10 LINPACK MFLOPS; superminicomputers and supermicrocomputers (i.e. 32-bit general-purpose systems), 0.1 to 1.0 LINPACK MFLOPS; and minicomputer and microcomputers, 0.01-0.1 LINPACK MFLOPS.



Comparative performances *of the three most widely used minisupercomputers as measured against the three national laboratory benchmarks demonstrates significant variability.*

A word of warning about benchmarks: The results apply only to the specific code executed and to the conditions under which it ran. Aside from arithmetic unit, memory size and bandwidth, the performance of scientific and engineering applications depends upon the operating system, the algorithms employed, the coding efficiency and the system architecture. All of these can be tweaked by computer manufacturers to optimize performance in specific benchmark tests.

Resellers evaluating minisupercomputers should look at other benchmarks. The Lawrence Livermore National Laboratory (LLNL) FORTRAN Kernals (LFK) and Sandia National Laboratories Speed Code (SSC) benchmarks, for example, include the significant amount of scalar processing typical of the "dusty decks" (pre-existing application software) that make up most of the code executed by minisupercomputers. These benchmarks, while not as well known as LINPACK are felt by many users to correlate better with real-life performance (see Bar chart).

Relevant third-party application programs such as Swanson Analysis Systems Inc.'s ANSYS and MacNeal Schwendler Corp.'s MSC/NASTRAN for finite-element analysis and Fidap (from Fluid Dynamics International Inc.) for fluid-dynamics analysis should also be considered. Raw peak or burst floating-point-instruction execution rates, dubbed "macho megaflops" by Frank McMahon, originator of the LLNL benchmark, should be regarded with skepticism.

Established benchmarks and applications are less useful in predicting the performance of new applications, such as the very high-performance graphics and image processing being encouraged by the falling cost of 1-to-10-FLMs capacity. The most meaningful test of a system's capabilities lies in the software to be run on the system. Absent that, prospective purchasers should seek benchmarks that match their intended application as closely as possible.

TAPE-MEASURING THE MINI-GIANTS

	Full precision LINPACK MFLOPS	Type*[1]	FPU	Installed (6/30/87)	Base price ($000)
Alliant					
FX/8 (8 CPUs)	7.6	MS	WTL1264/5		n/a
FX/1	1.6	MS	WTL1264/5	100+	99.5
Celerity					
6000	2.0-12.0[2]	MP	proprietary		285
Convex					
C-1/XP (1-4 CPUs)	3.0-n/a	MS	proprietary		475
C-1/XL	2.9	MS	proprietary	100+	385
CSPI					
MAP-6430	1.2	AP	proprietary	48	76
Elxsi					
6400 (1-12 CPUs)	1.1-n/a	MS	VORTEX		399
Encore					
MULTIMAX (20 CPUs)	5.2-5.6[2]	MMP	WTL1164/5		500
Floating Point Systems					
M64/60 (FPS-264)	5.6	AP	proprietary		640
M64/50	3.0	AP	proprietary		450
M64/40 (FPS-164)	1.7	AP	proprietary		250
M64/30	2.1	AP	proprietary		149
M64/20	1.2	AP	proprietary		99
MIPS					
M/1000	1.1	MP	proprietary	0 (4Q)	59.2
Multiflow					
TRACE 7/200	6	MS	WTL2264/5	0 (3Q)	299.5
Numerix					
NMX-464	1.0[2]	AP	ADSP3210/3220	10	59
Sequent					
Balance 2000 (30x32032)	2.25[2]	MMP	32081	100+	426
Symmetry (30x80386)	14[2]	MMP	WTL1164/5	0 (4Q)	788
Scientific Computer					
SCS-40	8.0	MS	proprietary	20	595
Sky Computers					
VORTEX	2-5[2,3]	AP	ADSP3210/3220	100+	9.9
Sun					
4	1.1[2]	MP	WTL1164/65	0 (4Q)	39.9

Notes:

* AP=attached processor
MAP=multiple attached
MMP=multimicroprocessor
MP=microprocessor
MS=minisuper processor

[1]Prices for attached processors exclude the (required) host processor.
[2]LINPACK data from manufacturer (others from June issue of "Performance of Various Computers Using Standard Linear Equations in a FORTRAN Environment" by Jack J. Dongarra, Argonne National Laboratory).
[3]Depending upon host interface employed.

went so far as to write a trace-scheduling compiler and then design a computer architecture around it. According to executive vice president Josh Fisher, "This resulted in very high utilization of the parallelism and high performance with modest (2-micron, 8,000-gate-array) technology and clock rates (130 ns)."

The price slashing that occurred in the workstation market earlier this year, when Apollo, DEC and Sun reduced entry-level prices by an average of 50 percent, will be repeated in the minisupercomputer arena next year. In fact, Convex has lowered the C-1 price by 20 percent and memory prices by 50 percent in response to competitive pressure, according to vice president of marketing Frank Vince. Add-on, standalone and superworkstation products starting at about $50,000, and board-level products at one-tenth the price, will provide attractive system integration and vertical-market opportunities for value-added resellers. However, processor supplier mortality is likely to be a problem.

Industry analysts Jeff Canin of Hambrecht & Quist Inc., San Francisco, and Greg Kisinski of Dataquest Inc., San Jose, both calculated total 1986 minisupercomputer revenues at $125 million. They forecast $250 million to $300 million in revenues this year and about $1 billion in 1990 (see Chart). This potential has attracted numerous would-be participants to what has become an overcrowded market. In a report on special-purpose processors last July, Canin suggests that there is probably room for no more than three or four profitable minisupercomputer makers. He predicts that the winners will outdistance the pack by the end of next year.

The shakeout has, in fact, already begun. Five fledgling minisupercomputer makers (American Supercomputer Inc., Culler Scientific Systems Corp., Denalcor, Fifth Generation Computer Corp., and Vitesse Electronics Corp.) ceased operations during the first half of 1987. Despite funding typically in excess of $30 million, several of the remaining start-ups have yet to ship a system. Those that run out of cash before becoming profitable are unlikely to survive.

In addition to financial stability, the H&Q study suggests that success factors include application-software support, adherence to industry standards, provision of upward migration paths, ease of integration into multivendor environments, and having an aggressive direct sales force. Mike Gallup, of Apollo adds,

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There's a Datasouth Demand Document printer for almost any communications environment. The DS 180 DD has standard Serial and Centronics-type parallel interfaces. The TX 5180 DD emulates the IBM 5256, 5224 and 5225 printers in System 34/36/38 environments. And the CX 3180 DD emulates the IBM 3287 in 3270 environments.

No matter what kind of form you're printing, there's a Datasouth printer that could be doing it better. So call us at 1-800-222-4528, and ask about our Demand Document printers.

When you consider all the money-saving advantages, it's really quite a steal.

Datasouth

AMERICA'S HIGH PERFORMANCE PRINTER COMPANY

P.O. Box 240947, Charlotte, NC 28224 • (704) 523-8500 • Tlx: 6843018, DASO UW • Sales: 1-800-222-4528 • Service: 1-800-438-5050 • West Coast Office: (415) 940-9828

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CIRCLE NO. 70 ON INQUIRY CARD

"Large companies have a broad range of requirements and seek vendors with the breadth of product line to match them."

Movement in the marketplace

Kisinski reports that a recent survey of minisupercomputer users revealed that 84 percent had ported their applications from other systems, 90 percent of them from a VAX environment. This emphasizes the importance of ease of conversion and of application-software support—and also of DEC's lack of a credible minisupercomputer offering.

The recent announcement that DEC's initial one-year joint marketing agreement with FPS is to be extended for another year suggests that DEC's entry (code-named "Pegasus") is at least 18 months and probably more than two years away. As a result of the spread of standalone minisupercomputer capability, UNIX will become a viable alternative to VMS in the scientific computing market, and C language will become more widely used. This, in turn, has created a demand for optimizing C compilers, with Convex again being first to market.

The Dataquest survey also indicated that Convex had a 22.1 percent share of the 1986 market, followed closely by FPS with 19.3 percent and Alliant Computer Systems Corp. was in third place with 14.8 percent. While both Convex and FPS seem likely to be among the survivors, Alliant's position is less secure. Second-quarter earnings were off 40 percent from the previous quarter. Further serious blows were the loss of support from Apollo in overseas marketing and in the resale of the VAX FORTRAN-compatible DSP9000 compute server, topped by Apollo's subsequent joint marketing agreement with Multiflow. What all this means is that resellers addressing this exciting new market are well-advised to look beyond price and performance to a careful evaluation of the corporate strengths and weaknesses of prospective suppliers. □

Interest Quotient (Circle One)
High 504 Medium 505 Low 506

Andrew Allison is a management consultant specializing in minicomputer and microcomputer technology products and markets. He had been more than 12 years with Digital Equipment Corp., Rolm Corp. and Advanced Micro Devices Inc. before founding his business in 1977.

CIRCLE NO. 71 ON INQUIRY CARD

MOTOROLA
File Edit Scaling CLUT Convert Special
motor
68020
Macintosh II

Apple picked our brains.

And so did hundreds of other companies.

Before millions of people picked Macintosh,™ Apple® picked Motorola's M68000 Family—the brains behind one of the most successful computer products ever launched.

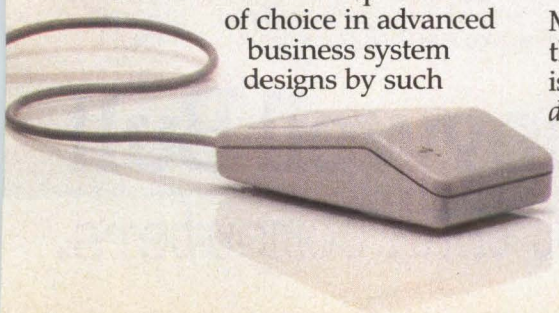
Now Apple has tapped the brainpower of the Motorola MC68020 microprocessor for the Macintosh II, bringing the high performance of a graphics workstation to business desktops everywhere.

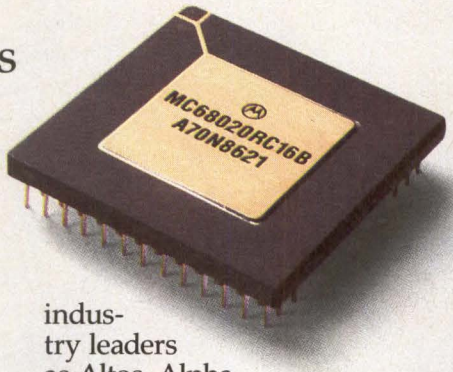
72% of all 32-bit systems ever shipped included at least one MC68020. That's more than half a million high-performance systems.

The high-performance business solution.

The MC68020 is not just the overwhelming choice in workstations—it is now setting new performance standards in the office—where it is essential to the computation, graphics and communication necessary for interconnected systems.

