

NOVEMBER 1986

# Mini-MicroSystems

THE MAGAZINE FOR COMPUTER SYSTEMS INTEGRATION

A CAHNERS PUBLICATION

## Convergent's 386 strategy: NGEN first, then PC server

### SPECIAL REPORTS:

- **Monitors/terminals**
- **Graphics terminal emulation**
- **Revamped MAP and TOP**
- **The ASIC edge**





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Don't buy another laser printer or other expensive peripheral — share the one you already have! The Giltronix PSD 8000 lets from 2 to 14 computers or terminals share the same printer, plotter, modem, or other peripheral device easily, efficiently, and economically.

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- 12-month limited warranty.

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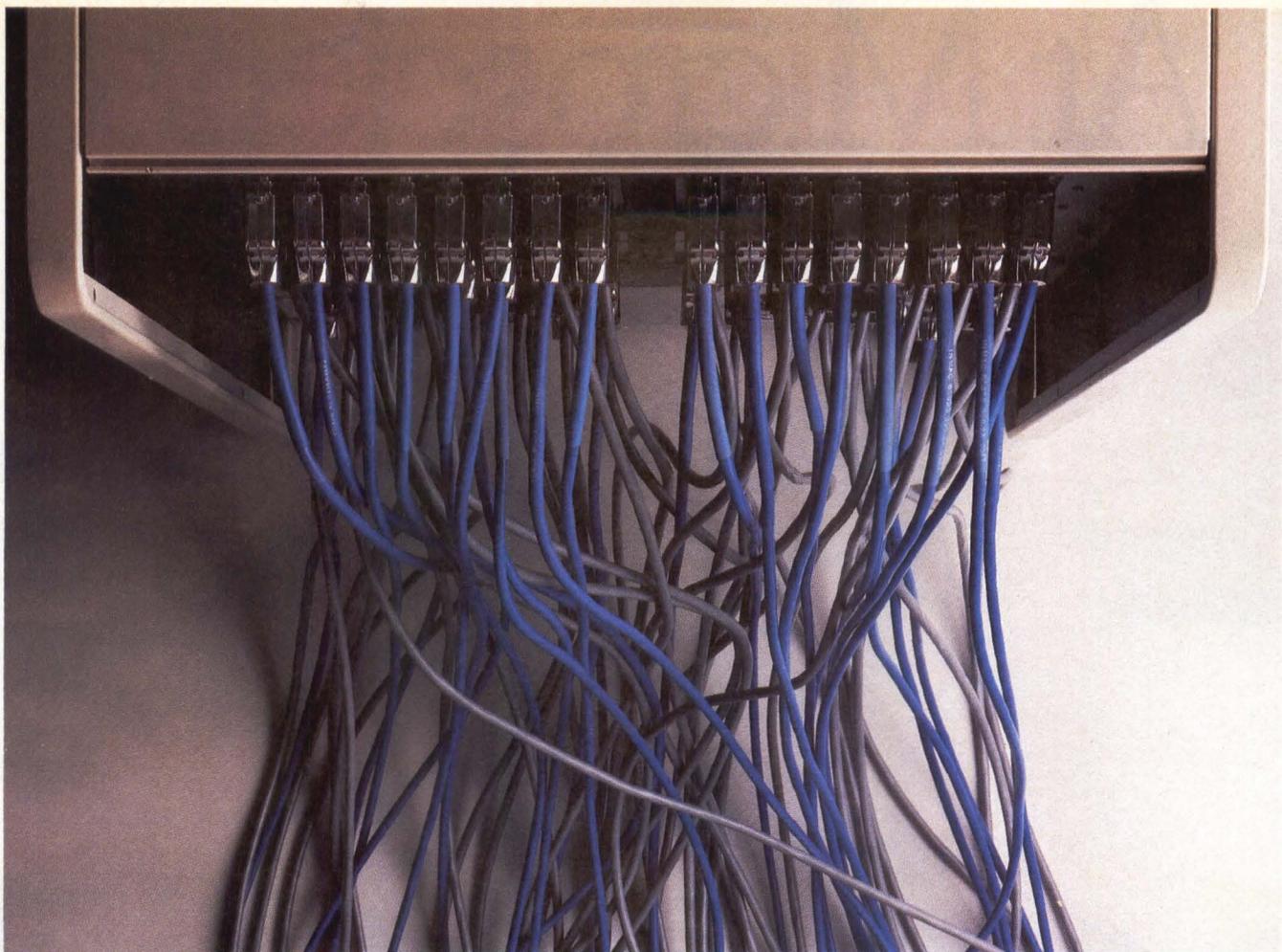
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CIRCLE NO. 1 ON INQUIRY CARD

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Telex 345542



## How many more reasons do you need to Unplug your computer?

Until now, connecting 128 terminals to your computer meant one thing. A myriad of cards taking up precious space on the backplane. And accomplishing nothing but communications. All of which could frustrate almost any self-respecting system designer into hanging up his calculator.

Well, at Systech, we understand the serial communications problems of a multi-user system. So we developed The Unplug™ asynchronous distributed multiplexer that can be used with any Multibus®, VMEbus or Multibus® II system.

The Unplug can take those 128 connections off the back of the computer and turn them into just one. And presto, you've got all the expansion slots you need for more important things. Like disks. Streaming tapes. More CPU power. A synchronous communications processor. And your imagination.

You see, what we did was move part of the computer's operating system—the part devoted to managing traffic to and from the terminals—out of the computer and into The Unplug. Giving the host computer the freedom to concentrate on more important tasks.

We know it sounds simple. And the truth is, it is. In fact, you might wonder why no one thought of it before. Then again, no one else has our commitment to make your job easier. And a lot more gratifying.

Just give us a call at Systech to hook up with The Unplug. Then you can start figuring out what you want to add on next.

Instead of trying to figure out how to untangle all those wires.

Systech Corporation, 6465 Nancy Ridge Drive, San Diego, CA 92121, (619) 453-8970.

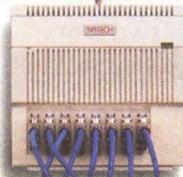
**CIRCLE NO. 2 ON INQUIRY CARD**

# The Unplug.

An outlet for your frustrations.

When you're ready to expand, you simply run one cable from the last Unplug to the next. And you've hooked up 8 new users, without ever opening the computer cabinet.

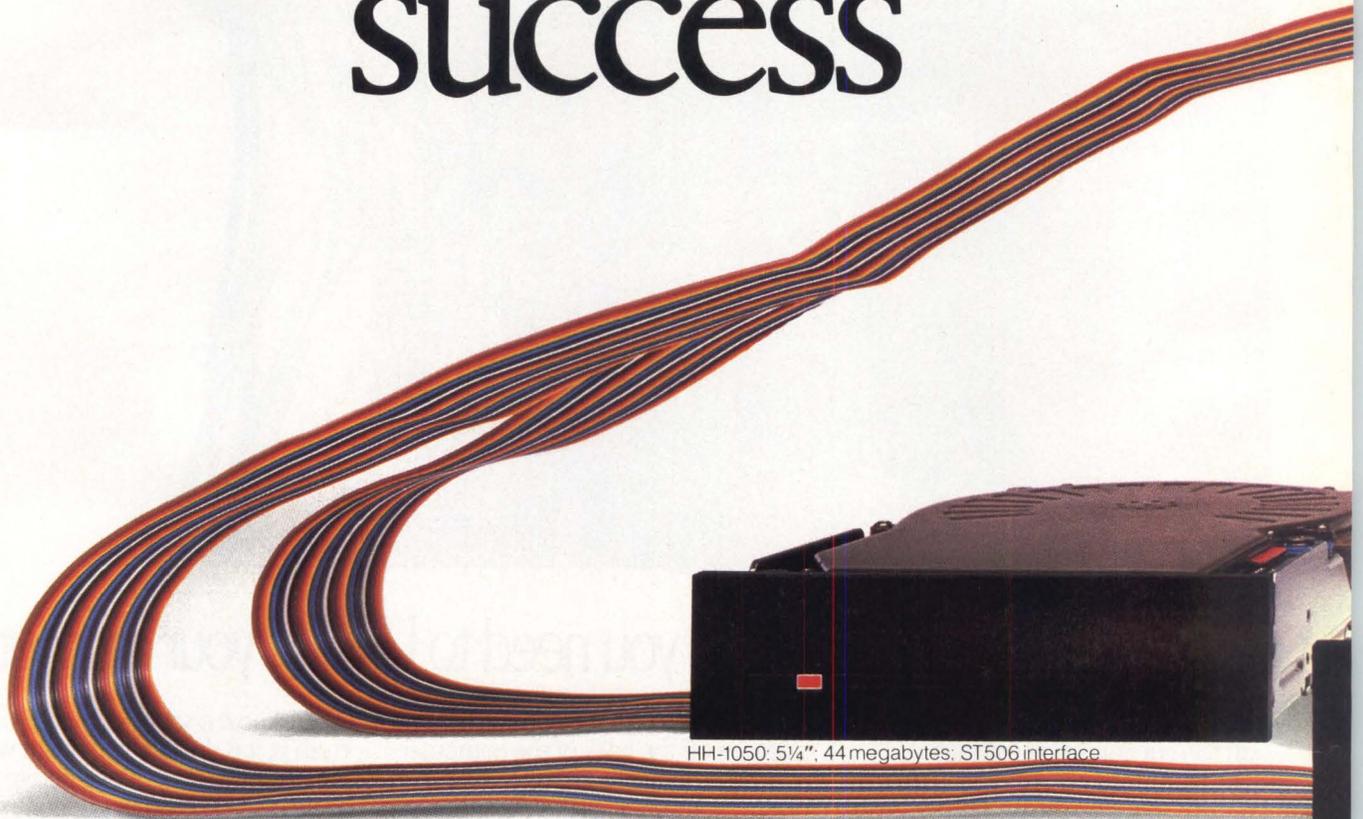
The Unplug is a trademark of Systech Corporation. Multibus is a registered trademark of Intel Corporation.



**SYSTECH**

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The Unplug patent pending.

# At Microscience success breeds success



HH-1050: 5¼"; 44 megabytes; ST506 interface

*Our 1050 half-height met with such success we've created two more just like it. Only this time we're doubling both capacity and speed, and building in smart controllers for either the SCSI or ESDI interface.*

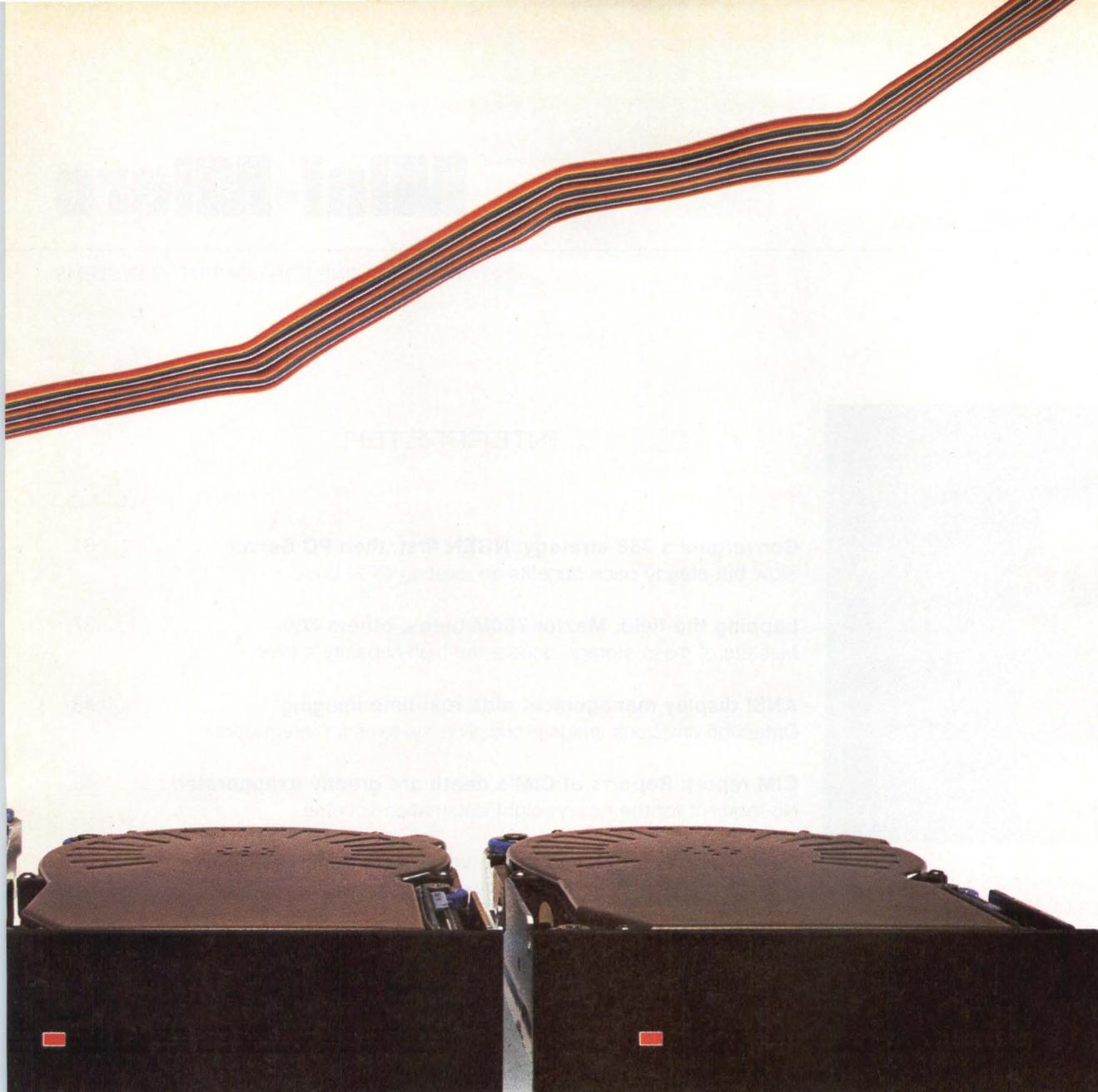
At Microscience, we believe in *evolution*, not *revolution*. That's why we built two new, faster, higher capacity, smarter half-height 5¼"

disk drives using the same mechanical HDA as our current best seller, the 44 MB HH-1050.

You get the performance specs you need for your next-generation small business PC, with the added assurance of a field-proven design. A design so reliable, we guarantee 30,000 hours MTBF for all three drives.

Plus, our two new drives offer the design-simplifying addition of built-in, smart controllers for either the SCSI or ESDI interface. This eliminates controller-to-drive interface and testing problems and helps assure more accurate data integrity.

HH-



HH-1050: 5 1/4"; 89 megabytes; SCSI interface

HH-2085: 5 1/4"; 89 megabytes; EDSI interface

These two new drives are just the latest

**Microscience 5 1/4" Half-Height Disk Drives**

Model Number	HH-1050	HH-1080	HH-2085
Formatted Cap. (MByte)	44.56	89.12	89.12
Unformatted Cap. (MByte)	53.33	106.66	106.66
Avg. Access Time (msec)	28	28	28
Transfer Rate (Mbits/sec)	5.0	10.0	10.0
Interface	ST-506	SCSI	ESDI
Positioning Method	Linear Voice Coil	Linear Voice Coil	Linear Voice Coil
MTBF	30,000	30,000	30,000

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CIRCLE NO. 3 ON INQUIRY CARD



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 Art design by Melanie McGinnis  
 Kaye, photography by David Monley.  
 Courtesy of Convergent  
 Technologies Inc.

## INTERPRETER

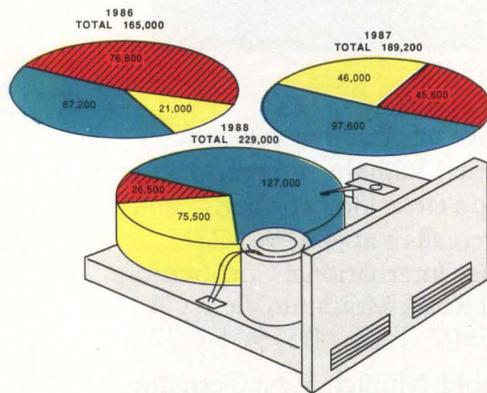
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\*Appearing in issues of subscribers who have DEC computers

\*Appearing in issues of subscribers who have DEC computers

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INTEGRATION

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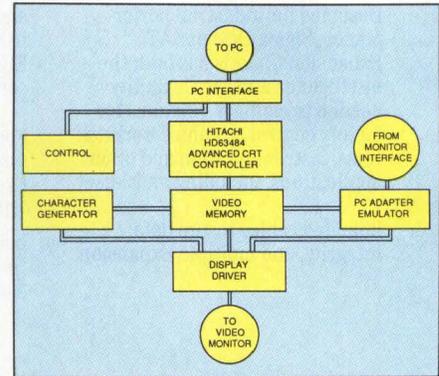
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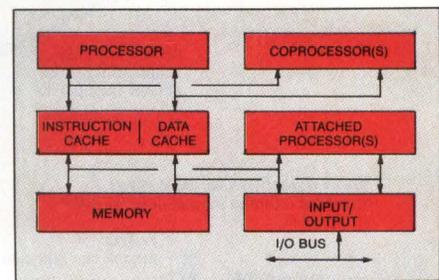
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## Persyst. The wise choice for PC data comm. Take a look!

Persyst's DCP-88 is a PC data comm solution worth eyeing. A front-end processor smart enough to offload comm processing so your PC can sink its claws into your application.

And the DCP-88 works with your IBM-PC, PC/XT, PC-AT, PC/RT or PC-compatible. To turn any PC into a real communications work station—not a way station.

**DCP-88's processor keeps your PC working on applications, not protocol overhead.** The onboard processor offloads comm overhead, freeing your PC to focus on applications.

Choose from two DCP-88 models—each with a processor poised to swoop into action. The DCP-88/VM with its 4.77 MHz 8088 is capable of handling most applications. Or, for nearly twice the throughput, select the DCP-88/VMX with a 7.16 MHz processor.

Either way, you get a powerful co-processor so your system's comm performance soars.

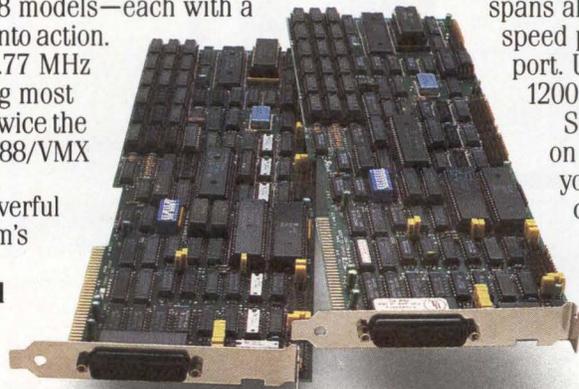
**Dual-ported onboard memory speeds data transfer.** With up to 512 KB memory, the DCP-88 has more than enough capacity to handle the most sophisticated comm applications.

And the board's dual ported memory architecture allows data to pass directly between processors at memory speed—so communications fly through your system.

**Multiple lines and protocols for a multitude of applications.** Adaptable as it is wise, the DCP-88 blends into your comm environment. With up to four serial ports, for example, you can tie to multiple hosts or PCs. Plus, the DCP-88 fully supports asynch, bisynch, SDLC and HDLC protocols so your system's smart enough for any application.

**Supports printers up to 1200 lpm.** The DCP-88 spans all your comm needs, providing high speed printer support via its optional parallel port. Up to 600 lpm on the DCP-88/VM and 1200 lpm on the DCP-88/VMX.

So don't let your PC comm stick you out on a limb. Not when the solution is staring you in the face. Call or write Persyst for a complete look at our DCP-88 line.



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Our Preview Terminal combines a high-resolution monitor with local memory, 30 ROM fonts, and support software. Software that allows you to preview Tektronix™ output, TeX™ typeset files, ReGIS™ graphics, and more.

**"Take a good look at what you're doing!"**

Take advantage of the T7800's vector graphics display. Use our Tektronix 4010/4014 emulation, and you'll swear you're working at a Tektronix terminal. With local pan and zoom and an optional mouse, you're equipped for lightning-fast vector graphics imaging.

The T7800 performs raster operations for manipulation of its

bit-mapped display. Window management allows you to define and use special characters, fonts, icons, and pop-up menus.

Or let the T7800 function as an alphanumeric terminal, with VT52™, VT100™, VT220™, and optional VT240™ emulation.

Plus, our T7800 has a built-in driver for our T610 and T810 Laser Printers. So you can print directly from the screen, quickly and easily.

Talaris has support software that exploits the T7800's half megabyte of memory. Download fonts, work with raster patterns and display lists, or create a print buffer. Use our PreTeXt™ software to preview TeX files exactly as they will appear when printed.

Find out more.

Contact us for additional information. Talaris Systems Inc., P.O. Box 261580, San Diego, CA 92126; (619) 587-0787.

Sonny Burkett  
VP Marketing  
Talaris Systems Inc.



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## INDUSTRY GROWTH AWAITS CONNECTIVITY, INTEGRATION

After several years of heady computer buying, users have retrenched. Instead of purchasing new or improved products, they have opted to continue implementing their existing hardware. According to market-research company, International Data Corp., most businesses raised their computer budgets more than 18 percent annually from 1982 to 1984. During the past two years, though, that growth rate has shrunk in half. And, unfortunately, that situation should persist into 1987.

What happened is that many companies discovered that computer performance fell short of expectation. In addition, many users did not change their proven data-handling routines. What's more, companies have acquired a degree of computer proficiency. They are thus taking a harder look at buying additional units. More important, though, they are frustrated over not being able to connect and integrate dissimilar computer equipment into information-service networks.

As a result, users are holding on to their reliable processors well beyond predicted life cycles—even when some models are no longer manufactured. Rather than being pioneers, some users have even installed used equipment.

Software has also contributed to users' woes. A recent Touche Ross Enterprise Group study of 526 businesses reveals that 70 percent of microcomputer users stated that software did not work out for their purposes. Others complained that software is unavailable, hard to find or misrepresented.

But users must share some of the blame, too. In many cases, corporate and management cultural and organizational problems submerge the technical ones. These difficulties involve: who keeps what information, who can access data and who approves transactions and changes. Because these time-consuming decisions encompass several departments and management layers, equipment purchasing cycles have doubled.

And even when users do buy new equipment these days, they have turned into hard-

nosed negotiators. Taking advantage of the slow sales environment, users are demanding corporate discounts, equipment trade-ins or free options.

Another-market research company, Dataquest Inc., predicts that the computer market will limp into 1987 on only a 2 percent annual growth rate in U.S. business sales.

What appears to be needed to spur growth are new products at reasonable prices that stimulate buyers' interests, states the trade press. Computer systems based on the 32-bit Intel Corp. 80386 microprocessor have recently been introduced. They represent the impetus to ignite the industry to higher economic heights, say numerous feature articles. What is glossed over, however, is that operating system and application software won't be ready until mid-1987.

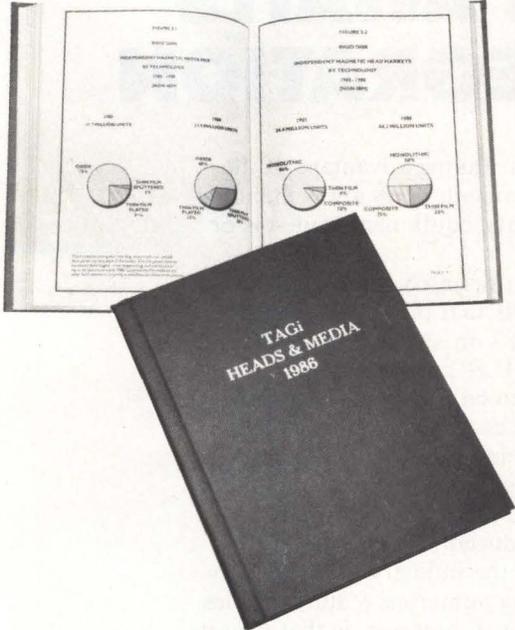
All is not doom and gloom though. For several manufacturers, the slowdown never happened. Such companies as Digital Equipment Corp., Compaq Computer Inc., Apple Computer Inc., NCR Corp., Tandem Computer Inc., Stratus Computer Inc. and Sun Microsystems Inc. kept growing in sales by offering products in niche markets.

What's needed then to accelerate this plodding growth rate? For one thing, ease of integration, connectivity and networking head the list of users' needs. Software that runs on many different computers is important. Yet another concern is for clearly defined and easily understood hardware and software standards. Bringing all of these strengths to bear on users' stormiest issue—how to connect together a widespread installation of incompatible computers into a controllable network—should loosen the industry's purse strings.

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

George V. Kotelly  
Editor-in-Chief

# WINCHESTER DISK HEADS AND MEDIA A Technology and Marketing Report



After a decade of experimentation, laboratory efforts and stunted sales, manufacturers of thin film magnetic heads and media are on the leading edge of a burgeoning market for their products. The market growth is fueled by pressure for ever increasing aerial density in Winchester disks being built in ever decreasing form factors.

Not all companies have benefited from accelerated growth. There were several casualties of discontinued operations in 1985-1986, but the surviving thin film media companies will ship a combined volume of over 4 million disks of varying dimensions during 1986. Issues and considerations posed by changing technology are covered in this TAGi report. Questions such as:

- Who are the manufacturers?
- What's best? Plated or sputtered media?
- Can particulate media match thin film performance?
- How long will particulate media continue to dominate?

It is more expensive to upgrade Winchester performance with thin film heads so growth in thin film magnetic heads has been slower to materialize, but 1986 shipments suggest a strong beginning. Questions that come to mind are:

- Who are the manufacturers?
- Will monolithics retain their pricing advantage?
- Can composites match thin film head track densities?
- Is there adequate thin film head production capacity?

In addition to surveying and analyzing the technology of heads and disks this TAGi report contains marketing data, with detailed forecasts by media size and head types as well as a review of industry trends and future growth projections.

Included in Winchester disks "Heads and Media Report" are profiles of 45 magnetic media and 32 magnetic head manufacturing companies. It also contains the most comprehensive glossary of industry terms ever published.

The Technology Assessment Group provides a vehicle for industry experts to share their knowledge with those who want reference material and tutorial information. The second TAGi volume under preparation, "2/7 Encoder/Decoder Designers Guide," is a primer on the implementation and application of 2/7 Run Limited Length Codes. It is sufficiently detailed to be used in the development of products.

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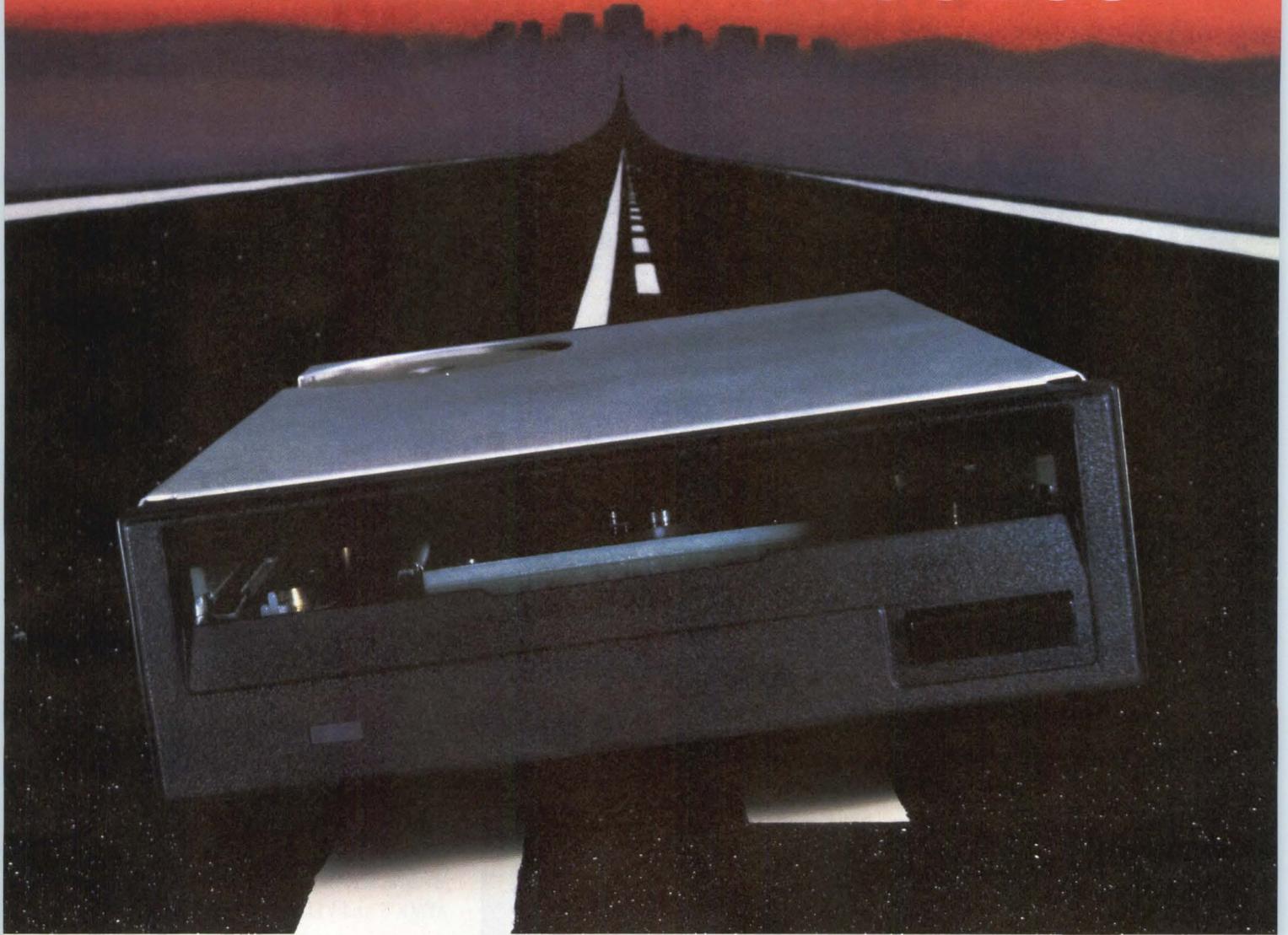
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CIRCLE NO. 8 ON INQUIRY CARD

# BUILD IN THE DRIVE WITH BUILT-IN SUCCESS



Your state of the art product merits components built to meet today's advanced needs. And that includes the compact, high density capacity of a Panasonic® 3.5" flexible disk drive.

Panasonic gives you the opportunity to provide the sophisticated products your customers are looking for. Our JU-394 3.5" drive actually offers more information storage than 5.25" and 8" units: 2.0MB. Our JU-386 drive has a capacity of 1.6/1.0MB. And since both our 3.5" drives themselves are more compact, they consume less power and weigh less than the bulkier 5.25" and 8" drives. Which

leaves more space and power for the other capabilities you want to add to your PC.

The JU-386 and JU-394 are easy to integrate into your system, too. Because they're plug-compatible with 5.25" drives. And perhaps most importantly, Panasonic helps make integration easy for you. Our in-house team of engineering and customer service professionals are ready to answer your technical questions and provide service when you need it. To help make sure that your system runs smoothly and fits your most complex applications.

So if you are driven to succeed, build in the disk drives built to do just that. The Panasonic JU-386 and JU-394. Part of Panasonic's full line of 3.5" and 5.25" disk drives.

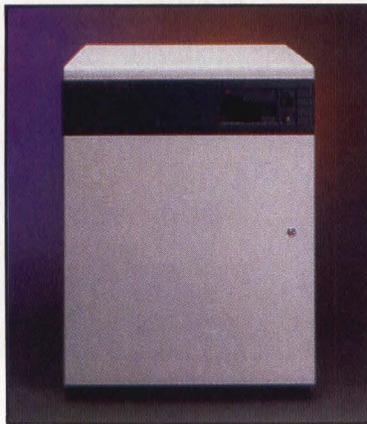
For more information, contact Panasonic Industrial Company, Memory Systems Division, 1731 Technology Drive, Suite 650, San Jose, CA 95110, (408) 294-5888. Or call any Hamilton-Avnet location at 1-800-228-7886.

**Panasonic**  
**Industrial Company**

CIRCLE NO. 9 ON INQUIRY CARD

**“Instead of asking  
how we can offer  
VAX 8600-like performance  
for \$50,000**

**ask how they  
can charge \$400,000??!”**



Frankly, the question should be important to your next supermini buying decision. Because side-by-side our RIDGE 3200 performance matches their 8600.

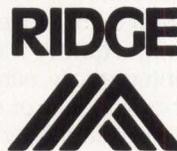
Ridge's powerful and proven RISC design provides superior architecture. Plus high performance integer and floating point calculations. 128mb real memory and 4GB virtual memory address space. A UNIX operating system user interface. 18mb/sec input/output and high-capacity file storage. And remote diagnostics that supplement Ridge's measured mean time between failure of 16 months.\*

And the RIDGE 3200 supports a full range of ECAD

and MCAD application software, including: DRACULA, ANSYS, MSC/NASTRAN, HILO-3, HSPICE, ABAQUS and VTI design tools, etc.

A \$400,000 VAX 8600, or an equally versatile RIDGE supermini for \$50,000. Is there really a question?

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\*Field experience measured on 200 Ridge 32 systems

**CIRCLE NO. 10 ON INQUIRY CARD**

# LETTERS

## ENHANSYS' PRICE

To the editor:

In your article, "Database integration shakes mini market" (MMS, April, Page 63), you misrepresented the cost of the Enhansys products. The cost to enable data access from dissimilar computers or databases starts at \$17,500, depending upon machine size and product components, not "\$150,000 or more" as stated in your article.

**John R. Finch**  
President  
Enhansys  
Cupertino, Calif. 95014

## SOFTWARE TOOLS

To the editor:

The article dealing with software tools caught my eye immediately (MMS, June, Page 95). I have long harbored a fondness for the productivity benefits that standard libraries and a standard approach provide. Too often, software tools are poooh-pooohed by personnel who think that "rolling your own" is the mark of professionalism.

I personally have long argued that developers for COBOL should do what it seems Entelekon [Software Systems] has done for C—provide a source of standard modules and a real set of models from which reliable programs could rapidly be built. (I wrote a book on the subject, *Commercial Software Engineering*, John Wiley and Sons, New York, 1985.) Regrettably, COBOL advocates seem unwilling to exploit the proven benefits of software engineering. I suspect there is a lingering reluctance to standardize among applications personnel, far more so than among systems programmers.

**Jim Janossy**  
Chicago, Ill. 60646

## BEER AND BIOCHIPS

To the editor:

Let me congratulate you on your article addressing biophysics and a new generation of devices exploiting the technology (MMS, July, Page 28). However, as a scientist, I was a little discouraged by the negative response of some of those with whom you talked. In addition, I detected a negative note in reference to what the Americans can contribute to this new technology.

Believe me, 90 percent of the creativity in this area will be American in origin. The Japanese are not creative. They exploit technologies. Biotechnology is not an extremely expensive business to enter. While I don't see the first biochip coming out of "inventor Jones'" garage, I do see the initial breakthrough coming from a small company with a close-knit beer-drinking brotherhood of six or seven scientists.

**Dr. Walton N. Hershfield**  
Vice President, Engineering  
Protection Engineering  
Stevensville, Mont. 59870

## WHAT'S IN A NAME?

To the editor:

One of the more important attributes of the activities we know as "engineering" is the systematization of its practices; the representation of the systematizing in uncounted handbooks, catalogues and other reference materials; and the ready access to that knowledge and information that enables the people called engineers not just to avoid reinventing wheels but also to discover the existence of and to use "tried and true" materials and processes as a matter of course. Probably it is not an exaggeration to say that, today, engi-

neering could not be practiced in the absence of any of that triad: systematizing, cataloguing and retrieving.

The preceding is a prelude to my comment about "Software development fires up workstations" (MMS, July, Page 101). Software developers still have a *long* way to go before they can call themselves software engineers.

After more than two decades in the "computing business," I am both shocked and surprised that an article about computer-aided software development can omit even passing mention of the failures both of those who are providing the computer aids and of those who might use them to emulate the behaviors of those whose name software developers would take unto themselves.

I intend to withhold the appellation "software engineer" until developers have accepted that the practice of their profession must rest, uniformly and firmly, on the triad of systematizing, cataloguing and retrieving. To be more precise, I will withhold my approval until the developers *do* something. Or, as Eliza Doolittle put it to Freddy Eynsford-Hill, "Words, words, words. Is that all you blighters can do?"

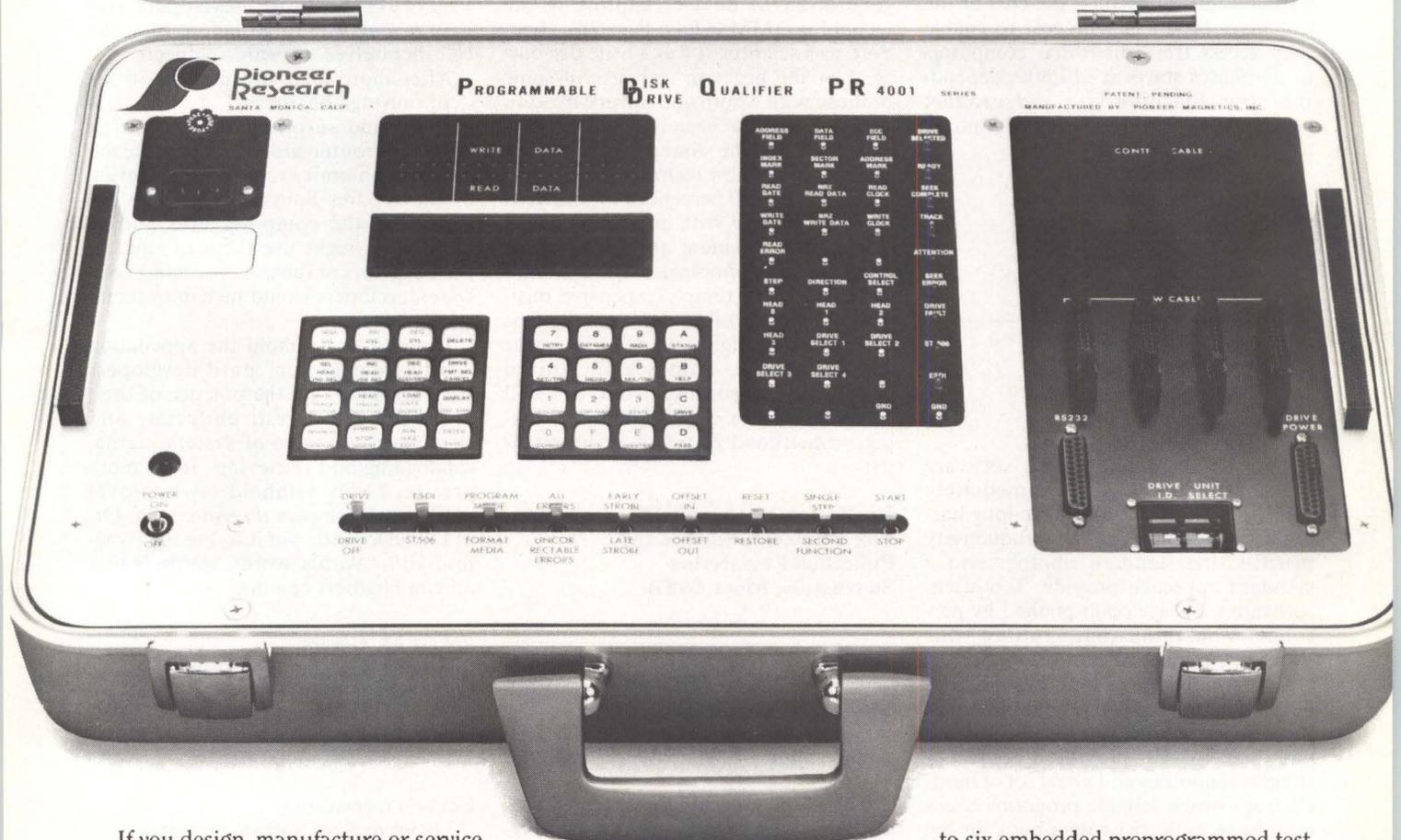
**Robert M. Gordon**  
Robert M. Gordon & Associates  
Los Angeles, Calif. 90067

**Editor's response:**

I'll leave it to software engineers to defend themselves. But I wonder if "engineer" and "engineering" are not words like "AI" and "UNIX market," i.e., so misused that they no longer are defensible by anyone. After all, we live in an age when garbage collectors are "sanitation engineers" and some hair dressers refer to themselves as "personal image engineering specialists."

— Mike Tucker

# All ESDI disk drives. One tester.



If you design, manufacture or service ESDI Winchester drives, take a good look at the picture in this ad. It's the only disk drive tester you'll ever need.

It's the advanced, high performance PR4001 Qualifier™ from Pioneer.

This programmable, portable microcomputer-in-a-briefcase tests *all* Winchester drives with ESDI interface. And it can test them at transfer rates up to 10MHz!

### One size tests all.

With the PR4001 Qualifier you can standardize all your company's testing needs on a single lightweight unit. Use it in development engineering, production test, receiving, inspection

and field service.

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

The PR4001 enables you to run up

to six embedded preprogrammed test sequences or enter your own test programs from your computer through either the keyboard or RS232C port. And you can input a custom set of drive parameters with no EPROMS to modify or boards to change.

### The intelligent disk drive tester.

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**CIRCLE NO. 11 ON INQUIRY CARD**

# To make the right protocol connections, don't get a board.

Each time you connect a PC or peripheral to your IBM System 34, 36 or 38, you face a dilemma. If you buy a board level protocol converter, you have to install it yourself — and use up a slot doing it. If you buy a multiport converter, you might be paying for ports you don't need.

That's why we're pleased to announce our one-port, portable Series III TWINAX protocol converter. Compact and affordable, it's perfect for communications applications that require a single local port.

Best of all, the Series III converter doesn't require technical expertise. Simply plug it in and it's ready to go. And it can be moved easily from device to device as your needs dictate.

The Series III TWINAX converter provides IBM System 3X connections for most devices, including printers, CRT's and micro-computers (such as IBM, Wang and Macintosh). It can be used with a low cost modem to give a remote device access to the 3X as well. And like our Series II multiport TWINAX converter, it incorporates three levels of internal diagnostics, menu-driven programmability, printer passthrough, file transfer and 25th status line capabilities.

So now, you can take care of virtually all your single port protocol connections without getting a board. Call us today at 1-800/531-5167 (in Texas, 512/836-8080) or write KMW Systems Corporation, 8307 Highway 71 West, Austin, Texas 78735.



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*For the right connections*

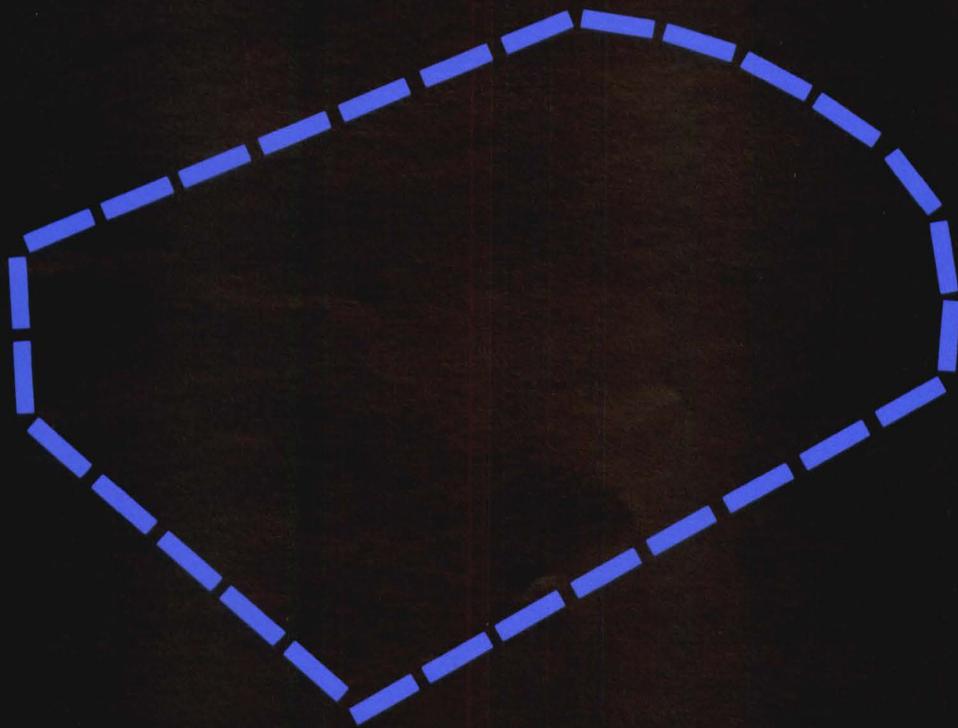
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CIRCLE NO. 12 ON INQUIRY CARD



You can't design  
the perfect PC...



# if you lack the drive.

Systems designers have long been searching for the micro Winchester that does everything exceptionally well.

Fortunately, they can get it now from Peripheral Technology, Inc.

Introducing the PT 225, 338, 238R, and 357R. The first family of all-in-one 3 1/2" hard disk drives.

High speed, large capacity, unusually low power consumption, and the reliability of an innovative head-lock system. In one lightweight package.



## IT FLIES.

A PTi micro Winchester is one of the fastest drives on the market. Using the world's first digital servo positioner, it averages an amazing 40 millisecond access time. Even at maximum seek distance—a blazing 68 milliseconds—it'll turbo-charge any PC, instrumentation or multi-user system.

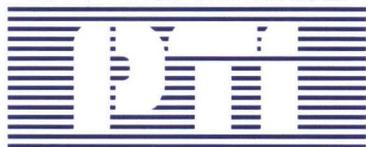
## IT'S FRUGAL.

At less than seven watts during operation, PTi drives use less energy running than others do standing still. So your system will run cooler, last longer.

## IT'S ROOMY.

Employing two and three platters, PTi micro Winchesters offer capacities from 20 to 47 megabytes. The extra-capacity "R" series was designed for use with the latest controllers supporting run length limited (2,7) data encoding.

**WE'VE GOT THE DRIVE.**



**PERIPHERAL TECHNOLOGY INC.**

685 East Cochran St. • Simi Valley, CA 93065 • (805) 581-1000

## IT'S SAFE.

PTi has designed an innovative locking system that will make your data absolutely safe in a power outage or in portable or rugged applications.

At power down, this innovative system automatically retracts the heads into a landing zone away from the data and then secures them with a unique head-lock mechanism. So power loss doesn't mean data loss.

## IT'S QUALITY.

All PTi micro Winchesters come with the quality assurance of the PTi name and the resources of an \$800 million international corporation.

More than 100 years of combined experience have been pooled to create the first family of all-in-one disk drives to perfect your design.

So if you're looking for speed, capacity, low power consumption, and safety in one 3 1/2" disk, plug in a micro Winchester from PTi.

If you've got the system, we've got the drive.

## SPECIFICATIONS\*

	PT 225	PT 338	PT 238R	PT 357R
Capacity (M bytes)				
Unformatted				
Per drive	25.6	38.4	38.4	57.6
Per surface	6.4	6.4	9.56	9.56
Per track (bytes)	10,416	10,416	15,624	15,624
Sectors per track	32	32	25	25
Access time				
(Includes head setting) in ms.				
Track to track	14	14	14	14
Average	40	40	40	40
Maximum	68	68	68	68
Track density (TPI)	983	983	983	983
Cylinders	615	615	615	615
R/W heads	4	6	4	6
Disks		2	2	3
Recording method	MFM	MFM	RLL(2,7)	RLL(2,7)
Interface	ST412	ST412	ST412	ST412

\*For complete specifications, call or write PTi.

# WHAT ARE NCC EXHIBITORS DOING THAT YOU SHOULD BE DOING?

**Selling products.** NCC '85 attendees have been tracked and surveyed over the last year. In the 9 months following the 1985 NCC, *70 percent of attendees bought products they had seen exhibited at the conference.* Another 54 percent expect to buy products or services seen at the NCC within the next 12 months. The average dollar purchase made by NCC attendees was over \$873,000.

**If you want to make sales leads, make them at NCC.**

**Enhancing company image.** Participating in NCC offers you key positioning and high recognition among the leaders of the industry. NCC is *the* place to exchange information with attendees, but also with other exhibitors.

**If you want to make contacts, make them at NCC.**

**Building awareness of your product.** The NCC audience—professionals, DP Managers, Users, MIS Directors, Consultants and Media—will be exploring the exhibits. NCC is the ideal forum to unveil a new product and demonstrate the technology to new and existing customers as well as exposure to approximately 750 media representatives.