While Apple's choice of the MC68020 was a smart move, there's no license on genius: the '020 is the microprocessor of choice in advanced business system designs by such





industry leaders as Altos, Alpha Micro, Casio, C.Itoh, Fujitsu, Honeywell Bull, NEC, NCR, Olivetti, Plexus, Ricoh, Sanyo, Sharp, TI, Toshiba and UNISYS.

The graphics solution.

The M68000 family helped Apple implement the visionary "point and click" graphic workstyle that has driven productivity up while driving training costs way down. Businesses of all sizes are discovering dramatic productivity increases in office computing through innovations such as desktop publishing.

The software solution.

Among programmers and designers dedicated to creating the best, most innovative applications, the M68000 architecture has been the leading choice by far—with over *seven million M68000* systems installed since 1979.

Meanwhile, the MC68020, on the market now for three years, is already backed by *two billion dollars worth* of 32-bit software. This is more 32-bit software than all competitive products combined!

The Brain Trust: Where M68000 microprocessors predominate.

Engineering Workstations
Apollo, Hitachi, HP, Sony, Sun, Tektronix.
Laser Printers
Apple, Canon, HP, IBM, QMS, Ricoh.
Departmental Computers
Convergent Technologies, Fujitsu, Honeywell Bull, NEC, NCR, UNISYS.
PBX and Telephone Systems
AT&T, Northern Telecom, Siemens.
Fault Tolerant Systems
IBM, NCR, Nixdorf, Stratus, Tandem.
Supercomputers
Alliant, BBN, Caltech, Fifth Generation.
Factory Automation
Allen-Bradley, ASEA, Bailey Controls, GM, Mitsubishi, Square D.

Join the Brain Trust.

Challenge us to persuade you of the sound business and technical reasons to join the M68020 Brain Trust. Write to us at Motorola Semiconductor Products Inc., P.O. Box 20912, Phoenix, AZ 85036.

We're on your design-in team.

Apple is a registered trademark and Macintosh is a trademark of Apple Computer, Inc.

MOTOROLA

Last year it was Peripheral of the Year.

This year it's four times better.

See us at
COMDEX/Fall '87
November 2-6, 1987
Las Vegas Convention Center
Booth #580

Last year, the Honeywell Bull 4/66 dot matrix printer was so well received by OEMs that we decided to build a family of four high-end printers around it. These new printers share the qualities that made the 4/66 famous, and possess open architectures that allow for ease of customization. In short, they'll broaden the range of applications available to OEMs.

First is the model 4/62 for the office. It provides high letter quality throughput. Next, is the model 4/66P: it simultaneously emulates a printer and a plotter for CAD/CAM applications on the Hewlett Packard 7475A and other compatible systems. Third is the model 4/66C which is compatible with the IBM 3287. And finally, the 4/66T is compatible with IBM systems 34 and 36.

All our new printers are easy to use. They change automatically from fanfold paper to single sheets, so you never have to re-thread paper onto a tractor feed. Plus, all provide automatic forms loading a zero tear off feature, and can handle paper sizes from 3″ to 17″ wide.

And they're quiet. With 18-needle print heads set in anti-noise shields, they make less noise in an office than conventional typewriters.

Finally, all are very fast, and very versatile. They produce three modes: 480 cps draft, 180 cps near letter quality, and 75 cps letter quality (the 4/62 actually has a letter quality speed of 120 cps). And they'll provide up to 20 optional type fonts, and seven colors.

If you're an OEM looking for a dot matrix printer built especially to suit your needs, contact Honeywell Bull Italia, Printers Division, 120 Howard St., Suite 800, San Francisco, CA 94106. Or call us at 415-974-4340.

Honeywell Bull

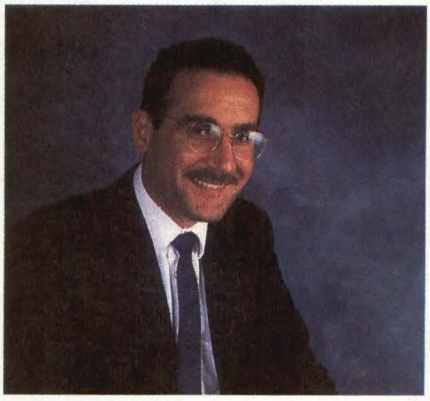
Customers are more important than computers.

CIRCLE NO. 72 ON INQUIRY CARD

SOFTWARE DESIGN

The allure of Ada for programmers

Saro B. Ghazarian
General Dynamics Corp.



Using an Ada compiler to detect errors at an early stage of the design helps reduce the probability of making errors during implementation.

Good software design efficiently converts the requirements specification into a top-level, or preliminary, and a detailed, or low-level, design of a software system. It is key to producing reliable, readable, understandable and easily maintainable software.

In order to ensure good software design, a program description language (PDL) must have characteristics that aid in the process of expressing and recording a design. It should support data definition and the expression of algorithm design. An Ada-based PDL (or Ada/PDL) provides constructs that support modularity, abstractions, strong data typing and description. And, although an Ada/PDL follows the Ada syntax, it can also be used to develop software written in other programming languages.

Flowcharting, once a common program-design practice, usually leads to poor program structure, especially when the number of programmers increases. Flowcharting may be useful in documenting the control flow of a software system, but it's not necessarily helpful in designing or in communicating the design intent among programmers.

An Ada/PDL is one alternative to flowcharts that closes this design-team communications gap. Conventional PDLs have been in use for about 10 years and growing evidence suggests that PDLs significantly improve a programmer's productivity, especially during the design phase. They provide software designers, programmers and managers a common body of terms and concepts. Not only do PDLs lead to structured designs but they also make documenting those designs easier.

Also, the use of an Ada/PDL can serve as a migration path leading to full use of Ada. The training required to use an Ada/PDL results in programmers at all levels becoming familiar with the Ada language and the software engineering principles it supports.

The advantages of using Ada as a design tool are:

- Provides useful constructs for expressing designs arising naturally from the application;
- An Ada-based PDL can be readily processed by computerized tools that support the design process.

But the primary purpose of the design activity remains communication among client, programmer and those who maintain the system.

Tools of the trade

One PDL processor is ADADL (Software Systems Design in Claremont, Calif.). The ADADL (Ada-based Design And Documentation Language) is an Ada-based PDL specifically designed to document both top-level and detailed-design phases of the software development life cycle.

The ADADL processor comprises more than 25 software tools written in C. These tools are used to analyze the ADADL source text in order to produce design reports and documentation. (Designs described using ADADL can be compiled without error on an Ada compiler.) The design reports produced by the ADADL processor provide the programmer with such information as program structure, data declarations and use, type declarations and use, invocation hierarchy, generic utilization, interrupt information, data dictionary, and design complexity.

In addition to the design reports, the design statements (pseudocode that shows control flow) are formatted to show the nesting of Ada control structures, such as loop . . . end, loop and if . . . end if. This formatting is commonly called "pretty printing." The pretty-printed document also highlights keywords and program unit invocations.

Because ADADL is Ada-based, Ada constructs are used wherever appropriate. One main reason for using ADADL is to use Ada semantics and the Ada syntax for describing those portions of the design that should be described in Ada code—those which define the structure of the program and the structure of the data. Specifically, program unit declarations of packages, tasks, subprograms and generics are strictly Ada. Similarly, type definitions and object definitions are strictly Ada. The control flow of the program and logic (algorithm definition) is not pure Ada code, it is Ada-based PDL. It should be at a higher

Saro B. Ghazarian is a senior software engineer at General Dynamics Corp., Pomona [Calif.] Data Systems Division.

The perfect PC takes bigger bytes.

Now here's a design dilemma that's hard to swallow.

On one hand, the market demands a PC with a smaller footprint to take up less space on a desk. On the other, the market demands high-capacity disk drives with ultra-pronto access to stored data.

PTi's solution: take bigger bytes.

Our 3.5" micro-Winchester hard drives are available in capacities from 20 to over 57 MB, and standard (MFM) or run length limited (RLL) configurations that offer more usable formatted storage space than comparable drives.

But that's just the first course.

Because PTi drives answer the market's "more speed" demands with an average access time of just 35 ms. And they stay cool and last longer, because at under seven watts operating, Peripheral Technology drives use less power running than others do standing still.

Worried about data integrity? Don't. Because PTi drives feature a one-of-a-kind system to automatically retract the heads to a safe landing zone at power down, then secure them with a unique head-locking mechanism.

And for dessert, PTi drives are available in standard 3.5" packages, or with a special 5.25" frame and bezel.

You want to design the perfect PC? Get the perfect drive. From Peripheral Technology.

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We've got the drive.

CIRCLE NO. 37 ON INQUIRY CARD

ADA FEATURES SUPPORT DESIGN

Design techniques and characteristics	Packages	Subprograms	Tasks	Specification body	Pragmatics	Types	Objects	Stubs/separate	Comments	Private parts	Exceptions	Repetitive specs	Allocations	Generics	Predefined packages	Naming	Statements
Abstraction	✓	✓	✓	✓		✓		✓	✓	✓		✓		✓	✓	✓	
Data flow		✓	✓				✓		✓						✓	✓	✓
Control flow	✓	✓	✓						✓		✓						✓
Algorithm design		✓	✓						✓		✓						✓
Data structure design	✓	✓				✓	✓		✓	✓			✓	✓	✓	✓	
Data reference	✓	✓	✓						✓								
Interfaces	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓				
Dependencies	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
Reusability	✓	✓		✓		✓	✓		✓					✓	✓		
Deferred decisions	✓	✓		✓		✓		✓	✓					✓			

Source: IEEE PDL Working Group

A significant amount *of design information can be expressed using Ada constructs. The rich set of features and constructs available eliminates the need to include this information within comments.*

level of abstraction than lines of code, that is, more easily understood.

In addition to helping the programmers, the ADADL processor helps software managers by providing up to 10 custom reports to track such things as each program unit's requirements traceability and the dates of completion of the design, coding or testing of each program unit.

ADADL also has been used to design programs that were ultimately coded in C. For example, Ada/PDL has been successfully used to design programs ultimately coded in JOVIAL and in assembly language.

A cure for documentation blues

There are two associated tools in the ADADL family: one, (Doc-Gen) provides automatic military/Department of Defense standard documentation, and the other (Test-Gen) provides assistance while testing the design (during design reviews for example) and in the testing of executable Ada code (during unit test).

Most programmers habitually document as little as possible. Thus, they appreciate the Doc-Gen tool. DOD/STD-2167 STLDD and SDDD specifications that are created automatically from the ADADL design. The Doc-Gen tool extracts all relevant information from the design (such as inputs, outputs, calls, called-by, etc.) and automatically formats it in a manner suitable for DOD-2167 types of documents. A similar formatting capability is available for MIL-STD-490 specs.

Moreover, the Department of Defense recently took the initiative in mandating the use of PDLs, as part of the DOD/STD-2167, and also mandates the use of an Ada/PDL in the DOD directive 3405.2. The use of a PDL is required so that contractors can establish and define the top-level and lower level design of software modules in a consistent manner.