**If you want to make news, make it at NCC.**

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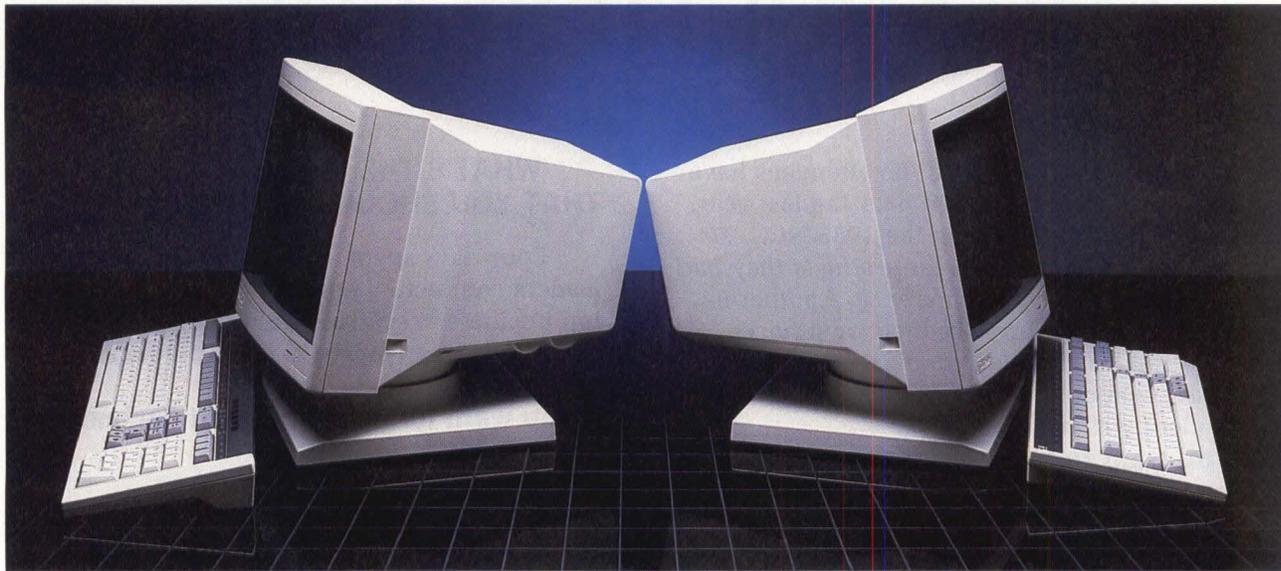
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Our two Ansi terminals have one very important characteristic in common: both are dead ringers for DEC's popular VT220 and VT100 series. Equipped with features that the VT220 and VT100 can only dream about.

For starters, our CIT 224 gives you VT220 mirror-image performance. In a 14-inch screen size, with large high-resolution

**CIT 224**

characters and soft white phosphors. You also get 45

programmable and

15 fixed function keys, 11 set-up menus and optional RS-422/423 interfaces.

Then there's our 14-inch multi-personality CIT 50+. With its VT100-like keyboard you get one-and-the-same emulation with the VT100. Plus such new generation features as a 26th label line and 32 programmable function keys.

But Ansi isn't its only cover. The CIT 50+ also sports Ascii emulation of the highest order. Meaning the CIT 50+ can take the same Ascii road as Wyse or Televideo.

On both our Ansi's, we've added the little things that users appreciate. Like a tilt-and-swivel base, a front-mounted power switch and a side-mounted keyboard jack.

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CIRCLE NO. 15 ON INQUIRY CARD

# BREAKPOINTS

## **WYSE DEBUTS '386 SYSTEM FOR WORKSTATION, MULTIUSER MARKET**



Wyse Technology, San Jose, Calif., has taken the wraps off an Intel Corp. 80386-based system that functions as both a standalone IBM Corp. PC/AT-compatible workstation and a multiuser system. The WYSEpc 386, due to be shown at Comdex/Fall this month, will sell for \$4,500 to \$10,000, depending on configuration. The machine has four 16-bit expansion slots and two 8-bit slots. It can address up to 16M bytes of main memory. There is room for one full-height and three half-height mass-storage devices. The WYSEpc 386 will support a pair of eight-port, add-in I/O controllers being developed by the company that will connect up to 16 terminals. Shipments are slated for early next year.—*Mike Seither*

## **WESTERN DIGITAL STACKS THE DECK WITH MODULAR PERIPHERALS**



At this month's Comdex/Fall show, Western Digital Corp., Irvine, Calif., will feature VersaStak, a variety of peripherals "stacked" one on top of the other. System integrators and OEMs can choose to stack rigid disks, tape drives, CDROMs and (next June) a file server. Key to the product is a unique packaging technique that eliminates interfacing and power cabling. Based on the small computer systems interface (SCSI), VersaStak includes an IBM Corp. PC/XT or PC/AT single-slot host adapter board that handles up to eight peripheral modules.—*Dave Simpson*

## **HEWLETT-PACKARD PLANS TO INTRODUCE STARLAN PRODUCT**

Hewlett-Packard Co., Palo Alto, Calif., will introduce its StarLan interface card this month with a price tag of \$595. HP is a long-standing backer of the IEEE's efforts on specifications for the 1M-bit-per-second StarLan protocol. Hewlett-Packard Information Networks Group, Cupertino, Calif., intends HP StarLan to link HP and IBM Corp. office workstations through a \$1,275-StarLan hub. Also scheduled for unveiling are communication products that will link HP computers on StarLan to remote IBM machines. Two of these products will hook HP Vectra or Portable Plus microcomputers to IBM minicomputers running VM/CMS, MVS/TSO and CICS via 3270 emulation. Others will connect HP 3000s running DeskManager software to IBM mainframes running DISOSS.—*Jim Donohue*

## **SEATTLE TELECOM & DATA READIES '386 BOARD**



Look soon for the STD-386 accelerator board from Seattle Telecom & Data Inc., Redmond, Wash. The IBM Corp. PC/AT-compatible board will employ an Intel Corp. 80386 and an optional 80387 processor-pair running at 16 MHz. The unit supplies 2M bytes to 16M bytes of on-board, dual-ported dynamic RAM array; an 80286-emulation unit, IBM EGA-compatibility and electrically programmable ROM. It will run both PC-DOS and XENIX transparent to the user and occupy a single adapter slot. Pricing is in the \$3,500 range.—*Megan Nields*

## **FUJITSU UNVEILS TWO-LASER WRITE ONCE OPTICAL DRIVE**

The storage products division of Fujitsu America Inc., San Jose, Calif., has introduced a 5¼-inch, write once, read many (WORM) drive that features two lasers, one to write while the other verifies data. The twin-beam design allows these two tasks to be performed in one revolution of the disk instead of two. The M2505A drive uses a cartridge that stores 300M bytes on each side. A Fujitsu controller based on the small computer systems interface (SCSI) common-command set will support four such drives, or 3.5G bytes on one SCSI node. Evaluation units that include drive and controller are priced around \$3,500 and will be available the first quarter of 1987.—*Mike Seither*

## **MICOM-INTERLAN ADOPTS TCP/IP TO NETWORK DEC, HP COMPUTERS**

Having decided that TCP/IP is an emerging de facto standard for local area network protocols, Micom-Interlan Corp., Boxborough, Mass., is adapting all of its products to support it. Announced this month is an updated network terminal server, NTS 100, that handles communications between eight dumb terminals (in the VT100 class) and any computers using TCP/IP protocols. NTS 100 will carry a price tag of about \$2,700. Beta testing begins next month; shipments are scheduled for the first quarter of next year. The NTS 100 can communicate with any minicomputer from vendors such as Digital Equipment Corp., Hewlett-Packard Co. and IBM Corp. running TCP/IP with the Defense Department's standard Telnet server application.—*Jim Donohue*

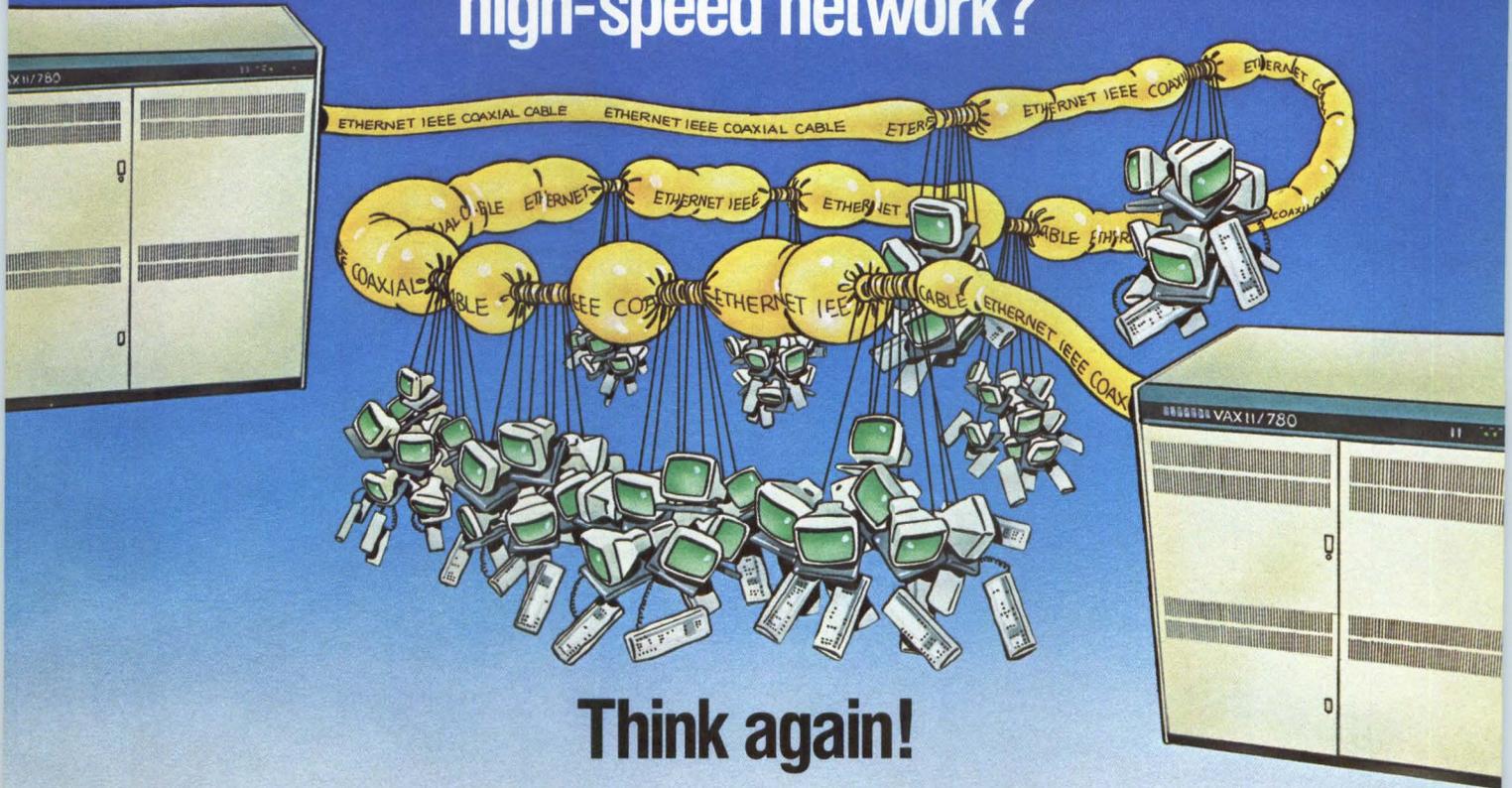
## **INTEL ADDS PUNCH TO MULTIBUS WITH 80386 BOARDS**

Intel Corp., Santa Clara, Calif., has given a significant boost to the processing power available on the Multibus with four new boards based on its flagship 80386 processor. Operating at 16 MHz, the iSBC 386/21, 386/22, 386/24 and 386/28 boards provide 1M, 2M, 4M and 8M bytes of 32-bit, dynamic RAM, expandable to 16M bytes via piggyback modules. A 64K-byte cache permits zero-state-reads. An iSBX expansion connector and multimaster arbitration come standard.—*Jesse Victor*

## **ESDI CONTROLLER FOR PC/AT SHIPS IN DECEMBER**

NCL America Inc. has introduced an enhanced small device interface (ESDI) disk drive controller for IBM Corp. PC/ATs and compatibles. The Sunnyvale, Calif., company is a subsidiary of National Computer Ltd., a Japanese controller manufacturer trying to gain a toehold in the U.S. market. Its model 5122 ESDI controller uses surface-mount technology to build a 6-inch-by-3½-inch card—shallow enough to fit inside the IBM PC, PC/AT and the XT model 286. NCL is marketing the controller to system integrators who want to load AT-class machines with 150M- to 300M-byte Winchester. OEM pricing for the controller is \$125. NCL is also bringing out a SCSI-to-AT host adapter. OEM cost: \$95. Both are expected to be in production by December.—*Mike Seither*

# Thinking of tying low-speed terminals onto a high-speed network?



## Think again!

A high-speed LAN is ideal for file transfer, distributed processing and CPU-to-CPU communications. But using it for terminal traffic can cause problems.

### You may be tying up bandwidth.

Low-speed terminal traffic on a high-speed network can rob bandwidth where it's needed most. That means slow file transfers and sluggish response for all network users. The protocol overhead required for a terminal to send small data packets across an Ethernet® link can mean that only 10% of the 10 Mbps bandwidth is available.

By connecting your terminals through an Equinox® Data PBX and connecting your computers together with Ethernet, your LAN runs at top efficiency. An Equinox Data PBX dedicates a full 12 Mbps to terminal data traffic. More than 1300 devices can run continuous 9600 bps data at the same time, providing the best possible response through the network.

**You'll tie up about \$500 per terminal.** When you consider the cost of Ethernet Terminal Servers, Taps, and

Cable, Ethernet can cost between \$300 and \$800 per terminal. An equivalent solution using an Equinox Data PBX with our 8-channel Terminal Servers and twisted pair wiring is about \$100 per terminal.

### You could tie up your computer.

Some Ethernet LANs handle terminal switching by running special software in your computer. So adding terminal traffic means your computer spends more time running the network and less time running applications. An Equinox Data PBX requires no special

software and handles all terminal network processing without disturbing the host. It even allows you to monitor the network load and provides additional security for access control.

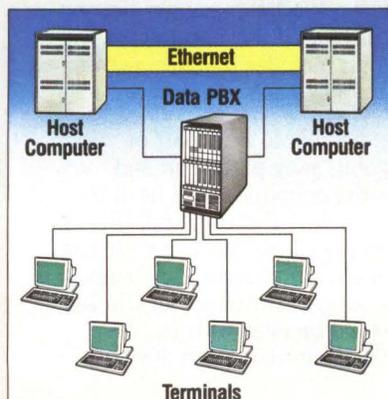
### We won't tie you down.

Putting your terminals on an Equinox Data PBX provides more terminal switching features for less money with greater efficiency, so you can get the most out of your LAN. And because it works with all types of computers and terminals you're not tied to a one-vendor solution.

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CIRCLE NO. 16 ON INQUIRY CARD

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Why a party? Well, it's because we've been told that more than a few of IBM's customers have been "going away" ever since we introduced our A★Star™ PC/AT compatible micro-computer. Now that we've announced our new A★Star II, we figure a lot more of their customers will be going away. That's because the A★Star II is the *only* "network ready" PC/AT compatible that can operate at 6, 8, 10 and 12 MHz. And because it's available in a super selection of models starting at only \$995!

The A★Star II is not just another clone, it's better...*much* better! Not only is it faster and more powerful

than IBM's model, it's also incredibly less expensive. Better yet, the A★Star II is built and backed by Wells American - a company that's been making micro-computers *longer* than IBM. (We bet that surprises even you!) Plus, the A★Star II is serviced nationwide by RCA Corporation - one of the world's largest and most respected consumer electronics firms. And if that's not enough, every unit includes free schematics and a money back guarantee!

If you'd like to be a part of our IBM going away party, clip and return the coupon or call us at the number below. But don't tell IBM! If they find out how many of their customers are going away, they might just go away themselves! Of course, that would be okay with us. We never *really* invited them anyway!

## A PC/AT FOR ONLY \$995? WHAT A REASON TO CELEBRATE!

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**CIRCLE NO. 17 ON INQUIRY CARD**

**MORE ON MAXTOR—A LITTLE MORE VERTICAL THAN YOU GUESSED**

The 760M-byte model EXT-8760 Winchester introduced by Maxtor Corp., San Jose, Calif., is more than just another high-capacity, high-performance, 17-msec average access time disk drive. Maxtor teamed up with vertical-recording specialists at Censtor Corp., San Jose, to incorporate the Censtor media and Monopol head. So, besides doubling capacity, it may be the first commercially available vertical-recording Winchester on the market. Don't expect to find the drive in large quantities until sometime in 1988.—*Carl Warren*

**RICOH READIES HIGH-DENSITY LASER PRINTER**

Laser printers may soon be able to produce the look of hot-press type as dot density rises dramatically. At this year's Comdex/Fall, Ricoh Corp., Fairfield, N.J., will likely show its newest laser printer engine, capable of 800 dots per inch. The engine, which was shown at the National Computer Conference this year, is expected to fit in the \$10,000 to \$15,000 price range.—*Carl Warren*

**ITT BUILDS EGA GRAPHICS INTO PC/AT-COMPATIBLE**

ITT Information Systems, San Jose, Calif., has continued the expansion of its XTRA line of personal computers with an Intel Corp. 80286 version that features a built-in adapter for enhanced monochrome or color and Hercules Computer Technology graphics applications. The XTRA/286 ATW (advanced technology workstation) uses ITT's FXP disk-caching software and has eight expansion slots (six for 16-bit cards, and two for 8-bit boards). The machine features three half-slots on the front panel for peripherals. An XTRA/286 with 640K bytes of RAM and a 1.2M-byte flexible disk drive lists for \$2,499. With a 30M-byte rigid disk drive, the XTRA/286 sells for \$4,299. ITT is now delivering the machines.

—*Mike Seither*

**PCET BUS COMMITTEE GOES STANDARD**

The Personal Computer Extended Technology (PCET) Bus Committee, formed last spring to define a standard for the IBM Corp. PC/AT bus and extend it to manage 32-bit operations for emerging high-performance microprocessors, has recently released the first draft of its proposal: 1086-0006A, rev. 1.0. The PCET IEEE task group chairman, Gary Lyons, hardware manager for Nestar Corp., Mountain View, Calif., says he expects to see the PCET proposal move quickly through the standards process.

—*Carl Warren*

**WANG LAPTOP COMPUTER UNDER LEGAL CLOUD**

Wang Laboratories Inc., Lowell, Mass., has introduced a laptop computer that uses an Intel Corp. 8086-compatible microprocessor, the V30, made by NEC Japan. The laptop features 512K bytes of RAM—expandable to 1M byte—a full-sized liquid crystal display, an internal rigid disk drive and a built-in printer. However, legal problems surround the unit's 8-MHz microprocessor. Intel is suing NEC for copywrite violation. Intel claims that

NEC engineers duplicated the code used in Intel's 8086 and 8088 microprocessors to build their V30, and is seeking to bar its being sold in the United States. A decision is expected in the first quarter of 1987.

—*Megan Nields*

## **LOW-COST ETHERNET/CHEAPERNET TERMINAL PROVIDES ACCESS TO UNIX**

British UNIX and networking specialist Logic Replacement Technology, Reading, England, has introduced a direct-connect Ethernet terminal with integrated TCP/IP networking protocols and high-performance window-management capability. For about the cost of an Ethernet interface, under \$1,500 (quantity one), the Atari 520/ST-based EtherTERM provides up to four icon-based and mouse-controlled windows with VT100 emulation. It can operate multiple shells on networks supporting TCP/IP. An optional "cheapernet" transceiver and connector are available.—*Andrew Allison*

## **SEAGATE PREPARES SCSI DRIVES FOR COMDEX PREVIEW**

Seagate Technology, Scotts Valley, Calif., has been quietly developing a full line of half-height and full-height medium- to high-capacity small computer systems interface (SCSI) Winchester disk drives for a Comdex/Fall unveiling this month. The series will include half-height drives with 20M-byte to 80M-byte capacities and 65-msec to 28-msec average access times. The 4000 series of full-height drives range in formatted capacities from 80M bytes to 160M bytes, with access times spanning 28 to 17 msec. The company plans to ship evaluation units in December, along with an IBM Corp. PC-compatible host adapter. Pricing is still uncertain.

—*Carl Warren*



## **INTEL LINKS THE PC TO THE BIT BUS**

For system integrators developing control systems, Intel Corp., Santa Clara, Calif., offers the \$495 PCX-344, an IBM Corp. PC-bus-to-RS485 bit-bus host adapter. The board comes with the real-time, kernel-distributed control executive (DCX)-51 as part of the firmware and is designed for distributed control. It is available now.—*Carl Warren*

## **APPLE'S MILWAUKEE MACHINE USES NUBUS ARCHITECTURE**

Scheduled for release at its annual stockholders meeting in January, Apple Computer Corp.'s newest machine, the Milwaukee, is being built around the IEEE P-1196 Nubus architecture. The machine, based on Motorola Inc.'s MC68020 processor, will have an open backplane to support multiple masters and slaves. Apparently, Apple is serious about using the Nubus since the Cupertino, Calif., company has been gearing the bus architecture to accommodate specially designed I/O boards.—*Carl Warren*



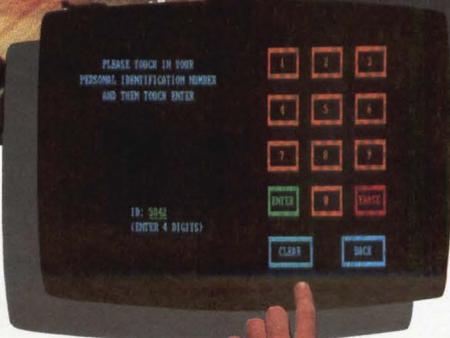
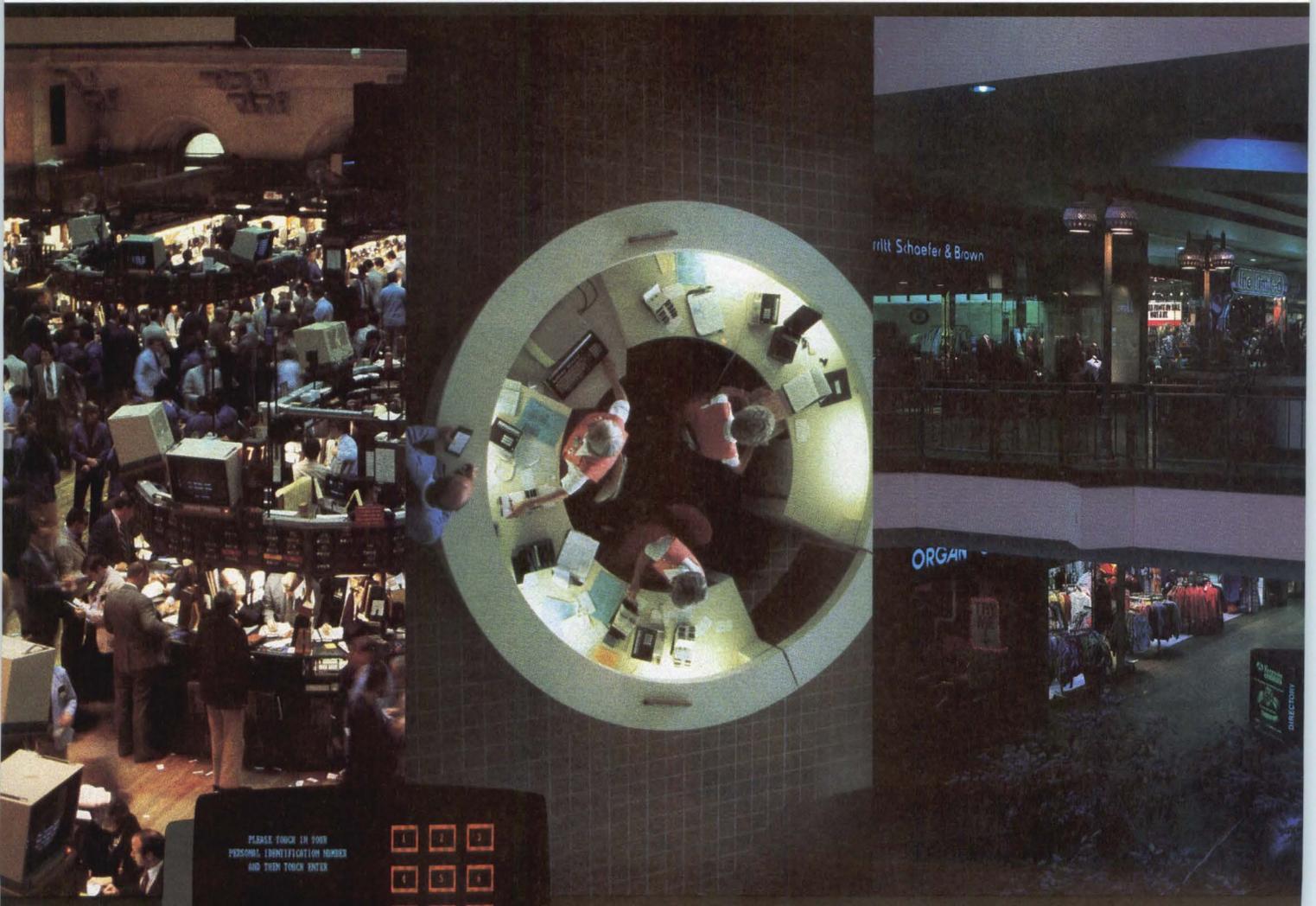
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## **Carroll Touch**

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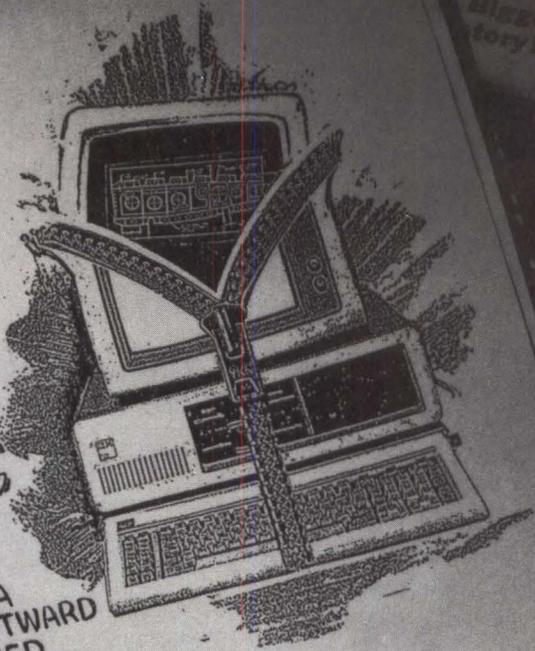
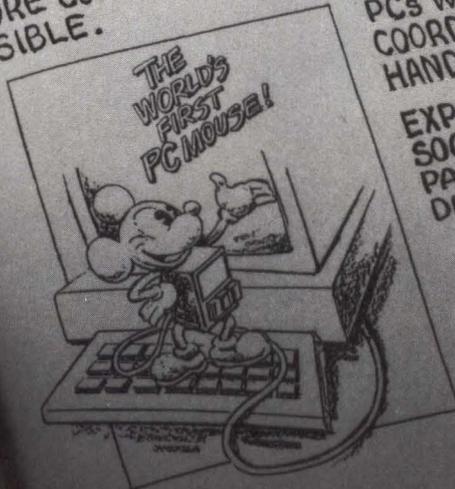
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# INTERPRETER

## Convergent's 386 strategy: NGEN first, then PC Server

Mike Seither

Associate Western Editor

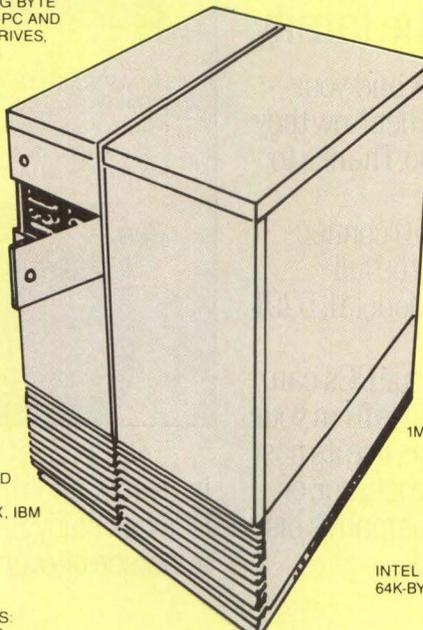
Convergent Technologies Inc. has begun what it hopes will be a long-term relationship with Intel Corp.'s 80386. It will use the 32-bit processor to stretch out the commercial life span of its NGEN computer systems. And, at the same time, the San Jose, Calif., manufacturer is redefining its networking strategy to make room for a new 80386-based server that will link at least 64 personal computers and that in turn can be connected to many other servers.

Convergent will ship production units of the new CPU, which operates with all the current NGEN peripheral modules, this month. Priced at about \$2,500 in OEM quantities, the CP003 processor costs about 15 percent more than the 16-bit, 80286 version, but it runs twice as fast. More important, the CP003 will allow Convergent users to run MS-DOS and UNIX applications—depending on the configuration—as well as programs written for its proprietary CTOS operating system.

Until recently the NGEN systems operated only under CTOS. This summer the company introduced separate NGEN coprocessors to allow its 80186 and 80286 CPUs to run DOS applications. That DOS capability was designed directly into the 80386 NGEN processor module.

Meanwhile, the new 386 ServerPC will be readied for shipment in the first quarter of 1987, according to Kathryn Hanson, Convergent's marketing director for the cluster-systems division. The server can execute DOS and UNIX applications concurrently and will offer OEMs a broad range of support. Communications capabilities will include AT&T Co.'s Remote File System, SNA, X.25 and TCP/IP

**LOOKING AT CONVERGENT'S 386 SERVERPC**



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**INTEL 80386 CPU WITH  
64K-BYTE CACHE**

(transmission control protocol/internet protocol). Initial networking will be limited to PC compatibles using Convergent's RS422 and Ethernet, but the company plans to support Starlan and the IEEE 802.5 token-ring network.

### 'Servers are sexy'

Mass-storage options for the 386 ServerPC range from 60M-byte quarter-inch tape drives to 380M-byte,

5¼-inch Winchester using the small computer system interface (SCSI). Convergent plans to support both synchronous (4M bits per second) and asynchronous (1.5M bits per second) SCSI drives.

The main server chassis features three expansion slots for add-in cards compatible with the IBM Corp. PC, and four slots for PC/AT-style boards. Four other slots allow users to expand system memory from 1M bytes to

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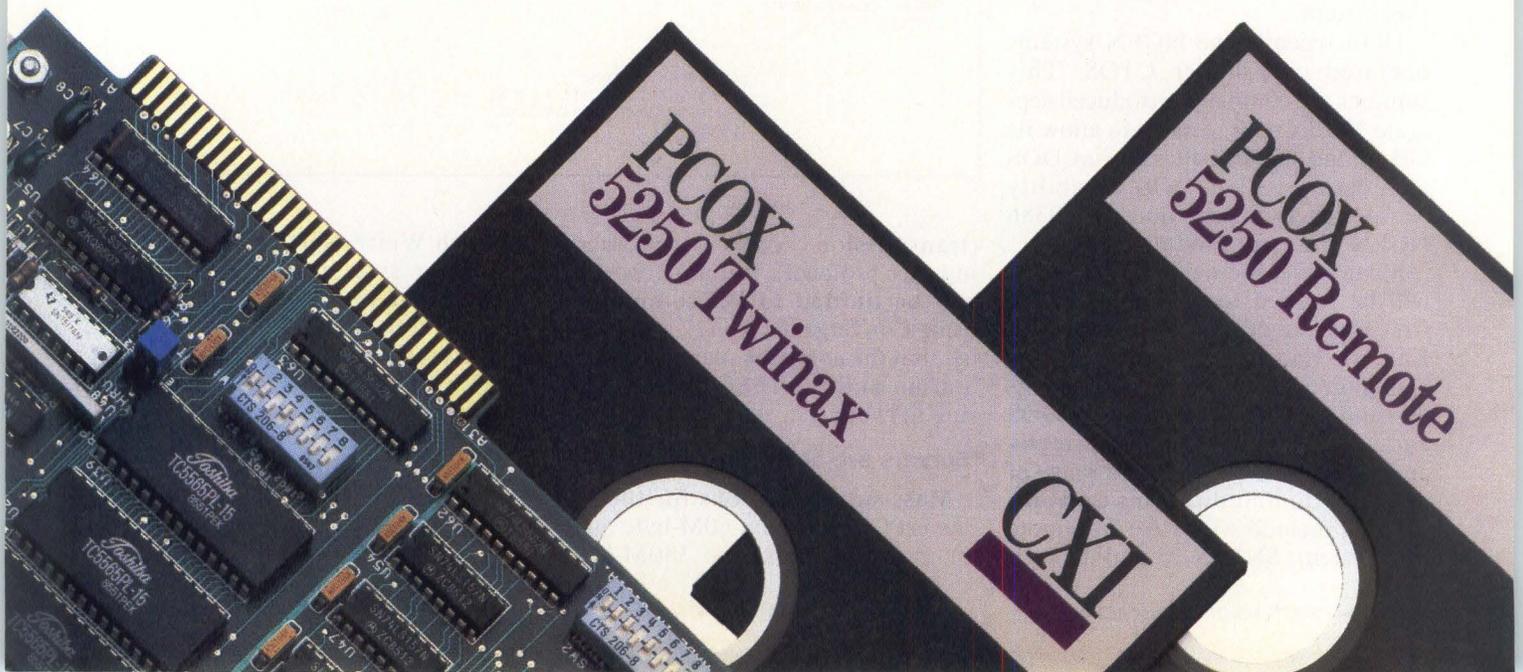
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16M bytes.

OEM pricing for a base 386 ServerPC system will begin around \$5,000. Systems at that price will include 1M byte of main memory, a 40M-byte Winchester and a 1.2M-byte flexible disk drive.

How well Convergent will do with a product line like servers, which it has never marketed before, is anyone's guess. "There's going to be a lot of competition," says International Data Corp. analyst Molly Upton of Framingham, Mass. "The world thinks servers are sexy now." But Upton says Convergent may have a better stake in the ground than others because of its experience in distributing applications down to the workstation level.

Convergent's server and NGEN announcements, made at Comdex/Fall in Las Vegas, Nev., closely follow 80386 introductions by other manufacturers, notably Compaq Computer Corp., that are using the Intel chip to build workstations substantially different from their earlier product lines. But Convergent, by first bringing out the 80386 on the familiar NGEN, is concentrating its efforts on an existing OEM customer base, says Hanson.

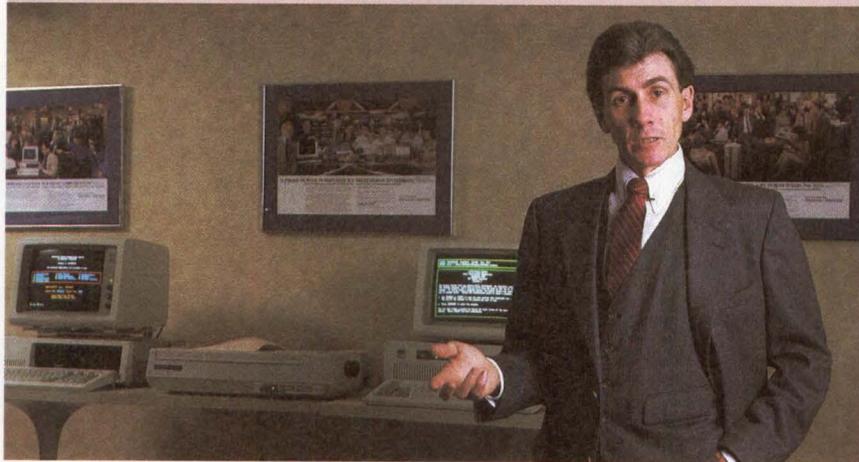
"The 386 offers a tremendous amount of design flexibility, but we didn't want to jump in with something new," Hanson declares. "We felt that a clear upgrade path and compatibility with our current product line were absolutely necessary."

### Rising clouds

Right now the most important Convergent product line appears to be the NGEN, which accounts for more than 50 percent of the company's current revenues. Convergent claims an installed base of more than 250,000 NGENs worldwide. NGEN systems are standalone workstations which can be clustered into work groups through the networking capabilities of CTOS. Although the NGEN has been a favorite product for big OEMs like Burroughs Corp. and NCR Corp., industry observers have noted the system's limitations.

"The thing that has clouded the future of the NGEN is CTOS. Over time it could get in Convergent's

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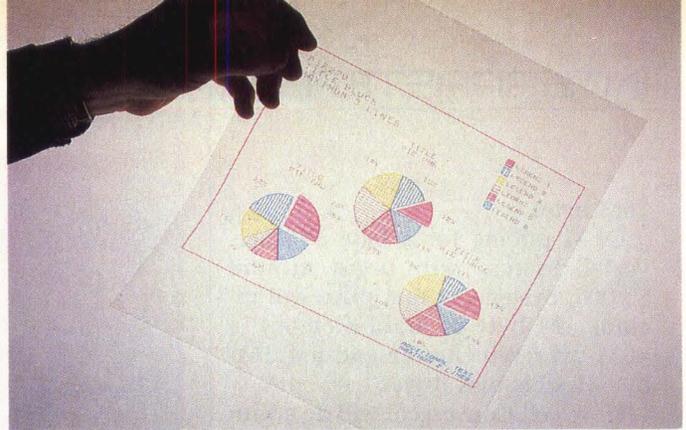


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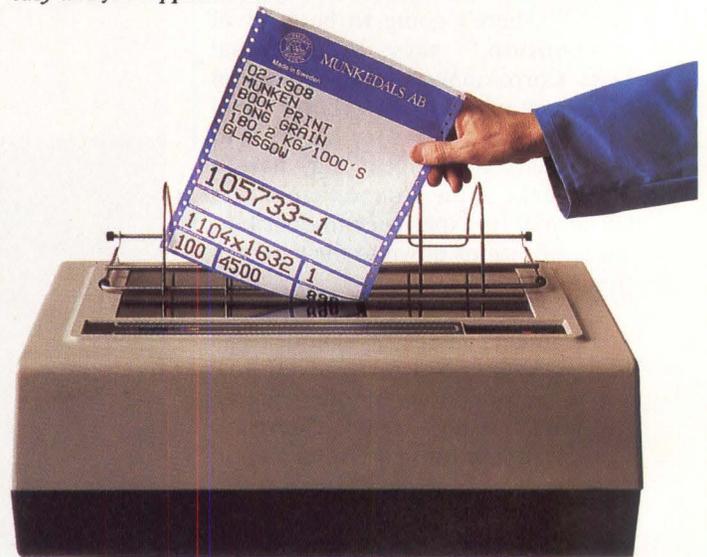
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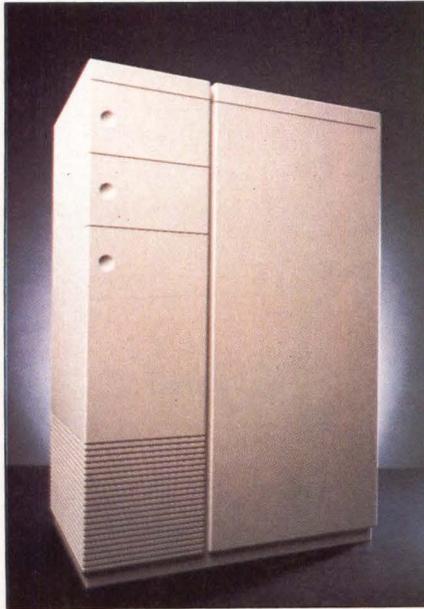
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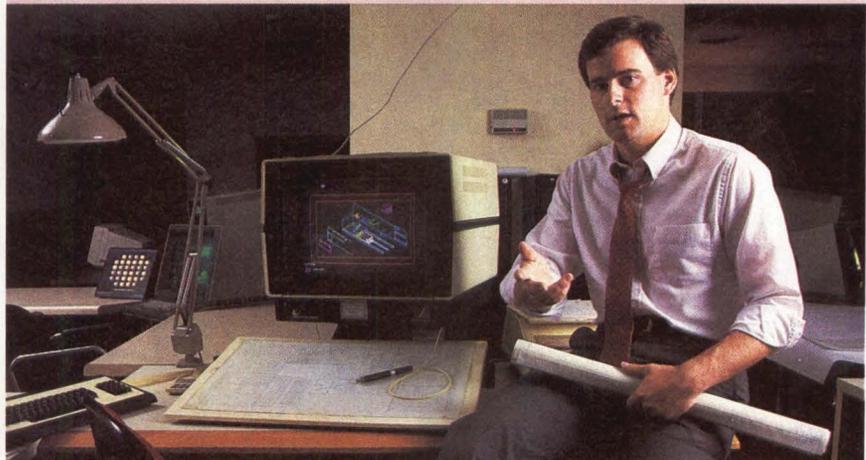
**Convergent Technologies' 80386-based CPU module** allows the company's familiar NGEN line to be used as a UNIX multiuser system, or a networked workstation that runs applications under proprietary CTOS and MS-DOS operating systems.

way," says Gwen Peterson, director of the computer industry service for Dataquest Inc., a San Jose, Calif., market-research company. "In most cases you see a trend away from proprietary operating systems toward standards like UNIX."

So far, Convergent's play in the UNIX market has been limited to its Frame line of multiuser systems, which operate on the Motorola Inc. MC68000 family of microprocessors. But with the Intel 80386, Convergent now plans to market an NGEN system that will run System V Release Three of UNIX. Unlike the CTOS version of the NGEN workstation, which drives only one terminal, the UNIX NGEN will support up to 16 terminals.

With the NGEN platform now supporting CTOS, DOS and UNIX, Convergent officials argue, OEMs are less likely to get boxed in. "We're not forcing customers into a commitment that, maybe next year, they will regret," says Hanson. "They can choose the application base that's appropriate for their business."

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In fact, a major Convergent goal is to target an even broader range of businesses while concentrating on traditional OEM deals. The idea is to buffer itself from downturns in the industry when OEMs cut or cancel orders. In the last several months Convergent has embarked on a bold buying campaign to acquire an interest in, or outright ownership of, VARs that are leaders in specific markets. This is in spite of posting more than \$5 million in operating losses during the second and third quarters and laying off more than 500 workers—about one-quarter of its work force.

Convergent expects to end fiscal 1986 in December with sales well under \$300 million, concedes chief financial officer John Russell. That compares with 1985 sales of \$392 million and a profit of \$11 million.

Convergent is buying because it's been flush with nearly \$100 million in cash and no debt. Last year it purchased a 40 percent stake in Baron Data Systems Inc. a San Leandro, Calif., company that supplies turnkey systems to court reporters. Baron in turn leveraged the Convergent cash this past May to buy the legal services division of Informatics General Corp., Phoenix, Ariz.

In an August deal involving a trade of stock, Convergent merged with Display Data Corp., a Hunt Valley, Md., company that sells computerized management systems to beverage distributors, automotive dealers and lumberyards.

Also in August Convergent spent

\$28.5 million to buy two divisions of UCCEL Corp. of Dallas. The divisions, Digital Systems of Pensacola, Fla., and Open Systems Inc., Minneapolis, Minn., specialize in software for accountants and contractors.

Convergent president Paul Ely has indicated that his company intends to acquire as many as eight vertical software companies. They will be man-

aged by Small Businesses Services, a newly formed Convergent subsidiary.

"I don't know of any other company that has gone out and bought distribution this way," says Sandy Gant, an analyst with InfoCorp., a Cupertino, Calif., market-research outfit. "There's risk in integrating the companies, but the potential for a new customer base is tremendous." □

## Lapping the field: Maxtor 760M bytes, others 380

**Mike Seither**

Associate Western Editor

A year ago Maxtor Corp. defined the upper reaches of the market for 5¼-inch rigid disk drives with a 380M-byte Winchester. Now, just as its arch rivals—Priam Corp. and Micropolis Corp.—are about to show system integrators drives with equally expansive capacities, Maxtor is at-

tempting a new high-end definition. This time it is the EXT-8000, a line of drives that pushes mass storage in a 5¼-inch format up to 760M bytes.

In the last few weeks Maxtor, San Jose, Calif., has shipped OEMs evaluation units of its EXT-8760, a 760M-byte drive equipped with the enhanced small device interface (ESDI). According to Bob Teal, Maxtor's vice president of marketing and quality

### FACT FILE

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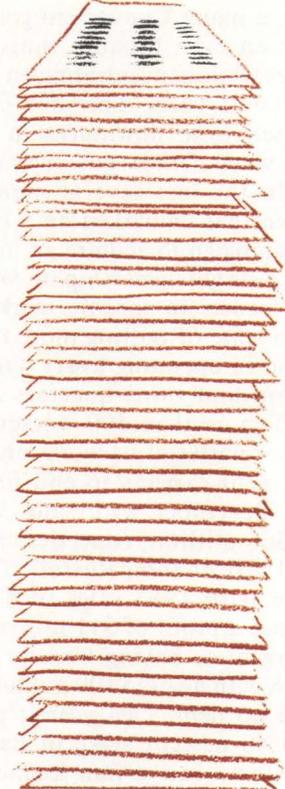
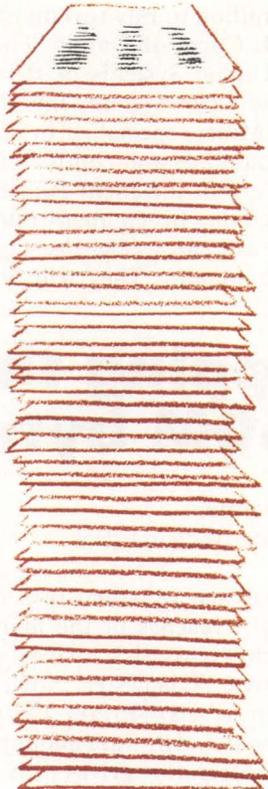
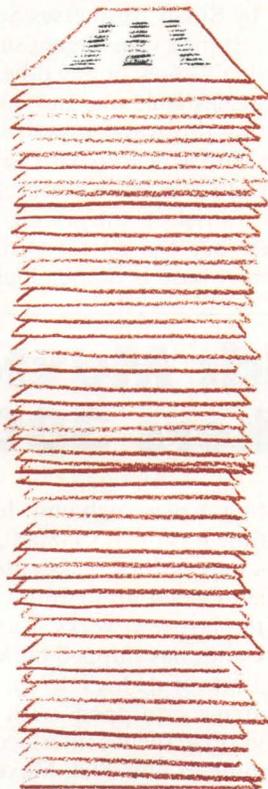
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assurance, the same drive with an embedded controller for the small computer systems interface (SCSI) will soon follow. Both versions use eight platters and have an average access time of 18 msec. They will sell for about \$3,000 in OEM quantities, Teal says.

Maxtor is boosting capacity through a combination of improvements to the technology in its current 380M-byte drives. First, recording density is up by 50 percent to 31,429 bits per inch. The number of tracks per inch has also been increased by one-third to 1,376. In addition, Maxtor has shaved weight off its actuators, making it easier for the voice-coil motor to swing the read/write heads into position. That results in considerably faster access times than experienced with Maxtor's current 380M-byte drives, which are rated at 28 msec.

Along with the 760M-byte products, Maxtor is also making available samples of the EXT-8380, a "depopulated" four-platter, 408M-byte drive. It too will support either the ESDI or SCSI interface. Priced at \$1,900, the EXT-8380 has an access time of 16 msec.

**Playing catch-up**

With the EXT-8000 line, Maxtor hopes to offer OEMs one basic drive that will serve the top of the market for 5¼-inch drives and allow the company to manufacture a competitively priced model for the growing 380M-byte sector. Teal says the new drives will be ready for production in April 1987.

So far, Maxtor is the only vendor shipping 380M-byte, 5¼-inch drives in any appreciable volume. OEMs for those products include Emulex Corp., Costa Mesa, Calif., which builds them into mass-storage subsystems for Digital Equipment Corp. computers, and the West German electronics giant Siemens AG, which uses the drives in its multiuser systems. Maxtor expects to announce more OEM contracts in the near future, says Teal.

Meanwhile, Priam, of San Jose, Calif., is poised to enter the 380M-byte fray. Marketing vice president Norm Hayes says the company now has small quantities of sample 382M-byte drives on hand for OEMs. Priam



**Maxtor ups the ante to 760M bytes in the 5¼-inch Winchester market with EXT-8760.**

is bringing out two models, the 638 (ESDI) and the 738 (SCSI). Both use eight platters and have an access time of 20 msec. Hayes would not discuss specific pricing, except to say that production models, to be available in 1987, would be cost-competitive, probably in the \$2,000 range. The new drives use the same basic head drive assembly as the 519, Priam's eight-platter, 190M-byte model. To double capacity, Priam has increased

bit and track density.

Also playing catch-up with Maxtor is Micropolis. This summer at the National Computer Conference the Chatsworth, Calif., manufacturer introduced its Series 1500 family of 382M-byte, 5¼-inch Winchesters. Like Maxtor and Priam, Micropolis plans to bring out ESDI (model 1550) and SCSI (model 1570) versions. Both have access times of 18 msec.

Dan Flaherty, Micropolis' chief financial officer, says the new Winchesters will sell for about \$1,900 in large OEM quantities. Micropolis has not yet begun shipping evaluation units, but Flaherty says they are expected to be available before the end of 1986.

**The SCSI-ESDI switch**

While it hasn't formally announced such a drive yet, Miniscribe Corp., Longmont, Colo., is likely to get into the 5¼-inch, 380M-byte business, though not for several more months. "We don't believe anyone will actively be integrating them into systems until mid-1987," says Bob Abrams,

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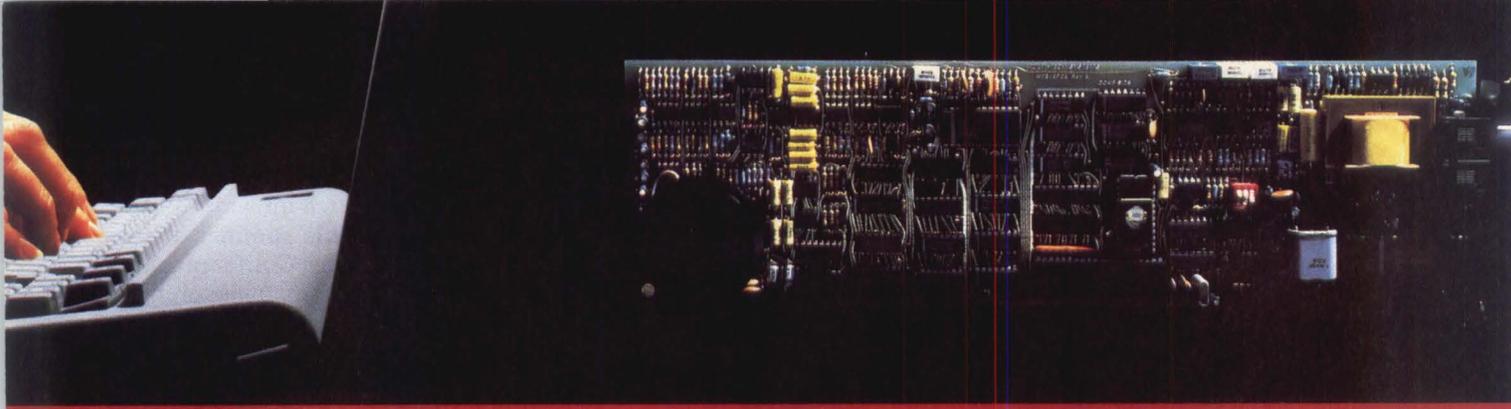
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Miniscribe's vice president for multi-user products division. "The window for introducing that class of drive hasn't closed yet."

Industry analysts seem to agree. Bob Katzive, vice president of Disk/Trend Inc., a Los Altos, Calif., consulting firm that follows the mass-storage market, says that OEMs are still evaluating smaller capacity, 5¼-inch drives in the 170M-to-190M-byte range. The 380M-byte drives are products for 1987 and 1988, he adds.

"As far as we can tell, they [170M-to-190M-byte products] are being designed-in, albeit slowly," says Katzive. "With the upheaval that's been going on in the industry, design cycles have been stretched out somewhat."

Still, Disk/Trend forecasts substantial growth for large-capacity 5¼-inch Winchester in the 300M-to-500M byte range, a market now largely dominated by 8-to-14-inch drives. Disk/Trend expects 5¼-inch drives to have one-third of the 300M-to-500M-byte segment by 1988. The growth will come at the expense of large-diameter drives (see chart).

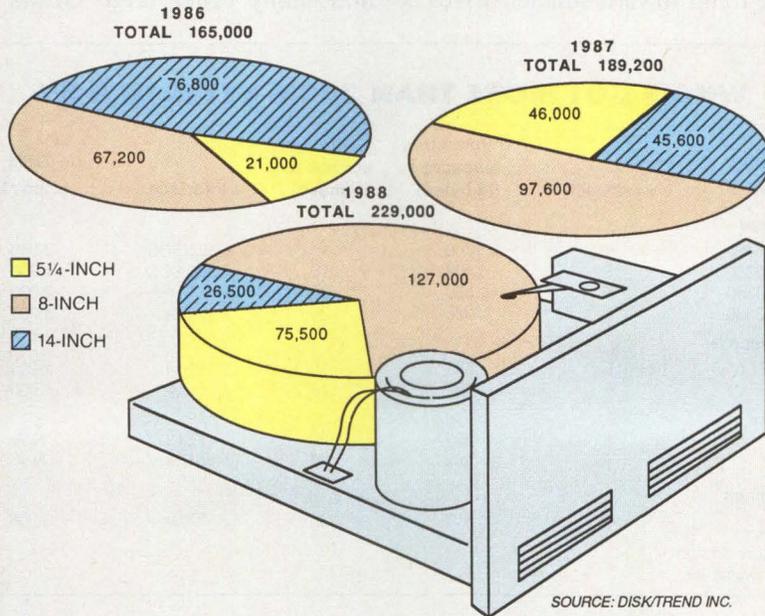
"There's no doubt the 14-inch drive is a dinosaur," says Micropolis' Flaherty. "It's going so quickly it doesn't know it's dead."

But it's unlikely the smaller drives will displace 8-inch and 10-inch Winchesters, says Joe Jaworski of Peripheral Concepts, an Irvine, Calif., consulting company that tracks the controller and interface business. That's because the performance of 5¼-inch drives cannot compare. Larger, 8-inch, drives equipped with the extended storage module device (ESMD) interface, for instance, have transfer rates from 15M-to-24M bits per second, compared with 10M bps on the ESDI and SCSI. Larger drives also have more data per cylinder, requiring less head travel to reach the data.

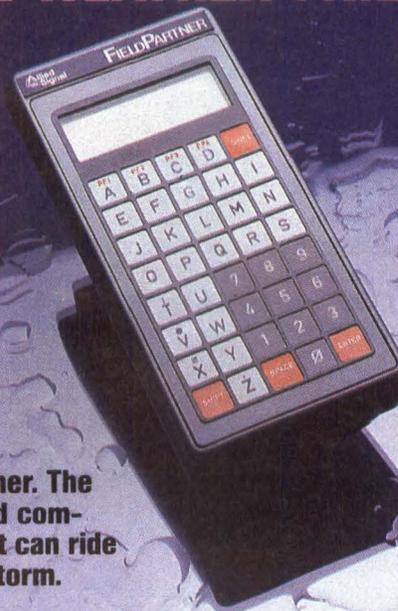
"Big, 5¼-inch, drives will go into new, very specific applications as computer systems continue to be sized down," says Jaworski. "Schematic capture and CAD/CAM [computer aided design/computer aided manufacturing], things that require a lot of storage, will be done on desktop

### BIG GROWTH AHEAD FOR PLATTER-PACKED 5¼-INCH WINCHESTERS

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machines rather than on minicomputers.”

The trend toward smaller drives is

clear, but how soon it will happen in a big way is unclear. As of now, DEC and many other large OEMs still

haven't announced the incorporation of 5¼-inch drives above 85M bytes, although that's expected shortly. On the other hand, a few DEC competitors such as Data General Corp. and Burroughs Corp. are not delaying. Similarly, in such highly competitive markets as engineering workstations, companies like Apollo Computer Inc. and Sun Microsystems Inc. are supporting 170M-to-190M-byte, 5¼-inch drives, says Flaherty.

“The issue is making the transition from the ST412/506 interface to modern ones like ESDI and SCSI,” says Flaherty. “There is engineering effort and time off the calendar required to do that. That's the reason they hesitate going for even 170M bytes. Once they change interfaces, it's no longer an engineering issue to go to 380M bytes.” □

**WHO'S GOT MORE THAN 300M BYTES IN A 5¼**

Vendor/ Drive	Availability*	Unformatted capacity (M bytes)	Average access time (msec)	Interface	OEM price (\$)
<b>Maxtor</b>					
EXT8760	E	760	18	ESDI/SCSI	3,040
EXT8380	E	408	16	ESDI/SCSI	1,900
EXT4380	P	380	28	ESDI	3,000
EXT3380	P	380	28	SCSI	3,000
<b>Micropolis</b>					
1558	E	382	18	ESDI	1,900
1578	E	382	18	SCSI	1,900
<b>Priam</b>					
738	E	382	20	ESDI	N/A
638	E	382	20	SCSI	N/A
<b>Siemens</b>					
1300	P	310	25	ESDI	3,350

\*P=production  
E=evaluation

**More potent 3½-inch Winchester boost low-end**

While manufacturers of 5¼-inch Winchester disk drives pursue capacities beyond 300M bytes, makers of 3½-inch Winchester drives are attracting users and integrators of low-end desktop systems. The lure: high-performance drives with capacities from 20M bytes to 80M bytes and access times as fast as 29 msec.

Among the companies with or preparing 3½-inch products are C. Itoh Electronics Inc., Los Angeles; Conner Peripherals, San Jose, Calif.; LaPine Technology Inc., Milpitas, Calif.; Microscience International Corp., Mountain View, Calif.; Miniscribe Corp., Longmont, Colo.; and Peripheral Technology Inc. (PTI), Chatsworth, Calif.

C. Itoh will offer the Y.E. Data Inc. 40M-byte drive which they expect to sell for under \$1,000 beginning sometime in the fourth quarter. The yet unnamed drive will most likely be available with either a standard ST506/412 interface or an embedded small computer systems interface (SCSI). Conner Peripherals' model CP 340, around \$750 for OEM quantities in the 5,000 to 10,000 range, sports a 50M-byte capacity and a 29-msec average access time. It uses an embedded SCSI interface.

The newest player, PTI, is taking an aggressive stance, with its series of 3½-inch drives that ranges in capacity from 20M bytes to 45M bytes formatted. Similarly, Microscience and Miniscribe are offering drives in the 10M-byte-to-40M-byte range.

The new 3½-inch drives not only save space but also consume less power than their big brothers—10

to 15W. However, when manufacturers reach the goal of 7W and below, the small drives will muscle their way into portable applications—many 10M-byte, 3½-inch drives already function at this low-power level.

To achieve high-capacity in a small space, drive makers are relying on better components in the form of sputtered media and minicomposite read/write heads. The 1986 “TAGi Head/Media” report, published by Technology Assessment Group Publications, Saratoga, Calif., says these will be the principal components in the small drives. These components coupled with encoding techniques such as 2,7 run-length limited (RLL) code, which puts down seven data bits for every two flux reversals, more than double the amount of data that can be stored on a platter. These techniques and media improvements lower the per-bit cost.

Because 3½-inch drives are moving up in the capacity range, so is the low-end storage requirement. Just two years ago, the low-end requirement, according to industry experts, was 10M bytes at a cost of about \$96 per megabyte. Today the low-end minimum is 20M bytes at about \$48 per megabyte—a 100 percent increase in capacity and a 50 percent reduction in price. And, due to the use of refined storage technology including RLL and SCSI interfaces, the TAGi report predicts that by 1990, capacity for small drives will be 50M bytes at between \$10 and \$12 per megabyte.

—Carl Warren

# ANSI display management aids real-time imaging

Jesse Victor, Associate Editor

Implementing sophisticated image-processing functions on an IBM Corp. PC usually requires extensive programming knowledge and several boards that tie up valuable expansion slots. Conversely, boards and software that are relatively easy to master can fall short in their image-processing capabilities, particularly for critical industrial and scientific applications.

The new MaxVision AT-1 image-processing system, Datacube Inc.'s first high-end product for the PC, solves this dilemma, according to the company. The system packs powerful, real-time image-processing and development functions and a user-friendly, window-and-menu-based interface into one PC/AT add-in board and expansion box. In addition, the AT-1's image-processing software takes a major step toward freeing system integrators and end users from vendor-specific implementations: It conforms to the emerging ANSI display-management system standard currently under development (see "ANSI sets sights on display-management standard," Page 46).

The system has a pipelined arithmetic and logic unit (ALU) for fast real-time convolutions, three frame stores, four input lookup tables (LUTs), macros for user-defined image operations, edge-enhancement operators, non-linear, morphological and other sophisticated image-processing functions. These allow MaxVision AT-1 to serve either as a general-purpose, 512-by-512-pixel, menu-driven factory-floor or laboratory system or as a development machine for custom, vertical-market or OEM applications.

## Processing perfects images

The four LUTs allow basic and fast preprocessing of the image acquired from up to four video sources, such as video cameras, image scanners or other charge-coupled devices. The three frame stores, holding 512 by

512 pixels by 8 bits, permit comparison of the processed image with a reference image for inspection operations. Two frame stores can be used as a 16-bit accumulator for 16-bit precision. Real-time Sobol edge-enhancement operators (which process x and y gradients simultaneously), finite impulse response (FIR) filters, convolutions and other menu-selectable image-processing techniques can sharpen the image to highlight crucial features.

MaxVision AT-1's morphological, nonlinear image-processing erosion and dilation techniques, previously implemented only on high-end systems, eliminate noise—pixels that do not contribute to image enhancement—and help to differentiate an object from the background. The techniques also help users isolate parts of an object for further processing. In contrast to relatively simple point operations that transform an individual pixel's gray-scale value or color, morphological functions use logical AND or OR operations to determine a pixel's value based on the values of neighboring pixels.

The \$9,500 MaxVision AT-1 "can do what would have required five \$6,000 Multibus boards to do in the past," asserts Bruce Mackie, director of sales and marketing at Datacube. "We combine high performance with reasonable cost. In the past, to do a 3-by-3 convolution on an entire image might take 30 seconds. MaxVision can do it in one-third of a second."

MaxVision AT-1's three levels of access to image-processing functions, which correspond to the system's three software layers, enhance the system's flexibility and separate easily learned general-purpose operations from more specialized commands, Mackie says.

At the top level, users manipulate a mouse to access pull-down menus to bring on and implement image-processing functions via multiple windows. Defining multiple regions of interest on an acquired image speeds

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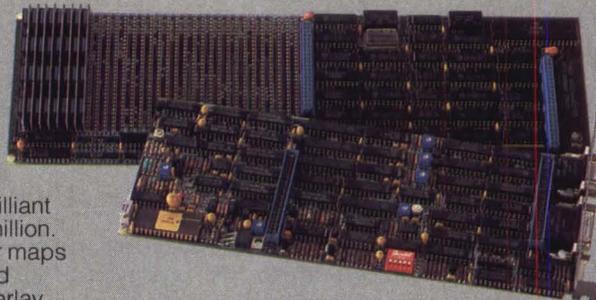
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Actual TARGA image created by Paul Reiche III for AT&T Island Graphics Art Contest. © 1986 AT&T

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up throughput by allowing the board to process the relevant subsets of a whole image's pixels.

This first level of access makes MaxVision AT-1 "a superb introduction to image processing," asserts Susan Solomon, marketing manager at Datacube. "If you have never done it before, it holds your hand," she says. Adds Mackie: "We wanted to take away the pain of program development. We see our strength in selling to a lab environment, for example. But lab people don't want to sit down and read tons of manuals. You can plug the box in, boot it up and get on the air within 10 minutes."

MaxVision AT-1's second, interactive, level permits a system integrator to use a keyboard to enter and execute C language or, alternatively, English-like commands, such as "Northeast edge detection." A look-ahead command-line interpreter anticipates whole commands from the first part entered.

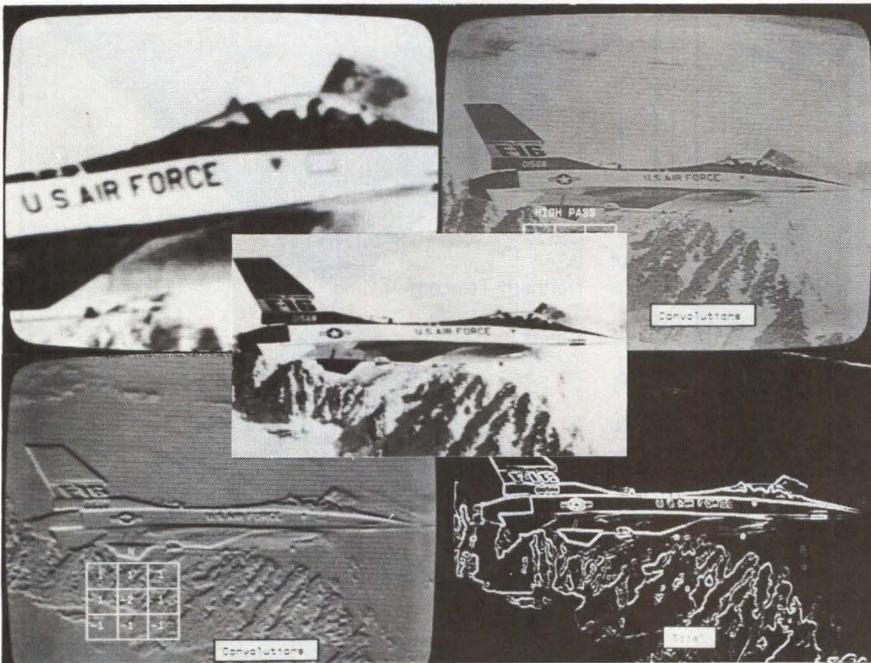
The third level, a collection of C language callable functions, speeds the development of specialized user interfaces, or image-processing programs, and implements one-to-one mapping between commands and the

user interface for direct control of the image-processing hardware.

Multiple audit trails record the processing commands entered at the second or third level. Files can be edited, re-executed and used to produce command scripts that can process successive images automatically. User-defined functions can be added to the standard image-processing menus.

### The real test is applications

The window-mouse interface allows inexperienced users to come up to speed quickly. But, the mathematical morphology and other advanced image-processing techniques, along with multiple real-time region-of-in-



**Menu-based image-processing functions on a digitized image (center) furnished by MaxVision AT-1 (upper right) include (clockwise from upper left) zoom, high-pass filtering, Sobel edge enhancement and north-edge enhancement.**

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terest processing and multiple inputs, give the box real potency for jobs such as assembly line product inspection and other industrial or scientific applications, Mackie emphasizes.

“You can select an image from one or more video sources, store it, process it, compare it with a reference image, use erosion and dilation to check [a part’s] alignment or look for

defects or holes. In oil-exploration applications, you can use MaxVision to process satellite Landsat images, manipulate seismic data and determine if there is a real salt dome out

## ANSI sets sights on display-management standard

Datacube Inc.'s MaxVision AT-1 is the first, but certainly not the last, image-processing product that conforms to the emerging ANSI display-management standard for a window-based user interface. Developed by the ANSI X3H3.6 committee, the first draft of the standard—encompassing graphics, image processing and text display—should be completed by the end of the third quarter of 1987, according to Dr. Georges Grinstein. Grinstein, who represents the University of Lowell on X3H3.6, heads the university's Graphics Research Lab, which helped develop MaxVision AT-1's image-processing software.

A functional specification defining interfaces among application programs, user interfaces, operating systems, machine code and final-user displays, the standard is designed to replace device-dependent display routines. System integrators and users would

no longer be shackled to proprietary interfaces.

“We want to provide a standard for window management that people can use to write applications incorporating windows,” explains Grinstein. “We want people who write application programs to know what the calls are. If you have, say, a solids-modeling package, you'd like it to work in many different window environments.”

Grinstein expects that the presence of a wide range of semiconductor, computer and workstation manufacturers, as well as software vendors, on the X3H3.6 committee will hasten acceptance of the standard. “Because Microsoft [Inc.], Apollo [Corp.] and Sun [Microsystems Inc.] are on the window committee, they will ensure that any changes necessary in their software products or hardware will be minimal.”

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there or just a reflection.”

A 10-MHz direct-memory-access interface connects the 19.5-by-17-by-3-inch box to the PC/AT. Because it has its own power supply and because the connector card that plugs into the computer draws only 0.7A at 5V, the system does not strain the AT's switcher.

MaxVision AT-1 is Datacube's first add-on product, and the -1 appendage signifies that it is the first in a new line of image-processing systems. The company plans to implement MaxVision AT-1's window/menu-based user interface and versions of its layered image-processing software on its other image-processing products, including its VMEbus MaxVideo line and Multibus Minvideo systems. The company will also port the software to workstations from Sun Microsystems Inc. and other vendors.

“We want a uniform software interface over our products,” says Mackie. “We want to create a menu-driven product for all our boards, including our Euclid-VME 16-bit, digital-signal processing board.”

### Imaging emerges from the lab

MaxVision AT-1's image-processing software, developed by Datacube and the University of Lowell's Department of Computer Science Graphics Research Lab and Lowell's Center for Productivity Enhancement, will be easily updated to conform to the final ANSI display-management standard, says Dr. Georges Grinstein. He is an associate professor in the department and a member of the ANSI X3H3.6 committee, which is developing the standard.

“We will enhance the package by adding expert-system tools for pattern recognition; a fairly extensive, full-natural-language interface, instead of the near-English commands we can accept now; and tutorials,” Grinstein says. “We will have a very rich image-processing environment.”

Because MaxVision AT-1 is not limited to one kind of user interface or to a restricted menu of capabilities, Datacube is actively pursuing OEM and vertical markets with its new image-development and processing system, Mackie says.

“MaxVision is a turnkey approach, but it is also extensible,” he comments. “An OEM can take the product, add more application-specific software using the tools we supply and create his own product. He can also create his own user interface, by using icons or other display techniques.”

Datacube faces some stiff competition in the image-processing arena from other PC/AT-based boards such as Imaging Technology Inc.'s Series 151 system (\$14,475) and Data Translation Inc.'s DT2851/DT2858 board set (\$5,685). But the company expects MaxVision AT-1's blend of powerful processing functions and advanced user interface to attract PC/AT users into the image-processing arena—and away from competing products.

“A lot of people have been disappointed with their first-generation image-processing systems,” says marketing manager Solomon. “They don't have enough processing power, or the boards have sophisticated features that people not familiar with image processing can't come up to speed on quickly. We want people who have been reluctant to get into image processing because of the expense or effort involved.” □

### FACT FILE

MaxVision AT-1

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\*8-bit-per-pixel resolution

\*256 gray-scale levels

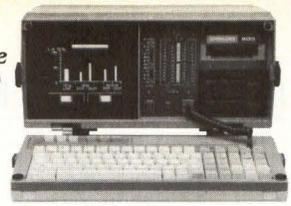
\*Window interface

\*Real-time and multiple-area-of-interest processing with pseudocolor output

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## CIM REPORT

## Reports of CIM's death are greatly exaggerated

**James F. Donohue**  
Managing Editor

Now, really, let's end this wake for computer integrated manufacturing, known to its friends as CIM. The beast is not dead. It may be a bit lame and underfed, but both are temporary conditions. CIM continues to be a super "potential" business for system integrators. And the "potential" gets closer to "real" every day.

The importance to CIM of the system integrator has been the big discovery this year. Even the giant vendors like Allen-Bradley Co., Digital Equipment Corp., Hewlett-Packard Co. and IBM Corp. have discovered they can't play at CIM without the help of, first, consultants and, second, system integrators. Consultants are needed to plan the CIM operation; system integrators are needed to select the parts and put them together. An analogy going around is taken from the construction industry: The consultant is the architect; the integrator is the construction company.

CIM, like its equally maligned associate, MRP (short for materials requirements planning), is a simple critter. The only time it gets complicated or nasty is when people make it that way. Both are just techniques for using computers to get control of a job: MRP for inventories; CIM for production machines. A lot of MRP, which has been around for decades, is junk, but companies that have made it work consider it golden. These companies include Instron Corp., Canton, Mass.; Steelcase Inc., Grand Rapids, Mich.; and Tennant Co., Minneapolis. CIM will be golden, too, where people take the time to do it right.

The main reason CIM has gotten a bad name is that the technology to make it work hasn't been available. Now some of it is. Examine just one small part of computer aided design/

manufacturing (CAD/CAM), which is itself only a small part of the CIM process. Until recently, CAD was done on standalone workstations using wire-frame modeling, a technique that describes only the edges and envelopes of an object's geometry. In wire-frame modeling, the display can be ambiguous and the geometry incomplete. What's needed is solid modeling, which defines the interior of parts being designed and produces a more complete geometric representation that can be applied to other CAD/CAM functions. These include finite-element analysis (stress calculations) and numerical-control (NC) programming.

### Near-mainframe performance

Solid modeling has been beyond the capabilities of existing, standalone CAD/CAM workstations. Where you found it, it was on terminals attached to a minicomputer or mainframe, and they could be very, very slow. However, the advent of 32-bit workstations has changed that. These machines give designers a tool, dedicated to their use only, that performs like a mainframe.

The number of manufacturing installations where you can find solid modeling has jumped from 40 in 1982 to about 1,000 today, according to a variety of sources. More than two dozen companies make solid modeling software for workstations, including many small and innovative companies like Matra Datavision, Woburn, Mass., which recently demonstrated programs for direct machining from solid models.

Another problem in CAD/CAM has been the lack of a standard for the exchange of graphics among machines that can't talk to each other. Now there are a number of translators, like Initial Graphics Exchange Specification (IGES), a neutral pro-

gram that acts as a go-between for incompatible computers that want to exchange graphic data. There are now more than a dozen companies that supply IGES translators as part of their CAD/CAM software. These include IBM; Matra Datavision; Auto-Trol Technology Corp., Denver; Computervision Corp., Bedford, Mass.; Intergraph Corp., Huntsville, Ala.; and Prime Computer Inc., Natick, Mass.

Even more encouraging than these advances in technology is evidence that sanity is seeping into our thinking about CIM. The experience of General Motors Corp., which is reported to have blown up to a billion dollars on a too-grand implementation of CIM, has convinced everybody—vendors, buyers, system integrators, consultants—that "small" is really the best way to go about computerizing in manufacturing.

At a three-day seminar on CIM sponsored by HP, the question was raised, "How do you eat an elephant?" The answer, "One bite at a time." The moral, of course, is that a multimillion dollar, fully integrated, grandiose implementation of CIM is too prone to disaster. You should bite off one chunk of the factory and put computers to work there; then take another bite; then another. Bob Hill, president of Hilco Technologies, a system integrator in St. Louis, advises implementing CIM in chunks that cost no more than \$100,000. "Build CIM over a period of years," he says.

CIM is far from dead, but, to be honest, it's not very healthy, either. This will be a bad year, in large part because GM has cut back sharply on expenditures for automation. One estimate is that shipments by CIM vendors will be off 20 percent in 1986. But tough times do not make a corpse. Terminate the wake.



## Davox thrives on niches in the voice/data business

Davox Corp., founded in 1981 and still privately held, sells computer-aided communications gear, including voice/data workstations, into niche markets, primarily banking and retail (credit-card collection), telephone companies (customer service) and brokerage houses (portfolio management/stock trading). It has 6,000 workstations installed and projects 1986 revenues of \$15 million—double 1985's figure.

In tough times for voice/data vendors, niche marketing has played a major part in the company's success, says Daniel A. Hosage, CEO and president. He answers questions from *Mini-Micro Systems* managing editor James F. Donohue.

**MMS. Integrated voice/data terminals (IVDTs) once were thought to have a great future in office automation. But there hasn't been much action.**

No. Too many people got so excited about their technology that they forgot about the customer. They believed the technology would solve all the problems. Americans are soft



**Daniel A. Hosage**, CEO and president of Davox Corp.

touches for that sort of thing, by the way. Europeans are much less willing to believe in technology as the solution of problems.

**MMS. Nevertheless, if we believed it, why didn't we make it happen?**

Times changed. In the late 1970s and early 1980s, people were receptive to broad-based, general concepts like, "Let's buy a lot of PCs and improve the quality of our decision making." We were willing to go down

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that Yellow Brick Road. Then life got tougher. Money was in much less supply. The customer became tougher and much more discriminating. He began to get tough about something called ROI, return on investment.

**MMS. And when Davox found itself in this situation, it went hunting for niche markets?**

What else could we do? We couldn't slit our throats. Rather, we said, "Let's try to discover some niches where we can deliver to the customer value that we can prove." We wanted to offer him a compelling reason to buy. We came up with critical-mission applications. I'm talking about telling a banker how to get cash into his bank faster and save money. One bank customer of ours is doing with 80 people the work that 100 people did before, using separate phones and data terminals. If you're paying

\$25,000 a year to your people, and you can cut 20 people, that's \$500,000 a year you've saved. The equipment that we put in costs about \$250,000. The payback is half a year.

**MMS. So you say that IVDT still has a big potential?**

I don't think there's any question about it. We back ISDN [integrated services digital network]. If the world agrees on ISDN, wonderful. If it doesn't, there's still going to be an integrated service network of some kind. There'll be chaos without it. We have a customer, one of the Bell operating companies, that has 64,000 terminals, six data networks and two telephone networks. They're going crazy. They're committed to the fact that in a couple of years from now—three years, five years—the networking, the central-office switching, the LAN controlling transmission of

the system through the building and the desktops are all going to have a significantly higher degree of integration than they do now—come hell or high water.

**MMS. What's your competition?**

Sloth. Ignorance. Unwillingness to change.

**FACT FILE**

Series 4900 and 5900  
**Davox Corp.**  
 4 Federal St.  
 Billerica, Mass. 01821  
 (617) 667-4455  
**Circle 474**

\*Series 4900/5900 voice/data workstations, based on Motorola Inc.'s MC68000 processor, add windowing capabilities and Digital Equipment Corp. VT220 terminal emulation to the company's Series 1900 workstations. The 1900 machines feature IBM Corp. 3270 terminal emulation as well as voice capabilities.

\*Sixteen programmable Smart Buttons provide single-key implementation of voice/data tasks, such as accessing a mainframe and autodialing telephone numbers stored in databases.

\*The workstations can hook into multiple databases stored in multiple IBM or DEC computer systems and display each simultaneously in windows on the screen.

\*512K bytes of memory.

\*Interfaces via twisted-pair wiring (DavoxNet) or via coaxial cable.

\*Price: Series 4900, green or amber monochrome display, \$2,695; Series 5900, color display, \$2,995.

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**LOOKING AHEAD IN MMS**

- The Fall edition of Peripherals Handbook with an editorial emphasis on disk drives and controllers will arrive in mid-November.

Reprints of Mini-Micro Systems' articles are available on a custom printing basis in quantities of 500 or more. For specific quotations, contact Katie Pyziak, (312) 635-8800.

# XYLOGICS.

## YOUR PARTNER FOR HIGH PERFORMANCE.

 At Xylogics, high performance means everything. To the company, and to its products. No other peripheral controller company has set a higher standard of high performance. Or met it.

Since 1977, we've dedicated all our efforts to designing, developing, manufacturing and marketing the industry's highest performance controllers. Nothing more. Never anything less.

Today, Xylogics' Multibus and VME peripheral and communications controllers are in use at over 25,000 customer sites. With an installed base of nearly 50,000 high performance controllers worldwide.

In fact, nearly half of all high performance Multibus disk and tape controllers in use today are ours. And in the emerging VME market, Xylogics is rapidly becoming the dominant supplier.

It's not surprising, then, that Xylogics has been selected as the exclusive high performance controller vendor by virtually every supermicro, parallel, multiprocessing and workstation company.

And little wonder that Xylogics has become one of the industry's most dramatic success stories over the past four years. At a time when much of high tech is hard hit, Xylogics is posting record sales. And it continues a record of unbroken profitability that began in 1984.

There's only one reason for this kind of high performance. A commitment to the highest standards of



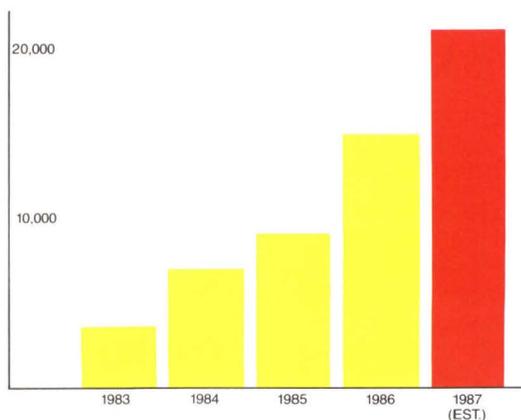
Bruce Bergman, President, CEO



excellence. Standards that give OEMs and systems integrators superior product quality, flexibility and a long term commitment.

We want your business. This means we'll work harder to get it, and smarter to keep it. All our development efforts focus on advancing controller technologies. With the latest and

fastest microprocessors. The most advanced microcircuitry. The newest and most sophisticated manufacturing equipment. And the industry's most aggressive R&D investment. All to keep Xylogics at the forefront of new high performance peripheral controller technology. And keep you growing with us.



ANNUAL CONTROLLER SHIPMENTS (UNITS)

# HIGH PERFORMANCE DEFINED.

Today's VME and Multibus systems have one thing in common. They all have to pass large amounts of data at high speeds between the CPU and peripherals, where data is stored.

Because this takes place in "real time," it poses a problem found in many supermicro, workstation, parallel and multiprocessing computers: the system can become CPU, Bus or I/O bound. This causes a severe decline in system performance.

In theory, the peripheral controller holds the key to overcoming these speed and capacity limitations. In reality, however, only the *right* peripheral controller truly designed and built for high performance solves the problem.

Xylogics makes the right controller. The industry's highest performance peripheral controllers for Multibus and VME applications.

## More Bandwidth

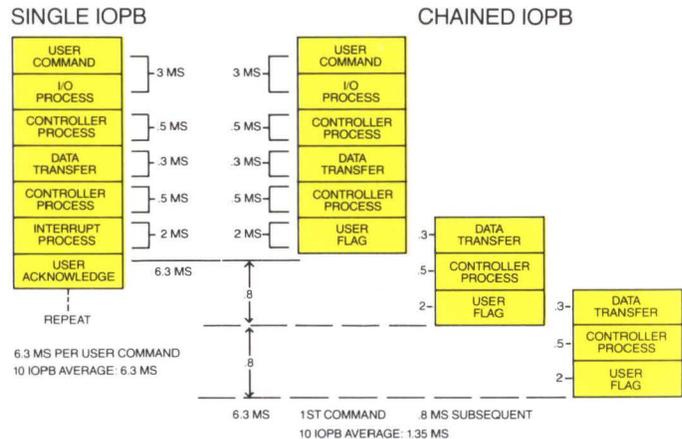
The common resource linking the peripheral controller and CPU is memory. If a peripheral controller is slow, then more memory is needed to move information back and forth between the CPU and storage devices such as Winchester disks, SMD disks and streaming start/stop tape drives. This makes other CPU tasks "memory poor." And negatively impacts CPU performance.

This critical role the peripheral controller plays dramatizes the fact that disk I/O performance is a key ingredient for high performance in a computer system. The more quickly data is transferred, the more bus bandwidth is available to handle demanding real-time applications, and the faster the CPU can "crunch" data.

## Three Key Design Features.

Xylogics' peripheral controllers are designed to deliver high performance. With a range of features no other controllers can match.

Xylogics controllers incorporate three key design features that set them apart from the competition. A First-In-First-Out (FIFO) buffer architecture that virtually eliminates performance degradation due to loss of disk revolutions. A command optimization feature that lets the controller get ahead and "be smart" about operating system requests. And a command queuing design that optimizes controller throughput.



## COMMAND QUEUING.

There are various ways to handle commands. Competitive controllers that claim high performance handle commands (which transfer data on related tracks or cylinders) individually. Xylogics' command queuing takes a different approach. IOPB (I/O Parameter Block) commands are grouped or chained together to allow immediate processing by the controller. As a result, interrupt processing on each IOPB is eliminated, saving time as well as CPU cycles. This design enables chains to be added "on the fly," allowing efficient overlap. Chains are DMA'd into the controller during times of low bus activity, which helps it get ahead on interpreting commands. For the end user, this translates into a much higher level of controller performance.

Other features include an I/O Parameter Block (IOPB) that allows asynchronous operation between system software and peripheral devices. A faster Direct Memory Access (DMA) channel for concurrent disk and tape transfers. Custom gate arrays and standard cell circuits to decrease board density and increase speed. Elevator seeks and zero latency reads to maximize performance. And for users of the new UNIX Version V Release 3 file system, Xylogics' scatter-gather design improves file system performance.

These features enable Xylogics controllers to approach the transfer limits of the Multibus and VME bus. Eliminate software overhead common to other controllers. Provide the highest possible utilization of disk or tape capacity and speed. And reduce the workload of a system's CPU by offloading I/O processing to the controller.

This kind of high performance in a peripheral controller is what made the leading computer manufacturers choose Xylogics as their exclusive supplier of high performance peripheral controllers.

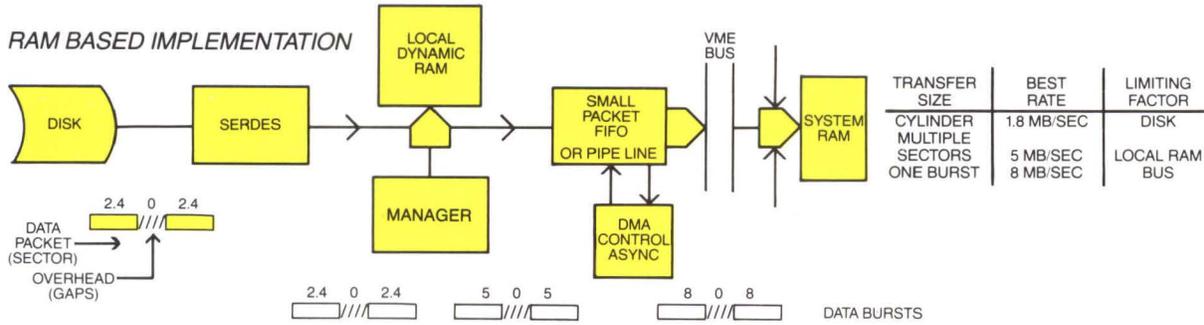
And it is this ability to process data 20% to 50% faster than other competitive products, that has made Xylogics the undisputed market leader.

# HIGH PERFORMANCE ILLUSTRATED.

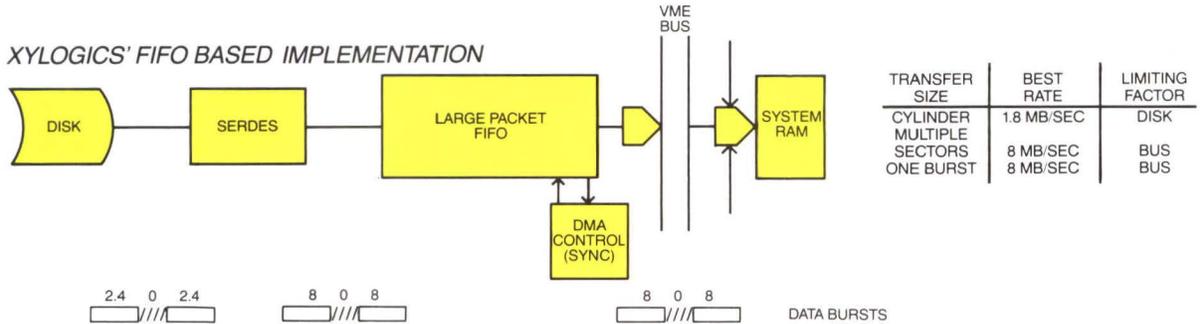
Sometimes, a few good illustrations are worth a page-full of words. The following drawings clearly—and dramatically—capture the essential differences between

the design of Xylogics' controllers and other competitive approaches. These design differences translate into one key benefit for OEM's: true high performance controller throughput.

## BUFFER ARCHITECTURES.



The RAM-based designs of other controllers limit any multiple burst transfers to internal controller RAM speed. Consequently, when the bus is clogged, data transfer suffers.



One of the reasons Xylogics' controllers move data faster is because they feature a First-In-First-Out (FIFO) buffering design. This means that instead of processing information through the controller to the CPU in batches (as competitive controllers do), Xylogics' products take data in and push it out continuously, without blocking or deblocking.

As illustrated here, Xylogics' FIFO-based design does not limit higher transfer rates over several bursts, an important feature when the bus is clogged. In these situations, the only limiting factor is the disk itself.

When a list of commands is given to the controller (in queued mode), commands that access adjacent areas of the disk can be executed together. This approach eliminates many long seeks and lost disk revolutions when blocks are on the same cylinder. This ability of Xylogics controllers to optimize commands, instead of handling them sequentially like competitive controllers, is a key reason for a higher level of performance.

	ORDER	TIME (MS)	ORDER	TIME (MS)
BLOCK 1 TRACK 0 HEAD 0	1	25	1	
BLOCK 30 TRACK 20 HEAD 2	2	45	4	25
BLOCK 41 TRACK 308 HEAD 0	3	45	8	45
BLOCK 20 TRACK 70 HEAD 4	4	30	6	30
BLOCK 32 TRACK 20 HEAD 2	5	25	5	2
BLOCK 30 TRACK 0 HEAD 4	6	45	2	8
BLOCK 4 TRACK 309 HEAD 1	7	16	9	16
BLOCK 5 TRACK 0 HEAD 4	8	45	3	0
BLOCK 21 TRACK 70 HEAD 3	9		7	2
		296 MS SEQUENTIAL		128 MS OPTIMIZED

COMMAND OPTIMIZATION

# MAXIMUM MULTIBUS PERFORMANCE.

No other controllers offer better performance than Xylogics when it comes to 16 or 32 bit microprocessors attached to large capacity disk, tape or other high performance peripheral storage devices.

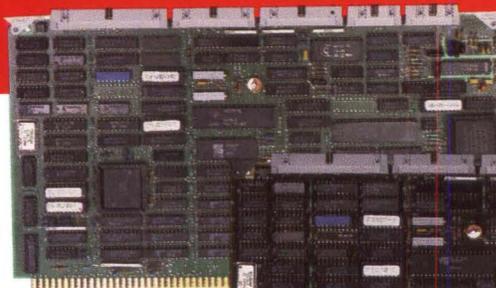
Take Xylogics' family of Multibus products, for example.

Made up of five controllers, these boards set new standards for price, performance and size for the IEEE-796 multibus. Each residing on one single height Multibus printed circuit board, Xylogics' controllers use the advanced technique of channel control for an optimal match to the multiprocessing environment of the IEEE-796 bus and 16/32 bit microprocessors such as the 8086, 68000, 16032, 80286, 32032 and Z8000.

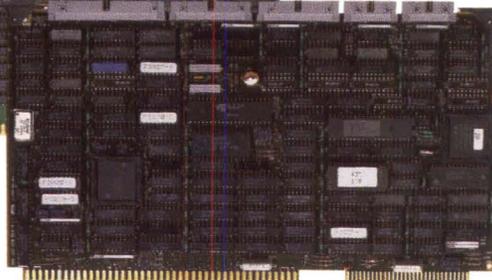
How do Xylogics' Multibus peripheral controllers outperform the competition? With a wide range of features that give OEMs, systems integrators and sophisticated end users many benefits.

And as you might expect, all Xylogics' Multibus controllers are program compatible with each other. This ensures full functionality and ease of use.

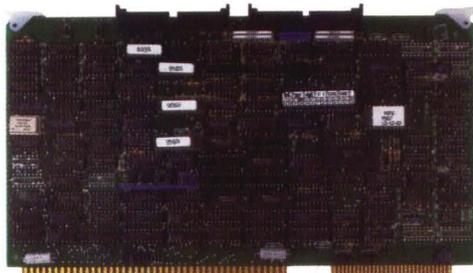
Feature	Benefit
Extensive Custom VLSI Use	Built-in Reliability/Lower Parts Count and Power Consumption
Fast DMA	Low Bus Utilization Overhead Increases System Performance
Large FIFO Buffer	Fastest Aggregate Transfer Rate
Single Board Design	Requires less backplane space
16,20 or 24 bit addressing	Compatible with all Multibuses
Programmable Throttle	Supports any Multibus system and optimizes system performance
Selectable Device Addresses	Match System Requirements
On-Board Diagnostic With Status LED	Power Up Self Test
Burned-In Components/ Power Cycled and Burned-In On Finished Controllers	Built In Reliability
High Speed Front End	Supports the latest high speed drives



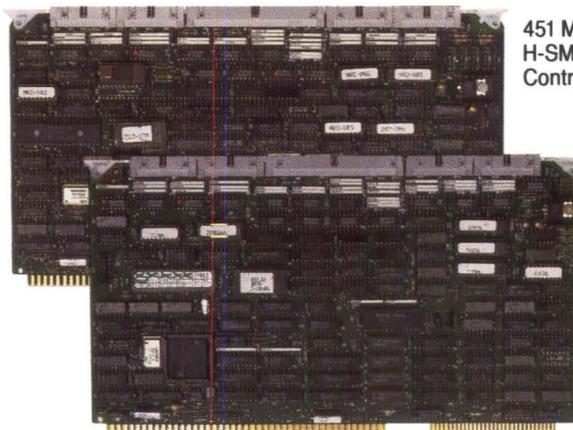
431 Multibus ST506 Disk



432 Multibus ESDI Disk



472 Tape



451 Multibus H-SMD Disk Controller

450 Multibus SMD Disk Controller

These features make the difference between average performance and the kind of high performance control Xylogics' products deliver day in and day out to virtually every leading supermicro, workstation, parallel and multiprocessing computer supplier.

Is it any wonder Xylogics has sold more high performance Multibus peripheral controllers to more major OEMs than anyone else?

Find out how Xylogics' high performance, reliability and support can be part of your Multibus success story. Call or write for information about our complete line of Multibus products.

**THE SECRET'S OUT.**



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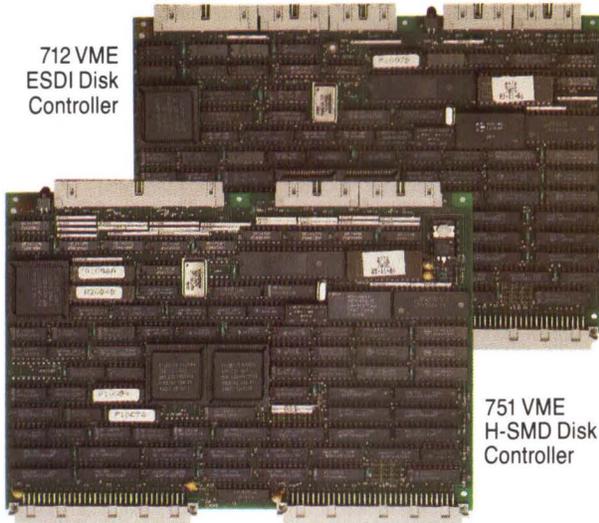
# VERSATILE VME PERFORMANCE.

When it comes to peripheral and communications control for the world's leading 32-bit bus, nothing comes close to Xylogics.

Currently made up of four different products, Xylogics' VME controllers give OEMs, systems integrators and sophisticated end users some major improvements over similar products.

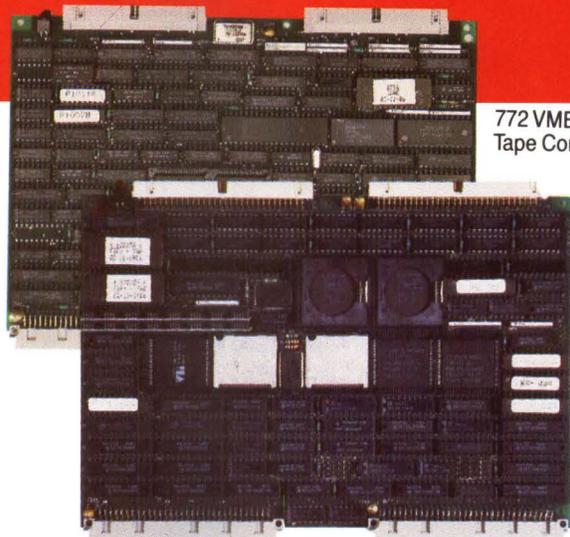
How do Xylogics' VME peripheral and communications controllers outperform the competition? With a wide range of features that give OEMs, systems integrators and sophisticated end users many benefits.