In addition to the tangible benefits, using Ada as a software design tool also offers some intangibles. It could become a training vehicle that not only teaches programmers how to design with modern software-engineering techniques in mind but also establishes a solid programming foundation. This solid foundation is especially valuable, because more and more programmers are coding in Ada.

Ada is also suitable for expressing solutions to problems throughout the life cycle of a software project, independently of the methodology in use.

It has many features and characteristics inherently useful for expressing software design in preliminary form and detailed form. By selectively using these features, software-engineering principles (e.g. reusability, reliability, readability, etc.) can be supported and design can be specified in a concise and precise manner. Ada features support modern software-engineering practices, particularly: structured programming, strong data typing, separate compilation, information hiding, encapsulation, data abstraction, separation of specification from implementation, reusability, and a rich set of control-flow structures that gives natural expression of design. Hence, Ada could be used throughout the development life cycle rather than just in the implementation phase.

For example, using an Ada compiler to detect errors at an early stage of the design helps reduce the probablity of making errors during the implementation phase. Having compilers or PDL processors, such as the ADADL, that can analyze the design to generate helpful information in report forms (e.g. object cross-reference report, type cross-reference report, program unit cross-reference report, invocation-tree report, instantiation report, complexity report per module and for the whole system, etc.) further helps in documenting the design.

Yet, there isn't an Ada compiler in the market that generates profile reports of the type mentioned above. On the other hand, PDL processors are available based on the Ada language that take programs written in Ada as an input to the processor and generate various valuable reports. □

Interest Quotient (Circle One)
High 498 Medium 499 Low 500

The ultimate driving machines.

The Wysepc 386 and Kierulff professionals, like Ellie.

Two high performers that are driven to give power users the greatest speed and performance possible.

Get behind the keyboard of a Wysepc 386 and you'll get the power of a supermicrocomputer for the price of a PC.

The Wysepc 386 is a 32-bit, 80386-based computer that runs at 16 MHz with zero wait-states. But unlike any other 386, it uses both static column RAM and interleaving to ensure even faster memory access.

This versatile IBM PC-AT compatible system is ideal for desktop publishing, computer aided design, or as a network file server.

And when you buy the Wysepc 386 from Kierulff, you'll get even more high performance features.

Along with our dedicated computer product experts, we also offer a variety of unique value-added services.

We'll provide custom configuration to your exact mass storage, keyboard and monitor specifications. We'll also test your system—as a whole—to make sure that every component is working properly. And, because we have one of the industry's largest stocks of Wyse products, we'll give you the best selection and availability possible.

So call 1-800-FOR PROS (1-800-367-7767). It'll directly connect you to the Kierulff office nearest you.

And these ultimate driving machines.

KIERULFF

Our people are the best part.

A division of DUCOMMUN INCORPORATED

CIRCLE NO. 74 ON INQUIRY CARD

NEW PRODUCTS

SYSTEMS

Megan Nields, Staff Editor

Laptop weighs under 12 pounds

- 80C88 processor
- Up to 2.5M bytes RAM
- LCD screen

A laptop IBM PC/XT-compatible computer, the One Model 2T weighs less than 12 pounds. The unit furnishes an LCD screen, an 80C88 processor running at 4.77 or 7.14 MHz and 512K bytes of RAM, expandable to 2.5M bytes. It displays 25 lines by 80 characters. Options include three dedicated memory cards and a communications controller. A 3½-inch flexible disk drive and serial and parallel ports are standard. $1,695. **Data General Corp.,** 4400 Computer Drive, Westboro, Mass. 01580, (617) 366-8911.

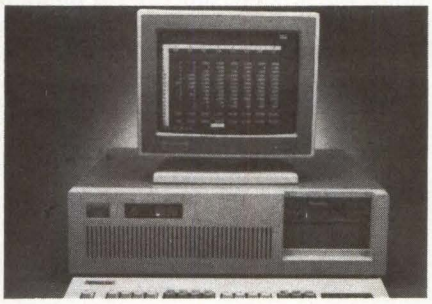
Circle 351

Microcomputer runs on 80386 processor

- 16 MHz
- 512K bytes of RAM
- Eight expansion slots

Based on the Intel 80386 microprocessor, the Pacer 386 runs at 16 MHz. The unit contains 512K bytes of RAM, expandable to 8M bytes via a 32-bit expansion board. It is configured with a 1.2M-byte flexible disk drive and a choice of rigid disk drives with capacities ranging from 20M to 100M bytes. Features include eight expansion slots, a graphics card and MS-DOS 3.2. $4,695. **Laser Digital Inc.,** 1024 Morse Ave., Sunnyvale, Calif. 94086, (408) 747-1966.

Circle 352

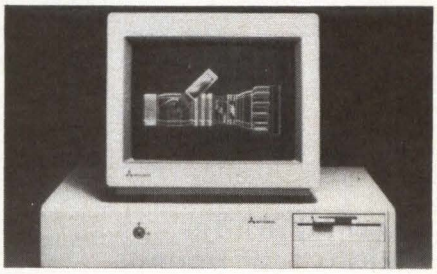


PC furnishes IBM compatibility

- 80286 processor
- 1M byte of RAM
- 1.2M-byte drive

An IBM PC/AT-compatible computer, the Delta A utilizes an Intel 80286 microprocessor. The system offers 1M byte of RAM, a 1.2M-byte flexible disk drive and a Hercules-compatible monochrome/graphics adapter. It comes standard with MS-DOS, GW BASIC and proprietary software. Features include a 12-inch monitor, eight expansion slots, one parallel and two serial interfaces. $1,995. **Delta Computer Corp.,** 260 Forbes Blvd., P.O. Box 809, Mansfield, Mass. 02048. (617) 339-5575.

Circle 353



Micros suit business applications

- Six configurations
- 80386 processor
- Up to 32 ports

Available in six configurations, the XTRA Multiple-User Series microcomputers suit business applications. Based on the Intel 80386 microprocessor, the units feature a proprietary Multiple Terminal Subsystem that can supply up to 32 ports. Memory capacity ranges from 1.6M to 4M bytes. XENIX System V version 2.2 and high-capacity rigid disk drives are included. A base configuration consists of 2M bytes of RAM, a Multiple Terminal Subsystem and a 40M-byte rigid disk drive. $14,799 and higher. **XTRA Business Systems,** 2350 Qume Drive, San Jose, Calif. 95131, (408) 945-8950.

Circle 354

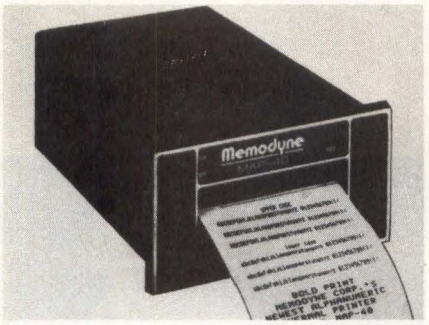
Computer offers 10 slots

- 80386 processor
- Up to 64K bytes of memory
- 40M-byte disk drive

Available in several configurations, the MP 386 is a 80386-based, 32-bit personal computer. Standard features include 32K bytes of cache memory, expandable to 64K bytes, 10 expansion slots and five half-height storage devices. System configurations offer the choice of a 40M-, 70M- or 120M-byte flexible disk drive. Software and hardware options are available. $5,995. **Mitsubishi Electronics America Inc.,** 991 Knox St., Torrance, Calif. 90502, (213) 515-3993.

Circle 355

PRINTERS

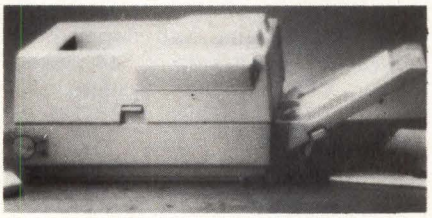


Thermal printer weighs four pounds

- Four print sizes
- Two interfaces
- 0.6 lps

MAP-40 is a 40-column thermal printer with alphanumeric and graphics capabilities. It furnishes four print sizes and a 0.6-lps print rate. Serial and parallel interfaces are standard. The unit weighs less than four pounds. $495, OEM pricing available. **Memodyne Corp.,** 200 Resevoir St., Needham, Mass. 02194, (617) 444-7000.

Circle 356

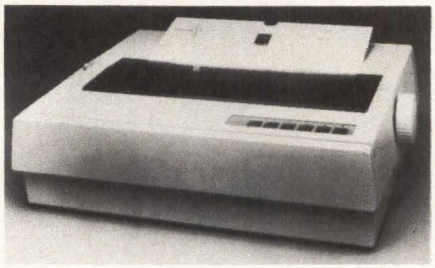


Mac personal printer needs rigid disk

- 300 dpi
- Aldus-compatible
- QuickDraw support

The Personal LaserPrinter supports applications written to printer interface guidelines for the Apple Macintosh Plus, SE and II. The LaserPrinter, compatible with Aldus PageMaker, relies on the Macintosh QuickDraw graphics language to lay out printed pages at 300 dpi. The printer supports outline fonts developed for the Apple LaserWriter and Bitstream fonts in preview, draft and high-quality mode. $2,599. **General Computer Corp.,** 215 First St., Cambridge, Mass. 02142, (617) 492-5500.

Circle 357



Printers target DEC OEMs

- 250 cps
- LA50 compatibility
- 10- and 15-inch carriage

The 9500D, 10-inch carriage; and 9515D, 15-inch carriage dot-matrix printers support LA50 emulation and handle most ANSI requirements in the Digital Equipment environment. For labels, envelopes and multipart forms, the devices offer either push or pull tractor feed and produce 250-cps draft quality with a 9-by-9 matrix and 28-cps NLQ print with a 9-by-10 matrix. For business graphics and bar-code applications, the printers support a resolution of 240 by 144 dpi. Other models of the 9500 series provide IBM ProPrinter and Epson FX series emulation. $749, 9500D; $949, 9515D. OEM discounts available. **C. Itoh Electronics Inc.,** 19300 S. Hamilton Ave., Torrance, Calif. 90248, (213) 327-9100.

Circle 358

Thermal printer codes in bursts and batches

- Flexible formats
- 5 inches per second
- User-defined labels

Designed for batch and burst bar-code applications, the model 8638 churns out labels at up to 5 inches per second. Using proprietary square-matrix technology—images and label are built of printed squares—users can design unique label formats and labels 4.5 inches wide with print areas of 3.3 inches. Formats include fields for bar codes, text and custom logos. The 8638 supports all major bar-code symbologies. $5,995. **Intermec Corp.,** 4405 Russell Road, Box 360602, Lynnwood, Wash. 98046, (206) 348-2600.

Circle 359

24-pin, dot-matrix printer runs at 450 cps

- Up to 450 cps
- Epson emulation
- Multipart forms

The 24-pin Microline 393 prints at up to 450 cps on paper ranging from 3-inch labels to 16-inch continuous forms. Paper can be fed from the bottom, rear or top. The 393's standard push tractor feeder accepts as many as four multipart forms, and the printhead gap can be adjusted for different form types. Standard Centronics and RS232 interfaces combined with Epson LQ emulation provide compatibility with a wide range of PCs and minicomputers. The printer supports bit-image graphics at resolutions up to 360 dpi and is available in two models, black and color. $1,399, black; $1,499, color. **Okidata,** 532 Fellowship Road, Mount Laurel, N.J. 08054, (609) 235-2600.

Circle 360

High-speed laser features PostScript compatibility

- 22 ppm
- 480 dpi
- 6M-byte RAM

The LN-2248 printstation uses a Motorola MC68020-based controller and 6M bytes of RAM to print pages containing graphics as well as proportionally spaced characters at 22 ppm. The 480-dpi resolution aims at technical, scientific and corporate publishing applications. The LN-2248 also uses a floating-point coprocessor and a Texas Instruments 34010 graphics processor that performs area fill, outline drawing and serial rasterization. An onboard package provides PostScript compatibility. $24,000. **Nissho Electronics (USA) Corp.,** 17310 Red Hill Ave., Irvine, Calif. 92714, (714) 261-8811.

Circle 361

IBM

Who says you have to pay extra to get an ASCII terminal equipped with these three letters?

Introducing the new family of IBM 3151 ASCII displays.

Now you can have the most versatile ASCII terminals IBM has ever made, for the lowest price IBM has ever offered. Our new 3151 family gives you more functions, and greater compatibility with more ASCII host system computers, for single unit purchase prices starting at less than $400* per terminal.

Three models and up to 16 emulations make them flexible.

The entry level Model 110 comes with 10 non-IBM emulations built in, and provides an 84-key keyboard with 12 definable function keys.

The full-function Models 310 and 410 come with 11 emulations, and are easily capable of more (such as DEC VT220/100/52™ and WYSE WY-50/50 +™) by simply adding a new low-cost, slimline cartridge.

Their 102-key keyboards, equipped with up to 36 definable function keys, are also recappable, so you can adapt them to fit just about any program.

We worked harder to make them easier to use.

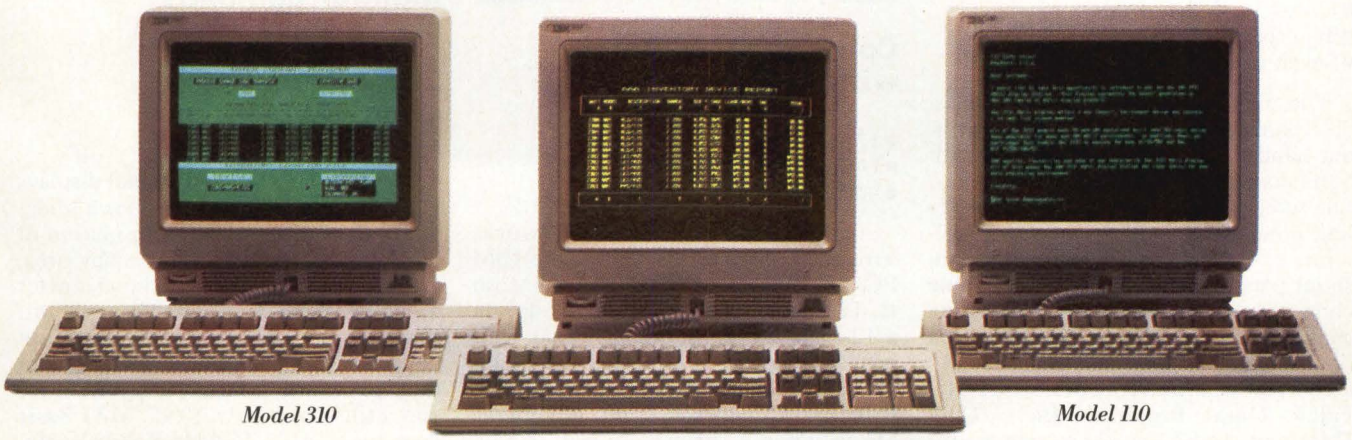
Besides being designed for compatibility with other computers, IBM's new ASCII terminals are more compatible with people.

New 14″ flat screen displays provide a non-glare viewing surface and smooth scrolling. Our 310 and 410 models also offer a choice of 80 or 132 column displays, with crisp character resolution, in green or amber-gold.

What's more, we built the logic into the monitors, making all three models more compact and more reliable.

However, the most important feature of our new displays isn't on the screen, but above it: the IBM name. IBM provides not only a choice of a one or three year warranty, but a tradition of quality, service and support.

It's no wonder these three letters have come to symbolize so much to so many people. And at these prices, they'll be even more in demand. For additional information, contact your IBM Marketing Representative, or call 1-800-IBM-2468 for a supplier near you.



Model 310 *Model 410* *Model 110*

*Prices subject to change without notice.

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CIRCLE NO. 75 ON INQUIRY CARD

TERMINALS

Monochrome screen addresses CAD/CAM, CAE

- 19-inch display
- 67-Hz refresh rate
- 1,600 by 1,280 pixels

A monochrome display for Intel 80386-based systems and the IBM PC and compatibles, the Vista 1600 boasts a 1,600-by-1,280-pixel resolution. The unit supplies a 19-inch screen and a 67-Hz refresh rate. It supports software such as Aldus PageMaker, Microsoft Windows and Ventura Publisher. Applications include CAD/CAM, CAE and desktop publishing. $2,395. **Cornerstone Technology,** 175A E. Tasman Drive, San Jose, Calif. 95134-1620, (408) 433-3983.

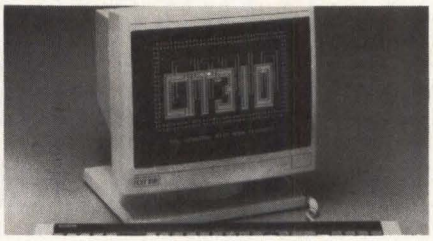
Circle 362

Terminal operates six views at a time

- Up to 38.4K-baud rate
- Two serial ports
- Seven pages of memory

The 500e video display terminal has a data transfer rate of 19.2K baud without handshaking and 38.4K baud with handshaking. It offers seven pages of full screen memory in 80-column, 25-line mode; and four pages in 132-column, 25-line mode. Two bidirectional serial ports can be configured by cable connection with concurrent processing capabilities that allow each to support a host online. The terminal operates up to six virtual windows concurrently. $645. **Falco Data Products Inc.,** 1294 Hammerwood Ave., Sunnyvale, Calif. 94089, (408) 745-7123.

Circle 363

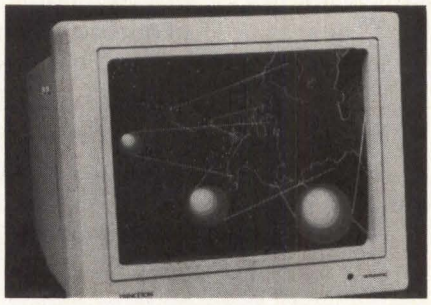


DEC-compatible display links to two hosts

- 180 functions
- Four pages of storage
- 14-inch monitor

Compatible with Digital Equipment products, the CIT310 alphanumeric terminal provides a 14-inch green or amber screen. The unit can be connected to two hosts for simultaneous operation. It includes 1K byte of nonvolatile memory for 180 functions, 45 function keys and 80 or 132 columns. Up to four pages of information can be stored. $749. **CIE Terminals Inc.,** 2505 McCabe Way, Irvine, Calif. 92714, (714) 660-1421.

Circle 364

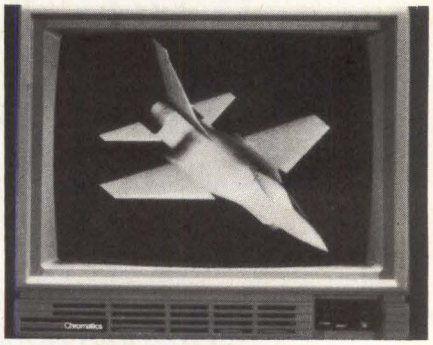


Color monitor works with IBM PS/2

- 12-inch screen
- Up to 64 colors
- 800 by 600 dpi

A color monitor, Ultrasync works with the IBM PS/2 as well as the IBM PC/XT, PC/AT and Apple Macintosh II. The unit displays 800 by 600 dpi on a 12-inch screen. In analog mode, infinite colors are available while TTL mode offers up to 64 colors. $795. **Princeton Graphics Systems,** 601 Ewing St., Building A, Princeton, N.J. 08540, (609) 683-1660.

Circle 365



Display system is fast on the draw

- 32-bit graphics engine
- 1,280 by 1,024 pixels
- GKS software

The Le Mans color graphic display system draws 1 million fully transformed, 2-D vectors per second; 250,000 fully transformed, 3-D vectors per second; and 25,000 smooth-shaded polygons per second. The 32-bit graphics engine contains up to 32M bytes of display-list memory; up to 24 double-buffered, bit-mapped memory planes; and supports GKS software. The system is interconnected via Motorola's standard 32-bit VME bus, and provides a 1,280-by-1,024-pixel non-interlaced display monitor. Under $25,000. **Chromatics Inc.,** 2558 Mountain Industrial Blvd., Tucker, Ga. 30084, (404) 493-7000.

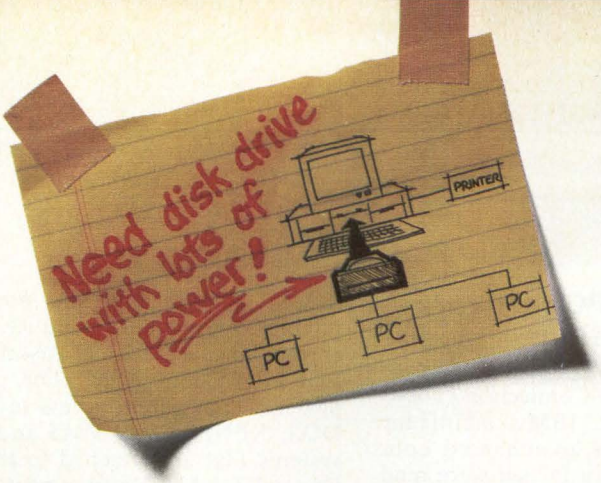
Circle 366

Monitor demands user password

- 864 by 350 pixels
- 19.2K baud
- 14-inch screen

The DT-4313 video terminal displays black characters on a flat 14-inch (diagonal) white screen, with a resolution of 864 by 350 pixels in the display area, and 720 by 350 pixels in the character area. The height-adjustable keyboard provides 14 programmable function keys. Features include a 19.2K-baud rate, password security, a screen saver and a tilt/swivel base. $795. **MAI Basic Four Inc.,** 14101 Myford Road, Tustin, Calif. 92680, (714) 731-5100.