712 VME  
ESDI Disk  
Controller



751 VME  
H-SMD Disk  
Controller

Like its disk and tape counterparts, Xylogics' newest VME family member, the 780 communications controller, sets new standards for high performance.



772 VME  
Tape Controller

780 VME Communications Controller

The 780 is the first VME communications controller to feature a full 32-bit, instead of 16-bit, data path. It can support UNIX line discipline processing on 16 full duplex asynchronous ports at 9600 baud, or 8 ports at 19.2K baud on a single board. This gives OEMs a 70% throughput advantage over other VME communications controllers. The 780 also provides full TTY subsystem emulation directly on the board. This reduces the amount of character I/O processing the host CPU must perform. Software is available for 4.2 BSD and System V versions of UNIX.

At Xylogics, we understand that no technological advancement is really beneficial until it can enhance system performance. Translating these new peripheral and communications technologies into system enhancements is at the heart of Xylogics' commitment to leadership.

And it's the reason why a majority of VME super-micro, workstation, parallel and multiprocessing computer suppliers are selecting Xylogics as the peripheral and communications controller vendor of choice.

Why settle for lower system performance on the world's fastest 32-bit bus?

Find out how Xylogics' high performance, reliability and support can be part of your VME success story. Call or write for information about our complete line of VME bus products.

Feature	Benefit
Burst DMA Rate Up To 18MB/s	Low Bus Overhead
Single Standard VME Board Design	Less Backplane Space
Programmable Bus Control	Allows System Optimization
Programmable Drive Parameters	Simple Reconfiguration
Fourth Generation Software Interface	More Net Throughput
UNIX Software Support	Ease of Integration
VLSI Design	Built-in Reliability/Lower Parts Count and Power Consumption
Command Queuing	On-Board Command Storage
Full 32-bit Support	Large Memories supported
Self Test Diagnostics	Power Up Tests
Command Optimization	Faster Command Execution
High Speed Front End	Supports the latest high speed drives

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# THE SECRET'S OUT.

What do virtually all of the leading super-micro, multiprocessing, workstation and parallel computing companies have in common with Xylogics?

An appreciation of high performance.

High performance in a company. And its products.

Xylogics' Multibus and VME controllers have become the secret behind these success stories.

Why?

Because Xylogics is a dedicated partner to OEM's. Partnerships based on an ability to meet OEM needs with superior product quality, flexibility, and a long term commitment. And, of course, the highest levels of performance.

Xylogics backs all this up with one of the industry's most experienced teams of hardware and software engineers. People trained and ready to provide any kind of remote or on-site assistance to help you integrate our products. And keep them operating at peak performance. Today and tomorrow.

It's a combination of capabilities no other peripheral controller company can match.

And it's a standard of high performance that clearly sets Xylogics apart.

Just ask our customers.

## THE SECRET'S OUT.



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- 751 VME H-SMD Disk Controller
- 772 VME Tape Controller
- 780 VME Communications Controller

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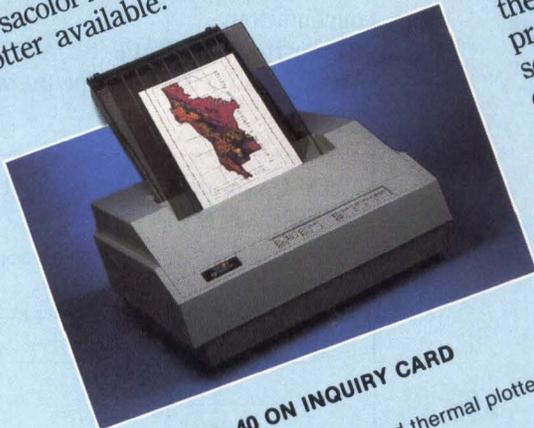
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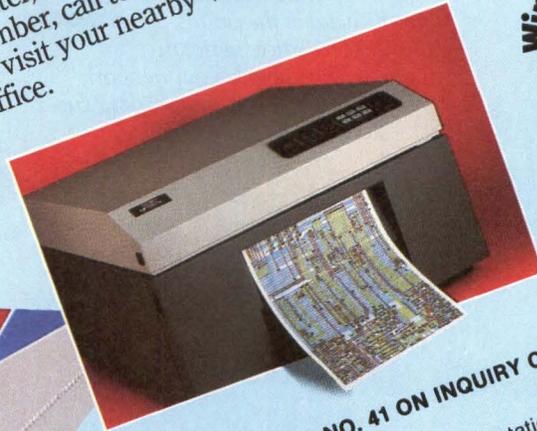
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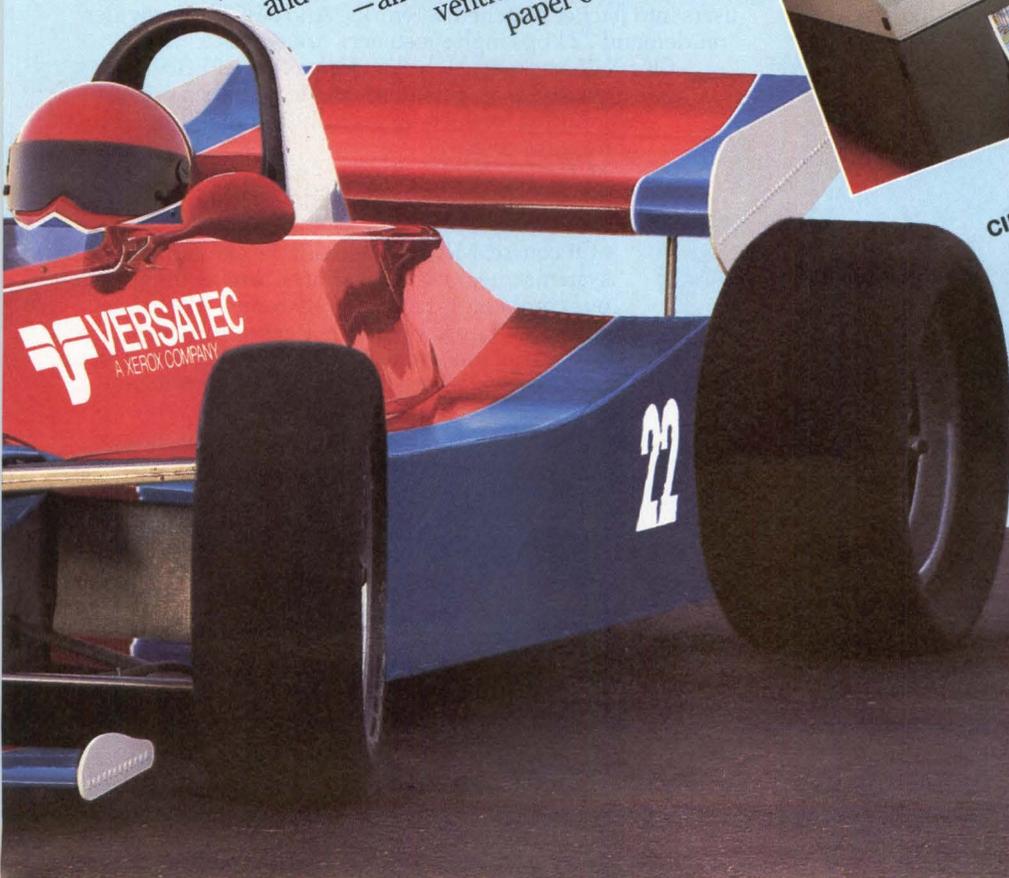
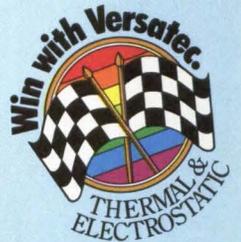
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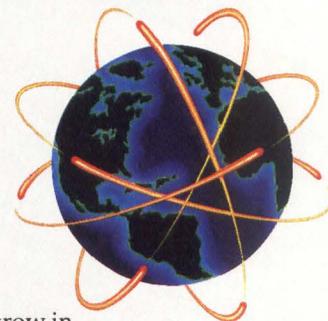
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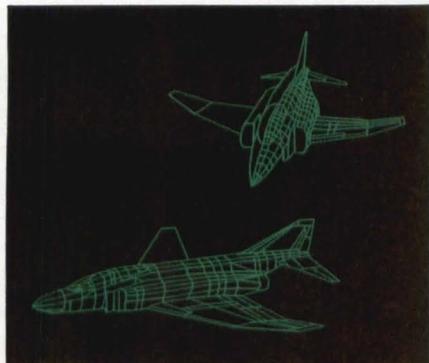
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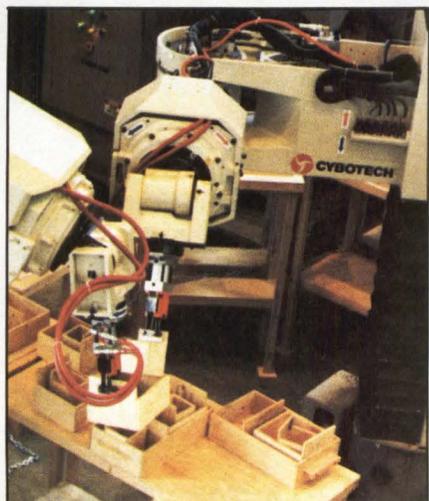
# FEATURE HIGHLIGHTS



p. 65 . . . . . Beyond cards



p. 81 . . . . . Brightening the picture



p. 95 . . . . . A look at MAP and TOP

## **IMPROVED MONITORS OUTSHINE EGA GRAPHICS 65**

While maintaining compatibility with the CGA standard, high-resolution monitors are going beyond the capabilities of EGA cards and even super-resolution PGA cards. The new monitors enable system integrators to push the IBM PC into applications previously reserved for expensive, dedicated graphics systems. Our report on display systems also includes a look at recent developments in the alphanumeric terminal market.

## **COLOR GRAPHICS BRIGHTEN TERMINAL EMULATION . . . . .81**

As a result of recent advances in both PC hardware and software, system integrators can now offer products that allow MS-DOS machines to mimic powerful graphics terminals. Graphics terminal emulators thus open up an array of applications for personal computer users. For example, there are over 300,000 graphics applications available for Tektronix 4010 emulators.

## **REVAMPED MAP AND TOP MEAN BUSINESS . . . . .95**

Specifications for MAP 3.0 and TOP 3.0 are scheduled for release within the next few months. And multivendor demonstrations of networks based on those new standards will be quick to follow. *Mini-Micro Systems'* continuing coverage of OSI-MAP-TOP developments explains the technical aspects and takes a look at what it means to office and factory.

## **TAILORING YOUR SYSTEM: THE ASIC EDGE . . . . .115**

System integrators without the IC experience of design engineers can now develop custom circuits in extremely quick turnaround times thanks to application-specific integrated circuits. They can thereby differentiate their products in an increasingly standardized market. Other benefits of ASICs include reduced size, lower power requirements and lower cost. Our report looks at three major types of ASICs: PLDs, gate arrays and standard-cell ICs.

## **RISCs CHALLENGE MINI, MICRO SUPPLIERS . . . . .127**

Blazing speeds and relative ease of design and development have propelled RISC systems into the limelight of the supermicrocomputer and minicomputer markets. By looking at how RISCs are evolving, and what to expect next year in performance, system integrators and OEMs can place the new machines in perspective.

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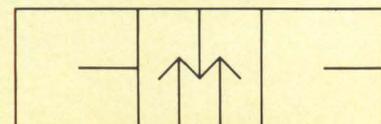
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**CIRCLE NO. 43 ON INQUIRY CARD**

# IMPROVED MONITORS OUTSHINE EGA GRAPHICS

Going beyond widely used EGA boards, display monitors endow microcomputers with the resolution of dedicated graphics and still accommodate older CGA cards

**Edward Teja**, Contributing Editor

The demand for improved color graphics has spurred the development of microcomputer display monitors that take full advantage of higher resolution graphics cards, such as IBM Corp.'s enhanced graphics adapter (EGA). As higher resolution color graphics become cost effective for more and more desktop computer users, system integrators are using them to increase the information density of displays, while still keeping the screen highly readable through the intelligent use of color.

But higher resolution displays are going beyond EGA and even professional graphics adapter (PGA) capabilities. Conferring the resolution previously offered only by dedicated graphics systems, they enable a microcomputer to serve computer aided design, computer aided engineering or computer integrated manufacturing applications, such as accurate process modelling using animated graphic presentations.

Normally, a mad scramble to implement newly affordable technology leads to a chaos of nonstandard interfaces and special software. Fortunately, because of foresight on the part of monitor vendors, most higher capability products work with both EGA and the large installed base of older (and lower resolution) IBM-compatible color graphics adapter (CGA) cards.

## Deflection frequencies keep pace

The most obvious result of pushing for higher display resolutions is the increasing deflection frequencies required in the monitor. Deflection, or horizontal-scan, frequency determines the number of raster lines the monitor can draw during one refresh of the screen—the limiting factor in a display monitor's vertical resolution.

Although a 15.75-kHz horizontal-scan rate is adequate to accommodate the 200 lines offered



by CGA systems, writing 350 lines for EGA systems requires 21.85-kHz horizontal-scan signals. PGA controllers, featuring 560 raster lines, sweep at 30.48 kHz.

For even higher resolutions—up to 1,280-pixel-by-1,024-line displays—high-end monitors are more than doubling that rate, pushing the necessary deflection frequencies to 64 kHz.

Besides the increased scan rate, another important difference between the EGA monitors and their higher resolution cousins (PGA and above) is that the EGA types (as well as CGA monitors) have transistor to transistor logic (TTL) inputs. The number of possible TTL logic levels determines the maximum number of colors—64—they can display.

Because PGA and other high-resolution monitors are all driven with analog input signals having unlimited states, they can display any color of the rainbow. As a result, high-end color monitors offer better resolution than their low-end brethren and also present richer, more varied hues. This capability can be important when a graphics display makes extensive use of shading.

Falling monitor prices are making high-qual-

**Providing local graphics processing, Tektronix's Series 4200 of intelligent terminals allow low-end systems to provide graphics functions normally found only on large systems.**

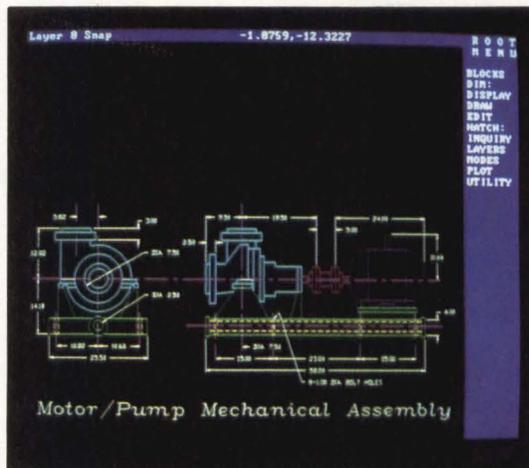
ity graphics displays available to more micro-computer users. Princeton Graphic Systems' 12-inch SR-12P PGA monitor, for example, provides 640-by-480-pixel resolution for only \$999. The problem, therefore, in implementing high-resolution graphics on a desktop computer is more likely to arise from the price of the PGA controller than that of the monitor.

In trying to get around the problem of price, NEC Home Electronics Inc. has introduced a new twist in monitor features. Its high-end Multisync monitor's 14-inch display works with any CGA, EGA or PGA controller. With CGA or EGA controllers, the monitor automatically senses the controller's horizontal-scan frequency and synchronizes with it. For PGA displays, a toggle switch connects the monitor to the system via analog inputs. Priced at \$899, Multisync can display as many as 800 pixels by 560 lines.

Furnishing 720-by-540-line resolution, Electrohome Ltd.'s ECM 1310 and ECM 1312 color monitors also automatically adjust the horizontal-scan frequency up to 34 kHz for any controller card. The ECM 1312 features a bright display for demanding CAD/CAM applications.

### Applications, such as CAD

*motor and pump schematics, which need higher resolution displays than are supplied by EGA or PGA boards, can use high-end controllers, such as the HR 1200 family from Pron-to.*



NEC and Electrohome aren't alone in the multipurpose monitor arena. A host of vendors have demonstrated similar products. C. Itoh Digital Products Inc., for example, offers the CM 4000, a 13-inch \$799 color monitor that supports both EGA and the more common CGA controllers. Thus, system integrators can upgrade graphics systems to at least EGA quality and move to a higher performance graphics controller board later.

Conrac Division offers a 14-inch color monitor that provides compatibility with both EGA and CGA scan-rate frequencies. The \$735 model 7064 features a CRT with a high-contrast shadow mask and an in-line gun. In CGA

mode, the unit can display 16 colors with 640-pixel-by-200-line resolution; in EGA mode, 16 colors from a 64-color palette with a 640-by-350 display.

In another approach to graphics system compatibility, Tatung Co. of America has introduced a half-sized board that plugs into a PC short slot. The board emulates EGA, CGA and monochrome graphics and drives Tatung's CM-1380 high-resolution monitor. Priced at \$599, the TEGA-22 card lets you configure a system with a high-resolution monitor that runs software written with standard controllers in mind.

For demanding engineering applications, you may need monitors larger than the standard 13- or 14-inch variety. So, Aydin Controls offers a 19-inch monitor that automatically synchronizes to the appropriate (CGA or EGA) scan frequency.

Colorgraphic Communications Corp. also has 19-inch noninterlaced monitors in its Vari-Sync line that automatically adjust to the appropriate scan frequencies for EGA and CGA (EG1522) and PGA (PG3200) boards. They have switch-selectable TTL or analog inputs and up to 640-by-480-pixel, firmware-based color displays. The company's Animatronics animation character set can display more than 50 moving process-control signals, such as boiling surfaces or rotating blades, as well as danger indications.

### Moving up in resolution

For many CAD/CAE and scientific-modeling applications, the resolution offered by EGA or PGA graphics subsystems still might not be enough. With 3D graphics, for example, unless you can display 1,024 by 1,024 pixels, the picture will be unclear. Until recently, satisfying a requirement for higher resolution usually meant moving up to dedicated workstations with dedicated high-resolution graphics subsystems. But today, for a price, you can plug much of that performance into a standard microcomputer. Naturally, you can't simply connect these higher performance monitors to a computer with EGA, or even PGA, controllers. But there are other options.

Many semiconductor firms offer the major building blocks for building your own graphics board. NCR Corp.'s Microelectronics Division, Colorado Springs, Colo., for example, has a selection of graphics chips that will furnish monochrome (model 7250) or color (model 7300) graphics and extremely high-quality text as well (a weakness in many graphics systems). The 7300 works with software interfaces such as Digital Research Inc.'s graphics environment manager (GEM) and Microsoft Corp.'s Windows program and the virtual device inter-

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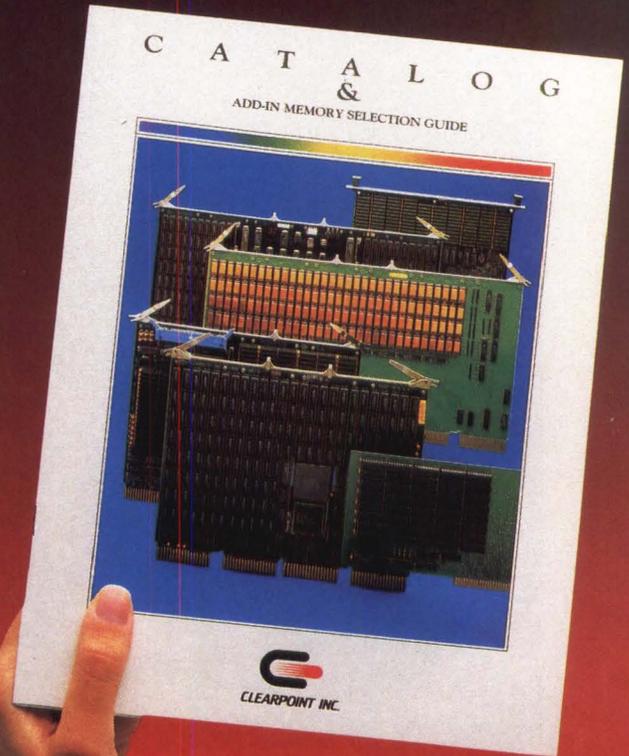
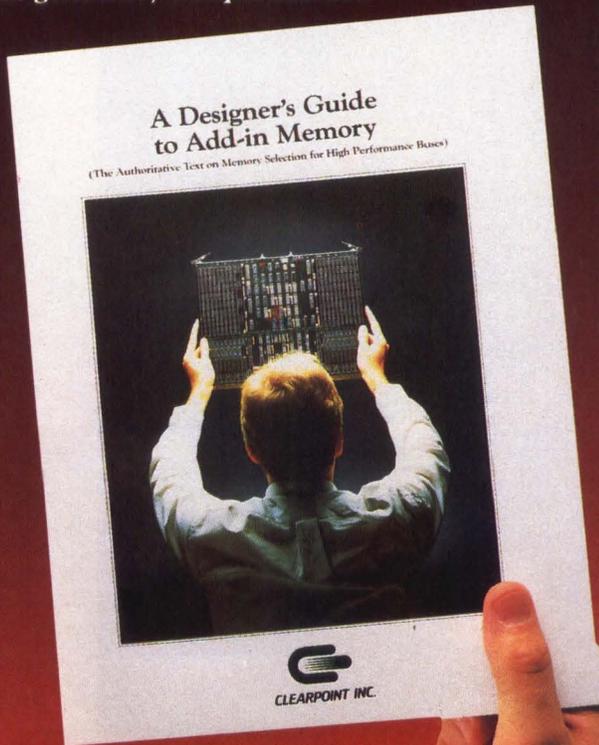
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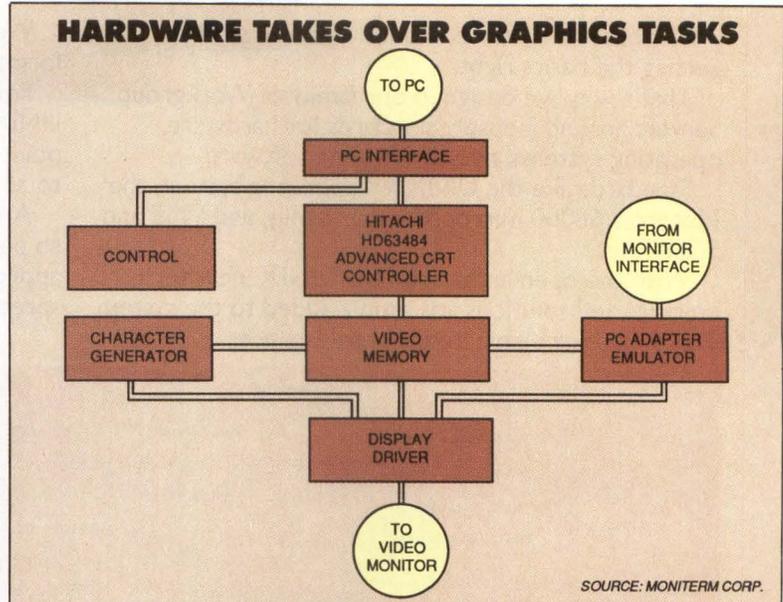
face (VDI).

If you aren't up to building your own graphics board, even with the help of specialized VLSI, consider buying one of the growing number of high-end graphics boards, such as the HR-1200 series from Pronto Computers Inc. of Torrance, Calif. They let users connect high-resolution displays (up to 1,280 by 1,024 pixels) to microcomputers, and the boards work with a host of monitors from U.S. and Japanese vendors.

The boards use a 256-bit-by-12-byte color-lookup table and 1.5M bytes of memory for the screen image plus additional memory for character fonts. Prices range from \$2,195 for a controller that displays 1,024 by 768 pixels in 16 colors to \$3,495 for one producing 1,280-by-1,024 resolution in 256 colors.

Frontier Technologies Corp. also has a controller suitable for CAD and other high-performance applications. The CADgraph 2 board features hardware zoom (16X) and scroll, interlaced or non-interlaced operation and supports four colors at 1,024 by 1,024 pixels or 16 colors at 640 by 480 pixels.

Some monitor vendors are packaging complete graphic subsystems for high-end micro-computer-based applications. Amdek Corp., for example, puts together a controller and a 15-inch monitor package, optimized for CAD/CAE or desktop-publishing applications, that produces a 1,280-by-800-pixel display. Although it is a monochrome and not a color subsystem, it emulates the CGA so that the computer can run software written for systems using the CGA card. The \$1,595 subsystem furnishes two hardware-generated 256-character sets for good-quality text display.



**A sophisticated controller**, driving a high-resolution 19-inch monitor in Moniterm's Viking 1 graphics-display system, includes the Hitachi HD63484 advanced CRT processor and puts into hardware many graphics tools normally provided by software.

Moniterm Corp. Viking 1 subsystem offers much the same performance benefits. It uses the Hitachi America Ltd. HD63484 graphics chip and puts into hardware many graphics tools, such as bit-block transfer and graphics primitives, normally implemented in software. The subsystem stores 1,024 by 2,048 data bits in memory and displays 1,280 by 960 pixels on a 19-inch monochrome screen, refreshed at a

## Alphanumeric terminals—the display workhorses

Because they are extremely efficient displays of text, and because their prices are low relative to graphics terminals, alphanumeric terminals are still the display devices of choice for most desktop computers. For the price of a basic electronic typewriter, system integrators can specify an intelligent alphanumeric terminal with features once found only on high-end models. Wyse Technology's \$699 WY-60, for example, furnishes user-selectable screen formats, seven pages of screen memory, 7-by-12-dot characters displayed in a 10-by-16 dot-matrix and a 14-inch screen.

For cost-sensitive applications, consider C. Itoh Electronic Inc.'s ANT. The \$299 alphanumeric terminal comes with a non-glare, 14-inch screen and the basic terminal emulations that system integrators have come to expect. The ANT displays 7-by-9-dot

characters in a 9-by-12-dot matrix—a format that was the norm only for high-end terminals just a short time ago. For adding color to Digital Equipment Corp. VT220 applications, consider Intecolor Corp.'s CT220, which offers the ColorKey feature. From a start-up menu, users can add color to various VT220 attributes via a single keystroke. The CT220 costs \$1,695.

Taking a new tack, terminal manufacturer Ampex Corp. recently released the Deep Base, a general-purpose enclosure that is 3 inches deeper than the company's standard terminal base. Targeting VARs and OEMs, Ampex sells the enclosure, monitor and keyboard for \$200 in volume quantities. The Deep Base allows resellers to customize VDTs or configure microcomputers by adding logic, disk drives, tape drives, etc.

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IBM PCs gain access to our UNIX databases through Multiplex,\* a PC-UNIX interconnect.

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**CIRCLE NO. 46 ON INQUIRY CARD**

# Where great systems converge.

To share even more resources and information, the Workgroup Servers connect to a wide range of computers from other vendors. Including IBM PCs\* and compatibles, Apple Macintoshes,\* other UNIX-based systems, IBM minis and mainframes.

By bringing all these systems together, you can take advantage of over 2,000 UNIX and 12,000 PC programs.

And since the Workgroup Servers are fully object code compatible, software that works on one system works on all of them.

Standards. Enhancements. Connectivity. Put them all together in a family of Workgroup Servers and you can solve a wide variety of specific problems. No matter what systems you're working with.

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The most expandable system in the Workgroup Server Family, it uses multiple processors to support up to 128 users.

Our fully integrated WGS/Office™ automation software includes a windowing interface, word processor, spreadsheet, calendar and electronic mail.

## The S/220:

68020 performance for up to 22 users in a small package.

## The S/50:

A "personal" UNIX system that doubles as a server for up to five users.



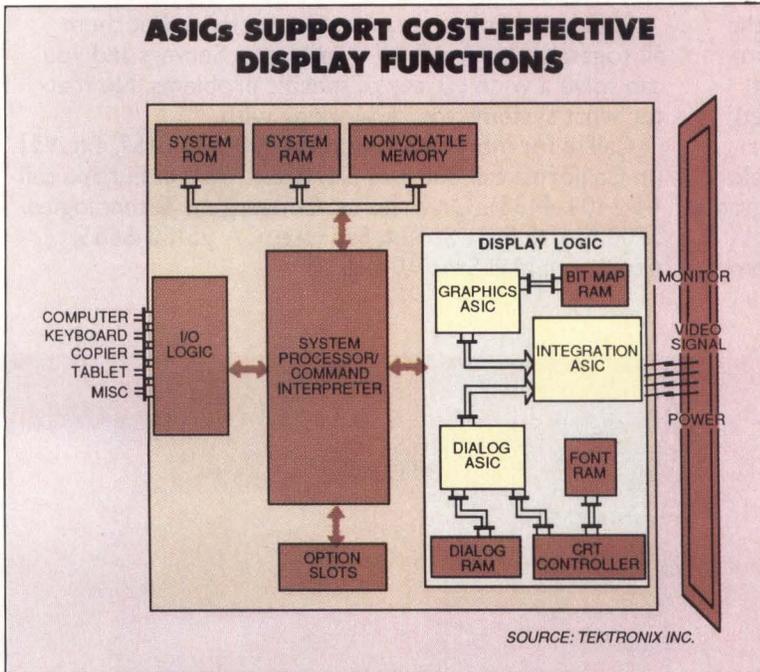
## THE WORKGROUP SERVER FAMILY

	S/50™	S/120™	S/220™	S/320™	S/640™	S/1280™
Max Users	5	12	22	32	64	128
Max RAM	2 MB	5 MB	5 MB	16 MB	64 MB	24 + MB
Max Disk Storage*	80 MB	140 MB	280 MB	4.0 GB	4.0 GB	6 GB
Technology	10 MHz 68010 CPU	12.5 MHz 68020 CPU	12.5 MHz 68020 CPU	12.5 MHz 68020 CPU	25 MHz 68020 CPU	4x16.67 MHz 68020 CPU
MIPS	.75	2.0	2.0	2.0	4.25	8.8

\*storage listed in unformatted capacities

# Convergent

When great ideas converge, great products emerge.



**Generous use of application-specific ICs (ASICs) helps Tektronix implement high-end graphics functions in its lower cost terminals.**

66-Hz rate to reduce flicker. The undisplayed data stores special font or format information.

A software driver accommodates emerging PC application software, such as Aldus Corp.'s PageMaker desktop-publishing package, with interfaces to Microsoft's Windows operating

environment. Because the \$2,195 subsystem runs IBM CGA and monochrome graphics as well as its own high-resolution graphics, you don't need separate monitors for word processing and CAE.

**The upper crust**

For applications requiring color, you need to build or buy a color controller capable of driving a high-resolution monitor such as C. Itoh Electronics Inc.'s 16-inch CD-S1611. The \$2,500 product relies on a 60-kHz high-speed, non-interlaced raster-scanning system to display 1,024 by 1,280 pixels. A 20-inch version (CD-S2011) costs \$3,000.

Other Japanese companies, such as Mitsubishi Electronics America Inc. and Seiko Instruments USA Inc., are well-known manufacturers of monitors with high (60 kHz) deflection frequencies. Self-convergence in-line guns and shadow-masked CRTs provide 1,024 by 780 lines in Mitsubishi's model C-8659 (\$2,195) and C-6679 (\$2,495) 15-inch monitors. The model FG-6000 (priced at \$2,995) has a higher resolution shadow mask. Dots on a 0.25-mm pitch, instead of the usual 0.31 mm, furnish 1,024-by-1,000-pixel resolution.

But Japanese vendors do not have this high-end market to themselves. American firms still play a significant role. Microvitec Inc., for example, offers a 20-inch non-interlaced monitor that presents resolutions as high as 1,365 by 1,024 pixels. Priced at \$2,195, these 940 Series monitors can work with PGA controllers, but also provide low-cost displays of higher resolution graphics.

A major player in the microcomputer terminals market, Wyse Technology has moved into the high-resolution monitor business with the WY-700 15-inch, dual-mode, monochrome monitor that supports CGA graphics in sharper detail using 2 by 4 pixels or 4 by 4 pixels to display each dot. Featuring resolutions as high as 1,280 by 800 when used with bit-mapped graphics cards, the WY-700 maps all colors into four shades of gray.

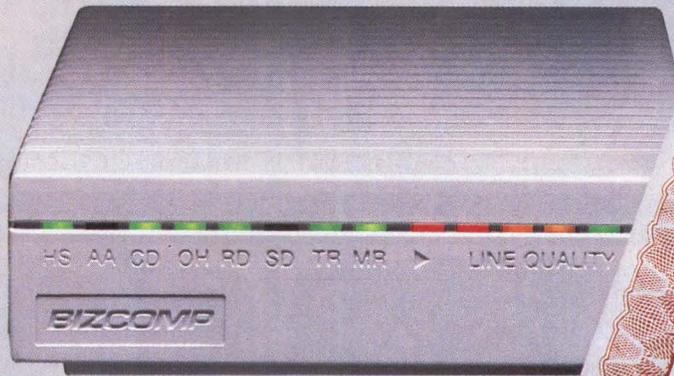
**Value-added video**

High-end graphics displays aren't restricted to monitors and graphics cards. Vendors of larger graphics systems, such as Tektronix Inc., offer intelligent terminals that speed up graphics functions by offloading processing from the microcomputer. They also solve the problem of integrating a computer, controller, monitor and software into a usable package.

Tektronix has established a de facto standard with its families of intelligent graphics terminals. Its new series of high-performance, intelligent, color graphics terminals begin in price

<b>REPRESENTATIVE EGA-COMPATIBLE MONITORS</b>				
Manufacturer	Model	CRT diameter (inches)	Price (\$)	CGA support
Amdek Corp.	722	13	799	yes
Aydin Controls	Patriot	19	2,700	yes
C. Itoh Digital Products Inc.	CM4000	13	799	yes
Colorgraphic Communications Corp.	EG1522	19	2,000	yes
Conrac Div.	7074	14	735	yes
Electrohome Ltd.	ECM1310	13	1,195	yes
	ECM1312	13	1,195	yes
IBM Corp.	Enhanced Color Display	13	849	yes
NEC Home Electronics Inc.	Multisync	14	899	yes
Princeton Graphic Systems	SR-12P	12	999	no
	HX-12E	12	785	yes
Quadram Corp.	Quadchrome Enhanced Display	14	795	yes
Tatung Co. of America	CM-1380F	13	785	yes
Taxan Corp.	EGA	13	795	yes

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Business managers demand open options for unexpected problems. The NonRisk Modem provides the answer to that challenge.

#### Why Bizcomp for Your Company

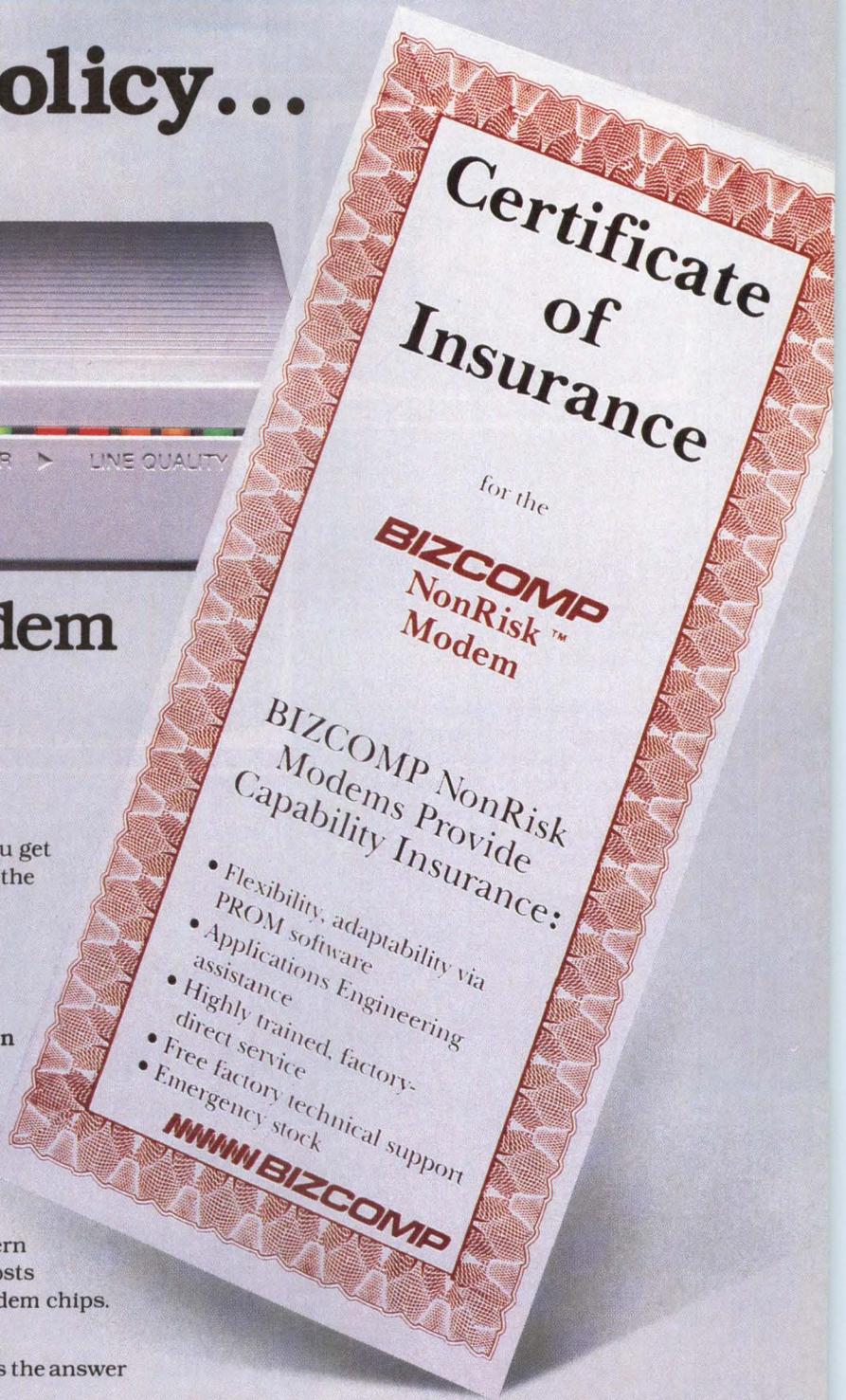
- Customer-proven field reliability
- Efficient, "no run-around" factory-direct relationship
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That's just part of our NonRisk Modem Solution. You can discover the rest by calling **408/733-7800**. We'll help you keep your options open. Call us today.

**CIRCLE NO. 47 ON INQUIRY CARD**

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# DON'T BUY A BOARD BUY A SOLUTION.



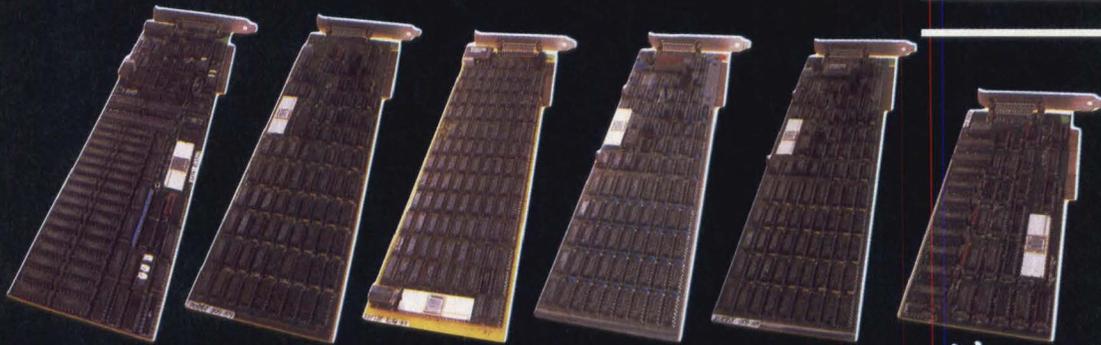
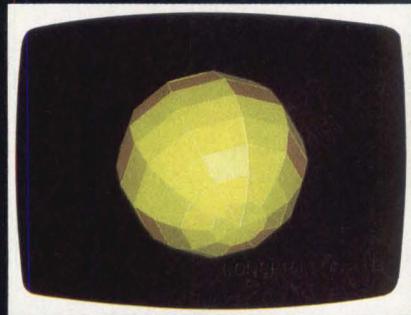
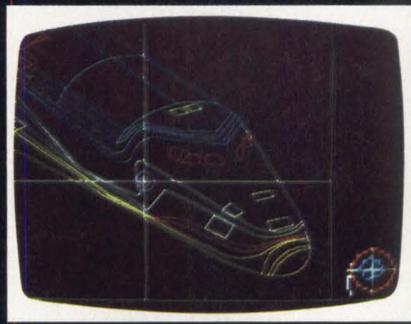
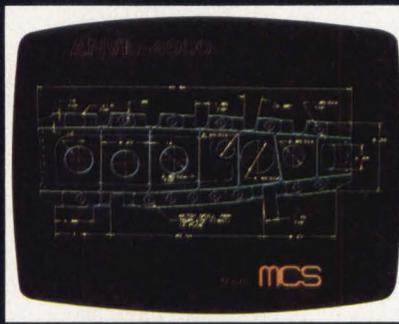
Ask yourself: What does the end-user **really** want when he turns his PC into a powerful CAD workstation?  
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A speedy application? A single screen to avoid the headache of twin tubes?

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CIRCLE NO. 252 ON INQUIRY CARD

with the \$2,495 model 4205, which displays 480 by 360 pixels. It furnishes many of the company's well-known graphics features, such as segmentation, zoom and pan. More expensive family members (models 4207 and 4208) provide 640 by 480 pixels for \$3,995 and \$4,995, respectively. All models have Digital Equipment Corp. VT100 emulation.

Extensive use of application-specific integrated circuits (ASICs) allows Tektronix to put high-end graphics functions into its lower priced terminals. The ASICs combine standard graphics controller functions, such as basic display functions, with specialized graphics features.

Tektronix's competitors have also been active in the intelligent-graphics-terminal arena. Seiko has introduced a 14-inch, 1,024-by-780-pixel terminal that combines an Intel Corp. 8-MHz 8086 processor and the 8087 math coprocessor with a gate array that handles color mapping. The \$4,995 model GR-1105 takes advantage of its dual processors to furnish high-speed drawing (4,500 quarter-inch vectors per second), segment and subsegment functions, local pan and zoom and multiple viewpoints.

Lear Siegler Inc. offers a family of color graphics terminals featuring Tektronix 4105 and 4107 compatibility with a lower price tag. The model 7105 (\$2,995) and 7107 (\$3,995) both feature 640-by-480 resolution and display 16 colors from a palette of 4,096. They can display simultaneously in as many as four windows. Standard drawing capabilities include vectors, circles, rectangles, solid fill and pattern fill.

Pericom Inc. has also joined the graphics-terminals war with functional equivalents of Tektronix's model 4100 units. The \$6,995 MX6000 has a 19-inch screen and 640-by-480-

## REPRESENTATIVE ALPHANUMERIC TERMINALS

Manufacturer	Model	CRT diameter (inches)	Price (\$)	Special features
Ampex Corp.	232	14	649	for PC/AT
	210 PLUS	14	469	16 resident emulations, 132 columns
CIE Systems Inc.	7101	14	595	DEC VT100 and other emulations
CIE Terminals Inc.	7102	14	645	for PC/AT
	CIT 50+	14	599	DEC VT100/200 and other emulation
	ANT	14	299	standard emulations
Datamedia Corp.	224	14	699	DEC VT220 emulation
	Elite 60	14	950	DEC VT100 emulation
Esprit Systems Inc.	Elite 90	14	925	132 columns, standard emulations
	OPUS2	14	549	132 columns, standard emulations
Falco Data Products Inc.	500	14	795	for PC/AT, ANSI X3.64 compatible, standard emulations
	5220	14	595	DEC VT100/220 emulation
	5500	14	595	for PC/AT, standard emulations
Kimtron Corp.	KT-7	14	595	standard emulations
	KT-22	14	599	DEC VT100/220 emulation
Lear Siegler Inc.	ADM1000	14	399	dual host ports for windowing and emulation of two terminals simultaneously
	ADM2000	14	699	
Liberty Electronics	Freedom One	14	449	132 columns, standard emulations
Tatung Co. of America Inc.	TVT-7261	14	695	multiple emulations
Wyse Technology	WY-60	14	699	includes Wyseworks utility package
	WY-95	14	995	ANSI X3.64 compatible; supports Tektronix 4010, 4014 and DEC Regis displays

## When is a monitor a terminal?

The literature on video displays is rife with confusing terminology. To clarify muddy waters, *Mini-Micro Systems* defines a monitor as a video display comprising a CRT and its associated electronics. Add a controller and you have a terminal, which connects to a host computer via an RS232 port. A subsystem contains a controller and monitor from one vendor wherein the controller plugs into a host-computer motherboard.

Because a terminal's analog or special interconnects are internal, it requires little in the way of integration. Most emulate some other, widely used, terminal, such as a Digital Equipment Corp. VT100, an Applied Digital Data Systems Inc. DDS Viewpoint or a Lear Siegler Inc. ADM-3A. One terminal model

can serve a variety of computer systems.

The advantage of a subsystem is that a vendor can optimize its operation for a particular type of computer system. The motherboard also provides more efficient communication paths than does a serial port. Less intelligence is needed in the controller, but each computer system requires a unique subsystem.

Specifying separate monitors and controllers offers maximum flexibility in terms of integration, features and pricing. But this approach can leave you stranded without application programs that will talk to your configuration. You can reduce this risk, however, by sticking to standard products, such as IBM Corp. enhanced graphics adapter (EGA)-compatible controllers and monitors.

## Companies mentioned in this article

**Amdek Corp.**  
2201 Lively Blvd.  
Elk Grove Village, Ill. 60007  
(312) 364-1180  
**Circle 314**

**Aydin Controls**  
414 Commerce Drive  
Fort Washington, Pa. 19034  
(215) 542-7800  
**Circle 315**

**C. Itoh Digital Products Inc.**  
19750 S. Vermont Ave.  
Torrance, Calif. 95052  
(213) 327-2110  
**Circle 316**

**C. Itoh Electronics Inc.**  
5301 Beethoven St.  
Los Angeles, Calif. 90066  
(213) 306-6700  
**Circle 317**

**CIE Systems Inc.**  
2515 McCabe Way  
Irvine, Calif. 92714  
(714) 660-1800  
**Circle 318**

**CIE Terminals Inc.**  
2505 McCabe Way  
Irvine, Calif. 92714  
(714) 660-1421  
**Circle 319**

**Colorgraphic Communications Corp.**  
5388 New Peachtree Road  
Atlanta, Ga. 30366  
(404) 455-3921  
**Circle 320**

**Conrac Division**  
600 N. Rimsdale Ave.  
Covina, Calif. 91722  
(818) 966-3511  
**Circle 321**

**Datamedia Corp.**  
11 Trafalgar Square  
Nashua, N.H. 03063  
(603) 886-1570  
**Circle 322**

**Electrohome Corp.**  
Display Systems  
809 Wellington St. N.  
Kitchener, Ontario  
N2G 4J6, Canada  
(519) 744-7111  
**Circle 323**

**Esprit Systems Inc.**  
100 Marcus Drive  
Melville, N.Y. 11747  
(516) 293-5600  
**Circle 324**

**Falco Data Products Inc.**  
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Sunnyvale, Calif. 94089  
(408) 745-7123  
**Circle 325**

**Frontier Technologies Corp.**  
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Milwaukee, Wis. 53211  
(414) 964-8689  
**Circle 326**

**IBM Information Systems**  
900 King St.  
Rye Brook, N.Y. 10573  
(914) 934-4000  
**Circle 327**

**Intecolor Corp.**  
225 Technology Park  
Norcross, Ga. 30092  
(404) 449-5961  
**Circle 328**

**Kimtron Corp.**  
Building 16  
1705 Junction Court  
San Jose, Calif. 95112  
**Circle 329**

**Lear Siegler Inc.**  
Data Products Div.  
901 E. Ball Road  
Anaheim, Calif. 92805  
(714) 778-3500  
**Circle 330**

**Liberty Electronics**  
625 Third St.  
San Francisco, Calif. 94017  
(415) 543-7000  
**Circle 338**

**Microvitec Inc.**  
1943 Providence Court  
College Park, Ga. 30337  
(404) 991-2246  
**Circle 339**

**Mitsubishi Electronics America Inc.**  
991 Knox St.  
Torrance, Calif. 90502  
(213) 515-3993  
**Circle 340**

**Moniterm Corp.**  
5740 Green Circle Drive  
Minnetonka, Minn. 55343  
(612) 935-4151  
**Circle 341**

**NEC Home Electronics Inc.**  
700 Nicholas Blvd.  
Elk Grove Village, Ill. 60007  
(312) 860-9500  
**Circle 342**

**Pericom Inc.**  
11 Sepulveda Blvd.  
Manhattan Beach, Calif. 90266  
(213) 318-6062  
**Circle 343**

**Princeton Graphic Systems**  
Building A  
601 Ewing St.  
Princeton, N.J. 08540  
(800) 221-1490  
**Circle 344**

**Quadram Corp.**  
1 Quad Way  
Norcross, Ga. 30039  
(404) 923-6666  
**Circle 345**

**Seiko Instruments USA Inc.**  
1623 Buckeye Drive  
Milpitas, Calif. 95035  
(408) 943-9100  
**Circle 346**

**Tatung Co. of America Inc.**  
Video Display Div.  
2850 El Presidio St.  
Long Beach, Calif. 90810  
(213) 637-2105  
**Circle 347**

**Taxan Corp.**  
18005 Cortney Court  
City of Industry, Calif. 91748  
(818) 810-1291  
**Circle 348**

**Tektronix Inc.**  
Information Display Group  
P.O. Box 1000  
Wilsonville, Ore. 97070  
(503) 644-0161  
**Circle 349**

**Wyse Technology**  
3751 N. First St.  
San Jose, Calif. 95134  
(408) 433-1000  
**Circle 350**

pixel resolution; the \$8,995 MX8000 puts 1,024-by-1,024-pixel resolution on a 19-inch screen. Both graphics workstations use a Motorola Inc. MC68000 processor and a Hitachi HD63484 graphics chip to control bit-mapped graphics and a separate Motorola 6809 for text.