Circle 367



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CIRCLE NO. 76 ON INQUIRY CARD

Kernel runs on 32-bit processors

A real-time, multitasking kernel, VRTX32 runs on 32-bit processors such as the Motorola MC68020 and Intel 80386. The software aims at aerospace, military, factory automation and communications applications. Functions include time slicing and message handling. $6,775. **Ready Systems,** 449 Sherman Ave., Palo Alto, Calif. 94306, (415) 326-2950.

Circle 368

Program creates color 3-D graphs

Running on IBM PC/XT, PC/AT and PS/2, Boeing Graph creates 2-D and 3-D color graphs. Each graph can be viewed from 16 preset angles or rotated 360 degrees. Real-time functions include zoom and pan. The software requires 512K bytes of memory, a rigid disk drive and an IBM EGA or compatible controller. It is not copy-protected. $350 and higher. **Boeing Computer Services,** Micro Software Products, P.O. Box 24346, Seattle, Wash. 98124-0346, (800) 368-4555.

Circle 369

DEC software enhances spreadsheets

Running under the VMS operating system, VAX Xway software, Version 1.1 supports Lotus 1-2-3, releases 1 and 2; Lotus Symphony, release 1; VAX DECalc, Version 3.0; VAX DECalc-PLUS, Version 3.0, or VAX Xway product command files; Multiplan Symbolic Link File Format (SYLK); Data Interchange format (DIF); ASCII tabular data with a specified separator between each data element; and ASCII data describable as fields. The package runs on all VAX computers operating with Version 4.4 or higher of DEC's VMS operating system. $450, VAXstation I system; $1,800, Micro VAX II computer; $10,800, VAX 8800 system. **Digital Equipment Corp.,** 146 Main St., Maynard, Mass. 01754-2571, (603) 881-2934.

Circle 370

Mainframe/PC software links applications

The Application Connection (T-A-C) connects to DB2, IBM's mainframe DBMS. It includes an enhanced Lotus 1-2-3 Connection, a PC software module of T-A-C that gives 1-2-3 users direct access to data in mainframe software products such as DB2 Focus, Nomad 2, Ramis, SAS, and SQL/DS from 1-2-3 spreadsheets. T-A-C runs under the VM/CMS and MVS-TSO operating systems on IBM and compatible mainframes. $100 and $200, microcomputer modules; $8,000 to $15,000, optional mainframe database modules; $10,000, VM/T-A-C module; $13,000, MVS-T-A-C Connection. **Lotus Development Corp.,** 55 Cambridge Parkway, Cambridge, Mass. 02142, (617) 577-8500.

Circle 371

Query/report writer suits OS/2

SQL*QMX, a query and report writer, allows users of Intel 80286 and 80386 machines, including the IBM PS/2 family, to develop and use OS/2 Extended Edition DBMS facilities under DOS 3.1+. Like IBM's QMF, the software provides a reporting and two query environments: Query-By-Example (QBE) and SQL commands. It performs SQL data manipulations UPDATE and DELETE. The package also supports PC-DOS for IBM PCs, MVS/XA and VM for IBM mainframes, and VAX/VMS for DEC VAX and MicroVAX computers. $395. **Oracle Corp.,** 20 Davis Drive, Belmont, Calif. 94002, (415) 598-8219.

Circle 372

Operating system targets real-time users

The iRMX 286 Release 2 operating system supports the 80386 processor and 80387 numerics coprocessor for factory automation, machine control, simulation, data acquisition and communication applications. It features 16M-byte memory addressability, multitasking and multiuser support, priority-based scheduling and on-target development. Capabilities include: iRMX 286 command line interpreter, interactive configuration utility, and reentrant languages such as Pascal, PL/M, FORTRAN and ASM. The package provides transparent access to files on DOS, XENIX, VAX/VMS and iNDX systems that are attached to the same OpenNET LAN. Development license; $5,500. **Intel Corp.,** W380, P.O. Box 58065, Santa Clara, Calif. 95052, (800) 548-4725.

Circle 373

Software supports laser printers

The Q&A Write word processing software includes font and laser printer support and tight integration with Ashton-Tate dBASE and Lotus 1-2-3 packages. It allows users to menu-select up to nine fonts in each document directly, and output to laser printers to produce typeset-quality documents. The software supports the Hewlett-Packard LaserJet, other popular laser printers and, through PostScript support, the Apple LaserWriter. Q&A Write also permits users to run dBASE II and III from its main menu and mailmerge with dBASE, 1-2-3, Q&A and other ASCII databases. Supporting MS-DOS/PC-DOS 3.1, Q&A Write runs on the IBM PC, XT, AT, PS/2 Models 30, 50, 60 and 80 and compatible computers; requires 384K bytes of RAM memory; supports popular printers; and contains both 3½-inch and 5¼-inch formats. $199. **Symantec Corp.,** 10201 Torre Ave., Cupertino, Calif 95014, (408) 253-9600.

Circle 374

386-based package executes MS-DOS, UNIX

The Merge 386 software package allows the simultaneous, transparent execution of both MS-DOS and UNIX operating systems. DOS is run as a multiuser operating system. It offers password security, file protection and a fully integrated file system. The program requires 2M bytes of RAM and a 20M-byte rigid disk drive. $695. **Locus Computing Corp.,** 3330 Ocean Park Blvd., Santa Monica, Calif. 90405, (213) 452-2435.

Circle 375

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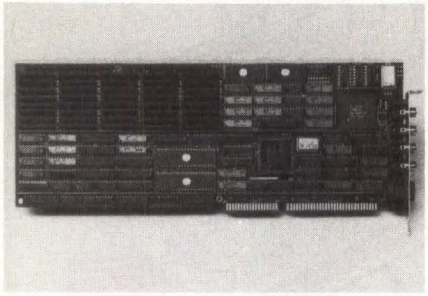
CIRCLE NO. 77 ON INQUIRY CARD

SUBASSEMBLIES



Graphics board offers 256 colors

- 1,280 by 1,024 pixels
- 1.25M bytes of RAM
- 4,096-color palette

Targeting CAD, solids modeling and desktop publishing applications, the Pro 1280 graphics board displays 256 colors from a 4,096-color or 16-million-color palette. The device has a 1,280-by-1,024-pixel resolution, 1.25M bytes of video RAM and 128K bytes of instructional RAM. It emulates IBM CGA, MDA and PGC units. Features include 32-bit graphics and VLSI software support. $3,000. **Number Nine Computer Corp.,** 725 Concord Ave., Cambridge, Mass. 02138, (617) 492-0999.

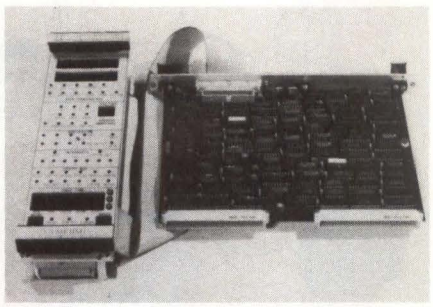
Circle 376

Board targets 80286 processors

- 16-bit unit
- Up to 4M bytes
- IBM compatible

A 16-bit expansion board, the Captain 286 aims at Intel 80286-based computer systems. The unit is compatible with the IBM XT 286 and PC/XT, as well as the EMS standard. It handles memory expansion up to 4M bytes via proprietary memory modules. Software allows users to switch between expanded and extended memory programs. An IBM-compatible printer port and an RS232C port are standard. $845 and higher. **Tecmar Inc.,** 6225 Cochran Road, Solon, Ohio 44139-3377, (216) 349-0600.

Circle 378

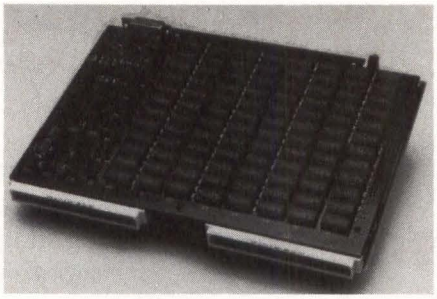


Bus monitor provides inside view of VMEbus

- Two LED displays
- Five control modes
- Fully transparent

Providing a direct "window" onto the VMEbus, the CVMEBM1 monitor remains totally transparent to the host system. This diagnostic tool plugs into a single slot on the VMEbus, and displays the status of 32-bit data and address lines on two banks of hexadecimal LEDs. Control modes are: transparent, stretch, strobe, single and latch. $3,000, volume discounts available. **Concise Technology,** P.O. Box 280, 708 Mandrake Drive, Batavia, Ill. 60510, (312) 879-7003.

Circle 380



VME-compatible SBC sports three versions

- MC68020 processor
- Two-channel controller
- 2M-, 4M-byte DRAM

Based on the Motorola MC68020 CPU, the CY4110, a VMEbus-compatible single-board computer comes in 12.5-, 16.67- and 20-MHz versions and supports both real-time and multiuser environments. Features include 2M to 4M bytes of dual-ported DRAM with parity, a 68440 two-channel DMA controller and controllers for a 1.5M-byte-per-second SCSI and a flexible disk drive. A real time clock is supplied. There are four RS232C I/O ports and a parallel printer port. $5,700 (12.5 MHz), $5,700 (16.67 MHz) and $6,100 (20 MHz). **Cyclone Microsystems,** 25 Science Park, New Haven, Conn. 06511, (203) 786-5536.

Circle 377

VLSI graphics speeds display controllers

- Optional overlay
- Raster capability
- Four, eight bit planes

Custom VLSI graphics drives the 4-MIPS performance of the 1000VM-Series display controllers for use in VMEbus-based systems. Pixel resolutions are 1,024 by 768 for the low-end 1054VM and 1,280 by 1,024 for CAD/CAM applications with the 1258VM. Both resolutions offer 4 or 8 bits per pixel from a palette of 4,096 colors, with a 16-million color option. Bit planes may be panned and zoomed independently over the overlay, and all systems can be optionally configured with two separate overlays of two bit planes each. $2,495, 1054VM; $3,995, 1258VM. **Metheus Corp.,** 5510 N.E. Elam Young Parkway, P.O. Box 1049, Hillsboro, Ore. 97123, (503) 640-8000.