Intelligent graphics terminals thus allow Tektronix and other vendors to furnish host-computer-independent graphics and migrate well-developed graphics hardware and software, such as Tektronix's PLOT-10 package to smaller systems without pricing themselves out of the market. The use of graphics terminals

opens high-end applications to desktop workstations previously served only by dedicated systems.

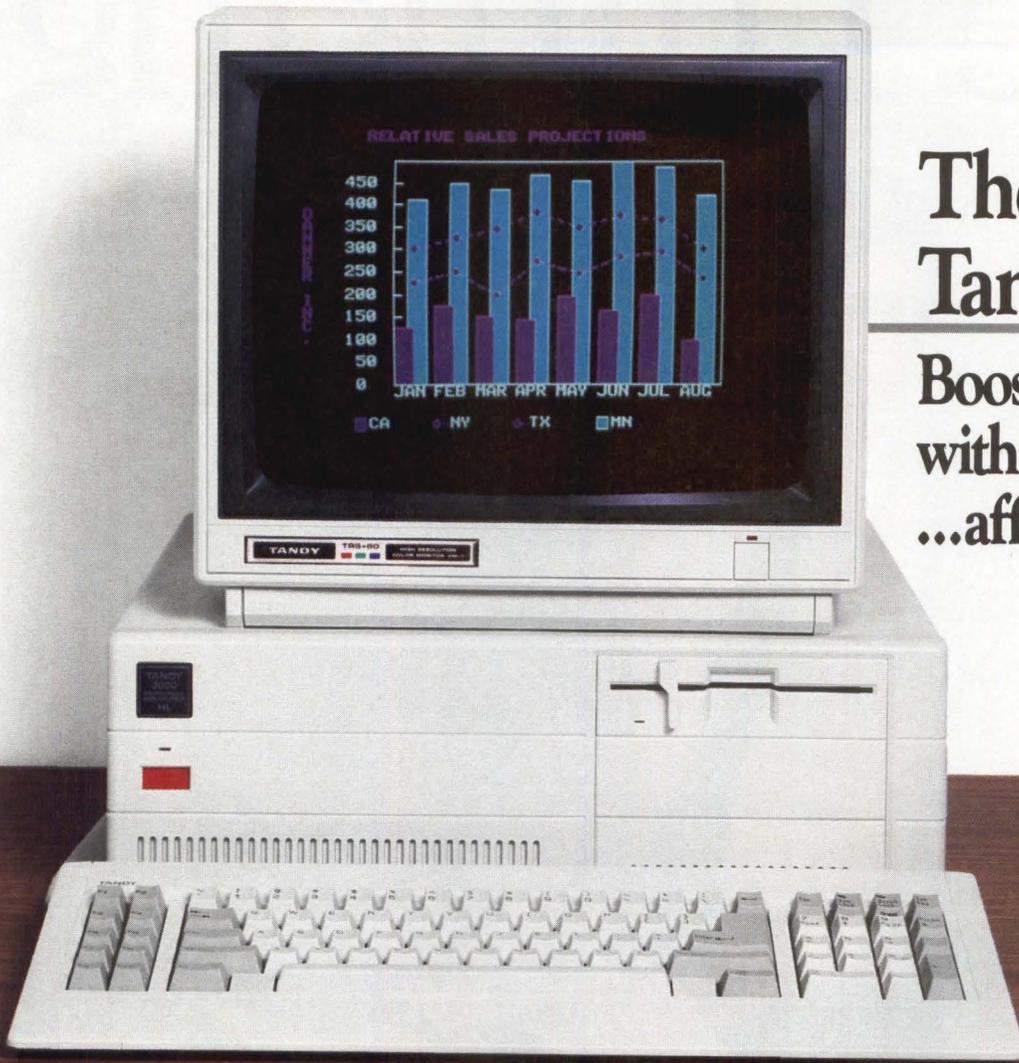
**Edward Teja**, *Mini-Micro Systems* contributing editor, is president of Freehold Corp., Studio City, Calif., which specializes in marketing and writing services for high-technology companies.

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Interest Quotient (Circle One)  
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CIRCLE NO. 49 ON INQUIRY CARD

# The Thinking

*Looks for typeset-quality printing and demands perfection in text and graphics integration.*

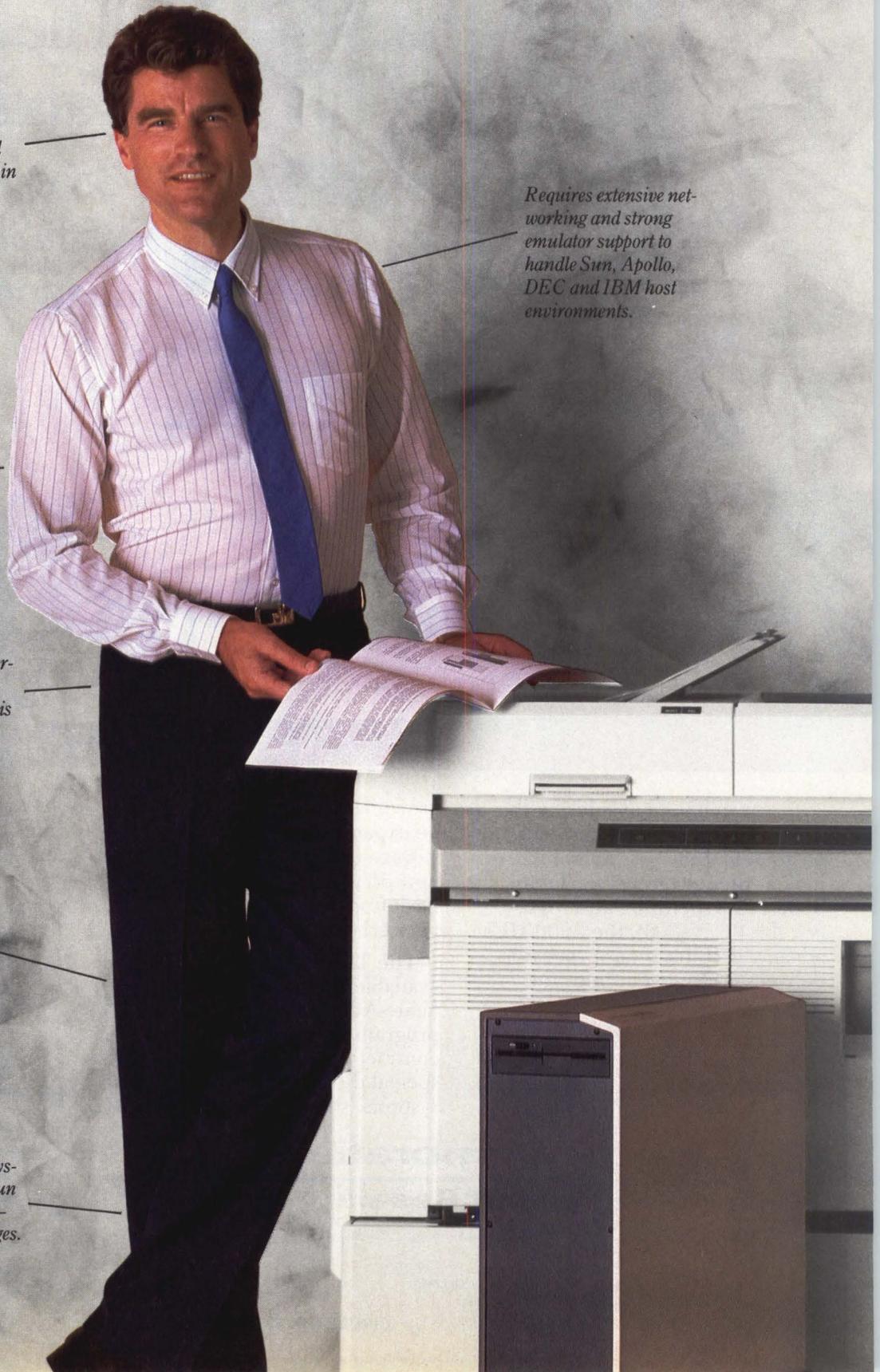
*Requires extensive networking and strong emulator support to handle Sun, Apollo, DEC and IBM host environments.*

*Needs to wrap both CAE and document processing needs in one laser printing system.*

*Wants to protect his investment with a versatile system that is easily upgraded as his needs change.*

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# Why buy PCs?

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If you are a DEC system user, chances are you've been looking at the advantages of supplementing its functions by adding a PC. The hundreds of software packages available promise an easier and more efficient worklife. CARDWARE can bring these packages to your fingertips at your current terminal without adding to your desk the clutter and expense of an additional computing device.

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- effective multi-user file management and data sharing
- simple data exchange between PC and DEC files
- use of your current DEC-supplied utilities to manage data backup files, enforce security, and provide accountability

Each CARDWARE processor can be accessed by any terminal connected to your system - **all users can run PC software by sharing a few CARDWARE processors**. When you are not using your terminal in the PC mode you can access the DEC system in the usual way.

Hundreds of installations in government, finance, and aerospace have found the LOGICRAFT answer. Integrate useful PC software, such as Lotus 1-2-3, into DEC systems environment with CARDWARE - **faster and more flexible than owning PCs, and less costly as well!**

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DEC VT240 running LOTUS 1-2-3



# COLOR GRAPHICS BRIGHTEN TERMINAL EMULATION

Color graphics terminal emulation remains a niche market with a small spectrum of players, but application prospects sparkle and new products shine

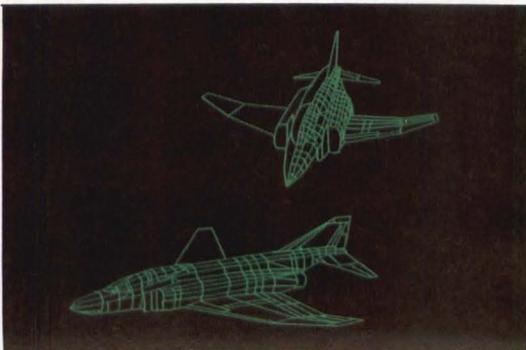
**Michael Tucker**, Associate Editor

The business of making IBM Corp. PC and compatible machines mimic terminals calls for increasingly sophisticated technology. And, while public attention has primarily focused on widely used alphanumeric emulators—which threaten sales of low-end dedicated alphanumeric terminals—this growing sophistication is clearly reflected in color graphics terminal emulation software. As the result of recent advances in both PC hardware and software, developers can now offer products that allow MS-DOS machines to mimic even powerful dedicated graphics terminals.

Although the emerging color graphics terminal emulation market has few players, it is growing rapidly and now includes such companies as Grafpoint, Graphics Software Systems Inc. (GSS), Microplot and Walker, Richer & Quinn Inc. Many of these are exploiting targeted niches within the narrow color graphics terminal market—such as emulating highly



**A 4107 emulator**, Grafpoint's TGRAF-07 allows IBM PCs to access demanding main-frame and minicomputer graphics applications. Here, a map of San Francisco is shown on a PC running the TGRAF-07 package (left) and a Tektronix 4107 graphics terminal (right).



**A 4010 emulator**, Graphics Software Systems' GSS\*Terminal provides monochrome graphics, alphanumeric functions and color capabilities.

use-specialized terminals—and thus have no competition.

A host of new boards and adapters have made PCs and compatibles the platform of choice for many users who would not otherwise be able to obtain high-level graphics. In fact, evidence exists that the tail is beginning to wag the dog. Such vendors as Logcraft Inc. are offering products that bring the graphics capabilities of PCs to non-MS-DOS machines.

The world of color graphics terminal emulation is basically defined by two factors—Tektronix Inc.'s graphics terminals and the



**A Hewlett-Packard emulator,** Walker, Richer & Quinn's *Reflection 7* proves there are alternatives to Tektronix's de facto emulation standards. *Reflection 7* allows an MS-DOS machine to mimic the HP 2627 color graphics terminal.

MS-DOS technology of IBM PCs and compatibles. Tektronix's dedicated graphics terminals have become the de facto industry standard in the same way as Digital Equipment Corp.'s VT series has become the standard in alphanumeric terminals (see "Terminals strike back," below). The DOS-based PC determines how closely software can imitate the Tektronix standard.

The Tektronix terminals have essentially defined the characteristics of the entire graphics emulation market. Explains Corley Phillips, president of Grafpoint, "Tektronix is undoubtedly the market leader. Tektronix's 4010 monochrome terminal defines the low end of the market, even though the company doesn't even make the product any more. That's what most people emulate. It's the Volkswagen of the industry, if you will."

The "race car" of the industry, says Phillips, is the Tektronix 4100 series of color graphics terminals, which Grafpoint emulates. The machines at the top of this line are extremely powerful, virtually graphics workstations in their own right, and there is some question

whether they could ever be successfully emulated on a 16-bit PC. However, the mid- to lower range 4100 terminals can be emulated, and they form the battleground for graphics terminal emulator developers.

The ability of the PC to function as a color terminal relates directly to its capacity as an image processor. That capacity is increasing daily. This year's flood of PC compatibles and PC coprocessor add-in boards based on 32-bit processors has given desktop machines the power to deal with demanding graphics software. And, PC developers and users can now exploit a new generation of graphics boards and extraordinarily advanced graphics chips (MMS, August, Page 33).

The combined effects of these developments make PCs a more attractive alternative to dedicated graphics terminals—at least at the low end. Notes Diane Farrell, senior researcher at the market-analysis company, International Data Corp. (IDC), Framingham, Mass., "Right now, color graphics emulators are not quite as good as dedicated terminals, but that technology is coming . . . PCs are going to do a lot of damage to terminal makers at the low end."

#### High on low-end emulators

Even though 4010 emulators are the low-end of the graphics emulation market, they are the high point of graphics emulation activity. Companies probably are making more PC-based 4010 products than any other type of emulator. These products range from slavishly exact imitations, which—like the original 4010—are monochromatic, to those that attempt to include some upper-end functionality.

The classic example of this type of product is PC-Plot-III, from Microplot. Notes Stephen Bean, Microplot's president, "I believe the PC was introduced in mid-1981. We were selling our product in the spring of '82." Since then, PC-Plot has sold over 14,000 copies and, at \$95, it remains one of the best sellers of such software.

Currently, the product emulates Tektronix's 4010 and 4014 terminals. It does not provide color, but this year Microplot expects to introduce complete 4027 color emulation. "This year," says Bean, "we'll also be introducing a

### Terminals strike back!

In October 1986, Tektronix Inc., Wilsonville, Ore., introduced the 4200 line of color graphics terminals. These machines expand the feature set of the company's 4107 terminals and do so at less than half the price of the 4107s. The 4205 costs \$2,495, the

4207 is priced at \$3,995 and the 4208 costs \$4,995.

In effect, the 4200s are trying to beat IBM Corp. PC terminal emulators at their own game. They're providing high-level graphics at an increasingly lower cost.

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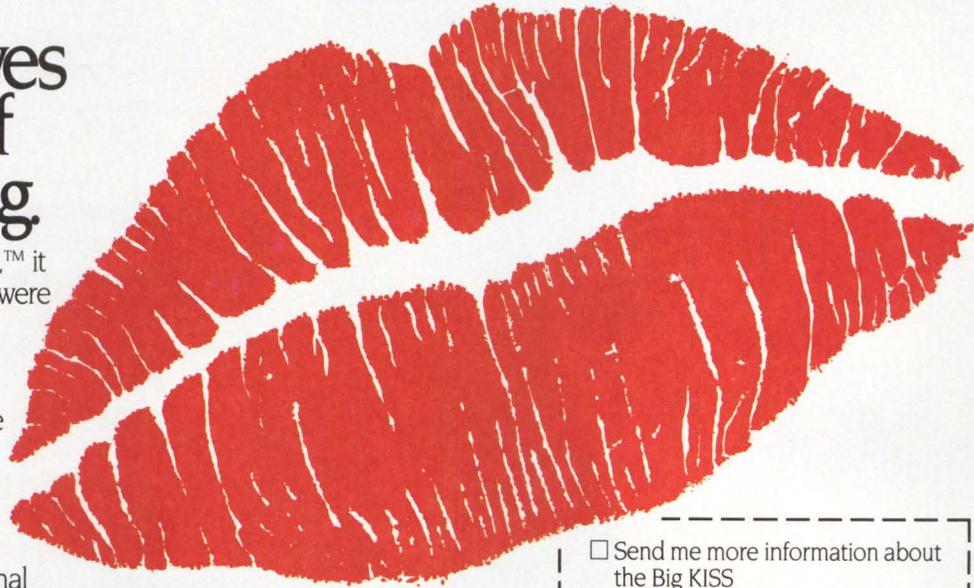
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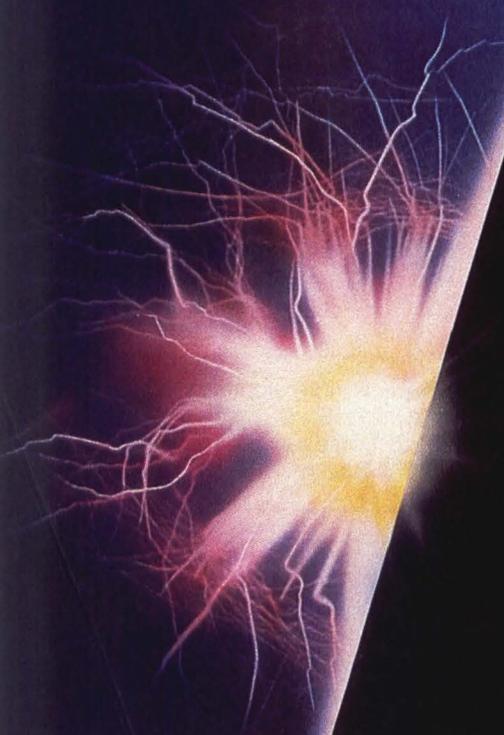
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## Access to what?

Color graphics terminals and their emulators have the same mission in life—they both give users access to graphics applications running on mainframes or minicomputers. Without them, these multiuser



machines would be as useless as a department store without a customer entrance. Therefore, mainframe and minicomputer vendors have found themselves forced into tight alliances with graphics-terminal and emulator vendors.

Given the huge number of personal computers already in place on users' desks, minicomputer and mainframe makers are becoming extremely interested in emulators. Celerity Computing of San Diego, for example, markets the Superserver, shown here running a finite-element-analysis application from Swanson Analysis Systems, Houston, Pa. The Superserver is a powerful superminicomputer dedicated to managing large numbers of PCs in a network. Celerity has announced plans to use TNET-5, Grafpoint's terminal emulator package for PC networks, as part of their effort to link PCs with their departmental machines.

partial 4100 emulation.”

Another popular 4010 emulator is GSS\*Terminal from GSS. Running on IBM PCs and compatibles, it provides both 4010 emulation and alphanumeric functions. The company believes that the product is most often used as a 4010 monochromatic display. It is thus a cost-effective solution to problems in computer aided design and computer aided manufacturing applications where precise drawing is more important than color.

Although not strictly a 4100 emulator, the product contains a subset of 4100 functions that enables it to handle color if the customer wants it. Moreover, GSS\*Terminal can handle some, but not all, the color graphics generated by the Tektronix 4105 terminal.

This influx of color into the product may say something about the long-term future of graphics terminal emulators: Users might not tolerate monochromatic products much longer.

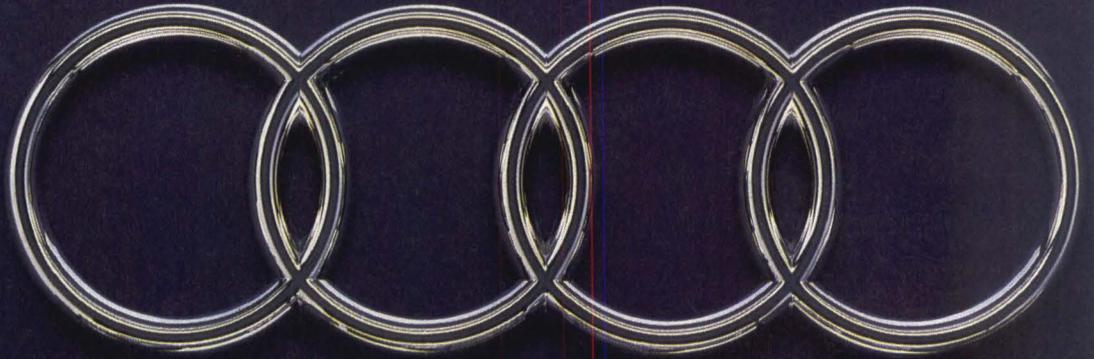
Still, GSS has found its terminal product profitable, despite the fact that traditionally the company has avoided the end-user market. Although GSS would rather specialize in the production of graphics tools, it has made GSS\*Terminal a popular OEM product. For example, the software is currently being re-marketed by AT&T Co. for its PC-compatible machines, and by IBM for both the PC and the RT PC. “It is a rather important product for us,” said one GSS official. “After all, there are about 300,000 large computer applications out there that you can access with 4010 terminal emulation.”

For most users, the 300,000 applications available via 4010 emulation are more than



*In a novel twist, the Grafvax from Logicraft allows users of DEC VAX minicomputers to access IBM PC graphics facilities. In combining a terminal emulator with a PC-compatible computer, Grafvax may indicate the evolution of emulators.*

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**MS-DOS machines can mimic powerful graphics terminals.**

enough. "There are lots of people who need only 4010 emulators, and lots of vendors selling 4010 emulation," says Grafpoint president Phillips. "If users come to us and say they need only a 4010 monochromatic display, or only limited color, then we send them to one of those other vendors."

Grafpoint specializes in emulations of the Tektronix 4100-series, particularly the 4105, the 4107 and the 4115. "We believe we are the only company currently selling 4100 emulations for the PC," says Phillips.

Grafpoint's 4105 product is TGRAF-05. Written entirely in assembly language, it requires only 128K bytes of memory and one flexible disk drive, but it is compatible with all software written for the 4105, 4010 and 4014. On a PC/AT with an enhanced graphics adapter (EGA) board, TGRAF-05 yields a 640-by-350-pixel resolution display with 64 colors.

TGRAF-7, the company's 4107 product, has all of TGRAF-05's capabilities, plus 4107 functions. With the product, as with the 4107, users can program the host machine to create and manipulate graphics on the PC. The local machine can thus perform such graphics operations as moving, rotating, erasing and copying images on the screen.

The 4115 emulator, TGRAF-15, can display images to 1,280-by-1,025-pixel resolution, with 256 colors out of a palette of 16 million colors.

Grafpoint claims that its biggest problem in marketing its products is convincing potential customers that a PC can actually do everything a graphics terminal can do. "In terms of hardware, the PC and the 4107 terminal are identical," says Phillips. "The processors are the same in each, the resolution is the same, and the cost is compatible . . . the biggest difference is that, in many cases, the PC hardware is actually superior to what you find in the terminal."

Indeed, Grafpoint is so confident in the PC as a vehicle for terminal emulation that it has a Tektronix 4125 emulator planned for introduction by year-end. If this emulator proves successful with buyers, it will be the highest level graphics emulator to find its way to the commercial market.

However, the company isn't putting all its bets on standalone PCs. It already markets TNET-5, a graphics terminal emulator for local area networks. Superminicomputer maker Celerity Computing, San Diego, has already announced plans to make the product part of an effort to link PCs with its high-end departmental machines.

**Beyond Tektronix**

The power of Tektronix terminals to set and maintain the industry standard for graphics display seems unshakeable. Even those software vendors whose emulation products are aimed at different markets than Tektronix's have a tendency to make compatible products.

Coefficient Systems Corp., for instance, offers VTERM III, a high-level DEC terminal emulator. Yet, when Coefficient decided to add graphics capacity to the product, the company choose to make VTERM III a 4010 emulator rather than a DEC graphics terminal emulator. Company representatives have said that the scientists and engineers using their product for CAD/CAM applications simply preferred the 4010 to DEC terminals.

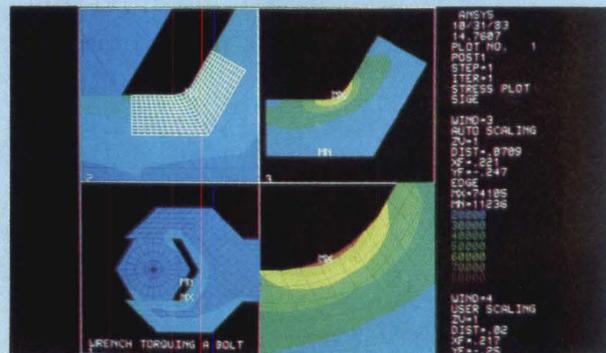
But, if Tektronix has set the graphics terminal standard, developers are not limited to it. They have found they can safely mimic the products of other companies. Walker, Richer & Quinn, for instance, has found a profitable niche producing emulators for Hewlett-Packard Co. terminals. "We went after what is essentially a small niche," says George Hubman, vice president of marketing. "But that niche has

**Threat from above**

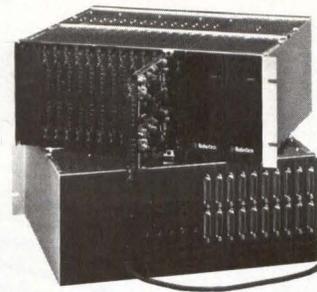
If graphics terminal emulators are threatened from below by increasingly powerful IBM Corp. PCs, then they are also threatened from above. Interactive workstations, which have always been heavily oriented towards graphics, are simultaneously dropping in price and supporting increasingly powerful graphics applications.

For example, Sun Microsystems Inc., Mountain View, Calif., has announced that Swanson Analysis Systems Inc.'s finite-element modeling program, Ansys, is available on the Sun-3 technical workstation. (In the photo, Ansys depicts the torque of a wrench tightening a bolt.) This setup means that engineers can have graphically oriented desktop

modelling that hitherto had been available only from a shared, multiuser machine.



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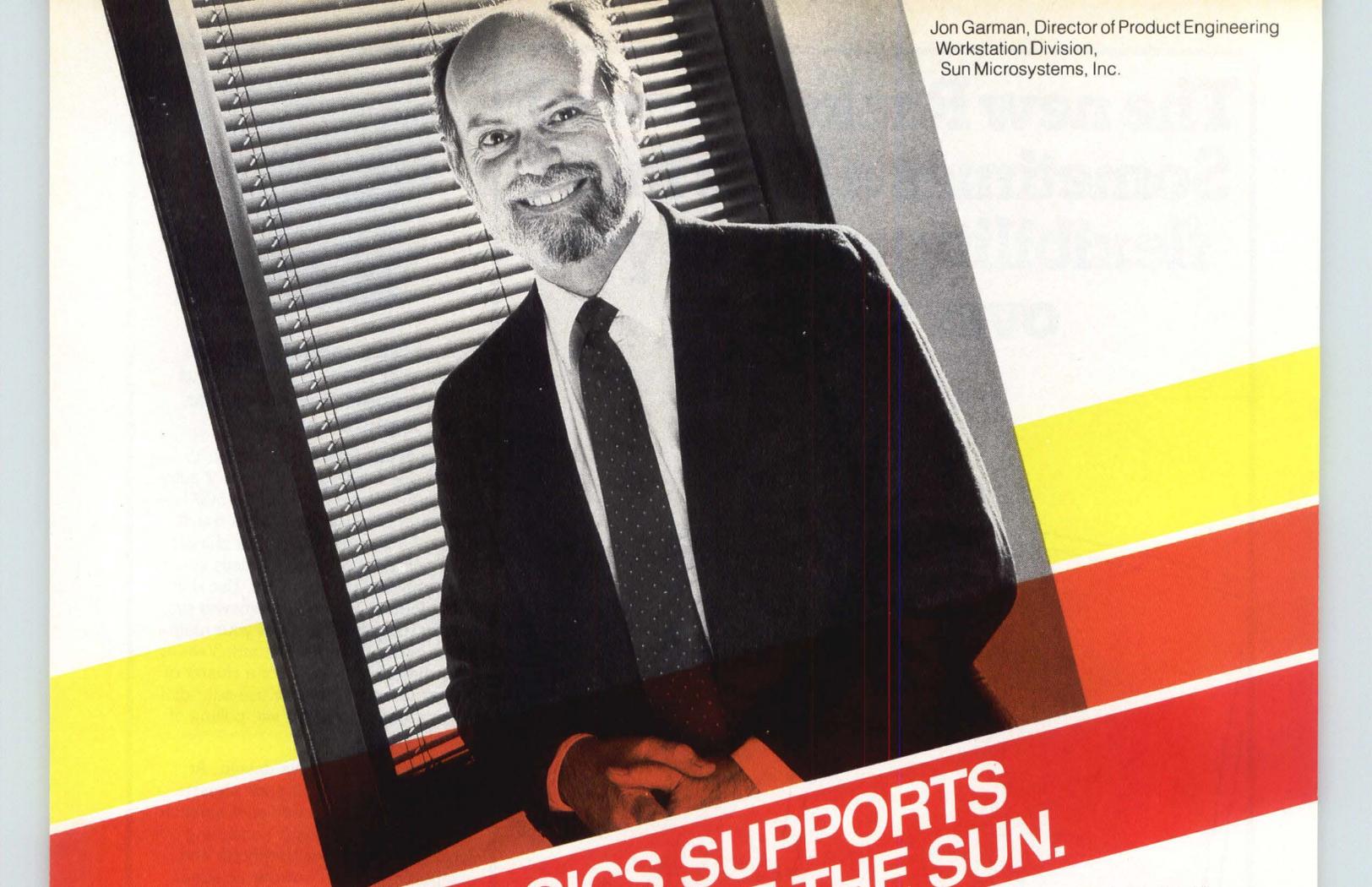
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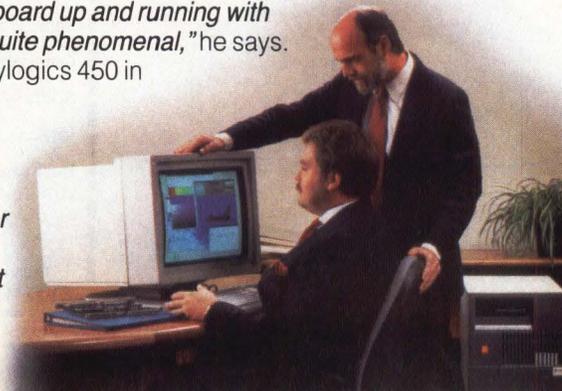
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significant volume. It has made us a \$5 million company very quickly."

The company sells such products as the Reflection 3, which emulates the HP 2623 graphics terminal, and Reflection 7, which provides color graphics HP terminal emulation. "HP itself is our single largest competitor and our largest customer," says Hubman. "HP is also our only OEM to date."

Hubman speculates that the success of his company's products is partly due to the flexibility of the PC, "I think everyone is finding that they want a PC. It can do things a terminal can't. The price of a PC, even with an EGA board, is still roughly the same as a dedicated terminal. Furthermore, you can do terminal graphics on a PC, but you can't run [Lotus Development Corp.'s] 1-2-3 on your terminal."

Indeed, the success of color graphics terminals have begun to call into question the future of graphics terminals themselves. Most analysts agree that at the high end, where graphics terminals are being used for such extraordinarily demanding applications as live-action animation, the terminal makers can be assured of a market for years to come. But, most observers seem convinced that at the low end, sales of terminal emulators for PCs will eventually outstrip dedicated terminals. "I'm surprised we haven't run [low-end-terminal] vendors out of business already," says Hubman. IDC's Farrell

adds, "There are a lot of PC product vendors out there . . . because, frankly, most people believe PCs are going to take quite a chunk of the graphics market."

However, some interesting complications have recently begun to unsettle the graphics terminal emulation market. All of them come from the same source that made them possible in the first place: the increasing sophistication of the PC.

The increasing power of the PC has made it a graphics engine in its own right. Now that PCs and compatibles can utilize 32-bit processors, they can also take advantage of a vast assortment of graphics software meant for 32-bit workstations, and even of software meant for minicomputers. Moreover, because they have been so amazingly popular, PCs have become the preferred graphics platform for designers, engineers and artists, the most intensive graphics users. The result has been the growth of a huge third-party graphics industry, eagerly supplying more sophisticated graphics products to the single largest graphics market in computing.

A sign of things to come, then, may be Logcraft's novel twist to "emulation" technology. Their Grafvax product allows DEC VAX users to exploit PC graphics software as well as PC graphics add-on boards. It combines a PC-compatible machine that can run PC-DOS software and an expansion chassis that can contain PC graphics boards with software. All of which makes it possible to display PC graphics on a VAX.

"DEC already has a variety of graphics capabilities," says Steven Landry, Logcraft's vice president of engineering, "but those do not include the ability to run popular PC graphics packages. In fact, I don't know anyone who can stay away from PC software for long. The popularity of that market, and the user-friendliness of that market, make it impossible."

In short, where once it was physically impossible for a PC to be more than a display tube for a mainframe graphics package, now the PC has itself become the leading graphics engine of today. And, already, some companies are beginning to experiment with "PC Terminals," inexpensive color graphics terminals that are meant to run off the PC itself. Eventually, then, emulators themselves may face pressure from below. □

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**'PCs are going to take quite a chunk of the graphics market.'**

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## Companies mentioned in this article

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### Grafpoint

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### Graphics Software Systems Inc.

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### Logcraft Inc.

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### Microplot

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### Tektronix Inc.

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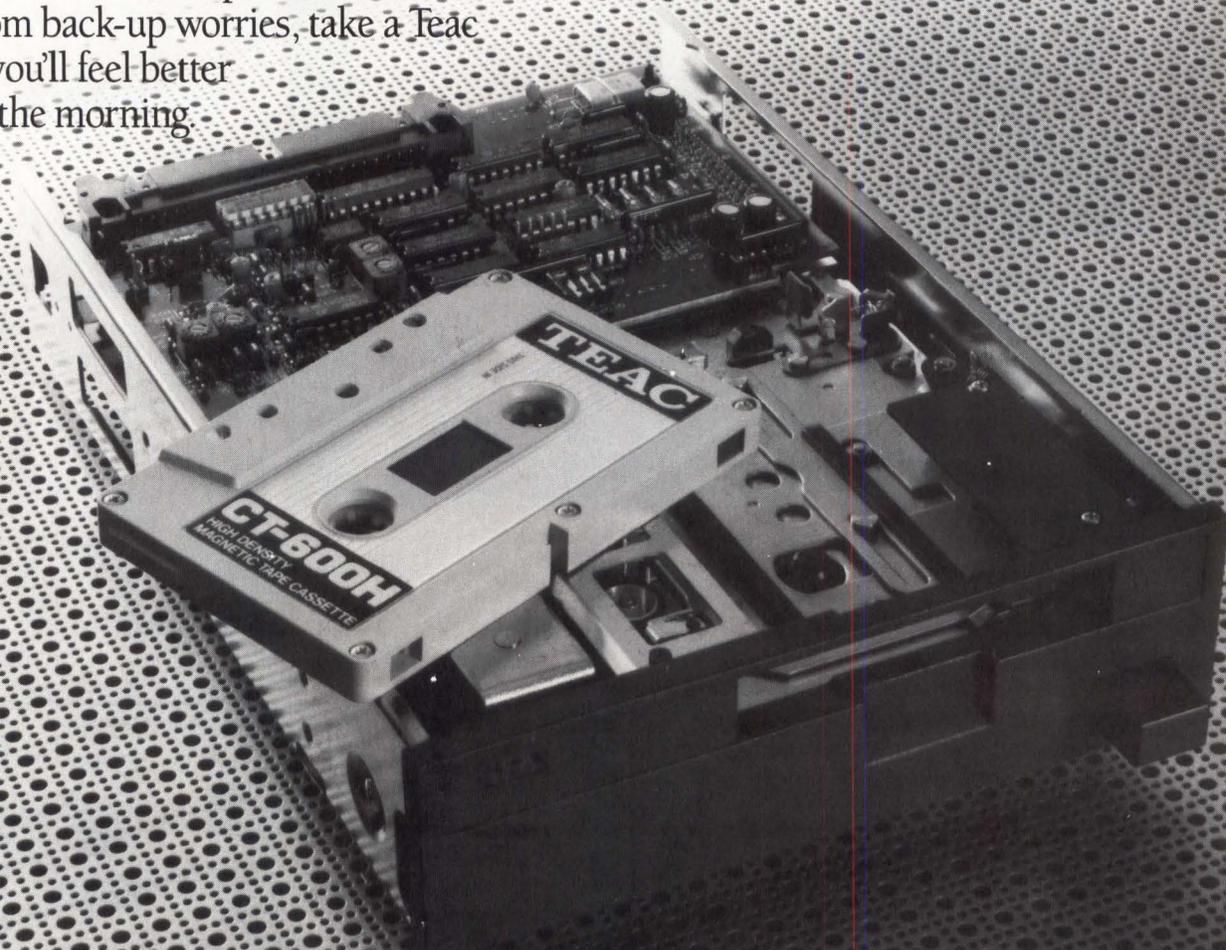
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# REVAMPED MAP AND TOP MEAN BUSINESS

New protocol standards forge ahead in factory implementations, and new functions and testing methods are emerging to meet demands and demonstrate interoperability

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Special Features Editor

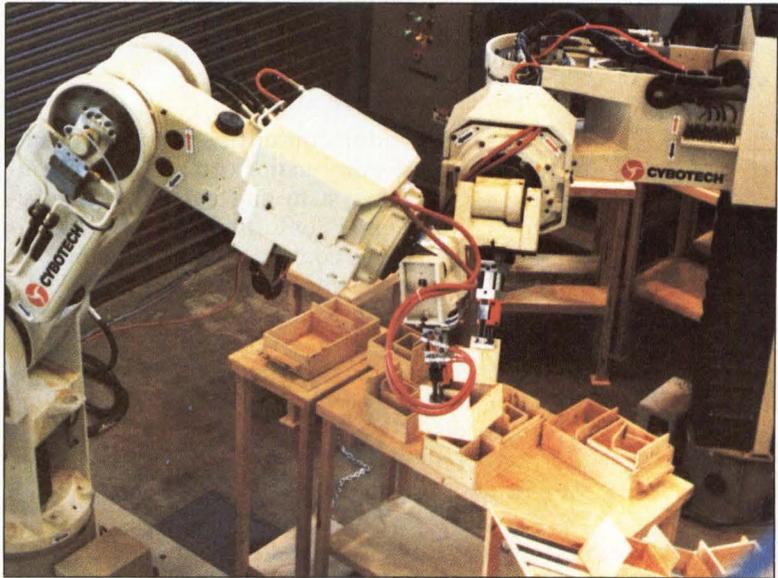
With the inroads that the Manufacturing Automation Protocols (MAP) and the Technical and Office Protocols (TOP) are making, it will not be long before users wonder how they ever accepted computers that could not talk to each other. MAP versions 2.1 and 2.2 are being implemented in about 25 production plants at various manufacturing companies, while banks as well as industries are participating in TOP specification. Meanwhile, product introductions abound. And functionality needed for real-world applications in manufacturing plants and in engineering and business offices will soon be available in specifications for MAP 3.0 and TOP 3.0. These specs are scheduled to be released in the first quarter of 1987, followed by a multivendor network demonstration of version 3.0 protocol implementations at Autofact in November 1987.

But despite these advances, practical concerns such as proof of interoperability, affordability, performance, speed and general business tradeoffs must be worked out before MAP and TOP can become true industry standards.

MAP and TOP are intrinsic parts of the broader field of flexible industrial automation. Flexible automation is intended to go beyond the inflexible operation of independent groups of machines and robots integrated under computer control. It aims at the integration and coordination of every hardware and software part of a production plant.

This is not now the case. With the current bottom-up integration approach, workers spend a large amount of time hand-carrying data printouts from programmable controllers to cars on conveyor belts, and between incompatible computer stations, so the next person in the assembly line can read and interpret them, manually key new data and walk the results farther down the production line.

In contrast, full integration of equipment will



allow data to flow from one end of an industrial process to another and drive the process (Fig. 1). The advantage lies in its allowing a plant setup to rapidly change over to respond to overproduction, subassembly defects, varied market needs, design changes and product customizing.

## What's up in MAP and TOP?

Small, medium and large companies, are all turf for MAP- and TOP-based networks, according to a survey of 237 MAP User Group members performed by CIMdata Inc., a Wellesley, Mass., consulting company involved in MAP/TOP multiclient information programs (Fig. 2). The respondents represented management, data-processing, operations, maintenance and product-design staff, both at corporate headquarters and at local plant sites. They came from a variety of industries, such as aerospace, automotive, farming, construction, mining and metal-working machinery manufacturing; and from chemical, petroleum, plastics and rubber companies.

**Two robots demonstrate a real-time, factory-automation task that requires their cooperation to transfer a part.**  
(Courtesy: Oded Maimon, Digital Equipment Corp.)

The respondents indicate that, on the average, they plan to implement MAP by mid-1987 and TOP by early 1988. Their major reason for switching to MAP or TOP is, as expected, support by multiple equipment suppliers. The chief concern about both MAP and TOP involves upgrading and retrofitting existing networks. However, the second chief concern vis-a-vis TOP, is the fear that TOP may not become a significant standard. Other MAP and TOP concerns include certification of products and the need for other networks, training and maintenance. And, one of the more surprising responses is the rating of cost and slow performance as major weaknesses with current networks as well as with MAP and TOP networks.

#### Standard must be stable

As for vendor commitment to MAP and TOP, almost every major computer, semiconductor, board, system and network manufacturer—not to mention software vendors, artificial-intelligence companies and value-added resellers—have introduced MAP- and TOP-compliant products or plan to do so shortly (MMS, June, Page 67). Like users, vendors have some reservations, particularly about interoperability, cost, performance and stability of the protocols.

As with the Autofact 1985 demonstration, vendors expect the MAP/TOP Expo at Auto-

fact 1987 to provide information about interoperability. Once there is assurance that different implementations work together, vendors can tackle cost and performance by implementing more of the protocols in VLSI and optimizing the software.

“But you must stabilize the standard long enough to allow vendors to move to silicon products,” says John Kline, general manager of manufacturing systems products at IBM Corp. “If you move too fast, you get a technology stream that is nice to have because it is state-of-the-art. But vendors will be on different time frames.”

General Motors Corp.’s MAP program manager, Mike Kaminski, recognizes this concern and expects the MAP and TOP 3.0 protocols to be long-term specifications. He points out that, “The 3.0 versions will make MAP and TOP 90 percent to 95 percent complete except for some room for expanded functionality, which should not affect compatibility.” And, although there will be a lag of product availability while assessment of the new specifications takes place, IBM evidently considers that the Autofact conference is a good time to come out with MAP products with upgraded functionality.

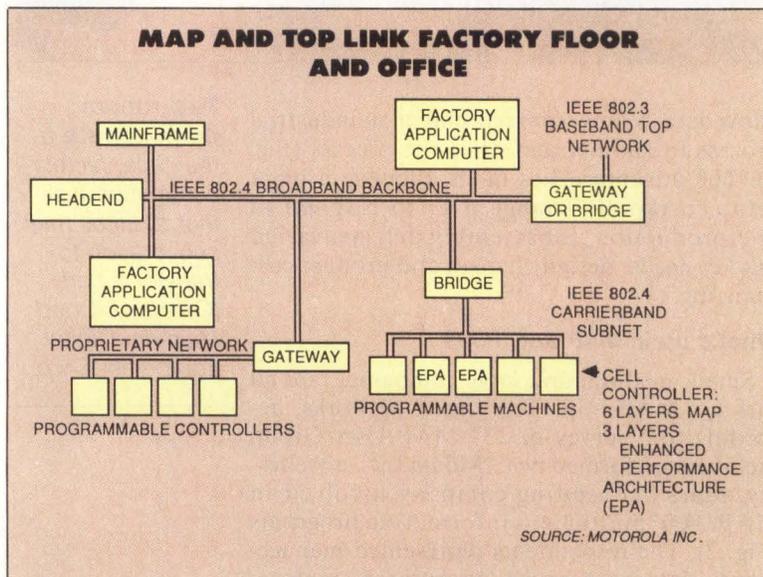
#### The new MAP

For the most part, MAP is based on the seven-layer Open Systems Interconnection protocols and the options within those protocols (Fig. 3). But it also includes recommendations based on protocols defined by ANSI, CCITT, the Electronic Industries Association (EIA), IEEE, the Instrument Society of America (ISA) and the National Bureau of Standards.

Version 3.0 will be the fifth published MAP specification. It differs from MAP 2.1 primarily in the file-transfer, real-time-messaging and presentation protocols and in the network-management and directory-services capabilities at the upper levels. The major lower layer differences are in MAP 2.2 as well as 3.0. They include the specification options of carrierband and “Mini-Map,” a scaled-down version of MAP.

MAP 3.0 for example, will expand the file-transfer protocol to the full FTAM (File Transfer, Access and Management), and will add the Presentation Layer (level 6) protocol kernel (MMS, July, Page 53). Only a subset of FTAM was included in MAP 2.1 because the rest of FTAM and the Presentation protocol were still in a state of flux at specification time.

The subset limits an application or user to bulk-file transfer. However, the full OSI FTAM and Presentation protocols are now draft international standards, with international standardization expected shortly. The full FTAM sup-



**Fig. 1. Factory automation techniques** integrate engineering and business environments with the factory floor using a MAP-based broadband backbone that connects to MAP-based 802.4 carrierband networks and TOP-based 802.3 baseband networks.