Circle 379

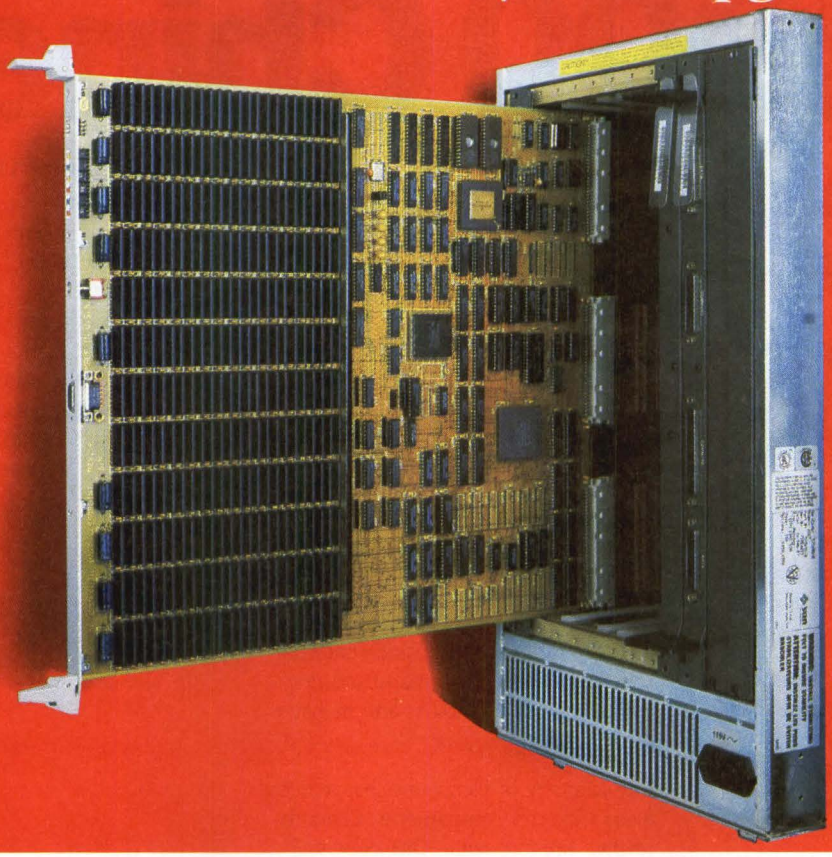
Print server ties eight users to four devices

- 512K-byte RAM
- Zero wait states
- AST, IBM compatible

Applicable with any serial or parallel printer or plotter, the Premium Connection family of intelligent print servers is compatible with AST, IBM or any other personal computer with an RS232C or RS423 port. All three models allow up to eight users to simultaneously access one to four devices. Based on an Intel 8-MHz 8088, the series features zero wait states, 512K bytes of RAM (upgradeable to 2.5M bytes) and four asynchronous serial ports. Model 2 incorporates a 1.2M-byte flexible disk and model 3 a 20M-byte rigid disk. Disk upgrades and expansion cards are optional. $1,150, $1,495 and $1,995. **AST Research Inc.,** 2121 Alton Ave., Irvine, Calif. 92714, (714) 863-1333.

Circle 381

Clearpoint's New 32MB Memory for the Sun 3/2XX and 4/2XX Delivers the Ultimate in Density and Upgradability



Plus Powerful On-Board and Remote Diagnostics

Four Times the Density of Sun Memory for the 3/200

The SNX2RAM offers the highest density possible for the Sun 3/2XX, plus compatibility with the Sun 4/2XX. The board uses advanced megabit ZIP DRAMs and the unique Clearpoint EDC chip set to achieve this unprecedented density.

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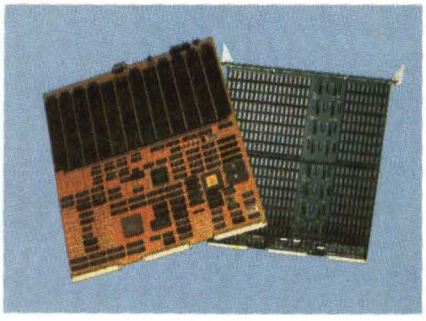

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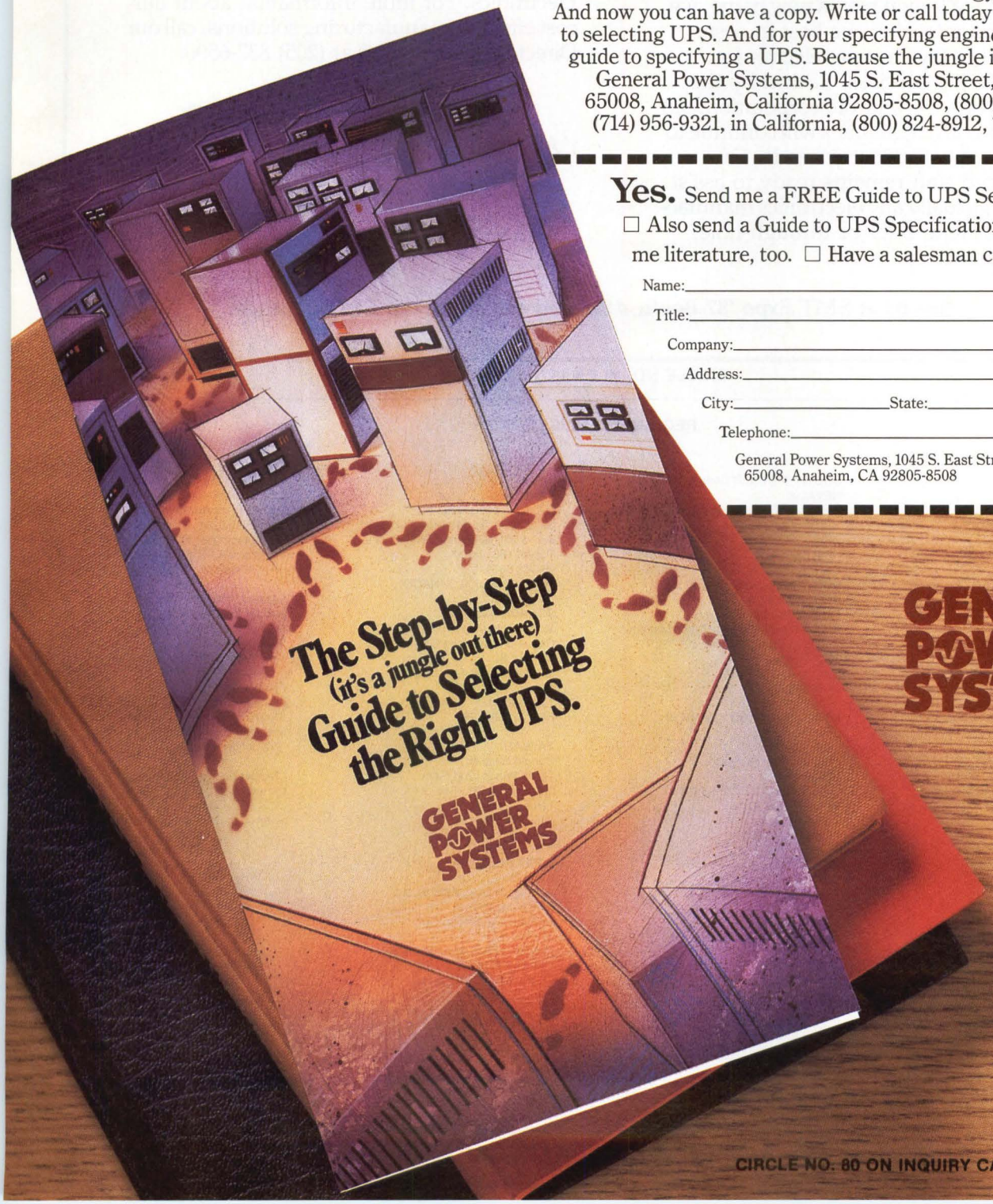

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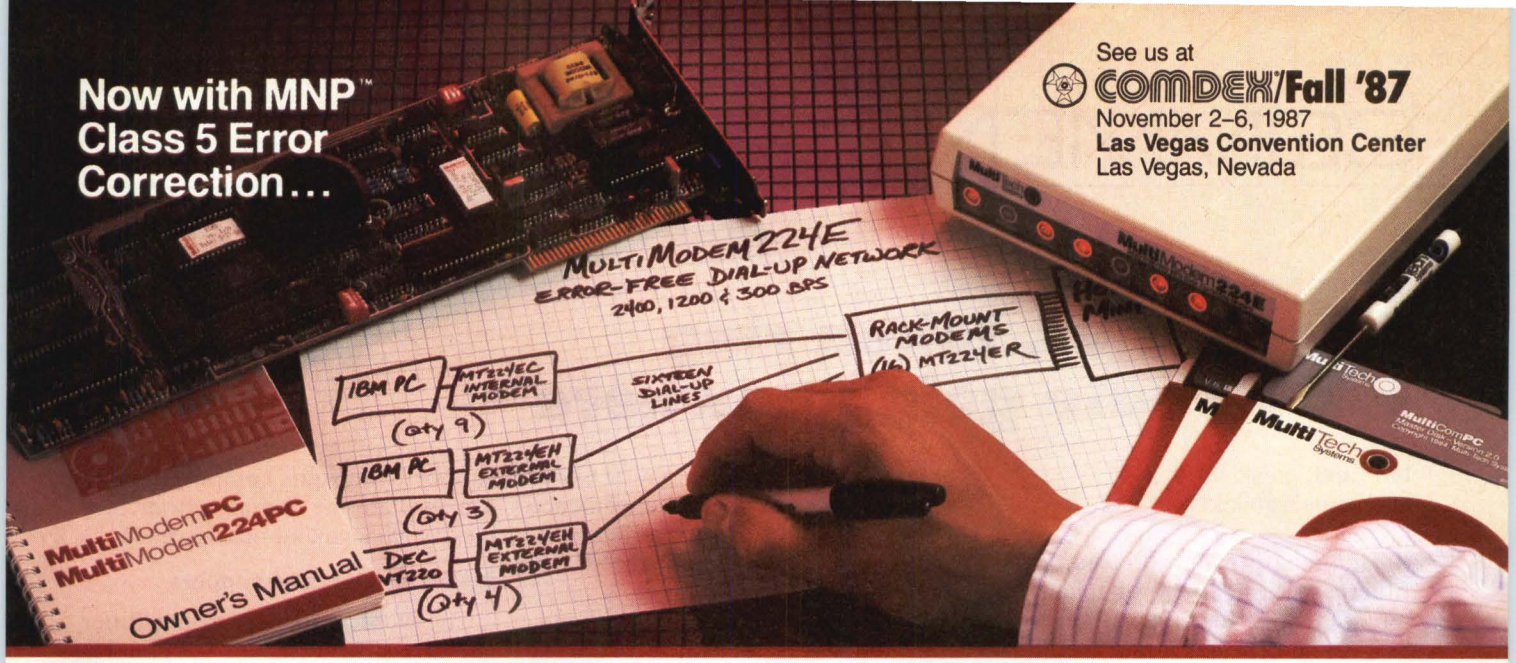

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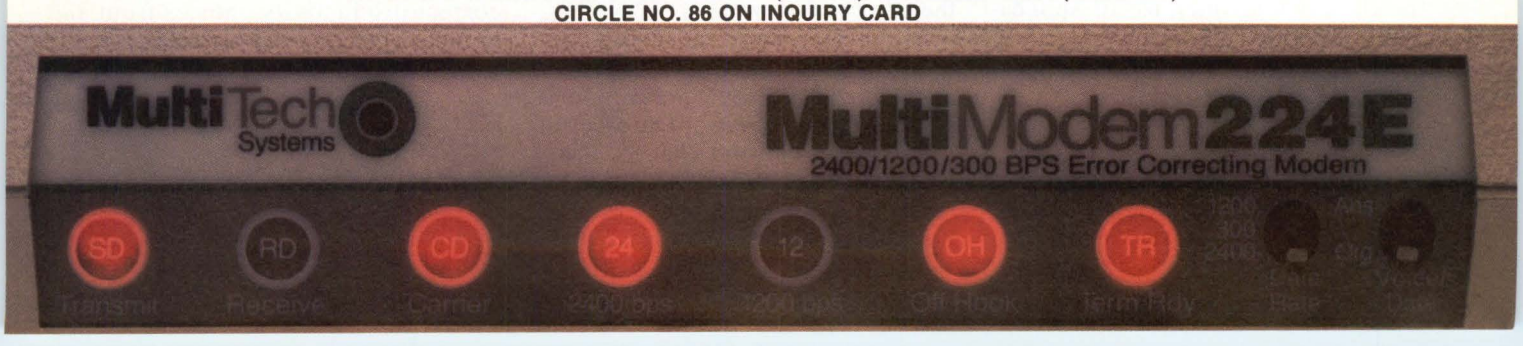

Ethernet vs. token ring is a debate going nowhere

Ian Ebel, president
Microserv Technologies Corp.