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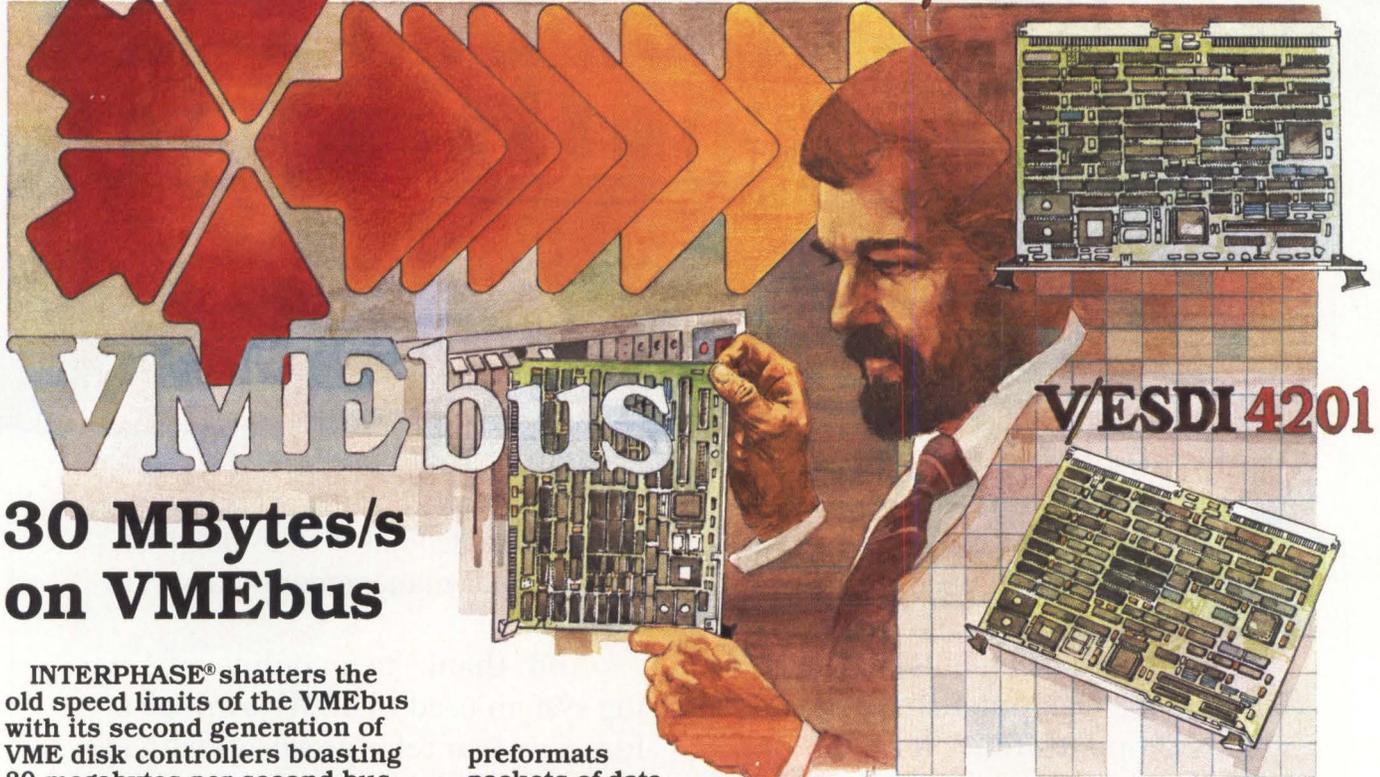
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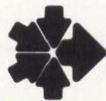
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ports file-access capabilities so users can selectively retrieve or update one record at a time, and file-management capabilities that allow users to remotely change access permissions and file attributes.

The Presentation Layer protocol negotiates the syntax that communicating computers will use to exchange information. This allows FTAM to work for all types of files. And the directory services allow users to transparently access remote machines without having to know its network address.

Despite FTAM's capabilities, it is not always usable by plant-floor devices because many of them do not have file systems. Moreover, these devices may not need the generality of FTAM.

Therefore, for communications and control in a plant-floor network, MAP 2.1 provided a real-time-messaging protocol called MMFS (Manufacturing Message-Format Standard). In MAP 3.0, MMFS will be replaced by the newer EIA standard—RS-511.

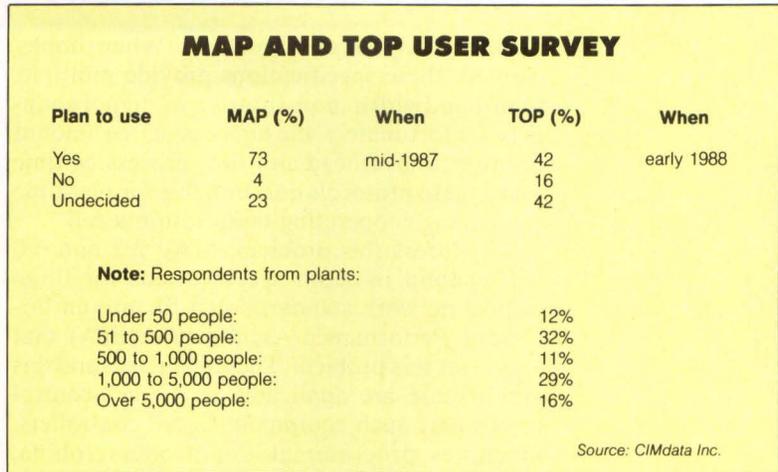
The chief problem with MMFS was its attempt to be all things to all people. Thereupon, it failed to define the message syntax exactly enough to ensure compatibility among different vendors' implementations of the same MMFS "conformance" classes.

In contrast, RS-511 has a well-defined structure that allows end-systems implementing the standard to perform their parsing correctly through the CCITT X.409 standard encoding syntax. In addition, specifications for handling various devices' specific semantics will be provided by companion standards, instead of by RS-511. These standards will be defined by the organizations most knowledgeable in the relevant fields. For example, EIA will specify the semantics for numerical controllers, the Robot Institute of America (RIA) will specify for robotics and ISA will specify for process control.

Network-management protocols are the newest major group of Application Layer (level 7) protocols. They have come far since the minimal, vague specification for the MAP demonstration at Autofact 1985.

MAP 3.0 defines five functional areas of network management: configuration, fault, performance, accounting and security. Specifications for configuration, fault and performance management will be part of the new MAP documents. Accounting and security are not being addressed at this point.

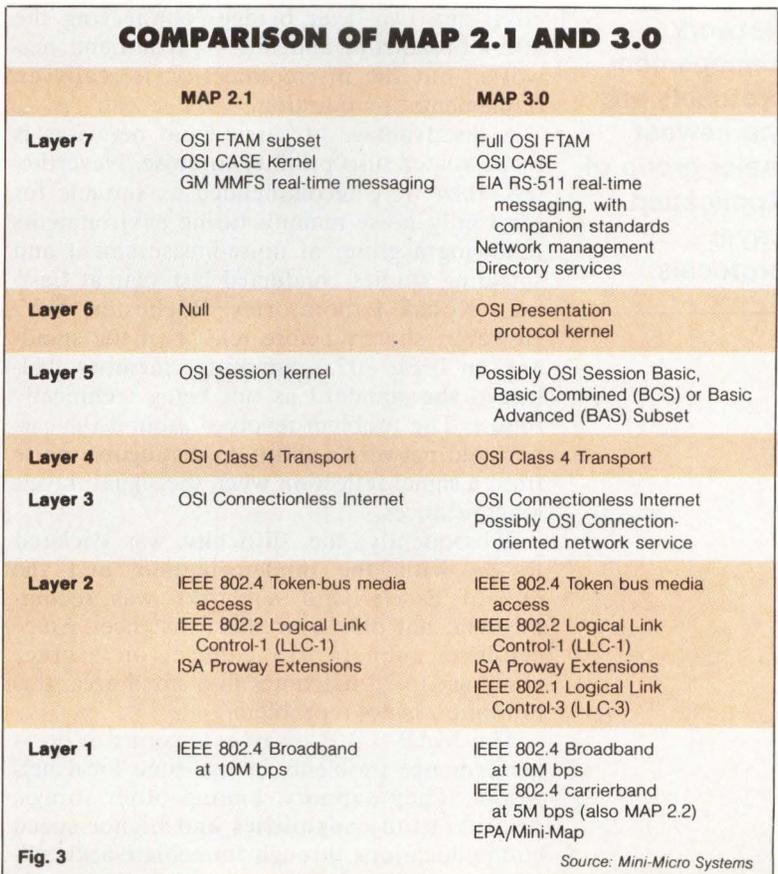
Unlike in previous specifications, only one network manager is needed for an interconnected group of heterogeneous networks. That network manager can communicate with, collect information about, and manage all the local and remote networks connected via a



**Fig. 2.** A survey of 237 MAP User Group members reveals that mid-1987 is the weighted-average year that the respondents plan to use MAP, compared to an anticipated early 1988 for TOP.

wide area network.

From the beginning, the MAP documents specified a seven-layer network that uses broadband coaxial cable as the backbone medium and the IEEE 802.4 (token bus) protocol's mechanical and electrical specifications for in-



terfacing devices to a network. When implemented, these specifications provide multiple, high-bandwidth, non-interfering signal channels. Unfortunately, the high cost, large amount of protocol overhead and slow processing time make these protocols questionable for real-time use among cooperating tasks within a cell.

To address this problem, MAP 2.2 and 3.0 will contain in-depth specifications for time-critical network standards that fit into an Enhanced Performance Architecture (EPA) that addresses this problem. These standards and this architecture are applicable at the cell-control level where such equipment as cell controllers, machines, programmable controllers, robots, numerical controllers and vision systems are connected. They include a carrierband option to the Physical Layer (level 1), certain token-bus carrierband options, the ISA Proway extensions, a new Data Link (level 2) protocol and Mini-Map.

The carrierband option specifies a single-channel coaxial cable with a smaller diameter than that of the broadband cable, a 5M-bit-per-second (bps) data rate and simpler modulation and phase-coherent signaling techniques. These specifications allow lower cost attachments in place of the expensive head-end and high-frequency modems required by broadband. GM envisions two-layer bridges connecting the 802.4 broadband and 802.4 carrierband networks, but the interconnection is really an implementation question.

A disadvantage of carrierband networks is their greater susceptibility to noise. Nevertheless, they were recommended as suitable for inherently noisy manufacturing environments following a group of noise-measurement and shielding studies conducted last year at Eastman Kodak Laboratories, Rochester, N.Y. However, shortly before release of the standard, an IEEE 802.4 committee member challenged the standard as not being technically robust. The problem revolved around the carrierband network's ability to distinguish noise from a signal reflection when the signal travels long distances.

Subsequently, the difficulty was declared to be with the implementation, and the use of carrierband networks was recommended, but only over short distances. Since cell-level subnetworks connect on average about six to 25 machines in a small area, this limitation is not a problem.

The MAP 3.0 Proway extensions address performance problems in real-time local networks. They support, among other things, prioritization capabilities and higher speed communications through immediate-acknowledge responses even though another node

might have the token.

A broader technique for expediting real-time performance substantially reduces protocol overhead by using Mini-Map in subnetworks. Mini-Map, which is essentially what its name implies, eliminates the middle MAP layers and interfaces MMFS or RS-511 directly to the lowest two layers. A special Data Link protocol, LLC-3 (Logical Link Control-3), substitutes for LLC-1 and supplies limited services for the carrierband network.

Opinions on the EPA and carrierband time scale vary. GM already has several sites scheduled to use the specification next year. Programmable control and vision system manufacturers feel that cost alone will drive users toward its use. Accordingly, users can expect carrierband products from Automatix Inc., Computrol Corp., Gould Inc., ModComp and Relcom Inc. Allen-Bradley Co. and Industrial Networking Inc. (INI) have gone so far as to introduce 802.4 carrierband implementations on a chip. Hewlett-Packard Co. suggests that many users are waiting until the standard settles a bit more. But CIMdata sees the EPA in the future of many types of companies.

"EPA is important to any industry needing high-speed communications," says John Bernard, senior associate at CIMdata. "This means not just the process industries, for which it was developed, but also for companies that use vision systems. Vision systems handle a lot of high-speed data very quickly, and there is no way that the present MAP structure can handle it."

#### TOP protocols mature

The TOP protocols are beginning to evolve. The next release of the TOP specification is timed to occur with the next MAP release, in the first quarter of 1987. At that time, the TOP version number will skip from 1.0 to 3.0 in order to maintain consistency with the MAP version numbers. The version will add significantly more functionality.

TOP and MAP networks are compatible. A core set of protocols—OSI layers 3, 4, 5 (Network, Transport, Session), 6 and parts of 7—are common to MAP and TOP and facilitate integration (Fig. 4). MAP and TOP diverge, however, at layer 7 where TOP specifies application protocols that address the application requirements of the technical and office user as opposed to factory floor requirements. They diverge also at the two lowest levels, where TOP specifies the less expensive, less deterministic 802.3 baseband media and media-access technique in place of the 802.4 broadband that MAP uses.

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**Network management protocols are the newest major group of Application Layer protocols.**

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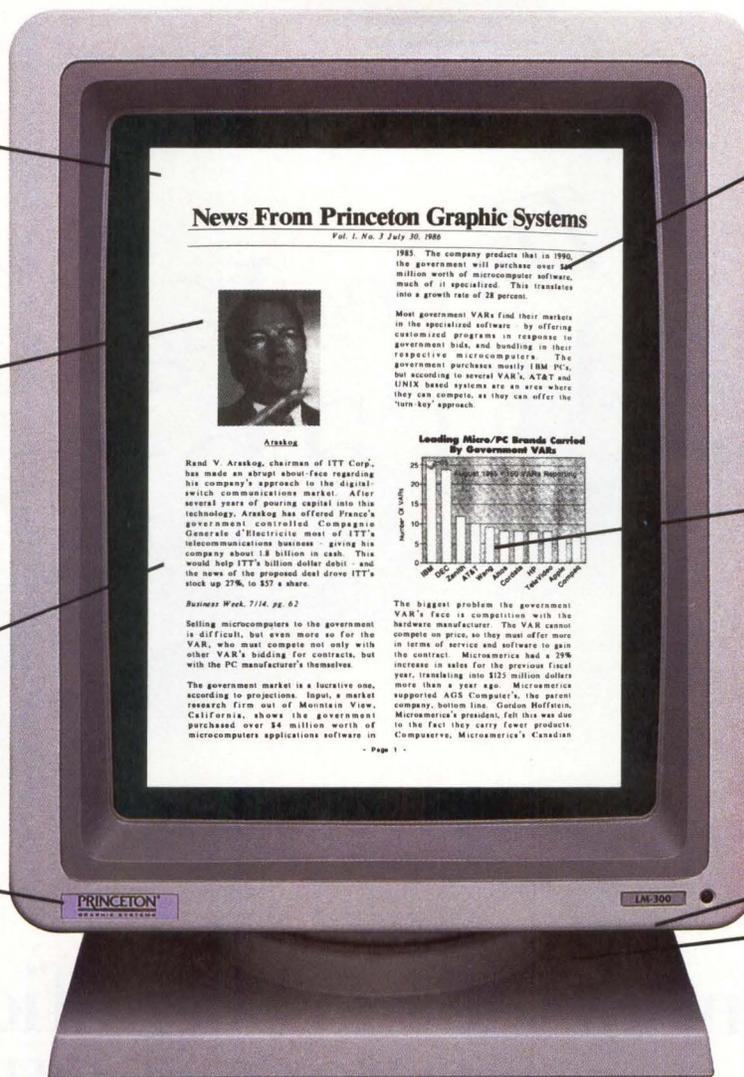
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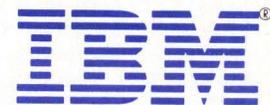
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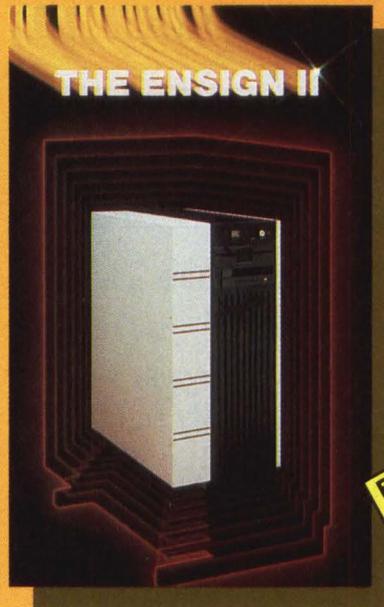
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saging protocols for private domain-to-private domain communications will be complete for TOP 3.0. For this, TOP specifies CCITT's X.400 messaging protocol in place of MAP's RS-511 real-time messaging protocol, which makes no sense for the office.

Because X.400 requires more Session Layer services than MAP 2.1's streamlined kernel subset provides, MAP and TOP have had different specifications at the Session Layer. The MAP/TOP Task Force is now looking into combining Session Layer subsets so that vendors can offer a single Session protocol that supports both MAP and TOP applications.

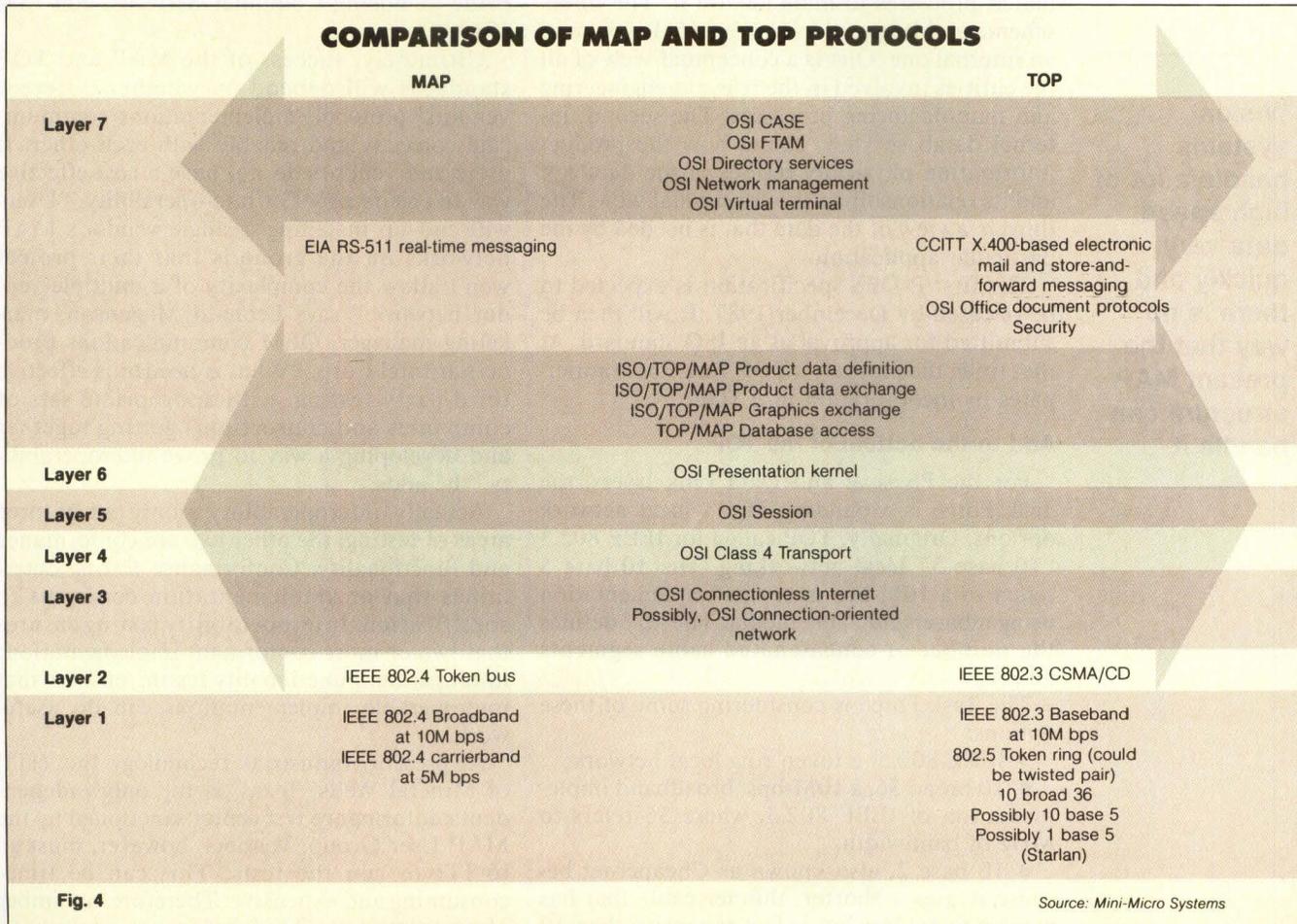
Other new and old areas in which TOP work is progressing include security and the Office Document Architecture (ODA), Office Document Interchange Format (ODIF), and Document Content Architecture (DCA) protocols. The office document protocols are based on OSI work. They standardize document formats, logical descriptions and procedures so documents can be transferred and revised at the other end.

As it now stands, OSI groups are defining some document content profiles, using some

already established content architectures, and special interest groups can add still more profiles. For example, under TOP, ODA implementations will exchange OSI-defined character (text) files. Exchange of graphics files compliant with the International Graphics Exchange Standard (IGES) is in the works. Plans are to also incorporate the ANSI X.12 Electronic Data Interchange standards for business type documents, such as invoices and bills-of-lading, and possibly the newly emerging spreadsheet architectures led by the National Bureau of Standards.

**Get rid of engineering drawings**

A newer document content architecture will specify product data. The product data definition will describe information about discrete parts and assemblies. Computers will use this product data definition, in conjunction with a product data exchange standard, to communicate product data information from the engineers' computers to the manufacturing tools. The goal is to produce a product without requiring manual intervention and engineering drawings.



The product data definition will include the pictorial or 3-D graphics representation of a product, along with textual and other information needed to completely define a product. The data described will be relevant to the entire life cycle of a product, from engineering design through manufacturing, quality assurance and testing to financial information. According to Boeing Computer Services, such a standard is particularly important to the aerospace industry.

The product data exchange specification (P-DES) is a new approach to communicating this information. It was developed because studies by TOP committees, and French and German graphics organizations, revealed that IGES was not up to the job. ISO therefore delegated the responsibility for coming up with a product data exchange standard to its American graphics contingent, working with IGES. This organization's concept of product data matches that of the MAP/TOP Task Force.

The IGES organization designed a three-schema architecture that could contain the engineering information needed to produce a product, be amenable to software that would read and interpret it, and would output automated processes to manufacture it. The three-schema architecture has two external views and an internal one. One is a conceptual view of all the entities involved in the relevant engineering and manufacturing processes. The second, internal database view, shows how the product information physically resides in the database and its relationship to the conceptual view. The third is a view of the data that is needed by the particular application.

The first P-DES specification is expected to be released by December 1987. It will then be submitted for approval as an ISO standard. At that time, the industry's TOP Task Force anticipates its incorporation into TOP.

#### **Add to the bottom of the TOP**

For the Physical and Data Link layers, the Task Force is expanding TOP's local network options. Originally, TOP called for IEEE 802.3 "10 base 5" local networking. The 10 base 5 refers to a 10M-bps data rate implementation using a baseband cable media. The "5" defines the number of concatenated cable segments allowed.

The Task Force is considering some of these options:

- IEEE 802.5, a token ring local network;
- 10 broad 36, a 10M-bps, broadband implementation of IEEE 802.3, where 36 refers to MHz of bandwidth;
- 10 base 2, also known as Cheapernet because it uses a shorter, thinner cable that has greater signal loss but is less expensive than 10

base 5;

- 1 base 5, which is the 1M-bps, twisted pair Starlan network.

For an option to be approved for version 3.0, it must be an approved standard and be supported by multiple vendor implementations that have demonstrated interoperability. By these criteria, 802.5 and 10 broad 36 qualify. Starlan, however, has passed the first level of acceptance in IEEE committees, and AT&T Co. and Retix are shipping products, but IEEE balloting must be completed and Starlan interoperability demonstrated.

#### **How MAP and TOP could flop**

TOP's core stack of protocols supports a broad range of applications. As a result, TOP now has technical representation in the United States and Europe from the banking community, the petroleum industry and the railways. Overall, so encouraging are the signs that the TOP Task Force is starting a subcommittee on transaction protocols, which are applicable to the retail and publishing industries, and is actively looking for more business participation. (Information for anyone wishing to join the standards effort is available from Laurie Bride at Boeing Computer Services, 206-763-5719.)

Ultimately, success of the MAP and TOP standards will depend on whether different vendors' protocol implementations communicate correctly and reliably with each other. If users and vendors do not have a cost-effective way to ensure proof of interoperability, "Users will end up installing a single vendor's MAP networks on the grounds that their project won't allow the complexity of a multiple-vendor network," says Leonard Magnuson, marketing manager, OEM communications products at Intel Corp. "What is needed is effective third-party testing, with appropriate sets of companies and consortiums getting together and developing a way to prove interoperability," he adds.

Actually, interoperability is only one of three areas of testing; the other two are conformance and functionality. Conformance testing determines that an implementation conforms to specification. Interoperability testing ensures that two or more conformant implementations interoperate. Functionality testing ensures that interoperable implementations can do useful work.

At present, Industrial Technology Inc. (ITI) of Mineral Wells, Texas, is the only independent conformance test center sanctioned by the MAP User Group. Vendors, however, must go to ITI to run the tests. This can be time-consuming and expensive. Therefore, a number of organizations, ITI included, are working on

---

**'Vision systems handle a lot of high speed data very quickly and there is no way that the present MAP structure can handle it.'**

---

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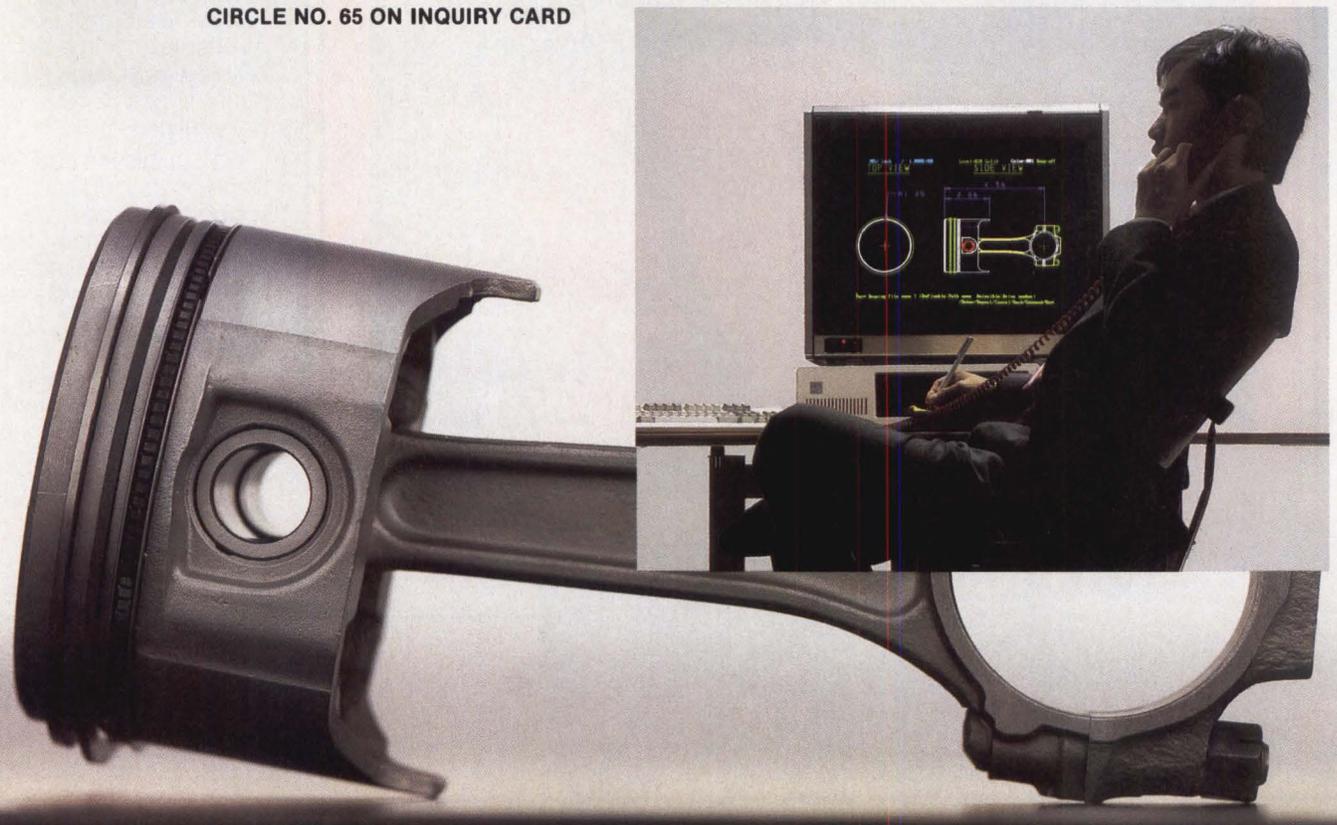
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## Selected vendors of MAP-related products

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procedures whereby vendors can prerin the tests in their own backyards and go to ITI for a quick confirmation.

ITI expects to have its tests for most of the protocols, including Common Application and Service Elements (CASE), FTAM, network management and directory services, available by the end of the year. Retix has software tools to prevalidate conformance of various protocols. And Tekelec Inc. markets MAP test tools and a portable MAP tester to perform initial debug, preconformance and interoperability testing.

At the National Bureau of Standards, various groups are developing test procedures for MAP interoperability. One group has developed a methodology and media-access control test machine to ensure that modem and head-end equipment from different manufacturers can communicate using the 802.4 Data Link protocol. By the end of the year, these test methods and equipment should identify protocol implementation differences and help correct them so that commonly used, heterogeneous modems from a variety of suppliers can interoperate.

And another group at the Bureau is coordi-

nating the development of OSInet, a globally distributed testing network that will be fully operational by the end of the year. OSInet will contain tools and software to test OSI, MAP and TOP preformance and interoperability and to prepare MAP and TOP products for demonstrations.

Within the last year, MAP and TOP products have been introduced, or shortly will be, from most major computer vendors. Among the newer announcements, IBM and INI have implemented a MAP interface for the industrial versions of the XT and AT. LISP-machine vendors also plan to support MAP and TOP so that users can distribute data acquisition and expert systems on traditional computers and LISP machines. In fact, LISP Machines Inc. is already shipping such products.

In addition, major network and data communications vendors offer MAP and TOP support products. Among the newest, Codenoll Technology Corp., Computrol, Motorola Inc., INI and Intel have integrated their networking and modem products to produce a MAP-compatible fiber-optic network.

Offloading communications onto plug-in

boards is efficient and cost-effective. So, sensing a market need, a number of companies have introduced board-level MAP and TOP products for Intel's Multibus, Motorola's VMEbus, IBM's PC-bus and various Digital Equipment Corp. buses. Examples come from INI, Intel, Motorola, Advanced Computer Communications, Excelan Inc., Micom/Interlan Inc. and Ungermann-Bass Inc., with National Semiconductor Corp. planning TOP boards.

To round out the list, companies such as Retix and Touch Communications Inc. supply a large number of the computer, board and system manufacturers, and even other third-party vendors, with MAP and TOP protocols.

It's clear that commitment to MAP and TOP is solid. Just the same, it would be wise not to get carried away by wildly unrealistic expectations of the new standards. Interoperability isn't easy. But if the attitudes of users and vendors are any indication, then interoperability will happen by the sheer will of all those involved. □

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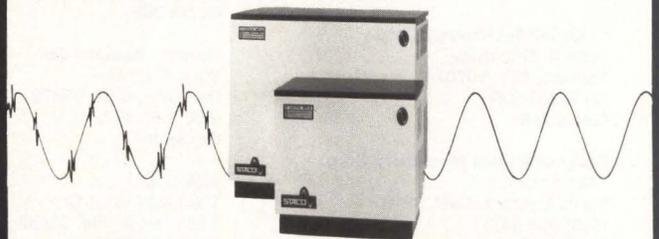
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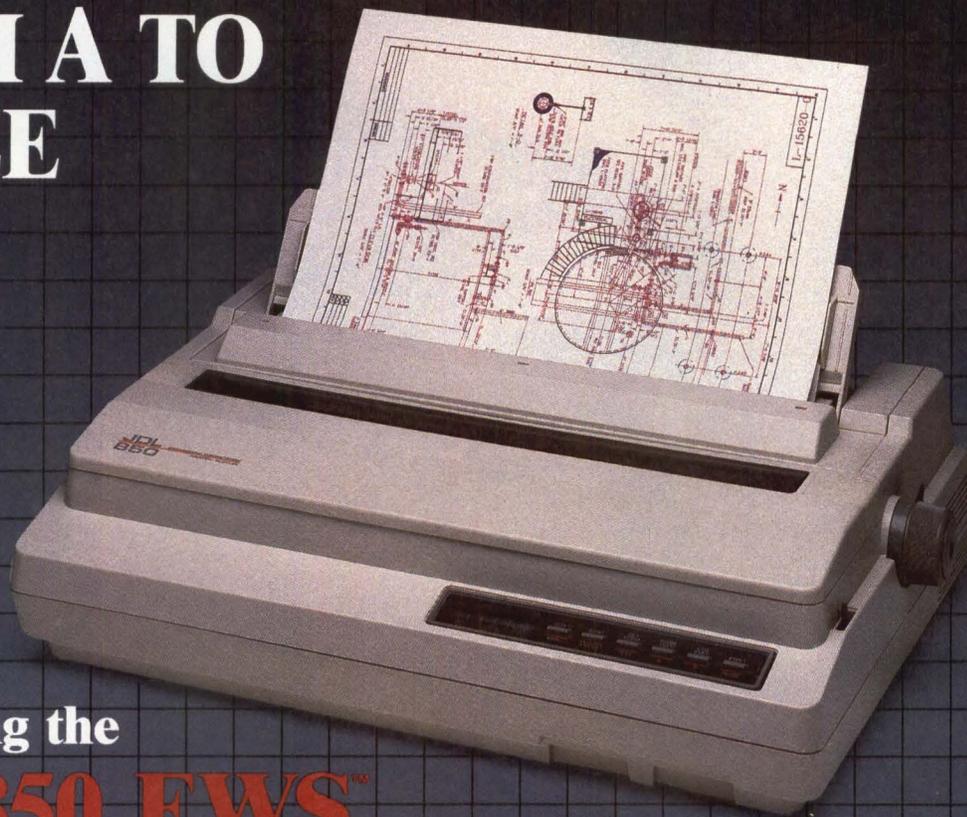
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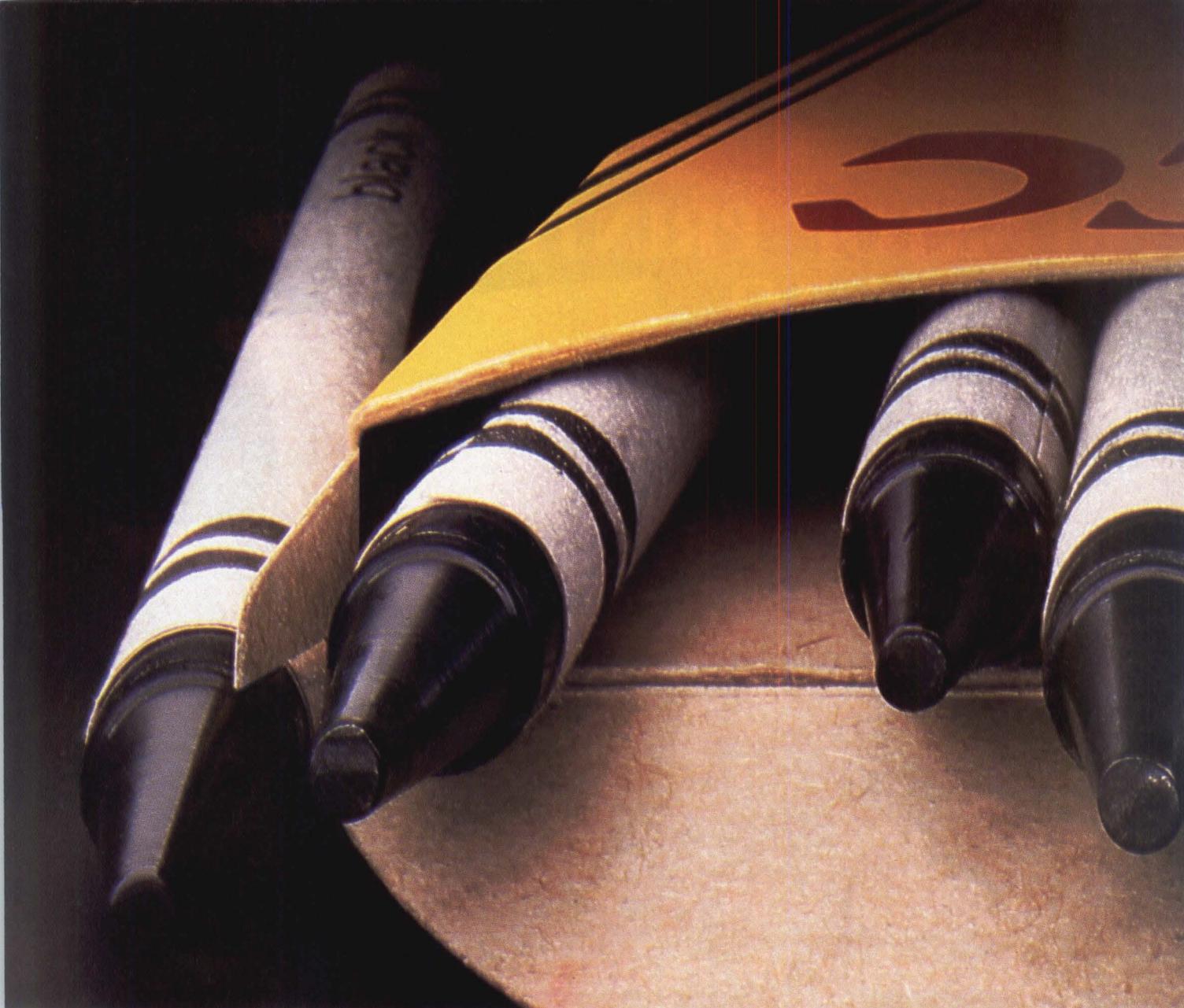
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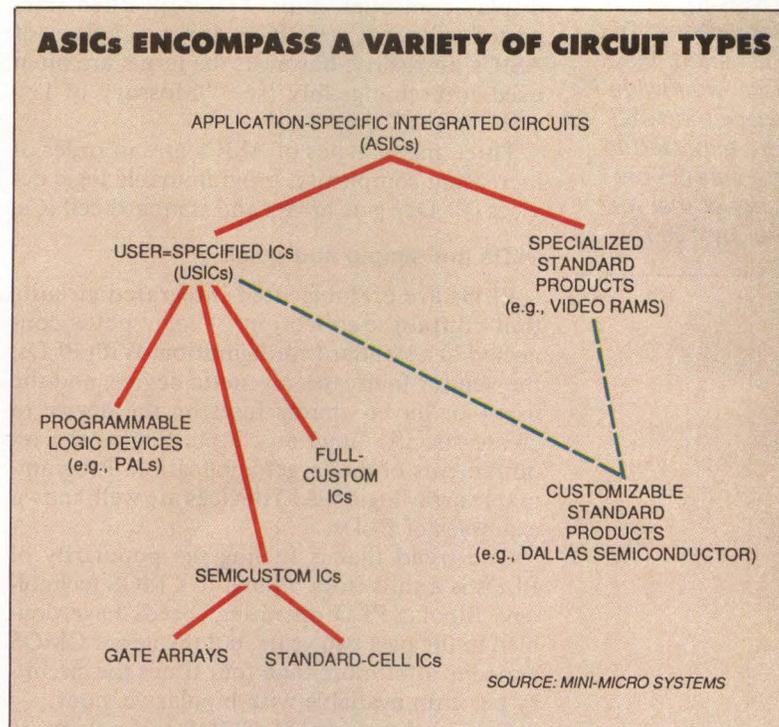
David Simpson, Senior Editor

Until recently, sophisticated users were forced to buy board-level products that usually incorporated general-purpose, off-the-shelf chips. One drawback to this was that users could not clearly distinguish products because those boards had no proprietary, or customized, characteristics.

However, thanks to application-specific integrated circuits (ASICs), that situation has changed. Now, system integrators without the IC experience of design engineers can develop custom circuits—in extremely quick turn-around times—and thus differentiate their products in an increasingly standardized market. Other benefits of ASICs include reduced size, lower power requirements and lower cost.

A key aspect of the ASIC revolution centers on transferring IC design responsibility from chip manufacturers to chip users. However, even for system integrators who can't afford IC customizing, ASICs prove important because they play a significant role in board-level products, such as small computer system interface (SCSI) peripheral controllers (see "ASICs shrink SCSI controllers," Page 121).

In fact, the advantages of ASICs are so overwhelming that, according to a recent report by Electronic Trend Publications, Saratoga, Calif., the market for ASICs will soar from \$2.1 billion in 1984 to \$7.2 billion in 1990. The report also predicts that the ASIC market will grow from 26 percent of the worldwide IC market in 1985 to 35 percent in 1990. Also by 1990, over 60 percent of all system-level designers will be involved in ASIC design, and system-level de-



signers will create over 10 times more circuits than will IC designers.

The term "ASIC" encompasses a variety of circuit types, ranging from specialized standard products, such as video RAMs, to full-custom ICs. To simplify definitions, "semicustom" refers to a chip that is partially standard (e.g., off-the-shelf and unalterable) and partially custom. "Full custom," of course, refers to a chip that is custom from the ground up. "Applica-

### STANDARD-CELL ASICs GROW AT 61% PER YEAR (Worldwide market, \$ billions)

	1985	1990	Annual growth rate (%)
Total IC market	8.0	20.3	20
Total ASIC market	2.1	7.2	28
Full custom	1.0	2.2	17
Gate array	0.7	2.1	22
Standard cell	0.2	2.3	61
Silicon compilers	0	0.4	
Other	0.08	0.2	22

Source: Electronic Trend Publications

**Application-specific integrated circuits (ASICs)**, which represented 26 percent of the total worldwide IC market in 1985, are expected to capture 35 percent of that market by 1990.

tion specific" means that the logic circuitry on the chip meets the requirements of a specific application; examples include peripheral and display controller chips. "User-specified integrated circuits" (USICs) are a subclass of ASICs. In reality, however, the terms are often used interchangeably (see "Glossary of key ASIC terms," Page 119).

Three major types of ASICs are, in order of increasing complexity, programmable logic devices (PLDs), gate arrays and standard-cell ICs.

#### PLDs are simple and quick

PLDs are prefabricated integrated circuits that contain a collection of logic gates connected in a standard configuration. With PLDs, the vendor fabricates a generic device, and the user—or buyer—burns fuses on the device to create specific functions, according to the requirements of the target application. Programmable array logic (PAL) devices are well-known examples of PLDs.

One trend that is fueling the popularity of PLDs is a shift from bipolar to CMOS technology. Bipolar PLD operating speeds have doubled in the past two years, but the newer CMOS versions offer more than four times the circuitry per chip available with bipolar versions.

Other advantages of CMOS technology include erasability, reprogrammability and better testability. Of course, CMOS devices are more expensive than bipolar devices. Other matters to consider in choosing a PLD include software support and yields.

An important advantage in using PLDs to create ASICs is that they have the fastest turnaround time (the time required to go from design concept to silicon), largely because they are customized on-site by the user. Leading PLD vendors include Altera Corp., Lattice Semiconductor Corp., Monolithic Memories

Inc. and Signetics Corp.

Development tools are key to taking advantage of PLDs. For example, Altera Corp. offers the Programmable Logic Development System (PLDS2), which it promotes as "The Foundry at your Fingertips." Running on an IBM Corp. PC or compatible, the system allows users to configure erasable PLDs (EPLDs), which are based on CMOS electrically programmable ROM technology. Priced at less than \$2,500, the PLDS2 is an easy-to-use design system that handles net list creation, performs placement and routing and actually programs the EPLD (two of which come with the PLDS2). Thus the desktop system produces a workable prototype—right on the user's desk. Altera calls its devices user-configurable ICs (UCICs), to differentiate them from other ASIC approaches.

And workstation vendors are making it easier to design PLD-based ASICs. For example, Daisy Systems Corp. recently started shipping PLD Master, a program that lets users design, test and simulate PLDs. The software runs on Daisy's Logician, Personal Logician and Mega-Logician workstations, providing a complete desktop solution for PLD design.

#### Gate arrays increase flexibility

With gate arrays, the vendor and buyer share most of the design work, thus leading to a more customized design than is possible with PLDs.

Gate array ASICs are fabricated by interconnecting previously built arrays of components. The design phase involves determining the layout of the metal lines connecting the individual components into the desired circuit.

With gate arrays, the vendor mass-produces about three-quarters of the chip, and the designer customizes the rest (usually with the assistance of the vendor). "The rest" typically comprises one to four layers of the chip. Once the design is completed, chips can be produced in about six to eight weeks, although production times vary widely depending on design complexity. Some vendors, such as LSI Logic Corp., are promising prototype production times of three weeks or less. Generally, design times for gate arrays are about half those of standard-cell ICs, as are production cycles (six to eight weeks vs. 12 to 16 weeks), according to Osvaldo Viva of Saratoga, Calif., an independent consultant specializing in the semiconductor industry.

Relative to standard-cell ICs, gate arrays offer distinct advantages, as well as disadvantages. For example, gate arrays have a lower design cost, shorter design and turnaround time and involve lower risk. On the other hand, they have a limited set of transistors and higher

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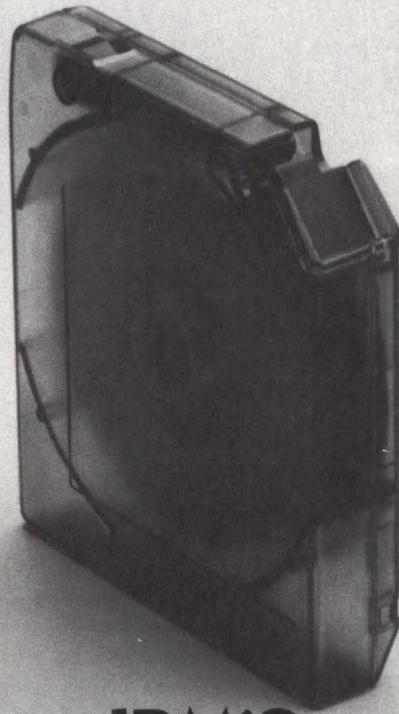
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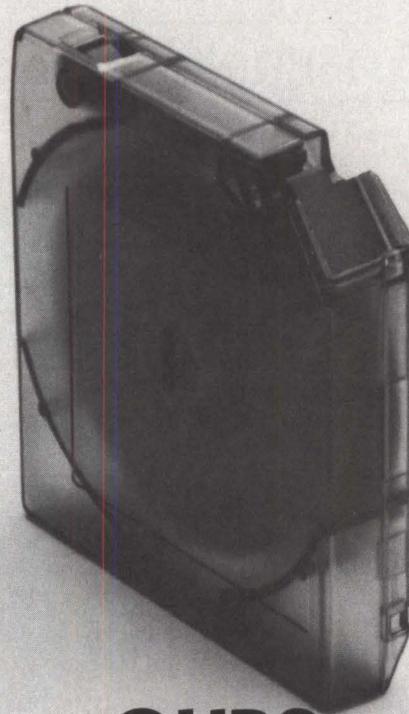
There's nothing new about 1/2 inch tape cartridge drives. IBM introduced the 3480 back in 1984. Unfortunately, its \$100,000 price tag to end-users, coupled with its 3 megabyte per second transfer rate, relegated its use to mainframes.

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

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

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

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### **HI/TC** HALF-INCH TAPE CARTRIDGE DRIVE COMPATIBILITY

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Computer Peripherals International-Kennedy Company-  
Pertec Peripherals Corporation-TEAC Corporation-  
Wangtek, Inc.**

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production costs.

A major drawback to gate arrays is that the advantages of flexibility and ease of design exact a price: wasted silicon. This, of course, increases costs because of the expensiveness of silicon. Although many designs waste only about 10 percent of the silicon, 25 percent waste is not uncommon. The other side of the cost coin is that the uncustomized gate array can be produced in large quantities, which translates to economies of scale.

Although some semiconductor manufacturers boast 50,000-gate arrays—using CMOS technology—that density level usually represents overkill. According to The Technology Research Group, Boston, which focuses on electronic design automation and custom and semicustom integrated circuits, most designs

require only 1,000 to 2,000 gates. The median for all semicustom chips—including ECL and CMOS gate arrays and CMOS standard cells—is about 2,000 gates. The Technology Research Group expects the median gate count to be around 3,500 by 1988.

Increasingly, semicustom gate arrays are replacing medium scale integration (MSI) and large scale integration (LSI) chips in applications such as portable computer systems, video and memory subsystems and signal processors. Compared to the devices they replace, gate arrays offer space and power savings, more functions, higher performance and increased reliability.

In addition, prices of gate arrays are falling precipitously. For example, between mid-1985 and mid-1986, the price-per-gate of medium-

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**One trend that is fueling the popularity of PLDs is a shift from bipolar to CMOS technology.**

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## Glossary of key ASIC terms

**Application-specific integrated circuit (ASIC):** a generic term encompassing all forms of custom and semicustom ICs designed specifically for a particular application. Sometimes called USICs, for user-specified integrated circuits.

**Cell:** Circuit performing a digital or linear function that is repeatedly used to design an LSI/VLSI chip.

**Cell library:** Collection of predefined cell functions stored in a computer aided design database. Custom devices can be designed by choosing appropriate cells from the library and locating them on a chip.

**Complementary metal oxide semiconductor (CMOS):** A fast, low-power chip-fabrication technology that has become the leading process for advanced designs.

**Density:** Number of gates (gate count) and/or elements on the circuit. A characteristic largely limited by the size (as measured in microns) of the smallest component element on the device.

**Design rules:** Collection of rules that defines minimum dimension of device-topological structures. Design rules also express process-parameter design limits such as gain factor, threshold level, oxide thickness and capacitance.