The debate over which is better, Ethernet (IEEE 802.3) or token ring (802.5), is like debating which is the best brand of wood screw. Neither is better, inherently, and they cost about the same.

The choice among networks often boils down to whether the building is already cabled for token ring or whether the customer has already made an investment in some Ethernet equipment.

Raw compatibility is no longer an issue. As far as connectivity is concerned, the clear-cut technical challenge of compatibility has been solved. People simply expect that if you buy a computer and plug it into a local area network wall outlet that it will be connected to the other resources on the LAN. The major concern now is not just to share resources but also to share data and, more and more, to share applications.

Not all connections perform equally well in every situation—even though the products that implement the connections have all become standard. Two factors in particular help measure the performance of a connection at a particular site: the cost of achieving a satisfactory rate of data transfer and the cost of network expansion.

Some gateways work best for moving data very rapidly between networks. (Example: Single Board Solutions from National Advanced Systems, Santa Clara, Calif.) Others, which may not move data quickly, are much easier to interface to application software. (Example: NetPath from Pathway Design Co., Natick, Mass.)

A foolish benefit

In those cases where high speed is a critical objective, such as in moving data among major network hubs, using the faster gateway may be worth the extra expense and inconvenience of writing the necessary interface software. Where the speed of the slower gateway is acceptable (as it is in 90 percent of LAN installations), spending more money to achieve an almost undetectable benefit is foolish.

Planning connections that allow for network expansion represents another set of decisions affecting productivity. There are many ways to connect equipment reliably, based on the bus, star and ring topologies. The configuration that best accommodates future growth is most often an arrangement of stars or hubs. Even if your current need is for only a simple ring-type arrangement, it would be foolish not to install a number of hubs in the building to allow for multiple rings in the future.

As the business grows, these other rings can be implemented as department-level subnets. Subnets provide the advantage of fast local communication among members of a specific work group. And they don't lose the advantage of efficient network-wide communications. You get seamless communication across the network without the traffic-control overhead of a gateway and without the management headaches that come when each department has its own LAN.

"Plug it in and it works" is the motto that reflects the state of mind of most end-users. Office workers have grown accustomed to copiers, typewriters, personal computers and telephones that hardly ever break down and that are backed up by on-call service on those occassions when they do break down.

In this new world, advanced technology does not have the same appeal as it once did. People want predictable results. They want protection from complexity and change. That's why selecting a computer solution has become less important than selecting the source of that solution. Through support, the right computer source can insulate the end-user from complexity, change and obsolescence.

Different flavors of support

The word "support" means different things to different people. The kind of support end users want is different from the kind of support demanded by resellers. To be successful in the end-user market, vendors of LANs have had to meet the no-fault standard required of other office equipment. No LAN supplier, whether third-party or vendor, can achieve a competitive advantage by merely selling reliability. That has become a common denomenator.

The kind of support that makes a difference to end users is support that helps them operate their business better and more competitively. They want applications specifically adapted to their type of business, and they want systems fine-tuned to the exact requirements of their installation.

In other words, where defining market-specific applications (or "product development") leaves off, local adaption (or "support") begins.

Successful resellers understand the support needs of their customers. In turn, the support needs of resellers must be understood by vendors wishing ultimately to move their equipment down the distribution stream into specific target markets.

Resellers need to know—of all the product options that could implement an application *reliably*—which are those that best implement it *productively*. Helping resellers make the correct productivity choices from a number of technically correct options is the vendors' key obligation.

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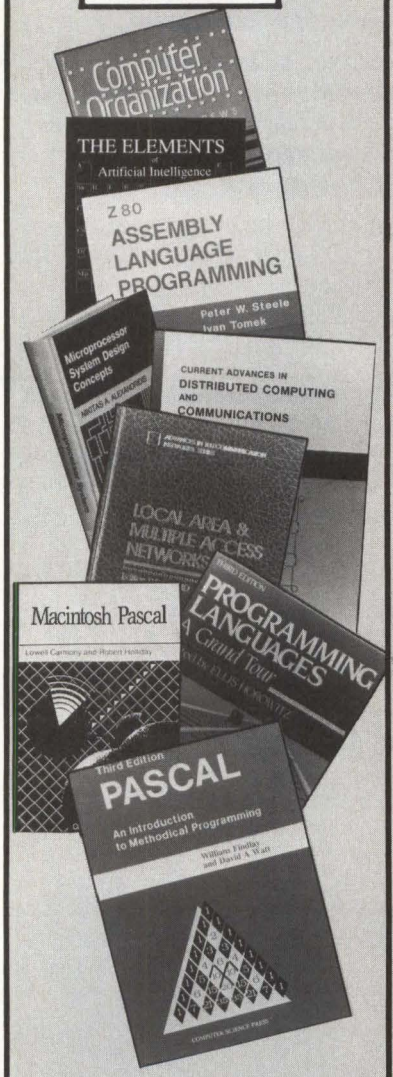

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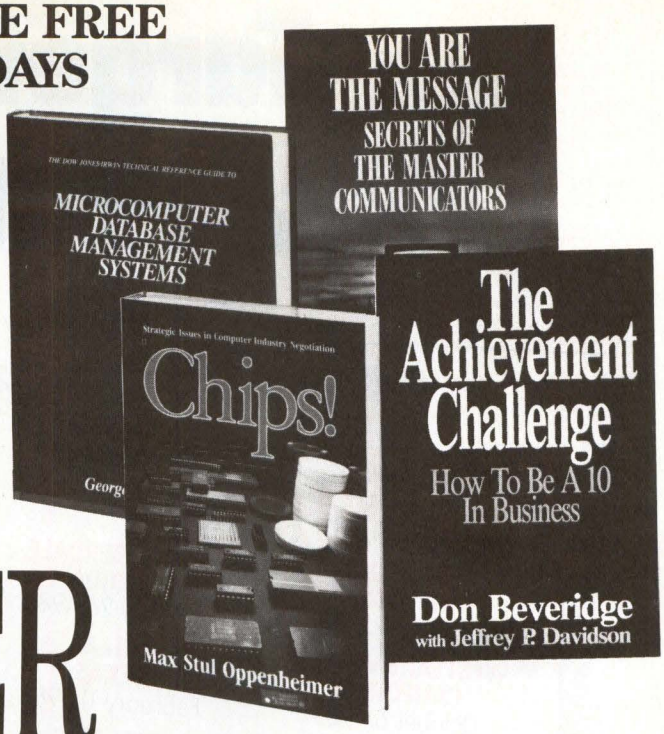

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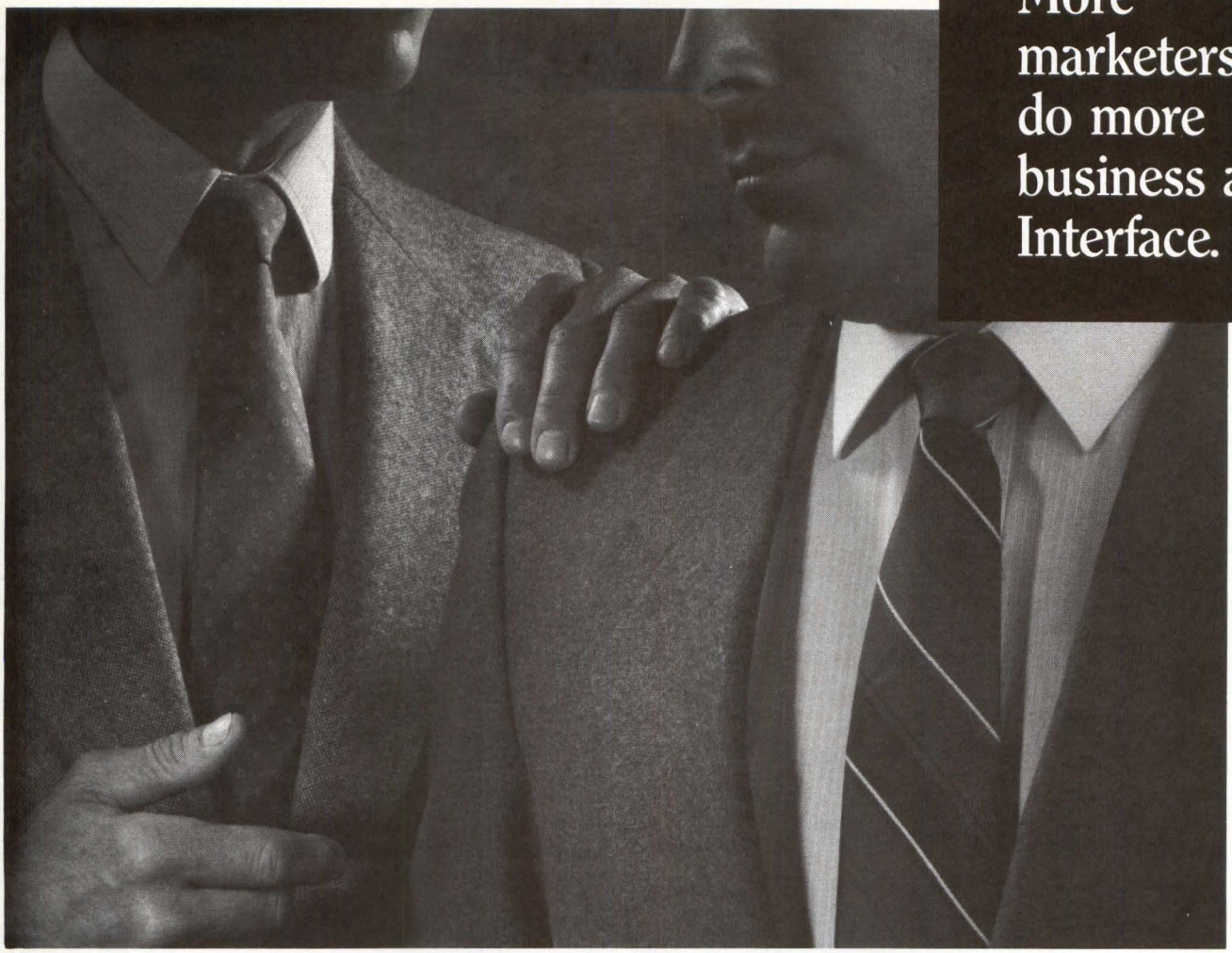

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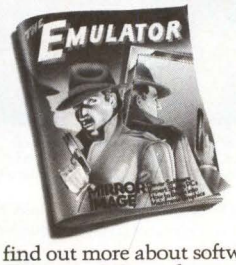

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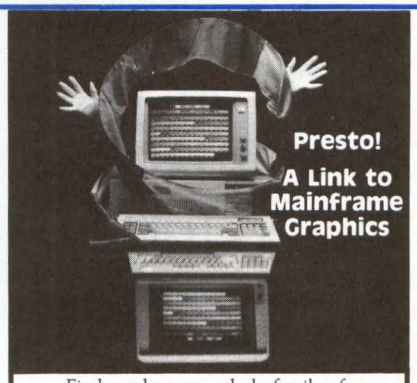

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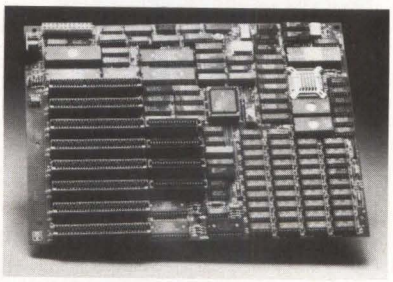

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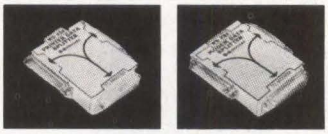

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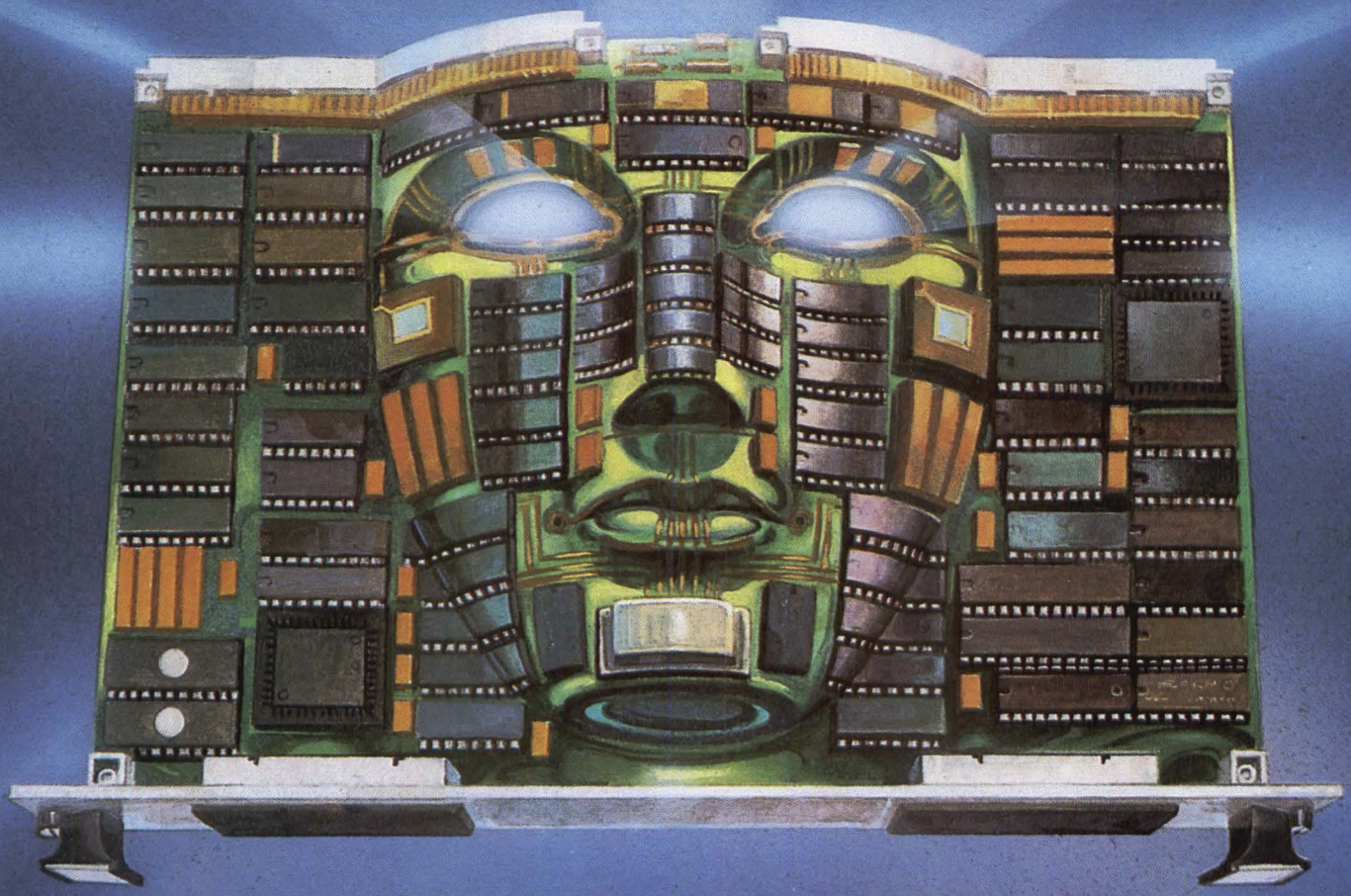

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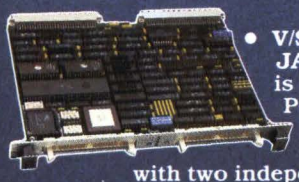
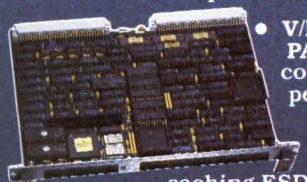


• **V/SCSI 4210 JAGUAR** is an Ultra-Performance caching host adapter with two independent and simultaneous SCSI ports and Command Queuing. It offers true Multi-Threaded control of any mix of up to 14 Synchronous and Asynchronous SCSI devices. Advanced systems concepts like disk striping and segregating high-end devices from slow or unbuffered ones become real. And Interphase's 30 MByte/s BUSpacket Interface℠ provides the industry's fastest VMEbus speed.



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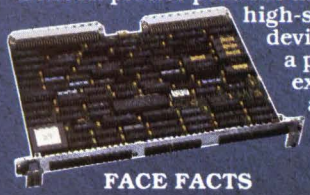

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CIRCLE NO. 84 ON INQUIRY CARD

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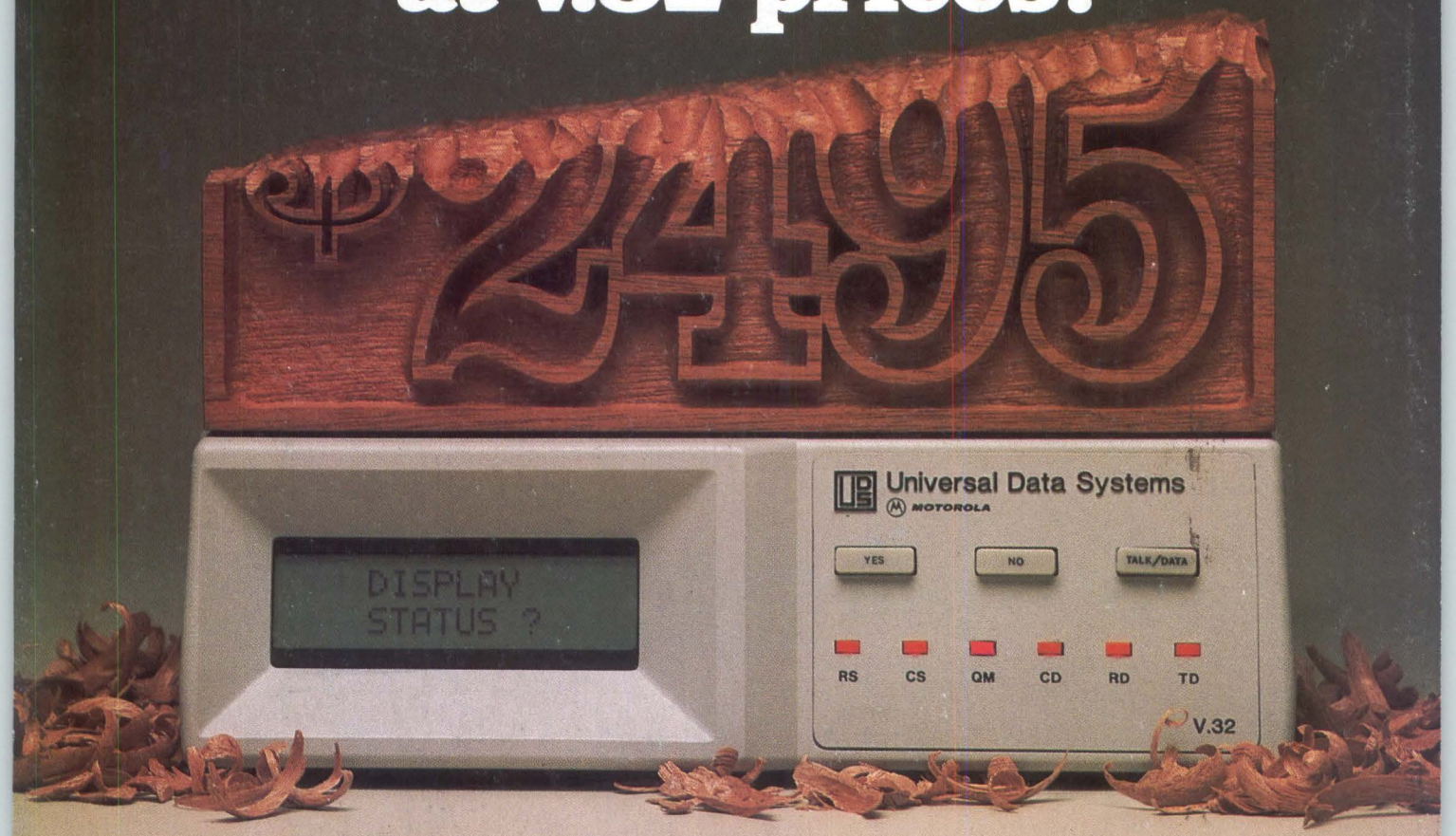

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