**Emitter-coupled logic (ECL):** A family of bipolar devices using differential transistor parts that run extremely fast, but which tend to consume much more power than CMOS technologies, especially while inactive.

**Foundry:** A company that provides IC manufacturing services, usually in the area of wafer fabrication.

**Gate:** The smallest building block for logical elements, often used as a benchmark of ASIC design complexity. A gate is usually the equivalent of a two-input NAND or NOR gate. In CMOS, gates can be

built from two n-channel and two p-channel transistors.

**Gate array:** An ASIC that is customized through one or more layers of metal interconnect. Generally, a CMOS masterslice that contains columns of transistors (organized in blocks of gates).

**Large-scale integration (LSI):** Device design integrating from 100 up to thousands of gate equivalents on a chip.

**Macrocells:** The physical gate-level elements and I/O buffers that form the basic building blocks for logic-array design. Macrocells are predefined and characterized metal interconnections of transistors on the array-base masterslice. They correspond to unique logic functions (NAND, NOR, flip-flops, buffers, etc.).

**Megacell:** A very large custom-optimized cell that performs a specific function. Megacells include ROMs, RAMs and bit-slice microprocessors.

**Medium-scale integration (MSI):** Device design integrating from 10 to 100 gate equivalents on a chip.

**Propagation delay:** The time it takes for a change in the input state of a gate to result in a change in the output state.

**Routing:** The process of designing interconnections between components in an integrated circuit.

**Semicustom:** A technique for building ASICs using predefined or prebuilt building blocks.

**Small-scale integration (SSI):** ICs containing fewer than 10 logic gate equivalents.

**Standard cell:** A technology allowing designers to use precharacterized gate-level cells in building-block fashion. These "fixed height variable width" cells are placed in columns and then routed.

**Very large-scale integration (VLSI):** Device design integrating thousands of gate equivalents on a chip.

—Source: *Electronic Trend Publications*

**WHAT DOES A TYPICAL CIRCUIT COST?\***

	Gate arrays	Standard cells	Full custom
Development time (weeks)	6-20	10-18	36-90
Development cost (\$ thousands)	20-40	30-60	75-250
Cost to modify (\$ thousands)	12-15	20-30	30-50
Production cost (\$)	6-15	4-10	3-6
Minimum economic quantity	1,000	20,000	75,000

\*Costs and schedules vary widely for all suppliers. Ranges shown are typical within the industry; minimum and maximum are in much wider range.

Source: Electronic Trend Publications

**A cost analysis**

*of developing and producing three types of ASICs shows that, as the chip becomes more customized, development costs rise, but production costs fall. This comparison assumes a typical circuit consisting of 2,500 to 3,000 gates, CMOS technology, 40-pin plastic package and commercial-grade screening.*

density CMOS gate arrays dropped almost 90 percent.

Further lowering costs, many vendors are putting full design capabilities on PCs and PC/ATs. For example, FutureNet Corp. this year introduced the DASH Semicustom Development system, which is based on the AT. The system allows users to design, verify and simulate gate arrays.

Similarly, Motorola Inc. this year announced a gate array design kit that runs on Daisy's MegaGatemaster workstation. The kit provides automatic place and route capability for designs using Motorola's gate arrays.

The leading gate array vendors are Fujitsu Microelectronics Inc. and LSI Logic, followed by Motorola, NEC Electronics USA Inc. and Toshiba America.

**Standard cells are highly customized**

Designers create standard-cell ICs by using libraries of predefined cells, or blocks of circuitry, which are available from semicustom vendors, sometimes at no charge (in order to gain manufacturing business). The designer arranges the cells on the chip with the aid of design software and computer aided design/computer aided engineering equipment—either their own equipment or the vendors'.

Unlike gate arrays, cells do not have fixed geometries because they are optimized for specific functions. Using a CAD system, the designer chooses appropriate modules from the cell library and specifies the connections between them. A layout program then places the cells in optimum locations on the chip and establishes the connections. The workstation then generates the layout and converts it into files to be used for generating masks. To make design easier, cell library vendors are offering larger and more complete cells, such as micro-

processors and memory.

Because standard cells take up less silicon, they're generally less expensive than gate arrays. In addition, standard-cell ICs can pack many more transistors than can gate arrays. In fact, using standard-cell ICs, designers can put an entire system on one chip.

The principal advantage of standard-cell ICs is flexibility because designers start with a *tabula rasa*—a blank piece of silicon on which they place whatever devices and functions the application requires, such as ROM and microprocessors. As such, standard-cell ASICs approach the flexibility offered by full-custom designs.

The disadvantages of standard-cell ICs, relative to gate arrays, include higher design cost; longer lead and turnaround time; and higher risk. Design cost is high because of the time required for customizing, which may involve all layers of the chip. That can extend turnaround times to as long as six months. Risk is high because the chips require much more testing than do gate arrays, which have already been pretested by the semicustom vendor. Also, if the design isn't right the first time, it takes a lot of time (money) to redesign.

**Market predictions are optimistic**

Analysts agree that standard-cell ICs will experience the fastest growth among the various types of ASICs over the next few years. After the standard-cell surge, a newer type of ASIC strategy—silicon compilation—will experience high growth. Gate arrays and full-custom designs will grow in absolute terms but will lose market share to the newer technologies.

The leading supplier of standard-cell ICs is NCR Corp., followed by a group of other vendors, including Gould AMI Semiconductors, Texas Instruments Inc. and VLSI Technology Inc.

In an effort to make design easier and more inexpensive, especially for users who are new to semicustom technology, all of the major standard-cell vendors are moving to workstation-based solutions. For example, at July's Design Automation Conference in Las Vegas, NCR introduced a workstation-based system that adds high-level functional cell generators/compiler to its semicustom design tools. It supports both standard-cell and gate-array designs. Called VIGEN, the system is based on Mentor Graphics Corp.'s IDEA series of low-cost engineering workstations and NCR's VLSI Design System (VISYS). The generators/compiler use silicon-compilation technology developed by Silicon Design Labs Inc.

The ideal method for implementing ASICs is silicon compilation, which uses a hierarchical methodology and high-level descriptions that are automatically translated into a layout. In other words, a silicon compiler—which is essentially a knowledge-based software system—emulates an IC designer. With silicon compilation, users can customize individual cells, making the chip extremely application specific.

Using a silicon compiler, a designer specifies

only the architectural level of design, whereas with standard-cell methods a designer must first specify the architectural level and then the logic level. In other words, silicon compilers automate all steps between architecture design and layout design.

Among ASIC technologies, silicon compilers provide the most efficient use of silicon and offer higher customizing. But, because it's a new technology, many problems remain, not

## ASICs shrink SCSI controllers

**John Kanzler**

Adaptive Data Systems Inc.

Manufacturers use application-specific integrated circuits (ASICs) on peripheral controllers—including those that handle the small computer systems interface (SCSI)—for a variety of reasons. Most important, ASICs reduce costs and provide increased performance and functionality in a space-saving package.

Before ASICs, SCSI controller manufacturers had struggled to provide controllers with increased performance and functionality, while reducing board size. Typically, controllers conform to the same form factors as the equipment they are mated to. For example, Winchester disk drives in 14-, 8-, 5¼- and 3½-inch form factors generally require board sizes of approximately 224, 80, 40 and 20 square inches, respectively.

The board for a typical 5¼-inch drive can be stuffed with as many as 80 general-purpose ICs in a four-to-six-layer, 40-square-inch package before running out of real estate. Such designs usually include performance trade-offs relative to memory size, number of drives supported, etc. The 3½-inch form factor, on its 20-square-inch controller board, particularly presents design obstacles for controller manufacturers trying to meet customers' performance expectations. However, using ASICs, Adaptive Data Systems Inc. (ADSI), which was recently acquired by Western Digital Corp., designed controllers with all the functionality of those full-size controllers on a board that is only 8 inches square.

Size reduction is only one advantage gained by using ASICs. Many SCSI controller manufacturers now design with ASICs for increased performance and capabilities.

Embedded controllers (the combination of controller and drive electronics on one board) are fueling the need for ASIC-based controllers. Embedded controllers offer many advantages besides real estate savings: a single source for both controller and drive, lower component count, increased reliability and lower cost. A case in point is the development of the enhanced small device interface (ESDI)-to-SCSI link

by manufacturers of 5¼-inch disk drives. Instead of two boards to take raw analog data from the drive to the ESDI board and then to the SCSI board, SCSI can be embedded on the same board that provides the drive electronics.

The advantages of embedding, especially the cost savings, are leading many drive manufacturers to seek working arrangements with controller houses that possess the expertise and the ASICs necessary for embedded controllers.

ADSI uses a unique set of ASICs on its own board-level controller products, which they also provide to other controller manufacturers. The ASICs are packaged to provide a two- or three-chip solution for a SCSI-Winchester, SCSI-streaming tape, SCSI-HBA (host bus adapter) controller, or any combination thereof.

The ADS-3570, a full-custom VLSI ASIC chip, provides the control for data buffering on intelligent peripherals. The ADS-3570 is a single-chip solution for multiport FIFO buffering applications that require only external RAM and cable driver/receivers. One port is optimized for the SCSI interface, providing all status and control signals. The other ports are used for the control of two peripherals and for the CPU interface. The ADS-3570 buffer manager, without any external logic, can control up to 64K static or 256K dynamic, 8- or 16-bit-wide memory arrays. The total bandwidth of the ADS-3570 is 7.5M bytes per second for an 8-bit-wide memory array or 15M bytes per second for a 16-bit-wide array.

Another full-custom VLSI ASIC—the ADS-1000—provides data handling and control for an intelligent Winchester disk controller. It operates with nearly any serial disk interface, including ST412, ST412HP, ST506, ESDI and storage module device. The ADS-1000 has a 24M-bit-per-second maximum transfer rate, and can perform full multisector operations without CPU intervention.

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**John Kanzler** is technical-support manager at Adaptive Data Systems Inc. (ADSI), Pomona, Calif.

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**A total system cost comparison, by type of IC used, reveals the potential advantages of using semicustom and full-custom approaches. Other factors to consider include time to market, performance and size.**

<b>SEMICUSTOM ICs SAVE BUCKS</b>					
<b>(Total system* cost by type of IC used)</b>					
	<b>SEMICUSTOM</b>				
	SSI/MSI	Programmable logic	Gate array	Standard cell	Full custom
No. of chips	800	65	12	10	6
No. of boards	16	2	1	1	1
Development cost—PCB (\$ thousands)	80	10	5	5	5
Development cost—IC (\$ thousands)	0	10	90	135	250
Redevelopment cost (\$ thousands)	3	3	15	28	40
Production cost—PCB (\$ millions)	12	1.5	1.2	1.2	1.0
Production cost—IC (\$ millions)	8	5.8	1.3	1.0	.5
<b>Total cost (\$ millions)</b>	<b>20</b>	<b>7.3</b>	<b>2.6</b>	<b>2.4</b>	<b>1.8</b>

\*The example systems consist of 10,000 gates and are produced in quantities of 50,000 units. Due to the volatility of prices, these figures are estimates and are meant only as a relative comparison by technology.

Source: Electronic Trend Publications

the least of which is nearly prohibitive costs. For example, Silicon Compilers Inc., a leader in the field, offers the Genasil Silicon Development System for over \$150,000 in a single-user basic configuration. And prices can easily soar to over \$1 million. Nevertheless, because silicon compilers automate so much of the ASIC design process, they will represent a significant portion of ASIC design methodologies in the next decade.

Deciding how to implement an ASIC is only the beginning of the concept-to-silicon cycle, which entails myriad steps. The important thing for those getting their feet wet in the semicustom sea is that vendors are offering more and more customer support. This typically centers on workstation support, training, CAE software availability and design centers.

There are more than 60 ASIC manufacturers in the United States, which account for more than 240 design centers worldwide. (A year ago, there were only 40 ASIC manufacturers and 140 design centers.) Design centers can be vendor-owned or independent. Choosing the best design center depends on a close analysis of the technological requirements of the ASIC design and the ability of the design center to meet those requirements. A complete listing of design centers and their locations—as well as ASIC vendors—is available from Electronic Trend Publications.

The amount of support provided by the ASIC vendor varies from company to company. But, that is perhaps the most important criterion for deciding what vendor to go to for

ASIC design, particularly for system integrators and OEMs new to semicustom design.

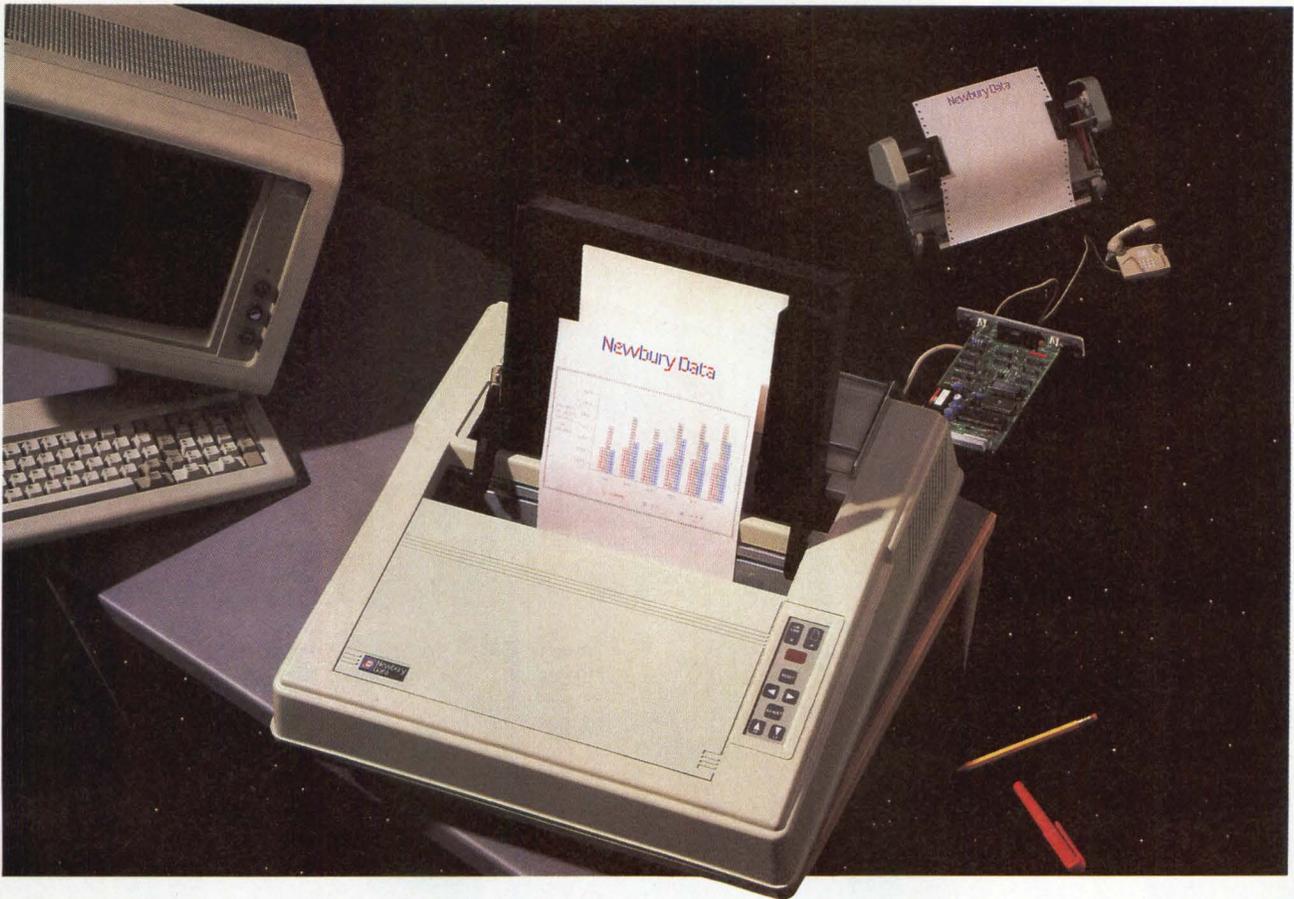
A recent study by The Technology Research Group reported that 15 percent of all semicustom chips were designed entirely by semicustom vendors; 6 percent involved distributors or independent consultants; 10 percent were designed by customers using their own CAE equipment; and 69 percent were designed by customers using equipment owned by semicustom vendors. This larger group included customer participation in the design cycles using the vendor's facility and vendor-provided software and assistance.

#### **What are the trends?**

As competition heats up, technology-exchange agreements between major semiconductor companies are becoming common. One example is a formidable codevelopment agreement between Motorola and NCR that covers a wide variety of ASIC technologies and equipment.

Also look for vendors to fill out their product lines in order to provide "one-stop shopping." Both of these trends will make it even more difficult for start-ups and may lead to a shake-out.

Nevertheless, the advent of ASICs bodes well for the still-slumping semiconductor industry. For example, semiconductor companies with idled design centers and foundries can retool and convert to ASIC development. The expected boom will also create huge opportunities for suppliers of hardware and software geared toward development and testing of these



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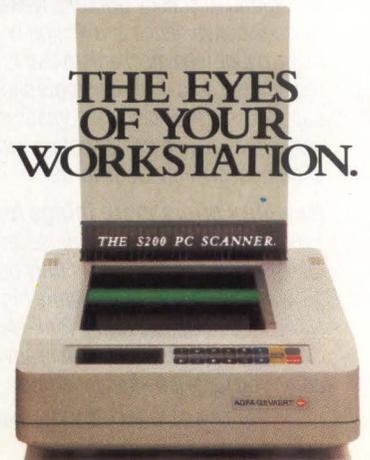
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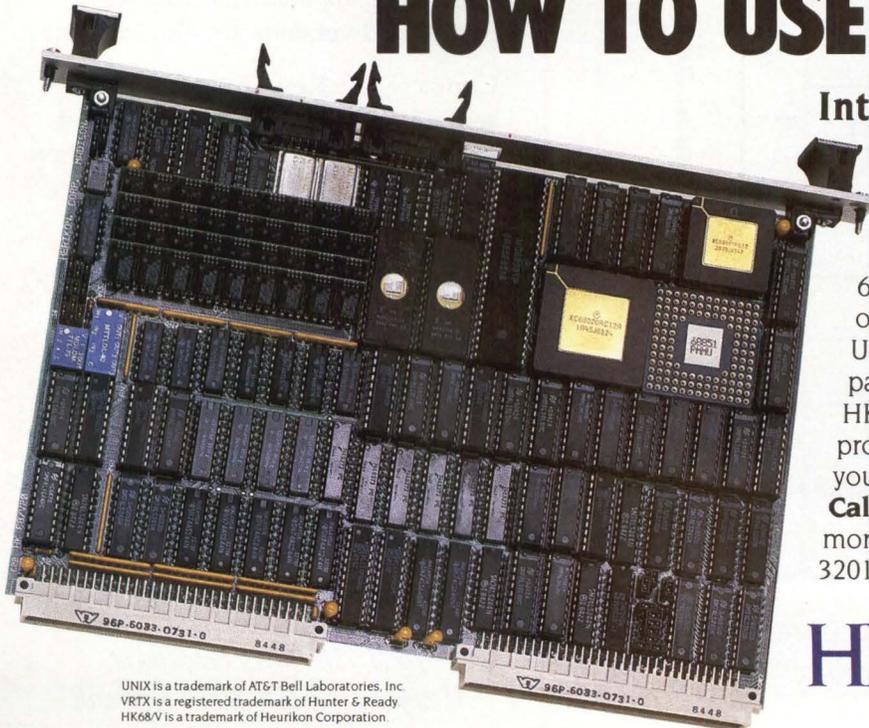
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new devices. And the need to amortize the cost of ASICs over relatively few devices will put pressure on ASIC equipment vendors to keep prices low. □

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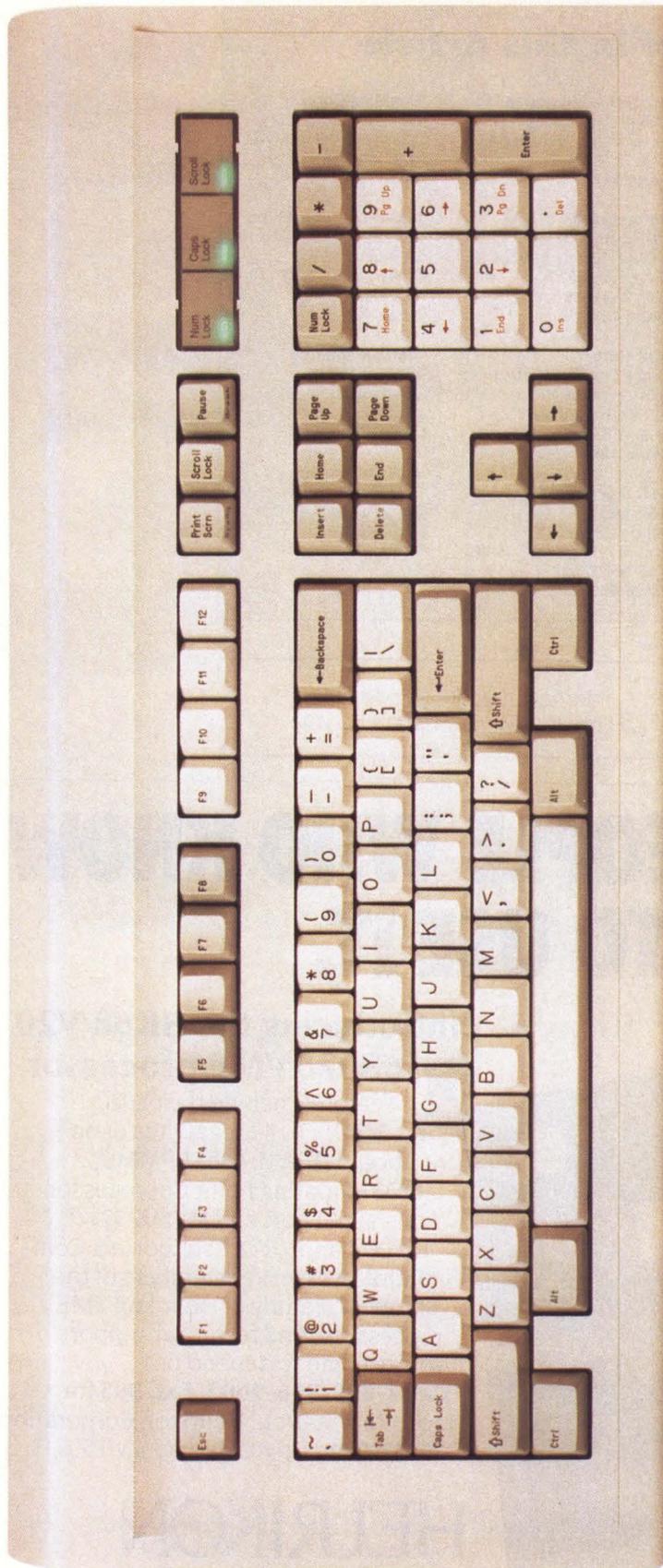
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# RISCs CHALLENGE MINI, MICRO SUPPLIERS

High-performance reduced instruction set computers from new vendors will force established players to explore their own RISC options

Andrew Allison, Contributing Editor

Over the past 25 years, consistent trends in computer capabilities and costs have masked seminal developments in technology. For example, many industry participants underestimated the impact in the 1960s of the minicomputer and of microprogrammed computer architecture and, in the 1970s, of the microprocessor and personal computer.

This effect has provided opportunities for new market entrants and resulted in major changes in industry structure. Reduced instruction set computer (RISC) architecture represents another development that bids to profoundly affect small-computer-system users during the next few years.

Although the acronym "RISC" was not coined until 1981, the first commercial RISC product, NCR Corp.'s 8500 mainframe, appeared in 1976. The 8500 processor, a precursor of the NCR/32 microprocessor, used an externally microprogrammed, three-stage-pipelined RISC architecture that performed 18

million instructions per second (MIPS). The 8500 processor has been utilized in several virtual machines to capture existing software. Its three-address, 32-bit instruction set comprised 163 register-intensive instructions using 64 internal registers and delayed branching—all typical RISC characteristics.

In 1983, Ridge Computers Inc. released the RISC32C, the first RISC system to be actively promoted as such. Three months later, Pyramid Technology Corp. followed with the announcement of its 90X, and in the spring of 1985, both Sperry Corp. and Harris Corp. announced RISC-like 32-bit minicomputers based on Computer Consoles Inc.'s Power 6/32 engine.

A few months later, Ridge and Pyramid introduced second-generation products, and in January 1986, IBM Corp. introduced the RT PC, a 32-bit, RISC-based "personal workstation. IBM had previously developed (in 1979), but never announced, a RISC minicomputer—the 801<sup>1</sup>. A few weeks after the IBM announcement, Hewlett-Packard Co. announced its Per-

## A RISC CHRONOLOGY

Year	1982	1983	1983	1985	1985	1985	1985	1986	1986	1986
Microprocessor	RISC I	RISC II	MIPS	NC4000	T414	SOAR	ARM	RT PC	Clipper	R2000
Developer	U.C.B.	U.C.B.	Stanford	Novix	Inmos	U.C.B.	Acorn	IBM	Fairchild	MIPS
Technology	NMOS	NMOS	NMOS	CMOS	CMOS	NMOS	CMOS	NMOS	CMOS	CMOS
Registers	78	138	16	ext.	4 <sup>1</sup>	32	25	16	32 <sup>2</sup>	34
Pipeline stages	3	3	5	0	0	3	3	3	3	5
Cycle time (nsec) <sup>3</sup>	667	330	500	167	50	360	150/300	170	30/60	60
Transistors (1,000s)	44.5	41	25	16	170	35	25	52	132	100

### NOTES:

<sup>1</sup>Plus 2K bytes of onboard, single-cycle-accessible static RAM

<sup>2</sup>Plus eight 64-bit registers for the integral floating-point processor, 1K-by-48-bit macro instruction ROM and separate 4K-byte instruction and data caches and memory-management units

<sup>3</sup>Processor/main-memory buses (if different)

SOURCE: MINI-MICRO SYSTEMS

formance Architecture—previously and perhaps better known as “Spectrum.”

Several manufacturers have introduced 5-MIPS-class, single-chip RISC microprocessors implemented with 1985 semiconductor and compiler technology. Refinement of these products and others under development will result in 8- to 10-MIPS microcomputers becoming commonplace in 1987 and in 16- to 20-MIPS microcomputers by 1989. Meanwhile, the leading minicomputer suppliers—Digital Equipment Corp., HP and IBM—have introduced RISC-based minicomputers.

### RISC gets streamlined

The term “RISC,” coined by Drs. D.A. Patterson and C.H. Séquin of the University of California at Berkeley<sup>2</sup>, is actually something of a misnomer. Reduced instruction sets are but one of a number of techniques that are employed in them. “Streamlined architecture,” coined by Dr. John Hennessy, of Stanford University<sup>3</sup> and a founder of MIPS Computer Systems Inc., is a more accurate description of what is typically called a RISC.

RISC proponents tout not only the architecture’s impressive performance but also its ease of design and development, resulting from the small amount of control logic it requires. For

example, control storage and logic consume half the area on a Motorola Inc. MC68000, whereas the same functions consume only 6 percent on the Berkeley RISC I. Design time for the 68000 was 1,000 man-months vs. the RISC I’s 15, and layout took 70 man-months for the 68000 compared with 12 for the RISC I. In addition, the Motorola chip has 68,000 devices vs. the RISC I’s 44,500 devices.

For the R2000 from MIPS Computer Systems (MMS, May, Page 33) and the Clipper from Fairchild Semiconductor Corp., control accounts for little more than 20 percent of the chip. That includes the address unit and, on the R2000, the master pipeline, leaving room for major additional functions. These include a memory-management unit (MMU) for the R2000 and a floating-point unit (FPU) for the Clipper.

RISC opponents counter that the benchmarks quoted are inapplicable and that the proponents have underestimated the difficulty of both developing useful software and of transporting applications to RISC systems. However, the de facto standardization of system software—UNIX System V with Berkeley 4.2 enhancements, C, FORTRAN 77 and Pascal—is steadily reducing the difficulties met in developing and porting RISC software.

## How to recognize a RISC

Reduced instruction set computer (RISC) implementations utilize several techniques to attain the objective of reducing the number of clock cycles needed. These include hardwired instruction control, load/store architecture, overlapped register banks, separate instruction/data paths and delayed branching.

**Hardwired instruction control** implements instructions directly, whereas complex instruction set computer (CISC) invariably uses microprogrammed architecture. Maurice Wilkes developed this technique at the University of Cambridge in England in 1956, as a way of handling slow computer memory.

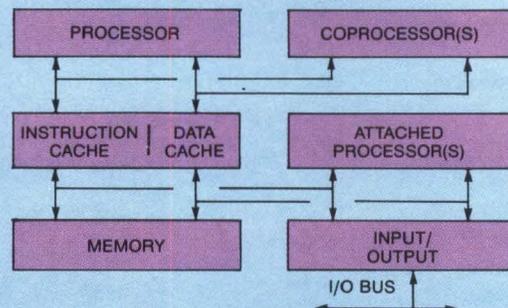
Microprogrammed architecture uses an additional level of programmed logic to construct the external instruction set from sequences of internal “microinstructions.” Microprogrammed instructions thus take several cycles—for example, the seven to 11 typical of the MC68000—to execute. The abandonment of this approach, which has been the mainstay of computer design for 20 years, is one of the most significant impacts of RISCs.

**Load/store architecture** minimizes references to system memory, accessing it only by loads, stores and branches. In a CISC, 30 percent to 50 percent of the instructions executed typically access data memory, and less than 20 percent are register-to-register

operations. For a typical RISC executing similar functions, less than 20 percent of the instructions might be loads or stores, and more than half of them, register-to-register operations.

**Overlapped register banks**, which facilitate procedure calls and returns, are one method of imple-

### RISC ARCHITECTURE LOOKS TO THE FUTURE



SOURCE: IBM JOURNAL OF RESEARCH AND DEVELOPMENT

**Split instruction/data paths** and separate processor, memory and I/O buses are common features on current RISC architectures, and RISC suppliers are reaching a consensus that this is how RISCs will be organized in the future.

A RISC, in effect, transfers the burden of providing high-level instructions from the computer to the compiler. Critics of this approach argue that this reduces the computer's efficiency. Proponents rebut that it makes sense to transfer the assembly of strings of simple instructions from the computer, where the resulting overhead affects every instruction executed, to the compiler, where the overhead affects only the compilation. RISC backers further claim that the advantages of transferring the task aren't attainable with complex instruction set computer (CISC) architectures because compilers cannot fully utilize their rich sets of instructions.

### RISC micros also succeed

The performance of RISC microprocessors to date provides empirical evidence that streamlining works. For example, consider Acorn Computers Ltd.'s ARM (Acorn RISC Machine), introduced in April 1985. The 32-bit ARM—fabricated and marketed in the United States—by VLSI Technology Inc., delivers 3 MIPS at 6.67 MHz and, in its initial 3-micron implementation, is slightly more than half the size of the 68020. The 2-micron version, introduced in the third quarter of this year, is about one-fourth the size of Motorola's 68020.

RISC performance relies largely upon optimizing compilers, and most RISCs support high-level languages and UNIX. However, the latest RISC to come out of Berkeley, SOAR (for Smalltalk on a RISC), supports a non-procedural language. SOAR was funded by the Department of Defense Advanced Research Projects Agency (DARPA). DARPA is also funding efforts by Texas Instruments Inc. to put LISP onto the SOAR chip, and the Massachusetts Institute of Technology is also developing LISP microprocessors (SCHEME-79 and -81<sup>4</sup>).

The SOAR chip provides another benchmark of RISC performance—in this case, vs. Dorado, a \$120,000 emitter-coupled-logic (ECL) personal computer that Xerox Corp.'s Palo Alto Research Center (PARC) developed to run Smalltalk. The MOS-based, single-chip SOAR handles procedure calls about four times faster than Dorado, eight times faster than a 68000 and roughly 30 times faster than a DEC VAX-11/780 minicomputer.

The first commercially available RISC microprocessor was Novix Inc.'s NC4000, introduced in 1985. The NC4000 is a 16-bit, 32-instruction, direct-execution vehicle for the FORTH programming language. In an initial 3-micron gate-array implementation, the NC4000 executed FORTH instructions roughly

menting the desired register orientation. Studies by researchers at the University of California at Berkeley indicate that eight overlapped banks with a total of 32 registers accommodate 99 percent of all procedure calls without overflow; that is, without encountering the unavailability of a register bank. This greatly reduces the number of off-chip memory accesses and contributes much to the performance of Berkeley architecture.

An alternative technique, the minimum-hardware approach, is exemplified by implementations developed by IBM Corp. and Stanford University. This approach relies heavily on compiler technology to optimize the use of a limited number of registers. The two techniques reflect the predilections—more specifically, the degree of compiler expertise—of the originators. Both techniques seem to work well, and they can easily be combined. Two sets of registers—user and supervisor—are a popular compromise between the two approaches.

**Separate instruction/data paths** result from a difference in bandwidth requirements. Simple instruction sets perform fewer functions per instruction than do complex instruction sets. Thus, RISCs require a higher instruction-memory bandwidth than do CISCs. On the other hand, the data-memory bandwidth of register-oriented architectures is much lower than that of memory-oriented architectures. This has resulted in a return to the Harvard Architecture of the earliest

computer implementations.

**Delayed branching** is a RISC implementation technique that appears in both the Berkeley and IBM/Stanford architectures. Most modern processors employ pipelining; that is, the overlapping of the fetch, decode, execution and results storage phases of several instructions to increase throughput. If the execution of one instruction depends on the results of a preceding one, the pipeline must be halted until the needed results are available, causing a pipeline "bubble."

The most common cause of a pipeline bubble is a branch instruction. CISCs contain sophisticated pipeline-interlock mechanisms to deal with this problem. RISCs deal with the problem differently. Rather than halt the pipeline and wait until the branch destination becomes available, many RISCs continue to execute instructions while waiting for the branch destination to become available to the processor, thus using machine cycles that would otherwise be wasted. Organizing the instruction flow to achieve this is a job for the compiler.

Because taken (destination unavailable) branches account for about one instruction in four executed on a CISC and one in five or six on a RISC, the delayed-branch technique considerably increases effective instruction bandwidth. The same delaying technique works well on the inherently time-consuming load and store instructions and is used in IBM/Stanford RISCs.

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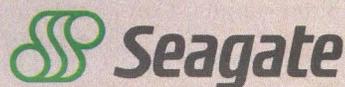
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50 times faster—8 to 10 MIPS at 6 MHz—than do conventional microprocessors such as the LSI-11 or 68000. FORTH suits image-processing and motion-control applications and the implementation of other high-level languages. PROLOG, LISP, Pascal and C compilers written in FORTH exist, and several research centers are developing higher performance 32-bit FORTH engines.

Because no single-chip RISCs are currently in volume production, RISC sales will garner no significant revenues in the overall microprocessor market in 1986. However, in 1987 several suppliers will be offering 3- to 7-MIPS single-board computers and systems based on single-chip RISC processors. Such largely UNIX-based systems will offer attractive prices and high-performance execution of programs written in C and FORTRAN and will serve most of the market now addressed by workstation and supermini suppliers.

In the search for ever-increasing performance, various permutations of CPU, FPU, MMU, register banks and caches will appear, most of them combining RISC and CISC features. The R2000, a derivative of the Stanford Microprocessor without Interlocking Pipeline Stages, integrates the MMU and CPU and offers 5 MIPS at 8 MHz. Fairchild's Clipper, on the other hand, combines the CPU and FPU on one chip and the MMU and cache on another. Manufacturers do seem to be arriving at a consensus regarding overall system architecture. Future implementations will likely have separate instruction/data paths and separate processor, memory and I/O buses.

The application range of RISC-based systems will extend to include a broad range of application-specific processors in addition to the extensive support of high-level languages, especially C. The resulting designs will act as standard cells for use in highly integrated, semicustom system design. To system integrators, this means that RISC CPUs with the power of all but the highest performance superminicomputers—already available on a single board—will become available on a single chip.

#### System-level implications emerge

Success in the superminicomputer and supermicrocomputer (full 32-bit) market depends on competing in terms of performance and price. Streamlined architecture seems certain to play an important role. Among newcomers to the supermini segment, Computer Consoles, Pyramid, Ridge and Celerity Computing Inc. incorporate RISC features in their products, as does superminicomputer supplier Convex Computer Corp.

Furthermore, DEC has included RISC attributes in two of the three VLSI implementations

of the VAX architecture. The MicroVAX I uses a custom data-path chip and omits the microcode and microsequencer that are typically implemented in standard MSI (medium-scale integration) and LSI. The MicroVAX I's performance exceeds that of the 11/730, and its design and implementation took less than a year.

Using another approach, the MicroVAX 32 is a single-chip implementation of 175 of the most frequently used VAX instructions. Another chip supports the 70 floating-point instructions, and software emulates the rest of the instruction set. The 58 percent of the full VAX instruction set implemented in the MicroVAX 32 provides 98 percent of the most frequently executed instructions, requires only 15 percent of the microcode of an 11/780 and, at 20 MHz, provides about 80 percent of the VAX's performance—another validation of architectural streamlining.

AT&T Co. is also rumored to be developing a RISC-based system, and Prime Computer Inc. has entered an OEM agreement with MIPS Computer. Other long-standing superminicomputer market participants Concurrent Computer Corp., Data General Corp., Gould Inc. and Wang Laboratories Inc. are—or should be—exploring their RISC options.

In addition to this competition from established supermini suppliers, participants in the small-systems business face the prospect of competition from a plethora of market entrants offering highly integrated, typically 32-bit products using merchant-market and semicustom RISC microprocessors and offering attractive prices and performance.

They will respond by providing streamlined architectural support for proprietary operating systems and application programs. Maintaining compatibility with a proprietary software base will not be easy, but the leading suppliers have the resources to respond quickly, and little alternative but to do so.

For the short- to mid-term, RISCs will most affect 32-bit systems. Those companies that lack proprietary content or the ability to capitalize on streamlining face the toughest competition. Because RISC-based UNIX support is not intrinsically proprietary, marginally differentiated competition will most likely engulf this market as it has the MS-DOS arena.

RISCs will also severely impact the 16-bit minicomputer and microcomputer markets. Merchant-market-microprocessor based systems will be squeezed between established minicomputer architectures—themselves facing mounting competition from 32-bit microprocessor-based products—and a proliferation of 32-bit systems.

Only two RISC-based system suppliers—

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**SOAR handles procedure calls about four times faster than Dorado, eight times faster than a 68000 and roughly 30 times faster than a DEC VAX-11/780 minicomputer.**

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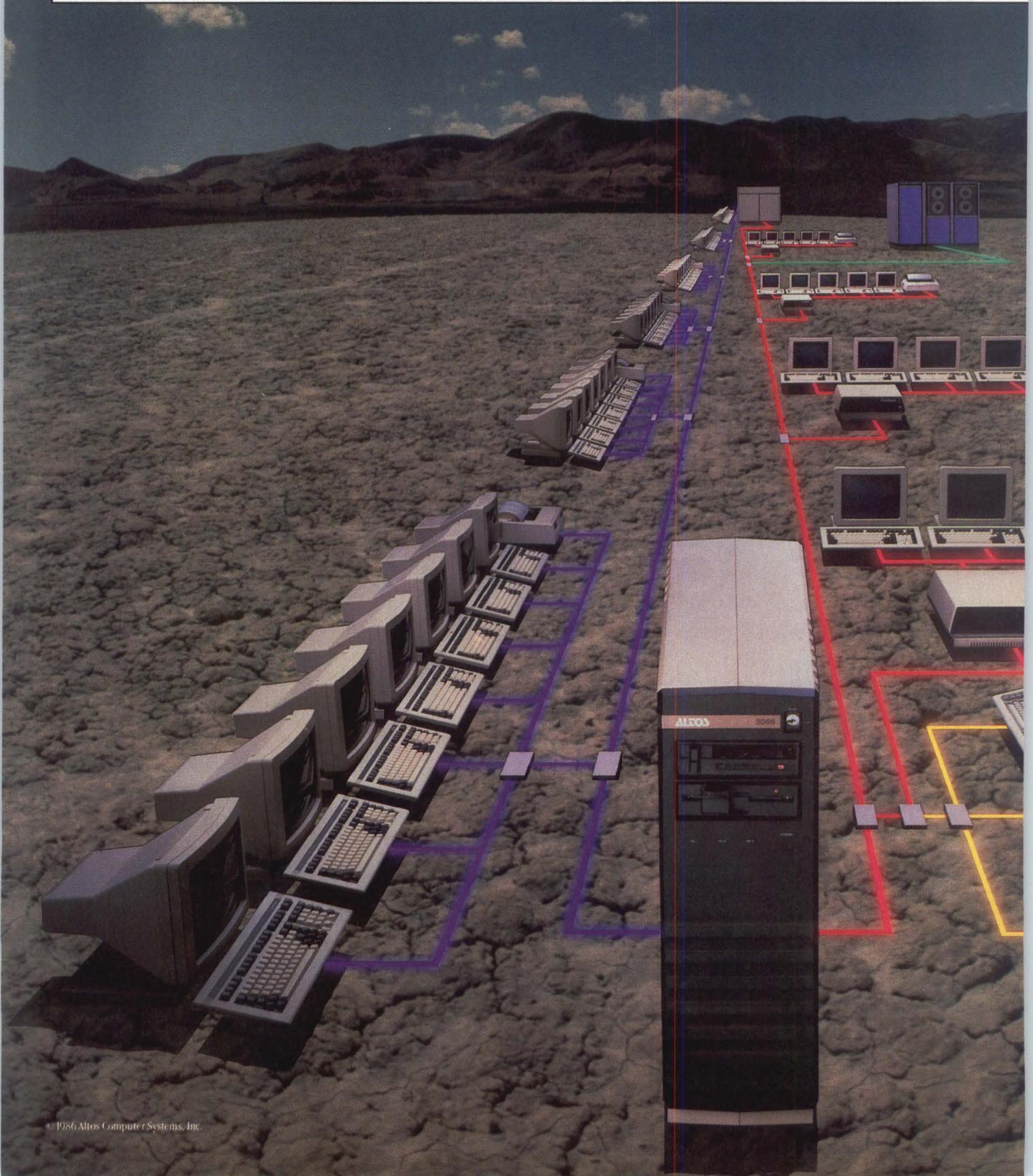
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Pyramid and Ridge—were well-established in 1985. They garnered about 70 percent of the roughly \$80 million in revenues from the sale of RISC-like systems for the year, with Pyramid outselling Ridge about 3-to-1. Although the revenues generated by RISC-like supermini-computer suppliers are currently negligible in the overall market, their products meet the performance requirements of most of the scientific/engineering and UNIX-based segments. The market share of such systems will grow rapidly, first at the expense of merchant-market CISC microprocessor-based systems, and later at the expense of proprietary superminicomputers. □

#### ENDNOTES

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<sup>3</sup>Hennessy, J.L., "VLSI Processor Architecture," *IEEE Transactions on Computers*, Volume C-33, No. 12, December 1984.

<sup>4</sup>Batali, J., Goodhue, E., Hanson, C., Shrobe, H., Stallman, R. and Sussman, G. "The SCHEME-81 Architecture—system and chip," *Procedures of the Conference for Advanced Research in VLSI*, Massachusetts Institute of Technology Press, January 1982, Pages 69 to 77.

**Andrew Allison** is an independent consultant specializing in the evaluation of small-systems technology and its application to product and market development. Before starting his practice in 1977, he was with Digital Equipment Corp., Rolm Corp. and Advanced Micro Devices.

Interest Quotient (Circle One)  
High 495 Medium 496 Low 497

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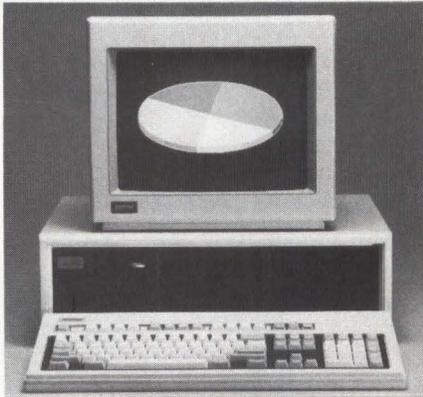
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- 14M bytes of RAM
- IBM PC/AT compatible

The Compaq Deskpro 386 is the first personal computer to utilize the 32-bit Intel 80386 microprocessor while maintaining industry-standard compatibility. The unit supplies up to 130M bytes of fixed disk storage with average access times to 19 msec, 14M bytes of RAM and 40M bytes of fixed disk backup. It currently operates under XENIX System V/286. Features include an optional 8-MHz 80287 coprocessor and IBM PC/AT compatibility. Applications are CAD/CAE, software development and engineering. Two configurations are available. **Compaq Computer Corp.**, 20555 FM 149, Houston, Texas 77070, (713) 370-0670.

Circle 430



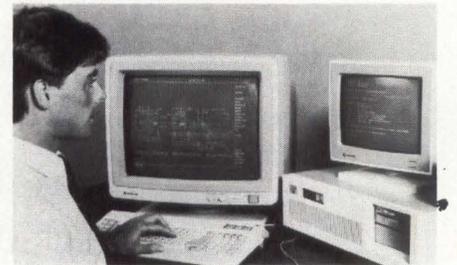
### Workstation suits CAD, CAM, CAE

- 1M byte of RAM
- 1,280 dots by 1,024 lines
- 1.3 million pixels

Accommodating CAD, CAM and CAE applications, the MicroDirect 286/CAE workstation offers 1M byte of on-board RAM, 1.8 MIPS and 1.3 million pixels. Graphics resolution is 1,280 dots by 1,024 lines. The unit runs AutoCAD and repaints it in less than 1 second. It is compatible with software for the IBM PC/AT. Options include a plotter or

laser printer and an IBM PC-DOS 3.1 operating system. \$10,886. **MicroDirect Inc.**, 180 Bent St., Cambridge, Mass. 02141, (617) 494-5300.

Circle 432



### Computer breaks price barrier

- 512K bytes of RAM
- 12-inch monitor
- IBM PC/XT compatible

An IBM PC/XT-compatible unit, the Blue Chip Personal Computer supplies 512K bytes of RAM, expandable to 640K bytes, one flexible disk drive and one parallel port. The system runs most 16-bit software programs such as Lotus 1-2-3, Symphony and WordStar. Features include a 12-inch monochrome monitor, six expansion slots and MS-DOS 2.1. \$699. **Blue Chip Electronics Inc.**, 7305 W. Boston Ave., Chandler, Ariz. 85226, (602) 961-1485.

Circle 433

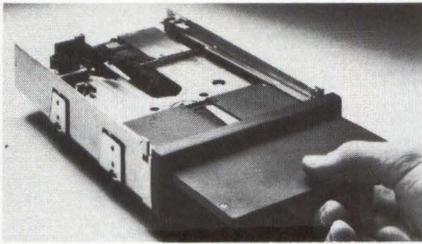
### Microcomputer based on MC68020 processor

- 128 bytes of static RAM
- 32-bit addressing
- 4M bytes of DRAM

An MC68020-based VME microcomputer, the HK68/V2F offers 4M bytes of onboard, dual-access DRAM with parity, 128K bytes of EPROM and 128 bytes of non-volatile static RAM. An RS232C port is standard. Features include four 8-bit timers, 32-bit addressing and mailbox-interrupt support. \$1,195. **Heurikon Corp.**, 3201 Latham Drive, Madison, Wis. 52713, (608) 271-8700.

Circle 434

NEW PRODUCTS  
DISK/TAPE

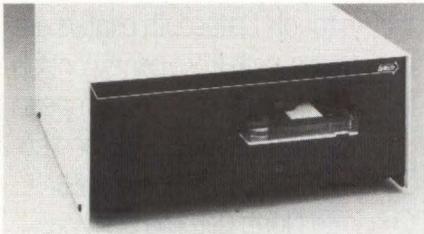


**Subsystem holds  
10M bytes**

- 5 1/4-inch unit
- 75-msec access time
- 333 tracks per inch

The DTC removable cartridge drive provides 10M-byte removable flexible media cartridges. The 5 1/4-inch unit supplies a 75-msec access time and 333 tracks per inch. It has a 21,640-bpi recording density. Internal data transfer rate is 2.2M bps; external rate, 0.275M bytes per second. Features include an embedded servo pattern and an SCSI interface. The device, geared toward OEMs, comes in four configurations. \$1,195 and higher. **Data Technology Corp.**, 2775 Northwestern Parkway, Santa Clara, Calif. 95051, (408) 496-0434.

Circle 435



**Tape drives offer  
IBM compatibility**

- 60M-byte capacity
- 90-ips tape speed
- Error checking

Available in four configurations, the Bi-Tech Winchester/Tape series supplies a formatted capacity of 60M bytes, internal; 45M bytes, external. Tape speed is 90 ips and data-transfer rate is 5M bytes per minute. Features include a proprietary software package, error checking and automatic backup. The units are compatible with the IBM PC, PC/XT and PC/AT. \$3,495 to \$3,995. **Bi-Tech Enterprises Inc.**, 10 Carlough Road, Bohemia, N.Y. 11716-2996, (516) 567-8155.

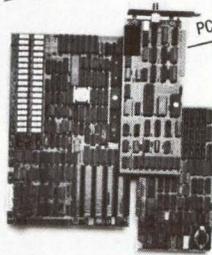
Circle 436

Bus Specific Networks

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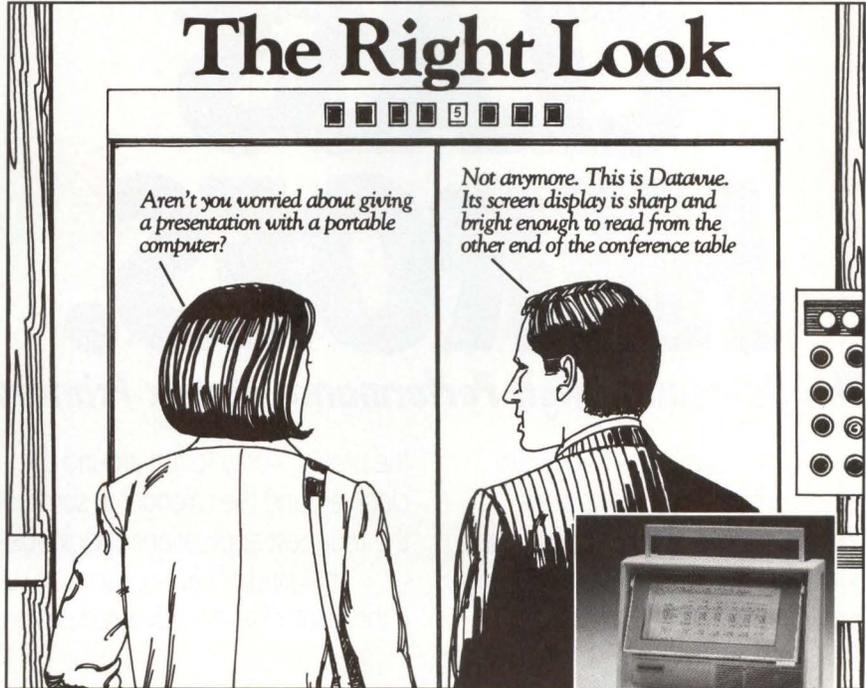
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CIRCLE NO. 80 ON INQUIRY CARD

## The Right Look

Aren't you worried about giving a presentation with a portable computer?

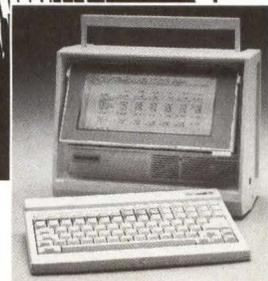
Not anymore. This is Datavue. Its screen display is sharp and bright enough to read from the other end of the conference table



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CIRCLE NO. 84 ON INQUIRY CARD



# WORKING CLASS HEROES.

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philosophy. One that created two hard-working matrix printers perfect for your medium-speed printing requirements, from 180 to 220 cps. Ready to take on multipart forms of up to 6 layers. Or produce Near Letter Quality text at 45 cps for word-processing applications. And although they're tough, Datasouth printers are easy to use, with front panel controls instead of dipswitches and jumpers.

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P.O. Box 240947, Charlotte, N.C. 28224, (704) 523-8500, Tlx: 6843018, DASO UW SALES: 1-800-222-4528, SERVICE: 1-800-438-5050, West Coast Office: (818) 702-9065

CIRCLE NO. 82 ON INQUIRY CARD

NEW PRODUCTS  
DISK/TAPE



**Tape subsystems store 10M to 40M bytes**

- 10M, 20M, 40M bytes
- IBM PC compatible
- Two transfer rates

Suiting the IBM PC, PC/XT, PC/AT and compatibles, the 400 Series Backup tape subsystem comes in four configurations. The 410 and 420 are 10M-byte and 20M-byte units, respectively, that support a 250K-bps data-transfer rate. The 20M-byte 425 and the 40M-byte 445 support a 500K-bps data-transfer rate. Features include servo head positioning, error correction and an optional external power supply. Menu-driven proprietary software allows either an entire rigid disk or selected files to be copied. \$799, model 410; \$950, models 426, 425; \$1,095, model 445. Irwin Magnetics, 2311 Green Road, Ann Arbor, Mich. 48105, (313) 996-3300.

Circle 437

**Winchesters supply 40-msec access time**

- 3½-inch unit
- 20M, 30M bytes
- ST506 interface

The PT 325 and PT 338 are 20M-byte and 30M-byte, 3½-inch Winchester disk drives, respectively. Supplying a 40-msec access time, the units feature a head-lock mechanism and automatic head-retraction for rugged applications. An ST506 interface is standard. The devices offer microprocessor-controlled self-test and diagnostic capabilities. Recording density is 983 tpi. \$330 and higher (OEM pricing.) Peripheral Technology Inc., 9176 Independence Ave., Chatsworth, Calif. 91311, (818) 709-8877.

Circle 438

Bus Specific Networks

# NEW SOLUTION

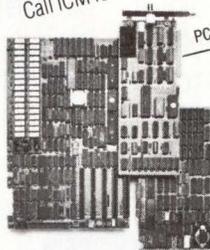
**Complete network solutions for the price of a single card.**  
Entry level costs to networking are reduced by ICM's unique integration of the most common components of both file servers and network workstations.

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Call ICM for more information and Reseller pricing.

**ONLY \$1595.**



PC, ARCNET, AND S-100 APPLICATIONS.



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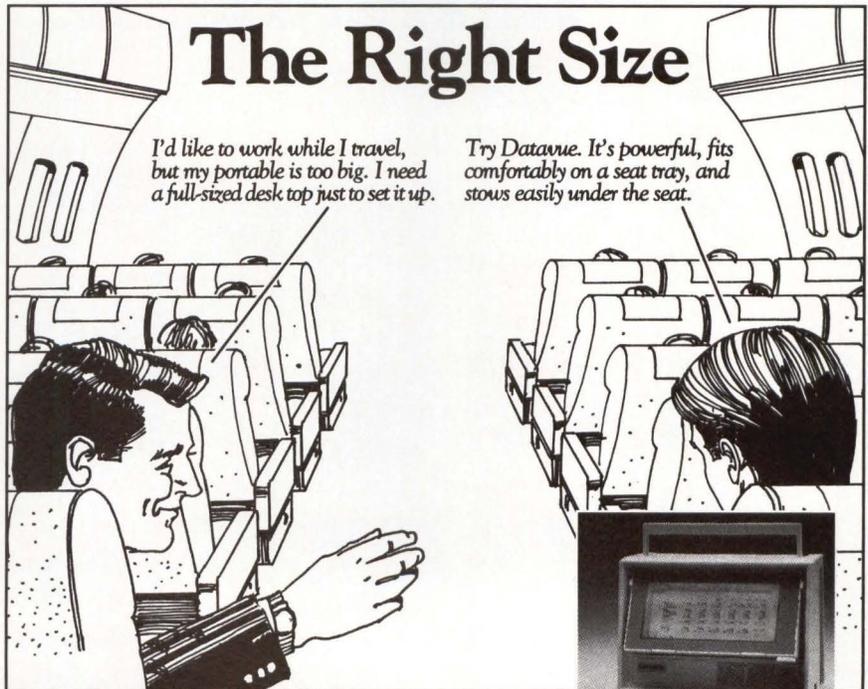
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In fact, copy anything. Faster. With higher quality. And more flexibility. For a lot less money.

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end, you get beautifully sharp color copies of everything on your screen. And you get them fast. Data is downloaded into the hardcopier instantly (there's no processing to slow things down). A-size copies and presentation quality transparencies are produced in under 40 seconds. And B-size copies are delivered in moments.

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 Symbolics  
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 Vectrix  
 Vermont Micro  
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 Wang



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## NEW PRODUCTS PRINTERS

### Page printer targets OEMs

- 75 ppm
- IBM compatible
- 26 fonts

An ion-deposition page printer producing 75 ppm, the S6000-2 targets OEMs. The unit includes an expanded font memory that handles up to 26 fonts of 128 characters simultaneously to create large characters or graphic images. A selectable interface option allows IBM 3211 or Dataproducts B-1500 emulation. \$65,000 to \$75,000. **Delphax Systems**, 35 Pacella Park Drive, Randolph, Mass. 02368, (617) 961-2312. **Circle 439**

### Laser printer accommodates 8 ppm

Printing both copies and originals at 8 ppm, the TurboLaser printer furnishes 1.5M bytes of memory and 300-dpi graphics. The unit works with the IBM PC, PC/XT, PC/AT and compatibles. It emulates Diablo and Epson printers. Applications include desktop publish-

ing. The device handles 5,000 to 10,000 pages per month. \$4,995. **AST Research Inc.**, 2121 Alton Ave., Irvine, Calif. 92714, (714) 863-1333.

**Circle 440**

### Printer handles 36, 140 cps

- Graphics
- Parallel interface
- Bidirectional

A combination daisywheel and dot-matrix printer, the Twinwriter 5 achieves 36 cps, letter quality and 140 cps, draft. The unit supplies a parallel and an optional serial interface and is compatible with all integrated software packages. Graphics are provided via six pixel resolutions. Features include bidirectional printing, a 60 dB(a) noise level and an optional cut-sheet feeder. Letter-quality and dot-matrix printing can be combined on the same document via software-driven commands. \$1,295. **Brother International Corp.** 8 Corporate Place, Piscataway, N.J. 08854, (201) 981-0300.

**Circle 441**

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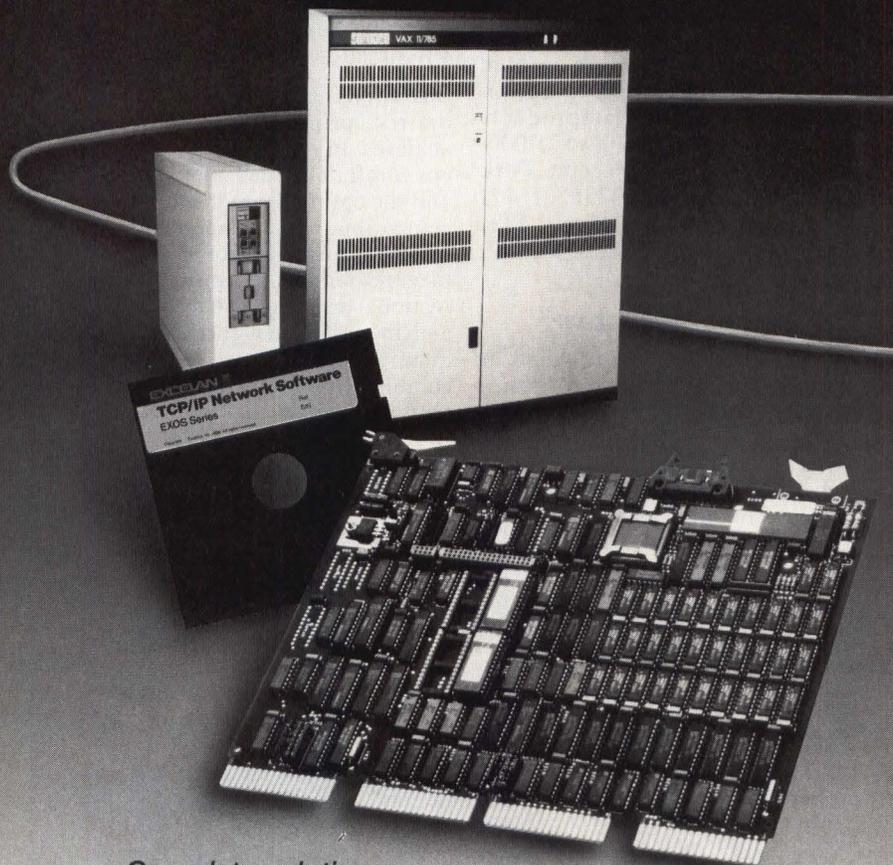


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## NEW PRODUCTS TERMINALS

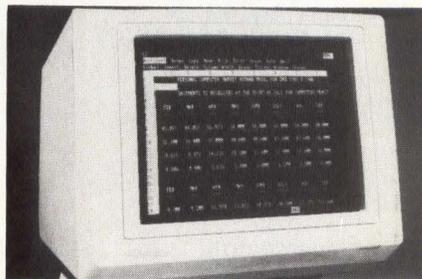


### Terminal emulates DEC, Tektronix units

- 1,024 by 780 pixels
- 14-inch monitor
- 30 resident fonts

The Talaris 7800 terminal emulates DEC VT220 and Tektronix 4014 units. It displays 1,024 by 780 pixels on a 14-inch screen, offers 30 proportionally spaced resident fonts and stores up to 300K bytes of font bit-maps that are downloaded from the host computer. A proprietary software package is included. \$2,890. Talaris Systems Inc., 5160 Carroll Canyon Road, P.O. Box 261580, San Diego, Calif. 92126, (619) 587-0787.

Circle 442



### Monitors suit IBM PC, PC/XT, PC/AT

- 12-inch units
- 25 lines
- 132 characters

Compatible with the IBM PC, PC/XT and PC/AT, the 410 series of monochrome monitors displays up to 25 lines and 132 characters per line on a 12-inch screen. An 18-MHz bandwidth provides 960-line resolution. Horizontal scan is 18.2 kHz and vertical refresh is 50 Hz. The units are available with amber, white or green characters. \$240 to \$250. Amdek Corp., 2201 Lively Blvd., Elk Grove Village, Ill. 60007, (312) 364-1180.

Circle 443

NEW PRODUCTS  
TERMINALS



**Terminals furnish  
1,024 by 800 pixels**

- Tektronix compatible
- 14-inch screen
- 38.4K baud rate

The Series 1500 graphics display terminals are compatible with ADDS, DEC, Hazeltine, Lear-Siegler, Tektronix, TeleVideo and Wyse units. The terminals display 1,024 by 800 pixels on a 14-inch screen. They supply a vector drawing rate of over 1 million pixels per second and a 38.4K-baud transmission rate. Alphanumeric features include a screen with 24 rows by 80 or 132 columns and four-speed smooth scrolling. The devices suit CAD, CAE and CAM applications. \$1,895. **Codonics**, 18001 Englewood Drive, Middleburg Heights, Ohio 44130, (216) 243-1198.

Circle 444

**ASCII terminal offers  
16 function keys**

- 26 lines
- 80 or 132 columns
- Line-drawing graphics

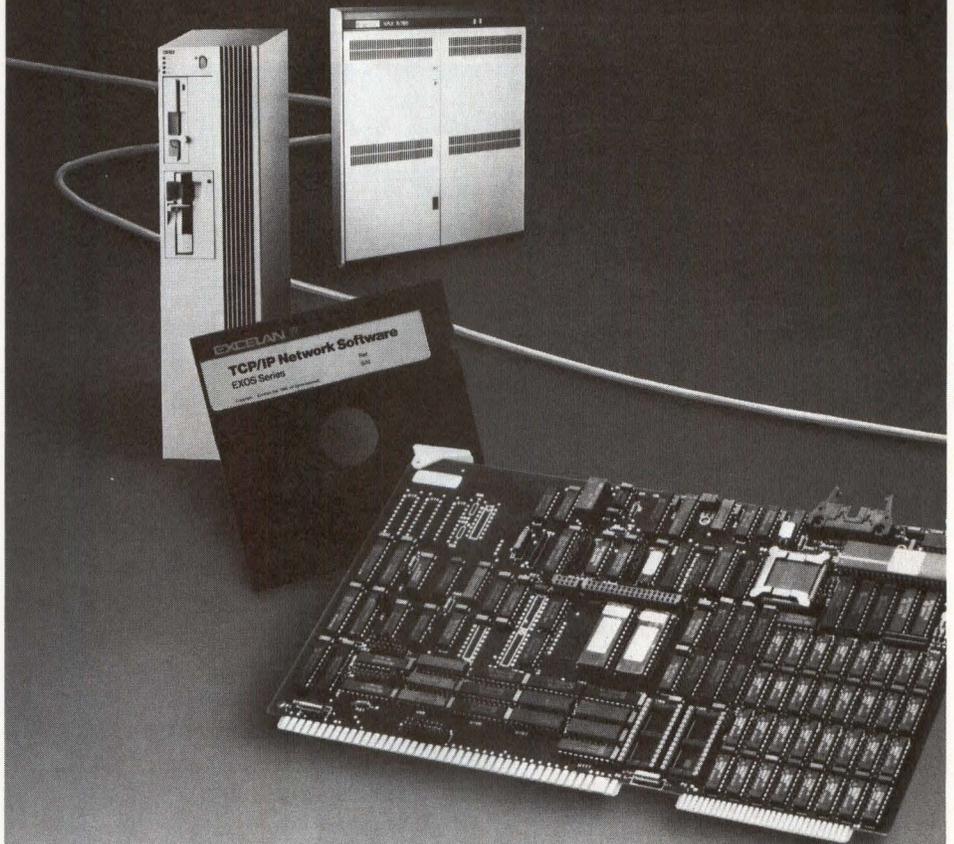
An ASCII terminal, OPUS 2 displays 26 data lines in 80- or 132-column format on a 14-inch screen. The unit features 16 programmable function keys, a 128 ASCII character set and line-drawing graphics. It emulates the ADDS Viewpoint, Esprit 6110+, TeleVideo 925/910 and Wyse 50 units. Screen memory is expandable from two to four pages. Transmission speeds range from 50 to 38.4K bps. \$549. **Esprit Systems Inc.**, 100 Marcus Drive, Melville, N.Y. 11747, (516) 293-5600.

Circle 445

Excelan Networking Series

# UNIX Users

## Connect Your VAX, NCR Tower and Others to Ethernet with TCP/IP



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- 1 year warranty on hardware
- Field proven, thousands of installations
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**EXCELAN**

### Half-card modem suits IBM PC

- 300 to 2,400 bps
- Bell 212A compatible
- 40-character buffer

A half-card modem for the IBM PC, PC/XT, PC/AT and compatibles, the MD 300 supplies automatic/manual originate and answer functions. The de-

vice operates at 300, 1,200 or 2,400 bps. It is compatible with Bell 103A and 212A, Hayes 1200B and 2400B and V.22 bis 2,400-bps modems. Features include a 40-character command buffer, automatic speed and parity detection, analog loopback testing and six option switches. \$295. **PC's Limited**, 1611 Headway Circle, Building 3, Austin, Texas 78754, (512) 339-6800.

Circle 446

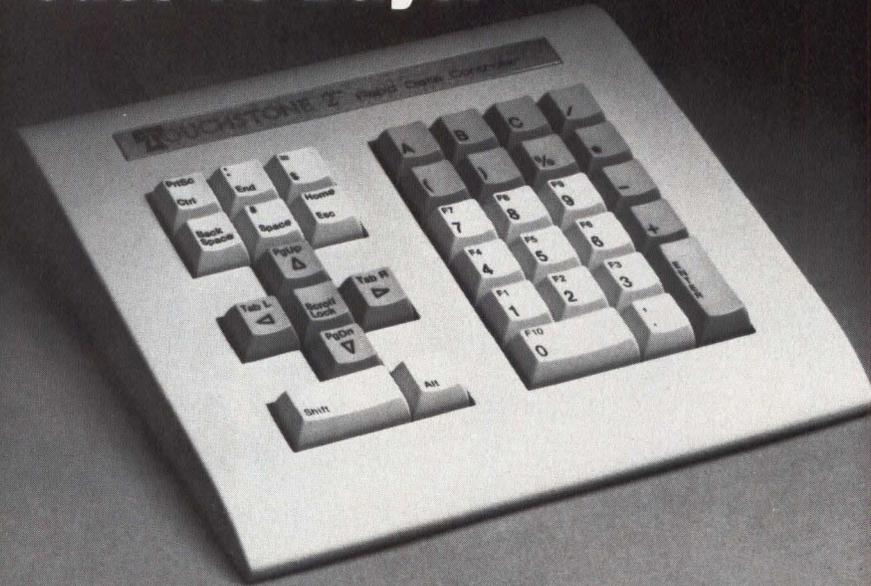
### Modem packs 1,200 bps

- Bell 212A compatible
- 4 by 2.4 by 1 inches
- Full-duplex operation

Producing 1,200 bps, the TravelComm 1200 portable modem measures 4 by 2.4 by 1 inches. The battery-operated unit is Bell 103- and 212A-compatible. It provides full-duplex operation and serial, binary and asynchronous data formats. It supports DTR and DTS commands. An RS232C port is standard. \$299. **Technigroup Inc.**, 16 Green Acre Lane, Northport, N.Y. 11768, (516) 261-0423.

Circle 447

## Custom Keypads in Just 10 Days!



#### Touchstone Keypads

The choice of thousands of serious PC users, the TOUCHSTONE 2 keypad is the premier auxiliary keypad for the IBM PC, XT, AT and many compatibles. Its solid construction, careful design and software transparency make it well worth its \$200.00 retail price.

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The compact design of the Touchstone keypad makes it ideal for applications where workspace is limited. However, this size makes it impossible to include every key, so we did the next best thing. We designed it for quick and economical reconfiguration.

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Specialized applications of the Touchstone keypad are unlimited: Public access systems, control systems, point-of-sale; wherever you need controlled access, simplified entry, space savings, or other custom features.

#### Fully Supported

Custom keypads from Touchstone have a one-year warranty. They can have macros or other multi-key combinations embedded; even high-quality custom keycaps within two weeks of order.

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Find out how easy it can be to get Touchstone keypads custom configured to your exact requirements. Write or call today, with no obligation.

**Call Toll Free**  
**1-800-828-6968**

In New York: 1-800-462-4891

International calls: 1-716-235-8358



**TOUCHSTONE**  
TECHNOLOGY INC.  
955 Buffalo Road  
Rochester, NY 14624

### Board-level modem runs at 2,400 bps

- 30 software options
- Bell 212A compatible
- Eight diagnostics

The VA4492E board contains two V.22 bis-, Bell 103- and 212A-compatible modems. They provide full-duplex asynchronous and synchronous operation at 1,200 and 2,400 bps, and asynchronous operation from 0 to 300 bps. The units feature error-free data exchange and 30 software options. Eight built-in diagnostics include analog and digital loopback tests and self-test. \$1,595. **Racal-Vadic**, 1525 McCarthy Blvd., Milpitas, Calif. 95035, (408) 946-2227.

Circle 448

### Software accommodates IBM communications

- MS-DOS 2.0
- Four modules
- XMODEM support

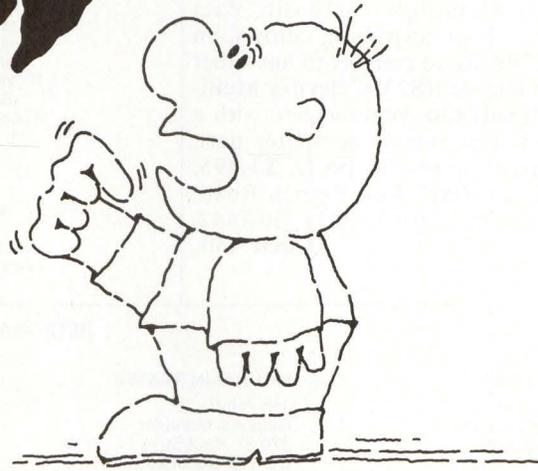
CompuTelex II communications software runs on the IBM PC, PC/XT and PC/AT. It requires 19.2K bytes of memory and MS-DOS 2.0 or higher. The package consists of four parts: The Communication Module, the Message Editor, the File Manager and the Database Manager. Functions include PC-to-PC and PC-to-mainframe communication and XMODEM support. \$149. **Micro Computer Trends**, Suite 202, 8421 Wilshire Blvd., Beverly Hills, Calif. 90211, (213) 653-4331.

Circle 449

RYAN-McFARLAND'S

# "I WANT MY ANSI 1985 COBOL NOW"

SPECIAL OFFER.



Programmers just can't wait to get RM/COBOL-85. Who can blame them?

Applications compile 2 times faster and run up to 8 times quicker compared to RM/COBOL. It can handle larger programs and larger files and actually use less disk space. And RM/COBOL-85 automatically solves networking problems by bringing existing RM/COBOL multiuser applications to the most popular pc networks—including IBM's PC Network, IBM's Token Ring, Novell's Advanced NetWare, 3COM's 3Plus and more. Plus RM/COBOL-85 provides the unique advantage of allowing programmers to write code to either the High 1974 or Intermediate 1985 ANSI standard, at the touch of a switch. Any existing RM/COBOL application can be recompiled in RM/COBOL-85 with its tremendous performance advantage. It's all part of Ryan-McFarland's commitment to upward compatibility.

Now for the special offer. RM/COBOL-85 will be available in January, but you don't have to wait because you can get RM/COBOL-8X now which contains all of the key 85 features. So you get immediate access to the perfor-

mance advantages of RM/COBOL-85. Plus you'll get first dibs on a free RM/COBOL-85 upgrade in January. To take advantage of this special offer, fill out and send in the coupon to Ryan-McFarland,

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CA 90274.

Or call 213-541-4828.

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RESELLERS, CIRCLE 63

END-USERS, CIRCLE 64

## NEW PRODUCTS DATACOM



### Multiplexer supports 500 computers

- Six ports
- Port switching
- RS232C devices

The MC610 statistical multiplexer supports up to 500 computers and terminals via multiple composite data channels. Port switching allows an RS232C device to connect to any other local or remote RS232C device. Multiple terminals can communicate with a single local or remote computer port. The unit supplies six ports. \$1,495. **Algo Inc.**, 9198-C Red Branch Road, Columbia, Md. 21045, (301) 730-7442. **Circle 450**

## STATEMENT OF OWNERSHIP

Statement of Ownership, Management and Circulation required by the Act of Congress of August 24, 1912, as Amended by the Acts of March 3 and July 12, 1946 and October 23, 1962 (Title 39 United States Code, Section 3685) of MINI-MICRO SYSTEMS (USPS 059-470), published monthly, with additional Digest issues in Feb., Apr., June, and Nov. (16 issues annually) at 270 St. Paul, Denver, CO. 80206 for September 1986. Annual Rates: \$65 US; \$70 Can./Mex.; \$95 Foreign.

- Names and complete addresses of the Publisher, Editor and Managing Editor are: Vice President and Publisher, S. Henry Sacks, 275 Washington Street, Newton, MA 02158. Editor-in-Chief, George V. Kotelly, 275 Washington Street, Newton, MA 02158. Managing Editor, James F. Donohue, 275 Washington Street, Newton, MA 02158.
- The owner is Cahners Publishing Co., a Division of Reed Holdings, Inc., 275 Washington Street, Newton, MA 02158.
- The known bondholders, mortgages, and other security holders owning or holding 1 percent or more of total amount of bonds, mortgages, or other security are: None.

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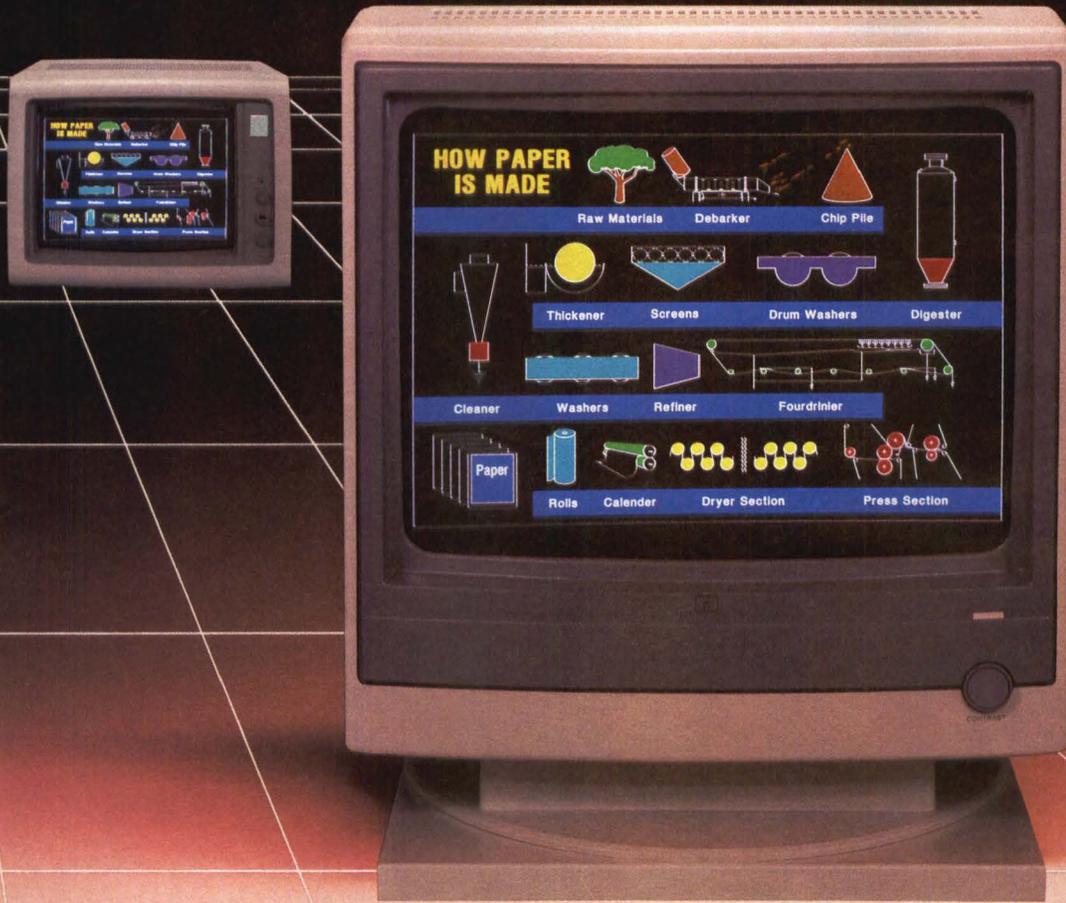
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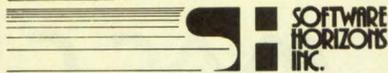
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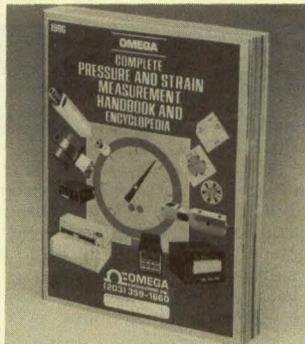
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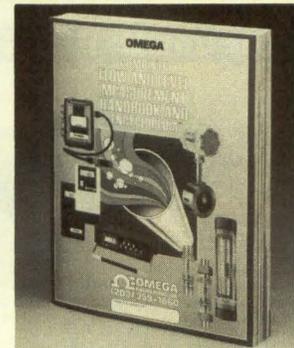
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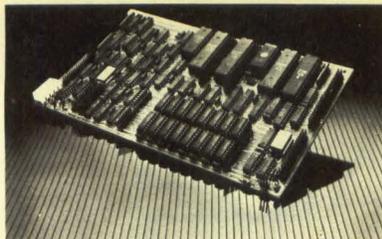
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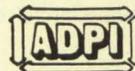
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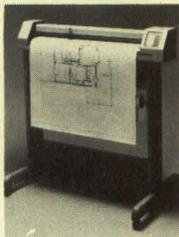
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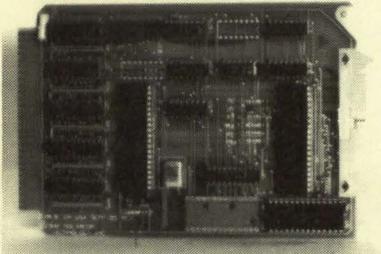
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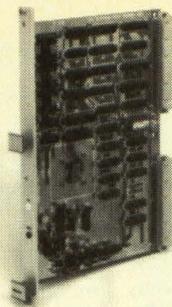
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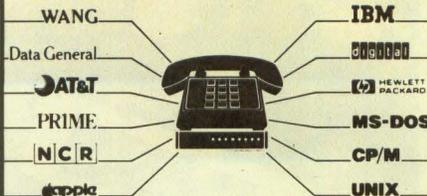
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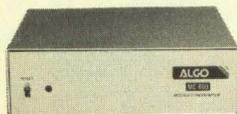
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CIRCLE NO. 218 ON INQUIRY CARD

## SOLUTIONS FOR DATA COLLECTION/CONTROL



Six Port RS-232-C System

## MC600 SERIES CONCENTRATOR

Permit multiple pairs of devices to share the same modems and telephone lines to reduce telecommunication costs.

- Microcomputer Networking
- Concentrator to Concentrator Networking
- Full Duplex
- Remote and Local Resource Sharing
- Point of Sale Concentration
- NETWORK TO OVER 500 PORTS

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301-730-7442  
Telex #333405 ALGO COL



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... and add data storage INTELLIGENT STAND ALONE



ALGO 1200 CARTRIDGE TAPE SYSTEMS

RS-232-C or IEEE-488

- Stores up to 5.3M of Binary or ASCII data.
- Intelligent search and retrieval.
- Standard power fail restart or optional power fail with NO Data Loss.
- IEEE-488 end/or RS-232-C with data rates up to 3,000 characters/sec.
- Large input buffer allows unit to accept data non-stop.
- Applications: Data Logging, Control system archiving, Program loading & storage, Back up, Telephone switch monitoring, Auto-pollled remote data storage.
- Price: Under 2000 in OEM Quantities. Direct replacement for Columbia Tape Drives.

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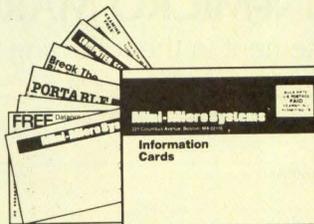
## LIKE-NEW INSTRUMENTS FOR SALE!

Thousands of bargain-priced electronic instruments - with warranties - available now. Analyzers, PROM programmers, oscilloscopes, printers, recorders, terminals...much more. Call for free catalog: Eastern Time Zone (including Miss, Tenn, Ala) (800) 225-1008, in Mass (800) 643-1011. All other locations (800) 227-8409, in Cal (800) 331-3440.



**Genstar REI Sales Company**

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## HIGH INQUIRIES LOW COST

- Sell products and services directly
- Introduce new products
- Investigate new applications
- Develop new sales leads

## MINI-MICRO SYSTEMS DIRECT RESPONSE POSTCARDS

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# POWER BROKER

**Big, Fast Hard Drives.** You knew that someday there would be a company that could breeze you by the 32 Mbyte hard drive barrier of the personal computer. That it would be fast, easy to install, and be network compatible. Dream no more, because the power is here.

## PROFESSIONAL BUSINESS SYSTEMS

is a systems integrator. We excel when the challenge is greatest. That's why we can offer hard drives for PC's that range in size greater than 500 Mbytes. Each drive includes cables, rails and software. The menu-driven software included with every hard drive will make your hardware integration easy. Comprehensive, step-by-step manual answers your technical questions concerning drive types, diagnostics, parking heads, data security, single and multiple partitions.

**Complete Customer Service.** Dedicated to customer service, **PROFESSIONAL BUSINESS SYSTEMS** is ready to serve you. Staffed by trained applications technicians, answers to your installation questions are as close as your telephone.

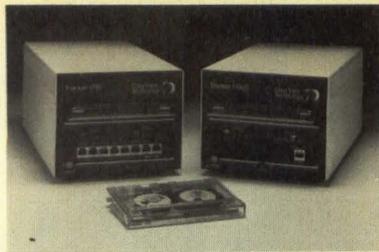
Sure, plenty of companies have announced high-capacity 5 1/4-inch Winchester. And one of these days they'll be shipping large DOS compatible hard drives in volume. But **PROFESSIONAL BUSINESS SYSTEMS** already is.

So if you need 5 1/4-inch Winchester, don't wait. Call us. We're ready to help.

**143 Mbyte \$3595 191 Mbyte \$3995**

**Professional Business Systems**  
615 N.W. Jackson Street, P.O. Box 1001  
Corvallis, OR 97339 (503) 754-1800

CIRCLE NO. 223 ON INQUIRY CARD



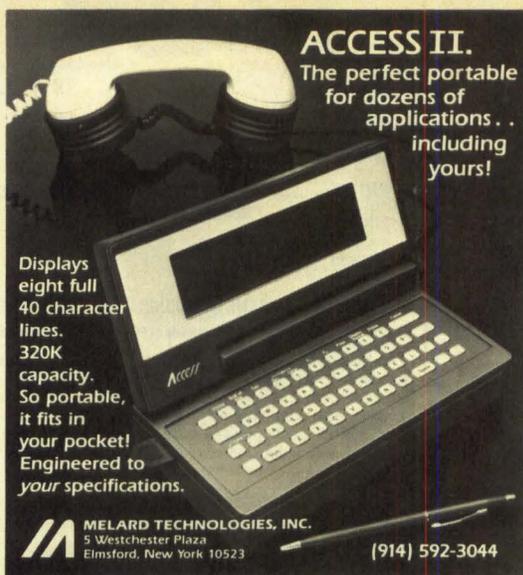
**TRACKER 1700 STAND ALONE 15 TO 20 MBYTE  
POWER FAIL PROTECTED RS-232-C  
CARTRIDGE TAPE SYSTEM**

- Uses DC-300 Data Cartridges
  - Automatic Power Fail Restart with NO DATA LOSS
  - Auto-answer for Remote Sight Polling
  - 24K Battery Backed CMOS Buffered Stop-Start system
  - Dual RS-232-C ports with Independent Baud rate select
  - Ideal replacement for Columbia, Tektronics and Tandburg tape drives.
  - Quantity priced under 2000.00
- Ideal applications: Data Logging, Telephone Call Logging, File Transfer, Data Archiving, Process Control System Monitoring. For All of Your RS-232-C Data Storage Needs Contact



**Data Track USA**  
9451 Sohap Lane  
Columbia, MD 21045  
301-992-9143  
Telex: 6971182 COLRESH

**CIRCLE NO. 224 ON INQUIRY CARD**



**ACCESS II.**  
The perfect portable  
for dozens of  
applications...  
including  
yours!

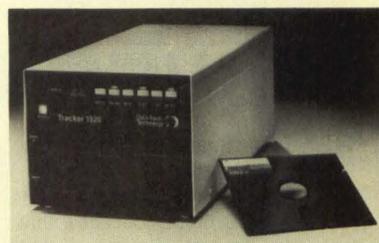
Displays  
eight full  
40 character  
lines.  
320K  
capacity.  
So portable,  
it fits in  
your pocket!  
Engineered to  
your specifications.



**MELARD TECHNOLOGIES, INC.**  
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Elmsford, New York 10523

(914) 592-3044

**CIRCLE NO. 226 ON INQUIRY CARD**



**IBM-PC/XT/AT COMPATIBLE  
POWER FAIL PROTECTED RS-232-C  
FLOPPY DATA COLLECTION AND TRANSFER  
SYSTEM WITH UP TO 2.4 MBYTE OF STORAGE**

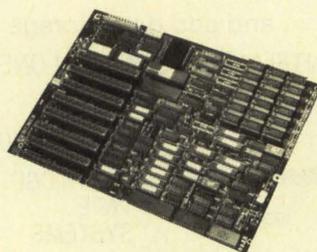
- Writes/Reads IBM PC/XT/AT compatible Disc
- Power Fail Protected with NO Data Loss
- Remote polling via auto answer modem
- Front panel manual or remote operation
- Single or Dual Disc system
- Up to 223 Files/Disc

Applications include: Data Logging, Program Loading, Telephone Call Logging, Store & Forward, and Message Handling. For All of Your RS-232-C Data Storage Needs Call



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**CIRCLE NO. 225 ON INQUIRY CARD**



**10 Mhz 80286  
IBM PC/XT MOTHERBOARD**

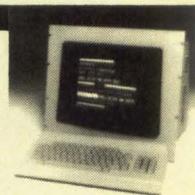
- 11.5 Times Faster Than PC; Twice as fast as the AT
- 1MB Ram On-Board Zero Wait States
- Optional 80287 Math Co-Processor
- PC/XT Hardware & Software Compatible
- Supports PC-DOS, Unix, Pick, CP/M-86, SMC OS



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**INDUSTRIAL  
ANSI X3.64  
VIDEO TERMINALS**



**DV7000 TERMINALS FROM ENTERPRISE SYSTEMS CORP.** can provide the solution to your industrial terminal requirements. Our terminals are housed in rugged completely shielded, all metal construction. They are available in table top or rack-mount (with or w/o keyboard) or in a NEMA 12 sealed housing for hostile environments. Special data formats and protocols, multi-page display, graphics and intelligent features are possible. We also have hardware to provide custom solutions for your non-display communications needs. **CALL TODAY ENTERPRISE SYSTEMS CORP.,** Box 698, Dover, NH 03820. Tel. (603) 742-7363.

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**ORDER  
FORM**

**Advertise in the MINI-MICRO MARKETPLACE.**

Please run my advertisement in the following issues : Jan Feb Feb 15 March  
April April 15 May June June 15 July Aug Sept Oct Nov Nov 15 Dec

**EFFECTIVE JANUARY 1986**

1x	3x	6x	12x	18x
\$660	\$595	\$575	\$560	\$545
	24x	48x		
	\$525	\$505		

**MATERIALS**

1. Glossy photo with 50-75 words.  
We will typeset your ad at no charge.
2. Camera ready artwork.
3. Film negatives: right reading emulsion side down.

**AD SIZE: 2 1/4" x 3 1/16"**

COMPANY \_\_\_\_\_  
ADDRESS \_\_\_\_\_  
CITY \_\_\_\_\_ STATE \_\_\_\_\_ ZIP \_\_\_\_\_  
TELEPHONE \_\_\_\_\_  
SIGNATURE \_\_\_\_\_

Space reservation by the first week of the month proceeding issue date.

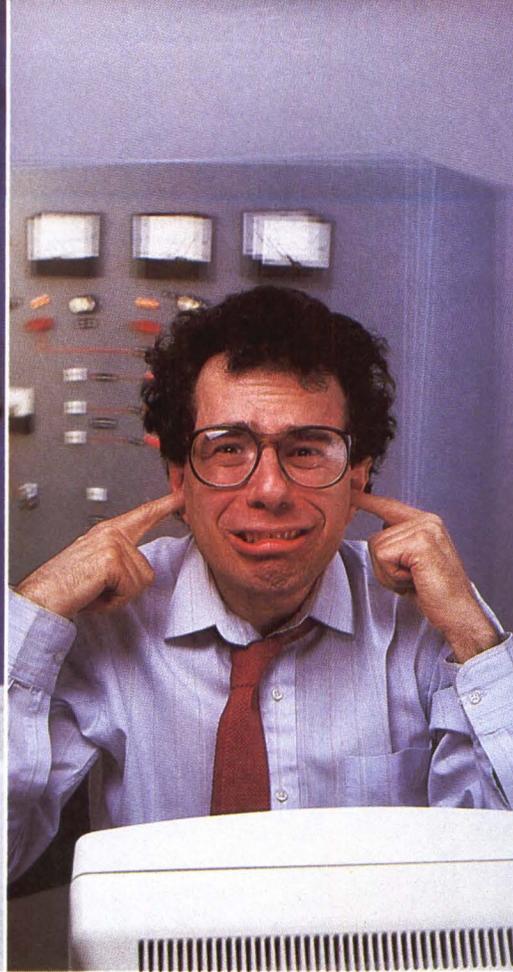
- Materials enclosed  Materials to come  Please send information

Send to: Carol Flanagan, **MINI-MICRO SYSTEMS**  
275 Washington St.  
Newton, MA 02158

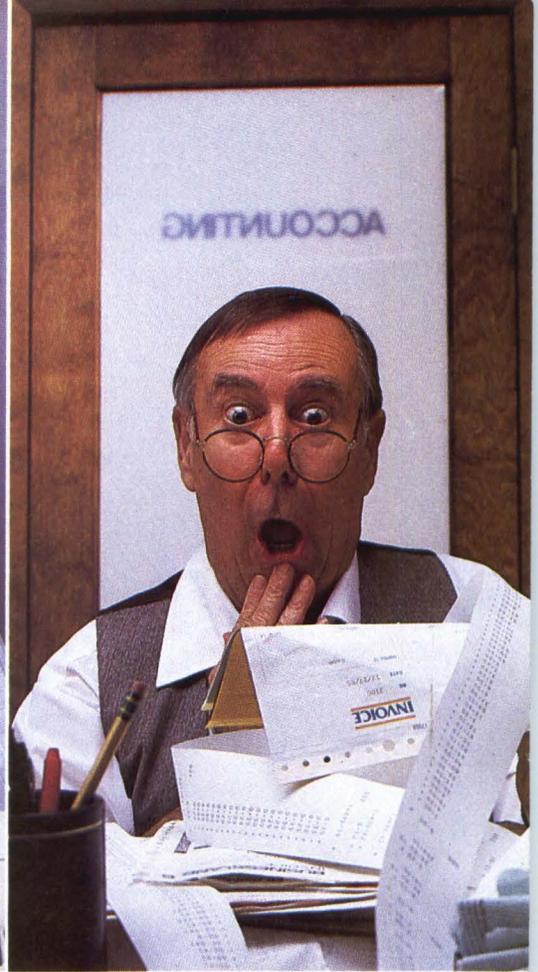
15% Agency commission to accredited agencies. Please specify agency.



Too big.



Too noisy.



Too much.

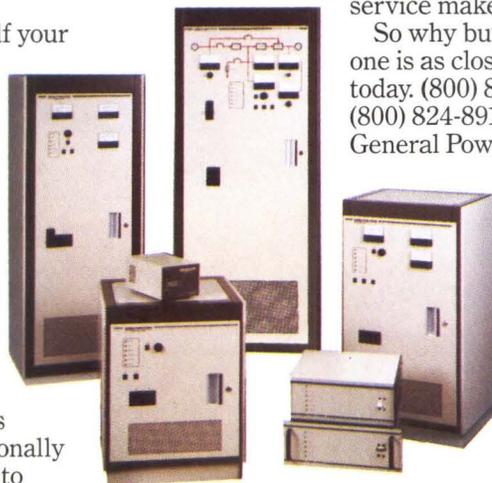
# How to keep from buying the wrong UPS.

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

Yes, you do need a UPS.

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

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



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

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

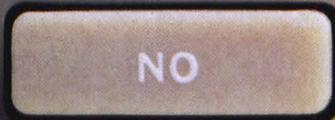
Now, UL Listed models  
1KVA-10KVA.

## GENERAL POWER SYSTEMS

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# Universal Data Systems



## Three Keys to Successful TDM or Statistical Multiplexing

Three keys! They're all you need to configure Universal Data Systems' new multiport V.33 modem/multiplexer combination. Separate versions offer either six-channel TDM or eight-channel statistical multiplexing capability.

In either configuration, the device is trellis coded at its basic 14.4 kbps operating speed and has alternate data rates of 12 or 9.6 kbps. If your system utilizes TDM, you may also choose between asynchronous and synchronous operation and you can have V.29 operation at 9.6 kbps.

The three-pushbutton/LCD control panel allows configuration choices (with different data rates for each channel if you desire), "soft strap" settings and easy review of both multiplexer and modem status.

The entire set-up and review process is menu-driven; the user need only answer a series of questions by pressing the appropriate YES or NO switch. When the process is complete, a



push on the HOME switch returns the device to the communications mode.

Diagnostics on both versions of the V.33 multiplexer/modem include local and remote digital loopback on each channel as well as local and remote analog loopback. All test features are compatible with CCITT V.52 and V.54 recommendations.

**YES**, you can now have TDM or stat mux capability in a single package with a 14.4 kbps trellis coded modem.

**NO**, these devices are not expensive to buy or difficult to apply.

**HOME** of the new V.33 multiplexer/modem is Universal Data Systems, 5000 Bradford Drive, Huntsville, AL 35805. Telephone 205/721-8000; Telex 752602 UDS HTV. Ask for detailed specs and quantity prices.

### QUANTITY ONE PRICES

V.33 with six-channel Time Division Mux    V.33 with eight-channel Statistical Mux

**\$3495**

**\$3995**

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Information Systems Group

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CIRCLE NO. 93 ON INQUIRY CARD

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